BURNS McDONNELL

MSW AUTH NO. 2284A

PART III – SITE DEVELOPMENT PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL VERTICAL EXPANSION
PROJECT NO. 155488

REVISION 1
MAY 16, 2025

Landfill Permit Amendment
Part III – Site Development Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488



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List of Abbreviations

Abbreviation	Term/Phrase/Name
City	City of El Paso, Texas
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM	Farm to Market Road
GCL	Geosynthetic Clay Liner
GCLER	Geosynthetic Clay Liner Evaluation Report
GEP Landfill or Facility	Greater El Paso Landfill, MSW Authorization Number 2284A
GLER	Geomembrane Liner Evaluation Report
GWSAP	Groundwater Sampling and Analysis Plan
IH	Interstate Highway
IPaC	Information for Planning and Conservation
LCS	leachate collection system
LFGMP	Landfill Gas Management Plan
LQCP	Liner Quality Control Plan
MSL	Mean Sea Level
MSW	municipal solid waste
NAVD 88	North American Vertical Datum of 1988
RUSLE	Revised Universal Soil Loss Equation
SDP	Site Development Plan
SOP	Site Operating Plan
SWDR	Surface Water Drainage Report
TAC	Texas Administrative Code
USFWS	United States Fish and Wildlife Service

III.1.0 Introduction

The City of El Paso, Texas (City) is currently operating the Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill or Facility), which is located approximately a quarter mile north of the intersection of Interstate Highway (IH) 10 and Farm to Market Road (FM) 1110 near Clint, Texas in El Paso County. The GEP Landfill is located on a 311-acre parcel adjacent to the City of El Paso Clint Landfill, MSW Authorization Number 1482. This permit application is for a vertical expansion of Phases 1 and 2 of the GEP Landfill. This Site Development Plan (SDP) contains information to comply with Texas Administrative Code (TAC) Title 30, Chapter 330, Subchapter B (30 TAC §330.63). The following appendices support this SDP.

- **Appendix III.A** – Permit Amendment Drawings
- **Appendix III.B** – Surface Water Drainage Report
- **Appendix III.C** – Leachate and Contaminated Water Plan
- **Appendix III.D** – Soil Liner Quality Control Plan
- **Appendix III.E** – Geology Report
- **Appendix III.F** – Groundwater Sampling and Analysis Plan
- **Appendix III.G** – Slope Stability and Settlement Analysis
- **Appendix III.H** – Landfill Gas Management Plan
- **Appendix III.I** – Final Closure Plan
- **Appendix III.J** – Post-Closure Plan
- **Appendix III.K** – Closure Cost Estimate
- **Appendix III.L** – Post-Closure Cost Estimate

III.2.0 General Facility Design [30 TAC §330.63(b)]

Facility design, construction, and operation will comply with this permit application and applicable TAC rules.

III.2.1 Access Control [30 TAC §330.63(b)(1)]

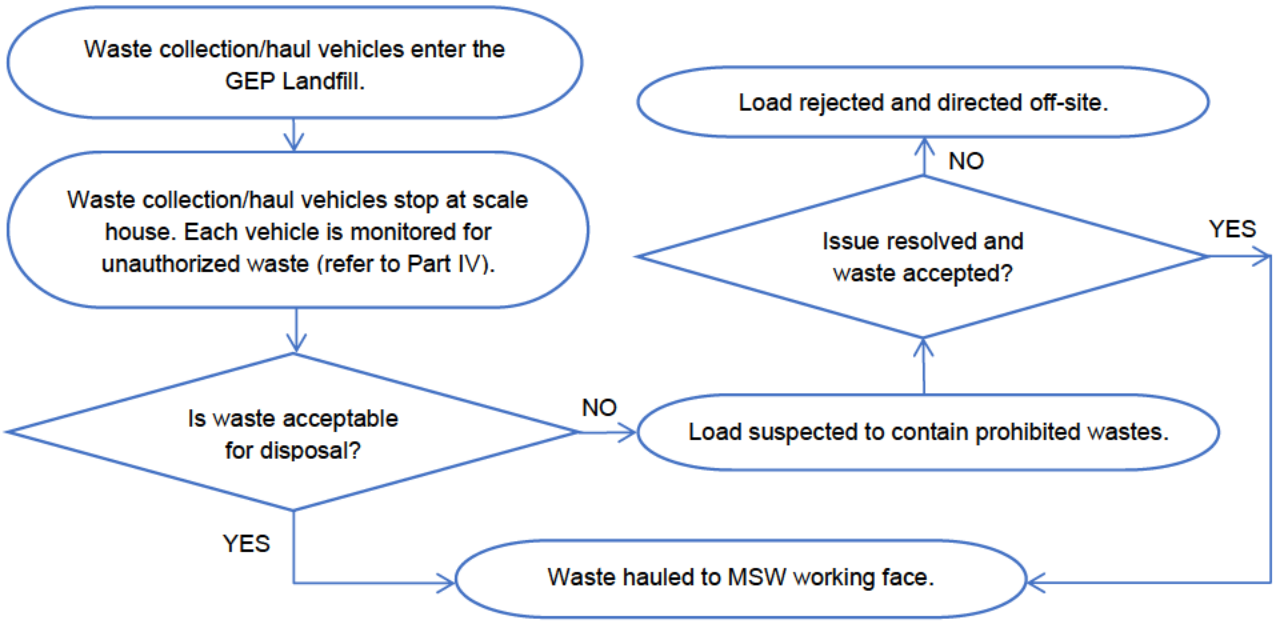
The entrance of the GEP Landfill will be secured using a chain-link fence with lockable gates. The perimeter will be secured utilizing barbed wire fence or similar. During operating hours, facility personnel will regularly watch for unauthorized persons in the vicinity of the working face, at the site entrance, and any other areas of the site. Entry to the active portion of the site is restricted to designated personnel, approved waste haulers, and properly identified personnel whose entrance is authorized by the manager, supervisor, or attendant. Visitors are allowed on-site only when accompanied by a site representative. Access gates will be locked after normal hours of operation to prevent the entry of livestock onto the site, to protect the public from exposure to potential health and safety hazards, and to discourage unauthorized entry and uncontrolled disposal of waste.

Maintenance of site access control will be performed as necessary to prevent uncontrolled access in accordance with 30 TAC §330.131 and Section IV.5.0 of the Part IV Site Operating Plan (SOP).

III.2.2 Waste Movement [30 TAC §§330.63(b)(2) and 330.63(b)(3)]

The GEP Landfill is a Type I MSW facility, which accepts residential and commercial waste, as well as some non-hazardous Class II and Class III industrial wastes. Special wastes will be handled in accordance with Section IV.24.0 of the Part IV SOP. Waste will be disposed of in permitted MSW disposal areas. A waste flow diagram describing the disposal sequence at the Facility is provided as **Figure III.2-1**. A drawing showing the site entrance facilities as well as disposal areas is provided as Drawing III.A.2 in **Appendix III.A**.

Figure III.2-1: Waste Flow Diagram



Waste enters the Facility via the site entrance road and passes through the scale house where the scale house attendant conducts screening, weighing, and documentation of incoming waste loads. The attendant will be familiar with the types of waste that can or cannot be accepted at the GEP Landfill and will direct the hauler to the appropriate disposal area or load inspection. If prohibited loads are discovered, the scale house attendant can reject the load and require the hauler or transporter to remove the load immediately upon discovery. At the working face, trained personnel will observe unloading and will have the authority and responsibility to reject loads that contain any prohibited wastes. Accepted loads will be directed to the working face for disposal.

Ventilation and odor control measures are discussed in greater detail in Section IV.14.0 of Part IV SOP. Landfill gas management design details related to ventilation and odor control measures are discussed in **Appendix III.H**.

Generalized construction details of the leachate evaporation ponds (including freeboard) and cells/sumps showing approximate dimensions and capacities, construction materials, covers, enclosures, etc. are provided in **Appendix III.A** and **Appendix III.C**.

No solid waste processing units are included in this permit.

III.2.2.1 Sequence of Site Development

The GEP Landfill will be developed in two phases with 20 individual cells outlined representing discrete construction limits for extending the landfill floor excavation and lining system as indicated on the drawings in **Appendix III.A**. Sequential fill plans are provided as **Drawings III.A.6 through III.A.9**.

III.2.3 Water Pollution Control [30 TAC §§330.55, 330.63(b)(4)]

In accordance with 30 §TAC 330.55(b), all liquids resulting from the operation of the GEP Landfill will be disposed of in a manner that will not cause surface water or groundwater pollution.

During the development of the landfill, diversion berms will be constructed to prevent stormwater from running onto the working area as well as to control run-off from the landfill. These berms will be constructed to contain the 25-year, 24-hour storm event. For a complete description of the berms refer to **Appendix III.B**.

Any water that comes in contact with the waste will be confined in the working face areas and will be collected in the leachate collection system. There will be no off-site discharge of contaminated water. **Appendix III.C** provides a complete description of contaminated water handling and disposal procedures.

No solid waste processing units are included in this permit.

III.2.4 Endangered Species Protection [30 TAC §330.63(b)(5)]

Neither the Facility nor its operation will result in the destruction or adverse modification of the critical habitat of endangered or threatened species or cause or contribute to the taking of endangered or threatened species. If endangered or threatened species are encountered during site operations, Texas Parks and Wildlife Department and United States Fish and Wildlife Service (USFWS) will be notified within 48-hours.

Prior to Facility development, Dr. Richard D. Worthington, Ph.D. of Floristic Inventories of the Southwest Program, conducted an intensive survey to determine the presence of any threatened and endangered

species at the Facility. The survey indicated that no endangered or threatened species were found on the subject site. Two species of concern were encountered: the Texas horned lizard and the sand prickly pear cacti. Dr. Worthington estimated that no more than five lizards were present. Five clumps of sand prickly pear were found on the site; however, the plant vigor was marginal and quite stressed. The landfill site development was considered not likely to impact endangered or threatened species, therefore there is no protection plan for threatened or endangered species required for this Facility.

The generation and review of the USFWS's Information for Planning and Conservation (IPaC) report for the permitted boundary was conducted and compared to the results of the aforementioned survey. No critical habitat of endangered or threatened species was identified within the permitted boundary, as supported by the survey results. The referenced IPaC is presented as Part I/II, Appendix I/II.H – Location Restrictions. Correspondence with the USFWS and Texas Parks and Wildlife Department are also included in Part I/II, Appendix I/II.H.

III.3.0 Facility Surface Water Drainage Report [30 TAC §330.63(c)]

The GEP Landfill has been designed to comply with the requirements of 30 TAC §§330.303(a) and 330.303(b). A Surface Water Drainage Report (SWDR) prepared in accordance with 30 TAC §330.63(c) and 30 TAC §330, Subchapter G is provided as **Appendix III.B**.

III.3.1 Drainage Analysis

The general surface water drainage design is a series of perimeter ditches that carry runoff around the landfill to detention ponds. Drainage controls are incorporated into the site design to reduce flooding and minimize the amount of sediment carried off the site and discharged into adjacent lands. Drainage controls include perimeter ditches, down chutes, terraces, berms, and culverts. All drainage calculations are provided in **Appendix III.B**. Calculations are also provided to verify that natural drainage patterns will not be significantly altered by the development of the landfill.

Temporary and permanent erosion and sediment controls for the Facility will consist of silt fences, terraces, diversion berms, sedimentation/detention ponds vegetation and/or rock armoring. These erosion controls have been designed to lower stormwater runoff velocities, keep soil erosion losses below permissible levels, and provide long-term, low maintenance, and geotechnical stability for the final cover. The location of temporary erosion controls will vary depending on the landfilling progress. The Erosion and Sedimentation Control Plan is provided as Attachment III.B.2 in **Appendix III.B**.

III.3.2 100-Year Flood

The site does not lie in the 100-year floodplain as shown on Figure I/II.A.11 in Part I/II, Appendix I/II.A, which is based on the Federal Emergency Management Agency (FEMA) Flood Service Map Center, Preliminary Flood Insurance Rate Map (FIRM) Panel 48141C0660F, dated July 08, 2020.

III.4.0 Waste Management Unit Design [30 TAC §330.63(d)]

The following section describes the waste management unit design for the GEP Landfill, which is in accordance with 30 TAC §330.63(d).

III.4.1 Surface Impoundment Design [30 TAC §330.63(d)(3)]

Construction details for the leachate evaporation ponds, including design freeboard, are provided in **Appendix III.C**. The liner quality control plan (LQCP) is provided in **Appendix III.D**.

III.4.2 Landfill Unit Design Parameters [30 TAC §330.63(d)(4)]

The following subsections describe the landfill unit design parameters, which are in accordance with 30 TAC §330.63(d)(4).

III.4.2.1 All-Weather Operations [30 TAC §330.63(d)(4)(A)]

Wet weather operations will be accommodated through the construction of an all-weather roadway from the on-site entrance roadway to the area being filled. The all-weather roadway will also serve as the access to the working fill area throughout the site. Landfill haul and access roads are shown on Drawing III.A.3 in Part III, Attachment III.A. Perimeter access road and cell access road details are provided on Drawing III.B.6 in Part III, Attachment III.B. Mud tracking control measures are provided in Part IV, Section 16.0

A wet weather unloading area will be constructed of crushed stone or similar as the fill area moves throughout the site.

Should the haul roads into the fill area become unusable, fill operations will continue by depositing the waste from the top of the excavation. For periods when filling occurs above grade, waste will be deposited at the toe of the fill area in the lined areas.

A series of speed bumps/mud removal devices will be installed along the interior access road prior to the site exit.

III.4.2.2 Landfilling Methods [30 TAC §330.63(d)(4)(B)]

Operations at the GEP Landfill utilize the area fill method. Landfilling occurs both below-grade and above-grade (or aerial filling). The disposal operation is accomplished in two phases as shown on the drawings in **Appendix III.A**. Typical cross sections and final contours are also provided in **Appendix III.A**.

Excavations will be performed with appropriate equipment. Waste will be placed in lifts and will be compacted with a compactor or other suitable equipment prior to the application of daily cover.

III.4.2.3 Landfill Design Parameters [30 TAC §330.63(d)(4)(C)]

Constructed cell excavation side slopes are sloped at 3 foot horizontal to 1 foot vertical (3H:1V). The elevation of deepest waste disposal is 3896.1 feet above mean sea level (msl) utilizing North American Vertical Datum of 1988 (NAVD 88). Final cover side slopes will be installed at 4H:1V slopes with a five

percent crown. The maximum elevation of waste disposal will be 4126.9 feet above msl (NAVD 88). The maximum elevation of the final cover will be 4128.1 feet above msl (NAVD 88). Details are provided in the drawings in **Appendix III.A**.

It should be noted that the previous permit application for the GEP Landfill (2284) utilized City Datum for listed elevations. A conversation from City Datum to NAVD 88 is provided in Part I/II, Appendix I/II-B.

III.4.2.4 Site Life Projections [30 TAC 330.63(d)(4)(D)]

The GEP Landfill is divided into two phases. Phase 1 encompasses approximately 93.9 acres and Phase 2 approximately 122.5 acres. The total volume for each section was determined by adding the below and above grade airspace together. To determine the available disposal capacity (including daily and intermediate cover), the bottom liner and final cover were subtracted from the total capacity. The total available disposal capacity for the GEP Landfill is presented in **Table III.4-1**, which is 34,864,506 cubic yards. Volumes were calculated by comparing the base and final surfaces created by AutoCAD.

Table III.4-1: Greater El Paso Landfill Disposal Capacity

Item	Phase 1 (North)	Phase 2 (South)	Total
Waste Area (Acres)[1]	93.9	122.5	216.4
Gross Volume Permitted under 2284 (CY)	11,355,647	17,455,872	28,811,519
Expansion Volume for 2284A (CY)	1,883,898	5,681,927	7,565,825
Gross Volume for 2284A (CY)	13,239,545	23,137,799	36,377,344
Less Alternate Final Cover Material (CY)[2]	353,534	461,071	814,605
Less 2-foot Protective Cover Material (CY)	303,029	395,204	698,233
Net Disposal Capacity (CY)	**12,582,982**	**22,281,524**	**34,864,506**

[1] Area within limit of waste placement as shown on the Drawings in **Appendix III.A**.
[2] Alternative final cover profile is 4-inches of rock armoring, 18-inches of infiltration layer, and 6-inches of base layer for a total of 28-inches. Geosynthetic thicknesses are considered negligible for calculations.

The GEP Landfill currently accepts approximately 1,600 tons of solid waste per day (6 days per week). The expected rate of solid waste deposition is anticipated to increase at approximately 2.0 percent based on the average growth rate for the past 5-years. For calculating volumes, a compaction density of 1,300 pounds per cubic yard was used. **Table III.4-2** shows the solid waste deposition projection used for calculating the expected site life of the GEP Landfill with the vertical expansion. Actual quantities accepted at the GEP Landfill will vary depending on the number of cities sending waste to the Facility, changes in population or economic activity, and changes in waste collection and disposal practices by private haulers using the Facility.

Using the remaining disposal capacity as of August 31, 2023 of 20,548,110 cubic yards (with the vertical expansion volume included), a site life of approximately 21.7 years from the August 31, 2023 survey was calculated, or capacity depleted in FY2045. Should waste quantities increase or decrease, the site life will be adjusted accordingly.

Table III.4-2: Greater El Paso Landfill Solid Waste Deposition Projection

Fiscal Year[1]	Yearly Tonnage	Yearly Volume (cy)	Capacity Remaining (cy)
2024	498,130	766,354	19,781,756
2025	508,092	781,681	19,000,075
2026	518,254	797,314	18,202,761
2027	528,619	813,261	17,389,501
2028	539,192	829,526	16,559,975
2029	549,976	846,116	15,713,859
2030	560,975	863,039	14,850,820
2031	572,195	880,299	13,970,521
2032	583,638	897,905	13,072,615
2033	595,311	915,863	12,156,752
2034	607,217	934,181	11,222,571
2035	619,362	952,864	10,269,707
2036	631,749	971,922	9,297,785
2037	644,384	991,360	8,306,425
2038	657,272	1,011,187	7,295,238
2039	670,417	1,031,411	6,263,827
2040	683,825	1,052,039	5,211,788
2041	697,502	1,073,080	4,138,708
2042	711,452	1,094,542	3,044,166
2043	725,681	1,116,432	1,927,734
2044	740,195	1,138,761	788,972
2045	754,999	1,161,536	Capacity Depleted Approx. May 2045

(1): The City's fiscal years run from September 1st through August 31st.

III.4.2.5 Landfill Cross Sections [30 TAC §§330.63(d)(4)(E) and (F)]

Landfill cross sections are provided in **Appendix III.A** – Drawings III.A.13 through III.A.21. The cross sections show the top of final cover, top of waste, existing ground, bottom of the excavations, and side slopes of trenches and fill areas. The fill cross sections go through or very near the soil borings to show boring logs on the soil profile. Lastly, the cross sections show construction and design details of proposed compacted perimeter and toe berms and aerial-fill waste disposal areas. Maximum elevations of the proposed fill as well as gas monitoring wells and groundwater monitoring wells are shown on Drawing III.A.10 in **Appendix III.A**. Static water elevations based on the maximum seasonal high groundwater surface are several hundred feet below ground and are shown on Drawing III.F.2 in **Appendix III.F**.

III.4.2.6 Liner Design [30 TAC §330.331]

The liner system for the GEP Landfill utilizes a geosynthetic clay liner (GCL) that is overlain with a flexible geomembrane liner, a geonet/geotextile drainage composite, and 24-inches of protective cover soil. Liner system details are provided on Drawing III.C.3 in **Appendix III.C**.

The final cover for the GEP Landfill consists of 2 feet of soil (18-inch infiltration layer, 6-inch base layer) overlain by non-woven geotextile and a 4-inch-thick layer of rock armoring. Final cover details are

provided on Drawing III.B.5 in **Appendix III.B**. Alternate final cover and alternate final liner demonstrations were performed and are provided in **Appendix III.I**, Attachment III.I.1.

III.4.2.7 Leachate Collection System [30 TAC §330.333]

The GEP Landfill includes a leachate collection system (LCS) that includes a geonet/geotextile drainage composite across the cell with collection pipes embedded in a drainage aggregate and a sump area. The materials recommended for the piping system include HDPE or an equivalent material capable of withstanding degradation from leachate. Pipe strength calculations have been provided as Attachment III.C.4 in **Appendix III.C**, which demonstrate that the piping system is of sufficient strength to prevent collapse under the pressure exerted from the overlying waste, cover materials, and equipment.

The LCS has been designed to function during the operating life and throughout the post-closure care period. Routine maintenance, including monitoring the leachate collection pipes and repairing pumps, will be required. Minimum maintenance requirements are described in **Appendix III.C**.

III.4.2.8 Liner Quality Control Plan [30 TAC §§330.63(d)(4)(G)]

A LQCP has been prepared under the direction of a licensed professional engineer and is provided in **Appendix III.D**.

III.4.2.9 Liner Evaluation Reports [30 TAC §§330.339 and 330.341]

Geosynthetic Clay Liner Evaluation Reports (GCLERs) and Geomembrane Liner Evaluation Reports (GLERs) shall be prepared in accordance with **Appendix III.D** and submitted to the TCEQ for evaluation and approval in accordance with 30 TAC §§330.339 and 330.341 prior to the disposal of solid waste in any area of the Facility.

III.5.0 Geology Report [30 TAC §330.63(e)]

A Geology Report has been prepared consistent with 30 TAC §330.63(e) and is provided as **Appendix III.E**. The Geology Report was prepared and signed by a qualified groundwater scientist.

III.6.0 Groundwater Sampling and Analysis Plan [30 TAC §330.63(f)]

A Groundwater Sampling and Analysis Plan (GWSAP) has been prepared to address the requirements in 30 TAC Subpart J – Groundwater Monitoring and Corrective Action. The GWSAP is provided as **Appendix III.F**.

The groundwater monitoring system shall be constructed, installed in sequence, and operated in accordance with the GWSAP. The groundwater monitoring system shall be used to monitor the quality of groundwater in the uppermost aquifer in accordance with 30 TAC §330.403. No special conditions are anticipated at this site. Groundwater is encountered in excess of 300 feet below ground surface at the Facility.

Monitoring wells shall be sampled in accordance with a monitoring program defined in the GWSAP and 30 TAC §§330.405 and 330.407.

Any monitoring well that is no longer used shall be properly plugged and abandoned in accordance with 30 TAC §330.421.

III.7.0 Landfill Gas Management Plan [30 TAC §330.63(g)]

A Landfill Gas Management Plan (LFGMP) has been prepared consistent with 30 TAC §330.63(g) and is provided as **Appendix III.H**. The LFGMP was prepared under the direction of a licensed professional engineer.

III.8.0 Closure Plan [30 TAC §330.63(h)]

The landfill shall be completed and closed in accordance with 30 TAC §330.63(h) and 30 TAC Subpart K, as laid out in the Final Closure Plan (**Appendix III.I**). Upon closure, the permittee shall submit to the Executive Director documentation of closure as prescribed in 30 TAC §330.457.

III.8.1 Existing Final Cover (Phase 1)

Final cover has been placed on Phase 1 (93.9 acres), and TCEQ acknowledged the closure of the unit on July 14, 2023. The final cover for Phase 1 consisted of 2 feet of soil (6-inch base layer, 18-inch infiltration layer) overlain by non-woven geotextile and a 4-inch-thick layer of rock armoring. Side slopes of the final cover for all above ground disposal were 25 percent (4H:1V). Terrace benches were incorporated into side slope designs to aid in erosion control. The landfill top dome was graded to a 3 percent slope. Drawings located in **Appendix III.A** provide the details for the existing closed Phase 1. **Appendix III.I** provides material and construction details for the final cover.

The vertical expansion of Phase 1 includes removing the crown final cover (34.6 acres) and vertically expanding the waste disposal area at a 4H:1V sideslope and finishing with a 5 percent crown. As detailed in the Surface Water Drainage Report (**Appendix III.B**), terraces will be constructed on the final cover slopes. Slope stability calculations have been completed and are included in **Appendix III.G**.

III.8.2 Final Cover Design

The final cover for the GEP Landfill is described in **Section III.4.2.6**. Side slopes of the final cover for all above ground disposal shall be 25 percent (4H:1V). Terrace benches have been incorporated into side slope designs to aid in erosion control and will be constructed on the final cover slopes. The landfill top dome shall be graded to a 5 percent slope. **Appendix III.B**, Attachment III.B.3 and **Appendix III.A** provides construction details for the final cover. Slope stability calculations have been completed and are included in **Appendix III.G**.

III.8.3 Soil Erosion Loss Calculations

Estimated soil losses due to erosion, as calculated by the Soil Conservation Service Revised Universal Soil Loss Equation (RUSLE), are within the permissible limits for comparable slope lengths and soil cover conditions. Attachment III.B.2 in **Appendix III.B** contains the Erosion and Sedimentation Control Plan and the soil loss calculations.

III.9.0 Post-Closure Plan [30 TAC §330.63(i)]

Consistent with 30 TAC §330.63(i), a post-closure plan has been prepared under the direction of a licensed professional engineer and is provided in **Appendix III.J**. Post-closure construction and maintenance shall be conducted in accordance with the Post-Closure Plan for a period of 30 years, or as otherwise determined by the Executive Director, pursuant to 30 TAC §330.463.

III.10.0 Cost Estimate for Closure and Post-Closure Care [30 TAC §330.63(j)]

Authorization to operate the Facility is contingent upon compliance with provisions contained within the permit and maintenance of financial assurance in accordance with 30 TAC Chapter 330, Subchapter K - Financial Assurance.

III.10.1 Closure Cost Estimates

Consistent with 30 TAC §330.503(a), a cost estimate of hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover is provided in **Appendix III.K**. The Closure Cost estimate in 2024 dollars is $13,963,373 based on the closure of all of Phase 2 (122.5 acres). A review of the Facility's permit conditions, current active areas, and cost estimates will be provided annually in accordance with 30 TAC §330.503(a)(1).

The City shall establish financial assurance for closure in accordance with 30 TAC Chapter 37, Subchapter R (relating to Financial Assurance for Municipal Solid Waste Facilities). Continuous financial assurance coverage for closure shall be provided until the Facility is officially placed under the post-closure maintenance period and all requirements of the final closure plan have been approved as evidenced in writing by the TCEQ.

III.10.2 Post-Closure Cost Estimates

Consistent with 30 TAC §330.507(a), a cost estimate of hiring a third party to conduct post-closure care activities is provided in **Appendix III.L**. The Post Closure Cost estimate in 2024 dollars is $2,157,660.

The City shall establish financial assurance for the costs of post-closure care of the unit in accordance with 30 TAC Chapter 37, Subchapter R (relating to Financial Assurance for Municipal Solid Waste Facilities). Continuous financial assurance coverage for post-closure care shall be provided until the Facility is officially released in writing by the TCEQ from the post-closure care period in accordance with all requirements of the post-closure care plan.

III.10.3 Corrective Action Cost Estimate

Consistent with 30 TAC §330.509, a corrective action program and a detailed written cost estimate of the cost of hiring a third party to perform the corrective action program is required if requested by the TCEQ. Currently a corrective action cost estimate for the site has not been requested by the TCEQ but will be provided if required.

APPENDIX III.A – PERMIT DRAWINGS

Greater El Paso Landfill

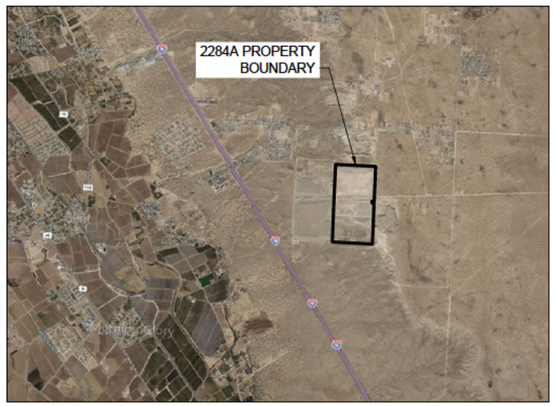
Vertical Expansion Permit Amendment

City of El Paso, TX

MSW Authorization No. 2284A

MAY 2024

BMcD Project No. 155488



GENERAL LOCATION MAP

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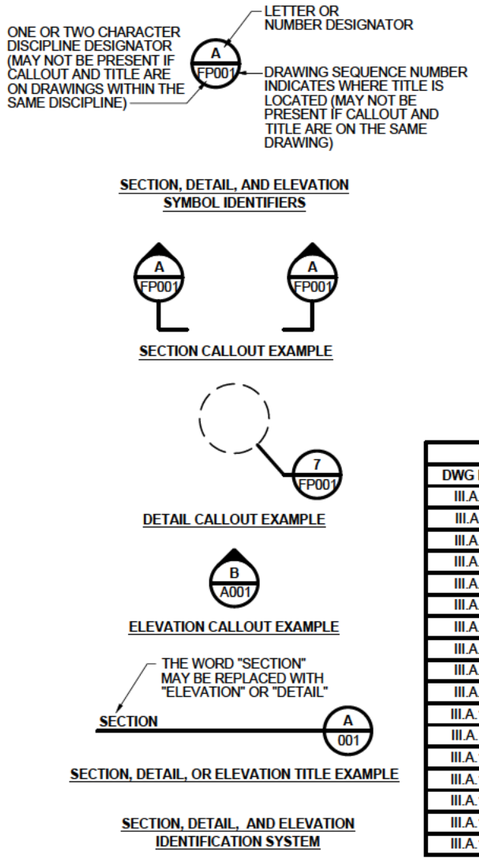

List of Drawings

SHEET INDEX	
DWG NO.	SHEET TITLE
III.A.0	COVER - INDEX
III.A.1	GENERAL NOTES, LEGEND, AND ABBREVIATIONS
III.A.2	ENTRANCE FACILITIES
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III.A.4	LANDFILL BASE GRADING PLAN
III.A.5	LANDFILL GRID SYSTEM
III.A.6	SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 11-14)
III.A.7	SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 15-16)
III.A.8	SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 17-18)
III.A.9	SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 19-20)
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III.A.11	LARGEST OPEN AREA
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SHEET INDEX	
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DWG NO.	SHEET TITLE
III.B.13	POND BC OUTFALL AND SECTIONS
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III.C.1	LEACHATE COLLECTION SYSTEM LAYOUT
III.C.2	LEACHATE COLLECTION SYSTEM PUMP PLAN AND SECTION
III.C.3	LEACHATE COLLECTION SYSTEM DETAILS, 1 OF 2
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III.C.6	PHASE 1 LEACHATE EVAPORATION POND DETAILS
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III.F.1	FINAL ENVIRONMENTAL MONITORING PLAN
III.F.2	FINAL GROUNDWATER MONITORING PLAN
III.H.1	EXISTING LANDFILL GAS MONITORING PROBE PLAN
III.H.2	LANDFILL GAS MANAGEMENT PLAN
III.H.3	LANDFILL GAS MONITORING PROBE DETAIL



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no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
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COVER - INDEX

PLAN LEGEND

- PROPERTY BOUNDARY
- PAVED ROAD
- GRAVEL ROAD
- PERMITTED WASTE LIMITS
- SURVEY LIMITS
- EXISTING 2' CONTOUR
- 3930 EXISTING 10' CONTOUR
- DRAINAGE PATH
- EXISTING POND
- GROUNDWATER SURFACE CONTOUR
- STRUCTURE
- X X EXISTING FENCE
- OHE OHE EXISTING OVERHEAD ELECTRICAL
- UGE UGE EXISTING UNDERGROUND ELECTRICAL
- UGC UGC EXISTING UNDERGROUND COMMUNICATIONS
- G G EXISTING GAS LINE
- EXISTING EASEMENT
- LCP LCP EXISTING LEACHATE PIPE COLLECTION SYSTEM
- FM FM EXISTING LEACHATE FORCE MAIN
- SITE BENCHMARK
- ABANDONED GROUNDWATER MONITORING WELL
- EXISTING GROUNDWATER MONITORING WELL
- FUTURE GROUNDWATER MONITORING WELL
- ABANDONED PIEZOMETER
- EXISTING PIEZOMETER
- EXISTING SOIL BORING, APPROXIMATE LOCATION
- EXISTING GAS MONITORING PROBE
- FUTURE GAS MONITORING PROBE
- CULVERT
- 3932 DESIGN 2' CONTOUR
- 3930 DESIGN 10' CONTOUR
- LCP LCP FUTURE LEACHATE PIPE COLLECTION SYSTEM
- FM FM LEACHATE/CONDENSATE FORCE MAIN
- GCCS FUTURE POTENTIAL LFG HEADER/LATERAL
- FUTURE POTENTIAL LFG EXTRACTION WELL
- MAXIMUM SEASONAL HIGH GROUNDWATER
- LETDOWN CHUTE
- 1 ORDER OF CELL CONSTRUCTION
- 20 LEACHATE COLLECTION SUMP RISER

DETAIL LEGEND

- GEOMEMBRANE
- xxxxxxxxxxxxxxxxxxxxxxxxxx GEOCOMPOSITE
- GEOTEXTILE
- COMPACTED SOIL LINER
- COMPACTED SOIL FINAL COVER/ GENERAL COMPACTED SOIL
- GEOSYNTHETIC CLAY LINER (GCL)
- PROTECTIVE COVER
- INTERIM/DAILY COVER
- PERFORATED PIPE
- ROCK ARMORING/RIPRAP/SUMP DRAINAGE ROCK
- SUBGRADE
- VEGETATIVE SOIL
- EARTH FILL
- INFILTRATION LAYER
- EROSION CONTROL MATTING
- STORMWATER DETENTION POND AREA

ABBREVIATIONS

AC.	ACRE
B	BORING
BM	BENCHMARK
BMcD	BURNS & MCDONNELL
℄	CENTERLINE
CM	CENTIMETER
DWG	DRAWING
E	EAST/EASTING
EL.	ELEVATION
EX.	EXISTING
FC	FINAL COVER
FL	DITCH FLOWLINE ELEVATION
FM	FORCE MAIN
FT.	FEET
G	GAS
GCCS	GAS COLLECTION AND CONTROL SYSTEM
GCL	GEOSYNTHETIC CLAY LINER
GMP	GAS MONITORING PROBE
HDPE	HIGH-DENSITY POLYETHYLENE
IN.	INCH
INV.	INVERT
K	HYDRAULIC CONDUCTIVITY
LCP	LEACHATE COLLECTION PIPE

ABBREVIATIONS CONT.

LFG	LANDFILL GAS
MIL	MILLI-INCH (1/1,000-INCH)
MIN	MINIMUM
MSW	MUNICIPAL SOLID WASTE
MW	MONITORING WELL
N	NORTH / NORTHING
NAD	NORTH AMERICAN DATUM
NAVD	NORTH AMERICAN VERTICAL DATUM
NO.	NUMBER
OHE	OVERHEAD ELECTRIC
OZ	OUNCE
OW	OBSERVATION WELL
PB	PIEZOMETER
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
S	SOUTH
SEC	SECOND
TYP.	TYPICAL
UGC	UNDERGROUND COMMUNICATION
UGE	UNDERGROUND ELECTRIC
W	WEST
YD	YARD

no.	date	by	ckd	description
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Millimeters
Scale For Microfilming
Inches

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133943
10-31-24
LICENSED
PROFESSIONAL ENGINEER

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MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

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City of El Paso, Texas

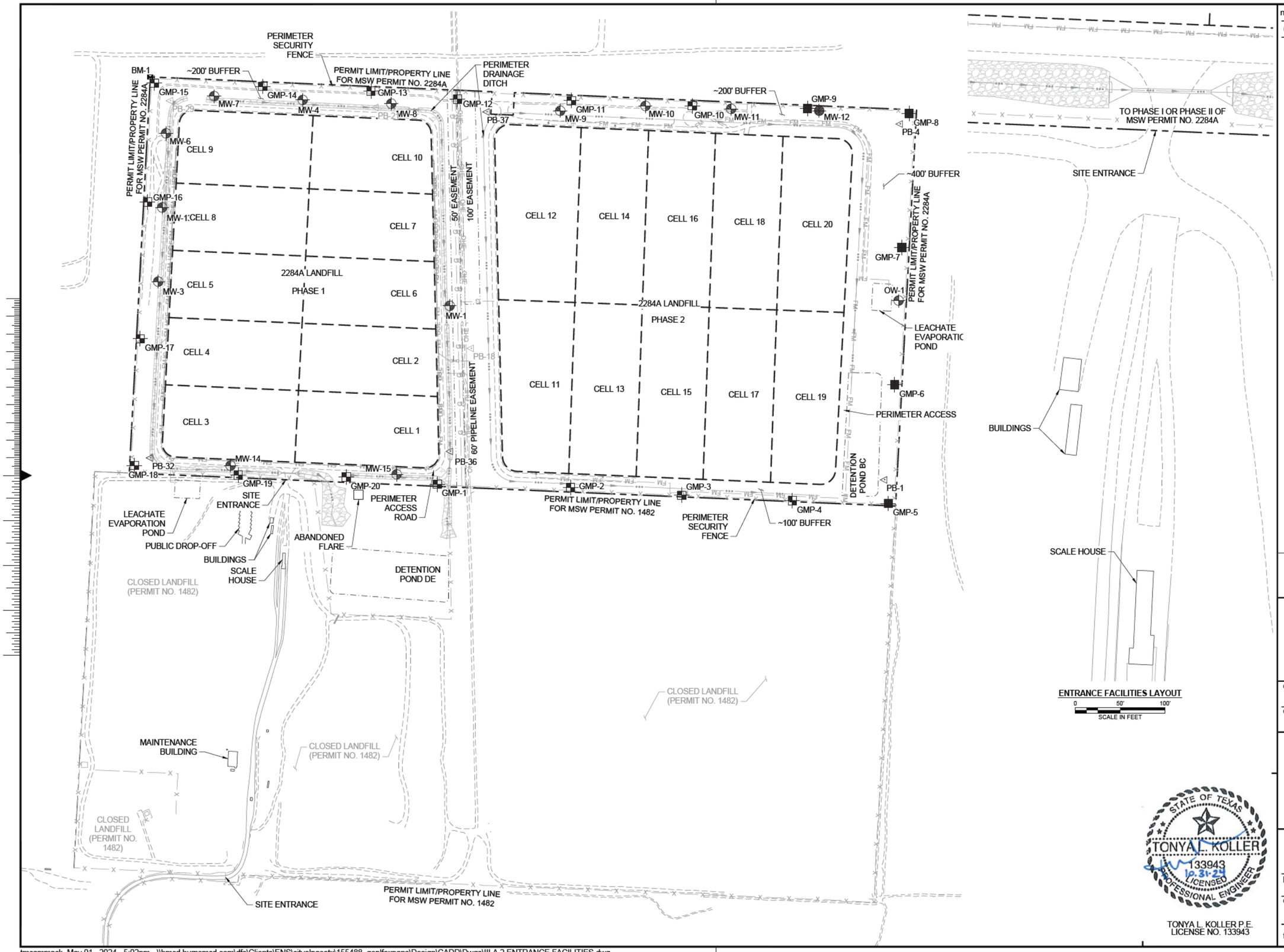
2284A PERMIT AMENDMENT

GENERAL NOTES, LEGEND, AND ABBREVIATIONS

project	contract
155488	-

drawing **III.A.1 – 0** rev.

file III.A.1 GENERAL NOTES, LEGEND, AND ABBREVIATIONS.dwg



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City of El Paso, Texas

2284A PERMIT AMENDMENT

ENTRANCE FACILITIES

project	contract
155488	-

drawing **III.A.2** – rev. **0**

file III.A.2 ENTRANCE FACILITIES.dwg

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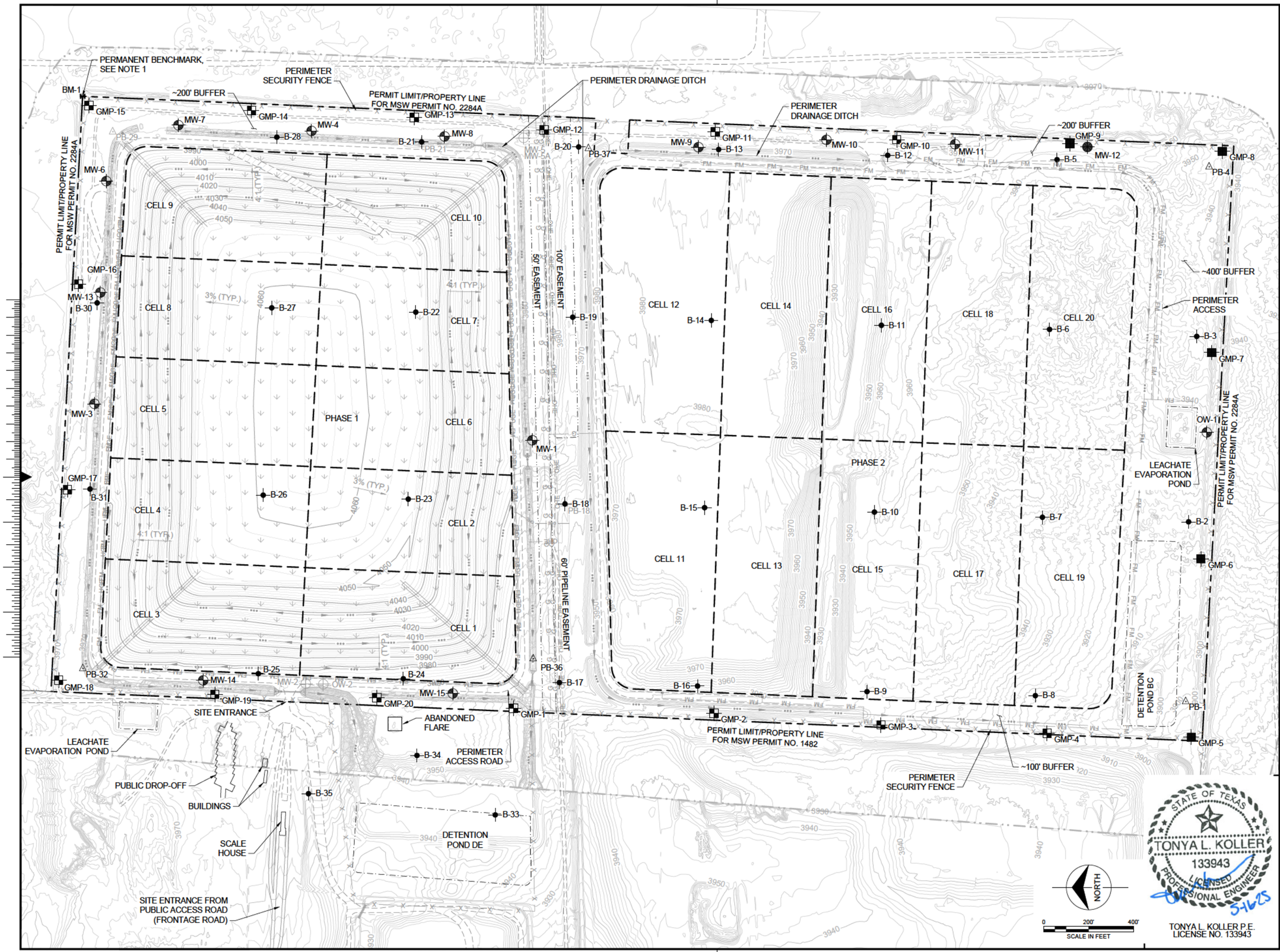

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ OD 1

NOTES:

1. PERMANENT BENCHMARK 3" Ø BRASS CAP SET IN CONCRETE (NAD83)
   N: 10,594,029.88 FEET
   E: 482,320.00 FEET
   ELEV:3986.67 FEET (NAVD88)
   LATITUDE: 31.602233
   LONGITUDE: -106.163511
2. INDEX CONTOUR INTERVAL, 2 FEET.
3. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
4. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
5. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
6. AT THE TIME OF DRAWING PREPARATION, WASTE PLACEMENT IS CURRENTLY OCCURRING IN CELLS 11-14, WHICH WERE CONSTRUCTED IN 2018.

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T. CAMMACK	T. KOLLER

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City of El Paso, Texas

2284A PERMIT AMENDMENT

EXISTING SITE LAYOUT

project	contract
155488	-

drawing **III.A.3 – 1** rev.

file III.A.3 EXISTING SITE LAYOUT.dwg

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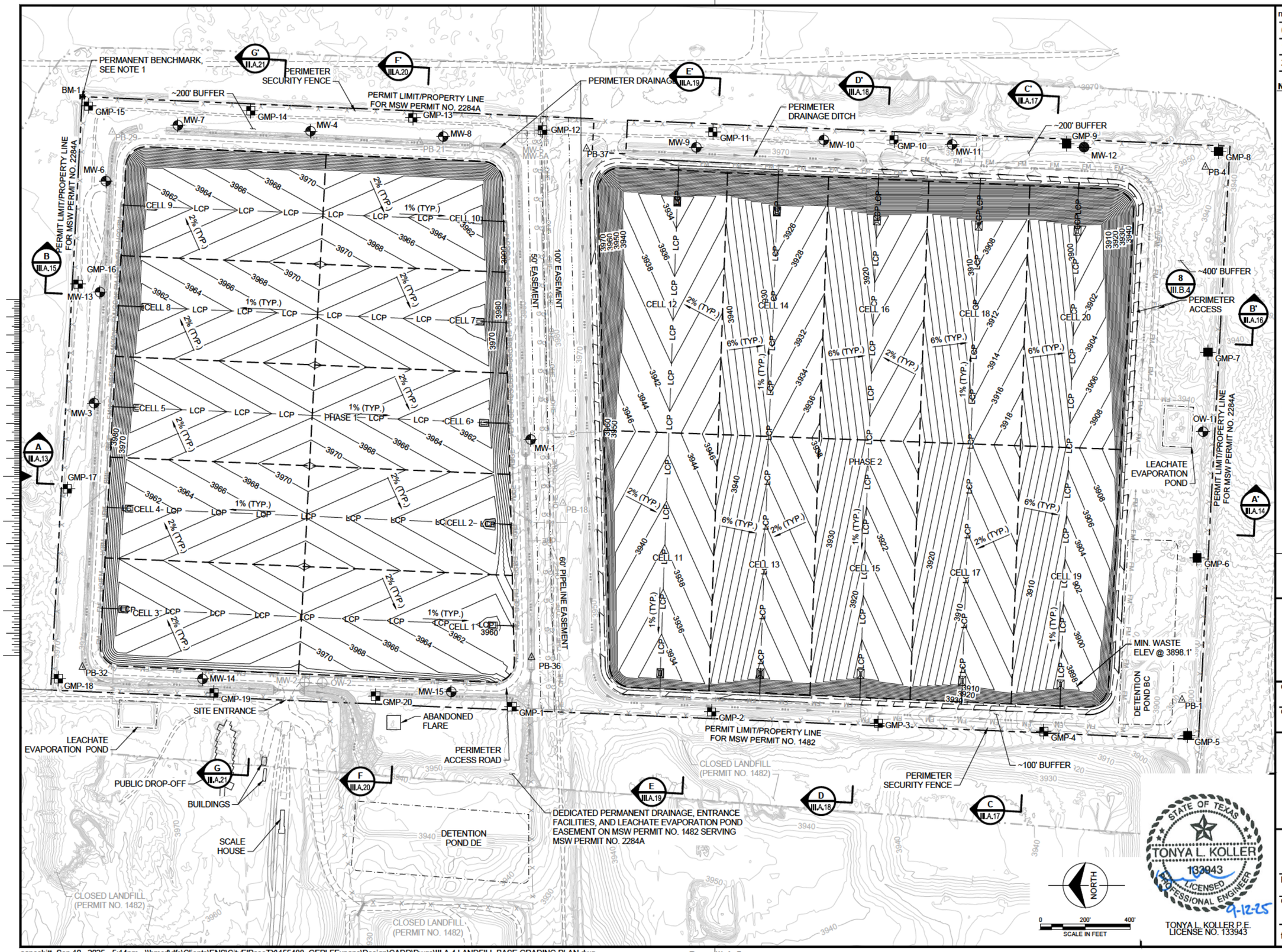

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1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	AAN	TLK	TCEQ NOD 2

NOTES:

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   E: 482,320.00 FEET
   ELEV:3986.67 FEET (NAVD88)
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4. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
5. DESIGN CONTOURS ARE FROM 2284 PERMIT AND REPRESENT TOP OF PROTECTIVE COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

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City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL BASE GRADING PLAN

project	contract
155488	-

drawing III.A.4 — rev. 2

file III.A.4 LANDFILL BASE GRADING PLAN.dwg

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9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

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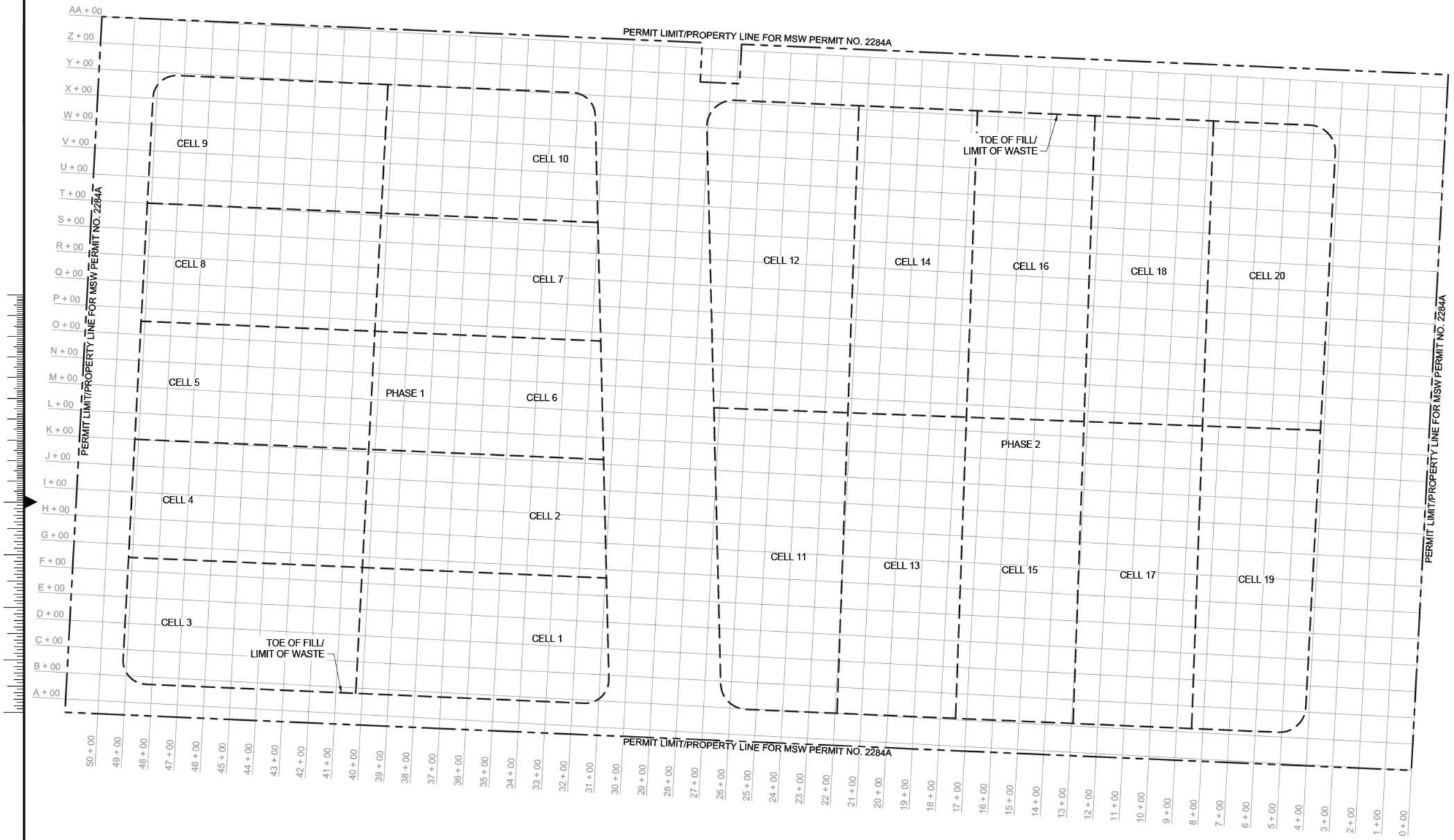

Scale For Microfilming
Millimeters
Inches

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NORTH

0 200' 400'
SCALE IN FEET

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Burns & McDonnell Engineering Co, Inc.
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

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City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL GRID SYSTEM

project	contract
155488	-

drawing **III.A.5 – 0** rev.

file III.A.5 LANDFILL GRID SYSTEM.dwg

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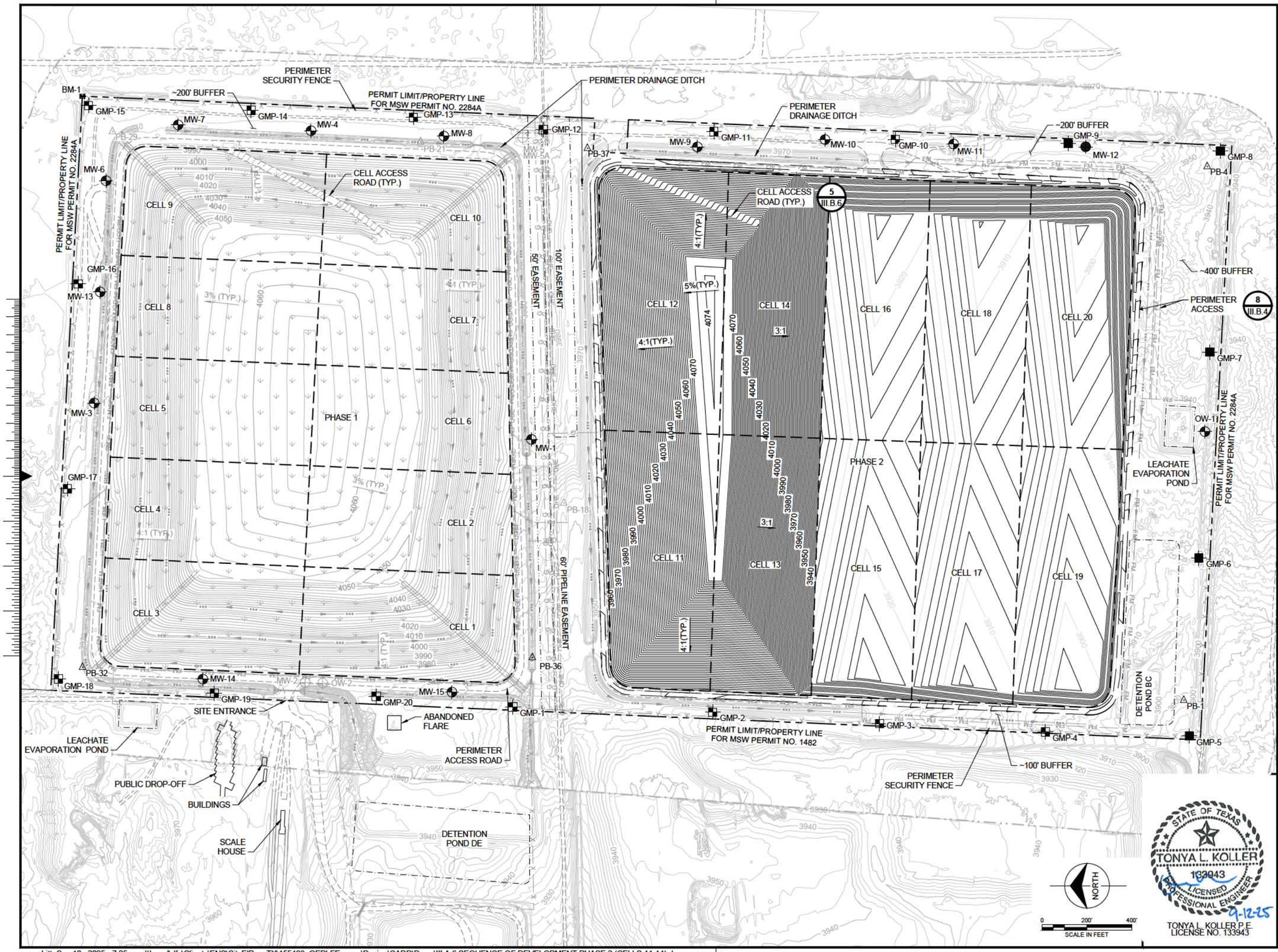

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1	9/12/25	AAN	TLK	TCEQ NOD 2

NOTES:

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5. DESIGN CONTOURS REPRESENT TOP OF FINAL INTERMEDIATE SURFACE FOR PHASE 2 (CELLS 11-14). CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

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date	detailed
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designed	checked
T. CAMMACK	T. KOLLER

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City of El Paso, Texas

2284A PERMIT AMENDMENT

SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 11-14)

project	contract
155488	-

drawing **III.A.6** rev. **1**

file III.A.6 SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 11-14).dwg

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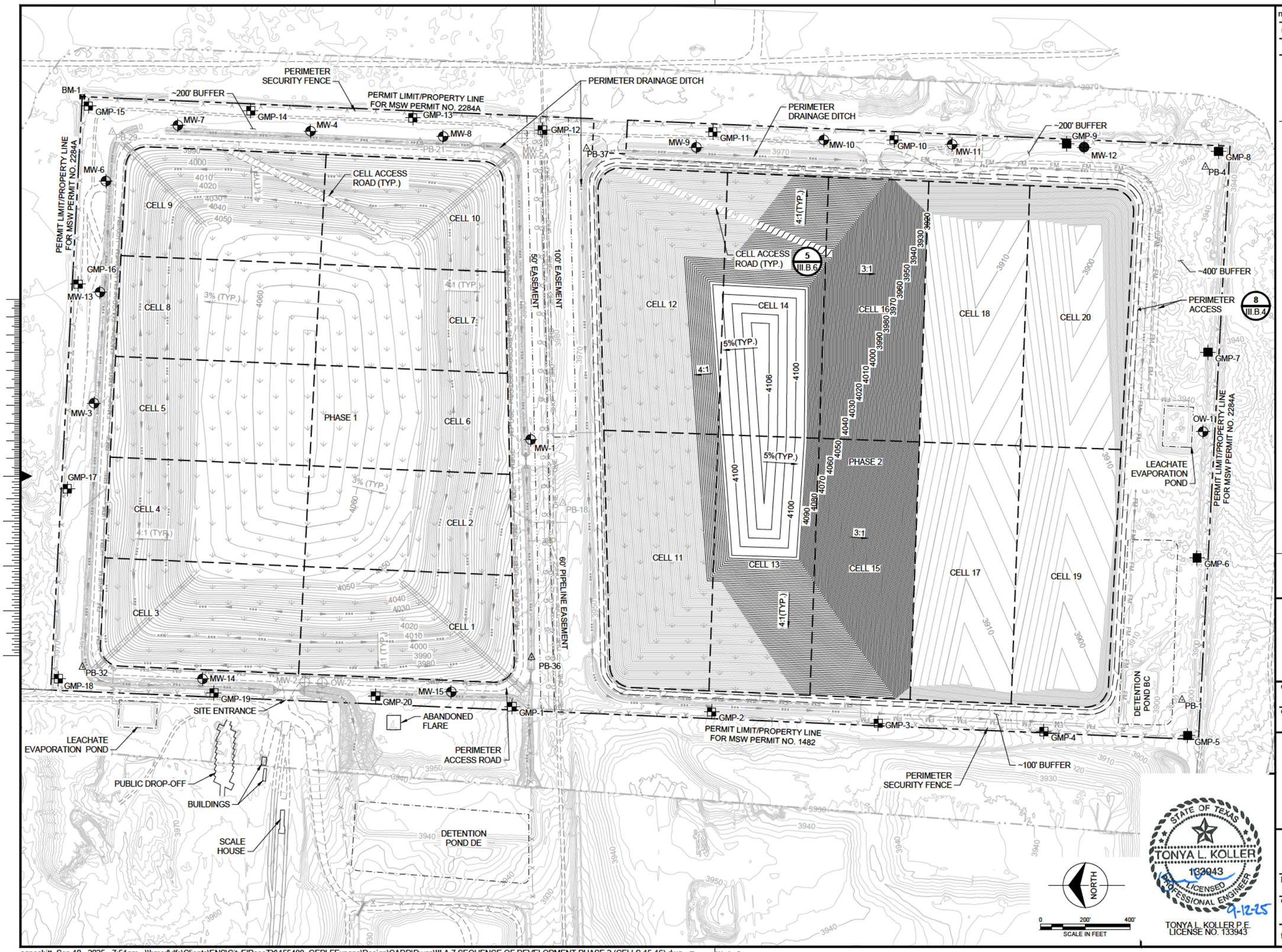

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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 15-16)

project	contract
155488	-

drawing **III.A.7** rev. **1**

file III.A.7 SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 15-16).dwg

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9-12-25

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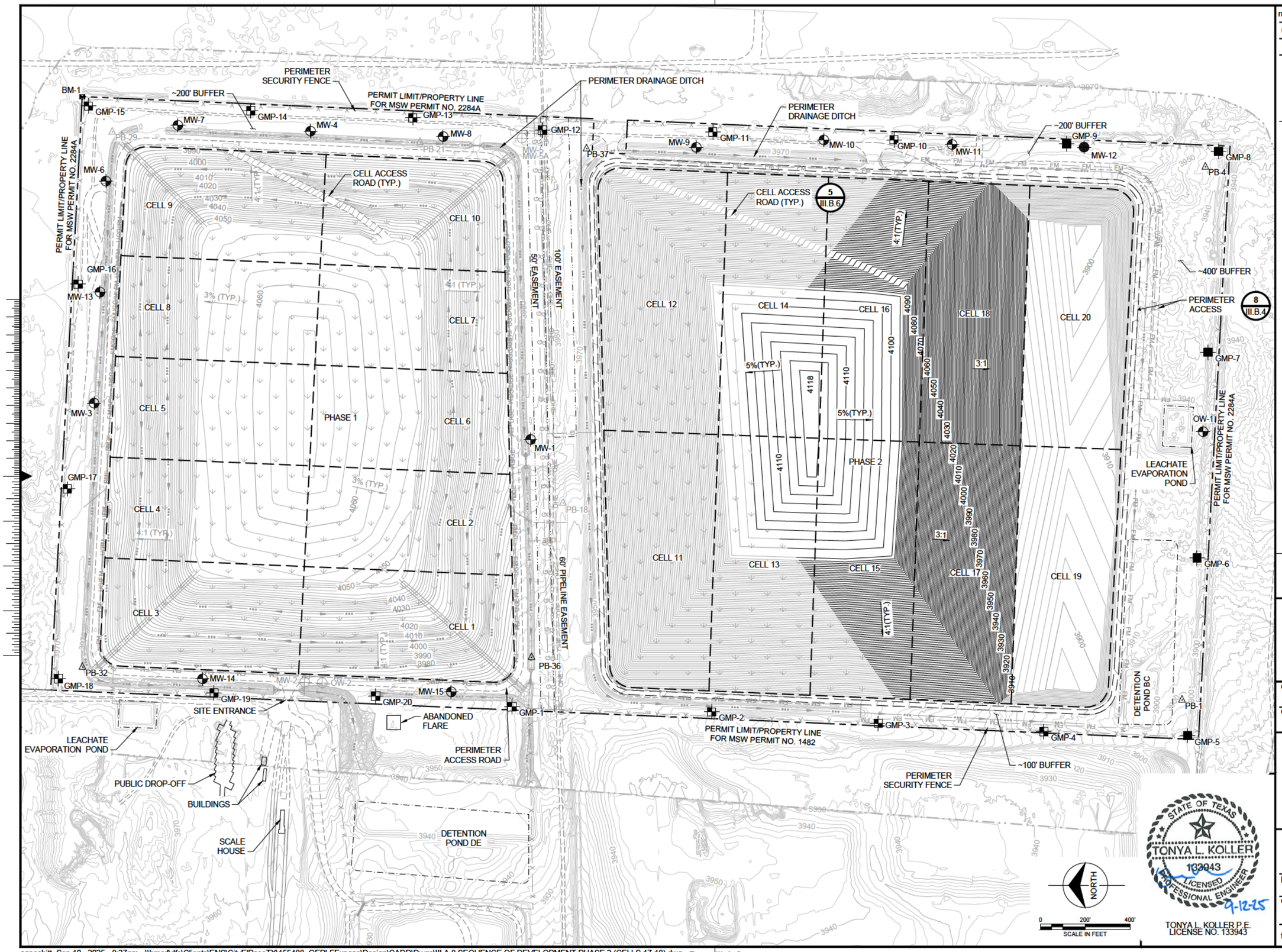

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1	9/12/25	AAN	TLK	TCEQ NOD 2

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1. INDEX CONTOUR INTERVAL, 2 FEET.
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3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL INTERMEDIATE SURFACE FOR PHASE 2 (CELLS 11-18). CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

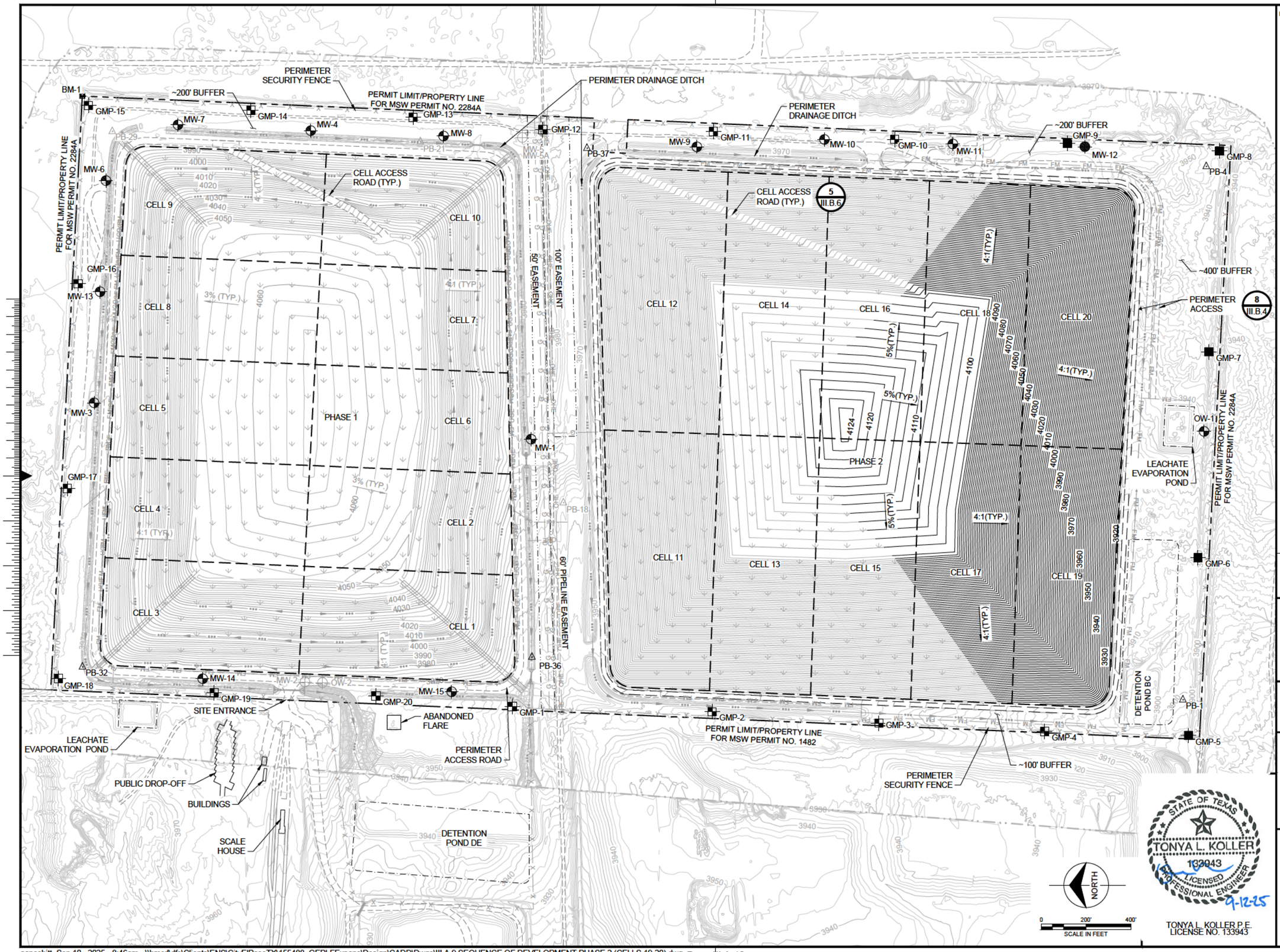
2284A PERMIT AMENDMENT

SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 17-18)

project	contract
155488	-

drawing **III.A.8** rev. **1**

file III.A.8 SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 17-18).dwg



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	9/12/25	AAN	TLK	TCEQ NOD 2

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 19-20)

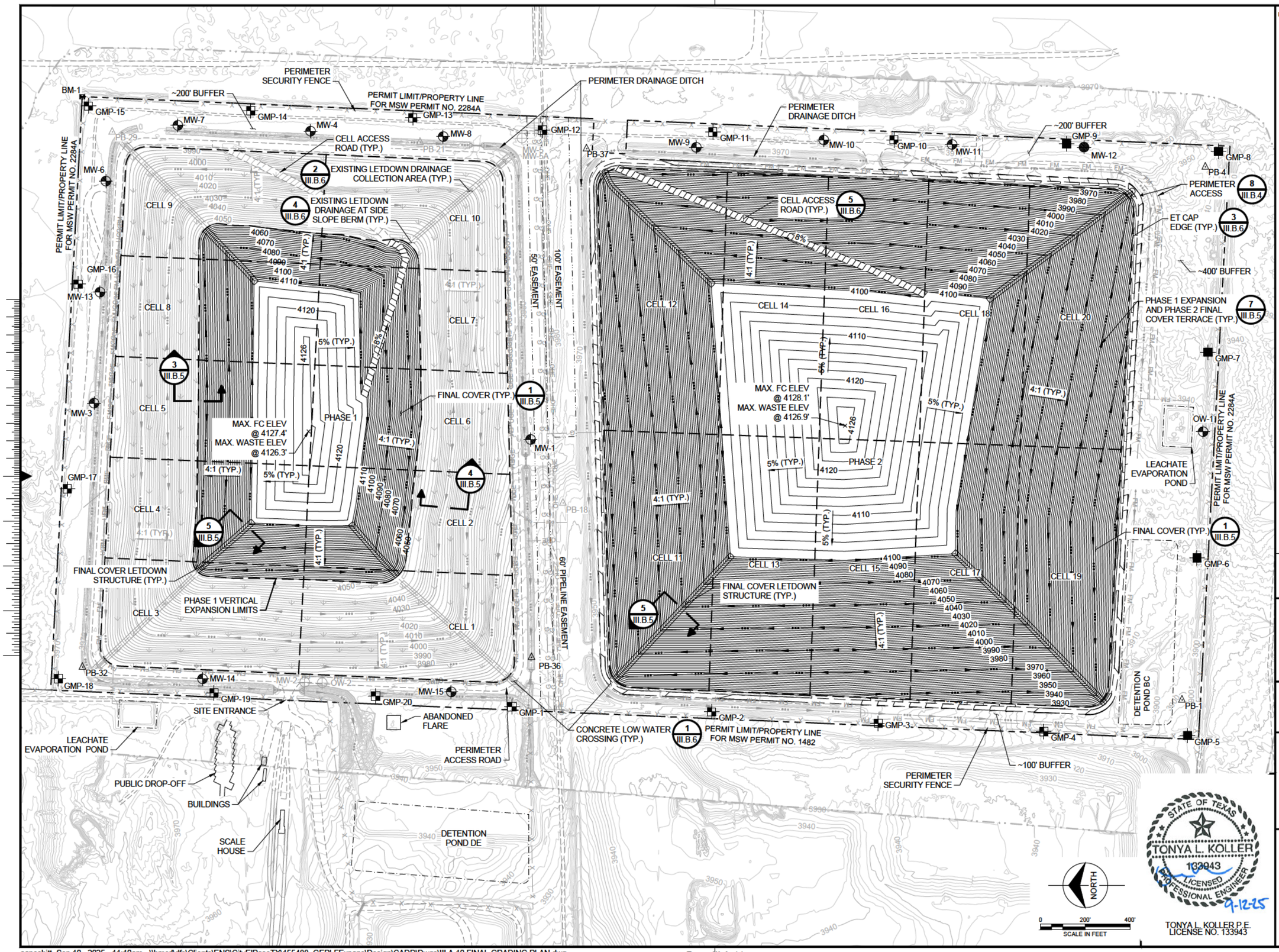
project	contract
155488	-

drawing **III.A.9** rev. **1**

file III.A.9 SEQUENCE OF DEVELOPMENT PHASE 2 (CELLS 19-20).dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	9/12/25	AAN	TLK	TCEQ NOD 2

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

FINAL GRADING PLAN

project	contract
155488	-

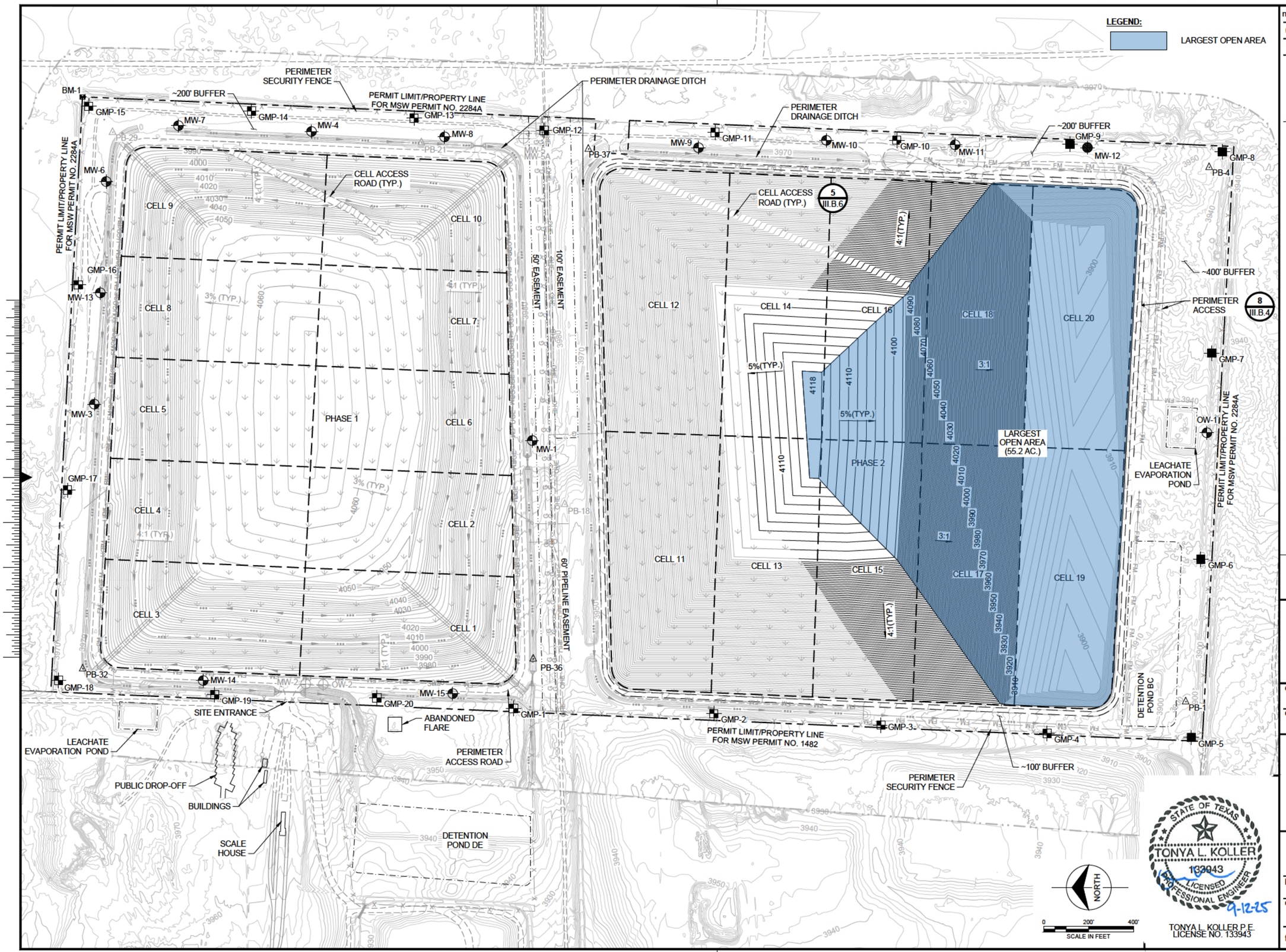
drawing **III.A.10** — rev. **1**

file III.A.10 FINAL GRADING PLAN.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming
Millimeters
Inches



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	9/12/25	AAN	TLK	TCEQ NOD 2

NOTES:

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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LARGEST OPEN AREA

project	contract
155488	-

drawing **III.A.11** rev. **1**

file III.A.11 LARGEST OPEN AREA.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming
Millimeters
Inches

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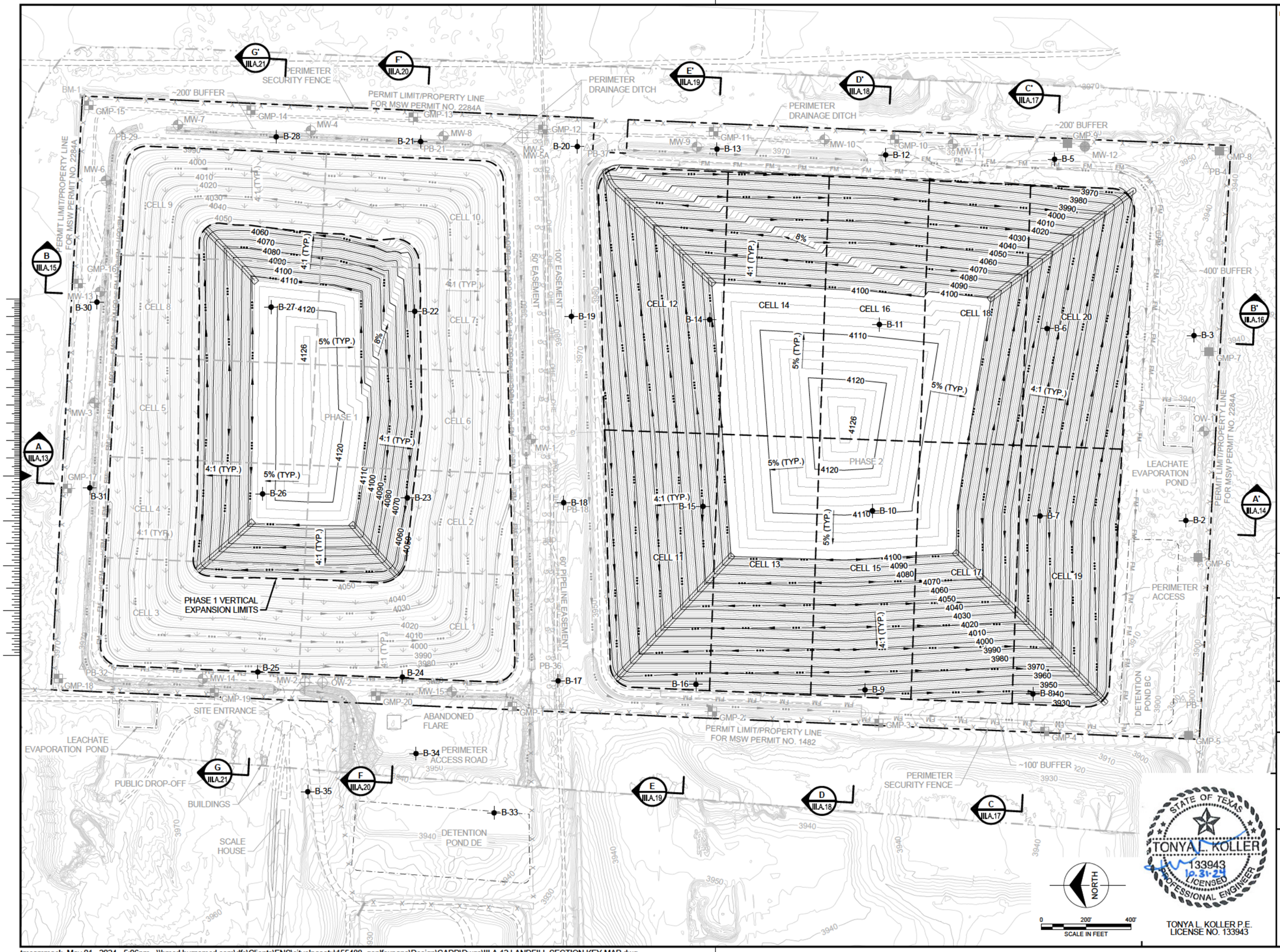

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

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FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION KEY MAP

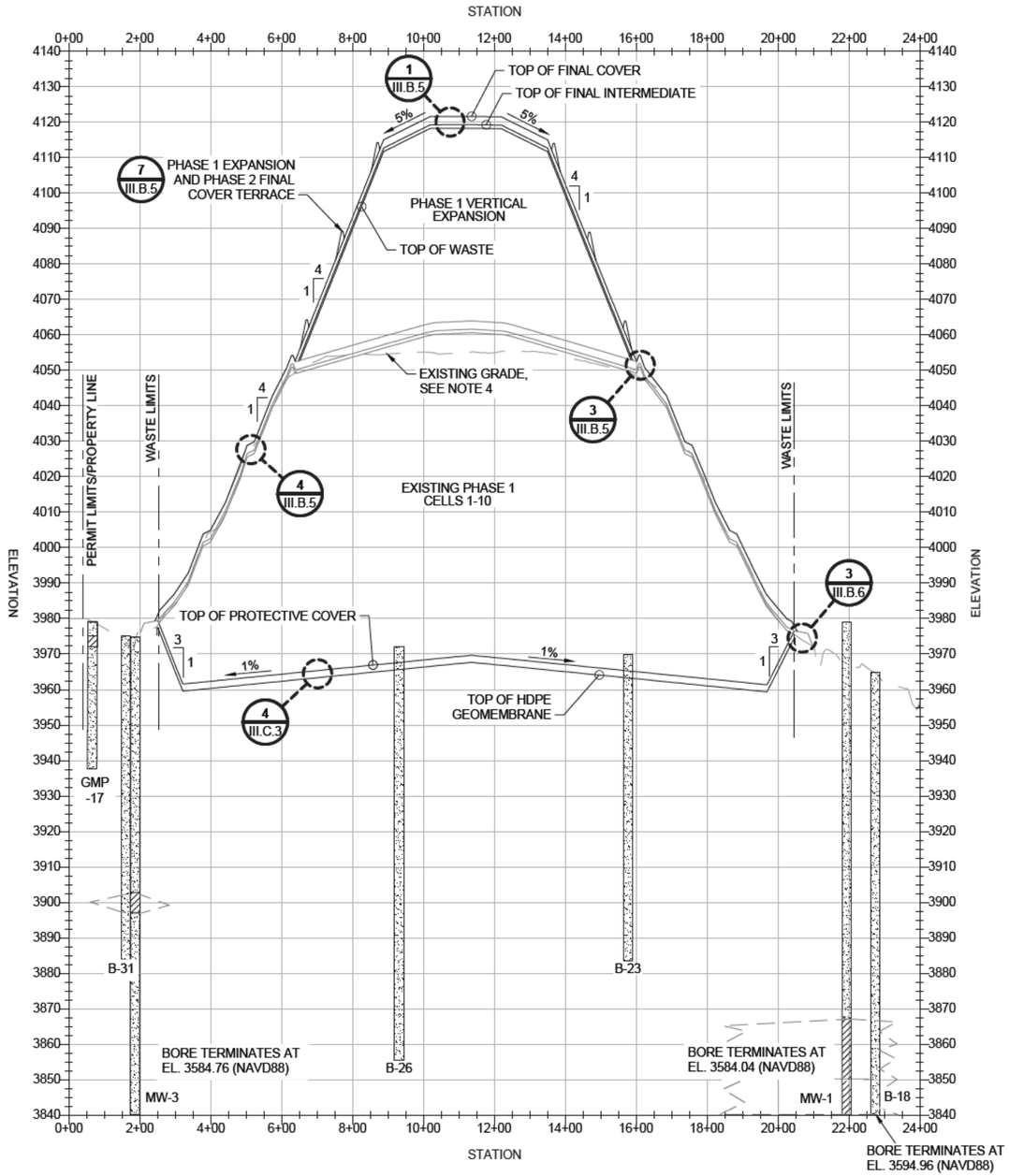
project	contract
155488	-

drawing III.A.12 – rev. 0

file III.A.12 LANDFILL SECTION KEY MAP.dwg

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 10-31-24

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION A-A* A III.A.4 / A III.A.12

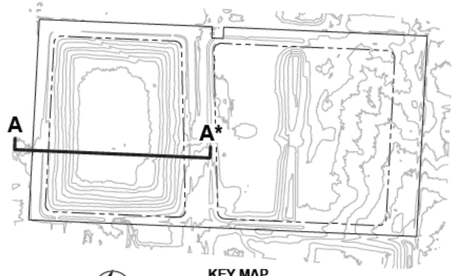
0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)				
GMP BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-17	3968.76	3927.26	3979.15	3937.65

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)				
MW BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-1	3968.65	3573.65	3979.04	3584.04
MW-3	3964.37	3575.37	3974.76	3584.76

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-18	3954.57	3584.57	3964.96	3594.96
B-23	3959.51	3873.01	3969.90	3883.40
B-26	3961.56	3845.06	3971.95	3855.45
B-31	3964.76	3873.26	3975.15	3883.65



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES
- 2284 GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
2. STATIC WATER ELEVATIONS BASED ON THE MAXIMUM SEASONAL HIGH GROUNDWATER SURFACE AS OF THE DATE OF THE ORIGINAL APPLICATION, SHOWN ON DRAWING III.E.21.
3. LITHOLOGY IS GENERALIZED BY SAND, SILT, AND CLAY. REFER TO BORING LOGS PROVIDED IN APPENDIX III.E FOR EXACT LITHOLOGY DESCRIPTIONS.
4. EXISTING GROUND SOURCES PROVIDED ON DRAWING III.A.3.
5. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION A-A', 1 OF 2

project	contract
155488	-

drawing **III.A.13** rev. **1**

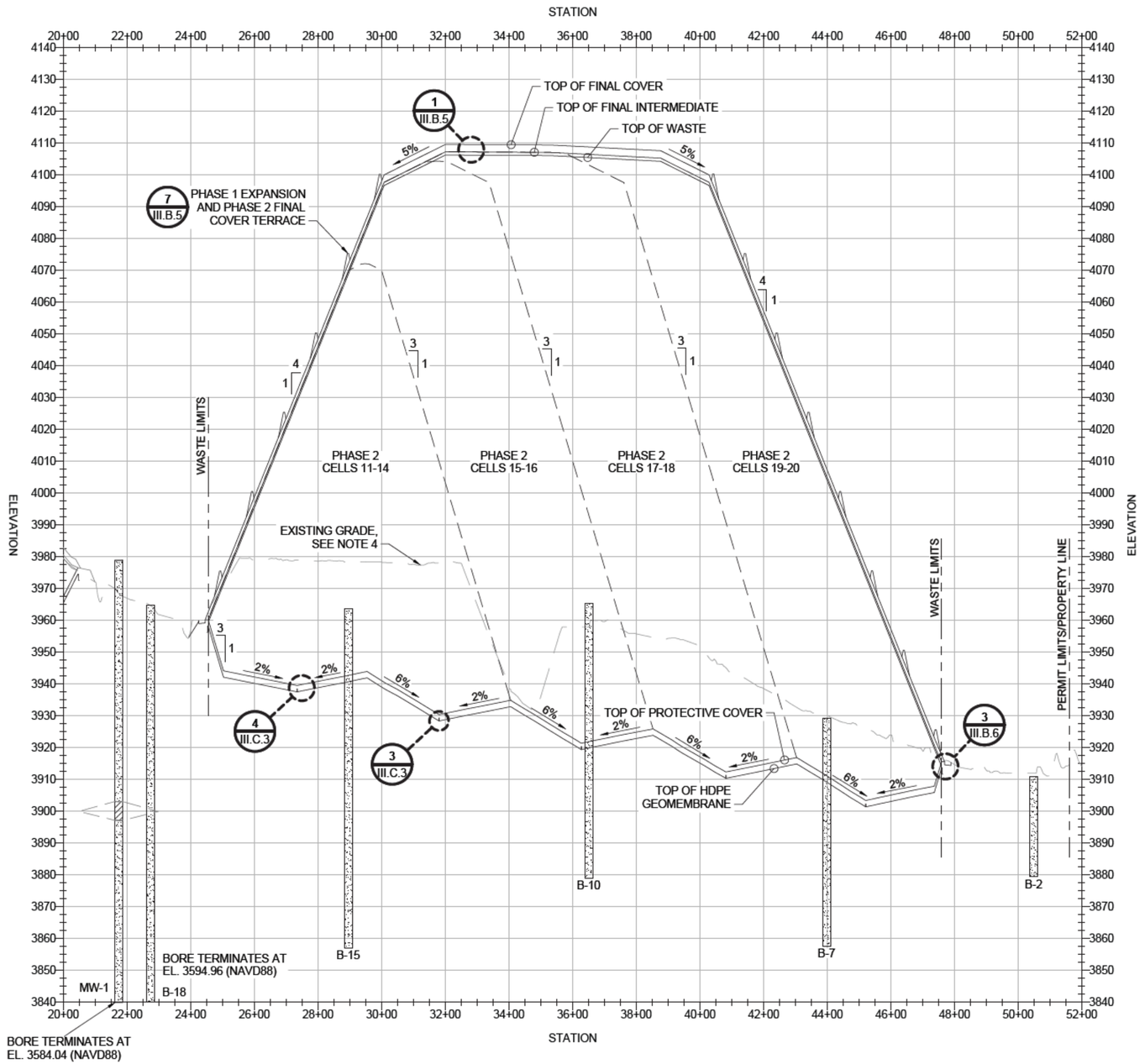
file III.A.13 LANDFILL SECTION A-A', 1 OF 2.dwg

STATE OF TEXAS NATHAN KILGORE GEOLOGY 15672 LICENSED PROFESSIONAL GEOSCIENTIST 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION A*-A'

A III.A.4 A III.A.12

0 10' 20' 40' SCALE IN FEET

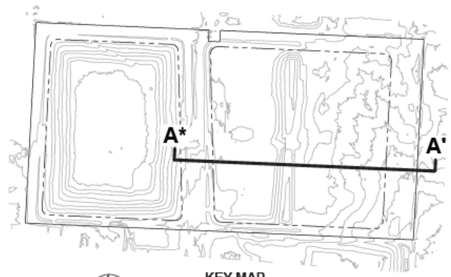
0 200' 400' SCALE IN FEET

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)

MW BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-1	3968.65	3573.65	3979.04	3584.04

SOIL BORING ELEVATIONS (SEE NOTE 5)

SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-2	3900.56	3869.06	3910.95	3879.45
B-7	3918.80	3847.30	3929.19	3857.69
B-10	3955.04	3868.54	3965.43	3878.93
B-15	3953.26	3846.76	3963.65	3857.15
B-18	3954.57	3584.57	3964.96	3594.96



KEY MAP

0 1000' 2000' SCALE IN FEET

LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
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no.	date	by	ckd	description
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1	5/16/25	AAN	TJS	TCEQ NOD 1

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION A-A', 2 OF 2

project	contract
155488	-

drawing III.A.14 – rev. 1

file III.A.14 LANDFILL SECTION A-A', 2 OF 2.dwg

STATE OF TEXAS NATHAN KILGORE GEOLOGY 15672 LICENSED PROFESSIONAL GEOSCIENTIST 5/16/2025

NATHAN S. KILGORE, P.G.
LICENSE NO. 15672

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 5-16-25

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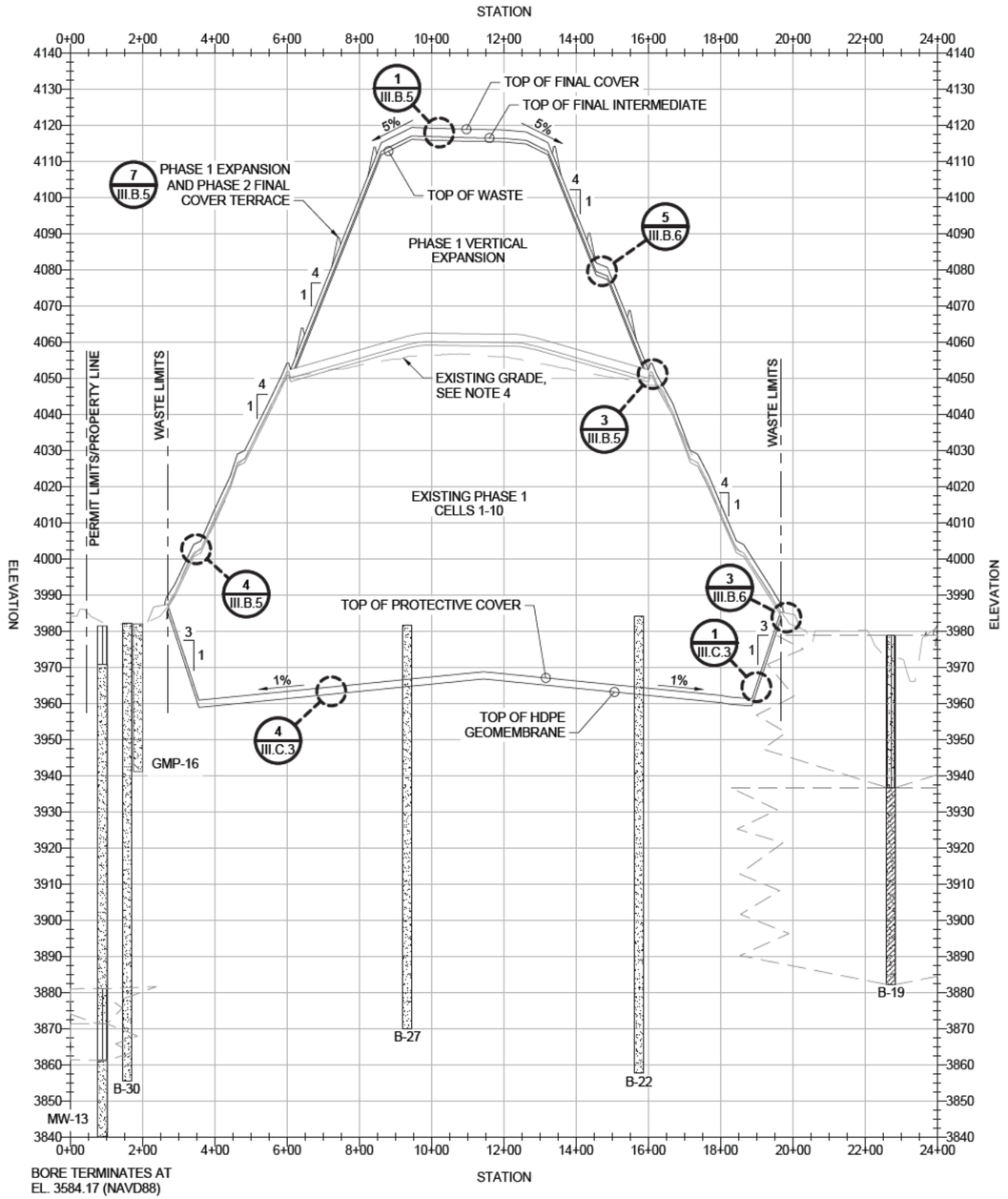


LANDFILL SECTION B-B* — B III.A.4 / B III.A.12

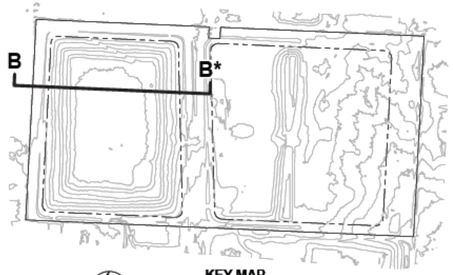
0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)				
GMP BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-16	3971.98	3931.98	3982.37	3942.37

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)		
MW BORING	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-13	3981.17	3584.17

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-19	3968.26	3871.76	3978.65	3882.15
B-22	3973.66	3847.16	3984.05	3857.55
B-27	3971.12	3859.62	3981.51	3870.01
B-30	3971.66	3845.16	3982.05	3855.55



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES
- 2284 GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION B-B', 1 OF 2

project	contract
155488	-

drawing **III.A.15** — rev. **1**

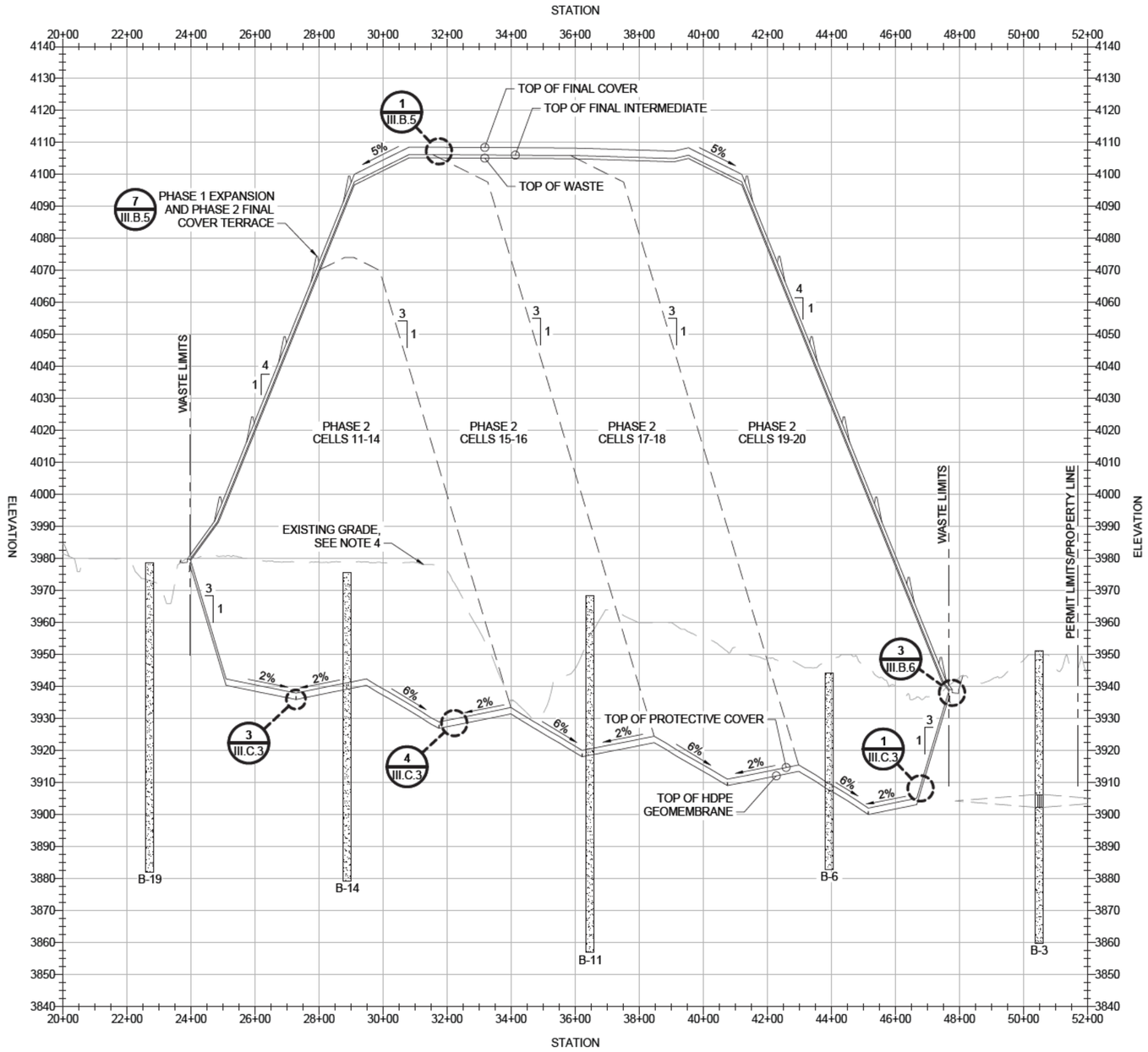
file III.A.15 LANDFILL SECTION B-B', 1 OF 2.dwg

STATE OF TEXAS — NATHAN KILGORE — GEOLOGY 15672 — LICENSED PROFESSIONAL GEOSCIENTIST — 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER — 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

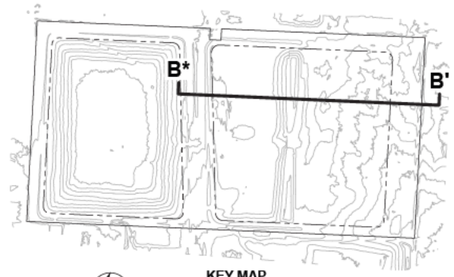


LANDFILL SECTION B*-B' (B III.A.4 / B III.A.12)

0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-3	3940.93	3849.43	3951.32	3859.82
B-6	3933.91	3872.41	3944.30	3882.80
B-11	3958.04	3846.54	3968.43	3856.93
B-14	3965.40	3868.90	3975.79	3879.29
B-19	3968.26	3871.76	3978.65	3882.15



KEY MAP

N

0 1000' 2000' SCALE IN FEET

LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
2. STATIC WATER ELEVATIONS BASED ON THE MAXIMUM SEASONAL HIGH GROUNDWATER SURFACE AS OF THE DATE OF THE ORIGINAL APPLICATION, SHOWN ON DRAWING III.E.21.
3. LITHOLOGY IS GENERALIZED BY SAND, SILT, AND CLAY. REFER TO BORING LOGS PROVIDED IN APPENDIX III.E FOR EXACT LITHOLOGY DESCRIPTIONS.
4. EXISTING GROUND SOURCES PROVIDED ON DRAWING III.A.3.
5. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION B-B', 2 OF 2

project	contract
155488	-

drawing **III.A.16** rev. **1**

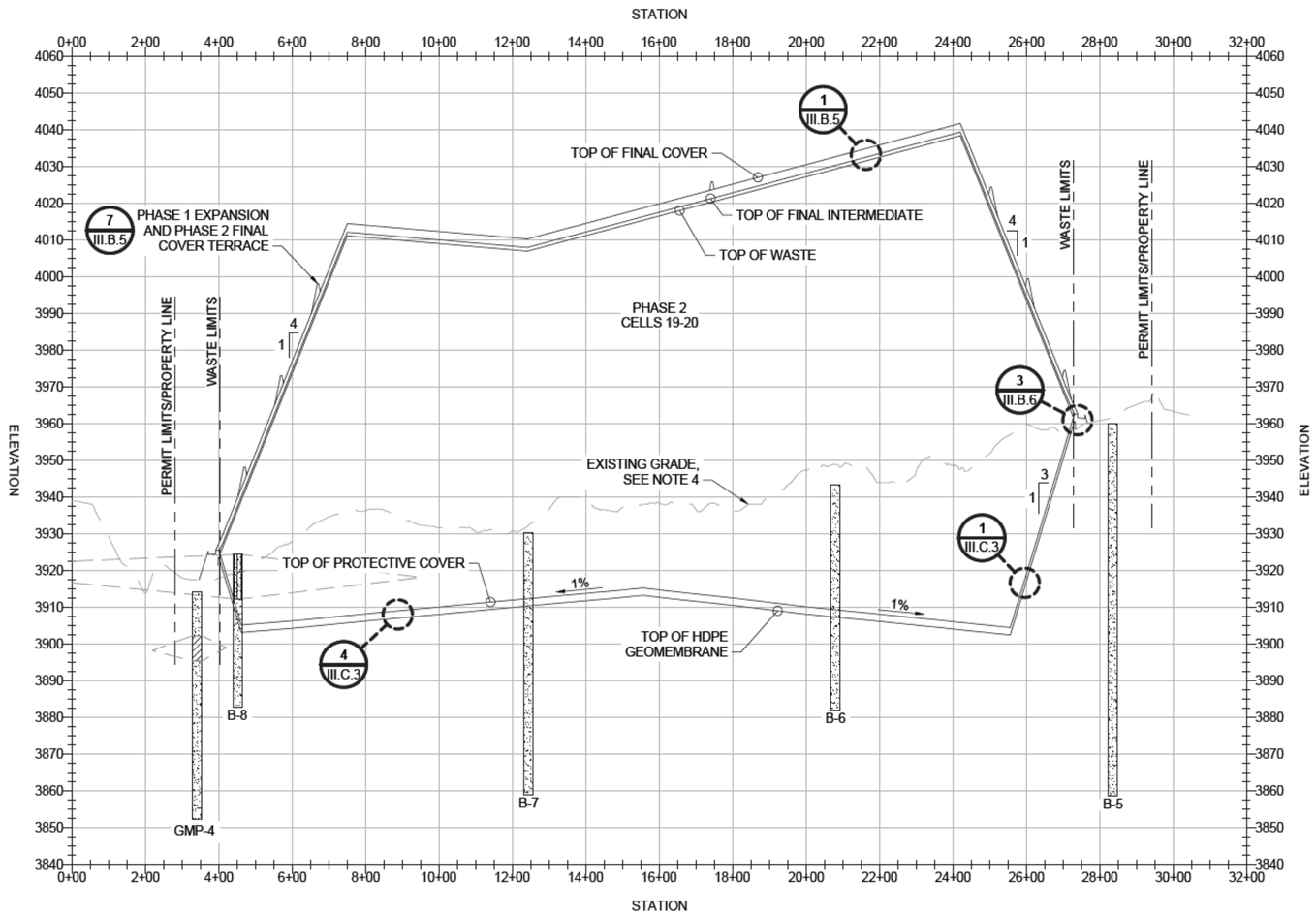
file III.A.16 LANDFILL SECTION B-B', 2 OF 2.dwg

STATE OF TEXAS — NATHAN KILGORE — GEOLOGY 15672 — LICENSED PROFESSIONAL GEOSCIENTIST — 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER — 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



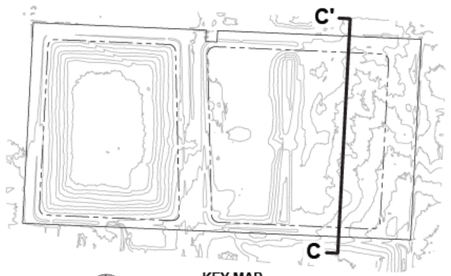
LANDFILL SECTION C-C' (C III.A.4 / C III.A.12)

0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)		
GMP BORING	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-17	3914.98	3852.68

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-5	3946.46	3844.96	3956.85	3855.35
B-6	3933.91	3872.41	3944.30	3882.80
B-7	3918.80	3847.30	3929.19	3857.69
B-8	3913.93	3872.43	3924.32	3882.82



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TSJ	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
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4. EXISTING GROUND SOURCES PROVIDED ON DRAWING III.A.3.
5. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN

FOR PERMITTING PURPOSES ONLY

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION C-C'

project	contract
155488	-

drawing **III.A.17 – 1** rev.

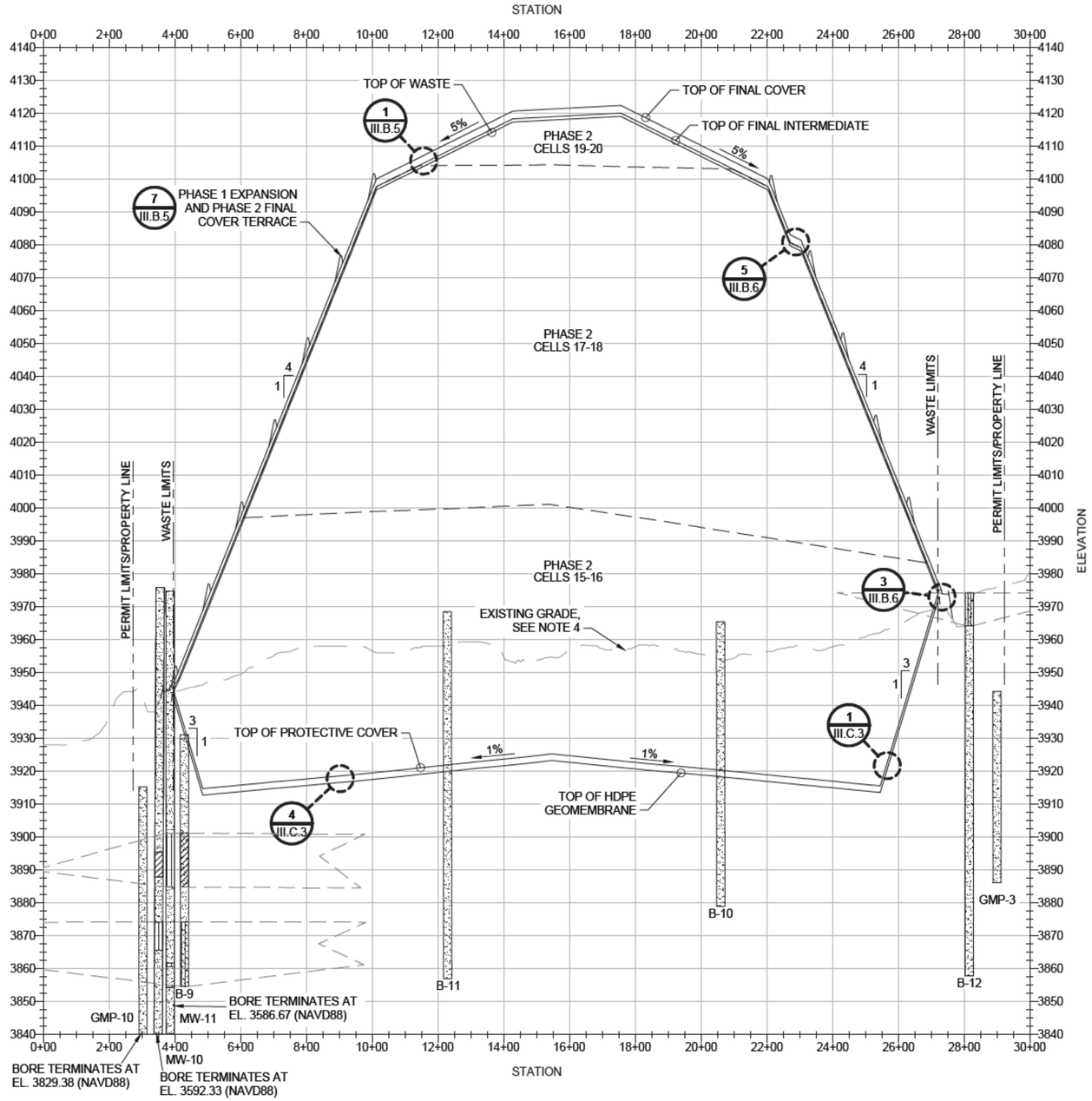
file III.A.17 LANDFILL SECTION C-C'.dwg

STATE OF TEXAS — NATHAN KILGORE — GEOLOGY 15672 — LICENSED PROFESSIONAL GEOSCIENTIST — 5/16/2025

NATHAN S. KILGORE, P.G.
LICENSE NO. 15672

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER — 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION D-D'

D III.A.4 D III.A.12

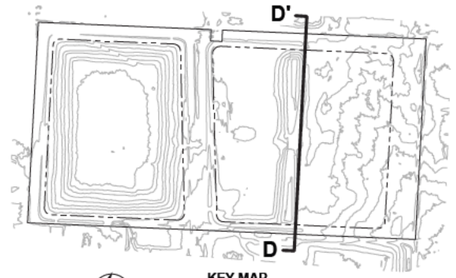
0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)		
GMP BORING	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-10	3914.98	3829.38
GMP-3	3944.70	3886.00

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)		
MW BORING	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-10	3976.33	3592.33
MW-11	3974.67	3586.67

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-9	3920.66	3844.16	3931.05	3854.55
B-10	3955.04	3868.54	3965.43	3878.93
B-11	3958.04	3846.54	3968.43	3856.93
B-12	3963.88	3847.38	3974.27	3857.77



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
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FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION D-D'

project	contract
155488	-

drawing **III.A.18** rev. **1**

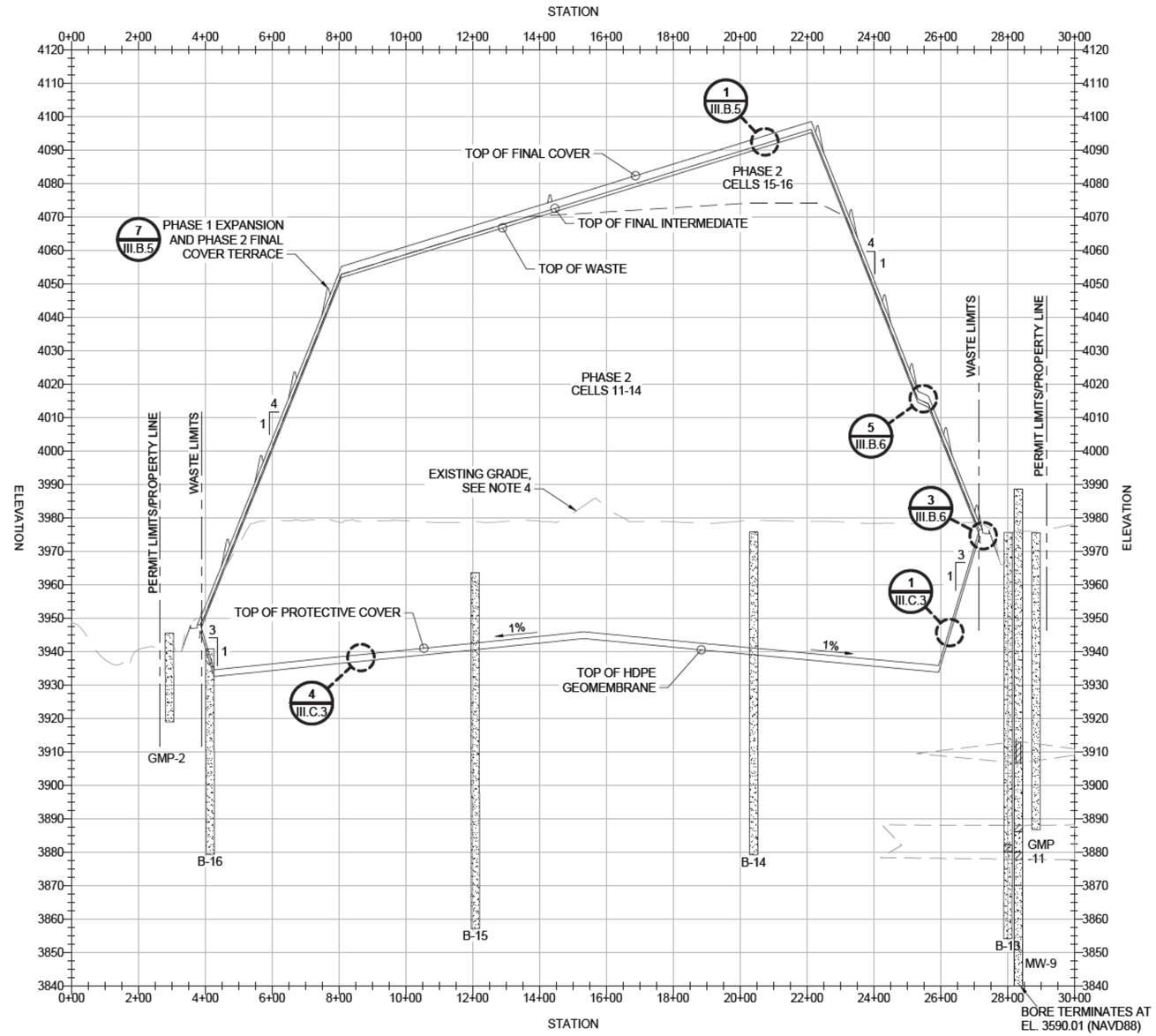
file III.A.18 LANDFILL SECTION D-D'.dwg

STATE OF TEXAS — NATHAN KILGORE — GEOLOGY 15672 — LICENSED PROFESSIONAL GEOSCIENTIST — 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER — 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION E-E'

E III.A.4 E III.A.12

0 10' 20' 40'
SCALE IN FEET

0 200' 400'
SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)

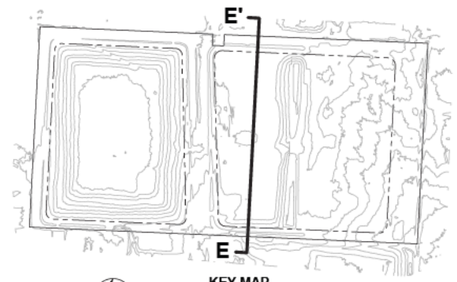
GMP BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-2	3935.93	3908.43	3946.32	3918.82
GMP-11	3965.25	3877.25	3975.64	3887.64

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)

MW BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-9	3976.62	3579.62	3987.01	3590.01

SOIL BORING ELEVATIONS (SEE NOTE 5)

SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-13	3965.28	3843.78	3975.67	3854.17
B-14	3965.40	3868.90	3975.79	3879.29
B-15	3953.26	3846.76	3963.65	3857.15
B-16	3960.45	3868.95	3940.84	3879.34



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- SILTY CLAY
- GENERALIZED INFERRED STRATA
- 2284A GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION E-E'

project	contract
155488	-

drawing **III.A.19** – rev. **1**

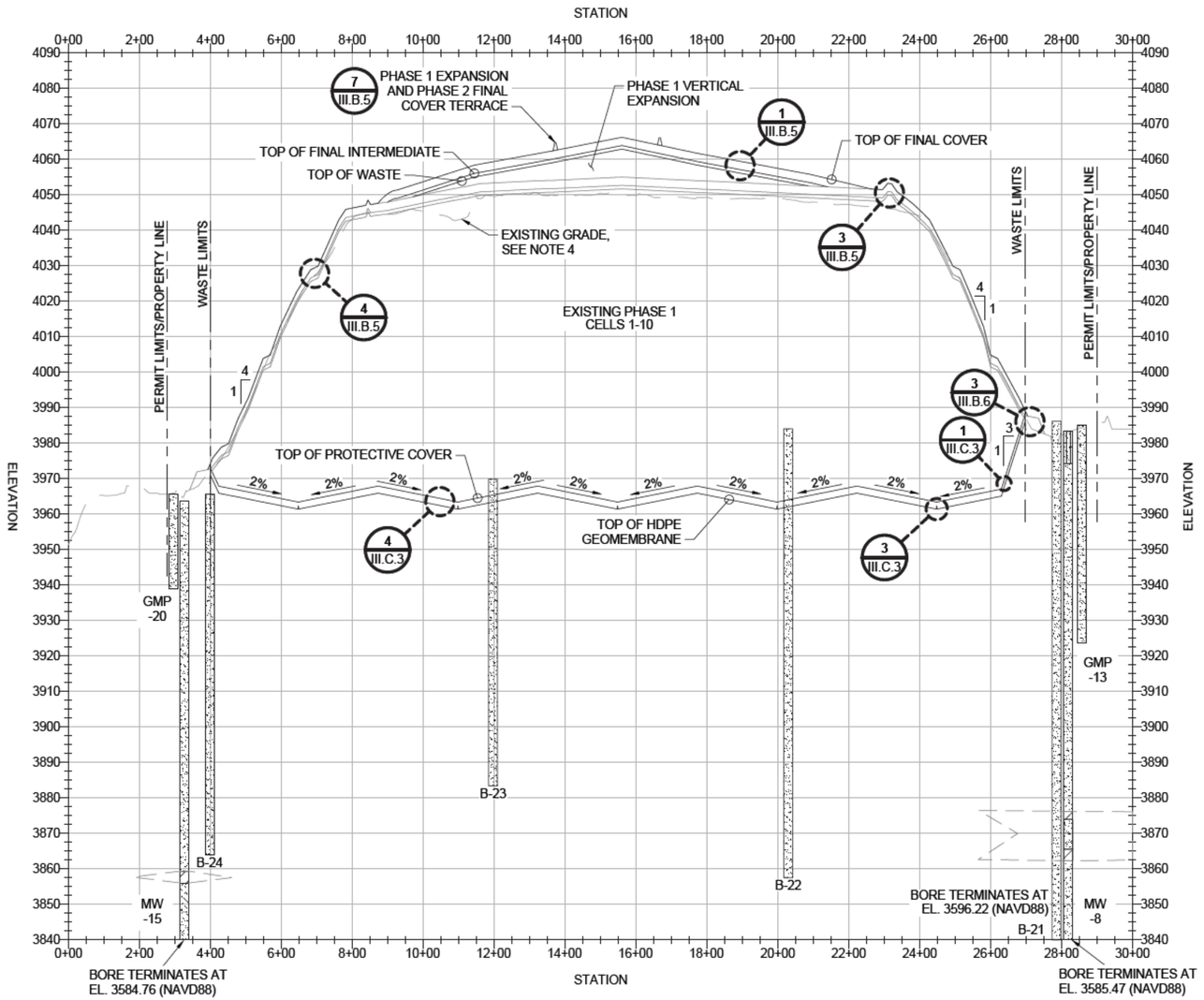
file III.A.19 LANDFILL SECTION E-E'.dwg

STATE OF TEXAS
NATHAN KILGORE
GEOLOGY
15672
LICENSED
PROFESSIONAL GEOSCIENTIST
5/16/2025

NATHAN S. KILGORE, P.G.
LICENSE NO. 15672

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION F-F'

F III.A.4 F III.A.12

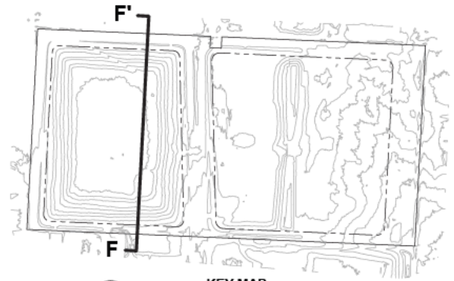
0 10' 20' 40'
SCALE IN FEET

0 200' 400'
SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)				
GMP BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-13	3975.08	3912.08	3985.47	3922.47
GMP-20	3954.73	3929.23	3965.12	3939.62

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)				
MW BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-8	3979.08	3575.08	3983.47	3585.47
MW-15	3964.37	3575.37	3963.63	3584.76

SOIL BORING ELEVATIONS (SEE NOTE 5)				
SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-21	3975.83	3585.83	3986.22	3596.22
B-22	3973.66	3847.16	3984.05	3857.55
B-23	3959.51	3873.01	3969.90	3883.40
B-24	3955.24	3853.74	3965.63	3864.13



LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES
- 2284 GRADES

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
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T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION F-F'

project	contract
155488	-

drawing **III.A.20 – 1** rev.

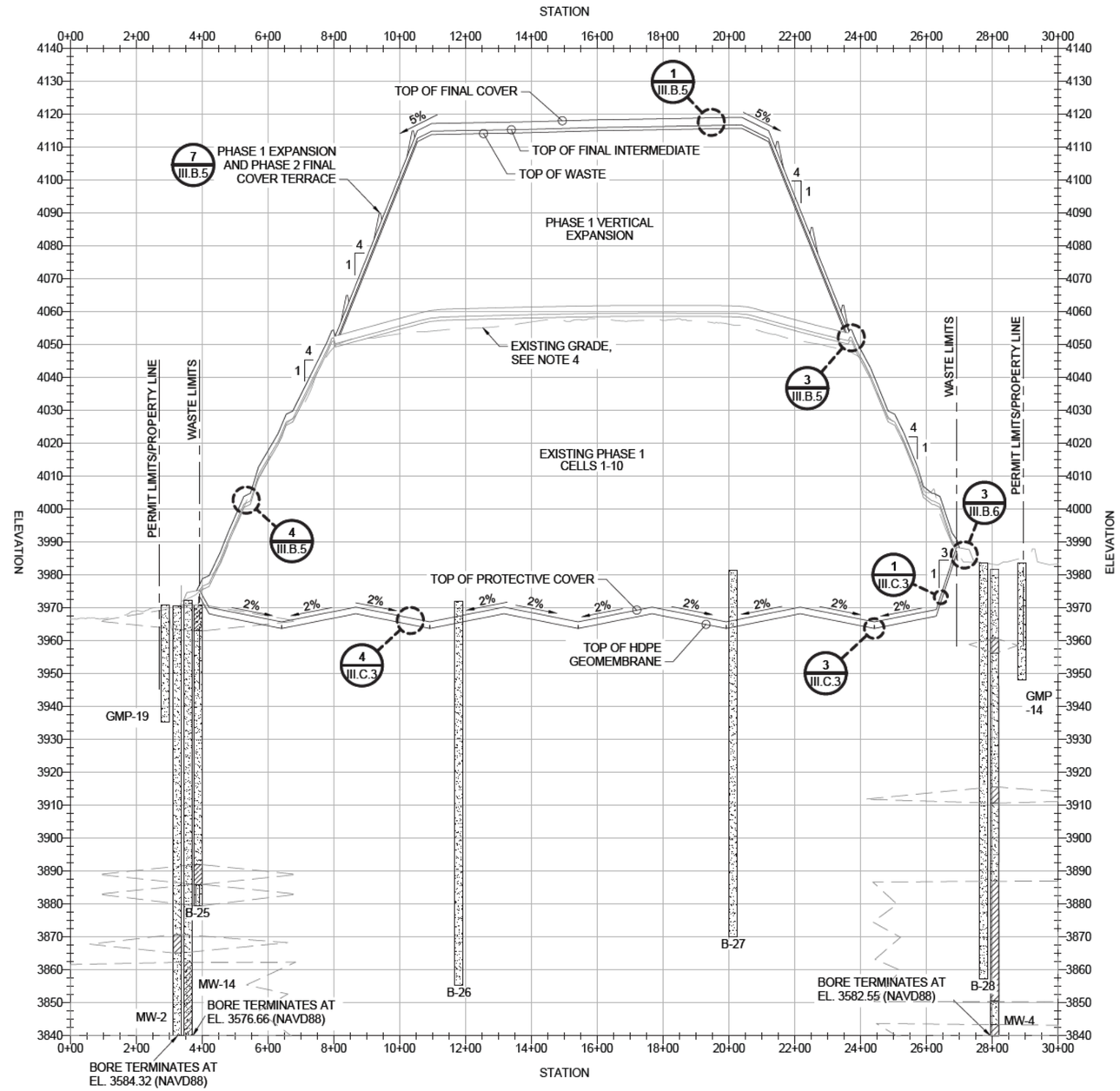
file III.A.20 LANDFILL SECTION F-F'.dwg

STATE OF TEXAS NATHAN KILGORE GEOLOGY 15672 LICENSED PROFESSIONAL GEOSCIENTIST 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



LANDFILL SECTION G-G' — G III.A.4 / G III.A.12

0 10' 20' 40' SCALE IN FEET

0 200' 400' SCALE IN FEET

GAS MONITORING PROBE BORING ELEVATIONS (SEE NOTE 5)

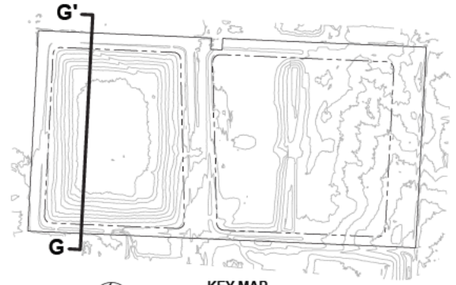
GMP BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
GMP-14	3974.60	3927.60	3984.99	3937.99
GMP-19	3961.89	3924.98	3972.28	3935.37

MONITORING WELL BORING ELEVATIONS (SEE NOTE 5)

MW BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
MW-2	3959.93	3537.93	3970.32	3584.32
MW-3	3964.37	3575.37	3974.76	3584.76
MW-4	3972.16	3572.16	3982.55	3582.55
MW-14	3961.27	3566.27	3971.66	3576.66

SOIL BORING ELEVATIONS (SEE NOTE 5)

SOIL BORING	SURFACE EL. (CITY DATUM)	BOTTOM EL. (CITY DATUM)	SURFACE EL. (NAVD88)	BOTTOM EL. (NAVD88)
B-25	3960.66	3869.16	3971.05	3879.55
B-26	3961.56	3845.06	3971.95	3855.45
B-27	3971.12	3859.62	3981.51	3870.01
B-28	3973.42	3846.92	3983.81	3857.31



KEY MAP

0 1000' 2000' SCALE IN FEET

LEGEND:

- CLAY
- SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GENERALIZED INFERRED STRATA
- 2284A GRADES
- 2284 GRADES

STATE OF TEXAS — NATHAN KILGORE — GEOLOGY 15672 — LICENSED PROFESSIONAL GEOSCIENTIST — 5/16/2025

NATHAN S. KILGORE P.G.
LICENSE NO. 15672

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER — 5-16-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. CROSS SECTION TRANSECT LINES DO NOT INTERSECT ALL BORINGS DEPICTED. GENERALIZED, INFERRED STRATA PRESENTED, AS INTERPRETED FROM DEPICTED BORINGS. REFER TO III.A.3 AND III.A.12 FOR BORING LOCATIONS.
2. STATIC WATER ELEVATIONS BASED ON THE MAXIMUM SEASONAL HIGH GROUNDWATER SURFACE, AS OF THE DATE OF THE ORIGINAL APPLICATION, SHOWN ON DRAWING III.E.21.
3. LITHOLOGY IS GENERALIZED BY SAND, SILT, AND CLAY. REFER TO BORING LOGS PROVIDED IN APPENDIX III.E FOR EXACT LITHOLOGY DESCRIPTIONS.
4. EXISTING GROUND SOURCES PROVIDED ON DRAWING III.A.3.
5. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN

FOR PERMITTING PURPOSES ONLY

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EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION G-G'

project	contract
155488	-

drawing **III.A.21** rev. **1**

file III.A.21 LANDFILL SECTION G-G'.dwg

APPENDIX III.B – SURFACE WATER DRAINAGE REPORT

MSW AUTH NO. 2284A

APPENDIX III.B – SURFACE WATER DRAINAGE REPORT

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 3
NOVEMBER 14, 2025

Part III, Appendix B
Surface Water Drainage Report
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024
Revision 1, May 16, 2025
Revision 2, September 12, 2025
Revision 3, November 14, 2025



prepared by

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List of Abbreviations

Abbreviation	Term/Phrase/Name
ac-ft	acre-foot
BMPs	best management practices
cfs	cubic feet per second
CN	curve number
FEMA	Federal Emergency Management Agency
FIRM	Preliminary Flood Insurance Rate Map
fps	feet per second
GEP Landfill	Greater El Paso Landfill, MSW Authorization Number 2284A
HEC-HMS	Hydraulic Engineering Center-Hydrologic Modeling System
hr	hour
in/hr	inches per hour
MSW	Municipal Solid Waste
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
RCP	reinforced concrete pipe
RG-417	TCEQ Regulatory Guidance, "Surface Water Drainage and Erosional Stability Guidelines for a Municipal Solid Waste Landfill", dated May 2018
SCS	Soil Conservation Service
sq. mi.	square mile
SWDR	Surface Water Drainage Report
TAC	Texas Administrative Code
T_c	Times of Concentration
TCEQ	Texas Commission on Environmental Quality
T_{lag}	Lag Times
TPDES	Texas Pollutant Discharge Elimination System
TR-55	"Urban Hydrology for Small Watersheds", Technical Release 55 developed by the Natural Resources Conservation Service
TxDOT	Texas Department of Transportation
USGS	United States Geological Survey

III.B.1.0 Introduction

The facility was designed to manage peak flows and erosion potential resulting from a 25-year storm, to comply with Texas Administrative Code 30 (TAC) §330.303. This surface water drainage report (SWDR) has been prepared for the City of El Paso, Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill). Included in this SWDR are the pre- and post-development drainage area maps and designs of temporary and permanent drainage appurtenances including interceptor ditches, down chutes, culverts, channels, and detention ponds.

The existing landfill consists of four permitted outfalls: Southeast (A), Southwest Detention Pond (BC), and West Detention Pond (D, E). Pre-development conditions reflect the previous permitted conditions of 2022 under Texas Commission on Environmental Quality (TCEQ) MSW Authorization Number 2284. In 2284A, Outfall A will remain as planned. Outfall BC, from Pond BC, will include the final cover conditions of Phase 2. Final cover is complete on Phase 1 which includes Pond DE. This permit includes a vertical expansion of Phase 1.

This SWDR has been prepared in general conformance with the requirements of 30 TAC §§330.63(c) and 330.305 and the TCEQ Regulatory Guidance, “Surface Water Drainage and Erosional Stability Guidelines for a Municipal Solid Waste Landfill”, dated May 2018 (RG-417). This SWDR includes the locations, details and supporting design methodology for the site’s stormwater control features, which include erosion and sediment control best management practices (BMPs), interceptor ditches, letdown chutes, drainage channels, perimeter ditches, swales, culverts, and detention/retention ponds. The overall routing of stormwater can be seen in the Drawings in **Attachment III.B.3**. Rainfall data was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 11 (version 2) precipitation frequency tables for the project location in El Paso County, Texas. A 25-year recurrence interval and 24-hour storm duration were selected for both the Pre- and Post-Development Conditions model. The facilities requested permit extents were also designed to provide protection from 100-year frequency flooding to comply with 30 TAC §330.307. Drainage calculations are included in **Attachment III.B.1**. Geotechnical stability calculations are provided in Part III, Appendix III.G.

An erosion and sedimentation control plan is provided in **Attachment III.B.2**. Estimates of soil loss over the 50-year development and 30-year post-closure period are also included.

A Notice of Intent for Stormwater discharge in association with an industrial activity under the Texas Pollutant Discharge Elimination System (TPDES) General Permit has been filed for the GEP Landfill. A copy TPDES General Permit is located in Part I/II, Appendix I/II.I.

Details regarding site geology and groundwater are provided in Part III, Appendix III.E. The site Groundwater Sampling and Analysis Plan is provided in Part III, Appendix III.F. A discussion of the leachate collection system performance, along with calculations for leachate quantity predictions and design adequacy is included as Part III, Appendix III.C.

III.B.2.0 Pre-Development Conditions

The GEP Landfill property occupies approximately 311 acres adjacent to the east boundary of the existing Clint Landfill (MSW Authorization Number 1482). The northern two-thirds of the site is nearly level to gently sloping to the west; surface soils on this portion of the site are brown loamy fine sands of the Hueco-Wink association. The southern third of the site slopes at approximately five percent to the south. The Soil Survey for El Paso County identifies soils on this portion of the site are of the Bluepoint association; these soils are also described as loamy fine sands. Site soils are of a poor quality for vegetation production. Site vegetation consists of sparse desert shrubs. The soils are moderately to very permeable and susceptible to blowing.

III.B.2.1 Pre-Development Conditions Drainage Patterns

Drawing III.B.2 in **Attachment III.B.3** shows the pre-development drainage patterns at the site (reflecting permit 2284). Per RG-417, the existing drainage patterns are the drainage patterns at the currently permitted site closure conditions. Drainage patterns beyond the extent of this topography in area C/Cos were estimated from the 1995 United States Geological Survey (USGS) 1:24000 topo map for Clint, Texas. Historical off-site and on-site drainage areas are shown on Drawing III.B.1 in **Attachment III.B.3**. The existing permitted drainage patterns, drawn by Parkhill, Smith, & Cooper are provided in Drawing III.B.2 in **Attachment III.B.3.**

A series of berms were constructed at some point in the past along the north, east and south sides of the property. A break in the berm along the east boundary just south of the pipeline easement allows runoff from area Cos to enter the property. This is the only location where run-on enters the property.

Stormwater runoff leaves the site at four points, labeled A, BC, D and E. Area A is on-site runoff located outside the reach of perimeter Ditch B. Its outfall is off-site to the south. This area will remain consistent from Permit 2284 to Permit 2284A. Runoff from areas B and C are collected from Phase 2 into boundary channels that are collected into Detention Pond BC. In similar fashion, Detention Pond DE collects runoff from the boundary channels of Phase 1 and discharges through two separate culverts on opposite ends on the basin.

The site does not lie in the 100-year floodplain as shown on Figure I/II.A.11 in Part I/II, Appendix I/II.A, which is based on the Federal Emergency Management Agency (FEMA) Flood Service Map Center, Preliminary Flood Insurance Rate Map (FIRM) Panel 48141C0660F, dated July 08, 2020.

III.B.2.2 Pre-Development Conditions Drainage Area Map

The drainage area for the site totals 464 acres. The pre-development area is divided into 25 sub-areas as shown in Drawing III.B.2 in **Attachment III.B.3**. The figure also contains a table summarizing pre-development flows from the sub-areas and at discharge points A-E.

III.B.2.3 Pre-Development Conditions Modeling

For determining the peak flows at all points, the Hydraulic Engineering Center-Hydrologic Modeling System (HEC-HMS) program was utilized. The Rational method was not used because the cumulative drainage area is greater than 200 acres. Soil Conservation Service (SCS) runoff curve number (CN) methodology as outlined in the SCS National Engineering Handbook, Section 4, Hydrology was used as a guide for developing input data for HEC-HMS in the pre-development calculations.

III.B.2.3.1 Rainfall Depth/Duration

For the previous permit, rainfall depth/duration data for durations of one hour and less were obtained from the NOAA Technical Memorandum Hydro 35. Also, rainfall depth/duration data for storm durations greater than one hour were obtained from National Weather Service Technical Paper TP-40. This data was used to create the HEC-1 and HEC-HMS models for the previous permit, which are included for reference in **Attachment III.B.1**. **Table III.B.2-1** contains the rainfall data for the previous permit models.

Table III.B.2-1: Hydro 35/TP-40 Rainfall Depth/Duration Data (Inches)

Duration	Return Period (Years)	
	25	100
5 min	0.44	0.55
10 min	0.81	1.04
15 min	1.08	1.40
30 min	1.47	1.89
60 min	1.87	2.40
2 hr	2.01	2.58
3 hr	2.15	2.75
6 hr	2.50	3.20
12 hr	2.81	3.60
24 hr	3.12	4.00

Rainfall depth and duration data for were updated using the 2025 NOAA Atlas 14, Volume 11 (Version 2) values, as shown in **Table III.B.2-2** for outfall comparison under Permit 2284A.

Table III.B.2-2: Atlas 14 Rainfall Depth/Duration Data (Inches)

Duration	Return Period (Years)	
	25	100
5 min	0.615	0.819
10 min	1.03	1.37
15 min	1.18	1.57
30 min	1.46	1.95
60 min	1.75	2.34
2 hr	2.02	2.68
3 hr	2.18	2.89
6 hr	2.47	3.28
12 hr	2.79	3.78
24 hr	3.17	4.39

III.B.2.3.2 Pre-Development Rainfall Intensity

Rainfall intensity for the rational method calculations was calculated based on the Texas Department of Transportation (TxDOT) Bridge Division Hydraulic Manual. Rainfall intensity (inches per hour [in/hr]) was computed as follows:

$$I = \frac{b}{(t+d)^e}$$

b = TxDOT factor for 25 year event in El Paso County = 60
d = TxDOT factor for 25 year event in El Paso County = 12.0
e = TxDOT factor for 25 year event in El Paso County = 0.843
t = longest time of concentration for basin being considered; minimum of 10 minutes per 30 TAC §330.305(f)(1)

III.B.2.3.3 Pre-Development T_c and T_{lag}

Pre-development Times of Concentration (T_c) and Lag Times (T_{lag}) were developed from USGS topographic maps and the previous permit plans shown in Drawings III.B.1 and III.B.2 in **Attachment III.B.3**. The methods presented in "Urban Hydrology for Small Watersheds" (Technical Release 55 [TR-55]) developed by the Natural Resources Conservation Service (NRCS) (formerly SCS) were used to calculate T_c. The T_{lag} for each subbasin was calculated using the following equation:

$$T_{lag} = T_c \times 0.6 \text{ (Haan, 1994)}$$

Attachment III.B.1 contains calculations for T_c and T_{lag}.

III.B.2.3.4 Pre-Development Loss Rates

According to the NRCS Web Soil Survey, site soils belong to the following hydrologic groups:

Table III.B.2-3: Site Soil Hydrologic Groups

Soil Classification	Hydrologic Soil Group
Hueco- Wink	A
Bluepoint association, rolling	A
Bluepoint gravelly association, rolling	A

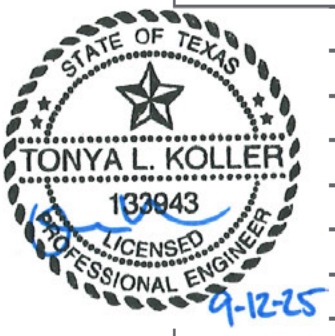
CNs for Pre-development Conditions were found by combining hydrologic soil classification with existing land use. Soil classification and land use are combined to select values for each subbasin CN from Tables 2.2a —2.2d in TR-55. A CN of 63 was used for desert shrub (poor condition). The tables from TR-55 are reproduced in **Attachment III.B.1**. Curve numbers used for all subbasins modeled are provided in **Table III.B.2-4**.

III.B.2.3.5 Pre-Development HEC-HMS Model

The output from the HEC-HMS model is included in **Attachment III.B.1**. Pre-development flows calculated by HEC-HMS, using the 2025 storm events for comparison, are summarized in **Table III.B.2-4**.

Table III.B.2-4: Pre-Development: SCS Parameters in HEC-HMS

Discharge	Subbasin	Area (acres)	Area (sq. mi.)	T_{lag} (hr.)	CN	Peak Discharge (cfs)	Peak Runoff (ac-ft)	Peak Velocity (fps)
	A1	5.0	0.008	0.12	63	4.57	0.25	1.61
Outfall A		**5.0**	0.008			**4.57**	**0.25**	**1.61**
	B1	17.5	0.027	0.16	96	81.2	4.22	2.31
	B2	18.1	0.028	0.16	96	89.85	4.67	2.31
	B3	19.3	0.030	0.16	96	90.15	4.69	2.31
	B4	15.3	0.024	0.07	96	100.36	3.78	2.39
	B5	9.9	0.015	0.08	96	60.58	2.36	2.39
	B6	7.4	0.012	0.07	96	47.94	1.87	2.39
	B7	19.4	0.030	0.57	73	14.68	1.74	4.46
	B8	17.9	0.028	0.24	75	32.05	2.05	4.46
	Cos	151.4	0.237	0.76	63	43.91	7.5	1.14
	C1	18.5	0.029	0.16	96	89.55	4.66	2.31
	C2	10.6	0.017	0.07	96	71.03	2.67	2.39
	C3	10.2	0.016	0.36	96	29.66	2.5	4.46
Inflow @ Pond BC		**315.5**	**0.493**			**476.2**	**42.5**	
Outflow @ Pond BC						**99.1**	**31.37**	**55.99**
	D1	9.7	0.015	0.18	96	42.14	2.33	19.1
	D2	10.3	0.016	0.21	96	41.18	2.48	19.1
	D3	12.5	0.020	0.12	96	68.52	3.11	19.1
	D4	7.7	0.012	0.12	96	41.11	1.86	19.1
	D5	24.8	0.039	0.14	76	56	2.64	4.23
	D6	12.9	0.020	0.17	88	45.14	2.29	3.09
	E1	9.9	0.015	0.18	96	42.14	2.33	19.1
	E2	10.5	0.016	0.13	96	52.91	2.49	19.1
	E3	12.9	0.020	0.11	96	70.98	3.11	19.1
	E4	12.5	0.020	0.11	80	39.7	1.63	4.28
	E5	8.2	0.013	0.12	96	44.54	2.02	19.1
	E6	11.9	0.019	0.04	80	50.61	1.55	12.11
Inflow @ Pond DE		**143.8**	**0.225**			**439.7**	**27.61**	
Outflow @ Pond DE						**36.4**	**26.3**	**10.3**



III.B.3.0 Post-Development Conditions

Post-development condition grading for the GEP Landfill is provided in Drawings III.B.3 and III.B.4 in **Attachment III.B.3**. Side slopes are graded at a 4H:1V and the cap is graded at a five percent slope. Sheet flow on the side slopes is cut off by "side slope interceptors" immediately above and roughly parallel to each 20-foot-wide bench constructed Phase 1 and every 100 horizontal feet for the vertical expansion of Phase 1 and for Phase 2. These interceptors reduce the erosion potential of sheet flows down the side slopes by minimizing the length of sheet flow and diverting it to armored down chutes. High points are located at the center of the north and south sections as indicated in the drawings in **Attachment III.B.3**.

III.B.3.1 Post-Development Conditions Modeling

Twenty-four sub-areas make up the post-development conditions drainage area as shown on Drawing III.B.4 in **Attachment III.B.3**. Sub-area D2, shown in the pre-development drainage map and calculations, is now included in sub-area E2 of the post-development conditions. Proposed grading and drainage controls are included in Drawings III.B.5 and III.B.6 in **Attachment III.B.3**. Post-development conditions T_c and T_{lag} were calculated using the TR-55 method, see **Table III.B.2-2**Error! Reference source not found.. Peak flows were calculated for sub-areas and the discharge point. The output from the HEC-HMS model is included in **Attachment III.B.1**. Post-development Conditions flows calculated by HEC-HMS are in **Table III.B.3-1**.

III.B.3.1.1 Post-Development Rainfall Depth/Duration

Rainfall data was obtained from the NOAA Atlas 14, Volume 11 (version 2) precipitation frequency tables for the project location. A 25-year recurrence interval and 24-hour duration event were selected for a cumulative depth of 3.37-inches at the time of the permit. **Table III.B.2-2** contains the values that were used in the HEC-HMS models for 24-hour rainfall depths for comparison of the pre-developed and post-developed conditions under Permit 2284A.

III.B.3.1.2 Post-Development Rainfall Intensity

Rainfall intensity for the rational method calculations was calculated based on the TxDOT Bridge Division Hydraulic Manual as shown on Page III.B-120. Rainfall intensity (in/hr) was computed as follows:

$$I = \frac{b}{(t+d)^e} = 6.12$$

b = TxDOT factor for 25 year event in El Paso County = 80.75
d = TxDOT factor for 25 year event in El Paso County = 7.36
e = TxDOT factor for 25 year event in El Paso County = 0.904
t = longest time of concentration for basin being considered; minimum of 10 minutes per 30 TAC §330.305(f)(1)

III.B.3.1.3 Post-Development T_c and T_{lag}

Post-Development T_c and T_{lag} were developed from USGS topographic maps and the previous permit plans shown in Drawings III.B.1 and III.B.2 in **Attachment III.B.3**. The methods presented in TR-55 were used to calculate T_c. The T_{lag} for each subbasin was calculated using the following equation:

$$T_{lag} = T_c \times 0.6 \text{ (Haan, 1994)}$$

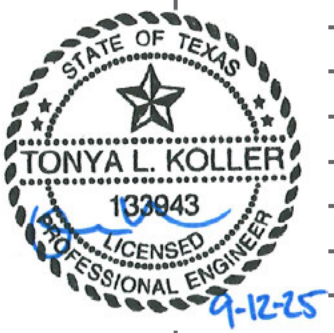
Attachment III.B.1 contains calculations for T_c and T_{lag}.

III.B.3.1.4 Post-Development Conditions HEC-HMS Model

The output from the HEC-HMS model is included in **Attachment III.B.1.** Post-development condition flows calculated by HEC-HMS are summarized in **Table III.B.3-1.**

Table III.B.3-1: Post-Development Conditions: SCS Parameters in HEC-HMS

Discharge	Subbasin	Area (acres)	Area (sq. mi.)	T_{lag} (hr.)	CN	Peak Discharge (cfs)	Peak Runoff (ac-ft)	Peak Velocity (fps)
	A1	5	0.01	0.12	63	4.57	0.25	1.61
@A		**5**	**0.01**			**4.57**	**0.25**	**1.61**
	B1	6.5	0.01	0.09	96	38.91	1.59	2.47
	B2	5.6	0.01	0.1	96	32.49	1.37	2.47
	B3	12.0	0.02	0.11	96	66.37	2.91	2.47
	B4	24.8	0.04	0.09	96	147.65	6.01	2.4
	B5	30.4	0.05	0.14	96	151.27	7.36	2.4
	B6	16.0	0.03	0.09	96	95.76	3.9	2.4
	B7	16.3	0.03	0.56	73	12.51	1.47	4.46
	B8	15.4	0.02	0.23	76	25.96	1.62	4.46
	Cos	151.4	0.24	0.78	63	42.5	7.4	1.14
	C1	7.1	0.01	0.1	96	40.61	1.71	2.47
	C2	20.8	0.03	0.08	96	129.52	5.05	2.4
	C3	9.4	0.01	0.36	96	26.89	2.26	4.46
Inflow @ Pond BC		**315.5**	**0.493**			**545.27**	**42.38**	
Outflow @ Pond BC						**95.71**	**31.35**	**54.1**
	D1	2.8	0.004	0.07	96	66.08	2.49	2.47
	D2	-	-	-	-	-	-	-
	D3	19.2	0.030	0.12	96	68.52	3.11	19.1
	D4	15.0	0.023	0.12	96	44.54	2.02	19.1
	D5	24.8	0.039	0.14	76	56	2.64	4.27
	D6	12.9	0.020	0.17	88	45.14	2.29	3.08
	E1	3.2	0.005	0.08	96	63.77	2.49	2.47
	E2	6.1	0.010	0.10	96	62.76	2.64	2.47
	E3	20.7	0.032	0.11	96	70.98	3.11	19.1
	E4	12.5	0.020	0.11	80	39.7	1.63	4.27
	E5	14.6	0.023	0.12	96	44.54	2.02	19.1
	E6	11.9	0.019	0.04	80	50.61	1.55	12.06
Inflow @ Pond DE		**143.8**	**0.225**			**396.8**	**25.76**	
Outflow @ Pond DE						**35.12**	**24.82**	**5.21**



III.B.3.2 Post-Development Conditions Drainage Controls

Drainage controls are incorporated into the site in order to reduce flooding and minimize the amount of sediment carried off the site. Drainage controls include berms, interceptor ditches, down chutes, culverts, channels, and detention ponds. Drainage controls are shown in Drawing III. B.3 in **Attachment III.B.3**, with details in Drawings III. B.5 and III.B.6 in **Attachment III.B.3**.

III.B.3.2.1 Runoff from Landfill Slopes

Sheet flows from the landfill cap will be intercepted by stormwater berms designed to channelize flows into stabilized down chutes to minimize erosion of the cap and side slopes. Flows from the down chutes enter the perimeter ditches. Sheet flows from the lowest portions of the 4H:1V side slopes collect in perimeter ditches before being routed to the detention ponds.

In accordance with 30 TAC §330.305(f)(2), calculations for peak runoff (Q) for a 25-year, 24-hour storm event were completed in HEC-HMS and can be found in **Attachment III.B.1**. The TxDOT Drainage Manual and NRCS method was used to calculate the time of concentrations and velocities for the sub-areas. The velocities for the final cover are reflected in **Attachment III.B.1.** Phase 1 sideslope interceptors below the cap were previously sized in accordance with 30 TAC §330.305(f)(1), as a part of the previous permit.

Calculations based on TxDOT Bridge Division Hydraulic Manual and provided in **Attachment III.B.1**, were computed as follows:

$$Q = cIA$$

Where: Q = Peak runoff from 25-year, 24-hour storm event, cubic feet per second (cfs)
C = Runoff coefficient, dimensionless
I = Rainfall intensity, in/hr (calculated above)
A = Area of sub-basin, acres

III.B.3.2.1.1 Top Berms

Top berms for phase 1 and phase 2 are designed in accordance with 30 TAC §330.305(f)(1). All berms are sized based on the largest calculated flow for a cap sub-area during a 24-hour, 25-year storm. Using the Rational Method for the largest runoff area contributing to a top berm, E2, the peak runoff is 18.9 cfs. Solving Manning's Equation yields a flow depth of 0.97-feet. Therefore, berms with a height of 2-feet will have a minimum 1.03-feet freeboard for the 24-hour, 25-year storm. A cross-sectional view and calculations are provided in **Attachment III.B.1.**

III.B.3.2.1.2 Sideslope Interceptors

For a 2:1 berm built on 4:1 sideslopes, Manning's equation is used to determine flow depth. The highest flow contributing to an interceptor is considered for calculating flow depth and available freeboard.

During Phase 1, under the previous permit, the maximum flow of 9.5 cfs results in a flow depth of 1.23 feet. The interceptor berms are designed to a depth of 2 feet, providing 0.77 feet of freeboard during a 24-hour, 25-year storm event.

For Phase 2, the expected flow is 13.1 cfs, yielding a flow depth of 1.39 feet during the 25-year design storm. A 2-foot interceptor berm will maintain a minimum freeboard of 0.61 feet.

III.B.3.2.1.3 Down Chutes/Let Down Structures

Down chutes (or let down structures) convey flows from the cap of the landfill or from the terrace/interceptors down the 4H:1V slopes and discharge into perimeter ditches. All down chutes will be lined with Flexamat Plus or equivalent and include a 3-foot by 3-foot gabion revetment and/or a water energy dissipator at the bottom. A plan view of a typical down chute is provided in Drawing III.B.3 in **Attachment III.B.3.** The typical section is provided in Drawings III.B.5 and III.B.6 in **Attachment III.B.3**. Down chute hydraulic calculations are included in **Attachment III.B.1**.

III.B.3.2.2 Perimeter Ditches

Perimeter ditches collect stormwater runoff from landfill slopes and buffer areas and discharge to the detention ponds. Ditches are trapezoidal with an 8-foot bottom and 3H:1V side slopes. Ditches will be lined with concrete stabilized rock riprap, gabion mattresses, concrete, or other suitable erosion control material. Table III.B.2.4-1 in **Attachment III.B.2** provides a summary of these ditches and Drawing III.B.5 in **Attachment III.B.3** provides a typical perimeter ditch section.

Supporting Manning's Equation calculations for interceptors, top berms, down chutes, and perimeter ditches, performed using Haestead Methods Flowmaster program, as well as Rational Method and HEC-HMS results, are included in **Attachment III.B.1**.

A culvert will be required to provide access across the perimeter ditches for this expansion. Culverts are shown on Drawing III.B.4 in **Attachment III.B.3**. Culvert C2 is the only culvert that has not yet been installed. Culvert C2 was sized using the HEC-HMS and HY-8 computer programs and calculations are provided in **Attachment III.B.1**.

III.B.3.2.3 Detention Ponds

Each phase of the facility will utilize a detention pond to control storm water runoff. Pond BC is located in the southern portion of the site and captures the runoff for Phase 2. Pond DE performs the same function for the northern phase; however, Pond DE is located west of the site on property owned by the City of El Paso within the permit limits of the Clint Landfill (MSW Permit No. 1482). Plan views for Ponds BC and DE are provided in Drawings III.B.11 and III.B.12 in **Attachment III.B.3**, respectively. Outfalls and Sections for Ponds BC and DE are provided on Drawings III.B.13 and III.B.14 in **Attachment III.B.3**. The purpose of the detention ponds is to attenuate post-development peak discharges at points BC and DE so as not to alter natural drainage patterns. Storage of runoff in the pond reduces peak discharge from ditches.

Pond DE has been designed to be drained by two 18-inch reinforced concrete pipe (RCP) riser barrel low-level outlets. The entrance to the low-level outlets are a minimum of 3-feet above the pond sump elevations to provide sediment storage. A concrete overflow spillway is designed to convey any overflow encountered during exceptional storm events. The pond is sized to convey the 25-year frequency storm without overtopping the spillways. Storm routing through the pond is incorporated in the HEC-HMS post-development conditions run. Stage-storage calculations for pond DE is provided in **Attachment III.B.1**.

Pond BC is designed to be drained by an 18-inch RCP riser barrel low level outlet and a concrete overflow spillway. The entrance of the low level outlet is a minimum of 3-feet above the pond sump elevation to provide sediment storage. Pond BC will be expanded upon as a part of the Phase II development. Final conditions storm routing through pond BC is incorporated in the HEC-HMS post-development conditions run included in **Attachment III.B.1**.

III.B.3.3 Sequence of Development for Drainage Appurtenances

Pond DE and the outlets to the existing landfill ditches have been constructed and will remain in place prior to beginning the vertical expansion for Phase 1. For Pond BC, the perimeter ditches adjacent to Cell 11 and 12 have been constructed along with Culverts B1 and C1. When filling operations allow, construction of interceptor ditches and down chutes can begin. Generally, top berms, down chutes, and interceptor ditches will be constructed as soon as practicable after final grades are attained.

III.B.3.4 Maintenance of Drainage Appurtenances

The landfill manager is responsible for maintaining drainage appurtenances. Refer to Table III.B.2.3-5, Structural Control Inspection Parameters in **Attachment III.B.2**, and the Site Operating Plan in Part IV, Table IV.3-3 for inspection and maintenance requirements.

III.B.3.5 Contaminated Water

The handling, storage, treatment, and disposal of contaminated surface or groundwater shall be in accordance with 30 TAC §330.207. Rainfall that shall come in contact and percolate through the working face of the waste unit shall be considered leachate, which is discussed in Appendix III.C – Leachate and Contaminated Water Plan, Section III.C.3.0.

The working face shall be maintained to prevent run on flow and to prevent runoff from leaving the landfill boundary after contacting exposed waste. Furthermore, the working face shall be enclosed within a soil diversion berm and will typically have minimal slopes, as to limit runoff and provide means for rainfall to percolate through the waste. Calculations are provided in **Attachment III.B.1** in the contaminated water containment and diversion berm calculations**.**

The leachate management system shall convey leachate collected from the bottom of each cell to evaporation ponds within the Facility. Drawings III.C.1, 5, and 7 in Attachment III.C.1 provide information on the force main layout and evaporation ponds. Additional discussion is also provided in Appendix III.C – Leachate and Contaminated Water Plan. All leachate transferred to offsite facilities will be handled in compliance with TCEQ requirements in accordance with 30 TAC §330.207(e).

III.B.4.0 Comparison of Pre- and Post-Development Drainage Patterns

Final drainage patterns will not be significantly altered by construction of the landfill. Similar to pre-development conditions, stormwater runoff from the site leaves the site at points in the same location, and from direct runoff areas adjacent to the site. Updates to NOAA Atlas 14 design storm depths were applied to the pre-development conditions in order to compare with the post-development conditions. All calculations for the outfalls are included in **Attachment III.B.1. Table III.B.4-1** provides a summary of the pre- and post-development conditions comparison.

Table III.B.4-1: Pre- vs. Post-Development Conditions Comparison

	Outfall	Discharge (cfs)	Volume (acre-ft)	Velocity (fps)
Pre-	A	4.57	0.25	1.61
	BC	99.1	31.37	55.99
	DE	36.4	26.3	10.3
Post-	A	4.57	0.25	1.61
	BC	95.71	31.35	54.1
	DE	35.12	24.82	9.9



III.B.4.1 Point A

Runoff from the far southeastern corner of the site exits at Point A. Development has minimal to no impact on the drainage area and does not significantly alter flow patterns. The peak discharge for Outfall A remains constant for pre-development and post-development conditions at 4.57 cfs. The pre- and post-development runoff volume does not change from 0.25 acre-feet for both. Discharge velocity remains relatively unchanged at 1.61 fps, as overland flow characteristics are largely governed by surface conditions rather than direct precipitation inputs in the NRCS method.

III.B.4.2 Point BC

Runoff from the southern half of the tract leaves the site at point BC. The 25-year flow at discharge point BC for pre-development conditions is 99.1 cfs. The 25-year flows combined at discharge point BC for the post-development conditions is 95.71 cfs. The outlet for basin BC remains the same from pre- to post-development, but the depth of the pond has been increased by 1 foot to maintain 1-foot of freeboard due to higher peak inflows. The velocity through the outlet is reduced from 56 fps to 54.1 fps and outfall BC has a lower runoff volume in total. Overall, point BC will not be adversely impacted due to development.

III.B.4.3 Point DE

Similar to pre-development conditions, runoff from the detention ponds exits into two pre-existing drainage ditches associated with the adjacent landfill. The combined pre-development flow leaving Pond DE is 36.4 cfs, with 35.12 cfs per outlet. Velocity and volume are also reduced in post-development conditions as shown in **Table III.B.4-1**.

ATTACHMENT III.B.1 – DRAINAGE STRUCTURES – DESIGN CALCULATIONS


STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER

El Paso ... New Landfill
Drainage Calculations
Developed Conditions TOC

By:_____ Date:__ __
Checked:_____ Date:_____

Sheet Flow (T_c only)		ID	A1	~~B1~~	~~B2~~	~~B3~~	~~B4~~	~~B5~~	~~B6~~	~~B7~~
Surface description			rock riprap	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~
Manning's roughness coefficient, n			0.02	~~0.02~~	~~0.02~~	~~0.02~~	~~0.02~~	~~0.02~~	~~0.02~~	~~0.02~~
Flow length, L		ft	300	~~300~~	~~300~~	~~300~~	~~300~~	~~300~~	~~250~~	~~300~~
Two-yr 24-hr rainfall, P		in	1.5	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~
Land slope, s		ft / ft	0.06	~~0.02~~	~~0.02~~	~~0.02~~	~~0.25~~	~~0.25~~	~~0.25~~	~~0.02~~
Travel time, $T_t = 0.007\ (nL)^{0.8} / P^{0.5} s^{0.4}$	Compute T_t	hr	0.07	~~0.11~~	~~0.11~~	~~0.11~~	~~0.04~~	~~0.04~~	~~0.04~~	~~0.11~~

Shallow concentrated flow		ID	A1	~~B1~~	~~B2~~	~~B3~~	~~B4~~	~~B5~~	~~B6~~	~~B7~~
Surface description (paved or unpaved)			unpaved	~~unpaved~~	~~unpaved~~	~~unpaved~~	~~unpaved~~	~~unpaved~~	~~unpaved~~	~~unpaved~~
Flow length, L		ft	700	~~1100~~	~~1200~~	~~1250~~	~~1000~~	~~1100~~	~~1100~~	~~500~~
Watercourse slope, s		ft / ft	0.01	~~0.01~~	~~0.01~~	~~0.01~~	~~0.01~~	~~0.01~~	~~0.01~~	~~0.005~~
Average velocity, V		ft / s	1.61	~~1.61~~	~~1.61~~	~~1.61~~	~~1.61~~	~~1.61~~	~~1.61~~	~~1.14~~
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr	0.12	~~0.19~~	~~0.21~~	~~0.22~~	~~0.17~~	~~0.19~~	~~0.19~~	~~0.12~~

Channel flow		ID	A1	B1	B2	B3	B4	B5	B6	B7
Cross sectional flow area, a		ft^2		~~8.5~~	~~8.5~~	~~8.5~~				~~39~~
Wetted perimeter, p_w		ft		~~10~~	~~10~~	~~10~~				~~23~~
Hydraulic radius, $r = a/p_w$		ft		~~0.850~~	~~0.850~~	~~0.850~~				~~1.696~~
Channel slope, s		ft / ft		~~0.25~~	~~0.25~~	~~0.25~~				~~0.006~~
Manning's roughness coefficient, n				~~0.035~~	~~0.035~~	~~0.035~~				~~0.035~~
$V = 1.49\ r^{2/3} s^{1/2} / n$	Compute V	ft / s		~~19.10~~	~~19.10~~	~~19.10~~				~~4.69~~
Flow length, L		ft		~~750~~	~~550~~	~~370~~				~~2900~~
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr		~~0.01~~	~~0.01~~	~~0.01~~				~~0.17~~

Watershed or subarea T_c or T_t	Total	hr	0.19	~~0.31~~	~~0.33~~	~~0.34~~	~~0.21~~	~~0.23~~	~~0.23~~	~~0.41~~
Lag time $T_L = 0.6T_c$		hr	0.12	~~0.19~~	~~0.20~~	~~0.20~~	~~0.13~~	~~0.14~~	~~0.14~~	~~0.24~~

Sheet Flow (T_c only)		ID	~~B8~~	~~C1~~	~~C2~~	~~C3~~	D1	D2	D3	D4
Surface description			~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	~~rock riprap~~	rock riprap	rock riprap	rock riprap	rock riprap
Manning's roughness coefficient, n			~~0.02~~	~~0.02~~	~~0.02~~	~~0.02~~	0.02	0.02	0.02	0.02
Flow length, L		ft	~~100~~	~~300~~	~~250~~	~~100~~	300	300	220	220
Two-yr 24-hr rainfall, P		in	~~1.5~~	~~1.5~~	~~1.5~~	~~1.5~~	1.5	1.5	1.5	1.5
Land slope, s		ft / ft	~~0.1~~	~~0.02~~	~~0.25~~	~~0.1~~	0.02	0.02	0.25	0.25
Travel time, $T_t = 0.007\ (nL)^{0.8} / P^{0.5} s^{0.4}$	Compute T_t	hr	~~0.02~~	~~0.11~~	~~0.04~~	~~0.02~~	0.11	0.11	0.03	0.03

Shallow concentrated flow		ID	~~B8~~	~~C1~~	~~C2~~	~~C3~~	D1	D2	D3	D4
Surface description (paved or unpaved)			~~unpaved~~	~~unpaved~~	~~unpaved~~	~~unpaved~~	unpaved	unpaved	unpaved	unpaved
Flow length, L		ft		~~1000~~	~~1100~~	~~4300~~	1000	1350	950	1000
Watercourse slope, s		ft / ft		~~0.01~~	~~0.01~~	~~0.005~~	0.01	0.01	0.01	0.01
Average velocity, V		ft / s		~~1.61~~	~~1.61~~	~~1.14~~	1.61	1.61	1.61	1.61
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr		~~0.17~~	~~0.19~~	~~1.05~~	0.17	0.23	0.16	0.17

Channel flow		ID	~~B8~~	~~C1~~	~~C2~~	~~C3~~	D1	D2	D3	D4
Cross sectional flow area, a		ft^2	~~39~~	~~8.5~~		~~39~~	8.5	8.5	8.5	8.5
Wetted perimeter, p_w		ft	~~23~~	~~10~~		~~23~~	10	10	10	10
Hydraulic radius, $r = a/p_w$		ft	~~1.696~~	~~0.850~~		~~1.696~~	0.850	0.850	0.850	0.850
Channel slope, s		ft / ft	~~0.03~~	~~0.25~~		~~0.005~~	0.25	0.25	0.25	0.25
Manning's roughness coefficient, n			~~0.035~~	~~0.035~~		~~0.035~~	0.035	0.035	0.035	0.035
$V = 1.49\ r^{2/3} s^{1/2} / n$	Compute V	ft / s	~~10.49~~	~~19.10~~		~~4.28~~	19.10	19.10	19.10	19.10
Flow length, L		ft	~~1600~~	~~500~~		~~4300~~	650	420	300	200
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr	~~0.04~~	~~0.01~~		~~0.28~~	0.01	0.01	0.00	0.00

Watershed or subarea T_c or T_t	Total	hr	~~0.07~~	~~0.29~~	~~0.23~~	~~1.35~~	0.30	0.35	0.20	0.21
Lag time $T_L = 0.6T_c$		hr	~~0.04~~	~~0.18~~	~~0.14~~	~~0.81~~	0.18	0.21	0.12	0.12

El Pas . New Landfill
Drainage Calculations
Developed Conditions TOC

By:_____ Date._ __
Checked:_____ Date:_____

Sheet Flow (T_c only)		ID	D5	D6	E1	E2	E3	E4	E5	E6
Surface description			rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap
Manning's roughness coefficient, n			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Flow length, L		ft	300	100	300	300	300	200	220	130
Two-yr 24-hr rainfall, P		in	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Land slope, s		ft / ft	0.01	0.1	0.02	0.25	0.25	0.25	0.25	0.04
Travel time, $T_t = 0.007\ (nL)^{0.8} / P^{0.5} s^{0.4}$	Compute T_t	hr	0.15	0.02	0.11	0.04	0.04	0.03	0.03	0.04

Shallow concentrated flow		ID	D5	D6	E1	E2	E3	E4	E5	E6
Surface description (paved or unpaved)			unpaved	unpaved	unpaved	unpaved	unpaved	unpaved	unpaved	unpaved
Flow length, L		ft			1000	1000	850		1000	
Watercourse slope, s		ft / ft			0.01	0.01	0.01		0.01	
Average velocity, V		ft / s			1.61	1.61	1.61		1.61	
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr			0.17	0.17	0.15		0.17	

Channel flow		ID	D5	D6	E1	E2	E3	E4	E5	E6
Cross sectional flow area, a		ft^2	39	39	8.5	8.5	8.5	39	8.5	39
Wetted perimeter, p_w		ft	23	23	10	10	10	23	10	23
Hydraulic radius, $r = a/p_w$		ft	1.696	1.696	0.850	0.850	0.850	1.696	0.850	1.696
Channel slope, s		ft / ft	0.005	0.0026	0.25	0.25	0.25	0.005	0.25	0.04
Manning's roughness coefficient, n			0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
$V = 1.49\ r^{2/3} s^{1/2} / n$	Compute V	ft / s	4.28	3.09	19.10	19.10	19.10	4.28	19.10	12.11
Flow length, L		ft	1200	2800	600	500	50	2400	200	1100
Travel time, $T_t = L / 3600\ V$	Compute T_t	hr	0.08	0.25	0.01	0.01	0.00	0.16	0.00	0.03

Watershed or subarea T_c or T_t	Total	hr	**0.23**	**0.28**	**0.30**	**0.22**	**0.19**	**0.19**	**0.21**	**0.07**
Lag time $T_L = 0.6T_c$		hr	0.14	0.17	0.18	0.13	0.11	0.11	0.12	0.04

Time of concetration or Travel time

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El Paso New Landfill
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By:_____ Date:_____
Checked:_____ Date:_____

Sheet Flow (T_c only)		ID	Cos
Surface description			dense grass
Manning's roughness coefficient, n			0.24
Flow length, L		ft	300
Two-yr 24-hr rainfall, P		in	1.5
Land slope, s		ft / ft	0.1
Travel time, $T_t = 0.007 (nL)^{0.8} / P^{0.5} s^{0.4}$	Compute T_t	hr	0.44

Shallow concentrated flow		ID	Cos
Surface description (paved or unpaved)			unpaved
Flow length, L		ft	3600
Watercourse slope, s		ft / ft	0.005
Average velocity, V		ft / s	1.14
Travel time, $T_t = L / 3600 V$	Compute T_t	hr	0.88

Channel flow		ID	Cos
Cross sectional flow area, a		ft^2	
Wetted perimeter, p_w		ft	
Hydraulic radius, $r = a/p_w$		ft	
Channel slope, s		ft / ft	
Manning's roughness coefficient, n			
$V = 1.49 r^{2/3} s^{1/2} / n$	Compute V	ft / s	
Flow length, L		ft	
Travel time, $T_t = L / 3600 V$	Compute T_t	hr	

Watershed or subarea T_c or T_t	Total	hr	1.32
Lag time $T_L = 0.6 T_c$		hr	0.79

STATE OF TEXAS
MICHAEL K. STACEY
65460
REGISTERED
11/29/99

for 5 page DRAINAGE CALCULATION

Time of concetration or Travel time

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Sheet Flow

Basin ID/Unit	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	Notes
Surface Description	Rock Riprap	Rock Riprap	Rock Riprap	Rock Riprap	Rock Riprap	Rock Riprap	Range - Natural	Range - Natural	Rock Riprap	Rock Riprap	Range - Natural	(1)Precipitation values obtained from NOAA Atlas 14, Volume 11, Version 2. Location Info: Latitude: 31.6019 deg, Longitude: -106.1867
Manning's Roughness Coefficient, n	N/A	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.13	0.02	0.02	0.13	(2)Slopes for Basins B7, B8, and C3 assumed to be 1%. No topography available
Flow Length, L	ft	300	300	300	100	100	100	300	105	300	100	130	
(1)2-yr 24-hr Rainfall, P	in	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	
(2)Slope, s	ft/ft	0.03	0.03	0.03	0.25	0.25	0.25	0.01	0.01	0.03	0.25	0.01	
Travel Time, T_t	hr	0.10	0.10	0.10	0.02	0.02	0.02	0.68	0.29	0.10	0.02	0.35	

$$T_t = \frac{0.007(nL)^{0.8}}{P^{0.5}S^{0.4}}$$

Shallow Concentrated Flow

Basin ID/Unit	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	Notes
Surface Description	unpaved	unpaved	unpaved				unpaved		unpaved			
Flow Length, L	ft	785	680	675				675		675			
Watercourse Slope, s	ft/ft	0.03	0.03	0.03				0.01		0.03			
(1)Average Velocity, V, where $V=16.135s^{0.5}$	ft/s	2.79	2.79	2.79				1.61		2.79			(1)Source: TDOT Hydraulic Design Manual Chapter 4, Section 11 - Time of Concentration
Travel Time, T_t	hr	0.08	0.07	0.07				0.12		0.07			

$$T_t = \frac{L}{3600Ks^{0.5}}$$

Channelized Flow

Basin ID/Unit	(1)B1	(1)B2	(1)B3	(2)B4	(2)B5	(2)B6	(3)B7	(3)B8	(1)C1	(2)C2	(3)C3	Notes
Cross-Sectional Area, A	ft^2	36.00	36.00	36.00	6.75	6.75	6.75	18.75	18.75	36.00	6.75	18.75	(1)Triangular channel with 30:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft
Wetted Permiter, P_w	ft^2	53.38	53.38	53.38	9.54	9.54	9.54	17.50	17.50	53.38	9.54	17.50	(2)Triangular channel with 4:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft
Hydraulic Radius, R, where $R=A/P_w$	ft^2	0.67	0.67	0.67	0.71	0.71	0.71	1.07	1.07	0.67	0.71	1.07	(3)Trapezoidal channel (perimeter ditch) with 3:1 side slopes, 8-ft bottom width and a flow depth of 1.5 ft
(4)Channel Slope, s	ft/ft	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.005	0.005	0.01	(4)Slopes for Basins B7, B8, and C3 assumed to be 1%. No topography available
Manning's Roughness Coefficient, n	N/A	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	
Velocity, V, where $V= 1.49R^{2/3}s^{1/2}/n$	ft/s	2.31	2.31	2.31	2.39	2.39	2.39	4.46	4.46	2.31	2.39	4.46	
Flow Length, L	ft	745	810	860	910	980	855	2470	1600	860	880	4100	
Travel Time, T_t	hr	0.09	0.10	0.10	0.11	0.11	0.10	0.15	0.10	0.10	0.10	0.26	

$$T_t = \frac{L}{3600V}$$

Basin Time of Concentration, T_c	hr	0.27	0.26	0.27	0.12	0.13	0.12	0.95	0.39	0.27	0.12	0.60
Lag Time, T_L, where $T_L=0.6T_c$	hr	0.16	0.16	0.16	0.07	0.08	0.07	0.57	0.24	0.16	0.07	0.36
	min	9.56	9.47	9.67	4.44	4.73	4.21	34.22	14.17	9.67	4.31	21.74

Proposed T_c														
Sheet Flow (T_c only)		ID	A1	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3
Surface description			rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	Range - Natural	Range - Natural	rock riprap	rock riprap	Range - Natural
Manning's roughness coefficient, n			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.13	0.02	0.02	0.13
Flow length, L		ft	300	300	300	300	100	100	100	300	105	300	100	130
Two-yr 24-hr rainfall, P		in	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
Land slope, s		ft/ft	0.06	0.05	0.05	0.05	0.25	0.25	0.25	0.01	0.01	0.05	0.25	0.01
Travel time, T_t	Compute Tt	hr	0.07	0.08	0.08	0.08	0.02	0.02	0.02	0.66	0.28	0.08	0.02	0.34

Shallow concentrated flow		ID	A1	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3
Surface description (paved or unpaved)			unpaved	unpaved	unpaved	unpaved				unpaved		unpaved		
Flow length, L		ft	700	300	249	309				675		300		
Watercourse slope, s		ft/ft	0.01	0.05	0.05	0.05				0.01		0.05		
Average velocity, V		ft/s	1.61	3.61	3.61	3.61				1.61		3.61		
Travel time, T_t	Compute Tt	hr	0.12	0.02	0.02	0.02				0.12		0.02		

Channel flow		ID	A1	B1[1]	B2[1]	B3[1]	B4[2]	B5[2]	B6[2]	B7[3]	B8[3]	C1[1]	C2[2]	C3[3]
Cross sectional flow area, a		ft^2		24.8	24.8	24.8	6.75	6.75	6.75	18.75	18.75	24.8	6.75	18.75
Wetted perimeter, pw		ft		33.4	33.4	33.4	9.5	9.5	9.5	17.5	17.5	33.4	9.5	17.5
Hydraulic radius, r=a/pw		ft		0.74	0.74	0.74	0.71	0.71	0.71	1.07	1.07	0.74	0.71	1.07
Channel slope, s		ft/ft		0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.005	0.005	0.01
Manning's roughness coefficient, n				0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Velocity	Compute V	ft/s		2.47	2.47	2.47	2.40	2.40	2.40	4.46	4.46	2.47	2.40	4.46
Flow length, L		ft		505	677	660	1118	1800	1205	2470	1600	520	1050	4100
Travel time, T_t	Compute Tt	hr		0.06	0.08	0.07	0.13	0.21	0.14	0.15	0.10	0.06	0.12	0.26

Watershed or subarea T_c or T_t	Total	hr	0.19	0.16	0.17	0.18	0.15	0.23	0.16	0.93	0.38	0.16	0.14	0.59

Lag time T_L		hr	0.12	0.09	0.10	0.11	0.09	0.14	0.09	0.56	0.23	0.10	0.08	0.36
		min	6.9	5.7	6.2	6.3	5.3	8.1	5.6	33.4	13.8	5.7	5.0	21.3

[1]Triangular channel with 20:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft

[2]Triangular channel with 4:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft

[3]Trapezoidal channel (perimeter ditch) with 3:1 side slopes, 8-ft bottom width and a flow depth of 1.5 ft

Proposed T_c													
Sheet Flow (T_c only)		ID	D1	D3	D4	D5	D6	E1	E2	E3	E4	E5	E6	Cos
Surface description			rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	rock riprap	dense grass
Manning's roughness coefficient, n			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.24
Flow length, L		ft	258	220	220	300	100	250	250	300	200	220	130	300
Two-yr 24-hr rainfall, P		in	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
Land slope, s		ft/ft	0.05	0.25	0.25	0.01	0.1	0.05	0.05	0.25	0.25	0.25	0.04	0.1
Travel time, T_t	Compute Tt	hr	0.07	0.03	0.03	0.15	0.02	0.07	0.07	0.04	0.03	0.03	0.04	0.43

Shallow concentrated flow		ID	D1	D3	D4	D5	D6	E1	E2	E3	E4	E5	E6	Cos
Surface description (paved or unpaved)				unpaved	unpaved					unpaved		unpaved		unpaved
Flow length, L		ft		950	1000					850		1000		3600
Watercourse slope, s		ft/ft		0.01	0.01					0.01		0.01		0.005
Average velocity, V		ft/s		1.61	1.61					1.61		1.61		1.14
Travel time, T_t	Compute Tt	hr		0.16	0.17					0.15		0.17		0.88

Channel flow		ID	D1[1]	D3	D4	D5	D6	E1[1]	E2[1]	E3	E4	E5	E6	Cos
Cross sectional flow area, a		ft^2	24.8	8.5	8.5	39	39	24.8	24.8	8.5	39	8.5	39	
Wetted perimeter, pw		ft	33.4	10	10	23	23	33.4	33.4	10	23	10	23	
Hydraulic radius, r=a/pw		ft	0.74	0.85	0.85	1.70	1.70	0.74	0.74	0.85	1.70	0.85	1.70	
Channel slope, s		ft/ft	0.005	0.25	0.25	0.005	0.0026	0.005	0.005	0.25	0.005	0.25	0.04	
Manning's roughness coefficient, n			0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	
Velocity	Compute V	ft/s	2.47	19.12	19.12	4.27	3.08	2.47	2.47	19.12	4.27	19.12	12.06	
Flow length, L		ft	420	300	200	1200	2800	560	955	50	2400	200	1100	
Travel time, T_t	Compute Tt	hr	0.05	0.00	0.00	0.08	0.25	0.06	0.11	0.00	0.16	0.00	0.03	

Watershed or subarea T_c or T_t	Total	hr	0.12	0.20	0.21	0.23	0.28	0.13	0.17	0.19	0.19	0.21	0.07	1.30

Lag time T_L		hr	0.07	0.12	0.12	0.14	0.17	0.08	0.10	0.11	0.11	0.12	0.04	0.78
		min	4.17	7.2	7.4	8.1	9.9	4.68	6.28	6.8	6.7	7.4	2.5	47.0

[1]Triangular channel with 20:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft

[2]Triangular channel with 4:1 and 2:1 (H:V) side slopes and a flow depth of 1.5 ft

[3]Trapezoidal channel (perimeter ditch) with 3:1 side slopes, 8-ft bottom width and a flow depth of 1.5 ft

HEC-1 Printouts

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  04/07/1999  TIME  17:24:50 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -ANSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

              *DIAGRAM
    1         ID   ************************************************************************
    2         ID   *                                                                      *
    3         ID   *          El Paso Clint Landfill  -  Developed Conditions             *
    4         ID   *                                                                      *
    5         ID   * ....................................................................*
    6         ID   * :                                                                  : *
    7         ID   * :          STORM DURATION.............24 HOUR                     : *
    8         ID   * :          RETURN PERIOD..............25 YEAR                     : *
    9         ID   * :          FILENAME.............. clintdev.DAT                    : *
   10         ID   * :          DATE..................   APR, 1999                     : *
   11         ID   * :          BY..................... DBP & MRD                     : *
   12         ID   * :..................................................................: *
   13         ID   ************************************************************************
   14         ID     SOILS:
   15         ID     SOIL CLASSIFICATIONS FOR El Paso COUNTY BY THE SCS WERE
   16         ID     USED AND AREA WEIGHTED CURVE NUMBERS ASSIGNED TO SUBBASINS
   17         ID
   18         ID     RAINFALL DISTRIBUTION: FROM TP40, HYDRO35
   19         ID     HYPOTHETICAL STORM - PH CARD
   20         ID
   21         ID     VELOCITIES FROM (SCS MANUAL, FIGURE 15.2)
   22         ID   ************************************************************************
   23         ID   1 0  0.55 1.40 2.40 2.58 2.75 3.20 3.60 4.00 (100 YEAR)
   24         ID   4 0  0.44 1.08 1.87 2.01 2.15 2.50 2.81 3.12 (25 YEAR)
   25         ID
   26         ID
   27         ID   FOR ROUTING FLOWS IN PROPOSED DITCHES USE TRAPEZOIDAL
   28         ID   CHANNEL, 8' BOTTOM WIDTH, 2:1 BANK SLOPES
   29         ID   DITCH   N=0.035
```

```
168         HC       5
            *
            * ************************************************************************
            *

169         KK  PONDBC
170         KM   LOW LEVEL OUTLET IS.....(1)18"RCP
171         KM   DOWNSTREAM FL LOW LEVEL OUTLET 3885.7 FT
172         KM   SPILLWAY OVERFLOW ELEVATION .. 3894.0 FT
173         KM   SPILLWAY WIDTH .............10.0 FT
174         KM   TOP OF DAM ELEVATION..... 3896.50 FT
175         KM   FOR TAILWATER USE CONST ELEV.  3894.0 FT
176         RS       1    ELEV      -1
177         SV       0    4.59    9.34   14.24   19.31   24.53   29.92
178         SE    3890    3891    3892    3893    3894    3895    3896
179         SL  3886.7   0.785    0.70     0.5
180         SS    3894      10     3.0     1.5
181         ST    3896     300     3.0     1.5
            * ************************************************************************

182         KK  SUB.D2
183         KM   AREA.....(AC)....10.3
184         KM   LAG TIME....(HR)... 0.21
185         KM   CN.................96
186         BA  0.0161
187         LS       0      96
188         UD    0.21
            *
            * ************************************************************************

189         KK  SUB.D4
190         KM   AREA.....(AC)....7.7
191         KM   LAG TIME....(HR)... 0.12
192         KM   CN.................96
193         BA  0.0120
194         IN      15
195         LS       0      96
196         UD    0.12
            *
            * ************************************************************************

197         KK  PT.D24
198         KM   COMBINE FLOW FROM D2 AND D4
199         HC       2
            * ************************************************************************
```


1

HEC-1 INPUT

```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

200         KK  THRUD2
201         KM   ROUTE RUNOFF THROUGH DITCH D2 TO COMBINATION PT D246
202         KM   TRAPEZOIDAL CHANNEL
203         RK    1300  0.0026   0.035       0    TRAP       8       5
            * ************************************************************************

204         KK  SUB.D6
205         KM   AREA.....(AC)....12.9
206         KM   LAG TIME....(HR)... 0.17
207         KM   CN.................88
208         BA  0.0202
209         IN      15
210         LS       0      88
211         UD    0.17
            *
            * ************************************************************************

212         KK PT.D246
213         KM   COMBINE FLOW FROM D2,D4,AND D6
214         HC       2
```

```
* ***********************************************************************

KK  SUB.D1
KM   AREA........(AC)....9.7
KM   LAG TIME....(HR)... 0.18
KM   CN.................96
BA  0.0152
IN      15
LS       0       96
UD    0.18
*
* ***********************************************************************

KK  SUB.D3
KM   AREA........(AC)....12.5
KM   LAG TIME....(HR)....0.12
KM   CN.................96
BA  0.0195
IN      15
LS       0       96
UD    0.12
*
* ***********************************************************************

KK  PT.D23
KM   COMBINE FLOW FROM D1,D3
HC       2
* ***********************************************************************
```



```
LINE  ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

KK THRUD22
KM   ROUTE RUNOFF THROUGH DITCH D2 TO POND DE COMBINATION PT
KM   TRAPEZOIDAL CHANNEL
RK    400   0.019   0.035       0    TRAP       8       5
* ***********************************************************************

KK  SUB.D5
KM   AREA........(AC)....24.8
KM   LAG TIME....(HR)....0.14
KM   CN.................76
BA  0.0388
IN      15
LS       0       76
UD    0.14
*
* ***********************************************************************

KK  SUB.E2
KM   AREA........(AC)....10.5
KM   LAG TIME....(HR)... 0.13
KM   CN.................96
BA  0.0164
IN      15
LS       0       96
UD    0.13
*
* ***********************************************************************

KK  SUB.E5
KM   AREA........(AC)....8.2
KM   LAG TIME....(HR)... 0.12
KM   CN.................96
BA  0.0128
IN      15
LS       0       96
UD    0.12
*
```

```
*****************************************************************
KK  PT.E25
KM   COMBINE FLOW FROM E2 AND E5
HC       2
*****************************************************************

KK  THRUE1
KM   ROUTE RUNOFF THROUGH DITCH E1 TO COMBINATION PTE1-5
KM   TRAPEZOIDAL CHANNEL
RK    2425   0.006   0.035       0    TRAP       8       5
*****************************************************************
```



```
1                              HEC-1 INPUT

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

KK  SUB.E1
KM   AREA.....(AC)....9.9
KM   LAG TIME....(HR)... 0.18
KM   CN.................96
BA  0.0155
IN      15
LS       0      96
UD    0.18
*
*****************************************************************

KK  SUB.E3
KM   AREA.....(AC)....12.9
KM   LAG TIME....(HR)... 0.11
KM   CN.................96
BA  0.0202
IN      15
LS       0      96
UD    0.11
*
*****************************************************************

KK  SUB.E4
KM   AREA.....(AC)....12.5
KM   LAG TIME....(HR)... 0.11
KM   CN.................80
BA  0.0195
IN      15
LS       0      80
UD    0.11
*
*****************************************************************

KK PT.E1-5
KM   COMBINE FLOW FROM AREAS E1-E5
HC       4
*
*****************************************************************

KK  CULVE2
KM   LOW LEVEL OUTLET IS.....(2)42"RCP
KM   DOWNSTREAM FL LOW LEVEL OUTLET 3952.23 FT
KM   SPILLWAY OVERFLOW ELEVATION .. 3958.0 FT
KM   SPILLWAY WIDTH ..............40.0 FT
KM   TOP OF DAM ELEVATION..... 3958.0 FT
KM   FOR TAILWATER USE CONST ELEV.  3955.2 FT
RS       1    ELEV      -1
SV       0    0.09    0.37    0.76    1.27    1.89    2.64
SE  3952.5    3953    3954    3955    3956    3957    3958
SL 3952.23   19.23    0.70     0.5
SS  3957.5      40     3.0     1.5
ST  3958.0      40     3.0     1.5
*****************************************************************
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 309          KK  THRUE2
 310          KM   ROUTE RUNOFF THROUGH DITCH E2 TO POND DE COMBINATION PT
 311          KM   TRAPEZOIDAL CHANNEL
 312          RK     570    0.05   0.035       0    TRAP       8       5
              * ***********************************************************************

 313          KK  SUB.E6
 314          KM   AREA........(AC)....11.9
 315          KM   LAG TIME....(HR)... 0.04
 316          KM   CN..................80
 317          BA  0.0186
 318          IN      15
 319          LS       0      80
 320          UD    0.04
              *
              * ***********************************************************************

 321          KK   PT.DE
 322          KM   COMBINE FLOW FROM AREAS D AND E
 323          HC       5
              *
              * ***********************************************************************

 324          KK  PONDDE
 325          KM   LOW LEVEL OUTLET IS..........(2)18"RCP
 326          KM   DOWNSTREAM FL LOW LEVEL OUTLET 3921.2 FT
 327          KM   SPILLWAY OVERFLOW ELEVATION .. 3931.5 FT
 328          KM   SPILLWAY WIDTH ................10.0 FT
 329          KM   TOP OF DAM ELEVATION.......... 3933.5 FT
 330          KM   FOR TAILWATER USE CONST ELEV.  3928.0 FT
 331          RS       1    ELEV      -1
 332          SV       0    3.93    8.66   13.54   18.56   26.37   37.29
 333          SE 3926.33    3927    3928    3929    3930  3931.5  3933.5
 334          SL  3921.6   0.884    0.70     0.5
 335          SS 3931.33      10     3.0     1.5
 336          ST 3933.33     800     3.0     1.5
              * ***********************************************************************

 337          KK  SUB.A1
 338          KM   AREA........(AC)....5.0
 339          KM   LAG TIME....(HR)... 0.12
 340          KM   CN..................63
 341          BA  0.0078
 342          IN      15
 343          LS       0      63
 344          UD    0.12
              *
              * ***********************************************************************
 345          ZZ
```

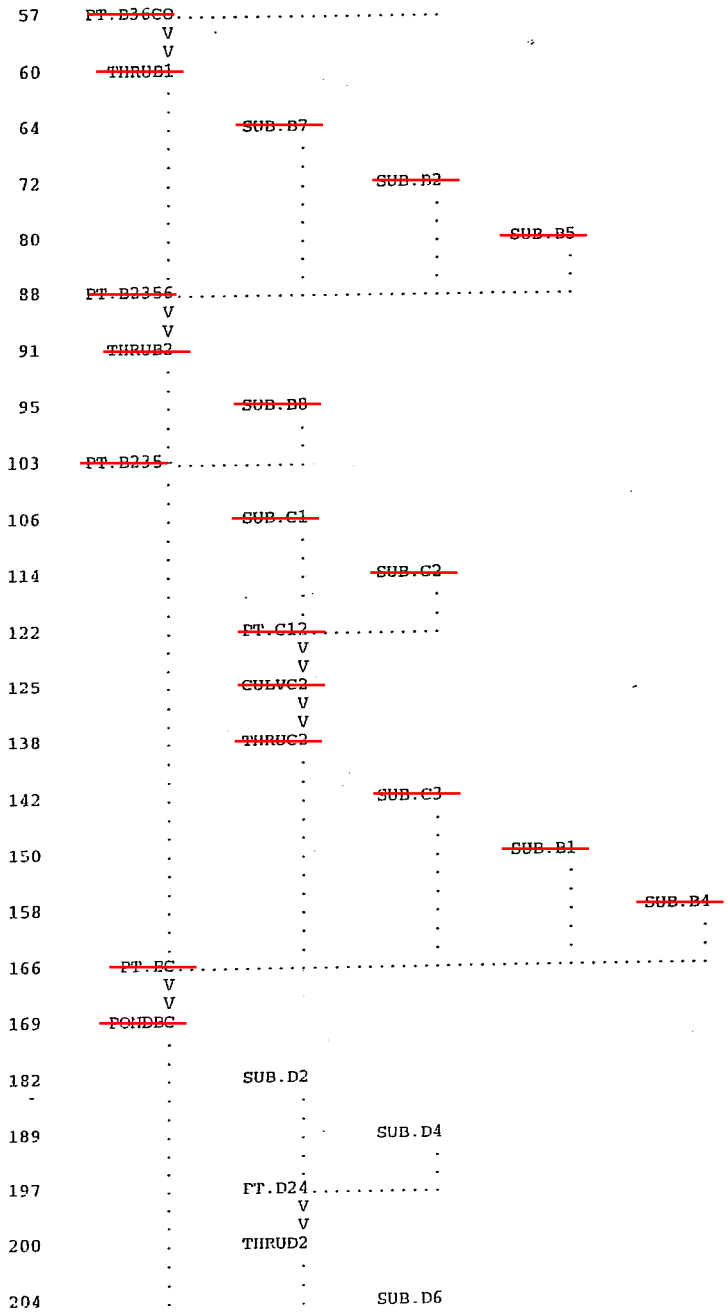
1

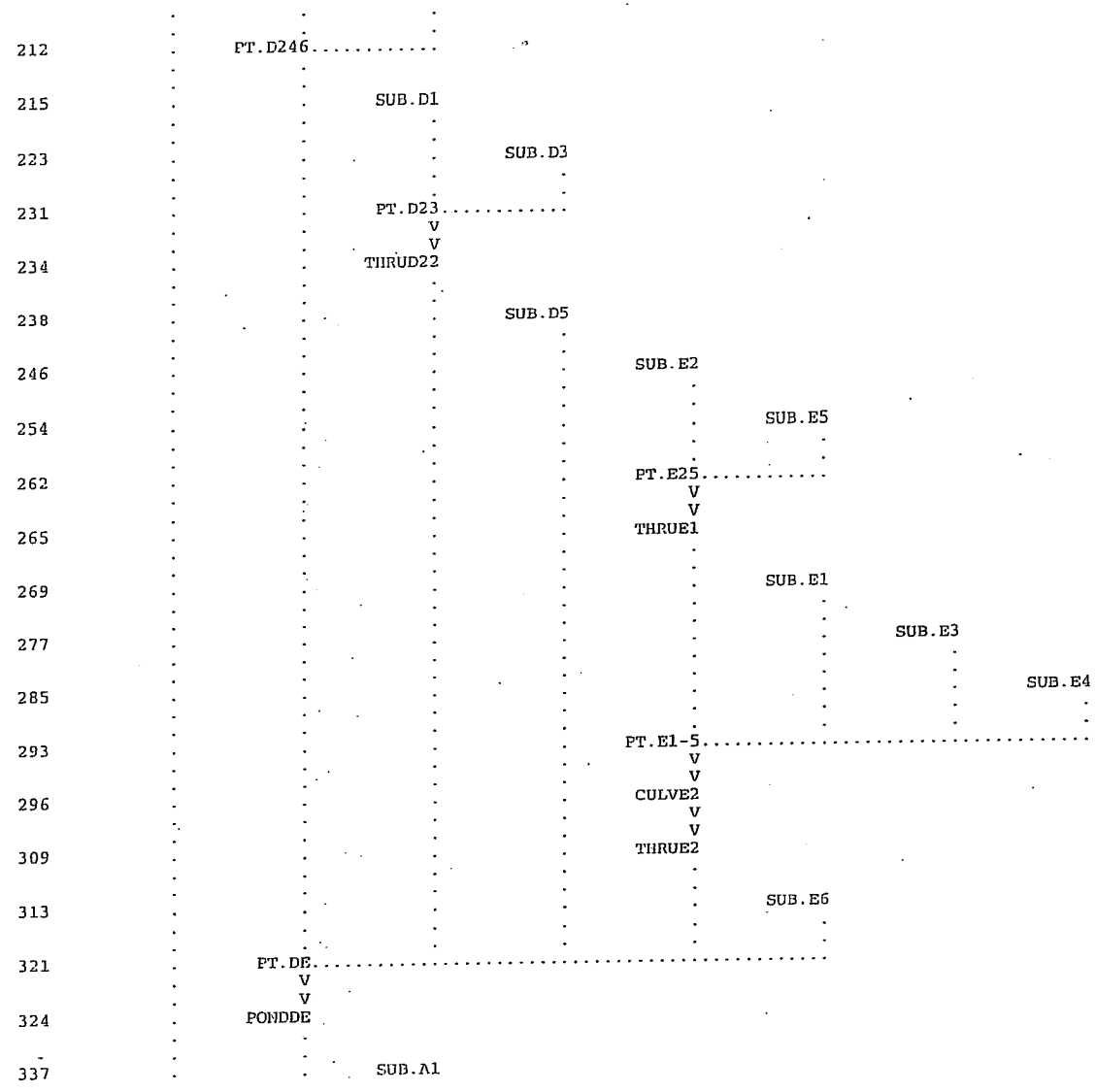
SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   33     SUB.COS(
              .
              .
   42         .      SUB.B3
              .          .
              .          .
   49         .          .      SUB.B6
              .          .          .
              .          .          .
```


57
PT.B36CO
60
THRUB1
64
SUB.B7
72
SUB.B2
80
SUB.B5
88
PT.B2356
91
THRUB2
95
SUB.B8
103
PT.B235
106
SUB.C1
114
SUB.C2
122
PT.C12
125
CULVC2
138
THRUC2
142
SUB.C3
150
SUB.B1
158
SUB.B4
166
PT.BC
169
PONDBC
182
SUB.D2
189
SUB.D4
197
PT.D24
200
THRUD2
204
SUB.D6



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

1**********

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* SEPTEMBER 1990 *
* VERSION 4.0 *
* *
* RUN DATE 04/07/1999 TIME 17:24:50 *

****

* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *

****

```
**********                                                          **********

                  ********************************************************
                  *                                                      *
                  *          El Paso Clint Landfill  -  Developed Conditions *
                  *                                                      *
                  * ..................................................... *
                  * :                                                   : *
                  * :          STORM DURATION.............24 HOUR       : *
                  * :          RETURN PERIOD..............25 YEAR       : *
                  * :          FILENAME..... clintdev.DAT               : *
                  * :          DATE.................  APR, 1999          : *
                  * :          BY..................... DBP & MRD          : *
                  * :...................................................: *
                  ********************************************************
                    SOILS:
                    SOIL CLASSIFICATIONS FOR El Paso COUNTY BY THE SCS WERE
                    USED AND AREA WEIGHTED CURVE NUMBERS ASSIGNED TO SUBBASINS

                    RAINFALL DISTRIBUTION: FROM TP40, HYDRO35
                    HYPOTHETICAL STORM - PH CARD

                    VELOCITIES FROM (SCS MANUAL, FIGURE 15.2)
                  ********************************************************************
                  1 0  0.55 1.40 2.40 2.58 2.75 3.20 3.60 4.00 (100 YEAR)
                  4 0  0.44 1.08 1.87 2.01 2.15 2.50 2.81 3.12 (25 YEAR)


                  FOR ROUTING FLOWS IN PROPOSED DITCHES USE TRAPEZOIDAL
                  CHANNEL, 8' BOTTOM WIDTH, 2:1 BANK SLOPES
                  DITCH   N=0.035

 32 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           4  MINUTES IN COMPUTATION INTERVAL
                     IDATE       1    0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE       1    0  ENDING DATE
                    NDTIME         1956  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .07 HOURS
                      TOTAL TIME BASE   19.93 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT
1

                                                RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                        TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK    TIME OF      AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN      MAXIMUM     TIME OF
     OPERATION       STATION        FLOW     PEAK                                            AREA       STAGE      MAX STAGE
                                                          6-HOUR      24-HOUR      72-HOUR
                                                                    ge 11
```

	SUB.D2	33.	10.20	4.	1.	1.	.02	
HYDROGRAPH AT	SUB.D4	29.	10.07	3.	1.	1.	.01	
2 COMBINED AT	PT.D24	60.	10.13	7.	2.	2.	.03	
ROUTED TO	THRUD2	59.	10.20	7.	2.	2.	.03	
HYDROGRAPH AT	SUB.D6	34.	10.13	4.	1.	1.	.02	
2 COMBINED AT	PT.D246	91.	10.20	10.	4.	4.	.05	
HYDROGRAPH AT	SUB.D1	33.	10.13	4.	1.	1.	.02	
HYDROGRAPH AT	SUB.D3	48.	10.07	5.	2.	2.	.02	
2 COMBINED AT	PT.D23	79.	10.13	8.	3.	3.	.03	
ROUTED TO	THRUD22	79.	10.13	8.	3.	3.	.03	
HYDROGRAPH AT	SUB.D5	38.	10.13	4.	1.	1.	.04	
HYDROGRAPH AT	SUB.E2	39.	10.13	4.	1.	1.	.02	
HYDROGRAPH AT	SUB.E5	31.	10.07	3.	1.	1.	.01	
2 COMBINED AT	PT.E25	70.	10.07	7.	2.	2.	.03	
ROUTED TO	THRUE1	69.	10.20	7.	2.	2.	.03	
HYDROGRAPH AT	SUB.E1	34.	10.13	4.	1.	1.	.02	
HYDROGRAPH AT	SUB.E3	51.	10.07	5.	2.	2.	.02	
HYDROGRAPH AT	SUB.E4	25.	10.13	2.	1.	1.	.02	
4 COMBINED AT	PT.E1-5	165.	10.13	18.	6.	6.	.08	
ROUTED TO	CULVE2	150.	10.20	38.	27.	27.	.08	3954.16 10.20
ROUTED TO	THRUE2	148.	10.20	40.	28.	28.	.08	
HYDROGRAPH AT	SUB.E6	29.	10.00	2.	1.	1.	.02	
5 COMBINED AT	PT.DE	357.	10.20	65.	37.	37.	.22	
ROUTED TO								

+		PONDDE	34.	15.07	33.	19.	19.	.22	
+								3932.04	15.07
	HYDROGRAPH AT								
+		SUB.A1	3.	10.13	0.	0.	0.	.01	
1									

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
THRUB1	MANE	2.46	92.00	612.77	.75	4.00	90.17	612.00	.75
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1125E+02 EXCESS= .0000E+00 OUTFLOW= .1120E+02 BASIN STORAGE= .4885E-01 PERCENT ERROR= .0									
THRUB2	MANE	1.03	199.39	614.14	.99	4.00	196.16	612.00	.99
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1896E+02 EXCESS= .0000E+00 OUTFLOW= .1894E+02 BASIN STORAGE= .2929E-01 PERCENT ERROR= .0									
THRUC2	MANE	1.68	87.57	607.53	16.72	4.00	87.37	608.00	17.48
CONTINUITY SUMMARY (AC-FT) - INFLOW= .3282E+02 EXCESS= .0000E+00 OUTFLOW= .3522E+02 BASIN STORAGE= .1952E+00 PERCENT ERROR= -7.9									
THRUD2	MANE	2.53	59.01	612.18	2.58	4.00	58.82	612.00	2.57
CONTINUITY SUMMARY (AC-FT) - INFLOW= .3866E+01 EXCESS= .0000E+00 OUTFLOW= .3860E+01 BASIN STORAGE= .1320E-01 PERCENT ERROR= -.2									
THRUD22	MANE	.40	78.94	608.50	2.58	4.00	78.72	608.00	2.58
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4776E+01 EXCESS= .0000E+00 OUTFLOW= .4775E+01 BASIN STORAGE= .2270E-02 PERCENT ERROR= .0									
THRUE1	MANE	3.21	69.68	612.47	2.58	4.00	69.12	612.00	2.58
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4020E+01 EXCESS= .0000E+00 OUTFLOW= .4018E+01 BASIN STORAGE= .1859E-01 PERCENT ERROR= -.4									
THRUE2	MANE	.32	149.80	612.81	9.81	4.00	148.34	612.00	10.38
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4386E+02 EXCESS= .0000E+00 OUTFLOW= .4414E+02 BASIN STORAGE= .2053E-01 PERCENT ERROR= -.7									

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION CULVC2
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	3928.52	3936.50	3937.00
STORAGE	0.	1.	1.
OUTFLOW	0.	217.	267.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

	1.00	3930.26	.00	0.	88.	.00	10.07	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION PONDBC
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	3881.96	3894.00	3896.00
STORAGE	0.	19.	30.
OUTFLOW	0.	7.	93.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	3895.87	.00	29.	85.	.00	11.07	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION CULVE2
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	3951.77	3957.50	3958.00
STORAGE	0.	2.	3.
OUTFLOW	0.	248.	302.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	3954.16	.00	0.	150.	.00	10.20	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION PONDDE
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	3916.63	3931.33	3933.33
STORAGE	0.	25.	36.
OUTFLOW	0.	15.	102.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	3932.04	.00	29.	34.	.00	15.07	.00

*** NORMAL END OF HEC-1 ***

HEC-HMS Printouts
Pre-Developed Conditions

Parkhill
May 2022,October, 2021

Project: GEPL_SS_Berm_Mod
Simulation Run: 24-hr 25-yr
Simulation Start: 30 September 2021, 24:00
Simulation End: 2 October 2021, 24:00

HMS Version: 4.9
Executed: 01 June 2022, 12:25

Global Parameter Summary - Subbasin

Area (MIē)

Element Name	Area (MIē)
B1	0.03
B2	0.03
B3	0.03
B4	0.02
B4.1	0
B5	0.02
B6	0.01
B7	0.03
B8	0.03
C1	0.03
C2	0.02
C3	0.02
Off - Site Contribution	0.24

Downstream

Element Name	Downstream
B1	Junction - 1
B2	Junction - 4
B3	Junction - 3
B4	Junction - 1
B5	Junction - 4
B6	Junction - 3
B7	Junction - 3
B8	Ditch B2
C1	Junction - 2
C2	Junction - 2
C3	Ditch C1
Off - Site Contribution	Junction - 3

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
B1	0	96
B2	0	96
B3	0	96
B4	0	96
B4.1	0	96
B5	0	96
B6	0	96
B7	0	75
B8	0	75
C1	0	96
C2	0	96
C3	0	96
Off - Site Contribution	0	63

Transform: Scs

Element Name	Lag	Unitgraph Type
B1	9.56	Standard
B2	9.47	Standard
B3	9.67	Standard
B4	4.44	Standard
B4.1	8.21	Standard
B5	4.44	Standard
B6	4.21	Standard
B7	34.22	Standard
B8	14.17	Standard
C1	9.67	Standard
C2	4.31	Standard
C3	21.74	Standard
Off - Site Contribution	45.6	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Ditch B1	Junction - 4
Ditch B2	Detention Pond BC
Ditch C1	Junction - 2
Ditch C2	Detention Pond BC

Route: Muskingum Cunge

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Space - Time Method	Index Parameter Type	Index Celerity	Index
Ditch B1	Muskingum Cunge	Trapezoid	2465	0.01	0.04	8	3	Combined Inflow	Automatic DX and DT	Index Celerity	5	0
Ditch B2	Muskingum Cunge	Trapezoid	1600	0.01	0.04	8	3	Combined Inflow	Automatic DX and DT	Index Celerity	5	0
Ditch C1	Muskingum Cunge	Trapezoid	1900	0.01	0.04	8	3	Combined Inflow	Automatic DX and DT	Index Celerity	5.5	Nc Speci
Ditch C2	Muskingum Cunge	Trapezoid	2200	0.01	0.04	8	3	Combined Inflow	Automatic DX and DT	Index Celerity	5	0

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
B1	0.03	44.07	01Oct2021, 12:00	2.72
B2	0.03	45.89	01Oct2021, 12:00	2.72
B3	0.03	48.49	01Oct2021, 12:00	2.72
B4	0.02	42.48	01Oct2021, 12:00	2.72
B4.1	0	6.89	01Oct2021, 12:00	2.72
B5	0.02	27.55	01Oct2021, 12:00	2.72
B6	0.01	20.44	01Oct2021, 12:00	2.72
B7	0.03	10.16	01Oct2021, 12:30	1.07
B8	0.03	13.03	01Oct2021, 12:15	1.07
C1	0.03	46.08	01Oct2021, 12:00	2.72
C2	0.02	29.15	01Oct2021, 12:00	2.72
C3	0.02	19.4	01Oct2021, 12:15	2.72
Off - Site Contribution	0.24	23.01	01Oct2021, 12:45	0.51
Ditch B1	0.31	63.75	01Oct2021, 12:15	0.86
Ditch B2	0.38	118.59	01Oct2021, 12:15	1.09
Ditch C1	0.02	17.13	01Oct2021, 12:15	2.72
Ditch C2	0.06	66.81	01Oct2021, 12:15	2.72
Junction - 1	0.05	86.56	01Oct2021, 12:00	2.72
Junction - 2	0.06	85.25	01Oct2021, 12:00	2.72
Junction - 3	0.31	75.12	01Oct2021, 12:00	0.86
Junction - 4	0.35	123	01Oct2021, 12:00	1.09
Detention Pond BC	0.49	48.28	01Oct2021, 13:30	1.31

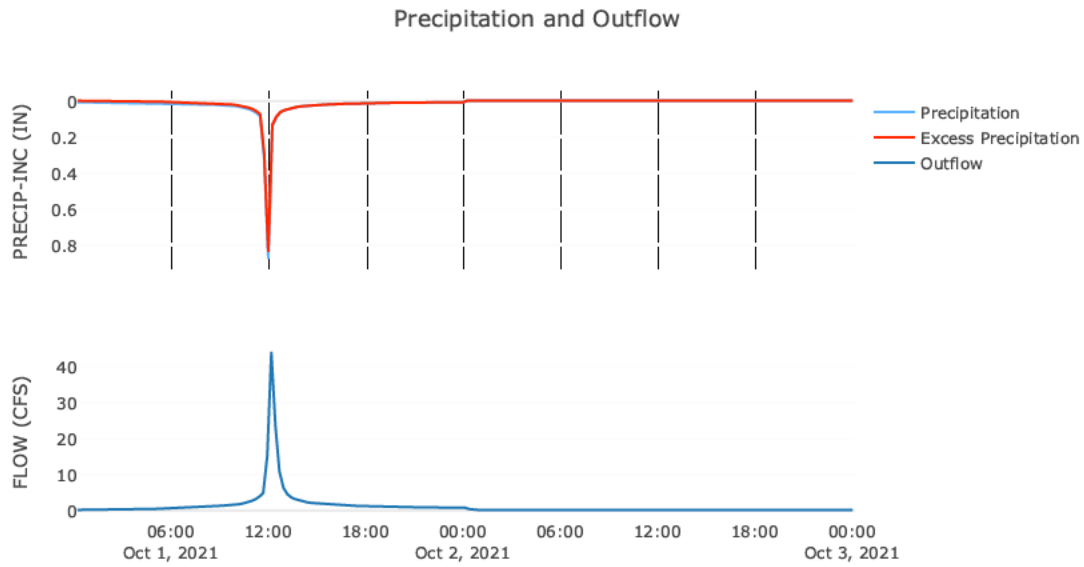
Subbasin: B1

Area (MIē) : 0.03
Downstream : Junction - 1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.56
Unitgraph Type	Standard

Results: B1	
Peak Discharge (CFS)	44.07
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	4.62
Loss Volume (AC - FT)	0.66
Excess Volume (AC - FT)	3.96
Direct Runoff Volume (AC - FT)	3.96
Baseflow Volume (AC - FT)	0



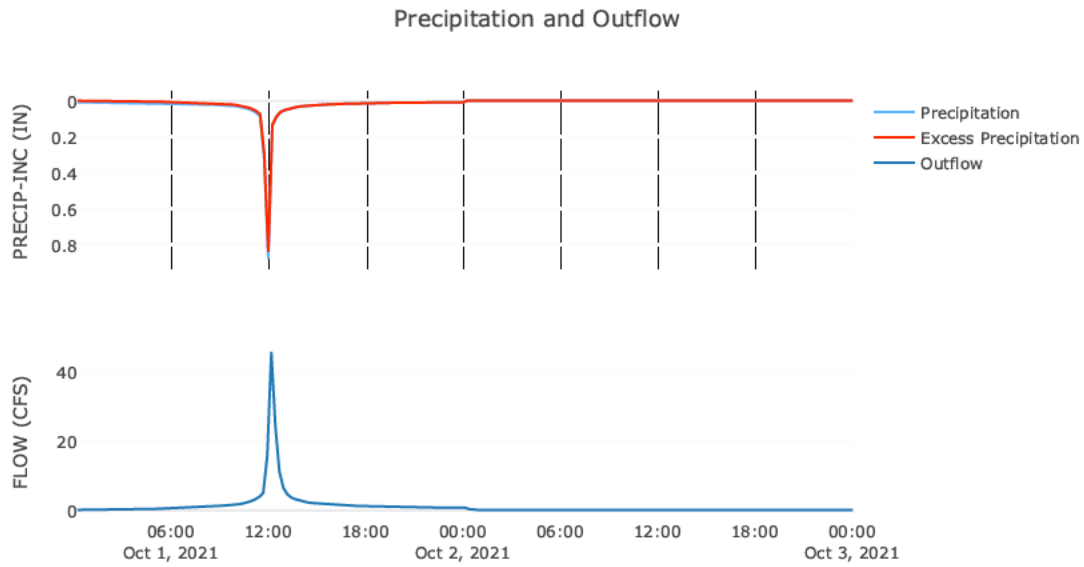
Subbasin: B2

Area (MIē) : 0.03
Downstream : Junction - 4

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.47
Unitgraph Type	Standard

Results: B2	
Peak Discharge (CFS)	45.89
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	4.78
Loss Volume (AC - FT)	0.68
Excess Volume (AC - FT)	4.1
Direct Runoff Volume (AC - FT)	4.1
Baseflow Volume (AC - FT)	0



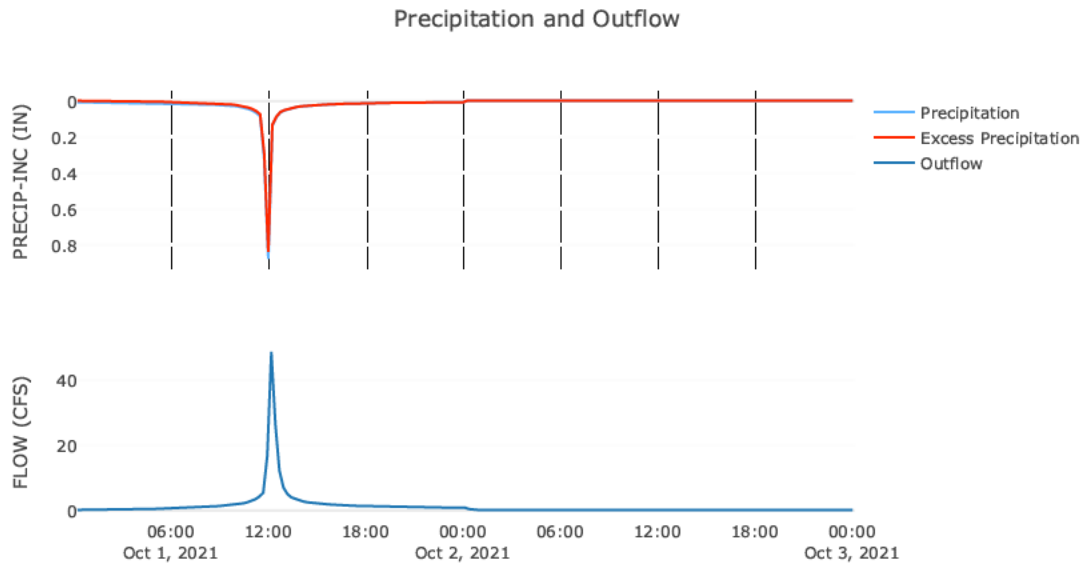
Subbasin: B3

Area (MIē) : 0.03
Downstream : Junction - 3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.67
Unitgraph Type	Standard

Results: B3	
Peak Discharge (CFS)	48.49
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	5.11
Loss Volume (AC - FT)	0.73
Excess Volume (AC - FT)	4.38
Direct Runoff Volume (AC - FT)	4.38
Baseflow Volume (AC - FT)	0



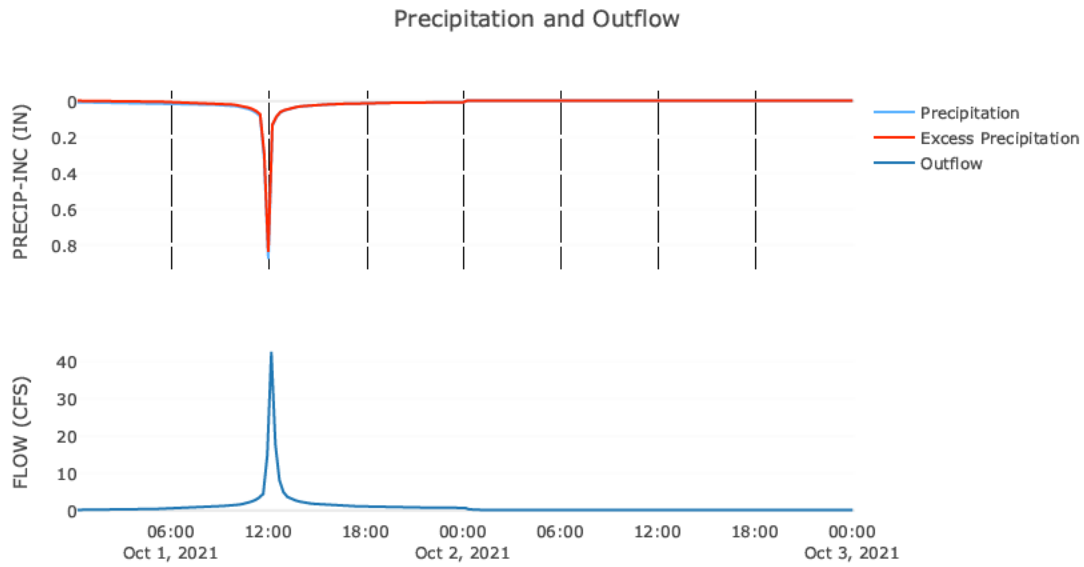
Subbasin: B4

Area (MIē) : 0.02
Downstream : Junction - 1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.44
Unitgraph Type	Standard

Results: B4	
Peak Discharge (CFS)	42.48
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	4.04
Loss Volume (AC - FT)	0.57
Excess Volume (AC - FT)	3.47
Direct Runoff Volume (AC - FT)	3.47
Baseflow Volume (AC - FT)	0



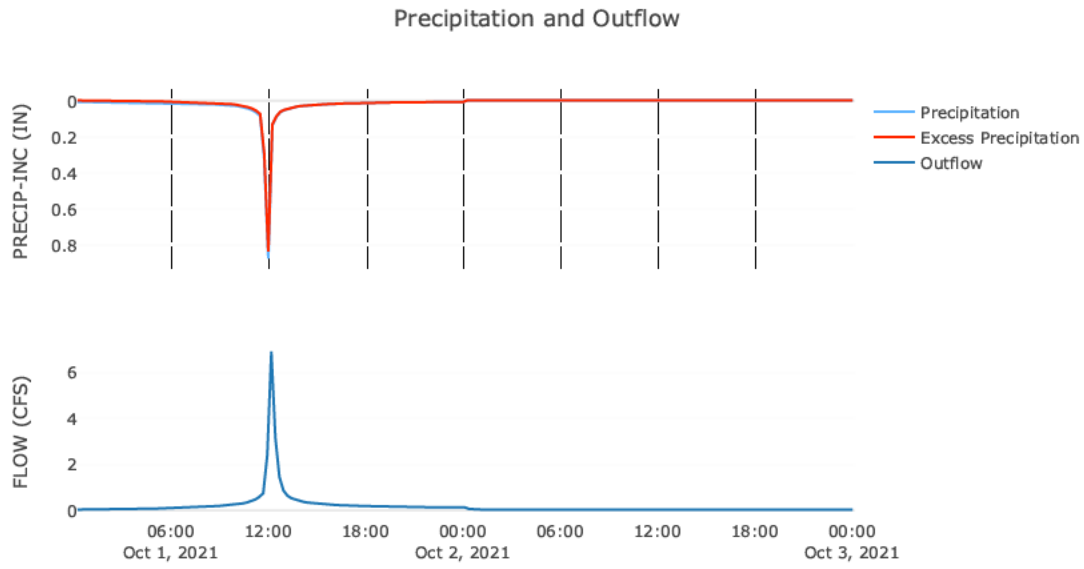
Subbasin: B4.1

Area (MIē) : 0

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	8.21
Unitgraph Type	Standard

Results: B4.1	
Peak Discharge (CFS)	6.89
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	0.68
Loss Volume (AC - FT)	0.1
Excess Volume (AC - FT)	0.58
Direct Runoff Volume (AC - FT)	0.58
Baseflow Volume (AC - FT)	0



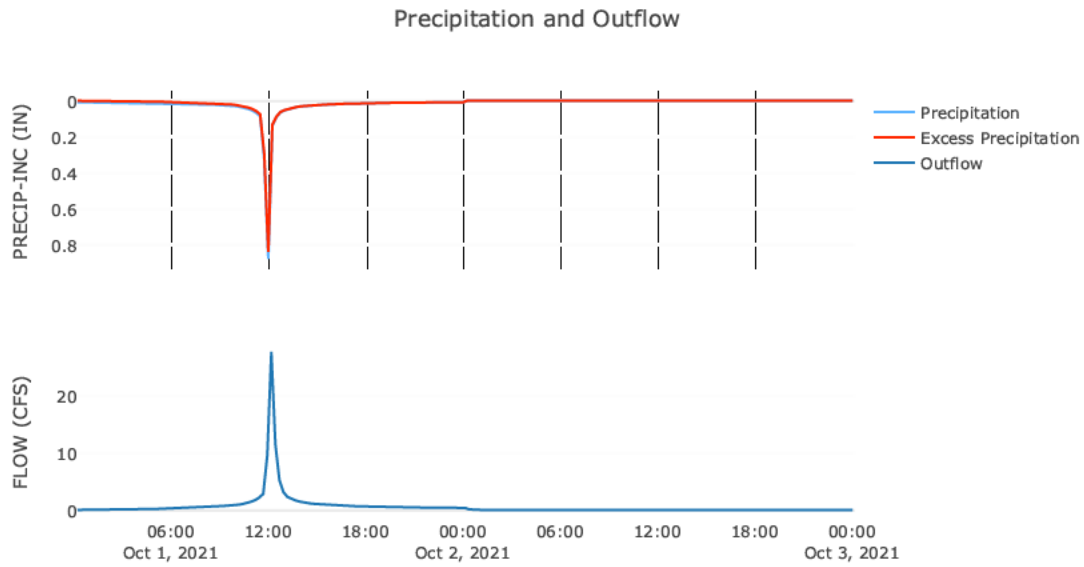
Subbasin: B5

Area (MIē) : 0.02
Downstream : Junction - 4

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.44
Unitgraph Type	Standard

Results: B5	
Peak Discharge (CFS)	27.55
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	2.62
Loss Volume (AC - FT)	0.37
Excess Volume (AC - FT)	2.25
Direct Runoff Volume (AC - FT)	2.25
Baseflow Volume (AC - FT)	0



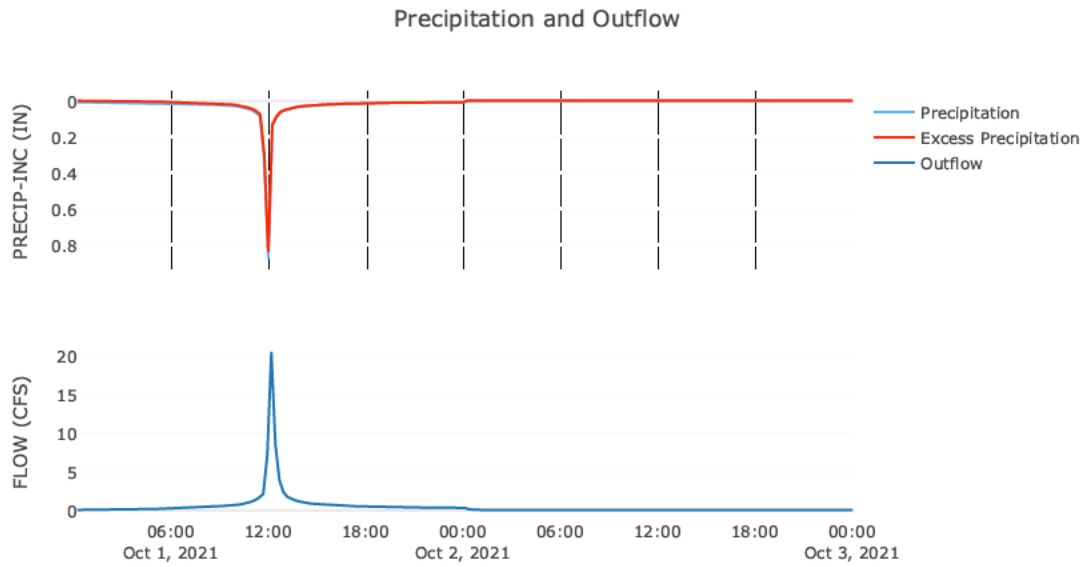
Subbasin: B6

Area (MIē) : 0.01
Downstream : Junction - 3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.21
Unitgraph Type	Standard

Results: B6	
Peak Discharge (CFS)	20.44
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	1.94
Loss Volume (AC - FT)	0.28
Excess Volume (AC - FT)	1.67
Direct Runoff Volume (AC - FT)	1.67
Baseflow Volume (AC - FT)	0



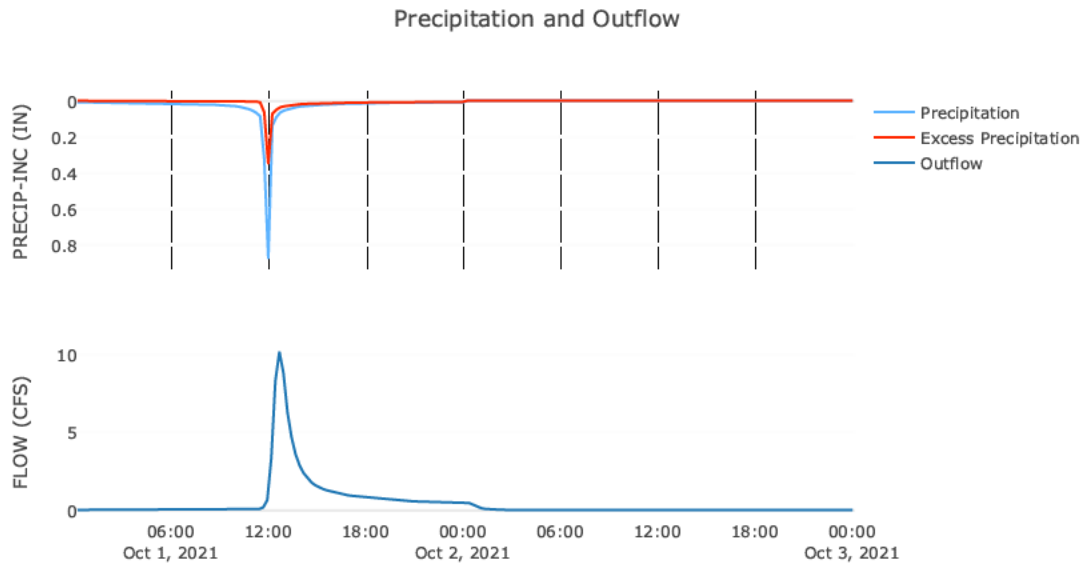
Subbasin: B7

Area (MIē) : 0.03
Downstream : Junction - 3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75

Transform: Scs	
Lag	34.22
Unitgraph Type	Standard

Results: B7	
Peak Discharge (CFS)	10.16
Time of Peak Discharge	01Oct2021, 12:30
Volume (IN)	1.07
Precipitation Volume (AC - FT)	5.19
Loss Volume (AC - FT)	3.43
Excess Volume (AC - FT)	1.76
Direct Runoff Volume (AC - FT)	1.76
Baseflow Volume (AC - FT)	0



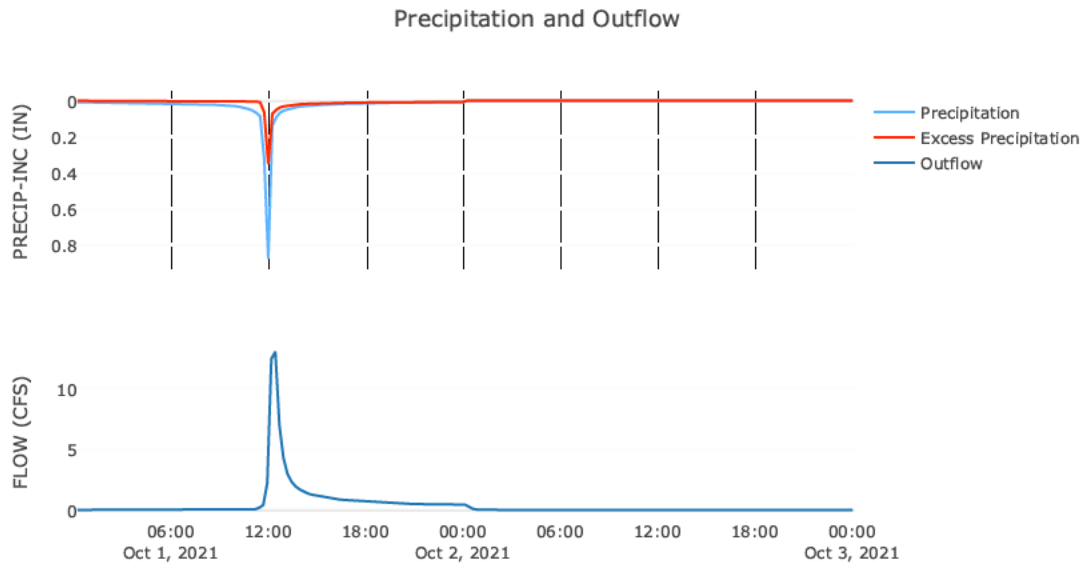
Subbasin: B8

Area (MIē) : 0.03
Downstream : Ditch B2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75

Transform: Scs	
Lag	14.17
Unitgraph Type	Standard

Results: B8	
Peak Discharge (CFS)	13.03
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	1.07
Precipitation Volume (AC - FT)	4.73
Loss Volume (AC - FT)	3.13
Excess Volume (AC - FT)	1.6
Direct Runoff Volume (AC - FT)	1.6
Baseflow Volume (AC - FT)	0



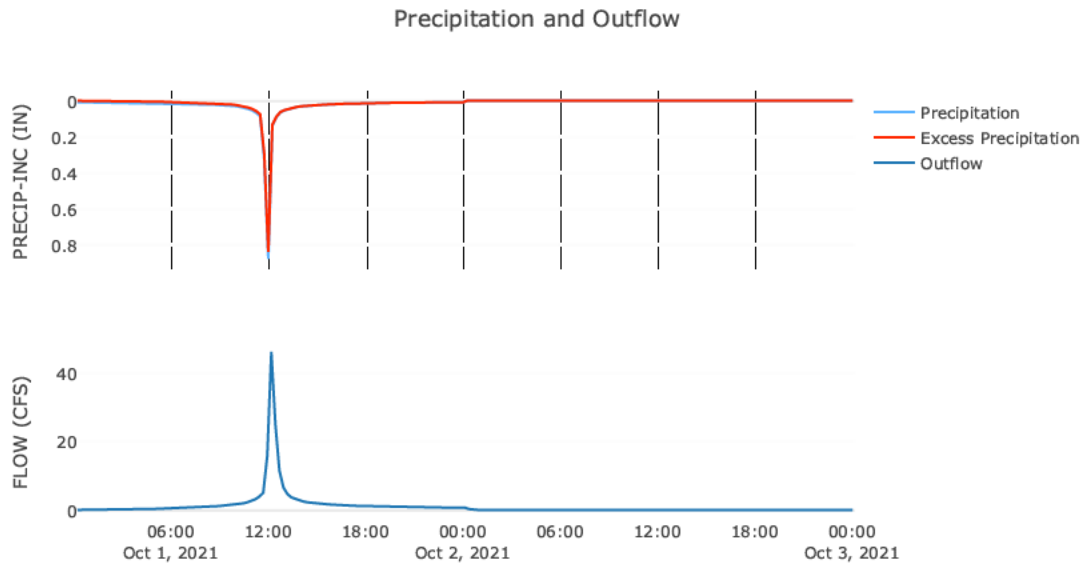
Subbasin: C1

Area (MIē) : 0.03
Downstream : Junction - 2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.67
Unitgraph Type	Standard

Results: C1	
Peak Discharge (CFS)	46.08
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	4.85
Loss Volume (AC - FT)	0.69
Excess Volume (AC - FT)	4.16
Direct Runoff Volume (AC - FT)	4.16
Baseflow Volume (AC - FT)	0



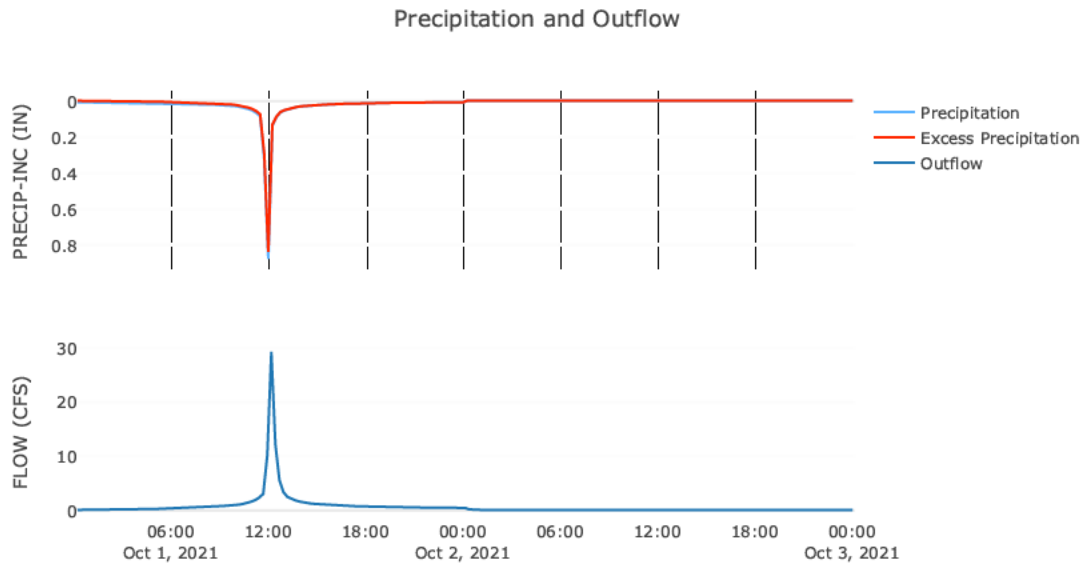
Subbasin: C2

Area (MIē) : 0.02
Downstream : Junction - 2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.31
Unitgraph Type	Standard

Results: C2	
Peak Discharge (CFS)	29.15
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72
Precipitation Volume (AC - FT)	2.77
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.38
Direct Runoff Volume (AC - FT)	2.38
Baseflow Volume (AC - FT)	0



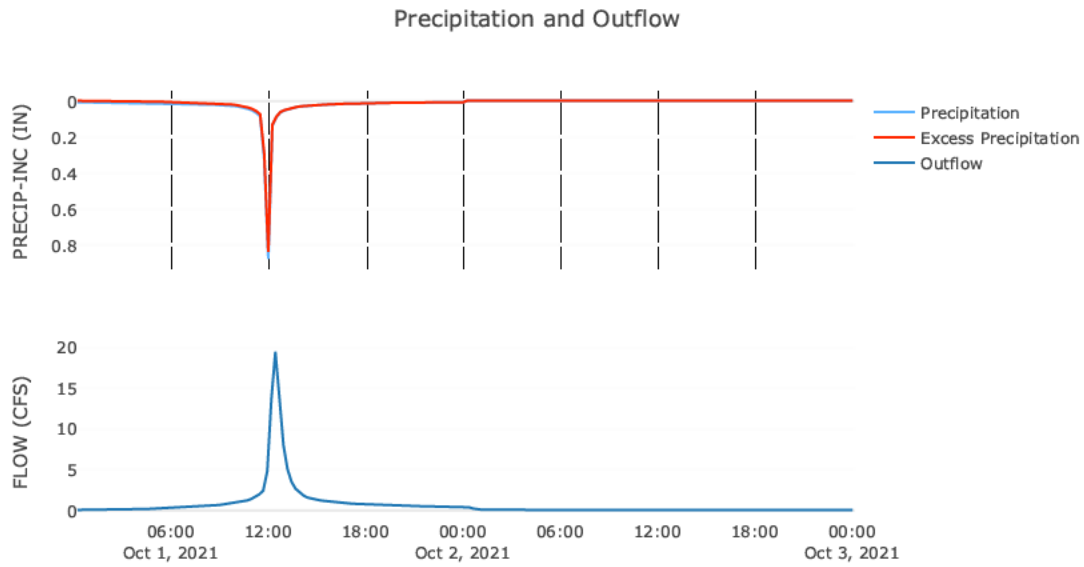
Subbasin: C3

Area (MIē) : 0.02
Downstream : Ditch C1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	21.74
Unitgraph Type	Standard

Results: C3	
Peak Discharge (CFS)	19.4
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	2.72
Precipitation Volume (AC - FT)	2.92
Loss Volume (AC - FT)	0.42
Excess Volume (AC - FT)	2.51
Direct Runoff Volume (AC - FT)	2.51
Baseflow Volume (AC - FT)	0



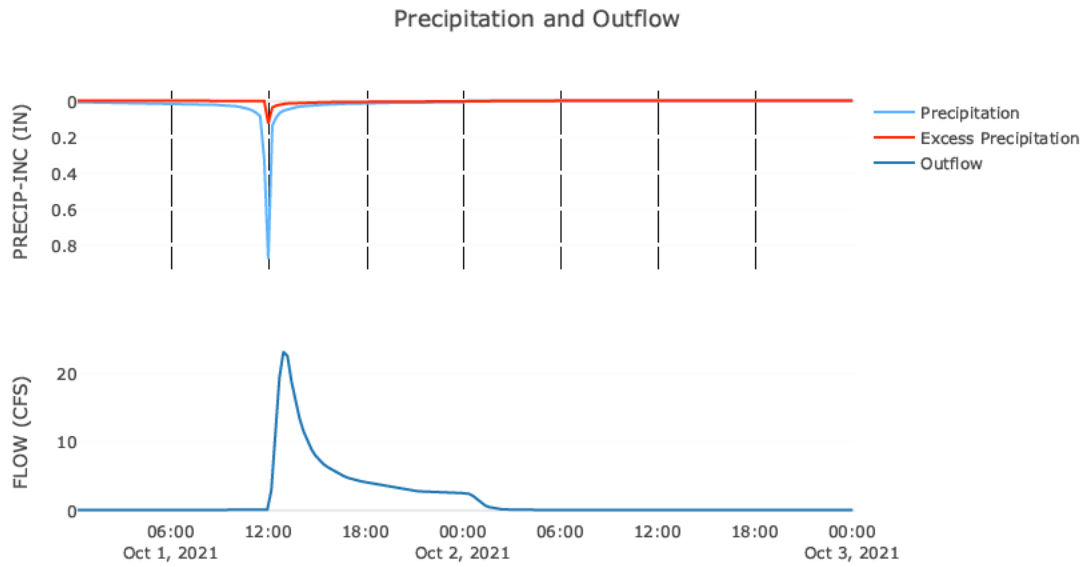
Subbasin: Off-Site Contribution

Area (MIē) : 0.24
Downstream : Junction - 3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	63

Transform: Scs	
Lag	45.6
Unitgraph Type	Standard

Results: Off-Site Contribution	
Peak Discharge (CFS)	23.01
Time of Peak Discharge	01Oct2021, 12:45
Volume (IN)	0.51
Precipitation Volume (AC - FT)	40
Loss Volume (AC - FT)	33.62
Excess Volume (AC - FT)	6.39
Direct Runoff Volume (AC - FT)	6.39
Baseflow Volume (AC - FT)	0

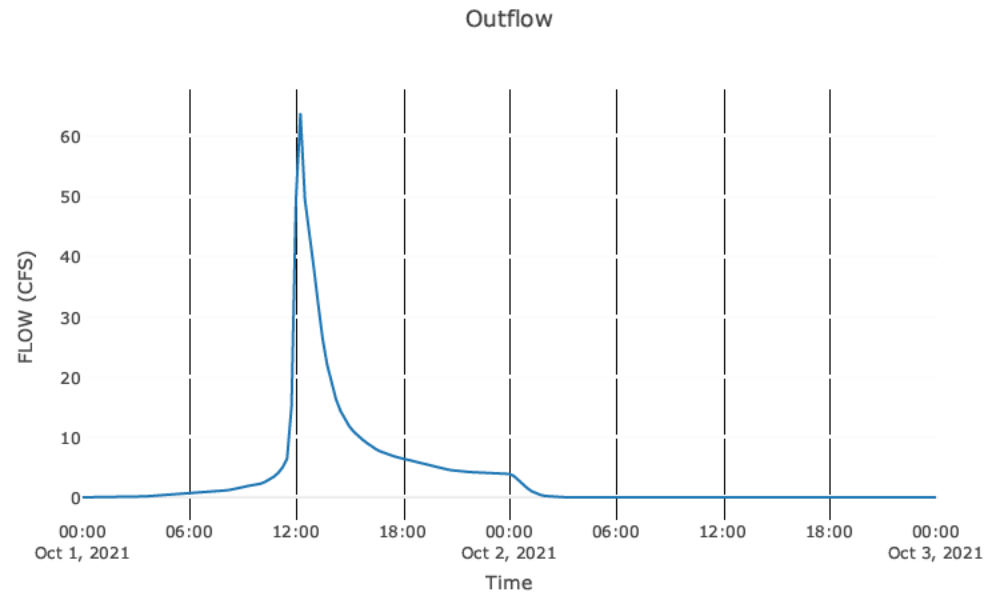


Reach: Ditch B1

Downstream : Junction - 4

Route: Muskingum Cunge	
Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	2465
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Bottom Width (FT)	8
Side Slope (FT/FT)	3
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Index Flow	0
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

Results: Ditch B1	
Peak Discharge (CFS)	63.75
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	0.86
Peak Inflow (CFS)	75.12
Inflow Volume (AC - FT)	14.19

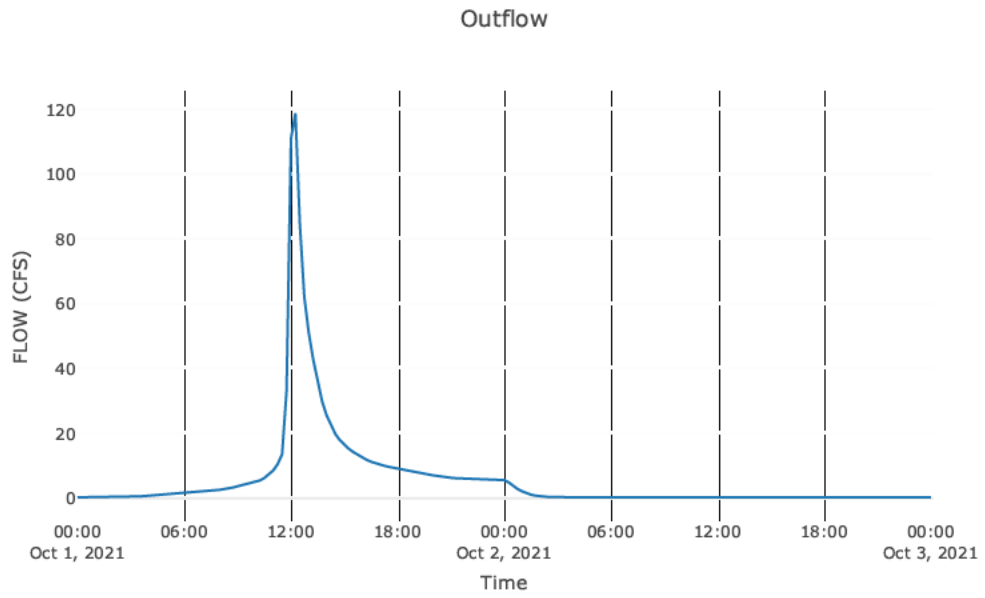


Reach: Ditch B2

Downstream : Detention Pond BC

Route: Muskingum Cunge	
Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	1600
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Bottom Width (FT)	8
Side Slope (FT/FT)	3
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Index Flow	0
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

Results: Ditch B2	
Peak Discharge (CFS)	118.59
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	1.09
Peak Inflow (CFS)	135.44
Inflow Volume (AC - FT)	22.14

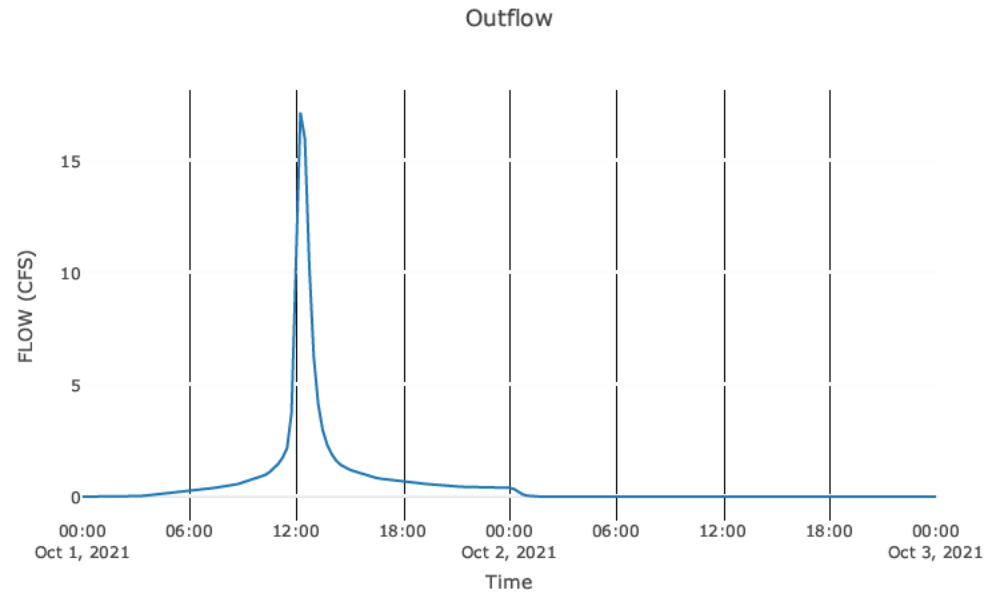


Reach: Ditch C1

Downstream : Junction - 2

Route: Muskingum Cunge	
Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	1900
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Bottom Width (FT)	8
Side Slope (FT/FT)	3
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5.5
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

Results: Ditch C1	
Peak Discharge (CFS)	17.13
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	2.72
Peak Inflow (CFS)	19.4
Inflow Volume (AC - FT)	2.51

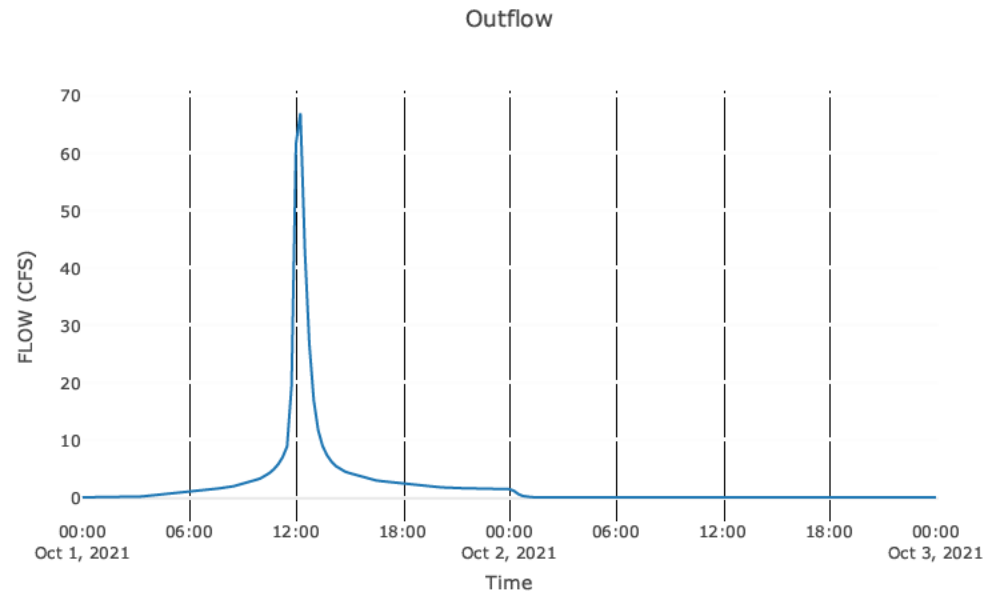


Reach: Ditch C2

Downstream : Detention Pond BC

Route: Muskingum Cunge	
Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	2200
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Bottom Width (FT)	8
Side Slope (FT/FT)	3
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Index Flow	0
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

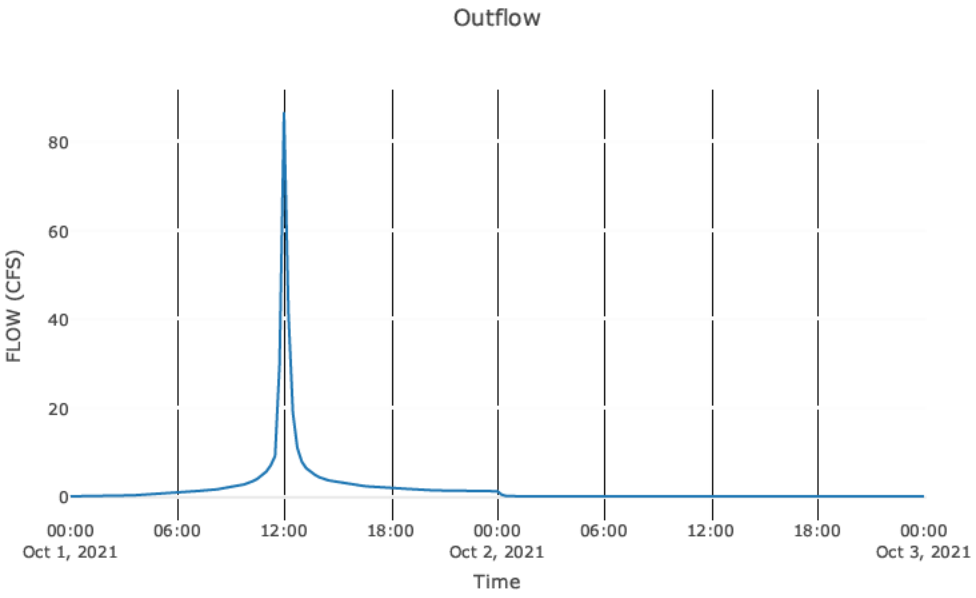
Results: Ditch C2	
Peak Discharge (CFS)	66.81
Time of Peak Discharge	01Oct2021, 12:15
Volume (IN)	2.72
Peak Inflow (CFS)	85.25
Inflow Volume (AC - FT)	9.05



Junction: Junction-1

Downstream : Detention Pond BC

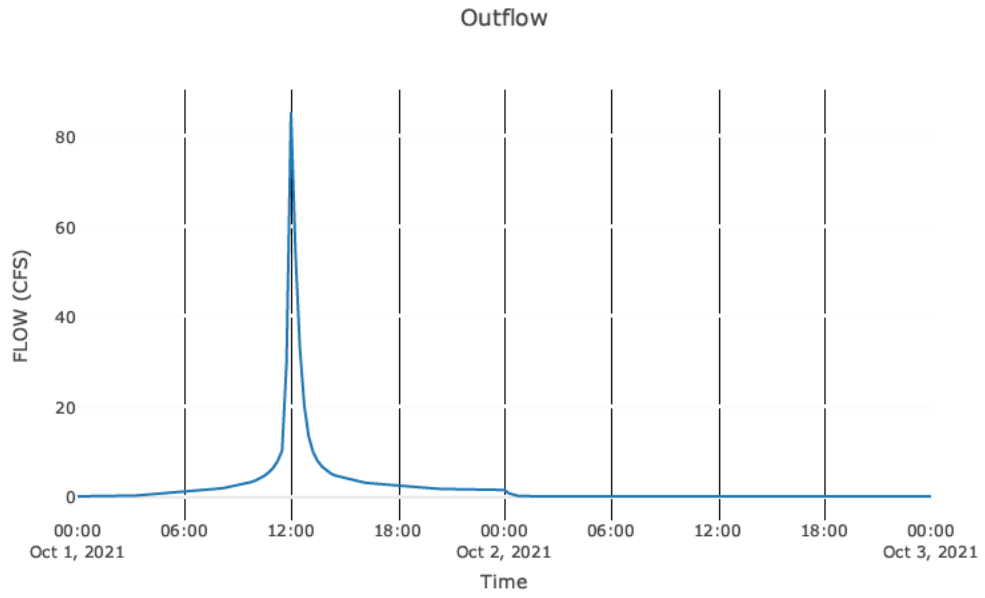
Results: Junction-1	
Peak Discharge (CFS)	86.56
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72



Junction: Junction-2

Downstream : Ditch C2

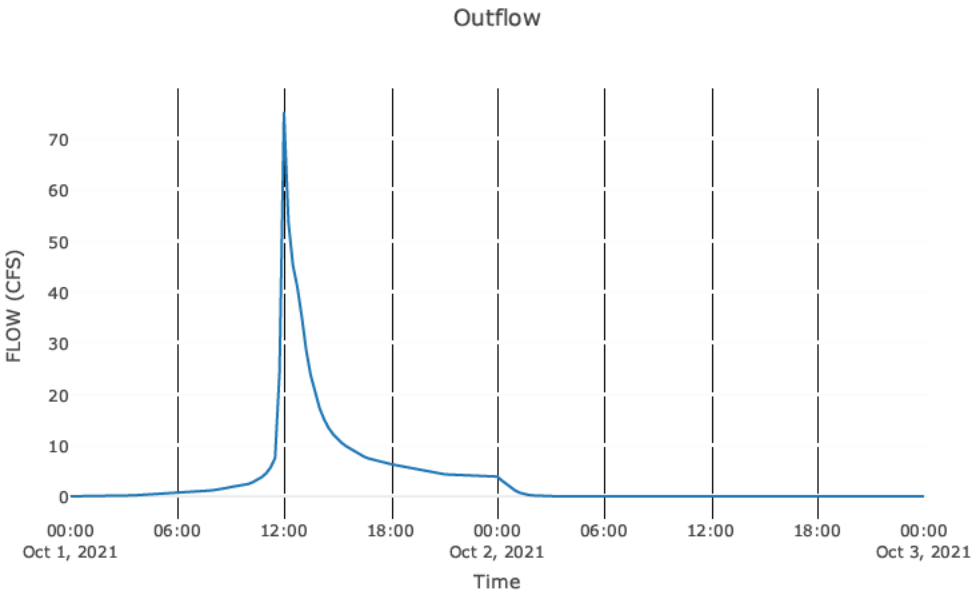
Results: Junction-2	
Peak Discharge (CFS)	85.25
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	2.72



Junction: Junction-3

Downstream : Ditch B1

Results: Junction-3	
Peak Discharge (CFS)	75.12
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	0.86

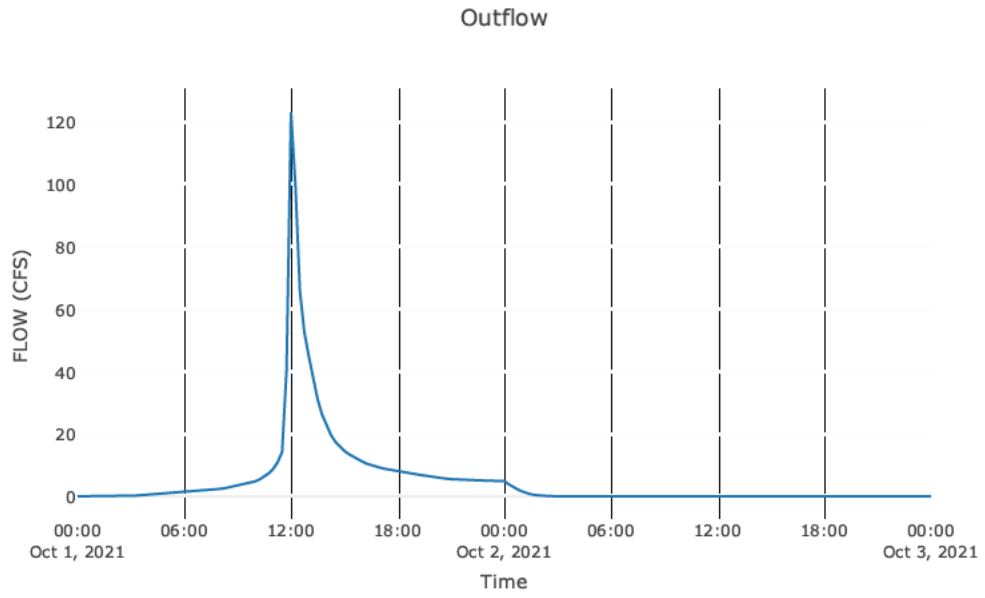


Junction: Junction-4

Downstream : Ditch B2

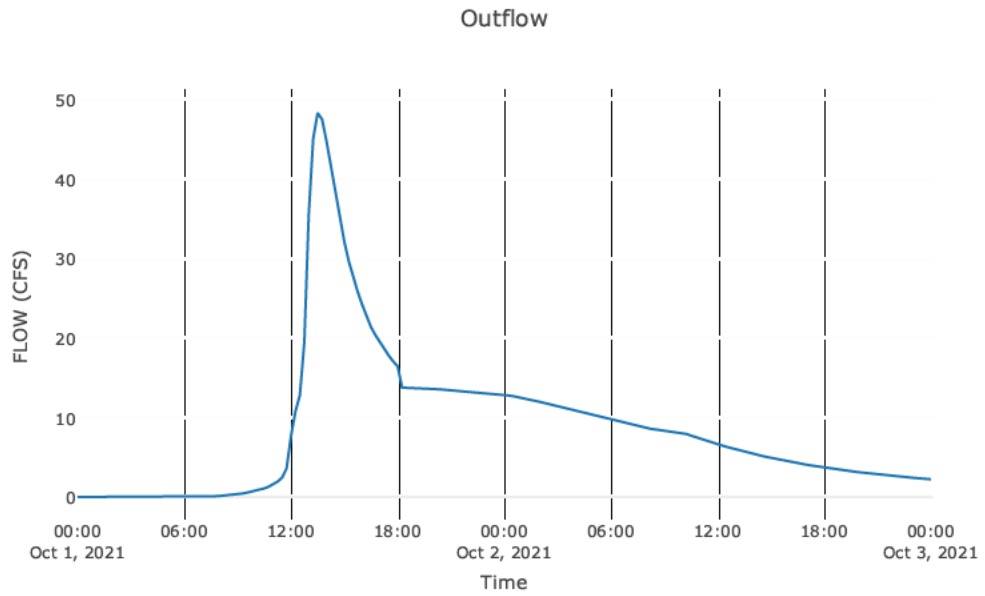
Results: Junction-4

Peak Discharge (CFS)	123
Time of Peak Discharge	01Oct2021, 12:00
Volume (IN)	1.09



Reservoir: Detention Pond BC

Results: Detention Pond BC	
Peak Discharge (CFS)	48.28
Time of Peak Discharge	01Oct2021, 13:30
Volume (IN)	1.31
Peak Inflow (CFS)	258.89
Time of Peak Inflow	01Oct2021, 12:00
Inflow Volume (AC - FT)	38.69
Maximum Storage (AC - FT)	21.61
Peak Elevation (FT)	3894.44
Discharge Volume (AC - FT)	34.53




STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
9-12-25

Project: GEPLandfill_Balanced
Simulation Run: 2022ExistingConditions25-Yr
Simulation Start: 31 December 1999, 24:00
Simulation End: 1 January 2000, 24:00

HMS Version: 4.13
Executed: 16 September 2025, 13:20

Global Parameter Summary - Subbasin

	Area (MI2)
Element Name	**Area (MI2)**
B3	0.03
B6	0.01
Cos	0.24
B2	0.03
B5	0.02
B8	0.03
B7	0.03
B1	0.03
B4	0.02
C1	0.03
C2	0.02
C3	0.02
A1	0.01
D2	0.02
D4	0.01
D6	0.02
D1	0.01
D5	0.04
D3	0.02
E6	0.02
E2	0.02
E5	0.01
E4	0.02
E3	0.02
E1	0.01

Downstream

Element Name	Downstream
B3	B3 Junction
B6	B3 Junction
Cos	Ditch B1
B2	B2 Junction
B5	B2 Junction
B8	Ditch B2
B7	Ditch B2
B1	B1 Junction
B4	B1 Junction
C1	C1 Junction
C2	C1 Junction
C3	Ditch C2
A1	Outfall A
D2	D4 Junction
D4	D4 Junction
D6	Ditch D1
D1	D1 Junction
D5	Ditch D2
D3	Ditch D2
E6	Ditch D3
E2	E2 Junction
E5	E2 Junction
E4	Ditch E1
E3	E1 Junction
E1	E1 Junction

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
B3	0	96
B6	0	96
Cos	0	63
B2	0	96
B5	0	96
B8	0	76
B7	0	73
B1	0	96
B4	0	96
C1	0	96
C2	0	96
C3	0	96
A1	0	63
D2	0	96
D4	0	96
D6	0	88
D1	0	96
D5	0	76
D3	0	96
E6	0	80
E2	0	96
E5	0	96
E4	0	80
E3	0	96
E1	0	96

Transform: Scs		
Element Name	**Lag**	**Unitgraph Type**
B3	9.6	Standard
B6	4.8	Standard
Cos	45.6	Standard
B2	9.6	Standard
B5	4.8	Standard
B8	14.4	Standard
B7	34.2	Standard
B1	9.6	Standard
B4	4.2	Standard
C1	9.6	Standard
C2	4.2	Standard
C3	21.6	Standard
A1	7.2	Standard
D2	12.6	Standard
D4	7.2	Standard
D6	10.2	Standard
D1	10.8	Standard
D5	8.4	Standard
D3	7.2	Standard
E6	2.4	Standard
E2	7.8	Standard
E5	7.2	Standard
E4	6.6	Standard
E3	6.6	Standard
E1	10.8	Standard

Global Parameter Summary - Reach

Downstream	
Element Name	**Downstream**
Ditch B1	Ditch B2
Ditch B2	Basin BC
Ditch C1	Culvert C2
Ditch C2	Basin BC
Ditch D1	D1 Junction
Ditch D2	Junction - 2
Ditch D3	Basin DE
Ditch E1	E1 Junction
Ditch E2	Basin DE

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Index Flow
Ditch B1	Kinematic Wave	Kinematic Wave	2769	0.01	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch B2	Kinematic Wave	Kinematic Wave	1596	0.03	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch C1	Kinematic Wave	Kinematic Wave	2080	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch C2	Kinematic Wave	Kinematic Wave	2335	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D1	Kinematic Wave	Kinematic Wave	1300	0	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D2	Kinematic Wave	Kinematic Wave	400	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D3	Kinematic Wave	Kinematic Wave	400	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch E1	Kinematic Wave	Kinematic Wave	2425	0.01	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch E2	Kinematic Wave	Kinematic Wave	570	0.05	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
B3	0.03	90.15	01Jan2000, 12:11	2.91
B6	0.01	47.94	01Jan2000, 12:06	2.91
Cos	0.24	43.91	01Jan2000, 12:57	0.59
B3 Junction	0.04	127.09	01Jan2000, 12:08	2.91
Ditch B1	0.28	128.75	01Jan2000, 12:18	0.93
B2	0.03	89.85	01Jan2000, 12:11	2.91
B5	0.02	60.58	01Jan2000, 12:06	2.91
B2 Junction	0.05	138.27	01Jan2000, 12:08	2.91
B8	0.03	32.05	01Jan2000, 12:17	1.27
B7	0.03	14.68	01Jan2000, 12:40	1.08
Ditch B2	0.39	248.22	01Jan2000, 12:18	1.19
B1	0.03	81.19	01Jan2000, 12:11	2.91
B4	0.02	100.36	01Jan2000, 12:05	2.91
C1	0.03	89.55	01Jan2000, 12:11	2.91
C2	0.02	71.03	01Jan2000, 12:05	2.91
C1 Junction	0.05	143.67	01Jan2000, 12:07	2.91
Ditch C1	0.05	143.19	01Jan2000, 12:12	2.9
Culvert C2	0.05	133.29	01Jan2000, 12:14	2.9
C3	0.02	29.66	01Jan2000, 12:23	2.91
Ditch C2	0.06	157.62	01Jan2000, 12:20	2.89
B1 Junction	0.05	163.93	01Jan2000, 12:07	2.91
Basin BC	0.5	99.1	01Jan2000, 13:06	1.17
Outfall BC	0.5	99.1	01Jan2000, 13:06	1.17
A1	0.01	4.57	01Jan2000, 12:10	0.6
D2	0.02	41.18	01Jan2000, 12:14	2.91
D4	0.01	41.11	01Jan2000, 12:08	2.91
D4 Junction	0.03	76.54	01Jan2000, 12:10	2.91
D6	0.02	45.14	01Jan2000, 12:12	2.15
Ditch D1	0.05	120.89	01Jan2000, 12:17	2.58
D1	0.01	42.14	01Jan2000, 12:12	2.91
D1 Junction	0.06	157.26	01Jan2000, 12:16	2.66

D5	0.04	56	01Jan2000, 12:10	1.27
D3	0.02	68.52	01Jan2000, 12:08	2.91
Ditch D2	0.12	247.17	01Jan2000, 12:14	2.25
Junction - 2	0.12	247.17	01Jan2000, 12:14	2.25
E6	0.02	50.61	01Jan2000, 12:04	1.53
Ditch D3	0.14	258.74	01Jan2000, 12:15	2.16
E2	0.02	52.91	01Jan2000, 12:09	2.91
E5	0.01	44.54	01Jan2000, 12:08	2.91
E2 Junction	0.03	97.07	01Jan2000, 12:09	2.91
E4	0.02	39.7	01Jan2000, 12:08	1.53
Ditch E1	0.05	136.59	01Jan2000, 12:16	2.33
E3	0.02	70.98	01Jan2000, 12:08	2.91
E1	0.01	42.14	01Jan2000, 12:12	2.91
E1 Junction	0.08	208.61	01Jan2000, 12:15	2.57
Culvert E2	0.08	194.13	01Jan2000, 12:18	2.55
Ditch E2	0.08	193.77	01Jan2000, 12:18	2.55
Basin DE	0.23	36.43	01Jan2000, 13:07	2.19
Outfall DE	0.23	36.43	01Jan2000, 13:07	2.19
Outfall A	0.01	4.57	01Jan2000, 12:10	0.6

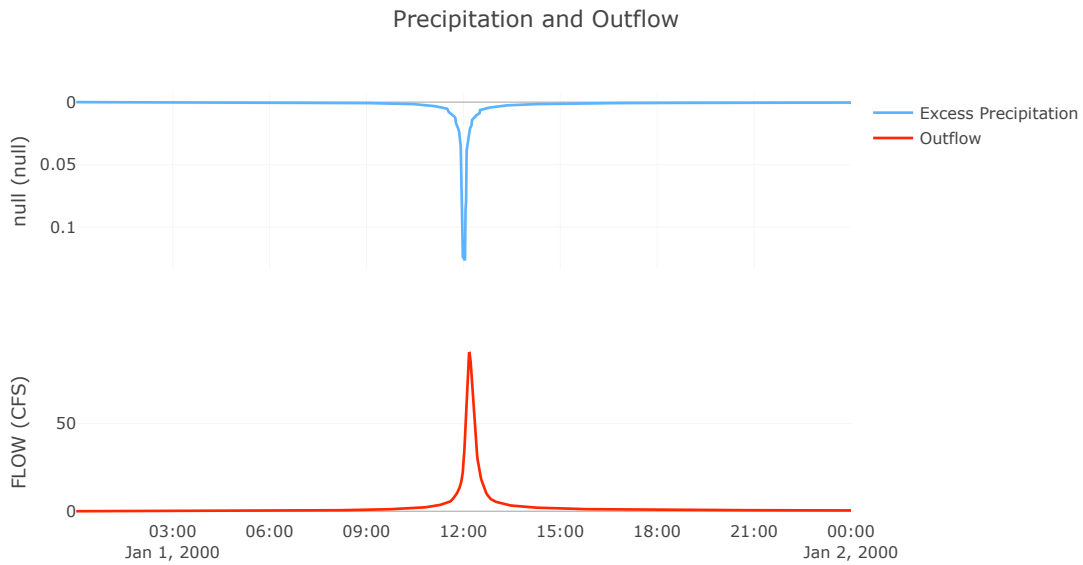
Subbasin: B3

Area (MI2) : 0.03
Downstream : B3 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.6
Unitgraph Type	Standard

Results: B3	
Peak Discharge (CFS)	90.15
Time of Peak Discharge	01Jan2000, 12:11
Volume (IN)	2.91
Precipitation Volume (AC - FT)	5.43
Loss Volume (AC - FT)	0.73
Excess Volume (AC - FT)	4.7
Direct Runoff Volume (AC - FT)	4.69
Baseflow Volume (AC - FT)	0



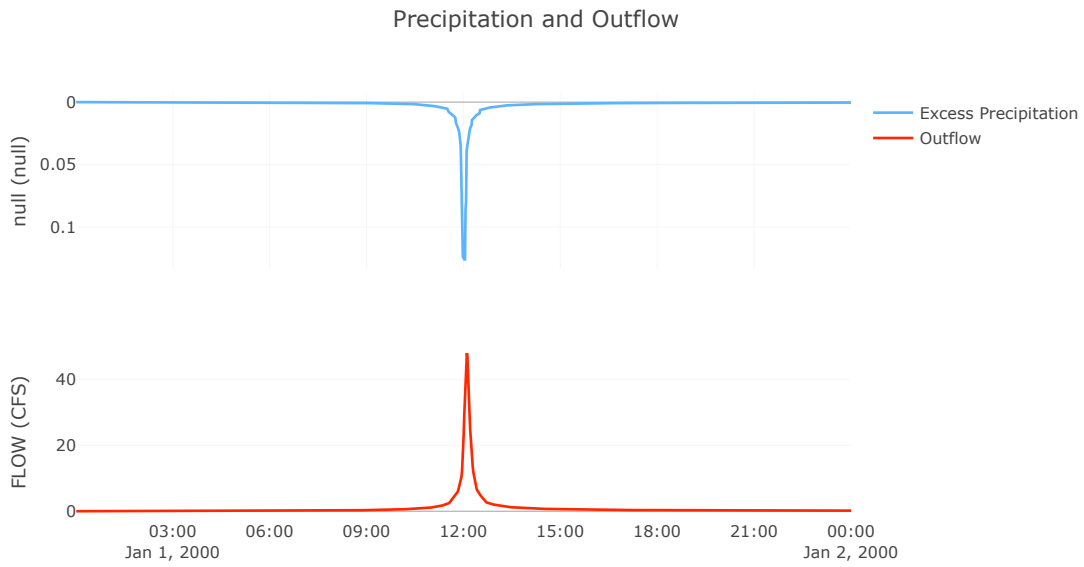
Subbasin: B6

Area (MI2) : 0.01
Downstream : B3 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.8
Unitgraph Type	Standard

Results: B6	
Peak Discharge (CFS)	47.94
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.16
Loss Volume (AC - FT)	0.29
Excess Volume (AC - FT)	1.87
Direct Runoff Volume (AC - FT)	1.87
Baseflow Volume (AC - FT)	0



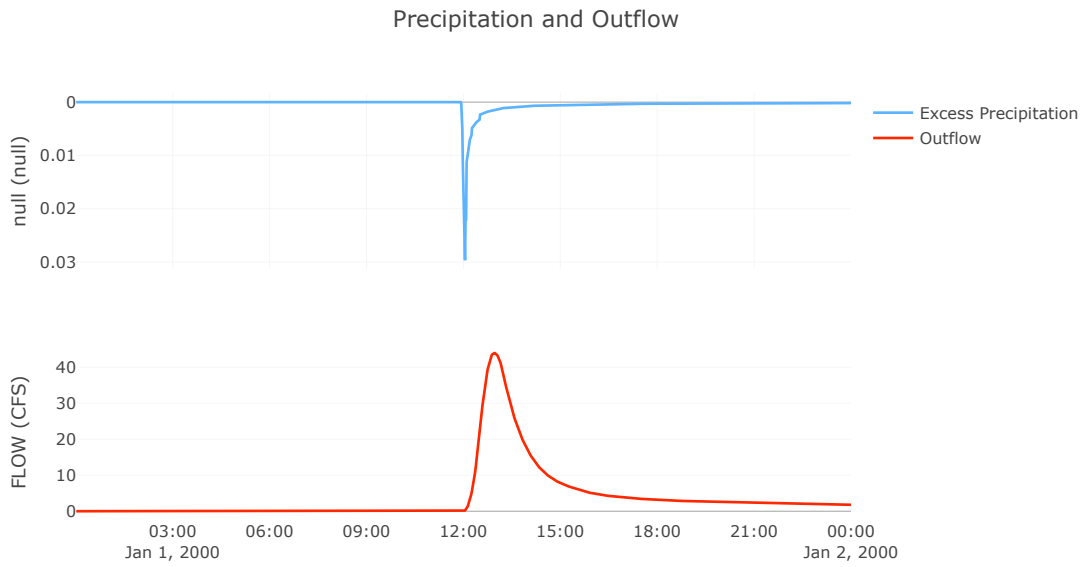
Subbasin: COS

Area (MI2) : 0.24
Downstream : Ditch B1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	63

Transform: Scs	
Lag	45.6
Unitgraph Type	Standard

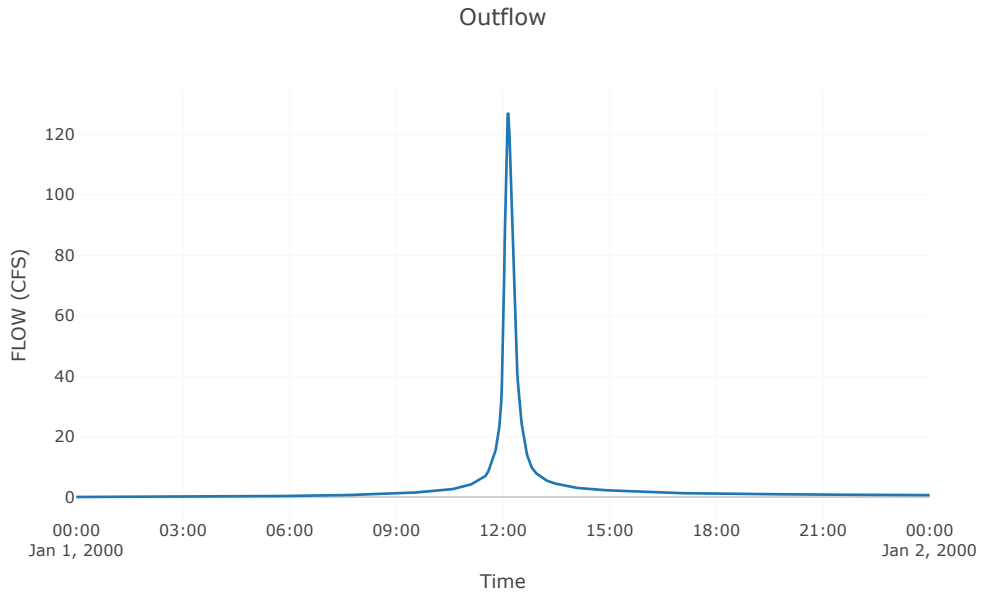
Results: COS	
Peak Discharge (CFS)	43.91
Time of Peak Discharge	01Jan2000, 12:57
Volume (IN)	0.59
Precipitation Volume (AC - FT)	43.14
Loss Volume (AC - FT)	35.49
Excess Volume (AC - FT)	7.65
Direct Runoff Volume (AC - FT)	7.5
Baseflow Volume (AC - FT)	0



Junction: B3 Junction

Downstream : Ditch B1

Results: B3 Junction	
Peak Discharge (CFS)	127.09
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91

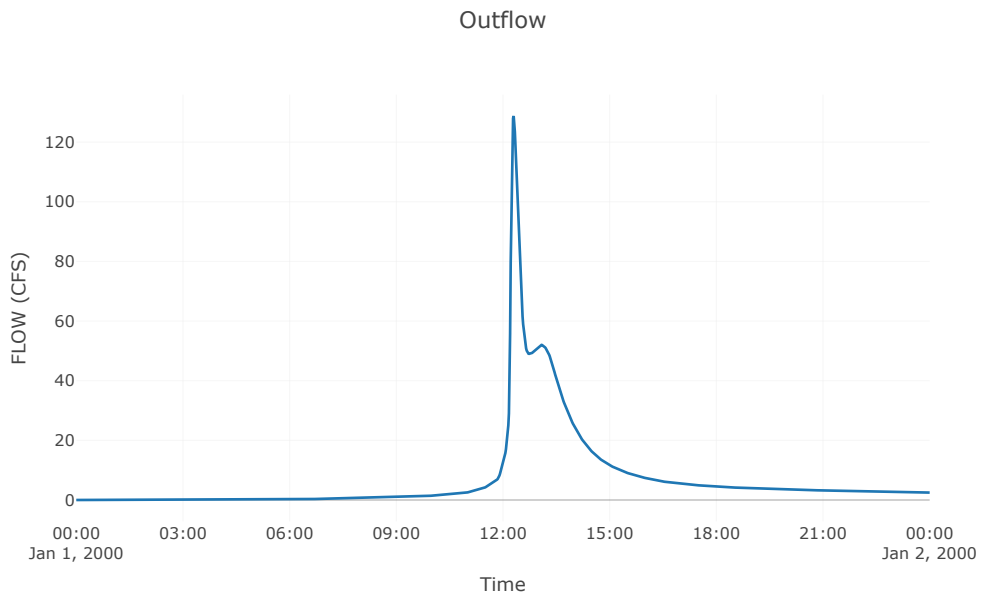


Reach: Ditch B1

Downstream : Ditch B2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2769
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch B1	
Peak Discharge (CFS)	128.75
Time of Peak Discharge	01Jan2000, 12:18
Volume (IN)	0.93
Peak Inflow (CFS)	128.81
Inflow Volume (AC - FT)	14.07



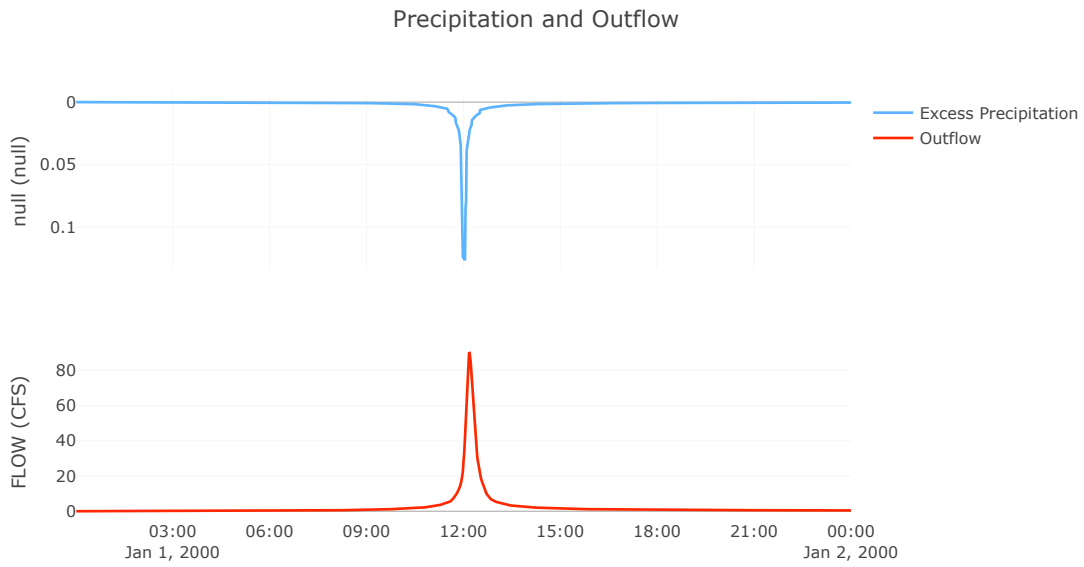
Subbasin: B2

Area (MI2) : 0.03
Downstream : B2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.6
Unitgraph Type	Standard

Results: B2	
Peak Discharge (CFS)	89.85
Time of Peak Discharge	01Jan2000, 12:11
Volume (IN)	2.91
Precipitation Volume (AC - FT)	5.41
Loss Volume (AC - FT)	0.73
Excess Volume (AC - FT)	4.68
Direct Runoff Volume (AC - FT)	4.67
Baseflow Volume (AC - FT)	0



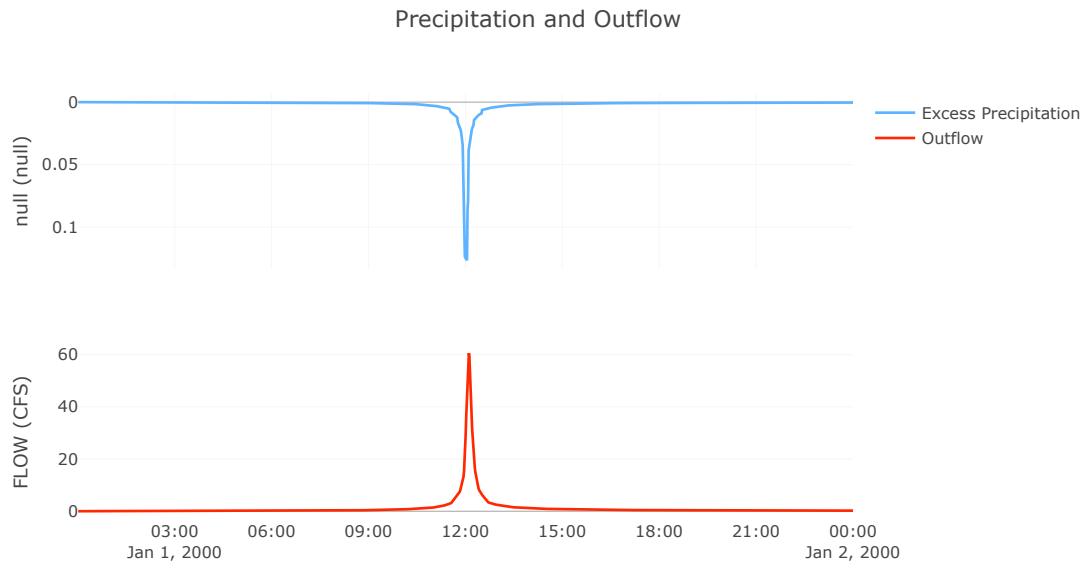
Subbasin: B5

Area (MI2) : 0.02
Downstream : B2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.8
Unitgraph Type	Standard

Results: B5	
Peak Discharge (CFS)	60.58
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.73
Loss Volume (AC - FT)	0.37
Excess Volume (AC - FT)	2.36
Direct Runoff Volume (AC - FT)	2.36
Baseflow Volume (AC - FT)	0

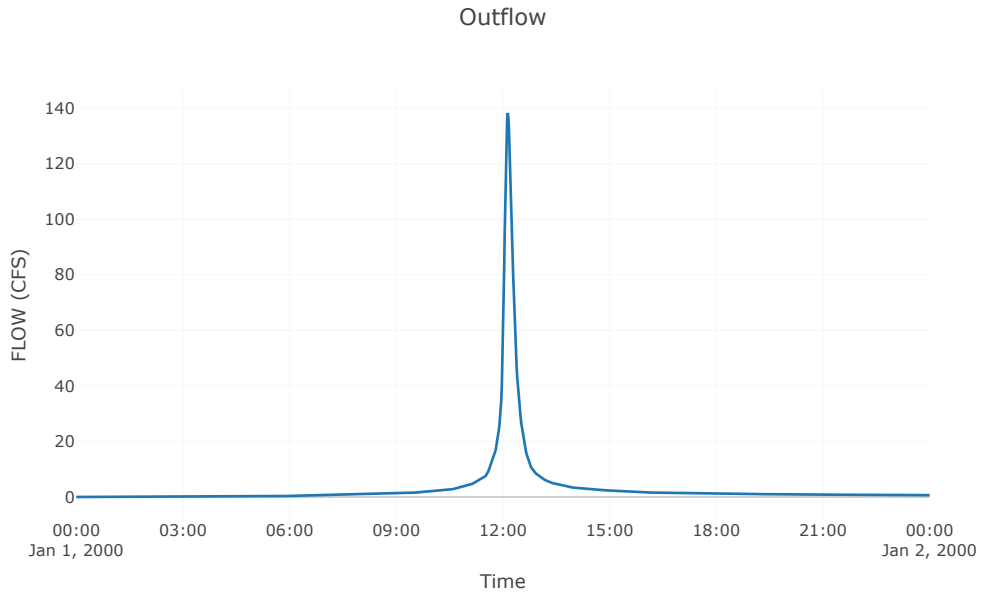


Junction: B2 Junction

Downstream : Ditch B2

Results: B2 Junction

Peak Discharge (CFS)	138.27
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91



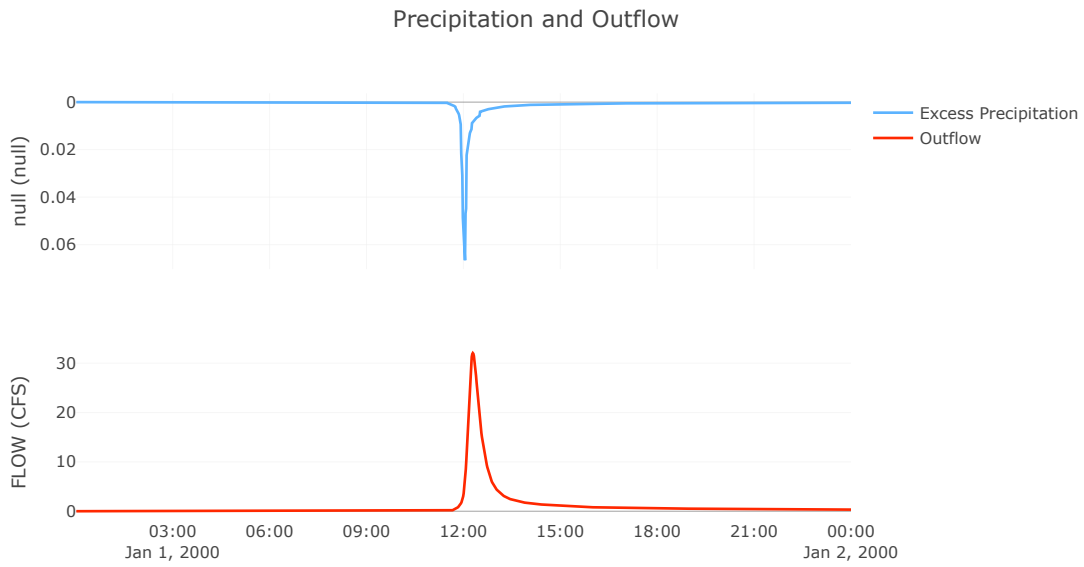
Subbasin: B8

Area (MI2) : 0.03
Downstream : Ditch B2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	76

Transform: Scs	
Lag	14.4
Unitgraph Type	Standard

Results: B8	
Peak Discharge (CFS)	32.05
Time of Peak Discharge	01Jan2000, 12:17
Volume (IN)	1.27
Precipitation Volume (AC - FT)	5.46
Loss Volume (AC - FT)	3.4
Excess Volume (AC - FT)	2.06
Direct Runoff Volume (AC - FT)	2.05
Baseflow Volume (AC - FT)	0



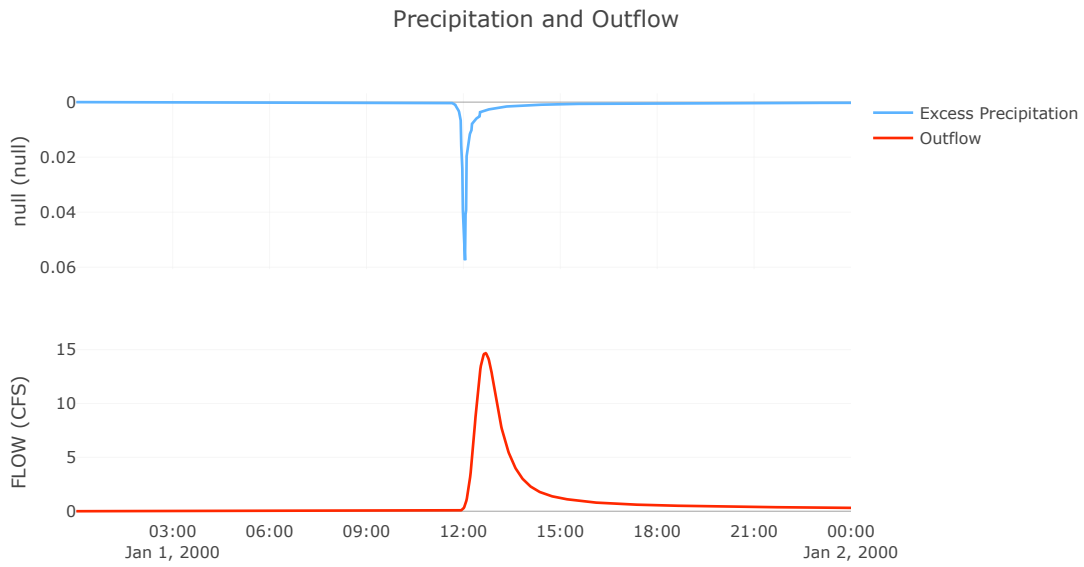
Subbasin: B7

Area (MI2) : 0.03
Downstream : Ditch B2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73

Transform: Scs	
Lag	34.2
Unitgraph Type	Standard

Results: B7	
Peak Discharge (CFS)	14.68
Time of Peak Discharge	01Jan2000, 12:40
Volume (IN)	1.08
Precipitation Volume (AC - FT)	5.43
Loss Volume (AC - FT)	3.67
Excess Volume (AC - FT)	1.76
Direct Runoff Volume (AC - FT)	1.74
Baseflow Volume (AC - FT)	0

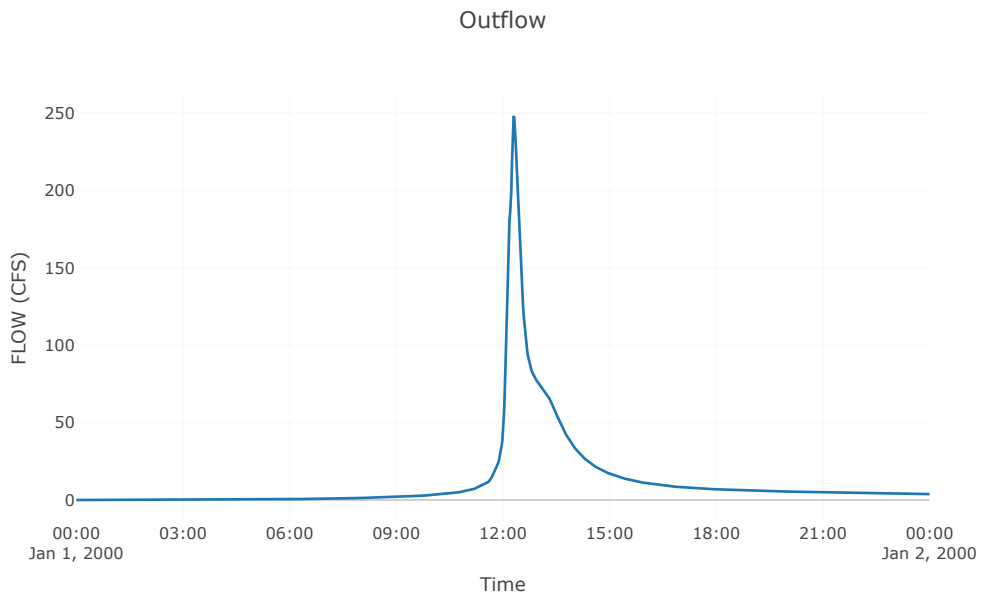


Reach: Ditch B2

Downstream : Basin BC

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	1596
Energy Slope (FT/FT)	0.03
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch B2	
Peak Discharge (CFS)	248.22
Time of Peak Discharge	01Jan2000, 12:18
Volume (IN)	1.19
Peak Inflow (CFS)	248.98
Inflow Volume (AC - FT)	24.77



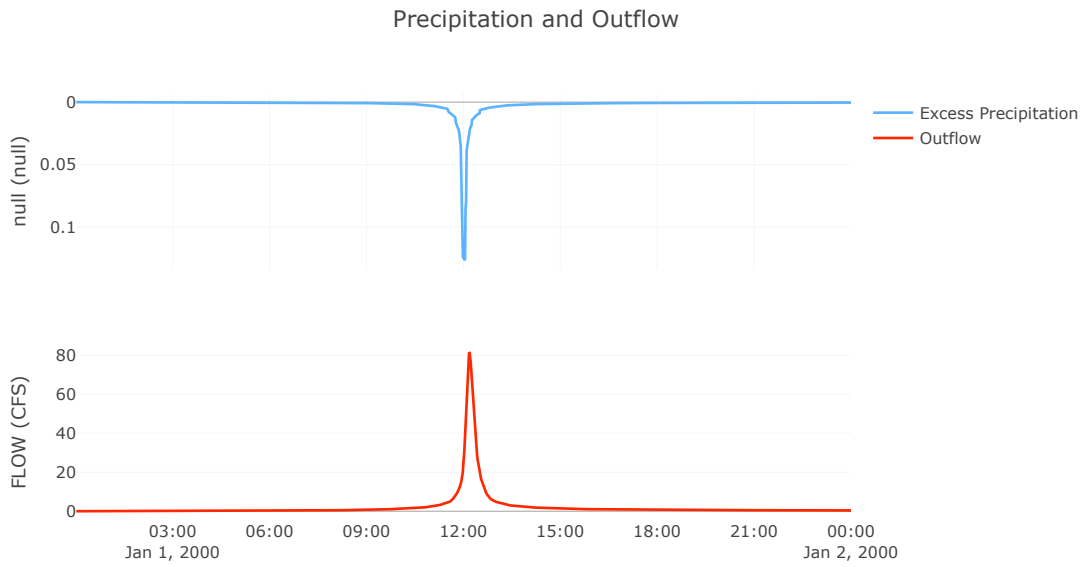
Subbasin: B1

Area (MI2) : 0.03
Downstream : B1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.6
Unitgraph Type	Standard

Results: B1	
Peak Discharge (CFS)	81.19
Time of Peak Discharge	01Jan2000, 12:11
Volume (IN)	2.91
Precipitation Volume (AC - FT)	4.89
Loss Volume (AC - FT)	0.66
Excess Volume (AC - FT)	4.23
Direct Runoff Volume (AC - FT)	4.22
Baseflow Volume (AC - FT)	0



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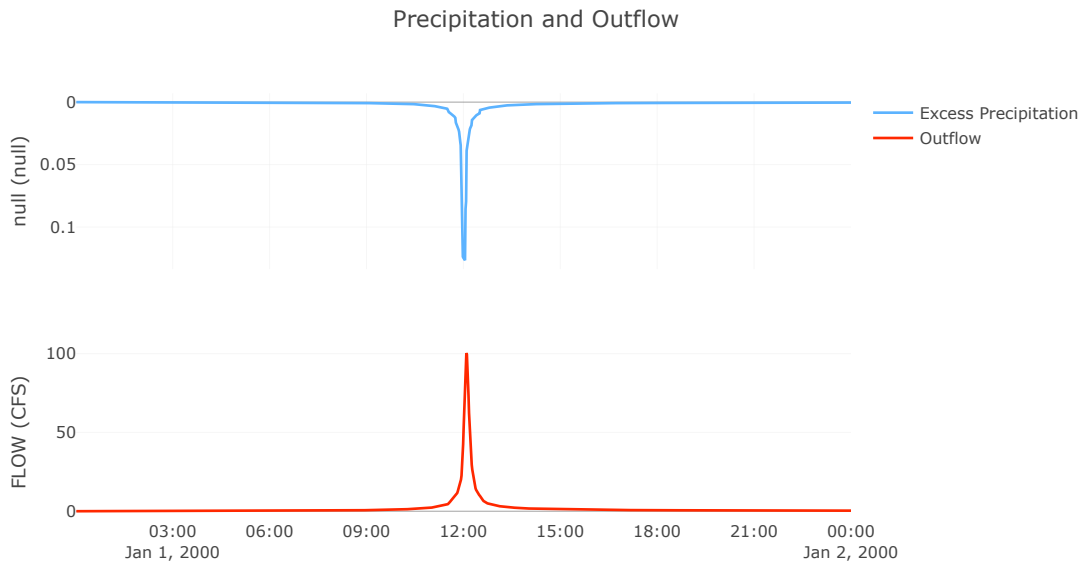
Subbasin: B4

Area (MI2) : 0.02
Downstream : B1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.2
Unitgraph Type	Standard

Results: B4	
Peak Discharge (CFS)	100.36
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	2.91
Precipitation Volume (AC - FT)	4.37
Loss Volume (AC - FT)	0.59
Excess Volume (AC - FT)	3.78
Direct Runoff Volume (AC - FT)	3.78
Baseflow Volume (AC - FT)	0



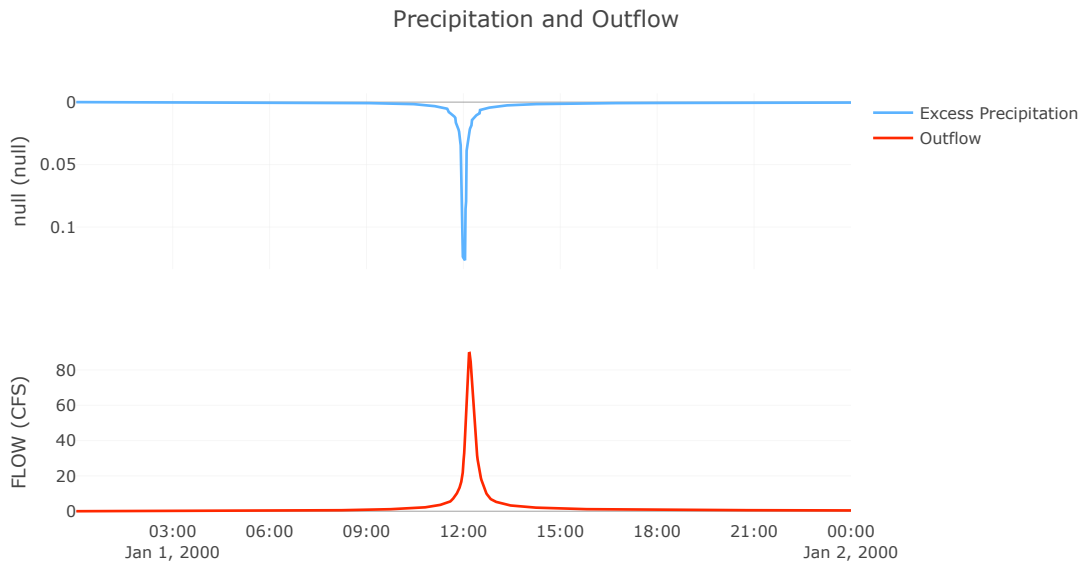
Subbasin: C1

Area (MI2) : 0.03
Downstream : C1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	9.6
Unitgraph Type	Standard

Results: C1	
Peak Discharge (CFS)	89.55
Time of Peak Discharge	01Jan2000, 12:11
Volume (IN)	2.91
Precipitation Volume (AC - FT)	5.39
Loss Volume (AC - FT)	0.72
Excess Volume (AC - FT)	4.67
Direct Runoff Volume (AC - FT)	4.66
Baseflow Volume (AC - FT)	0



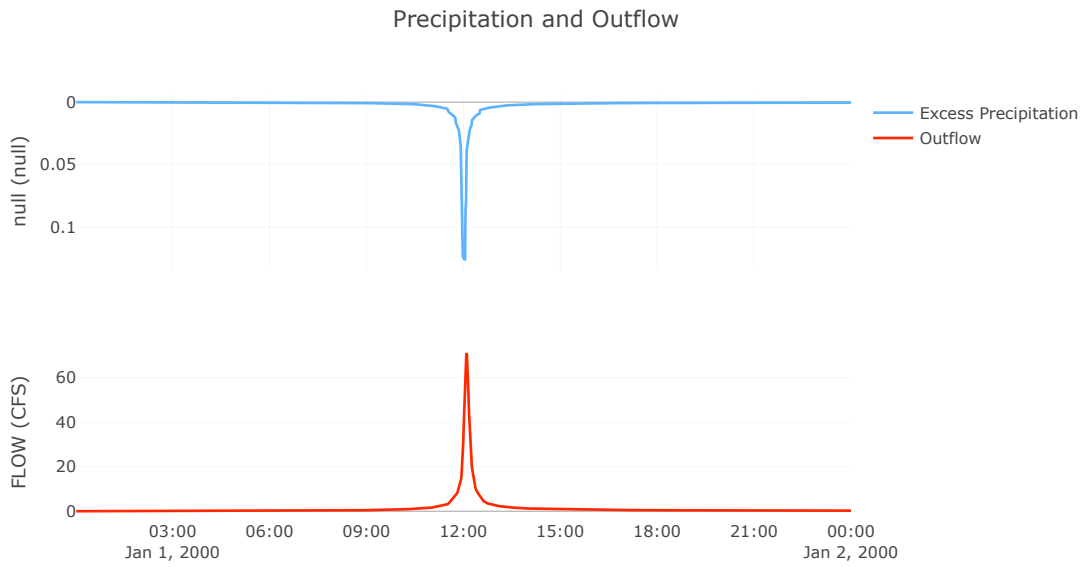
Subbasin: C2

Area (MI2) : 0.02
Downstream : C1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.2
Unitgraph Type	Standard

Results: C2	
Peak Discharge (CFS)	71.03
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.09
Loss Volume (AC - FT)	0.42
Excess Volume (AC - FT)	2.68
Direct Runoff Volume (AC - FT)	2.67
Baseflow Volume (AC - FT)	0



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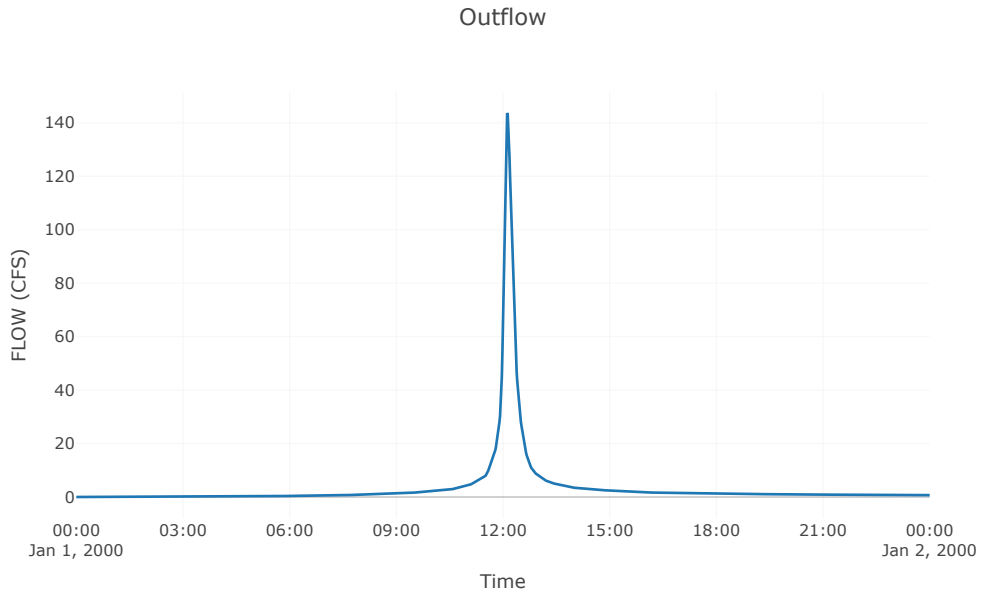
Junction: C1 Junction

Downstream : Ditch C1

Results: C1 Junction	
Peak Discharge (CFS)	143.67
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91

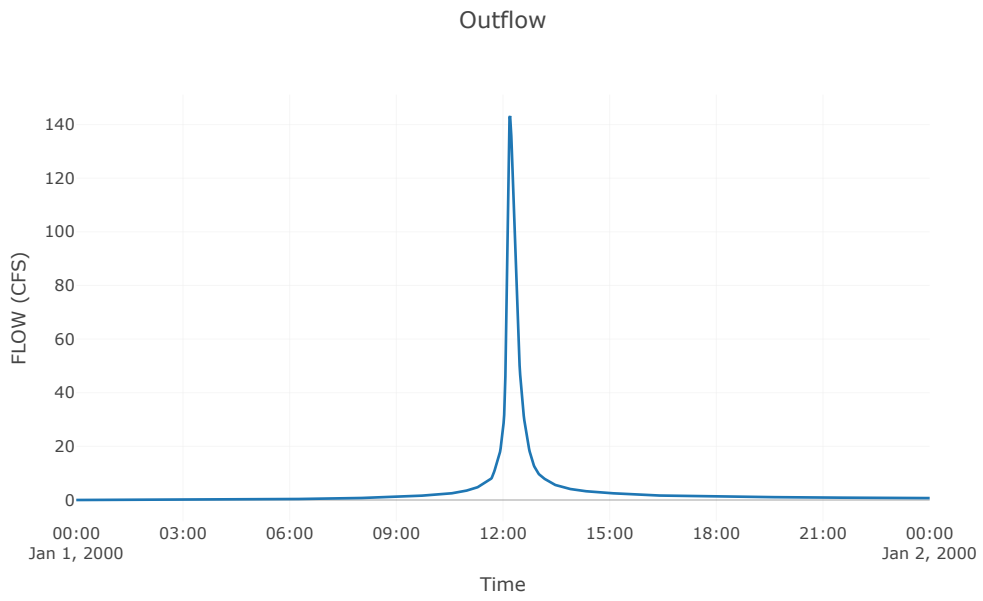


Reach: Ditch C1

Downstream : Culvert C2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2080
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

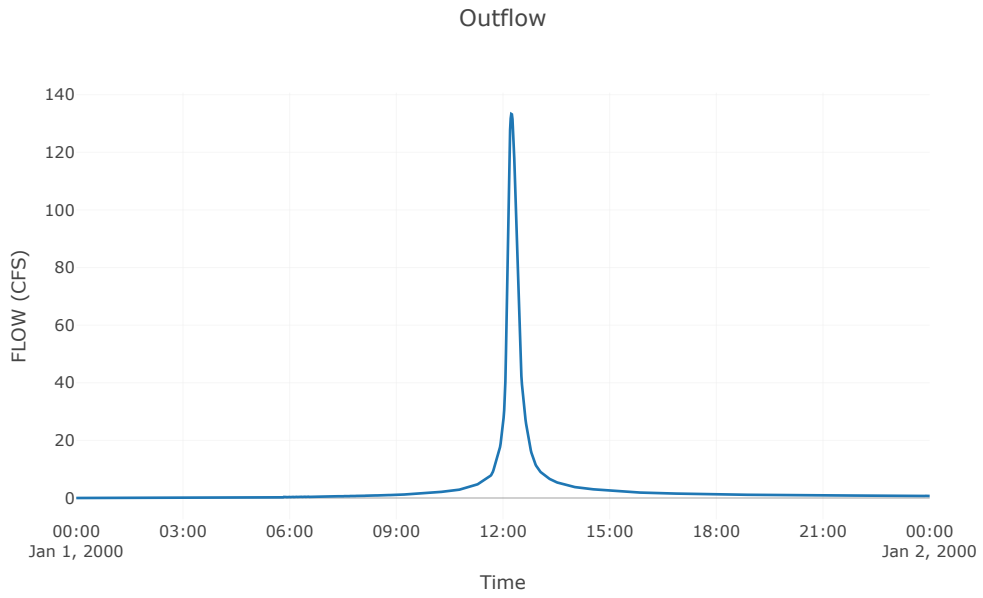
Results: Ditch C1	
Peak Discharge (CFS)	143.19
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.9
Peak Inflow (CFS)	143.67
Inflow Volume (AC - FT)	7.33



Reservoir: Culvert C2

Downstream : Ditch C2

Results: Culvert C2	
Peak Discharge (CFS)	133.29
Time of Peak Discharge	01Jan2000, 12:14
Volume (IN)	2.9
Peak Inflow (CFS)	143.19
Time of Peak Inflow	01Jan2000, 12:12
Inflow Volume (AC - FT)	7.3
Maximum Storage (AC - FT)	0.32
Peak Elevation (FT)	3934.07
Discharge Volume (AC - FT)	7.29



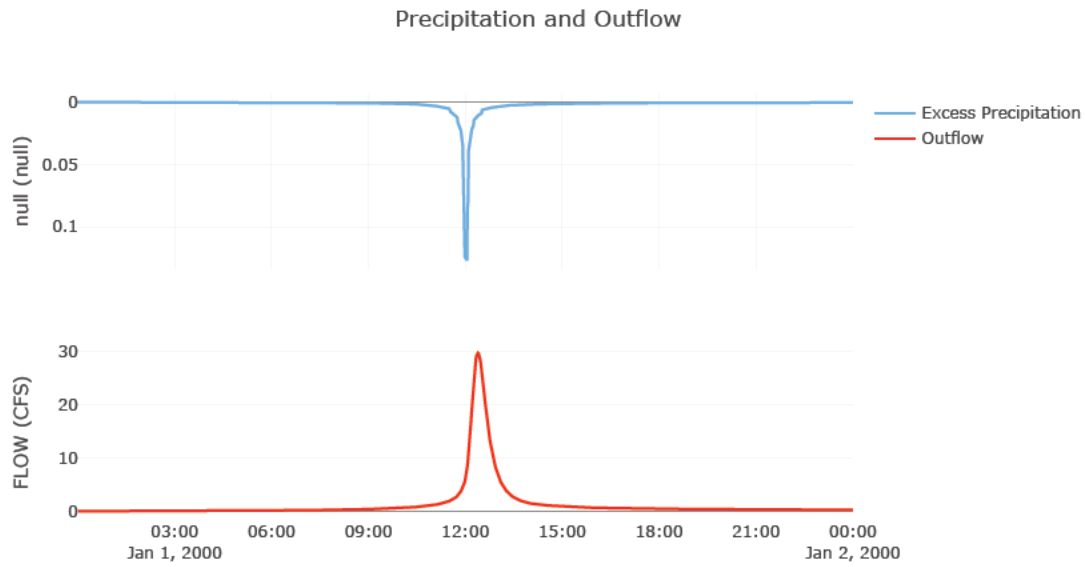
Subbasin: C3

Area (MI2) : 0.02
Downstream : Ditch C2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	21.6
Unitgraph Type	Standard

Results: C3	
Peak Discharge (CFS)	29.66
Time of Peak Discharge	01Jan2000, 12:23
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.89
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.5
Direct Runoff Volume (AC - FT)	2.5
Baseflow Volume (AC - FT)	0

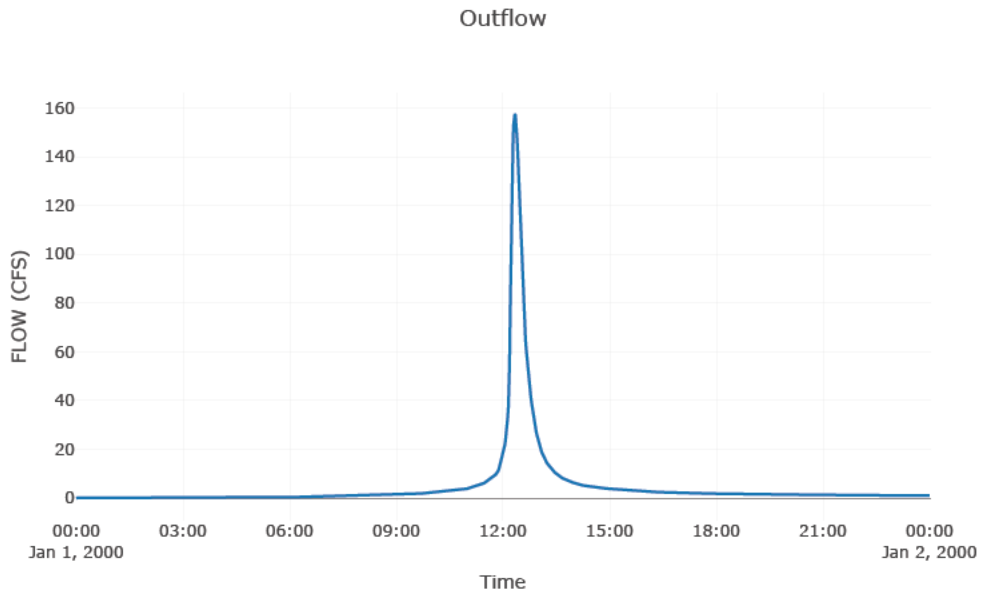


Reach: Ditch C2

Downstream : Basin BC

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2335
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

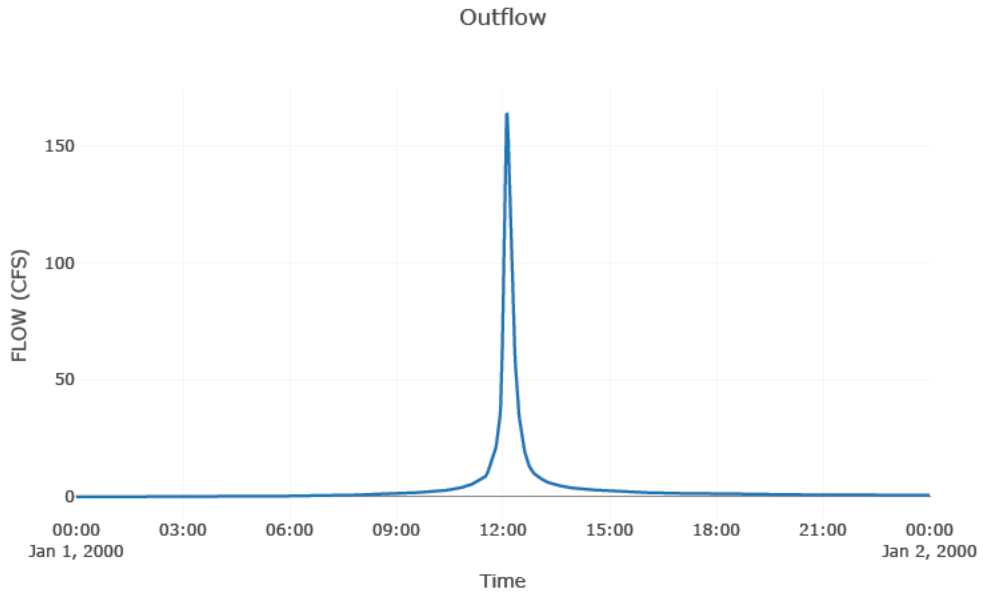
Results: Ditch C2	
Peak Discharge (CFS)	157.62
Time of Peak Discharge	01Jan2000, 12:20
Volume (IN)	2.89
Peak Inflow (CFS)	157.65
Inflow Volume (AC - FT)	9.79



Junction: B1 Junction

Downstream : Basin BC

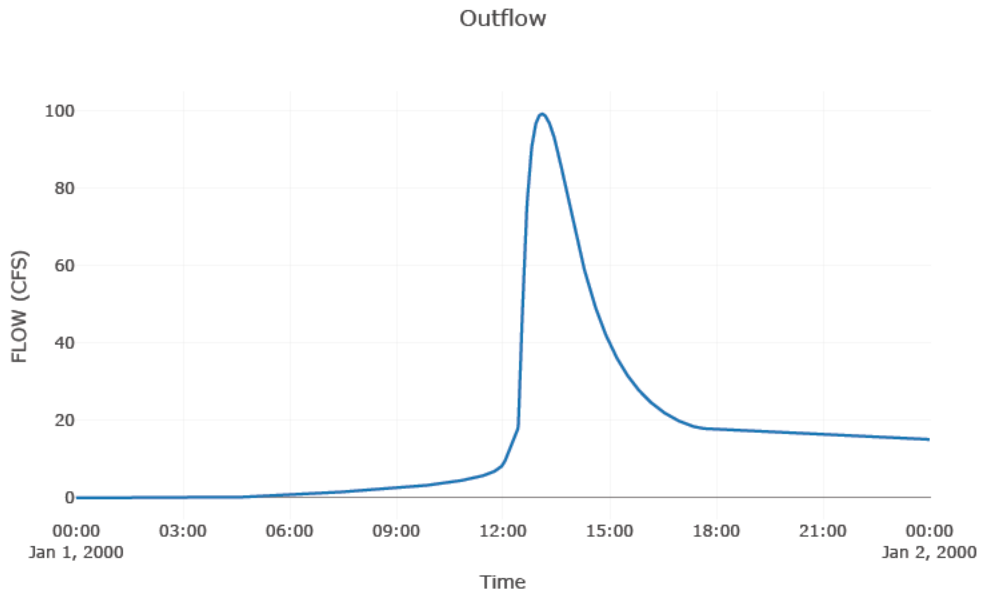
Results: B1 Junction	
Peak Discharge (CFS)	163.93
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91



Reservoir: Basin BC

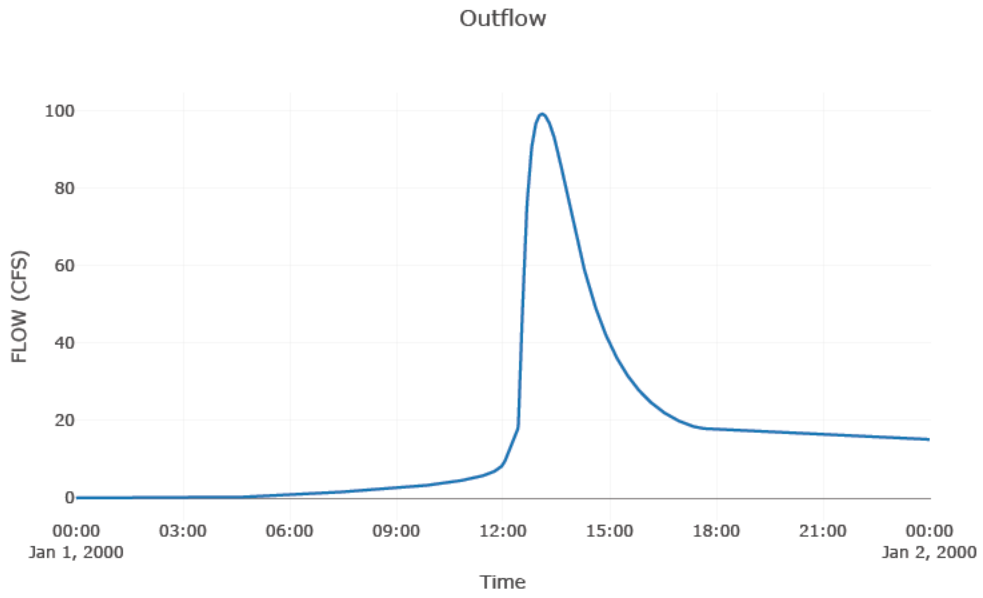
Downstream : Outfall BC

Results: Basin BC	
Peak Discharge (CFS)	99.1
Time of Peak Discharge	01Jan2000, 13:06
Volume (IN)	1.17
Peak Inflow (CFS)	476.17
Time of Peak Inflow	01Jan2000, 12:18
Inflow Volume (AC - FT)	42.47
Maximum Storage (AC - FT)	24.7
Peak Elevation (FT)	3895.03
Discharge Volume (AC - FT)	31.37



Sink: Outfall BC

Results: Outfall BC	
Peak Discharge (CFS)	99.1
Time of Peak Discharge	01Jan2000, 13:06
Volume (IN)	1.17



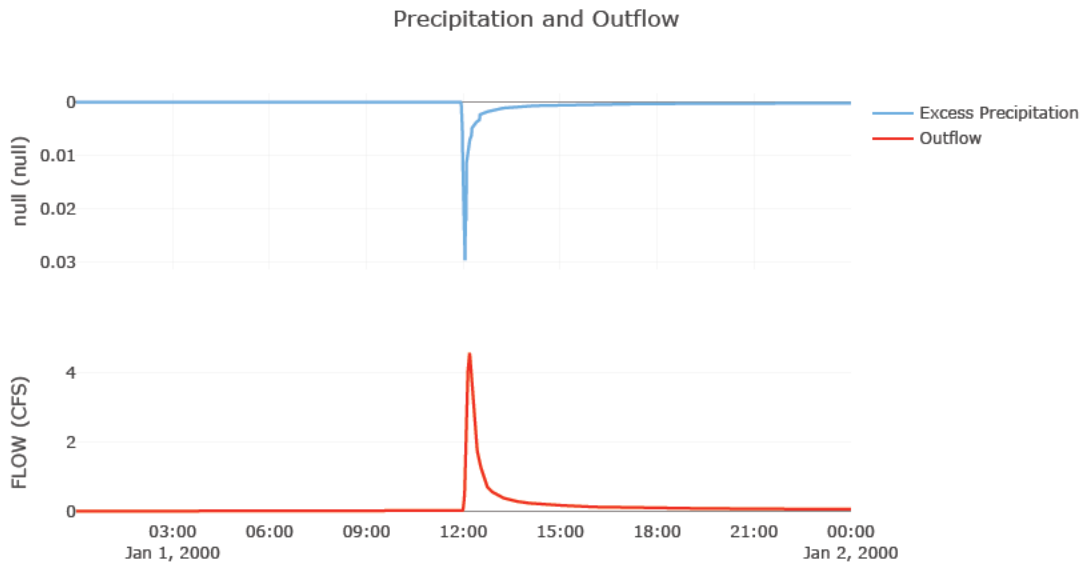
Subbasin: A1

Area (MI2) : 0.01
Downstream : Outfall A

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	63

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

Results: A1	
Peak Discharge (CFS)	4.57
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	0.6
Precipitation Volume (AC - FT)	1.4
Loss Volume (AC - FT)	1.15
Excess Volume (AC - FT)	0.25
Direct Runoff Volume (AC - FT)	0.25
Baseflow Volume (AC - FT)	0



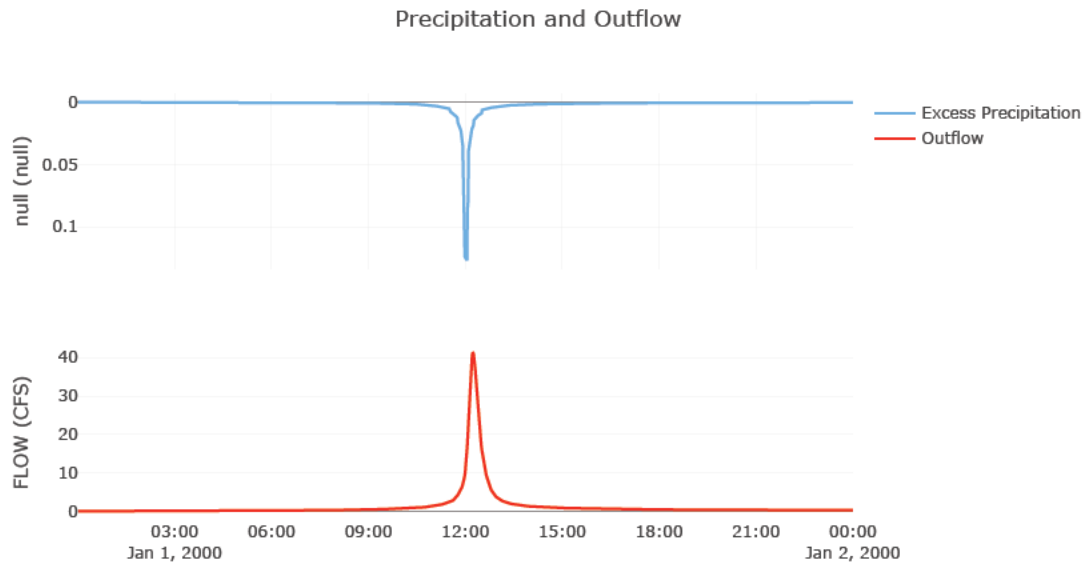
Subbasin: D2

Area (MI2) : 0.02
Downstream : D4 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	12.6
Unitgraph Type	Standard

Results: D2	
Peak Discharge (CFS)	41.18
Time of Peak Discharge	01Jan2000, 12:14
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.88
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.49
Direct Runoff Volume (AC - FT)	2.48
Baseflow Volume (AC - FT)	0



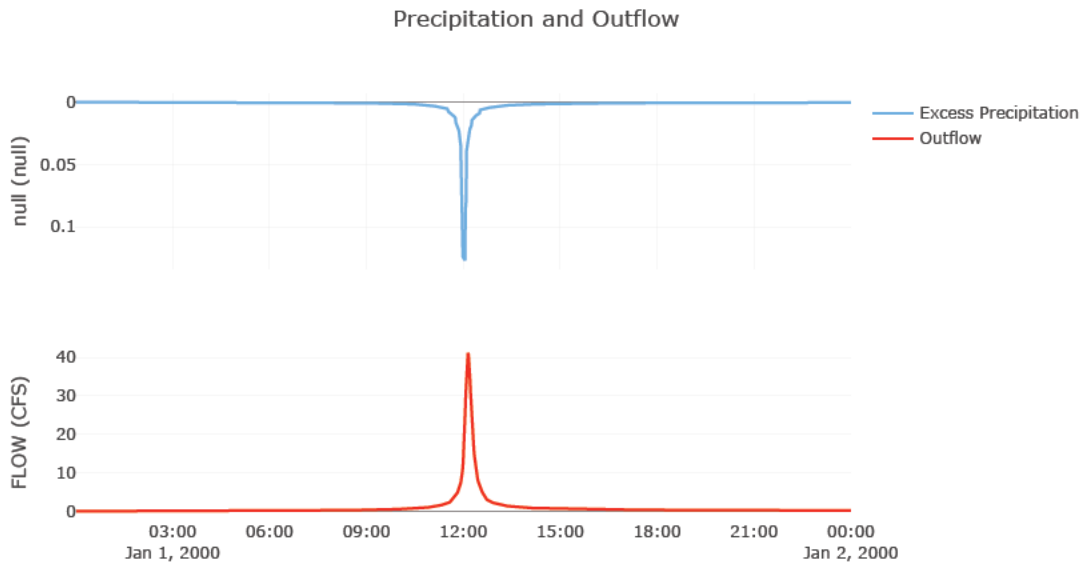
Subbasin: D4

Area (MI2) : 0.01
Downstream : D4 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

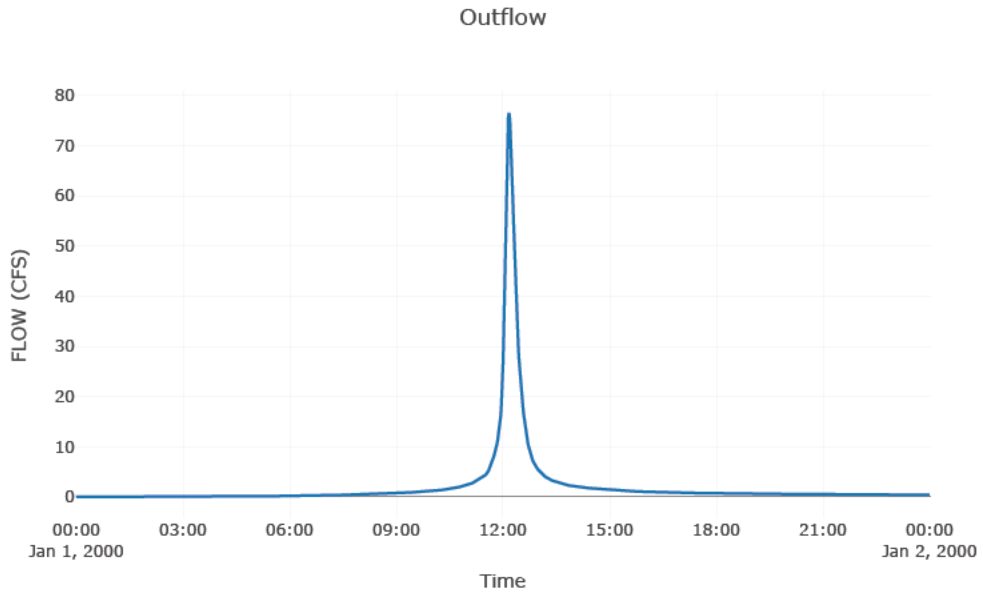
Results: D4	
Peak Discharge (CFS)	41.11
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.16
Loss Volume (AC - FT)	0.29
Excess Volume (AC - FT)	1.87
Direct Runoff Volume (AC - FT)	1.86
Baseflow Volume (AC - FT)	0



Junction: D4 Junction

Downstream : Ditch D1

Results: D4 Junction	
Peak Discharge (CFS)	76.54
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	2.91



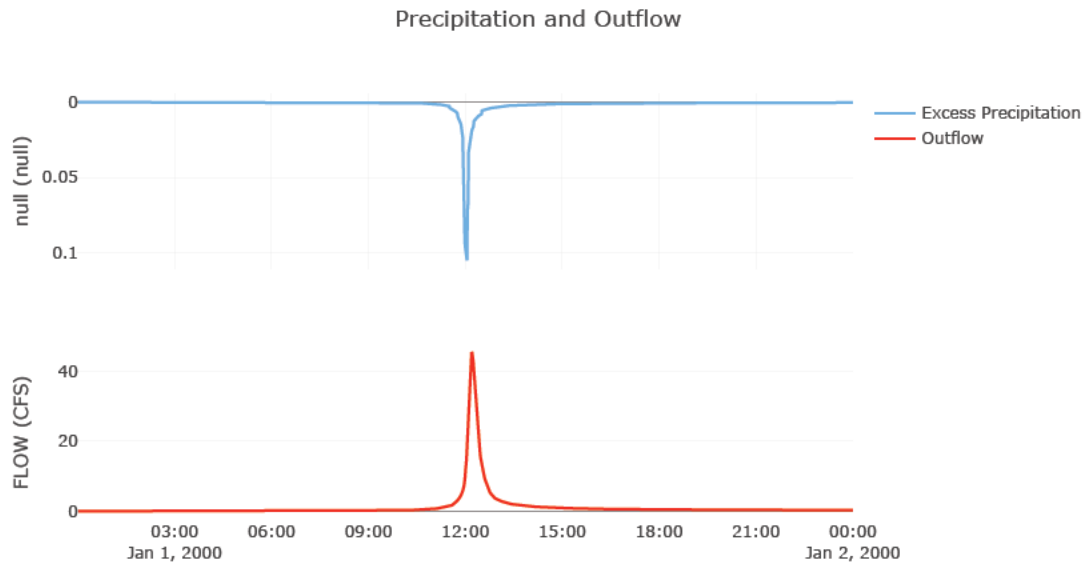
Subbasin: D6

Area (MI2) : 0.02
Downstream : Ditch D1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	88

Transform: Scs	
Lag	10.2
Unitgraph Type	Standard

Results: D6	
Peak Discharge (CFS)	45.14
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.15
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	1.3
Excess Volume (AC - FT)	2.29
Direct Runoff Volume (AC - FT)	2.29
Baseflow Volume (AC - FT)	0

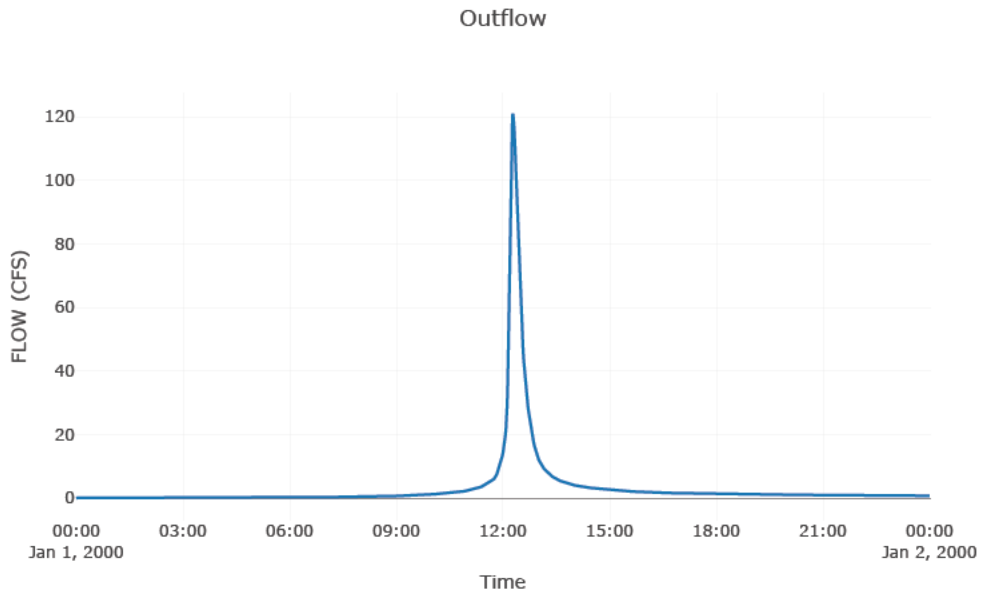


Reach: Ditch D1

Downstream : D1 Junction

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	1300
Energy Slope (FT/FT)	0
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch D1	
Peak Discharge (CFS)	120.89
Time of Peak Discharge	01Jan2000, 12:17
Volume (IN)	2.58
Peak Inflow (CFS)	121.06
Inflow Volume (AC - FT)	6.64



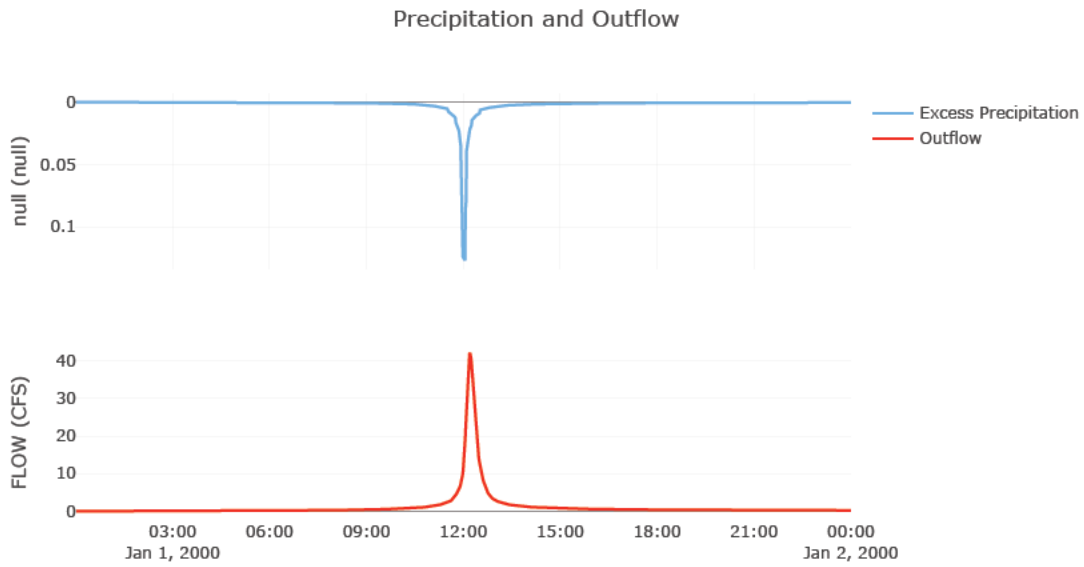
Subbasin: D1

Area (MI2) : 0.01
Downstream : D1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	10.8
Unitgraph Type	Standard

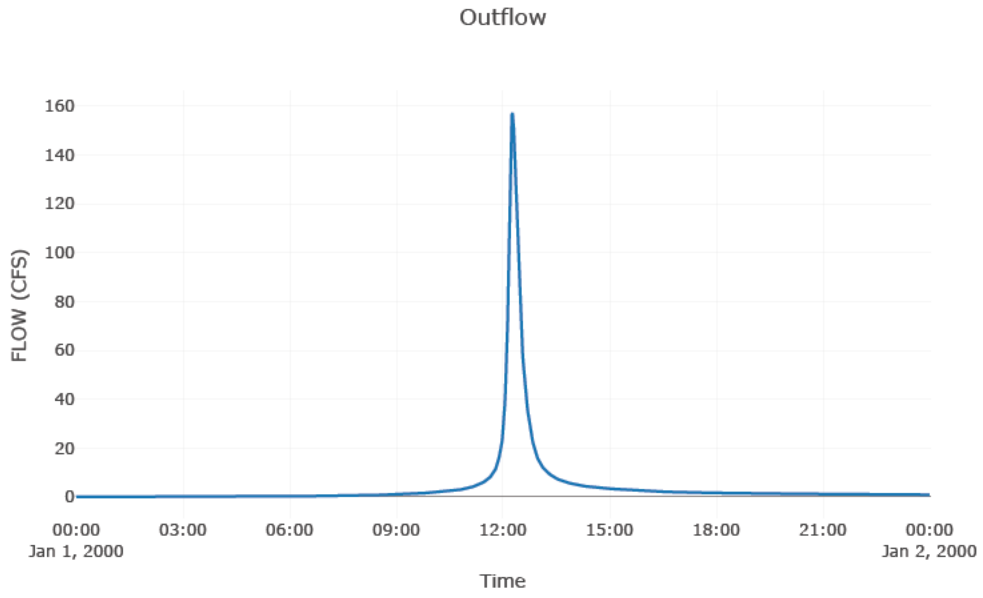
Results: D1	
Peak Discharge (CFS)	42.14
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.7
Loss Volume (AC - FT)	0.36
Excess Volume (AC - FT)	2.33
Direct Runoff Volume (AC - FT)	2.33
Baseflow Volume (AC - FT)	0



Junction: D1 Junction

Downstream : Ditch D2

Results: D1 Junction	
Peak Discharge (CFS)	157.26
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	2.66



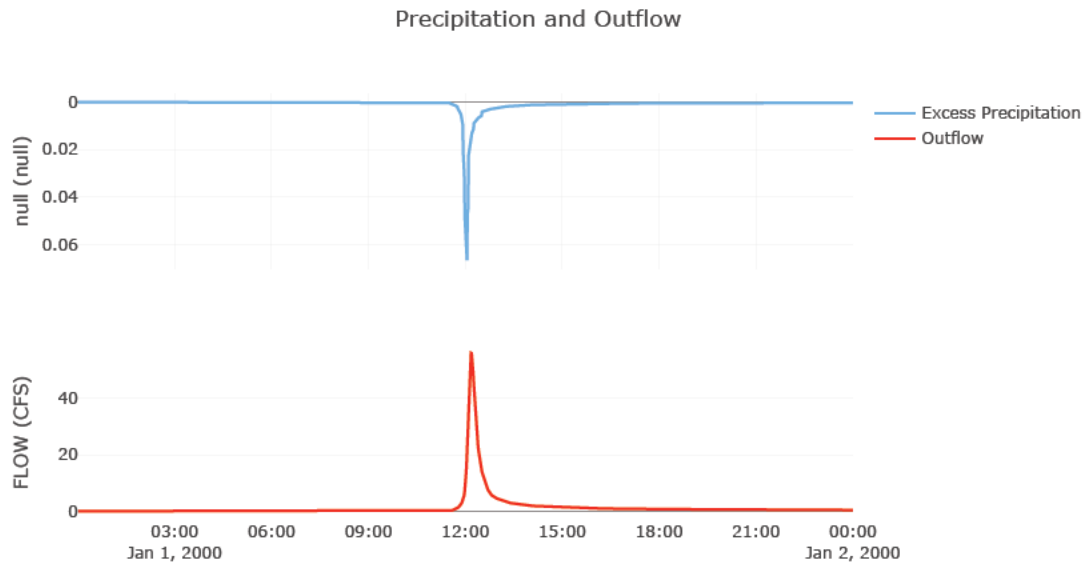
Subbasin: D5

Area (MI2) : 0.04
Downstream : Ditch D2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	76

Transform: Scs	
Lag	8.4
Unitgraph Type	Standard

Results: D5	
Peak Discharge (CFS)	56
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	1.27
Precipitation Volume (AC - FT)	7.01
Loss Volume (AC - FT)	4.36
Excess Volume (AC - FT)	2.65
Direct Runoff Volume (AC - FT)	2.64
Baseflow Volume (AC - FT)	0



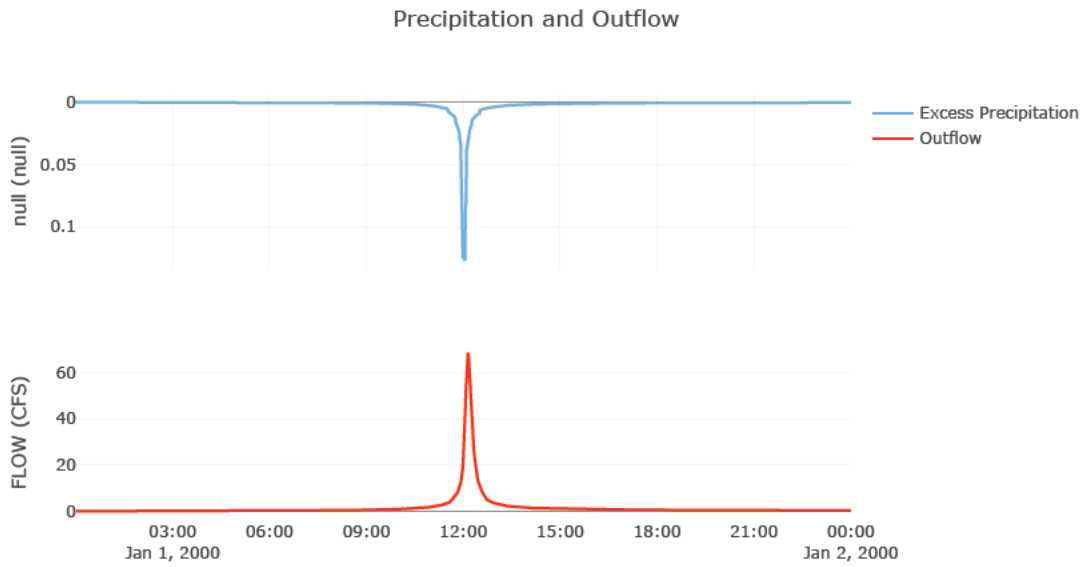
Subbasin: D3

Area (MI2) : 0.02
Downstream : Ditch D2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

Results: D3	
Peak Discharge (CFS)	68.52
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	0.48
Excess Volume (AC - FT)	3.11
Direct Runoff Volume (AC - FT)	3.11
Baseflow Volume (AC - FT)	0

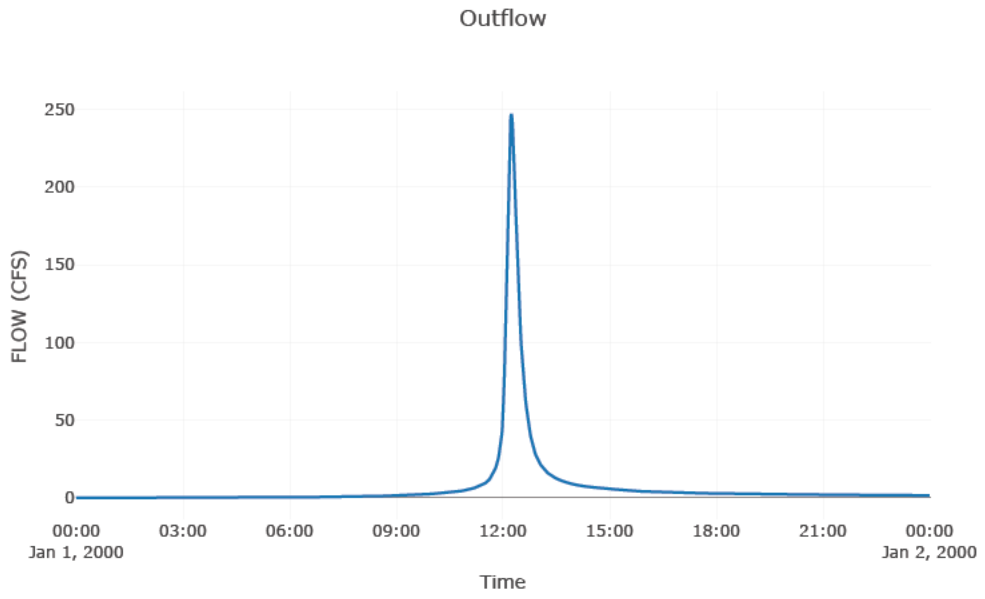


Reach: Ditch D2

Downstream : Junction - 2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	400
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

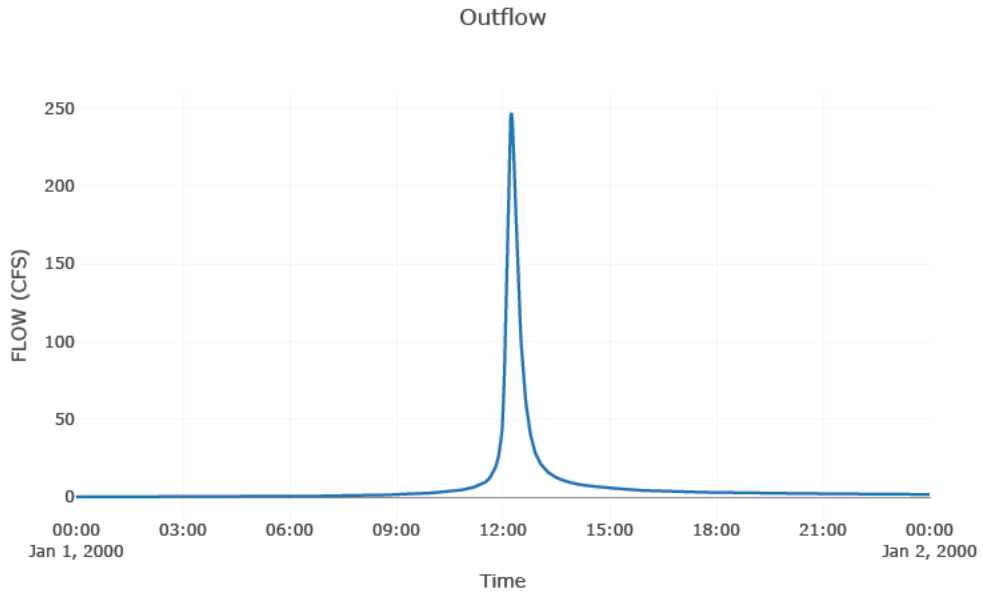
Results: Ditch D2	
Peak Discharge (CFS)	247.17
Time of Peak Discharge	01Jan2000, 12:14
Volume (IN)	2.25
Peak Inflow (CFS)	247.31
Inflow Volume (AC - FT)	14.68



Junction: Junction-2

Downstream : Ditch D3

Results: Junction-2	
Peak Discharge (CFS)	247.17
Time of Peak Discharge	01Jan2000, 12:14
Volume (IN)	2.25



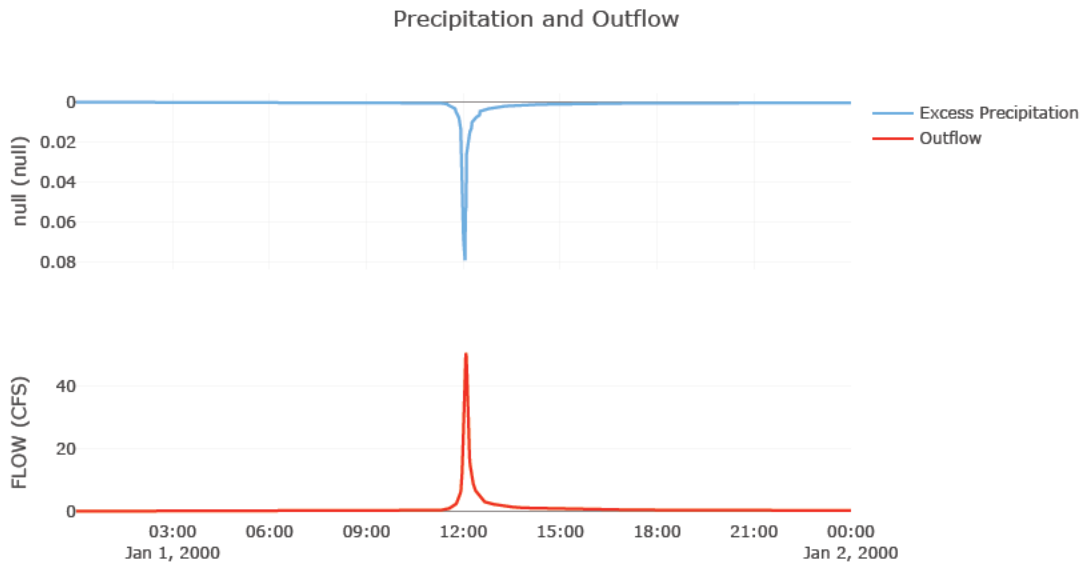
Subbasin: E6

Area (MI2) : 0.02
Downstream : Ditch D3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	80

Transform: Scs	
Lag	2.4
Unitgraph Type	Standard

Results: E6	
Peak Discharge (CFS)	50.61
Time of Peak Discharge	01Jan2000, 12:04
Volume (IN)	1.53
Precipitation Volume (AC - FT)	3.41
Loss Volume (AC - FT)	1.86
Excess Volume (AC - FT)	1.55
Direct Runoff Volume (AC - FT)	1.55
Baseflow Volume (AC - FT)	0

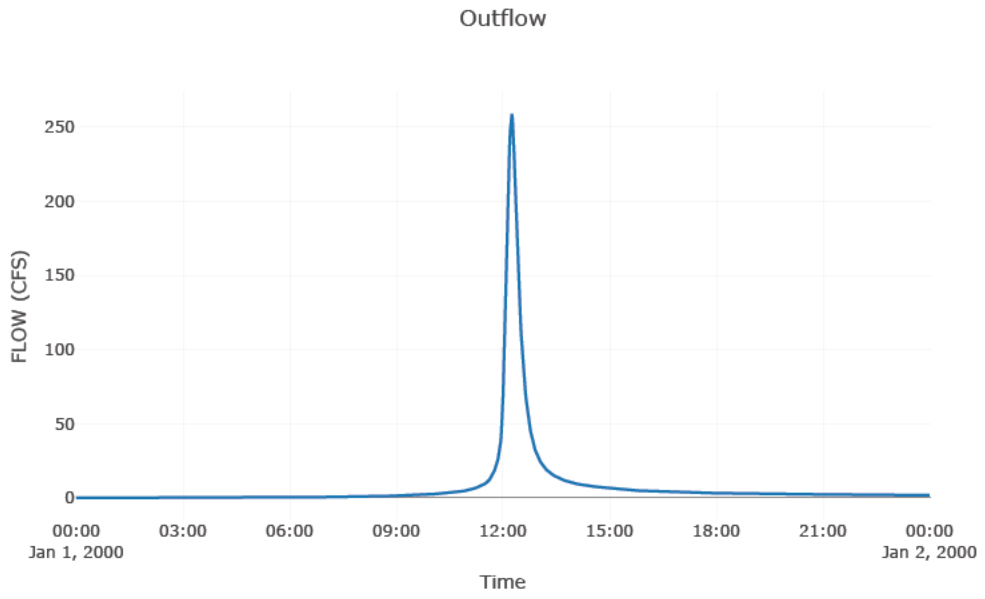


Reach: Ditch D3

Downstream : Basin DE

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	400
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch D3	
Peak Discharge (CFS)	258.74
Time of Peak Discharge	01Jan2000, 12:15
Volume (IN)	2.16
Peak Inflow (CFS)	259.41
Inflow Volume (AC - FT)	16.22



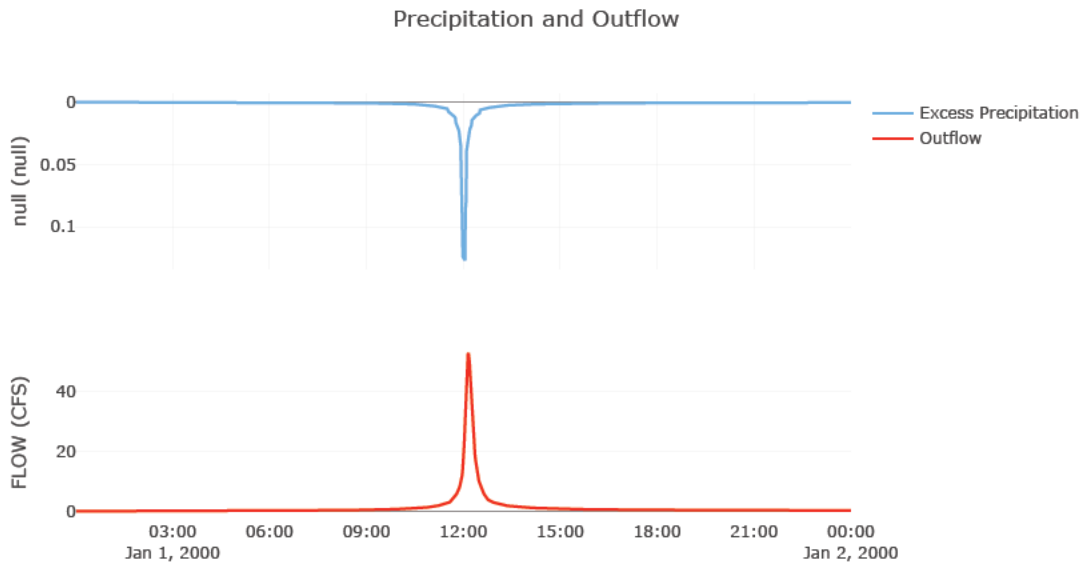
Subbasin: E2

Area (MI2) : 0.02
Downstream : E2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.8
Unitgraph Type	Standard

Results: E2	
Peak Discharge (CFS)	52.91
Time of Peak Discharge	01Jan2000, 12:09
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.88
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.49
Direct Runoff Volume (AC - FT)	2.49
Baseflow Volume (AC - FT)	0



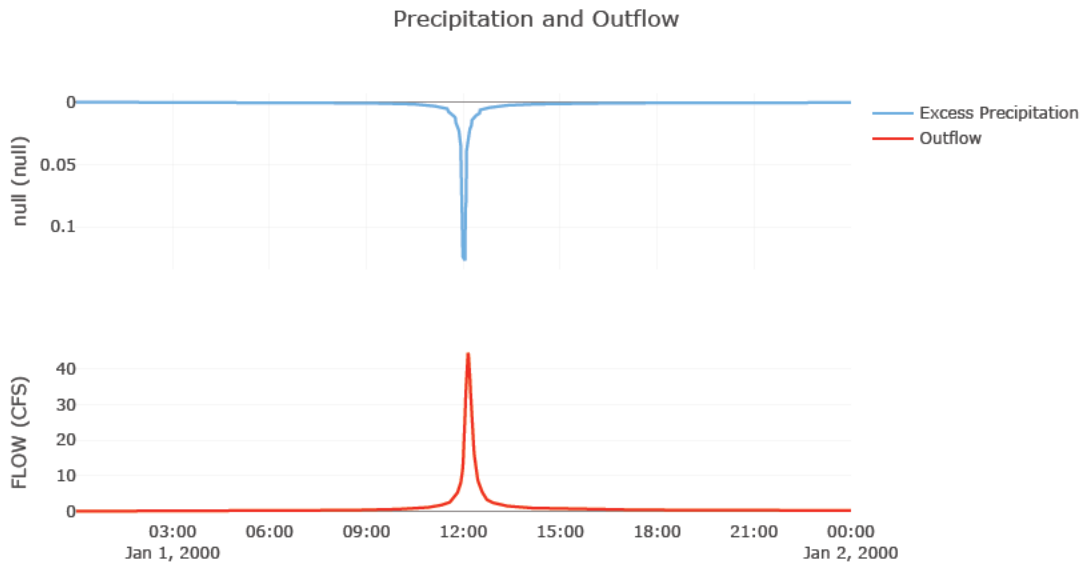
Subbasin: E5

Area (MI2) : 0.01
Downstream : E2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

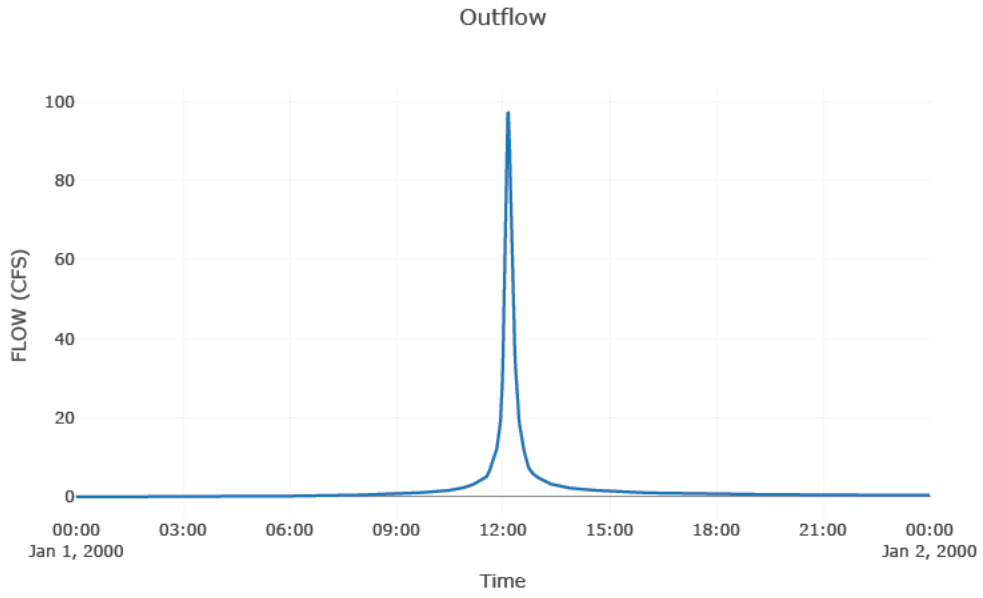
Results: E5	
Peak Discharge (CFS)	44.54
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.34
Loss Volume (AC - FT)	0.31
Excess Volume (AC - FT)	2.02
Direct Runoff Volume (AC - FT)	2.02
Baseflow Volume (AC - FT)	0



Junction: E2 Junction

Downstream : Ditch E1

Results: E2 Junction	
Peak Discharge (CFS)	97.07
Time of Peak Discharge	01Jan2000, 12:09
Volume (IN)	2.91



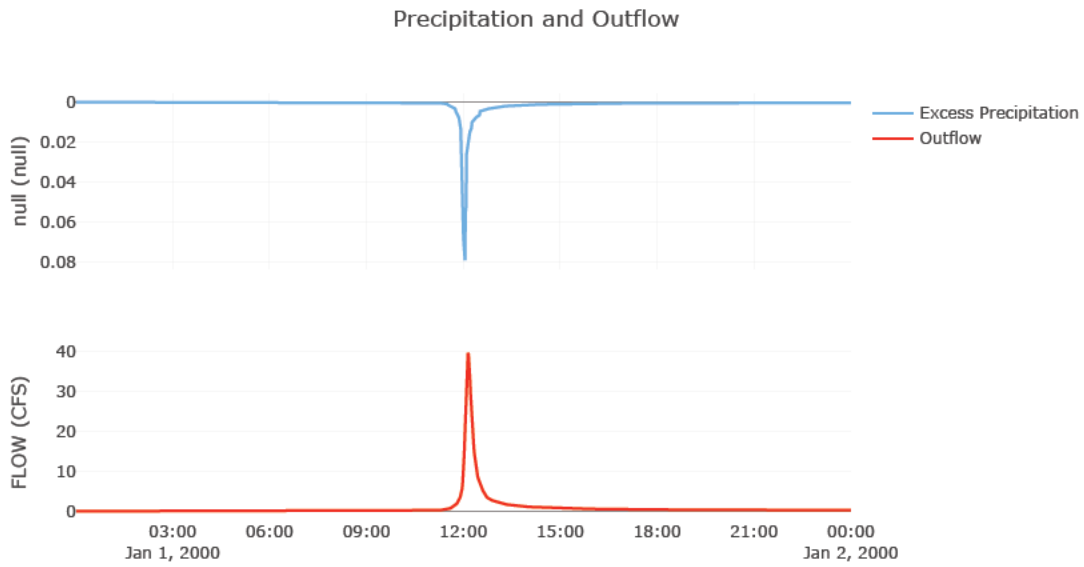
Subbasin: E4

Area (MI2) : 0.02
Downstream : Ditch E1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	80

Transform: Scs	
Lag	6.6
Unitgraph Type	Standard

Results: E4	
Peak Discharge (CFS)	39.7
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	1.53
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	1.96
Excess Volume (AC - FT)	1.64
Direct Runoff Volume (AC - FT)	1.63
Baseflow Volume (AC - FT)	0

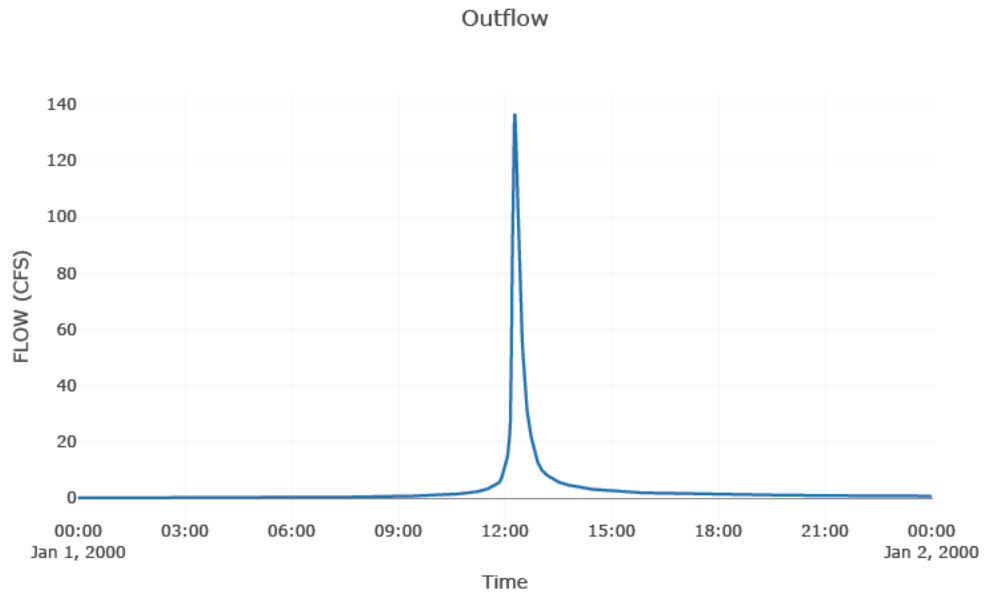


Reach: Ditch E1

Downstream : E1 Junction

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2425
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch E1	
Peak Discharge (CFS)	136.59
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	2.33
Peak Inflow (CFS)	136.71
Inflow Volume (AC - FT)	6.14



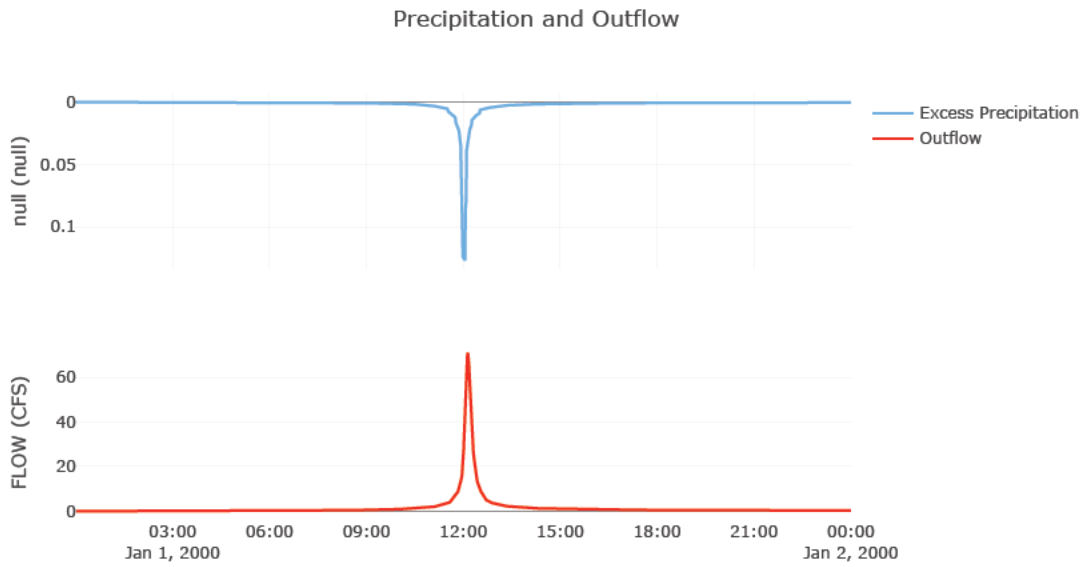
Subbasin: E3

Area (MI2) : 0.02
Downstream : E1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6.6
Unitgraph Type	Standard

Results: E3	
Peak Discharge (CFS)	70.98
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	0.48
Excess Volume (AC - FT)	3.11
Direct Runoff Volume (AC - FT)	3.11
Baseflow Volume (AC - FT)	0



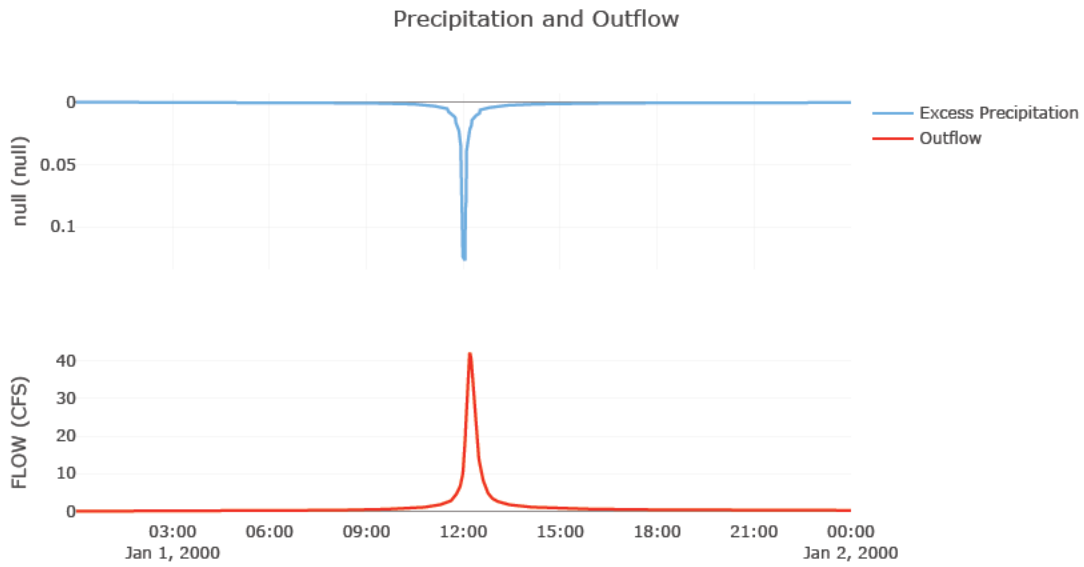
Subbasin: E1

Area (MI2) : 0.01
Downstream : E1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	10.8
Unitgraph Type	Standard

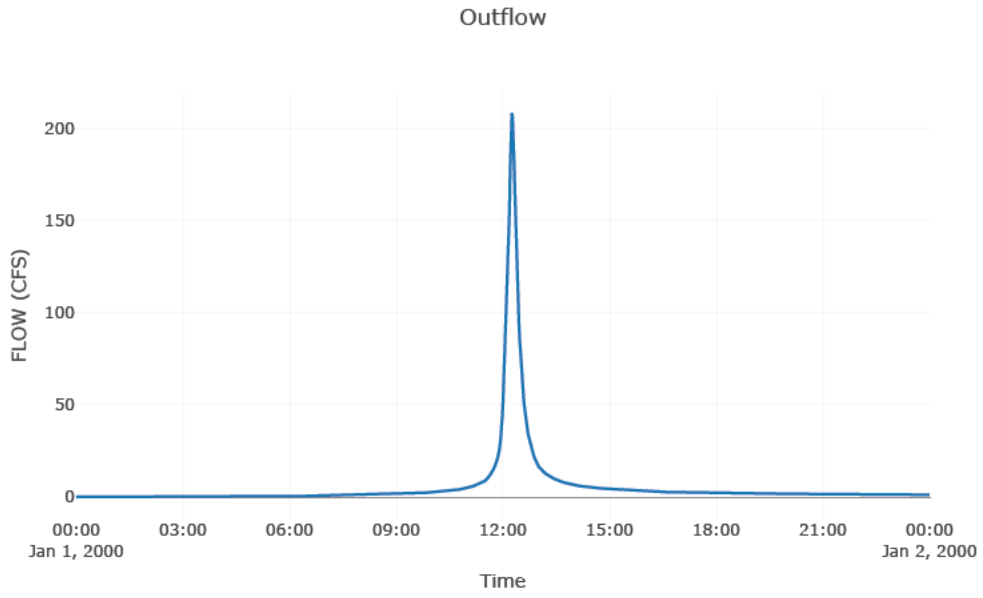
Results: E1	
Peak Discharge (CFS)	42.14
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.7
Loss Volume (AC - FT)	0.36
Excess Volume (AC - FT)	2.33
Direct Runoff Volume (AC - FT)	2.33
Baseflow Volume (AC - FT)	0



Junction: E1 Junction

Downstream : Culvert E2

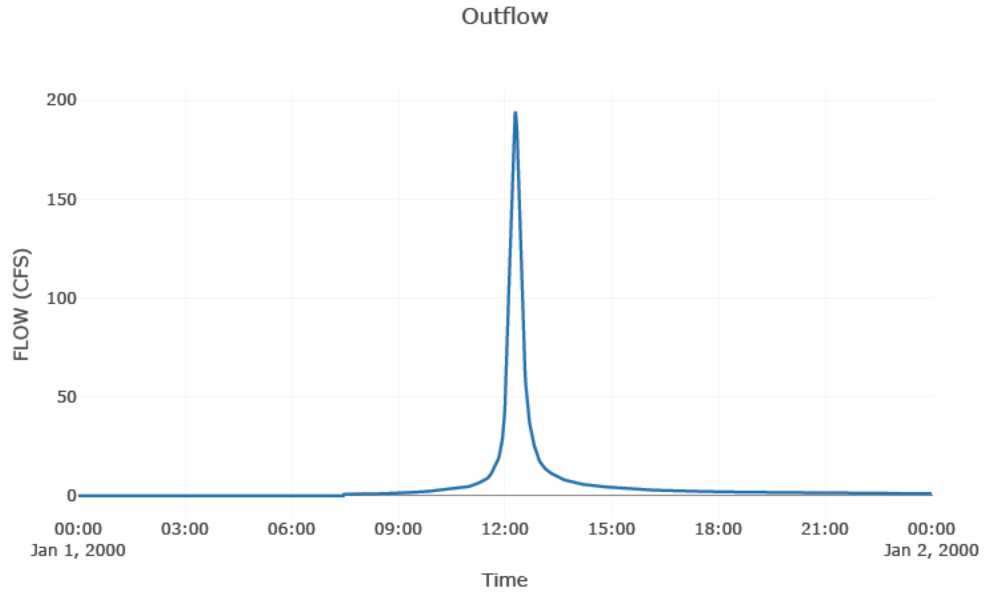
Results: E1 Junction	
Peak Discharge (CFS)	208.61
Time of Peak Discharge	01Jan2000, 12:15
Volume (IN)	2.57



Reservoir: Culvert E2

Downstream : Ditch E2

Results: Culvert E2	
Peak Discharge (CFS)	194.13
Time of Peak Discharge	01Jan2000, 12:18
Volume (IN)	2.55
Peak Inflow (CFS)	208.61
Time of Peak Inflow	01Jan2000, 12:15
Inflow Volume (AC - FT)	11.53
Maximum Storage (AC - FT)	1.27
Peak Elevation (FT)	3956.01
Discharge Volume (AC - FT)	11.41

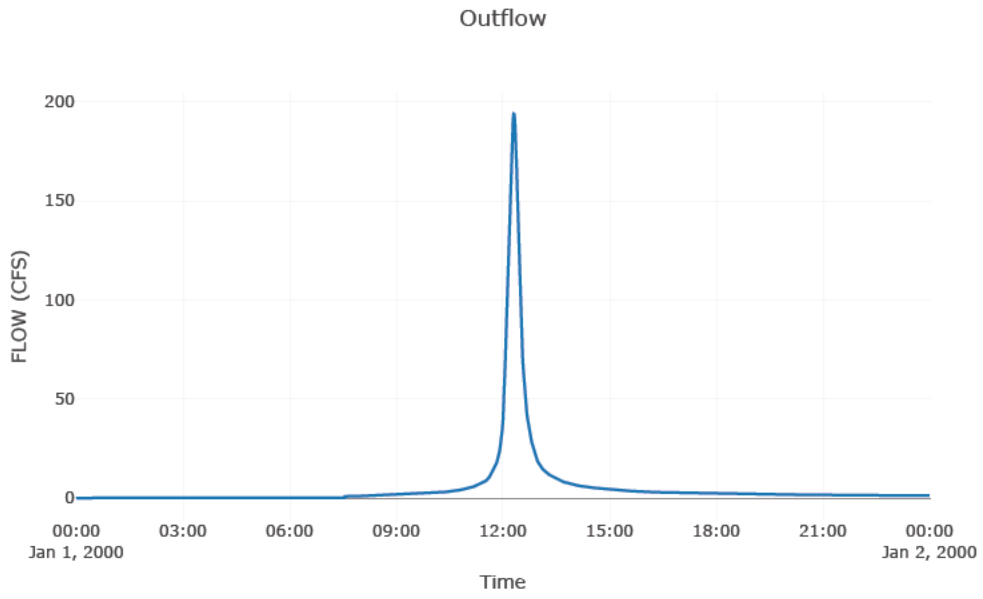


Reach: Ditch E2

Downstream : Basin DE

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	570
Energy Slope (FT/FT)	0.05
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

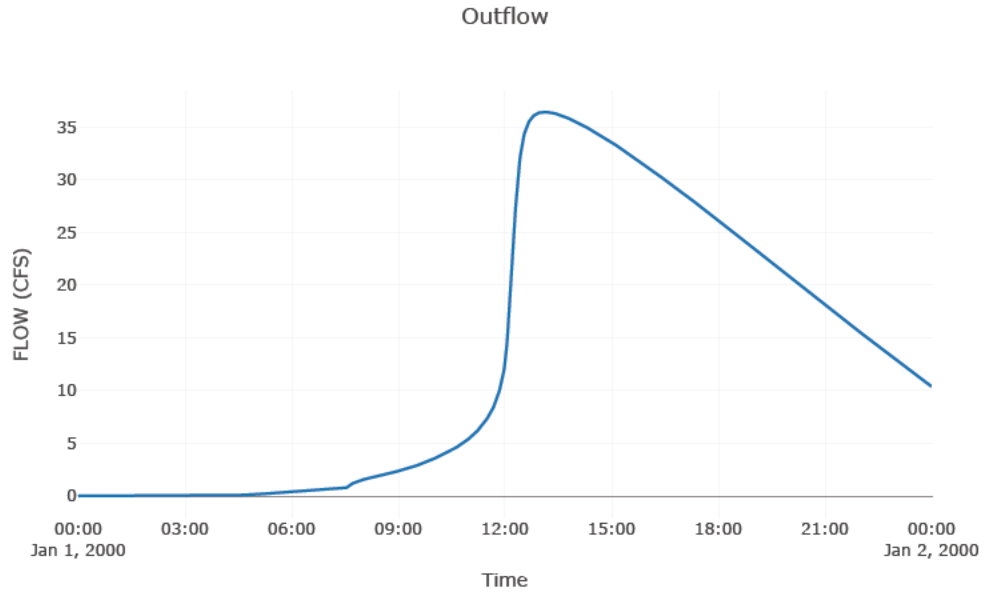
Results: Ditch E2	
Peak Discharge (CFS)	193.77
Time of Peak Discharge	01Jan2000, 12:18
Volume (IN)	2.55
Peak Inflow (CFS)	194.13
Inflow Volume (AC - FT)	11.41



Reservoir: Basin DE

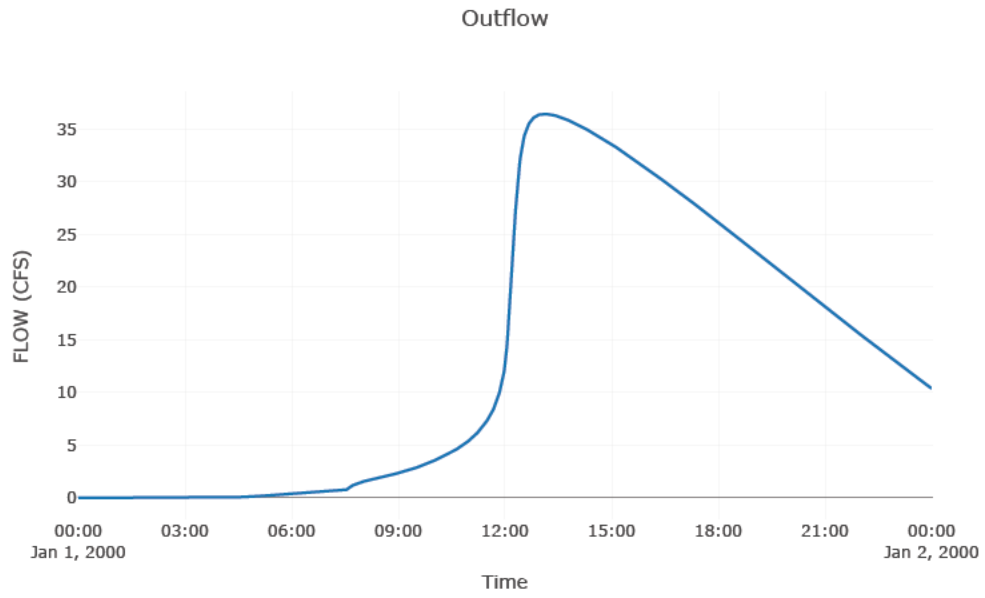
Downstream : Outfall DE

Results: Basin DE	
Peak Discharge (CFS)	36.43
Time of Peak Discharge	01Jan2000, 13:07
Volume (IN)	2.19
Peak Inflow (CFS)	439.66
Time of Peak Inflow	01Jan2000, 12:17
Inflow Volume (AC - FT)	27.61
Maximum Storage (AC - FT)	20.85
Peak Elevation (FT)	3930.44
Discharge Volume (AC - FT)	26.32



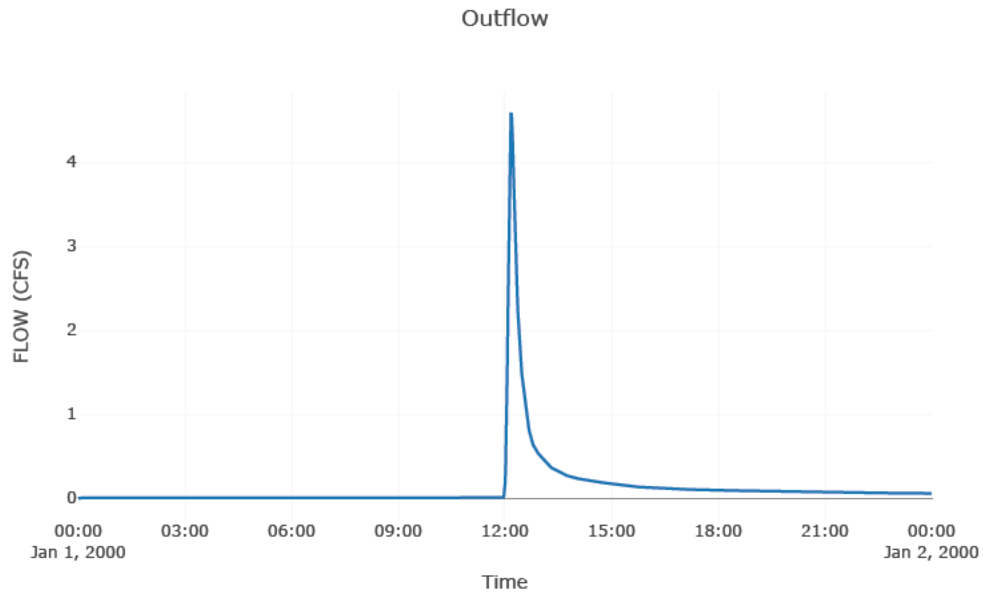
Sink: Outfall DE

Results: Outfall DE	
Peak Discharge (CFS)	36.43
Time of Peak Discharge	01Jan2000, 13:07
Volume (IN)	2.19



Sink: Outfall A

Results: Outfall A	
Peak Discharge (CFS)	4.57
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	0.6




STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
9-12-25

Project: GEPLandfill_Sept2025
Simulation Run: ProposedConditions25Year
Simulation Start: 31 December 1999, 24:00
Simulation End: 1 January 2000, 24:00

HMS Version: 4.13
Executed: 16 September 2025, 10:58

Global Parameter Summary - Subbasin

	Area (MI2)
Element Name	**Area (MI2)**
B4	0.04
B1	0.01
B6	0.03
B3	0.02
Cos	0.24
B5	0.05
B2	0.01
B7	0.03
B8	0.02
C2	0.03
C1	0.01
C3	0.01
A1	0.01
D4	0.01
D6	0.02
D1	0.02
D5	0.04
D3	0.02
E6	0.02
E2	0.02
E5	0.01
E4	0.02
E3	0.02
E1	0.02

Downstream

Element Name	Downstream
B4	B1 Junction
B1	B1 Junction
B6	B3 Junction
B3	B3 Junction
Cos	Ditch B1
B5	B2 Junction
B2	B2 Junction
B7	Ditch B2
B8	Ditch B2
C2	C1 Junction
C1	C1 Junction
C3	Ditch C2
A1	Outfall A
D4	D4 Junction
D6	Ditch D1
D1	D1 Junction
D5	Ditch D2
D3	Ditch D2
E6	Ditch D3
E2	E2 Junction
E5	E2 Junction
E4	Ditch E1
E3	E1 Junction
E1	E1 Junction

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
B4	0	96
B1	0	96
B6	0	96
B3	0	96
Cos	0	63
B5	0	96
B2	0	96
B7	0	73
B8	0	76
C2	0	96
C1	0	96
C3	0	96
A1	0	63
D4	0	96
D6	0	88
D1	0	96
D5	0	76
D3	0	96
E6	0	80
E2	0	96
E5	0	96
E4	0	80
E3	0	96
E1	0	96

Transform: Scs		
Element Name	**Lag**	**Unitgraph Type**
B4	5.4	Standard
B1	5.4	Standard
B6	5.4	Standard
B3	6.6	Standard
Cos	46.8	Standard
B5	8.4	Standard
B2	6	Standard
B7	33.6	Standard
B8	13.8	Standard
C2	4.8	Standard
C1	6	Standard
C3	21.6	Standard
A1	7.2	Standard
D4	7.2	Standard
D6	10.2	Standard
D1	4.2	Standard
D5	8.4	Standard
D3	7.2	Standard
E6	2.4	Standard
E2	6	Standard
E5	7.2	Standard
E4	6.6	Standard
E3	6.6	Standard
E1	4.8	Standard

Global Parameter Summary - Reach

Downstream	
Element Name	**Downstream**
Ditch B1	Ditch B2
Ditch B2	Basin BC
Ditch C1	Culvert C2
Ditch C2	Basin BC
Ditch D1	D1 Junction
Ditch D2	Junction - 2
Ditch D3	Basin DE
Ditch E1	E1 Junction
Ditch E2	Basin DE

Route: Kinematic Wave

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Shape	Number of Subreaches	Width (FT)	Side Slope (FT/FT)	Initial Variable	Index Parameter Type	Index Flow
Ditch B1	Kinematic Wave	Kinematic Wave	2769	0.01	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch B2	Kinematic Wave	Kinematic Wave	1596	0.03	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch C1	Kinematic Wave	Kinematic Wave	2080	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch C2	Kinematic Wave	Kinematic Wave	2335	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D1	Kinematic Wave	Kinematic Wave	1300	0	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D2	Kinematic Wave	Kinematic Wave	400	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch D3	Kinematic Wave	Kinematic Wave	400	0.02	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch E1	Kinematic Wave	Kinematic Wave	2425	0.01	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05
Ditch E2	Kinematic Wave	Kinematic Wave	570	0.05	0.04	Trapezoid	2	8	5	Combined Inflow	Index Flow	0.05

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
B4	0.04	147.65	01Jan2000, 12:06	2.91
B1	0.01	38.91	01Jan2000, 12:06	2.91
B6	0.03	95.76	01Jan2000, 12:06	2.91
B3	0.02	66.37	01Jan2000, 12:08	2.91
Cos	0.24	42.48	01Jan2000, 12:58	0.59
B3 Junction	0.04	161.75	01Jan2000, 12:07	2.91
Ditch B1	0.28	161.62	01Jan2000, 12:16	0.94
B5	0.05	151.27	01Jan2000, 12:09	2.91
B2	0.01	32.49	01Jan2000, 12:07	2.91
B2 Junction	0.06	181.57	01Jan2000, 12:09	2.91
B7	0.03	12.51	01Jan2000, 12:39	1.08
B8	0.02	25.96	01Jan2000, 12:16	1.27
Ditch B2	0.39	318.12	01Jan2000, 12:16	1.25
C2	0.03	129.52	01Jan2000, 12:06	2.91
C1	0.01	40.61	01Jan2000, 12:07	2.91
C1 Junction	0.04	169.25	01Jan2000, 12:06	2.91
Ditch C1	0.04	168.55	01Jan2000, 12:10	2.9
Culvert C2	0.04	148.65	01Jan2000, 12:13	2.9
C3	0.01	26.89	01Jan2000, 12:23	2.91
Ditch C2	0.06	168.15	01Jan2000, 12:18	2.89
B1 Junction	0.05	186.56	01Jan2000, 12:06	2.91
Basin BC	0.49	95.71	01Jan2000, 13:02	1.19
Outfall BC	0.49	95.71	01Jan2000, 13:02	1.19
A1	0.01	4.57	01Jan2000, 12:10	0.6
D4	0.01	44.54	01Jan2000, 12:08	2.91
D6	0.02	45.14	01Jan2000, 12:12	2.15
D4 Junction	0.01	44.54	01Jan2000, 12:08	2.91
Ditch D1	0.03	86.38	01Jan2000, 12:16	2.43
D1	0.02	66.08	01Jan2000, 12:05	2.91
D1 Junction	0.05	104.3	01Jan2000, 12:15	2.59
D5	0.04	56	01Jan2000, 12:10	1.27

D3	0.02	68.52	01Jan2000, 12:08	2.91
Ditch D2	0.11	204.15	01Jan2000, 12:12	2.17
Junction - 2	0.11	204.15	01Jan2000, 12:12	2.17
E6	0.02	50.61	01Jan2000, 12:04	1.53
Ditch D3	0.13	224.54	01Jan2000, 12:08	2.07
E2	0.02	62.76	01Jan2000, 12:07	2.91
E5	0.01	44.54	01Jan2000, 12:08	2.91
E2 Junction	0.03	106.29	01Jan2000, 12:07	2.91
E4	0.02	39.7	01Jan2000, 12:08	1.53
Ditch E1	0.05	145.11	01Jan2000, 12:16	2.34
E3	0.02	70.98	01Jan2000, 12:08	2.91
E1	0.02	63.77	01Jan2000, 12:06	2.91
E1 Junction	0.09	206.41	01Jan2000, 12:14	2.58
Culvert E2	0.09	193.17	01Jan2000, 12:17	2.56
Ditch E2	0.09	193.17	01Jan2000, 12:17	2.55
Basin DE	0.21	35.12	01Jan2000, 13:03	2.18
Outfall DE	0.21	35.12	01Jan2000, 13:03	2.18
Outfall A	0.01	4.57	01Jan2000, 12:10	0.6

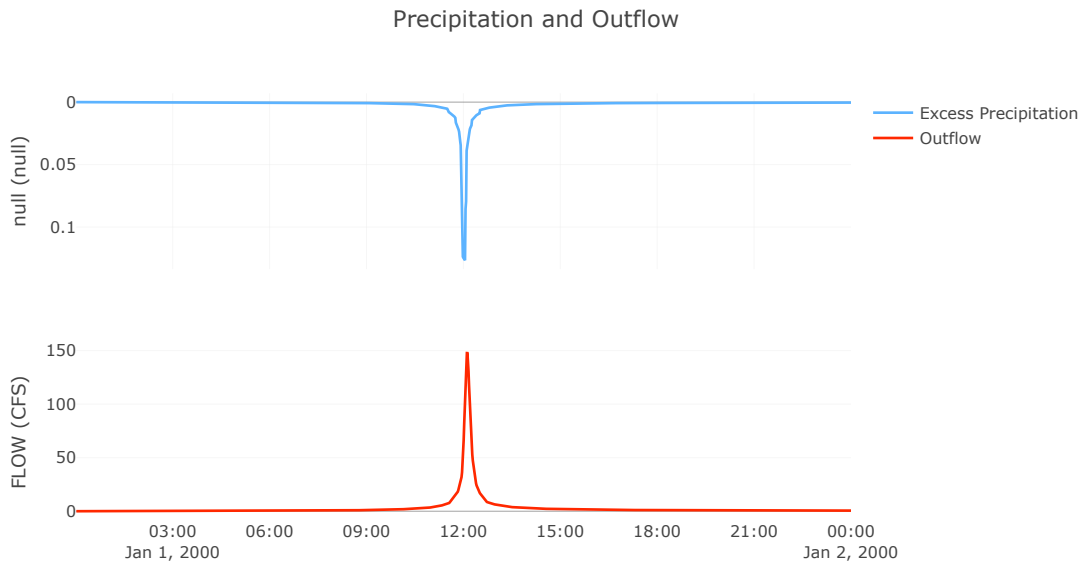
Subbasin: B4

Area (MI2) : 0.04
Downstream : B1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	5.4
Unitgraph Type	Standard

Results: B4	
Peak Discharge (CFS)	147.65
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	6.96
Loss Volume (AC - FT)	0.94
Excess Volume (AC - FT)	6.02
Direct Runoff Volume (AC - FT)	6.01
Baseflow Volume (AC - FT)	0



ember 1 , 2025

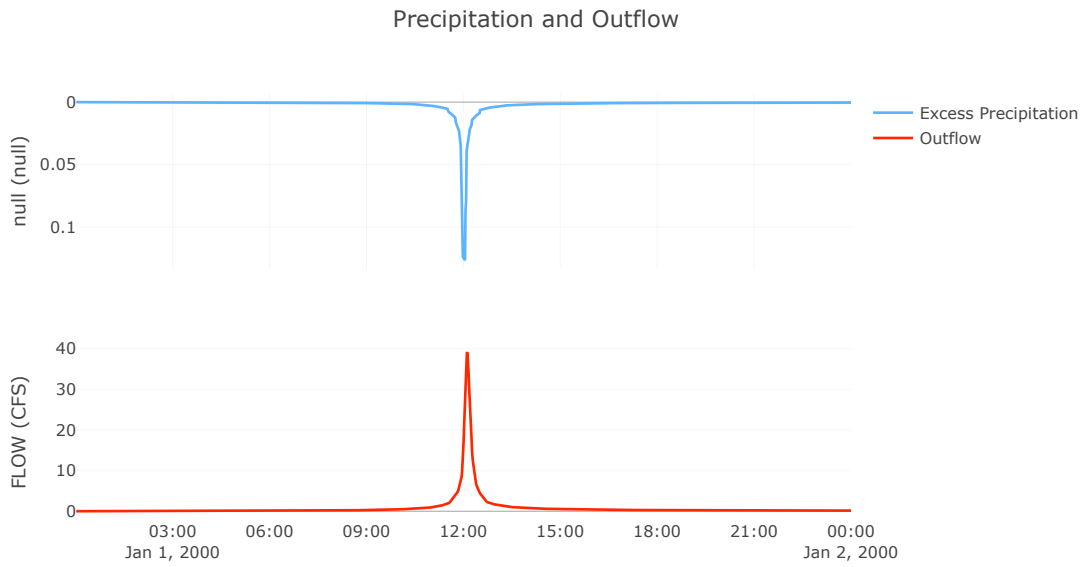
Subbasin: B1

Area (MI2) : 0.01
Downstream : B1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	5.4
Unitgraph Type	Standard

Results: B1	
Peak Discharge (CFS)	38.91
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	1.83
Loss Volume (AC - FT)	0.25
Excess Volume (AC - FT)	1.59
Direct Runoff Volume (AC - FT)	1.59
Baseflow Volume (AC - FT)	0



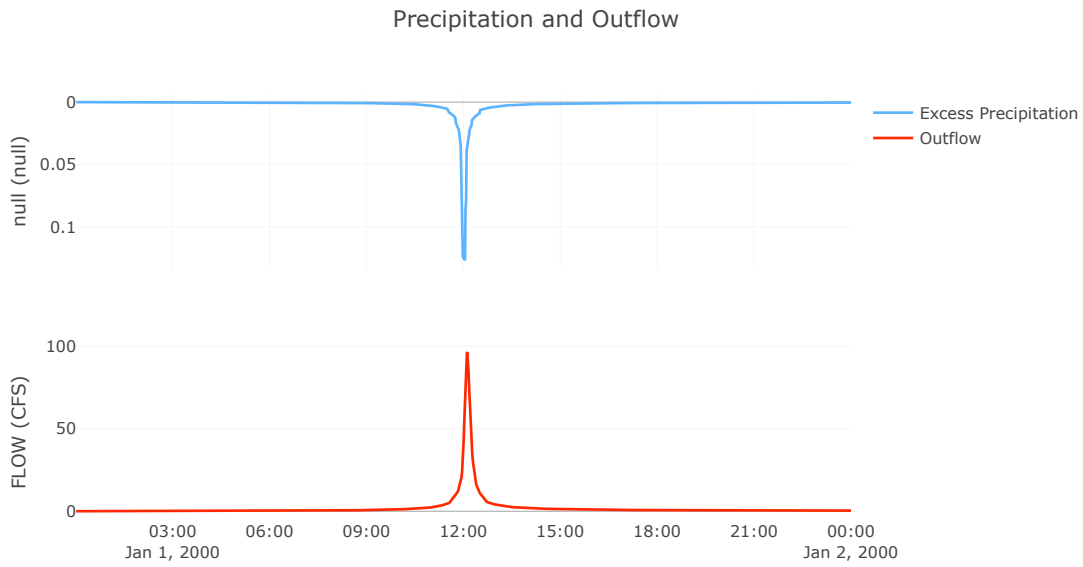
Subbasin: B6

Area (MI2) : 0.03
Downstream : B3 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	5.4
Unitgraph Type	Standard

Results: B6	
Peak Discharge (CFS)	95.76
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	4.51
Loss Volume (AC - FT)	0.61
Excess Volume (AC - FT)	3.9
Direct Runoff Volume (AC - FT)	3.9
Baseflow Volume (AC - FT)	0



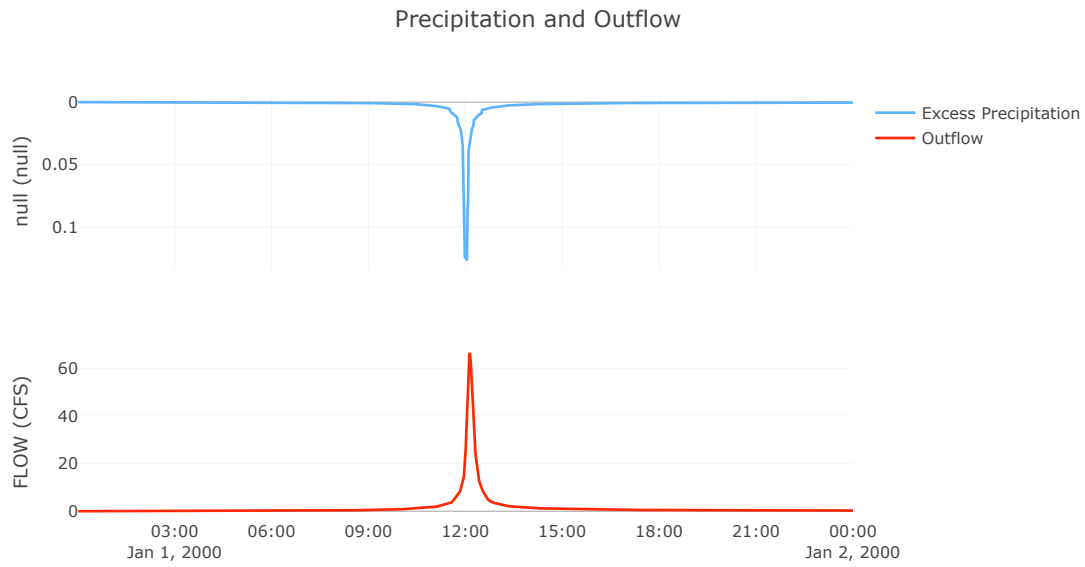
Subbasin: B3

Area (MI2) : 0.02
Downstream : B3 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6.6
Unitgraph Type	Standard

Results: B3	
Peak Discharge (CFS)	66.37
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.36
Loss Volume (AC - FT)	0.45
Excess Volume (AC - FT)	2.91
Direct Runoff Volume (AC - FT)	2.91
Baseflow Volume (AC - FT)	0



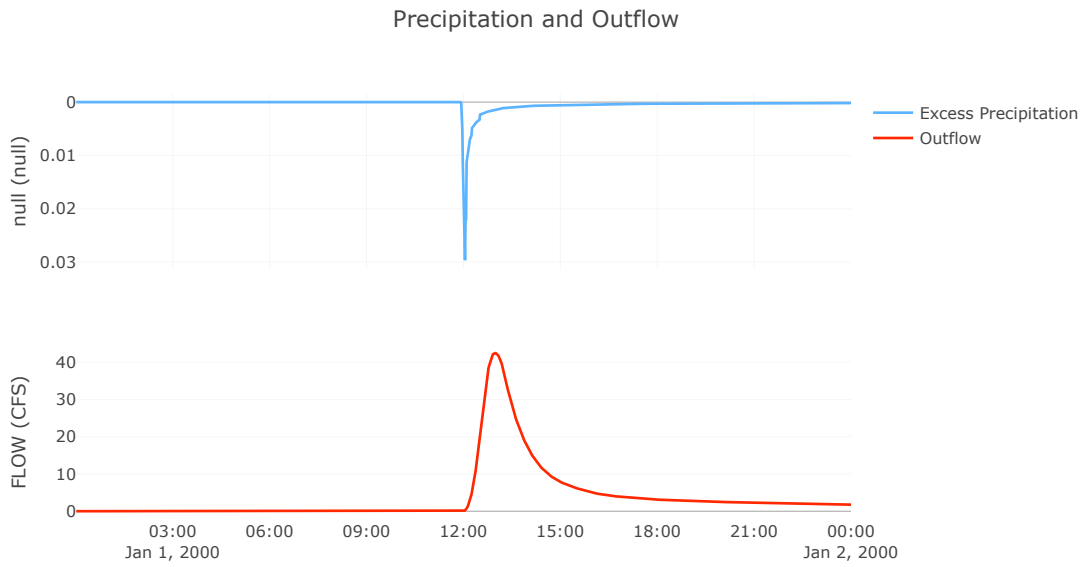
Subbasin: COS

Area (MI2) : 0.24
Downstream : Ditch B1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	63

Transform: Scs	
Lag	46.8
Unitgraph Type	Standard

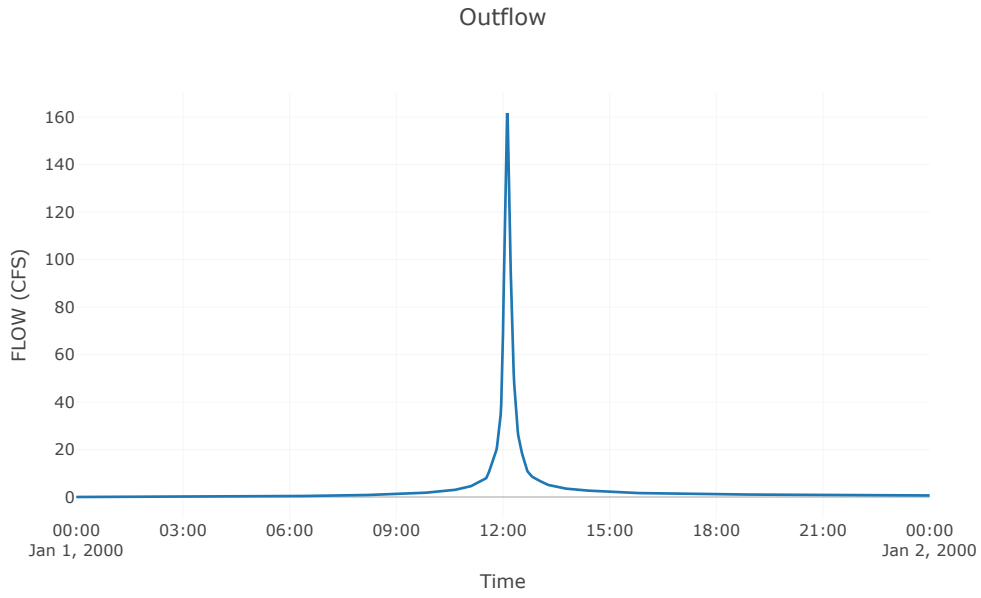
Results: COS	
Peak Discharge (CFS)	42.48
Time of Peak Discharge	01Jan2000, 12:58
Volume (IN)	0.59
Precipitation Volume (AC - FT)	42.52
Loss Volume (AC - FT)	34.99
Excess Volume (AC - FT)	7.54
Direct Runoff Volume (AC - FT)	7.39
Baseflow Volume (AC - FT)	0



Junction: B3 Junction

Downstream : Ditch B1

Results: B3 Junction	
Peak Discharge (CFS)	161.75
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91

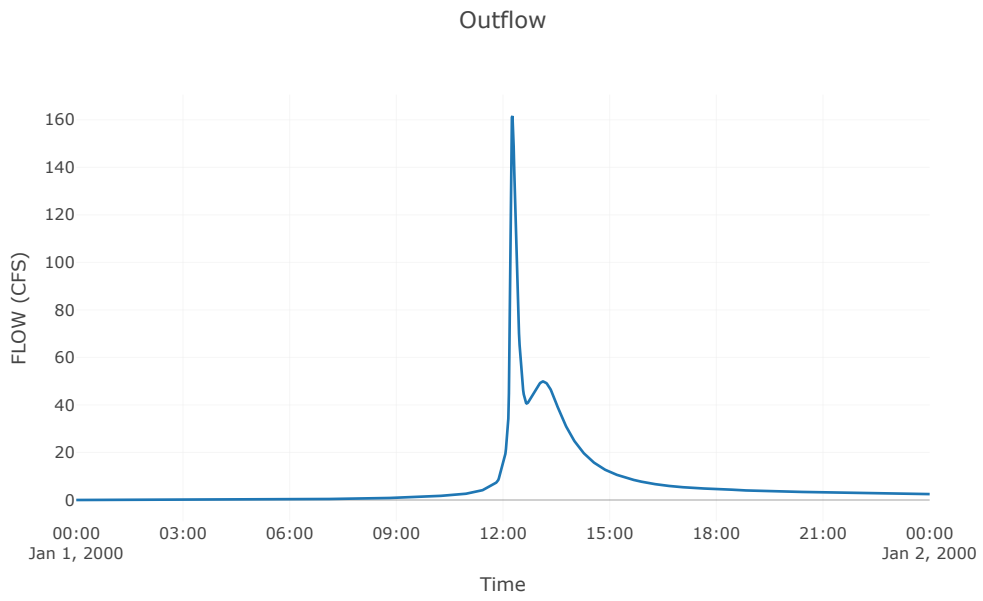


Reach: Ditch B1

Downstream : Ditch B2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2769
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch B1	
Peak Discharge (CFS)	161.62
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	0.94
Peak Inflow (CFS)	162.86
Inflow Volume (AC - FT)	14.2



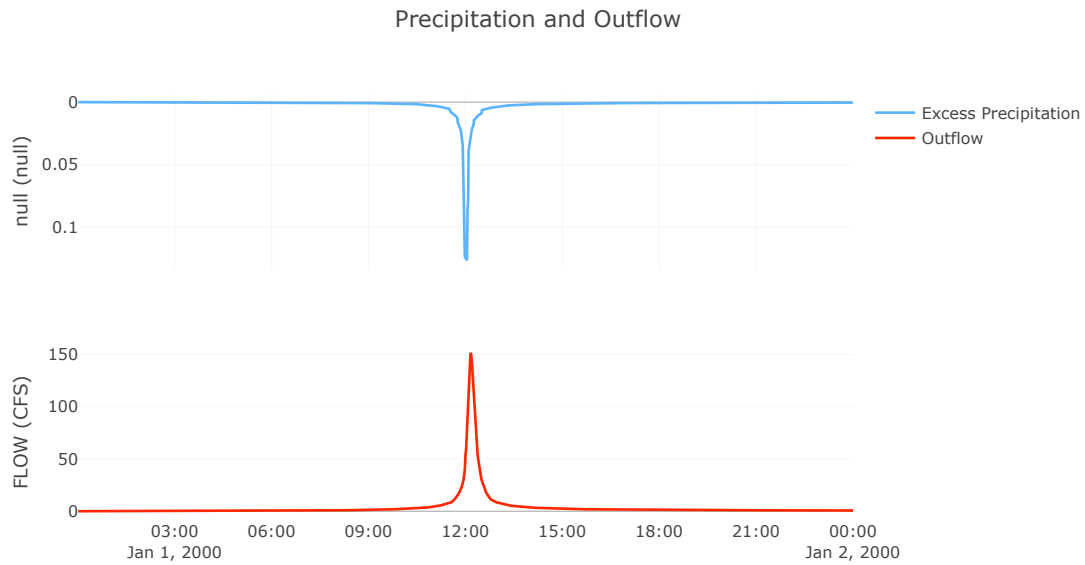
Subbasin: B5

Area (MI2) : 0.05
Downstream : B2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	8.4
Unitgraph Type	Standard

Results: B5	
Peak Discharge (CFS)	151.27
Time of Peak Discharge	01Jan2000, 12:09
Volume (IN)	2.91
Precipitation Volume (AC - FT)	8.52
Loss Volume (AC - FT)	1.15
Excess Volume (AC - FT)	7.37
Direct Runoff Volume (AC - FT)	7.36
Baseflow Volume (AC - FT)	0



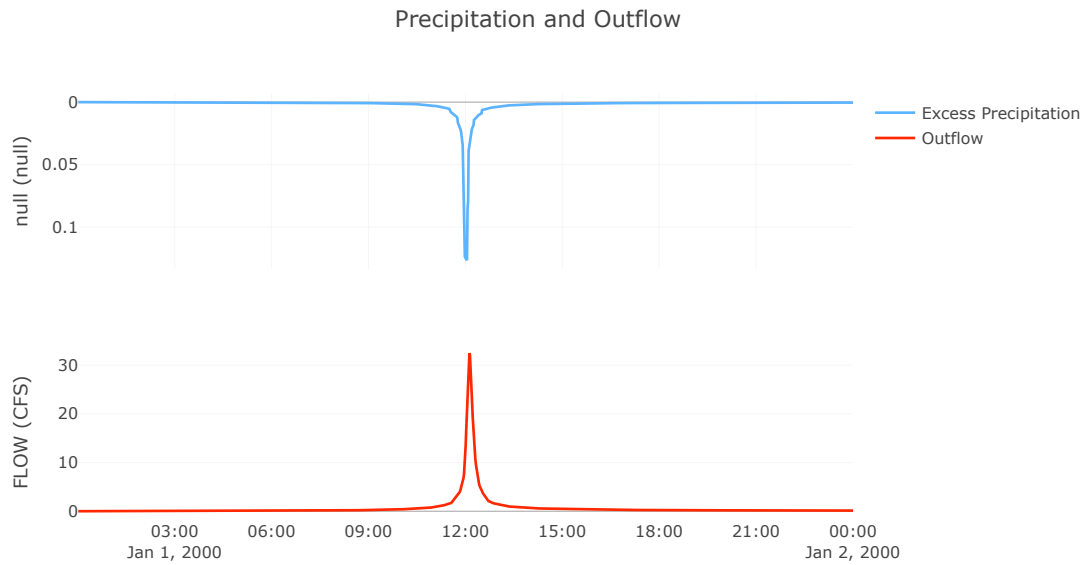
Subbasin: B2

Area (MI2) : 0.01
Downstream : B2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6
Unitgraph Type	Standard

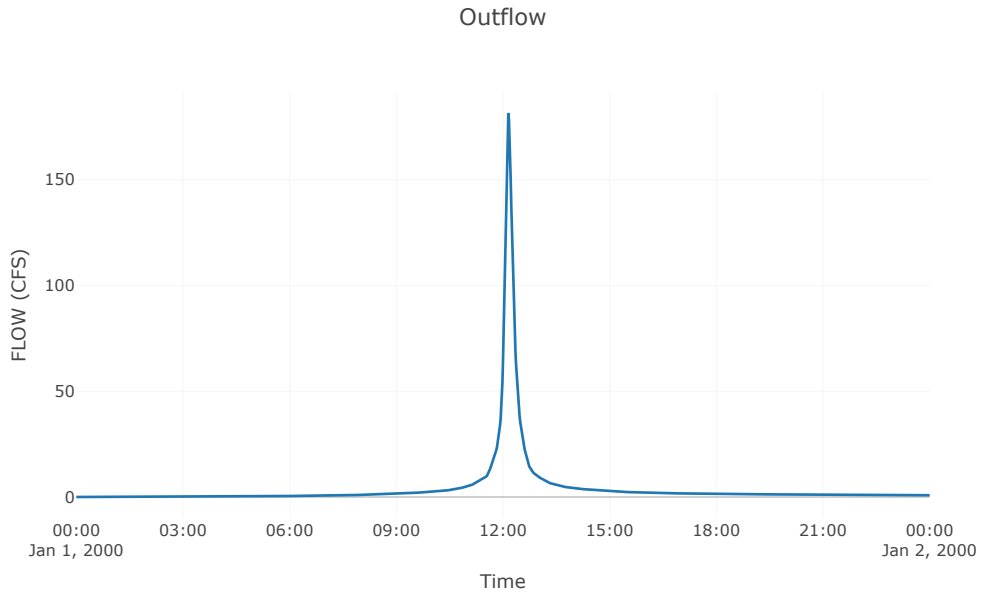
Results: B2	
Peak Discharge (CFS)	32.49
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91
Precipitation Volume (AC - FT)	1.58
Loss Volume (AC - FT)	0.21
Excess Volume (AC - FT)	1.37
Direct Runoff Volume (AC - FT)	1.37
Baseflow Volume (AC - FT)	0



Junction: B2 Junction

Downstream : Ditch B2

Results: B2 Junction	
Peak Discharge (CFS)	181.57
Time of Peak Discharge	01Jan2000, 12:09
Volume (IN)	2.91



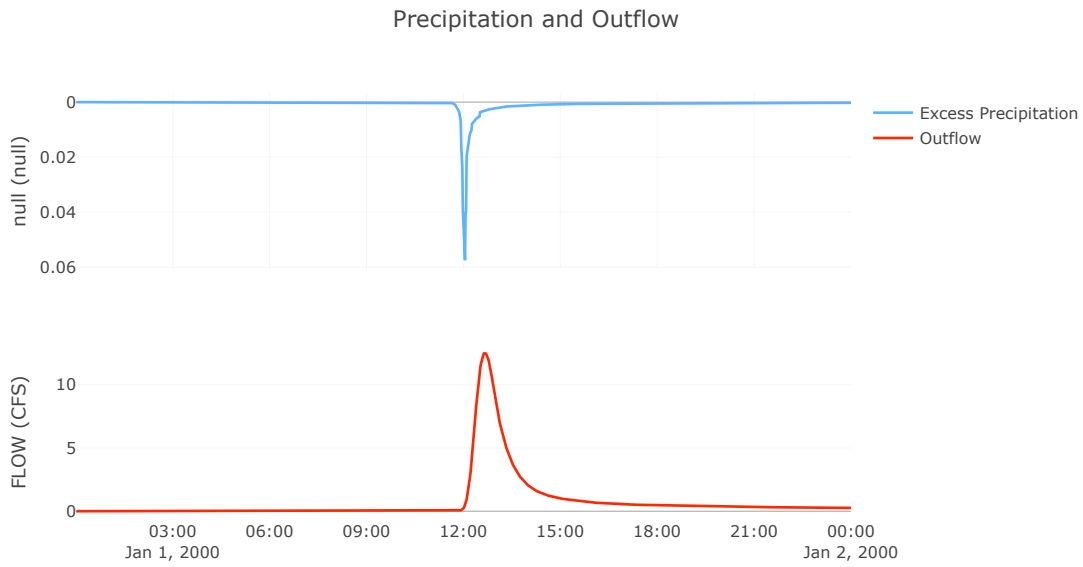
Subbasin: B7

Area (MI2) : 0.03
Downstream : Ditch B2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73

Transform: Scs	
Lag	33.6
Unitgraph Type	Standard

Results: B7	
Peak Discharge (CFS)	12.51
Time of Peak Discharge	01Jan2000, 12:39
Volume (IN)	1.08
Precipitation Volume (AC - FT)	4.57
Loss Volume (AC - FT)	3.08
Excess Volume (AC - FT)	1.48
Direct Runoff Volume (AC - FT)	1.47
Baseflow Volume (AC - FT)	0



ember 1 , 2025

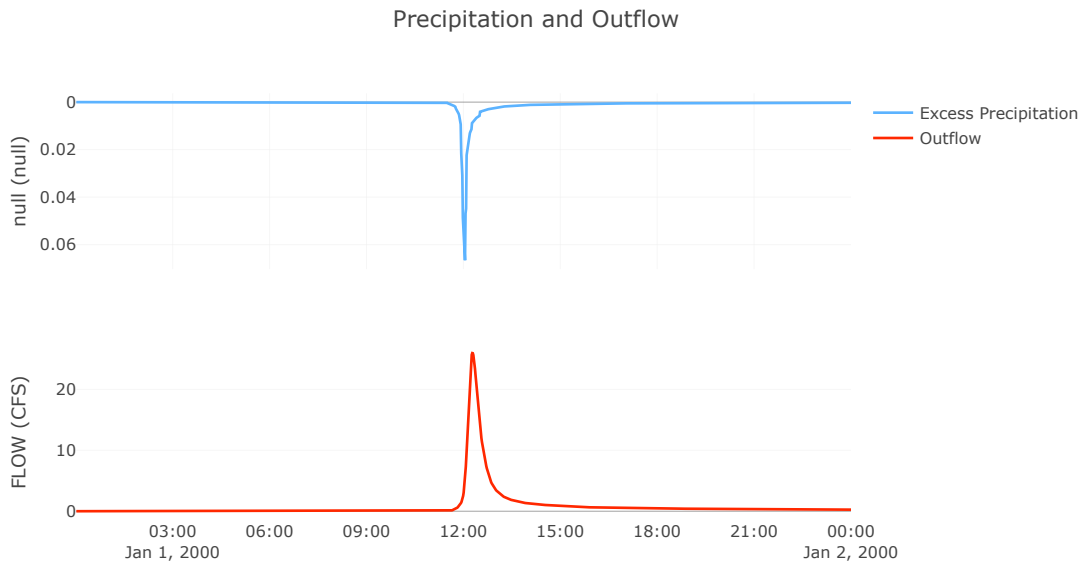
Subbasin: B8

Area (MI2) : 0.02
Downstream : Ditch B2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	76

Transform: Scs	
Lag	13.8
Unitgraph Type	Standard

Results: B8	
Peak Discharge (CFS)	25.96
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	1.27
Precipitation Volume (AC - FT)	4.31
Loss Volume (AC - FT)	2.69
Excess Volume (AC - FT)	1.63
Direct Runoff Volume (AC - FT)	1.62
Baseflow Volume (AC - FT)	0



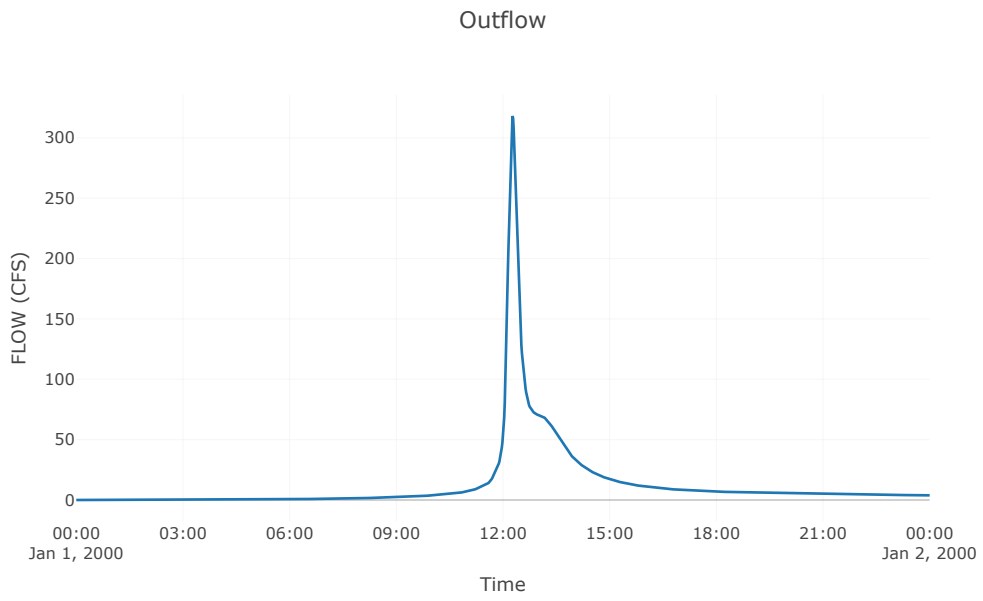
ember 1 , 2025

Reach: Ditch B2

Downstream : Basin BC

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	1596
Energy Slope (FT/FT)	0.03
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch B2	
Peak Discharge (CFS)	318.12
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	1.25
Peak Inflow (CFS)	319.25
Inflow Volume (AC - FT)	25.89



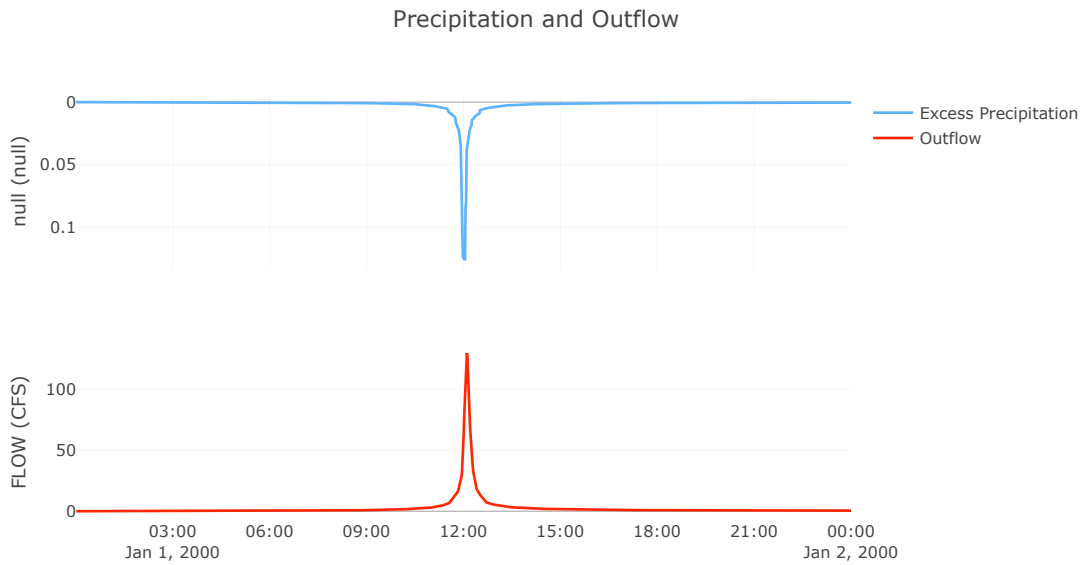
Subbasin: C2

Area (MI2) : 0.03
Downstream : C1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.8
Unitgraph Type	Standard

Results: C2	
Peak Discharge (CFS)	129.52
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	5.84
Loss Volume (AC - FT)	0.79
Excess Volume (AC - FT)	5.06
Direct Runoff Volume (AC - FT)	5.05
Baseflow Volume (AC - FT)	0



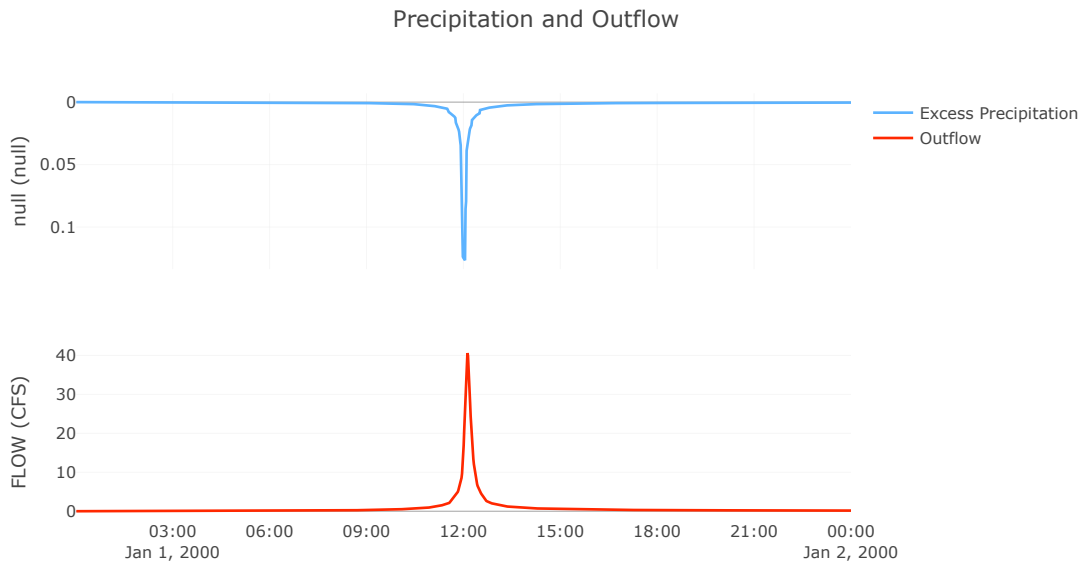
Subbasin: C1

Area (MI2) : 0.01
Downstream : C1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6
Unitgraph Type	Standard

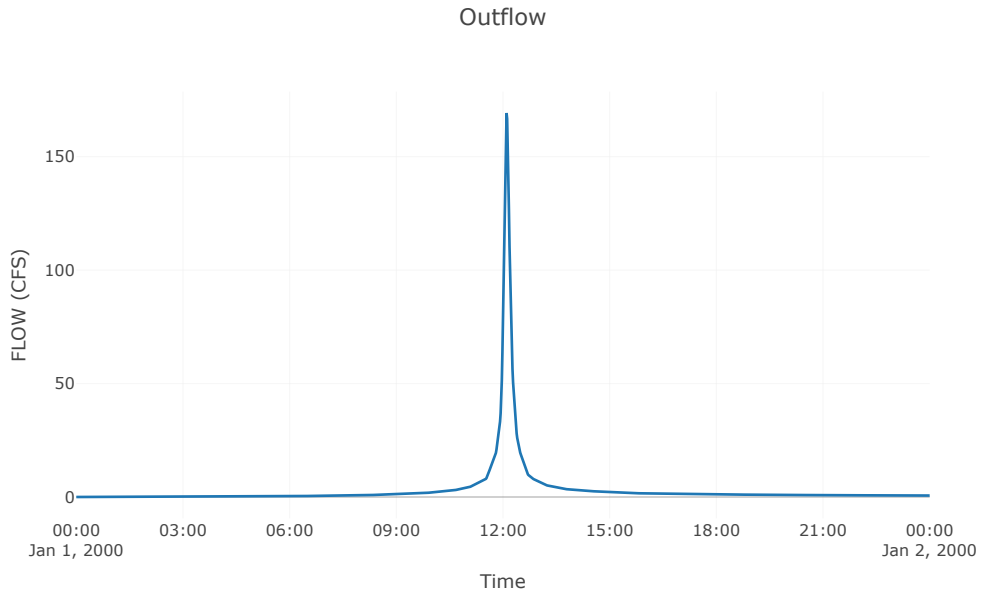
Results: C1	
Peak Discharge (CFS)	40.61
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91
Precipitation Volume (AC - FT)	1.98
Loss Volume (AC - FT)	0.27
Excess Volume (AC - FT)	1.71
Direct Runoff Volume (AC - FT)	1.71
Baseflow Volume (AC - FT)	0



Junction: C1 Junction

Downstream : Ditch C1

Results: C1 Junction	
Peak Discharge (CFS)	169.25
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91

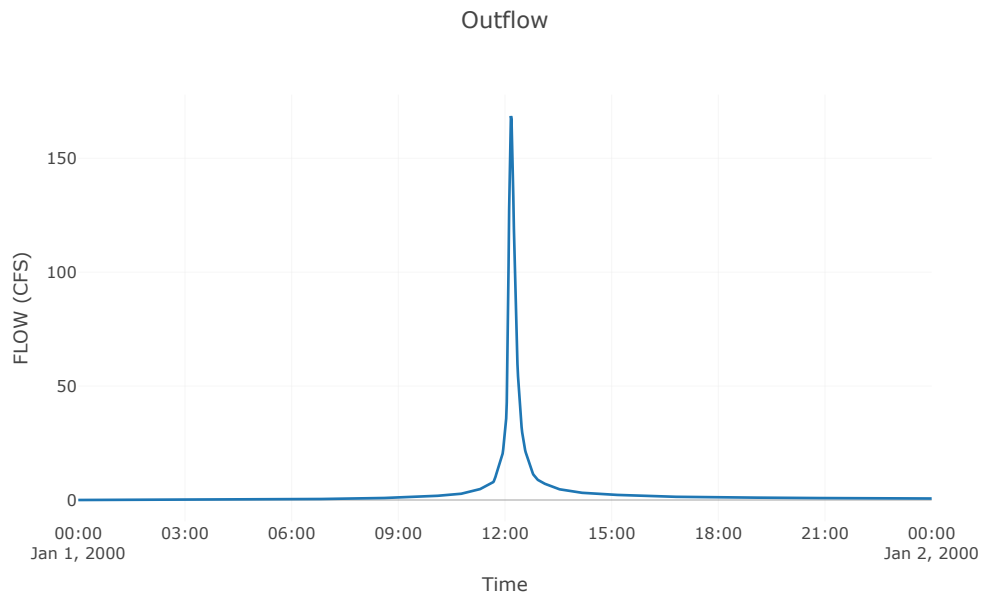


Reach: Ditch C1

Downstream : Culvert C2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2080
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

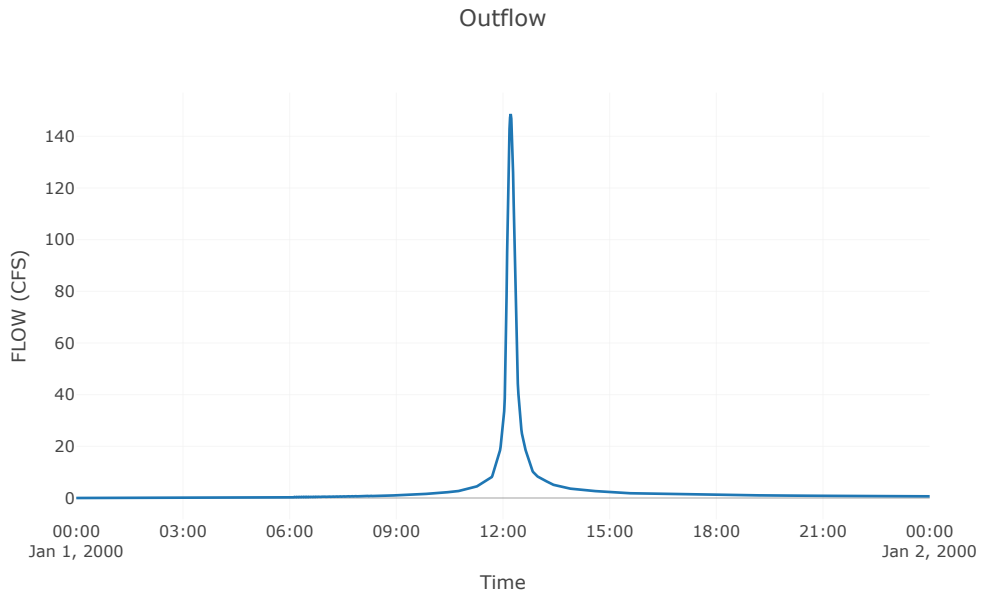
Results: Ditch C1	
Peak Discharge (CFS)	168.55
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	2.9
Peak Inflow (CFS)	169.25
Inflow Volume (AC - FT)	6.76



Reservoir: Culvert C2

Downstream : Ditch C2

Results: Culvert C2	
Peak Discharge (CFS)	148.65
Time of Peak Discharge	01Jan2000, 12:13
Volume (IN)	2.9
Peak Inflow (CFS)	168.55
Time of Peak Inflow	01Jan2000, 12:10
Inflow Volume (AC - FT)	6.73
Maximum Storage (AC - FT)	0.4
Peak Elevation (FT)	3945.14
Discharge Volume (AC - FT)	6.72



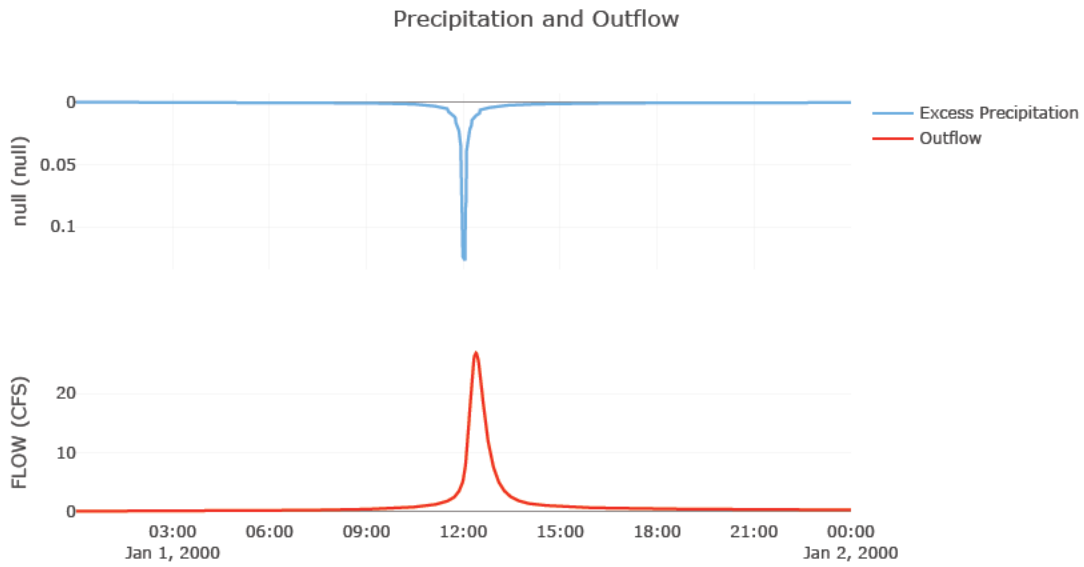
Subbasin: C3

Area (MI2) : 0.01
Downstream : Ditch C2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	21.6
Unitgraph Type	Standard

Results: C3	
Peak Discharge (CFS)	26.89
Time of Peak Discharge	01Jan2000, 12:23
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.62
Loss Volume (AC - FT)	0.35
Excess Volume (AC - FT)	2.27
Direct Runoff Volume (AC - FT)	2.26
Baseflow Volume (AC - FT)	0

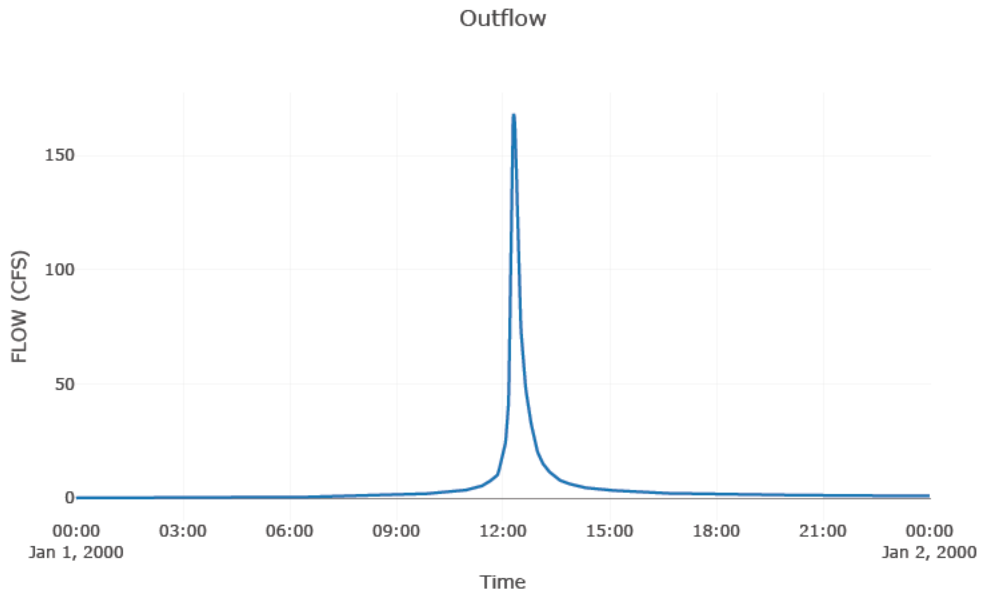


Reach: Ditch C2

Downstream : Basin BC

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2335
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

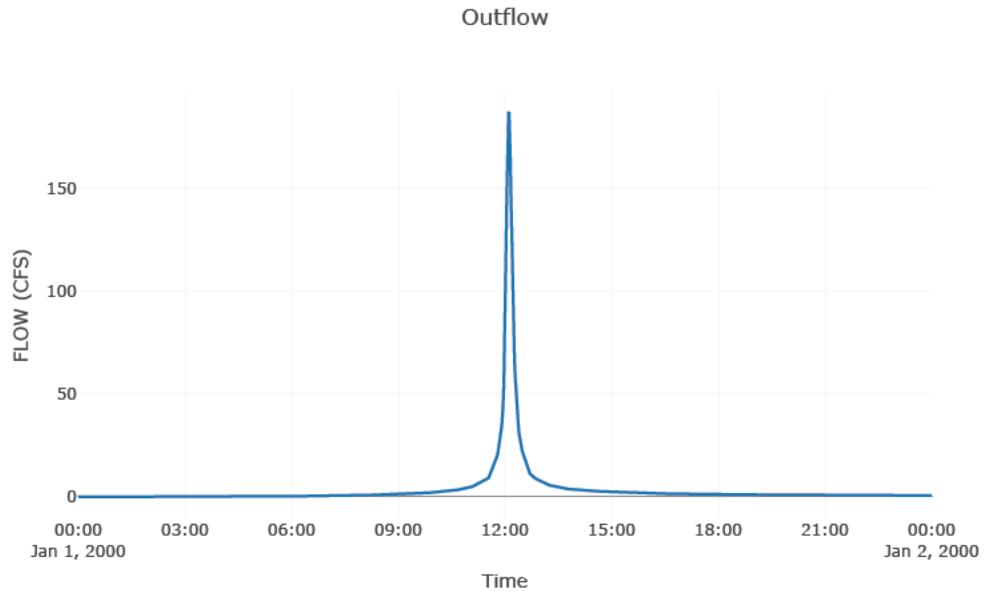
Results: Ditch C2	
Peak Discharge (CFS)	168.15
Time of Peak Discharge	01Jan2000, 12:18
Volume (IN)	2.89
Peak Inflow (CFS)	168.23
Inflow Volume (AC - FT)	8.98



Junction: B1 Junction

Downstream : Basin BC

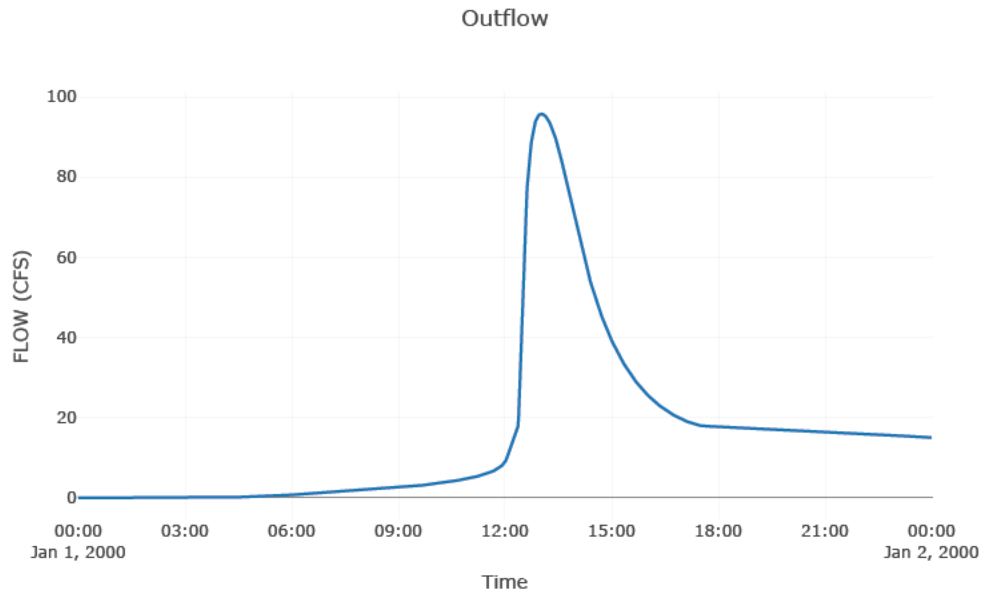
Results: B1 Junction	
Peak Discharge (CFS)	186.56
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91



Reservoir: Basin BC

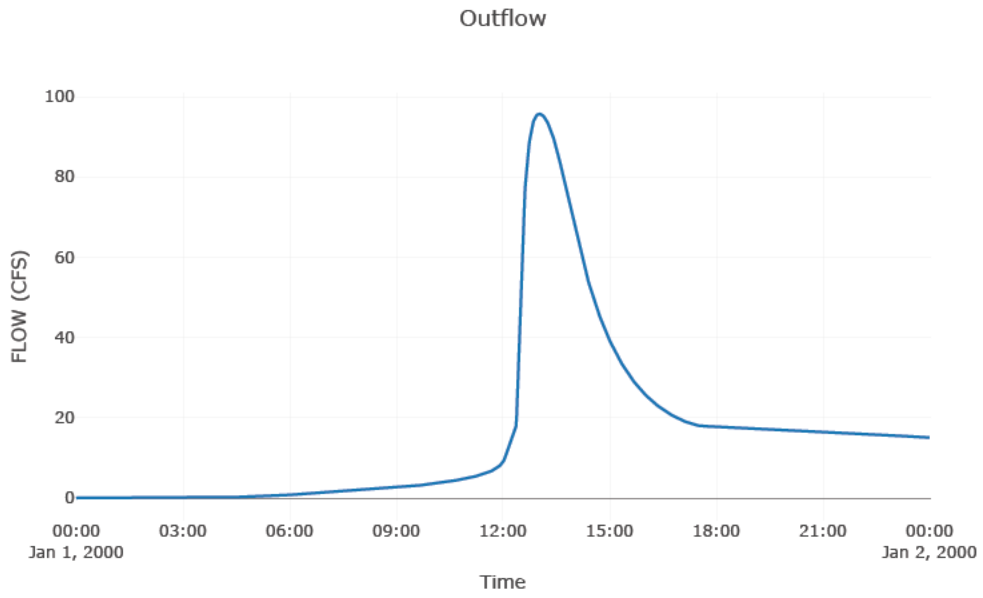
Downstream : Outfall BC

Results: Basin BC	
Peak Discharge (CFS)	95.71
Time of Peak Discharge	01Jan2000, 13:02
Volume (IN)	1.19
Peak Inflow (CFS)	545.27
Time of Peak Inflow	01Jan2000, 12:16
Inflow Volume (AC - FT)	42.38
Maximum Storage (AC - FT)	24.54
Peak Elevation (FT)	3905.39
Discharge Volume (AC - FT)	31.35



Sink: Outfall BC

Results: Outfall BC	
Peak Discharge (CFS)	95.71
Time of Peak Discharge	01Jan2000, 13:02
Volume (IN)	1.19



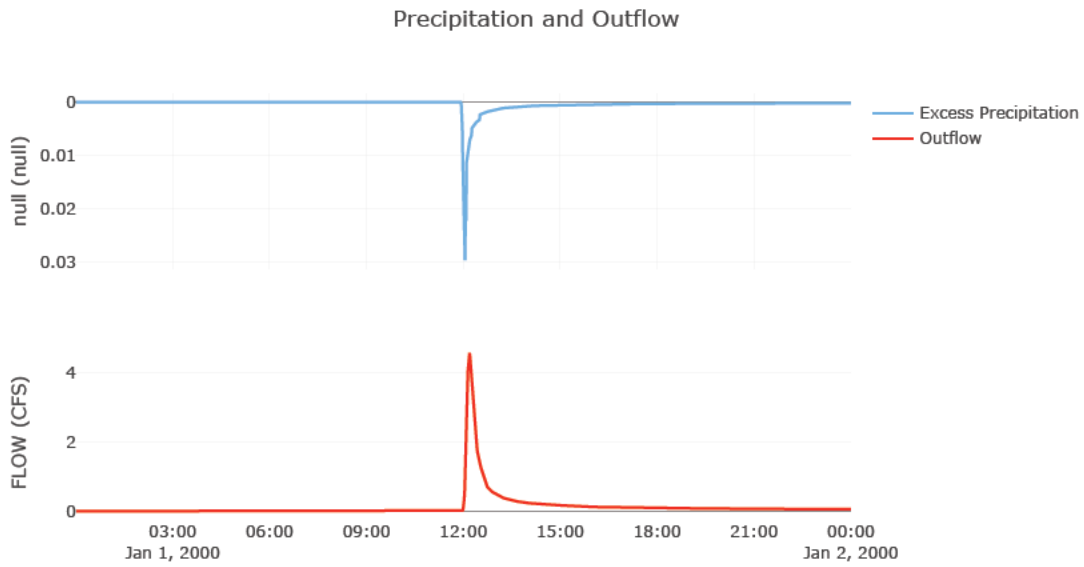
Subbasin: A1

Area (MI2) : 0.01
Downstream : Outfall A

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	63

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

Results: A1	
Peak Discharge (CFS)	4.57
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	0.6
Precipitation Volume (AC - FT)	1.4
Loss Volume (AC - FT)	1.15
Excess Volume (AC - FT)	0.25
Direct Runoff Volume (AC - FT)	0.25
Baseflow Volume (AC - FT)	0



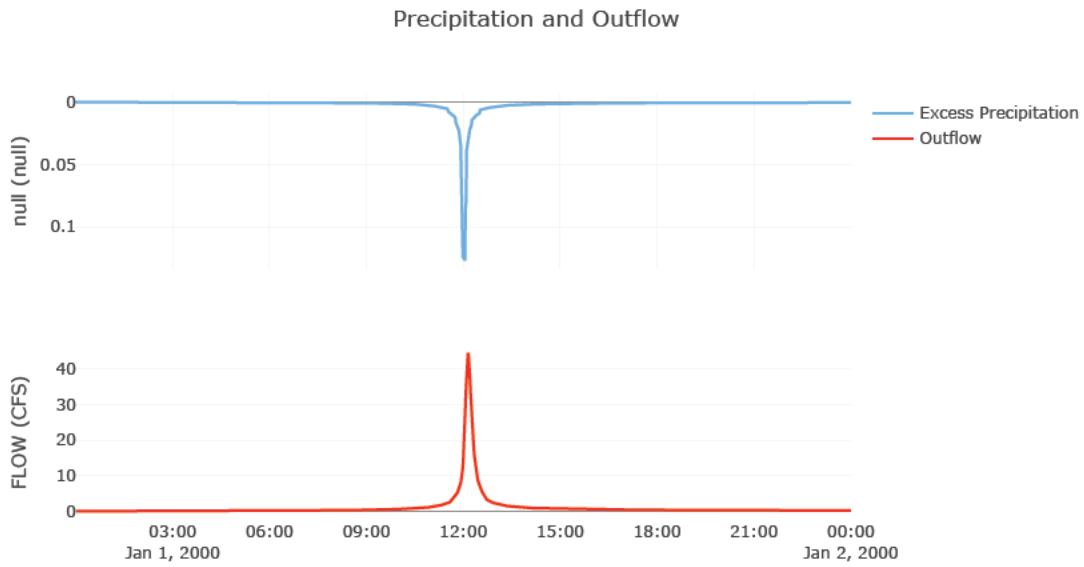
Subbasin: D4

Area (MI2) : 0.01
Downstream : D4 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

Results: D4	
Peak Discharge (CFS)	44.54
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.34
Loss Volume (AC - FT)	0.31
Excess Volume (AC - FT)	2.02
Direct Runoff Volume (AC - FT)	2.02
Baseflow Volume (AC - FT)	0



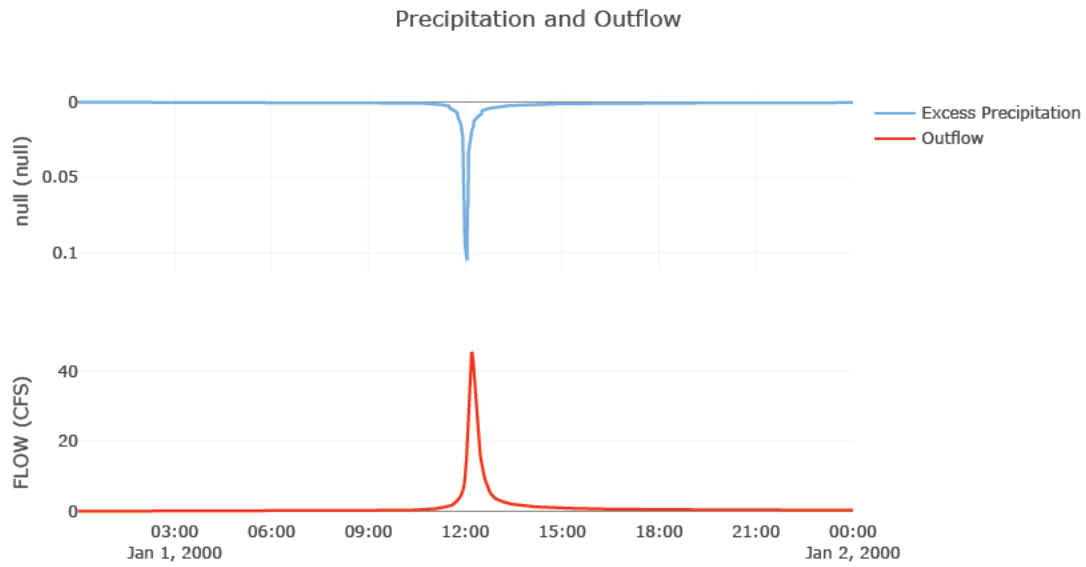
Subbasin: D6

Area (MI2) : 0.02
Downstream : Ditch D1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	88

Transform: Scs	
Lag	10.2
Unitgraph Type	Standard

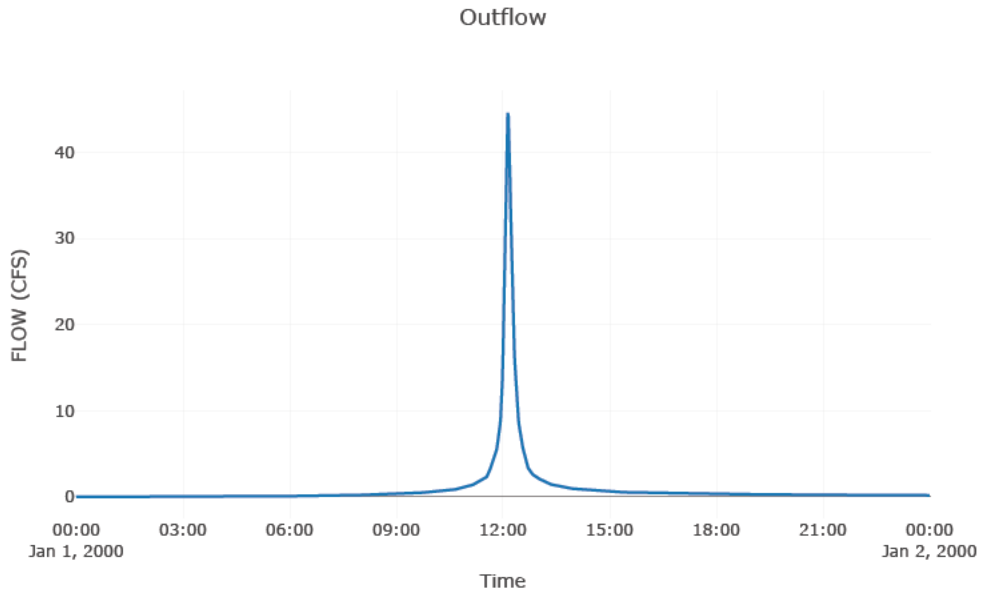
Results: D6	
Peak Discharge (CFS)	45.14
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.15
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	1.3
Excess Volume (AC - FT)	2.29
Direct Runoff Volume (AC - FT)	2.29
Baseflow Volume (AC - FT)	0



Junction: D4 Junction

Downstream : Ditch D1

Results: D4 Junction	
Peak Discharge (CFS)	44.54
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91

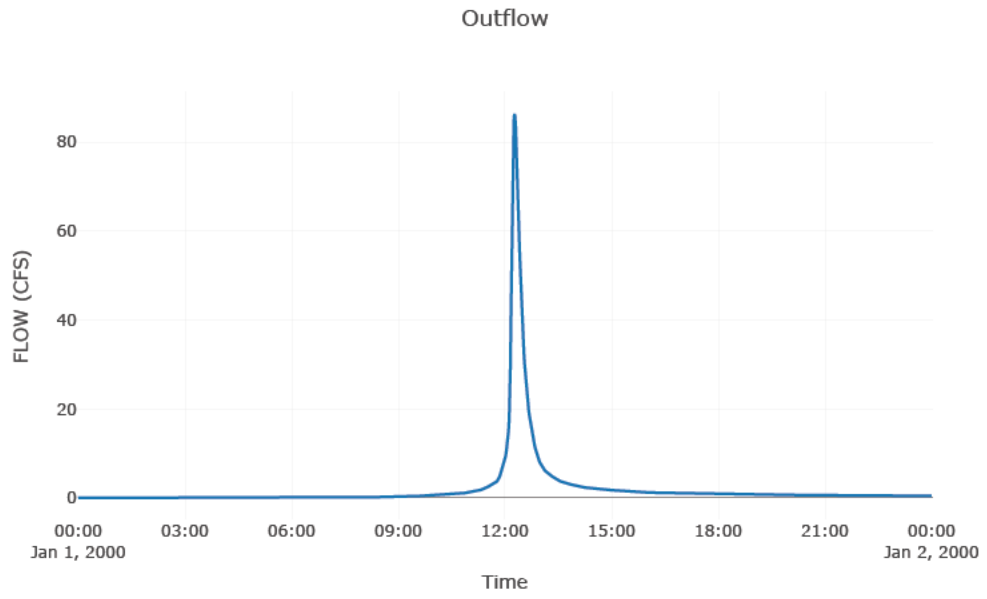


Reach: Ditch D1

Downstream : D1 Junction

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	1300
Energy Slope (FT/FT)	0
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch D1	
Peak Discharge (CFS)	86.38
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	2.43
Peak Inflow (CFS)	86.54
Inflow Volume (AC - FT)	4.31



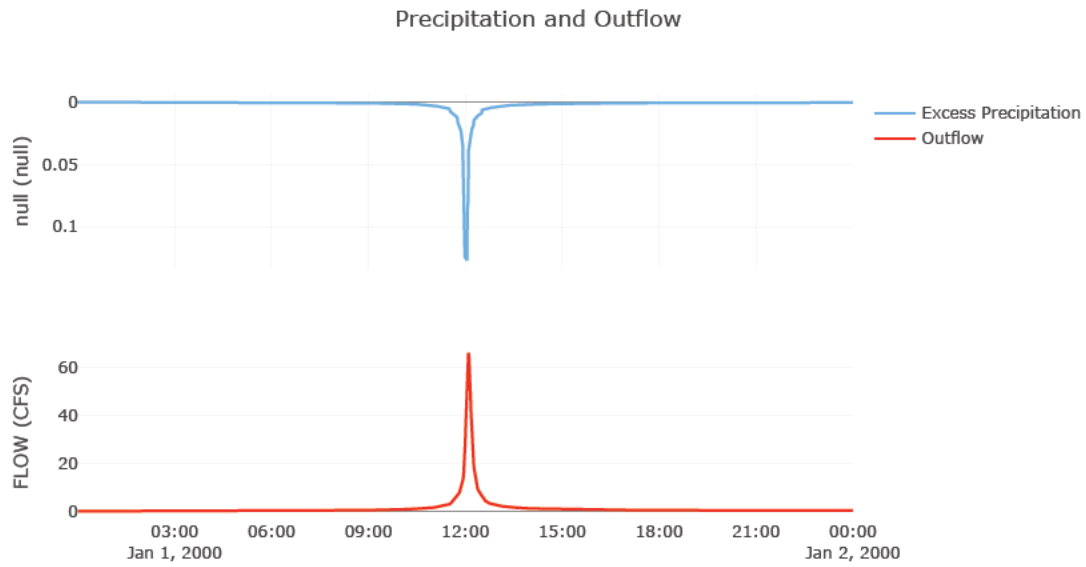
Subbasin: D1

Area (MI2) : 0.02
Downstream : D1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.2
Unitgraph Type	Standard

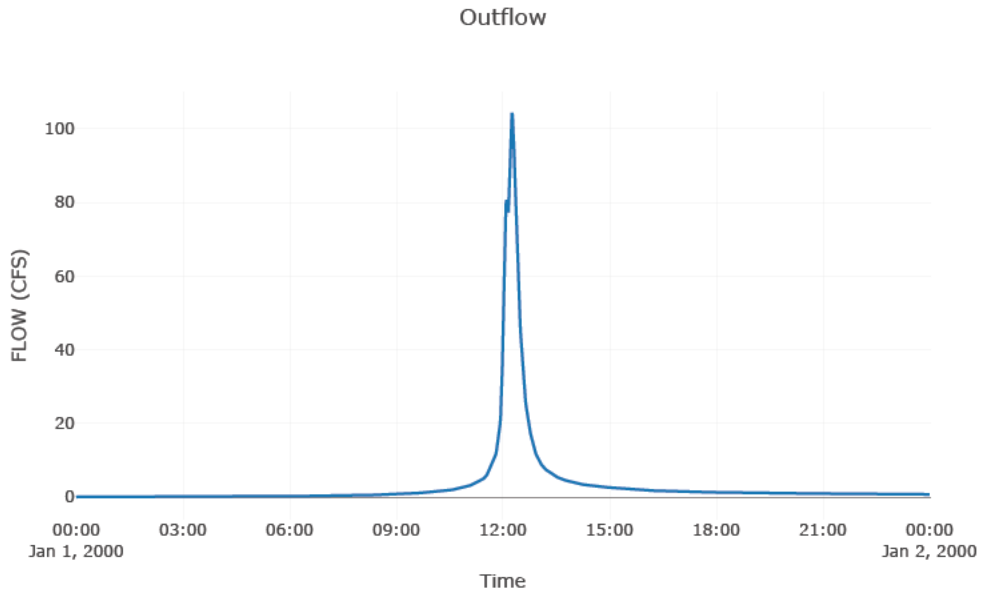
Results: D1	
Peak Discharge (CFS)	66.08
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.88
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.49
Direct Runoff Volume (AC - FT)	2.49
Baseflow Volume (AC - FT)	0



Junction: D1 Junction

Downstream : Ditch D2

Results: D1 Junction	
Peak Discharge (CFS)	104.3
Time of Peak Discharge	01Jan2000, 12:15
Volume (IN)	2.59



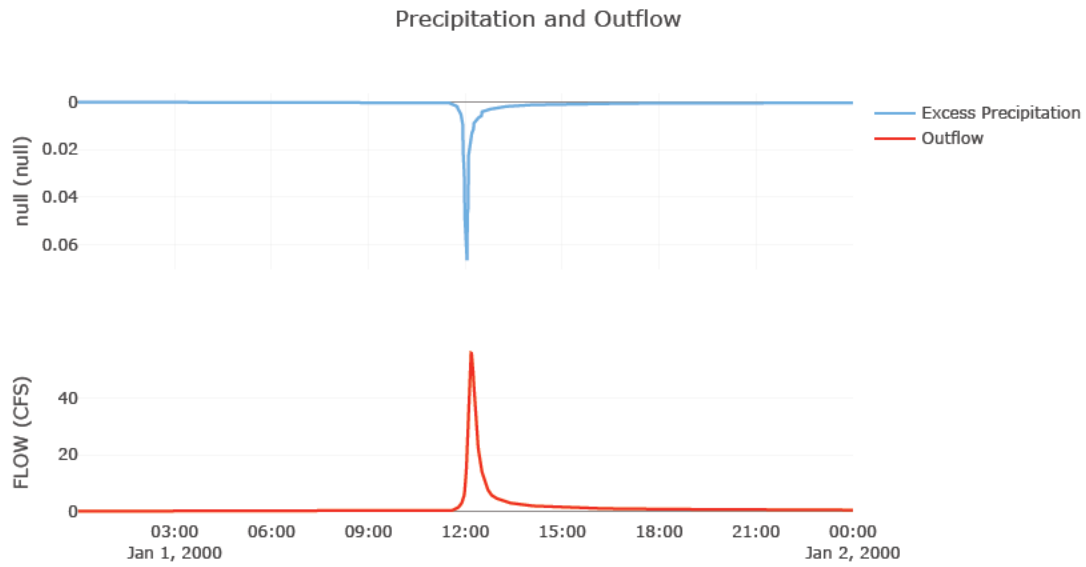
Subbasin: D5

Area (MI2) : 0.04
Downstream : Ditch D2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	76

Transform: Scs	
Lag	8.4
Unitgraph Type	Standard

Results: D5	
Peak Discharge (CFS)	56
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	1.27
Precipitation Volume (AC - FT)	7.01
Loss Volume (AC - FT)	4.36
Excess Volume (AC - FT)	2.65
Direct Runoff Volume (AC - FT)	2.64
Baseflow Volume (AC - FT)	0



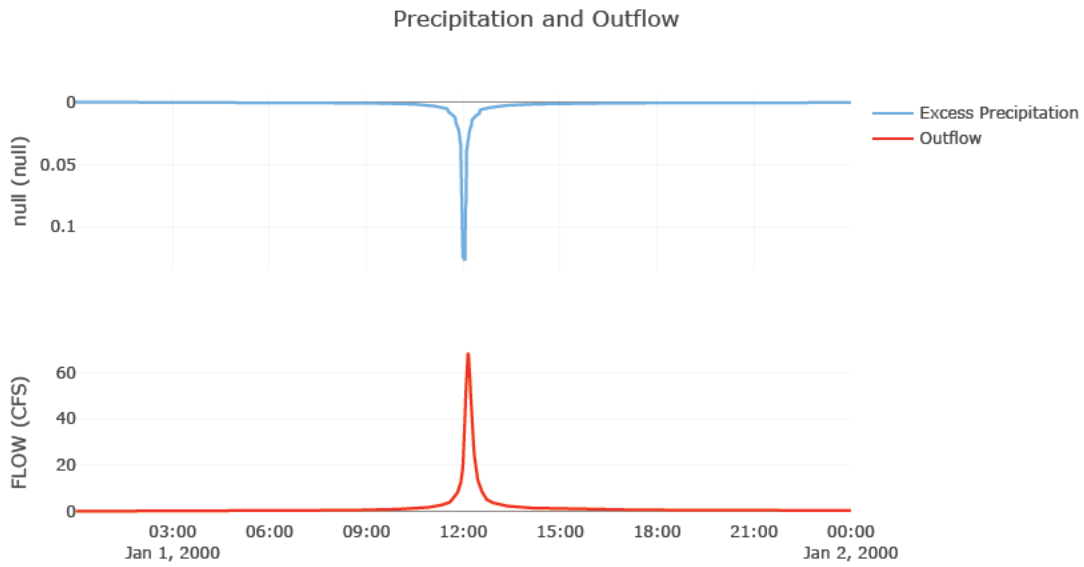
Subbasin: D3

Area (MI2) : 0.02
Downstream : Ditch D2

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

Results: D3	
Peak Discharge (CFS)	68.52
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	0.48
Excess Volume (AC - FT)	3.11
Direct Runoff Volume (AC - FT)	3.11
Baseflow Volume (AC - FT)	0

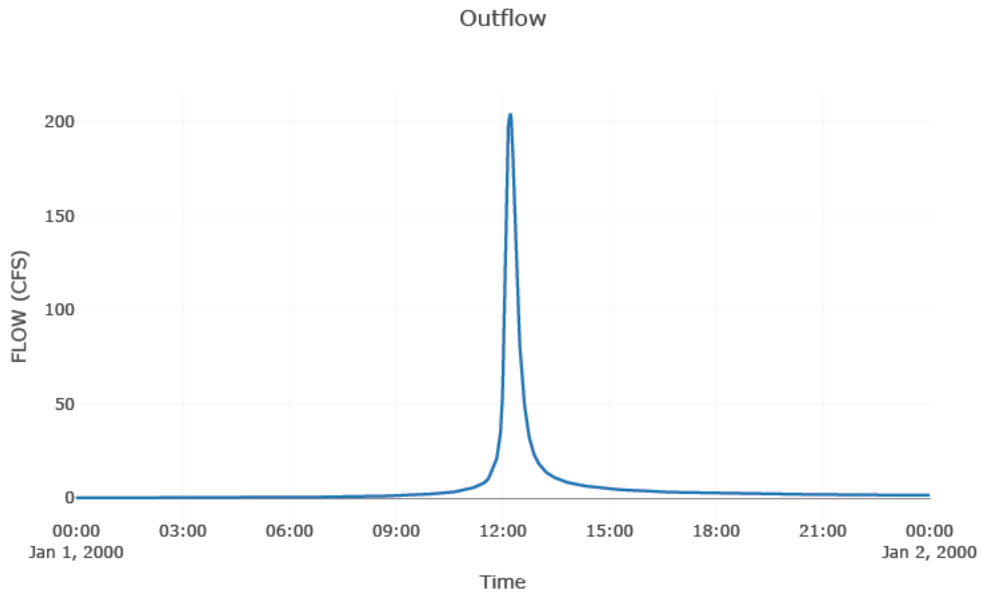


Reach: Ditch D2

Downstream : Junction - 2

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	400
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

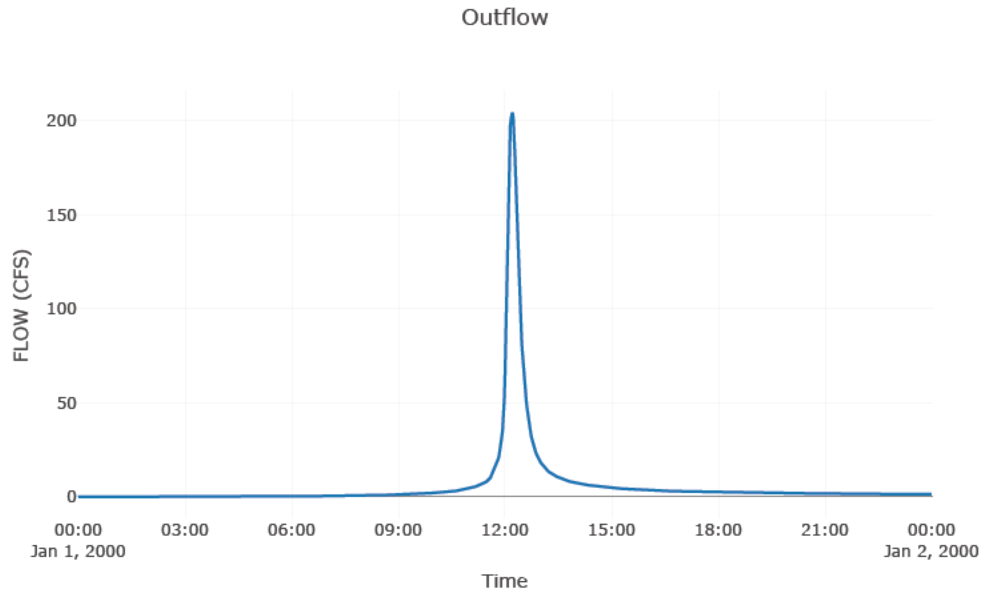
Results: Ditch D2	
Peak Discharge (CFS)	204.15
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.17
Peak Inflow (CFS)	204.3
Inflow Volume (AC - FT)	12.52



Junction: Junction-2

Downstream : Ditch D3

Results: Junction-2	
Peak Discharge (CFS)	204.15
Time of Peak Discharge	01Jan2000, 12:12
Volume (IN)	2.17



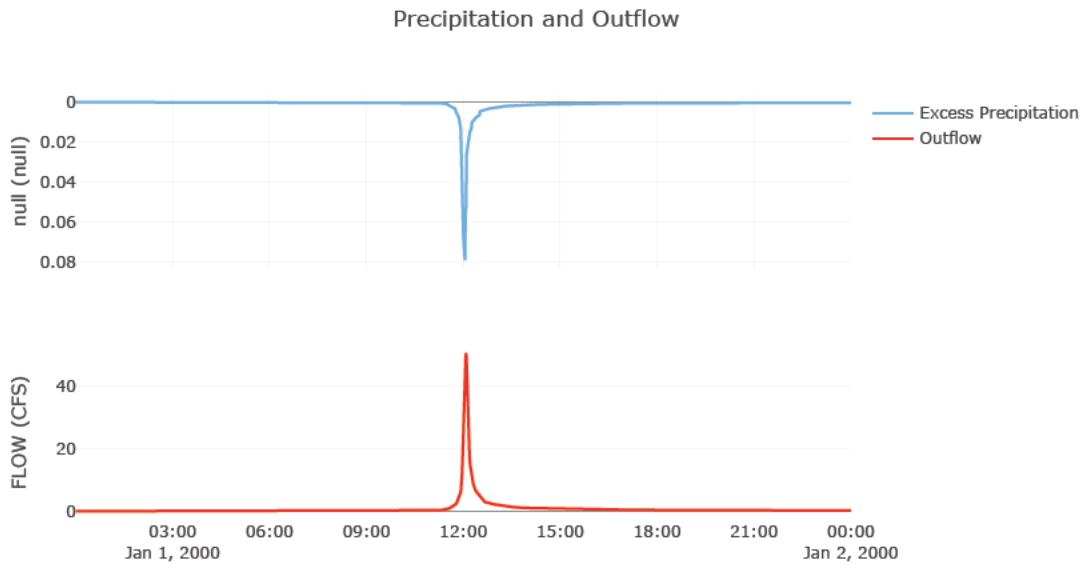
Subbasin: E6

Area (MI2) : 0.02
Downstream : Ditch D3

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	80

Transform: Scs	
Lag	2.4
Unitgraph Type	Standard

Results: E6	
Peak Discharge (CFS)	50.61
Time of Peak Discharge	01Jan2000, 12:04
Volume (IN)	1.53
Precipitation Volume (AC - FT)	3.41
Loss Volume (AC - FT)	1.86
Excess Volume (AC - FT)	1.55
Direct Runoff Volume (AC - FT)	1.55
Baseflow Volume (AC - FT)	0

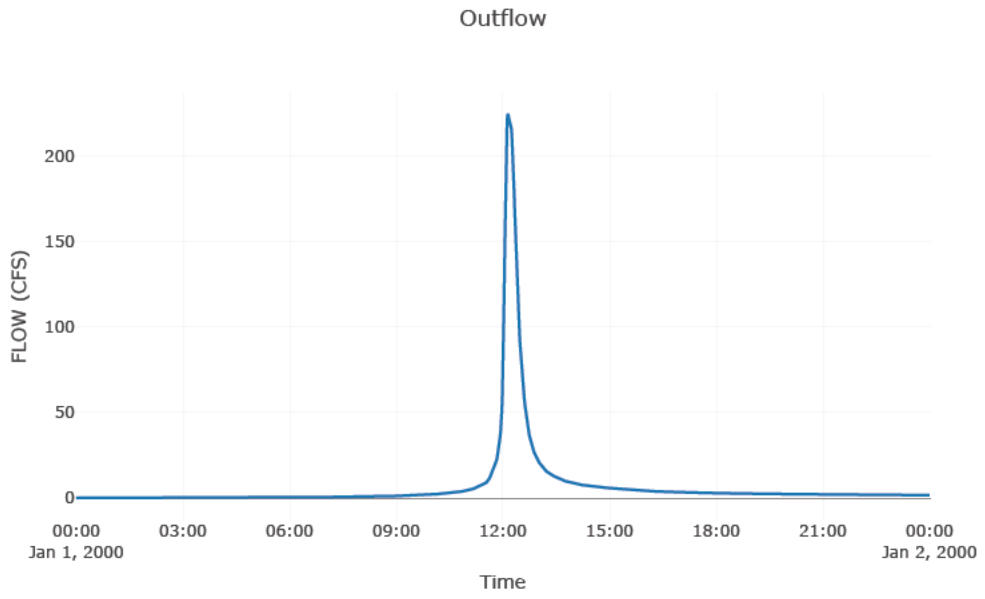


Reach: Ditch D3

Downstream : Basin DE

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	400
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch D3	
Peak Discharge (CFS)	224.54
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.07
Peak Inflow (CFS)	224.56
Inflow Volume (AC - FT)	14.06



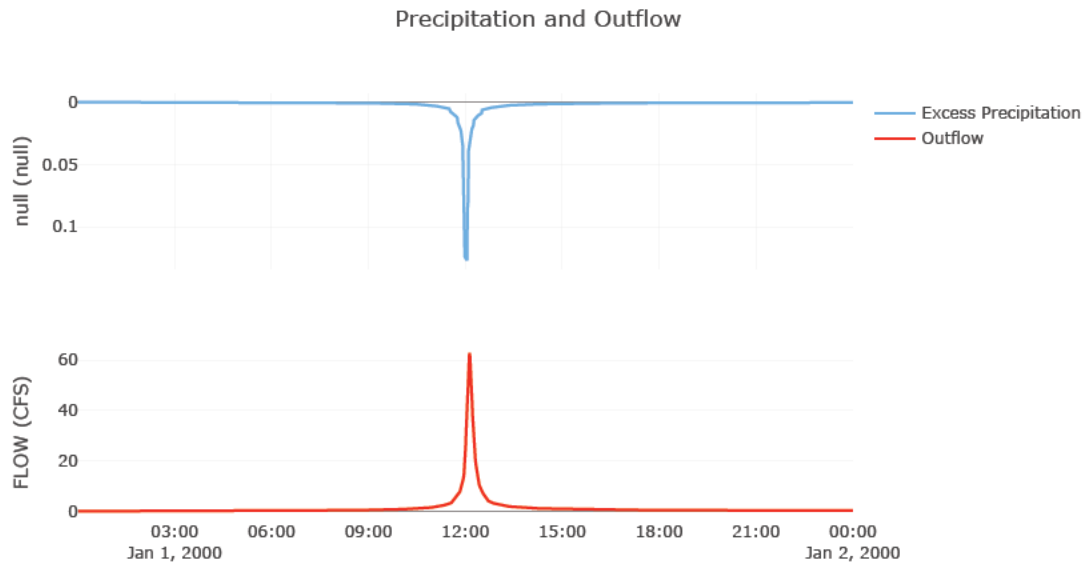
Subbasin: E2

Area (MI2) : 0.02
Downstream : E2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6
Unitgraph Type	Standard

Results: E2	
Peak Discharge (CFS)	62.76
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.06
Loss Volume (AC - FT)	0.41
Excess Volume (AC - FT)	2.64
Direct Runoff Volume (AC - FT)	2.64
Baseflow Volume (AC - FT)	0



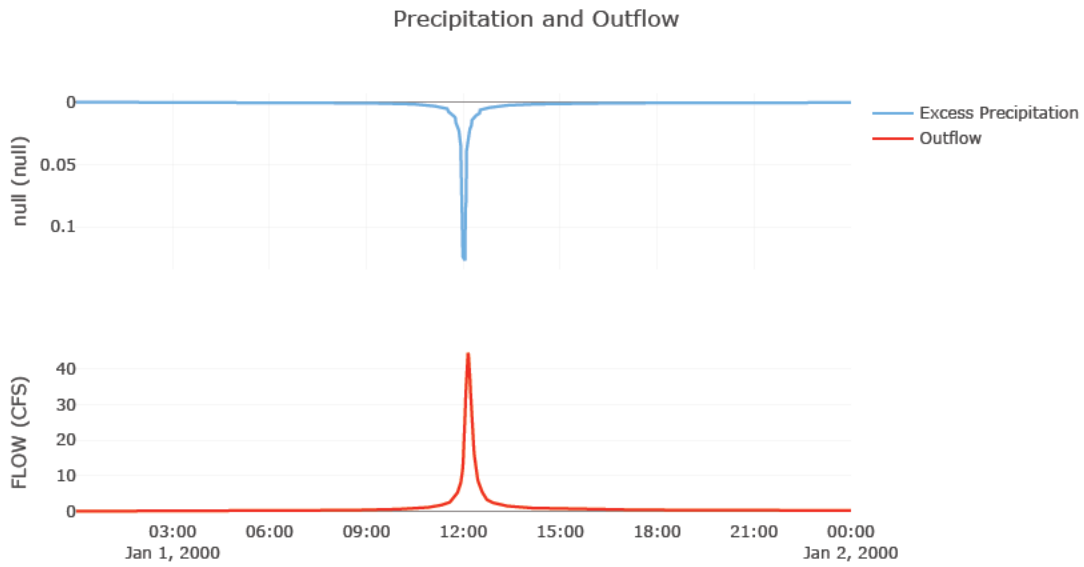
Subbasin: E5

Area (MI2) : 0.01
Downstream : E2 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	7.2
Unitgraph Type	Standard

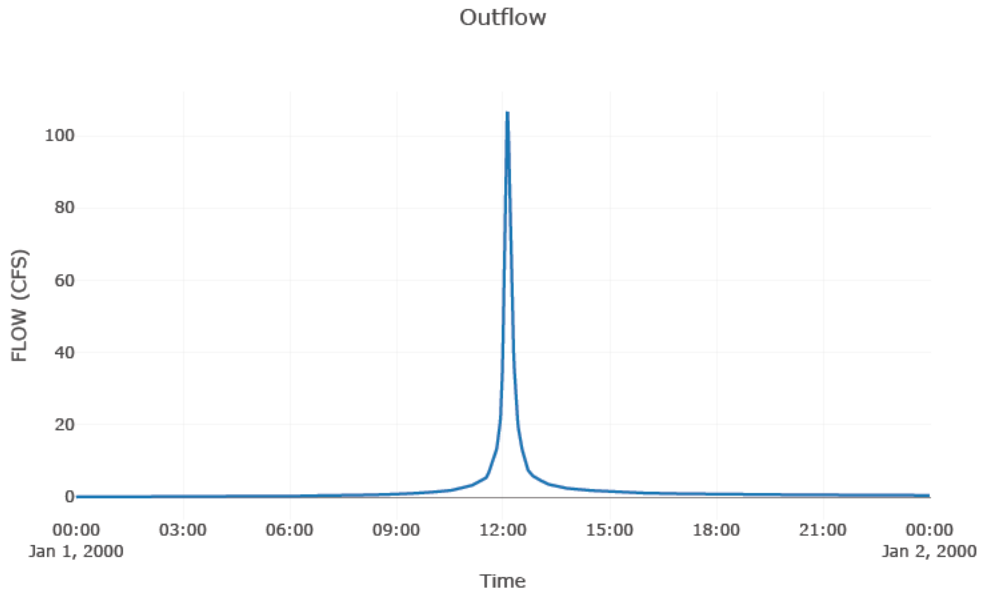
Results: E5	
Peak Discharge (CFS)	44.54
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.34
Loss Volume (AC - FT)	0.31
Excess Volume (AC - FT)	2.02
Direct Runoff Volume (AC - FT)	2.02
Baseflow Volume (AC - FT)	0



Junction: E2 Junction

Downstream : Ditch E1

Results: E2 Junction	
Peak Discharge (CFS)	106.29
Time of Peak Discharge	01Jan2000, 12:07
Volume (IN)	2.91



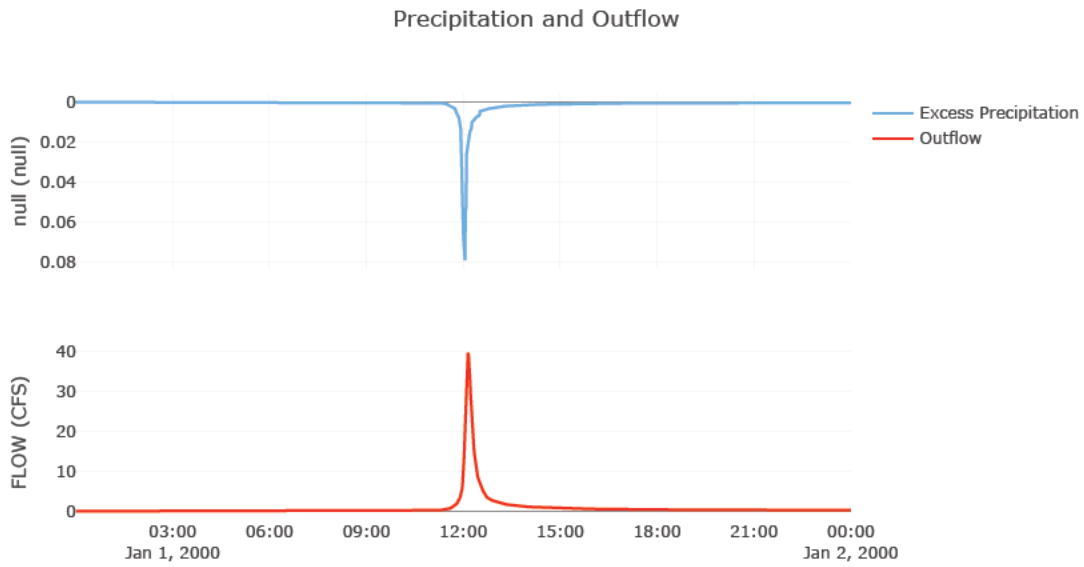
Subbasin: E4

Area (MI2) : 0.02
Downstream : Ditch E1

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	80

Transform: Scs	
Lag	6.6
Unitgraph Type	Standard

Results: E4	
Peak Discharge (CFS)	39.7
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	1.53
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	1.96
Excess Volume (AC - FT)	1.64
Direct Runoff Volume (AC - FT)	1.63
Baseflow Volume (AC - FT)	0

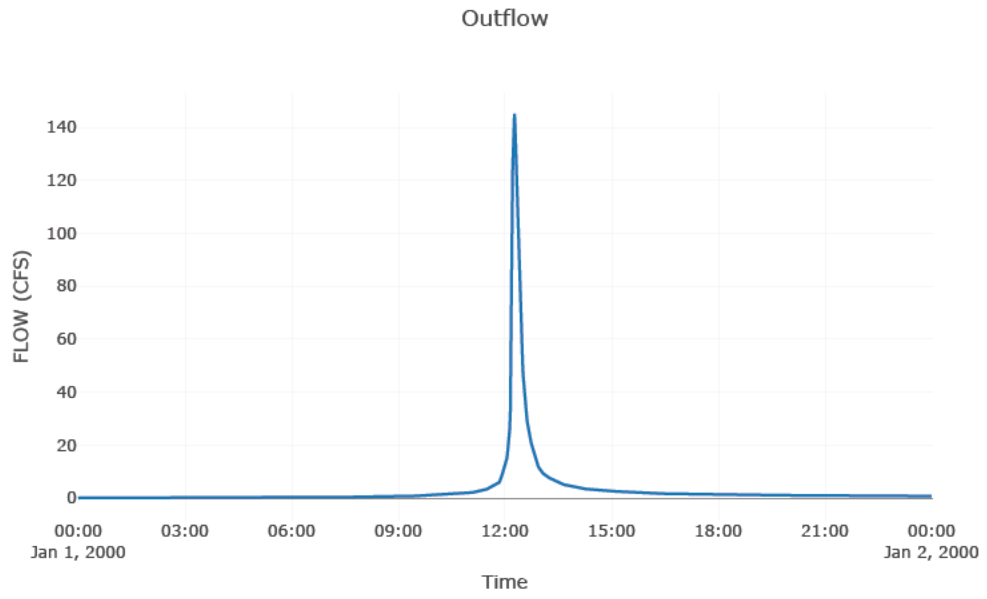


Reach: Ditch E1

Downstream : E1 Junction

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	2425
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

Results: Ditch E1	
Peak Discharge (CFS)	145.11
Time of Peak Discharge	01Jan2000, 12:16
Volume (IN)	2.34
Peak Inflow (CFS)	145.99
Inflow Volume (AC - FT)	6.3



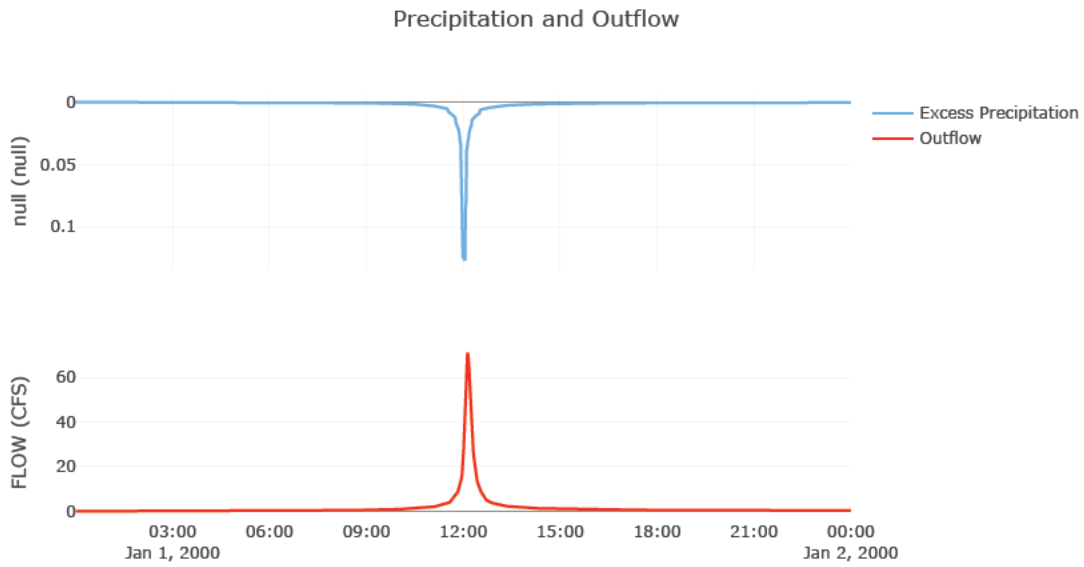
Subbasin: E3

Area (MI2) : 0.02
Downstream : E1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	6.6
Unitgraph Type	Standard

Results: E3	
Peak Discharge (CFS)	70.98
Time of Peak Discharge	01Jan2000, 12:08
Volume (IN)	2.91
Precipitation Volume (AC - FT)	3.59
Loss Volume (AC - FT)	0.48
Excess Volume (AC - FT)	3.11
Direct Runoff Volume (AC - FT)	3.11
Baseflow Volume (AC - FT)	0



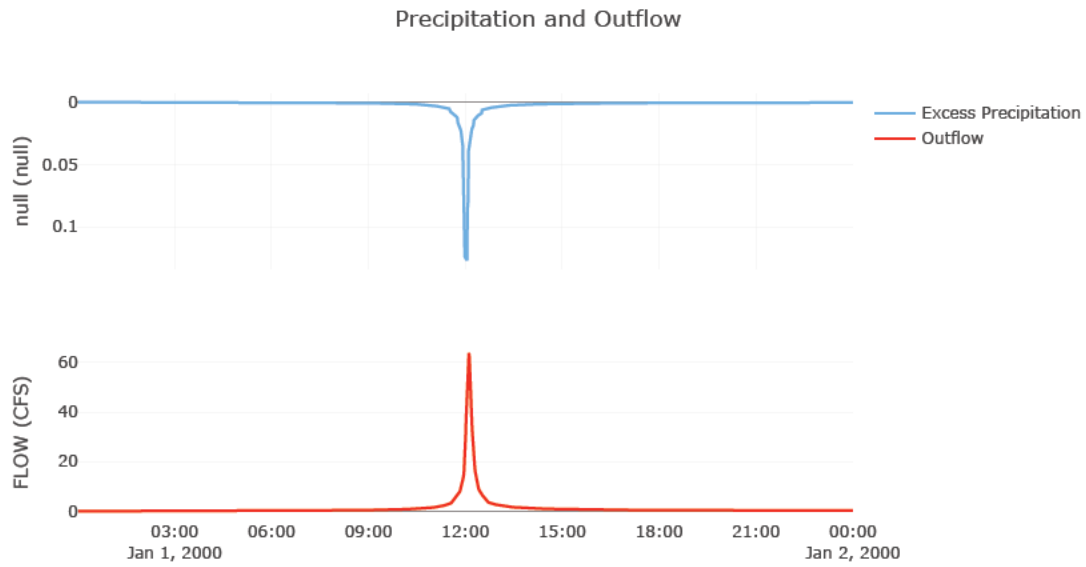
Subbasin: E1

Area (MI2) : 0.02
Downstream : E1 Junction

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	96

Transform: Scs	
Lag	4.8
Unitgraph Type	Standard

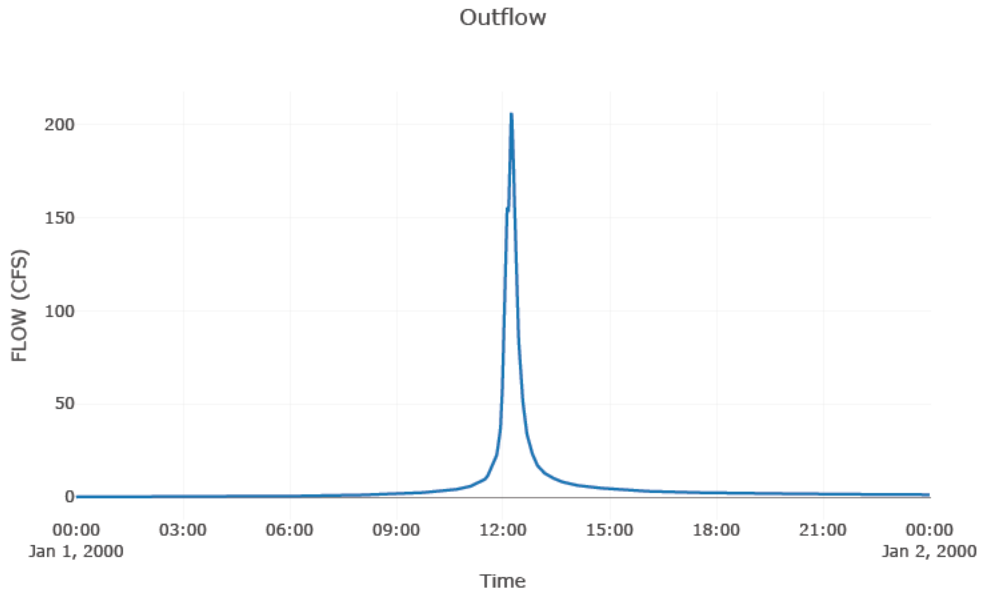
Results: E1	
Peak Discharge (CFS)	63.77
Time of Peak Discharge	01Jan2000, 12:06
Volume (IN)	2.91
Precipitation Volume (AC - FT)	2.88
Loss Volume (AC - FT)	0.39
Excess Volume (AC - FT)	2.49
Direct Runoff Volume (AC - FT)	2.49
Baseflow Volume (AC - FT)	0



Junction: E1 Junction

Downstream : Culvert E2

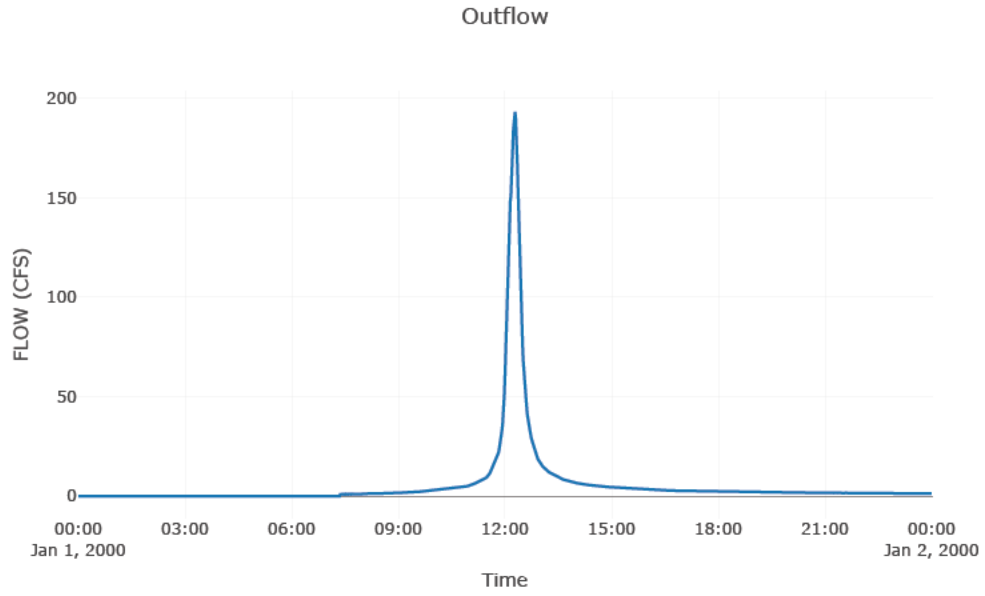
Results: E1 Junction	
Peak Discharge (CFS)	206.41
Time of Peak Discharge	01Jan2000, 12:14
Volume (IN)	2.58



Reservoir: Culvert E2

Downstream : Ditch E2

Results: Culvert E2	
Peak Discharge (CFS)	193.17
Time of Peak Discharge	01Jan2000, 12:17
Volume (IN)	2.56
Peak Inflow (CFS)	206.41
Time of Peak Inflow	01Jan2000, 12:14
Inflow Volume (AC - FT)	11.84
Maximum Storage (AC - FT)	1.27
Peak Elevation (FT)	3966.39
Discharge Volume (AC - FT)	11.73

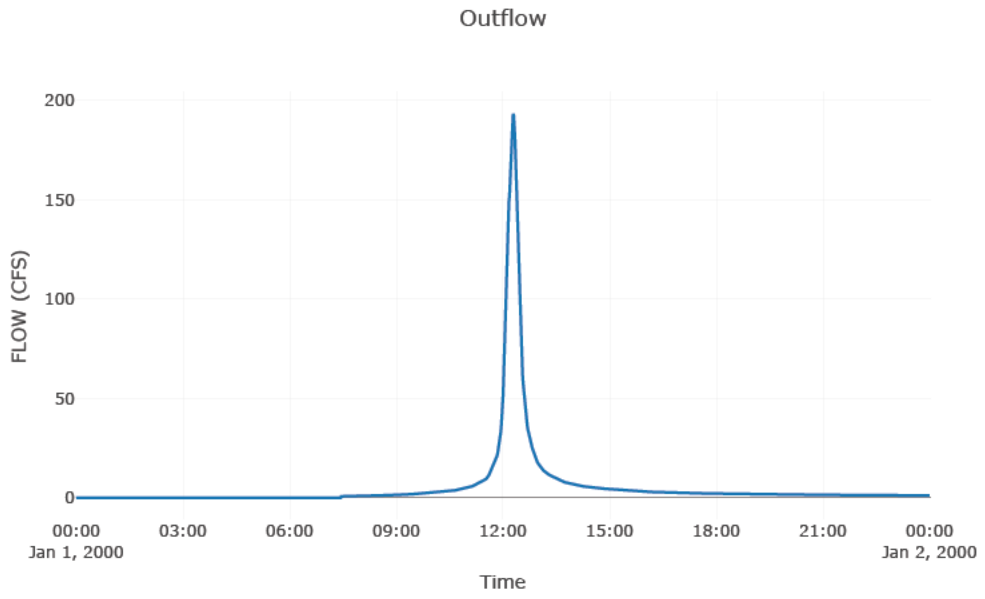


Reach: Ditch E2

Downstream : Basin DE

Route: Kinematic Wave	
Method	Kinematic Wave
Channel	Kinematic Wave
Length (FT)	570
Energy Slope (FT/FT)	0.05
Mannings n	0.04
Shape	Trapezoid
Number of Subreaches	2
Width (FT)	8
Side Slope (FT/FT)	5
Initial Variable	Combined Inflow
Index Parameter Type	Index Flow
Index Flow	0.05

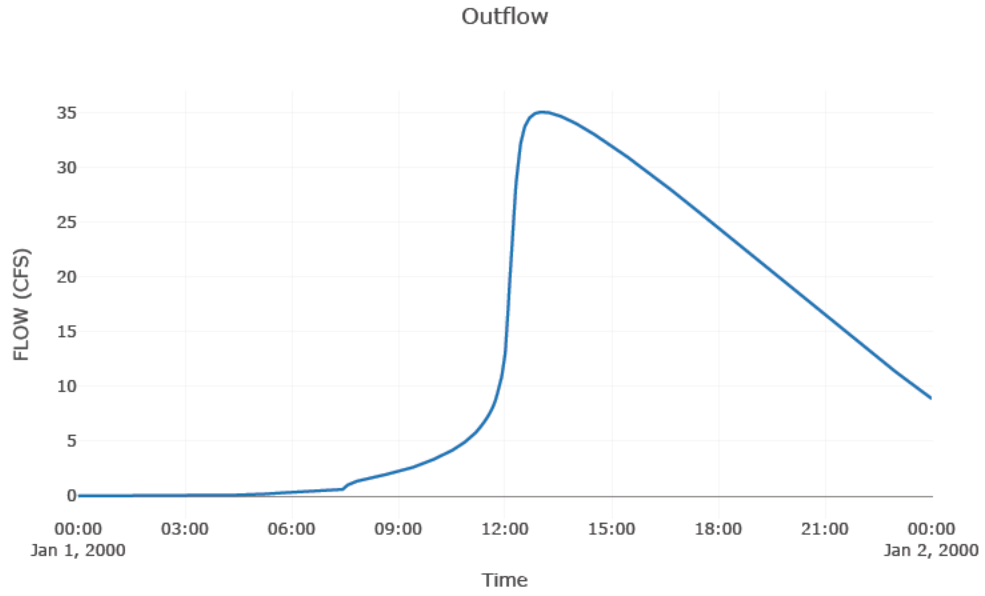
Results: Ditch E2	
Peak Discharge (CFS)	193.17
Time of Peak Discharge	01Jan2000, 12:17
Volume (IN)	2.55
Peak Inflow (CFS)	193.17
Inflow Volume (AC - FT)	11.73



Reservoir: Basin DE

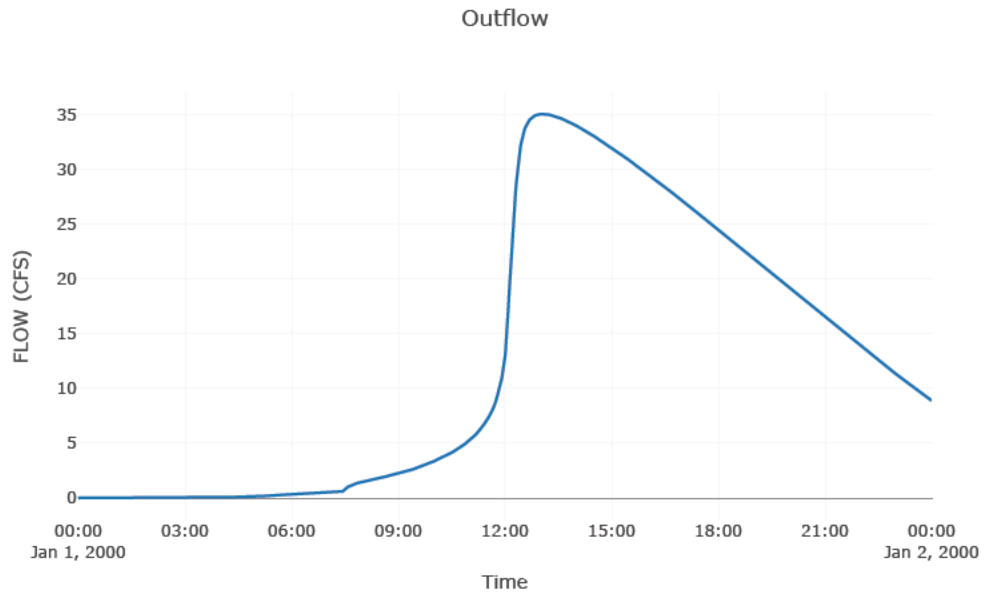
Downstream : Outfall DE

Results: Basin DE	
Peak Discharge (CFS)	35.12
Time of Peak Discharge	01Jan2000, 13:03
Volume (IN)	2.18
Peak Inflow (CFS)	396.8
Time of Peak Inflow	01Jan2000, 12:15
Inflow Volume (AC - FT)	25.76
Maximum Storage (AC - FT)	19.61
Peak Elevation (FT)	3940.59
Discharge Volume (AC - FT)	24.82



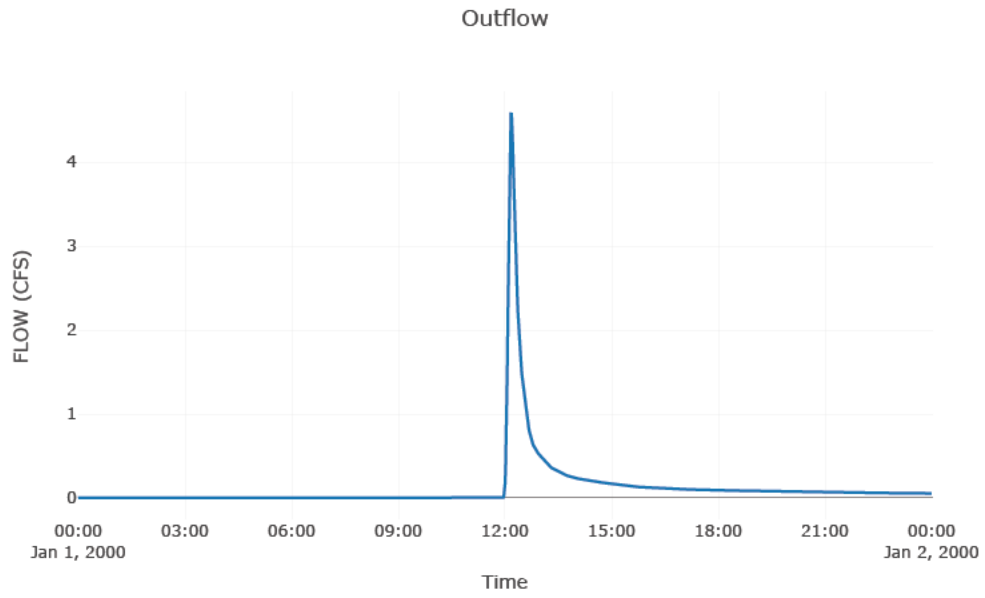
Sink: Outfall DE

Results: Outfall DE	
Peak Discharge (CFS)	35.12
Time of Peak Discharge	01Jan2000, 13:03
Volume (IN)	2.18



Sink: Outfall A

Results: Outfall A	
Peak Discharge (CFS)	4.57
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	0.6



NOAA Atlas 14, Volume 11, Version 2
Location name: El Paso, Texas, USA*
Latitude: 31.5954°, Longitude: -106.1722°
Elevation: 3938 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.235** (0.178-0.311)	**0.300** (0.228-0.387)	**0.402** (0.306-0.526)	**0.490** (0.368-0.653)	**0.615** (0.446-0.843)	**0.713** (0.504-1.01)	**0.819** (0.565-1.19)	**0.939** (0.631-1.40)	**1.11** (0.723-1.72)	**1.26** (0.795-1.98)
10-min	**0.394** (0.298-0.520)	**0.502** (0.381-0.647)	**0.672** (0.511-0.879)	**0.818** (0.614-1.09)	**1.03** (0.747-1.41)	**1.19** (0.845-1.69)	**1.37** (0.944-1.98)	**1.56** (1.05-2.32)	**1.82** (1.18-2.81)	**2.03** (1.29-3.21)
15-min	**0.452** (0.342-0.597)	**0.576** (0.437-0.744)	**0.772** (0.588-1.01)	**0.941** (0.706-1.25)	**1.18** (0.856-1.62)	**1.37** (0.966-1.93)	**1.57** (1.08-2.28)	**1.80** (1.21-2.69)	**2.15** (1.40-3.32)	**2.44** (1.54-3.85)
30-min	**0.560** (0.424-0.739)	**0.714** (0.542-0.922)	**0.957** (0.728-1.25)	**1.17** (0.875-1.55)	**1.46** (1.06-2.01)	**1.70** (1.20-2.39)	**1.95** (1.34-2.83)	**2.24** (1.51-3.34)	**2.67** (1.73-4.12)	**3.02** (1.91-4.77)
60-min	**0.671** (0.508-0.887)	**0.856** (0.649-1.10)	**1.15** (0.872-1.50)	**1.40** (1.05-1.86)	**1.75** (1.27-2.40)	**2.03** (1.44-2.87)	**2.34** (1.61-3.39)	**2.68** (1.80-3.98)	**3.17** (2.06-4.89)	**3.58** (2.26-5.65)
2-hr	**0.785** (0.597-1.03)	**0.996** (0.760-1.28)	**1.33** (1.02-1.73)	**1.61** (1.22-2.14)	**2.02** (1.47-2.75)	**2.34** (1.66-3.27)	**2.68** (1.86-3.86)	**3.08** (2.08-4.55)	**3.66** (2.39-5.61)	**4.15** (2.64-6.51)
3-hr	**0.853** (0.652-1.12)	**1.08** (0.828-1.38)	**1.44** (1.10-1.87)	**1.74** (1.32-2.30)	**2.18** (1.59-2.95)	**2.52** (1.79-3.51)	**2.89** (2.00-4.14)	**3.32** (2.24-4.88)	**3.96** (2.59-6.04)	**4.50** (2.86-7.02)
6-hr	**0.962** (0.739-1.25)	**1.22** (0.939-1.55)	**1.63** (1.26-2.10)	**1.98** (1.50-2.59)	**2.47** (1.81-3.33)	**2.86** (2.04-3.96)	**3.28** (2.29-4.68)	**3.78** (2.57-5.54)	**4.54** (2.98-6.88)	**5.18** (3.31-8.02)
12-hr	**1.04** (0.805-1.35)	**1.34** (1.03-1.68)	**1.80** (1.40-2.30)	**2.20** (1.69-2.88)	**2.79** (2.06-3.74)	**3.26** (2.34-4.49)	**3.78** (2.65-5.35)	**4.38** (2.99-6.36)	**5.29** (3.48-7.95)	**6.06** (3.88-9.30)
24-hr	**1.13** (0.875-1.45)	**1.48** (1.13-1.83)	**2.00** (1.55-2.54)	**2.47** (1.90-3.20)	**3.17** (2.36-4.23)	**3.75** (2.72-5.15)	**4.39** (3.09-6.17)	**5.13** (3.51-7.38)	**6.21** (4.10-9.25)	**7.11** (4.58-10.8)
2-day	**1.25** (0.976-1.60)	**1.67** (1.28-2.03)	**2.28** (1.78-2.87)	**2.85** (2.20-3.67)	**3.70** (2.78-4.94)	**4.44** (3.24-6.07)	**5.25** (3.71-7.32)	**6.13** (4.21-8.75)	**7.38** (4.90-10.9)	**8.41** (5.43-12.7)
3-day	**1.34** (1.05-1.71)	**1.81** (1.39-2.19)	**2.48** (1.94-3.11)	**3.10** (2.41-3.99)	**4.05** (3.06-5.39)	**4.87** (3.57-6.64)	**5.77** (4.09-8.02)	**6.73** (4.64-9.57)	**8.10** (5.38-11.9)	**9.19** (5.95-13.8)
4-day	**1.42** (1.12-1.81)	**1.91** (1.47-2.31)	**2.62** (2.06-3.29)	**3.28** (2.56-4.21)	**4.28** (3.24-5.68)	**5.14** (3.78-6.99)	**6.09** (4.33-8.44)	**7.11** (4.90-10.1)	**8.54** (5.68-12.5)	**9.71** (6.29-14.6)
7-day	**1.61** (1.27-2.04)	**2.15** (1.67-2.60)	**2.94** (2.32-3.67)	**3.66** (2.86-4.67)	**4.75** (3.60-6.25)	**5.67** (4.17-7.65)	**6.68** (4.77-9.20)	**7.79** (5.40-11.0)	**9.38** (6.26-13.7)	**10.7** (6.95-15.9)
10-day	**1.77** (1.40-2.24)	**2.34** (1.83-2.84)	**3.19** (2.53-3.98)	**3.96** (3.11-5.04)	**5.11** (3.88-6.70)	**6.07** (4.47-8.15)	**7.12** (5.09-9.77)	**8.28** (5.75-11.6)	**9.95** (6.66-14.4)	**11.3** (7.38-16.8)
20-day	**2.27** (1.81-2.85)	**2.92** (2.32-3.56)	**3.92** (3.13-4.86)	**4.79** (3.78-6.05)	**6.06** (4.61-7.86)	**7.07** (5.23-9.42)	**8.17** (5.87-11.1)	**9.38** (6.55-13.1)	**11.1** (7.47-16.0)	**12.5** (8.19-18.4)
30-day	**2.67** (2.14-3.34)	**3.38** (2.72-4.14)	**4.50** (3.62-5.57)	**5.46** (4.32-6.87)	**6.81** (5.20-8.80)	**7.88** (5.84-10.4)	**9.01** (6.49-12.2)	**10.3** (7.18-14.2)	**12.0** (8.10-17.2)	**13.4** (8.80-19.7)
45-day	**3.20** (2.57-3.98)	**4.00** (3.24-4.91)	**5.30** (4.28-6.55)	**6.40** (5.08-8.02)	**7.92** (6.06-10.2)	**9.10** (6.76-12.0)	**10.3** (7.46-14.0)	**11.6** (8.18-16.1)	**13.5** (9.12-19.2)	**14.9** (9.82-21.8)
60-day	**3.65** (2.94-4.54)	**4.55** (3.70-5.58)	**6.01** (4.87-7.41)	**7.22** (5.75-9.04)	**8.91** (6.83-11.4)	**10.2** (7.60-13.4)	**11.5** (8.35-15.5)	**12.9** (9.10-17.8)	**14.8** (10.1-21.1)	**16.3** (10.8-23.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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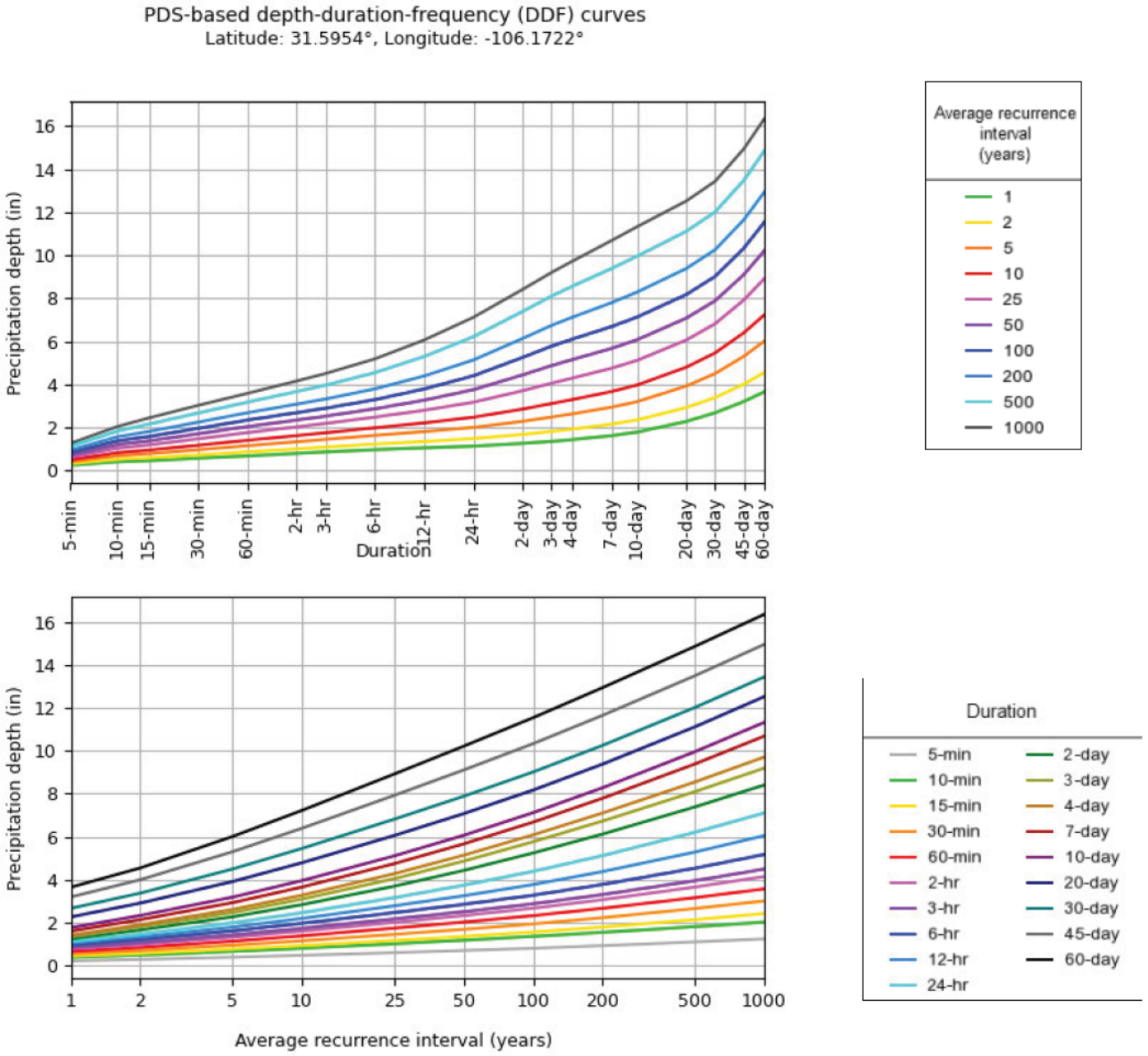
PF graphical



NOAA Atlas 14, Volume 11, Version 2

Created (GMT): Wed Apr 23 17:16:16 2025

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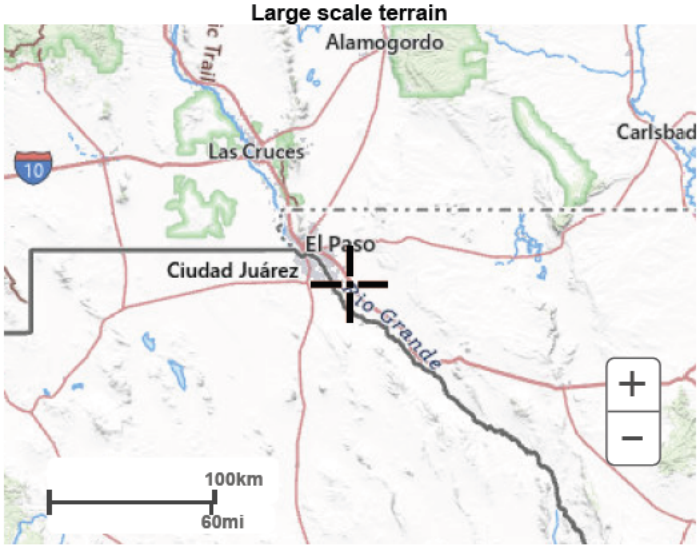
Maps & aerials

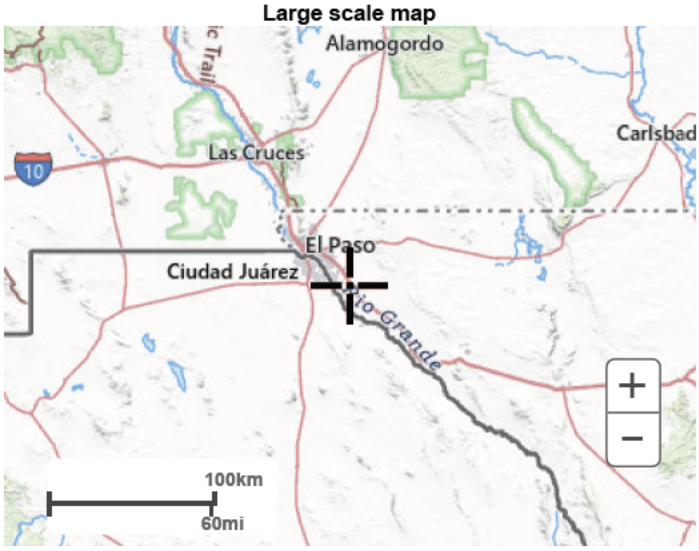
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Rainfall Intensity-Duration-Frequency Coefficients for Texas

Based on United States Geological Survey (USGS) Scientific Investigations Report 2004–5041
"Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas"

1. Select English or SI Units

English

2. Select or Enter a County

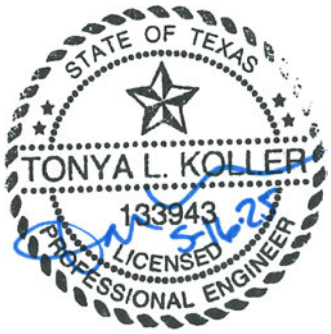
El Paso

3. Enter a Time of Conc.
Select Units

10 min

Coefficient	50% (2-year)	20% (5-year)	10% (10-year)	4% (25-year)	2% (50-year)	1% (100-year)
e	0.8722	0.8916	0.9184	0.9037	0.8987	0.8902
b (in.)	30.36	48.03	70.58	80.75	90.38	100.88
d (min)	4.11	5.22	7.20	7.36	7.76	8.56
Intensity (in./hr)	3.02	4.24	5.18	6.12	6.81	7.49

(Spreadsheet Release Date: August 31, 2015; data table reshuffle by Asquith July 14, 2016)


STATE OF TEXAS
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HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.00 cfs

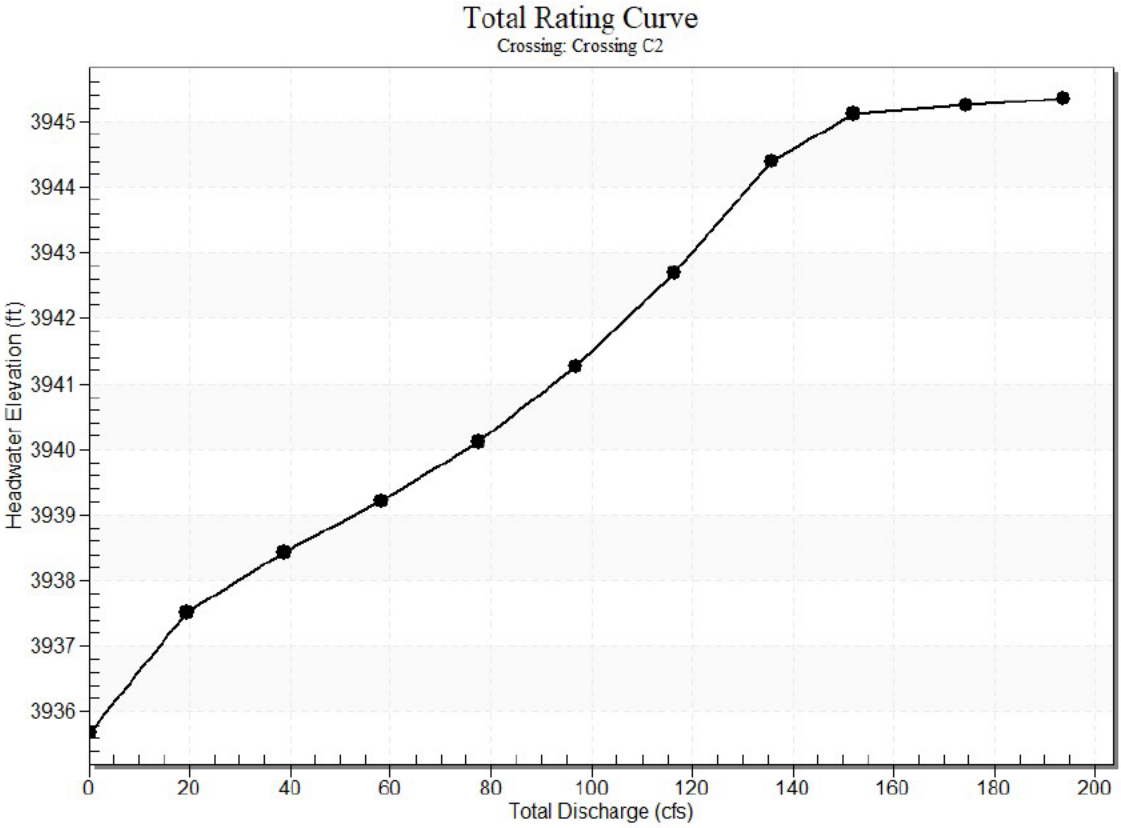
Design Flow: 152.00 cfs

Maximum Flow: 193.82 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing C2

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert C2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
3935.68	0.00	0.00	0.00	1
3937.51	19.38	19.38	0.00	1
3938.44	38.76	38.76	0.00	1
3939.22	58.15	58.15	0.00	1
3940.12	77.53	77.53	0.00	1
3941.26	96.91	96.91	0.00	1
3942.69	116.29	116.29	0.00	1
3944.39	135.67	135.67	0.00	1
3945.11	152.00	143.11	8.78	10
3945.25	174.44	144.51	29.79	6
3945.34	193.82	145.44	48.28	5
3945.00	141.96	141.96	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing C2



Culvert Data: Culvert C2

Table 1 - Culvert Summary Table: Culvert C2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00 cfs	0.00 cfs	3935.68	0.00	0.000	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
19.38 cfs	19.38 cfs	3937.51	1.83	0.0*	1-S2n	0.84	1.35	0.84	0.56	10.98	3.61
38.76 cfs	38.76 cfs	3938.44	2.76	0.0*	1-S2n	1.19	1.93	1.23	0.82	12.87	4.51
58.15 cfs	58.15 cfs	3939.22	3.54	0.0*	5-S2n	1.49	2.39	1.54	1.03	14.30	5.11
77.53	77.53	3940.1	4.44	1.34	5-	1.75	2.75	1.8	1.20	15.2	5.57

cfs	cfs	2		3	S2 n			3		1	
96.91 cfs	96.91 cfs	3941.26	5.58	2.729	5-S2 n	2.01	3.03	2.11	1.35	16.00	5.94
116.29 cfs	116.29 cfs	3942.69	7.01	4.348	5-S2 n	2.27	3.22	2.38	1.49	16.68	6.27
135.67 cfs	135.67 cfs	3944.39	8.71	6.206	5-S2 n	2.54	3.34	2.66	1.61	17.26	6.55
152.00 cfs	143.11 cfs	3945.11	9.43	6.904	5-S2 n	2.66	3.20	2.77	1.71	17.50	6.76
174.44 cfs	144.51 cfs	3945.25	9.57	7.040	5-S2 n	2.69	3.18	2.79	1.84	17.57	7.02
193.82 cfs	145.44 cfs	3945.34	9.66	7.133	5-S2 n	2.70	3.17	2.80	1.94	17.60	7.23

* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

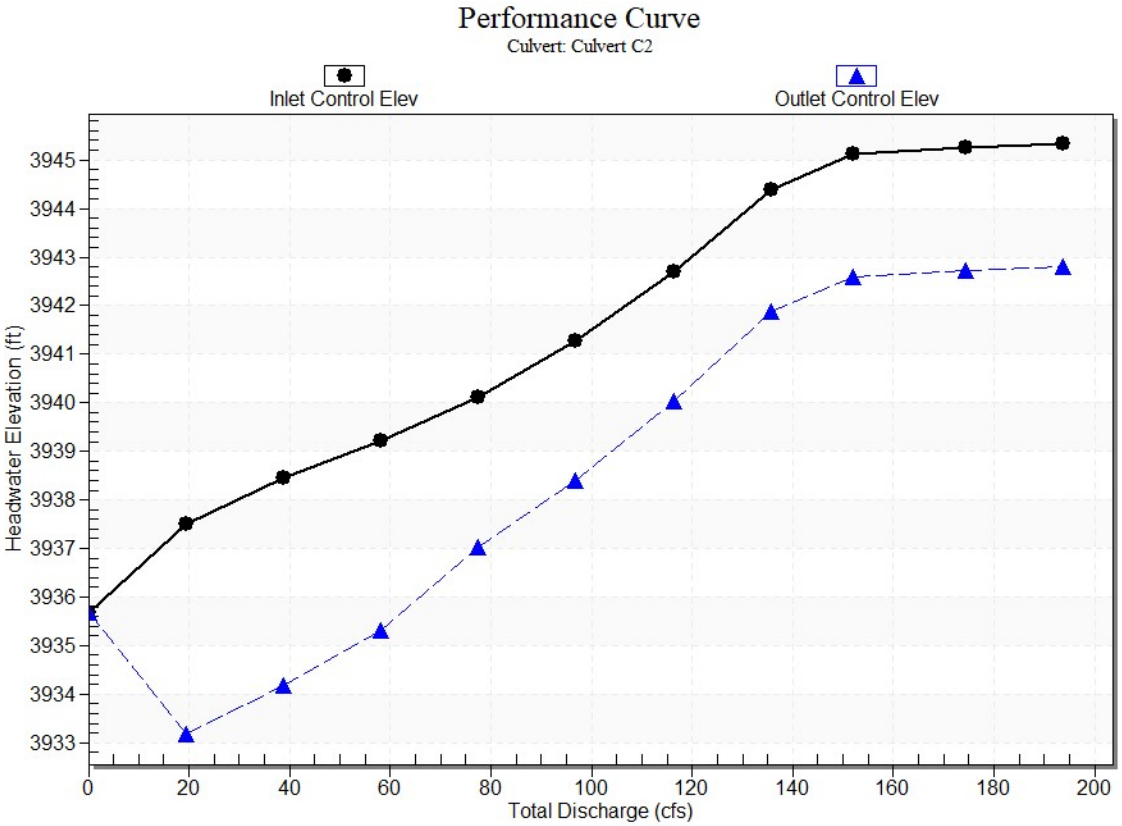
Inlet Elevation (invert): 3935.68 ft,

Outlet Elevation (invert): 3931.68 ft

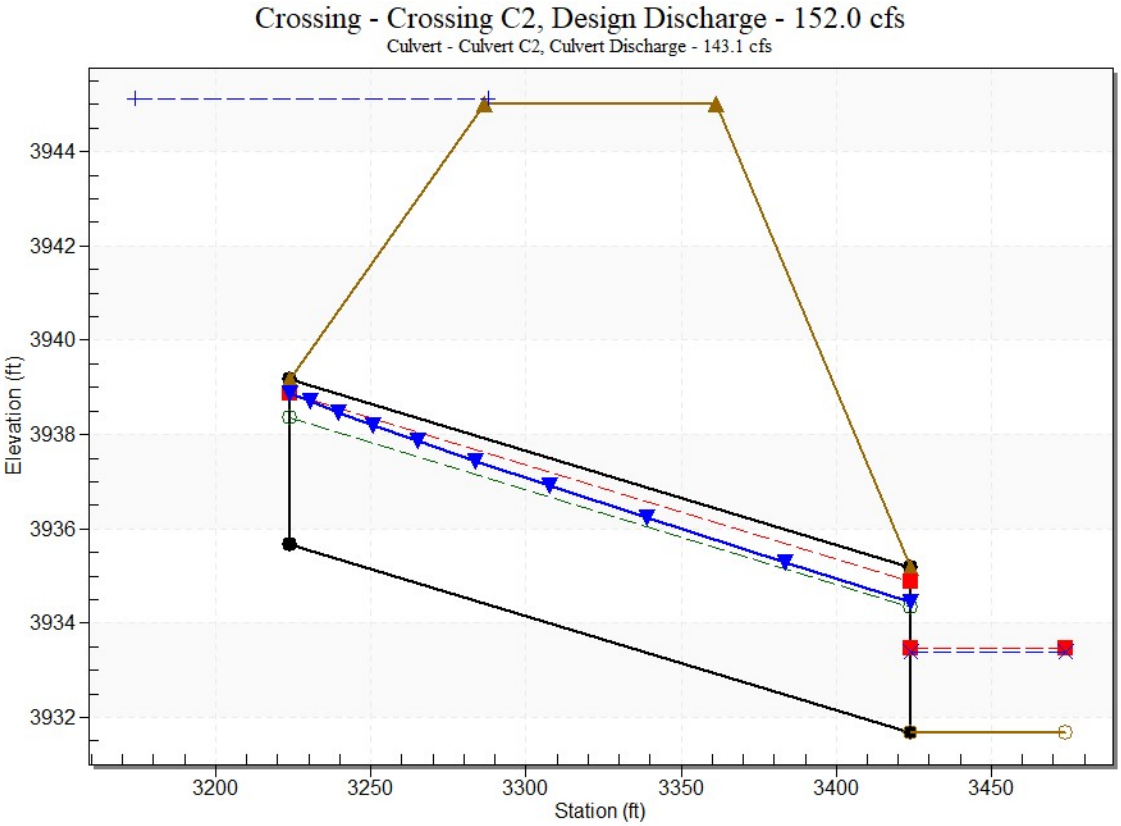
Culvert Length: 200.04 ft,

Culvert Slope: 0.0200

Culvert Performance Curve Plot: Culvert C2



Water Surface Profile Plot for Culvert: Culvert C2



Site Data - Culvert C2

Site Data Option: Culvert Invert Data

Inlet Station: 3224.00 ft

Inlet Elevation: 3935.68 ft

Outlet Station: 3424.00 ft

Outlet Elevation: 3931.68 ft

Number of Barrels: 1

Culvert Data Summary - Culvert C2

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: Crossing C2

Table 2 - Downstream Channel Rating Curve (Crossing: Crossing C2)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
0.00	3931.68	0.00	0.00	0.00	0.00
19.38	3932.24	0.56	3.61	0.69	0.92
38.76	3932.50	0.82	4.51	1.02	0.98
58.15	3932.71	1.03	5.11	1.28	1.00
77.53	3932.88	1.20	5.57	1.50	1.03
96.91	3933.03	1.35	5.94	1.69	1.04
116.29	3933.17	1.49	6.27	1.86	1.05
135.67	3933.29	1.61	6.55	2.01	1.07
152.00	3933.39	1.71	6.76	2.14	1.07
174.44	3933.52	1.84	7.02	2.29	1.08
193.82	3933.62	1.94	7.23	2.42	1.09

Tailwater Channel Data - Crossing C2

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 8.00 ft

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0200

Channel Manning's n: 0.0350

Channel Invert Elevation: 3931.68 ft

Roadway Data for Crossing: Crossing C2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 90.00 ft

Crest Elevation: 3945.00 ft

Roadway Surface: Gravel

Roadway Top Width: 75.00 ft


STATE OF TEXAS
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11-18-25

RATIONAL METHOD **Q = C I A**

C = RUNOFF COEFFICIENT, refer to Table 4-10: Runoff Coefficients for Urban Watersheds Texas Department of Transportation Hydraulic Design Manual (2019)
I = Rainfall intensity, per Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas
A = Area, largest sub-area contributing to drainage control

Active Face Diversion Berm

Q = (0.58)*(6.12)*(4) = **14.2 cfs**

C = 0.58, calculated in Contaminated Water Containment worksheet
I = 6.12 in/hr
A = 4 acres, calculated in Contaminated Water Containment worksheet

Intermediate Cover Side Slope Interceptor Ditches / Terraces

Q = (0.25)*(6.12)*(3.88) = **5.94 cfs**

C = 0.25, Sand or sandy loam soil, 5%
I = 6.12 in/hr
A = 3.88 acres, Drainage Area from B5

Intermediate Cover Top/Toe/Diversion Berms

Q = (0.25)*(6.12)*(7.23) = **11.06 cfs**

C = 0.25, Sand or sandy loam soil, 5%
I = 6.12 in/hr
A = 7.23 acres, Drainage Area from B3

Side Slope Interceptor Ditches / Terraces

Q = (0.8)*(6.12)*(3.88) = **19.0 cfs**

C = 0.8, Riprap
I = 6.12 in/hr
A = 3.88 acres, Drainage Area from B5

Top/Toe/Diversion Berms

Q = (0.8)*(6.12)*(7.23) = **35.4 cfs**

C = 0.8, Riprap
I = 6.12 in/hr
A = 7.23 acres, Drainage Area from B3

Letdown Structure

Q = (0.8)*(6.12)*(35.98) = **176.2 cfs**

C = 0.8, Riprap
I = 6.12 in/hr
A = 35.98 acres, Drainage Area from B2 & B5

Perimeter Ditches

- Calculated using HEC-HMS

Rainfall Intensity-Duration-Frequency Coefficients for Texas

Based on United States Geological Survey (USGS) Scientific Investigations Report 2004–5041
"Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas"

1. Select English or SI Units

English

2. Select or Enter a County

El Paso

3. Enter a Time of Conc.
Select Units

10 min

Coefficient	50% (2-year)	20% (5-year)	10% (10-year)	4% (25-year)	2% (50-year)	1% (100-year)
e	0.8722	0.8916	0.9184	0.9037	0.8987	0.8902
b (in.)	30.36	48.03	70.58	80.75	90.38	100.88
d (min)	4.11	5.22	7.20	7.36	7.76	8.56
Intensity (in./hr)	3.02	4.24	5.18	6.12	6.81	7.49

(Spreadsheet Release Date: August 31, 2015; data table reshuffle by Asquith July 14, 2016)

Worksheet for Active Face Diversion Berm

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.018	
Channel Slope	0.005	ft/ft
Left Side Slope	3.000	H:V
Right Side Slope	2.000	H:V
Discharge	14.20	cfs ← See Page III.B-129

Results		
Normal Depth	14.4	in
Flow Area	3.6	ft²
Wetted Perimeter	6.5	ft
Hydraulic Radius	6.7	in
Top Width	6.00	ft
Critical Depth	13.8	in
Critical Slope	0.006	ft/ft
Velocity	3.95	ft/s
Velocity Head	0.24	ft
Specific Energy	1.44	ft
Froude Number	0.898	
Flow Type	Subcritical	

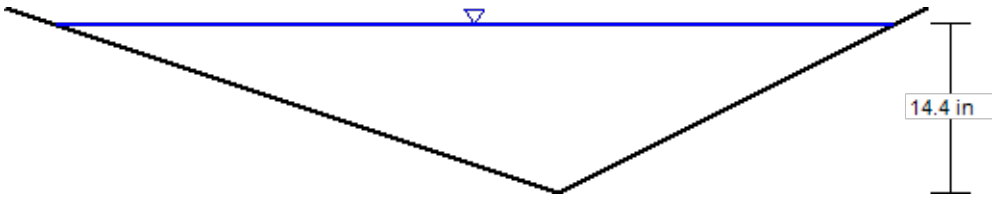
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	14.4	in
Critical Depth	13.8	in
Channel Slope	0.005	ft/ft
Critical Slope	0.006	ft/ft

Cross Section for Active Face Diversion Berm

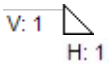
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.018
Channel Slope	0.005 ft/ft
Normal Depth	14.4 in
Left Side Slope	3.000 H:V
Right Side Slope	2.000 H:V
Discharge	14.20 cfs



Normal Depth 14.4 in < 27 in Berm Height, See Detail 8 on Drawing III.B.5.

SIZING CALCULATIONS FOR CONTAINMENT AND DIVERSION BERMS INCLUDING WATER DEPTH AND DESIGN FREEBOARD OF 1-FOOT CAN BE FOUND IN ATTACHMENT III.B.1, P.III.B-187.



Worksheet for Intermediate Cover Side Slope Interceptor Ditches/Berms/Terraces

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.020	
Channel Slope	0.010	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	2.000	H:V
Discharge	5.94	cfs ← See Page III.B-129

Results		
Normal Depth	8.8	in
Flow Area	1.6	ft²
Wetted Perimeter	4.7	ft
Hydraulic Radius	4.2	in
Top Width	4.41	ft
Critical Depth	9.0	in
Critical Slope	0.009	ft/ft
Velocity	3.67	ft/s
Velocity Head	0.21	ft
Specific Energy	0.94	ft
Froude Number	1.066	
Flow Type	Supercritical	

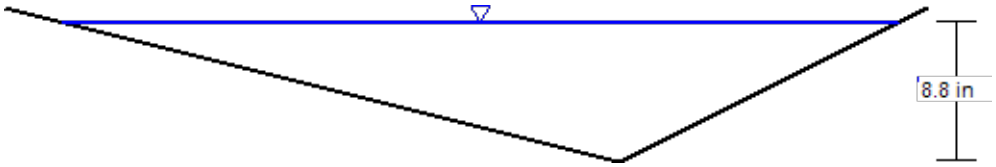
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.8	in
Critical Depth	9.0	in
Channel Slope	0.010	ft/ft
Critical Slope	0.009	ft/ft

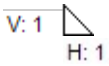
Cross Section for Intermediate Cover Side Slope Interceptor Ditches/Berms/Terraces

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.010 ft/ft
Normal Depth	8.8 in
Left Side Slope	4.000 H:V
Right Side Slope	2.000 H:V
Discharge	5.94 cfs



Normal Depth 8.8 in < 24 in Berm Height, See Details 4 & 7, on Drawing III.B.5 (while these represent final cover conditions, the berm detail will be the same for intermediate cover conditions).



Worksheet for Intermediate Cover Top/Toe/Diversion Berms

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.020	
Channel Slope	0.005	ft/ft
Left Side Slope	20.000	H:V
Right Side Slope	2.000	H:V
Discharge	11.06	cfs ← See Page III.B-129

Results		
Normal Depth	7.7	in
Flow Area	4.5	ft²
Wetted Perimeter	14.3	ft
Hydraulic Radius	3.8	in
Top Width	14.12	ft
Critical Depth	6.9	in
Critical Slope	0.009	ft/ft
Velocity	2.44	ft/s
Velocity Head	0.09	ft
Specific Energy	0.73	ft
Froude Number	0.760	
Flow Type	Subcritical	

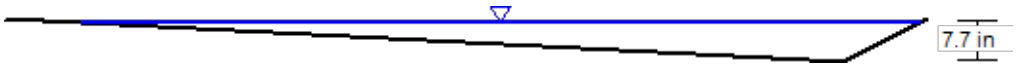
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.7	in
Critical Depth	6.9	in
Channel Slope	0.005	ft/ft
Critical Slope	0.009	ft/ft

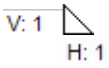
Cross Section for Intermediate Cover Top/Toe/Diversion Berms

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.005 ft/ft
Normal Depth	7.7 in
Left Side Slope	20.000 H:V
Right Side Slope	2.000 H:V
Discharge	11.06 cfs



Normal Depth 7.7 in < 24 in Berm Height, See Detail 3 on Drawing III.B.5 (while these represent final cover conditions, the berm detail will be the same for intermediate cover conditions).



Worksheet for Side Slope Interceptor Ditches/Berms/Terraces

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	0.010	ft/ft
Left Side Slope	4.000	H:V
Right Side Slope	2.000	H:V
Discharge	19.00	cfs ← See Page III.B-129

Results		
Normal Depth	16.8	in
Flow Area	5.9	ft²
Wetted Perimeter	8.9	ft
Hydraulic Radius	7.9	in
Top Width	8.41	ft
Critical Depth	14.4	in
Critical Slope	0.023	ft/ft
Velocity	3.22	ft/s
Velocity Head	0.16	ft
Specific Energy	1.56	ft
Froude Number	0.679	
Flow Type	Subcritical	

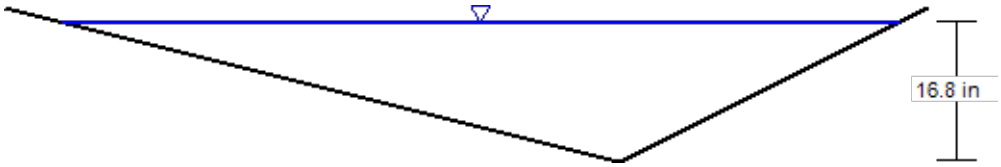
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	16.8	in
Critical Depth	14.4	in
Channel Slope	0.010	ft/ft
Critical Slope	0.023	ft/ft

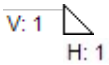
Cross Section for Side Slope Interceptor Ditches/Berms/Terraces

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.010 ft/ft
Normal Depth	16.8 in
Left Side Slope	4.000 H:V
Right Side Slope	2.000 H:V
Discharge	19.00 cfs



Normal Depth 16.8 in < 24 in Berm Height, See Details 4 & 7, on Drawing III.B.5.



Worksheet for Top/Toe/Diversion Berms

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	0.005	ft/ft
Left Side Slope	20.000	H:V
Right Side Slope	2.000	H:V
Discharge	35.40	cfs ← See Page III.B-129

Results		
Normal Depth	14.7	in
Flow Area	16.5	ft²
Wetted Perimeter	27.3	ft
Hydraulic Radius	7.3	in
Top Width	26.93	ft
Critical Depth	11.0	in
Critical Slope	0.024	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energy	1.30	ft
Froude Number	0.484	
Flow Type	Subcritical	

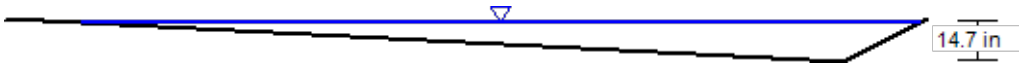
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	14.7	in
Critical Depth	11.0	in
Channel Slope	0.005	ft/ft
Critical Slope	0.024	ft/ft

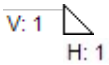
Cross Section for Top/Toe/Diversion Berms

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.005 ft/ft
Normal Depth	14.7 in
Left Side Slope	20.000 H:V
Right Side Slope	2.000 H:V
Discharge	35.40 cfs



Normal Depth 14.7 in < 24 in Berm Height, See Detail 3 on Drawing III.B.5.



Worksheet for Letdown Structure

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.041	
Channel Slope	0.250	ft/ft
Left Side Slope	2.000	H:V
Right Side Slope	2.000	H:V
Bottom Width	8.00	ft
Discharge	176.20	cfs ← See Page III.B-129

Results		
Normal Depth	12.8	in
Flow Area	10.9	ft²
Wetted Perimeter	12.8	ft
Hydraulic Radius	10.2	in
Top Width	12.28	ft
Critical Depth	24.8	in
Critical Slope	0.023	ft/ft
Velocity	16.24	ft/s
Velocity Head	4.10	ft
Specific Energy	5.17	ft
Froude Number	3.045	
Flow Type	Supercritical	

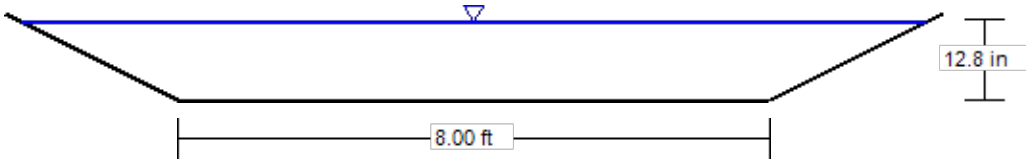
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	12.8	in
Critical Depth	24.8	in
Channel Slope	0.250	ft/ft
Critical Slope	0.023	ft/ft

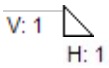
Cross Section for Letdown Structure

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.041
Channel Slope	0.250 ft/ft
Normal Depth	12.8 in
Left Side Slope	2.000 H:V
Right Side Slope	2.000 H:V
Bottom Width	8.00 ft
Discharge	176.20 cfs



Normal Depth 12.8 in < 18 in Berm Height, See Detail 5 on Drawing III.B.5.



Worksheet for Ditch B1 - Flow from B3, B6, B7, & C-Offsite

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	161.62 cfs

Results	
Normal Depth	22.5 in
Flow Area	25.5 ft²
Wetted Perimeter	19.8 ft
Hydraulic Radius	15.4 in
Top Width	19.23 ft
Critical Depth	22.1 in
Critical Slope	0.017 ft/ft
Velocity	6.35 ft/s
Velocity Head	0.63 ft
Specific Energy	2.50 ft
Froude Number	0.972
Flow Type	Subcritical

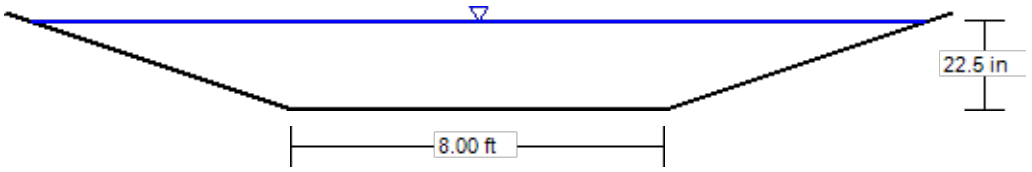
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

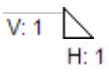
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	22.5 in
Critical Depth	22.1 in
Channel Slope	0.016 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch B1 - Flow from B3, B6, B7, & C-Offsite

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Normal Depth	22.5 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	161.62 cfs





Worksheet for Ditch B1 - Flow from B3, B6, B7, & C-Offsite

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.006 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	161.62 cfs

Results	
Normal Depth	28.7 in
Flow Area	36.4 ft²
Wetted Perimeter	23.1 ft
Hydraulic Radius	18.9 in
Top Width	22.37 ft
Critical Depth	22.1 in
Critical Slope	0.017 ft/ft
Velocity	4.44 ft/s
Velocity Head	0.31 ft
Specific Energy	2.70 ft
Froude Number	0.614
Flow Type	Subcritical

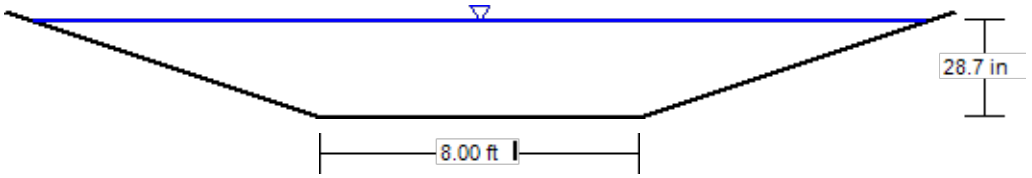
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

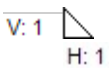
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	28.7 in
Critical Depth	22.1 in
Channel Slope	0.006 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch B1 - Flow from B3, B6, B7, & C-Offsite

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.006 ft/ft
Normal Depth	28.7 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	161.62 cfs





Worksheet for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.043 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs

Results	
Normal Depth	24.6 in
Flow Area	29.0 ft²
Wetted Perimeter	21.0 ft
Hydraulic Radius	16.6 in
Top Width	20.31 ft
Critical Depth	31.8 in
Critical Slope	0.015 ft/ft
Velocity	10.95 ft/s
Velocity Head	1.86 ft
Specific Energy	3.92 ft
Froude Number	1.615
Flow Type	Supercritical

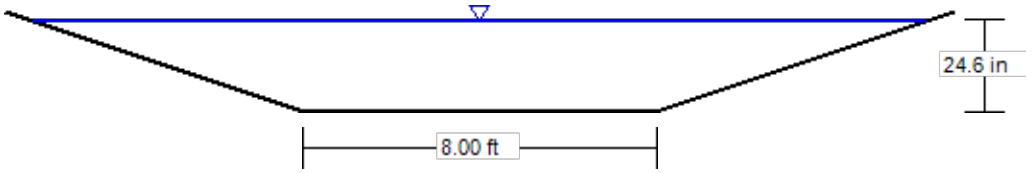
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

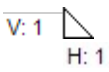
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	24.6 in
Critical Depth	31.8 in
Channel Slope	0.043 ft/ft
Critical Slope	0.015 ft/ft

Cross Section for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.043 ft/ft
Normal Depth	24.6 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs





Worksheet for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.021 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs

Results	
Normal Depth	29.3 in
Flow Area	37.5 ft²
Wetted Perimeter	23.5 ft
Hydraulic Radius	19.2 in
Top Width	22.67 ft
Critical Depth	31.8 in
Critical Slope	0.015 ft/ft
Velocity	8.49 ft/s
Velocity Head	1.12 ft
Specific Energy	3.56 ft
Froude Number	1.164
Flow Type	Supercritical

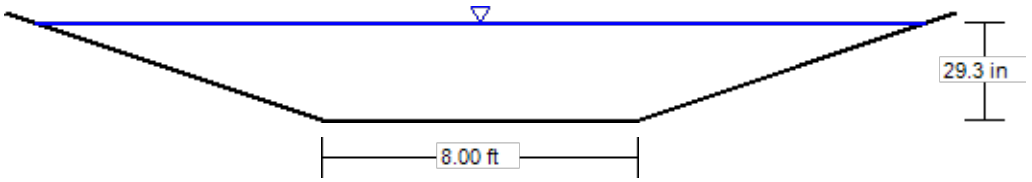
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

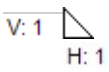
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	29.3 in
Critical Depth	31.8 in
Channel Slope	0.021 ft/ft
Critical Slope	0.015 ft/ft

Cross Section for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.021 ft/ft
Normal Depth	29.3 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs





Worksheet for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs

Results	
Normal Depth	31.5 in
Flow Area	41.7 ft²
Wetted Perimeter	24.6 ft
Hydraulic Radius	20.3 in
Top Width	23.75 ft
Critical Depth	31.8 in
Critical Slope	0.015 ft/ft
Velocity	7.63 ft/s
Velocity Head	0.91 ft
Specific Energy	3.53 ft
Froude Number	1.016
Flow Type	Supercritical

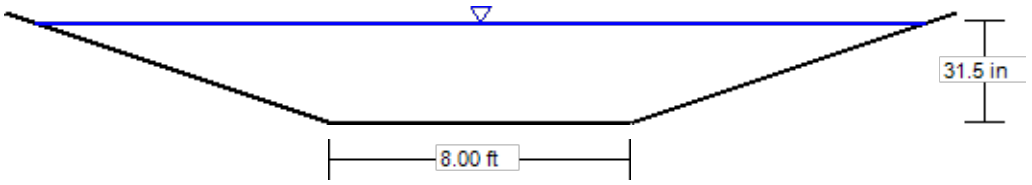
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

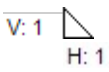
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	31.5 in
Critical Depth	31.8 in
Channel Slope	0.016 ft/ft
Critical Slope	0.015 ft/ft

Cross Section for Ditch B2 - Flow from B2, B5, B8, & Ditch B1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Normal Depth	31.5 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	318.12 cfs





Worksheet for Ditch C1 - Flow from C3-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.027 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs

Results	
Normal Depth	20.1 in
Flow Area	21.8 ft²
Wetted Perimeter	18.6 ft
Hydraulic Radius	14.1 in
Top Width	18.04 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	7.74 ft/s
Velocity Head	0.93 ft
Specific Energy	2.60 ft
Froude Number	1.242
Flow Type	Supercritical

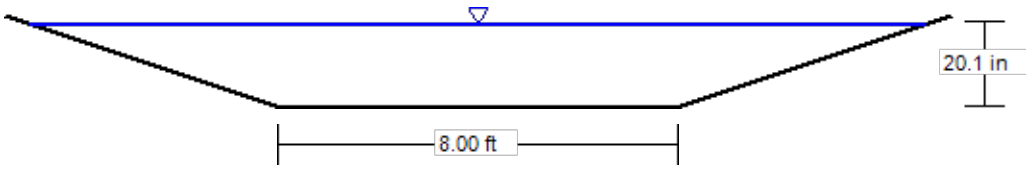
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

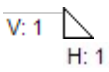
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	20.1 in
Critical Depth	22.6 in
Channel Slope	0.027 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C1 - Flow from C3-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.027 ft/ft
Normal Depth	20.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs





Worksheet for Ditch C1 - Flow from C3-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs

Results	
Normal Depth	32.4 in
Flow Area	43.5 ft²
Wetted Perimeter	25.1 ft
Hydraulic Radius	20.8 in
Top Width	24.21 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	3.88 ft/s
Velocity Head	0.23 ft
Specific Energy	2.93 ft
Froude Number	0.510
Flow Type	Subcritical

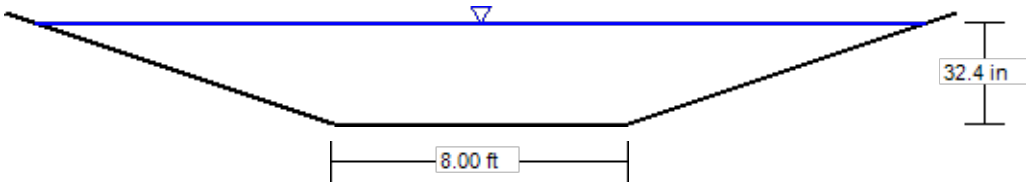
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

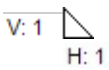
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	32.4 in
Critical Depth	22.6 in
Channel Slope	0.004 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C1 - Flow from C3-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Normal Depth	32.4 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs





Worksheet for Ditch C1 - Flow from C3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.008 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs

Results	
Normal Depth	27.8 in
Flow Area	34.6 ft²
Wetted Perimeter	22.6 ft
Hydraulic Radius	18.3 in
Top Width	21.88 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	4.88 ft/s
Velocity Head	0.37 ft
Specific Energy	2.68 ft
Froude Number	0.684
Flow Type	Subcritical

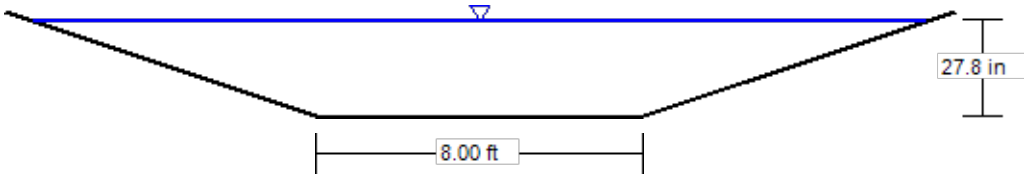
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

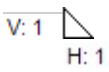
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	27.8 in
Critical Depth	22.6 in
Channel Slope	0.008 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C1 - Flow from C3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.008 ft/ft
Normal Depth	27.8 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.55 cfs





Worksheet for Ditch C2 - Flows from C1, C2, Ditch C1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs

Results	
Normal Depth	32.4 in
Flow Area	43.4 ft²
Wetted Perimeter	25.1 ft
Hydraulic Radius	20.8 in
Top Width	24.19 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	3.87 ft/s
Velocity Head	0.23 ft
Specific Energy	2.93 ft
Froude Number	0.510
Flow Type	Subcritical

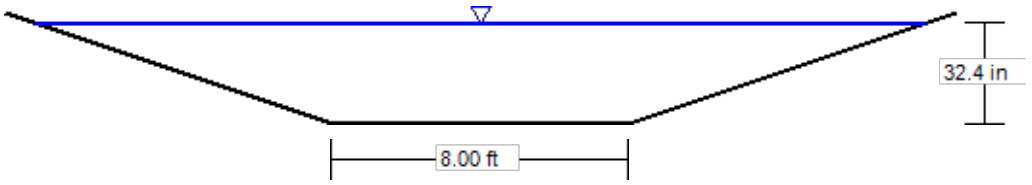
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

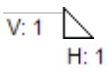
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	32.4 in
Critical Depth	22.6 in
Channel Slope	0.004 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C2 - Flows from C1, C2, Ditch C1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Normal Depth	32.4 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs





Worksheet for Ditch C2 - Flows from C1, C2, & Ditch C1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.039 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs

Results	
Normal Depth	18.1 in
Flow Area	19.0 ft²
Wetted Perimeter	17.6 ft
Hydraulic Radius	13.0 in
Top Width	17.07 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	8.87 ft/s
Velocity Head	1.22 ft
Specific Energy	2.73 ft
Froude Number	1.484
Flow Type	Supercritical

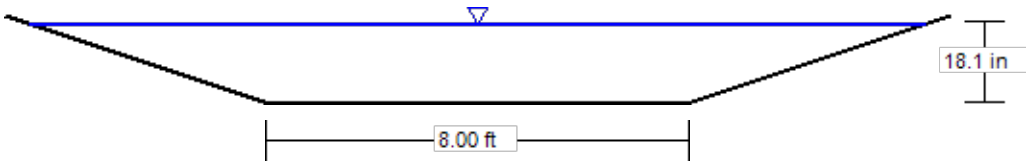
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

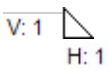
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.1 in
Critical Depth	22.6 in
Channel Slope	0.039 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C2 - Flows from C1, C2, & Ditch C1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.039 ft/ft
Normal Depth	18.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs





Worksheet for Ditch C2 - Flows from C1, C2, & Ditch C1.3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.076 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs

Results	
Normal Depth	15.3 in
Flow Area	15.0 ft²
Wetted Perimeter	16.1 ft
Hydraulic Radius	11.2 in
Top Width	15.64 ft
Critical Depth	22.6 in
Critical Slope	0.017 ft/ft
Velocity	11.17 ft/s
Velocity Head	1.94 ft
Specific Energy	3.21 ft
Froude Number	2.008
Flow Type	Supercritical

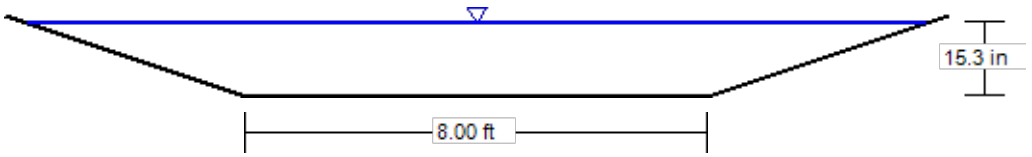
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

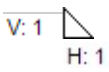
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	15.3 in
Critical Depth	22.6 in
Channel Slope	0.076 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch C2 - Flows from C1, C2, & Ditch C1.3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.076 ft/ft
Normal Depth	15.3 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	168.15 cfs





Worksheet for Ditch D1 - Flow from D4, D6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	86.38 cfs

Results	
Normal Depth	25.0 in
Flow Area	29.7 ft²
Wetted Perimeter	21.2 ft
Hydraulic Radius	16.8 in
Top Width	20.49 ft
Critical Depth	15.6 in
Critical Slope	0.019 ft/ft
Velocity	2.91 ft/s
Velocity Head	0.13 ft
Specific Energy	2.21 ft
Froude Number	0.427
Flow Type	Subcritical

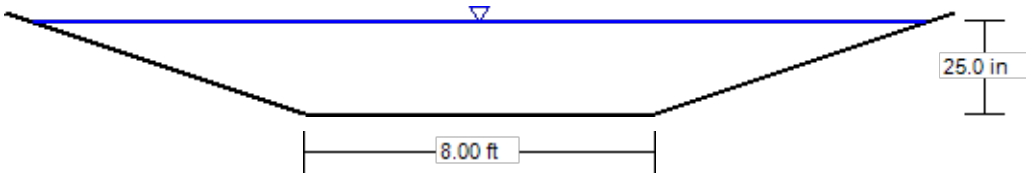
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

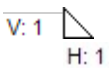
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	25.0 in
Critical Depth	15.6 in
Channel Slope	0.003 ft/ft
Critical Slope	0.019 ft/ft

Cross Section for Ditch D1 - Flow from D4, D6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Normal Depth	25.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	86.38 cfs





Worksheet for Ditch D2 - Flow from D1, D3, D5, & Ditch D1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.026 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs

Results	
Normal Depth	22.3 in
Flow Area	25.2 ft²
Wetted Perimeter	19.8 ft
Hydraulic Radius	15.3 in
Top Width	19.15 ft
Critical Depth	25.1 in
Critical Slope	0.016 ft/ft
Velocity	8.09 ft/s
Velocity Head	1.02 ft
Specific Energy	2.88 ft
Froude Number	1.242
Flow Type	Supercritical

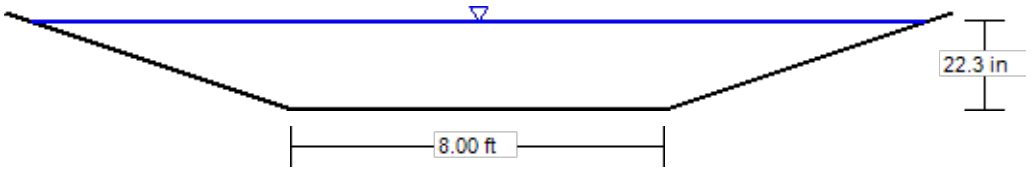
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

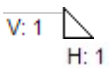
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	22.3 in
Critical Depth	25.1 in
Channel Slope	0.026 ft/ft
Critical Slope	0.016 ft/ft

Cross Section for Ditch D2 - Flow from D1, D3, D5, & Ditch D1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.026 ft/ft
Normal Depth	22.3 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs





Worksheet for Ditch D2 - Flow from D1, D3, D5, & Ditch D1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs

Results	
Normal Depth	38.1 in
Flow Area	55.6 ft²
Wetted Perimeter	28.1 ft
Hydraulic Radius	23.8 in
Top Width	27.05 ft
Critical Depth	25.1 in
Critical Slope	0.016 ft/ft
Velocity	3.67 ft/s
Velocity Head	0.21 ft
Specific Energy	3.38 ft
Froude Number	0.451
Flow Type	Subcritical

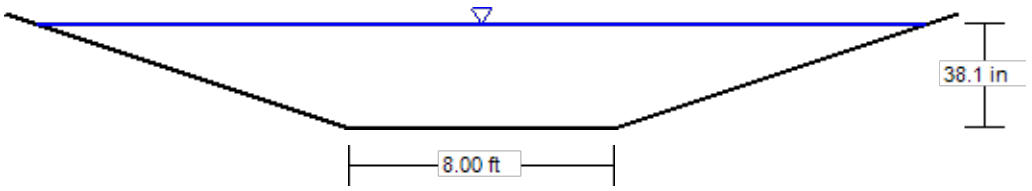
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

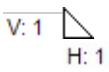
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	38.1 in
Critical Depth	25.1 in
Channel Slope	0.003 ft/ft
Critical Slope	0.016 ft/ft

Cross Section for Ditch D2 - Flow from D1, D3, D5, & Ditch D1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Normal Depth	38.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs





Worksheet for Ditch D2 - Flow from D1, D3, D5, & Ditch D1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs

Results	
Normal Depth	25.1 in
Flow Area	29.9 ft²
Wetted Perimeter	21.2 ft
Hydraulic Radius	16.9 in
Top Width	20.56 ft
Critical Depth	25.1 in
Critical Slope	0.016 ft/ft
Velocity	6.83 ft/s
Velocity Head	0.72 ft
Specific Energy	2.82 ft
Froude Number	0.998
Flow Type	Subcritical

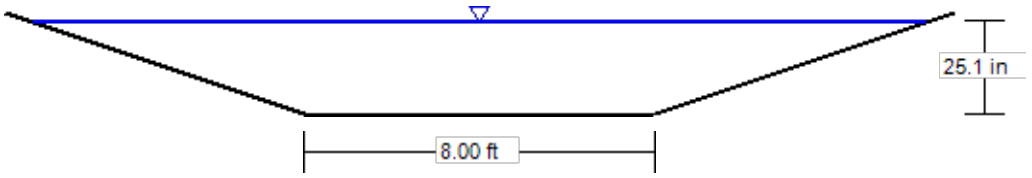
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

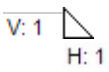
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	25.1 in
Critical Depth	25.1 in
Channel Slope	0.016 ft/ft
Critical Slope	0.016 ft/ft

Cross Section for Ditch D2 - Flow from D1, D3, D5, & Ditch D1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.016 ft/ft
Normal Depth	25.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	204.15 cfs





Worksheet for Ditch D3 - Flow From E6 & Ditch D2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.034 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	224.54 cfs

Results	
Normal Depth	21.9 in
Flow Area	24.6 ft²
Wetted Perimeter	19.5 ft
Hydraulic Radius	15.1 in
Top Width	18.95 ft
Critical Depth	26.4 in
Critical Slope	0.016 ft/ft
Velocity	9.13 ft/s
Velocity Head	1.29 ft
Specific Energy	3.12 ft
Froude Number	1.412
Flow Type	Supercritical

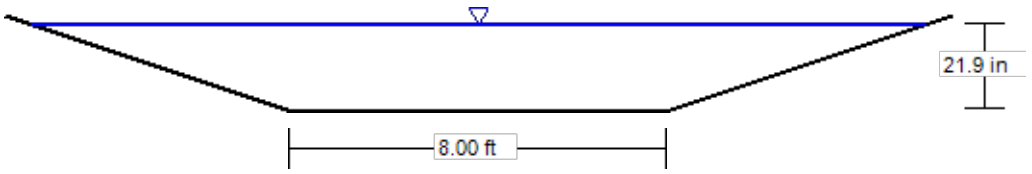
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

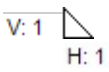
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	21.9 in
Critical Depth	26.4 in
Channel Slope	0.034 ft/ft
Critical Slope	0.016 ft/ft

Cross Section for Ditch D3 - Flow From E6 & Ditch D2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.034 ft/ft
Normal Depth	21.9 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	224.54 cfs





Worksheet for Ditch D3 - Flow From E6 & Ditch D2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.026 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	224.54 cfs

Results	
Normal Depth	23.5 in
Flow Area	27.1 ft²
Wetted Perimeter	20.4 ft
Hydraulic Radius	16.0 in
Top Width	19.73 ft
Critical Depth	26.4 in
Critical Slope	0.016 ft/ft
Velocity	8.28 ft/s
Velocity Head	1.07 ft
Specific Energy	3.02 ft
Froude Number	1.246
Flow Type	Supercritical

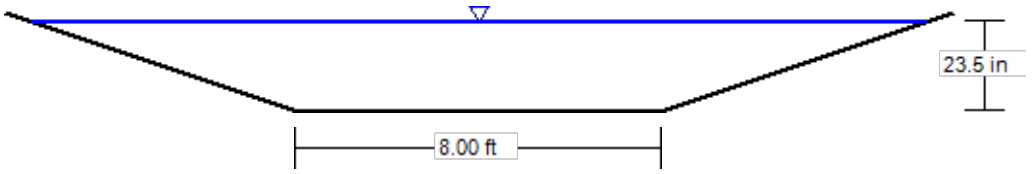
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

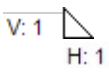
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	23.5 in
Critical Depth	26.4 in
Channel Slope	0.026 ft/ft
Critical Slope	0.016 ft/ft

Cross Section for Ditch D3 - Flow From E6 & Ditch D2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.026 ft/ft
Normal Depth	23.5 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	224.54 cfs





Worksheet for Ditch E1 - Flow from E2, E4, & D5.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.019 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs

Results	
Normal Depth	20.3 in
Flow Area	22.2 ft²
Wetted Perimeter	18.7 ft
Hydraulic Radius	14.2 in
Top Width	18.16 ft
Critical Depth	20.8 in
Critical Slope	0.017 ft/ft
Velocity	6.55 ft/s
Velocity Head	0.67 ft
Specific Energy	2.36 ft
Froude Number	1.045
Flow Type	Supercritical

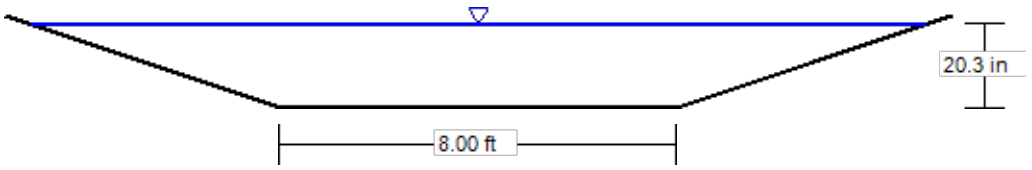
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

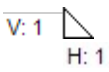
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	20.3 in
Critical Depth	20.8 in
Channel Slope	0.019 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch E1 - Flow from E2, E4, & D5.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.019 ft/ft
Normal Depth	20.3 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs





Worksheet for Ditch E1 - Flow from E2, E4, & D5.3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs

Results	
Normal Depth	30.1 in
Flow Area	39.0 ft²
Wetted Perimeter	23.9 ft
Hydraulic Radius	19.6 in
Top Width	23.06 ft
Critical Depth	20.8 in
Critical Slope	0.017 ft/ft
Velocity	3.72 ft/s
Velocity Head	0.22 ft
Specific Energy	2.73 ft
Froude Number	0.505
Flow Type	Subcritical

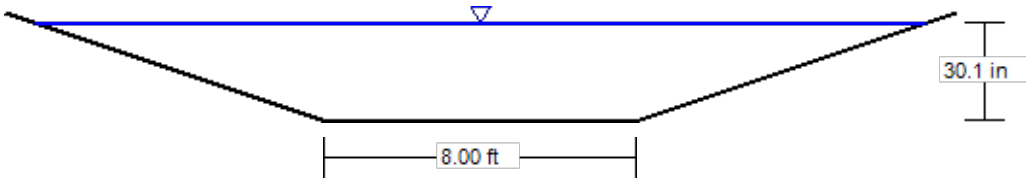
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

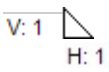
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	30.1 in
Critical Depth	20.8 in
Channel Slope	0.004 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch E1 - Flow from E2, E4, & D5.3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Normal Depth	30.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs





Worksheet for Ditch E1 - Flow from E2, E4, & E5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs

Results	
Normal Depth	33.8 in
Flow Area	46.3 ft²
Wetted Perimeter	25.8 ft
Hydraulic Radius	21.5 in
Top Width	24.89 ft
Critical Depth	20.8 in
Critical Slope	0.017 ft/ft
Velocity	3.13 ft/s
Velocity Head	0.15 ft
Specific Energy	2.97 ft
Froude Number	0.405
Flow Type	Subcritical

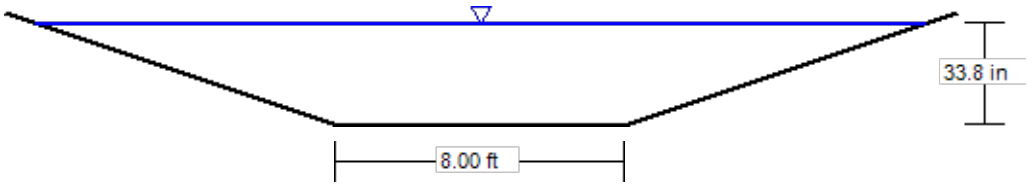
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

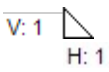
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	33.8 in
Critical Depth	20.8 in
Channel Slope	0.003 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch E1 - Flow from E2, E4, & E5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.003 ft/ft
Normal Depth	33.8 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	145.11 cfs





Worksheet for Ditch E2 - Flow from E1, E3, & Ditch E1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.051 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	193.17 cfs

Results	
Normal Depth	18.2 in
Flow Area	19.1 ft²
Wetted Perimeter	17.6 ft
Hydraulic Radius	13.0 in
Top Width	17.12 ft
Critical Depth	24.4 in
Critical Slope	0.017 ft/ft
Velocity	10.12 ft/s
Velocity Head	1.59 ft
Specific Energy	3.11 ft
Froude Number	1.691
Flow Type	Supercritical

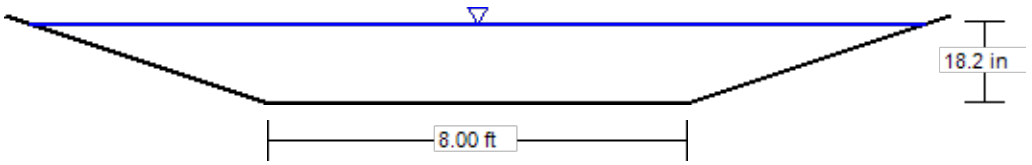
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

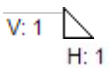
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.2 in
Critical Depth	24.4 in
Channel Slope	0.051 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch E2 - Flow from E1, E3, & Ditch E1.2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.051 ft/ft
Normal Depth	18.2 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	193.17 cfs





Worksheet for Ditch E2 - Flow from E1, E3, & Ditch E1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	193.17 cfs

Results	
Normal Depth	35.1 in
Flow Area	49.0 ft²
Wetted Perimeter	26.5 ft
Hydraulic Radius	22.2 in
Top Width	25.53 ft
Critical Depth	24.4 in
Critical Slope	0.017 ft/ft
Velocity	3.94 ft/s
Velocity Head	0.24 ft
Specific Energy	3.16 ft
Froude Number	0.502
Flow Type	Subcritical

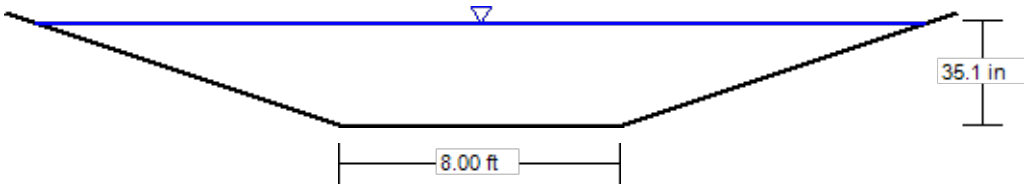
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

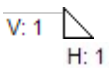
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	35.1 in
Critical Depth	24.4 in
Channel Slope	0.004 ft/ft
Critical Slope	0.017 ft/ft

Cross Section for Ditch E2 - Flow from E1, E3, & Ditch E1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.035
Channel Slope	0.004 ft/ft
Normal Depth	35.1 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	8.00 ft
Discharge	193.17 cfs





Worksheet for Basin BC Spillway

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.069	
Channel Slope	0.020	ft/ft
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V
Bottom Width	31.00	ft
Discharge	95.71	cfs ← See Page III.B-88

Results		
Normal Depth	11.9	in
Flow Area	33.6	ft²
Wetted Perimeter	37.3	ft
Hydraulic Radius	10.8	in
Top Width	36.94	ft
Critical Depth	7.8	in
Critical Slope	0.082	ft/ft
Velocity	2.85	ft/s
Velocity Head	0.13	ft
Specific Energy	1.12	ft
Froude Number	0.526	
Flow Type	Subcritical	

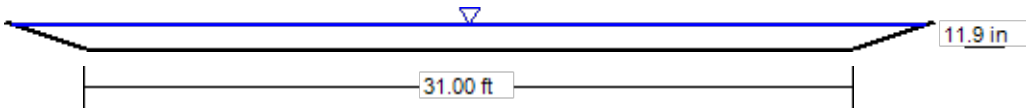
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	11.9	in
Critical Depth	7.8	in
Channel Slope	0.020	ft/ft
Critical Slope	0.082	ft/ft

Cross Section for Basin BC Spillway

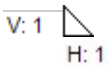
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.069
Channel Slope	0.020 ft/ft
Normal Depth	11.9 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	31.00 ft
Discharge	95.71 cfs



Normal Depth 11.9 in < 24 in Spillway Depth, See Drawing III.B.13.

NOTE: During normal conditions, the pond high water level will be a foot below the emergency spillway. If the outlet structure were to malfunction, then the pond will safely pass the 25-year, 24-hour storm event as calculated above.



Worksheet for Basin DE Spillway

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.069
Channel Slope	0.020 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	10.00 ft
Discharge	17.56 cfs

Results	
Normal Depth	8.3 in
Flow Area	8.3 ft²
Wetted Perimeter	14.4 ft
Hydraulic Radius	6.9 in
Top Width	14.13 ft
Critical Depth	5.2 in
Critical Slope	0.096 ft/ft
Velocity	2.11 ft/s
Velocity Head	0.07 ft
Specific Energy	0.76 ft
Froude Number	0.486
Flow Type	Subcritical

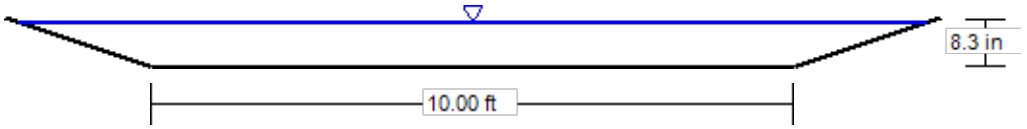
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

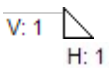
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.3 in
Critical Depth	5.2 in
Channel Slope	0.020 ft/ft
Critical Slope	0.096 ft/ft

Cross Section for Basin DE Spillway

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.069
Channel Slope	0.020 ft/ft
Normal Depth	8.3 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	10.00 ft
Discharge	17.56 cfs





Low Water Crossing

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.018
Channel Slope	0.250 ft/ft
Left Side Slope	10.000 H:V
Right Side Slope	10.000 H:V
Bottom Width	10.00 ft
Discharge	176.20 cfs

Results	
Normal Depth	6.3 in
Flow Area	8.0 ft²
Wetted Perimeter	20.6 ft
Hydraulic Radius	4.7 in
Top Width	20.50 ft
Critical Depth	16.7 in
Critical Slope	0.005 ft/ft
Velocity	22.01 ft/s
Velocity Head	7.53 ft
Specific Energy	8.06 ft
Froude Number	6.211
Flow Type	Supercritical

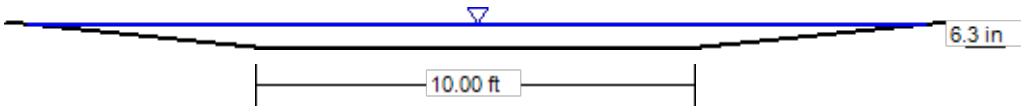
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

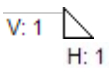
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.3 in
Critical Depth	16.7 in
Channel Slope	0.250 ft/ft
Critical Slope	0.005 ft/ft

Cross Section for Low Water Crossing

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.018
Channel Slope	0.250 ft/ft
Normal Depth	6.3 in
Left Side Slope	10.000 H:V
Right Side Slope	10.000 H:V
Bottom Width	10.00 ft
Discharge	176.20 cfs





CONTAMINATED WATER CONTAINMENT AND DIVERSION BERM CALCULATIONS



Rev 2, September 12, 2025

Greater El Paso Landfill
CONTAMINATED WATER CONTAINMENT AND DIVERSION BERM CALCULATION

BURNS McDONNELL

PROJECT	Greater El Paso Landfill Permit 2284A
SUBJECT	Contaminated Water Containment and Diversion Berms
PROJECT NUMBER	155488
DATE	Sep-25

Purpose: The purpose of this calculation is to determine the height of the contaminated water containment berm at the downstream edge of the active face and the height of the diversion berm controlling stormwater run-on to the active face.

Methodology: These calculations are organized into two parts: those pertaining to the containment berm and those pertaining to the diversion berm. First, the containment berm height was calculated by estimating the volume of runoff within the active area, then solving for the required height based on this volume, the length of the berm and the geometry of the v-shaped water cross-section. Second, the diversion berm height was calculated using the Rational Method to estimate the peak flow from a typical run-on drainage basin and Mannings Equation to size the v-shaped swale. Runoff peak flows and volumes were calculated using the 25-year, 24-hour storm event for El Paso, TX.

Assumptions:
1. Runoff coefficient for the active face is determined according to exposed waste at 3% slopes.
2. The average weekly waste placement rate, used to size the active face was determined using the 2019 annual disposal tonnage, a 1,300 lb/cy factor, and a compaction ratio of 2:1 (volume in truck:volume in landfill)
3. The lift thickness, used to size the active face, is 10 feet. This is typical for landfill operations.
4. The active face is square-shaped.
5. The active face has a slope of 3%.
6. The containment/diversion berms shall have 2:1 slopes and no minimum top width.
7. Time of concentration is assumed to be 10 min.
8. Runoff coefficient for the run-on basin is determined according to interim cover material at 3:1 slopes that extend to touch the flowine of the berm.
9. Area of the run-on basin is 4 acres. This is equivalent to approximately 14 former active faces.
10. A 0.5% flowline slope was used to design the run-on berm. Actual slopes at time of installation should be 1.0%. This accounts for settlement.

References:
1. Texas DOT Hydraulic Design Manual, 2019
2. NOAA Atlas 14, Volume 11, Version 2 Estimates for El Paso, TX
3. Rainfall Intensity-Duration-Frequency Coefficients for Texas Version 2.1, 2015
4. Flowmaster Output

7222	= Data Input Cell
7222	= Calculated and/or Referenced

Conclusions: 2-foot containment and diversion berms with 2:1 side slopes shall be installed around the active face. The diversion portion of the berm, along the upstream edge of the active face, shall have a flowline of at least 0.5% for the duration of the active face.

Prepared By:	J. Pistorius	Date:	Sep-25
Checked By:	K. Benjamin	Date:	Sep-25

Greater El Paso Landfill
CONTAMINATED WATER CONTAINMENT CALCULATION

Calculation by: JGP Date: Sep-25

					Reference
1) PEAK VOLUME OF CONTMINATED WATER					
MSW Runoff Coefficient, C					
Watershed Relief Component, Cr		**Cr =**	0.09		Reference 1, Assumption 1
Soil Infiltration Component, Ci		**Ci =**	0.06		Reference 1, Assumption 1
Vegetal Cover Component, Cv		**Cv =**	0.16		Reference 1, Assumption 1
Surface Type Component, Cs		**Cs =**	0.04		Reference 1, Assumption 1
Overall Runoff Coefficient, C = Cr + Ci + Cv + Cs		**C =**	0.35		Reference 1
25-year, 24-hour Rainfall Depth, D					
Rainfall Depth		**D =**	3.17	in	Reference 2
			0.26	ft	
Area, A					
In-place waste volume per year, Wyear		**W_{year} =**	767,385	CY	Assumption 2
In-place waste volume per week	**$W = W_{year} / 52$**	**W =**	14,757	CY	Assumption 2
			398,450	ft^3	
Lift Thickness, T		**T =**	10	ft	Assumption 3
Contact Water Area	**A = W/T**	**A =**	39,845	ft^2	
			0.91	acres	
Contaminated Water Volume, V					
V = Total Contaminated Water = C x D x A		**V =**	3,684	ft^3	
2) REQUIRED CONTAINMENT BERM HEIGHT					
Downstream Berm Length, L	**$L = A^{0.5}$**	**L =**	199.61	ft	Assumption 4
Required Cross-Sectional Area	**$A_x = V/L$**	**A_x =**	18.46	ft^2	
Slope of Active Area (inside edge of triangular cross-sectional area, A_x)		**S_1 =**	0.03	ft/ft	Assumption 5
Slope of Berm (outside edge of triangular cross-sectional area, Ax)		**S_2 =**	0.50	ft/ft	Assumption 6
Height of Contaminated Water	**$H_W = (2Ax / [(1/S_2)+(1/S_1)])^{0.5}$**	**H_W =**	1.02	ft	
Height of Containment Berm	**$H_B = H_W$ + 12 inches freeboard**	**H_B =**	2.02	ft	

Use a berm height of 2.25 feet.

NOTE:
Areas and Lengths calculated using AutoCAD Civil3D

Greater El Paso Landfill
ACTIVE FACE RUN-ON DIVERSION CALCULATION

Calculation by: JGP Date: Sep-25

				Reference
1) PEAK FLOW OF RUN-ON WATER				
Runoff Coefficient, C				
Watershed Relief Component, Cr	**Cr =**	0.30		Reference 1, Assumption 8
Soil Infiltration Component, Ci	**Ci =**	0.08		Reference 1, Assumption 8
Vegetal Cover Component, Cv	**Cv =**	0.12		Reference 1, Assumption 8
Surface Type Component, Cs	**Cs =**	0.08		Reference 1, Assumption 8
Overall Runoff Coefficient, C = Cr + Ci + Cv + Cs		0.58		
Average Rainfall Intensity, I				
Time of Concentration, T	**T_c =**	10.0	min	Assumption 7
25- Year Intensity-Frequency-Duration Coefficient, e	**e =**	0.9037		Reference 3
25- Year Intensity-Frequency-Duration Coefficient, b	**b =**	80.750	in	Reference 3
25- Year Intensity-Frequency-Duration Coefficient, d	**d =**	7.360	min	Reference 3
Average Rainfall Intensity, $I = b/(T_c + d)^e$	**I =**	6.123	in/hr	Reference 3
Drainage Area, A				
Drainage Area, A	**A =**	4.00	Ac	Assumption 9
Peak Flow, Q				
Q= Total Discharge from Watershed = C x I x A	**Q =**	14.2	**cfs**	
2) REQUIRED DIVERSION BERM HEIGHT				
Slope of Run-on Basin (inside edge of triangular cross-sectional area)	**S =**	0.33	ft/ft	Assumption 8
Slope of Berm (outside edge of triangular cross-sectional area)	**S =**	0.50	ft/ft	Assumption 6
Slope of Swale Flowline	**S =**	0.50	%	Assumption 10
Mannings Roughness Coefficient, n	**n =**	0.018		Reference 1
Depth of Flow	**H_W =**	1.200	ft	Reference 4
Height of Diversion Berm **$H_B = H_W$ + 12 inches freeboard**	**H_B =**	2.20	ft	

Use a berm height of 2.25 feet.

NOTE:
Areas and Lengths calculated using AutoCAD Civil3D. Depth of flow calculated in Flowmaster.

Hydraulic Design Manual



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Table 4-11: Runoff Coefficients for Rural Watersheds

Watershed characteristic	Extreme	High	Normal	Low
Relief - C_r	0.28-0.35 Steep, rugged terrain with average slopes above 30%	0.20-0.28 Hilly, with average slopes of 10-30%	0.14-0.20 Rolling, with average slopes of 5-10%	0.08-0.14 Relatively flat land, with average slopes of 0-5%
Soil infiltration - C_i	0.12-0.16 No effective soil cover; either rock or thin soil mantle of negligible infiltration capacity	0.08-0.12 Slow to take up water, clay or shallow loam soils of low infiltration capacity or poorly drained	0.06-0.08 Normal; well drained light or medium textured soils, sandy loams	0.04-0.06 Deep sand or other soil that takes up water readily; very light, well-drained soils
Vegetal cover - C_v	0.12-0.16 No effective plant cover, bare or very sparse cover	0.08-0.12 Poor to fair; clean cultivation, crops or poor natural cover, less than 20% of drainage area has good cover	0.06-0.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	0.04-0.06 Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent cover
Surface Storage - C_s	0.10-0.12 Negligible; surface depressions few and shallow, drainageways steep and small, no marshes	0.08-0.10 Well-defined system of small drainageways, no ponds or marshes	0.06-0.08 Normal; considerable surface depression, e.g., storage lakes and ponds and marshes	0.04-0.06 Much surface storage, drainage system not sharply defined; large floodplain storage, large number of ponds or marshes
Table 4-11 note: The total runoff coefficient based on the 4 runoff components is $C = C_r + C_i + C_v + C_s$				

While this approach was developed for application to rural watersheds, it can be used as a check against mixed-use runoff coefficients computed using other methods. In so doing, the designer would use judgment, primarily in specifying C_s, to account for partially developed conditions within the watershed.

Mixed Land Use

For areas with a mixture of land uses, a composite runoff coefficient should be used. The composite runoff coefficient is weighted based on the area of each respective land use and can be calculated as:

Table 4-10: Runoff Coefficients for Urban Watersheds

Type of drainage area	Runoff coefficient
Heavy soil, steep 7%	0.25-0.35
Streets:	
Asphaltic	0.85-0.95
Concrete	0.90-0.95
Brick	0.70-0.85
Drives and walks	0.75-0.95
Roofs	0.75-0.95

Rural and Mixed-Use Watershed

Table 4-11 shows an alternate, systematic approach for developing the runoff coefficient. This table applies to rural watersheds only, addressing the watershed as a series of aspects. For each of four aspects, the designer makes a systematic assignment of a runoff coefficient "component." Using Equation 4-22, the four assigned components are added to form an overall runoff coefficient for the specific watershed segment.

The runoff coefficient for rural watersheds is given by:

$$C = C_r + C_i + C_v + C_s$$

Equation 4-22.

***Where**:*

C = runoff coefficient for rural watershed

C_r = component of coefficient accounting for watershed relief

C_i = component of coefficient accounting for soil infiltration

C_v = component of coefficient accounting for vegetal cover

C_s = component of coefficient accounting for surface type

The designer selects the most appropriate values for C_r, C_i, C_v, and C_s from Table 4-11.

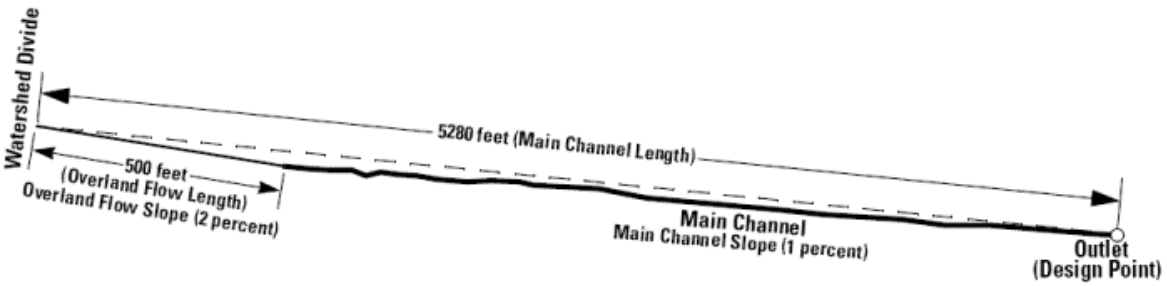

Figure 4-7. Example application of Kerby-Kirpich method

Natural Resources Conservation Service (NRCS) Method for Estimating t_c

The NRCS method for estimating t_c is applicable for small watersheds, in which the majority of flow is overland flow such that timing of the peak flow is not significantly affected by the contribution flow routed through underground storm drain systems. With the NRCS method:

$$t_c = t_{sh} + t_{sc} + t_{ch}$$

Equation 4-16.

***Where**:*

t_{sh} = sheet flow travel time

t_{sc} = shallow concentrated flow travel time

t_{ch} = channel flow travel time

NRCS 1986 provides the following descriptions of these flow components:

Sheet flow is flow over plane surfaces, usually occurring in the headwater of streams. With sheet flow, the friction value is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment.

Sheet flow usually becomes shallow concentrated flow after around 100 feet.

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on USGS quadrangle sheets.

For open channel flow, consider the uniform flow velocity based on bank-full flow conditions. That is, the main channel is flowing full without flow in the overbanks. This assumption avoids the significant iteration associated with rainfall intensity or discharges (because rainfall intensity and discharge are dependent on time of concentration).

For conduit flow, in a proposed storm drain system, compute the velocity at uniform depth based on the computed discharge at the upstream. Otherwise, if the conduit is in existence, determine full capacity flow in the conduit, and determine the velocity at capacity flow. You may need to compare this velocity later with the velocity calculated during conduit analysis. If there is a significant difference and the conduit is a relatively large component of the total travel path, recompute the time of concentration using the latter velocity estimate.

If it is determined that a low slope condition or a transitional slope condition exists, the user should consider using an adjusted slope in calculating the time of concentration. See Time of Concentration.

Sheet Flow Time Calculation

Sheet flow travel time is computed as:

$$t_{sh} = \frac{0.007(n_{ol}L_{sh})^{0.8}}{(P_2)^{0.5}S_{sh}^{0.4}}$$

Equation 4-17.

***Where**:*

t_{sh} = sheet flow travel time (hr.)

n_{ol} = overland flow roughness coefficient (provided in Table 4-6)

L_{sh} = sheet flow length (ft) (100 ft. maximum)

P_2 = 2-year, 24-h rainfall depth (in.) (provided in - NOAA's Precipitation Frequency Data Server for Atlas 14)

S_{sh} = sheet flow slope (ft/ft)

Table 4-6: Overland Flow Roughness Coefficients for Use in NRCS Method in Calculating Sheet Flow Travel Time (NRCS 1986)

Surface description		n_{ol}
Smooth surfaces (concrete, asphalt, gravel, or bare soil)		0.011
Fallow (no residue)		0.05
Cultivated soils:	Residue $cover \leq 20\,\%$	0.06
	Residue cover > 20%	0.17
Grass:	Short grass prairie	0.15
	Dense grasses	0.24
	Bermuda	0.41

Table 4-6: Overland Flow Roughness Coefficients for Use in NRCS Method in Calculating Sheet Flow Travel Time (NRCS 1986)

Surface description		n_{ol}
Range (natural):		0.13
Woods:	Light underbrush	0.40
	Dense underbrush	0.80

NOTE: 'n' values for overland flows (nol) are not to be used in other channel or floodplain applications.

Shallow Concentrated Flow

Shallow concentrated flow travel time is computed as:

$$t_{sc} = \frac{L_{sc}}{3600 K S_{sc}^{0.5}}$$

Equation 4-18.

***Where**:*

t_{sc} = shallow concentrated flow time (hr.)

L_{sc} = shallow concentrated flow length (ft)

K = 16.13 for unpaved surface, 20.32 for paved surface

S_{sc} = shallow concentrated flow slope (ft/ft)

Channel Flow

Channel flow travel time is computed by dividing the channel distance by the flow rate obtained from Manning's equation. This can be written as:

$$t_{ch} = L_{ch} \Big/ \left((3600 \frac{1.49}{n} R^{\frac{2}{3}} S_{ch}^{\frac{1}{2}}) \right)$$

Equation 4-19.

***Where**:*

t_{ch} = channel flow time (hr.)

L_{ch} = channel flow length (ft)

S_{ch} = channel flow slope (ft/ft)

n = Manning's roughness coefficient

$R = \frac{a}{p_w}$ = channel hydraulic radius (ft), and is equal to p_w, where: a = cross sectional area (ft^2) and p_w = wetted perimeter (ft), consider the uniform flow velocity based on bank-full flow conditions. That is, the main channel is flowing full without flow in the overbanks. This assumption avoids the significant iteration associated with other methods that employ rainfall intensity or discharges (because rainfall intensity and discharge are dependent on time of concentration).

Manning's Roughness Coefficient Values

Manning's roughness coefficients are used to calculate flows using Manning's equation. Values from American Society of Civil Engineers (ASCE) 1992, FHWA 2001, and Chow 1959 are reproduced in Table 4-7, Table 4-8, and Table 4-9.

Table 4-7: Manning's Roughness Coefficients for Open Channels

Type of channel	Manning's n
A. Natural streams	
1. Minor streams (top width at flood stage < 100 ft)	
a. Clean, straight, full, no rifts or deep pools	0.025-0.033
b. Same as a, but more stones and weeds	0.030-0.040
c. Clean, winding, some pools and shoals	0.033-0.045
d. Same as c, but some weeds and stones	0.035-0.050
e. Same as d, lower stages, more ineffective	0.040-0.055
f. Same as d, more stones	0.045-0.060
g. Sluggish reaches, weedy, deep pools	0.050-0.080
h. Very weedy, heavy stand of timber and underbrush	0.075-0.150
i. Mountain streams with gravel and cobbles, few boulders on bottom	0.030-0.050
j. Mountain streams with cobbles and large boulders on bottom	0.040-0.070
2. Floodplains	
a. Pasture, no brush, short grass	0.025-0.035
b. Pasture, no brush, high grass	0.030-0.050
c. Cultivated areas, no crop	0.020-0.040
d. Cultivated areas, mature row crops	0.025-0.045
e. Cultivated areas, mature field crops	0.030-0.050
f. Scattered brush, heavy weeds	0.035-0.070
g. Light brush and trees in winter	0.035-0.060
h. Light brush and trees in summer	0.040-0.080

Table 4-7: Manning's Roughness Coefficients for Open Channels

Type of channel	Manning's n
i. Medium to dense brush in winter	0.045-0.110
j. Medium to dense brush in summer	0.070-0.160
k. Trees, dense willows summer, straight	0.110-0.200
l. Trees, cleared land with tree stumps, no sprouts	0.030-0.050
m. Trees, cleared land with tree stumps, with sprouts	0.050-0.080
n. Trees, heavy stand of timber, few down trees, flood stage below branches	0.080-0.120
o. Trees, heavy stand of timber, few down trees, flood stage reaching branches	0.100-0.160
3. Major streams (top width at flood stage > 100 ft)	
a. Regular section with no boulders or brush	0.025-0.060
b. Irregular rough section	0.035-0.100
B. Excavated or dredged channels	
1. Earth, straight and uniform	
a. Clean, recently completed	0.016-0.020
b. Clean, after weathering	0.018-0.025
c. Gravel, uniform section, clean	0.022-0.030
d. With short grass, few weeds	0.022-0.033
2. Earth, winding and sluggish	
a. No vegetation	0.023-0.030
b. Grass, some weeds	0.025-0.033
c. Deep weeds or aquatic plants in deep channels	0.030-0.040
d. Earth bottom and rubble sides	0.028-0.035
e. Stony bottom and weedy banks	0.025-0.040
f. Cobble bottom and clean sides	0.030-0.050
g. Winding, sluggish, stony bottom, weedy banks	0.025-0.040
h. Dense weeds as high as flow depth	0.050-0.120
3. Dragline-excavated or dredged	
a. No vegetation	0.025-0.033
b. Light brush on banks	0.035-0.060
4. Rock cuts	

Procedure for using the Rational Method

The rational formula estimates the peak rate of runoff at a specific location in a watershed as a function of the drainage area, runoff coefficient, and mean rainfall intensity for a duration equal to the time of concentration. The rational formula is:

$$Q = \frac{CIA}{Z}$$

Equation 4-20.

***Where**:*

Q = maximum rate of runoff (cfs or m^3/sec.)

C = runoff coefficient

I = average rainfall intensity (in./hr. or mm/hr.)

A = drainage area (ac or ha)

Z = conversion factor, 1 for English, 360 for metric

Rainfall Intensity

The rainfall intensity (I) is the average rainfall rate in in./hr. for a specific rainfall duration and a selected frequency. The duration is assumed to be equal to the time of concentration. For drainage areas in Texas, you may compute the rainfall intensity using Equation 4-21, which is known as a rainfall intensity-duration-frequency (IDF) relationship (power-law model).

$$I = \frac{b}{(t_c + d)^e}$$

Equation 4-21.

Where:

I = design rainfall intensity (in./hr.)

t_c = time of concentration (min) as discussed in Section 11

e, b, d = coefficients based on rainfall IDF data.

In September 2018, the National Oceanic and Atmospheric Administration (NOAA) released updated precipitation frequency estimates for Texas. These estimates are available through NOAA's Precipitation Frequency Data Server (PFDS) website and the report documenting the approach is also available at the same website - NOAA Atlas 14, Volume 11: Precipitation-Frequency Atlas of the United States. This new rainfall data is considered best available data and should be used for all projects. Tabular IDF data are

available from the PFDS, but linear interpolation or curve generation is needed to obtain intensity values between tabular durations. Ongoing TxDOT research will produce future e, b, d coefficients to better automate intensity calculations. However, barring significant project implementation concerns, Atlas 14 IDF data should be used. Exceptions must be approved by the DHE or DES HYD and noted on the plans or drainage report.

Currently, the coefficients in Equation 4-21 can be found in the EBDLKUP-2015v2.1.xlsx spreadsheet lookup tool (developed by Cleveland et al. 2015) for specific frequencies listed by county (See video/tutorial on the use of the EBDLKUP-2015v2.1.xlsx spreadsheet tool). This spreadsheet is based on prior rainfall frequency-duration data contained in the Atlas of Depth-Duration Frequency (DDF) of Precipitation of Annual Maxima for Texas (TxDOT 5-1301-01-1).

If a project is approved to use the older values from the EBDLKUP-2015v2.1.xlsx spreadsheet lookup tool or from existing functionality in design software like GEOPAK, they should still evaluate the new NOAA rainfall changes for their project area and, if there are increases for the design frequency, estimate an appropriate level of freeboard for use. The freeboard amount and a description of how it was generated should be noted in both the plans and the drainage report. Software that facilitates Rational Method calculations often has IDF curves from rainfall data embedded into the software. Location-specific IDF from the new NOAA rainfall data can be imported for each project into the software.

TxDOT is currently working with Texas Transportation Institute (TTI) staff, as part of research project 0-6980, to update the IDF curve relationships for the state of Texas based on the 2018 NOAA rainfall data. This work will include an update of the EBDLKUP-2015v2.1.xlsx file linked above and planned for inclusion in the next HDM update.

The general shape of a rainfall IDF curve is shown in Figure 4-9. As rainfall duration approaches zero, the rainfall intensity tends towards infinity. Because the rainfall intensity/duration relationship is assessed by assuming that the duration is equal to the time of concentration, small areas with exceedingly short times of concentration could result in design rainfall intensities that are unrealistically high. To minimize this likelihood, use a minimum time of concentration of 10 minutes. As the duration tends to infinity, the design rainfall tends towards zero. Usually, the area limitation of 200 acres for Rational Method calculations should result in rainfall intensities that are not unrealistically low. However, if the estimated time of concentration is

NOAA Atlas 14, Volume 11, Version 2
Location name: El Paso, Texas, USA*
Latitude: 31.5954°, Longitude: -106.1722°
Elevation: 3938 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.235** (0.178-0.311)	**0.300** (0.228-0.387)	**0.402** (0.306-0.526)	**0.490** (0.368-0.653)	**0.615** (0.446-0.843)	**0.713** (0.504-1.01)	**0.819** (0.565-1.19)	**0.939** (0.631-1.40)	**1.11** (0.723-1.72)	**1.26** (0.795-1.98)
10-min	**0.394** (0.298-0.520)	**0.502** (0.381-0.647)	**0.672** (0.511-0.879)	**0.818** (0.614-1.09)	**1.03** (0.747-1.41)	**1.19** (0.845-1.69)	**1.37** (0.944-1.98)	**1.56** (1.05-2.32)	**1.82** (1.18-2.81)	**2.03** (1.29-3.21)
15-min	**0.452** (0.342-0.597)	**0.576** (0.437-0.744)	**0.772** (0.588-1.01)	**0.941** (0.706-1.25)	**1.18** (0.856-1.62)	**1.37** (0.966-1.93)	**1.57** (1.08-2.28)	**1.80** (1.21-2.69)	**2.15** (1.40-3.32)	**2.44** (1.54-3.85)
30-min	**0.560** (0.424-0.739)	**0.714** (0.542-0.922)	**0.957** (0.728-1.25)	**1.17** (0.875-1.55)	**1.46** (1.06-2.01)	**1.70** (1.20-2.39)	**1.95** (1.34-2.83)	**2.24** (1.51-3.34)	**2.67** (1.73-4.12)	**3.02** (1.91-4.77)
60-min	**0.671** (0.508-0.887)	**0.856** (0.649-1.10)	**1.15** (0.872-1.50)	**1.40** (1.05-1.86)	**1.75** (1.27-2.40)	**2.03** (1.44-2.87)	**2.34** (1.61-3.39)	**2.68** (1.80-3.98)	**3.17** (2.06-4.89)	**3.58** (2.26-5.65)
2-hr	**0.785** (0.597-1.03)	**0.996** (0.760-1.28)	**1.33** (1.02-1.73)	**1.61** (1.22-2.14)	**2.02** (1.47-2.75)	**2.34** (1.66-3.27)	**2.68** (1.86-3.86)	**3.08** (2.08-4.55)	**3.66** (2.39-5.61)	**4.15** (2.64-6.51)
3-hr	**0.853** (0.652-1.12)	**1.08** (0.828-1.38)	**1.44** (1.10-1.87)	**1.74** (1.32-2.30)	**2.18** (1.59-2.95)	**2.52** (1.79-3.51)	**2.89** (2.00-4.14)	**3.32** (2.24-4.88)	**3.96** (2.59-6.04)	**4.50** (2.86-7.02)
6-hr	**0.962** (0.739-1.25)	**1.22** (0.939-1.55)	**1.63** (1.26-2.10)	**1.98** (1.50-2.59)	**2.47** (1.81-3.33)	**2.86** (2.04-3.96)	**3.28** (2.29-4.68)	**3.78** (2.57-5.54)	**4.54** (2.98-6.88)	**5.18** (3.31-8.02)
12-hr	**1.04** (0.805-1.35)	**1.34** (1.03-1.68)	**1.80** (1.40-2.30)	**2.20** (1.69-2.88)	**2.79** (2.06-3.74)	**3.26** (2.34-4.49)	**3.78** (2.65-5.35)	**4.38** (2.99-6.36)	**5.29** (3.48-7.95)	**6.06** (3.88-9.30)
24-hr	**1.13** (0.875-1.45)	**1.48** (1.13-1.83)	**2.00** (1.55-2.54)	**2.47** (1.90-3.20)	**3.17** (2.36-4.23)	**3.75** (2.72-5.15)	**4.39** (3.09-6.17)	**5.13** (3.51-7.38)	**6.21** (4.10-9.25)	**7.11** (4.58-10.8)
2-day	**1.25** (0.976-1.60)	**1.67** (1.28-2.03)	**2.28** (1.78-2.87)	**2.85** (2.20-3.67)	**3.70** (2.78-4.94)	**4.44** (3.24-6.07)	**5.25** (3.71-7.32)	**6.13** (4.21-8.75)	**7.38** (4.90-10.9)	**8.41** (5.43-12.7)
3-day	**1.34** (1.05-1.71)	**1.81** (1.39-2.19)	**2.48** (1.94-3.11)	**3.10** (2.41-3.99)	**4.05** (3.06-5.39)	**4.87** (3.57-6.64)	**5.77** (4.09-8.02)	**6.73** (4.64-9.57)	**8.10** (5.38-11.9)	**9.19** (5.95-13.8)
4-day	**1.42** (1.12-1.81)	**1.91** (1.47-2.31)	**2.62** (2.06-3.29)	**3.28** (2.56-4.21)	**4.28** (3.24-5.68)	**5.14** (3.78-6.99)	**6.09** (4.33-8.44)	**7.11** (4.90-10.1)	**8.54** (5.68-12.5)	**9.71** (6.29-14.6)
7-day	**1.61** (1.27-2.04)	**2.15** (1.67-2.60)	**2.94** (2.32-3.67)	**3.66** (2.86-4.67)	**4.75** (3.60-6.25)	**5.67** (4.17-7.65)	**6.68** (4.77-9.20)	**7.79** (5.40-11.0)	**9.38** (6.26-13.7)	**10.7** (6.95-15.9)
10-day	**1.77** (1.40-2.24)	**2.34** (1.83-2.84)	**3.19** (2.53-3.98)	**3.96** (3.11-5.04)	**5.11** (3.88-6.70)	**6.07** (4.47-8.15)	**7.12** (5.09-9.77)	**8.28** (5.75-11.6)	**9.95** (6.66-14.4)	**11.3** (7.38-16.8)
20-day	**2.27** (1.81-2.85)	**2.92** (2.32-3.56)	**3.92** (3.13-4.86)	**4.79** (3.78-6.05)	**6.06** (4.61-7.86)	**7.07** (5.23-9.42)	**8.17** (5.87-11.1)	**9.38** (6.55-13.1)	**11.1** (7.47-16.0)	**12.5** (8.19-18.4)
30-day	**2.67** (2.14-3.34)	**3.38** (2.72-4.14)	**4.50** (3.62-5.57)	**5.46** (4.32-6.87)	**6.81** (5.20-8.80)	**7.88** (5.84-10.4)	**9.01** (6.49-12.2)	**10.3** (7.18-14.2)	**12.0** (8.10-17.2)	**13.4** (8.80-19.7)
45-day	**3.20** (2.57-3.98)	**4.00** (3.24-4.91)	**5.30** (4.28-6.55)	**6.40** (5.08-8.02)	**7.92** (6.06-10.2)	**9.10** (6.76-12.0)	**10.3** (7.46-14.0)	**11.6** (8.18-16.1)	**13.5** (9.12-19.2)	**14.9** (9.82-21.8)
60-day	**3.65** (2.94-4.54)	**4.55** (3.70-5.58)	**6.01** (4.87-7.41)	**7.22** (5.75-9.04)	**8.91** (6.83-11.4)	**10.2** (7.60-13.4)	**11.5** (8.35-15.5)	**12.9** (9.10-17.8)	**14.8** (10.1-21.1)	**16.3** (10.8-23.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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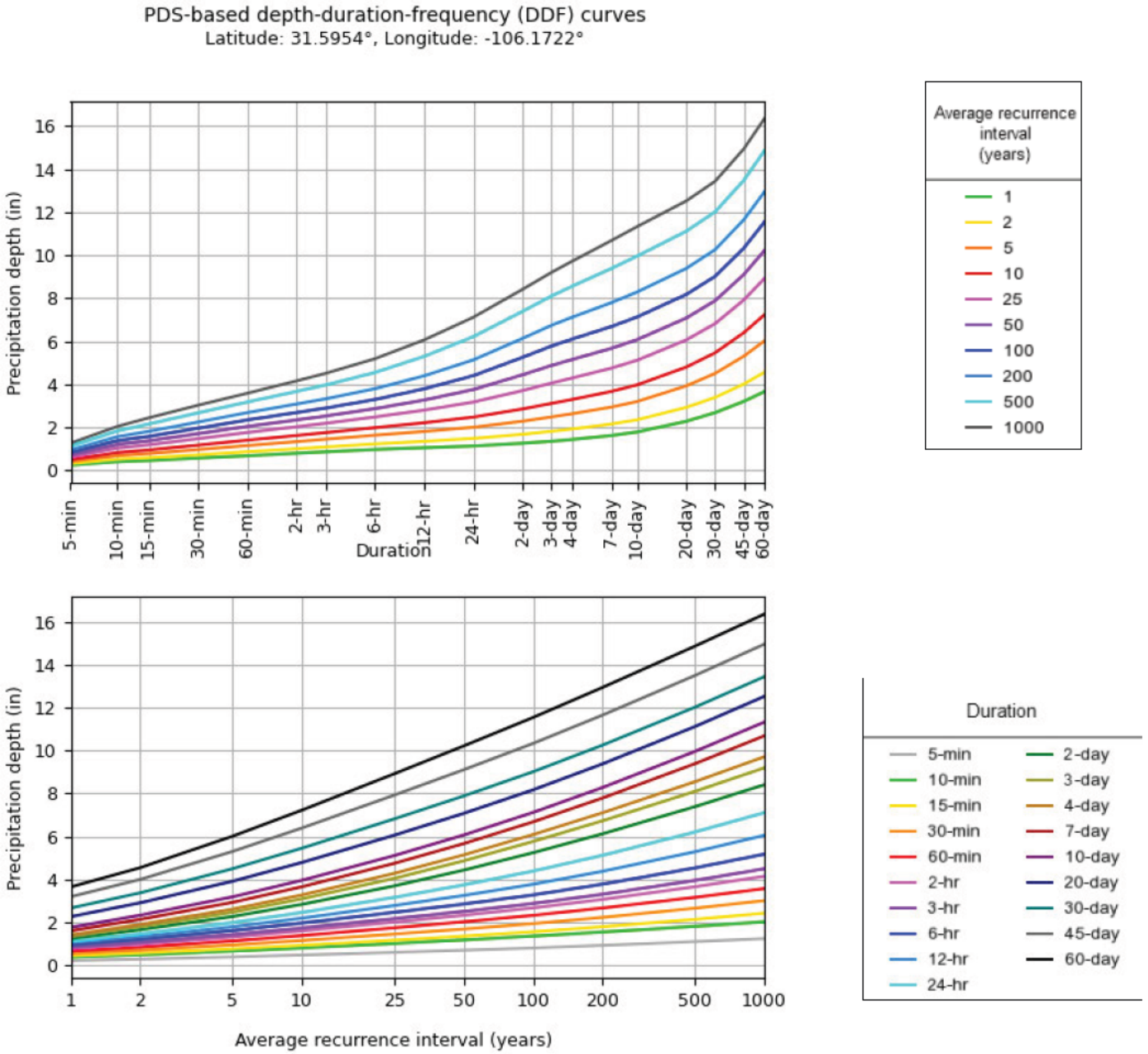
PF graphical



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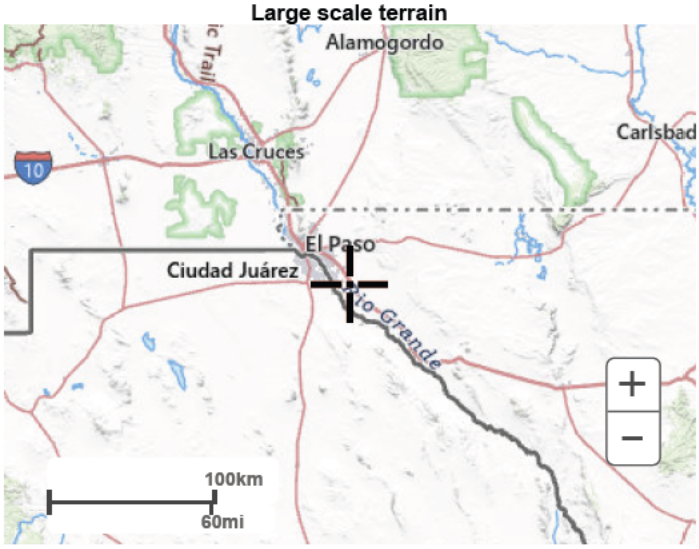
Maps & aerials

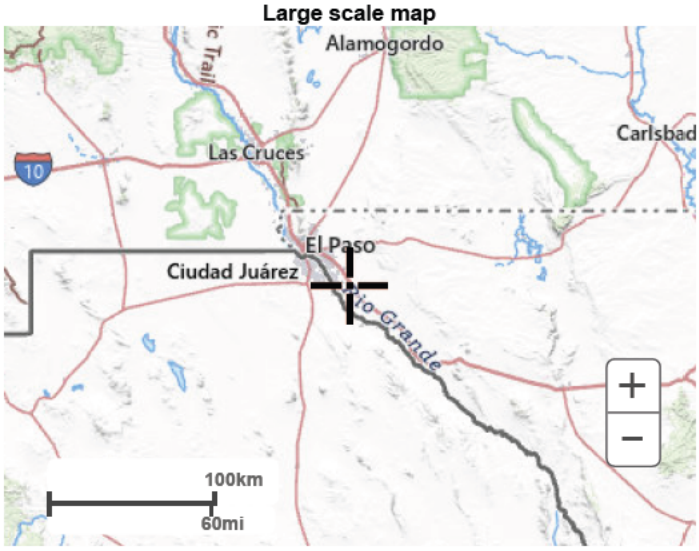
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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Disclaimer

Rainfall Intensity-Duration-Frequency Coefficients for Texas

Based on United States Geological Survey (USGS) Scientific Investigations Report 2004–5041
"Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas"

1. Select English or SI Units

English

2. Select or Enter a County

El Paso

3. Enter a Time of Conc.
Select Units

10 min

Coefficient	50% (2-year)	20% (5-year)	10% (10-year)	4% (25-year)	2% (50-year)	1% (100-year)
e	0.8722	0.8916	0.9184	0.9037	0.8987	0.8902
b (in.)	30.36	48.03	70.58	80.75	90.38	100.88
d (min)	4.11	5.22	7.20	7.36	7.76	8.56
Intensity (in./hr)	3.02	4.24	5.18	6.12	6.81	7.49

(Spreadsheet Release Date: August 31, 2015; data table reshuffle by Asquith July 14, 2016)

Worksheet for Active Face Diversion Berm

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.018
Channel Slope	0.005 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	2.000 H:V
Discharge	14.20 cfs

Results	
Normal Depth	14.4 in
Flow Area	3.6 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	6.7 in
Top Width	6.00 ft
Critical Depth	13.8 in
Critical Slope	0.006 ft/ft
Velocity	3.95 ft/s
Velocity Head	0.24 ft
Specific Energy	1.44 ft
Froude Number	0.898
Flow Type	Subcritical

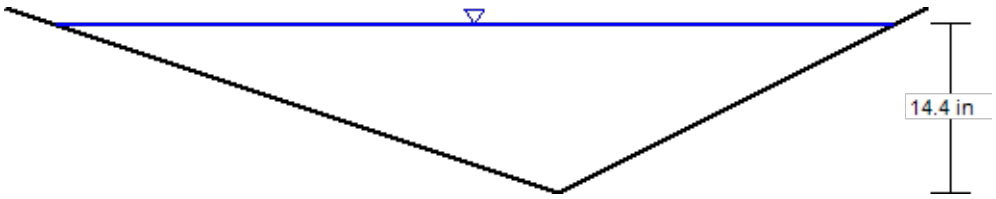
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

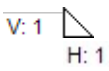
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	14.4 in
Critical Depth	13.8 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Cross Section for Active Face Diversion Berm

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.018
Channel Slope	0.005 ft/ft
Normal Depth	14.4 in
Left Side Slope	3.000 H:V
Right Side Slope	2.000 H:V
Discharge	14.20 cfs






STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
11-18-25

Open Channel Energy Dissipator – Trapezoidal Channel (Low-Water Crossing)

INPUTS		
Design Discharge Q (cfs)	176.200	
Bottom Width b (ft)	8.000	
Side Slope z (H:V, both sides)	2.000	
Channel Longitudinal Slope S0 (ft/ft)	0.250	
Manning n (dimensionless)	0.041	
G (ft/s^2)	32.174	
Initial Guess: Depth y1 (ft) – use Goal Seek	1.336	
CALCULATIONS (trapezoidal channel)		
Top Width T (ft)	13.344	
Area A (ft^2)	14.257	
Wetted Perimeter P (ft)	13.974	
Hydraulic Radius R (ft)	1.020	
Velocity V (ft/s)	12.359	
Hydraulic Depth D=A/T (ft)	1.068	
Normal Depth Residual f(y)=Q-(1/n)A R^(2/3) S0^(1/2)	0.000	
Unit Discharge q per top width (cfs/ft)	13.205	
Froude Number Fr1 = V/sqrt(g*D)	2.108	Supercritical
Approx. Sequent Depth y2 (ft) [uses Belanger with Fr1 and y1]	3.370	
Minimum Basin Length (ft) (per HEC-14)	18.824	< 30' Road Width
		Crossing Contains Hydraulic Jump

ATTACHMENT III.B.2 – EROSION AND SEDIMENTATION CONTROL PLAN

MSW AUTH NO. 2284A

ATTACHMENT III.B.2 – EROSION AND SEDIMENTATION CONTROL PLAN

MSW AUTH NO. 2284A
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 1
MAY 16, 2025

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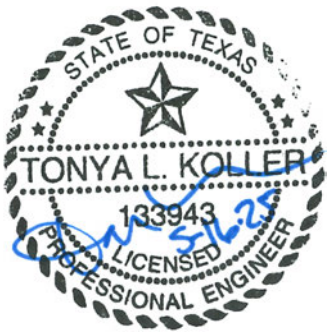

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List of Abbreviations

Abbreviation	Term/Phrase/Name
C	cover management factor
c	Rational Method runoff coefficient
Cccc	canopy cover factor
Cplu	prior land use factor
Csc	surface cover factor
Csm	soil moisture factor
Csr	surface roughness factor
EPA	United States Environmental Protection Agency
ESCP	Erosion and Sedimentation Control Plan
fps	feet per second
GEP Landfill	Greater El Paso Landfill, MSW Authorization Number 2284A
I	rainfall intensity
K	soil erodibility factor
L	slope length factor
MSW	Municipal Solid Waste
NRCS	Natural Resources Conservation Service
P	support practices factor
R	rainfall value
RG-17	Texas Commission on Environmental Quality Regulatory Guidance, "Surface Water Drainage and Erosional Stability Guidelines for a Municipal Solid Waste Landfill", dated May 2018
RUSLE	Revised Universal Soil Loss Equation
S	slope factors
SCS	Soil Conservation Service
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
USDA	United States Department of Agriculture

III.B.2.1.0 Introduction

This Erosion and Sedimentation Control Plan (ESCP) was developed to provide structural and non-structural control measures for the Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill) to provide long term erosional stability during landfill operation, closure, and post-closure care. The ESCP was developed to meet the requirements of Chapter 30 of Texas Administrative Code (TAC) Rule §330.305(d). The soil erodibility calculations for final and interim scenarios are provided in **Appendix III.B.2.A**. These calculations were completed using the Revised Universal Soil Loss Equations (RUSLE) which is developed and maintained by the Natural Resources Conservation Service (NRCS). These calculations show weighted soil loss values of less than 3 tons/acre/year for final cover conditions and less than 50 tons/acre for interim conditions, which complies with the recommendation set forth in the Texas Commission on Environmental Quality (TCEQ) Regulatory Guidance, “Surface Water Drainage and Erosional Stability Guidelines for a Municipal Solid Waste Landfill”, dated May 2018 (RG-417).

III.B.2.1.1 Pre-Development Conditions

The GEP Landfill is located in northeast El Paso County and encompasses approximately 311 acres adjacent to the existing Clint Landfill, MSW Authorization Number 1482. Prior to the landfill development, the site and surrounding area were vacant land. The northern two-thirds of the site was nearly level to gently sloping to the west; surface soils on this portion of the site are brown loamy fine sands of the Hueco-Wink association. The southern third of the site sloped at approximately five percent to the south. The Soil Survey for El Paso County, Texas (United States Department of Agriculture (USDA) Soil Conservation Service (SCS), April 1971), identifies that soils on this portion of the site are of the Bluepoint association; these soils are also described as loamy fine sands. Site soils are of a poor quality for vegetation production. Site vegetation consists of sparse desert shrubs. The soils are moderately to very permeable and susceptible to blowing and the hazard of water erosion is moderate to severe.

Pre-development site drainage conditions are shown on Drawing III.B.2 in **Attachment III.B.3**. Surface drainage was toward the south and southwest direction.

III.B.2.1.2 Post-Development Drainage Conditions

During landfill operation, temporary diversion berms and drainage swales will be constructed to protect open fill areas from on-site surface water run-on and run-off. Calculations for temporary berms are provided in Appendix III.C – Leachate and Contaminated Water Plan. Drainage controls for final cover are incorporated into the site in order to reduce flooding and minimize the amount of sediment carried off the site. Drainage controls include berms, interceptor ditches, down chutes, culverts, channels, and detention ponds. Drainage controls are shown in Drawing III. B.3 in **Attachment III.B.3**, with details in Drawings III. B.5 and III.B.6 in **Attachment III.B.3**.

The interim external embankment slopes of the landfill shall be no greater than 3:1. These slopes shall be equipped with semi-permanent swales, as discussed in **Section III.B.2.3.1.4.** These swales shall be installed along the slopes with a minimum spacing of 25 vertical feet (100 horizontal feet on 3:1 slopes) which is consistent with the final cover design. This spacing will limit the runoff type to sheet flow with negligible velocity before being collected in the armored swales. Swale spacing throughout the site is shown in the drawings in **Attachment III.B.3.**

III.B.2.2.0 Soil Loss Calculation

30 TAC §330.305(d)(2) requires the demonstration of interim and long-term erosional stability of the landfill, to include the estimation of soil loss.

Soil loss calculations have been performed using the RUSLE as presented in NRCS Agricultural Handbook #703, “Design Hydrology and Sedimentology for Small Catchments” by Haan and Barfield and the United States Environmental Protection Agency (EPA). These loss calculations have been completed for the external embankment side slopes and top surfaces for both intermediate and final cover conditions.

Based on the RUSLE, it is anticipated that an average of approximately 2.65 tons of soil per acre per year will erode from the final cover, and 46.99 tons of soil per acre per year will erode from the intermediate cover external slopes (4H:1V) and 48.05 tons of soil per acre per year for the intermediate cover internal slopes (3H:1V). Refer to the calculation sheets provided on the following pages. The amount of erosion from the intermediate cover external side slopes when using diversion berms or sediment capture will be below 50 tons per acre per year. The long-term stability of the landfill is demonstrated with estimated losses less than 3 tons/acre/year from the external side slopes.

III.B.2.2.1 RUSLE Calculation

The RUSLE calculation is the product of variables representing rainfall value (R), soil erodibility factor (K), slope length factor (L), slope factors (S), cover management factor (C), and support practices factor (P). The cover management factor is also the product of another calculation involving variables for prior land use (Cplu), canopy cover factor (Ccc), surface cover factor (Csc), surface roughness factor (Csr), and soil moisture factor (Csm). The values for each variable were selected from tables contained in either the NRCS Agricultural Handbook #703 or “Design Hydrology and Sedimentology for Small Catchments” by Haan and Barfield.

- The rainfall value variable, R, is the same for all RUSLE calculations for the site. A value of 20.0 was determined per the NRCS Agricultural Handbook.
- The soil erodibility factor, K, is also the same for all RUSLE calculations for the site. A value of 0.24 was determined per the soil survey report from the NRCS.
- The support practices factor, P, is also the same for all RUSLE calculations for the site. A value of 1.0 was selected as a conservative value which assumes no extra erosion prevention efforts.
- The slope length factor, L, and the slope factor, S, vary depending on whether the calculation is for the top dome surface, an external embankment side slope or rock armored let-down chute. External embankment side slope calculations assume a slope length of 200-feet for external intermediate slopes (4H:1V) and 140-feet for internal intermediate slopes (3H:1V). Top dome surface calculations assume a max slope length of 600-feet at a 5 percent slope. Lastly, a final cover of rock armoring (or equivalent) in the longest chute of 800-feet at 25 percent slope.
- The cover factor calculation uses two different variations for this site: rock cover and no cover. A prior land use factor, Cplu, of 1.0 was selected for these conditions. This value represents the former range and was found in Table 8-10.B of the Haan, Barfield text.
- A canopy cover factor of 1.0 was selected for all conditions. This value was selected conservatively to represent no canopy coverage even if there is vegetation established.
- A surface roughness subfactor; Csr, of 1.0 was selected for all conditions as a conservative estimate assuming zero root development.

- A soil moisture subfactor, Csm, of 1.0 was selected for all conditions, which is a value for rangeland from the Haan, Barfield text.
- The cover factor that does not vary between the conditions is the surface cover subfactor, Csc.
- For the final cover condition, the fraction of ground cover was set at 0.35, which was selected as a conservative estimate for the continuous crushed rock covering. For the no vegetative cover condition, the fraction of the ground cover was set at 0.0 because there will be no groundcover.

Overall, the variables for the RUSLE calculations were selected to be conservative, but to still give a fair comparison between the different conditions.

RUSLE results are discussed in **Section III.B.2.3.2** and calculations are provided in **Appendix III.B.2.A**.

III.B.2.3.0 Erosion and Sediment Controls

The most effective means to reduce the amount of soil loss during construction of the landfill is to prevent erosion. The primary goal of erosion control is to minimize the area of disturbance through the phasing of construction activities, implementation of intermediate erosion control practices, and the timely establishment of permanent controls. The following paragraphs describe the structural and non-structural controls to be employed at this landfill throughout the development of the facility.

III.B.2.3.1 Structural Controls

Structural controls are those items that need to be constructed or installed to limit erosion. Structural controls will be implemented as necessary during the development of the landfill. These include silt fences, ditch checks, sediment logs and straw bales. Additionally, rock filter berms, gabions, interceptor ditches, down chutes, culverts, channels, and detention ponds which are discussed in **Part III, Appendix B, Section III.B.3.0**. Calculations for these structural controls are provided in **Attachment III.B.1.** The interim and permanent structural controls will be constructed in accordance with the Sequence of Development as provided in the Site Development Plan. In general, the following types of erosion controls will be used at the facility.

III.B.2.3.1.1 Slope Erosion Protection

Areas of the landfill that reach final design elevations will be armored with native stone or equivalent as part of the final cover system. Intermediate slopes may remain bare depending on the length of time the area is exposed prior to commencing filling. In intermediate baren conditions, structural controls will be used to control velocity where maximum non-erodible velocities are not maintained. Calculations performed in **Appendix III.B.2.A** demonstrate that for bare soil interim condition, soil loss is not a large concern. However, velocity calculations performed using Manning's Equation and provided in **Attachment III.B.1** show that velocity above permissible limits may be an issue. Therefore, structural controls such as ditch checks, sediment control logs, etc. are required to reduce interim velocities below permissible limits, see **Section III.B.2.3.1.4**. The site will have excess soil available for operations at the landfill. It is likely that some of the soil will remain stockpiled for extended periods of time; therefore, it will be necessary to install perimeter silt fences to prevent soil loss and erosion.

III.B.2.3.1.2 Sediment Capture and Cover Replenishment

A sediment capture and cover replenishment system may be used to keep soil loss below 50 tons per acre of cover per year. As shown in **Table III.B.2.3-3**, the annual soil loss per acre will not exceed 50 tons. In the event that a surplus of 50 tons per acre is lost, earth-moving equipment on site will be sufficient to replenish the captured surplus of sediment per acre of external side slope. The sediment capture facilities will be monitored monthly, as well as after any rain event. The slopes will be replenished whenever a downstream sediment capture device becomes full or after a major storm event. The sediment capture facilities will be placed at the toe of slope for all intermediate side slopes. Structures must also be placed on the slopes to keep the flow velocity on the slopes below the maximum non-erodible velocity for bare soil of 1.5-feet per second. The suggested capture structures include silt fences, sediment logs, ditch checks and sediment traps. Non-erodible velocities are discussed more in-depth in **III.B.2.4.0** and controls for achieving these velocities on interim conditions are listed in **Table III.B.2.3-1**.

III.B.2.3.1.3 Drainage Channel Erosion Protection

Perimeter channels will be constructed around the landfilled area to divert runoff around the landfill to the detention ponds. The erosion for each channel section is selected based on the flow velocity in the channel from a 25-year storm. Channels with a flow velocity less than 1.5-feet per second may be bare soil without erosion control lining. Channel sections with a flow velocity less than 4.0-feet per second may use vegetative lining as a continuous erosion control lining, or velocity control devices may be used to bring the flow velocity below 1.5-feet per second between the devices to allow for bare soil without continuous lining. Channel sections with a flow velocity greater than 4.0-feet per second must use a more heavy-duty continuous lining, such as gabions, concrete, or Flexamat Plus, riprap or velocity control devices. Drawings III.B.4-6 in **Attachment III.B.3** contain channel locations and details. Non-erodible and design velocities are discussed further in **Section III.B.2.4.0**.

III.B.2.3.1.4 Interim Controls

Interim Controls will be installed around the base of soil stockpile areas, active excavation and construction areas, and other areas as necessary to control siltation of run-off control facilities. Interim controls will be necessary to keep soil losses to an acceptable level as vegetative cover may be difficult to establish. They will be needed to prevent the transmission of silt into detention and drainage structures and eventually off site. These interim controls may include sediment capture and replenishment system, silt fences, straw bales, filter dams, sediment traps, and interceptor berms. Interim controls will not be installed on any sections of daily cover. **Table III.B.2.3-1** includes parameters for the installation of various structural controls.

III.B.2.3.1.4.1 Crown/Top Slope Controls

Before installing the rock armoring, the crown may temporarily be exposed to bare soil conditions. During this interim phase, soil loss, as indicated in **Section III.B.2.3.2,** is not a major concern for the crown. However, high peak velocities could pose a risk to erosion. Structural controls—outlined in **Table III.B.2.3-1,** should be implemented to regulate stormwater velocity on top slopes and within the diversion berm around the edge of the top slope. Per NRCS time of concentration calculations, see Appendix III.B.1, this can be achieved for the top slope by spacing a grade break control (i.e. silt fence, sediment log) every 300 feet to control sheet flow. To regulate velocity within the diversion berm, a check control (such as straw bales, ditch checks, or sediment logs) should be placed as specified in **Table III.B.2.3-1.**

III.B.2.3.1.4.2 Side Slope Controls

During interim conditions, two slope configurations are required for interceptor ditches:

- External embankments: The slope will be 4H:1V.
- Internal intermediate slope construction: The slope will be 3H:1V.

These slope conditions were calculated to account for soil loss and peak velocities. In accordance with RG-417 requirements, two-foot interceptor ditches must be spaced as follows:

- 200 feet apart for 4H:1V slopes.
- 140 feet apart for 3H:1V slopes.

For 4H:1V slopes, a structural control (i.e., silt fence, sediment log, straw bale, etc.) must be placed every 50 feet to slow sheet flow to the allowable velocity. The same is true for 3H:1V slopes on the internal intermediate slope, where the structural control spacing needs to be 35-feet.

For channel flow within the interceptor ditches, check controls—such as straw bales, ditch checks, or sediment logs—should be installed at the spacing and area specified in **Table III.B.2.3-1** to effectively reduce peak flow to manageable rates.

Table III.B.2.3-1: Structural Controls

Control	Typical Placement	Max Spacing/ Max Drainage Area	Slope Restrictions
Silt Fence	Downstream of disturbed area which has not received permanent erosion controls	100 ft 75 ft 50 ft 25 ft	3%-5% 5%-10% 10%-20% 20%-50%
Straw Bales	Perpendicular to slope, downstream of disturbed area which has not received permanent erosion controls	100 ft spacing max	3:1 max
Rock Filter Dam Type 1	Toe of slope, around inlets, in small ditches, and swale outlets	5 acres max	2:1 max
Rock Filter Dam Type 2	In larger ditches and at swale outlets	5 acres max	2:1 max
Rock Filter Dam Type 3	In stream flow, attached to the stream bed	5 acres max	2:1 max
Rock Filter Dam Type 4	In ditches and smaller channels	5 acres max	2:1 max
Ditch Checks	In swales or channels	5 acres max, spaced for desired velocity	3:1 max
Sediment Logs	In swales, channels, or on slopes	25 to 50 ft while slowing flow, 100 ft once at desired velocity	2:1 max

III.B.2.3.2 Effectiveness of Applied Controls

The structural controls applied to the landfill after final cover is installed include terracing with diversion berms and rock armoring. These structural controls are used to keep the soil losses to appropriate amounts for both long- and short-term erosional stability for the facility. A RUSLE analysis was completed to determine the effectiveness of each control.

Table III.B.2.3-2: Effectiveness of Applied Controls: Final Cover

Condition	Results
Final Cover Side Slope with Rock Armoring	2.45 Tons/Acre/Year
Final Cover Crown with Rock Armoring	0.20 Tons/Acre/Year

The total soil loss for final cover conditions with rock armoring, diversion berms, and grade break berms (at the edge of the crown) is 2.65 tons/acre/year. Therefore, it is possible to keep the soil loss below the maximum allowable amount of 3 tons/acre/year using rock armoring.

Table III.B.2.3-3: Effectiveness of Applied Controls: Intermediate Cover

Condition	Results
Intermediate Cover External Side Slopes (4H:1V)	37.82 Tons/Acre/Year
Intermediate Cover Crown (20H:1V)	9.17 Tons/Acre/Year
Internal Intermediate Cover Slope (3H:1V)	38.88 Tons/Acre/Year

The total soil loss for both internal and external intermediate cover conditions with bare soil, diversion berms, and grade break berms (at the edge of the crown) are below 50 tons/acre/year as shown in **Table III.B.2.3-3.** If construction diversion berms cannot be achieved in a timely manner, a sediment capture and cover replenishment system will be used to capture and replace at least the amount of projected loss in excess of the maximum allowable amount on a yearly basis. RUSLE calculations are provided in **Appendix III.B.2.A**.

III.B.2.3.3 Non-Structural Controls

Non-structural controls are used in the design and daily operations of the landfill. These controls include maintenance of the landfill facilities with regard to soil loss and sediment deposition.

Maintenance of erosion and sedimentation controls is an integral part of the daily operation of the landfill. The Site Supervisor is the responsible party for the installation and maintenance of all erosion and sedimentation controls. **Table III.B.2.3-4** describes an appropriate maintenance schedule for erosion damage. The frequency of maintenance can be adjusted if minimal or excessive damage is discovered per event.

The non-structural controls also include plans and designs to minimize disruption of the natural drainage, topography, and vegetative cover features. This has been achieved through the design of the landfill and its drainage controls, which also comply with City of El Paso drainage standards. **Appendix III.B** discusses the changes in natural drainage and topography.

The non-structural controls also include phased development to minimize the area of bare soil exposed at any time and plans to disturb only the smallest area necessary to perform current activities. This will be achieved through the phasing of the landfill development. There will be two phases of development which are made up of ten cells each. These cells will be opened at a rate consistent with the waste acceptance rate, preventing any interruption of waste acceptance. Another non-structural control used will be the scheduling of construction activities during the times of the year with the least erosion potential. The time of the year with the least erosional potential for this site runs from October through June. Extra emphasis will be placed on erosion control during construction activities that occur outside of this period.

The final non-structural control that will be utilized at the facility is the timely stabilization of exposed surfaces. Any exposed surface will have structural controls applied as soon as practicable and within 180 days of placement of intermediate of final cover, as shown in **Table III.B.2.3-4**.

Table III.B.2.3-4: Structural Control Inspection Parameters

Inspection Site	Frequency	Corrective Action
Intermediate Cover	Biweekly or after storm event	Place additional soil in areas of erosion loss, reseed any areas with insufficient vegetative cover, use temporary controls to protect areas of severe erosional damage
Silt Fence	Weekly or after storm event	Repair any damage and remove collected sediment
Hay Bales	Weekly or after storm event	Repair any damage, replace worn bales, and remove excess sediment
Final Cover – Rock Armoring	Monthly or after storm event	Repair any damage with more rock, consider placement of permanent controls to protect areas of reoccurring damage
Drainage Channels and Detention Ponds	Monthly or after storm event	Remove any areas of sediment buildup, reseed areas of insufficient vegetative cover, and repair damage to structural lining
Culverts	Monthly or after storm event	Remove any areas of sediment buildup
Outflow Points	During Storm Event	Note sediment load off-site and adjust on-site controls appropriately
Ditch Creek	Monthly or after storm event	Remove accumulated sediment, remove collected debris, repair any damage
Sediment Collection System	On schedule with type of structure	Remove collected sediment and place on upstream cover; Ensure sediment collection capability is not compromised
Sediment Trap	Monthly or after each rain event	Remove collected sediment where collected to 50% of capacity; Repair trap if needed

III.B.2.3.4 Controls Installation Schedule

As the development of the landfill progresses, the effectiveness of the erosion controls is highly dependent upon the controls being installed at the appropriate time in the development. Timely installation of needed controls will protect against significant erosion damage. **Table III.B.2.3-5** contains the installation time requirements for all controls.

Table III.B.2.3-5: Controls Installation Schedule

Control	Installation Timeframe
Silt Fence or Equivalent	In concurrence with upstream disturbance
Rock Armoring (final cover)	Begin closure activities in accordance with the Closure Plan in Appendix III.I
Diversion Berms	In concurrence with development of final contours
Channel Protection (gabion, riprap, concrete, check dam, or equivalent)	In concurrence with development of drainage channels
Filter Dam	In concurrence with upstream disturbance
Sediment Capture System	Upon placement of intermediate cover upstream.

III.B.2.3.5 Wind Erosion Control

The historical wind speed in the City of El Paso averages 8.8-miles per hour and site soils are classified as having a high potential for erosion. As a result, wind erosion will need to be controlled during all phases of landfill development. This will be achieved with the intermediate phase of landfill development, mainly through non-structural controls. Non-structural controls to be used at the site include limiting the amounts of disturbed ground to the smallest area necessary to perform current activities, prompt stabilization of disturbed ground, and inspection and repair of disturbed ground after a windy day or specific event. One control that will be utilized specifically to limit wind erosion will be the wetting of access roads and disturbed ground by a water truck.

Once the landfill has received final cover, the wind erosion potential will be reduced significantly as a result of permanent stabilization, which includes crushed rock exterior. Permanent stabilization for all other areas on the site includes re-establishment of natural vegetation. This will maximize the long-term wind erosion stability of the facility.

III.B.2.4.0 Non-Erodible Velocities

30 TAC §330.305(d)(1) requires the demonstration that the estimated peak velocities for all external embankment slopes and top surfaces shall be less than the permissible non-erodible velocity under similar conditions.

The permissible non-erodible velocities have been determined by comparing intermediate and final cover conditions to the permissible velocities at certain cover conditions as published by the USDA. The USDA posts these velocities in the Stream Restoration Design National Engineering Handbook, Chapter 8.

Based upon this comparison, the maximum velocity over each surface has been compared to permissible velocity for its cover condition and results are provided in **Table III.B.2.4-1**. For most situations, the minimally acceptable condition is listed. If achieving the minimally acceptable condition is not possible, a condition with a higher non-erodible velocity or a condition which will reduce the velocity of flow will be implemented. For example, the section of Ditch B2 at 4.3 percent slopes could use rock lining, which has a higher non-erodible velocity than bare soil.

The cover condition for each type of slope has been selected to meet both soil-loss and max non-erodible velocity criteria. Note that for intermediate cover, the external side slopes do not meet maximum non-erodible velocity criteria in a non-vegetated condition. Because this situation may only occur during intermediate cover conditions, temporary structural controls, such as ditch checks, or a sediment capture and cover replenishment system will be implemented to keep cover conditions on these slopes on par with all other slopes. Therefore, the side slopes will either require vegetation or velocity control drives to be placed within 180 days of placement of intermediate cover to control side slope erosion.

All berms, ditches, and channels are sized based on the largest peak flow calculated using the Rational Method (Q = cIA) during a 24-hour, 25-year storm. The final cover design is expected to behave hydrologically similar to rock riprap, so a Rational Method runoff coefficient (c) of 0.8 was used to calculate peak storm flows. For the intermediate cover, a runoff coefficient of 0.25 was used, assuming sand or sandy loam soil with a slope of 3-5%. A rainfall intensity (I) of 6.12 inches per hour was calculated for El Paso County, Texas. The largest contributing area to each drainage control was used to calculate the peak flow, which was then used to size the depth of each drainage feature. These calculations are included in **Attachment III.B.1.**

Table III.B.2.4-1: Non-Erodible Velocities

Flow Surface	Condition	Max Velocity[4] (fps)	Max Non-erodible Velocity[1] (fps)	Acceptable
Intermediate Cover				
External Side Slope (4H:1V)	Non-vegetated	1.43	1.5	Yes
External Side Slope Interceptor Ditch	Non-vegetated	3.67	1.5	No[3]
Top Slope (20H:1V)	Non-vegetated	1.08	1.5	Yes
Top Slope Diversion Berm	Non-vegetated	2.44	1.5	No[3]
Internal Side Slope (3H:1V)	Non-vegetated	1.50	1.5	Yes
Internal Side Slope Berm	Non-vegetated	3.80	1.5	No[3]

Flow Surface	Condition	Max Velocity[4] (fps)	Max Non-erodible Velocity[1] (fps)	Acceptable
Final Cover				
External Side Slope (4H:1V)	Rock-armored	1.64	10.0	Yes
Interceptor Ditch	Rock-armored	3.22	10.0	Yes
Top Dome (20H:1V)	Rock-armored	3.61	10.0	Yes
Diversion Berm	Rock-armored	2.15	10.0	Yes
Letdown Structure	Rock Stabilized[2]	16.24	20.0	Yes
Channels				
Ditch B1 – 0.6%	Rock Stabilized[2]	4.38	20.0	Yes
Ditch B1 – 1.6%	Rock Stabilized[2]	6.26	20.0	Yes
Ditch B2 – 1.6%	Rock Stabilized[2]	7.19	20.0	Yes
Ditch B2 – 4.3%	Rock Stabilized[2]	10.31	20.0	Yes
Ditch B2 – 2.1%	Rock Stabilized[2]	8.00	20.0	Yes
Ditch C1 – 0.8%	Rock Stabilized2	2.46	20.0	Yes
Ditch C1 – 2.7%	Rock Stabilized[2]	3.78	20.0	Yes
Ditch C1 – 0.4%	Rock Stabilized[2]	1.99	20.0	Yes
Ditch C2 – 0.4%	Rock Stabilized[2]	3.90	20.0	Yes
Ditch C2 – 3.9%	Rock Stabilized[2]	8.93	20.0	Yes
Ditch C2 – 7.6%	Rock Stabilized[2]	11.26	20.0	Yes
Ditch D1 – 0.3%	Rock Stabilized[2]	2.89	20.0	Yes
Ditch D2 – 0.3%	Rock Stabilized[2]	3.64	20.0	Yes
Ditch D2 – 1.6%	Rock Stabilized[2]	6.77	20.0	Yes
Ditch D2 – 2.6%	Rock Stabilized[2]	8.02	20.0	Yes
Ditch D3 – 2.6%	Rock Stabilized[2]	8.24	20.0	Yes
Ditch D3 – 3.4%	Rock Stabilized[2]	9.08	20.0	Yes
Ditch E1 – 0.3%	Rock Stabilized[2]	3.11	20.0	Yes
Ditch E1 – 1.9%	Rock Stabilized[2]	6.49	20.0	Yes
Ditch E1 – 0.4%	Rock Stabilized[2]	3.69	20.0	Yes
Ditch E2 – 0.4%	Rock Stabilized[2]	3.91	20.0	Yes
Ditch E2 – 5.1%	Rock Stabilized[2]	10.03	20.0	Yes



[1] Max velocities provided by USDA NRCS National Engineering Handbook, Part 654 Stream Restoration Design, Chapter 8.

[2] Rock Stabilized may include gabion-lined, Flexamat Plus, Riprap, or approved equal. See Detail 2 (ditch) and Detail 5 (let down structure), Drawing III.B.5 in Attachment III.B.3.

[3] Maximum non-erodible velocities are exceeded in the non-vegetated berms/ditches. Sediment capture and replenishment or alternative structural controls need to be used as discussed in **Section III.B.2.3.1.4** for compliance with maximum non-erodible velocities.

[4] Max velocities calculated using Rational Method and HEC-HMS for peak flows and Manning's Equation byway of FlowMaster for Normal Depth and Velocity and the NRCS method for estimating T_c, these are included in **Attachment III.B.1**.

APPENDIX III.B.2.A – RUSLE SOIL EROSION CALCULATIONS

Rainfall Value (R)

= 20 — Fig. 2-1, NRCS Agricultural Handbook #703

Soil Erodibility factor (K)

= 0.24 — Per NRCS Web Soil Survey

Topographic Factor (LS)

= 800 feet @ 25% — based on longest downchute, B2, Dwg III.B.4

= 23.24 — Per NRCS Agricultural Handbook #703, Table 4-3

Cover Management Factor (C)

= 0.022 — See C factor calculation sheet

Support Practice Factor (P)

= 1 — Conservative Estimate

Calculated Soil Loss (A)

= RKLSCP

= 2.45 tons/acre/year < 3 tons/acre/year in accordance with RG-417



Rainfall Value (R)
= 20 — Fig. 2-1, NRCS Agricultural Handbook #703

Soil Erodibility factor (K)
= 0.24 — Per NRCS Web Soil Survey

Topographic Factor (LS)
= 600 feet @ 5% — based on longest crown slope, Dwg III.B.4
= 1.91 — Per NRCS Agricultural Handbook #703, Table 4-3

Cover Management Factor (C)
= 0.022 — See C factor calculation sheet

Support Practice Factor (P)
= 1 — Conservative Estimate

Calculated Soil Loss (A)
= RKLSCP
= 0.20 tons/acre/year



Rainfall Value (R)

= 20 — Fig. 2-1, NRCS Agricultural Handbook #703

Soil Erodibility factor (K)

= 0.24 — Per NRCS Web Soil Survey

Topographic Factor (LS)

= 200 feet @ 25% — based on longest side slope, Dwg III.B.4

= 7.88 — Per NRCS Agricultural Handbook #703, Table 4-3

Cover Management Factor (C)

= 1 bare soil — See C factor calculation sheet

Support Practice Factor (P)

= 1 — Conservative Estimate

Calculated Soil Loss (A)

= RKLSCP

= 37.82 tons/acre/year



Rainfall Value (R)

= 20 — Fig. 2-1, NRCS Agricultural Handbook #703

Soil Erodibility factor (K)

= 0.24 — Per NRCS Web Soil Survey

Topographic Factor (LS)

= 140 feet @ 33.3% — based on active face slope interceptor ditches being spaced @ 55 feet

= 8.10 — Per NRCS Agricultural Handbook #703, Table 4-3

Cover Management Factor (C)

= 1 bare soil — See C factor calculation sheet

Support Practice Factor (P)

= 1 — Conservative Estimate

Calculated Soil Loss (A)

= RKLSCP

= 38.88 tons/acre/year



Rainfall Value (R)
= 20 — Fig. 2-1, NRCS Agricultural Handbook #703

Soil Erodibility factor (K)
= 0.24 — Per NRCS Web Soil Survey

Topographic Factor (LS)
= 600 feet @ 5% — based on longest crown slope, Dwg III.B.4
= 1.91 — Per NRCS Agricultural Handbook #703, Table 4-3

Cover Management Factor (C)
= 1 bare soil — See C factor calculation sheet

Support Practice Factor (P)
= 1 — Conservative Estimate

Calculated Soil Loss (A)
= RKLSCP
= 9.17 tons/acre/year



C_{plu} = prior land us subfactor
= **1.0** for rangeland — table 8-10.B, page 271, Haan , Barfield text

C_{cc} = canopy cover subfactor
= $1 - F_c exp(-0.1H)$
F_c = fraction of surface covered by canopy
= 0 — conservative estimate
H = average canopy height in feet
= 0 — conservative estimate
= **1.0**

C_{sc} = surface cover subfactor
= $exp[-bR_c(6/6+R_g))^{0.08}]$ — eq. 8.53, page 270, Haan, Barfield text
b = constant
= 4.5 — table 8-10.B, page 271, Haan , Barfield text
R_c = fraction ground cover
= 0.85 — conservative estimate for 85% rock covering
R_g = surface roughness variable
= $(25.4R_R - 6)(1 - exp(-0.0015R_S))(exp(-0.14P_T))$ — eq. 8.55, page 271, Haan, Barfield text
R_R = random roughness
= 0.5 total root and buriend residue — conservative estimate from Ag. Handbook #703
R_S = [lb/acre]
= 0 — conservative estimate assuming limited vegetative cover
P_T = average yearly rainfall
= 8.67 Inches — National Weather Service Data
= 0.00
= **0.022**

C_{sr} = surface roughness subfactor
= $exp(-0.26*R_G)$ — eq. 8.62, page 273, Haan, Barfield text
R_G = surface roughness variable
= 0
= **1.0**

C_{sm} = soil moisture subfactor
= **1.0** for rangeland — page 273, Haan, Barfield text

C = Cover Management Factor
= $C_{plu}C_{cc}C_{sc}C_{sr}C_{sm}$

= **0.022**

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
5/13/2025

C_{plu} = prior land us subfactor
= **1.0** for rangeland — table 8-10.B, page 271, Haan , Barfield text

C_{cc} = canopy cover subfactor
= $1 - F_c\exp(-0.1H)$
F_c = fraction of surface covered by canopy
= 0 — conservative estimate
H = average canopy height in feet
= 0 — conservative estimate
= **1.0**

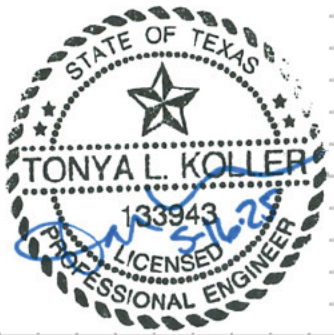
C_{sc} = surface cover subfactor
= $\exp[-bR_c(6/6+R_g))^{0.08}]$ — eq. 8.53, page 270, Haan, Barfield text
b = constant
= 4.5 — table 8-10.B, page 271, Haan , Barfield text
R_c = fraction ground cover
= 0.0 — conservative estimate
R_g = surface roughness variable
= $(25.4R_R - 6)(1 - \exp(-0.0015R_S))(\exp(-0.14P_T))$ — eq. 8.55, page 271, Haan, Barfield text
R_R = random roughness
= 0.5 total root and buriend residue — conservative estimate from Ag. Handbook #703
R_S = [lb/acre]
= 0 — conservative estimate
P_T = average yearly rainfall
= 8.67 Inches — National Weather Service Data
= 0.00
= **1.0**

C_{sr} = surface roughness subfactor
= $\exp(-0.26*R_G)$ — eq. 8.62, page 273, Haan, Barfield text
R_G = surface roughness variable
= 0
= **1.0**

C_{sm} = soil moisture subfactor
= **1.0** for rangeland — page 273, Haan, Barfield text

C = Cover Management Factor
= $C_{plu}C_{cc}C_{sc}C_{sr}C_{sm}$

= **1.0**



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TOPOGRAPHIC FACTOR (LS) CALCULATIONS



Table 4-3.
Values for topographic factor, LS, for high ratio of rill to interrill erosion.[1]

Slope (%)	Horizontal slope length (ft)																
	<3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	800	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.12	0.13
1.0	0.09	0.09	0.09	0.09	0.09	0.10	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.24	0.26	0.27
2.0	0.13	0.13	0.13	0.13	0.13	0.16	0.21	0.25	0.28	0.33	0.37	0.40	0.43	0.48	0.56	0.63	0.69
3.0	0.17	0.17	0.17	0.17	0.17	0.21	0.30	0.36	0.41	0.50	0.57	0.64	0.69	0.80	0.96	1.10	1.23
4.0	0.20	0.20	0.20	0.20	0.20	0.26	0.38	0.47	0.55	0.68	0.79	0.89	0.98	1.14	1.42	1.65	1.86
5.0	0.23	0.23	0.23	0.23	0.23	0.31	0.46	0.58	0.68	0.86	1.02	1.16	1.28	1.51	1.91	2.25	2.55
6.0	0.26	0.26	0.26	0.26	0.26	0.36	0.54	0.69	0.82	1.05	1.25	1.43	1.60	1.90	2.43	2.89	3.30
8.0	0.32	0.32	0.32	0.32	0.32	0.45	0.70	0.91	1.10	1.43	1.72	1.99	2.24	2.70	3.52	4.24	4.91
10.0	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72	3.09	3.75	4.95	6.03	7.02
12.0	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60	4.09	5.01	6.67	8.17	9.57
14.0	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48	5.11	6.30	8.45	10.40	12.23
16.0	0.39	0.49	0.56	0.62	0.67	0.98	1.64	2.21	2.73	3.68	4.56	5.37	6.15	7.60	10.26	12.69	14.96
20.0	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16	8.23	10.24	13.94	17.35	20.57
25.0	0.45	0.64	0.80	0.93	1.04	1.56	2.67	3.67	4.59	6.30	7.88	9.38	10.81	13.53	18.57	23.24	27.66
30.0	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55	13.35	16.77	23.14	29.07	34.71
40.0	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67	18.17	22.95	31.89	40.29	48.29
50.0	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42	22.57	28.60	39.95	50.63	60.84
60.0	0.63	1.07	1.47	1.84	2.19	3.36	5.97	8.37	10.63	14.89	18.92	22.78	26.51	33.67	47.18	59.93	72.15

[1]Such as for freshly prepared construction and other highly disturbed soil conditions with little or no cover (not applicable to thawing soil)

NRCS SOIL REPORT

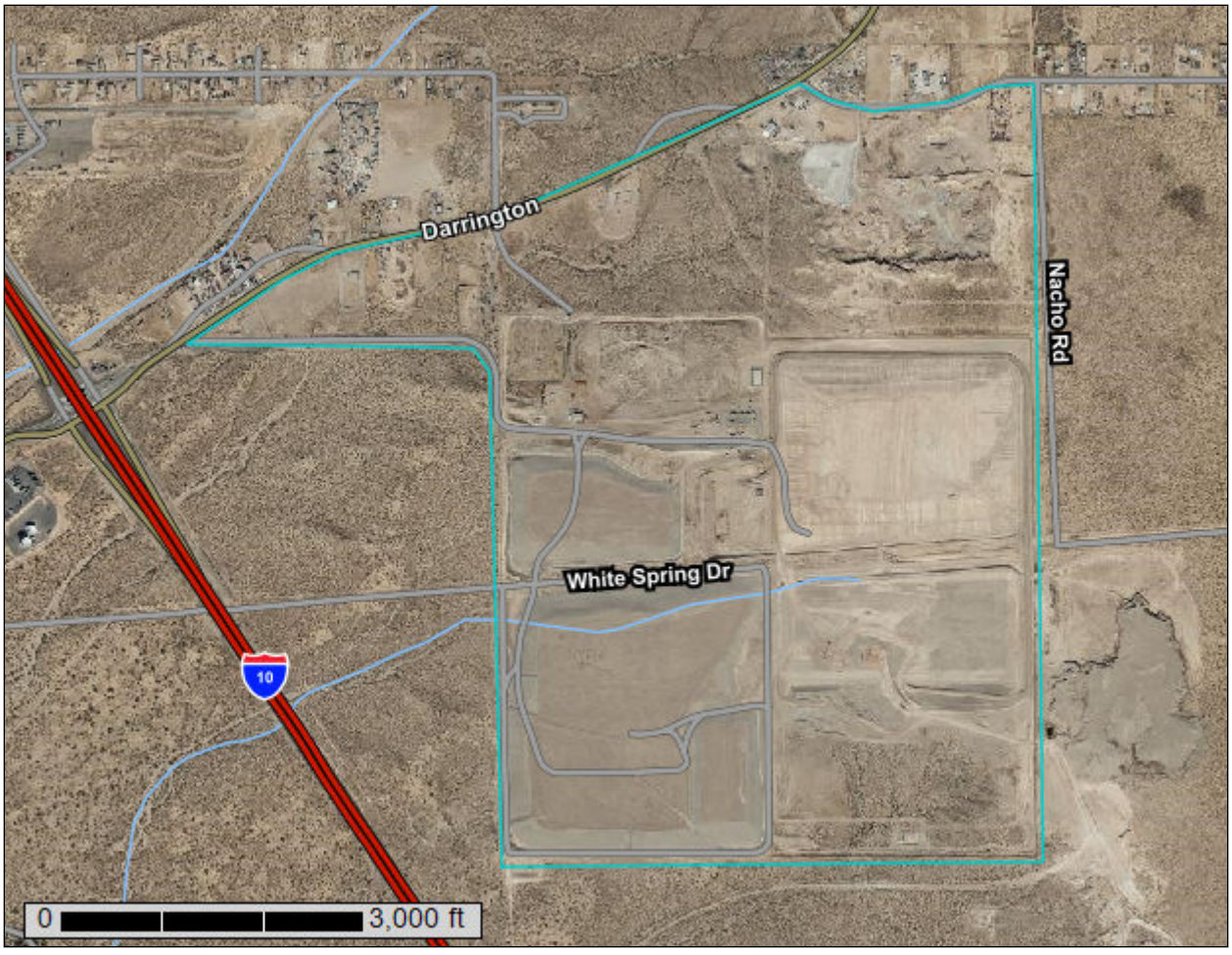
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for El Paso County, Texas (Main Part)



November 7, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

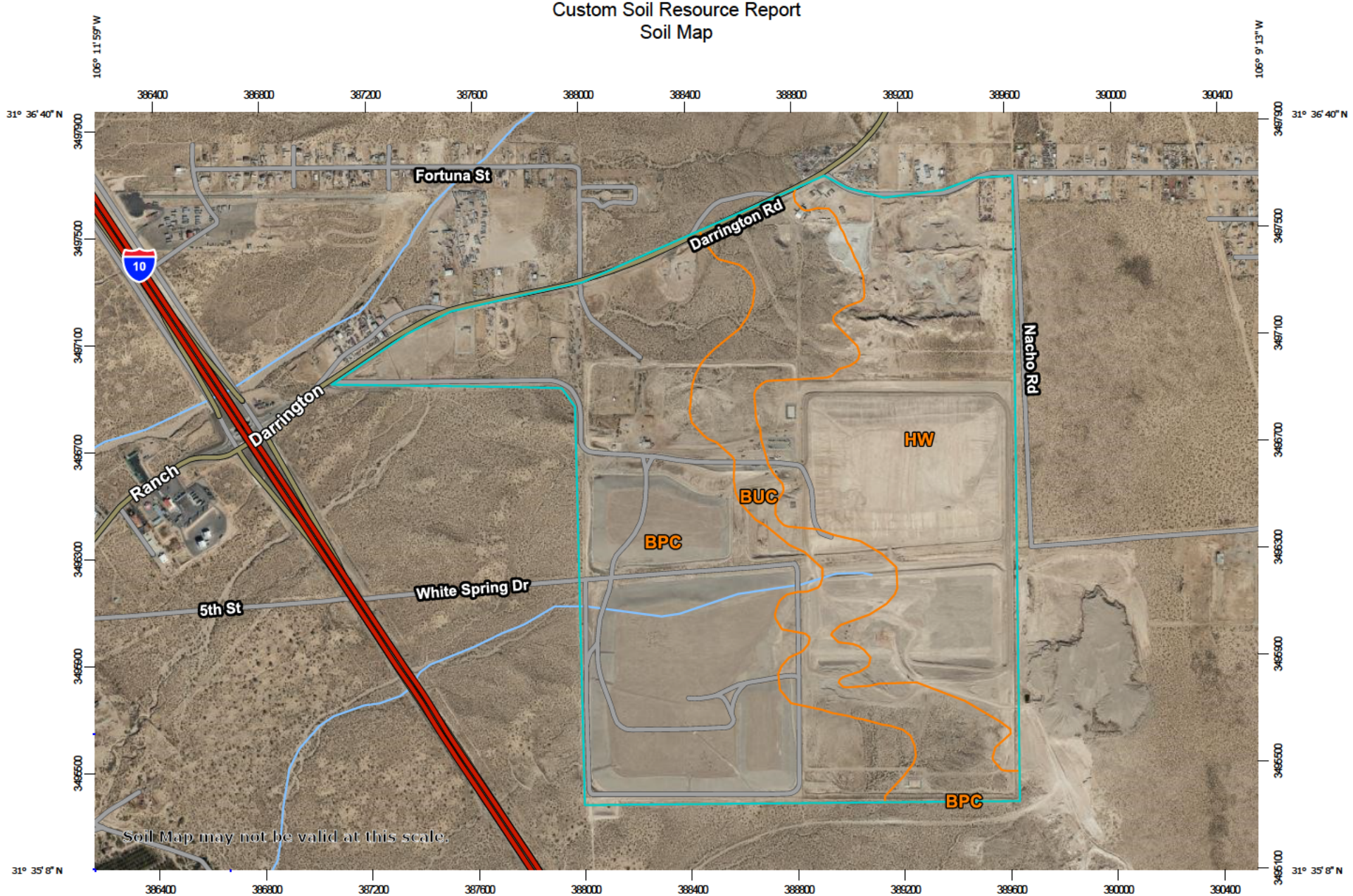
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


106° 11' 59" W
106° 9' 13" W
386400
386800
387200
387600
388000
388400
388800
389200
389600
390000
390400
31° 36' 40" N
31° 35' 8" N
3497900
3497500
3497100
3496700
3496300
3495900
3495500
3495100
Fortuna St
Darrington Rd
10
Darrington
Ranch
Nacho Rd
HW
BUC
BPC
White Spring Dr
5th St
BPC
Soil Map may not be valid at this scale.
N
Map Scale: 1:20,000 if printed on A landscape (11" x 8.5") sheet.
Meters
0 250 500 1000 1500
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County, Texas (Main Part)
Survey Area Data: Version 22, Sep 5, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 15, 2020—Nov 17, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BPC	Bluepoint association, rolling	434.9	45.4%
BUC	Bluepoint gravelly association, rolling	188.1	19.6%
HW	Hueco-Wink association, hummocky	335.6	35.0%
Totals for Area of Interest		**958.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County, Texas (Main Part)

BPC—Bluepoint association, rolling

Map Unit Setting

National map unit symbol: rcwg
Elevation: 1,400 to 5,200 feet
Mean annual precipitation: 3 to 10 inches
Mean annual air temperature: 55 to 66 degrees F
Frost-free period: 180 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Bluepoint and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bluepoint

Setting

Landform: Hillsides
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Wind-modified sandy alluvium

Typical profile

H1 - 0 to 6 inches: loamy fine sand
H2 - 6 to 12 inches: fine sand
H3 - 12 to 60 inches: stratified sand to loamy fine sand to very fine sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: R042BB011NM - Deep Sand, Desert Shrub
Hydric soil rating: No

BUC—Bluepoint gravelly association, rolling

Map Unit Setting

National map unit symbol: rcwj
Elevation: 1,400 to 5,200 feet
Mean annual precipitation: 4 to 10 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 1 to 80 days
Farmland classification: Not prime farmland

Map Unit Composition

Bluepoint, gravelly, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bluepoint, Gravelly

Setting

Landform: Hillsides
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Wind-modified sandy alluvium

Typical profile

H1 - 0 to 12 inches: gravelly fine sand
H2 - 12 to 60 inches: fine sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 3.0
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: R042AC244TX - Gravelly, Desert Grassland
Hydric soil rating: No

HW—Hueco-Wink association, hummocky

Map Unit Setting

National map unit symbol: rcww
Elevation: 2,700 to 4,500 feet
Mean annual precipitation: 5 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 210 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Hueco and similar soils: 45 percent
Wink and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hueco

Setting

Landform: Sand sheets
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Pleistocene-age coarse-loamy alluvium

Typical profile

H1 - 0 to 4 inches: loamy fine sand
H2 - 4 to 26 inches: fine sandy loam
H3 - 26 to 58 inches: cemented material
H4 - 58 to 80 inches: variable

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: R042BB012NM - Sandy, Desert Shrub
Hydric soil rating: No

Description of Wink

Setting

Landform: Sand sheets
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Pleistocene-age coarse-loamy alluvium

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 24 inches: fine sandy loam
H3 - 24 to 73 inches: variable
H4 - 73 to 80 inches: very gravelly loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R042BB012NM - Sandy, Desert Shrub
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 20 percent
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

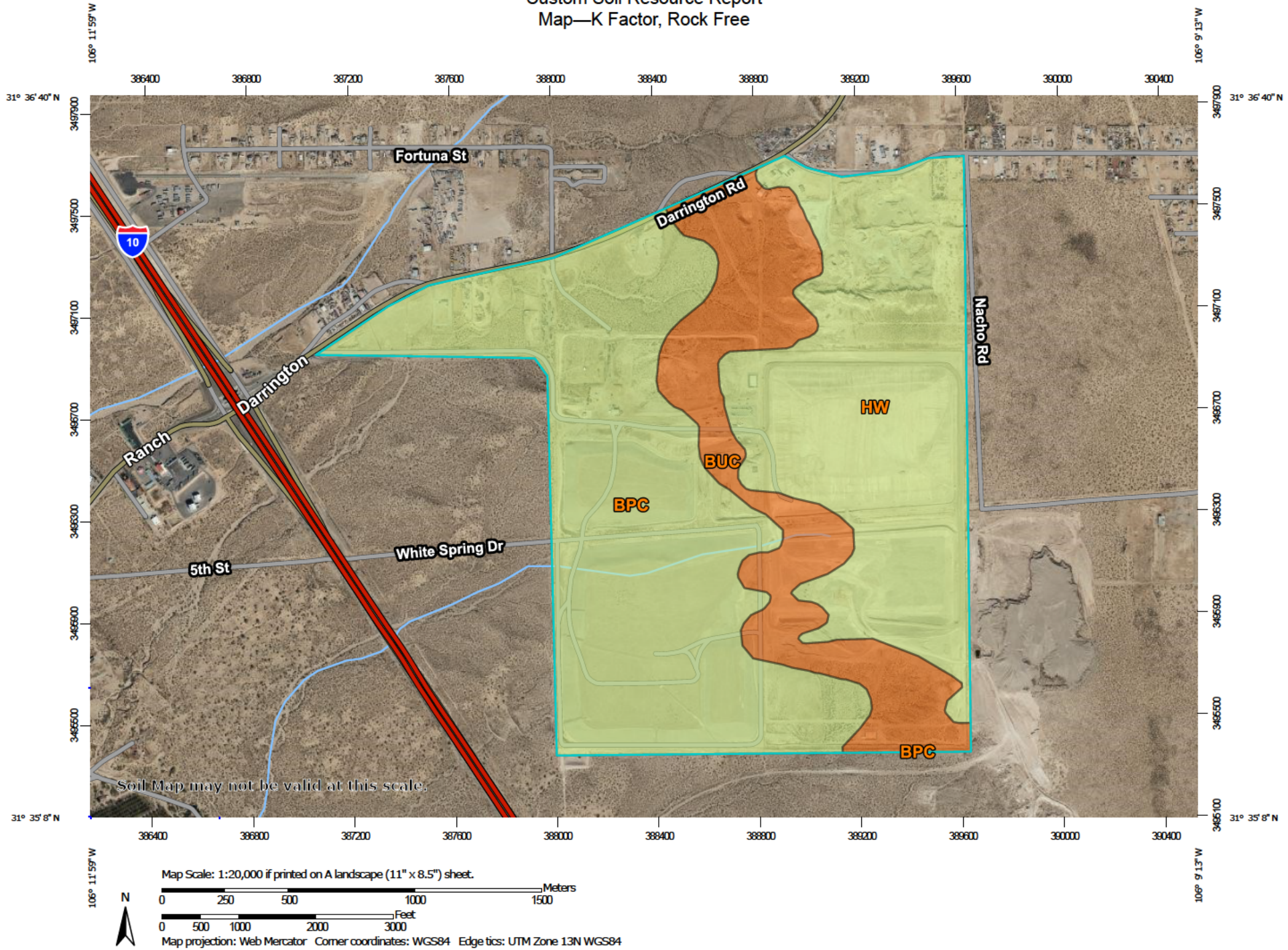
K Factor, Rock Free

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kf (rock free)" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Factor K does not apply to organic horizons and is not reported for those layers.

Custom Soil Resource Report
Map—K Factor, Rock Free



Map Scale: 1:20,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 250 500 1000 1500

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County, Texas (Main Part)
Survey Area Data: Version 22, Sep 5, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 15, 2020—Nov 17, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—K Factor, Rock Free

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BPC	Bluepoint association, rolling	.24	434.9	45.4%
BUC	Bluepoint gravelly association, rolling	.05	188.1	19.6%
HW	Hueco-Wink association, hummocky	.24	335.6	35.0%
Totals for Area of Interest			**958.7**	**100.0%**

Rating Options—K Factor, Rock Free

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Health Properties

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This folder contains information on soil properties that are important indicators of soil health.

Soil Health - Bulk Density, One-Third Bar

Bulk density, one-third bar is the oven-dry weight of the soil material less than 2 millimeters in size per unit volume of soil at a water tension of 1/3 bar (33 kPa). It indicates the density of the soil and is expressed in grams per cubic centimeter (g/cc) of soil material.

Significance:

Bulk density is one of several soil properties frequently used as a measure of soil health (Volchko et al., 2014) and as an indicator of soil compaction and root restriction. It reflects the soils capacity to provide structural support, water and solute movement, and soil aeration (Arshad et al., 1996). Even though bulk density varies with soil texture, it is a dynamic soil property that also varies depending on the structural condition of the soil. It can be altered by cultivation, trampling by animals, compaction by agricultural machinery, and raindrop impact (Arshad et al., 1996). Any soil management that alters the soil cover, the amount of organic matter, soil structure, or porosity will affect soil bulk density (USDA-NRCS, 2008). A dense soil will restrict root growth and seedling emergence, reduce the available water capacity, restrict water and air movement, and ultimately reduce productivity.

Management that improves soil bulk density includes reducing soil disturbance when the soil is wet, applying conservation practices that increase or maintain soil organic matter contents, and maintaining soil surface protection (such as a cover crop, especially a multi-species cover that can provide a wide range of root penetration).

Measurement of bulk density is essential for weight to volume or area conversions of other properties, such as soil carbon stocks and nutrient pools. It is also used in the calculation of pore space.

Factors Affecting Bulk Density:

Inherent factors.Bulk density is dependent on soil texture and the densities of soil mineral particles (sand, silt, and clay) and organic matter particles, as well as their packing arrangement. Generally, loose, porous soils and those rich in organic matter have lower bulk densities. Sandy soils have relatively high bulk densities since total pore space in sands is less than that of silty or clayey soils. Finer-textured soils that have good structure, such as silt loams and clay loams, have higher pore space and lower bulk density compared to sandy soils.

There is a general relationship of soil bulk density to root growth based on soil texture. Bulk densities ideal for root growth are less than 1.60 g/cc for sandy textures, less than 1.40 g/cc for loamy textures, and less than 1.10 g/cc for clayey textures. Bulk densities that restrict root growth are greater than 1.80 g/cc for sandy textures, 1.65 g/cc for loamy textures, and 1.47 g/cc for clayey textures.

Dynamic factors.Bulk density is changed by crop and land management practices that affect soil cover, organic matter, soil structure, and/or porosity. Cultivation can result in compacted soil layers with increased bulk density. Livestock as well as the use of agricultural and construction equipment can compact the soil and reduce porosity, especially on wet soils. Freeze-thaw action in the soil can lead to lowered bulk density.

Measurement:

In general, there are two broad groupings of bulk density methods. One group is for soil materials that are cohesive enough that a field sample can be removed, and the other group is for soils that are too fragile for field sampling and require an excavation operation. In methods for the former group, a clod sample is coated with a plastic film and the volume determined by submergence. There are also various core methods for the former group in which a cylinder of known volume is used to obtain a sample. The detailed procedures are outlined in the Kellogg Soil Survey Laboratory Methods Manual (Soil Survey Staff, 2014).

References:

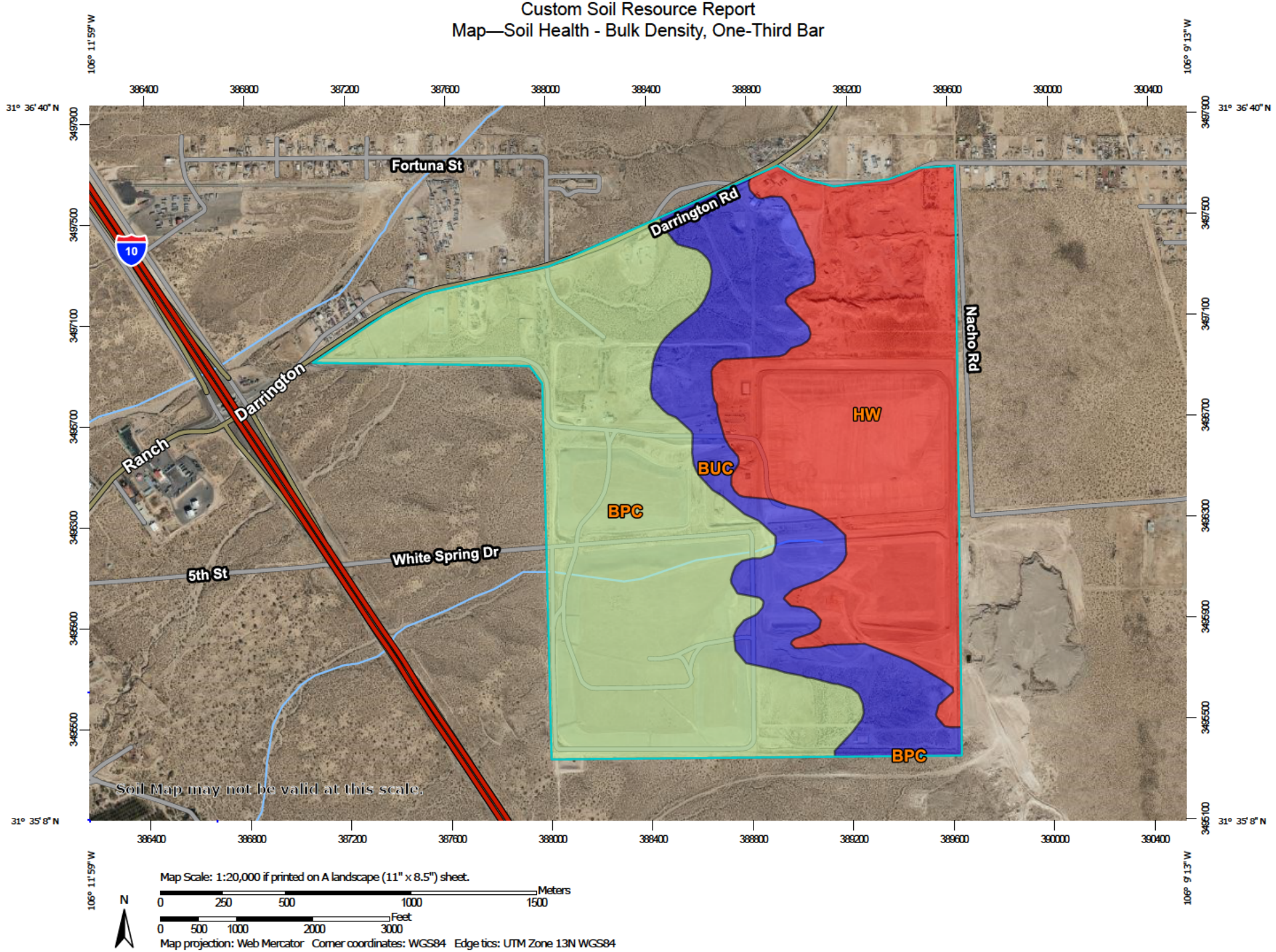
Arshad, M.A., B. Lowery, and R. Grossman. 1996. Physical tests for monitoring soil quality. In: J.W. Doran and A.J. Jones (eds.) Methods for Assessing Soil Quality. Soil Science Society of America Special Publication 49:123-142.

Soil Survey Staff. 2014. Kellogg Soil Survey Laboratory methods manual. Soil Survey Investigations Report No. 42, Version 5.0. R. Burt and Soil Survey Staff (eds.). U.S. Department of Agriculture, Natural Resources Conservation Service.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2008. Soil quality indicatorsBulk density.

Volchko, Y., J. Norrman, L. Rosen, and T. Norberg. 2014. A minimum data set for evaluating the ecological soil functions in remediation projects. Journal of Soils and Sediments 14:1850-1860.

Custom Soil Resource Report
Map—Soil Health - Bulk Density, One-Third Bar



Map Scale: 1:20,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 250 500 1000 1500

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 1.53
- > 1.53 and <= 1.55
- > 1.55 and <= 1.60
- Not rated or not available

Soil Rating Lines
- <= 1.53
- > 1.53 and <= 1.55
- > 1.55 and <= 1.60
- Not rated or not available

Soil Rating Points
- <= 1.53
- > 1.53 and <= 1.55
- > 1.55 and <= 1.60
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

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Please rely on the bar scale on each map sheet for map measurements.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 22, Sep 5, 2023

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Table—Soil Health - Bulk Density, One-Third Bar

Map unit symbol	Map unit name	Rating (grams per cubic centimeter)	Acres in AOI	Percent of AOI
BPC	Bluepoint association, rolling	1.55	434.9	45.4%
BUC	Bluepoint gravelly association, rolling	1.60	188.1	19.6%
HW	Hueco-Wink association, hummocky	1.53	335.6	35.0%
Totals for Area of Interest			**958.7**	**100.0%**

Rating Options—Soil Health - Bulk Density, One-Third Bar

Units of Measure: grams per cubic centimeter

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

References

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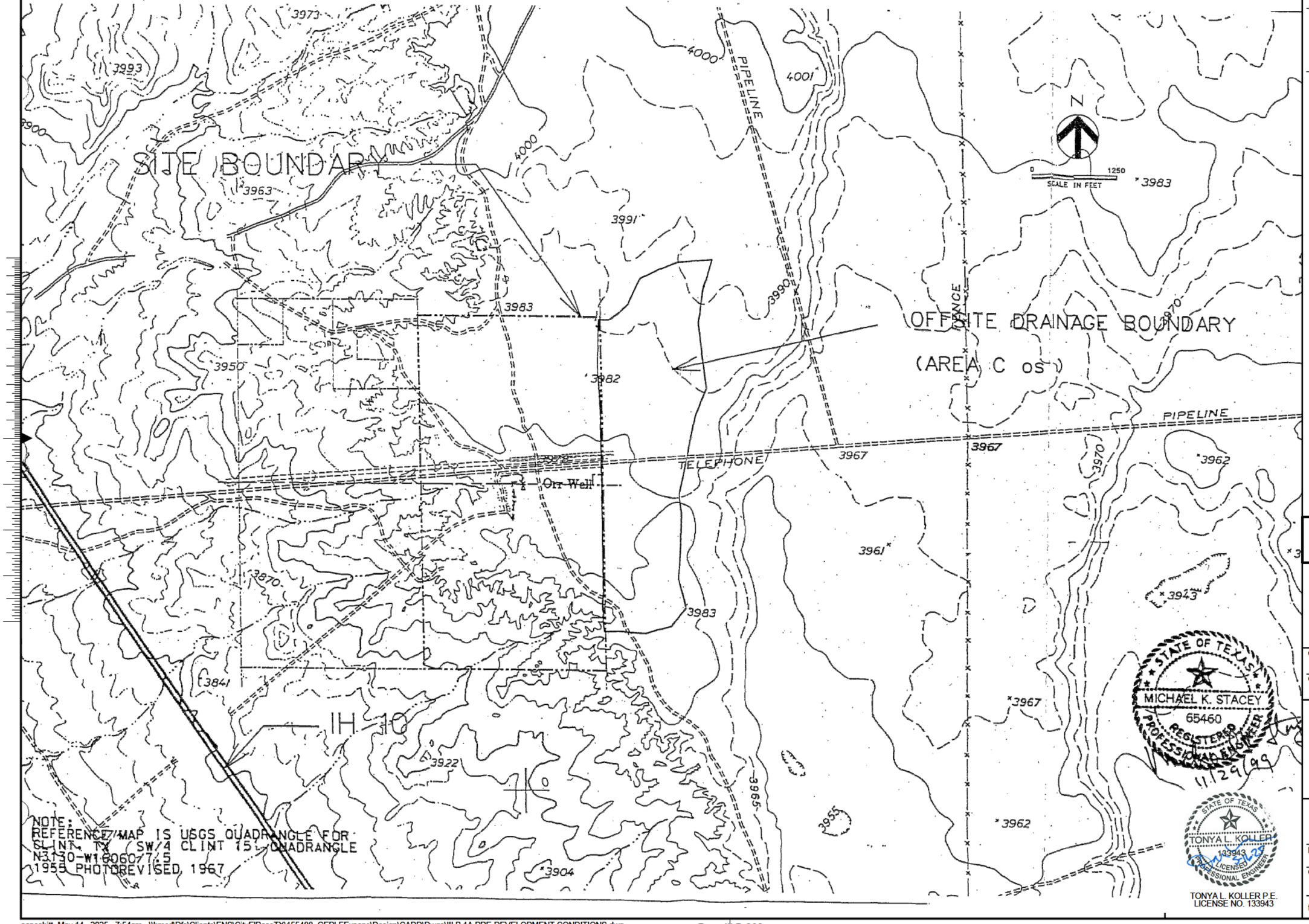
ATTACHMENT III.B.3 – DRAWINGS



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. DRAWING ORIGINALLY FROM THE CLINT LANDFILL NEW PERMIT PREPARED BY HDR ENGINEERING AND SIGNED BY MICHAEL K. STACEY ON NOVEMBER 29, 1999.
2. TOPOGRAPHICAL DATUM ASSUMED TO BE CITY DATUM.

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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

STATE OF TEXAS
MICHAEL K. STACEY
65460
REGISTERED PROFESSIONAL ENGINEER
11/29/99

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

HISTORIC OFFSITE DRAINAGE CONDITIONS

project	contract
155488	-

drawing **III.B.1A – 1** rev.

file III.B.1A PRE-DEVELOPMENT CONDITIONS.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943

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N

0 300 600
SCALE IN FEET

LEGEND

- DRAINAGE BASIN
- DRAINAGE SUB-BASIN
- PERMIT LIMIT
- FLOW DIRECTION
- [A] DISCHARGE POINT
- (1) DRAINAGE BASIN IDENTIFIER
- STREAM OR DITCH

DISCHARGE	SUBBASIN	AREA (AC.)	DISCHARGE (CFS)
	A1	7	5.3
@A		7	5.3
	B1	79	38
	C1	151	34
	C2	82	33
@B		313	81
	D1	42	20
	D2	10	4.8
@D		52	25
	E1	91	26
	E2	8	4.6
@E		99	27.5

NOTE: FOR OFFSITE TOPOGRAPHY SEE DRAWING III.B.1A

TOPOGRAPHY INFORMATION PROVIDED BY ROE ENGINEERS BASED ON AERIAL PHOTOGRAPHY DATED 11-11-97

NO AREAS WITHIN SITE ARE SUBJECT TO 100 YEAR FLOODPLAIN AS SHOWN IN FEMA PANEL NO. 4802120012A

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1

NOTES:

1. DRAWING ORIGINALLY FROM THE CLINT LANDFILL NEW PERMIT PREPARED BY HDR ENGINEERING AND SIGNED BY MICHAEL K. STACEY ON SEPTEMBER 1, 2000. DISCHARGE VELOCITIES AND DRAWING REFERENCES UPDATED FROM ORIGINAL SEALED DRAWING.
2. TOPOGRAPHICAL DATUM ASSUMED TO BE CITY DATUM.
3. DRAINAGE PATTERNS PROVIDED OUTSIDE OF THE SITE BOUNDARY IN AREA C1 ARE APPROXIMATED FROM THE 1995 USGS TOPOGRAPHIC MAP OF EL PASO.

STATE OF TEXAS
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STATE OF TEXAS
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

HISTORIC ON-SITE DRAINAGE CONDITIONS

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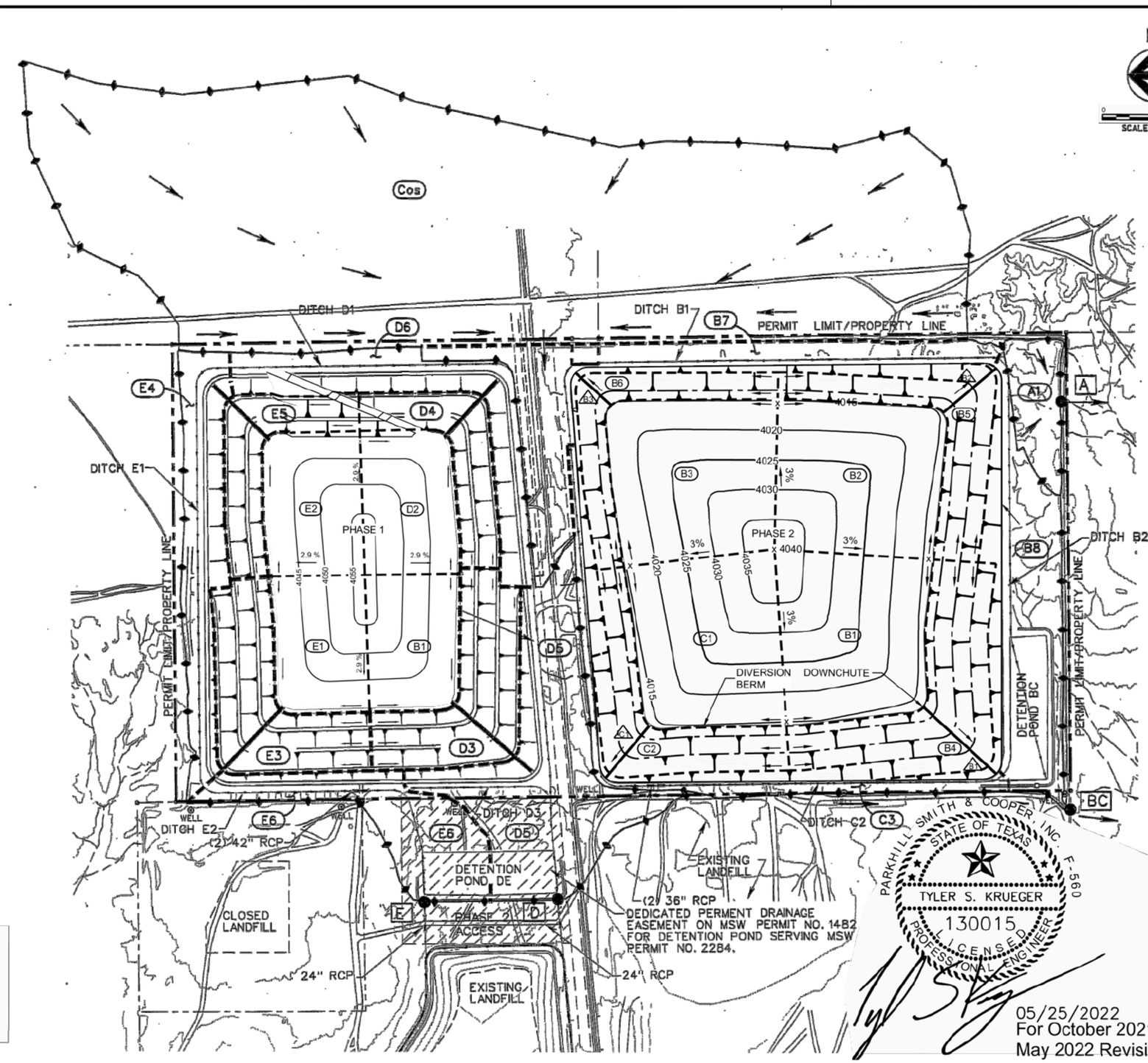
155488	-

drawing **III.B.1B** — rev. **1**

file III.B.1B PRE-DEVELOPMENT DRAINAGE CONDITIONS.dwg



PRE-DEVELOPED CONDITIONS SUMMARY

Discharge Point	Subbasin	Area (acres)	Discharge (cfs)
A	A1	5.0	4.57
			4.57
Pond BC	B1	17.5	81.2
	B2	18.1	89.85
	B3	19.3	90.15
	B4	15.3	100.36
	B5	9.9	60.58
	B6	7.4	47.94
	B7	19.4	14.68
	B8	17.9	32.05
	Cos	151.4	43.91
	C1	18.5	89.55
	C2	10.6	71.03
	C3	10.2	29.66
Inflow @ Pond BC[1]			476.2
Outflow @ Pond BC[1]			99.1
Pond DE	D1	9.7	42.14
	D2	10.3	41.18
	D3	12.5	68.52
	D4	7.7	41.11
	D5	24.8	56
	D6	12.9	45.14
	E1	9.9	42.14
	E2	10.5	52.91
	E3	12.9	70.98
	E4	12.5	39.7
	E5	8.2	44.54
	E6	11.9	50.61
Inflow @ Pond DE[1]			439.7
Outflow @ Pond DE[2]			36.4

[1]From the HEC HMS Output included in ATTACHMENT III.B.1 of this Attachment

[2]From the HEC HMS Output included in ATTACHMENT III.B.1 of this Attachment

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2

NOTES:

1. DRAWING ORIGINALLY FROM THE 2022 PERMIT MODIFICATION (2284) COMPLETED BY PARKHILL, SMITH AND ASSOCIATES AND SIGNED BY TYLER S. KRUEGER ON MAY 25, 2022. THE DISCHARGE (CFS) FOR THE PRE-DEVELOPMENT CONDITIONS HAS BEEN REVISED FROM THE ORIGINAL APPLICATION TO REFLECT THE NOAA ATLAS 14 RAINFALL RESULTS.
2. TOPOGRAPHICAL DATUM ASSUMED TO BE CITY DATUM.

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
TYLER S. KRUEGER
130015
LICENSED PROFESSIONAL ENGINEER

05/25/2022
For October 2021 and May 2022 Revisions Only

STATE OF TEXAS
MICHAEL K. STACEY
65460
REGISTERED PROFESSIONAL ENGINEER
9/12/25

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
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REVISION FOR PRE-DEVELOPED (ATLAS 14) RAINFALL DATA CHANGE ONLY. SEE NOTE 1.

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date	detailed
5/16/2025	A. NESBITT
designed	checked
T. SCHMIDT	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas
2284A PERMIT AMENDMENT
PRE-DEVELOPMENT DRAINAGE CONDITIONS

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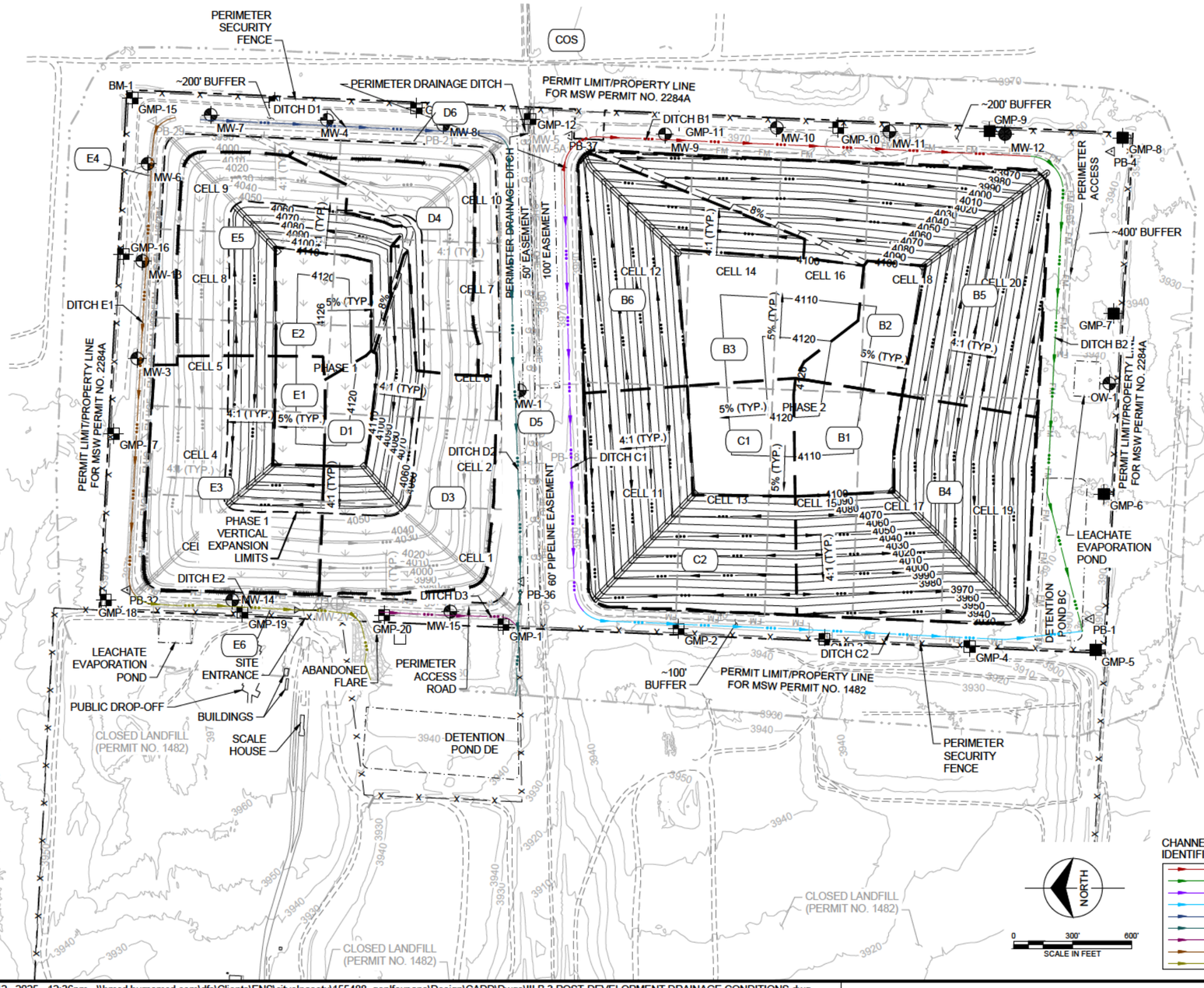
drawing **III.B.2** rev. **2**

file III.B.2PRE-DEVELOPMENTDRAINAGECONDITIONS.DWG



PLAN LEGEND

- DRAINAGE SUBBASIN
- PERMIT LIMIT
- FLOW DIRECTION
- A — DISCHARGE POINT
- B5 — DRAINAGE BASIN IDENTIFIER
- STREAM OR DITCH
- CULVERT

NOTE: SEE DRAWING III.A.1 FOR COMPLETE LEGEND.

DEVELOPED CONDITIONS SUMMARY

DISCHARGE	SUBBASIN	AREA (AC.)	DISCHARGE (CFS)
	A1	5.0	4.57
@A		5.0	4.57
	B1	6.5	38.91
	B2	5.6	32.49
	B3	12.0	66.37
	B4	24.8	147.65
	B5	30.4	151.27
	B6	16.0	95.76
	B7	16.3	12.51
	B8	15.4	25.96
	COS	151.4	42.5
	C1	7.1	40.61
	C2	20.8	129.52
	C3	9.4	26.89
INFLOW @ POND BC		315.5	545.27
OUTFLOW @ POND BC			95.71
	D1	2.8	66.08
	D3	19.2	68.52
	D4	15.0	44.54
	D5	24.8	56
	D6	12.9	45.14
	E1	3.2	63.77
	E2	6.1	62.76
	E3	20.7	70.98
	E4	12.5	39.7
	E5	14.6	44.54
	E6	11.9	50.61
INFLOW @ POND DE		143.8	396.8
OUTFLOW @ POND DE			35.12

CHANNEL IDENTIFICATION	SIDE SLOPES	CHANNEL SLOPE (FT/FT) (SEE ATT. III.B.1, P. III.B-128)	BOTTOM WIDTH (FT)
DITCH B1	3:1	VARIES	8
DITCH B2	3:1		8
DITCH C1	3:1		8
DITCH C2	3:1		8
DITCH D1	3:1		8
DITCH D2	3:1		8
DITCH D3	3:1		8
DITCH E1	3:1		8
DITCH E2	3:1		8

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2
3	11/14/25	JGP	TLK	TCEQ NOD 3

NOTES:

1. INDEX CONTOUR INTERVAL, 10 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 10 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 10 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX — CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

POST-DEVELOPMENT DRAINAGE CONDITIONS

project	contract
155488	-

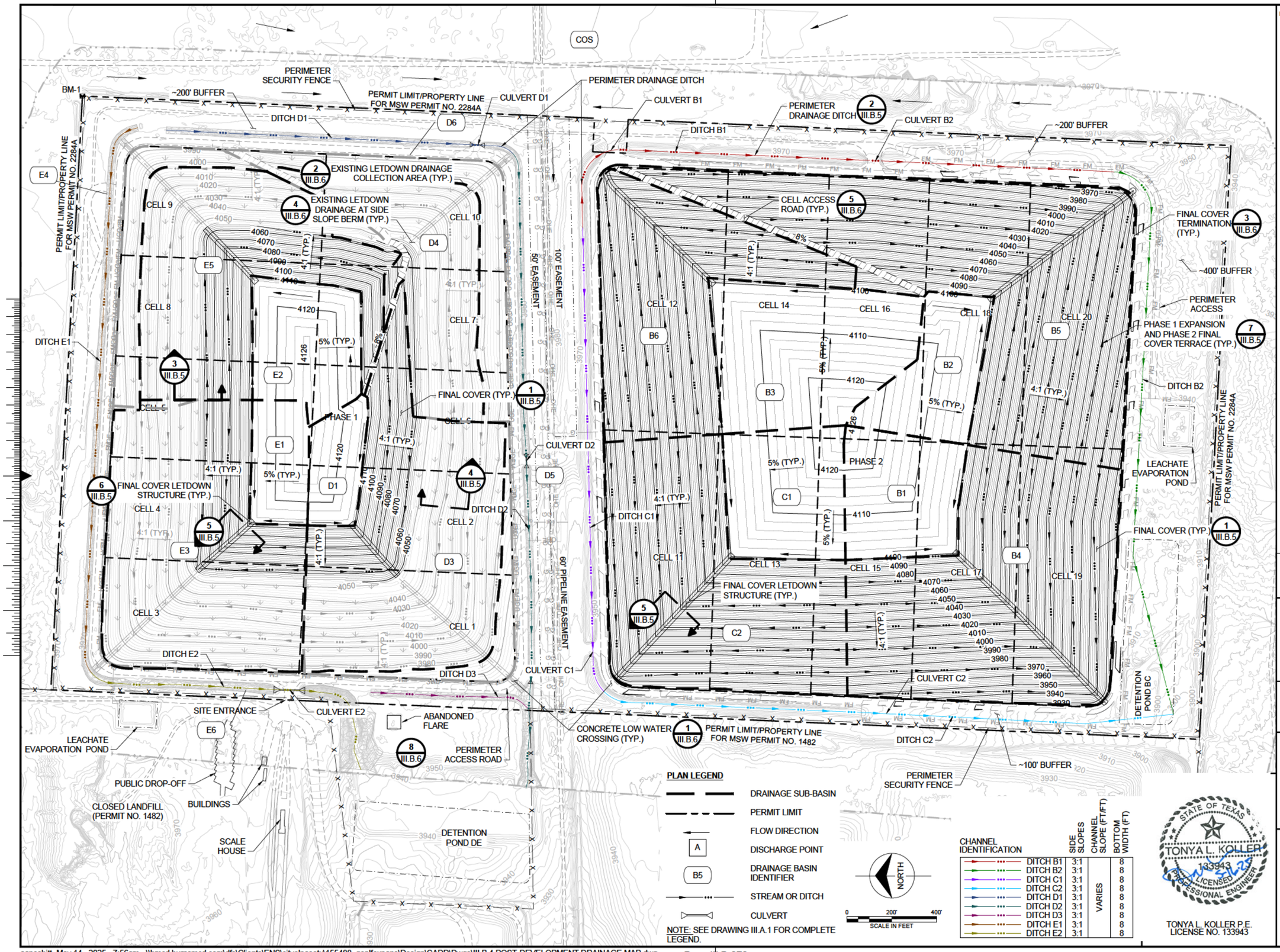
drawing **III.B.3** rev. **3**

file III.B.3 POST-DEVELOPMENT DRAINAGE CONDITIONS.dwg

STATE OF TEXAS — TONYA L. KOLLER — 133943 — LICENSED PROFESSIONAL ENGINEER

11-10-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943



CHANNEL IDENTIFICATION	SIDE SLOPES	CHANNEL SLOPE (FT/FT)	BOTTOM WIDTH (FT)
DITCH B1	3:1	VARIES	8
DITCH B2	3:1		8
DITCH C1	3:1		8
DITCH C2	3:1		8
DITCH D1	3:1		8
DITCH D2	3:1		8
DITCH D3	3:1		8
DITCH E1	3:1		8
DITCH E2	3:1		8

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ OD 1

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

POST-DEVELOPMENT DRAINAGE MAP

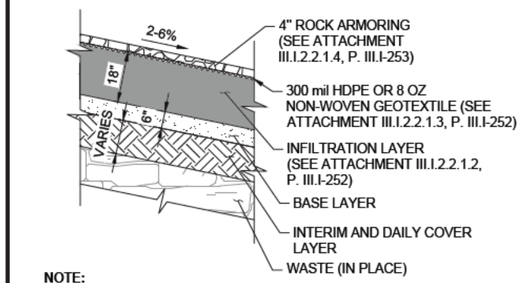
project	contract
155488	-

drawing **III.B.4** – rev. **1**

file III.B.4 POST-DEVELOPMENT DRAINAGE MAP.dwg

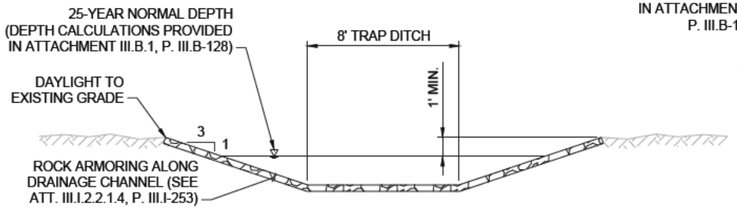
STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943

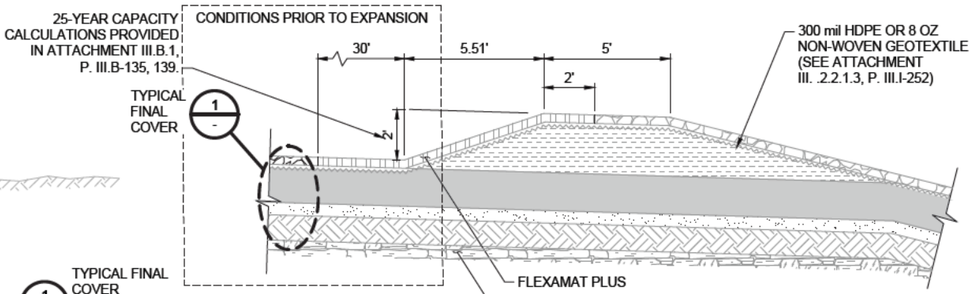


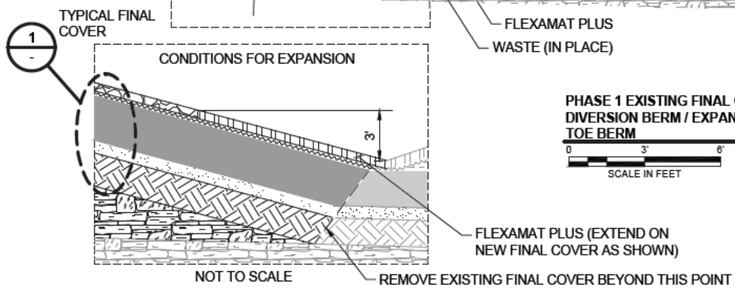
NOTE:
THICKNESS ARE MEASURED PERPENDICULAR TO SURFACE

FINAL COVER (TYP.) — NOT TO SCALE — 1 - | 1 III.B.4 | 1 III.B.6 | 1 III.B.11 | 1 III.B.12

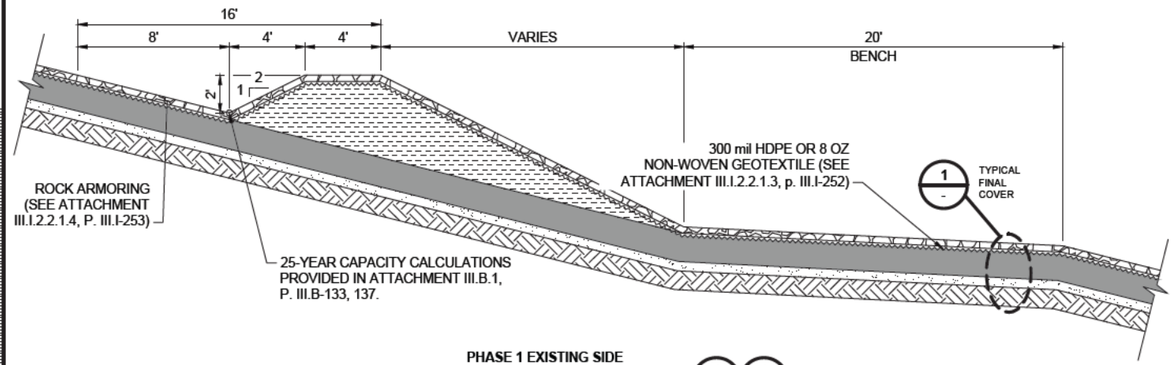


PERIMETER DRAINAGE DITCH (TYP.) — 0 4' 8' SCALE IN FEET — 2 III.B.4 | 2 III.B.11 | 2 III.B.12

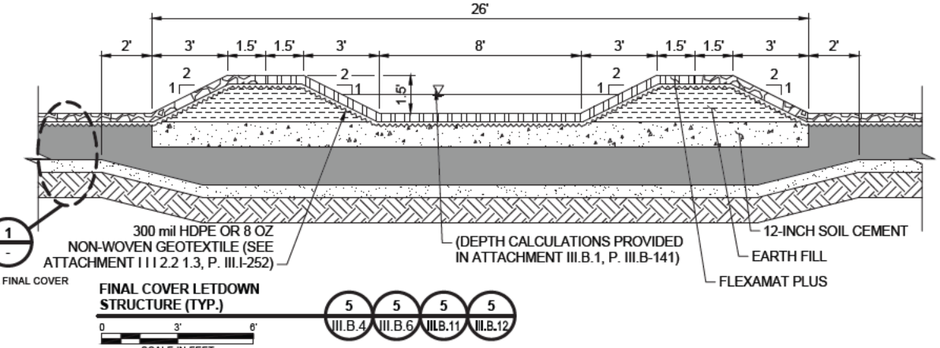




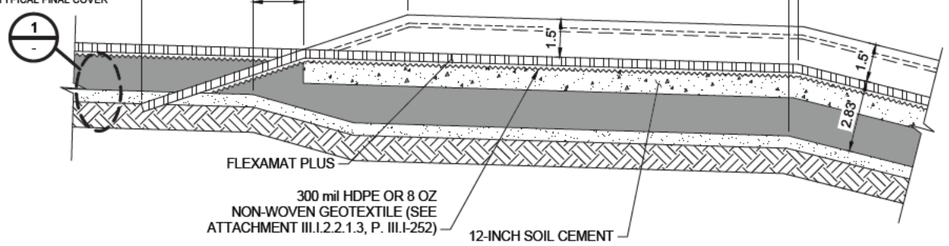
PHASE 1 EXISTING FINAL COVER DIVERSION BERM / EXPANSION TOE BERM — 0 3' 6' SCALE IN FEET — 3 III.B.4 | 3 III.B.6



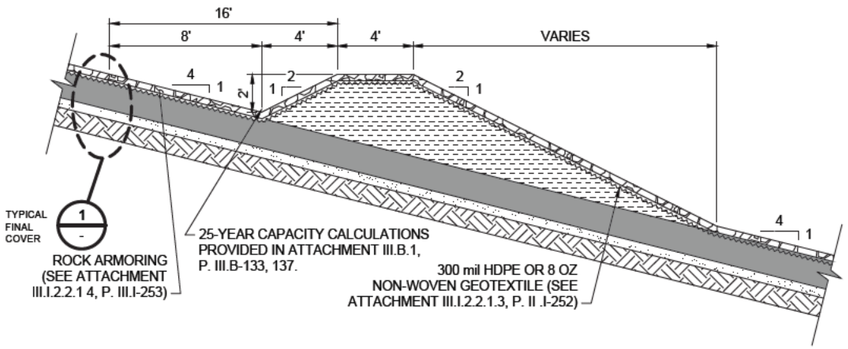
PHASE 1 EXISTING SIDE SLOPE BERM — 0 4' 8' SCALE IN FEET — 4 III.B.4 | 4 III.B.6

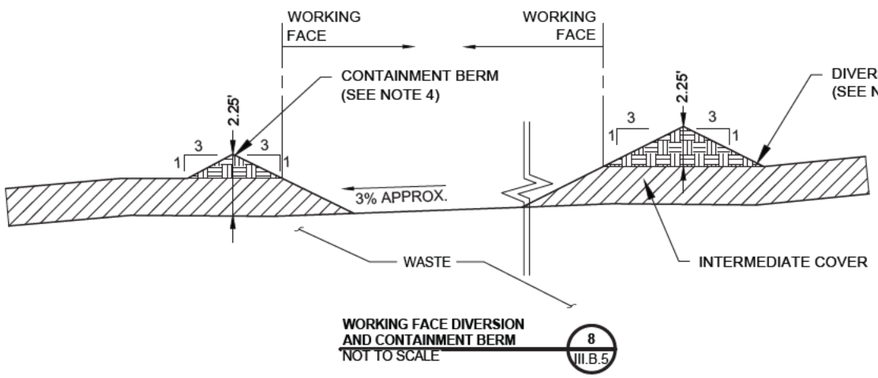


FINAL COVER LETDOWN STRUCTURE (TYP.) — 0 3' 6' SCALE IN FEET — 5 III.B.4 | 5 III.B.6 | 5 III.B.11 | 5 III.B.12

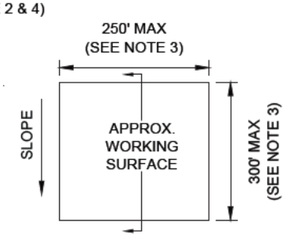


FINAL COVER LETDOWN STRUCTURE (TYP.) — 0 3' 6' SCALE IN FEET — 6 III.B.4





WORKING FACE DIVERSION AND CONTAINMENT BERM — NOT TO SCALE — 8 III.B.5



DETAIL 6 KEY

PHASE 1 EXPANSION AND PHASE 2 FINAL COVER TERRACE DETAIL — 0 4' 8' SCALE IN FEET — 7 III.B.4 | 7 III.B.11

NOTES FOR DETAIL 8:

1. WORKING FACE WILL RELOCATE IN CONJUNCTION WITH CURRENT WASTE FILLING PATTERNS.
2. DIVERSION BERM FLOWLINE SHALL BE 0.5% MINIMUM TO CONVEY UNCONTAMINATED WATER AROUND WORKING FACE.
3. MAXIMUM WORKING FACE DIMENSIONS ARE DEPENDENT UPON WASTE QUANTITY.
4. SIZING CALCULATIONS FOR CONTAINMENT AND DIVERSION BERMS INCLUDING WATER DEPTH AND DESIGN FREEBOARD OF 1-FOOT CAN BE FOUND IN ATTACHMENT III.B.1, P.III.B-187.

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TONYA L. KOLLER P.E.
LICENSE NO. 133943

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2
3	11/14/25	JGP	TLK	TCEQ NOD 3

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BURNS McDONNELL
9400 WARD PARKWAY
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816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

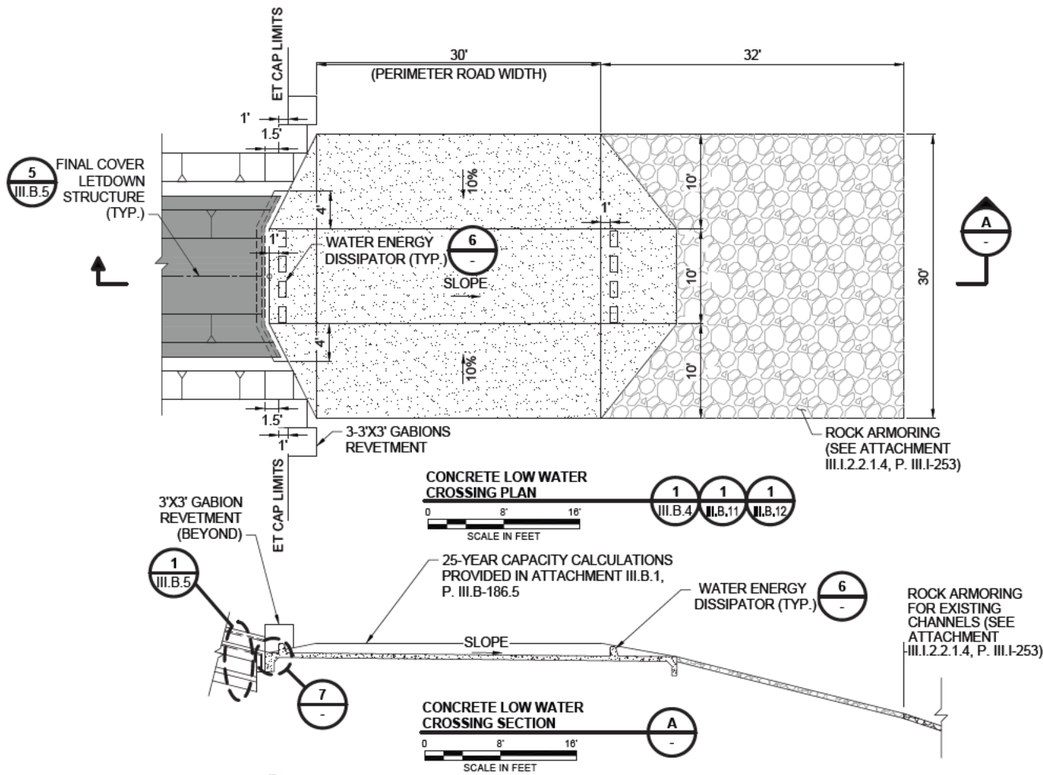
2284A PERMIT AMENDMENT

DRAINAGE DETAILS, 1 OF 2

project	contract
155488	-

drawing **III.B.5** rev. **3**

file III.B.5 DRAINAGE DETAILS, 1 OF 2.dwg



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1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2
3	11/14/25	JGP	TLK	TCEQ NOD 3

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

DRAINAGE DETAILS, 2 OF 2

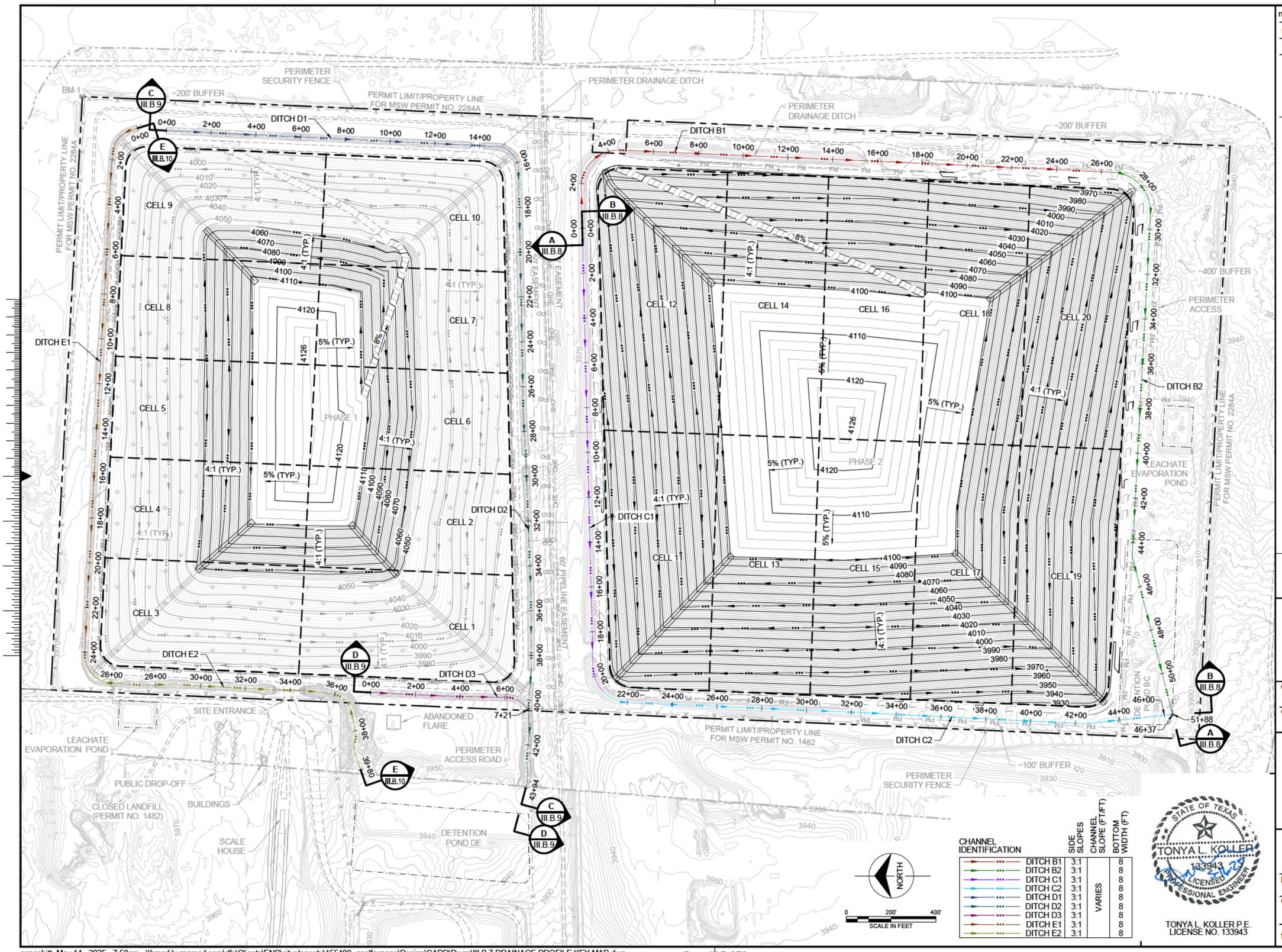
project	contract
155488	-

drawing **III.B.6 – 3**

file III.B.6 DRAINAGE DETAILS 2 OF 2.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
11-1025

TONYA L. KOLLER P.E.
LICENSE NO. 133943



CHANNEL IDENTIFICATION	SIDE SLOPES	CHANNEL SLOPE (FT/FT)	BOTTOM WIDTH (FT)
DITCH B1	3:1	VARIES	8
DITCH B2	3:1		8
DITCH C1	3:1		8
DITCH C2	3:1		8
DITCH D1	3:1		8
DITCH D2	3:1		8
DITCH D3	3:1		8
DITCH E1	3:1		8
DITCH E2	3:1		8

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ OD 1

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

DRAINAGE PROFILE KEY MAP

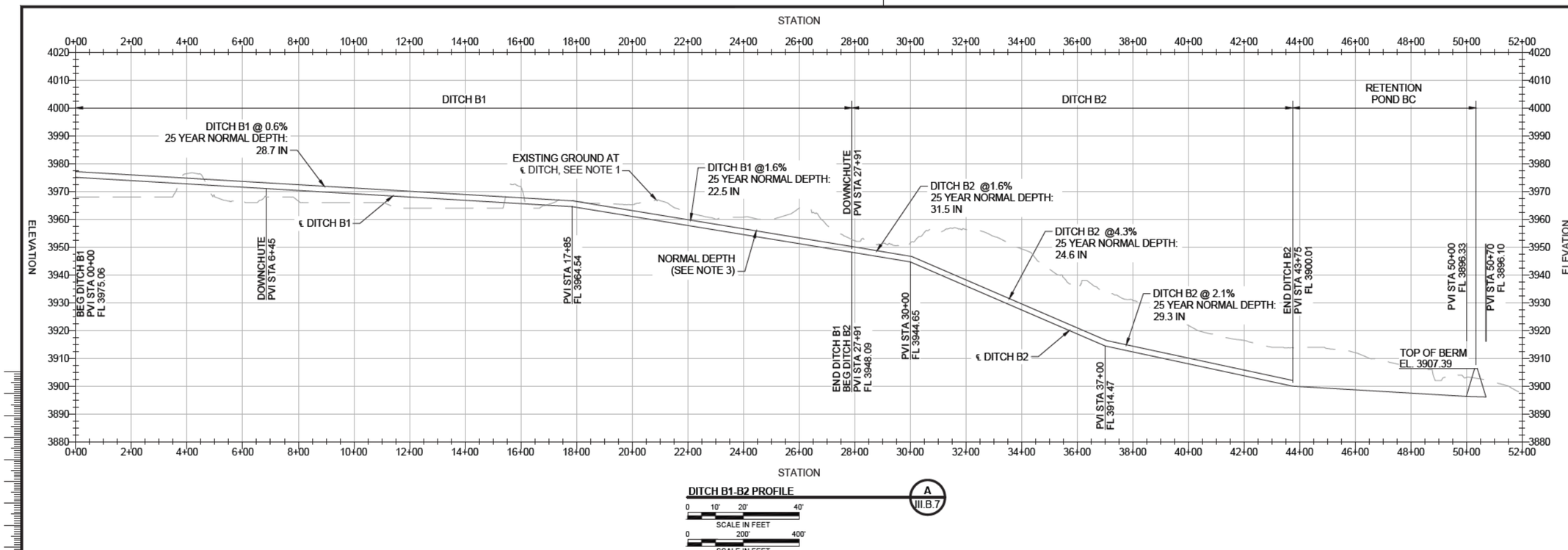
project	contract
155488	-

drawing **III.B.7** – rev. **1**

file III.B.7 DRAINAGE PROFILE KEY MAP.dwg

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943



DITCH B1-B2 PROFILE

A
III.B.7

SCALE IN FEET
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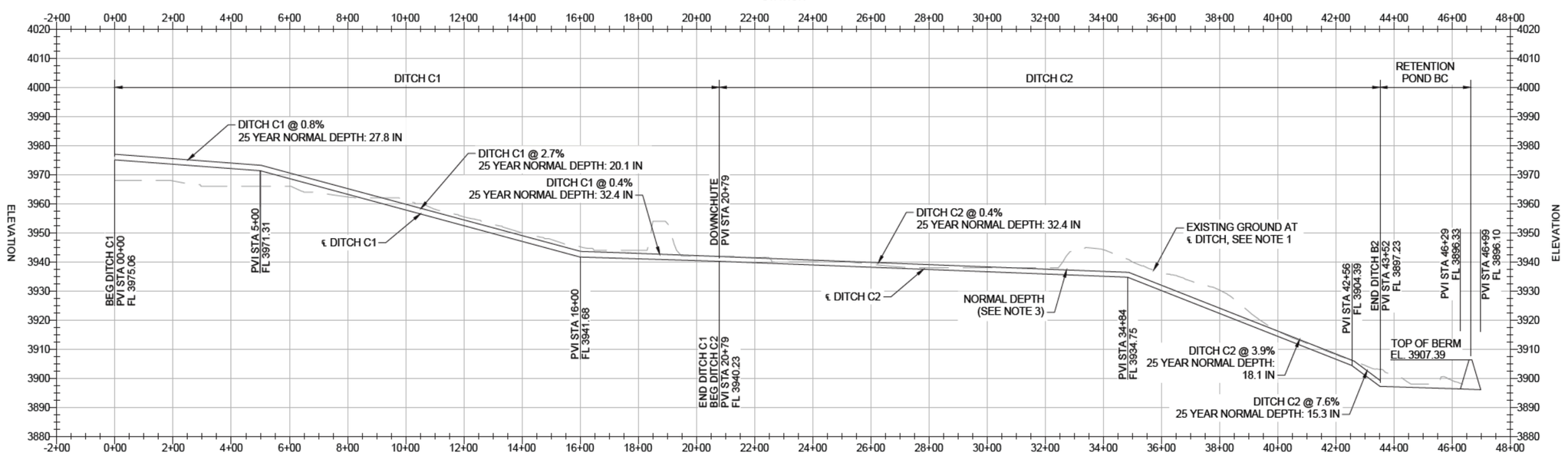
0 200' 400'



DITCH C1-C2 PROFILE

B
III.B.7

SCALE IN FEET
0 10' 20' 40'
0 200' 400'

TONYA L. KOLLER P.E.
LICENSE NO. 133943

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2

NOTES:

1. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022.
2. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
3. 25-YEAR NORMAL DEPTH CALCULATIONS PROVIDED IN ATTACHMENT III.B.1, P. III.B-128.

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

FOR PERMITTING PURPOSES ONLY

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

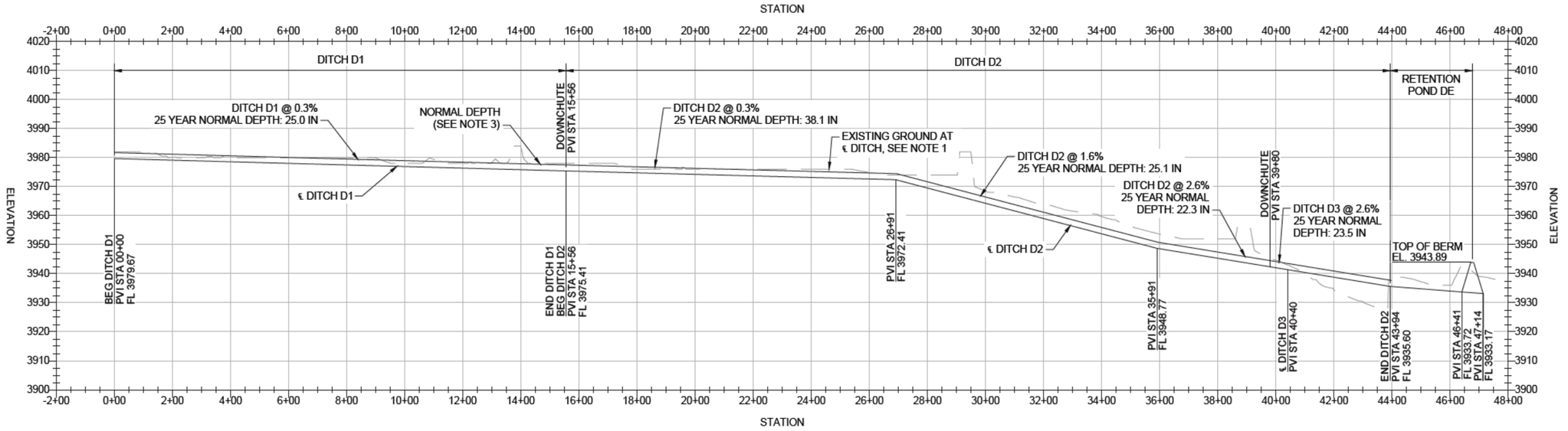
2284A PERMIT AMENDMENT

DRAINAGE PROFILES DITCH B1, B2, C1, C2

project	contract
155488	-

drawing **III.B.8** rev. **2**

file III.B.8 DRAINAGE PROFILES DITCH B1, B2, C1, C2.dwg



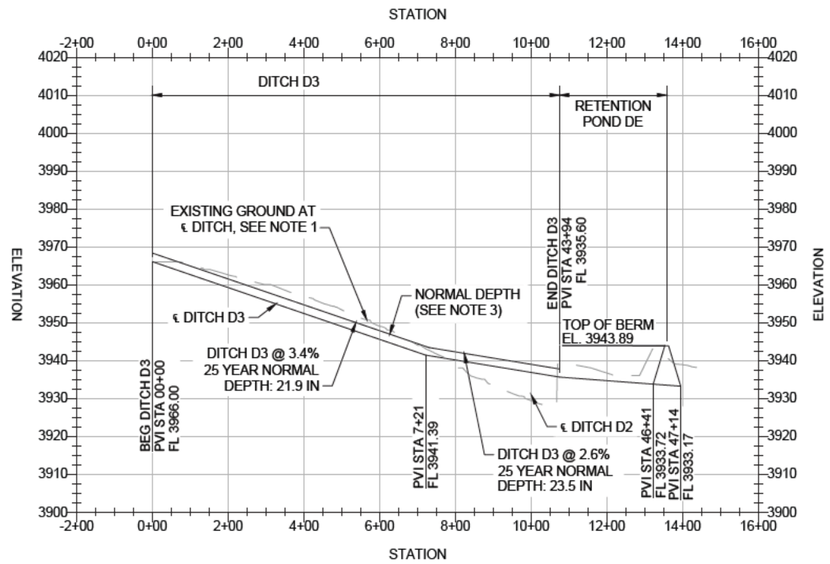
DITCH D1-D2 PROFILE

C

III.B.7

SCALE IN FEET

SCALE IN FEET



DITCH D3 PROFILE

D

III.B.7

SCALE IN FEET

SCALE IN FEET

no.	date	by	ckd	description
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1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2

NOTES:

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

DRAINAGE PROFILES DITCH D1, D2, D3

project	contract
155488	-

drawing **III.B.9 – 2**

file **IIIB.9 DRAINAGE PROFILES DITCH D1, D2, D3.dwg**

STATE OF TEXAS
TONYA L. KOLLER
133943
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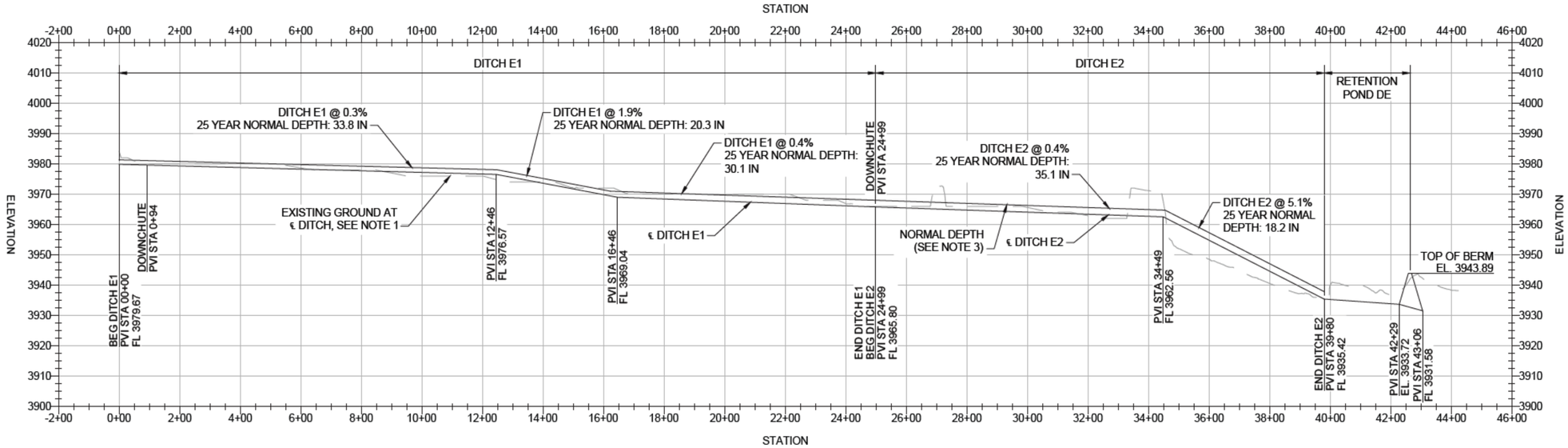
PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming
Millimeters
Inches



DITCH E1-E2 PROFLE — E — III.B.7

0 10' 20' 40'
SCALE IN FEET

0 200' 400'
SCALE IN FEET

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD
1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2

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FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

DRAINAGE PROFILES DITCH E1, E2

project	contract
155488	-

drawing **III.B.10** rev. **2**

file III.B.10 DRAINAGE PROFILES DITCH E1, E2.dwg

STATE OF TEXAS
TONYA L. KOLLER
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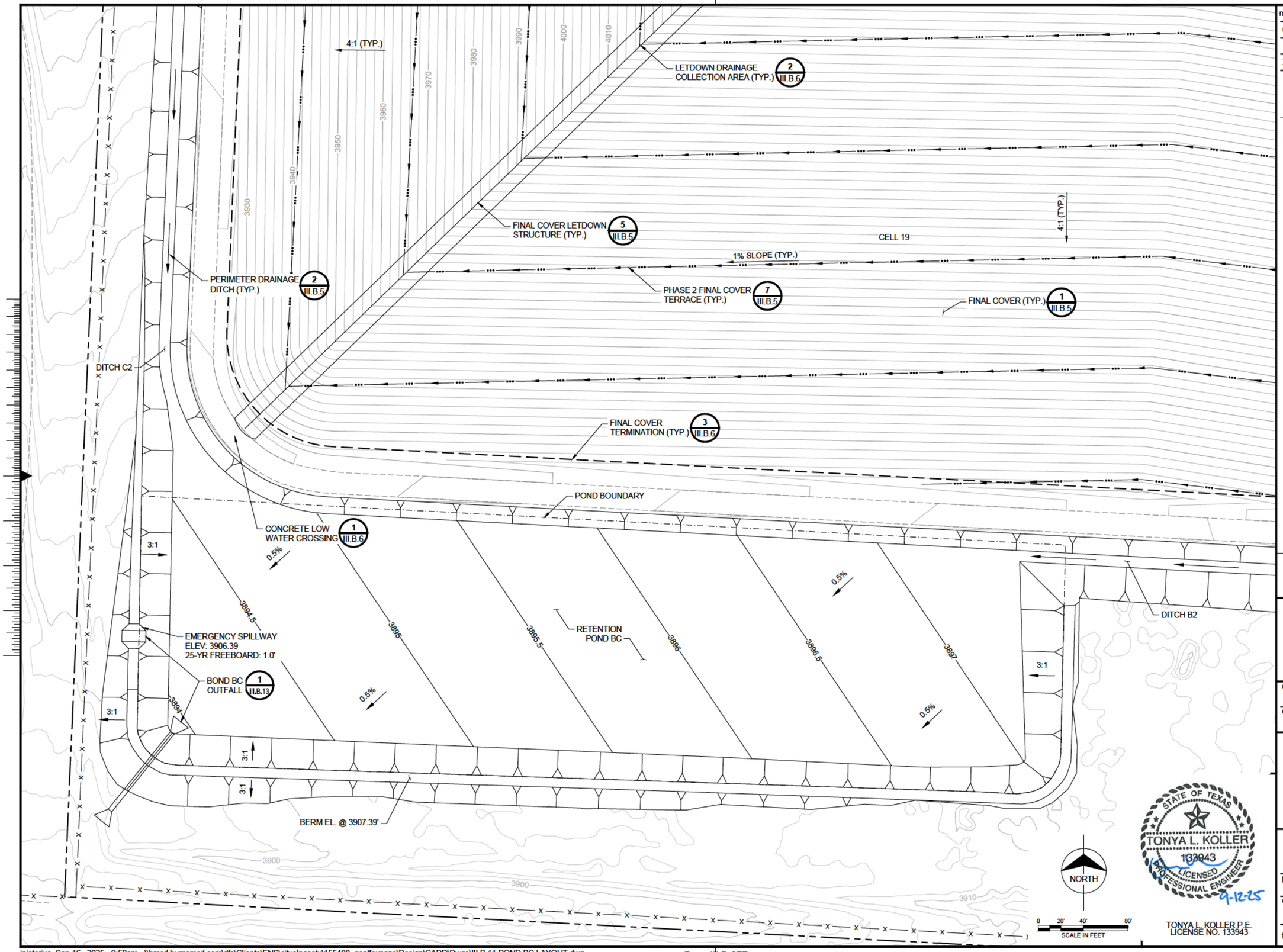
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming: Millimeters / Inches



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1	5/16/25	AAN	TJS	TCEQ NOD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
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4. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 2. CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

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FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

POND BC LAYOUT

project	contract
155488	-

drawing **III.B.11** rev. **2**

file III.B.11 POND BC LAYOUT.dwg

STATE OF TEXAS
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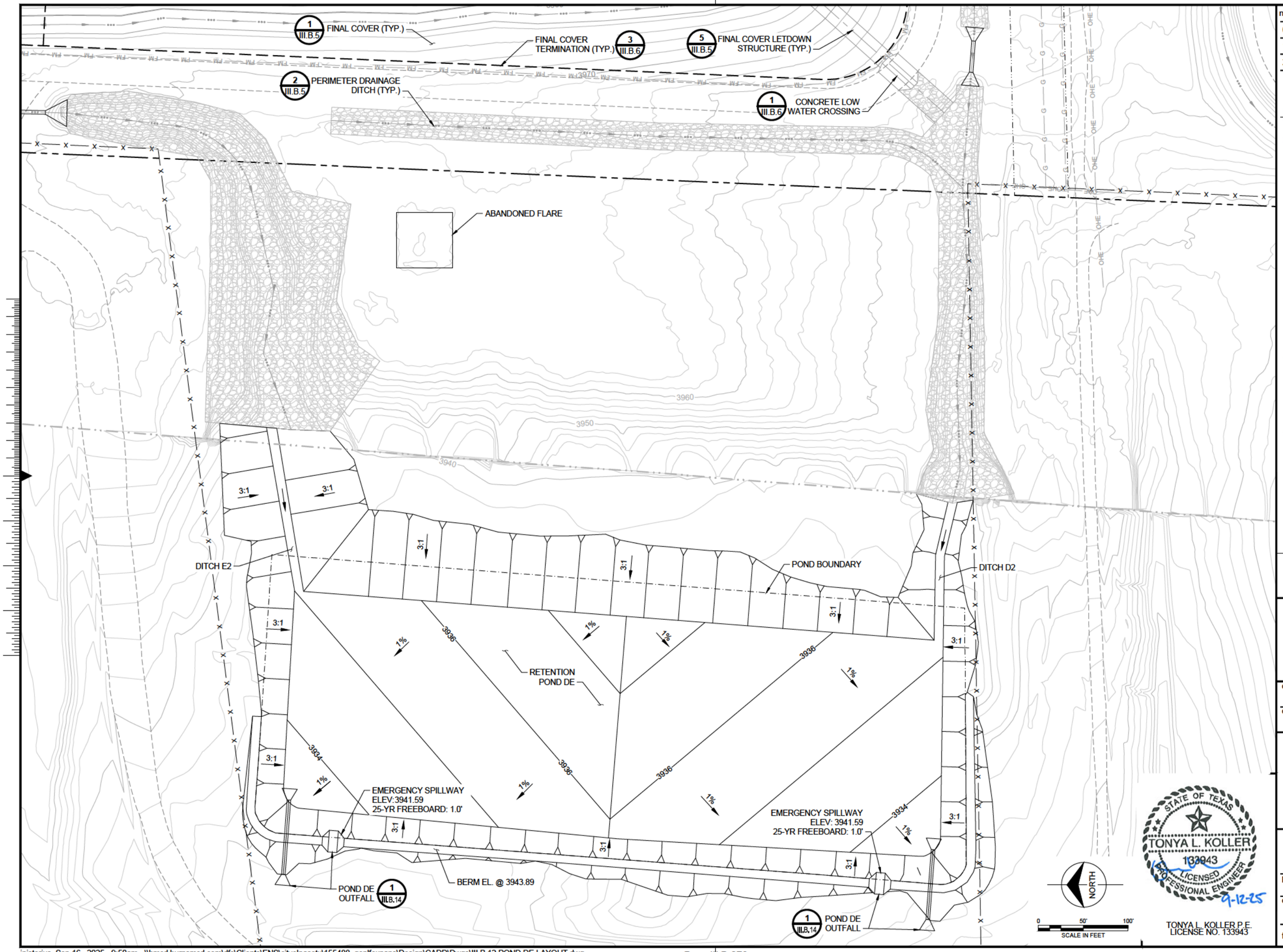
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming: Millimeters / Inches



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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

POND DE LAYOUT

project	contract
155488	-

drawing **III.B.12** rev. **2**

file III.B.12 POND DE LAYOUT.dwg

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 9-12-25

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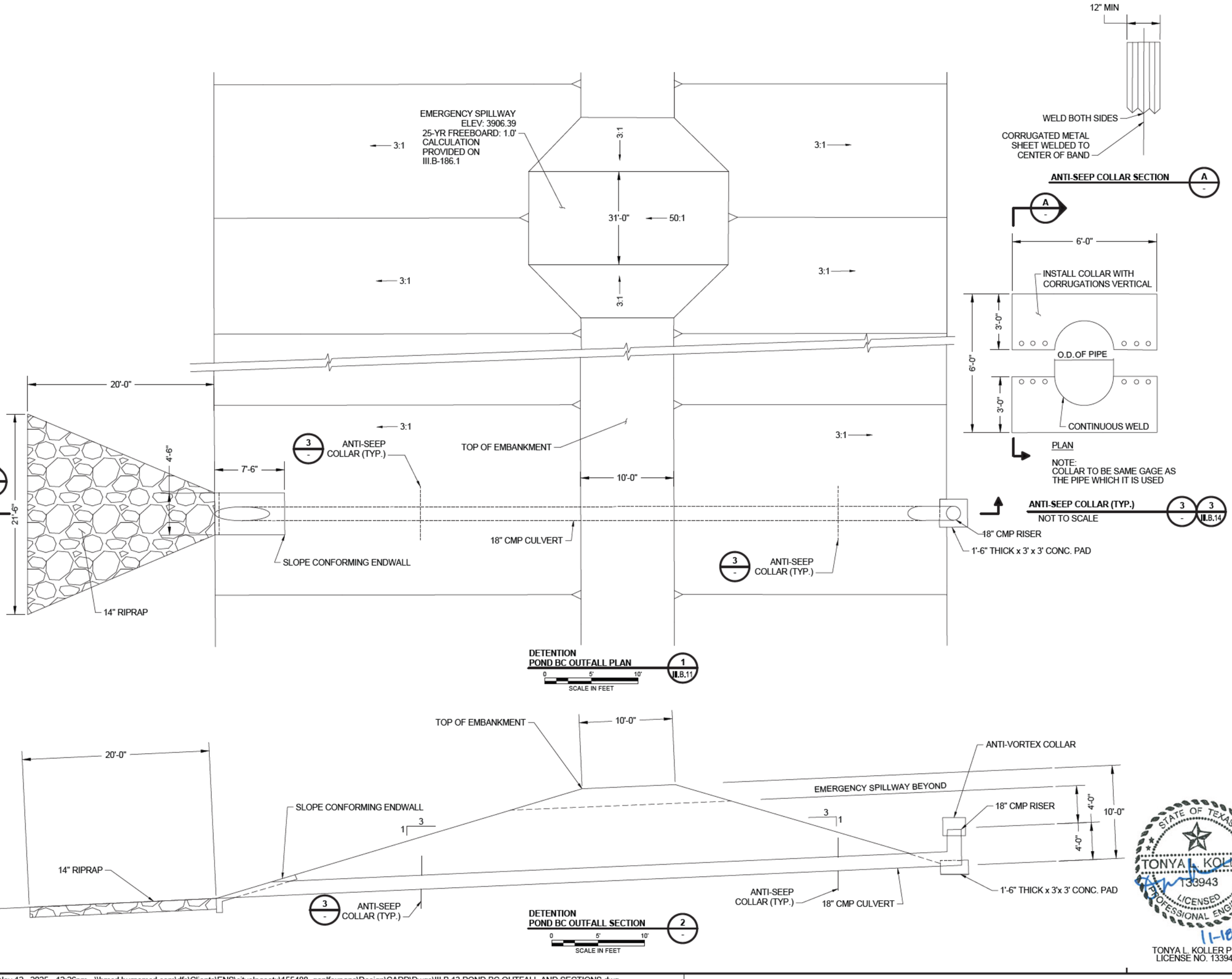
LICENSE NO. 133943



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2	9/12/25	JGP	TLK	TCEQ NOD 2
3	11/14/25	JGP	TLK	TCEQ NOD 3

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KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

POND BC OUTFALL AND SECTIONS

project	contract
155488	-

drawing **III.B.13** rev. **3**

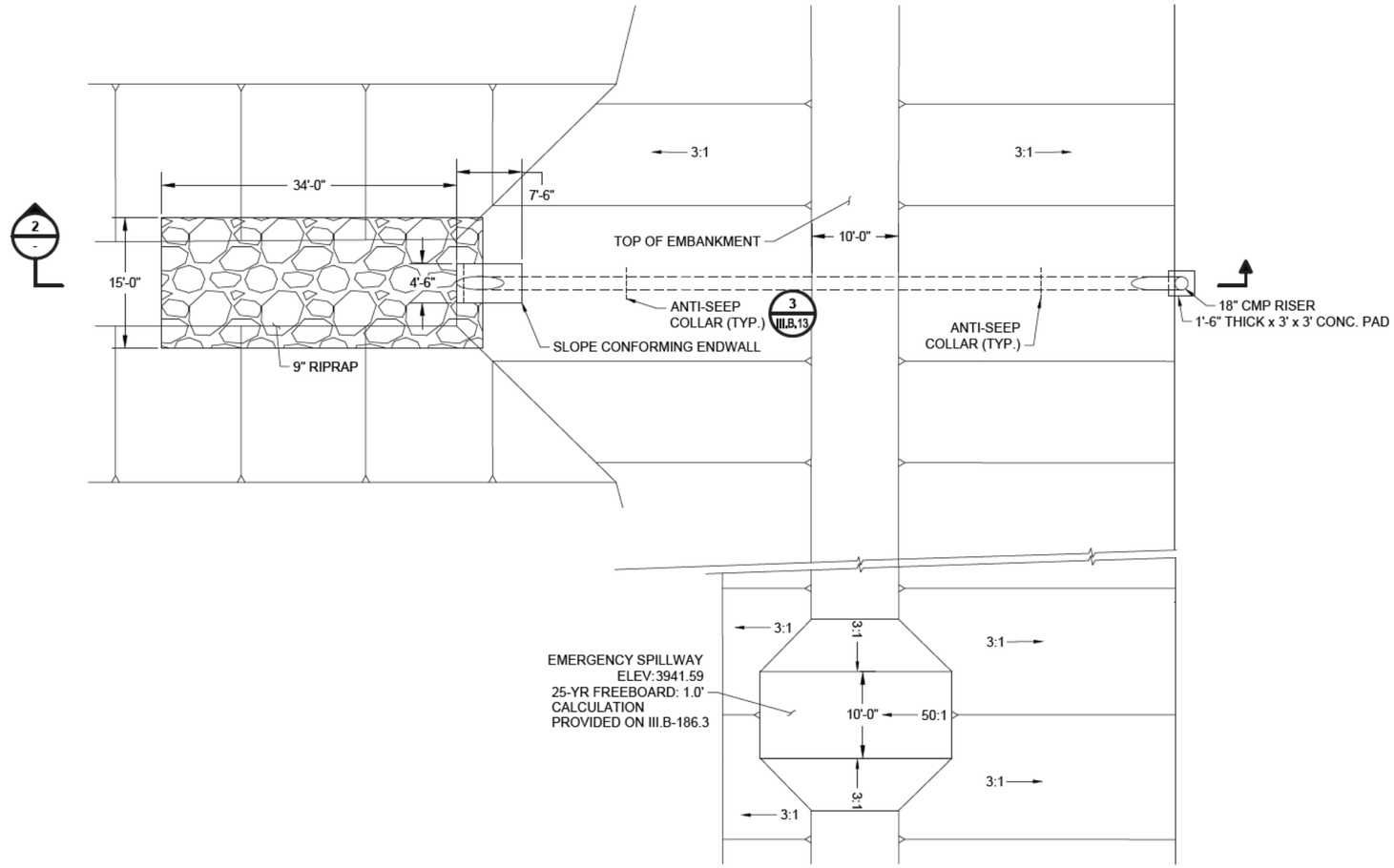
file III.B.13 POND BC OUTFALL AND SECTIONS.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
11-18-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

jpistorius Nov 12, 2025 - 12:26pm - \\bmcd.burnsmcd.com\dfs\Clients\ENS\cityelpasotx\155488_geplfexpans\Design\CADD\Dwgs\III.B.13 POND BC OUTFALL AND SECTIONS.dwg

Rev 3, November 14, 2025



DETENTION
POND DE OUTFALL PLAN 1
III.B.12

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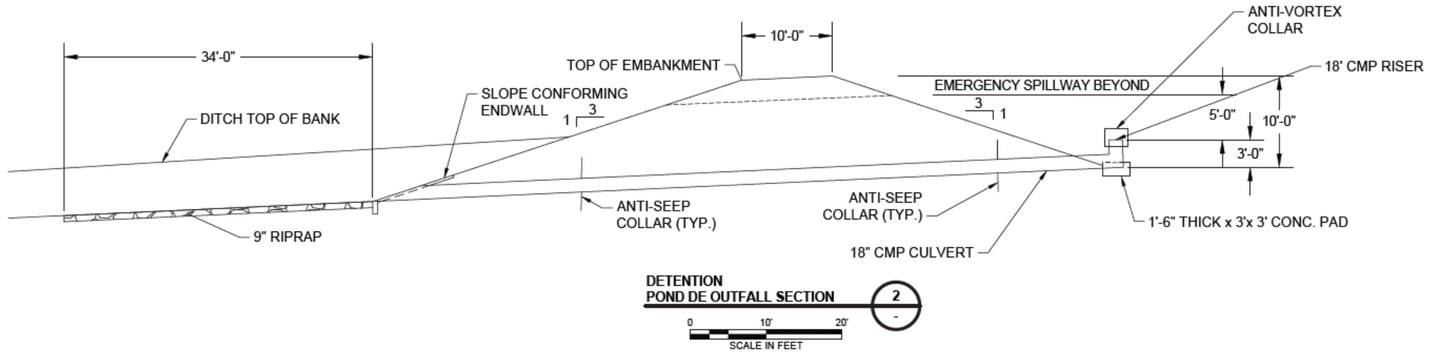

DETENTION
POND DE OUTFALL SECTION 2
-

0 10' 20'
SCALE IN FEET

no.	date	by	ckd	description
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1	5/16/25	AAN	TJS	TCEQ OD 1
2	9/12/25	JGP	TLK	TCEQ NOD 2
3	11/14/25	JGP	TLK	TCEQ NOD 3

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

POND DE OUTFALL AND SECTIONS

project	contract
155488	-

drawing **III.B.14** rev. **3**

file III.B.14 POND DE OUTFALL AND SECTIONS.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
11-10-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

APPENDIX III.C – LEACHATE AND CONTAMINATED WATER PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

APPENDIX III.C – LEACHATE AND CONTAMINATED WATER PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 2
SEPTEMBER 12, 2025

Part III, Appendix III.C
Leachate and Contaminated Water Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024
Revision 1, May 16, 2025
Revision 2, September 12, 2025



prepared by

Burns & McDonnell Engineering Company, Inc.
6200 Bridge Point Pkwy, Building 4, Suite 400, Austin, TX 78730
Texas Firm Registration No. F-845

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ATTACHMENT III.C.3 – HELP MODELING

ATTACHMENT III.C.4 – PIPE STRENGTH CALCULATIONS

ATTACHMENT III.C.5 – HISTORICAL SUMP CAPACITY CALCULATIONS

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List of Abbreviations

Abbreviation	Term/Phrase/Name
GCL	geosynthetic clay liner
GEP Landfill	Greater El Paso Landfill MSW Authorization Number 2284A
HDPE	high density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
LACWP	Leachate and Contaminated Water Plan
MSW	municipal solid waste
MULTIMED	Multimedia Exposure Assessment Model
TCEQ	Texas Commission on Environmental Quality

III.C.1.0 Introduction

This document presents the Leachate and Contaminated Water Plan (LACWP) for the Greater El Paso Landfill Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill) Expansion. This LACWP provides methods to minimize the volume of contaminated water generated, details the leachate collection system design, and describes procedures for storage, treatment, and disposal of the leachate and contaminated water. A discussion of geology and hydrogeology at the GEP Landfill is presented in Part III, Appendix III.E – Geology Report. A discussion of the consideration of local groundwater use, which is not anticipated for use as drinking water, is provided in Part III, Appendix III.E, Section III.E.5.4. Previous appendices to this LACWP included condensate capacity calculations, however the GEP Landfill does not have a landfill gas collection and control system at this time and therefore does not currently produce condensate.

III.C.2.0 Leachate Management [30 TAC §§330.331(a), (b), 330.333]

III.C.2.1 Facility Design

III.C.2.1.1 Sequence of Development

The GEP Landfill is comprised of two phases consisting of approximately 216.4 acres. There are 20 separate leachate collection drainage areas and sumps for the entire site. Each leachate collection drainage area is separated by an interior berm. The areas are comprised of a leachate collection pipe placed on a 1 percent grade. The bottom of the GEP Landfill is sloped at a 2-6 percent grade and any liquid generated drains to the collector and subsequently to the sump area for that collector. Drawing III.C.1 in **Attachment III.C.1** contains the phase and cell configuration for the GEP Landfill, as well as the individual leachate collection systems.

Refer to Part III, Appendix III.A – Permit Drawings for fill sequence details. New areas are filled adjacent to and over previously deposited waste. Areas that remain open and do not receive waste for extended lengths of time (more than 180 days) are covered with a minimum of 12 inches of intermediate cover. Refer to Part IV – Site Operating Plan for a detailed description of the sequence of development.

III.C.2.1.2 Alternate Liner Profile

The Texas Commission on Environmental Quality (TCEQ) allows the use of alternate liner designs capable of performing as well or better than the regulatory design standard. The existing liner varies from the design standard Subtitle D liner in that the 2-foot-thick compacted clay liner is replaced by a geosynthetic clay liner (GCL). A geomembrane overlies the GCL. This type of liner system for municipal solid waste disposal facilities has proven effective throughout the United States, particularly in arid or semi-arid regions such as El Paso. The profile for this liner is as follows:

- Waste
- 24-inches Protective Cover Soil (native soils)
- Geonet Geocomposite Drainage Layer
- Geomembrane (60 mil high density polyethylene (HDPE))
- Geosynthetic Clay Liner

This liner has been shown to perform superior to the prescriptive Subtitle D liner system. Previously approved Hydrologic Evaluation of Landfill Performance (HELP) modeling demonstrating the effectiveness of the prescriptive and alternate liner profiles is provided in **Attachment III.C.2**. The information compiled for this attachment was excerpted from the document Permit No. 2284, Part III, Attachment 15 – Leachate and Contaminated Water Plan, Appendix 1 – HELP Version 3.07 Output, and Appendix 2 – MULTIMED 2.0 Output, prepared by HDR, December 2000. Note that the original document has been redacted to only provide the relevant information. Details of the liner profile are provided in Drawing III.C.3 in **Attachment III.C.1**.

III.C.2.1.3 Alternate Final Cover Profile

The final cover design is an alternative design which has been developed in accordance with the requirements of the TCEQ and has been previously approved for the GEP Landfill. The final cover design

includes an infiltration layer that achieves an equivalent reduction in infiltration as the prescriptive infiltration layer.

This alternative final cover system is designed to prevent erosion from occurring off the cover system due to wind or water, which is a common problem in the area. It also promotes runoff from the site as opposed to infiltration into the site. The profile for the alternative final cover system is as follows:

- 4-inch rock cover
- Non-woven Geotextile
- 18-inch infiltration layer
- 6-inch base layer
- 12-inch Interim and daily cover layer

Previously approved UNSAT-H modeling demonstrating the effectiveness of the alternate final cover profile is provided in Appendix III.I, Attachment III.I.1. The information compiled for this attachment was excerpted from the document Permit No. 2284, Part III, Attachment 12 – Alternate Final Cover Demonstration, prepared by Parkhill, Smith, & Cooper, Inc., March 2012. Details of the final cover profile are provided in Drawing III.B.5 in Appendix III.B.

III.C.2.2 Leachate Collection [30 TAC §330.333(3)]

The leachate collection and management system is designed to prevent the leachate head on the liner from exceeding 30 centimeters (approximately 1 foot). The leachate collection and management system consists of the following components:

- Drainage layer
- Collection piping
- Sumps, pumps, and risers
- Leachate conveyance
- Storage
- Treatment and disposal

This system collects and removes leachate from the GEP Landfill, minimizing head buildup on the alternate composite liner, and effectively conveying leachate to the lined evaporation ponds.

III.C.2.2.1 Drainage Layer

The drainage layer is placed above the composite liner to allow leachate to flow laterally to perforated pipes and is designed to maintain flow throughout the drainage layer. The drainage layer is composed of 2 feet of protective cover soil (with a minimum permeability of $1x10^{-4}$ cm/sec) over a geonet/geotextile drainage composite (with a minimum permeability of 2 cm/sec). This drainage layer is used on the floor area as well as the side slopes. The drainage composite includes a geotextile that separates protective cover soil from the geonet and maintains the hydraulic conductivity of the system.

The drainage composite is installed on the landfill floor with a 2-6 percent cross slope to promote flow toward the leachate collection piping and ultimately to the sump area. The drainage composite provides sufficient flow capacity to effectively transmit leachate to the collection piping and sump area, thereby reducing head buildup. Leachate head buildup is estimated using the impingement rates from the HELP model, along with estimated transmission rates of the drainage composite.

III.C.2.2.2 Leachate Collection Piping

The leachate collection system uses 6-inch diameter perforated collection piping, at a minimum grade of 1 percent. The collection piping is HDPE SDR 17, or approved equal, with perforations and is chemically resistant to the leachate expected to be generated in accordance with 30 TAC §330.333(1). Supplemental information on the chemical resistance of HDPE piping from the 2023 Plastics Pipe Institute Technical Report 19 titled “Chemical Resistance of Plastic Piping Materials” is provided in **Attachment III.C.7**. The perforated collection piping is embedded in granular material. The trench is wrapped with a geotextile to prevent sediment from entering the granular layer and potentially clogging the pipe. Leachate collection piping details are provided on Drawing III.C.3 in **Attachment III.C.1**. The perforated collection piping discharges leachate into the sump area at the base grade low points of the cell area. Leachate collection pipes do not penetrate the liner.

Cleanouts are provided at the top of the side slopes for periodic maintenance of the collection piping. The cleanouts are constructed of a minimum 6-inch diameter non-perforated HDPE pipe joined to the perforated collectors in the sump. The 6-inch pipe size has sufficient cross-sectional area for effective cleaning by pressurized jetting equipment. Refer to Drawing III.C.1 in **Attachment III.C.1** for cleanout locations.

Pipe strength and deformation calculations were performed to demonstrate that the leachate collection piping are of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and any equipment used at the landfill. Pipe strength calculations are provided in **Attachment III.C.4**.

III.C.2.2.3 Leachate Collection Sumps

Leachate entering the geocomposite drainage layer and collection piping is discharged into collection sumps. To allow accumulation of leachate, the sump invert is approximately 3 feet below the pipe invert. The sump can hold up to 4,732 gallons of leachate before it requires pumping based on previously approved sump capacity calculations provided in **Attachment III.C.5**. The information compiled for this attachment was excerpted from the document Permit No. 2284, Part III, Attachment 15, Appendix 3 – Pipe Strength Calculations and Sump Capacity, prepared by HDR, August 2000. Note that the original document has been redacted to only provide the relevant information (i.e., the sump capacity calculations). Leachate collected in the sumps is pumped through a force main into one of two lined evaporation ponds. Drawing III.C.2 in **Attachment III.C.1** shows a plan and section through the sump area and collection system details.

III.C.2.2.4 Leachate Conveyance

Extraction of leachate from the collection sumps is accomplished by submersible pumps, which can be operated manually or automatically. Leachate levels in the collection sumps are monitored to maintain a head buildup of less than 30 centimeters (approximately 1 foot) on the landfill floor adjacent to the sump.

A sump riser pipe is located directly up the side slope from the sump at the disposal area perimeter. Risers are 18-inch diameter HDPE pipe and provide a means for lowering submersible pumps down the 3:1 side slope incline into the collection sumps. The lower portion of the riser within the sump is perforated to allow leachate to flow to the pumps.

The depth of leachate on the liner is measured with an electric liquid level indicator. This indicator is calibrated to reflect the depth of leachate above the liner at the top of the sump. When the liquid level of leachate reaches the top of the sump (i.e., the liner), leachate in the sump is pumped to the evaporation ponds through a force main system.

Backflow prevention is installed at each sump to prevent leachate from flowing into the sumps from the force main system. Occasionally it may be necessary to withdraw leachate from the collection sumps into tanker trucks for transportation to an authorized and permitted facility for treatment and disposal. In this case, spill containment for truck hose connection and loading is provided by a portable trough or similar spill containment device. Protection is provided at hose connection locations.

III.C.2.2.5 Leachate Storage, Treatment and Disposal

Leachate storage is provided on-site in the sumps and the evaporation ponds. Leachate evaporation pond capacity calculations are provided in **Attachment III.C.6**. These calculations were developed using historical precipitation records rather than a single design storm event (i.e., 25-year, 24-hour of 3.17 inches from NOAA Atlas 14). Historical rainfall data was obtained from Station USW00023044 at the El Paso International Airport for the previous 30 years (1994-2024) to determine an average annual rainfall of 8.40-inches and maximum rainfall of 17.51-inches. Evaluating historical annual precipitation trends provides a more representative basis for assessing pond capacity. This design approach therefore reflects realistic long-term operating conditions.

The pond and force main layouts are shown on Drawing III.C.1 in **Attachment III.C.1**. Pond details are shown on Drawing III.C.5 and III.C.7 in **Attachment III.C.1**. Evaporation pond capacity calculations were completed for each pond under the average and maximum precipitation conditions. Under average precipitation conditions, the Phase 1 and Phase 2 leachate evaporation ponds provide sufficient capacity to evaporate all leachate generated onsite. Under maximum precipitation conditions, the Phase 1 pond continues to meet evaporation requirements for Phase 1 leachate; however, the Phase 2 pond storage requirements exceed its evaporation capacity. If evaporation ponds approach or reach their storage capacity, leachate will be collected in tanker trucks and transported to a permitted facility for treatment and disposal. All leachate transferred to offsite facilities will be handled in compliance with TCEQ requirements in accordance with 30 §TAC 330.207(e).

III.C.2.2.6 Monitoring and Maintenance Activities

Regular maintenance and monitoring for the leachate collection and transfer system is performed and will continue to be performed throughout the development of the GEP Landfill, and for at least 30 years after closure. The following monitoring and maintenance activities are performed:

- Depth of leachate on liner: The depth of leachate is measured with an electric liquid level indicator located in the leachate sump. The depth of fluid (if any) above the liner at the top of the sump is read and recorded monthly and after significant rainfall events during the active life of the GEP Landfill, and will be recorded semi-annually during the post-closure period. Monitors are located at the sump.
- Pump maintenance/replacement: Portable pumps are maintained as appropriate. The permanent sump pumps are checked annually and maintained as necessary. Backup pumps (portable pumps) are provided so the primary pumps may be removed and repaired. Maintenance activities on the pumps will continue to occur during the post-closure period.
- Cleanout: Cleanouts have been provided on all collectors. Cleanout activities occur on an annual basis, or more often as needed, and will continue during the post-closure period.
- Storage facilities: Leachate is pumped to the evaporation ponds. The evaporation ponds are inspected annually for leaks, tears, or damage to the liner. Inspections are performed as outlined in the Site Operating Plan and is completed when the ponds are dry. Any sediment remaining after the ponds are dry is washed or swept to the deepest part of the pond. Following sediment removal, the liner may be thoroughly inspected. A concrete pad at the deep end allows equipment to access the bottom of the ponds and remove any sediment. If the ponds are

- unavailable, leachate may be transported to an approved/permitted facility on an as-needed basis during the active life of the GEP Landfill. After closure, the transport frequency requirements will likely decrease. The required transport frequency will be reevaluated after closure and will be based on the actual amount of leachate generated.

III.C.2.3 Leachate Generation

The HELP Model Version 4.0.1 was used in the design and evaluation of the leachate management system. The HELP model is a hydrologic model of water movement across, into, through, and out of landfills. Landfill leachate generation was estimated based on local climatic factors, soil, and design data in a daily sequential analysis that accounts for the effects of surface storage, runoff, infiltration, evapotranspiration, percolation, soil moisture storage, and lateral drainage.

To conduct an evaluation of the liner system, the rate of moisture percolation to the liner and leachate collection systems must first be estimated. Cursory examinations of the water balance for the El Paso, Texas area indicate a significant negative moisture balance. This would seem to indicate that the generation of leachate, particularly given the moisture retention capacity of municipal solid waste, would be non-existent.

The HELP model was used to simulate design conditions to demonstrate adequate performance of the alternate liner and alternative final cover systems. A summary of the HELP model inputs, assumptions, and results is provided in **Attachment III.C.3**.

III.C.2.3.1 Fate and Transport

Fate and transport modeling for the GEP Landfill was provided with the previous application. The modeling included a steady-state pulse load, Gaussian source boundary condition, and a conservative infiltration rate. Historical fate and transport modeling is provided in **Attachment III.C.2**.

III.C.3.0 Contaminated Water Minimization and Management [30 TAC §§330.207(b), (e), (f), 330.227]

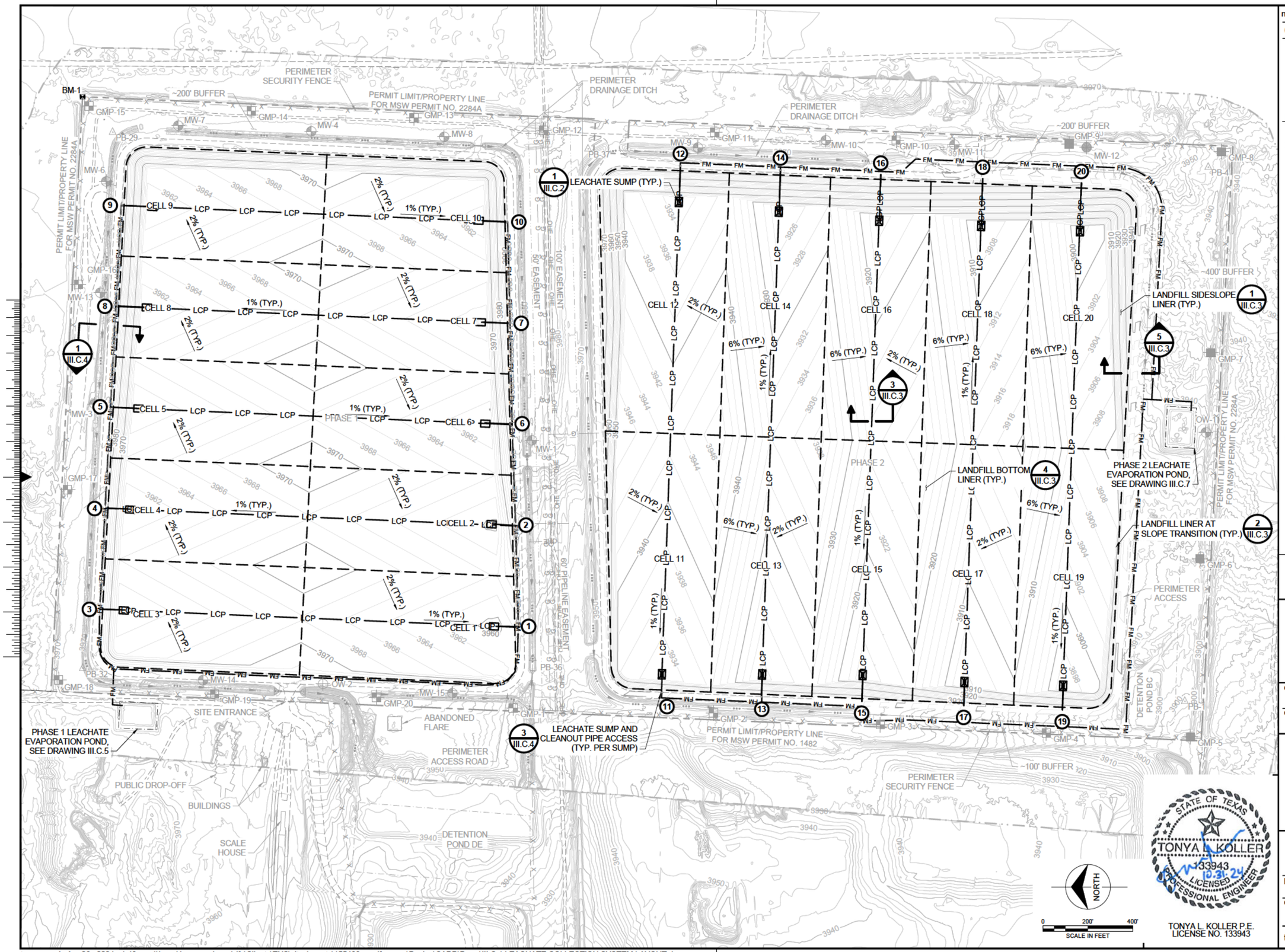
Stormwater is managed to limit the quantity that may come into contact with waste. Berms are utilized to segregate uncontaminated rainfall from leachate in parts of the cell area that have not yet received waste. As operations progress to an aerial fill, an intermediate layer of soil is placed over inactive areas that are not filled to final grade. As landfill areas are brought to final grade, final cover will be installed in accordance with Appendix III.D.

The GEP Landfill's leachate collection system collects leachate and conveys it via a force main system to two lined evaporation ponds, as discussed in **Section III.C.2.2.5**. Leachate evaporation pond capacity calculations are provided in **Attachment III.C.6**. The City tracks operations at the GEP Landfill to evaluate leachate generation.

Containment berms and liner termination berms have been and will be constructed to prevent water from undeveloped areas of the GEP Landfill from entering the lined area. The berms have been designed for the 25-year 24-hour storm event. Refer to Part III, Appendix III.B for berm design calculations and Attachment III.B.3, Drawings III.B.4, III.B7, III.B.8, and III.B.9 for berm locations and profiles. In addition, working face berms are constructed as operations progress to an aerial fill. Any water that comes in contact with waste is confined in the working face area and is collected in the leachate collection system. Should a rainfall event occur whereby the collected contaminated surface water run-off remains on the working face for 48 hours, the excess contaminated water will be pumped out of the area to tanker trucks and transported to the on-site storage facilities (e.g., leachate evaporation ponds) or off-site for proper disposal/treatment. There will be no off-site discharge of contaminated water.

The interim drainage controls help to minimize the amount of water entering the leachate collection system and potential flooding in the developed cell area. Water that is collected outside the working face area, but within the cell area, is considered to be uncontaminated and can be pumped out of the excavated area if water accumulation is excessive (does not evaporate within 48 hours).

ATTACHMENT III.C.1 – DRAWINGS



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0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
4. DESIGN CONTOURS PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS TOP OF PROTECTIVE COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET.
5. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LEACHATE COLLECTION SYSTEM LAYOUT

project	contract
155488	-

drawing **III.C.1** – rev. **0**

file III.C.1 LEACHATE COLLECTION SYSTEM LAYOUT.dwg

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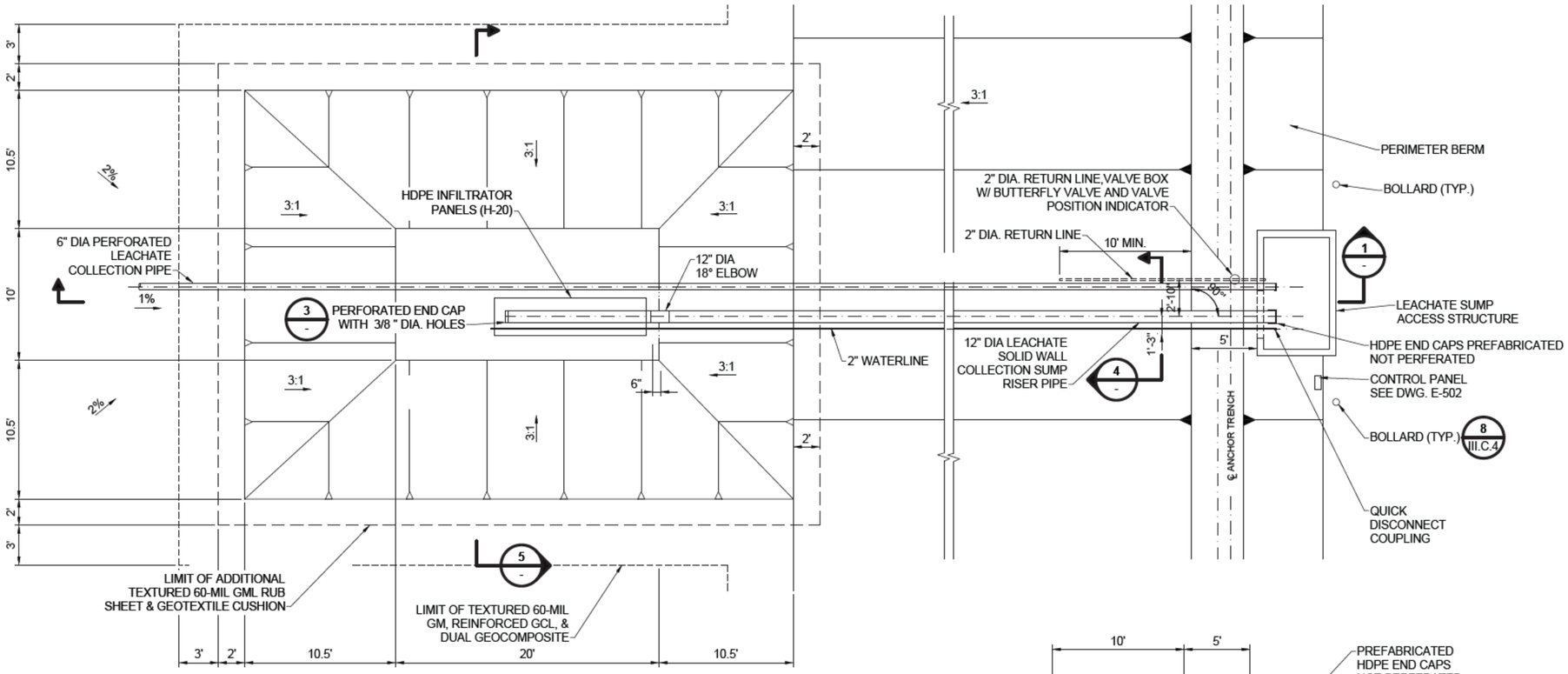
133943
10.31.24
LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming
Millimeters
Inches



SUMP PLAN A -
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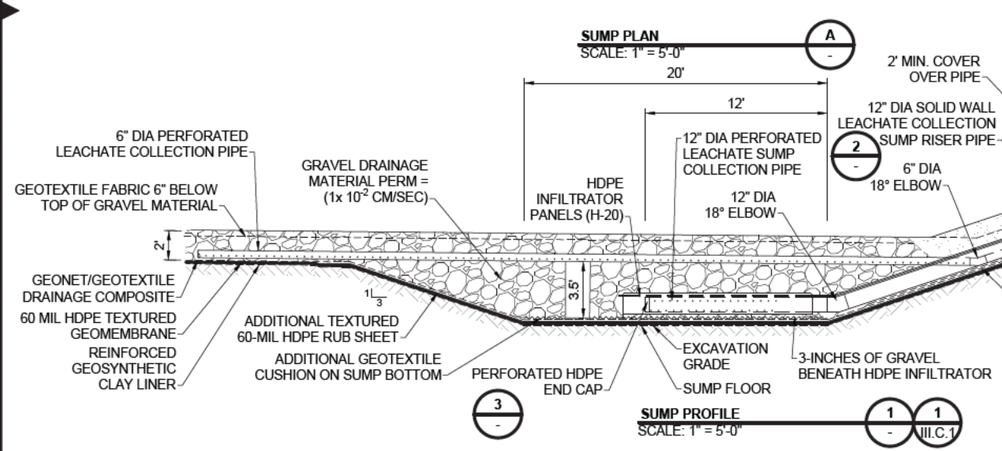

SUMP PROFILE 1 - 1 III.C.1
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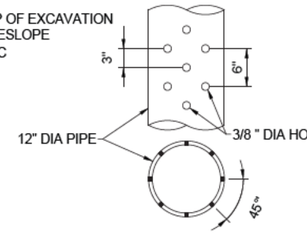
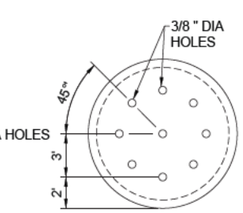


LEACHATE COLLECTION SUMP PERFORATION DETAIL 2 -
NOT TO SCALE



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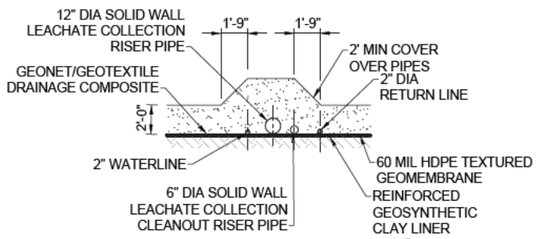

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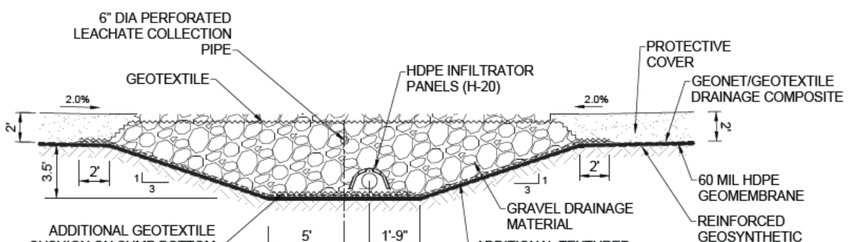

LEACHATE SUMP SECTION 5 -
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NOTES:
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LEACHATE COLLECTION SYSTEM PUMP PLAN AND SECTION

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drawing **III.C.2** — rev. **0**

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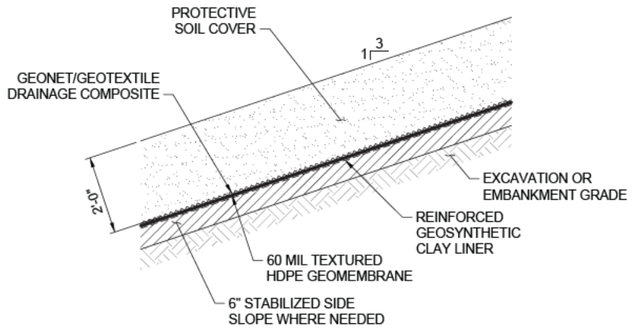

TYPICAL LINER DETAIL LANDFILL SIDE SLOPE — 1 / III.C.4
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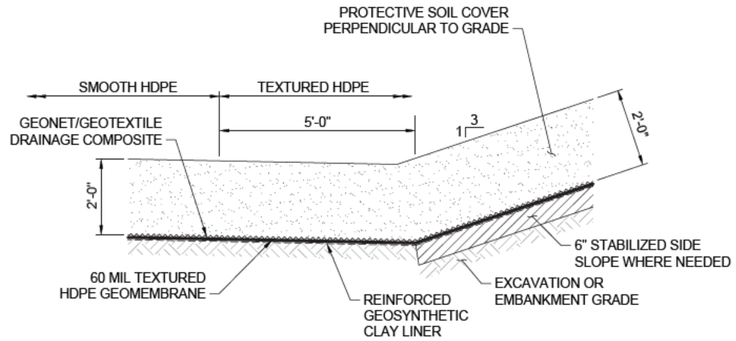

LINER AT SLOPE TRANSITION — 2 / III.C.1
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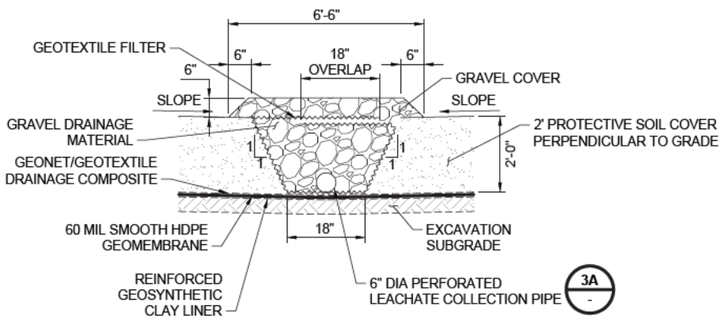
NOTE:
REINFORCED GCL FOR SIDE SLOPES DIFFERS FROM REINFORCED GCL TO BE PLACED ON FLOOR.



LEACHATE COLLECTION PIPE — 3 / III.C.1
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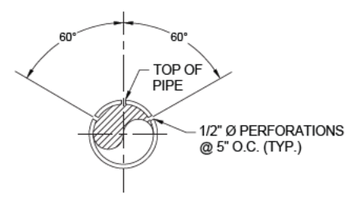

TYP. 6" PERFORATED LEACHATE COLLECTION PIPE — 3A / -
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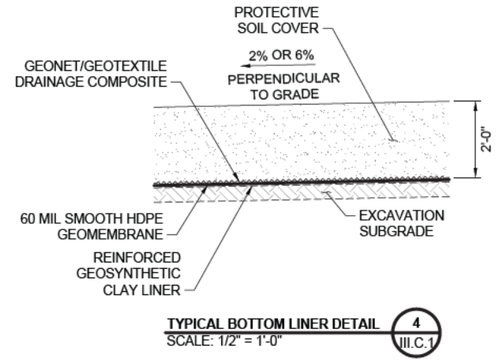

TYPICAL BOTTOM LINER DETAIL — 4 / III.C.1
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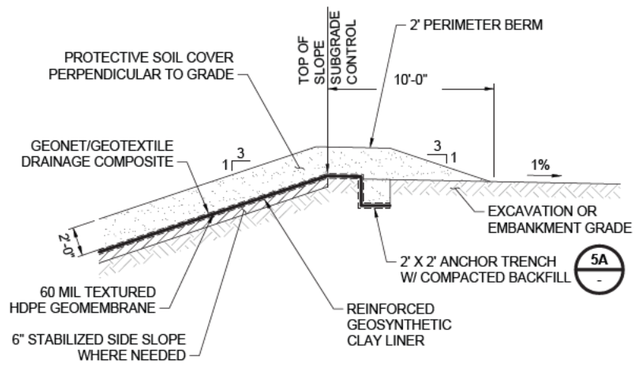

TYPICAL ANCHOR TRENCH AT PERIMETER — 5 / III.C.1
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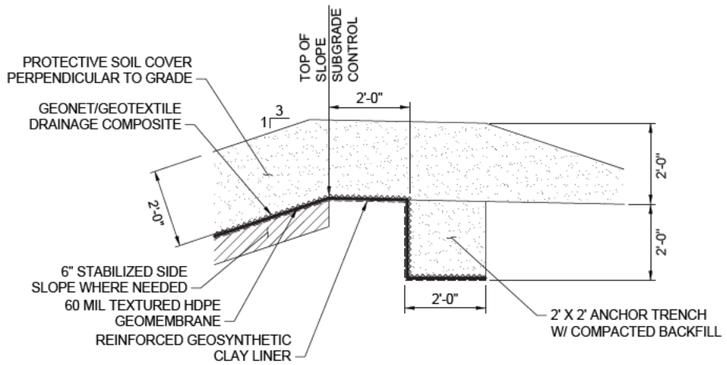

ANCHOR TRENCH DETAIL — 5A / - / 5A / III.C.4
SCALE: 1/2" = 1'-0"

NOTE:
REINFORCED GCL ON SIDE SLOPES OF CELL DIFFERS FROM REINFORCED GCL ON FLOOR OF CELL.

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LEACHATE COLLECTION SYSTEM DETAILS, 1 OF 2

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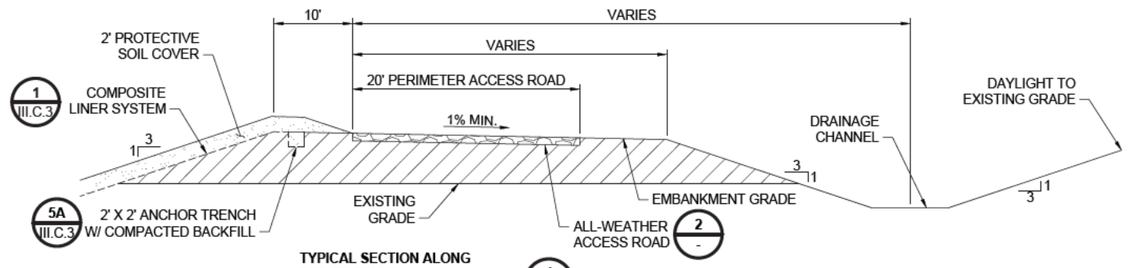
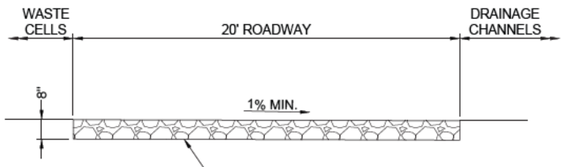
LICENSE NO. 133943

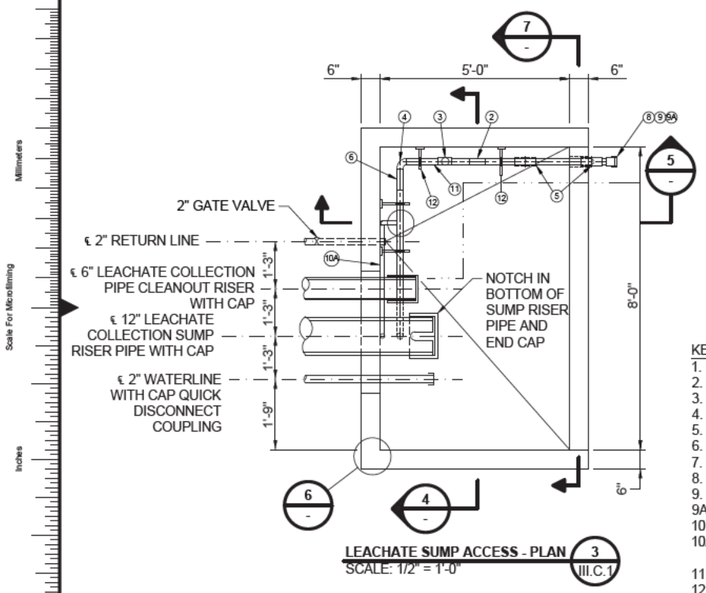
Scale For Microfilming: Millimeters / Inches



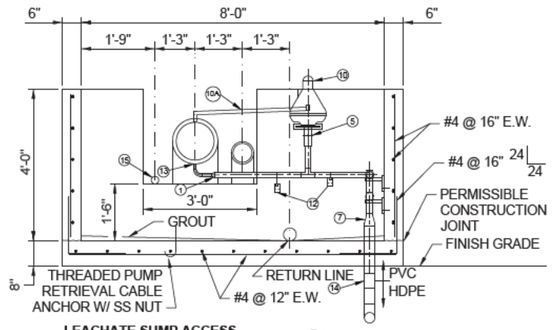
TYPICAL SECTION ALONG TOP OF CELLS 1 III.C.1
SCALE: 1" = 10'



PERIMETER ACCESS ROAD 2 -
NOT TO SCALE



LEACHATE SUMP ACCESS - PLAN 3 III.C.1
SCALE: 1/2" = 1'-0"



LEACHATE SUMP ACCESS - SECTION 4 -
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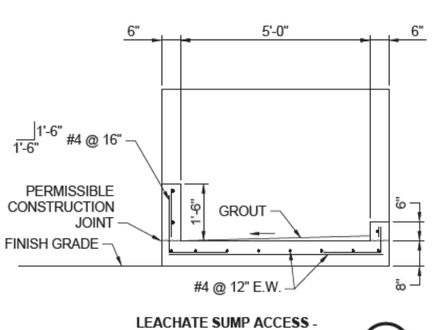
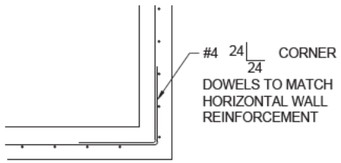


LEACHATE SUMP ACCESS - SECTION 5 -
SCALE: 1/2" = 1'-0"

CONCRETE NOTES:
1. ALL CONCRETE SHALL HAVE 4000 PSI COMPRESSIVE STRENGTH @ 28 DAYS, NORMAL WEIGHT.
2. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENT FOR STRUCTURAL CONCRETE" ACI-318 LATEST EDITION.
3. STANDARD SPECIFICATIONS FOR "DEFORMED AND PLAIN CARBON-STEEL BARS FOR CONCRETE REINFORCEMENT: ASTM A615 GRADE 60."
4. ALL EXPOSED CORNERS SHALL HAVE 1 IN CHAMFER, UNLESS OTHERWISE NOTED.

STRUCTURAL STEEL NOTES:
1. STRUCTURAL STEEL SHAPES & PLATES SHALL MEET THE REQUIREMENTS OF ASTM A36 UNLESS OTHERWISE NOTED.
2. DESIGN FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) SPECIFICATIONS.
3. WELDING SHALL CONFORM TO THE REQUIREMENT OF THE "STRUCTURAL WELDING CODE-STEEL (AWS D1.1) OF THE AMERICAN WELDING SOCIETY" CLASS 70 SERIES ELECTRODES.
4. STRUCTURAL BOLTS TO CONFORM TO ASTM A490 HIGH STRENGTH BOLTS. MINIMUM SIZE: 3/4 IN.
5. HEADED STUDS TO CONFORM TO ASTM A108, AUTOMATICALLY END WELD HEADED STUDS AND REBARS IN ACCORDANCE WITH THE AWS CODE AND MANUFACTURER'S RECOMMENDATIONS. FILLET WELDING OF HEADED STUDS AND REBARS IS NOT ALLOWED.
6. COVER ON ALL REINFORCEMENT SHALL BE A MIN. OF 2-1/2 INCHES.
7. ANCHOR BOLTS TO MEET THE REQUIREMENT OF ASTM F1554-36.

KEYED NOTES:
1. 1-1/2" X 2" CONCENTRIC REDUCER, SCH. 80 PVC, SOCKET
2. 2" TEE, SCH. 80 PVC, SOCKET
3. EPG FLOW METER, EP-200, 2" SOCKET X SOCKET
4. 2" 90 ELBOW, SCH. 80 PVC, SOCKET
5. 2" PVC SPEARS TRUE-UNION 2000 BALL VALVE OR EQUAL, SOCKET
6. 2" PVC SPEARS TRUE-UNION 2000 BALL CHECK, OR EQUAL, SOCKET
7. 4" X 2" CONCENTRIC REDUCER, SCH. 80 PVC, SOCKET
8. 2" TYPE D CAM & GROOVE COUPLER, FEMALE COUPLER X FEMALE NPT, POLYETHYLENE
9. 2" TYPE DP DUST PLUG, POLYETHYLENE
9A. 2" STAINLESS STEEL CHAIN
10. COMBINATION AIR VALVE, 2" FNPT INLET, STAINLESS STEEL, ARI D-025,T,2 AS SPECIFIED
10A. 1" AIR VALVE DRAIN - PVC, SLOPE TO 12" LEACHATE PUMPING CASING-DRILL AND INSTALL COUPLING FOR CONNECTION.
11. 2" SCH. 80 PVC PIPE, ENDS TO MATCH DRAWINGS
12. PIPE SUPPORTS, UNISTRUT OR EQUAL GALVANIZED CHANNEL AND U-BOLT PIPE ANCHORS
13. MATCH CONNECTION THREADS AND PIPE SIZE
14. 4" PVC/HDPE PIPE ADAPTOR
15. 2" WATERLINE WITH QUICK DISCONNECT COUPLING



TYPICAL CORNER REINFORCING 6 -
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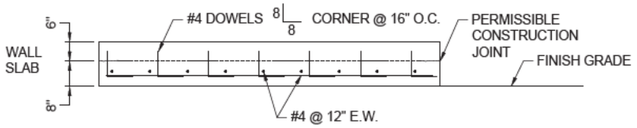

LEACHATE SUMP ACCESS - SECTION 7 -
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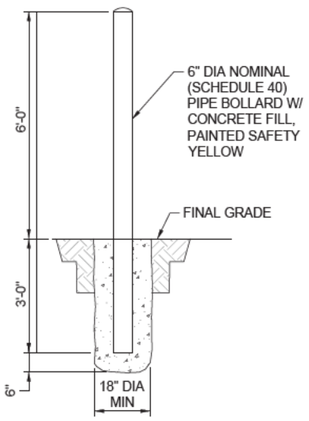

TYPICAL BOLLARD DETAIL 8 III.C.2
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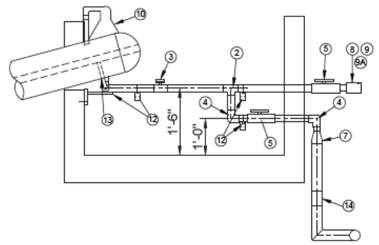


SUMP ACCESS STRUCTURE PIPING 9 -
SCALE: 1/2" = 1'-0"

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:
1. DETAILS FROM CELLS 11-14 CONSTRUCTION AT THE GREATER EL PASO LANDFILL.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO
City of El Paso, Texas

2284A PERMIT AMENDMENT

LEACHATE COLLECTION SYSTEM DETAILS, 2 OF 2

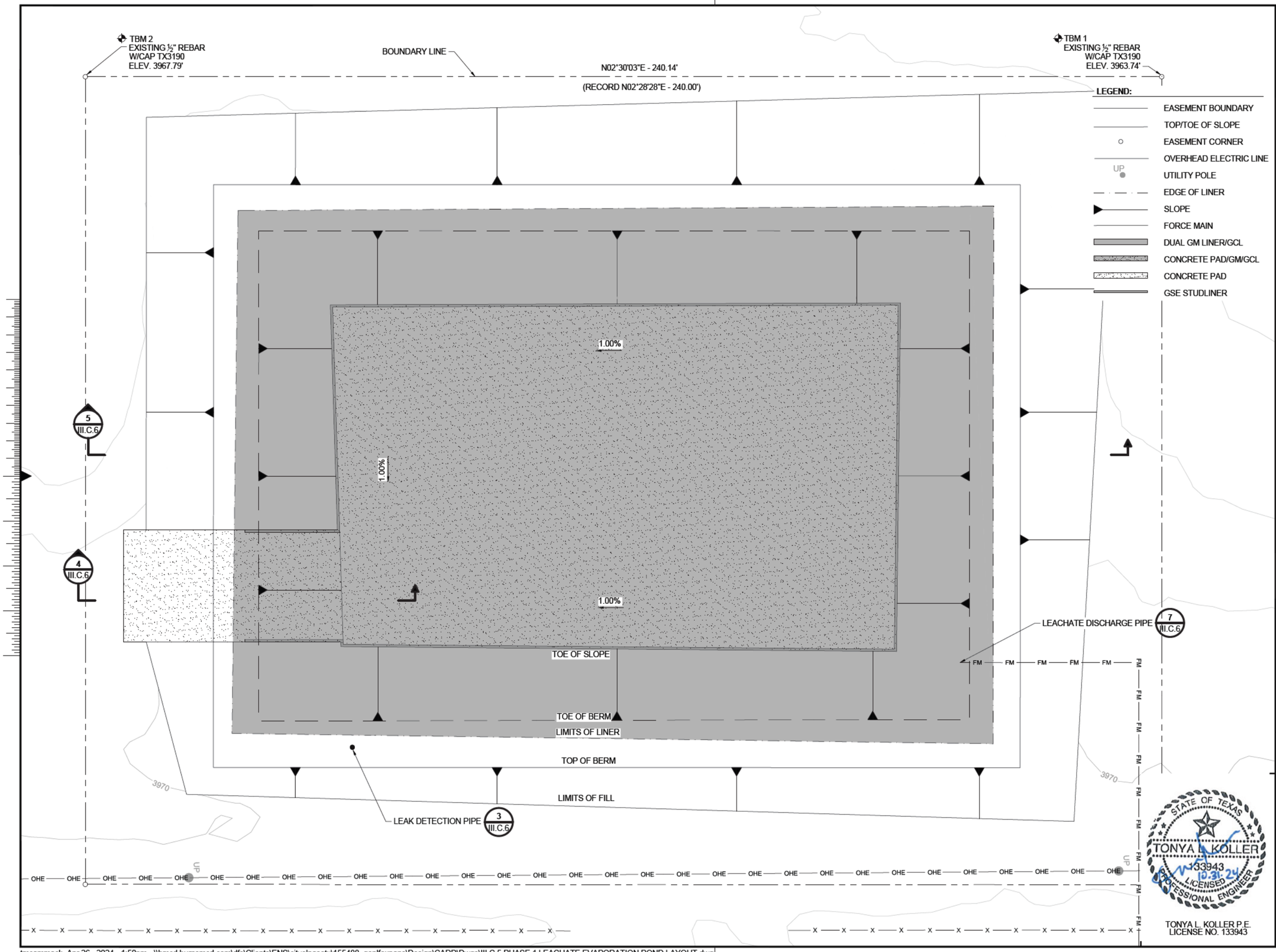
project	contract
155488	-

drawing III.C.4 — rev. 0

file III.C.4 LEACHATE COLLECTION SYSTEM DETAILS, 2 OF 2.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
10.31.24
LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. LEACHATE EVAPORATION POND DETAILS FROM AS-RECORDED DRAWING FROM LEACHATE POND CONSTRUCTION DATED MARCH 2011.
4. COORDINATES ARE BASED UPON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE, NAD83. ELEVATIONS ARE BASED UPON NAVD88 DATUM.

NORTH

0 10' 20'
SCALE IN FEET

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KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

PHASE 1 LEACHATE EVAPORATION POND LAYOUT

project	contract
155488	-

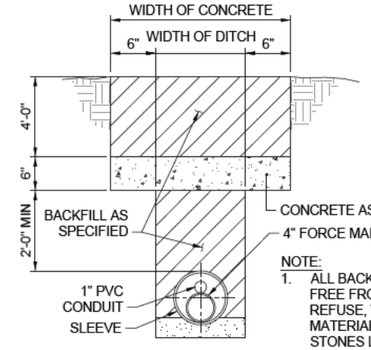
drawing **III.C.5** — rev. **0**

file III.C.5 PHASE 1 LEACHATE EVAPORATION POND LAYOUT.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
10.31.24
LICENSED
PROFESSIONAL ENGINEER

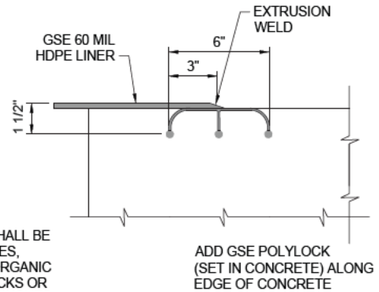
TONYA L. KOLLER P.E.
LICENSE NO. 133943

tmcammack Apr 26, 2024 - 1:50pm - \\bmcd.burnsmcd.com\dfs\Clients\ENS\cityelpasotx\155488_geplfexpans\Design\CADD\Dwgs\III.C.5 PHASE 1 LEACHATE EVAPORATION POND LAYOUT.dwg



NOTE:
1. ALL BACKFILL MATERIAL SHALL BE FREE FROM CINDERS, ASHES, REFUSE, VEGETABLE OR ORGANIC MATERIAL, BOULDERS, ROCKS OR STONES LARGER THAN 3/4-INCHES, OR OTHER UNSUITABLE MATERIAL.

FORCE MAIN CHANNEL CROSSING 1 / -
NOT TO SCALE



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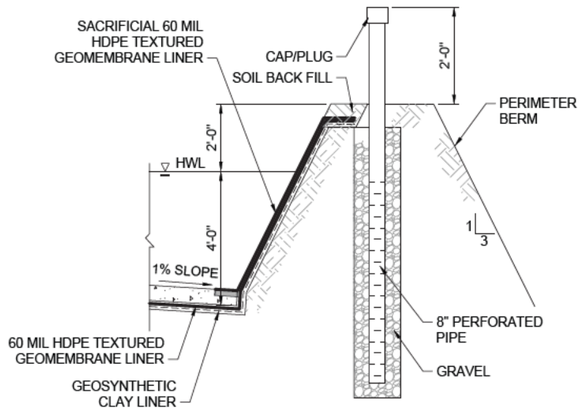

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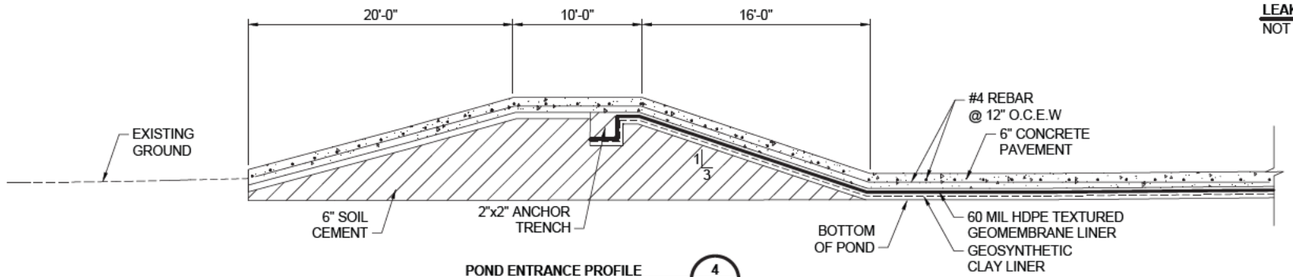

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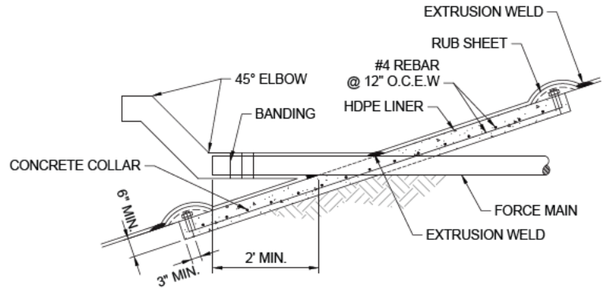

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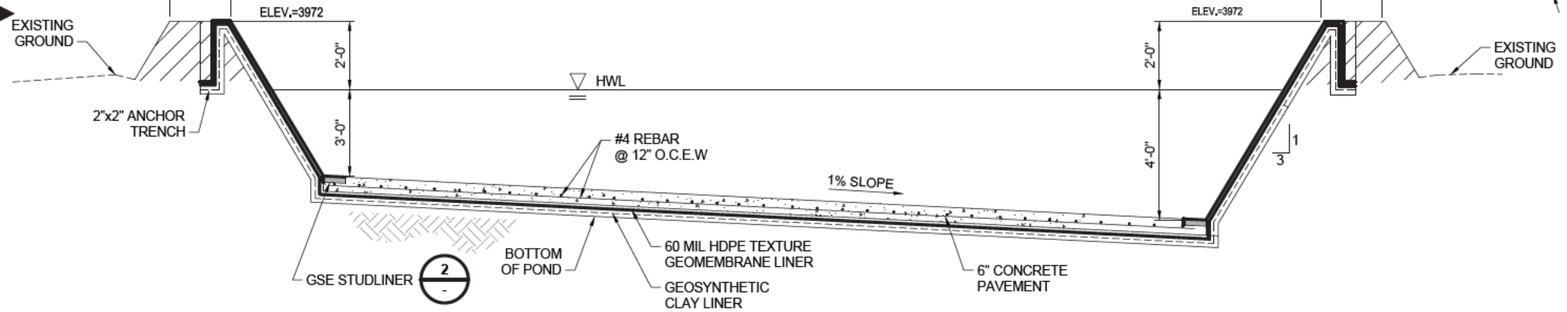

EVAPORATION POND PROFILE 5 / III.C.5
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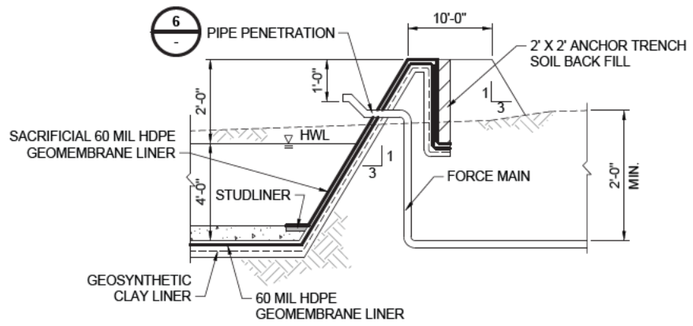

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NOT TO SCALE

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:
1. LEACHATE EVAPORATION POND DETAILS FROM AS-RECORDED DRAWING FROM LEACHATE POND CONSTRUCTION DATED MARCH 2011.

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KANSAS CITY, MO 64114
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Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO
City of El Paso, Texas

2284A PERMIT AMENDMENT

PHASE 1 LEACHATE EVAPORATION POND DETAILS

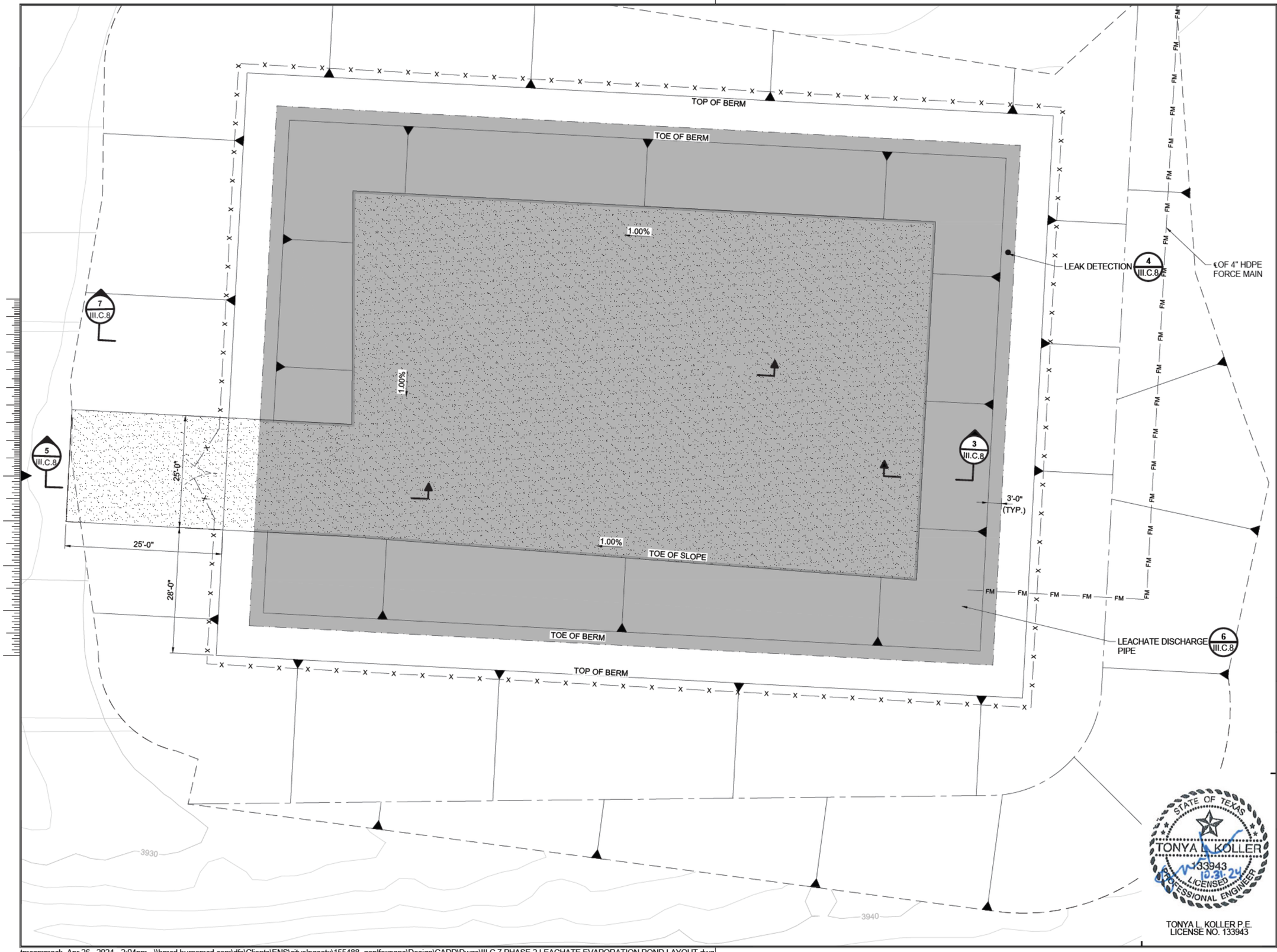
project	contract
155488	-

drawing **III.C.6** – rev. **0**

file III.C.6 PHASE 1 LEACHATE EVAPORATION POND DETAILS.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
10.31.24
LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943



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0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
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816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

PHASE 2 LEACHATE EVAPORATION POND LAYOUT

project	contract
155488	-

drawing **III.C.7** rev. **0**

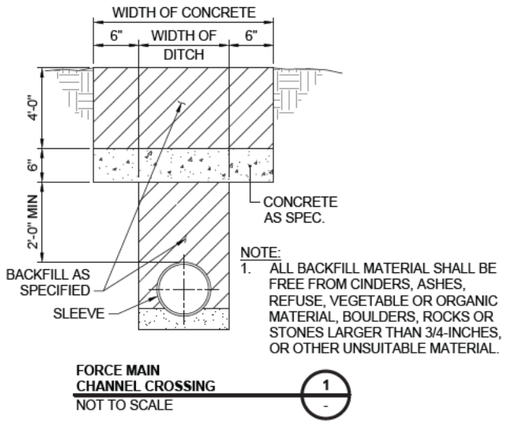
file III.C.7 PHASE 2 LEACHATE EVAPORATION POND LAYOUT.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED
PROFESSIONAL ENGINEER
10-31-24

TONYA L. KOLLER P.E.
LICENSE NO. 133943

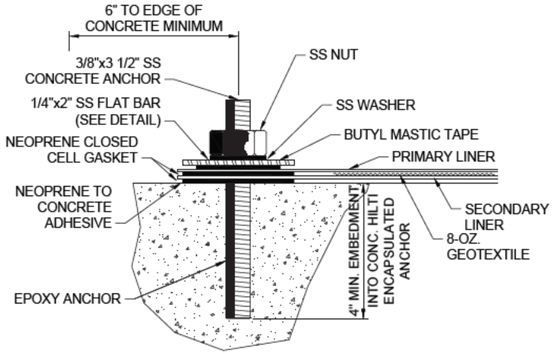
Millimeters
Inches
Scale For Microfilming

tmcammack Apr 26, 2024 - 2:04pm - \\bmcd.burnsmcd.com\dfs\Clients\ENS\cityelpasotx\155488_geplfexpans\Design\CADD\Dwgs\III.C.7 PHASE 2 LEACHATE EVAPORATION POND LAYOUT.dwg



NOTE:
1. ALL BACKFILL MATERIAL SHALL BE FREE FROM CINDERS, ASHES, REFUSE, VEGETABLE OR ORGANIC MATERIAL, BOULDERS, ROCKS OR STONES LARGER THAN 3/4-INCHES, OR OTHER UNSUITABLE MATERIAL.

FORCE MAIN CHANNEL CROSSING 1 -
NOT TO SCALE



MECHANICAL ATTACHMENT TO CONCRETE 2 -
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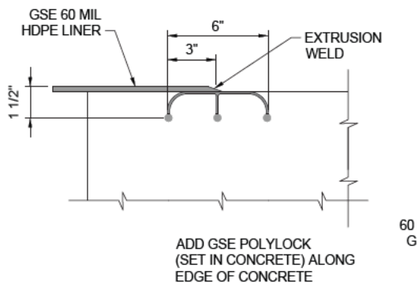

GSE POLYLOCK (OR APPROVED EQUAL) 3 - / 3 III.C.7
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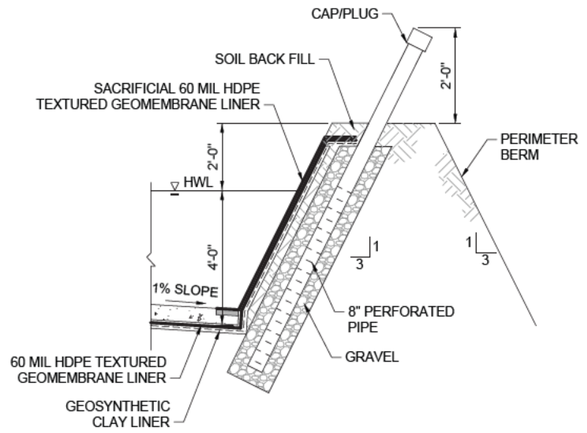

LEAK DETECTION PIPE 4 - / III.C.7
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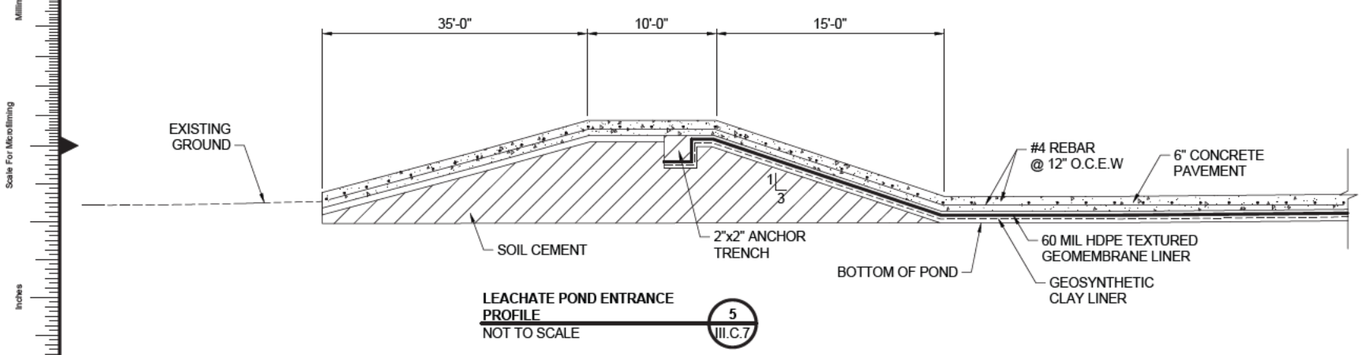

LEACHATE POND ENTRANCE PROFILE 5 - / III.C.7
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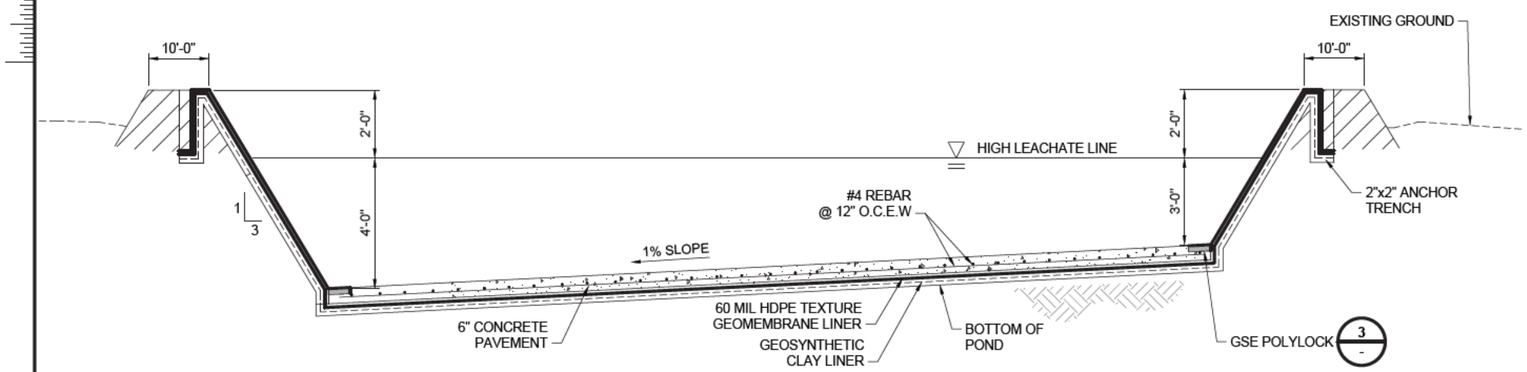
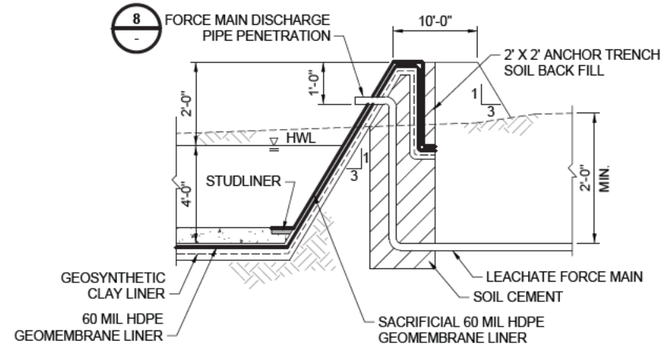


LEACHATE POND PROFILE 7 - / III.C.7
NOT TO SCALE

8 - FORCE MAIN DISCHARGE PIPE PENETRATION



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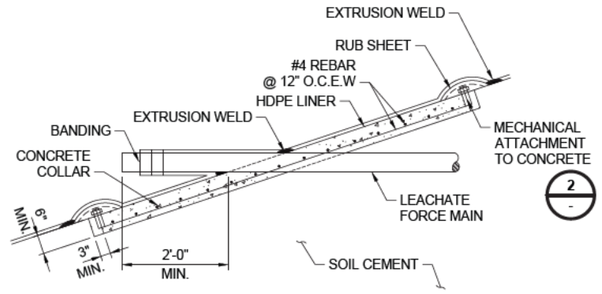

FORCE MAIN DISCHARGE PIPE PENETRATION 8 -
NOT TO SCALE

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LICENSE NO. 133943

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:
1. LEACHATE EVAPORATION POND DETAILS FROM AS-RECORDED DRAWING FROM LEACHATE POND CONSTRUCTION DATED FEBRUARY 2018.

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Burns & McDonnell Engineering Co, Inc.
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date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

PHASE 2 LEACHATE EVAPORATION POND DETAILS

project	contract
155488	-

drawing **III.C.8** – rev. **0**

file III.C.8 PHASE 2 LEACHATE EVAPORATION POND DETAILS.dwg

ATTACHMENT III.C.2 – HISTORICAL HELP AND MULTIMED MODELING FOR ALTERNATE LINER PROFILE

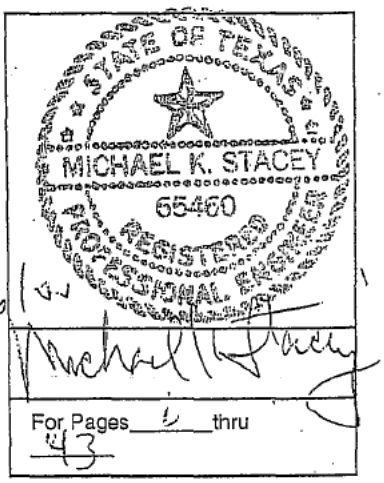
(Excerpt from Permit No. 2284, Attachment 15 – Leachate and Contaminated Water Plan, Appendix 1 – Help Version 3.07 Output, and Appendix 2 – MULTIMED 2.0 Output)

PART III
ATTACHMENT 15

LEACHATE AND CONTAMINATED WATER PLAN

FOR

CLINT LANDFILL
PERMIT APPLICATION NO. 2284
CITY OF EL PASO
EL PASO COUNTY, TEXAS
~~NOVEMBER~~ DECEMBER 2000



4.0 LINER SYSTEM DESIGN

The Texas Natural Resources Conservation Commission (TNRCC) allows the use of alternate liner designs for municipal solid waste facilities. The proposed liner varies from the design standard Subtitle D liner in that the two foot thick compacted clay liner is replaced by a geosynthetic clay liner (GCL). A flexible membrane liner (FML) overlies the GCL. This type of liner system for municipal solid waste disposal facilities has proven effective throughout the United States, particularly in arid or semi-arid regions such as the one in which the proposed facility is located.

4.1 Description

To conduct an evaluation of the proposed liner system, the rate of moisture percolation to the liner and leachate collection systems must first be estimated. Cursory examinations of the water balance for the El Paso, Texas area indicate a significant negative moisture balance. This would seem to indicate that the generation of leachate, particularly given the moisture retention capacity of municipal solid waste, would be non-existent. However, to comply with TNRCC guidance, a worst-case rate of leachate production (other than zero) was used in the evaluation of liner and leachate collection systems.

Pursuant to §330.202, HDR has implemented the HELP and MULTIMED models generally as recommended by the TNRCC for the demonstration of alternate liner designs. These models were executed in the most appropriate and competent manner insofar as the level of technology and the intended use of the models allow.

4.2 Subtitle D Liner

The Subtitle D standard liner consists of a flexible membrane liner (FML) overlying a two-foot layer of compacted clay liner. The profile for this type of liner system includes:

Waste

24" Protective Cover Soil (native soils)

Flexible Membrane Liner (60 mil HDPE)

24" Compacted Clay Liner (CCL)

The major concern with this liner system is the limited availability of clay soils in the area. The arid location of the site would prohibit the use of a clay liner system. With this in mind, the following alternative cover was proposed.

4.3 Alternate Liner

The proposed liner replaces the compacted clay liner with a geosynthetic clay liner (GCL). The GCL is still overlain with a FML (60 mil HDPE). This type of liner system is commonly accepted in semi-arid areas and has been proven effective for this type of facility. The profile for this liner is:

Waste

24" Protective Cover Soil (native soils)

Flexible Membrane Liner (60 mil HDPE)

Geocomposite Clay Liner (GCL)

This liner has been shown to perform superior to the subtitle D liner system and has gained wide acceptance in semi-arid regions such as the location of the facility.

4.4 Conclusion and Recommendation

The municipal solid waste regulations allow for the inclusion of a designed alternate liner system capable of performing as well or better than the regulatory design standard. The proposed bottom liner system includes a geosynthetic clay liner overlain by a flexible membrane (60 mil HDPE) liner and a leachate collection system. To demonstrate adequate performance of the proposed alternate liner system, the Hydrologic Evaluation of Landfill Performance (HELP) Model and the Multimedia Exposure Assessment Model (MULTIMED) programs were used to simulate the design conditions. The data for these runs are included in Appendices 1 and 2 of this attachment. Summary sheets showing results and assumptions are included in Figures 15-3 and 15-4.

The fate and transport modeling scheme for the facility included a steady-state pulse load, Gaussian source boundary condition, and a conservative infiltration rate. Fate and transport modeling is shown in detail in Section 7.0 of this attachment. The resulting Dilution Attenuation Factor for the most appropriate scenario was ~~1440~~262. This value is greater than the TNRCC minimum value of 260 and the design is therefore considered to be adequate.

FIGURE 15-3
HELP MODEL ELP98-1B (VERSION 3.07) SUMMARY FOR YEAR 1

Landfill Cross Section
6" Daily Cover
120" Waste
24" Protective Cover Soil
FML
24" Clay Liner

Model ELP98-1B Parameters
(Simulation Duration for one year)

Layer	Soil Texture	Thickness (in)	Permeability (cm/sec)	Initial Moisture Content	Final Moisture Content	Field Capacity	Wilting Point	Porosity
1	6	6	0.00072	0.1900	0.2215	0.1900	0.0850	0.4530
2	18	120	0.00100	0.2000	0.2010	0.2920	0.0770	0.6710
3	6	24	0.00072	0.1900	0.1900	0.1900	0.0850	0.4530
4	35	0.06	2.00E-13	-	-	-	-	-
5	16	24	1.00E-07	0.4270	0.4270	0.4180	0.3670	0.4270

Assumptions

- Synthetic weather generation using normal monthly temperature and precipitation values for El Paso Station
- Default City - El Paso, TX
- Soil texture for daily and protective cover is based on the available on-site soils.
- Leaf area index = 0.0 for bare ground.
- Evaporative zone depth = 36 inches
- Runoff curve number determined by model.
- FML placement = good
- FML pinhole density = 4 holes / acre
- FML installation defects = 4 holes / acre
- Landfill surface area = 0.001 acre.
- Slope of drainage layer = 2% (bottom) = 2% (top)
- Maximum length along slope = 100 feet
- User initialized values for moisture content. Soil moisture content set to field capacity to simulate steady state conditions. Moisture content for waste set to 20 percent.

Results

	inches/month	inches/day
Peak Average Annual Percolation	0.000000	0.000000

FIGURE 15-4
HELP MODEL ELP98-1 (VERSION 3.07) SUMMARY FOR YEAR 1

Landfill Cross Section
6" Daily Cover
120" Waste
24" Protective Cover Soil
FML
GCL

Model ELP98-1 Parameters
(Simulation Duration for one year)

Layer	Soil Texture	Thickness (in)	Permeability (cm/sec)	Initial Moisture Content	Final Moisture Content	Field Capacity	Wilting Point	Porosity
1	6	6	0.00072	0.1900	0.2215	0.1900	0.0850	0.4530
2	18	120	0.00100	0.2000	0.2010	0.2920	0.0770	0.6710
3	6	24	0.00072	0.1900	0.1900	0.1900	0.0850	0.4530
4	35	0.06	2.00E-13	-	-	-	-	-
5	17	0.24	3.00E-09	0.7500	0.7500	0.7470	0.4000	0.7500

Assumptions

- Synthetic weather generation using normal monthly temperature and precipitation values for El Paso Station
- Default City - El Paso, TX
- Soil texture for daily and protective cover is based on the available on-site soils.
- Leaf area index = 0.0 for bare ground.
- Evaporative zone depth = 36 inches
- Runoff curve number determined by model.
- FML placement = good
- FML pinhole density = 4 holes / acre
- FML installation defects = 4 holes / acre
- Landfill surface area = 0.001 acre.
- Slope of drainage layer = 2% (bottom) = 2% (top)
- Maximum length along slope = 100 feet
- User initialized values for moisture content. Soil moisture content set to field capacity to simulate steady state conditions. Moisture content for waste set to 20 percent.

Results

	inches/month	inches/day
Peak Average Annual Percolation	0.000000	0.000000

t_s = thickness of liner
a = area of the geomembrane hole, and
k_{st} = hydraulic conductivity of low-permeability soil underlying geomembrane

This equation is taken from "Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects", *Geosynthetics International*, vol. 4, Nos. 3-4, pp. 335-348, 1997 by Giroud, J.P. The calculations for this equation are shown in Appendix 6 of this attachment. The calculation resulted in a value of 4.27×10^{-6} m/yr or 4.60×10^{-7} in/day. This is the value that was used for contaminant fate and transport modeling. It should be noted that the City is currently running a test cell to demonstrate that a liner system may not be needed at all due to the arid climate that results in a negative water balance which produces minimal or no leachate. Should this demonstration succeed, the liner for the new landfill may be deemed unnecessary as well.

7.0 POTENTIAL LEACHATE FATE AND TRANSPORT

As part of an alternate liner demonstration, the TNRCC ~~recommends~~ suggests that the MULTIMED model may be used to evaluate probable fate and transport of leachate resulting from liner leakage. The following sections describe the MULTIMED model in general as well as its application to the Clint landfill. Section 7.1 presents an overview of the program. Section 7.2 discusses the baseline data and assumptions used to model the vadose and saturated zones below the landfill. Discussion of the transient modeling assumptions and results is given in Section 7.3.

7.1 MULTIMED Model Overview

The United States Environmental Protection Agency's (USEPA) Multimedia Exposure Assessment Model (MULTIMED) is a suite of multidimensional fate and transport algorithms that simulate the movement, dispersion, diffusion and degradation of contaminants leaching from waste disposal facilities. Use of this model is ~~recommended~~ suggested by the TNRCC as an evaluation tool for the anticipated performance of landfill liner systems and their suitability to site-specific hydrogeologic conditions. From the model documentation, "*...simplifying assumptions required to obtain the analytical solutions limit the complexity of the systems which can be represented by MULTIMED. The model does not account for site-specific spatial variability, the shape of the land disposal facility, site specific boundary conditions, or multiple aquifers and pumping wells. Nor can MULTIMED simulate processes, such as flow in fractures and chemical reactions between contaminants, which can have a significant affect on the concentration of contaminants at a site.*" (Sharp-Hansen, et al., 1993).

The acceptability of an alternate liner design is based upon the dilution attenuation factor, DAF, resulting from site specific fate and transport modeling of the liner design in its unique hydrogeologic setting. Because this method is based on the premise that the model estimation of concentration at the point of compliance (POC) is linear with respect to the input concentration, the DAF is the factor by which the initial concentration can be expected to decrease between the bottom of the land disposal unit and the point of compliance. The design would, according to the USEPA, be acceptable if the DAF is 100 or greater, due to the maximum expected concentration of contaminants. Typical leachate contaminant concentrations found in municipal solid waste landfills are

approximately 100 times greater than the Maximum Contaminant Level (MCL) for each constituent (Sharp-Hansen, et al., 1993).

However, according to the Alternate Liner Design Handbook released by the TNRCC (1993), much more conservative default initial contaminant concentrations are required. The TNRCC document requires a minimum DAF of 260, or 2.6 times the USEPA recommended attenuation, for an alternate liner design to be deemed acceptable.

As part of the State mandated alternative liner demonstration, leakage through the liner must be estimated and input into the MULTIMED model. However, the HELP model leachate generation values (as given in the output from the HELP program) are not adequate to run the models for this site. Equations presented above to calculate liner leakage were used to estimate the maximum anticipated leakage through the liner system at the landfill. These worst-case leakage rates (MULTIMED source infiltration) were input to the MULTIMED model as constant, non-decaying, leakage rates to estimate leachate concentrations at the landfill's ~~relative~~ relevant point of compliance. ~~This approach is the most applicable and conservative options available in the MULTIMED model as well as sensitivity analysis.~~

7.2 Base MULTIMED Input Data

The base values input to the MULTIMED simulations for the City of El Paso Landfill are given in Tables 15-1 to 15-5 at the end of this section. These tables represent the same tables found in the TNRCC Alternate Liner Design Handbook, pages 17 through 21.

Table 15-1
Chemical-Specific Variables

Variable Name	Value	Comments
Solid phase decay coefficient		Derived by model
Dissolved phase decay coefficient		Derived by model
Overall decay coefficient		Derived by model
Acid catalyst hydrolysis constant	0.0	Model default value
Neutral hydrolysis rate constant	0.0	Model default value
Base catalyst hydrolysis constant	0.0	Model default value
Reference temperature	25°C	Model default value
Normalized distribution coefficient	0.0	Model default value
Distribution coefficient		Derived by model
Biodegredation coefficient	0.0	Not allowed by TNRCC

Note: Chemical-specific variables are all default values from the MULTIMED set-up program, PREMED.

As stated previously, no leakage is anticipated to occur at this facility. This conclusion has been well supported by very conservative HELP modeling. However, to comply with State Guidelines, MULTIMED modeling is being performed. Based upon the no-percolation results of HELP modeling, any leakage (infiltration) input to the MULTIMED model will have a very high factor of safety.

These tables do not include the statistical data requested in the TNRCC Handbook because they refer to the Monte Carlo simulations which were not used in this exercise. There is little if any material readily available that describe the statistical variance or boundary conditions for the data relating to each of the computer-simulated material properties. The Monte Carlo simulation, although useful in describing parameter uncertainty, assumes that the probability distribution of any given parameter is known. Probability distributions are generally constructed from large sets of site specific data. The cost and timeliness of collecting such data is prohibitive, particularly as these data relate to Subtitle D applications. Assuming a parameter probability distribution when the distribution is unknown does not reduce uncertainty, as the certainty of the output is then a function of the assumed certainty of the input parameter (Salhotra et. al., 1990).

Table 15-2
Source-Specific Data

Variable Name	Value	Comments
Infiltration rate	~~7.82~~4.27 x 10^{-6} m/yr	Assumed leakage rates
Area of disposal unit	906,000 m^2	Scaled from FigIII.Att.1.1
Spread of contaminant source	Gaussian	σ = W/6 (W = width scale)
Recharge rate	0.0	**Conservative value**
Initial concentration at landfill	1.0	Per TNRCC Handbook
Length scale of facility	N/A	derived by model
Width scale of facility	N/A	derived by model

Table 15-3
Unsaturated Zone Transport Variables

Variable Name	**Value**	**Comments**
Thickness of layer	91m	local groundwater well data
Longitudinal dispersivity	Derived	α_V = 0.02 + 0.022L, L=depth
Percent organic matter	0.0	Conservative assumption
Soil bulk density	1.7	Typical of sandy materials
Biological decay	0.0	Not allowed by TNRCC

Table 15-4
Unsaturated Zone Flow Variables

Variable Name	Value	Comments
Saturated hydraulic conductivity	~~32~~ 318 m/yr	Attachment 5
Unsaturated zone porosity	0.25	Attachment 5
Air entry pressure head	0.0	Assumed value
Depth of unsaturated zone	91m	Geologic Reports
Residual water content	.04	Assume 80% wilting point
Brooks and Corey exponent	0.0	Not used
ALFA Van Genuchten	0.145	MULTIMED Table 6-5, sand
BETA Van Genuchten	0.29	MULTIMED Table 6-5, sand

Table 15-5
Aquifer-Specific Data

Variable Name	Value	Comments
Particle diameter	N/A	Not used by model
Aquifer porosity	0.25	Assumed same as vadose
Bulk density	2.0 g/cc	Bolson deposits
Aquifer thickness	90	Conservative value
Mixing zone depth	Derived	derived
Hydraulic conductivity	~~32~~ 318 m/yr	Attachment 5
Hydraulic gradient	~~0.0088 %~~0.000088	Attachment 5
Groundwater seepage velocity	Derived	$V_s = KS/\theta$
Retardation coefficient	Derived	$R_s = 1 + \rho_b K_d/\theta$
Longitudinal dispersivity	Derived	$\alpha_L = 0.1\ x_r$
Transversal dispersivity	Derived	$\alpha_T = \alpha_L /3$
Vertical dispersivity	Derived	$\alpha_V = 0.056\ \alpha_L$
Temperature of aquifer	25.0°C	Assumed Value
pH	7.30	Assumed Value
Organic carbon content	0.003	Assumed Value
Receptor distance from well	96 m	N gradient to POC

7.3 Steady-State Modeling Considerations

The MULTIMED model was used in the steady-state mode to simulate the Clint Landfill with worst case leakage from an entire active cell area with constant, non-decaying source leakage terms. However, the steady-state transport of leachate from the landfill unit through the vadose zone and the underlying aquifer to the point of compliance requires that the contaminant source is sufficiently large to ensure that the down gradient concentration, once reached, will be maintained. This assumption is not valid for the Clint Landfill given the extremely negative water balance, and the thickness of the underlying vadose formation. Furthermore, the steady-state assumptions require that the source of contamination be continuous and constant, an assumption that is also not appropriate for the Clint Landfill. The MULTIMED model documentation states that *"...If these assumptions can not be made at a particular site, inaccurate results will be produced... Steady-state models are also inappropriate when the simulation includes chemicals that sorb or transform significantly."* (Sharp-Hansen, pg. 50).

Steady-state model runs disregard the effects of the unsaturated zone altogether despite the relative depth and time of transport as compared to the real pulse term of leachate through the landfill liner system. Running the model assuming steady-state flow and transport boundary conditions forces the immediate appearance of leachate at the water table and neglects the potential attenuation effects due to adsorption, biodegradation and hydrolysis on the source concentration of the leachate load to the groundwater system. The flow field in the unsaturated zone is assumed by the model to be at a steady state. This does not accurately reflect the unsteady, pulse nature of

the system being modeled, especially since the worst case leakage rate is used to establish the flow rate through the system. The model neglects the effects of lateral and transverse advection and dispersion. Molecular diffusion of the modeled plume, particularly at the boundaries, is not accounted for by the model. Adsorption and decay of the leachate constituents is also not recognized by the MULTIMED model, as applied in accordance with the TNRCC Alternate Liner Design Handbook.

A Gaussian source term was specified for the MULTIMED models. This type of source was chosen in view of the higher concentrations resulting from the Gaussian plume distribution used to calculate the mixing zone depth and concentrations as compared to those resulting from the Patch source as included in the model. As noted above, the mixing zone depth was calculated by the program using a Gaussian distribution function.

Vertical, longitudinal and transverse dispersivities were calculated by the model. The model calculates vertical dispersivity as one-tenth the distance from the unit boundary to the POC. The transverse dispersivity was calculated as one third of the longitudinal dispersivity, or one-thirtieth the distance to the POC. Similarly, the model predicts the vertical dispersivity as 0.056 times the longitudinal dispersivity, or the distance to the POC divided by 178.57. These relationships may be restated as:

$$Longitudinal\ Dispersivity\ (\alpha_L) = 0.1\, x_r$$

$$Transverse\ Dispersivity\ (\alpha_T) = \frac{\alpha_L}{3}$$

$$Vertical\ Dispersivity\ (\alpha_V) = 0.056(\alpha_L)$$

where x_r is the distance from the edge of the landfill unit to the POC.

The model calculated the groundwater seepage velocity assuming a uniform, saturated porous medium (Darcy's assumptions) as

$$Seepage\ Velocity\ (V_s) = \frac{KS}{\theta}$$

where K is the apparent hydraulic conductivity of the aquifer, S is the aquifer hydraulic gradient and θ is the aquifer porosity. No biodegradation was assumed to be active in the model, thus the retardation factor, R_s, was assumed to be 1.0 or non-reactive.

8.0 LEACHATE COLLECTION AND MANAGEMENT SYSTEM

The leachate collection and management system is designed to ensure that the leachate head on the liner is not greater than one foot. The final leachate collection and management system consists of six main components as follows.

- Drainage layer
- Collectors (Pipes)
- Sumps, pumps, and risers
- Leachate conveyance
- Storage

PART III

ATTACHMENT 15

APPENDIX 1

HELP VERSION 3.07 OUTPUT

FOR

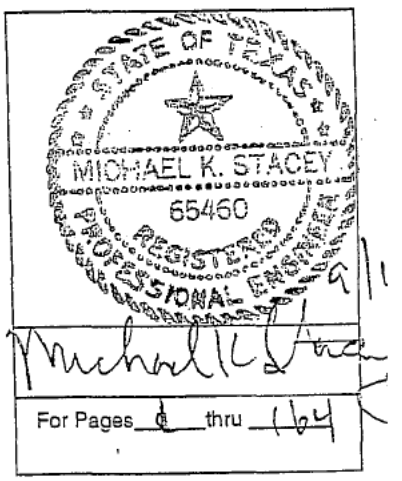
CLINT LANDFILL

PERMIT APPLICATION NO. 2284

CITY OF EL PASO

EL PASO COUNTY, TEXAS

AUGUST 2000



```
**********  **********  **********
**********************************************************************
**                                                                  **
**                                                                  **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE            **
**            HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)            **
**            DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**              USAE WATERWAYS EXPERIMENT STATION                   **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY         **
**                                                                  **
**                                                                  **
**********************************************************************
**********************************************************************

PRECIPITATION DATA FILE:     C:\HELP3\ELPASO.D4
TEMPERATURE DATA FILE:       C:\HELP3\ELPASO.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ELPASO.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ELPASO.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ELP98-1.D10
OUTPUT DATA FILE:            c:\help3\ELP98-1.OUT

TIME:  17:31     DATE:   8/28/2000

**********************************************************************

     TITLE:  Initial Lift 6" Cover 10' Waste Liner

**********************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.

                              LAYER  1
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   6
THICKNESS                        =      6.00   INCHES
POROSITY                         =      0.4530 VOL/VOL
FIELD CAPACITY                   =      0.1900 VOL/VOL
WILTING POINT                    =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT       =      0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =  0.720000011000E-03 CM/SEC

                              LAYER  2
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4530	VOL/VOL
FIELD CAPACITY	=	0.1900	VOL/VOL
WILTING POINT	=	0.0850	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1900	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03	CM/SEC

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.24	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	86.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.001	ACRES
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	7.140	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	22.848	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.820	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	29.880	INCHES
TOTAL INITIAL WATER	=	29.880	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM EL PASO TEXAS

STATION LATITUDE	=	31.80	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	66	
END OF GROWING SEASON (JULIAN DATE)	=	315	
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	40.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	27.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	46.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	48.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.38	0.45	0.32	0.19	0.24	0.56
1.60	1.21	1.42	0.73	0.33	0.39

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
44.20	48.40	55.10	63.60	71.90	80.80
82.50	80.30	74.10	63.60	51.40	44.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/I
PRECIPITATION	0.00 0.76	0.15 1.35	0.03 3.80	0.37 0.00	0.10 0.49	0.0 1.0
RUNOFF	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0 0
EVAPOTRANSPIRATION	0.301 0.204	0.241 0.481	0.242 3.850	0.219 0.934	0.209 0.452	0.1 0.5
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0 0.0

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0 0.0
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0 0.0

****

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCEI

4

PRECIPITATION	8.15	29.585	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.838	28.451	96.17
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	0.312	1.134	3.83
SOIL WATER AT START OF YEAR	29.880	108.464	
SOIL WATER AT END OF YEAR	30.192	109.598	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DE
PRECIPITATION						
TOTALS	0.00	0.15	0.03	0.37	0.10	0.03
	0.76	1.35	3.80	0.00	0.49	1.07
STD. DEVIATIONS	0.00	0.00	0.00	0.00	0.00	0.0(
	0.00	0.00	0.00	0.00	0.00	0.0(
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.0(
	0.000	0.000	0.000	0.000	0.000	0.0(
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.0(
	0.000	0.000	0.000	0.000	0.000	0.0(
EVAPOTRANSPIRATION						
TOTALS	0.301	0.241	0.242	0.219	0.209	0.1
	0.204	0.481	3.850	0.934	0.452	0.5
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.0
	0.000	0.000	0.000	0.000	0.000	0.0

45

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
	0.0000	0.0000	0.0000	0.0000	0.0000	0.00

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.15 (0.000)	29.6	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	7.838 (0.0000)	28.45	96.167
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.000	0.000
AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.312 (0.0000)	1.13	3.833

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4

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 1

	(INCHES)	(CU. FT.)
PRECIPITATION	0.88	3.194
RUNOFF	0.000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
SNOW WATER	0.10	0.3641

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2529
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1700

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47

FINAL WATER STORAGE AT END OF YEAR 1

LAYER	(INCHES)	(VOL/VOL)
1	1.3292	0.2215
2	24.1231	0.2010
3	4.5600	0.1900
4	0.0000	0.0000
5	0.1800	0.7500
SNOW WATER	0.000	

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**                                                                           *
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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                *
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 *
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    *
**                    USAE WATERWAYS EXPERIMENT STATION                      *
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               *
**                                                                           *
**                                                                           *
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PRECIPITATION DATA FILE:      C:\HELP3\ELPASO.D4
TEMPERATURE DATA FILE:        C:\HELP3\ELPASO.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\ELPASO.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\ELPASO.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\ELP98-1B.D10
OUTPUT DATA FILE:             c:\help3\ELP98-1B.OUT


TIME:  17:33     DATE:   8/28/2000


*************************************************************************  **

     TITLE:  Initial Lift 6" Cover 10' Waste Subtitle D Liner

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   6
           THICKNESS                    =      6.00   INCHES
           POROSITY                     =      0.4530 VOL/VOL
           FIELD CAPACITY               =      0.1900 VOL/VOL
           WILTING POINT                =      0.0850 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.1900 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC


                                  LAYER  2
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5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4530	VOL/VOL
FIELD CAPACITY	=	0.1900	VOL/VOL
WILTING POINT	=	0.0850	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1900	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03	CM/SEC

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	86.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.001	ACRES
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	7.140	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	22.848	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.820	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	39.948	INCHES
TOTAL INITIAL WATER	=	39.948	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM EL PASO TEXAS

STATION LATITUDE	=	31.80	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	66	
END OF GROWING SEASON (JULIAN DATE)	=	315	
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	40.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	27.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	46.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	48.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.38	0.45	0.32	0.19	0.24	0.56
1.60	1.21	1.42	0.73	0.33	0.39

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR EL PASO TEXAS

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NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
44.20	48.40	55.10	63.60	71.90	80.80
82.50	80.30	74.10	63.60	51.40	44.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/D
PRECIPITATION	0.00 0.76	0.15 1.35	0.03 3.80	0.37 0.00	0.10 0.49	0.03 1.07
RUNOFF	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0(0.0(
EVAPOTRANSPIRATION	0.301 0.204	0.241 0.481	0.242 3.850	0.219 0.934	0.209 0.452	0.19 0.51
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0(0.0(

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0 0.0
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.0 0.0

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCEN

53

PRECIPITATION	8.15	29.585	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.838	28.451	96.17
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	0.312	1.134	3.83
SOIL WATER AT START OF YEAR	39.948	145.011	
SOIL WATER AT END OF YEAR	40.260	146.145	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.00 0.76	0.15 1.35	0.03 3.80	0.37 0.00	0.10 0.49	0.03 1.07
STD. DEVIATIONS	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
RUNOFF						
TOTALS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.00 0.00
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.00 0.00
EVAPOTRANSPIRATION						
TOTALS	0.301 0.204	0.241 0.481	0.242 3.850	0.219 0.934	0.209 0.452	0.19 0.51
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.00 0.00

5

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 1

	INCHES		CU. FEET	PERCENT
PRECIPITATION	8.15	(0.000)	29.6	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	7.838	(0.0000)	28.45	96.167
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00000)	0.000	0.000(
AVERAGE HEAD ON TOP OF LAYER 4	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.312	(0.0000)	1.13	3.833

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5

PEAK DAILY VALUES FOR YEARS 1 THROUGH 1

	(INCHES)	(CU. FT.)
PRECIPITATION	0.88	3.194
RUNOFF	0.000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
SNOW WATER	0.10	0.3641

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2529
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1700

56

FINAL WATER STORAGE AT END OF YEAR 1

LAYER	(INCHES)	(VOL/VOL)
1	1.3292	0.2215
2	24.1231	0.2010
3	4.5600	0.1900
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

57

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**                                                                          *
**                                                                          *
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               *
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                *
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   *
**                    USAE WATERWAYS EXPERIMENT STATION                     *
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             *
**                                                                          *
**                                                                          *
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\ELPASO.D4
TEMPERATURE DATA FILE:        C:\HELP3\ELPASO.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\ELPASO.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\ELPASO.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\ELP98-1C.D10
OUTPUT DATA FILE:             c:\help3\ELP98-1C.OUT


TIME:  17:33     DATE:   8/28/2000


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     TITLE:  Initial Lift 6" Cover 10' Waste Alternate Liner (No GCL)

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   6
          THICKNESS                    =       6.00   INCHES
          POROSITY                     =       0.4530 VOL/VOL
          FIELD CAPACITY               =       0.1900 VOL/VOL
          WILTING POINT                =       0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT   =       0.1900 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC


                                  LAYER  2
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59

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	120.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4530	VOL/VOL
FIELD CAPACITY	=	0.1900	VOL/VOL
WILTING POINT	=	0.0850	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1900	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03	CM/SEC

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	86.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.001	ACRES
EVAPORATIVE ZONE DEPTH	=	36.0	INCHES

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INITIAL WATER IN EVAPORATIVE ZONE	=	7.140	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	.848	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.820	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	29.700	INCHES
TOTAL INITIAL WATER	=	29.700	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EL PASO TEXAS

STATION LATITUDE	=	31.80 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	66
END OF GROWING SEASON (JULIAN DATE)	=	315
EVAPORATIVE ZONE DEPTH	=	36.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	40.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	27.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	46.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	48.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.38	0.45	0.32	0.19	0.24	0.56
1.60	1.21	1.42	0.73	0.33	0.39

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
44.20	48.40	55.10	63.60	71.90	80.80
82.50	80.30	74.10	63.60	51.40	44.40

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EL PASO TEXAS
AND STATION LATITUDE = 31.80 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DE
PRECIPITATION	0.00	0.15	0.03	0.37	0.10	0.03
	0.76	1.35	3.80	0.00	0.49	1.07
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.301	0.241	0.242	0.219	0.209	0.19:
	0.204	0.481	3.850	0.934	0.452	0.51:
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
	0.0000	0.0000	0.0000	0.0000	0.0000	0.00

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

'ERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	00
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	0.00

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.15	29.585	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.838	28.451	96.17
PERC./LEAKAGE THROUGH LAYER 4	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	0.312	1.134	3.83
SOIL WATER AT START OF YEAR	31.980	116.087	
SOIL WATER AT END OF YEAR	32.292	117.221	

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SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DE
PRECIPITATION						
TOTALS	0.00	0.15	0.03	0.37	0.10	0.03
	0.76	1.35	3.80	0.00	0.49	1.07
STD. DEVIATIONS	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	0.00
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	0.00
EVAPOTRANSPIRATION						
TOTALS	0.301	0.241	0.242	0.219	0.209	0.19
	0.204	0.481	3.850	0.934	0.452	0.51
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.00
	0.000	0.000	0.000	0.000	0.000	0.00
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
	0.0000	0.0000	0.0000	0.0000	0.0000	0.00

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

6

AVERAGES	0.0000	0.0000	0.000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 1

	INCHES	CU. FEET	PERCEN
PRECIPITATION	8.15 (0.000)	29.6	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	7.838 (0.0000)	28.45	96.167
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00000 (0.00000)	0.000	0.000
AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.312 (0.0000)	1.13	3.833

****

64

PEAK DAILY VALUES FOR YEARS 1 THROUGH 1

	(INCHES)	(CU. FT.)
PRECIPITATION	0.88	3.194
RUNOFF	0.000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
SNOW WATER	0.10	0.3641

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2529
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1700

65

FINAL WATER STORAGE AT END OF YEAR 1

LAYER	(INCHES)	(VOL/VOL)
1	1.3292	0.2215
2	24.1231	0.2010
3	4.5600	0.1900
4	0.0000	0.0000
SNOW WATER	0.000	

PART III

ATTACHMENT 15

APPENDIX 2

MULTIMED 2.0 OUTPUT

FOR

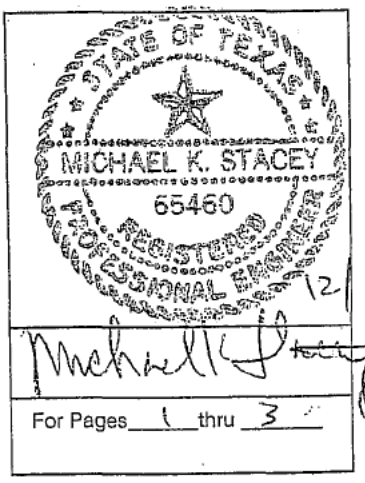
CLINT LANDFILL

PERMIT APPLICATION NO. 2284

CITY OF EL PASO

El PASO COUNTY, TEXAS

~~NOVEMBER~~ DECEMBER 2000



1

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED - (Version 2.00 Beta - October 1996)

1
Run options
--- -------

El Paso 1999 Site, Steady State, q=4.27e-6 m/yr

POC to the North, for entire landfill
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user
Run was steady-state
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1

STATE OF TEXAS
MICHAEL K. STACEY
65460
REGISTERED
ENGINEER
12/6/00

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	0.000	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.427E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.906E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	20.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	549.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	716.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

(2)

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	0.100E-06	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.00	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	90.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	92.0	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	318.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.880E-04	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	0.000	100.
pH	--	CONSTANT	7.30	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	96.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3817E-02

ATTACHMENT III.C.3 – HELP MODELING

BURNS McDONNELL

MSW AUTH NO. 2284A

ATTACHMENT III.C.3 – HELP MODELING

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 1
MAY 16, 2025

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SCENARIO 1 – OPEN CONDITION HELP MODEL OUTPUT
SCENARIO 2 – INTERMEDIATE COVER CONDITION HELP MODEL OUTPUT
SCENARIO 3A – FINAL COVER CONDITION (SIDESLOPES) HELP MODEL OUTPUT
SCENARIO 3B – FINAL COVER CONDITION (CROWN) HELP MODEL OUTPUT

TABLES

Table III.C.3-1: Summary of HELP Model Inputs and Results 72

List of Abbreviations

Abbreviation	Term/Phrase/Name
GCL	Geosynthetic Clay Liner
Gpm	gallons per minute
HDPE	high density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
TAC	Texas Administrative Code
USDA	U.S. Department of Agriculture

III.C.3.1.0 Introduction

The primary analysis method used for the landfill water balance analysis is the Hydrologic Evaluation of Landfill Performance (HELP) Model, version 4.0.1.

The HELP Model is a quasi-two-dimensional hydrogeologic water balance model developed specifically to perform hazardous and municipal waste landfill evaluations. The model requires weather, soil, and design data that are representative of the landfill location and design. It utilizes solution techniques that account for the effects of surface storage, snow melt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembrane, or composite liners.

The model can be used to evaluate various combinations of vegetation, cover soils, waste cells, lateral drainage layers, low permeability barrier soils, and synthetic geomembrane liners. The model provides estimates of the amount of runoff, evapotranspiration, drainage, leachate collection, and barrier soil and liner leakage that may be expected based on the design model case.

III.C.3.2.0 Design Criteria

The HELP Model requires climatological, vegetative, soil, and design data specific to the landfill site. The following sections document the basis for data selection, including assumptions, and the layer profiles used in the HELP Model analyses.

III.C.3.2.1 Climatological Data

The required climatological data for the HELP Model includes daily precipitation values, mean monthly temperatures, and solar radiation representative of the landfill site. These values were synthetically generated by the program and were simulated for 30 years. The HELP model synthetic weather generator is based on a routine developed by the U.S. Department of Agricultura (USDA) Agricultural Research Service. Weather parameter values used in the synthetic generator are imported from a database of calculated weather parameters for over 13,000 points located on a 0.25 by 0.25 degree grid across the continental United States developed by the Environmental Protection Agency's Office of Pesticide Programs using two NOAA data products. The program retrieves parameter values from the closest grid point in the dataset based on the latitude and longitude specified for the landfill location.

III.C.3.2.2 Landfill Development

Three stages of landfill development were evaluated to calculate leachate generation rates. The three stages include:

Stage 1 – Active filling. The first stage of landfill development is after the initial 10-foot-thick lift of waste has been placed in the cell.

Stage 2 – Intermediate cover. The second stage of landfill development represents areas that have reached intermediate grades and intermediate cover soils have been placed over the waste. Intermediate waste thicknesses were assumed to be 197-feet-thick, which represents the maximum depth of waste for the areas at intermediate grades.

Stage 3 – Final cover. The final stage of landfill development is when an area has reached final grade and receives its final cover. Two final cover scenarios were run based on varying slopes and their associated infiltration potential. One scenario assessed the side slopes of the landfill (Scenario 3A, 4:1 slope), and one scenario assessed the crown of the landfill (Scenario 3B, 5 percent slope).

III.C.3.2.3 Landfill Design

III.C.3.2.3.1 Final Cover Design

The final cover system includes the following components (from top to bottom):

- 4-inch rock armor layer
- Non-woven geotextile
- 18-inch infiltration layer
- 6-inch base layer
- 12-inch interim and daily cover layer

III.C.3.2.3.2 Liner Design

The composite liner system includes the following components (from top to bottom):

- 24-inch protective cover layer
- Geonet geocomposite drainage layer
- 60-mil high density polyethylene (HDPE) geomembrane liner
- Geosynthetic Clay Liner (GCL)

III.C.3.2.3.3 Additional Design Assumptions

The following additional assumptions were used for the HELP Model analyses:

- Evaporative zone depth of 24 inches.
- SCS runoff curve numbers were determined by the program based on default soil data, vegetative cover, and surface slope.
- The default growing period was used for the landfill location.
- Maximum leaf area index of 0 for bare ground.
- Default soil characteristics were used for total porosity, field capacity, and wilting point.
- Geomembrane placement was assumed to be good with four installation defects per acre and four material defects per acre.

III.C.3.3.0 Results

III.C.3.3.1 Hydraulic Head on Liner

The maximum allowable height of free-standing liquid over the liner in the fill area must not exceed 30 centimeters (approximately 12 inches) pursuant to Chapter 30 Texas Administrative Code (TAC) §330.331(a)(2). The HELP Model was used to calculate the maximum daily hydraulic head over the liner system for each stage of landfill development. The model calculates the depth of the hydraulic head on the liner as a function of the drainage slope, slope length, permeability of the drainage material.

The cell design criteria for each scenario, as summarized in **Table III.C.3-1**, were input into the model. Stage 1 was modeled for 10 years since this represents a conservative time period for active fill conditions. Stage 2 (intermediate slopes) was modeled for 20 years. Stages 3A and 3B (final cover) were modeled for 30 years to evaluate the post-closure care time period scenario. The peak daily hydraulic head depth over the liner for each development stage is shown in **Table III.C.3-1**.

The regulatory requirement was met for each scenario. Each scenario maintains less than 30 centimeters (approximately 12 inches) of head on the liner system.

Table III.C.3-1: Summary of HELP Model Inputs and Results

Design Information		Scenario			
		1	2	3A	3B
General	Landfill Development Stage	Open Condition (Daily Cover)	Intermediate Cover Condition	Final Cover Condition (Sideslopes)	Final Cover Condition (Crown)
Cover System Components	4-Inch-Thick Rock Cover	N/A	N/A	✓	✓
	18-Inch-Thick Infiltration Layer	N/A	N/A	✓	✓
	6-Inch-Thick Base Layer	N/A	N/A	✓	✓
	Interim and Daily Cover Layer	6 Inches	12 Inches	12 Inches	12 Inches
	SCS Runoff Curve Number	75.3	75.3	73.9	69.5
Waste Depth (Feet)		10	197	197	197
Liner System Components	Protective Cover (Drainage Layer) Thickness	2-Feet	2-Feet	2-Feet	2-Feet
	Protective Cover (Drainage Layer) Permeability (cm/s)	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$
	Geonet Geocomposite	✓	✓	✓	✓
	Drainage Layer Flow Length (Feet)	260	260	260	260
	Drainage Layer Slope (%)	2%	2%	2%	2%
	60-mil HDPE Geomembrane	✓	✓	✓	✓
	Geosynthetic Clay Liner	✓	✓	✓	✓
Evapotranspiration Data	Evaporative Zone Depth (Inches)	24	24	24	24
	Maximum Leaf Area Index	0	0	0	0
	Vegetative Cover	1.0 (Bare Ground)	1.0 (Bare Ground)	1.0 (Bare Ground)	1.0 (Bare Ground)
Results	Maximum Head (Inches)	0.00	0.00	0.00	0.00
	Peak Daily Leachate Collected (Gal/Acre)	0.00	0.00	0.00	0.00
	Average Annual Leachate Collected (Gal/Acre)	0.00	0.00	0.00	0.00

SCENARIO 1 – OPEN CONDITION HELP MODEL OUTPUT



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill - Open Condition **Simulated On:** 1/11/2024 15:04

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
Daily Cover
Material Texture Number 45

Thickness	=	6	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	120	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
Drainage Layer
Material Texture Number 44

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Geonet Geocomposite

Material Texture Number 43

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 5

Type 4 - Flexible Membrane Liner

HDPE Membrane

Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 6

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	97	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches
Initial Water in Evaporative Zone	=	4.74	inches
Upper Limit of Evaporative Storage	=	14.796	inches
Lower Limit of Evaporative Storage	=	1.896	inches
Initial Snow Water	=	0	inches

Initial Water in Layer Materials	=	29.882	inches
Total Initial Water	=	29.882	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days
End of Growing Season (Julian Date)	=	315	days
Average Wind Speed	=	9.2	mph
Average 1st Quarter Relative Humidity	=	40	%
Average 2nd Quarter Relative Humidity	=	27	%
Average 3rd Quarter Relative Humidity	=	46	%
Average 4th Quarter Relative Humidity	=	48	%

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.534581	0.490989	0.256844	0.185036	0.391841	0.962971
1.986818	2.158113	1.760566	0.591161	0.414942	0.617085

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
54.4	55.8	64.2	72.6	81	88.2
92.2	89.8	83.5	73.8	64	56.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Average Annual Totals Summary

Title: GEP Landfill - Open Condition
Simulated on: 1/11/2024 15:08

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	10.70	[1.96]	38,856.5	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	10.682	[1.683]	38,775.8	99.79
Subprofile1				
Lateral drainage collected from Layer 4	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 6	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 5	0.0000	[0]	---	---
Water storage				
Change in water storage	0.0222	[0.5374]	80.7	0.21

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill - Open Condition
Simulated on: 1/11/2024 15:08

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	1.75		6,350.9
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 4	0.0000		0.0000
Percolation/leakage through Layer 6	0.000000		0.0000
Average head on Layer 5	0.0000		---
Maximum head on Layer 5	0.0000		---
Location of maximum head in Layer 4	0.00	(feet from drain)	
Other Parameters			
Snow water	0.5645		2,049.1
Maximum vegetation soil water	0.2621	(vol/vol)	
Minimum vegetation soil water	0.1442	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill - Open Condition
Simulated on: 1/11/2024 15:09
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.0820	0.1803
2	24.2804	0.2023
3	4.5600	0.1900
4	0.0024	0.0100
5	0.0000	0.0000
6	0.1800	0.7500
Snow water	0.0000	---

SCENARIO 2 – INTERMEDIATE COVER CONDITION HELP MODEL OUTPUT



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill - Int. Cover **Simulated On:** 1/11/2024 15:11

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
Intermediate Cover
Material Texture Number 45

Thickness	=	12	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	2364	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
Drainage Layer
Material Texture Number 44

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Geonet Geocomposite

Material Texture Number 43

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 5

Type 4 - Flexible Membrane Liner

HDPE Membrane

Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 6

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	97	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches
Initial Water in Evaporative Zone	=	4.68	inches
Upper Limit of Evaporative Storage	=	13.488	inches
Lower Limit of Evaporative Storage	=	1.944	inches
Initial Snow Water	=	0	inches

Initial Water in Layer Materials	=	479.822	inches
Total Initial Water	=	479.822	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days
End of Growing Season (Julian Date)	=	315	days
Average Wind Speed	=	9.2	mph
Average 1st Quarter Relative Humidity	=	40	%
Average 2nd Quarter Relative Humidity	=	27	%
Average 3rd Quarter Relative Humidity	=	46	%
Average 4th Quarter Relative Humidity	=	48	%

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.396332	0.374491	0.23155	0.258364	0.310414	0.753763
2.058051	2.09888	1.738273	0.673355	0.474463	0.805184

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
56.5	56.9	63.6	70.8	83.2	89.3
92.1	90.6	81.5	75.5	65	58.8

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Average Annual Totals Summary

Title: GEP Landfill - Int. Cover
Simulated on: 1/11/2024 15:15

	Average Annual Totals for Years 1 - 20*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	9.97	[1.5]	36,190.1	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	9.868	[1.651]	35,819.2	98.98
Subprofile1				
Lateral drainage collected from Layer 4	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 6	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 5	0.0000	[0]	---	---
Water storage				
Change in water storage	0.1022	[0.4813]	370.8	1.02

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill - Int. Cover
Simulated on: 1/11/2024 15:15

	Peak Values for Years 1 - 20*		
	(inches)		(cubic feet)
Precipitation	1.41		5,111.8
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 4	0.0000		0.0000
Percolation/leakage through Layer 6	0.000000		0.0000
Average head on Layer 5	0.0000		---
Maximum head on Layer 5	0.0000		---
Location of maximum head in Layer 4	0.00	(feet from drain)	
Other Parameters			
Snow water	0.7530		2,733.4
Maximum vegetation soil water	0.2704	(vol/vol)	
Minimum vegetation soil water	0.1501	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill - Int. Cover
Simulated on: 1/11/2024 15:16
Simulation period: 20 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	3.0874	0.2573
2	474.0357	0.2005
3	4.5600	0.1900
4	0.0024	0.0100
5	0.0000	0.0000
6	0.1800	0.7500
Snow water	0.0000	---

SCENARIO 3A – FINAL COVER CONDITION (SIDESLOPES)
HELP MODEL OUTPUT



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill-Final Cover Side **Simulated On:** 1/11/2024 15:18

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
G - Gravel
Material Texture Number 21

Thickness	=	4	inches
Porosity	=	0.397	vol/vol
Field Capacity	=	0.032	vol/vol
Wilting Point	=	0.013	vol/vol
Initial Soil Water Content	=	0.013	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-01	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer
Infiltration Layer
Material Texture Number 45

Thickness	=	18	inches
Porosity	=	0.34	vol/vol
Field Capacity	=	0.083	vol/vol
Wilting Point	=	0.057	vol/vol
Initial Soil Water Content	=	0.061	vol/vol
Effective Sat. Hyd. Conductivity	=	1.30E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
Base Layer
Material Texture Number 44

Thickness	=	6	inches
Porosity	=	0.34	vol/vol
Field Capacity	=	0.083	vol/vol
Wilting Point	=	0.057	vol/vol
Initial Soil Water Content	=	0.062	vol/vol
Effective Sat. Hyd. Conductivity	=	6.60E-03	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer
Intermediate Cover

Material Texture Number 47

Thickness	=	12	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	2364	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

Drainage Layer

Material Texture Number 46

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 7

Type 2 - Lateral Drainage Layer

Geonet Geocomposite

Material Texture Number 43

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 8

Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 9
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	73.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches
Initial Water in Evaporative Zone	=	1.274	inches
Upper Limit of Evaporative Storage	=	8.388	inches
Lower Limit of Evaporative Storage	=	1.192	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	481.344	inches
Total Initial Water	=	481.344	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days

End of Growing Season (Julian Date)	=	315 days
Average Wind Speed	=	9.2 mph
Average 1st Quarter Relative Humidity	=	40 %
Average 2nd Quarter Relative Humidity	=	27 %
Average 3rd Quarter Relative Humidity	=	46 %
Average 4th Quarter Relative Humidity	=	48 %

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.389199	0.560636	0.298795	0.170173	0.406434	0.840774
2.233709	1.776433	1.694243	0.669587	0.455754	0.670554

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
50.5	55.4	63.5	73.9	83.6	88.9
90.1	90.9	84.9	76.1	63.3	58.3

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Average Annual Totals Summary

Title: GEP Landfill-Final Cover Side
Simulated on: 1/11/2024 15:21

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	10.17	[1.94]	36,903.6	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	7.255	[1.353]	26,335.9	71.36
Subprofile1				
Lateral drainage collected from Layer 7	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 9	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 8	0.0000	[0]	---	---
Water storage				
Change in water storage	2.9112	[0.6913]	10,567.8	28.64

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill-Final Cover Side
Simulated on: 1/11/2024 15:22

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	1.47		5,323.1
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 7	0.0000		0.0000
Percolation/leakage through Layer 9	0.000000		0.0000
Average head on Layer 8	0.0000		---
Maximum head on Layer 8	0.0000		---
Location of maximum head in Layer 7	0.00	(feet from drain)	
Other Parameters			
Snow water	0.4930		1,789.4
Maximum vegetation soil water	0.1307	(vol/vol)	
Minimum vegetation soil water	0.0497	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill-Final Cover Side
Simulated on: 1/11/2024 15:22
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	0.1489	0.0372
2	-1.5868	-0.0882
3	4.5902	0.7650
4	2.8127	0.2344
5	558.6877	0.2363
6	4.5600	0.1900
7	0.0024	0.0100
8	0.0000	0.0000
9	0.1800	0.7500
Snow water	0.0000	---

SCENARIO 3B – FINAL COVER CONDITION (CROWN) HELP MODEL OUTPUT



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill-Final Cover Crown **Simulated On:** 1/11/2024 15:24

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)

G - Gravel

Material Texture Number 21

Thickness	=	4	inches
Porosity	=	0.397	vol/vol
Field Capacity	=	0.032	vol/vol
Wilting Point	=	0.013	vol/vol
Initial Soil Water Content	=	0.013	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-01	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer

Infiltration Layer

Material Texture Number 43

Thickness	=	18	inches
Porosity	=	0.34	vol/vol
Field Capacity	=	0.083	vol/vol
Wilting Point	=	0.057	vol/vol
Initial Soil Water Content	=	0.061	vol/vol
Effective Sat. Hyd. Conductivity	=	1.30E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer

Base Layer

Material Texture Number 44

Thickness	=	6	inches
Porosity	=	0.34	vol/vol
Field Capacity	=	0.083	vol/vol
Wilting Point	=	0.057	vol/vol
Initial Soil Water Content	=	0.062	vol/vol
Effective Sat. Hyd. Conductivity	=	6.60E-03	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer

Intermediate Cover

Material Texture Number 47

Thickness	=	12	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	2364	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer
Drainage Layer
Material Texture Number 46

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 7

Type 2 - Lateral Drainage Layer
Geonet Geocomposite
Material Texture Number 45

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 8

Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 9
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	69.5	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches
Initial Water in Evaporative Zone	=	1.274	inches
Upper Limit of Evaporative Storage	=	8.388	inches
Lower Limit of Evaporative Storage	=	1.192	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	481.344	inches
Total Initial Water	=	481.344	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days

End of Growing Season (Julian Date)	=	315 days
Average Wind Speed	=	9.2 mph
Average 1st Quarter Relative Humidity	=	40 %
Average 2nd Quarter Relative Humidity	=	27 %
Average 3rd Quarter Relative Humidity	=	46 %
Average 4th Quarter Relative Humidity	=	48 %

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.538454	0.454232	0.225889	0.209983	0.455077	0.871666
1.882752	2.183845	1.933728	0.570373	0.462221	0.666975

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
54.3	54.9	65.1	71.3	81.5	88.9
93	88.4	83.6	76	65	56.2

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 31.63/-106.16

Average Annual Totals Summary

Title: GEP Landfill-Final Cover Crown
Simulated on: 1/11/2024 15:25

	Average Annual Totals for Years 1 - 30*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	10.46	[1.82]	37,952.4	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	7.451	[1.247]	27,046.2	71.26
Subprofile1				
Lateral drainage collected from Layer 7	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 9	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 8	0.0000	[0]	---	---
Water storage				
Change in water storage	3.0045	[0.6928]	10,906.2	28.74

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill-Final Cover Crown
Simulated on: 1/11/2024 15:25

	Peak Values for Years 1 - 30*		
	(inches)		(cubic feet)
Precipitation	1.75		6,350.9
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 7	0.0000		0.0000
Percolation/leakage through Layer 9	0.000000		0.0000
Average head on Layer 8	0.0000		---
Maximum head on Layer 8	0.0000		---
Location of maximum head in Layer 7	0.00	(feet from drain)	
Other Parameters			
Snow water	0.5837		2,118.9
Maximum vegetation soil water	0.1422	(vol/vol)	
Minimum vegetation soil water	0.0497	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill-Final Cover Crown
Simulated on: 1/11/2024 15:26
Simulation period: 30 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	0.0520	0.0130
2	-1.5104	-0.0839
3	4.5042	0.7507
4	2.9850	0.2488
5	561.3970	0.2375
6	4.5600	0.1900
7	0.0024	0.0100
8	0.0000	0.0000
9	0.1800	0.7500
Snow water	0.0000	---

ATTACHMENT III.C.4 – PIPE STRENGTH CALCULATIONS



Pipe Strength Calculations Completed by: EGC Date: 2/21/2025
Greater El Paso Landfill Major Permit Amendment

Calculation 1: Evaluate earth and live loads on leachate collection piping to determine:
a. Ring Deflection
b. Compressive Ring Thrust
c. Constrained (Buried) Pipe Wall Buckling

Approach: Use formulas for "Standard Installation - Trench or Embankment" provided in The Plastics Pipe Institute Handbook of Polyethylene Pipe, 2nd Addition, 2008.

Proposed Pipe: 6" Dia. SDR 11 HDPE

1.a. Ring Deflection Calculation

Use Spangler's Modified Iowa Formula

Design Criteria:

Recommended Maximum Deflection	5.0%	PPI, pg 218
Allowable Deflection	7.5%	PPI, pg 218

Step 1: Determine Deflection [ΔX/D$_M$]:

PPI, Equation 3-10, pg 211

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{K_{BED}L_{DL}P_E + K_{BED}P_L}{\frac{2E}{3}\left(\frac{1}{DR-1}\right)^3 + 0.061F_S E'}\right)$$

Input Variables:	Value	Units	Source	Notes
Outside Diameter [OD] =	6.625	in	ISCO	
Pipe Bedding Factor [K_{BED}] =	0.1		PPI, pg 211	
Deflection Lag Factor [L_{DL}] =	1		PPI, pg 212	
Pipe Mod of Elasticity [E] =	65,000	psi	PPI, Table B.1.1, pg 99	10 hour loading. Note that material designation code PE 4710 was assumed.
Soil Mod of Reaction [E'] =	3,000	psi	PPI, Table 3-7, pg 214	Crushed rock, mod comp (85 to 95% Proctor)
Waste Depth [W_D] =	0	ft		
Waste Density [W_{DEN}] =	50	pcf		
Sand Depth [S_D] =	0	ft		
Sand Density [S_{DEN}] =	125	pcf		
Aggregate Depth [A_D] =	2	ft		
Aggregate Density [A_{DEN}] =	150	pcf		
Vertical Soil Pressure Due to Earth Load [P_E]	**300**	**psf**		
Vertical Soil Pressure Due to Earth Load [P_E]	**2.08**	**psi**		
Soil Support Factor [F_S]	1		PPI, Table 3-10, pg 216	B_d = 18" D_o = 6.625" (B_d/D_o=2.7); E'$_N$ = 3,000 psi (slightly compact); E'$_N$/E'=1; F_S=1.0
Mean Diameter [D_M]	6.235	in	ISCO	
Dimension Ratio [DR]	17			

Equipment	F250	289D	D5	D5 LGP	316	
Vertical Soil Pressure Due to Live Load [P_L] (psf)	**434**	**696**	**1038**	**914**	**1680**	See Calculation 2
Vertical Soil Pressure Due to Live Load [P_L] (psi)	**3.01**	**4.83**	**7.21**	**6.35**	**11.66**	
Deflection % [ΔX/DM*100]	**0.26%**	**0.36%**	**0.48%**	**0.44%**	**0.71%**	
Δ X (inch)	**0.02**	**0.02**	**0.03**	**0.03**	**0.04**	
Acceptable per Recommended Max. Deflection?	**YES**	**YES**	**YES**	**YES**	**YES**	
Acceptable per Allowable Max. Deflection?	**YES**	**YES**	**YES**	**YES**	**YES**	

1.b. Compressive Ring Thrust Calculation

Design Criteria:

Maximum Allowable Compressive Stress	1150 psi	PPI, Table C.1, pg 102 for PE 4710 pipe

Step 1: Determine Compressive Stress [S]:

PPI, Equation 3-13, pg 219

$$S = \frac{(P_E + P_L)DR}{288}$$

Equipment	F250	289D	D5	D5 LGP	316	
Vertical Soil Pressure Due to Live Load [P_L] (psf)	**434**	**696**	**1038**	**914**	**1680**	See Calculation 2
Vertical Soil Pressure Due to Live Load [P_L] (psi)	**3.01**	**4.83**	**7.21**	**6.35**	**11.66**	
Compressive Stress [S] (lb/in^2)	**43**	**59**	**79**	**72**	**117**	

Pipe Strength Calculations Completed by: EGC Date: 2/21/2025

Greater El Paso Landfill Major Permit Amendment

Max Allowable (lb/in^2)	**1150**	**1150**	**1150**	**1150**	**1150**
Acceptable per Allowable Stress?	**YES**	**YES**	**YES**	**YES**	**YES**

1.c. Constrained (Buried) Pipe Wall Buckling

Design Criteria:

Allowable Constrained Buckling Pressure (P_{WC}) is greater than Earth Pressure (P_E) plus Live Load Pressure (P_L) with a Factor of Safety (N) against buckling of 2.

Use the following equations:

Step 1: Determine Allowable Constrained Buckling Pressure (P_{WC}):

PPI, Equation 3-15, pg 221

$$P_{WC} = \frac{5.6}{N}\sqrt{RB\,E\,\frac{E}{12(DR-1)^3}}$$

Step 2: Determine Buoyancy Reduction Factor (R):

PPI, Equation 3-17, pg 222

$$R = 1 - 0.33\frac{H_{GW}}{H}$$

Step 3: Determine B':

PPI, Equation 3-18, pg 222

$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

Input Variables:	Value	Units	Source	Notes
Safety Factor [N]	2		PPI, pg 222	
Pipe Mod of Elasticity [E] =	65,000	psi	PPI, Table B.1.1, pg 99	10 hour loading. Note that material designation code PE 4710 was assumed.
Soil Mod of Reaction [E'] =	3,000	psi	PPI, Table 3-7, pg 214	Crushed rock, mod comp (85 to 95% Proctor)
Dimension Ratio [DR]	17			
Natural Log Base Number [e] =	2.71828			
Height of Groundwater Above Pipe [H_{GW}] =	0.5	ft	Assumed if 1 ft of head on liner	
Depth of Cover [H] =	2.0	ft	2' aggregate	
Buoyancy Reduction Factor [R] =	**0.92**		**Calculated**	
B'	**0.2216**		**Calculated**	
Allowable Constrained Buckling Pressure [P_{WC}] =	**80.2**	**psi**	**Calculated**	
Earth Pressure [P_E]	**2.08**	**psi**		

Live Load Pressure [P_L]

Equipment	F250	289D	D5	D5 LGP	316
Vertical Soil Pressure Due to Live Load [P_L] (psf)	**434**	**696**	**1038**	**914**	**1680**
Vertical Soil Pressure Due to Live Load [P_L] (psi)	**3.01**	**4.83**	**7.21**	**6.35**	**11.66**
Earth Pressure [P_E] + Live Load Pressure [P_L]	**5.10**	**6.92**	**9.30**	**8.43**	**13.75**
Allowable Constrained Buckling Pressure [P_{WC}] =	**80.2**	**80.2**	**80.2**	**80.2**	**80.2**
Is P_{WC} less than [P_E+P_L]?	**YES**	**YES**	**YES**	**YES**	**YES**

Pipe Strength Calculations Completed by: EGC Date: 2/21/2025
Greater El Paso Landfill Major Permit Amendment

Calculation 2: Determine live loads on leachate collection piping from typical construction equipment.

Approach: Use formulas provided in The Plastics Pipe Institute Handbook of Polyethylene Pipe, 2nd Addition, 2008.

2. Live Load Calculation

Step 1: Determine Vertical Soil Pressure Due to Live Load [P_L]:

PPI, Equation 3-2, pg 202

$$P_L = \frac{I_f W_w}{a_C}\left(1 - \frac{H^3}{\left(r_T{}^2 + H^2\right)^{1.5}}\right)$$

Input Variables:	Value	Units	Source	Notes
Impact factor [I_f]	2		PPI, pg 199, unpaved surface	
Wheel load [W_w]	see below	lb		
Contact area [a_C]	see below	sf		
Equivalent radius [r_T]	see below	ft		

PPI, Equation 3-3, pg 202

$$r_T = \sqrt{\frac{a_C}{\pi}}$$

Depth of cover (H)	2	ft	2' aggregate	

Equipment types:	**Wheel load (W_w) (lb)**	**Contact area (a_C) (sf)**	**Equivalent radius (r_T) (ft)**	**P_L (psf)**
Ford F250 [(1)]	2000	1	0.6	434
Caterpillar 289 D Skid Steer [(2)]	5300	7.9	1.6	696
Caterpillar D5 Dozer [(3)]	10157	12.7	2.0	1038
Caterpillar D5 Dozer LGP [(3)]	10496	16.4	2.3	914
Caterpiller 316 Excavator [(4)]	19515	16.7	2.3	1680

Sources:
(1) https://www.ford.com/trucks/super-duty/2017/models/f250-xl/
(2) http://www.cat.com/en_US/products/new/equipment/compact-track-and-multi-terrain-loaders/compact-track-loaders/18484366.html
(3) http://www.cat.com/en_US/products/new/equipment/dozers/small-dozers/1000001276.html
(4) http://www.cat.com/en_US/products/new/equipment/excavators/small-excavators/1000026572.html

Pipe Strength Calculations Completed by: EGC Date: 2/21/2025
Greater El Paso Landfill Major Permit Amendment

Calculation 3: Evaluate earth loads on leachate collection piping to determine:
a. Ring Deflection
b. Compressive Ring Thrust
c. Constrained (Buried) Pipe Wall Buckling

Approach: Use formulas for "Deep Fill Installation" provided in The Plastics Pipe Institute Handbook of Polyethylene Pipe, 2nd Addition, 2008.

3.a. Ring Deflection Calculation

Watkins-Gaube Graph

Design Criteria:		
Recommended Maximum Deflection	5.0%	PPI, pg 218
Allowable Deflection	7.5%	PPI, pg 218

Use the following equations:

Step 1: Determine Rigidity Factor [R_F]:

PPI, Equation 3-24, pg 230

$$R_f = \frac{12E_s(DR-1)^3}{E}$$

Step 2: Determine Secant Modulus of the Soil [E_s]:

PPI, Equation 3-26, pg 230

$$E_s = M_s \frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

Step 3: Determine Soil Strain [ε_s]:

PPI, Equation 3-27, pg 231

$$\varepsilon_s = \frac{wH}{144 \quad E_s}$$

Step 4: Determine Percent Deflection [$\Delta X/D_M$]:

PPI, Equation 3-28, pg 231

$$\frac{\Delta X}{D_M}(100) = D_f \varepsilon_s$$

Input Variables:	Value	Units	Source	Notes
Dimension Ration [DR] =	17		Design factor	
Pipe Mod of Elasticity [E] =	29,000	psi	PPI, Table B.1.1, pg 99	50 year loading. Note that material designatio
Soil Modulus [M_s] =	3,200	psi	PPI, Table 3-12, pg 228	Vertical soil stress of 100 psi, 90% Std. Procto
Poisson's Ratio [μ] =	0.3		PPI, Table 3-13, pg 230	Assumed based on Sand (Dense)
Rigidity Factor [R_f] =	**4,029**		**Calculated**	
Secant Modulus of Soil [E_s] =	**2,377**	**psi**	**Calculated**	

Pipe Strength Calculations Completed by: EGC Date: 2/21/2025

Greater El Paso Landfill Major Permit Amendment

Final Cover Depth [F_D] =	3.33	ft	Final Cover layers are combined
Final Cover Density [F_{DEN}] =	125	pcf	
Waste Depth [W_D] =	197	ft	Max. waste thickness for complete expansion area
Waste Density [W_{DEN}] =	50	pcf	Waste density based on site-specific AUF calculation
Sand Depth. [S_D] =	0	ft	
Sand Density [S_{DEN}] =	125	pcf	
Aggregate Depth [A_D] =	2	ft	
Aggregate Density [A_{DEN}] =	150	pcf	
Soil Strain [ε_S] =	**3.09**	**percent**	**Calculated**
Deformation Factor [D_F] =	1.6		PPI, Figure 3-6, pg 231
Mean Diameter [D_M]	6.235	in	ISCO
Percent Deflection [$\Delta X/D_M*100$]	**4.94**	**percent**	**Calculated**

Is Percent Deflection less than Recommended Max Deflection of 5%? ***YES***

Is Percent Deflection less than Allowable Max Deflection of 7.5%? ***YES***

Total Deflection [ΔX] **0.31 in** **Calculated**

3.b. Compressive Ring Thrust Calculation

Design Criteria:

Maximum Allowable Compressive Stress 1150 psi

PPI, Table C.1, pg 102 for PE 4710 pipe

Use the following equations:

Step 1: Determine Vertical Arching Factor [VAF]:

PPI, Equation 3-21, pg 227

$$VAF = 0.88 - 0.71\frac{S_A - 1}{S_A + 2.5}$$

Step 2: Determine Hoop Thrust Stiffness Ratio [S_A]:

PPI, Equation 3-22, pg 227

$$S_A = \frac{1.43 M_S r_{cent}}{EA}$$

Step 3: Determine Radial Directed Earth Pressure [P_{RD}]:

PPI, Equation 3-23, pg 228

$$P_{RD} = (VAF)wH$$

Step 4: Determine Compressive Stress [S]:

PPI, Equation 3-13, pg 219

$$S = \frac{P_{RD}\ DR}{288}$$

Pipe Strength Calculations Completed by: EGC Date: 2/21/2025
Greater El Paso Landfill Major Permit Amendment

Input Variables:	Value	Units	Source	Notes
Dimension Ration [DR] =	17		Design factor	
Pipe Mod of Elasticity [E] =	29,000	psi	PPI, Table B.1.1, pg 99	50 year loading. Note that material designation code PE 4710 was assumed.
Soil Modulus [M_s] =	3,200	psi	PPI, Table 3-12, pg 228	Vertical soil stress of 100 psi, 90% Std. Proctor
Radius to Centroid Axis of Pipe [r_{cent}] =	3.313	in	ISCO	
Wall Thickness [A] =	0.390	in	ISCO	
Hoop Thrust Stiffness Ratio [S_A] =	**1.340**		**Calculated**	
Vertical Arching Factor [VAF] =	**0.817**		**Calculated**	
Final Cover Depth [FD] =	3.33	ft	Final Cover layers are combined	
Final Cover Density [FDEN] =	125	pcf		
Waste Depth [WD] =	197	ft	Max. waste thickness for complete expansion area	
Waste Density [WDEN] =	50	pcf		
Sand Depth [SD] =	0	ft		
Sand Density [SDEN] =	125	pcf		
Aggregate Depth [AD] =	2	ft		
Aggregate Density [ADEN] =	150	pcf		
Radial Earth Pressure [P_{RD}] =	**8,634**	**psf**	**Calculated**	
	60.0	**psi**	**Calculated**	
Compressive Stress [S] =	**509.6**	**psi**	**Calculated**	

Is Compressive Stress less than Allowable Compressive Stress of 1,150 psi? ***YES***

3.c. Constrained (Buried) Pipe Wall Buckling

Design Criteria:

Factor of Safety against buckling: Greater than 2 PPI, pg 222

Use the following equations:

Step 1: Determine Critical Constrained Buckling Pressure [P_{CR}]:

PPI, Equation 3-29, pg 233

$$P_{CR} = \frac{2.4 \phi R_H (EI)^{\frac{1}{3}} (E_S^*)^{\frac{2}{3}}}{D_M}$$

Step 2: Determine [E^*_S]:

PPI, Equation 3-29 (notes), pg 233

$$E^*_S = \frac{E_S}{(1 - \mu)}$$

Input Variables:	Value	Units	Source	Notes
Calibration Factor [Φ] =	0.55		PPI, pg 233	for granular soils
Geometry Factor [R_H] =	1.0		PPI, pg 233	uniform fill
Pipe Mod of Elasticity [E] =	29,000	psi	PPI, Table B.1.1, pg 99	50 year loading. Note that material designation code PE 4710 was assumed.
Pipe Wall Moment of Inertia [I]	0.005	in^3	ISCO	$I = t^3/12$; where t = wall thick (0.390 in for 6" SDR 17 pipe)

Pipe Strength Calculations

Completed by: EGC Date: 2/21/2025

Greater El Paso Landfill Major Permit Amendment

Poisson's Ratio [μ] =	0.3	PPI, Table 3-13, pg 230	Assumed based on Sand (Dense)
Mean Diameter [D_M]	6.235 in	ISCO	
Secant Modulus of Soil [E_s] =	**2,377 psi**	**Calculated**	
E^*_S	**3,396 psi**	**Calculated**	
Critical Constrained Buckling Pressure [P_{CR}] =	**250.3 psi**	**Calculated**	
Safety Factor Against Buckling	**4.18**	**Calculated**	**SF = P_{CR}/P_{RD}**
Is Safety Factor against buckling greater than 2?			***YES***

ATTACHMENT III.C.5 – HISTORICAL SUMP CAPACITY CALCULATIONS

(Excerpt from Permit No. 2284, Attachment 15 – Leachate and Contaminated Water Plan, Appendix 3 – Pipe Strength Calculations and Sump Capacity)

PART III

ATTACHMENT 15

APPENDIX 3

PIPE STRENGTH CALCULATIONS AND SUMP CAPACITY

FOR

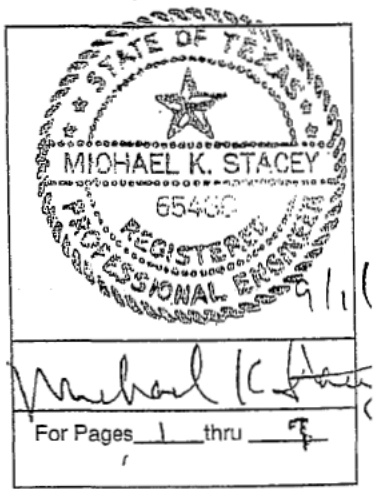
CLINT LANDFILL

PERMIT APPLICATION NO. 2284

CITY OF EL PASO

EL PASO COUNTY, TEXAS

AUGUST 2000



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Phase II\Attachment 15\Volume.xls\main

Job No.	08305-005-0	Calc No.

Computation

HDR

Project	City of El Paso Clint Landfill	Computed	mrd
System	Attachment 15	Date	8/29/00
Component	Leachate Collection System	Reviewed	
Task	Leachate Sump Capacity	Date	

Purpose

Calculate the sump capacity of leachate sump.

Find

Description	Variable	Units
Sump Available Capacity	V_a	gallons
Sump Total Capacity	V_{TOT}	gallons

Given

Description	Value	Source	
Bottom Sump Area [sf]	200	Design Plans	10 feet x 20 feet
Top Sump Area [sf]	1271	Design Plans	31 feet x 41 feet
Available Sump Area [sf]	416	Design Plans	16 feet x 26 feet
Sump Depth [ft]	3.5	Design Plans	42 inches
Available Sump Depth [ft]	2.5	Design Plans	30 inches

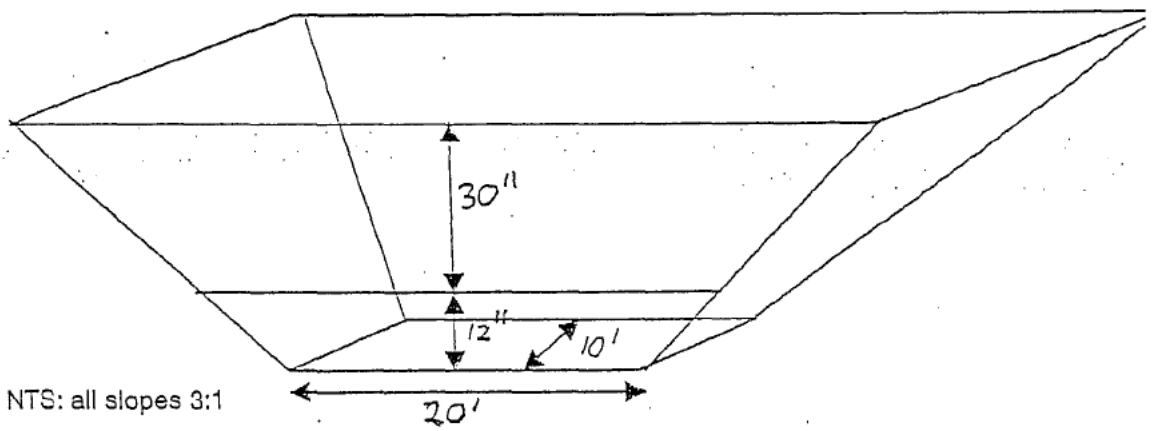
Solution

Description	Value	Comment
Sump total capacity	5777	42" deep sump
Sump available capacity	4732	12" deep not available

Assumptions

Use average end area to calculate volumes.

Diagram



NTS: all slopes 3:1

Equations

Vol = (A1+A2)/2 x D *Equation 1* *average end area volume*

Sheet 1 of 2

6

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Phase II\Attachment 15\s ... lume.xls\main

Job No.	08305-005-0	Calc No.	

Computation

HDR

Project	City of El Paso Clint Landfill	Computed	
System	Attachment 15	Date	8/29/00
Component	Leachate Collection System	Reviewed	
Task	Leachate Sump Capacity	Date	

Calculation

Description	Equation	Comment	Value	Verificatio
Total capacity	equation 1	42 " sump		2574 cf
Convert to gallons	cf x 7.48			19255 gal
Convert with gravel porosity	assume gravel porosity		0.3	5777 gallons
Available capacity				
Available capacity	equation 1	30 " available		2109 cf
Convert to gallons	cf x 7.48			15773 gal
Convert with gravel porosity	assume gravel porosity		0.3	4732 gallons

Sheet 2 of 2

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ATTACHMENT III.C.6 – LEACHATE EVAPORATION POND CAPACITY CALCULATIONS

Phase 1 Leachate Evaporation Pond Calculations - Average Precipitation Conditions

Greater El Paso Landfill, 2284A **9/12/2025**

Evaporation Pond Data	Units	Value	Sources/Notes/Equations
Length	feet	147	Based on design
Width	feet	97	Based on design
Total Liner Surface Area	square feet	20,006	Based on design
Depth (3:1)	feet	3	The depths of the evaporation ponds ranges from 3 feet to 4 feet (see Drawing III.C.6, detail 5). A depth of 3 feet was used for the entire pond as a conservative estimate.
Total Water Surface Area at Depth	square feet	14,250	= Design L * W at 3-ft Pond Depth
Volume Provided	cubic feet	30,879	$V = \frac{(Ab + aB + 2(ab + AB)) \cdot h}{6}$
Volume Provided	gallons	230,978	Volume provided converted to gallons (1 CF = 7.48 gal)

Pond Input	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation - Depth[1]	inches	0.29	0.41	0.22	0.16	0.28	0.79	1.60	1.63	1.48	0.63	0.42	0.47	8.40
Percentage of Annual Rainfall Each Month[2]	%	3.5%	4.9%	2.6%	1.9%	3.3%	9.4%	19.1%	19.4%	17.6%	7.5%	5.0%	5.6%	100%
Mean Monthly Precipitation Generation in Ponds (Precip * Liner Area) - Volume[3]	gallons	3,677	5,105	2,764	1,975	3,480	9,863	20,009	20,358	18,464	7,816	5,286	5,913	104,709
Monthly Leachate Generation from Landfill[4]	gallons	1,053	1,463	792	566	997	2,826	5,733	5,833	5,290	2,239	1,514	1,694	30,000
Net Volume in (Precip + Leachate)	gallons	4,730	6,567	3,555	2,541	4,476	12,689	25,741	26,191	23,754	10,055	6,800	7,607	134,709

Pond Output	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Precipitation - Depth[1]	feet	0.02	0.03	0.02	0.01	0.02	0.07	0.13	0.14	0.12	0.05	0.04	0.04
Monthly Reference ET for Open-Water (ETo)[5]	inches	2.74	3.53	6.07	8.19	9.83	11.12	9.19	8.94	7.69	5.89	3.58	2.49
Open-water Coefficient (Kc)[6]	--	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Potential Evaporation Depth (PET = ETo * Kc)	feet	0.24	0.31	0.53	0.72	0.86	0.97	0.80	0.78	0.67	0.52	0.31	0.22
Net Evaporation Depth (ET = PET - Precip)	feet	0.22	0.27	0.51	0.70	0.84	0.91	0.67	0.65	0.55	0.46	0.28	0.18
Potential Evaporation Volume (ET * Surface Water Area)	cubic feet	3,066	3,915	7,305	10,023	11,925	12,926	9,553	9,208	7,830	6,600	3,960	2,542
Net Volume Out (ET Vol)	gallons	22,935	29,286	54,642	74,976	89,199	96,683	71,457	68,876	58,568	49,365	29,623	19,011

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Pond Storage Needed (In less Out)	gallons	-	-	-	-	-	-	-	-	-	-	-	-
Monthly Pond Storage Needed Beyond Existing Pond Capacity	gallons	-	-	-	-	-	-	-	-	-	-	-	-

Conclusion: **Under average precipitation levels, the evaporation exceeds leachate generation for every month. Therefore, there is no accumulation of leachate in the Phase 1 Leachate Evaporation Pond.**

Sources/Notes/Equations:

[1] NOAA National Centers for Environmental Information Climate Data for El Paso International Airport, 1994-2024.

[2] Mean monthly precipitation divided by 8.40 inches

[3] Mean monthly precipitation depth converted to gallons (precip inches * 1 ft / 12 inches * pond area * 7.48 gal / 1 CF)

[4] The HELP model results using the HELP simulated precipitation (average of 10.29 inches per year) for the location of the Landfill resulted in 0 gallons of leachate generation (HELP model results included in Attachment III.C.3). Based on conversations with the City, the Landfill generates approximately 30,000 gallons of leachate per year on average. In order to simulate a worst case scenario, these calculations assume all 30,000 gallons are directed to the Phase 1 Leachate Evaporation Pond for this calculation. The current open area in Phase 2 Cells 11-14 is 51.0 acres and the Phase 1 vertical expansion area is 34.6 acres, so this assumption is conservative.

[5] Texas A&M AgriLife Extension - historic Eto for El Paso. https://texaset.tamu.edu/ (select "average Eto" from "ET and Weather Data" drop down)

[6] Food and Agriculture Organization of the United Nations - Irrigation and Drainage paper No. 56. https://www.fao.org/4/x0490e/x0490e0b.htm



Phase 2 Leachate Evaporation Pond Calculations - Average Precipitation Conditions

Greater El Paso Landfill, 2284A **9/12/2025**

Evaporation Pond Data	Units	Value	Sources/Notes/Equations
Length	feet	148	Based on design
Width	feet	98	Based on design
Total Liner Surface Area	square feet	19,256	Based on design
Depth (3:1)	feet	3	The depths of the evaporation ponds ranges from 3 feet to 4 feet (see Drawing III.C.6, detail 5). A depth of 3 feet was used for the entire pond as a conservative estimate.
Total Water Surface Area at Depth	square feet	14,504	= Design L * W at 3-ft Pond Depth
Volume Provided	cubic feet	31,524	$V = \frac{(Ab + aB + 2(ab + AB)) \cdot h}{6}$
Volume Provided	gallons	235,800	Volume provided converted to gallons (1 CF = 7.48 gal)
Cell 11-14 Area	acres	51.0	
Cell 15-20 Area	acres	71.5	
Phase 2 Area (Cell 11-20)	acres	122.5	
Phase 2 Area : Cell 11-14 Area ratio	N/A	2.4	

Pond Input	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation - Depth[1]	inches	0.29	0.41	0.22	0.16	0.28	0.79	1.60	1.63	1.48	0.63	0.42	0.47	8.40
Percentage of Annual Rainfall Each Month[2]	%	3.5%	4.9%	2.6%	1.9%	3.3%	9.4%	19.1%	19.4%	17.6%	7.5%	5.0%	5.6%	100%
Mean Monthly Precipitation Generation in Ponds (Precip * Liner Area) - Volume[3]	gallons	3,539	4,913	2,660	1,901	3,349	9,494	19,259	19,596	17,772	7,523	5,088	5,692	100,786
Monthly Leachate Generation from Landfill[4]	gallons	2,529	3,512	1,901	1,359	2,394	6,786	13,765	14,006	12,703	5,377	3,636	4,068	72,036
Net Volume in (Precip + Leachate)	gallons	6,068	8,425	4,561	3,260	5,743	16,280	33,024	33,602	30,475	12,900	8,724	9,760	172,822

Pond Output	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Precipitation - Depth[1]	feet	0.02	0.03	0.02	0.01	0.02	0.07	0.13	0.14	0.12	0.05	0.04	0.04
Monthly Reference ET for Open-Water (ETo)[5]	inches	2.74	3.53	6.07	8.19	9.83	11.12	9.19	8.94	7.69	5.89	3.58	2.49
Open-water Coefficient (Kc)[6]	--	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Potential Evaporation Depth (PET = ETo * Kc)	feet	0.24	0.31	0.53	0.72	0.86	0.97	0.80	0.78	0.67	0.52	0.31	0.22
Net Evaporation Depth (ET = PET - Precip)	feet	0.22	0.27	0.51	0.70	0.84	0.91	0.67	0.65	0.55	0.46	0.28	0.18
Potential Evaporation Volume (ET * Surface Water Area)	cubic feet	3,121	3,985	7,436	10,202	12,138	13,156	9,724	9,373	7,970	6,717	4,031	2,587
Net Volume Out (ET Vol)	gallons	23,345	29,809	55,618	76,315	90,792	98,410	72,733	70,106	59,614	50,246	30,152	19,350

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Pond Storage Needed	gallons	-	-	-	-	-	-	-	-	-	-	-	-
Monthly Pond Storage Needed Beyond Existing Pond Capacity	gallons	-	-	-	-	-	-	-	-	-	-	-	-

Conclusion: **Under average precipitation levels, the evaporation exceeds leachate generation for every month. Therefore, there is no accumulation of leachate in the Phase 2 Leachate Evaporation Pond.**

Sources/Notes/Equations:

[1] NOAA National Centers for Environmental Information Climate Data for El Paso International Airport, 1994-2024.

[2] Mean monthly precipitation divided by 8.40 inches

[3] Mean monthly precipitation depth converted to gallons (precip inches * 1 ft / 12 inches * pond area * 7.48 gal / 1 CF)

[4] The HELP model results using the HELP simulated precipitation (average of 10.29 inches per year) for the location of the Landfill resulted in 0 gallons of leachate generation (HELP model results included in Attachment III.C.3). Based on conversations with the City, the Landfill currently generates approximately 30,000 gallons of leachate per year on average. The total area of Phase 2 when fully developed (Cells 11-20) will be 122.5 acres, representing an area increase by a factor of 2.4 relative to the area of Phase 2 currently open (Cells 11-14, 51.0 acres). In order to simulate a worst case scenario, yearly leachate generation was assumed to be 30,000 gallons multiplied by a factor or 2.4, which represents 72,036 gallons to the Phase 2 Leachate Evaporation Pond.

[5] Texas A&M AgriLife Extension - historic Eto for El Paso. https://texaset.tamu.edu/ (select "average Eto" from "ET and Weather Data" drop down)

[6] Food and Agriculture Organization of the United Nations - Irrigation and Drainage paper No. 56. https://www.fao.org/4/x0490e/x0490e0b.htm



Phase 1 Leachate Evaporation Pond Calculations - Maximum Precipitation Conditions

Greater El Paso Landfill, 2284A **9/12/2025**

Evaporation Pond Data	Units	Value	Sources/Notes/Equations
Length	feet	147	Based on design
Width	feet	97	Based on design
Total Liner Surface Area	square feet	20,006	Based on design
Depth (3:1)	feet	3	The depths of the evaporation ponds ranges from 3 feet to 4 feet (see Drawing III.C.6, detail 5). A depth of 3 feet was used for the entire pond as a conservative estimate.
Total Water Surface Area at Depth	square feet	14,250	= Design L * W at 3-ft Pond Depth
Volume Provided	cubic feet	30,879	$V = \frac{(Ab + aB + 2(ab + AB)) \cdot h}{6}$
Volume Provided	gallons	230,978	Volume provided converted to gallons (1 CF = 7.48 gal)
Maximum Annual : Average Annual ratio	N/A	2.1	The increase from the average annual precipitation to the maximum annual precipitation for 1994-2024.

Pond Input	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation - Depth[1]	inches	0.29	0.41	0.22	0.16	0.28	0.79	1.60	1.63	1.48	0.63	0.42	0.47	8.40
Percentage of Annual Rainfall Each Month[2]	%	3.5%	4.9%	2.6%	1.9%	3.3%	9.4%	19.1%	19.4%	17.6%	7.5%	5.0%	5.6%	100%
Monthly Precipitation Based on Max Annual Rainfall[7]	inches	0.61	0.85	0.46	0.33	0.58	1.65	3.35	3.40	3.09	1.31	0.88	0.99	17.51
Mean Monthly Precipitation Generation in Ponds (Precip * Liner Area) - Volume[3]	gallons	7,667	10,645	5,763	4,119	7,256	20,569	41,724	42,454	38,503	16,299	11,022	12,331	218,352
Monthly Leachate Generation from Landfill[4]	gallons	2,197	3,050	1,651	1,180	2,079	5,893	11,954	12,163	11,031	4,670	3,158	3,533	62,560
Net Volume in (Precip + Leachate)	gallons	9,864	13,695	7,414	5,299	9,335	26,462	53,679	54,617	49,535	20,969	14,180	15,864	280,912

Pond Output	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Monthly Precipitation - Depth[7]	feet	0.05	0.07	0.04	0.03	0.05	0.14	0.28	0.28	0.26	0.11	0.07	0.08
Monthly Reference ET for Open-Water (ETo)[5]	inches	2.74	3.53	6.07	8.19	9.83	11.12	9.19	8.94	7.69	5.89	3.58	2.49
Open-water Coefficient (Kc)[6]	--	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Potential Evaporation Depth (PET = ETo * Kc)	feet	0.24	0.31	0.53	0.72	0.86	0.97	0.80	0.78	0.67	0.52	0.31	0.22
Net Evaporation Depth (ET = PET - Precip)	feet	0.19	0.24	0.49	0.69	0.81	0.84	0.53	0.50	0.42	0.41	0.24	0.14
Potential Evaporation Volume (ET * Surface Water Area)	cubic feet	2,686	3,388	7,020	9,819	11,565	11,906	7,485	7,104	5,922	5,792	3,414	1,930
Net Volume Out (ET Vol)	gallons	20,093	25,340	52,506	73,449	86,509	89,058	55,990	53,138	44,294	43,323	25,537	14,439

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Pond Storage Needed	gallons	-	-	-	-	-	-	-	1,479	5,240	-	-	1,425
Monthly Pond Storage Needed Beyond Existing Pond Capacity	gallons	-	-	-	-	-	-	-	-	-	-	-	-

Conclusion: **Under maximum precipitation levels, the evapotranspiration exceeds leachate generation for January-July, October, and November. Leachate generation exceeds evapotranspiration in August, September, and December. The volume of leachate generated is significantly less than the capacity provided by the Phase 1 Leachate Evaporation Pond.**

Sources/Notes/Equations:

[1] NOAA National Centers for Environmental Information Climate Data for El Paso International Airport, 1994-2024.

[2] Mean monthly precipitation divided by 8.40 inches

[3] Mean monthly precipitation depth converted to gallons (precip inches * 1 ft / 12 inches * pond area * 7.48 gal / 1 CF)

[4] The HELP model results using the maximum precipitation (17.51 inches per year) for the location of the Landfill resulted in 0 gallons of leachate generation for intermediate conditions (HELP model results included in Attachment III.C.6). Based on conversations with the City, the Landfill generates approximately 30,000 gallons of leachate per year on average. This is assumed to be under the average annual precipitation of 8.40 inches. The maximum average annual precipitation at the Landfill is 17.51 inches, representing 2.1 times the average annual precipitation. In order to simulate a worst case scenario, yearly leachate generation was assumed to be 30,000 gallons multiplied by a factor of 2.1, which represents 62,560 gallons, all of which is assumed to be directed to the Phase 1 Leachate Evaporation Pond. The current open area in Phase 2 Cells 11-14 is 51.0 acres and the Phase 1 vertical expansion area is 34.6 acres, so this assumption is conservative.

[5] Texas A&M AgriLife Extension - historic Eto for El Paso. https://texaset.tamu.edu/ (select "average Eto" from "ET and Weather Data" drop down)

[6] Food and Agriculture Organization of the United Nations - Irrigation and Drainage paper No. 56. https://www.fao.org/4/x0490e/x0490e0b.htm

[7] Calculated based on the maximum precipitation times the percentage of annual rainfall each month.



Phase 2 Leachate Evaporation Pond Calculations - Maximum Precipitation Conditions **Greater El Paso Landfill, 2284A** **9/12/2025**

Evaporation Pond Data	Units	Value	Sources/Notes/Equations
Length	feet	148	Based on design
Width	feet	98	Based on design
Total Liner Surface Area	square feet	19,256	Based on design
Depth (3:1)	feet	3	The depths of the evaporation ponds ranges from 3 feet to 4 feet (see Drawing III.C.6, detail 5). A depth of 3 feet was used for the entire pond as a conservative estimate.
Total Water Surface Area at Depth	square feet	14,504	= Design L * W at 3-ft Pond Depth
Volume Provided	cubic feet	31,524	$V = \frac{(Ab + aB + 2(ab + AB)) \cdot h}{6}$
Volume Provided	gallons	235,800	Volume provided converted to gallons (1 CF = 7.48 gal)
Maximum Annual : Average Annual ratio	N/A	2.1	The increase from the average annual precipitation to the maximum annual precipitation for 1994-2024.

Pond Inputs	Units	Value	Sources/Notes/Equations
HELP Model Annual Leachate Generation Max Precip	cu ft/acre	10,313.7	Annual Leachate Generation Modeled in HELP with maximum annual precipitation (17.51 inches)
HELP Model Annual Leachate Generation Max Precip	gal/acre	77,146	Leachate generation converted to gallons/acre
Leachate Generated from Cells 15-18 (HELP)	gallons	3,681,478	Leachate generation multiplied by acreage of Cells 15-18 (47.7 acres)
Leachate Generated from Cells 11-14[8]	gallons	62,560	Normal average leachate generation of 30,000 gallons times precipitation ratio.

Pond Input	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation - Depth[1]	inches	0.29	0.41	0.22	0.16	0.28	0.79	1.60	1.63	1.48	0.63	0.42	0.47	8.40
Percentage of Annual Rainfall Each Month[2]	%	3.5%	4.9%	2.6%	1.9%	3.3%	9.4%	19.1%	19.4%	17.6%	7.5%	5.0%	5.6%	100%
Monthly Precipitation Based on Max Annual Rainfall[7]	inches	0.61	0.85	0.46	0.33	0.58	1.65	3.35	3.40	3.09	1.31	0.88	0.99	17.51
Mean Monthly Precipitation Generation in Ponds (Precip * Liner Area) - Volume[3]	gallons	7,380	10,246	5,547	3,964	6,984	19,798	40,161	40,863	37,060	15,688	10,609	11,869	210,171
Monthly Leachate Generation from Landfill[4]	gallons	131,466	182,527	98,815	70,623	124,418	352,685	715,438	727,951	660,205	279,472	189,000	211,438	3,744,037
Net Volume in (Precip + Leachate)	gallons	138,845	192,773	104,362	74,588	131,402	372,482	755,599	768,815	697,265	295,160	199,609	223,307	3,954,208

Pond Output	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation - Depth[1]	feet	0.05	0.07	0.04	0.03	0.05	0.14	0.28	0.28	0.26	0.11	0.07	0.08	
Monthly Reference ET for Open-Water (ETo)[5]	inches	2.74	3.53	6.07	8.19	9.83	11.12	9.19	8.94	7.69	5.89	3.58	2.49	
Open-water Coefficient (Kc)[6]	--	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	
Potential Evaporation Depth (PET = ETo * Kc)	feet	0.24	0.31	0.53	0.72	0.86	0.97	0.80	0.78	0.67	0.52	0.31	0.22	
Net Evaporation Depth (ET = PET - Precip)	feet	0.19	0.24	0.49	0.69	0.81	0.84	0.53	0.50	0.42	0.41	0.24	0.14	
Potential Evaporation Volume (ET * Surface Water Area)	cubic feet	2,734	3,448	7,145	9,995	11,772	12,119	7,619	7,231	6,027	5,895	3,475	1,965	
Net Volume Out (ET Vol)	gallons	20,452	25,792	53,444	74,761	88,054	90,649	56,989	54,087	45,085	44,096	25,993	14,697	594,100

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Pond Storage Needed	gallons	118,394	166,981	50,918	-	43,348	281,834	698,609	714,728	652,180	251,064	173,616	208,610	
Cumulative Pond Volume	gallons	118,394	285,375	286,718	235,627	278,974	517,633	934,409	950,527	887,979	486,864	409,416	444,409	
Excess Volume of Leachate to be Hauled	gallons	-	49,575	50,918	-	43,175	281,834	698,609	714,728	652,180	251,064	173,616	208,610	3,124,309

Conclusion: **Under maximum precipitation levels, leachate pond storage requirements exceed the leachate evaporation pond capacity. During excessive rain condtions, the City may have to haul leachate to a permitted facility as discussed in Section III.C.2.2.5 of Part III, Appendix III.C.**

Sources/Notes/Equations:

[1] NOAA National Centers for Environmental Information Climate Data for El Paso International Airport, 1994-2024.

[2] Mean monthly precipitation divided by 8.40 inches

[3] Mean monthly precipitation depth converted to gallons (precip inches * 1 ft / 12 inches * pond area * 7.48 gal / 1 CF)

[4] The HELP model results using the maximum precipitation (17.51 inches per year) for the location of the Landfill resulted in 10,313.7 cf/acre for leachate generation for Cells 15-18 under open conditions (HELP model results included in Attachment III.C.6). For Cells 11-14, see note 8, which is added to the Cell 15-18 HELP model data, all of which is assumed to be directed to the Phase 2 Leachate Evaporation Pond. When the City moves into Cells 15-18, this is the "worst case" for leachate generation with 47.7 acres under open condition and Cells 11-14 (51.0 acres) under intermediate condition.

[5] Texas A&M AgriLife Extension - historic Eto for El Paso. https://texaset.tamu.edu/ (select "average Eto" from "ET and Weather Data" drop down)

[6] Food and Agriculture Organization of the United Nations - Irrigation and Drainage paper No. 56. https://www.fao.org/4/x0490e/x0490e0b.htm

[7] Calculated based on the maximum precipitation times the percentage of annual rainfall each month.

[8] The HELP model results using the maximum precipitation (17.51 inches per year) for the location of the Landfill resulted in 0 gallons of leachate generation for intermediate conditions (HELP model results included in Attachment III.C.6). Based on conversations with the City, the Landfill generates approximately 30,000 gallons of leachate per year on average. This is assumed to be under the average annual precipitation of 8.40 inches. The maximum average annual precipitation at the Landfill is 17.51 inches, representing 2.1 times the average annual precipitation. In order to simulate a worst case scenario, yearly leachate generation was assumed to be 30,000 gallons multiplied by a factor of 2.1, which represents 62,560 gallons, all of which is assumed to be directed to the Phase 2 Leachate Evaporation Pond.



LEACHATE EVAPORATION PONDS – OPEN CONDITION HELP MODEL OUTPUT (MAXIMUM PRECIPITATION)



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill - Open Condition **Simulated On:** 9/5/2025 11:58

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
Daily Cover
Material Texture Number 45

Thickness	=	6	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	120	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
Drainage Layer
Material Texture Number 44

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Geonet Geocomposite
Material Texture Number 43

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 5

Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 6

Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	97	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches

Initial Water in Evaporative Zone	=	4.74	inches
Upper Limit of Evaporative Storage	=	14.796	inches
Lower Limit of Evaporative Storage	=	1.896	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	29.882	inches
Total Initial Water	=	29.882	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days
End of Growing Season (Julian Date)	=	315	days
Average Wind Speed	=	9.2	mph
Average 1st Quarter Relative Humidity	=	40	%
Average 2nd Quarter Relative Humidity	=	27	%
Average 3rd Quarter Relative Humidity	=	46	%
Average 4th Quarter Relative Humidity	=	48	%

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.79	0.8	0.43	0.35	0.67	1.46
3.47	3.5	3.03	1.07	0.77	1.134516

Note: Precipitation was simulated using NOAA data for the following weather stations:
EL PASO INTERNATIONAL AIRPORT, TX US, 0, 0

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
46.5	51.2	58.8	66.5	76	84
84.3	82.7	77.3	67.2	55.1	46.6

Note: Temperature was simulated using NOAA data for the following weather stations:
EL PASO INTERNATIONAL AIRPORT, TX US, 0, 0
Solar radiation was simulated using NSRDB data for the following location:

Average Annual Totals Summary

Title: GEP Landfill - Open Condition
Simulated on: 9/5/2025 12:00

	Average Annual Totals for Years 1 - 10*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	17.40	[0.35]	63,162.0	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	13.457	[2.147]	48,847.4	77.34
Subprofile1				
Lateral drainage collected from Layer 4	2.8412	[2.8978]	10,313.7	16.33
Percolation/leakage through Layer 6	0.000003	[0.000002]	0.0113	0.00
Average Head on Top of Layer 5	0.0089	[0.0091]	---	---
Water storage				
Change in water storage	1.1022	[1.5064]	4,000.9	6.33

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill - Open Condition
Simulated on: 9/5/2025 12:00

	Peak Values for Years 1 - 10*		
	(inches)		(cubic feet)
Precipitation	3.50		12,705.0
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 4	0.1723		625.3
Percolation/leakage through Layer 6	0.000000		0.0003
Average head on Layer 5	0.1976		---
Maximum head on Layer 5	0.3850		---
Location of maximum head in Layer 4	6.62	(feet from drain)	
Other Parameters			
Snow water	0.7803		2,832.5
Maximum vegetation soil water	0.3731	(vol/vol)	
Minimum vegetation soil water	0.1666	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill - Open Condition
Simulated on: 9/5/2025 12:01
Simulation period: 10 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	0.6032	0.1005
2	33.9322	0.2828
3	6.1695	0.2571
4	0.0192	0.0798
5	0.0000	0.0000
6	0.1800	0.7500
Snow water	0.0000	---

LEACHATE EVAPORATION PONDS – INTERMEDIATE CONDITION HELP MODEL OUTPUT (MAXIMUM PRECIPITATION)



HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: GEP Landfill - Int. Cover **Simulated On:** 9/8/2025 9:15

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
Intermediate Cover
Material Texture Number 45

Thickness	=	12	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 2

Type 1 - Vertical Percolation Layer (Waste)
Municipal Solid Waste (MSW) (900 pcy)
Material Texture Number 18

Thickness	=	2364	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.2	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 3

Type 1 - Vertical Percolation Layer
Drainage Layer
Material Texture Number 44

Thickness	=	24	inches
Porosity	=	0.453	vol/vol
Field Capacity	=	0.19	vol/vol
Wilting Point	=	0.085	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-04	cm/sec

Layer 4

Type 2 - Lateral Drainage Layer
Geonet Geocomposite
Material Texture Number 43

Thickness	=	0.24	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	2.00E+00	cm/sec
Slope	=	2	%
Drainage Length	=	260	ft

Layer 5

Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	4	Holes/Acre
FML Installation Defects	=	4	Holes/Acre
FML Placement Quality	=	3	Good

Layer 6

Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were specified by the user.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	97	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	24	inches

Initial Water in Evaporative Zone	=	4.68	inches
Upper Limit of Evaporative Storage	=	13.488	inches
Lower Limit of Evaporative Storage	=	1.944	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	479.822	inches
Total Initial Water	=	479.822	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	31.63	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	66	days
End of Growing Season (Julian Date)	=	315	days
Average Wind Speed	=	9.2	mph
Average 1st Quarter Relative Humidity	=	40	%
Average 2nd Quarter Relative Humidity	=	27	%
Average 3rd Quarter Relative Humidity	=	46	%
Average 4th Quarter Relative Humidity	=	48	%

Note: Evapotranspiration data was obtained for El Paso, Texas

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
0.79	0.8	0.43	0.35	0.67	1.46
3.47	3.5	3.03	1.07	0.77	1.134516

Note: Precipitation was simulated using NOAA data for the following weather stations:
EL PASO INTERNATIONAL AIRPORT, TX US, 0, 0

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
46.5	51.2	58.8	66.5	76	84
84.3	82.7	77.3	67.2	55.1	46.6

Note: Temperature was simulated using NOAA data for the following weather stations:
EL PASO INTERNATIONAL AIRPORT, TX US, 0, 0
Solar radiation was simulated using NSRDB data for the following location:

Average Annual Totals Summary

Title: GEP Landfill - Int. Cover
Simulated on: 9/8/2025 9:20

	Average Annual Totals for Years 1 - 20*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	17.46	[0.25]	63,361.7	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	12.799	[1.435]	46,459.0	73.32
Subprofile1				
Lateral drainage collected from Layer 4	0.0000	[0]	0.0000	0.00
Percolation/leakage through Layer 6	0.000000	[0]	0.0000	0.00
Average Head on Top of Layer 5	0.0000	[0]	---	---
Water storage				
Change in water storage	4.6564	[1.4239]	16,902.7	26.68

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: GEP Landfill - Int. Cover
Simulated on: 9/8/2025 9:21

	Peak Values for Years 1 - 20*		
	(inches)		(cubic feet)
Precipitation	3.50		12,705.0
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 4	0.0000		0.0000
Percolation/leakage through Layer 6	0.000000		0.0000
Average head on Layer 5	0.0000		---
Maximum head on Layer 5	0.0000		---
Location of maximum head in Layer 4	0.00	(feet from drain)	
Other Parameters			
Snow water	0.7803		2,832.5
Maximum vegetation soil water	0.3787	(vol/vol)	
Minimum vegetation soil water	0.1724	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: GEP Landfill - Int. Cover
Simulated on: 9/8/2025 9:21
Simulation period: 20 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.0622	0.1719
2	566.1454	0.2395
3	4.5600	0.1900
4	0.0024	0.0100
5	0.0000	0.0000
6	0.1800	0.7500
Snow water	0.0000	---

ATTACHMENT III.C.7 – CHEMICAL RESISTANCE OF PLASTIC PIPING MATERIALS TECHNICAL REPORT FROM THE PLASTICS PIPE INSTITUTE

CHEMICAL RESISTANCE OF PLASTIC PIPING MATERIALS

TR-19

2023



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Foreword

This technical report was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute (PPI). These members have shown their commitment to developing and improving quality products by assisting standards development organizations in the development of standards, and also by developing design aids and reports to help engineers, code officials, specifying groups, contractors and users.

The purpose of this technical report is to provide information on the transport of various chemicals using plastic piping materials.

PPI has prepared this technical report as a service to the industry. The information in this report is offered in good faith and believed to be accurate at the time of its preparation, but is offered “as is” without any express or implied warranty, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Additional information may be needed in some areas, especially with regard to unusual or special applications. Consult the manufacturer or material supplier for more detailed information. A list of member manufacturers is available on the PPI website. PPI does not endorse the proprietary products or processes of any manufacturer and assumes no responsibility for compliance with applicable laws and regulations.

PPI intends to revise this technical report within five years, or sooner if required, from the date of its publication, in response to comments and suggestions from users of the document. Please send suggestions of improvements to the address below. Information on other publications can be obtained by contacting PPI directly or visiting our website.

The Plastics Pipe Institute, Inc.

https://www.plasticpipe.org/

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CHEMICAL RESISTANCE OF PLASTIC PIPING MATERIALS

1.0 INTRODUCTION

This technical report has been developed as an informative guide on the resistance of plastic piping and fitting materials to chemical attack.

It is divided into several sections:

- Section 2: How to Interpret the chemical resistance rating provided in Table 3
- Section 3: Chemical resistance in general, and considerations for end use applications
- Section 4: Types of chemical attack on plastics
- Section 5: Other considerations
- Section 6: Chemical Resistance Data for Plastic Piping in Non-Pressure Applications and Data Table
- Section 7: Additional resources

Listings of chemical resistance data are presented in Table 3 for common plastic piping materials applicable to **non-pressure applications**.

Determination of suitability for specific applications under stress (e.g., pressurized service) is beyond the scope of this report. Users should contact the specific pipe or fitting manufacturer for recommendations on pressurized applications.

Note 1: Safety Consideration: Additional engineering and safety considerations exist when transporting liquids above their atmospheric boiling temperature and gases. Both situations constitute piping under pressure and, due to the stored energy of compressed gases, pose a significant danger potentially leading to injury or death.

Note 2: Drinking water, also known as potable water, is water that is safe to drink or to use for food preparation. Across North America, the majority of the drinking water that is provided in public water systems is treated with a disinfectant to control the growth of harmful microorganisms. Potable water disinfectants include chlorine, chloramines, and rarely, chlorine dioxide. Piping materials intended for treated water must be resistant to such disinfectants at various levels, as described in product standards.

For specific information about the resistance of crosslinked polyethylene (PEX) to disinfectants, please see:

- PPI TN-53 ***Guide to Chlorine Resistance Ratings of PEX Pipes and Tubing for Potable Water Applications***,
- PPI TN-67 ***Chlorine Dioxide and Plastic Hot- And Cold- Water Plumbing Distribution Pipes***, and

- PPI Statement A - ***Relative Oxidative Aggressiveness of Chloramines and Free Chlorine Disinfectants on Crosslinked Polyethylene (PEX) Pipes used in Treated Potable Water***

For specific information about the resistance of high-density polyethylene (HDPE) to disinfectants, please see:

- PPI TN-44 ***Long Term Resistance of AWWA C906 Polyethylene (PE) Pipe to Potable Water Disinfectants*** and
- PPI TN-49 ***Recommendations for AWWA C901 Service Tubes in Potable Water Applications***

For specific information about the resistance of chlorinated polyvinyl chloride (CPVC) to disinfectants, please see ***Section 4: Effects of Potable Water Disinfectants on CPVC*** of PPI TN-62 ***Suitability and Fitness of CPVC Piping Systems for Commercial Building Applications***.

2.0 HOW TO INTERPRET THE RATINGS SHOWN IN TABLE 3

The chemical resistance ratings for the pipe and fitting materials and chemicals provided in Table 3 are neither authoritative nor exhaustive. They are only intended as starting point for a proper engineering evaluation. The suitability of a pipe or fitting material in a given application must include the appropriate engineering evaluation of the application including the factors (e.g., temperatures, pressure, chemical concentrations, material stress and expected service life) as discussed in other sections of this document.

As the ratings which are presented are a consolidation of laboratory and field experience from over 50 years of plastic industry experience and not the result of a systematic study, inconsistencies in results may appear in Table 3. It is important to note that a rating (e.g., “R- Resistance”) to a certain temperature or concentration does not imply a lack of resistance above that temperature or concentration. The literature and manufacturers may have other data or experience that supports the use of the material at higher temperatures and this evidence should be considered as part of the engineering analysis.

It is strongly recommended that each user satisfy themselves by means of appropriate tests or from previous experience before a particular plastic piping system is used to transport a specific chemical under the particular conditions of interest. The information in this report is intended to give general guidance only in making tests, and then assessing the results of such tests and experiences.

3.0 CHEMICAL RESISTANCE IN GENERAL

Plastic pipe and fitting materials are generally resistant to attack from many chemicals. This inherent property makes them suitable for use in numerous fluid and gas transport applications.

However, there are certain chemicals that may damage plastic pipes, either through exposure on the outside of the pipe to chemicals, on the internal surface of the pipe during the transport of such chemicals, or with exposure to inert fluids containing chemicals in various concentrations.

Each material has unique resistance to chemicals in various situations. The suitability of a pipe or fitting system for use in a particular fluid or gas application is a function of several factors, described below:

3.1. Pipe and Fitting Materials

The specific plastic material used in pipe and fittings impacts its chemical resistance. This report includes the materials listed in Table 1.

Table 1: Plastic Materials Identification

ABS	acrylonitrile-butadiene-styrene
CPVC	chlorinated polyvinyl chloride
PP	polypropylene
PP-R[1]	polypropylene random copolymer
PP-RCT[1]	polypropylene random copolymer with modified crystallinity and temperature resistance
PVC	polyvinyl chloride
PE	polyethylene (representative of medium density polyethylene [MDPE] and high density polyethylene [HDPE]; not representative of low density polyethylene [LDPE])
PE-RT[2]	polyethylene of raised temperature resistance
PB	polybutylene
PVDF	polyvinylidene fluoride
PEX	crosslinked polyethylene
PA11/ PA12	polyamide 11 / polyamide 12
PA66	polyamide 66
PSU	polysulfone
PPSU	polyphenylsulfone

[1] PP-R and PP-RCT are chemically similar to PP and are grouped together in Table 3; they may be assumed to have similar chemical resistance

[2] PE-RT is chemically similar to MDPE and HDPE and are grouped together in Table 3; they may be assumed to have similar chemical resistance

3.2. Product Design and Joining Systems

Piping dimensions, including wall thickness, construction, and composition (layers, fillers, etc.), can affect chemical resistance.

The type of joining system can also affect the performance of the system in chemical handling applications. Heat fusion and solvent cementing do not introduce different materials into the system. The resistance of solvent cement to certain chemicals can vary from grade to grade.

Other components and appurtenances in the piping system can have different chemical resistances. Certain types of mechanical joints include gaskets using elastomers with their own unique resistances. Some piping systems include other plastic or non-plastic materials used as mechanical fitting components which can have different chemical resistance.

3.3. Operating Conditions - Internal and External

- Chemicals or mixtures of chemicals, and their concentrations.
- Operating temperature — maximum, minimum, and cyclical variations.
- Operating pressure or applied stress — maximum, minimum and cyclical variations.

4.0 TYPES OF CHEMICAL ATTACK ON PLASTICS

In general, chemicals that affect plastics do so in several ways, including solvation, chemical attack, and environmental stress cracking.

4.1. Permeation, Swelling, Plasticization, Solvation, and Extraction

Permeation is the transport of chemicals through the pipe wall via diffusion through the free volume of the polymer matrix without significant change in the material properties. Permeability may be of interest in situations where the pipe is to function as a liner pipe for a less resistant material (e.g., fiberglass or steel), where the pipe is transporting particularly hazardous substances, or where the pipe is installed in contaminated soil.

Permeability of specific plastic piping materials is not addressed in this document. PPI Statement N - ***Barrier Properties of Plastic Pipe Used for Potable Water Service,*** states “In areas of known or suspected contamination, the design of the distribution system should be based on a careful analysis of the situation.

Appropriate technical data and individual manufacturers' recommendations should be consulted on the overall design of a pipe system for these systems."

Note 3: See also ***PPI Comments on Permeation of Water Pipes and on the AWWA-RF Report on Hydrocarbons*** at link

Absorption occurs when a chemical diffuses into the free volume of the polymer matrix and accumulates there. This may result in one or more of the following effects: swelling, plasticization, or solvation. In the case of absorption, physical properties may be affected, but the polymer molecule itself is not chemically changed, degraded or destroyed.

Swelling is an increase in the bulk volume of a material caused by the absorption of liquids or vapors from the environment. It may or may not be accompanied by plasticization, which results in softening and loss of strength in the material.

In extreme cases, the solvating compound can fully dissolve the plastic material.

Sometimes the polymer itself may not be soluble, but it may contain a soluble formulary ingredient that may be extracted from the polymer compound. This is more common in plasticized materials where loss of plasticizer may result in embrittlement. It is not common in plastic materials used for pipes and fittings and is not addressed in this document.

In gas or vapor transmission service, there may be a very slight loss of contents through the pipe wall.

Lastly, a solvating or permeating chemical entrained in the material may be released when heat fusion or solvent cement joining is performed. Thus, heat fusion (e.g., welding) or solvent cement joining may be unreliable if performed on permeated pipes. Caution should be used in performing these processes if solvation or permeation are suspected.

4.2. Direct Chemical Attack

Direct chemical attack occurs when exposure to a chemical causes a chemical alteration of the polymer molecules by chain scission, crosslinking, oxidation, or substitution reactions.

Direct chemical attack frequently causes a severe reduction of mechanical physical properties such as tensile strength, ductility, burst pressure, and impact resistance.

Chemical resistance may vary greatly from one plastic material to another (i.e., PVC, ABS, PE, etc.), and also among different cell classifications of the same plastic type (e.g., PVC 1120 to PVC 2110, PE 3608 to PE 4710, etc.). There may also be slight variations among commercial products having the same cell classification, based on compound ingredients known as stabilizers or “additive packages”.

The chemical resistance of plastic piping and fittings is basically a function of the chemical resistance of the plastic material, including additives and other ingredients in the final compound. In general, the fewer filler ingredients used, the better the chemical resistance.

Plastic pipes with significant filler percentages may be susceptible to chemical attack whereas an unfilled material may be affected to a lesser degree or not at all.

4.3. Environmental Stress Cracking

Environmental stress cracking (ESC) is defined as the “development of cracks in a material that is subjected to stress or strain in the presence of specific chemicals”, as per ASTM F412 S***tandard Terminology for Plastic Piping Systems***.

Environmental stress cracking is a fundamentally different phenomenon than chemical attack, even though they may present similarly (e.g., crazing or whitening of parts, sloughing of material, minor crack formation). ESC does not result in chemical alteration of the polymer molecule. ESC is caused by a chemical agent in combination with inherent and applied stresses. It can often be minimized with proper installation. Direct chemical attack does not require any stress or strain on the material for it to occur, although it may be accelerated in conditions of high stress or strain.

5.0 OTHER CONSIDERATIONS

5.1. Chemical Families

While the effect of each individual chemical is specific, some chemicals can be grouped into general categories based on similarities in chemical characteristics (acids, bases, alcohols, etc.). For example, water-based (aqueous) solutions of neutral inorganic salts generally have the same effect on plastic piping materials as water alone; thus, sodium chloride, potassium alum, calcium

chloride, copper sulfate, potassium sulfate and zinc chloride solutions have the same effect as water.

However, at elevated temperatures or high concentrations, some salt solutions may attack some plastic materials through either oxidation or chemical substitution when they would be benign at lower temperatures and concentrations.

5.2. Accelerating factors (concentration, temperature, stress)

Generally, the resistance of a particular plastic to a specific chemical will decrease with an increase in concentration. For example, for some materials, dilute sulfuric acid may be acceptable, whereas 95% sulfuric acid may not.

The resistance of a particular plastic to a specific chemical generally decreases as temperature increases because the rate of chemical phenomenon (i.e., reactivity, permeation rate, solvation) tends to increase. This rate increase is logarithmic with respect to temperature over most plastic functional temperatures and generally follows to the Arrhenius equation.

The chemical resistance of a particular plastic generally decreases with increasing applied stress. This is commonly seen when the presence of certain chemicals causes environmental stress cracking where unstressed parts exhibit good chemical resistance.

The chemical resistance of a particular plastic generally decreases where temperature or applied stress are varied or cycled. These effects can be greater overall in combination. Testing should be conducted if the system is expected to perform across a wide range of temperatures and stresses to determine the overall combined effect.

5.3. Combinations of Chemicals

In some cases, combinations of chemicals may have a synergistic effect on damaging a plastic material, and a mixture may cause damage where the individual chemicals do not. It cannot be assumed that an individual chemical's lack of effect would apply for combinations that include several chemicals. When the possible combined effect of several chemicals is unknown, the material should be tested in the complete chemical mixture(s) in question.

5.4. Multi-Layered (Composite) Piping

Some piping products utilize a multi-layered (composite) construction, in which the pipe wall is constructed of layers of different materials. The layers may consist of both plastic and non-plastic.

For example, PE/AL/PE and PEX/AL/PEX pipes contain mid-wall aluminum layers. Examples of all-plastic composite pipes include PVC/ABS/PVC and fiber-core PP-R or PP-RCT pipes. Layered composite material pipes may have chemical resistance that differs from the chemical resistance of the individual materials.

5.5. Rate of Chemical Attack

Chemicals that attack plastics do so at a certain rate, some slowly and some more quickly. But usually, any chemical attack is increased when temperature or stress are increased, or when temperature or stress are varied. The particular rate of chemical attack must be taken into consideration in the life-cycle evaluation for a particular application. Each combination of material cost, installation cost and service life must be evaluated and judged on its own merits.

In certain cases involving a slow rate of chemical attack, particularly when the application will be pressurized, simple immersion data, like that represented in Table 3, may not adequately characterize performance throughout the intended design life. Longer-term testing to replicate service conditions is advisable to fully measure the effects of these chemicals.

6.0 CHEMICAL RESISTANCE DATA FOR PLASTIC PIPING IN NON-PRESSURE APPLICATIONS AND DATA TABLE

When plastic pipes come into contact with chemical agents it is important to know how the pipe may be affected. For non-pressure applications, where the pipe is not subject to continuous internal pressure or stress, chemical immersion test data may provide suitable information. The pipe manufacturer may have additional data from similar tests, or information on previous installations under similar field conditions.

The following cautions apply to Table 3 *List of Chemical Resistances*:

- ***Data Sources.*** The information in Table 3 has been obtained from numerous sources. The data are based primarily on plastic material test specimens that have been immersed in the chemical and evaluated, and to a lesser degree, on field-experience. In most cases, detailed information on the test conditions (e.g., exposure time), and on test results (e.g., change in weight, change in volume, and change in

strength) was not available. Therefore, this information is best used only for comparison of different plastic materials.

- *Combinations of Chemicals.* Chemicals that individually do not have an effect may affect the pipe if combined with certain other chemicals. The list of possible combinations of chemicals is endless. Table 3 does not address chemical combinations.
- *Composite Piping.* Layered composite piping may have chemical resistance that differs from that of the individual materials in the layers. Table 3 is not applicable to layered composite piping products.
- *Applicability to fiberglass* and *filled materials.* Table 3 is not applicable to reinforced epoxy resin (fiberglass) pipes, and to plastic pipes containing significant percentages of filler materials.
- *Concentrations.* Where no concentrations are given (indicated as '**P**'), the commercially pure material is indicated, except in the case of solids where saturated aqueous solutions are indicated.

See Table 2 for the **Resistance Codes** which are used throughout Table 3.

Table 2: Resistance Codes

Code	Meaning	Typical Result
R to xx°F	Plastic material is generally **Resistant** up to the temperature (°F) indicated by code and may have limited resistance at higher temperatures	Swelling < 3% or weight loss < 0.5% and elongation at break not significantly changed Typical performance properties not significantly affected
L to xx°F	Plastic material has **Limited** resistance at the temperature (°F) indicated by code. Compatibility at lower temperatures should not be assumed	Material may experience swelling in the range of 3 - 8% or weight loss of 0.5 - 5% and/or reduction in elongation at break by < 50% Some effect on performance properties
N	Plastic material is **Not** resistant.	Material may experience swelling > 8% or weight loss > 5% and/or reduction in elongation at break by > 50%
P	**Pure** Concentration	
—	Data not available Check with piping manufacturer	

Chemicals that do not normally affect the properties of an unstressed plastic may cause completely different behavior (such as stress cracking) when under mechanical stress, such as constant internal pressure or mechanical stress cycles.

Unstressed immersion test chemical resistance information is applicable only when the plastic pipe will not be subject to mechanical load or stress that is constant, or cycles frequently.

When the pipe will be subject to a continuous applied mechanical stress or to combinations of chemicals, testing that duplicates the expected field conditions, as closely as possible, should be performed on representative samples of the pipe product to properly evaluate that plastic pipe for use in this application.

7.0 OTHER RESOURCES

The following references provide additional information on chemical compatibility of plastic piping and may provide useful guidance:

- ***PPI Comments on Permeation of Water Pipes and on the AWWA-RF Report on Hydrocarbons***
- PPI Statement A ***– Relative Oxidative Aggressiveness of Chloramines and Free Chlorine Disinfectants on Crosslinked Polyethylene (PEX) Pipes used in Treated Potable Water***
- PPI Statement N ***– Barrier Properties of Plastic Pipe Used for Potable Water Service***
- PPI TN-11 ***– Suggested Temperature Limits for Thermoplastic Pipe Installation and for Non-Pressure Pipe Operation***
- PPI TN-44 ***– Long Term Resistance of AWWA C906 Polyethylene (PE) Pipe to Potable Water Disinfectants***
- PPI TN-49 ***– Recommendations for AWWA C901 Service Tubes in Potable Water Applications***
- ***PPI TN-52 – Guide to High-Temperature Applications of Non-Potable PEX Pipe and Tubing Systems***
- PPI TN-53 ***– Guide to Chlorine Resistance Ratings of PEX Pipes and Tubing for Potable Water Applications***
- ***PPI TN-67 – Chlorine Dioxide and Plastic Hot- And Cold- Water Plumbing Distribution Pipes***
- ISO TR 10358 ***Plastics pipes and fittings for industrial applications — Collection of data on combined chemical-resistance***

******May not be fully applicable to pressurized applications******

Table 3: List of Chemical Resistances (°F)

Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Acetaldehyde **CAS# 75-07-0** CH_3CHO	40%	---	N	---	L to 73	R to 73	---	N	R to 73	---	---	---	---
	Pure	---	N	R to 140	N	L to 73	L to 73	---	L to 140	L to 176	---	R to 73	---
Acetamide **CAS# 60-35-5** CH_3CONH_2	5%	R to 120	---	R to 140	---	R to 140	---	R to 75	R to 140	---	---	---	---
Acetic Acid **CAS# 64-19-7** CH_3COOH	vapor	R to 120	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	10%	---	R to 180	---	---	---	---	R to 248	R to 180	R to 176	---	---	---
	25%	N	N	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	40%	---	---	---	---	---	---	R to 140	---	---	---	---	---
	50%	---	---	---	---	---	---	R to 140	---	L to 68	---	---	---
	60%	N	N	R to 180	R to 73	R to 73	R to 73	R to 104	---	---	---	---	---
	85%	N	N	R to 120	R to 73	R to 73	R to 73	---	---	---	---	R to167	R to 167
	glacial	N	N	R to 120	R to 73	R to 73	R to 73	R to 104	R to 68	---	---	R to 167	R to 167
Acetic Anhydride **CAS# 108-24-7** $(CH_3CO)_2O$	---	N	N	R to 73	N	R to 73	R to 140	N	R to 73	L to 68	---	---	---
Acetone **CAS# 67-64-1** CH_3COCH_3	5%	N	R to 180	R to 73	N	L to 73	R to 140	R to 212	L to 73	L to 140	---	N	---
	10%	---	L to 180	---	---	---	---	R to 122	---	---	---	---	---
	100%	---	N	---	---	---	---	---	---	---	---	---	---
Acetophenone **CAS# 98-86-2** $C_6H_5COCH_3$	---	N	N	R to 120	--	R to 73	---	R to 68	R to 73	---	---	---	---
Acetyl Chloride **CAS# 75-36-5** CH_3COCl	---	N	N	---	N	---	---	R to 125	---	---	---	---	---
Acetylene **CAS# 74-86-2** $HC{\equiv}CH$	gas 100%	R to 73	N	R to 73	N	R to 73	L to 73	R to 250	R to 73	R to 140	---	---	---
Acetylnitrile CAS 75-05-8 $CH_3C{\equiv}N$	---	---	N	---	N	---	---	---	---	---	---	---	---

******May not be fully applicable to pressurized applications******

Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Acrylic Acid **CAS# 79-10-7** $H_2C=CHCOOH$	97%	---	N	---	N	R to 140	---	---	R to 140	---	---	---	---
Acrylonitrile **CAS# 107-13-1** $H_2C=CHC\equiv N$	---	---	N	---	N	R to 140	---	R to 75	R to 140	---	---	---	---
Adipic Acid **CAS#124-04-9** $COOH(CH_2)_4COOH$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 73	R to 176	R to 140	---	---	---	---
Allyl Alcohol **CAS# 107-18-6** $CH_2 = CHCH_2 OH$	96%	---	L to 73	R to 140	R to 73	N	R to 140	R to 125	L to 100	---	---	---	---
Allyl Chloride **CAS# 107-05-1** $CH_2=CHCH_2Cl$	--	---	N	---	N	L to 73	---	R to 140	L to 73	---	---	---	---
	Liquid	---	---	---	---	---	---	R to 68	---	---	---	---	---
Aluminum Ammonium Sulfate (Alum) **CAS# 7784-25-0** $AlNH_4 (SO_4)_2 \cdot 12H_2O$	Saturated	---	R to 180	R to 140	R to 140	R to 140	---	---	R to 140	---	---	---	---
Aluminum Chloride **CAS# 7446-70-0** $AlCl_3$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Aluminum Fluoride Anhydrous **CAS# 7764-18-1** AlF_3	Saturated	R to 160	R to 180	R to 180	R to 73	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Aluminum Hydroxide **CAS# 21645-51-2** $Al(OH)_3$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Aluminum Nitrate **CAS# 13473-90-0** $Al(NO_3)_3 \cdot 9H_2O$	Saturated	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Aluminum Oxychloride **CAS# 1327-41-9**	--	---	R to 180	R to 180	R to 140	---	R to 140	R to 125	---	---	---	---	---
Aluminum Potassium Sulfate (Alum) **CAS# 10043-67-1** $AlK(SO_4)_2 \cdot 12H_2O$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
Aluminum Sulfate **CAS# 10043-01-3** $Al_2(SO_4)_3$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	C to 73	R to 212	R to 140	R to 194	---	---	---

******May not be fully applicable to pressurized applications******

Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Ammonia Gas **CAS# 7664-41-7** NH_3	100%	N	N	R to 140	R to 140	R to 140	R to 140	---	R to 140	R to 140	---	---	---
Ammonium Acetate **CAS# 631-61-8** CH_3COONH_4	Saturated	R to 120	R to 180	R to 73	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
Ammonium Bifluoride **CAS# 1341-49-7** NH_4HF_2	Saturated	---	R to 180	R to 180	R to 140	---	R to 140	R to 150	R to 140	---	---	---	---
Ammonium Bisulfide **CAS# 12124-99-1** $(NH_4)HS$	---	---	---	---	R to 140	---	---	---	---	---	---	---	---
Ammonium Carbonate **CAS# 506-87-6** $(NH_4)_2CO_3$	Saturated	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Ammonium Chloride **CAS# 12125-02-9** NH_4Cl	Saturated	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ammonium Dichromate **CAS# 7789-09-5** $(NH_4)_2Cr_2O_7$	--	---	R to 73	---	R to 73	---	---	R to 250	---	---	---	---	---
Ammonium Fluoride **CAS# 12125-01-8** NH_4F	10%	R to 120	R to 180	R to 212	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
	25%	R to 120	R to 180	R to 212	L to 140	R to 140	R to 73	---	R to 140	---	---	---	---
Ammonium Hydroxide **CAS# 1336-21-6** NH_4OH	10%	R to 120	N	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	30%	---	---	---	---	R to 140	---	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	---	R to 194	---	---	---	---
Ammonium Metaphosphate **CAS# 13446-46-3** NH_3HPO_3	Saturated	--	--	R to 212	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Ammonium Nitrate **CAS# 6484-52-2** NH_4NO_3	Saturated	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ammonium Persulfate **CAS# 7727-54-0** $(NH_4)_2S_2O_8$	---	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ammonium Phosphate (Monobasic) **CAS# 7722-76-1** $NH_4H_2PO_4$	---	R to 120	L to 73	R to 212	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	R to 199	R to 199

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Ammonium Sulfate **CAS# 7783-20-2** $(NH_4)_2SO_4$	Saturated	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ammonium Sulfide **CAS# 12135-76-1** $(NH_4)_2S$	dilute	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 200	R to 140	---	---	---	---
	Saturated	---	---	---	---	R to 140	---	R to 125	---	---	---	---	---
Ammonium Thiocyanate **CAS# 1762-95-4** NH_4SCN	50-60%	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 73	---	---	---	---
Amyl Acetate **CAS# 628-63-7** $CH_3COOC_5H_{11}$	--	N	N	N	N	R to 73	---	R to 122	R to 73	C to 194	---	---	---
Amyl Alcohol **CAS# 75-41-0** $C_5H_{11}OH$	--	---	N	---	N	R to 140	R to 140	R to 212	R to 140	---	R to 73	---	---
	100%	---	---	---	---	---	L to 140	---	---	---	---	---	---
n-Amyl Chloride **CAS# 543-59-9** $CH_3(CH_2)_3CH_2Cl$	--	N	N	N	N	L to 73	---	R to 285	L to 73	---	---	---	---
Aniline **CAS# 62-53-3** $C_6H_5NH_2$	--	N	N	---	N	R to 73	L to 140	R to 68	L to 140	---	---	---	---
Aniline Chlorohydrate	--	---	N	---	N	L to 73	N	---	L to 73	---	---	---	---
Aniline Hydrochloride **CAS# 142-04-1** $C_6H_5NH_2 \bullet HCl$	Saturated	---	N	---	N	R to 140	N	R to 75	R to 140	---	---	---	---
Anthraquinone **CAS# 84-65-2** $C_{14}H_8O_2$	--	---	R to 180	---	R to 140	L to 73	L to 73	---	L to 73	---	---	---	---
Anthraquinone Sulfonic Acid **CAS# 82-49-5** $C_{14}H_7O_2 \bullet SO_3 \bullet H_2O$	--	---	R to 180	R to 73	R to 140	R to 140	L to 73	---	L to 73	---	---	---	---
Antimony Trichloride **CAS# 10025-91-9** $SbCl_3$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 140	R to 140	---	---	---	---
Aqua Regia ` **CAS# 8007-56-5** (Nitrohydrochloric Acid) $HCl+HNO_3$	--	N	R to 73	N	L to 73	N	N	L to 194	N	---	---	N	---
Arsenic Acid **CAS# 7778-39-4** H_3AsO_4	80%	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Asphalt **CAS# 8052-42-4**	--	---	N	R to 73	N	R to 73	R to 140	R to 250	R to 73	---	---	---	---
Barium Carbonate **CAS# 513-77-9** $BaCO_3$	Saturated	R to 120	R to 180	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Barium Chloride **CAS# 10361-37-2** $BaCl2 \cdot 2H_2O$	Saturated	R to 120	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	R to 194	---	---	---
Barium Hydroxide **CAS# 17194-00-2** $Ba(OH)_2$	30%	---	---	---	---	R to 140	---	R to 250	R to 140	---	---	---	---
	Saturated	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 212	---	---	---	---
Barium Nitrate **CAS# 10022-31-8** $Ba(NO_3)_2$	Saturated	R to 73	R to 180	R to 140	R to 73	R to 140	---	R to 250	R to 140	---	---	---	---
Barium Sulfate **CAS# 7727-43-7** $BaSO_4$	Saturated	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Barium Sulfide **CAS# 21109-95-5** BaS	Saturated	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 248	---	---	---	---
Beer	--	R to 120	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 140	R to 68	---	---	---
Beet Sugar Liquors	--	---	R to 180	R to 180	R to 140	R to 73	R to 140	R to 230	R to 73	---	---	---	---
Benzaldehyde **CAS# 100-52-7** C_6H_5CHO	10%	N	N	R to 73	R to 73	R to 73	L to 73	L to 70	R to 73	R to 104	---	---	---
Benzene **CAS# 71-43-2** C_6H_6	--	N	N	N	N	N	N	N	N	---	R to 73	N	---
Benzene Sulfonic Acid **CAS# 98-11-3** $C_6H_5SO_3H$	10%	---	R to 180	R to 180	R to 140	R to 73	---	R to 175	R to 73	---	---	---	---
	10%+	---	N	---	N	---	---	R to 125	---	---	---	---	---
Benzoic Acid **CAS# 65-85-0** C_6H_5COOH	100%	R to 160	R to 180	R to 73	R to 140	R to 140	R to 140	R to 230	R to 140	---	---	---	---
Benzoyl Chloride **CAS# 99-88-4** C_6H_5COCl	Sat. Sol.	---	---	---	---	---	---	L to 68 R to 170 with sunlight protection or pigmented pipe	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Benzyl Alcohol **CAS# 100-51-6** $C_6H_5CH_2OH$	--	---	N	R to 120	N	R to 140	---	R to 250	R to 140	R to 68	---	---	---
Benzyl Chloride **CAS# 100-44-7** C_7H_7Cl	--	---	N	---	---	---	---	R to 285	R to 140	---	---	---	---
Bismuth Carbonate **CAS#5892-10-4** $(BiO)_2CO_3$	Saturated	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Black Liquor	Saturated	---	R to 180	R to 140	R to 140	R to 120	R to 140	---	R to 120	---	---	---	---
Bleach-See Sodium Hypochlorite													
Borax **CAS# 1303-96-4** $Na_2B_4O_7 \cdot 10H_2O$	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 275	R to 140	---	---	---	---
Boric Acid **CAS# 10043-35-3** H_3BO_3	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	R to 113	---
Bromic Acid **CAS# 15541-45-4** $HBrO_3$	Saturated	---	R to 180	N	R to 140	N	R to 140	R to 212	N	---	---	---	---
	10%	---	---	---	---	R to 140	---	---	---	---	---	---	---
Bromine **CAS# 7726-95-6** Br_2	Liquid	R to 73	N	N	N	N	N	R to 248	N	N	---	---	---
	vapor 25%	---	R to 180	N	R to 140	N	---	---	N	---	---	---	---
Bromine Water	Saturated	---	R to 180	N	R to 140	N	L to 73	R to 176	N	---	---	---	---
Bromobenzene **CAS# 108-86-1** C_6H_5Br	--	---	N	---	N	---	---	R to 150	---	---	---	---	---
Bromotoluene (Benzyl bromide) CAS# 95-46-5 $C_6H_5CH_2Br$	--	---	N	L	N	---	---	R to 175	---	---	---	---	---
Butadiene **CAS# 106-99-0** $H_2C=CHCH=CH_2$	50%	---	---	N	R to 140	R to 73	---	---	R to 73	---	---	---	---
	Gas	---	---	---	---	---	---	R to 212	---	---	---	---	---
Butane **CAS# 106-97-8** C_4H_{10}	50%	---	R to 180	R to 140	R to 140	R to 140	N	---	R to 140	---	---	---	---
	Gas	---	---	---	---	---	---	R to 68	---	---	---	---	---
n-Butanol **CAS# 71-36-3** C_4H_9OH	Liquid	---	L to 73	---	---	---	---	R to 140	---	---	---	N	---

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Butyl Acetate **CAS# 123-86-4** $CH_3COOCH_2CH_2CH_2CH_3$	100%	N	N	L to 73	N	L to 73	L to 73	L to 104	L to 73	R to 194	---	---	---
Butyl Alcohol **CAS# 71-36-3** $CH_3(CH_2)_2CH_2OH$	--	---	L to 73	R to 180	R to 140	R to 140	R to 140	R to 200	R to 140	L to 104	---	R to 73	---
Butyl Cellosolve **CAS# 111-76-2** $HOCH_2CH_2O(CH_2)_3CH_3$	--	---	N	---	R to 73	---	---	---	---	---	---	---	---
n-Butyl Chloride **CAS# 109-69-3** C_4H_9Cl	--	N	N	---	---	---	---	---	---	---	---	---	---
Butyl Glycol **CAS# 111-76-2** $HOCH_2CH_2O(CH_2)_3CH_3$	Liquid	---	N	---	---	---	---	R to 212	---	---	---	---	---
Butylene **CAS# 107-01-7** (isomer not specified) $CH_3CH=CHCH_3$	Liquid	---	---	N	R to 140	N	---	R to 285	N	---	---	---	---
Butyl Phenol **CAS# 98-54-4** (CH3)3C6H4OH	--	---	---	N	L to 73	R to 73	R to 73	R to 220	R to 73	---	---	---	---
Butyl Phthalate **CAS# 84-74-2** $C_{16}H_{22}O_4$	--	---	N	R to 180	---	---	---	R to 140	---	---	---	---	---
Butyl Stearate **CAS# 123-95-5** $CH_3(CH2)_{16}COO(CH_2)_3CH_3$	--	---	---	---	R to 73	---	---	---	---	---	---	---	---
Butynediol **CAS# 110-65-6** $HOCH_2C{\equiv}CCH_2OH$	--	---	---	---	R to 73	---	---	----	---	---	---	---	---
Butyric Acid **CAS# 107-92-6** $CH_3CH_2CH_2COOH$	--	N	N	R to 180	R to 73	R to 73	R to 73	---	R to 73	---			---
	20%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	Liquid	---	---	---	---	---	---	R to 176	R to 73	---			---
Cadmium Cyanide **CAS# 542-83-6** $Cd(CN)_2$	--	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Calcium Bisulfide $Ca(HS)_2 \cdot 6H_2O$	--	---	R to 180	---	N	R to 140	---	---	R to 140	---	---	---	---
Calcium Bisulfite	--	---	R to 180	R to 180	R to 140	N	R to 140	---	N	---	---	---	---

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CAS# 13780-03-5 $Ca(HSO_3)_2$	Saturated	---	---	---	---	---	---	R to 248	---	---	---	---	---
Calcium Carbonate $CaCO_3$	Saturated	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Calcium Chlorate CAS# 10137-74-3 $Ca(ClO_3)_2 \cdot 2H_2O$	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Calcium Chloride CAS# 10043-52-4 $CaCl_2$	Saturated	R to 120	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 176	R to 194	---	---	---
Calcium Hydrogen Sulfide CAS# 9046-53-1 $Ca(H_2S)$	>10%	---	---	---	---	---	---	R to 248	---	---	---	---	---
Calcium Hydroxide CAS# 1305-62-0 $Ca(OH)_2$	--	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 275	R to 140	---	---	---	---
	30%	---	---	---	---	R to 140	---	R to 275	R to 140	---	---	---	---
Calcium Hypochlorite CAS# 7778-54-3 $Ca(OCl)_2$	30%	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	L to 212	---	---	---	---	---
Calcium Nitrate CAS# 10124-37-5 $Ca(NO_3)_2$	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	---	---	---	R to 140	---	R to 212	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 176	---	---	---	---	---
Calcium Oxide CAS# 1305-78-8 CaO	--	---	R to 180	---	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Calcium Sulfate CAS# 7778-18-9 $CaSO_4$	--	R to 100	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Camphor CAS# 76-22-2 $C_{10}H_{16}O$	--	N	---	R to 73	R to 73	R to 73	---	---	R to 73	---	R to 73	---	---
Cane Sugar Liquors (Sucrose) CAS# 57-50-1 $C_{12}H_{22}O_{11}$	--	---	R to 180	R to 180	R to 140	R to 140	R to 150	R to 275	R to 140	---	---	---	---
Carbitol CAS# 111-90-0 $CH_3CH_2O(CH_2)_2O(CH_2)_2OH$	--	---	N	---	R to 73	---	---	---	---	---	---	---	---
Carbon Dioxide CAS# 124-38-9 CO_2	Dry 100%	R to 160	R to 180	R to 140	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
	Wet	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Carbon Disulfide **CAS# 75-15-0** CS_2	--	N	N	N	N	L to 140	---	---	L to 73	R to 104	---	N	---
Carbon Monoxide **CAS# 630-08-0** CO	Gas	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 140	R to 140	---	---	---	---
Carbon Tetrachloride **CAS# 56-23-5** CCl_4	--	N	N	N	R to 73	L to 73	N	L to 212	L to 68	N	---	N	---
Carbonic Acid **CAS# 463-79-6** H_2CO_3	Saturated	R to 185	R to 180	R to 140	R to 140	R to 140	---	R to 275	R to 140	---	R to 73	---	---
Castor Oil **CAS# 8001-79**	--	---	L to 180	R to 140	R to 140	R to 73	R to 140	R to 285	R to 73	---	---	---	---
Caustic Potash **CAS# 1310-58-3** KOH	50%	R to 160	R to 180	R to 180	R to 140	R to 140	R to 73	---	R to 140	---	---	---	---
Cellosolve **CAS# 110-80-2**	--	---	N	R to 73	R to 73	L to 120	R to 140	---	L to 120	---	---	N	---
Cellosolve Acetate **CAS# 111-15-9** $CH_3COOCH_2CH_2OC_2H_5$	--	---	N	R to 73	R to 73	---	---	---	---	---	---	---	---
Chloral Hydrate **CAS# 302-17-0** $CCl_3CH(OH)_2$	All	---	---	L to 73	R to 140	R to 120	R to 140	---	R to 120	---	---	---	---
Chloramine **CAS# 10599-90-3** NH_2Cl	Dilute	---	R to 180	R to 73	R to 73	R to 73	---	---	R to 73	---	N	---	---
Chloric acid **CAS# 7790-93-4** $HClO_3$	10%	---	R to 180	R to 73	R to 140	R to 73	---	---	R to 73	---	---	---	---
	20%	---	R to 185	R to 73	R to 140	R to 73	---	---	R to 73	---	---	---	---
Chlorine Gas **CAS# 7782-50-5** Cl_2	0-20 PPM moisture content	N	L to 73	N	L to 73	L to 73	---	R to 200 with sunlight cover or pigmented pipe	L to 73	---	---	---	---
	20-50 PPM moisture content	N	L to 73	N	N	L to 73	---	R to 200 with sunlight cover or pigmented pipe	L to 73	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
	50+ PPM moisture content	N	L to 73	N	N	L to 73	---	R to 200 with sunlight cover or pigmented pipe	L to 73	---	---	---	---
Chloroacetic Acid **CAS# 79-11-8** $CH_2ClCOOH$	50%	N	N	L to 73	R to 140	R to 120	N	N	R to 120	---	---	---	---
	>10%	---	---	---	---	---	---	R to 140 with sunlight cover or pigmented pipe	---	---	---	---	---
Chloroacetyl Chloride **CAS# 79-04-9** $ClCH_2COCl$	--	---	N	---	R to 73	---	---	---	---	---	---	---	---
Chlorobenzene **CAS# 108-90-7** C_6H_5Cl	Dry	N	N	R to 73	N	L to 73	N	R to 170 with sunlight cover or pigmented pipe	L to 73	---	---	---	---
	Liquid	---	---	---	---	---	---	R to 170 with sunlight cover or pigmented pipe	R to 68	L to 176	R to 73	---	---
Chlorobenzyl Chloride **CAS# 104-83-6** $ClC_6H_4CH_2Cl$	--	---	N	---	N	L to 120	---	R to 125	L to 120	---	---	---	---
Chloroethanol **CAS# 107-07-3** $ClCH_2CH_2OH$	Liquid	---	N	---	---	---	N	R to 122	---	---	---	---	---
Chloroform **CAS# 67-66-3** $CHCl_3$	Dry	N	N	N	N	L to 73	L to 73	---	N	---	N	N	---
	Liquid	---	---	---	---	---	---	R to 212	N	---	---	---	---
Chloromethane **CAS# 74-87-3** CH_3Cl	Gas	---	N	---	---	---	---	R to 212	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Chloropicrin CAS# 76-06-2 CCl_3NO_2	--	---	N	---	N	R to 73	---	R to 150	R to 73	---	---	---	---
Chlorosulfonic Acid CAS# 7790-94-5 $ClSO_2OH$	--	---	R to 73	N	R to 73	L to 120	N	---	N	---	---	---	---
	50%	---	---	---	---	---	---	R to 68 with sunlight cover or pigmented pipe	---	---	---	---	---
	100%	---	---	---	---	N	---	N	N	---	---	---	---
Chromic Acid CAS# 7738-94-5 H_2CrO_4	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
	10%	R to 73	R to 180	R to 140	R to 140	R to 73	R to 140	R to 212	R to 73	N	---	N	N
	30%	N	R to 180	R to 73	R to 140	R to 73	R to 140	R to 212	R to 73	---	---	N	N
	40%	N	R to 180	R to 73	R to 140	R to 73	R to 73	R to 212	R to 73	---	---	N	N
	50%	N	L to 140	R to 73	N	R to 73	N	R to 212	R to 73	---	---	N	N
Chromium Potassium Sulfate (dodecahydrate) CAS# 7788-99-0 $CrK(SO_4)_2 \cdot 12H_2O$	>10%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	--	---	---	R to 73	---	R to 73	---	---	R to 73	---	---	---	---
	Saturated	---	---	---	---	---	R to 212	---	---	---	---	---	---
Citric Acid CAS# 77-92-9 $C_6H_8O_7$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	L to 140	---	---	L
Coconut Oil CAS# 8001-31-8	--	---	L to 180	R to 73	R to 140	R to 73	R to 140	R to 248	R to 73	---	---	---	---
Cod Liver Oil	Work Sol.	---	L to 180	---	---	---	---	R to 248	---	---	---	---	---
Coffee	--	---	R to 180	R to 140	R to 140	R to 140	---	---	R to 140	---	---	R to 203	R to 203
Coke Oven Gas	--	---	---	R to 73	R to 140	R to 140	---	---	R to 140	---	---	---	---
Copper Acetate CAS# 142-71-2 $Cu(C_2H_3O_2)_2 \cdot H_2O$	Saturated	---	R to 73	R to 73	R to 73	---	---	R to 250	---	---	---	---	---
Copper Carbonate CAS # 12069-69-1 $CuCO_3$	Saturated	---	R to 180	---	R to 140	R to 140	---	R to 285	R to 140	---	---	---	---
Copper Chloride CAS# 7447-39-4 $CuCl_2$	Saturated	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Copper Cyanide **CAS# 544-92-3** CuCN	Saturated	---	R to 180	---	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Copper Fluoride Dihydrate **CAS# 13454-88-1** $CuF_2 \cdot 2H_2O$	2%	---	R to 180	R to 73	R to 140	R to 140	R to 140	R to 250	R to 140	---	---	---	---
Copper Nitrate **CAS# 3251-23-8** $Cu(NO_3)_2 \cdot 3H_2O$	30%	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	---	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Copper Sulfate **CAS#7758-99-8** $CuSO_4 \cdot 5H_2O$	Saturated	R to 120	R to 180	R to 120	R to 140	R to 140	R to 140	R to 212	R to 140	R to 194	---	---	---
Corn Oil **CAS# 8001-30-7**	--	---	L to 180	R to 73	R to 140	R to 120	---	R to 285	R to 120	---	---	R to 200	---
Corn Syrup **CAS# 8029-43-4** C6H12O6	--	---	R to 185	R to 140	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Cottonseed Oil **CAS# 8001-29-4**	--	R to 120	L to 180	R to 140	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---
Creosote	--	---	N	R to 73	N	R to 140	---	---	R to 140	---	---	---	---
Cresol **CAS# 95-48-7** $CH_3C_6H_4OH$	90%	N	N	R to 73	N	R to 73	N	R to 68	R to 73	---	---	---	---
Cresylic Acid **CAS# 106-44-5**	50%	---	N	---	R to 140	L to 73	N	R to 150	L to 73	---	---	---	---
Crotonaldehyde **CAS# 123-73-9** $CH_3CH=CHCHO$	--	---	N	L to 73	N	---	---	---	---	---	---	---	---
	Liquid	---	---	---	---	---	---	R to 104	--	---	---	---	---
Crude Oil **CAS# 8002-05-9**	--	---	L to 180	R to 140	R to 140	L to 120	L to 73	R to 212	L to 120	R to 140	---	---	---
Cupric Fluoride See Copper Fluoride Dihydrate											---		
Cupric Sulfate **CAS# 7758-99-8** $CuSO_4 \cdot 5H_2O$	Saturated	R to 100	R to 180	R to 73	R to 140	R to 140	---	---	---	---	---	---	---
Cuprous Chloride **CAS# 7758-89-6** CuCl	Saturated	R to 70	R to 180	---	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Cyclohexane **CAS# 110-82-7** C_6H_{12}	--	R to 73	R to 73	N	N	N	---	R to 275	N	L to 140	---	N	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Cyclohexanol **CAS# 108-93-0** $C_6H_{11}OH$	--	L to 120	L to 73	R to 140	N	R to 73	L to 73	R to 104	R to 73	---	---	---	---
Cyclohexanone **CAS# 108-94-1** $C_6H_{10}O$	Liquid	N	N	R to 73	N	R to 120	N	R to 75	R to 73	L to 140	---	---	---
Detergents (Heavy Duty)	--	---	L to 180	R to 180	R to 140	R to 140	---	---	R to 140	---	---	---	---
Dextrin (Starch Gum) **CAS# 9004-53-9**	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 140	---	---	---	---
Dextrose **CAS# 50-99-7** $C_6H_{12}O_6$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Diacetone Alcohol **CAS# 123-42-2** $CH_3COCH_2C(CH_3)_2OH$	--	---	N	R to 120	N	---	---	R to 75	---	L to 140	---	N	N
Dibutoxyethyl Phthalate **CAS# 117-83-9** $C_{20}H_{30}O_6$	--	---	N	---	N	---	---	---	---	---	---	---	---
n-Dibutyl Ether **CAS# 142-96-1** $C_4H_9OC_4H_9$	--	---	N	---	---	R to 73	---	---	R to 73	---	---	---	---
Dibutyl Phthalate **CAS# 84-74-2** $C_6H_4(COOC_4H_9)_2$	--	N	N	R to 73	N	R to 73	---	N	R to 73	---	---	N	---
Dibutyl Sebacate **CAS# 109-43-3** $C_4H_9OCO(CH_2)_8OCOC_4H_9$	--	---	N	R to 73	R to 73	R to 73	---	N	R to 73	---	---	---	---
Dichloroacetic Acid **CAS# 79-43-6** $CHCl_2COOH$	50%	---	N	---	---	---	---	R to 176	---	---	---	---	---
Dichlorobenzene **CAS# 25321-22-6** $C_6H_4Cl_2$	--	N	N	L to 73	N	L to 120	---	---	L to 120	---	---	N	---
	Liquid	---	---	---	---	---	---	R to 140	---	---	---	---	---
Dichloroethylene **CAS# 75-35-4** $C_2H_2Cl_2$	--	---	N	L to 73	N	L to 120	---	---	L to 120	---		---	---
	Liquid	---	---	---	---	---	---	R to 248	---	---	---	---	---
Diesel Fuels	--	---	L to 180	R to 140	R to 140	R to 73	L to 73	R to 212	R to 73	---	R to 73	R to 122	R to 122
Diethanolamine **CAS# 111-42-2** $(CH_2CH_2OH)_2NH$	Solid	---	---	---	---	---	---	N	---	---	---	---	---
	20%	---	---	---	---	---	---	---	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Diethylamine **CAS# 109-89-7** $C_4H_{10}NH$	--	N	N	---	N	L to 120	N	N	L to 120	---	---	---	---
Diethyl Ether **CAS# 60-29-7** $C_4H_{10}O$	--	N	N	R to 73	R to 73	L to 140	---	---	L to 140	R to 140	---	N	---
Diglycolic Acid **CAS# 110-99-6** $O(CH_2COOH)_2$	Saturated	---	R to 73	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	10%	---	---	---	---	---	---	R to 140	---	---	---	---	---
Dimethylamine **CAS# 124-40-3** $(CH_3)_2NH$	--	---	N	R to 73	R to 140	R to 73	N	N	R to 73	---	---	---	---
Dimethylformamide **CAS# 68-12-2** $HCON(CH_3)_2$	--	N	N	R to 180	N	R to 120	---	N	R to 120	---	---	---	---
	Liquid	---	---	---	---	---	---	N	N	---	---	---	---
Dimethylhydrazine **CAS# 57-14-7** $(CH_3)_2NNH_2$	--	---	N	---	N	---	---	---	---	---	---	---	---
Dimethyl Phthalate **CAS# 131-11-3** $C_6H_4(COOCH_3)_2$	--	---	N	---	---	L to 73	---	R to 75	L to 73	---	---	---	---
Dioctyl Phthalate **CAS# 117-81-7** $C_6H_4(COOC_8H_{17})_2$	--	N	N	L to 73	N	L to 73	L to 73	---	L to 73	R to 140	---	R to 73	---
Dioxane **CAS# 123-91-1** $C_4H_8O_2$	--	--	N	L to 140	N	R to 140	---	---	R to 140	---	---	---	---
	Liquid	---	---	---	---	---	---	L to 68	---	---	---	---	---
Diphenyl Oxide **CAS# 101-84-8** $(C_6H_5)_2O$	Saturated	---	---	---	---	L to 73	---	---	L to 73	---	---	---	---
Disodium Phosphate **CAS# 7558-79-4** Na_2HPO_4	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
DOWTHERM A ethyl glycol **CAS# 110-80-5**	--	---	---	---	N	---	---	---	R to 180	---	---	---	---
Ethanol **CAS# 64-17-5** C_2H_5OH	40%	---	L to 140	---	---	---	---	R to 68	---	---	---	---	---
	95%	---	L to 140	---	---	---	---	R to 122	R to 140	---	---	---	---
	Liquid	---	L to 140	---	---	---	---	R to 122	R to 140	---	---	R to 122	---
Ether **CAS# 60-29-7** ROR	--	N	N	L to 73	N	R to 73	N	---	R to 73	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Ethyl Acetate **CAS# 141-78-6** $CH_3COOCH_2CH_3$	--	N	N	L to 140	N	R to 73	L to 73	---	R to 73	R to 140	---	N	---
	Liquid	---	---	---	---	---	---	L to 68	---	---	---	---	---
Ethyl Acetoacetate **CAS# 141-97-9** $CH_3COCH_2COOC_2H_5$	--	N	N	---	N	---	---	L to 75	---	---	---	---	---
Ethyl Acrylate **CAS# 140-88-5** $CH_2=CHCOOC_2H_5$	--	---	N	---	N	---	---	L to 75	---	---	---	---	---
Ethyl Alcohol-See Ethanol											---		
Ethyl Benzene **CAS# 100-41-4** $C_6H_5C_2H_5$	--	---	N	L to 73	N	L to 73	---	R to 125	---	---	---	---	---
Ethyl Chloride **CAS# 75-00-3** C_2H_5Cl	Dry	---	N	L to 73	N	L to 73	---	---	L to 73	---	---	---	---
	Gas	---	---	---	---	---	---	R to 212	---	---	---	---	---
Ethyl Chloroacetate **CAS# 105-39-5** $ClCH_2COOC_2H_5$	--	---	N	---	N	---	---	---	---	---	---	---	---
Ethyl Ether **CAS# 60-29-7** $(C_2H_5)_2O$	Liquid	---	N	N	N	N	N	R to 122	N	---	---	---	---
Ethylene Bromide **CAS# 106-93-4** $BrCH_2CH_2Br$	Dry	---	N	---	N	---	N	---	---	---	---	---	---
Ethylene Chloride **CAS# 75-01-4** (Vinyl Chloride) CH_2CHCl	Dry	N	N	L to 73	N	L to 140	---	R to 285	L to 140	---	---	N	---
Ethylene Chlorohydrin **CAS# 107-07-3** $ClCH_2CH_2OH$	--	---	N	R to 73	N	---	N	---	---	---		---	---
	Liquid	---	---	---	---	---	---	L to 68	---	---	---	---	---
Ethylene Diamine **CAS# 107-15-3** $NH_2CH_2CH_2NH_2$	--	N	N	R to 73	N	R to 140	---	---	R to 140	---	---	---	---
Ethylene Dichloride **CAS# 107-06-2** $C_2H_4Cl_2$	Dry	N	N	L to 140	N	L to 73	R to 140	---	L to 73	---	---	---	---
Ethylene Glycol **CAS# 107-21-1** $OHCH_2CH_2OH$	Liquid	R to 73	L to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 212	---	---	R to 73	---
	50% Solution	---	R to 180	---	---	---	---	---	---	---	---	R to 248	---

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Ethylene Oxide **CAS# 75-21-8** CH_2CH_2O	--	---	N	L to 73	N	R to 73	---	R to 200	R to 73	L to 140	---	---	---
2-Ethylhexanol **CAS# 104-76-7** $CH_3(CH_2)_3CHC_2H_5CH_2OH$	--	---	---	---	---	R to 73	---	R to 250	R to 73	---	---	---	---
Fatty Acids R-COOH	--	R to 160	R to 73	R to 120	R to 140	R to 120	R to 150	R to 285	R to 120	R to 194	---	---	---
Ferric Chloride (Aqueous) **CAS# 10025-77-1** $FeCl_3$	Saturated	R to 120	R to 180	R to 140	R to 140	R to 140	R to 150	R to 212	R to 140	---	---	---	---
Ferric Hydroxide **CAS# 1309-33-7** $Fe(OH)_3$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Ferric Nitrate **CAS# 10421-48-4** $Fe(NO_3)_3$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ferric Sulfate **CAS# 10028-22-5** $Fe_2(SO_4)_3$	--	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Ferrous Chloride **CAS# 7758-94-3** $FeCl_2$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Ferrous Hydroxide **CAS# 18624-44-7** $Fe(OH)_2$	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Ferrous Nitrate $Fe(NO_3)_2$	--	R to 160	R to 180	R to 140	R to 140	R to 140	---	R to 275	R to 140	---	---	---	---
Ferrous Sulfate **CAS# 7720-78-7** $FeSO_4$	--	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Fish Oil **CAS# 8016-13-5**	---	---	L to 180	R to 180	R to 140	R to 140	R to 140	R to 200	R to 140	---	---	---	---
Fluoroboric Acid **CAS# 16872-11-0** HBF_4	---	R to 73	R to 73	R to 140	R to 140	R to 140	---	---	R to 140	---	---	---	---
	Solid	---	---	---	---	---	---	R to 104	---	---	---	---	---
Fluorine Gas (Dry) **CAS# 7782-41-4** F_2	100%	---	L to 73	N	R to 73	L to 73	L to 73	---	L to 73	N	N	---	---
Fluorine Gas (Wet) **CAS# 7782-41-4** F_2	--	N	L to 73	N	R to 73	N	N	---	N	N	N	---	---

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Fluorosilicic Acid **CAS# 16961-83-4** H_2SiF_6	30%	---	R to 180	R to 140	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
	40%	---	R to 180	---	---	---	---	R to 140	---	---	---	---	---
	50%	---	R to 180	R to 73	R to 140	R to 140	R to 140	R to 212	--	---	---	---	---
	Saturated	---	R to 180	---	---	---	---	R to 212	---	---	---	---	---
Formaldehyde **CAS# 50-00-0** HCHO	Dilute	R to 160	R to 73	R to 140	R to 140	R to 140	R to 140	R to 176	---	L to 104	---	---	---
	35%	R to 160	N	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	R to 100	---
	37%	R to 160	N	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	50%	---	N	---	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Formic Acid **CAS# 64-18-6** HCOOH	10%	---	R to 180	---	---	---	---	R to 212	R to 140	N	N	---	---
	40%	---	---	---	---	---	---	R to 212	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 176	R to 140	---	---	---	---
	85%	---	---	---	---	---	---	R to 212	---	---	---	R to 122	---
	100%	N	L to 73	R to 140	R to 73	R to 140	R to 150	---	R to 140	---	---	---	---
Freon 11 **CAS# 75-69-4** CCl_3F	100%	N	N	N	R to 140	R to 73	---	---	R to 73	---	---	---	---
Freon 12 **CAS# 75-71-8** CCl_2F_2	100%	---	N	R to 73	R to 140	R to 73	---	---	R to 73	R to 68	---	R to 73	---
	Work. Sol.	---	N	---	---	---	---	R to 212	R to 68	---	---	---	---
Freon 21 **CAS# 75-43-4** $CHCl_2F$	100%	---	N	N	N	L to 120	---	---	L to 120	---	---	---	---
Freon 22 **CAS# 75-45-6** $CHClF_2$	100%	---	N	R to 73	N	L to 120	---	---	L to 120	R to 68	---	N	---
Freon 113 **CAS# 76-13-1** $C_2Cl_2F_3$	100%	---	N	N	R to 140	R to 73	---	---	R to 73	---	---	---	---
Freon 114 **CAS# 76-14-2** $C_2Cl_2F_4$	100%	---	N	N	R to 140	R to 73	---	---	R to 73	---	---	---	---
Fructose **CAS# 57-48-7** $C_6H_{12}O_6$	Saturated	R to 73	R to 180	R to 180	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---
Fruit Juice	Work. Sol.	---	---	---	---	---	---	R to 212	---	R to 104	R to 73	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Furfural **CAS# 98-01-1** C_4H_3OCHO	100%	N	N	N	N	L to 140	---	L to 75	L to 140	L to 140	---	---	---
Gallic Acid **CAS# 149-91-7** $C_6H_2(OH)_3COOH \cdot H_2O$	--	---	R to 180	---	R to 140	R to 73	---	L to 75	R to 73	---	---	---	---
Gasoline, Leaded	--	N	N	N	R to 140	R to 73	N	R to 285	R to 73	---	---	---	---
Gasoline, Unleaded	--	N	N	N	R to 140	R to 73	N	---	R to 73	---	---	---	R to 122
Gasoline (Fuel) **CAS# 8006-61-9**	--	---	---	---	---	---	---	R to 212	---	R to 160	---	---	R to 122
Gasohol	--	N	N	N	R to 140	R to 73	N	---	R to 73	---	---	---	R to 122
Gasoline, Sour	--	N	N	N	R to 140	L to 73	N	R to 285	L to 73	---	---	---	---
Gelatin **CAS# 9000-70-8**	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Glucose **CAS# 50-99-7**	--	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
$C_6H_{12}O_6 \cdot H_2O$	10%	---	---	---	---	---	---	R to 248	---	---	---	---	---
Glycerine **CAS# 56-81-5**	--	R to 140	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	R to 73	---
$C_3H_5(OH)_3$	Liquid	---	---	---	---	---	---	R to 248	---	---	---	---	---
	Saturated	---	N	R to 73	R to 140	R to 140	---	---	R to 140	---	---	---	---
Glycolic Acid	10%	---	---	---	---	---	---	R to 212	---	---	---	---	---
CAS# 79-14-1	30%	---	---	---	---	---	---	R to 140	---	---	---	---	---
$OHCH_2COOH$	65%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Glyoxal **CAS# 107-22-2** OCHCHO	--	---	---	---	---	R to 140	---	---	R to 140	---	---	---	---
Grape Sugar **CAS# 50-99-7**	--	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Grapefruit Juice	Work. Sol.	---	---	---	---	---	---	R to 122	---	---	---	---	---
Grease	--	---	---	---	---	---	---	R to 250	---	R to 194	---	---	---
Green Liquor	--	R to 160	R to 180	---	R to 140	---	R to 140	---	---	---	---	---	---
n-Heptane **CAS# 142-82-5** C_7H_{16}	Liquid	R to 73	R to 73	N	R to 140	R to 73	N	R to 212	R to 73	---	---	N	---
n-Hexane **CAS# 110-54-3** C_6H_{14}	Liquid	L	R to 73	R to 73	R to 73	---	---	R to 176	---	---	R to 73	R to 73	---

Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Hexanol, Tertiary Type I **CAS# 25917-35-5** $CH_3(CH_2)_4CH_2OH$	--	---	L to 180	---	R to 140	R to 140	R to 140	R to 175	R to 140	---	---	---	---
Hydraulic Oil (Petroleum)	--	---	---	---	R to 73	R to 73	---	---	R to 73	---	---	---	---
Hydrazine **CAS# 302-01-2** H_2NNH_2	--	---	N	R to 73	N	---	---	R to 200	---	---	---	---	---
Hydrobromic Acid **CAS# 10035-10-6** HBr	20%	R to 73	R to 73	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	50%	N	---	R to 120	---	R to 140	---	---	R to 140	---	---	---	---
	66%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Hydrochloric Acid **CAS# 7647-01-0** HCl	10%	L to 120	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 212	L to 104	---	---	---
	20%	---	---	---	---	---	---	R to 212	R to 212	---	---	---	R to 212
	30%	L to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	R to 140	R to 122
	Conc.	---	---	---	---	---	---	---	R to 140	---	---	---	---
Hydrocyanic Acid **CAS# 74-90-8** HCN	--	R to 160	R to 73	R to 73	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 248	---	---	---	---	---
	10%	---	---	---	---	---	---	R to 248	---	---	---	---	---
Hydrofluoric Acid **CAS# 7664-39-3** HF	Dilute	R to 73	R to 180	R to 180	R to 73	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	30%	N	L to 180	R to 140	R to 73	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	N	N	R to 73	R to 73	R to 120	R to 140	R to 212	R to 120	---	---	---	---
	60%	---	---	---	---	R to 140	---	R to 140	R to 140	---	---	---	---
	70%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	100%	N	N	L to 73	N	R to 120	---	---	R to 120	---	---	---	---
	Gas	---	---	---	---	---	---	R to 104	---	---	---	---	---
Hydrogen **CAS# 1333-74-0** H_2	Gas	---	R to 73	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	R to 194	---	---	---
Hydrogen Cyanide **CAS# 74-90-8** HCN	--	---	---	R to 73	R to 140	---	---	R to 275	---	---	---	---	---
Hydrogen Fluoride, Anhydrous **CAS# 7664-39-3** HF	--	---	L	R to 73	N	---	---	R to 200	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Hydrogen Peroxide **CAS# 7722-84-1** H_2O_2	10%	---	R to 180	---	---	---	---	R to 212	---	---	N	---	---
	30%	---	R to 180	---	---	---	---	R to 212	---	L to 104	---	R to 73	R to 73
	50%	---	R to 120	R to 73	R to 140	R to 140	N	R to 212	R to 140	---	---	---	---
	90%	---	---	L to 73	R to 140	R to 73	N	---	R to 73	---	---	R to 73	---
Hydrogen Phosphide (Type I) **CAS # 7803-51-2** PH_3	--	---	R to 73	---	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Hydrogen Sulfide **CAS# 7783-06-4** H_2S	Dry	---	R to 180	R to 150	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
	Wet	---	R to 180	---	R to 140	R to 140	---	---	R to 180, L to 212	---	---	---	---
Hydrogen Sulfite **CAS# 15181-46-1** HO_3S	10%	---	---	---	---	R to 140	---	R to 248	R to 140	---	---	---	---
Hydroquinone **CAS# 123-31-9** $C_6H_4(OH)_2$	Saturated	---	R to 73	---	R to 140	R to 140	R to 140	R to 250	---	R to 140	---	---	---
Hydroxylamine Sulfate **CAS# 10039-54-0** $(NH_2OH) \cdot H_2SO_4$	--	---	---	---	R to 140	R to 140	---	---	R to 140	---	---	---	---
Hypochlorous Acid **CAS# 7790-92-3** HOCl	10%	R to 73	L to 180	R to 73	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	70%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Inks	--	---	---	R to 140	---	R to 140	---	---	R to 140	---	---	---	---
Iodine **CAS# 7553-56-2** I_2	10%	N	R to 73	R to 73	N	L to 120	N	R to 176	L to 120	---	---	---	---
IRM 901 Oil (ASTM #1)	--	---	180	L to 140	R to 140	R to 73	R to 140	R to 248	R to 73	---	---	---	---
IRM 902 Oil (ASTM #2)	--	---	180	L to 140	R to 140	R to 73	R to 140	---	R to 73	---	---	---	---
IRM 903 Oil (ASTM #3)	--	---	180	L to 140	R to 140	R to 73	R to 140	---	R to 73	---	---	---	---
Isobutyl Alcohol **CAS# 78-83-1** $(CH_3)_2CHCH_2OH$	--	L to 73	L to 73	R to 73	---	R to 140	---	R to 250	R to 140	---	---	---	---
Isooctane **CAS# 540-84-1** $(CH_3)_3CCH_2CH(CH_3)_2$	Liquid	---	---	L to 73	---	R to 73	---	R to 212	R to 73	---	---	---	---
Isopropyl Acetate **CAS# 108-21-4** $CH_3COOCH(CH_3)_2$	--	N	N	---	---	R to 73	---	---	R to 73	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Isopropyl Alcohol **CAS# 67-63-0** $(CH_3)_2CHOH$	--	---	L to 180	R to 212	R to 140	R to 140	R to 140	L to 212	R to 140	---	---	---	---
Isopropyl Ether **CAS# 108-20-3** $(CH_3)_2CHOCH(CH_3)_2$	--	---	N	L to 73	N	R to 73	---	R to 125	R to 73	---	---	---	---
JP-4 Fuel	--	---	L to 73	L to 73	R to 140	R to 73	---	R to 200	R to 73	---	---	R to 73	---
JP-5 Fuel	--	---	L to 73	L to 73	R to 140	R to 73	---	R to 200	R to 73	---	---	---	---
Kerosene **CAS# 8008-20-6**	--	R to 73	N	L to 140	R to 140	L to 140	L to 73	R to 285	L to 140	---	---	---	---
Ketchup	--	---	R to 180	---	R to 73	---	---	R to 285	---	---	---	R to 72	---
Ketones	--	N	N	L to 73	N	R to 73	---	---	R to 73	---	---	---	---
Kraft Liquors	--	R to 73	R to 180	---	R to 140	R to 120	R to 140	---	R to 120	---	---	---	---
Lactic Acid **CAS# 50-21-5** $CH_3CHOHCOOH$	10%	---	---	---	---	---	---	R to 140	---	---	---	---	---
	25%	R to 73	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	80%	N	L to 180	R to 140	R to 73	R to 140	---	---	R to 140	---	---	---	---
	Liquid	---	---	---	---	---	---	R to 212	---	R to 194	---	---	---
Lard Oil	--	---	L to 180	---	R to 140	L to 120	R to 73	---	L to 120	---	---	---	---
Latex	--	---	---	R to 140	---	R to 140	---	---	R to 140	---	---	---	---
Lauric Acid **CAS# 143-07-7** $CH_3(CH_2)_{10}COOH$	--	---	L to 180	R to 140	R to 140	R to 120	---	R to 230	R to 120	---	---	---	---
Lauryl Chloride (Type I) **CAS# 112-52-7** $CH_3(CH_2)_{10}CH_2Cl$	--	---	N	---	R to 140	R to 120	R to 73	R to 248	R to 120	---	---	---	---
Lead Acetate (trihydrate) **CAS# 6080-56-4** $Pb(CH_3COO)_2 \cdot 3H_2O$	Saturated	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Lead Chloride **CAS# 7758-95-4** $PbCl_2$	--	---	R to 180	R to 140	R to 140	R to 120	---	R to 250	R to 120	---	---	---	---
Lead Nitrate **CAS# 10099-74-8** $Pb(NO_3)_2$	Saturated	---	R to 180	R to 140	R to 140	R to 120	---	R to 250	R to 120	---	---	---	---
Lead Sulfate **CAS# 7446-14-2** $PbSO_4$	--	---	R to 180	R to 140	R to 140	R to 120	---	R to 250	R to 120	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Lead Tetraethyl **CAS# 78-00-2** $C_8H_{20}Pb$	--	---	---	---	---	---	---	R to 212	---	---	---	---	---
Lemon Oil **CAS# 8008-56-8**	--	---	N	L to 73	---	---	---	R to 250	---	---	---	---	---
Lemon Juice	--	---	---	---	---	L to 140	---	R to 250	L to 140	---	---	R to 122	---
Ligroin (*Petroleum Ether*) **CAS# 8032-32-4**	--	---	---	R to 140	---	---	---	R to 212	---	---	---	---	---
Lime Slurry	--	---	---	---	---	R to 140	---	---	R to 140	---	---	---	---
Lime Sulfur **CAS# 1344-81-6**	--	---	R to 73	R to 73	R to 73	R to 120	R to 140	---	R to 120	---	---	---	---
Linoleic Acid **CAS# 60-33-3** $CH_3(CH_2)_4(CH{=}CHCH_2)_2(CH_2)_6COOH$	--	---	L to 180	R to 180	R to 140	---	R to 73	R to 250	---	---	---	---	---
Linoleic Oil (Type I)	--	---	---	---	R to 140	---	R to 73	---	---	---	---	---	---
Linseed Oil **CAS# 8001-26-1**	--	73	L to 180	R to 140	R to 140	R to 73	R to 73	R to 248	R to 73	R to 194	---	---	---
Liqueurs	--	---	---	R to 140	R to 140	R to 120	R to 140	---	R to 120	---	---	---	---
Lithium Bromide **CAS# 7550-35-8** LiBr	--	---	---	R to 140	R to 140	R to 140	---	R to 230	R to 140	---	---	---	---
	65%	---	R to 180	---	---	---	---	R to 230	---	---	---	R to 212	R to 212
Lithium Chloride **CAS# 7447-41-8** LiCl	--	---	R to 180	R to 140	R to 140	R to 120	---	R to 250	R to 120	---	---	---	---
Lithium Hydroxide **CAS# 1310-65-2** LiOH	--	---	R to 73	R to 140	---	R to 120	---	---	R to 120	---	---	---	---
Magnesium Carbonate **CAS# 546-93-0** $MgCO_3$	--	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Magnesium Chloride **CAS# 7786-30-3** $MgCl_2$	Saturated	R to 120	R to 180	R to 140	R to 140	R to 140	R to 140	R to 140	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	----	R to 194	---	---	---
Magnesium Citrate **CAS# 6150-80-7** $MgC_6H_8O_7 \cdot 5H_2O$	--	---	R to 180	---	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Magnesium Hydroxide **CAS# 1309-42-8** $Mg(OH)_2$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Magnesium Nitrate **CAS# 10377-60-3** $Mg(NO_3)_2 \cdot 2H_2O$	--	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Magnesium Oxide **CAS# 1309-48-4** MgO	--	R to 160	R to 180	---	---	---	---	---	---	---	---	---	---
Magnesium Sulfate **CAS# 7487-88-9** $MgSO_4 \cdot 7H_2O$	--	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Maleic Acid **CAS# 110-16-7** HOOCCH=CHCOOH	Saturated	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	R to 140	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Malic Acid **CAS# 6915-15-7** $COOHCH_2CH(OH)COOH$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 140	---	---	---	---
Manganese Sulfate **CAS# 7785-87-7** $MnSO_4 \cdot 4H_2O$	--	---	R to 180	R to 180	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Margarine	Work Sol.	---	---	---	---	---	---	R to 248	---	---	---	---	---
Mercuric Chloride **CAS# 7487-94-7** $HgCl_2$	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	--	---	---	---	---	---	R to 212	---	---	---	---	---
Mercuric Cyanide **CAS# 592-04-1** $Hg(CN)_2$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Mercuric Sulfate **CAS# 7783-35-9** $HgSO_4$	Saturated	---	R to 180	R to 140	R to 140	R to 140	---	---	R to 140	---	---	---	---
Mercurous Nitrate (Dihydrate) **CAS# 14836-60-3** $HgNO_3 \cdot 2H_2O$	10%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Mercury **CAS# 7439-97-6** Hg	Liquid	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	R to 194	---	---	---
Methane **CAS# 74-82-8** CH_4	--	N	R to 73	R to 73	R to 140	R to 140	---	R to 285	R to 140	R to 140	---	---	---
Methanol (Methyl Alcohol) **CAS# 67-56-1** CH_3OH	5%	---	R to 180	---	---	---	---	R to 140	---	---	---	---	---
	Liquid	---	N	R to 180	R to 140	R to 140	R to 140	L to 176	R to 140	---	R to 73	R to 73	---

Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Methoxyethyl Oleate **CAS# 111-10-4** $CH_3OCH_2CH_2OOCC_{17}H_{33}$	--	---	N	---	R to 73	---	---	---	---	---	---	---	---
Methyl Acetate **CAS# 79-20-9** $CH_3CO_2CH_3$	--	N	N	R to 140	N	L to 120	---	R to 100	L to 120	---	---	---	---
Methyl Acrylate **CAS# 96-33-3** $CH_2=CHCOOCH_3$	Tech Pure	---	N	---	---	R to 140	---	R to 100	R to 140	---	---	---	---
Methylamine **CAS# 74-89-5** CH_3NH_2	--	---	N	N	N	---	---	N	---	---	---	---	---
Methyl Bromide **CAS# 74-83-9** CH_3Br	--	---	N	N	N	L to 73	---	R to 285	L to 73	R to 68	---	---	---
Methyl Butyl Ketone **CAS# 591-78-6** $CH_3CO(CH_2)_3CH_3$	Liquid	---	N	---	---	---	---	L to 122	---	---	---	---	---
Methyl Cellosolve **CAS# 109-86-4** $HOCH_2CH_2OCH_3$	--	---	N	R to 73	N	L to 120	---	---	L to 120	---	---	---	---
Methyl Chloride **CAS# 74-87-3** CH_3Cl	Dry	N	N	N	N	L to 120	N	R to 285	L to 120	R to 68	---	---	---
Methyl Chloroform **CAS# 71-55-6** CH_3CCl_3	--	N	N	L to 73	N	L to 120	---	R to 125	L to 120	---	---	---	---
Methyl Ethyl Ketone (MEK) **CAS# 78-93-3** $CH_3COC_2H_5$	100%	N	N	R to 73	N	N	R to 73	L to 68	R to 73	L to 140	---	N	---
Methyl Isobutyl Carbinol **CAS# 108-11-2** $(CH_3)_2CHCH_2CH(CH_3)OH$	--	---	N	---	N	---	---	---	---	---	---	---	---
Methyl Isobutyl Ketone **CAS# 108-10-1** $(CH_3)_2CHCH_2COCH_3$	--	N	N	R to 73	N	R to 73	---	---	R to 73	---	---	---	---
Methyl Isopropyl Ketone **CAS# 563-80-4** $CH_3COCH(CH_3)_2$	--	---	N	---	N	R to 73	---	---	R to 73	---	---	---	---
Methyl Methacrylate **CAS# 80-62-6** $CH_2=C(CH_3)COOCH_3$	--	---	N	---	R to 73	R to 140	---	R to 68	R to 140	---	---	N	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Methyl Sulfate **CAS# 77-78-1** $(CH_3)_2SO_4$	--	---	R to 73	L to 73	R to 73	R to 140	---	---	---	R to 68	---	---	---
Methylene Bromide **CAS# 74-95-3** CH_2Br_2	--	---	N	N	N	L to 120	---	R to 175	L to 120	---	---	---	---
Methylene Chloride **CAS# 75-09-2** CH_2Cl_2	100%	---	N	N	N	N	R to 73	L to 104	N	---	N	N	---
Methylene Chlorobromide **CAS# 74-97-5** CH_2ClBr	--	---	N	--	N	---	---	---	---	---	---	---	---
Methylene Iodide **CAS# 75-11-6** CH_2I_2	--	---	N	N	N	L to 120	---	R to 200	L to 120	---	---	---	---
Methylsulfuric Acid **CAS# 75-93-4** CH_3HSO_4	--	---	---	R to 140	R to 140	---	---	R to 150	---	---	---	---	---
Milk	--	R to 160	L to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	R to 194	R to 140	R to 200	---
Mineral Oil (Paraffin Oil) **CAS# 8012-95-1**	--	R to 73	R to 180	L to 140	R to 140	R to 73	L to 73	R to 212	L to 176	---	---	---	---
Molasses	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 140	---	---	---	---
Monochloroacetic Acid **CAS# 79-11-8** $CH_2ClCOOH$	50%	---	N	R to 140	R to 140	R to 140	---	---	R to 140	---	---	---	---
Monochlorobenzene **CAS# 108-90-7** C_6H_5Cl	Tech Pure	---	N	R to 73	N	L to 120	---	---	L to 120	---	---	---	---
Monoethanolamine **CAS# 141-43-5** $HOCH_2CH_2NH_2$	--	---	N	---	N	---	---	---	---	---	---	---	---
Motor Oil	--	---	R to 73	L to 140	R to 140	R to 140	---	R to 275	R to 140	---	---	---	---
Morpholine **CAS# 110-91-8** C_4H_8ONH	--	---	N	R to 140	---	R to 140	---	L to 75	R to 140	---	---	N	N
Mustard, Aqueous	Work. Sol.	---	---	---	---	---	---	R to 248	---	---	---	R to 72	---
Naphtha **CAS# 8030-30-6**	--	---	R to 73	R to 73	R to 140	R to 73	R to 73	R to 122	L to 176	R to 140	---	---	---
Naphthalene **CAS# 91-20-3** $C_{10}H_8$	--	---	R to 73	R to 73	N	R to 73	R to 73	R to 200	R to 73	R to 194	---	N	---

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Natural Gas **CAS# 68410-96-6**	--	R to 73	---	R to 73	R to 140	R to 140	R to 73	---	R to 140	---	---	---	---
Nickel Acetate **CAS# 373-02-4** $Ni(OOCCH_3)_2 \cdot 4H_2O$	--	---	R to 180	R to 73	---	R to 140	---	R to 250	R to 140	---	---	---	---
Nickel Chloride **CAS# 7718-54-9** $NiCl_2$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 250	R to 140	---	---	---	---
Nickel Nitrate **CAS# 13138-45-9** $Ni(NO_3)_2 \cdot 6H_2O$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Nickel Sulfate **CAS# 7786-81-4** $NiSO_4$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	R to 140	---
Nicotine **CAS# 54-11-5** $C_{10}H_{14}N_2$	--	---	---	---	R to 140	R to 140	R to 140	L to 70	R to 140	---	---	---	---
Nicotinic Acid **CAS# 59-67-6** C_5H_4NCOOH	--	---	---	---	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Nitric Acid **CAS# 7697-37-2** HNO_3	5%	---	---	---	---	---	---	R to 176	L to 140	N	N	R to 210	---
	10%	L to 73	R to 180	R to 180	R to 140	R to 73	L to 73	R to 212	L to 140	---	---	---	---
	20%	---	---	---	---	---	---	R to 212	L to 140	---	---	---	---
	30%	N	R to 130	R to 140	R to 140	R to 73	N	R to 212	L to 140	---	---	---	---
	40%	N	R to 120	R to 73	R to 140	R to 73	N	L to 248	L to 140	---	---	---	---
	50%	N	R to 110	N	R to 100	L to 73	N	---	L to 140	---	---	---	---
	65%	---	---	---	---	---	---	L to 248	---	---	---	---	---
	70%	N	R to 100	N	R to 73	L to 73	N	---	L to 73	---	---	---	---
	85%	---	---	---	---	---	---	N	---	---	---	---	---
	100%	N	N	N	N	N	N	---	N	---	---	---	---
Nitrobenzene **CAS# 98-95-3** $C_6H_5NO_2$	100%	N	N	L to 140	N	N	---	R to 122	N	---	---	---	---
Nitroglycerine **CAS# 55-63-0** $CH_2NO_3CHNO_3CH_2NO_3$	--	---	N	---	N	R to 73	---	R to 125	R to 73	---	---	---	---
	1%	---	N	---	---	---	---	R to 140	---	---	---	R to 73	R to 73

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Nitroglycol **CAS#628-96-6** $NO_3(CH_2)_2NO_3$	--	---	---	---	N	---	---	---	---	---	---	---	---
Nitrous Acid **CAS# 7782-77-6** HNO_2	10%	---	R to 73	L to 73	R to 140	R to 73	---	R to 125	R to 73	---	---	---	---
Nitrous Oxide **CAS# 10024-97-2** N_2O	--	---	R to 73	R to 73	R to 73	R to 73	---	---	R to 73	---	---	R to 68	---
n-Octane **CAS# 111-65-9** C_8H_{18}	--	---	R to 73	---	---	---	---	R to 285	---	---	---	R to 73	---
Oleic Acid **CAS# 112-80-1** $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$	--	R to 160	L to 180	R to 73	R to 140	L to 140	R to 150	R to 248	L to 140	R to 140	---	R to 73	---
Oleum **CAS# 57-06-7** $H_2SO_4 \cdot xSO_3$	--	N	N	N	N	N	N	N	N	---	N	---	---
Olive Oil **CAS# 8001-25-0**	--	R to 160	L to 180	R to 73	R to 140	R to 140	---	R to 248	R to 140	---	---	---	---
Oxalic Acid	50%	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
CAS# 144-62-7 $HOOCCOOH \cdot 2H_2O$	10%	---	---	---	---	---	---	R to 140	---	R to 140	---	---	---
	Saturated	---	---	---	---	---	---	R to 122	---	---	---	---	---
Oxygen Gas **CAS# 7782-44-7** O_2	--	R to 160	R to 180	N	R to 140	R to 140	---	R to 212	R to 140	R to 140	---	---	---
Ozone **CAS# 10028-15-6** O_3	--	---	R to 180	L to 73	R to 140	L to 120	---	R to 230	L to 120	L to 68	---	---	---
Palm Oil **CAS# 8002-75-3**	--	---	---	R to 73	---	R to 140	---	R to 230	R to 140	---	---	---	---
Palmitic Acid **CAS# 57-10-3** $CH_3(CH_2)_{14}COOH$	10%	R to 73	R to 73	R to 180	R to 140	R to 120	R to 150	R to 250	R to 120	---	---	---	---
	70%	---	R to 73	R to 180	R to 73	R to 120	---	R to 250	R to 120	---	---	---	---
Paraffin **CAS# 8002-74-2** $C_{36}H_{74}$	--	R to 73	R to 180	R to 140	R to 140	L to 140	---	R to 212	L to 140	---	---	---	---
Peanut Oil **CAS# 8002-03-7**	--	---	L to 180	R to 140	---	---	---	R to 275	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
n-Pentane **CAS# 109-66-0** $CH_3(CH_2)_3CH_3$	--	N	L to 180	N	L to 140	L to 120	---	---	L to 120	---	---	---	---
Peracetic Acid **CAS# 79-21-0** CH_3COOOH	40%	N	N	R to 73	R to 73	---	---	R to 150	---	---	---	---	---
Perchloric Acid (Type I) **CAS# 7601-90-3** $HClO_4$	10%	---	R to 73	---	---	---	---	R to 212	---	---	---	---	---
	15%	---	---	R to 140	R to 73	R to 140	L to 73	---	R to 140	---	---	---	---
	70%	R to 73	---	L to 73	R to 73	R to 73	N	R to 212	R to 73	---	---	---	---
Perchloroethylene **CAS# 127-18-4** (tetrachloroethylene) $Cl_2C=CCl_2$	--	N	N	L to 73	L to 140	L to 120	---	L to 212	L to 120	L to 68	---	N	---
Perphosphate **CAS# 7758-23-8**	--	---	---	R to 140	R to 73	---	---	---	---	---	---	---	---
Petroleum Ether **CAS# 8032-32-4**	--	---	---	R to 140	---	---	---	R to 212	---	---	---	---	---
Phenol **CAS# 108-95-2** C_6H_5OH	--	N	R to 73	R to 73	R to 73	R to 140	R to 73	---	R to 73	N	N	---	---
	5%	---	---	---	---	---	---	---	L to 73	---	---	L to 140	---
	50%	---	---	---	---	---	---	R to 176	---	---	---	---	---
	90%	---	---	---	---	N	---	---	N	---	---	---	---
	Solid	---	---	---	---	---	---	L to 122	---	---	---	---	---
Phenylhydrazine **CAS# 100-63-0** $C_6H_5NHNH_2$	--	---	N	N	N	N	---	R to 104	N	---	---	---	---
Phenylhydrazine Hydrochloride **CAS# 59-88-1** $C_6H_5NHNH_2 \cdot HCl$	10%	---	---	---	---	---	---	R to 140	N	---	---	---	---
Phosphine **CAS# 7803-51-2** PH_3	Gas	---	---	---	---	---	---	R to 104	---	---	---	---	---
Phosphoric Acid **CAS# 7664-38-2** H_3PO_4	10%	---	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	R to 73	R to 180	R to 212	R to 140	R to 140	R to 73	R to 212	R to 140	L to 104	---	---	---
	80%								R to 212		---	---	---
	85%	---	R to 180	R to 212	R to 140	R to 73	---	---	R to 73	---	---	---	---
	90%								R to 212		---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
	98%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Phosphoric Anhydride **CAS# 1314-56-3** P_2O_5	--	---	R to 73	R to 73	R to 73	---	---	---	---	---	---	---	---
Phosphorous (Red) **CAS# 7723-14-0** P	--	---	---	---	R to 73	R to 140	---	L to 75	R to 140	---	---	R to 120	---
Phosphorous (White/Yellow) **CAS# 12185-10-3** P4	--	--	---	---	R to 73	R to 140	---	---	R to 140	---	---	R to 120	---
Phosphorus Oxychloride **CAS# 10025-87-3** $POCl_3$	Liquid	---	---	---	---	---	---	N	---	---	---	---	---
Phosphorus Pentoxide **CAS# 1314-56-3** P_2O_5	--	---	R to 73	R to 73	R to 73	R to 140	---	R to 200	R to 140	---	---	---	---
Phosphorus Trichloride **CAS# 7719-12-2** PCl_3	--	--	N	R to 73	N	R to 120	L to 73	R to 200	R to 120	---	---	---	---
Phthalic Acid **CAS# 88-99-3** $C_6H_4(COOH)_2$	--	---	N	R to 140	L to 140	R to 140	---	---	R to 140	---	---	---	---
	Susp.	---	N	---	---	---	---	R to 212	---	---	---	---	---
Picric Acid **CAS# 88-89-1** $C_6H_2(NO_2)_3OH$	10%	N	N	R to 73	N	R to 73	R to 73	R to 212	R to 73	L to 68	---	---	---
	Saturated.	---	---	---	---	---	---	R to 212	---	---	---	---	---
Pine Oil **CAS# 8002-09-3**	--	---	N	R to 140	---	R to 73	---	R to 200	R to 73	---	---	---	---
Plating Solutions (Brass)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Cadmium)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Chrome)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Copper)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Gold)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Lead)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Nickel)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Rhodium)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Silver)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Plating Solutions (Tin)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Plating Solutions (Zinc)	--	---	R to 180	R to 140	R to 140	R to 140	L to 73	R to 220	R to 140	---	---	---	---
Potash (Aq)-See Potassium Hydroxide **CAS# 1310-58-3** KOH													
Potassium Alum **CAS# 10043-67-1** $AlK(SO_4)_2 \cdot 12H_2O$	--	---	R to 180	---	R to 140	R to 140	---	R to 285	R to 140	---	---	---	---
Potassium Aluminum Sulfate **CAS# 10043-67-1** $AlK(SO_4)_2 \cdot 12H_2O$	--	---	R to 180	R to 180	R to 140	---	L to 73	---	---	---	---	---	---
Potassium Amyl Xanthate **CAS# 2720-73-2** $CH_3(CH_2)_4OC(=S)$-SK	--	---	---	---	R to 73	---	---	---	---	---	---	---	---
Potassium Bicarbonate **CAS# 298-14-6** $KHCO_3$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Potassium Bi- chromate **CAS# 7778-50-9** $K_2Cr_2O_7$	Saturated	---	R to 180	R to 140	R to 140	---	L to 73	R to 212	---	---	---	---	---
	40%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Bisulfate **CAS# 7646-93-7** $KHSO_4$	--	---	R to 180	R to 212	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
Potassium Borate **CAS#12045-78-2** $K_2B_4O_7 \cdot 4H_2O$	--	--	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Potassium Bromate **CAS# 7758-01-2** $KBrO_3$	--	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	10%	---	---	---	---	---	---	---	R to 180	---	---	---	---
Potassium Bromide **CAS# 7758-02-3** KBr	--	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Potassium Carbonate **CAS# 584-08-7** K_2CO_3	--	R to 73	R to 180	R to 180	R to 140	R to 140	R to 140	N	R to 140	---	---	---	---
Potassium Chlorate (Aqueous) **CAS# 3811-04-9** $KClO_3$	--	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 200 with sunlight cover or pigmented pipe	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Potassium Chloride **CAS# 7747-40-7** KCl	--	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Potassium Chromate **CAS# 7789-00-6** K_2CrO_4	--	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---
Potassium Cyanide **CAS# 151-50-8** KCN	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Potassium Dichromate **CAS# 7778-50-9** $K_2Cr_2O_7$	Saturated	--	R to 180	R to 180	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---
Potassium Ethyl Xanthate **CAS# 140-89-6** $KS_2COC_2H_5$	--	---	---	---	R to 73	---	---	---	---	---	---	---	---
Potassium Ferricyanide **CAS# 13746-66-2** $K_3Fe(CN)_6$	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---
Potassium Ferrocyanide **CAS# 13943-58-3** $K_4Fe(CN)_6 \cdot 3H_2O$	--	---	R to 180	R to 180	R to 140	R to 140	---	R to 248	R to 140	---	---	---	---
Potassium Fluoride **CAS# 7789-23-3** KF	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Potassium Hydroxide **CAS# 1310-58-3** KOH	10%	---	---	---	---	---	---	R to 176	---	---	---	---	---
	20%	---	---	---	---	---	---	R to 176	---	---	---	---	---
	25%	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	35%	---	---	---	---	---	---	---	---	---	---	R to 176	---
	50%	---	R to 180	---	---	---	---	R to 176	---	L to 104	L to 73	---	---
Potassium Hydrogen Sulfite **CAS# 10117-38-1** $KHSO_3$	10%	---	---	---	---	---	---	R to 140	---	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Hypochlorite **CAS# 7778-66-7** KClO	--	R to 160	R to 180	---	R to 140	R to 120	---	---	R to 120	---	---	---	---
	3%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Iodide **CAS# 7681-11-0** KI	--	---	R to 180	R to 73	R to 73	R to 140	---	R to 212	R to 140	---	---	---	---
Potassium Nitrate	--	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	L to 104	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
CAS# 7757-79-1 KNO_3	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Orthophosphate CAS# 7778-77-0 H_2KPO_4	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Perborate CAS# 13769-41-0 $KBHO_3$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 285	R to 140	---	---	---	---
Potassium Perchlorate CAS# 7778-74-7 $KClO_4$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 200	R to 140	---	---	---	---
Potassium Permanganate CAS# 7722-64-7 $KMnO_4$	10%	---	R to 180	R to 73	R to 140	R to 140	R to 140	R to 176	R to 140	---	N	---	---
	20%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	25%	---	R to 180	R to 73	R to 73	R to 140	---	---	R to 140	---	---	---	---
	30%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Potassium Persulfate CAS# 7727-21-1 $K_2S_2O_8$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 176	R to 140	---	---	---	---
Potassium Sulfate CAS# 7778-80-5 K_2SO_4	--	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	R to 194	---	---	---
Potassium Sulfide CAS# 1312-73-8 K_2S	--	---	R to 180	R to 140	---	R to 140	R to 140	R to 200	R to 140	---	---	---	---
Potassium Sulfite CAS# 10117-38-1 $K_2SO_3 \cdot 2H_2O$	--	---	R to 180	R to 140	---	R to 140	---	R to 200	R to 140	---	---	---	---
Propane CAS# 74-98-6 C_3H_8	--	---	R to 73	R to 73	R to 140	R to 140	R to 73	R to 248	R to 140	R to 140	---	---	---
Propargyl Alcohol CAS# 107-19-7 $HC{\equiv}CCH_2OH$	--	---	L to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Propionic Acid CAS# 79-09-4 $CH_3CH_2CO_2H$	--	N	N	R to 140	---	R to 140	---	R to 140	R to 140	---	---	N	L to 104
Propyl Alcohol (Type I) CAS# 71-23-8 $CH_3CH_2CH_2OH$	--	73	L to 73	R to 140	R to 140	R to 140	R to 140	R to 122	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Propylene Dichloride **CAS# 78-87-5** $CH_3CHClCH_2Cl$	100%	---	N	N	N	N	---	R to 200	N	---	---	---	---
Propylene Glycol **CAS#57-55-6** $C_3H_8O_2$	100					R to 180			R to 180		---		
	50% Aqueous					R to 180			R to 200		---		
Propylene Oxide **CAS# 75-56-9** CH_3CHCH_2O	--	---	N	R to 73	N	R to 140	---	N	R to 140	---	---	---	---
Pyridine **CAS# 110-86-1** $N(CH)_4CH$	--	---	N	L to 140	N	R to 73	---	R to 68	R to 73	L to 68	---	---	---
Pyrogallic Acid **CAS# 87-66-1** $C_6H_3(OH)_3$	--	---	---	---	R to 73	--	--	R to 100	---	---	---	---	---
Quinone **CAS# 106-51-4** $C_6H_4O_2$	--	---	---	R to 140	---	R to 140	---	---	R to 140	---	---	---	---
Rayon Coagulating Bath	--	---	R to 180	---	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Salicylaldehyde **CAS# 90-02-8** C_6H_4OHCHO	--	---	N	R to 73	N	R to 120	---	---	R to 120	---	---	---	---
Salicylic Acid **CAS# 69-72-7** $C_6H_4(OH)(COOH)$	--	---	---	R to 140	R to 140	R to 140	---	R to 212	R to 140	---	---	---	---
Selenic Acid Aq. **CAS# 13410-01-0** H_2SeO_4	--	---	R to 180	---	R to 140	R to 140	R to 140	R to 150	R to 140	---	---	---	---
Silicic Acid **CAS# 10193-36-9** $SiO_2 \cdot nH_2O$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Silicone Oil **(Polydimethylsiloxane)** **CAS# 63148-62-9**	--	---	R to 180	R to 212	R to 73	R to 73	---	R to 250	R to 73	---	---	---	---
Silver Acetate **CAS# 563-63-3** $AgCH_3COO$	Saturated	---	R to 180	---	---	---	---	R to 212	---	---	---	---	---
Silver Chloride **CAS# 7783-90-6** AgCl	--	R to 160	R to 180	R to 140	R to 140	---	---	R to 200	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Silver Cyanide **CAS# 506-64-9** AgCN	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Silver Nitrate **CAS# 7761-88-8** $AgNO_3$	--	R to 160	R to 180	R to 180	R to 140	R to 140	L to 73	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Silver Sulfate **CAS# 10294-26-5** Ag_2SO_4	--	R to 160	R to 180	R to 140	R to 140	R to 140	L to 73	R to 250	R to 140	---	---	---	---
Sodium Acetate **CAS# 127-09-3** CH_3COONa	Saturated	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Alum **CAS# 10102-71-3** $AlNa(SO_4)_2 \cdot 12H_2O$	--	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Sodium Aluminate **CAS# 1302-42-7** $Na_2Al_2O_4$	30%	---	---	---	---	---	---	---	---	---	---	R to 165	---
	Saturated	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Sodium Benzoate **CAS# 532-32-1** C_6H_5COONa	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Sodium Bicarbonate **CAS# 144-55-8** $NaHCO_3$	--	R to 73	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Bisulfate **CAS# 7681-38-1** $NaHSO_4$	--	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Sodium Bisulfite **CAS# 7631-90-5** $NaHSO_3$	--	---	R to 180	R to 140	R to 140	R to 140	---	R to 285	R to 140	---	---	---	---
Sodium Borate (Borax) **CAS# 1303-96-4** $Na_2B_4O_7 \cdot 10H_2O$	1%	---	---	---	---	---	---	---	---	---	---	R to 113	---
	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Sodium Bromide **CAS# 7647-15-6** NaBr	Saturated	R to 120	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	--	---	---	---	---	R to 248	---	---	---	---	---
Sodium Carbonate **CAS# 497-19-8** Na_2CO_3	--	R to 73	R to 180	R to 212	R to 140	R to 140	R to 140	N	R to 140	R to 140	---	---	---
	1.70%	---	---	---	---	---	---	---	---	---	---	R to 210	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Sodium Chlorate **CAS# 7775-09-9** $NaClO_3$	Saturated	---	R to 180	R to 140	R to 73	R to 140	R to 140	R to 250 with sunlight cover or pigmented pipe	R to 140	---	---	---	---
Sodium Chloride **CAS# 7647-14-5** NaCl	Saturated		R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	R to 194	---	---	---
	10%	---	---	---	---	---	---	R to 212	---	---	---	R to 140	---
Sodium Chlorite **CAS# 7758-19-2** $NaClO_2$	25%	---	R to 180	R to 73	N	R to 140	---	R to 250	R to 140	---	---	---	---
Sodium Chromate **CAS# 7775-11-3** $Na_2CrO_4 \cdot 4H_2O$	--	R to 120	R to 180	R to 140	---	R to 140	---	R to 176	R to 140	---	---	---	---
Sodium Cyanide **CAS# 143-33-9** NaCN	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Dichromate **CAS# 10588-01-9** $Na_2Cr_2O_7 \cdot 2H_2O$	Saturated	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
	20%	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Sodium Ferricyanide **CAS#14217-21-1** $Na_3Fe(CN)_6$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Sodium Ferrocyanide **CAS# 14434-22-1** $Na_4Fe(CN)_6$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Sodium Fluoride **CAS# 7681-49-4** NaF	--	R to 120	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Hydrogen Sulfite **CAS# 7631-90-5** $NaHSO_3$	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
Sodium Hydroxide (Caustic Soda) **CAS# 1310-73-2** NaOH	5%	---	---	---	---	---	---	L to 68	---	---	---	---	---
	15%	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	R to 212
	30%	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	N	R to 140	---	---	---	---
	50%	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	L to 104	---	R to 194	---
	70%	R to 120	---	R to 212	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Sodium Hypochlorite	--	R to 120	R to 180	R to 73	R to 73	R to 140	R to 140	---	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
CAS# 7681-52-9 NaOCl • $5H_2O$	2% Cl	---	---	---	---	---	---	R to 212	---	---	---	---	---
	5% Cl	---	R to 180	R to 120	R to 140	L to 140	---	---	L to 140	---	---	---	---
	12% Cl	R to 73	R to 180	R to 120	R to 140	R to 73	R to 140	R to 68	R to 73	---	---	R to 190	---
Sodium Iodide CAS# 7681-82-5 NaI	--	---	R to 180	---	R to 140	---	---	R to 285	---	---	---	---	---
Sodium Metaphosphate CAS# 10361-03-2 $(NaPO_3)n$	--	---	R to 180	R to 120	R to 140	---	---	---	---	---	---	---	---
Sodium Metasilicate CAS# 6834-92-0 Na_2SiO_3	100%	---	---	---	---	---	---	---	---	---	---	R to 212	
Sodium Nitrate CAS# 7631-99-4 $NaNO_3$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Nitrite 7632-00-0 $NaNO_2$	--	R to 160	R to 180	R to 73	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Palmitate CAS# 408-35-5 $CH_3(CH_2)_{14}COONa$	5%	---	R to 180	R to 140	R to 140	---	---	R to 250	---	---	---	---	---
Sodium Perborate CAS# 7632-04-4 $NaBO_3$ • $4H_2O$	--	R to 120	R to 180	R to 73	R to 140	R to 73	---	---	R to 73	---	---	---	---
Sodium Perchlorate CAS# 7601-89-0 $NaClO_4$	--	---	R to 180	R to 212	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Sodium Peroxide CAS# 1313-60-6 Na_2O_2	10%	---	R to 180	---	R to 140	R to 140	---	R to 200	R to 140	---	---	---	---
Sodium Phosphate CAS# 7601-54-9 NaH_2PO_4	Acid	R to 120	R to 180	R to 212	R to 140	R to 140	R to 140	R to 140	R to 140	---	---	---	---
	Alkaline	---	R to 120	R to 180	R to 212	R to 140	R to 140	---	R to 140	---	---	---	---
	Neutral	---	R to 120	R to 180	R to 212	R to 140	R to 140	---	R to 180	---	---	---	---
Sodium Silicate CAS# 6834-92-0 $2Na_2O \cdot SiO_2$	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	10%	---	---	---	---	---	---	R to 140	---	---	---	---	---
	50%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	100%	---	---	---	---	---	---	---	---	---	---	R to 194	---
Sodium Sulfate	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	---	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
CAS# 7757-82-6 Na_2SO_4	0.10%	---	---	---	---	---	---	R to 140	---	---	---	---	---
Sodium Sulfide **CAS# 1313-82-2** Na_2S	30%	---	---	---	---	---	---	---	---	---	---	R to 165	---
	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	---	R to 140	L to 104	---	---	---
Sodium Sulfite **CAS# 7757-83-7** Na_2SO_3	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Sodium Thiosulfate **CAS# 7772-98-7** $Na_2S_2O_3 \cdot 5H_2O$	--	---	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	R to 248	---	---	---	---	---
Soybean Oil **CAS# 8001-22-7**	--	---	L to 180	R to 73	---	R to 140	---	R to 275	R to 140	---	---	---	---
Stannic Chloride **CAS# 7646-78-8** $SnCl_4$	Saturated	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 275	R to 140	---	---	---	---
Stannous Chloride **CAS# 7772-99-8** $SNCl_2$	15%	R to 120	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	Saturated	---	---	---	---	R to 140	---	R to 285 with sunlight cover or pigmented pipe	R to 140	---	---	---	---
Starch **CAS# 9005-25-8**	--	---	R to 180	R to 140	R to 140	R to 140	---	R to 230	R to 140	---	---	---	---
Soluble Starch **CAS# 9005-84-9** $(C_6H_{10}O_5)_n$	Saturated	---	R to 180	---	---	R to 140	---	---	R to 140	---	---	---	---
Stearic Acid **CAS# 57-11-4** $CH_3(CH_2)_{16}COOH$	--	---	R to 73	R to 73	R to 140	R to 120	R to 150	R to 285	R to 120	L to 194	---	---	---
Stoddard's Solvent **CAS# 8052-41-3**	--	---	N	---	N	R to 73	R to 140	---	R to 73	---	---	---	---
Styrene **CAS# 100-42-5** $C_6H_5CH=CH_2$	--	---	N	R to 73	---	L to 73	---	R to 175	L to 73	R to 104	---	---	---
Succinic Acid **CAS# 110-15-6** $COOH(CH_2)_2COOH$	--	---	R to 180	R to 140	R to 140	R to 140	---	---	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Sugar **CAS# 50-99-7** $C_6H_{12}O_6$	Aq.	---	R to 180	---	R to 140	R to 140	---	R to 285	R to 140	---	---	---	---
Sulfamic Acid **CAS# 5329-14-6** HSO_3NH_2	20%	--	N	R to 180	N	---	---	---	---	---	---	---	---
Sulfur **CAS# 7404-34-9** S	--	---	R to 180	R to 212	R to 140	R to 140	R to 140	R to 250	---	R to 104	---	---	---
Sulfur Chloride **CAS# 10025-67-9** S_2Cl_2	--	---	---	L to 73	---	---	---	R to 75	---	---	---	---	---
Sulfur Dioxide **CAS# 7446-09-5** SO_2	Gas Dry	N	R to 73	R to 140	R to 140	R to 140	---	R to 175	R to 140	---	---	---	---
	Gas Wet	N	N	R to 140	R to 73	R to 120	R to 73	R to 175	R to 120	---	---	---	---
Sulfur Trioxide **CAS# 7446-11-9** SO_3	Gas Dry	---	---	---	R to 140	N	---	N	N	L to 68	---	---	---
	Gas	---	N	---	R to 73	N	---	N	---	---	---	---	---
Sulfuric Acid **CAS# 7664-93-9** H_2SO_4	20%								R to 237		---		
	30%	R to 120	R to 180	R to 180	R to 140	R to 140	R to 140	R to 248	R to 180, L to 212	---	---	---	---
	50%	R to 73	R to 180	R to 140	R to 140	R to 120	L to 73		R to 140	---	---	---	R to 212
	60%	L to 73	R to 180	R to 73	R to 140	R to 120	L to 73	R to 248	---	---	---	---	---
	70%	L to 73	R to 180	R to 73	R to 140	R to 120	L to 73	---	---	---	---	---	---
	80%	L to 73	R to 180	R to 73	R to 140	R to 120	N	L to 248	R to 140	---	---	---	---
	90%	L to 73	R to 150	R to 73	R to 73	R to 120	N	R to 212	---	---	---	---	---
	93%	N	R to 140	L to 73	R to 73	L to 73	N	---	---	---	---	---	---
	94% - 98%	N	R to 130	L to 73	N	L to 73	N	L to 212	L to 85	---	---	R to 140	R to 140
	100%	N	N	N	N	N	N	---	N	L to 194	---	---	---
Sulfurous Acid **CAS# 7782-99-2** H_2SO_3	--	---	R to 73	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Tall Oil **CAS# 8002-26-4**	--	---	L to 180	R to 180	R to 140	R to 120	---	R to 285	R to 120	---	--	---	---
Tannic Acid **CAS# 1401-55-4** $C_{76}H_{52}O_{46}$	10%	N	R to 180	R to 73	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Tartaric Acid	--	R to 160	R to 180	R to 140	R to 140	R to 140	R to 140	R to 248	R to 140	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
CAS# 526-83-0 $HOOC(CHOH)_2COOH$	Saturated	---	---	---	---	---	---	R to 248	---	R to 194	---	---	---
Terpineol **CAS# 8000-41-7** $C_{10}H_{17}OH$	--	---	---	---	L to 140	---	---	---	---	---	---	---	---
Tetrachloroethane **CAS# 79-34-5** $CHCl_2CHCl_2$	--	---	N	L to 73	L to 140	L to 120	---	R to 230	L to 120	---	---	---	---
Tetrachloroethylene **CAS# 127-18-4** $Cl_2C=CCl_2$	--	N	N	L to 73	L to 140	L to 120	---	L to 212	L to 120	L to 68	---	---	---
Tetraethyl Lead **CAS# 78-00-2** $Pb(C_2H_5)_4$	--	---	R to 73	R to 73	R to 73	---	---	R to 285	---	R to 68	---	---	---
Tetrahydrofuran **CAS# 109-99-9** C_4H_8O	--	N	N	L to 73	N	L to 73	L to 73	L to 68	N	---	---	---	---
Tetralin **CAS# 119-64-2** $C_{10}H_{12}$	--	---	N	N	N	N	---	---	N	---	---	---	---
Tetra Sodium Pyrophosphate **CAS# 7722-88-5** $Na_4P_2O_7 \cdot 10H_2O$	--	---	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Thionyl Chloride **CAS# 7719-09-7** $SOCl_2$	--	---	N	N	N	N	R to 140	N	N	---	---	---	---
Tin (II) Chloride **CAS# 7772-99-8** $SnCl_2$	--	---	R to 180	---	---	---	---	R to 212	---	---	---	---	---
Tin (IV) Chloride **CAS# 7646-78-8** $SnCl_4$	--	---	R to 180	---	---	---	---	R to 212	---	---	---	---	---
Titanium Tetrachloride **CAS# 7550-45-0** $TiCl_4$	--	---	---	R to 140	L to 73	R to 120	---	---	R to 120	---	---	---	---
Toluene (Toluol) **CAS# 108-88-3** $CH_3C_6H_5$	--	N	N	L to 73	N	L to 120	N	R to 175	L to 120	R to 140	R to 73	N	N
Tomato Juice	--	---	R to 180	R to 212	R to 140	R to 140	---	R to 250	R to 140	---	---	---	---
Tributyl Citrate **CAS# 77-94-1** $C_{18}H_{32}O_7$	--	---	N	L to 73	R to 73	L to 120	---	---	L to 120	---	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Tributyl Phosphate **CAS# 126-73-8** $(C_4H_9)_3PO_4$	--	---	N	L to 140	N	R to 73	---	L to 75	R to 73	R to 194	---	---	---
Trichloroacetic Acid **CAS# 76-03-9** CCl_3COOH	50%	---	N	R to 140	R to 140	R to 140	---	R to 104	R to 140	---	---	---	---
	10%	---	N	---	---	R to 140	---	---	R to 140	---	---	---	---
Trichlorobenzene **CAS# 12002-48-1** $C_6H_3Cl_3$	--	---	N	---	---	---	---	R to 140	---	---	---	---	---
Trichloroethane **CAS# 71-55-6** $C_2H_3Cl_3$	--	---	N	---	---	---	---	R to 150	---	---	R to 73	N	---
Trichloroethylene **CAS# 79-01-6** $CHCl=CCl_2$	--	N	N	N	N	L to 120	N	R to 176	L to 68	L to 68	---	N	---
Triethanolamine **CAS# 102-71-6** $(HOCH_2CH_2)_3N$	--	L to 73	N	R to 140	R to 73	R to 73	R to 73	L to 104	R to 73	---	---	---	---
Triethylamine **CAS# 121-44-8** $(C_2H_5)_3N$	--	---	N	N	R to 140	R to 73	---	R to 125	R to 73	---	---	---	---
Trimethylolpropane **CAS# 77-99-6** $(CH_2OH)_3C_3H_5$	--	---	R to 73	R to 140	R to 73	L to 120	---	---	L to 120	---	---	---	---
Trisodium Phosphate **CAS# 10101-89-0** $Na_3PO_4 \bullet 12H_2O$	--	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Turpentine **CAS# 8006-64-2**	--	N	N	N	R to 140	L to 120	L to 73	R to 285	L to 120	R to 140	R to 73	---	---
Urea **CAS# 57-13-6** $CO(NH_2)_2$	--	---	N	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
	10%	---	---	---	---	---	---	R to 212	---	---	---	---	---
	Saturated	---	---	---	---	---	---	R to 176	---	L to 140	---	---	---
Urine	--	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	---	R to 140	---	---	---	---
Vaseline (Petroleum Jelly) **CAS# 8009-03-8**	--	---	N	R to 140	N	R to 120	---	R to 200	R to 120	---	R to 73	---	---
Vegetable Oil	--	---	L to 180	R to 140	R to 140	R to 140	---	R to 248	R to 140	---	---	---	---
Vinegar **CAS# 64-19-7**	--	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 250	R to 140	R to 194	---	---	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Vinyl Acetate **CAS# 108-05-4** $CH_3COOCH=CH_2$	--	---	N	R to 73	N	R to 140	---	L to 68	R to 140	---	---	---	---
Water, Acid Mine H_2O	--	R to 160	R to 200	R to 140	R to 140	R to 140	R to 180	R to 300	R to 180	---	---	---	---
Water, Hot Brine H_2O with NaCl)		--	--	--	--	--	--	--	--	--	--	--	--
H_2O with sylvinite (KCl, NaCl))		--	--	--	--	--	--	--	R to 237	--	--	--	--
Water, Deionized H_2O	--	R to 160	R to 200	R to 140	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Distilled H_2O	--	R to 160	R to 200	R to 212	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Potable H_2O	--	R to 160	R to 200	R to 212	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Salt H_2O	--	R to 160	R to 200	R to 212	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Sea H_2O	--	R to 160	R to 200	R to 212	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Soft H_2O	--	R to 160	R to 200	R to 212	R to 140	R to 140	R to 180	R to 300	R to 180	R to 194	R to 180	---	---
Water, Residential Waste H_2O	--	R to 73	R to 200	R to 212	R to 140	R to 140	R to 180	R to 275	R to 180	R to 194	R to 180	---	---
Whiskey	--	---	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
White Liquor	--	R to 73	R to 180	---	R to 140	---	---	---	---	---	---	---	---
Wine	--	R to 73	R to 180	R to 140	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
Xylene (Xylol) **CAS# 1330-20-7** $C_6H_4(CH_3)_2$	--	N	N	N	N	N	N	L to 140	N	L to 194	L to 73	---	---
Zinc Acetate **CAS# 557-34-6** $Zn(CH_3COO)_2 \cdot 2H_2O$	--	---	R to 180	---	---	---	---	R to 250	---	---	---	---	---
Zinc Carbonate **CAS# 3486-35-9** $ZnCO_3$	--	---	R to 180	R to 140	---	R to 140	---	R to 212	R to 140	---	---	---	---
Zinc Chloride **CAS# 76-46-85-7** $ZnCl_2$	--	R to 120	R to 180	R to 180	R to 140	R to 140	---	---	R to 140	---	---	---	---
	50%	---	---	---	---	---	---	---	---	L to 73	---	---	---
	Saturated	---	---	---	---	---	---	R to 212	---	---	---	---	---
Zinc Nitrate **CAS# 7779-88-6** $Zn(NO_3)_2 \cdot 6H_2O$	Saturated	R to 160	R to 180	R to 180	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	20%	---	---	---	---	---	---	---	---	---	---	R to 210	---

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Chemical Formula	Concentration	ABS	CPVC	PP (PP-R, PP-RCT)	PVC	PE (MDPE, HDPE, PE-RT)	PB	PVDF	PEX	PA11, PA12	PA66	PSU	PPSU
Zinc Oxide **CAS# 1314-13-2** ZnO	--	---	R to 180	---	---	---	---	R to 212	---	---	---	---	---
Zinc Stearate **CAS# 557-05-1** $(CH_3(CH_2)_{16}COO)_2Zn$	--	---	---	---	---	---	---	R to 122	---	---	---	---	---
Zinc Sulfate **CAS# 7733-02-0** $ZnSO_4 \cdot 7H_2O$	Saturated	R to 160	R to 180	R to 212	R to 140	R to 140	R to 140	R to 212	R to 140	---	---	---	---
	20%	---	---	---	---	---	---	---	---	---	---	R to 212	---

APPENDIX III.D – SOIL LINER QUALITY CONTROL PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

APPENDIX III.D – LINER QUALITY CONTROL PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL VERTICAL EXPANSION
PROJECT NO. 155488

REVISION 1
MAY 16, 2025

Part III, Appendix III.D
Liner Quality Control Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488



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prepared by

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Texas Firm Registration No. F-845

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List of Abbreviations

Abbreviation	Term/Phrase/Name
ASTM	American Society for Testing Materials
cm/sec	centimeters per second
ft^2	square foot
GCL	geosynthetic clay liner
GCLER	Geosynthetic Clay Liner Evaluation Report
GLER	Geomembrane Liner Evaluation Report
GEP Landfill	Greater El Paso Landfill, MSW Authorization Number 2284A (GEP Landfill)
GQCP	Geotechnical Quality Control Professional
GRI	Geosynthetic Research Institute
GRI-GM9	GRI Test Method GM 9 "*Cold Weather Seaming of Geomembranes*"
GRI-GM13	GRI-GM13 Standard Specification "*Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes*"
GRI-GM19a	GRI-GM19a Standard Specification "*Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers*"
HDPE	High Density Polyethylene
lbs/ft^2	pounds per square foot
LCS	Leachate Collection System
LQCP	Liner Quality Control Plan
mL	milliliter
MSW	municipal solid waste
QA	quality assurance
QC	quality control
POR	Professional of Record
psi	pounds per square inch
RG	Regulatory Guidance
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

III.D.1.0 Introduction [30 TAC §330.339]

III.D.1.1 General

This Liner Quality Control Plan (LQCP) has been prepared in accordance with Texas Administrative Code (TAC) Title 30, Chapter 330, Rule §330.339 and Texas Commission on Environmental Quality (TCEQ) Regulatory Guidance (RG)-534: *Guidance for Liner Construction and Testing for a Municipal Solid Waste Landfill*. The LQCP has been prepared under the direction of a licensed professional engineer.

The LQCP presents engineering and quality control requirements for each component of the liner and leachate collection system construction at the Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill). Details of the liner and leachate collection systems, including a cross sectional view of the liner system, are presented in Part III, Appendix III.C.

The LQCP shall be used in conjunction with the Site Development Plan appendices and final construction drawings and specifications. The LQCP addresses the following:

- A Quality Assurance (QA) Program and Procedures to be implemented during the composite liner construction including field observation, laboratory and field testing, and acceptance criteria for constructed work.
- Recording and documenting procedures to demonstrate that the constructed composite liner meets the requirements of project plans and specifications.
- Lines of communication, responsibilities, and role of QA team and other related project personnel.
- Report submittals required by the TCEQ.

III.D.1.2 Definitions

This section provides the definitions for terms used in this LQCP.

American Society for Testing and Materials (ASTM) – An organization of industry professionals that develops voluntary testing standards.

Earthwork Contractor – The firm responsible for excavation and subgrade preparation under the liner installation. The firm may also be responsible for placing protective cover and granular drainage materials over the installed lining system.

Fish Mouth – A semi-conical opening of the seam that is formed by an edge wrinkle in one sheet of the geomembrane.

Geomembrane Contractor – The firm responsible for handling, storing, placing, seaming, and other aspects of the installation of the geomembrane, geosynthetic cushion, and geotextiles as a part of the composite lining system.

Geomembrane Liner – Essentially an impermeable synthetic material used as an integral part of a lining system. It is sometimes referred to as a flexible membrane, sheet, or panel. On this project, the geomembrane liner will consist of a High Density Polyethylene (HDPE) material.

Geomembrane Liner Evaluation Report (GLER) – A stand-alone as-built report prepared per the methods and procedures contained in the approved LQCP that details the installation and testing of the geomembrane.

Geosynthetic Clay Liner (GCL) – GCLs are factory manufactured, hydraulic barriers typically consisting of bentonite clay or other very low permeability clay materials, supported by geotextiles and/or geomembranes which are held together by needling, stitching, and/or chemical adhesives.

Geosynthetic Clay Liner Evaluation Report (GCLER) – A stand-alone as-built report prepared per the methods and procedures contained in the approved LQCP that details the installation and testing of the GCL.

Geosynthetic Research Institute (GRI) – Located at Drexel University, the GRI conducts research with geosynthetic materials and develops industry testing standards for these materials. This institute is supported by many geosynthetic manufacturers, installers, and raw materials suppliers to the industry.

Geosynthetics – A generic classification given to synthetic (man-made plastic) materials used in geotechnical engineering applications. Included are geomembrane, geotextiles, geonets, geogrids, geocomposites, and geocells.

Geotechnical Quality Control Professional (GQCP) – Person(s) of firm(s) authorized by the Owner to manage and oversee the execution of the work. Also referred to as the Professional of Record (POR). The GQCP is responsible for observing, testing, and documenting activities related to liner QA during the installation of the lining system, and for issuing the final GLER and GCLER. All completed work is subject to approval of the GQCP. For liner construction work involving geosynthetics, the GQCP must be a professional engineer with experience in geosynthetics. The GQCP or his representative should be on site for all liner construction and testing for geosynthetic clay liners, geomembrane liners, geotextiles, and geocomposite materials. One hundred percent of all non-destructive testing of seams for geomembrane liners should be directly observed by the GQCP or his representative.

Geotextile – A permeable synthetic textile used with soil, rock, sand, gravel, or any other similar materials as an integral part of the composite lining system. It provides protection to the geomembrane as a geosynthetic cushion and serves as a filter interface between two types of soil materials.

High Density Polyethylene (HDPE) – A polymer prepared by low-pressure polymerization of ethylene as the principal monomer and having the characteristics of ASTM D1348, Type III and IV polyethylene. Such polymer resins have densities greater than or equal to 0.941 g/cc as noted in ASTM D1248.

Independent Testing Laboratory – A laboratory that is independent of ownership or control by the permittee or any party to the construction of the liner or the manufacturer of the liner products used.

Manufacturer – Firm(s) responsible for the production of geomembrane, geocomposite, and geotextile from resin.

Owner – The City of El Paso.

Project Documents – All contractor submittals, construction plans, “as-built” plans, construction specifications, quality assurance plan, safety plan, and project schedule.

Project Plans and Specifications – All project related plans and specifications including design modifications and “as-built” plans.

Quality Assurance (QA) – Actions taken by the Geotechnical Quality Control Professional (GQCP) to assure conformity of the liner system production and installation with the LQCP, drawings, and specifications. QA is provided by a party independent of installation.

Quality Assurance Laboratory – The firm responsible for conducting tests on samples of liner system components taken from the site. The laboratory shall be independent of the Owner, Manufacturer, Lining Contractor, and any party involved with the manufacture and/or installation of any of the geosynthetics.

Quality Control (QC) – Actions taken by the geosynthetic manufacturers and contractors to ensure that the geosynthetic materials and workmanship meet the requirements of project plans and specifications.

Qualified Engineering Technician – The qualified representative of the GQCP who is National Institute for Certification in Engineering Technician – Certified in Geotechnical Engineering Technology at Level 2 or higher, who is an engineering technician with a minimum of four years of direct related experience or a graduate engineer/geologist with one year of directly related experience.

Representative Sample – a representative sample of geomembrane material consists of one or more specimens (commonly referred to as coupons) from the same rectangular portion of geomembrane material, oriented along a seam that is removed for field or laboratory testing purposes.

Specimen – with respect to geomembrane destructive testing, a specimen is an individual test strip (sometimes called coupon) from a sample location. A sample location usually consists of many specimens.

Work – All tools, equipment, supervision, labor, and material or supplies necessary to complete the project as specified herein and as shown on the plans.

III.D.2.0 Geosynthetic Clay Liner

This section includes the requirements for selection, installation, and protection of GCL during liner construction for the GEP Landfill.

III.D.2.1 Manufacturing and Submittals

The active ingredient of the GCL shall be natural sodium bentonite. The bentonite shall be encapsulated between two geotextiles. The geotextile backed GCL shall provide sufficient internal shear strength for the slopes to be lined. All GCLs shall be evaluated for stability prior to use on site and the evaluation included in the GCLER submittal.

The bentonite shall be continuously adhered to both geotextiles to ensure that the bentonite will not be displaced during handling, transportation, storage, and installation, including cutting, patching, and fitting around penetrations. The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL manufacturer. The permeability of the GCL overlap seams shall be equal to or less than the permeability of the body of the GCL sheet.

The GCL manufacturer shall have a minimum of 2 years of continuous experience in the manufacture of similar GCL products. The GCL manufacturer must demonstrate, by submitting a list of previous projects, a minimum of 5 million square feet of manufacturing experience of similar GCL products.

Submit the following to the GQCP for approval prior to GCL deployment:

- Written certification that GCL manufacturer has continuously inspected each roll of GCL for the presence of broken needles using metal detectors and other defects and found GCL to be defect-free. The GCL manufacturer shall use magnets or other methods to remove broken needles from the GCL.
- Ensure that overlap alignment lines will be marked on the top side of the GCL as an installation guide.
- Label rolls with the GCL manufacturer’s name, product identification, roll and lot number, roll dimensions, roll weight, and any other information which is necessary to trace the quality assurance documentation.
- Wrap GCL rolls around cores that are structurally sound to prevent excessive bending or buckling during handling.
- Cover finished rolls with a waterproof, tightly fitting, weatherproof wrapping in preparation for shipment. GCL rolls must be stored indoors prior to shipment to the site.
- Quality control certificates signed by a responsible party of the GCL manufacturer for each roll delivered to the site. Each certificate shall include roll identification numbers and results of all quality control tests. At a minimum, results shall be given for tests corresponding to **Table III.D.2-1**. The bentonite and textile suppliers shall each certify the respective properties under Manufacturer's QC. The GCL manufacturer shall also perform the bentonite tests described under Manufacturer's QC and third-party tests.

Table III.D.2-1: Standard Tests for GCL Materials

Test	Item	Type of Test	Standard Test Method	Frequency of Testing
Manufacturer's Quality Control	Bentonite(A)	Free Swell(A)	ASTM D5890	Per 50 tons and every truck or railcar
		Fluid Loss(A)	API 13B or ASTM D5891	
	Geotextile	Grab Tensile Strength(B)	ASTM D4632	Per 200,000 square foot (ft^2)
		Mass/Unit Area	ASTM D5261	
	GCL Product	Grab Tensile Strength(B)	ASTM D4632	Per 200,000 ft^2
		Tensile Strength	ASTM D6768	
		Bentonite Mass/Unit Area(C)	ASTM D5993	Per 40,000 ft^2
		Bentonite Moisture Content	ASTM D2216, D4643, or D5993	
		Permeability(D)	ASTM D5084	Per week for each production line(E)
		Lap Joint Permeability(D)(F)	ASTM D5084	Per each material and lap type
Conformance Testing by Independent Laboratory	GCL Product	Clay Mass/Unit Area(C)	ASTM D5993	Per 100,000 ft^2
		Permeability(D)(F)	ASTM D5084	
		Direct Shear(F)(G)	ASTM D5321	Per GCL/adjoining material type

A – Tests to be performed on bentonite before incorporation into GCL. Free swell shall have a minimum test value of 24 milliliters (mL). Fluid loss shall have a maximum value of 18 mL.
B – For geotextile backed products only. Geotextiles shall meet minimum manufacturer's criteria.
C – Minimum test value of 0.8 pounds per square foot (lb/ft^2) on an oven dry basis (zero percent moisture).
D – Maximum 3×10^{-9} centimeters per second (cm/sec) permeability.
E – Report last 20 permeability values, ending on production data of supplied GCL.
F – Test at confining/consolidating pressures simulating field conditions.
G – Not applicable for slopes of 7H:1V or flatter. Testing must be on material in hydrated state unless GCL is to include geomembrane on both sides of GCL, and must use strain rates, confining pressures, and other parameters which simulate field conditions.

III.D.2.2 Delivery, Handling, and Storage

The Contractor will provide an on-site storage area for GCL rolls from time of delivery until installed as recommended by the GCL manufacturer. For off-loading and on-site delivery, use either a crane or front-end loader fitted with a sling and center rod, which is pushed through the core around which the GCL is rolled, or forklift with a "stinger," or other equipment that does not damage the GCL rolls.

GCL shall be stored on a platform or otherwise elevated off the ground and covered with a tarp to preclude moisture intrusion while awaiting deployment. GCL shall be stored and protected from dirt, water, ultraviolet light exposure, and other sources of damage. If the weatherproof wrapping is damaged and the outer portions of the GCL get wet or partially hydrated, the damaged portion of the GCL will be removed and the remainder of the roll will be covered tightly with weatherproof wrapping. The integrity and readability of GCL roll labels shall be preserved. Rolls must not be stacked higher than recommended by the manufacturer to preclude thinning of bentonite at contact points.

III.D.2.3 GCL Installation

The GQCP or their representative will collect samples delivered to the site or designated by the GCL manufacturer by roll number to be delivered to the site for conformance testing.

III.D.2.3.1 Subgrade Preparation

The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of geosynthetic materials and as recommended by the GCL manufacturer. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the GCL or other synthetic liner materials. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 3/4 inch. The subgrade must be rolled with a smooth-wheeled roller and not contain rough or uneven surfaces. Prior to GCL placement, ensure the soil surface is smooth, uniform, and compacted. During installation, ensure that rutting or raveling is not caused by installation equipment. Maintain adequate drainage of the soil surface until GCL installation is complete.

The Contractor shall submit to the GQCP a Subgrade Surface Acceptance Form, signed by the Contractor, for each area that will be covered directly by GCL as installation proceeds.

III.D.2.3.2 GCL Deployment

Handle GCL in a manner to ensure it is not damaged as recommended by the GCL manufacturer during GCL deployment. At a minimum, comply with the following:

- Installation personnel must not smoke or wear damaging shoes when working on GCL.
- Avoid dragging of the geotextile or bentonite facing of the GCL on the subgrade.
- Do not use deployed GCL as a work area unless a protective tarp, rub sheet, or other protective covering is placed over the GCL.
- Do not store generators, gasoline or solvent cans, tools, or other supplies directly on GCL.
- Install GCL panels with the proper side up.
- During GCL deployment, do not entrap in or beneath GCL, stones, trash, or moisture that could damage GCL.
- Place-by-hand, or by using light equipment with low contact pressure rubber tires (e.g., smooth-tired ATVs or golf carts), over other geosynthetics.
- Cover GCLs that are single geomembrane-backed with a second geomembrane on the bentonite side to prevent hydration of the bentonite.
- On slopes, anchor the GCL securely and deploy it down the slope in a controlled manner.
- Unroll GCLs on side slopes in the direction of the slope.
- Anchor GCLs at the top of the slope, and then unroll working down to keep the material free of wrinkles and folds.
- Do not allow horizontal seams on slopes steeper than 7H:1V.
- Overlap each panel in accordance with **Section III.D.2.3.3**.
- For needle-punched GCLs, add granular bentonite to the overlapped areas at the manufacturer's specified rate.
- Ensure deployed GCL panels contain no folds or excessive slack.
- Visually examine entire GCL surface. Ensure no potentially harmful foreign objects, such as needles, stones, cutting blades, tools, or other objects, are present.
- Prevent damage to underlying layers during placement of GCL. Avoid rutting of the subgrade by carefully selecting appropriate equipment to deploy GCL over soil.
- Vehicular traffic other than low contact pressure vehicles such as smooth-tired all-terrain vehicles or golf carts must not be allowed on deployed GCL.
- Do not place GCL in the rain or at times of impending rain.
- Avoid placing GCL during excessive winds (especially non-woven GCLs that require dry bentonite between the overlaps). Weight the GCL with sandbags or equivalent in the presence of wind.

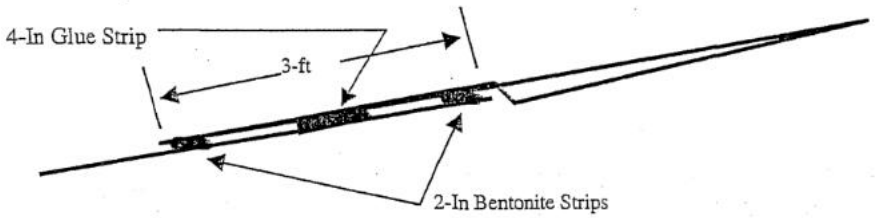
- Remove and replace with new GCL material if the bentonite material becomes partially hydrated before placement of overlying geomembrane.
- In general, only deploy GCL that can be covered during that day by geomembrane.
- Cut GCL with a cutter (hook blade), scissors, or other approved device. Project adjacent materials from potential damage due to cutting of GCL.
- Do not place GCL in areas of ponded water. Maintain adequate drainage of the soil surface until installation is complete.

III.D.2.3.3 Overlaps

Overlap GCL to the manufacturer's recommendations that will vary according to seam location and climatic conditions. For needle-punched GCLs, apply granular bentonite to overlapped area at a rate required by the manufacturer. At sumps, overlap GCLs at least 1 foot. At bottom of collection sumps, unroll an extra layer of GCL on top of previously installed GCL. Avoid placing seams on top of underlying seams.

In general, horizontal seams and mid-slope anchor trenches are not allowed on side slopes. However, if prohibitive slope lengths cannot otherwise be overcome, a glue-bonded seam may be approved by the GQCP. The following conditions must be met as provided in **Figure III.D.2-1**.

Figure III.D.2-1: Horizontal GCL Seam



1. The upper (up-slope) GCL panel shall overlap the lower (down-slope) panel by a minimum of three feet.
2. A wood-type glue shall be used to form a continuous glue-strip not less than four inches wide with sufficient glue to provide a uniform white coating on the lower GCL panel.
3. Two-inch wide granular bentonite strips shall be installed as shown in **Figure III.D.2-1**.
4. During startup, at least one destructive sample per 500 linear feet of proposed glued seam will be prepared and tested prior to approval of this method. All seams shall exhibit a tensile strength not less than the parent GCL panel. The glued seam shall not fail in the glued section.
5. Additional destructive testing of actual seams will not be required if the glued seams are verified to have been done in a similar fashion to the startup glued seams described above.

III.D.2.3.4 Defects and Repairs

Repair all flaws or damaged areas by placing a patch of the same material extending at least 1 foot beyond the flaw or damaged area. Add granular bentonite to the overlapped edges of the patch at the manufacturer's specified rate.

III.D.2.3.5 Quality Assurance/Quality Control Testing Requirements

QA/QC for the GCL installation shall consist of the following:

- Verify quality control testing of GCL products are completed and testing results meet the requirements specified in **Table III.D.2-1** are completed. These tests are generally performed by:

(1) the supplier of the various components (bentonite, geotextile, and geomembrane), (2) the GCL manufacturer, and (3) a third-party independent laboratory.

- Demonstrate that the overlap procedure produces a lap joint essentially as impermeable as the GCL itself. Use the same type of bentonite in the lap-joint as used in the manufacture of the GCL.
- Re-verify the lap joint permeability through testing if any of the component materials change.
- Complete lap joint testing as part of the conformance testing if lap joint permeability testing on the material used has not been done or is not valid.
- Conduct direct shear testing on hydrated GCL (for GCL which is not “sandwiched” between geomembranes) – include: (1) internal shear and (2) shear between GCL and underlying or overlying material (such as soil, geomembrane, geosynthetic material, etc.).
- Conduct the direct shear testing with site-specific materials for the initial liner area.
    - The direct shear testing does not need to be repeated for subsequent areas unless any of the component materials (such as either GCL or adjacent soil or geosynthetic) change.
    - If any of the component materials change, direct shear testing must be repeated with each material change.
- Demonstrate adequate stability of the GCL on the constructed slopes with the minimum strength parameters obtained in the direct shear testing.

III.D.2.4 Warranty

The Manufacturer shall provide a five (5) year warranty to the Owner against manufacturing defects. The warranty shall include defective products found to be not in compliance with the requirements of this LQCP. The warranty shall include the supply of the replacement GCL material. The warranty shall not include the cost of re-installation, defects, or failures due to improper installation.

III.D.2.5 Cell 13 Construction Supplemental Information

Attachment III.D.1 includes “as-built” information for construction measures taken during the placement of the soil and liner system on Cell 13 due to unforeseen field conditions and does not entitle future construction of the liner system per the measures discussed.

III.D.3.0 Geomembrane Liner

This section covers the work necessary to construct and test the geomembrane component of the base liner system, which will consist of a 60-mil High Density Polyethylene (HDPE) geomembrane material. The overall objective is to provide an effective lining system at the completion of the work. The geomembrane liner shall generally conform to the testing requirements of GRI-GM13 Standard Specification "*Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes*" (GRI-GM13) except as modified herein. Textured geomembrane liner will be used on the excavation side slopes. Smooth geomembrane liner will be used on the floor of the landfill.

III.D.3.1 Manufacturing and Submittals

III.D.3.1.1 Materials

The geomembrane liner materials shall be new, first quality products designed and manufactured specifically for the purposes of the work, and shall have satisfactorily demonstrated by prior use to be suitable and durable for such purposes. Reground, reworked, or trim material in the form of chips or edge strips may be added if the material is from the same manufacturer and is the same formulation in geomembrane being produced. Recycled or reclaimed materials must not be used in the manufacturing process.

The geomembrane liner shall be an unmodified HDPE containing no plasticizers, fillers, chemical additives, reclaimed polymers, or extenders. For ultraviolet resistance, the geomembrane liner shall contain between 2 percent and 3 percent carbon black as determined by ASTM D1603. The only other compound ingredients to be added to the geomembrane resin shall be antioxidants and heat stabilizers required for manufacturing that are less than 1 percent. The geomembrane shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 15 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams.

The manufacturing and conformance testing requirements for geomembrane liners are provided in **Table III.D.3-1**. The values in GRI-GM13 for all geomembrane material properties will also need to be met.

Extrusion resin used for fusion welding with extrudate to make field seams between geomembrane sheets and for repairs shall be produced from and the same material as the HDPE sheet resin. Physical properties shall be same as geomembrane lining sheets.

Additional conformance testing includes the verification that the geomembrane meets the required specifications prior to acceptance from the manufacturer and conformance testing required by an independent third-party laboratory.

The Contractor shall submit written certification by the Geomembrane Manufacturer that the lining materials conform to the requirements of the LQCP; are similar and of same formulation as that for which certification is submitted; and has been demonstrated by actual usage to be satisfactory for the intended application.

Table III.D.3-1: Standard Tests on HDPE Geomembrane Material

Test	Type of Test	Standard Test Method	Frequency of Testing
Resin	Melt Flow Index	ASTM D1238	Per 100,000 ft^2 and every resin lot
	Specific Gravity/Density	ASTM D1505/D792	
Manufacturer's Quality Control [B]	Thickness	ASTM D5199 (smooth) ASTM 5994 (textured)	Per manufacturer's QC specifications
	Specific Gravity/Density	ASTM D1505/D792	Per 100,000 ft^2 and every resin lot
	Carbon Black Content	ASTM D1603	
	Carbon Black Dispersion	ASTM D5596	
	Tensile Properties	ASTM D638 Type IV[(A)]	
	Tear	ASTM D1004	
	Puncture	ASTM D4833	
Conformance Testing by Independent Laboratory	Thickness	ASTM D5199 (smooth) ASTM 5994 (textured)	Per 50,000 ft^2 and every resin lot
	Specific Gravity/Density	ASTM D1505/D792	Per 100,000 ft^2 and every resin lot
	Carbon Black Content	ASTM D1603	
	Carbon Black Dispersion	ASTM D5596	
	Tensile Properties	ASTM D638 Type IV [A]	

A – NSF 54 modified with 2-inch initial gauge length assumed for elongation at break.
B – Manufacturer's quality control testing shall be completed in accordance with GRI-GM13.

III.D.3.1.2 Contractor's and Geomembrane Manufacturer's QC Program

The Geomembrane Manufacturer and the Contractor shall submit a complete description of its quality control program, as applicable, for manufacturing, handling, installing, testing, repairing, and providing a completed lining in accordance with requirements of the LQCP. The description shall include, but not be limited to, polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests, and acceptance.

The Quality Control Plan(s) to be implemented for the Work by the Geomembrane Manufacturer and the Contractor shall be in accordance with applicable paragraphs of the LQCP.

The Geomembrane Manufacturer shall always provide on-site technical supervision and assistance during installation of the lining system. The Geomembrane Manufacturer and Contractor, as applicable to each, shall submit for approval by the GQCP written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the LQCP, project specifications and drawings, and approved submittals.

III.D.3.1.3 Contractor's Installation Plan

Prior to start of work, the Geomembrane Manufacturer and the Contractor each shall submit for approval by the GQCP documented evidence of its ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of two (2) million square feet of similar lining material in solid waste containment structures. The Contractor can meet these criteria by teaming with a subcontractor who is identified in the bid along with the firm's experience.

The Contractor shall submit the name and qualifications of its project superintendent that will be on the project whenever lining materials are being handled/installed plus the names and qualifications of senior installation personnel on the project.

The Contractor shall submit installation drawings, description of installation procedures, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at its perimeter, making field seams, and making anchors/seals to pipes and structures.

The Contractor shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer and to the LQCP.

The Contractor shall submit for approval by the GQCP certification that the surface(s) on which the lining will be placed is acceptable. Installation of the lining shall not commence until this certification is furnished to the GQCP.

The Contractor shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer and to the LQCP.

The GQCP shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason which may result in a defective liner.

III.D.3.2 Delivery, Handling, and Storage

The Contractor shall submit for approval by the GQCP a method for handling and storage of lining material(s) which have been delivered to the project site. These materials shall be stored in accordance with the Manufacturer's recommendation.

All geomembrane liner materials shall be shipped in rolls. Folded or creased sections of panels are not acceptable and will not be used unless they are a normal part of the manufacturing process.

Geomembrane lining materials delivered to the site shall be inspected for damage and defects, such as pinholes, surface blemishes, and scratches. The geomembrane liners will be unloaded with cranes or forklifts at the job site’s temporary storage location with minimum handling to ensure no damage occurs. The materials will not be pushed, slid, or dragged.

The storage area will be suitably prepared, without stones or other rough objects. Materials will be kept dry and not stored directly on the ground to protect against soft, wet, rocky, and rough ground. The geomembrane liners shall be free from mud, soil, dirt, and debris.

Stacking of lining shall not be higher than five rolls to protect rolls from being crushed or flattened. The rolls will be secured to prevent shifting, abrasion, and other adverse movements. If the geomembranes are stored onsite for longer than 6 months, a cover or temporary shelter is necessary to protect against precipitation, ultraviolet exposure, and accidental damage.

The Contractor shall be completely responsible for shipping, storage, handling, and installation of all lining materials in compliance with the LQCP.

III.D.3.3 Geomembrane Liner Installation

Prior to installation of the geomembrane liner, a site inspection will be conducted by the GQCP and the Contractor to verify measurements, structures, and surface conditions to support the geomembrane liner.

III.D.3.3.1 Pre-Installation Meeting

The GQCP will initiate a pre-installation meeting with the Geomembrane Manufacturer and Contractor prior to installation of the lining system. Topics for review/discussion shall include, as a minimum, project plans and specifications, approved submittals, training, and qualification procedures for Contractor personnel, and demonstration of making a field welded seam(s) including peel and shear tests.

Prior to installation of the lining system, the Contractor shall instruct the workmen of the hazards of installation, such as handling sheets of lining material in high winds; use of equipment; application of solvents, adhesives, and caulks; and walking on lining surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements when working on the geomembrane. Safety shoes must be worn when handling heavy objects.

III.D.3.3.2 Subgrade Preparation

The following subgrade preparation procedures and manufacturer's recommendations shall be followed:

- Geomembrane liners are installed in direct and uniform contact with the underlying GCL liner.
- Contractor shall ensure that underlying GCL liner is not hydrated prior to geomembrane liner installation.

The Contractor will provide written documentation to the GQCP that surfaces to receive the geomembrane liner have been inspected and are acceptable for installation of the lining.

III.D.3.3.3 Geomembrane Liner Deployment

Prior to geomembrane deployment and throughout installation, the Contractor shall reduce any damage to the geomembrane liner by complying with the following:

- Inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site.
- Ensure the underlying GCL is not damaged during deployment.
- Ensure the geomembrane is not being placed during inclement weather such as rain, high winds, or freezing temperatures.
    - Unless the Contractor can demonstrate that installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised.
- Limit vehicular traffic on the liner to low-ground-pressure supporting equipment only. Any damaged areas due to vehicular traffic will be repaired by the Contractor under the supervision of the GQCP.
- No gasoline driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies.
- Prohibit personnel working on the geomembrane from smoking, wearing damaging shoes, and engaging in any other activity likely to damage the geomembrane.
- Repair any scuffed surfaces resulting from abuse of any kind at GQCP's direction.
- Only geomembrane sheets that are to be placed and seamed in one day shall be unrolled.

- Geomembrane liner field seams will be lap seams as shown on approved plans and drawings. The lap seams will be formed by lapping the edges of geomembrane liner sheets a minimum of 3 inches and visually inspected.
    - Lap seam intersections involving more than 3 thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2 feet.
- Placement of the geomembrane liner will be done such that good fit, direct, and uniform on all covers and grade changes and will be placed in such a manner as to reduce field seaming to a minimum.
- The lining will be anchored in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the GQCP.
- Excessive slack will be avoided to minimize rippling during subsequent layer construction.
- Bridging, wrinkles, folds, or fish mouths will be removed prior to seaming. Only normal factory-induced creasing may be acceptable.
- Cut, overlap, and weld the material where wrinkles or folds occur. Constructed seams are not required to carry significant tensile loads.
    - During wrinkle or fold repairs, adjacent geomembrane may not necessarily be required to meet the 3-inch minimum overlap if approved by the GQCP.
- The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials.
- For extrusion weld seams, bevel edge of geomembrane liner, and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one hour before seaming.
- Bond and seal all completed seals tightly.
- Double-sided tape, glue, or other methods will not be used in place of extrusion or fusion welding for bonding.
- For field seaming and repairs, fusion or extrusion welding is acceptable.
    - Any repairs to the geomembrane will be made with the HDPE lining material itself, using approved fusion welding systems, equipment, and techniques.
    - The patch size will be 6 inches larger in all directions than the area to be patched.
    - All corners of the patch will be rounded with a 1-inch minimum radius.
- Seams on side slopes will be oriented parallel to the side slope direction and no horizontal field seams will be allowed on the slope.
- Sheets of lining material on the slopes will extend down slope out onto bottom a minimum of 5 feet from toe of slope.
- The number of seams in corners and odd-shaped geometric locations will be minimized.
- Seaming will not be attempted when the ambient air temperature is above 104°F.
- Seaming will not be allowed when the ambient air temperature is below 32°F, unless GRI Test Method GM 9 “*Cold Weather Seaming of Geomembranes*” (GRI-GM9) standards are followed.
- Any unseamed edges at the end of each day or installation segment will be anchored with sandbags.
- No staples, U-shaped rods, or other penetrating anchors will be used.

Additionally during installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sandbags will be used as required to hold the lining material in position during installation. Sandbags will be sufficiently close-knit to preclude fines from working through the bottom, sides, or seams. Paper bags, whether lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags will contain not less than 40, nor more than 60 pounds of sand having 100 percent passing a number 8 screen and will be tied closed after filling, using only plastic ties. Bags that are split, torn, or otherwise losing their contents will be immediately removed from the work area and any spills immediately cleaned up. Metal or wire ties will not be used.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to ensure that no trash, tools, and other unwanted materials are trapped beneath the lining. Care will be taken to ensure that all scraps of lining material are removed from the work area prior to completion of the installation. During installation, water shall not be allowed to pond on the geomembrane liner material. The Contractor shall have available appropriate pumps to immediately remove ponding water.

III.D.3.3.4 Trial Seams

For seam testing, all test seam procedures and seam testing will be observed and performed by the GQCP. All seam testing will follow current ASTM standards and GRI-GM19a Standard Specification "*Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers*" (GRI-GM19a).

Each day prior to commencing field seaming, the following trial seam testing will be conducted under the same conditions for which the panels will be welded:

- Test seams will be made on fragment pieces of geomembrane to verify that adequate seaming conditions.
  - Every individual employee preforming seamer activities will make at least one test seam each day they perform field seaming to determine the peel and tensile strength of the seam.
  - The GQCP may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity.
- Test the welder and the machine for each new trial seam when using extrusion welding.
- Test the machine only for each new trial seam when using fusion welding.
- The trial weld sample must be a minimum of three feet long and one foot wide, with the seam centered lengthwise.
- Adjoining one-inch-wide specimens will be die-cut from the test seam sample.
  - A minimum of two peel and two shear tests will be performed per trial seam in the field.
  - Double wedge weld trial seams shall have a minimum of four peel tests performed.
- The extensometer testing apparatus used for peel and shear tests will have an updated calibration certificate that is traceable to National Bureau of Standards prior to the start of testing.
- Trial seam failure criteria are the same as for destructive seam testing.
- Test specimens exhibit acceptable break codes and properties as specified in the most current version of GRI-GM19a.
- Elongation measurements are not required for trial seams.
- For failed test specimens:
  - If one test specimen fails, repeat the trial seam.
  - If the repeated trail seam also fails, then construct and test two more trial seams.
  - Repeat this process until all test seams pass.
- Do not begin field welding, for the machine or welder (if applicable), until all test seams pass.

Additional trial seams may be required:

- At the beginning of each seaming period for each seaming apparatus used that day (the beginning of each seaming period is the morning, and immediately after a break).
- For each occurrence of significantly different environmental conditions (such as temperature, humidity, or dust).
- Any time the machine is turned off for more than 30 minutes.
- When seaming different geomembranes (e.g., tie-ins and smooth to textured liner).

Throughout trial seam testing, the GQCP must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results.

III.D.3.3.5 Destructive Testing

During the field seaming operation, destructive samples will be removed from field seams by the Contractor at locations selected by the GQCP. Repairs to the field seams will be made in accordance with repair procedures specified in this LQCP. The following details the destructive testing requirements:

- Take destructive test samples of field seams at a minimum of one stratified location for every 500 linear feet or major fraction thereof.
- Take destructive test samples of repaired geomembrane leaks and seams at a frequency of one stratified test every 500 linear feet or major fraction thereof. Individual repairs of leaks or failed seams, which are greater than 10 feet, shall count toward the 500 linear foot testing interval.
- Destructive samples will have a width of 12 inches plus the seam width and length of 42 to 48 inches.
- Conduct, at a minimum, a destructive test for each welding machine used for seaming or repairs.
- Take additional destructive test samples if deemed necessary by the GQCP.
- A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary.
- Field testing shall include at least two peel tests per sample (four for testing both tracks on dual-track fusion welded seams) and two shear test specimens.
- Independent laboratory testing shall consist of five shear tests and five peel tests per sample (ten for both tracks of dual-track fusion welded seams). The independent testing agency will save all test samples including specimens tested until notified by the GQCP relative to their disposal.
- Destructive seam-testing locations shall be cap-stripped over the entire length of the failed seam made with the same liner material and extend at least six inches in all directions. The cap will be completely seamed by extrusion welding to the geomembrane liner. Capped sections shall be non-destructively tested.
- Meet the break codes, strength, elongation, and percent peel separation as described in GRI-GM19a for all laboratory-tested specimens from a destructive-test location.
- Meet the break codes and strengths as described in GRI-GM19a for field-tested specimens.
- If a destructive test fails, an additional destructive test at least 10 feet on both sides of the failed destructive test will be conducted.
    - If any of the additional destructive tests fail, the sampling and testing process will be repeated until the failed seam is located by passing destructive tests.
- Any failed seam between passing destructive tests will be capped. Alternatively, all seams done by the welder or machine within the time period represented by the failed destructive test may be capped.
    - In the event capping of a field seam is required, the Contractor will use a cover strip of the same liner material and extend at least six inches in all directions. The cap will be completely seamed by extrusion welding to the geomembrane liner. Capped sections shall be non-destructively tested.

III.D.3.3.6 Non-Destructive Testing

Depending on seam welding equipment used, all seams and repairs will be non-destructive tested by a vacuum testing device, a spark testing device, and/or air pressure. To perform non-destructive testing, the following is required:

- Continuous non-destructive testing by the installer on all factory and field seams will be observed by the GQCP.
- Conduct:
  - Air-pressure testing for dual-track fusion welds.
  - Vacuum-box testing for all extrusion welds.
  - Spark testing with the use of conductive wires or liners.
- Isolate all indicated leaks and repair leaks.

Below are the steps for air-pressure testing:

1. Seal the ends of the air channel of the dual-track fusion weld and pressurize to approximately 30 pounds per square inch (psi) for HDPE geomembrane.
2. After pressure of 30 psi is reached, shut off the air pump.
3. Wait 5 minutes.
4. Observe the air pressure.

The air pressure will be observed under the guidance of a loss < 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends and a loss of ≥ 4 psi indicates the presence of a seam leak that will need to be isolated and repaired.

If an extrusion weld is used, the Contractor will further test all seams and repairs in the geomembrane liner by vacuum box. All vacuum box testing will be done in the presence of the GQCP. The area to be tested will be cleaned of all dust, debris, dirt, and other foreign matter. A soap solution will be applied to the test area and the suction vacuum of approximately 4 to 8 psi will be applied and held at least ten seconds to identify any suspicious areas as evidenced by bubbles in the soap solution.

The Contractor will further test all seams and repairs in the geomembrane liner by using a high voltage spark detector if vacuum box or air pressure methods cannot be performed. The setting of the detector will be 20,000 volts. In order to conduct this test, all seams to be tested will be provided with not less than gauge 24-30 copper wires properly embedded in the seams and grounded. All spark testing will be done in the presence of the GQCP. All defective areas will be marked for repair.

Defects will be clearly marked and repaired by installing patches or cap strips made from the same type of liner material and extend at least 6 inches in all directions of the faulty spot or area detected. Extrusion welding methods will be used to install the patch and the repairs will be retested destructively at a frequency of one stratified test every 500 linear feet and for each welding machine used. Individual repairs of leaks or failed seams, which are greater than 10 feet, shall count toward the 500 linear foot testing interval.

III.D.3.3.7 Repairs and Retesting

All geomembrane liner sheets, seams, anchors, seals, and repairs will be visually inspected by the Contractor for defects as the installation progresses and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the GQCP.

Repair all seam leaks, destructive test locations, and any other liner defects by installing patches or cap strips over the damaged area. The patch or cap strip must be of the same type of liner material and extend for a distance of at least six inches in all directions of the faulty spot or area detected. Use extrusion welding methods to install the patch or cap strip. At a minimum, repairs shall be non-destructively tested and possibly destructively.

All costs of retesting of the geomembrane liner including reruns of field weld tests and all repairs will be at the Contractor's expense.

III.D.3.3.8 Anchor Trench and Backfilling

The anchor trench should be completed around all portions of the geomembrane where the leading edge(s) of the geomembrane will not be needed for a tie-in for expansion into the next area to be lined. The excavated anchor trench shall have rounded corners in order to help protect the geomembrane. Do not allow loose soil to underlie the geomembrane in the anchor trench. Time excavations of the anchor trench closely with the installation of the geomembrane.

Backfill and compact the anchor trench to at least 90 percent of the maximum dry density as determined by the moisture/density compaction values determined in the soils portion of this document. Use care when backfilling and compacting the trench to prevent damage to the geomembrane. Backfill the anchor trench at the earliest practicable time following geosynthetics deployment. Results of the compaction testing need not be reported.

III.D.3.3.9 Geomembrane Liner Acceptance

The Contractor will retain responsibility for the integrity of the geomembrane liner system until acceptance by the GQCP. The geomembrane liner will be accepted by the GQCP when:

1. Installation is completed.
2. Written certification letters including “as built” drawings, have been received by the Contractor.
3. Documentation of completed installation, including all reports, is complete.
4. Verification of adequacy of field seams and repairs, including associated testing, is complete.

Acceptance of the completed work will include receipt of all submittals and all work completed to the satisfaction of the GQCP.

III.D.3.4 Warranty

III.D.3.4.1 Geomembrane Manufacturer’s Warranty

The Geomembrane Manufacturer shall furnish a written lining material warranty as described in GRI-GM13. The warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet or other normal weather aging. The warranty shall be limited to replacement of material only and shall not cover installation of said material.

III.D.3.4.2 Contractor’s Warranty

The Contractor shall furnish a written guarantee that the entire lining work constructed to be free of defects in material and workmanship and installed pursuant to the LQCP for a period of two (2) years following the date of acceptance of the work by the GQCP. During the 23rd month, a pre-guaranteed expiration inspection will be conducted to identify any necessary repair work covered by the guarantee. The Contractor shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Contractor shall make repairs and/or replacements promptly, the Owner may do so, and the Contractor shall be liable to the Owner for the cost of such repairs and/or replacements.

III.D.4.0 Leachate Collection System

A leachate collection system (LCS) will be placed above the Geomembrane Liner. The LCS will consist of a heat bonded geonet/geotextile drainage composite (geocomposite) on the floor and sidewalls with granular (gravel) drainage material embedded leachate collection pipes in the sump and pipe trench areas. The leachate collection pipes will consist of six-inch diameter pipe with 3/8-inch diameter holes on six-inch entrances. The LCS will be constructed to maintain less than a 30-cm depth of leachate over the liner and details regarding the performance of the liner system are provided in Part III, Appendix III.C.

III.D.4.1 Granular Drainage Media

To avoid piping losses into the collection pipes, the granular drainage material around the pipes shall consist of clean, rounded, river-run gravel meeting the requirements of ASTM C33 for coarse aggregate. Crushed material will not be acceptable. The gravel should meet the gradation requirements of Size No. 6 (nominal size 3/4 inch to 3/8 inch) or coarser. The maximum gravel size shall not exceed two-inches. The gravel will have a permeability of 1 x 10^{-2} cm/sec and the percent calcium carbonate by weight shall not exceed 15 percent (using J&L Test Method S-105-89, ASTM D3042, or other appropriate method). At least one set of pre-construction tests will be conducted for each drainage media from each proposed source. Granular drainage materials selected for use will be tested at regular intervals for conformance during construction. An independent laboratory will be used to conduct quality assurance testing on the granular drainage material at a frequency of 1 test per 3,000 cubic yards of material placed for grain size analysis (ASTM D6913) and permeability (ASTM D2434).

Place and spread granular materials using equipment and methods to minimize generation of fine particles. Granular drainage materials should not be compacted besides incidental compaction during placement. All tests will be conducted on material after placement to allow for any grain size reduction, which may occur during the placement process.

The required thickness of drainage materials will be verified by survey methods on an established grid system with not less than one verification point per 5,000 square feet of surface area.

A minimum of 8-ounce non-woven geotextile meeting the standard test requirements in **Table III.D.4-1** will be placed around the granular drainage materials to prevent intrusion of fines. All geotextile materials will be hand placed.

Placement of granular drainage materials over geomembrane liner will generally not proceed at ambient temperatures below 32°F or above 104°F and should be conducted at the coolest part of the day to minimize the development of wrinkles or folding of the geosynthetic materials. A minimum of one foot of material is required between low ground pressure dozers (i.e., track pressure less than 5 psi) and the geomembrane. Greater material thickness must be maintained above the geomembrane to support heavier spreading equipment and hauling vehicles. In such cases, a minimum of 2 feet of drainage material thickness will be used unless otherwise specified in the design. Granular materials should not be compacted, other than what is incidental to the placement and spreading process.

III.D.4.2 Geocomposite Drainage Materials

Geocomposite Drainage Materials will be formed of non-woven geotextile fabric heat bonded to a geonet core. Geotextile fabric used for the geocomposite will be a minimum of 8-ounce non-woven material

meeting the standard test requirements in **Table III.D.4-1**. The protective cover will be carefully spread on top of the geocomposite to avoid damage to the underlying geosynthetics.

Geocomposite Drainage Materials used on the liner floor will have either a single layer of geotextile fabric bonded to one side of the geonet core or a dual sided geotextile. If used, the single-sided geocomposite will be installed so that the geotextile is above the geonet core. Geocomposite Drainage Material used on the side slopes will have geotextile fabric bonded on both sides of the geonet core.

Geocomposite materials will be tested as described in **Table III.D.4-2**.

Table III.D.4-1: Standard Tests on Geotextile Materials

Test Category	Test	Test Method	Frequency of Testing
Manufacturer's Quality Control	Mass/Area	ASTM D5261	Per 100,000 ft^2 and every resin lot
	Grab Tensile Strength	ASTM D4632	
	Grab Elongation	ASTM D4632	
	CBR Puncture Strength	ASTM D6241	
	Thickness	ASTM D5199	
	Apparent Opening Size	ASTM D4751	
	Permittivity	ASTM D4491	

Table III.D.4-2: Standard Tests on Geocomposite Material

Test Category	Test	Test Method	Frequency of Testing
Manufacturer's Quality Control: Resin (geonet)	Specific Gravity/Density	ASTM D1505	Per 100,000 ft^2 and every resin lot
	Melt Flow Index	ASTM D1238	
Manufacturer's Quality Control: Geonet	Density	ASTM D1505	Per 100,000 ft^2 and every resin lot
	Mass/Area	ASTM D5261	
	Thickness	ASTM D5199	
	Compression	ASTM D1621	
	Transmissivity	ASTM D4716	
Manufacturer's Quality Control: Geotextile	Geotextiles shall be tested in accordance with **Table III.D.4-1**.		
Manufacturer's Quality Control: Geocomposite Product	Transmissivity	ASTM D4716	One test per product type
	Ply Adhesion	ASTM D7005	One test per project
Conformance Testing by Independent Laboratory	Transmissivity	ASTM D4716	One test per product type
	Ply Adhesion	ASTM D7005	One test per project

III.D.4.3 Leachate Chimneys

“Leachate chimneys” will be installed through the protective cover to allow a direct hydraulic conduit between the lowest waste layers and the LCS. A minimum 8-ounce geotextile will completely encase the pipe embedment gravel layer with a full-with geotextile overlap where the chimney daylights through the protective cover. The geotextile overlap will be covered by a minimum six-inch thick layer of the granular material used as the pipe embedment.

III.D.5.0 Ballast/Protective Cover

III.D.5.1 General

This section addresses the need for soil or waste ballast at the landfill and as well as covers the work necessary for construction of the protective cover system over the LCS. Two protective cover systems are proposed for use at the landfill. One system uses available soil on-site as the cover material. This system is described in **Section III.D.5.3**. The other system uses on-site soil material for the lower 12-inches and tire chips in the upper 12-inches. The alternative system of soil/tire chips is described in **Section III.D.5.4**.

III.D.5.2 Ballast

The landfill facility is located in a sand desert setting with very deep groundwater beneath the site as described in detail in Part III, Appendix III.E, Geology Report. A discussion of the consideration of local groundwater use is provided in Part III, Appendix III.E, Section III.E.5.0. Groundwater in this area is not anticipated to be used as groundwater, as discussed further in Section III.E.5.4. The northern portion of the facility is relatively flat; however, the southern portion exhibits significant elevation relief as the topography drops towards the distant Rio Grande River. Because of this topographic relief, excavation depths for this site vary from approximately 15 feet to 60 feet below the existing ground surface.

Based on historic measured groundwater depths, the excavated landfill cells will be well above the seasonal high-water table. As a result, ballasting of the cells against hydrostatic uplift will not be required at this facility.

III.D.5.3 Protective Cover Soil

A minimum 2-foot-thick protective cover will be placed above the LCS. The protective cover may use on site soil in combination with the chimneys described in **Section III.D.4.3**. The maximum gravel size shall not exceed two inches. Pre-construction and conformance testing for the protective cover soils will include maximum size gradation with a minimum conformance testing frequency of one grain-size analysis (ASTM D6913) per 5,000 cubic yards (or fraction thereof) of in-place material.

Protective cover does not require compaction control; however, it should be stable for construction and disposal traffic. Care will be exercised in placement so as not to shift, wrinkle, or damage the underlying geosynthetic layers, and the placement methods will be documented. Protective cover will be placed such that the top surface, while spreading, is always at least 2 feet above the geosynthetic layers, unless low ground pressure dozers are used (i.e., track pressure less than 5 psi), in which case at least one foot should be maintained between the dozer and the geosynthetics. A greater thickness will be maintained to support loaded hauling trucks and trailers and for turning areas. Drivers will proceed with caution when on the overlying soil and prevent spinning of tires or sharp turns.

Protective cover will generally be placed in an up-slope direction for sidewalls if the same material is being used. Where the top few feet of sidewall (typically less than 5 feet vertically) is to be protected by a different soil type, such as clay for tying in the final cover soil liner, this material may be placed from the top if adequate care is taken to protect the synthetic liner components.

The required thickness of protective cover will be verified by survey methods on an established grid system with not less than one verification point per 5,000 square feet of surface.

III.D.5.4 Protective Cover Soil/Tire Chips

Tire chips may be used to construct the protective cover's upper 12-inch-thick layer. The tire chips are to be placed on top of a soil layer that is a minimum 12-inches in thickness. The protective cover soil layer is necessary to prevent direct contact between the geomembrane liner and the tire chips.

Tire chips must be inspected prior to installation for verification that the following criteria is met:

1. Maximum size of tire chip, 2-inches measured in any direction
2. Tire chips are free of organic material, angular rock, or deleterious materials
3. Steel wire protruding from tire chip is not excessive and does not extend 3-inches beyond edge of tire chip

Prior to placement of tire chips, the lower 12-inch-thick layer of soil will be tested and verified using the procedure outlined in **Section III.D.5.3** of this LQCP. Any areas that do not meet the required 12-inch thickness shall receive additional soil material and the new thickness verified by additional survey for minimum requirements.

Upon verification that the lower soil level is at the required thickness, placement of tire chips may begin. Tire chips will be placed using similar equipment employed with the soil cover placement operation. Tire chips will be spread over the required area to a minimum thickness of 12-inches. Care must always be taken to avoid direct contact between the tire chips and geomembrane liner.

Following placement of tire chips, the area will be surveyed for thickness verification. A minimum of one measured survey point per 5,000 ft^2 of constructed surface area will be taken. The surveyed locations will coincide with the locations surveyed to verify lower protective cover soil layer thickness. Any locations that are not at the required thickness will receive additional tire chips until the proper thickness is obtained and verified by field survey. The results of the survey will be included in the Geomembrane Liner Evaluation Report (GLER).

III.D.6.0 Marking and Identifying of Evaluated Areas

Red markers will be placed so that all areas for which Geosynthetic Clay Liner Evaluation Report (GCLER) and Geomembrane Liner Evaluation Report (GLER) have been submitted and approved by the TCEQ are readily identifiable. Such markers are to provide site workers with immediate knowledge of the extent of approved disposal areas.

Red markers will be steel or wooden posts and will extend at least six feet above ground level. Markers will not be obscured by vegetation and will be placed so that they are not destroyed during operations. Sufficient intermediate markers will be installed to show the required boundary. Lost markers will be promptly replaced. Limits of the evaluated area will be referenced to the site grid system. Markers will not be placed inside the evaluated area or through the constructed liner.

III.D.7.0 GCLER, GLER, and Construction Documentation

Upon completion of all required liner construction and evaluation, the GQCP will prepare and submit both the Geosynthetic Clay Liner Evaluation Report (GCLER) and Geomembrane Liner Evaluation Report (GLER) to the TCEQ for review and approval. These will be submitted along with a construction documentation report. Multiple submittals of the reports or documentation during the project may be made, if they may facilitate review of the project by the TCEQ. The GCLER and GLER will be signed and sealed by the GQCP performing the evaluation and counter-signed by the site operator or his authorized representative.

The construction documentation will contain a narrative describing the conduct of work and testing programs required by the LQCP, "as-built" or record drawings, and appendices of field and laboratory data. Because the volume of data for these projects can be quite large, the documents may be subdivided for ease of review. The preferred document format will include the GCLER, GLER, narrative, as-built drawings, and summaries of test results in a single volume. The remaining appendices will be placed in accompanying volumes. GCLER and GLER submittals will include test documentation in a form as recommended in TCEQ technical guides.

Specifically, the construction documentation report will contain or discuss the following information, at a minimum:

- Geomembrane manufacture’s certifications, documentation of all manufacturer’s and independent testing, seaming and repair records, seam tests, and a site map showing locations and panels, repairs, and tests.
- GCL documentation of all manufacturer’s and independent materials tests, manufacturer’s certifications, stability analyses (if required), and a site map showing panel layout.
- Manufacturer’s certification and testing documentation for all geosynthetics.
- All test documentation for LCS components and protective cover.

The report will also include pertinent record drawings including:

- Area covered by all previous liner evaluation report submittals with the dates of acceptance by the TCEQ noted on the map
- Area covered by the current submittal
- Sectored fill layout plan
- Grid system of the site
- Graphic scale and north arrow
- Location of the subject trench or cell with GCLER/GLER markers
- Previous filled and active areas
- As-built panel layout drawings, showing location of destructive test samples, patches, and repairs
- As-built drawings showing elevations of protective cover to confirm thickness

The GQCP should supervise all field sampling and testing of components of the liner and its construction to ensure standards and requirements are followed. The GQCP must review the results of all field and laboratory testing of the liner and its construction for conformance to the approved LQCP. Any completed lined area that fails to meet the minimum specified conditions of the required tests must be reworked or

reconstructed to achieve the required results. Inability to achieve the required results through reworking is cause for rejection of the area in question. Retest all reworked areas to prove adequacy to meet all the applicable requirements. Per 30 TAC §330.341(b) and (c), no area may be used for the receipt of solid waste until the TCEQ has given confirmation of its acceptance of the documentation report or fourteen days from the date(s) of arrival of the documentation report at the TCEQ, MSW Permits Section, have lapsed.

ATTACHMENT III.D.1 – SLQCP SUPPLEMENTAL INFORMATION

MSW PA_2284_APL_20180109_Admin Review

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

January 9, 2018

RECEIVED
APR 03 2018
TCEQ
CENTRAL FILE ROOM

Ms. Ellen A. Smyth, P.E.
Director of Environmental Services
City of El Paso
7968 San Paulo Drive
El Paso, Texas 79907

Re: Greater El Paso Landfill – El Paso County
Municipal Solid Waste (MSW) – Permit No. 2284
Permit Modification – Soil Liner Quality Control Plan (SLQCP)
Tracking Nos.: 22229392; RN101478766/CN601410244

Dear Ms. Smyth:

We have reviewed your application for a municipal solid waste (MSW) permit modification dated November 10, 2017, requesting changes to the existing Soil and Liner Quality Control Plan for the above-referenced facility. The information presented is technically sufficient for a municipal solid waste permit modification.

Enclosed is a copy of the above referenced modification which is now part of the facility's permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Mr. Steve Odil at (512) 239-4568 or in writing at the address on our letterhead (please include mail code MC 124 on the first line).

This action is taken under authority delegated by the executive director of the Texas Commission on Environmental Quality.

Sincerely,

cgoodin

Chance Goodin, Manager
Municipal Solid Waste Permits Section
Waste Permits Division

CG/SPO/nck

cc: Mr. Nicholas N. Ybarra, Parkhill Smith & Cooper, Inc., El Paso

Enclosure

MSWPA_2284_APL_20171110_Applications

PARKHILLSMITH&COOPER

501 W. San Antonio
El Paso, Texas 79901
915.533.6811

November 10, 2017

Mr. Chance Goodin, Manager
Municipal Solid Waste Permits Section, MC 124
Texas Commission on Environmental Quality
Building A, Room 122
12100 Park 35 Circle
Austin, Texas 78753-1808

RECEIVED
NOV 17 2017
WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY

Re: City of El Paso, El Paso County, Texas
TCEQ MSW No. 2284
Permit Modification Request
Soil and Liner Quality Control Plan (SLQCP)

Dear Mr. Goodin:

In accordance with 30 Texas Administrative Code §305.70(j)(5), the City of El Paso requests a permit modification to the facility permit to make changes to the Soil and Liner Quality Control Plan (SLQCP). Changes to the SLQCP will be included as an appendix to the SLQCP with supplementary information addressing liner system construction measures taken during unforeseen field conditions. One original and one copy of the permit modification request are enclosed with this letter. An additional copy is also being transmitted to the Region 6 Office in El Paso.

Please call me at (915) 543-3357 if you have any questions.

Sincerely,

PARKHILL, SMITH & COOPER, INC.

By Nicholas H. Ybarra
Nicholas N Ybarra, P.E.
Project Manager

NYY/lc
Enclosures
\\Data1\Projects\2016\5128.16\02_DSGN\04_REPT\MOD_SLQCP_2017\00_cb_modltr.docx

cc: TCEQ Region 6 Office, El Paso
Mr. Cristian Benitez, City of El Paso

GREATER EL PASO LANDFILL

TCEQ MSW Permit No. 2284

City of El Paso, El Paso County, Texas

APPENDIX A - SLQCP SUPPLEMENTAL INFORMATION

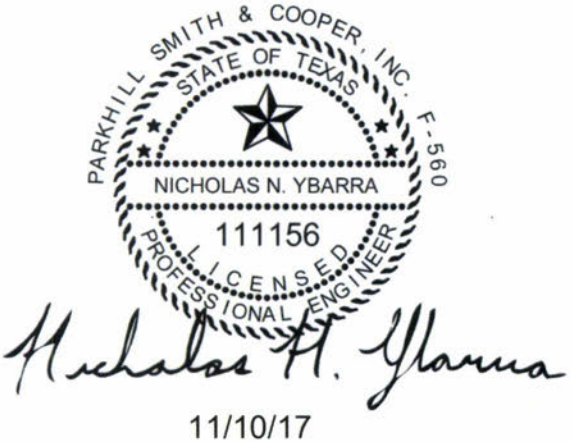
Prepared for:

City of El Paso
7968 San Paulo
El Paso, Texas 79907

NOVEMBER 2017

Prepared by:

Parkhill, Smith & Cooper, Inc. (PSC)
501 W. San Antonio
El Paso, Texas 79901
TBPE F-560



11/10/17

PSC Project No.: 01.5128.16

PARKHILLSMITH&COOPER

APPENDIX A - SLQCP SUPPLEMENTAL INFORMATION

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3. CONCLUSION 3

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ATTACHMENT A.2 – SHEAR STRESS CALCULATIONS
ATTACHMENT A.3 – TRI LABORATORY RESULTS

1.



11/10/17

1. INTRODUCTION

The Greater El Paso Landfill (MSW) Permit No. 2284 commenced construction of the soil and liner system on June 12, 2017 in accordance with the Soil and Liner Quality Control Plan (SLQCP). During construction, a portion of the in-place geosynthetic clay liner (GCL) material of the liner system became hydrate due to unforeseen field conditions of precipitation. Construction measures to remedy the issue involved drying the material, adding a layer of 10-mil plastic and a layer of reinforced GCL layer between the hydrated GCL and the geomembrane liner (GML), further discussed in detail.

2. HYDRATED GCL REMEDIATION – CELL 13

The hydrated GCL area in Cell 13 encapsulates an area of approximately 30,250 square feet. The hydrated GCL which runs through the center of the Cell 13 is placed at 2 percent on the southern half and 6 percent on the northern half. To remedy the issue, the GML covering the GCL was cut open and pulled back to expose the hydrated GCL approximately 10-ft past the saturated limit. The GCL was air dried for 2-days to stabilize the GCL and remove moisture. After the drying time was completed, a 10-mil poly sheeting material was placed over the remediated GCL to act as a moisture barrier. The 10-mil sheeting material extended 1-ft beyond the limits of saturation and was adhered to the GCL to prevent movement. A new reinforced GCL, extending 1-ft beyond the limits of the plastic sheeting, was heat bonded to the lower GCL layer beneath. This insured that dry GCL material would be continuous throughout the cell. In addition, bentonite was placed between the two layers of GCL, for additional infiltration protection. The GML was closed and dual fusion welded to a new 60-mil HDPE panel placed in between the cut location. All GML repairs were then air pressure tested and vacuum tested. The additional reinforced GCL layer will ensure the full capacity of the soil and liner system as a hydraulic barrier. The approximate location and profile of the modified soil and liner system are depicted in Figure A-1 located in Attachment A.1.

2.1. INTERFACE FRICTION SHEAR TEST – CELL 13

An interface friction shear test was performed for the hydrated GCL/10-mil poly sheeting/reinforced GCL layers to determine the shear strength of the liner materials under loaded conditions. The shearing rate between these layers was analyzed at a 0.04 inches per minute. Tests results are shown in attachment A.3.

The required shear strength was expressed in terms of the minimum friction angle. The minimum friction angle determined was 22 degrees, typically used on side slopes. Although the hydration occurred on the floor of the cells, the same angle was used for conservative calculations. The minimum required shear strength ignores the effect of internal cohesion or interfacial adhesion. The peak friction angle of 12.30 degrees (21.08% slope), provided from laboratory results and the effects of interfacial adhesion. The normal stress used to derive the actual and required shear strength was calculated using the site soil density and the maximum slope of the cell floor of 6 percent.

As shown in Table 1 the minimum required shear strength of the material placement to prevent failure is 86.87 pounds per square foot (psf). The actual shear strength of the hydrated GCL/10-mil poly sheeting/reinforced GCL liner system is 125.88 psf. The factor of safety for the hydrated GCL/10-mil poly sheeting/reinforced GCL liner system is 1.4, in addition to performing required shear strength at a 22 degree slope.

Results for the soil and liner system meet the minimum shear stress requirement needed for stability of the system. Calculations and laboratory results are included as Attachment A.2.

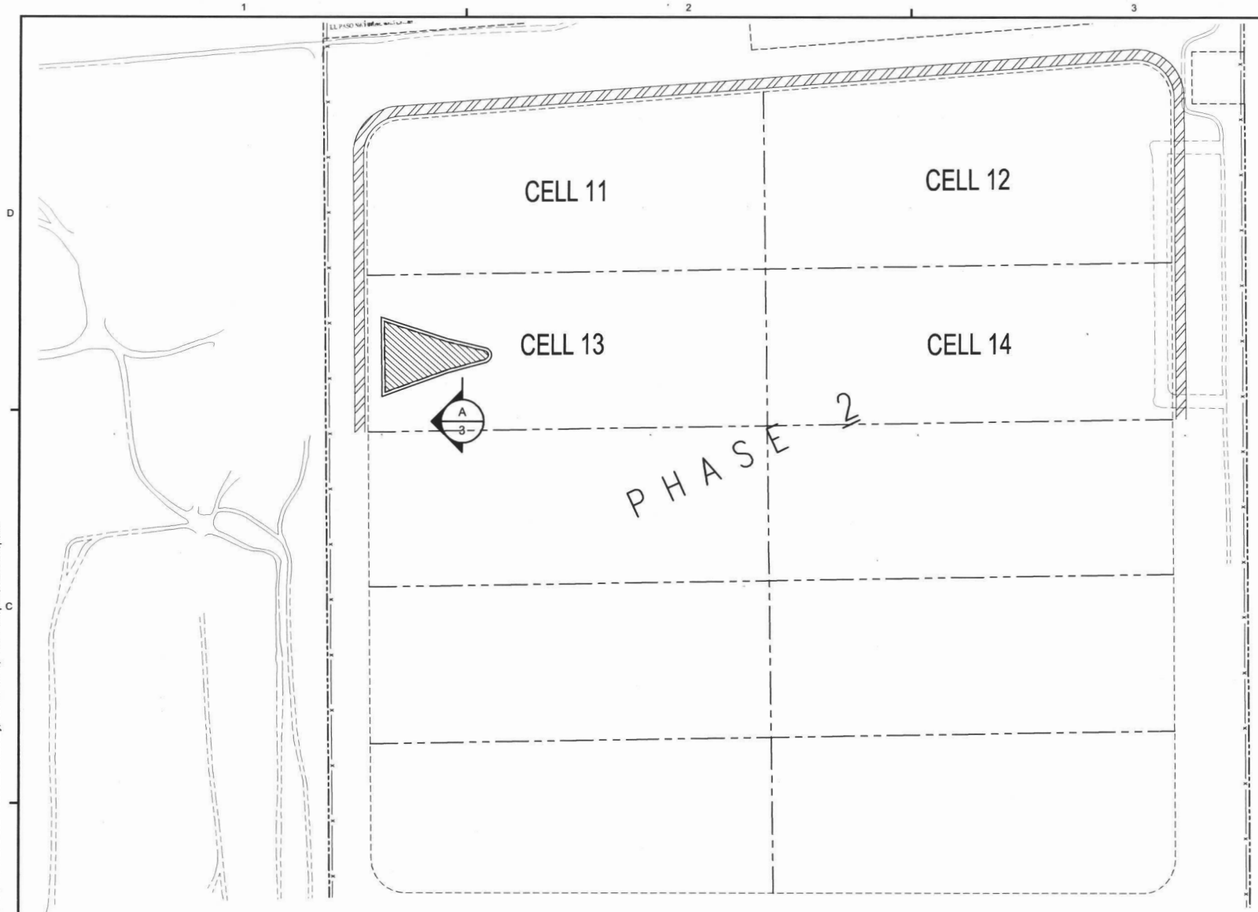
TABLE 1 - Shear Strength	
$\tau_{required}$	86.87 psf
τ_{actual}	125.88 psf

3. CONCLUSION

The modified soil and liner system of Cell 13 meets the performance standards of the SLQCP. Per the request of the Texas Commission on Environmental Quality (TCEQ), the supplemental information is an "as-built" informational permit report and does not entitle future construction of the liner system per the measures discussed above.

ATTACHMENT A.1

FIGURE A-1



SITE LAYOUT — A/1

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
NICHOLAS N. YBARRA
111156
LICENSED
PROFESSIONAL ENGINEER

Nicholas N. Ybarra

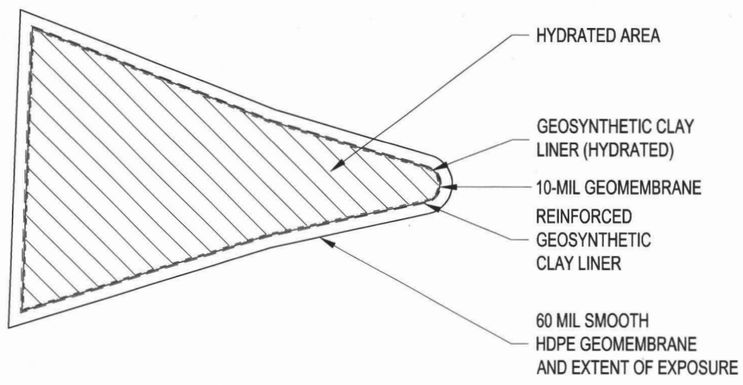
11/10/17

N

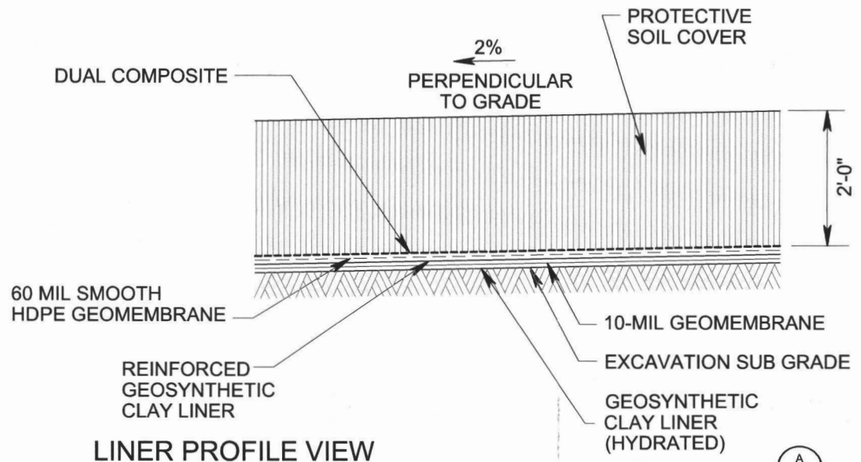
0 200 400

LEGEND

- PERMIT LIMIT/PROPERTY LINE
- EASEMENT
- CELL LIMITS
- FENCE



LINER PLAN VIEW — A/2
SCALE: NTS



LINER PROFILE VIEW — A/3
SCALE: NTS

REFERENCES – BENCH MARKS
BENCHMARK:

BY	REVISIONS	DATE

PARKHILL SMITH & COOPER
PSC
501 SAN ANTONIO EL PASO, TX. 79901 (915)533-0811

SCALE
Hor. AS SHOWN
Ver. AS SHOWN

DATE
DESIGN BY
DRAWN BY
CHKD. BY
APPD. BY

PROJECT NAME
GREATER EL PASO LANDFILL
PHASE 2 - CELLS 11-14

CITY OF EL PASO

SHEET TITLE

FIGURE
A-1

FILE No.

Sht. 1 of 1

FILE NAME: \\Data1\Projects\2016\5128.16\02_DSGN\02_DWG\050_CIVIL\5128.16 - 5128.16 GEPL Cells 11-14 Bid and Const Admin - 5128.16.dwg LAYOUT NAME: G-002 PRINTED: Thursday, November 09, 2017 - 1:09pm USER: LCapeda

ATTACHMENT A.2

SHEAR STRESS CLACULATIONS

Hydarted GCL-10 mil GM-GCL

Eq. 1 $\tau_{required} = \sigma * \tan(\varphi_{min})$

Eq. 2 $\tau_{actual} = C + \sigma * \tan(\varphi)$

Shear Stress		
$\tau_{required}$	86.87	psf
τ_{actual}	125.88	psf

Inputs	
79.00	C - adhesion (psf)
215.01	σ - normal stress (psf)
12.30	φ - friction angle (degree)
22	φ_{min} - friction angle (degree)

Conditions		
Soil Density	107.70	pcf
16.5H:1V	3.47	degress
16.5H:1V	6%	Slope
2 ft soil		

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
NICHOLAS N. YBARRA
111156
LICENSED PROFESSIONAL ENGINEER

Nicholas N. Ybarra

11/10/17

ATTACHMENT A.3

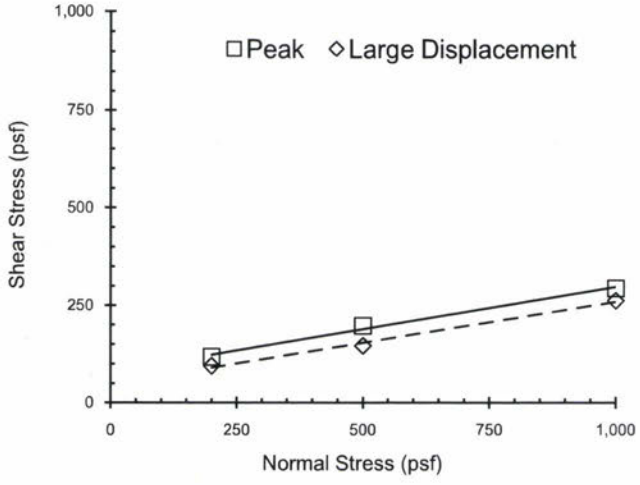
TRI LABORATORY RESULTS

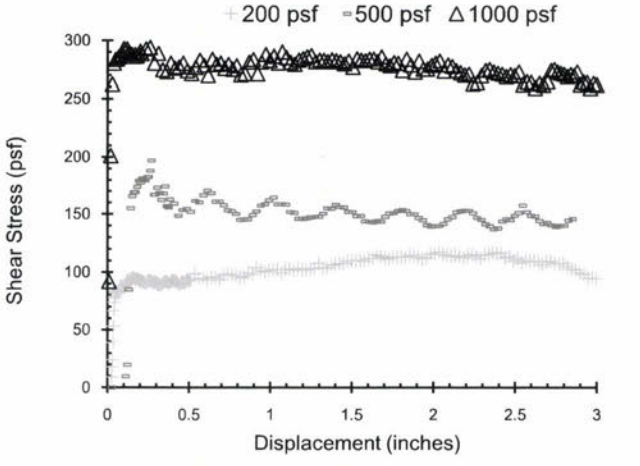
Interface Shear Strength of Geosynthetic Clay Liner by Direct Shear (ASTM D6243)

Client: Parkhill Smith and Cooper
Project: City of El Paso

TRI Log #: 29956-8
Richard S. Lacey, P.E. 10/2/2017
Analysis & Quality Review/Date

Bentoliner EC - nonwoven side up -Attached vs. 10-mil Tarp - floating vs. vs. Bentoliner EC - nonwoven side up - attached





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	12.3	12.0
Y-intercept or Adhesion	psf	79	47
Minimum Secant Angle	Degrees	16.4	14.7

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Bentoliner EC - nonwoven side up	
Floating	vs. 10-mil Tarp	
Lower Box	Bentoliner EC - nonwoven side up - Pre-hydrated under no load for 24 hours then air dried 2 days.	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 72 hours prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes

Shearing occurred at the Tarp v. underlying GCL interface at all three stresses.

Specimen No.		-	1	2	3
Normal Stress		psf	200	500	1,000
Box Edge Dimension		in	12	12	12
Bearing Slide Resistance		lbs	10	13	18
Peak	Shear Stress	psf	117	197	294
	Secant Angle	deg.	30.4	21.5	16.4
Large Displacement	Shear Stress	psf	95	146	262
	Secant Angle	deg.	25.3	16.2	14.7

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. - AUSTIN, TX 78733 - USA | PH: 800.880.TEST OR 512.263.2101

Soils / Aggregates

Report Date: May 24, 2017

amec foster wheeler

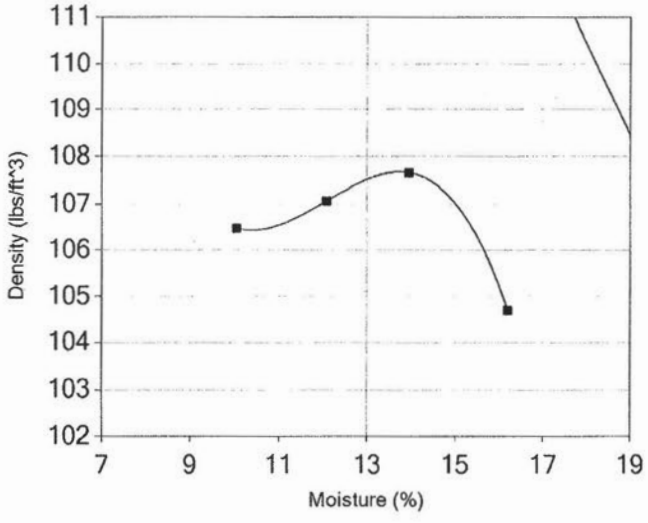
Client		Project	
Name:	City of El Paso	**Name:**	(1737191038) Clint Landfill - Liner Installation
Address:	Capital Improvements Department 218 N Campbell, 2nd Floor El Paso, TX 79901	**Address:**	El Paso, TX
Attention:	Project Manager	**Phase:**	**Task:**
PO Number:		**Manager:**	David Varela
Sample Date:	4/25/2017 by Client	**Lab/Ref. #:**	17360
Source:	611 #13 Bottom of Cell	**Description:**	Light Brown Sand with Trace of Gravel

Type of Specification: No project specification was provided.

Sieve Analysis: (ASTM C117-13/C136-14)

200 Wash Procedure: A

Sieve Size	Passing	Specification Min	Specification Max
1in.	100%		
3/4in.	100%		
1/2in.	99%		
3/8in.	99%		
#4	98%		
#10	96%		
#40	81%		
#100	12%		
#200	3.7%		



Plasticity Index (ASTM D4318-10) PI Air Dried.

Preparation Method: Wet **Liquid Limit Method:** A

Soil Classification (ASTM D2487-11) SP

		Specification Min	Specification Max
Liquid Limit:	NV		
Plastic Limit:	NV		
Plasticity Index:	NP		

Moisture Density Relationship: (ASTM D1557-12) Method: A

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.6 Assumed

Maximum Density (lbs/ft^3): 107.7

Optimum Moisture (%): 13.7

Remarks:

Distribution:

Reviewed By: David Varela

Amec Foster Wheeler Environment & Infrastructure, Inc. - 125 Montoya - El Paso, Texas 79932 - phone: (915) 585-2472 fax: (915) 585-2626

Texas Registered Engineering Firm F-0012

Soils / Aggregates

amec foster wheeler

Report Date: May 24, 2017

Client

Name:	City of El Paso
Address:	Capital Improvements Department 218 N Campbell, 2nd Floor El Paso, TX 79901
Attention:	Project Manager
PO Number:	
Sample Date:	4/25/2017 by Client
Source:	Cell 13 Top of Cell

Project

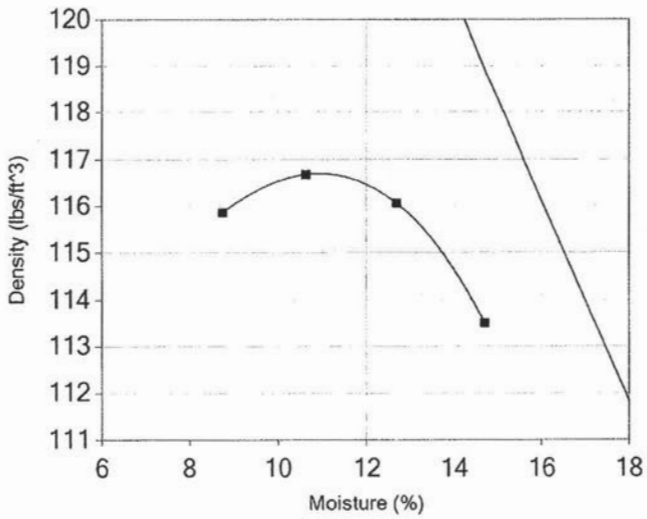
Name:	(1737191038) Clint Landfill - Liner Installation
Address:	El Paso, TX
Phase:	**Task:**
Manager:	David Varela
Lab/Ref. #:	17361
Description:	Brown Sand with Trace of Clay and Gravel

Type of Specification: No project specification was provided.

Sieve Analysis: (ASTM C117-13/C136-14)

200 Wash Procedure: A

Sieve Size	Passing	Specification Min	Specification Max
1in.	100%		
3/4in.	100%		
1/2in.	98%		
3/8in.	97%		
#4	95%		
#10	91%		
#40	75%		
#100	21%		
#200	13%		



Plasticity Index (ASTM D4318-10) PI Air Dried.

Preparation Method: Wet **Liquid Limit Method:** A

Soil Classification (ASTM D2487-11) SM

		Specification Min	Specification Max
Liquid Limit:	NV		
Plastic Limit:	NV		
Plasticity Index:	NP		

Moisture Density Relationship: (ASTM D1557-12) Method: B

Preparation Method: Dry **Rammer Type:** Mechanical

Specific Gravity: 2.651 Assumed

Maximum Density (lbs/ft^3): 116.7

Optimum Moisture (%): 10.9

Remarks:

Distribution:

Reviewed By: David Varela

Amec Foster Wheeler Environment & Infrastructure, Inc. - 125 Montoya - El Paso, Texas 79932 - phone: (915) 585-2472 fax: (915) 585-2626

Texas Registered Engineering Firm F-0012

APPENDIX III.E – GEOLOGY REPORT

BURNS McDONNELL

MSW AUTH NO. 2284A

APPENDIX III.E – GEOLOGY REPORT

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 2
SEPTEMBER 12, 2025

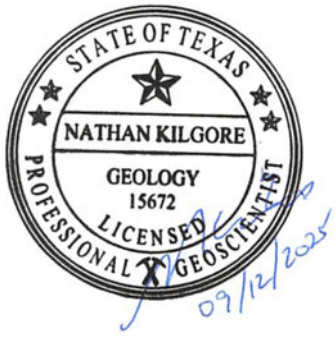
Part III, Appendix III.E
Geology Report
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024
Revision 1, May 16, 2025
Revision 2, September 12, 2025



prepared by

Burns & McDonnell Engineering Company, Inc.
6200 Bridge Point Pkwy, Building 4, Suite 400, Austin, TX 78730
Texas Firm Registration No. F-845

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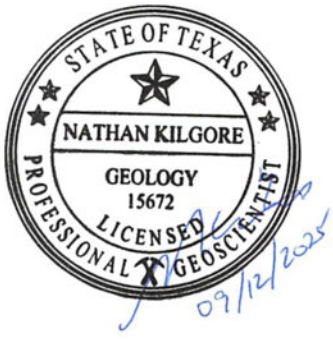

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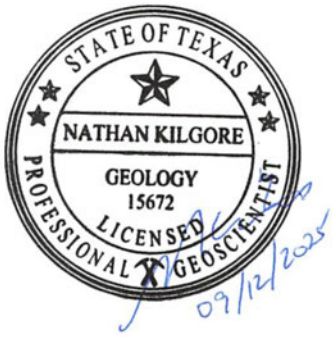

List of Abbreviations

Abbreviation	Term/Phrase/Name
30 TAC	Title 30 of the Texas Administrative Code
ASTM	American Society for Testing and Materials
bgs	Below Ground Surface
BPC	Bluepoint (association)
BUC	Bluepoint gravelly (association)
CFR	Code of Federal Regulations
CH	Clay soils, high plasticity (USCS)
CL	Clay soils, low plasticity (USCS)
cm/sec	Centimeters per Second
CPS	Cathodic Protection System
EPNG	El Paso Natural Gas
Facility	Greater El Paso Landfill
ft	Feet
ft/day	Feet per Day
ft/ft	Feet per Feet
HW	Hueco-Wink association
I.D.	Inner Diameter
mg/L	Milligrams per Liter
MH	Silt (USCS)
MW	Monitoring Well
PB	Piezometer Borings
POC	Point of Compliance
psi	Pounds per Square Inch
Qao	Old Quaternary deposits
Qb	Young Quaternary deposits
QTb	Tertiary to Quaternary-age Bolson Deposits
Qws	Windblown sands (Holocene age)
SC	Clayey sand (USCS)
Site	Greater El Paso Landfill
SPT	Standard Penetration Test
SP-SM	Sand, poorly graded, with silt (USCS)

SM	Silty sand (USCS)
SP	Sand, poorly graded (USCS)
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TWDB	Texas Water Development Board
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USCS	Unified Soil Classification System

III.E.1.0 Project Information

III.E.1.1 Purpose

The owner/operator has obtained a permit to use a 311-acre tract of land as a municipal solid waste landfill, the Greater El Paso Landfill (facility or site), located to the southeast of the City El Paso, Texas in El Paso County. This document conforms to the minimum requirement of Title 30 of the Texas Administrative Code (30 TAC) §330.63(e).

III.E.1.1.1 Report Organization

This report presents information required in 30 TAC §330.63(e). The information is discussed and presented in the sections of this report.

- Regional physiography and topography of the area.
- Regional geology in the vicinity of the landfill.
- Geological Processes in the subject region. This report contains a discussion of the existing faults, potential erosion, potential earthquake, liquefaction, and wetlands.
- Regional Hydrogeology. Regional aquifers, groundwater composition, recharge characteristics and aquifer withdrawal are briefly discussed in this report.
- Subsurface soil investigation. Included in this report is information pertaining to the soil boring locations and sampling procedures, subsurface stratigraphy encountered in the borings, piezometer borings, and depth to the groundwater encountered in the borings.
- Laboratory testing, slope stability, and constructability.
- Historical groundwater elevations and aquifer testing.
- Groundwater flow and potential pollutant migration into the underlying aquifer.

III.E.2.0 Regional Physiography and Topography

The facility is located approximately 21 miles southeast of the City of El Paso, Texas as depicted on Part I/II, Appendix I/II.A, Figure I/II.A.1). The City of El Paso is one of the largest metropolitan areas in Texas and is located adjacent to New Mexico and Mexico in the westernmost portion of Texas.

The facility lies within the Rio Grande rift portion of the Mexican Highlands section of the Basin and Range Physiographic Province (Hawley, 1975; Fenneman, 1931; Thornbury, 1965)[1] [2] [3]. The Mexican Highlands Section are an area of variable geologic structure characterized by high desert valleys and mountain ranges (Thornbury, 1965). The Mexican Highlands Section is subdivided into the Bolson and Rio Grande subsections Hawley (1975). The Bolson subsection covers a large area of southwestern New Mexico and portions of Texas, Arizona, and Chihuahua, Mexico and includes the facility location. This region is characterized by broad intermontane basins with internal drainage, called bolsons, which are bounded by fault-block mountain ranges.

East of the Franklin Mountains is the Hueco Bolson, which extends northward into New Mexico where it merges with the Tularosa Basin. The Rio Grande River crosses the southeast portion of this area in an entrenched valley. The area where the facility is located is commonly incised into thick deposits of basin fill typically ranging in age from Pliocene to Holocene and is within the Hueco Bolson. The facility is located along the eastern flank of the Rio Grande Alluvium which is a broad alluvial plain with very gentle slopes marking the valley of the Rio Grande River.

The locations of the Hueco and Mesilla Bolsons [Basins] and the surrounding topography are depicted in **Attachment III.E.1**. There are several agricultural ditches and “river drains” containing surface water between the facility and the Rio Grande River which is located to the southwest of the facility. The closest natural surface water body to the facility is the Rio Grande River. This river is located approximately 5.4 miles southwest of the facility and a portion of the agricultural area associated with the river are located approximately 1.25 miles southwest of the facility. In general, the facility slopes in a southwesterly direction. A topographic map of the facility is presented as **Part I/II, Appendix I/II.A, Figure I/II.A.6** from the United States Geological Survey (USGS) 7.5-minute map for Clint, TX, CHH[4].

Per the United Stated Department of Agriculture (USDA) Web Soil Survey of El Paso County, Texas, the facility is located on three mapped soil associations. The results of the USDA Web Soil Survey are presented as **Attachment III.E.2**. Approximately two-thirds of the facility is mapped as the Hueco-Wink (HW) association. One-quarter of the facility, primarily in the southern portion, is mapped as Bluepoint gravelly (BUC) association. The remainder of the facility, primarily in the southwest quadrant, is mapped as the Bluepoint (BPC) association. All soils association are well-drained or “somewhat excessively drained”, and typically have little to no surface runoff.

The surface soil, in general, slopes toward the south or southwest at a rate ranging from 0 to 15 percent. Facility elevations are presented on Figure I/II.B.5 in Part I/II, Appendix I/II.B.

[1] Fenneman, N. M., 1931, Physiography of Western United States, New York, McGraw-Hill Book Co.

[2] Thornbury, W. D., 1965, Regional Geomorphology of the United States, New York, John Wiley & Sons.

[3] Hawley, John W., 1975, Quaternary history of Doña Ana County region, south-central New Mexico, in: Las Cruces Country, Seager, William R.; Clemons, Russell E.; Callender, Jonathan F., New Mexico Geological Society, Guidebook, 26th Field Conference, pp. 139-150.

[4] U.S. Geological Survey, 20220517, US Topo 7.5-minute map for Clint, TX,CHH: USGS - National Geospatial Technical Operations Center (NGTOC).

III.E.3.0 Regional Geology

III.E.3.1 Stratigraphy and Lithology

The facility is located within the area of the Geologic Atlas of Texas, Van Horn-El Paso Sheet[5] which is presented as **Attachment III.E.3**. The facility is located approximately 3 miles west of Clint, Texas. A regional, geologic cross-section of the area near the facility, as well as a map depicting the cross-section transect line (H-H') location, are presented as **Attachment III.E.4**. A generalized stratigraphic column of the area around the facility is presented as **Attachment III.E.5**.

The geological framework of the area, which composes the eastern portion of the Basin and Range Province, started when tectonic adjustments began the formation of the basins, or bolsons, in the early Miocene through crustal stretching, folding, and faulting. As the basins developed, erosion and subsequent deposition of sediments lead to the formation of the Santa Fe Group (Seager et al., 1971; Strain, 1969)[6] [7]. Renewed faulting in Late Miocene and Pliocene time, coupled with continued relative uplift, produced a series of en echelon grabens, which formed the Mesilla Bolson and the Hueco Bolson, and which characterize this section of the Rio Grande rift. These regional bolsons received several thousands of feet of sediments during the Late Cenozoic through erosion of the uplifted areas (Strain, 1966).

Basin fill was initially derived from the surrounding mountains, or ranges. During the Pleistocene, the ancestral Rio Grande River flowed into closed basins in the area, depositing thick sequences of sediments within ephemeral or playa lakes (Strain, 1969; Hawley, 1975; Hawley et al., 2009)[8]. This basin fill composes the Santa Fe Group(Hawley et al., 1969)[9].

The Hueco Bolson deposits of the Santa Fe Group have been divided into five lithostratigraphic units including (from oldest to youngest) the Hayner Ranch Formation, the Rincon Valley Formation, the Fort Hancock Formation, the Palomas Formation, and the Camp Rice Formation (Hawley et al., 2009). These formations compose the Upper, Middle, and Lower sections of the Santa Fe Group and represent the deposition of sediments within the basins and the ephemeral or playa lakes that may have occupied them. The Lower (oldest) Santa Fe is characterized by poorly consolidated, fine- to medium-grained sediments derived from surrounding uplands of volcanic origin, as well as from surrounding eolian (wind) deposits. This section was deposited in the Early to Middle Miocene (Hawley et al., 2009).

The Middle Santa Fe marked a period of accelerated basin subsidence and continued deposition of fine-grained sediments with interbedded sand strata during the Middle to Late Miocene. These deposits are indicative of basin-floor and piedmont-slope depositional environments (Hawley et al., 2009).

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[5] Geologic Atlas of Texas, Van Horn-El Paso Sheet, by J. W. Dietrich, D. E. Owen, C. A. Shelby, and V. E. Barnes. Color map, scale 1:250,000, and 12-page explanatory booklet, 1968; revised 1983.

[6] Strain, W. S., 1969, Late Cenozoic strata of the El Paso area, in Border Stratigraphy Symposium: New Mex. Bur. Mines and Min. Res. Circ. 104, p. 122-12.

[7] Seager, W. R., Hawley, J. W., and Clemons, R. E., 1971, Geology of San Diego Mountain area, Doña Ana County, New Mexico: New Mex. Bur. Mines and Min. Res. Bull. 97, 38 p.

[8] Hawley, J. W., Kennedy, J. F., Granados-Olivas, A., & Ortiz, M. A., 2009. Hydro-geologic Framework of the Binational Western Hueco Bolson-Paso del Norte Area, Texas, New Mexico, and Chihuahua: Overview and Progress Report on Digital-Model Development. Technical Report.

[9] Hawley, J.W., Kottlowski, F.E., Strain, W.S., Seager, W.R., King, W.E., and LeMone, D.V., 1969, The Santa Fe Group in the south-central New Mexico border region: NM Bureau of Mines & Mineral Resources Circular 104, p. 52-76.

The Upper Santa Fe is characterized by medium- to coarse-grained sedimentary, fluvial deposits that are indicative of a time of rapid subsidence of the basins. During this time in the Late Miocene, Pliocene, and Early Pleistocene, layers of volcanic ash are observed within the Upper Santa Fe, denoting a period of volcanic activity in the areas of the headwaters of the ancestral Rio Grande River. Volcanic ash deposited within the Upper Santa Fe is considered to have originated from events as far away as Wyoming and Colorado. (Hawley et al., 2009) The Camp Rice Formation is an exemplary formation within the Upper Santa Fe Group and recorded continued fluvial aggradation by the ancestral Rio Grande River in the Hueco Bolson (Strain, 1966). It is primarily composed of gravel, sand, silt and occasional discontinuous lenses of volcanic ash. Its color varies from very light gray to shades of pink, orange, and light brown. The Camp Rice Formation is expressed at the surface by low, rounded hills and badland-type topography. Fossils may be found in the formation and indicate that the formation was deposited during the late early to middle Pleistocene (Strain, 1969).

Following deposition of the Upper Santa Fe, periods of river incision and continued basin subsidence occurred. Sediment deposition continued in the Quaternary (Pleistocene and Holocene), The formations exposed at the ground surface at the facility are predominately Cenozoic-age Tertiary and Quaternary Systems sediments. The formations described herein will be from the oldest to the youngest and in their respective sequence of surface exposure from west to east. The most westerly outcrop is Tertiary to Quaternary-age Bolson deposits (QTb) of the Pliocene and Lower Pleistocene deposits. Sediments of Quaternary-age Old Quaternary deposits (Qao) of the Pleistocene period follow these deposits. The next formation cropping out east of the Qao is known as the Young Quaternary deposits (Qb) of the Holocene. The most easterly formation is the Windblown sand (Qws) of the Holocene.

The QTb is described by the USGS as consisting of clay, silt, sandstone, and conglomerate with gypsiferous fine-grained sand. Caliche may be present. The deposits coarsen toward the margins where pebble to boulder conglomerates are observed. This unit may be up to 2,000 feet thick.

The Qao consist of alluvium, colluvium, caliche, and gypsite. The sediments are gravelly sands that are light brown and graded to a fine-grain loamy sand.

Overlying the Qao sediments are the fluvial and lacustrine deposits of Cenozoic-age Qb of clays, silts, sands, and gypsum sediments. The sediments are most likely remnants of Holocene shallow lake and evaporitic environments.

The Holocene age Windblown sands are eolian deposits in the form of sand dunes. Sands associated with these dunal features are fine-grained, well-rounded, well-sorted. and siliciclastics. Typically, structures associated with these dunal sands are low angled cross bedding. The sediments are indicative of an arid environment, which is present in the region.

The stratigraphic sequence at the facility is further discussed in **Section III.E.6.0** of this appendix.

III.E.4.0 Geological Processes

III.E.4.1 Regional Geological Processes

III.E.4.1.1 Faults

The Hueco and Mesilla bolsons were primarily formed by normal faulting. These block-faulted grabens are asymmetrical due to downward fault movement being greater on one side of the basin than the other.

Numerous fault scarps of Quaternary age are present in the Hueco Bolson near the facility, as displayed on the Geologic Atlas of Texas, Van Horn-El Paso Sheet which is presented as **Attachment III.E.3**. Several generally north-south trending scarps are present to the east of the facility. The age of faulting in the Hueco Bolson has been dated as less than ½ million years, potentially less than 0.2 million years, based on offset in the Camp Rice Formation and in soils formed on the Camp Rice Formation (Seager, 1980). The USGS' Quaternary Fault and Fold Database of the United States provides the most recent prehistoric deformation for the Hueco Bolson Fault Zone as middle and late Quaternary (<750,000 years) and includes a comment, "Timing of movement is not well constrained, but scarps are present on early to middle Pleistocene deposits (Collins and Raney, 1991 #846). Cross-cutting relationships with younger deposits are unknown." The USGS also lists the age of faulted surficial deposits as "Middle Pleistocene alluvium and soils (Collins and Raney, 1991 # 846); no detailed studies have been conducted to determine if younger (upper Quaternary) deposits are faulted. Collins and Raney (1997 #7419) suggest that stage III-IV calcic horizons capping the early to middle Pleistocene upper Camp Rice Formation could be offset." (Collins and Jochems, compilers, 2016)[10]

Based on the Geologic Atlas of Texas, Van Horn – El Paso sheet, the facility is located approximately ½ mile to the west of the nearest inferred fault line. As documented by the preparer of the initial permit application for this facility, "There is no active fault line observed within the vicinity of the new landfill site. Evidences such as structural damage, surface depression, surface lineations, vegetation changes, and crude oil and natural gas accumulations were not observed during our site observation. No ground movement caused by the existing fault within the landfill site vicinity was recorded for the past 50 years. This section fulfills the requirements of 30 TAC §330.555, Fault Areas."

III.E.4.1.2 Subsidence

Based on the publication titled, "Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping TWDB Contract Number 1648302062," "Figure 4-28" illustrates the area of the facility as an area of low to medium risk of subsidence vulnerability due to groundwater pumping of the Hueco-Mesilla Bolsons Aquifer (Furnans et al., 2017)[11]. Subsidence has not been recorded at the facility.

III.E.4.1.3 Erosion

Potential erosion due to surface water processes such as overland flow, channeling, gullying, and fluvial processes is limited due to the climatic conditions and the location of the facility. The facility is located in

[10] Collins, E., and Jochems, A.P., compilers, 2016, Fault number 901, Hueco fault zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 10/30/2023.

[11] Furnans, J., Keester, M., Colvin, D., Bauer, J., Barber, J., Gin, G., Danielson, V., Erickson, L., Ryan, R., Khorzad, K., Worsley, A., & Snyder, G. (2017). Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping (TWDB Contract Number 1648302062). LRE Water, LLC, Blanton & Associates, Inc., Wet Rock Groundwater Services, LLC, and GLS Solutions, Inc.

an arid region with typical annual rainfall of less than 9 inches per year. Windblown sands are prevalent at the ground surface at the facility and form dunes.

The Surface Water Drainage Report provided in **Part III, Appendix III.B** incorporates armor, berms, and other measures to mitigate surficial erosion from water flow during the life of the facility. Rainfall data obtained from NOAA Atlas 14, Volume 11 (version 2) is provided in **Part III, Appendix III.B.2.3.1**.

Stream flow during storm events is diverted by either the berms or a perimeter drainage ditch during site development of the landfill. Diversion measures are depicted in **Part III, Appendix III.B, Attachment III.B.4**. A narrative description of erosion control is presented in **Part III, Appendix III.B, Attachment III.B.1**.

III.E.4.1.4 Earthquake

The Seismic Hazard Map, "2014 Seismic Hazard Map – Texas", published by the United States Geological Survey) indicates that the facility is located in a low to moderate seismic impact area. Seismic impact within this area is expected to be low and the potential for severe damage is anticipated to be low during the service life of the facility. The referenced map is presented as **Attachment III.E.6**. Seismic impact zone considerations were incorporated into the slope stability analysis provided in Part III, Appendix III.G, as discussed on page III.G-8. Calculations are presented in Attachment III.G.5. An initial screening-level seismic stability evaluation, using the maximum credible earthquake ground acceleration from the U.S. Geological Survey, indicated a factor of safety of less than 1.0. Accordingly, a more detailed Makdisi and Seed (1978) displacement analysis was conducted. This method accounts for yield accelerations, slope geometry, and site-specific earthquake characteristics to estimate displacements during the design seismic event. The calculated displacement was less than 15 centimeters, which is within the published allowable range for landfill containment systems. Based on these results, the potential for severe damage to the landfill containment structures due to seismic activity is anticipated to be low.

III.E.4.1.5 Liquification Potential

Based on the density of the sandy soils encountered, the depth to groundwater, lack of surface water, and the designated seismic hazard, the liquefaction potential at this facility is considered negligible.

III.E.4.1.6 Wetlands

This is an existing facility and prior to initial permit issuance, the U.S. Army Corps of Engineers, Albuquerque District, determined that there were no regulated wetlands at the facility. A copy of the U.S. Army Corps of Engineers correspondence is provided in **Part I/II, Appendix I/II.G**.

III.E.5.0 Regional Hydrogeology

III.E.5.1 Regional Aquifers

The major aquifer in the regional area is the Hueco-Mesilla Bolsons Aquifer (see **Attachment III.E.7**). The unconfined aquifer extends from New Mexico into western Texas and is located in El Paso County and Hudspeth County. The aquifer is fault-bounded and unconfined with underlying and surrounding lithologic units that are considered to be impermeable. The sediments in which the aquifer is found consist of unconsolidated to poorly consolidated silt, sand, gravel, and clay from alluvial, fluvial, and lacustrine deposition within the basins, or bolsons. The maximum thickness of the Hueco Bolson is 9,000 feet (TWDB, 2016)[12]. A conceptual cross-section of the Hueco Bolson is depicted in **Attachment III.E.8** . There are no minor aquifers in the region of the facility, as identified by the Texas Water Development Board (TWDB); therefore, the Hueco-Mesilla Bolsons Aquifer is not hydraulically connected to other major or minor aquifers in the vicinity of the facility.

Regional groundwater flow in the aquifer is modeled to be to the south and southeast and the average horizontal hydraulic conductivity in the area is estimated at 33 feet per day with a range of 3 to 164 feet per day. A regional potentiometric surface map with simulated conditions from 1996 is presented as **Attachment III.E.9**. In the vicinity of the facility, the groundwater flow direction is simulated as southeast and is considered to be under water table conditions. Vertical hydraulic conductivities are estimated between 0.02 and 0.07 feet per day and the specific yield of the aquifer is estimated to be 0.18. (Heywood and Yager, 2003)[13]. Groundwater levels in the area of the facility are measured to be between 250 to 400 feet (ft) below ground surface (bgs) below the City of El Paso and less than 70 ft bgs below the Rio Grande. Additionally, well yields of the aquifer in the interior portion of the Hueco Bolson range between 300 and 700 gallons per minute (Sheng et al., 2001)[14].

Since development has grown in El Paso and in Ciudad Juarez, groundwater withdrawal through pumping has caused the Rio Grande River to become a losing stream, when it was previously a gaining stream, and it is now a source of recharge of the aquifer. Additionally, groundwater withdrawals from these metropolitans have caused the groundwater potentiometric surface to change in these areas over the years, causing groundwater to flow towards points of groundwater withdrawal (Heywood and Yager, 2003).

III.E.5.2 Groundwater Composition

The Hueco-Mesilla Bolsons aquifer in the Texas portion of the Hueco Bolson is estimated to contain 9 million acre-feet of fresh water (Bredehoeft, Ford, Harden, Mace, and Rumbaugh, 2004)[15]. Generally, the aquifer contains fresh water in its upper portion and becomes saline with depth. Concentrations of total dissolved solids (TDS) of the aquifer typically range between 1,000 and 3,000 milligrams per liter (mg/L), or slightly saline, with TDS concentrations in the area of the facility ranging from approximately 3,000 to 10,000 mg/L, or moderately saline (TWDB, 2016).

[12] Texas Water Development Board (TWDB). (2016). Texas Aquifer Study: Groundwater Quantity, Quality, Flow, and Contributions to Surface Water. Retrieved from [https://www.twdb.texas.gov/groundwater/docs/studies/TexasAquifersStudy_2016.pdf].
[13] Heywood, C. E., & Yager, R. M. (2003). Simulated ground-water flow in the Hueco Bolson, an alluvial-basin aquifer system near El Paso, Texas. U.S. Geological Survey Water-Resources Investigations Report 02-4108, 55p.
[14] Sheng, Z., Mace, R. E., & Fahy, M. P. (2001). The Hueco Bolson: An Aquifer at the Crossroads. Texas Water Development Board.
[15] Bredehoeft, J., Ford, J. Harden, B., Mace, R. and Rumbaugh, J., 2004, Review and interpretation of the Hueco Bolson groundwater model: report prepared for El Paso Water Utilities, 18p.

Groundwater samples collected from the Hueco Bolson by the TWDB between 2000 and 2015 indicated that arsenic concentrations in some of the samples exceeded applicable drinking water standards. Additionally, concentration of chloride, fluoride, iron, manganese, sulfate, and TDS exceeded respective secondary water quality standards in some samples collected during a previous study.

III.E.5.3 Aquifer Recharge Characteristics

Recharge to the regional aquifer occurs from infiltration or precipitation which falls directly on the surface and runoff from the adjoining bolson surfaces, leakage from the Rio Grande River and numerous canals which traverse the heavily cultivated and irrigated floodplain, and excess irrigation water applied to the area. Additionally, aquifer recharge occurs along the flanks of the Franklin Mountains. The Rio Grande River is not within 5 miles of the facility; however, areas of concentrated surface flows, such as within arroyos or unlined agricultural canals, are within 5 miles of the facility and may provide minor or intermittent recharge to the aquifer (Sheng et al., 2001).

In addition, through a wastewater recycling system at the Fred Hervey Water Reclamation Plant, wastewater is treated to meet water drinking standards and is injected into shallow recharge wells in the Hueco Bolson. The rate of recharge from this operation in 1995 was approximately 1.2 billion gallons per year (Sheng et al., 2001).

III.E.5.4 Aquifer Withdrawal

Groundwater withdrawal from public supply wells and concrete lining of a portion of the Rio Grande River in the City of El Paso has affected the aquifer's recharge-discharge relationships and has caused fluctuations in the direction of groundwater flow. As a result of extensive groundwater withdrawals and modifications of recharge zones, water levels of the aquifer declined several hundred feet from the early 1900s until the late 1980s. Since the late 1980s, data suggests that regional water levels of the aquifer may be stabilizing; however, in the area of the facility, water levels are suggested to have declined between 5 to 10 feet from 2010 to 2015 (latest regional data identified) (TWDB, 2016).

All water wells, excluding groundwater monitoring wells associated with the facility, located within a 1-mile radius of the facility are shown on **Attachment III.E.23**. There are three water wells, used for the withdrawal of water, located within a one-mile radius of the facility, according to the Texas Water Development Board (TWDB) records. A map depicting the locations of these wells is presented as **Attachment III.E.23**. One of these water wells, the Orr well, was located within the facility and is noted as "Plugged or Destroyed" according to TWDB records. TWDB has assigned the other two water wells with State Well Number 4931204 and with State Well Number 4931205. The range of depths of these water wells is between 325 feet to 570 ft bgs. TWDB records related to these water wells are presented as **Attachment III.E.24**. Static water levels in the above-mentioned water wells range from 269 feet to 370 feet. The variation in the recorded depths is due mainly to the difference in surface elevation and topography across the area. Water wells 4931204 and 4931205 are located approximately 1,860 feet west and 3,895 feet northwest of the facility, respectively. Based on an apparent southeastern direction of groundwater flow at the facility, both wells appear to be positioned upgradient to side-gradient, and neither well provides a source of drinking water.

III.E.6.0 Subsurface Investigation

III.E.6.1 Boring Plan

As previously approved, the subsurface conditions in the approximately 311 acres of the facility were initially evaluated in 1998 and 2000 by a total of 37 borings, drilled at the locations presented in **Attachment III.E.10**. The last two borings (PB-36 and PB-37) were drilled at a later date (between July to August, 2000) to address concerns presented by the Texas Commission on Environmental Quality (TCEQ) in their first Notice of Technical Deficiency of the original permit application. Piezometers PB-36 and PB-37 replaced PB-18 and PB-21 because the original piezometers did not intersect the measured groundwater elevation. The original 35 borings and their locations were approved by the TCEQ prior to the execution of the exploratory drilling and subsequent approval was granted by the TCEQ for the drilling and completion of piezometers PB-36 and PB-37. The borings were surveyed and marked by Roe Engineering, L.C. The horizontal and vertical dimensions of the boring and piezometer locations were established using the state plane coordinate system. A benchmark was established to properly define the property boundary and is referenced to the City of El Paso datum.

III.E.6.2 Soil Borings and Sampling Procedures

As previously approved, the borings drilled in 1998 and 2000 were drilled in accordance with ASTM D 420 procedures, employing a truck-mounted drilling rig. Drilling equipment was periodically pressure washed between borings. A list of the borings with ground elevations, the boring logs for the 37 borings mentioned in **Section III.E.6.1**, and the original boring installation notes for the piezometers are presented as **Attachment III.E.11**, **Attachment III.E.12**, and **Attachment III.E.13**, respectively.

In general, the borings were advanced with 4¼-inch I.D. hollow stem auger to a maximum depth of 290 feet. Typically, borings that advanced below 290 feet were drilled with a 2-inch diameter three-wing chevron bit and mud-rotary drilling techniques to the termination depth in the boring. Hollow stem augers were used as casing in the investigation of mud-rotary borings.

The borings were drilled to the depths indicated in **Table III.E.6-1**, below the original ground surface elevation, as shown on the boring logs. In addition, as part of the sampling procedures, split-spoon samples associated with Standard Penetration Tests (SPTs) were collected in the field for subsequent classification and laboratory testing. A total of 41 split spoon samples were collected with brass liners to obtain soil samples for permeability and unconfined compressive strength tests. SPTs conducted in each soil boring, and the number of soil samples collected from each boring, are shown in **Table III.E.6-1**. The SPT results are noted as “blows per foot” on the non-piezometer boring logs in **Attachment III.E.12**. The borings were logged by either a qualified geologist or a geotechnical engineer experienced in borehole logging except where cutting returns were not adequate for characterization. These individuals were familiar with the local geology and hydrogeology. Field logs of the borings were prepared throughout the drilling operations. The subsurface soils encountered in the borings were visually classified in the field in accordance with ASTM D2488.

The mud rotary drilling method was used in drilling piezometer PB-36 and PB-37. The purpose of drilling piezometer PB-36 and PB-37 was to verify the depth of groundwater near the location PB-18 and PB-21, respectively.

Table III.E.6-1: Boring Completion Depths and Associated Number of Samples

Boring No.	Boring Depth (feet)	Number of SPT Tests	Number of Samples Collected
PB-1	343	39	40
B-2	31.5	6	6
B-3	91.5	18	18
PB-4	390	22	24
B-5	101.5	12	12
B-6	61.5	8	8
B-7	71.5	9	9
B-8	41.5	8	8
B-9	76.5	15	15
B-10	86.5	17	17
B-11	111.5	13	13
B-12	116.5	13	13
B-13	121.5	9	15
B-14	96.5	4	12
B-15	106.5	12	12
B-16	61.5	12	12
B-17	71.5	14	14
PB-18	370	21	22
B-19	96.5	19	19
B-20	121.5	14	14
PB-21	390	21	22
B-22	126.5	13	13
B-23	86.5	17	17
B-24	101.5	12	12
B-25	91.5	18	18
B-26	116.5	21	21
B-27	111.5	12	12
B-28	126.5	14	14
PB-29	400	21	22
B-30	126.5	15	15
B-31	91.5	18	18
PB-32	380	21	22
B-33	101.5	13	13
B-34	86.5	17	17
B-35	106.5	21	21
PB-36	405	3	10
PB-37	403	3	10

III.E.6.3 General Subsurface Stratigraphy

In order to describe a general subsurface soil profile of the facility, five, geologic cross-sections were constructed and are presented as **Attachment III.E.14**. Cross section transects are presented on **Attachment III.E.14**. These cross-sections depict subsurface data obtained during boring and piezometer installation and the data are supported by observations made during the installation of groundwater monitoring wells. Boring logs from groundwater monitoring well installations are presented in **Attachment III.E.12**.

In general, the subsurface conditions encountered in the borings drilled at the facility can be grouped into a single generalized stratum, with relatively uniform physical and engineering properties. This stratum consists of tan to brown, fine to coarse grained sands with varying amounts of calcareous sands, silt, gravel, and interbedded clay or silt layers varying in thickness. These soils were encountered from ground surface elevation to the total depth studied in the borings. These soils were encountered at a dry to wet condition and at a loose to hard relative density and/or consistency with SPT values ranging from 6 to more than 50 blows per foot of penetration. In general, the sandy soils may be classified as SP, SP-SM, SM, and SC. The interbedded silt or clay layers may be classified as CH, CL, and MH in accordance with ASTM D 2487 and the Unified Soil Classification System (USCS), with occasional lenses of gravel.

Clayey soils classified as CH or CL typically have coefficient permeability values less than $1x10^{-7}$ cm/sec. The clayey soils with coefficient of permeability values equal or less than $1x10^{-7}$ cm/sec are considered impermeable. The extension of these soil layers between soil boring locations were interpreted based on the soil encountered in the borings.

Based on the results of permeability testing, the fine to coarse-grained sands mentioned above possess permeability values ranging from $1x10^{-2}$ to $1x10^{-4}$ cm/sec. Interbedded clay or silt layers encountered within the sand layer possess unconfined compressive strength between approximately 43.6 psi (pounds per square inch) and 234.6 psi.

In conclusion, the unsaturated zone of the facility consists primarily of fine to coarse-grained sands. The permeability values of the unsaturated zone range from $1x10^{-2}$ to $1x10^{-4}$ cm/sec. It is apparent that the existing clay or silt layer reduces the permeability values; therefore, the average permeability value of $1x10^{-3}$ cm/sec was considered appropriate for determining pollutant migration.

III.E.6.4 Piezometer Borings

As previously approved, in order to determine the depth to groundwater, eight (8) borings were advanced into the uppermost aquifer and converted to piezometers. The locations of the piezometer borings (PB-1, PB-4, PB-18, PB-21, PB-29, PB-32, PB-36 and PB-37) are shown on **Attachment III.E.10**. Surveyed locations of the piezometers, sealed by Registered Professional Land Surveyors, are presented as **Attachment III.E.15**.

The piezometer borings were completed by a licensed well driller in general accordance with applicable regulations at the time of boring installation and with at least one person who had completed a 40-hour Hazardous Material Course as described in Title 29 of the Code of Federal Regulations (CFR) 1910.

The piezometer borings were drilled initially to a depth of 200 feet, below the existing ground surface elevation using a hollow stem-auger drilling method. Standard Penetration Tests were performed and associated soil samples were collected with a split-spoon sampler. The borings were then continued using mud-rotary drilling methods to prevent caving of the subsurface sandy soils. Soil samples were collected periodically during the drilling operations. In the case of PB-36 and PB-37, mud rotary drilling methods were used throughout their depth of exploration.

Upon completion of the sampling and drilling operations, the eight soil borings were converted into piezometers. These borings were identified with the designation, “PB.” The piezometers were constructed using 2- or 4-inch diameter Schedule 40 PVC riser and 0.010” machine-slotted screen. The boring annulus was completed using 10-20 filter sand, to a minimum depth of 1-foot above the top of the screen, followed by a 5-foot plug of bentonite. In addition, the wells were grouted to the surface and the casing extended above the ground surface elevation. Piezometer completion included a riser cap, hollow metal box riser protector (with a lock), mounted into a 4-inch x 4-foot x 4-foot concrete pad. Pipe bollard posts were placed around the perimeter of the piezometers. A typical construction diagram of a piezometer boring, as well as a typical construction diagram of a groundwater monitoring well at the facility are presented as **Attachment III.E.16**. The piezometer boring logs are included in **Attachment III.E.12**.

A hot-pressure washer was used to decontaminate the drilling equipment and tools at the facility prior to drilling, between piezometer locations, and before departure from the facility.

The piezometers were developed as required by 30 TAC §330.421(c), at the time of installation.

III.E.6.5 Groundwater Monitoring Well Installation

Groundwater monitoring wells and a groundwater observation well were installed at the facility in accordance with applicable groundwater monitoring requirements. A map depicting the locations of all monitoring wells installed at the facility is presented as **Attachment III.E.17**. Installation of the monitoring wells has taken place during multiple events as the facility has developed. Monitoring well data sheets, which contain information related to the installation and construction of each monitoring well, are presented as **Attachment III.E.18**. Surveyed locations of the monitoring wells are presented in **Attachment III.E.15**. Plugging reports of monitoring wells are presented as **Attachment III.E.19**. Groundwater data and other information related to the groundwater monitored by these wells are described in the following section of this report.

III.E.6.6 Groundwater

As noted on the piezometer and groundwater monitoring well installation logs presented in **Attachment III.E.12**, groundwater at the facility has been encountered at depths ranging from approximately 286 to 378 feet (ft) below ground surface (bgs) with an average depth of approximately 359 ft bgs. In general, collected potentiometric surface data suggests that the groundwater beneath the facility generally flows to the east, southeast, and northeast, which is congruent with the regional groundwater flow direction to the southeast in the area of the facility. Historical groundwater measurements are tabulated in **Attachment III.E.20**, and will be updated with subsequent monitoring events. Additionally, a map depicting the seasonally high-water table is presented as **Attachment III.E.21**.

The uppermost groundwater-water bearing unit beneath the facility, in which the groundwater monitoring wells are installed, is considered to be unconfined and in general, the laboratory-reported total dissolved solids (TDS) concentrations in samples collected from the groundwater monitoring wells are <3,000 milligrams per liter. Laboratory analytical reports with TDS concentrations are presented as **Attachment III.E.22**. The screened intervals of the majority of the groundwater monitoring wells installed at the facility are installed within a brown, soft, clay layer that often contains silt and sand or at the lithological contact of the clay layer and the overlying, fine-grained sand unit.

Water levels have been measured at regular intervals since piezometers were initially installed in January 25, 1999. Measured groundwater elevations are presented in **Attachment III.E.20**.

Sampling of the groundwater monitoring system’s fifteen (15) monitoring wells is conducted on a semi-annual basis as part of the landfill’s current detection monitoring program. All results and associated

statistical analyses are reported to the TCEQ. Results from the most recent semi-annual groundwater monitoring events (June 2023, December 2023, and June 2024) are summarized as follows:

During June 2023, toluene was detected in wells MW-1, MW-9, MW-10, MW-11, PB-36, and PB-37, as well as in the field blank. The concentration in the field blank was greater than the concentration of any detection observed in the monitoring wells. It was concluded that toluene was introduced as a field or sample handling contaminant and not sourced from the landfill. Toluene was not detected during the December 2023 semi-annual sampling event at any monitoring well location. Selenium was detected in MW-6 during the December 2023 semi-annual event but did not produce an increasing trend using the TCEQ-approved statistical methods and remains in detection monitoring.

During the June 2024 semi-annual monitoring event, one (1) exceedance was identified for antimony at MW-11. However, a comparison using the TCEQ-approved statistical methods did not identify an increasing trend.

To date, all wells remain in the detection monitoring program, and no significant increases of detection monitoring program constituents have been identified. This indicates that operation of the landfill is not currently impacting the underlying aquifer. All semi-annual groundwater monitoring results are submitted to TCEQ.

III.E.6.6.1 Historical Groundwater Elevation

There are three water wells, used for the withdrawal of water, located within a one-mile radius of the facility, according to the Texas Water Development Board (TWDB) records. A map depicting the locations of these wells is presented as **Attachment III.E.23**. One of these water wells, the Orr well, was located within the facility and is noted as “Plugged or Destroyed” according to TWDB records. TWDB has assigned the other two water wells with State Well Number 4931204 and with State Well Number 4931205. The range of depths of these water wells is between 325 feet to 570 ft bgs. TWDB records related to these water wells are presented as **Attachment III.E.24**. Static water levels in the above-mentioned water wells range from 269 feet to 370 feet. The variation in the recorded depths is due mainly to the difference in surface elevation and topography across the area.

Additionally, a potential vertical conduit was found within the facility during the initial site investigations. This vertical conduit consisted of a cathodic protection system (CPS) for the El Paso Natural Gas (EPNG) pipeline. The CPS was located in right-of-way “571683” and was designated “CPS #301” by EPNG. The City of El Paso and EPNG negotiated relocation of the CPS outside of the facility and the previous CPS location was plugged and abandoned in accordance with applicable regulations. The original location of the CPS is depicted in Part II, Figure I/II.A.3.

III.E.6.6.2 Aquifer Testing

The hydraulic conductivity of the aquifer was estimated by performing a “slug” test in three of the piezometers, specifically, “slug-in” tests. This data was used to approximate the rate of groundwater movement. The slug tests were conducted in accordance with the ASTM D 4044, Standard Test Method for Instantaneous Change in Head – Test for Determining Hydraulic Properties of Aquifers and ASTM D 5912, Standard Test Method for Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head. A copy of the ASTM documentation used for the slug tests is presented as **Attachment III.E.25**. The slug tests were performed with a pressure transducer, measuring tape, and water bailers. The head differences and elapsed time were recorded with a data logger. The results of the testing indicated that the hydraulic conductivity of the underlying aquifer ranged from $1x10^{-4}$ to $1x10^{-6}$ cm/sec. The normalized curves of slug test results and related calculations are presented in **Attachment III.E.26**.

The constant head permeability testing results are presented as **Attachment III.E.27**. Soil sampling results are discussed in the following section.

III.E.6.6.3 Groundwater Flow Direction

Groundwater contour maps have been developed during groundwater monitoring events at the facility and are included in historical groundwater monitoring reports submitted to the TCEQ. Groundwater flow at the facility is generally to the northeast, east, and southeast. Historical groundwater elevation measurements support a generally eastward flow of groundwater beneath the facility with some deviations to the north and south. This groundwater frow direction aligns closely with the inferred groundwater flow direction illustrated on the regional potentiometric surface map, presented as **Attachment III.E.9**.

Hydraulic gradients were determined for the two events that represent the highest groundwater elevations (November 2006) and lowest groundwater elevations (September 2004). The gradients were determined by calculating the difference between the groundwater contours (head difference) and dividing by the horizontal distance between the contours. The values are in ft/ft; multiply by 5,280 for the gradient in feet

per mile. Minimum and maximum rates of groundwater movement for each of the two events were estimated using the groundwater velocity equation (Driscoll, 1986):

$$v = 2{,}830Ki/ne$$

Where:

v = groundwater velocity (ft/day);
K= hydraulic conductivity (cm/sec);
i = hydraulic gradient (ft/ft);
ne = effective porosity (percent); and
2,830 converts cm/sec to ft/day.

The hydraulic conductivity is estimated to be 1 x 10^{-5} cm/sec based off of the results of the slug tests provided in the previous section. Minimum and maximum hydraulic gradients were estimated for each event. Estimated hydraulic gradients for the September 2004 event ranged from a minimum of 2.6979 x 10^{-4} to a maximum of 3.9303 x 10^{-3}. Estimated hydraulic gradients for the November 2006 event ranged from a minimum of 4.007 x 10^{-4} to 3.6794 x 10^{-3}. The average effective porosity is estimated to be 30 percent, based on values from Freeze and Cherry (1979). Using the equation and the values described above, the estimated minimum and maximum groundwater velocities for the water-bearing zone are:

September 2004

$$v_{min} = \frac{2{,}830 \times 1.00\text{E-}05 \times 2.698\text{E-}04}{0.30}$$

$$v_{min} = 2.545\text{E-}05 \text{ ft/day}$$

and

$$v_{max} = \frac{2{,}830 \times 1.00\text{E-}05 \times 3.930\text{E-}03}{0.30}$$

$$v_{max} = 3.708\text{E-}04 \text{ ft/day}$$

November 2006

$$v_{min} = \frac{2{,}830 \times 1.00\text{E-}05 \times 4.007\text{E-}04}{0.30}$$

$$v_{min} = 3.780\text{E-}05 \text{ ft/day}$$

and

$$v_{max} = \frac{2{,}830 \times 1.00\text{E-}05 \times 3.679\text{E-}03}{0.30}$$

$$v_{max} = 3.471\text{E-}04 \text{ ft/day}$$

The maximum velocity calculated for the two above events is 0.0003708 ft/day, which is equal to 0.135 ft/year.

III.E.6.6.4 Point of Compliance

As stated in 30 TAC §330.3(106), “Point of Compliance” is defined as a “vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility.”

The direction of groundwater flow was originally determined for the facility based on collected, water-level measurements from each monitoring well. Based on these measurements, the average flow vector was calculated at each monitoring well. This data was used to establish the Point of Compliance (POC).

As required by 30 TAC §330.403(e)(3) the owner/operator will “notify the Executive Director in writing” if an event or change is likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination. This will be based on evaluation of the groundwater elevations during groundwater monitoring of the landfill. Additional groundwater monitoring wells or sampling points and modification to the site development plan may be required to adequately monitor the groundwater.

III.E.6.6.5 Pollutant Migration

Pollutant migration is dependent upon the thickness of vadose zone, climate, and the soil characteristic within the zone.

The subsurface soil investigation study presented in **Section III.E.6.3** indicated that the existing soil within the vadose zone consists of poorly graded fine to medium sand, gravel, silt, clay, or combinations of these soils. The presence of clayey soils and fine-grained sand intermixed with silt and clay in various thickness may attenuate the vertical and horizontal migration of pollutants. Additionally, the distance between the landfill liner and the underlying groundwater table mitigates the potential of pollutant migration from the landfill to the groundwater.

In accordance with 330.63(e)(6)(K), I have reviewed the groundwater data described in a report submitted with this certification and have found no evidence that the Greater El Paso municipal solid waste landfill located at 2600 Darrington Road, El Paso, Texas 79928 has contaminated groundwater in the uppermost aquifer.

III.E.7.0 Laboratory Testing

III.E.7.1 Soil Testing

In the laboratory, each soil sample collected during boring installation was evaluated and visually classified by a member of our geotechnical engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical engineering properties of the strata were evaluated by the following tests provided in **Table III.E.7-1**:

Table III.E.7-1: Geotechnical Testing Procedures

Type of Test	ASTM Procedure	Number Conducted
Natural Moisture Contents	D2216	88
Particle Size Analysis	D422/D487	88
Atterberg Limits	D2217/D4318	77
Soil Classifications	D2487	79
Fraction Organic Carbon	D5715	71
Dry Unit Weights	D4718	51
Specific Gravity	D854	39
Permeability	D2434	41
Unconfined Compressive Strength	D2166	4

Results of the laboratory tests are presented in graphical or numerical form on the boring logs in **Attachment III.E.12**. A summary of all laboratory tests is tabulated in **Attachment III.E.288**, along with the results of 88 particle size analyses and the results of four unconfined compressive strength tests. The results of all permeability tests are presented in **Attachment III.E.28**.

III.E.7.2 Slope Stability Analysis

A detailed slope stability analysis is presented as **Appendix III.G**.

III.E.7.3 Soil Suitability for Construction

Based on the results of initial site reconnaissance, laboratory testing, and engineering analyses conducted prior to initial permit issuance, it was concluded that the existing soil was suitable for use in the construction of landfills for subgrade preparation, protective cover, and daily cover.

ATTACHMENT III.E.1 – BOLSONS MAP

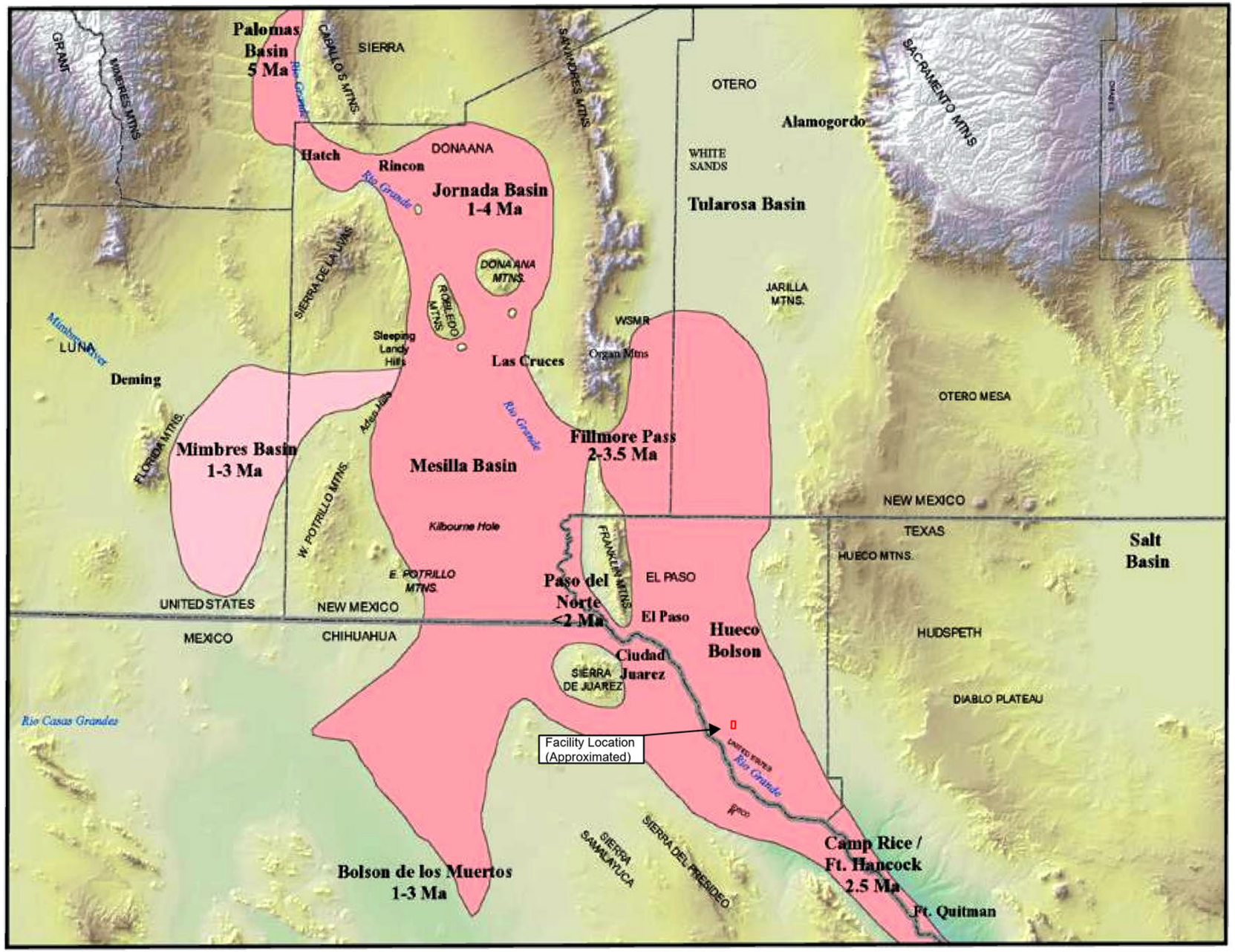


FIGURE 9. Evolution of the Ancestral Rio Grande fluvial system (pink) during the Pliocene and Early Pleistocene.

For Permitting Purposes Only

Property/Permit Boundary

Notes:
1. Hawley, J.W., Kennedy, J.F., Granados-Olivas, A., & Ortiz, M. A., 2009. Hydro-geologic Framework of the Binational Western Hueco Bolson-Paso del Norte Area, Texas, New Mexico, and Chihuahua: Overview and Progress Report on Digital-Model Development. Technical Report.

NORTH

20 10 0 20

Miles

BURNS McDONNELL

Attachment III.E.1
Bolson Map
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

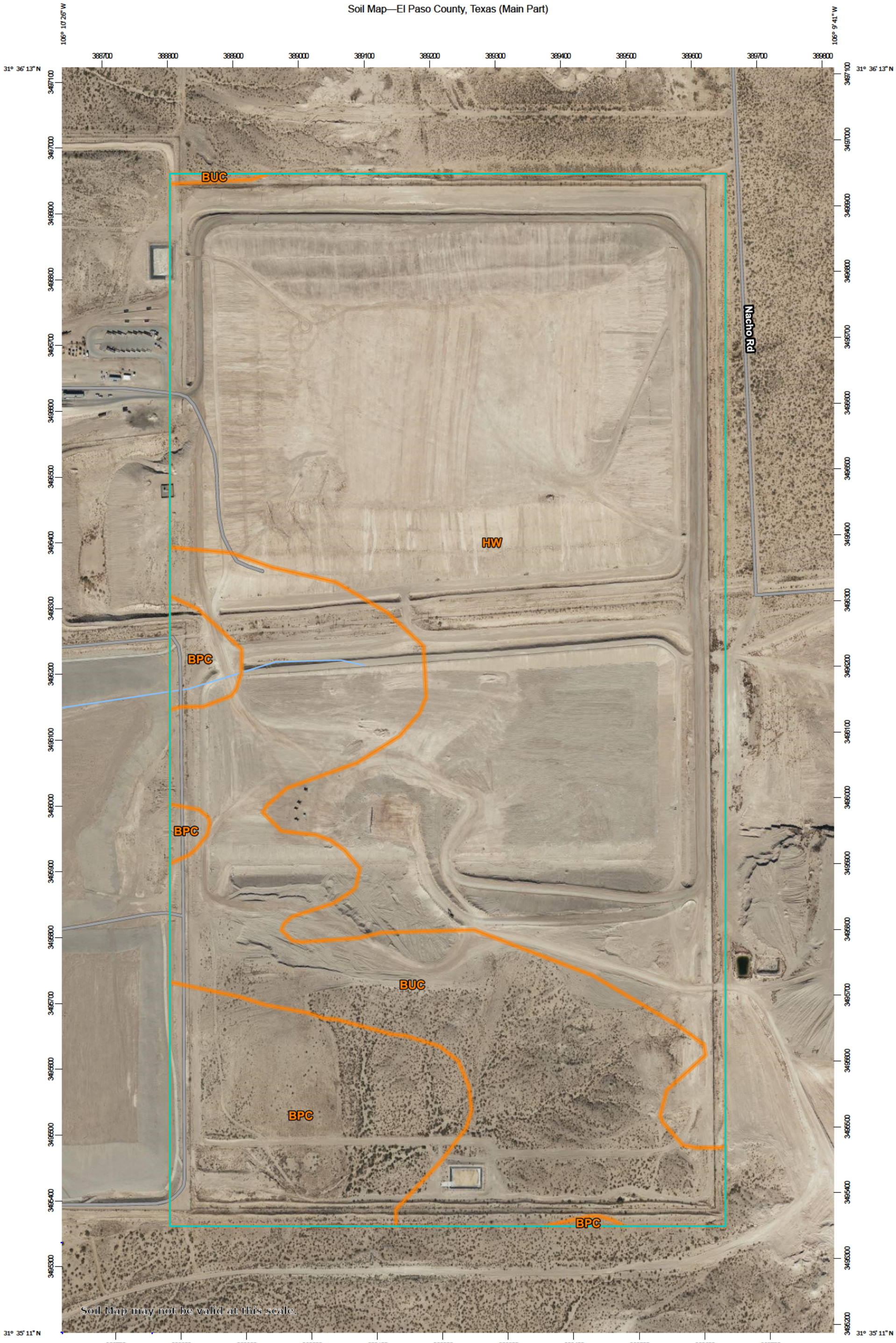
Source: Esri, BMcD

Issued: 11/28/2023

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology.aprx embillings 11/28/2023
Service Layer Credits: World Topographic Map: Texas Parks & Wildlife, CONANP, Esri, HERE, Garmin, Foursquare, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS

ATTACHMENT III.E.2 – USDA WEB SOIL SURVEY

Soil Map—El Paso County, Texas (Main Part)



Map Scale: 1:5,390 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County, Texas (Main Part)
Survey Area Data: Version 21, Aug 24, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

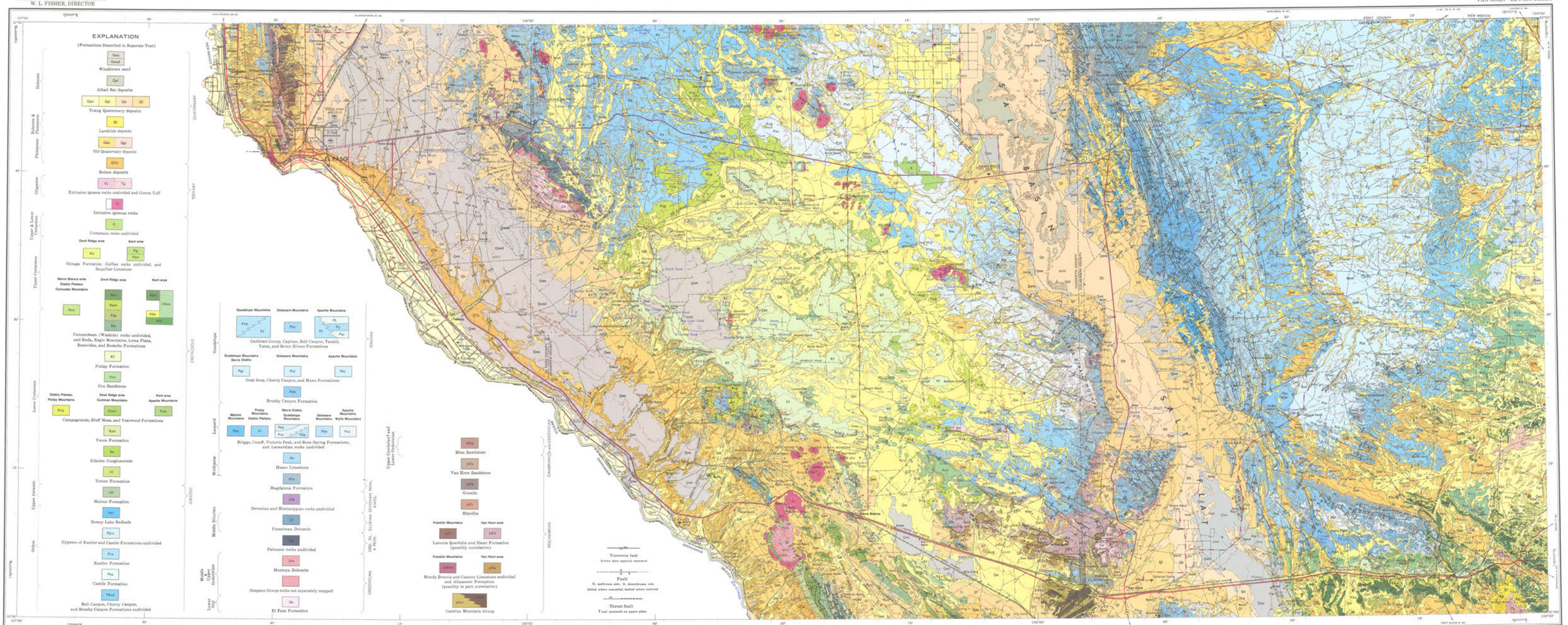
Date(s) aerial images were photographed: Nov 15, 2020—Nov 17, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BPC	Bluepoint association, rolling	38.2	11.3%
BUC	Bluepoint gravelly association, rolling	85.6	25.4%
HW	Hueco-Wink association, hummocky	212.6	63.2%
Totals for Area of Interest		**336.4**	**100.0%**

ATTACHMENT III.E.3 – GEOLOGIC ATLAS OF TEXAS, VAN HORN-EL PASO SHEET



GEOLOGIC ATLAS OF TEXAS, VAN HORN - EL PASO SHEET

E. RUSSELL LLOYD MEMORIAL EDITION

REVISED 1983

Van Horn part of sheet:

Prepared by the U.S. Army Map Service (USAS), Corps of Engineers, Washington, D.C. Compiled in 1955 by photogrammetric methods and from USGS 1:62,500, 1933-41. Planimetric detail revised by photo-planimetric methods. Control by USGS and USC&GS. Photograys field annotated 1954. Limited revision by U.S. Geological Survey 1964.

El Paso part of sheet:

Prepared by the Army Map Service (AMS), Corps of Engineers, U.S. Army, Washington, D.C. Compiled in 1962 by photogrammetric methods and from United States Quadrangles, 1:25,000, AMS, 1955 and 1:62,500, USGS 1939. Planimetric detail revised by photo-planimetric methods. Aerial photography 1954-57. Horizontal and vertical control by USGS, USC&GS and AMS. Photograys field annotated 1958.

Partially funded by Texas Department of Water Resources

10,000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

LOCATION MAP

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

1983 MAGNETIC DECLINATION FOR CENTER OF THIS SHEET IS 10°31'E
MEAN ANNUAL CHANGE 10.0' WESTERLY

INDEX OF GEOLOGIC MAPPING

Numbers in outlined areas refer to items in Bibliography in "Index to Areal Geologic Maps in Texas, 1891-1961," by T. E. Brown (1963), Univ. Texas, Austin, Bur. Econ. Geology. For area **A**, see P. B. Dickinson, Jr., and J. R. Smith, Jr. (1965). region, Texas, U.S. Geol. Survey Prof. Paper 480, Plate I; for area **B**, see C. L. Rogers (1950), Geology of the Sierra Blanca area, Hudspeth County, Texas: U.S. Geol. Survey Prof. Paper 479, Plate I; for area **C**, see J. P. Brand and R. K. DeFord (1962), Geology of eastern half of Kent Quadrangle, Culberson, Reeves, and Jeff Davis Counties, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 24; for area **D**, see J.W. Wood (1966), Geology of Apache Mountains, Trans-Pecos Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 29; for area **E**, see J. L. Rose (1972), Geology of Eagle Mountains and vicinity, Hudspeth County, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 35; for area **F**, see R. L. Harbour, Geology of the northern Franklin Mountains, Texas and New Mexico, U.S. Geol. Survey Bull. 1298, 129 p., plates in pocket; for area **G**, see B. R. Jones and D. F. Reaser (1970), Geology of the southern Quitman Mountains, Hudspeth County, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 39; for area **H**, see R. G. Gross (1965) Geology of Sierra Tinaja Pinta and Cornudas Station areas, northern Hudspeth County, Texas, Univ. Texas, Austin, M.A. thesis; and for area **I**, see W. R. Seager (1982), Quaternary fault system in the Tularosa and Hueco Basins, southern New Mexico and West Texas, New Mexico Geological Society, 33rd Field Conference, p. 131-135; and C. D. Henry and J. K. Gluck (1981) A preliminary assessment of the geologic setting, hydrology, and geochemistry of the Hueco Tanks geothermal area, Texas and New Mexico, Univ. Texas, Austin, Bur. Econ. Geology Geol. Circ. 81-1, 49 p.



VIRGIL E. BARNES, PROJECT DIRECTOR

Geologic mapping mostly from sources shown on index map. Mapping received from Shell Oil Company and Cities Service Petroleum Company gratefully acknowledged. Geology of unmapped areas compiled and hole checked by J. W. Dietsch, D. E. Owen, and C. A. Shelby, using high-altitude aerial photographs. Mapping compiled and scribed by J. W. Macon and cartographic revision by M. R. Dey. Mapping reviewed by West Texas Geological Society, Geologic Atlas Committee: L. W. Bridges (Shell Oil Company), Chairman; O. L. Evans (Louisiana Land and Exploration Company); Robert Penfold (Mobil Oil Company); Sam Bishop (Humble Oil & Refining Company); T. S. Jones (Union Oil Company of California); and Walter Ammen (Pan American Petroleum Corporation)

GEOLOGIC ATLAS OF TEXAS
VAN HORN-EL PASO SHEET

E. RUSSELL LLOYD MEMORIAL EDITION

J. W. Dietrich, D. E. Owen, C. A. Shelby, and V. E. Barnes

VIRGIL E. BARNES, Project Director

1968

REVISED 1983

REPRINTED 1995

EXPLANATION



Windblown sand

Qwsd, areas of large dunes



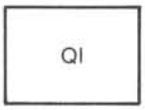
Alkali flat deposits

Alkali and salt impregnated clay, dolomite, and very fine grained sand; some intermittent salt lakes



Young Quaternary deposits

Qalr, alluvium along the Rio Grande
Qal, alluvium and low terrace deposits along other streams
Qb, lacustrine and fluviatile deposits of clay, silt, sand, and gypsum in bolsons
Qf, colluvium and fans



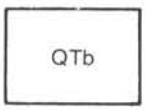
Landslide deposits

Displaced bouldery masses of rock



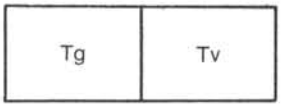
Old Quaternary deposits

Qao, alluvium, colluvium, caliche, and gypsite on surfaces dissected by modern drainage. **Kent area**, includes Gozar and Bigtank Gravels. Terraces along the **Rio Grande. Sierra Blanca area**, includes Balluco, Ramey, Gills, Madden, and Miser Gravels
Toy Limestone, Qgt, nonmarine limestone, mostly in southwestern Reeves County



Bolson deposits

Clay, sand, and gravel, in part gypsiferous, some caliche; includes Gatuna Formation of Kent area



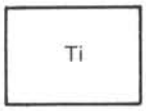
Gomez Tuff and extrusive igneous rocks undivided

Gomez Tuff, Tg, peralkaline ash-flow tuff, densely welded to friable; gray, brown, green, and reddish-brown to black devitrified glass; thickness up to 1,200 feet in Davis Mountains.

Holocene
Holocene & Pleistocene
Pleistocene
Oligocene
QUATERNARY
TERTIARY

Oligocene

Extrusive igneous rocks undivided, Tv, in **Quitman Mountains**, interbedded flows and pyroclastic rocks of the Square Peak Volcanics; in **Sneed (Cox) Mountain and west of Victoria Peak**, small basalt flow remnants

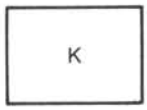


Intrusive igneous rocks

Stocks, laccoliths, sills, and dikes of rhyolite, rhyolite porphyry, quartz monzonite, monzonite, granodiorite, granite, syenite, trachyte, basalt, and altered diabase

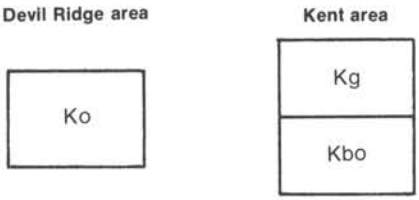
TERTIARY

Upper & Lower Cretaceous



Cretaceous rocks undivided

Franklin Mountains area, small outcrops of limestone, marl, shale, and sandstone; mostly Comanchean, some Gulfian. **Northern Diablo Plateau**, basal clastic rocks including Cox Sandstone and Campagrande Formation undivided. **Sierra Blanca area**, Gulfian sandstone and siltstone



Ojinaga Formation, Gulfian rocks undivided, and Boquillas Limestone

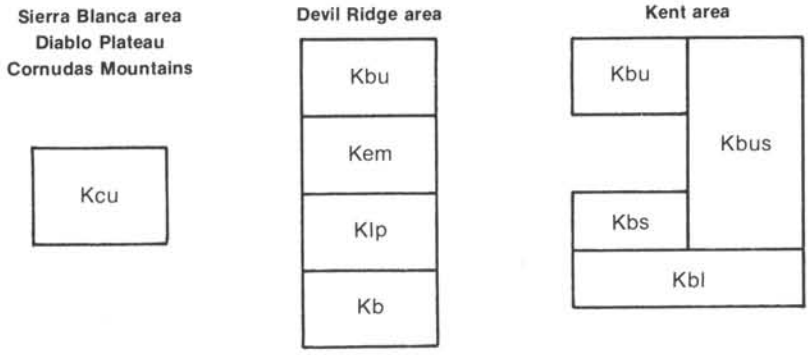
Ojinaga Formation, Ko, shale, sandstone, and limestone. Upper part, interbedded sandstone, fine to coarse grained, brown; and shale, gray to olive, in part sandy; grades downward to poorly exposed interbedded shale and sandy shale. Lower part, interbedded fissile shale and flaggy limestone, gray and black; thickness 1,600± feet

Gulfian rocks undivided, Kg, marl, shale, and argillaceous limestone. Fossils indicate correlation with Central Texas units—Taylor, Austin, upper part of Eagle Ford; thickness 300± feet

Boquillas Limestone, Kbo, limestone, marl, and shale. Upper part, interbedded marl and shale; lower part, limestone, silty to sandy, flaggy, dark grayish orange near base; marine megafossils; thickness 200± feet

Upper Cretaceous

CRETACEOUS



Comanchean (Washita) rocks undivided and Buda, Eagle Mountains, Loma Plata, Benevides, and Boracho Formations

Comanchean rocks undivided, Kcu. **West of Arroyo Campo Grande**, pre-Finlay(?) limestone and shale. **Quitman Mountains and Sierra Blanca area**, marl, clay, and limestone younger than Finlay Limestone. **Sneed (Cox) Mountain**, Finlay Formation and overlying marl and clay. **Diablo Plateau**, marl and clay approximately correlative with Benevides Formation. **Sierra Prieta**, fossiliferous shale, sandy shale, and marl correlative with Benevides and younger formations. **Cornudas Mountains and Dog Mountain**, upper part silty limestone and shale; middle part sandstone; lower part conglomeratic limestone; contains late Comanchean fossils.

Lower Cretaceous

Kent area, Buda Limestone and San Martine Member of Boracho Formation undivided, Kbus, in collapsed areas

Buda Limestone, Kbu. **Devil Ridge area**, limestone, very fine grained, nodular, thin, bedded, light-brownish gray; weathers very pale orange to pale yellowish brown; thickness 240 feet. **Kent area**, fossiliferous limestone and sandstone. Limestone thin to thick bedded, very hard (upper 40 feet); thin to thick bedded, argillaceous (middle 60 feet); coquinoid, clastic (lower 40 feet). Sandstone locally at base, fine to medium grained, hard, quartzitic, some phosphatic nodules, shark teeth, and quartz pebbles; thickness 140 feet

Eagle Mountains Sandstone, Kem, quartz sandstone, very fine grained, calcareous, ferruginous, crossbedded in part, thin bedded; some sandy limestone and shale interbeds; weathers shades of orange and brown, outcrop littered by angular, platy fragments of sandstone; thickness 130 feet

Loma Plata Limestone, Klp, mostly limestone and interbedded marl, very fine grained, thin bedded, medium light gray to brownish gray, some black shale and thin nodular limestone interbeds near base; weathers very pale orange; marine megafossils; thickness 2,200± feet

Benevides Formation, Kb, quartz sandstone, fine grained, calcareous, somewhat argillaceous, friable, grayish pink to pale red; thickness 100 feet or less

Boracho Formation composed of two members.

San Martine Limestone, Kbs, limestone thin to thick bedded, argillaceous, thin interbeds of calcareous shale; prominent 30-foot ledge at base in some localities; marine megafossils throughout; thickness 230 feet

Levinson Limestone, Kbl, limestone, marl, shale, and sandstone. Upper two-thirds, limestone, thin to thick bedded, light gray to light olive gray; interbeds of yellowish marl and shale. Lower one-third, shale, light to dark gray; a few thin to thick beds of limestone; sandstone locally near base. Abundant marine megafossils include species found in Kiamichi, Duck Creek, and Fort Worth Formations of north Texas; thickness 150± feet

Kf

Finlay Formation

Limestone, marl, shale, and sandstone. **Devil Ridge area**, mostly limestone, very fine grained, thin to thick bedded, nodular, medium gray; weathers pale yellowish brown; a few thin beds of shale, siltstone, and very fine grained sandstone near base; thickness 600± feet. **Finlay Mountains**, mostly limestone and marl, proportion of marl increases from one-fourth in west to one-half in east; limestone, thick bedded and massive in caprock, mostly medium to thin bedded and nodular, gray; thin sandstone beds near base; abundant marine microfossils and macrofossils; thickness 200± feet. **Diablo Plateau**, mostly limestone in rimrock northwest of the Finlay Mountains; sandstone in uppermost part west of Tepee Butte, marl increases eastward, sandstone increases northeastward; thickness 175 feet, feathers out northeastward; locally includes small outcrops of Cox Sandstone and Campagrande Formation at base of mesa scarp and on north side of Diablo Plateau. **Kent area**, sandstone, sandy limestone, and massive coarse-grained limestone; thickness 15-40 feet, thins northward

Kcx

Cox Sandstone

Quartz sandstone, conglomerate, limestone, and shale. **Devil Ridge area**, mostly quartz sandstone, fine to medium grained, thin bedded, crossbedded, ripple marked, various shades of gray, brown, orange, and pink; a few thin beds of fossiliferous sandy limestone and yellowish shale; conglomeratic at base; thins along Devil Ridge from 1,700 feet at southeast end to 550 feet at northwest end. **Finlay Mountains and Diablo Plateau west of Gunsight Hills**, mostly siltstone and shale; sandstone and fossiliferous limestone concentrated in upper half; siltstone, shale, and limestone decrease and sandstone increases eastward; thickness 50-700 feet, thins northeastward. **Diablo Pleateau east of Gunsight Hills**, mostly sandstone, interbeds of marl and shale in lower part, well-rounded pebbles of chert and quartz sprinkled throughout sandstone and concentrated in lenses; thickness 135-450 feet, thins northeastward. **Kent area and northward**, mostly sandstone, fine to medium grained, thin to thick bedded, crossbedded in part, pebbly in part; interbeds of silty marl and quartz-pebble conglomerate; outcrops north of Cottonwood Draw probably in part equivalent to Finlay Formation; preserved in numerous collapse structures within outcrop area of Castile and Rustler, small outcrops not separately mapped; thickness 25-170 feet, highly variable in northern outcrops because of irregular topography at time of deposition; thins northward

Lower Cretaceous

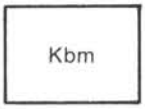
CRETACEOUS

Diablo Plateau
Finlay Mountains

Devil Ridge area
Quitman Mountains

Kent area
Apache Mountains





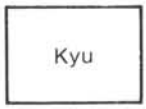


Campagrande, Bluff Mesa, and Yearwood Formations

Campagrande Formation, Kcg, limestone, marl, conglomerate, sandstone, siltstone, and shale; thins northeastward. **Finlay Mountains**, upper 200-250 feet, alternating marl and limestone, thin to thick bedded, gray; abundant marine megafossils and foraminifers; lower part interbedded sandstone, fossiliferous limestone, siltstone, sandy shale, conglomerate composed of limestone and chert; thickness 375-800 feet. **Northwestern Diablo Plateau**, mostly varicolored limestone- and chert-pebble conglomerate, in upper part interbedded limestone and calcareous shale; thickness 50-300 feet. **Triple Hill**, limestone, in part sandy, thick bedded, gray; thickness 315+ feet. **Sierra Prieta**, limestone, conglomeratic in lower part, mostly thin bedded, nodular, gray, commonly yellow and red mottled; some marl and clay interbeds; thickness 80± feet. **Sneed (Cox) Mountain area**, interbedded limestone, shale, and marl; conglomerate locally at base, up to 80 feet thick, rests on irregular surface; thickness 180 feet maximum

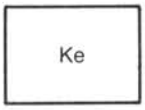
Bluff Mesa Formation, Kbm, limestone, sandstone, and sandy shale. Mostly limestone, very fine grained, sandy, oolitic near middle, thin to thick lenticular beds; lenses of quartz sandstone, fine to coarse grained, calcareous and siliceous; some interbeds of sandy shale; abundant marine megafossils and foraminifers; thickness 1,100-1,470 feet

Yearwood Formation, Kye, limestone and interbedded shale, thin to thick bedded, light-gray, conglomerate up to 55 feet thick at base; thickness 160 feet, feathers out northward



Yucca Formation

Limestone, sandstone, siltstone, shale, and conglomerate. Mostly limestone, aphanitic to fine grained, in part sandy, in part dolomitic, thin bedded, dark gray to brown to red. Quartz sandstone, fine grained, indistinctly crossbedded, commonly spotted with iron oxide; in part calcareous, white and gray, weathers brown, in part siliceous, gray, purple, and green. Shale and quartz siltstone, thin partings to 3-foot beds, bright red to purple. Drab limestone- and chert-pebble conglomerate. Sandstone proportionately less downward, proportionately more southward. Overall appearance a distinctive red brown. Marine megafossils in a few beds. Thickness 600 feet at Eagle Spring to 5,500+ feet in Quitman Gap, wedges out northeastward



Etholen Conglomerate

Mostly conglomerate composed of gray to black well-rounded limestone blocks and fragments up to 18 inches across and chert fragments, generally black, up to 6 inches across in a gray to white limestone and sparry calcite matrix. A few angular blocks of limestone up to 15 feet long in lowest exposed beds. Some thin beds of sandy shale, brownish-yellow to olive-brown sandstone, gray limestone, and red, nodular limestone. Thickness 700± feet, base not exposed



Torcer Formation

Limestone, sandstone, shale, and conglomerate. Mostly limestone, fine grained, argillaceous, sandy, contains scattered limestone pebbles, mostly medium to thick bedded, dark gray to black, weathers light gray. Sandstone, medium grained, thin bedded, crossbedded, gray, weathers brown. Shale, calcareous, sandy, in partings and a few thick beds. At base, quartzitic sandstone, thick bedded, conglomeratic; quartz, chert, and limestone granules, pebbles, and cobbles sprinkled throughout and as quartz- and calcite-cemented conglomerate lenses and beds; weathers rusty brown; thickness 10-50 feet. Marine megafossils and foraminifers. Thickness of formation 400 feet

Upper Jurassic

JURASSIC

Jm

Malone Formation

Limestone, shale, siltstone, sandstone, gypsum, and conglomerate. Upper part, mostly limestone, aphanitic, beds 3-7 feet thick, black, weathers gray; up to 25 feet of brownish-yellow sandstone and limestone at top. Lower part, complexly interfingered sandstone, siltstone, shale, limestone, and conglomerate in various proportions, some impure gypsum; short-distance lateral facies changes common. Sandy shale and siltstone, mostly calcareous, massive, beds up to 15 feet thick, pink through red and brown to black; sandstone, mostly calcareous, fine to coarse grained, thin bedded, in part crossbedded, gray to brownish yellow; limestone conglomerate common at base and top; limestone, sandy, mostly thin bedded, a few beds up to 3 feet thick. Mostly sandy shale and siltstone at northwest end of Malone Mountains, grades southeastward to mostly sandstone. Marine megafossils. Thickness of formation 150-1,000+ feet

Pdl

Dewey Lake Redbeds

Siltstone, sandstone, clay, and gypsum. Siltstone and fine-grained quartz sandstone, reddish orange, reddish brown, and brownish yellow. Clay, silty, red and grayish green, gypsiferous, numerous thin beds. Gypsum in white to red masses up to 5 feet across, scarce. Small outcrops preserved in collapse structures within areas mapped as Castile Gypsum not separately mapped

Pgrc

Gypsum of Rustler and Castile Formations undivided

Gypsum in collapse structures, white, banded with thin layers of brown calcite; brecciated as much as 30 feet below the surface, mostly from uppermost part of Rustler Formation; may include gypsum and limestone residual from Salado Formation

Pru

Rustler Formation

Limestone, siltstone, sandstone, gypsum, and clay. **Near Kent**, limestone, dolomitic, thin bedded, light greenish gray to yellowish gray, some beds brecciated; thickness 140+ feet. **Near Cottonwood Draw**, upper part, limestone and dolomitic limestone similar to that near Kent, thickness 100-140 feet; lower part, siltstone and fine-grained sandstone, thin to medium bedded, yellowish gray; thickness 0-50 feet. **Near Lat. 31°50′**, upper part, limestone and dolomitic limestone, thickness 50+ feet; middle part, siltstone and sandstone, yellowish gray, thickness 50-70 feet; lower part, siltstone and fine-grained sandstone, thin to medium bedded, red; interbeds of earthy to sparry red gypsum; a few beds of red and greenish-gray clay; thickness 50+ feet. Small outcrops collapsed into Castile Gypsum not separately mapped

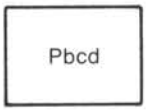
Pcs

Castile Formation

Gypsum, anhydrite, and limestone. Mostly anhydrite at depth and gypsum at surface, banded, commonly 5 to 30 alternating laminae of brown calcite and white gypsum per inch, gypsum layers 3 to 20 times as thick as calcite; highly contorted, commonly brecciated as much as 30 feet below surface. Limestone units scarce, thin to medium bedded, dark brown to black, mostly less than 10 feet thick. At base, near southwest margin of outcrop, up to 100 feet of dolomitic limestone, thick bedded, massive. Thickness of formation 1,500-2,000 feet. Within outcrop area younger rocks are preserved in numerous unmapped collapse structures, may include gypsum and limestone residual from Salado Formation

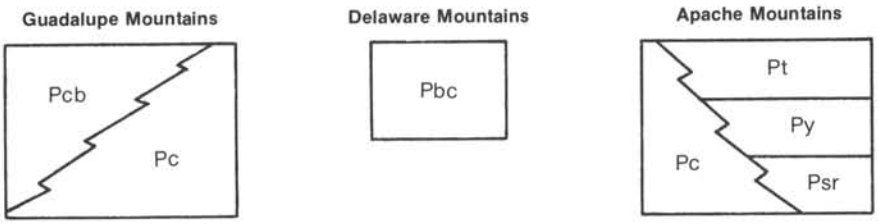
Ochoa

PERMIAN



Bell Canyon, Cherry Canyon, and Brushy Canyon Formations undivided

Western part of Delaware Mountains



Carlsbad Group, Capitan, Bell Canyon, Tansill, Yates, and Seven Rivers Formations

Carlsbad Group, Pcb, limestone and sandstone, three units not separately mapped: Tansill Formation, Yates Formation, and Seven Rivers Formation. Limestone, mostly dolomitic, in part pisolitic, thin bedded, light gray to white becoming varicolored northwestward (shelfward). Some quartz sandstone, fine grained, thin bedded, gray; proportion increases northwestward, becomes somewhat shaly, brownish yellow and red. Grades to massive Capitan Limestone southeastward (reefward)

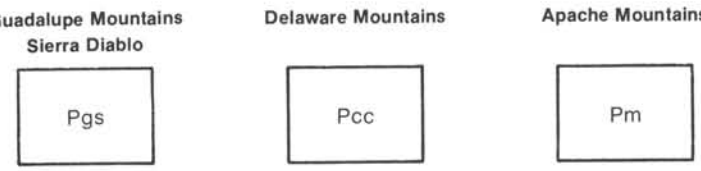
Capitan Limestone, Pc. **Guadalupe Mountains**, reef limestone, in shelfward part dolomitic, massive, beds mostly 15-100 feet thick, white, light gray, grayish yellow, brownish yellow; grades to Carlsbad Group shelfward, to Bell Canyon Formation basinward (southeastward); marine fossils; thickness 1,000-2,000 feet. **Apache Mountains**, reef limestone and dolomite, medium to coarse grained, indistinctly to thickly bedded, very light to dark gray; grades to Bell Canyon Formation basinward (northward), to Yates and Seven Rivers Formations shelfward (southward); marine megafossils; thickness up to 900 feet

Bell Canyon Formation, Pbc, sandstone and limestone. Mostly sandstone, very fine grained, very thin to thick bedded, in part massive, brownish yellow. Limestone, five units not separately mapped (from top—Lamar, McCombs, Rader, Pinery, and Hegler), fine grained, mostly thin bedded, dark gray to black, thicknesses of individual units 10-40 feet in basin, 50-100 feet near Capitan reef; fossils scarce except near Capitan reef. Grades into Capitan Limestone. Thickness of formation 670 feet near Capitan reef, 1,000+ feet in basin

Tansill Formation, Pt, mostly dolomite, fine grained, very thick to medium bedded, pale yellowish brown; weathers very pale orange, small anhydrite crystal molds common on weathered surfaces; some fossiliferous limestone in northern Apache Mountains; thickness 75-100+ feet

Yates Formation, Py, siltstone, shale, limestone, and dolomite. In southern area siltstone, very fine grained sandstone, and shale, thin to medium bedded, some thin beds of sandy limestone, dolomite, and locally redbeds; grades to limestone and dolomite northward (reefward) and in turn to Capitan Limestone, a few thin beds of siltstone, thin to thick bedded; forms light-colored moderate slope between dark-colored bluffs of adjacent formations; thickness up to 290 feet

Seven Rivers Formation, Psr, dolomite, some dolomitic limestone, fine grained, medium to thick bedded, light gray to very pale orange; grades to Capitan Limestone northward (reefward); marine microfossils; thickness 440 feet



Goat Seep, Cherry Canyon, and Munn Formations

Goat Seep Limestone, Pgs (tongue of Cherry Canyon sandstone at base not separately mapped). Upper unit (Goat Seep Limestone), mostly limestone, in part dolomitic, in part sandy, mostly thick bedded, massive, light gray to brownish yellow; sandstone interbeds more abundant downward; poorly preserved marine fossils; thickness 200+ to 1,200 feet. Lower unit (sandstone tongue of Cherry Canyon Formation), mostly sandstone, very fine to fine grained, soft, brownish yellow to pink; some units of limestone, cherty, sandy, thin bedded, brown, limestone more abundant in Guadalupe Mountains; forms moderate slope; silicified marine fossils; thickness 150-300 feet

Guadalupe

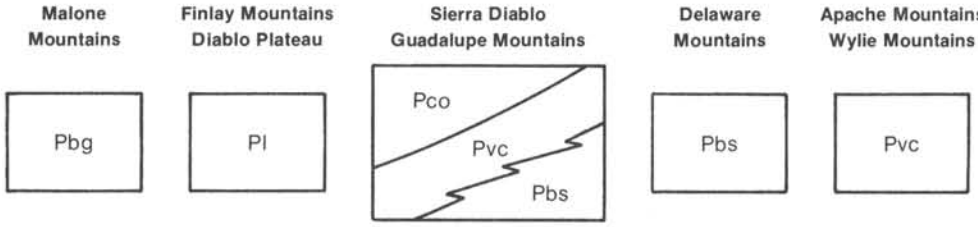
Cherry Canyon Formation, Pcc, sandstone, siltstone, and limestone. Mostly very fine grained quartz sandstone and siltstone, mostly noncalcareous, in part shaly, mostly thin bedded, some varvelike bedding and ripple marks, irregularly bedded channel fillings common in lower two-thirds. Locally persistent thin quartzite beds in lower part. Sandy limestone in thin beds, lenses, and nodules in a few places. Limestone, three units not separately mapped (from top: Manzanita, South Wells, and Getaway), thin to thick bedded, some sandstone interbeds. **Western Apache Mountains**, interbedded dolomite, limestone, and fine- to very fine grained dolomitic sandstone; basal 50 feet exposed. Thickness of formation 1,000 feet

Munn Formation, Pm, dolomite, limestone, siltstone, and sandstone. Upper part, mostly dolomite and limestone, fine to coarse grained, in part oolitic, medium to thick bedded, white to grayish orange; some siltstone and fine-grained quartz sandstone, proportion increases southward. Lower part, mostly dolomite and dolomitic limestone, fine grained, very thick bedded, light brownish gray to pale yellowish brown, weathers a distinctive brown; thin beds of siltstone and fine-grained sandstone scarce, more numerous northward. Marine megafossils and microfossils. Thickness of formation 450+ feet



Brushy Canyon Formation

Mostly sandstone (discontinuous Pipeline Shale Member at base not separately mapped). Sandstone, in part medium grained, thick bedded, a few persistent massive units, brownish yellow, yellowish gray; in part fine grained, thin bedded, beds in part varvelike, brownish yellow to brownish gray; a few sandy, fossiliferous limestone lenses; a few thin beds of green siliceous shale and chert. Pipeline Shale Member, up to 150 feet of shale, sandstone, limestone, and conglomerate; shale, siliceous, platy, black; sandstone, shaly; limestone, many thin beds, gray and black; conglomerate at base up to 25 feet thick; marine megafossils. Thickness of formation 1,000± feet



Briggs Formation, Cutoff Shale, Victorio Peak, and Bone Spring Limestones, and Leonardian rocks undivided

Briggs Formation, Pbg, mostly gypsum; some carbonate rocks. Gypsum, sparry, granular, white. Carbonate rocks: in upper part, limestone and pisolitic dolomite interbedded with gypsum; at base, persistent 25-foot unit of brownish-yellow, sandy dolomite; in middle part, mostly dolomite, fine grained, thick bedded with laminations, dark gray; some breccia masses; locally at base, pale brown to gray, fine-grained limestone; in lower part, limestone, fine grained, cherty, dark gray, marine megafossils. Thickness of formation 630 feet, base not exposed

Leonardian rocks undivided, Pl, locally includes Wolfcampian Hueco Limestone. **Finlay Mountains**, marlstone, limestone, limestone-pebble conglomerate; mostly marlstone, in part silty, well indurated, thin bedded and laminated, large-scale crossbedding in places, weathers light gray; limestone, in part dolomite, cherty in upper part, medium to thick bedded, dark gray, large-scale crossbedding, abundant in upper part, scattered discontinuous beds in lower part, marine megafossils; limestone-pebble conglomerate distributed throughout, more abundant in upper 200 and lower 900 feet; thickness 1,650+ feet, base not exposed. **Northern Diablo Plateau**, mostly light-colored limestone and dolomite equivalent to Victorio Peak and Bone Spring Limestones, includes some beds equivalent to Hueco Limestone

Cutoff Shale, Pco, shale, siltstone, sandstone, and limestone; meager marine megafossils. **West side of Guadalupe Mountains**, discontinuous outcrops mapped with Victorio Peak Limestone; mostly shale, in part siliceous and black, in part sandy and brown; some soft sandstone; some cherty limestone, thin bedded, black, brownish yellow, and gray; thickness 230 feet maximum. **North of Sierra Diablo**, interbedded limestone, shale, and sandstone; limestone, thin bedded or platy, gray to black; shale, siliceous, sandy, brown; sandstone, fine grained, thin bedded; some thin layers of earthy gypsum; thickness 250-275 feet. **Northwest end of Apache Mountains**, mostly clay shale and siltstone, thin bedded, yellowish brown; some limestone, thin to medium bedded, dark gray to black, weathers light gray; thickness 230 feet

Victorio Peak Limestone, Pvc, limestone, dolomite, sandstone, and siltstone; includes at top Cutoff

Leonard

PERMIAN

Leonard

Wolfcamp

?

PERMIAN

?

PENNSYLVANIAN

Shale, described above, along west side of Guadalupe Mountains and at northwest end of Apache Mountains. **Guadalupe Mountains**, upper part, limestone, thick bedded, light gray to white; middle part, mostly limestone, thin bedded, some interbedded sandstone; lower part, dolomitic limestone, fine grained, thick bedded, grayish brown; abundant marine fossils; thickness 800 feet. **Sierra Diablo**, along east-facing escarpment, mostly limestone, in part slightly dolomitic, thick bedded, light gray, abundant marine megafossils; southwest of escarpment, mostly dolomite and dolomitic limestone, thin to medium bedded, white to gray, rare ghosts of marine fossils; thickness 900-1,500 feet. **Northwestern end of Apache Mountains**, upper part, limestone and dolomitic limestone, very thick bedded, light brownish gray, marine fossils; lower part, interbedded grayish-orange siltstone and fine-grained, very pale orange to pale red dolomite, thin bedded; thickness 280+ feet. **Wylie Mountains**, four units not separately mapped, from top downward: (1) mostly dolomite, medium grained, porous, pale brownish gray, abundant fusulinids; (2) marl, poorly exposed, thin but distinctive because of slope break; (3) mostly limestone, some dolomite, fine grained, thin to medium bedded, yellowish gray to light brownish gray; thin interbeds of marl abundant near base; (4) interbedded marly limestone, marl, red silty shale, and limestone-pebble conglomerate; thickness of four units 1,600 feet

Bone Spring Limestone, Pbs, limestone, dolomite, sandstone, and shale. Mostly limestone, in part cherty, thin bedded, dark gray to black, marine megafossils scarce; some beds of siliceous shale and shaly limestone; a few thin beds of platy, fine-grained, calcareous, quartz sandstone. **Near north end of Sierra Diablo, at Victorio Peak, and in Baylor Mountains**, interbedded deposits marginal to basin, mostly limestone and dolomite, thick bedded, massive, gray, abundant marine megafossils and fusulinids; thickness 900-1,700 feet, grades to Victorio Peak Limestone southwestward

Ph

Hueco Limestone

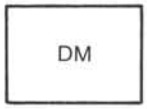
Limestone, dolomite, sandstone, shale, mudstone, and conglomerate. **Hueco Mountains**, five units not separately mapped, from top down: (1) Upper member of Alacran Mountain Formation—limestone, medium to very thick bedded, olive gray, thickness 750 feet; (1a) Deer Mountain Red Shale Member of Alacran Mountain Formation—mudstone, light to medium olive gray, weathers reddish brown, and limestone, medium bedded, in part cherty, medium light gray, thickness 180 feet; (2) Cerro Alto Limestone—limestone, medium to thick undulatory beds, medium light to dark gray, some marl interbeds, thickness 250-450 feet; (3) upper member of Hueco Canyon Formation—limestone, medium to very thick bedded, somewhat cherty, olive gray, maximum thickness 660 feet; and (3a) Powwow Conglomerate Member of Hueco Canyon Formation—calcareous mudstone, marl, and limestone-pebble conglomerate, thickness 0-100 feet; maximum thickness 1,500 feet. **Franklin Mountains**, three units not separately mapped, limestone, fine grained, medium to thick bedded, light colored; thickness 2,200 feet. **Cornudas Mountains, Sixteen Mountains, and Sierra Tinaja Pinta**, black, thin-bedded, petroliferous limestone; grades upward into light-colored dolomite; base not exposed. **Sierra Diablo area**, mostly dolomitic limestone and dolomite, aphanitic, thin bedded, dark gray, cliff forming, abundant fusulinids; grades southwestward into mostly limestone, in part cherty, in part dolomitic, thin to thick bedded, gray, many partings of marl, weathers to alternating bluffs and slopes, abundant marine megafossils. In lower part, marl and thin beds of limestone, gray and yellowish gray, marine megafossils; grades downward to shale, sandstone, and conglomerate, mostly red and brown; generally poorly exposed; thickness, absent to 250 feet. Thickness of Hueco Limestone 300-1,100 feet, feathers out in northern Baylor Mountains. **Wylie and Eagle Mountains**, mostly limestone, in part cherty, thin to thick bedded, aphanitic, gray, cliff forming. In lower part, marl and fossiliferous limestone, grades downward to shale, siltstone, sandstone, and poorly consolidated pebble-to-boulder conglomerate; thickness, absent to 200+ feet

IPm

Magdalena Formation

Limestone, shale, and marl. **Franklin Mountains**, four units not separately mapped (from top—unnamed unit, Bishops Cap, Berino, and La Tuna), mostly limestone, mostly fine grained, in part cherty particularly in basal unit, very thick bedded, basal unit massive, light gray to black; some interbedded shale; thickness 2,700 feet. **Hueco Mountains**, three units not separately mapped. Upper unit, limestone, including one reef, interbedded marl, some

conglomerate. Middle unit, marl, shale, and some limestone. Lower unit, coralline limestone, thick bedded, maximum thickness 1,300 feet. **Sierra Diablo**, two units in different exposures, with undetermined relations. In northern exposure, limestone, cherty, dark gray, overlain by shale, gray to black, abundant megafossils; thickness undetermined, overlies Mississippian, top truncated. In southern exposure, limestone, gray, thick bedded, fossiliferous, forms prominent ledges; thickness 170 feet, base not exposed and top truncated



Devonian and Mississippian rocks undivided

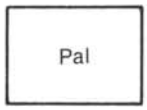
Limestone, shale, and chert. **Franklin Mountains**, five units not separately mapped (Mississippian—(1) Helms Shale, (2) Rancheria Formation, (3) Las Cruces Limestone; Devonian—(4) Percha Shale, (5) Canutillo Formation), from the top down: (1) gray and green shale, sandstone, impure fossiliferous limestone, thickness 150 feet; (2) limestone, argillaceous, bituminous, cherty, black; weathers rusty brown; thickness 250 feet; (3) limestone, aphanitic, evenly bedded, black; weathers gray; sparsely fossiliferous; thickness 60 feet; (4) shale, black; thickness 40 feet; (5) fossiliferous limestone, in part cherty, light brown and light gray; some sandstone, black, weathers brown; thickness 135 feet. **Hueco Mountains**, Mississippian rocks, upper part, shale, sandy shale, and nodules of fossiliferous limestone grading downward to brown-weathering, flaggy, sandy limestone; lower part, gray, thin- to medium-bedded limestone, upper half cherty; thickness 500± feet. Devonian rocks, upper part, blue shale; lower part, mostly bedded chert, white, gray, brownish yellow and brown; some interbedded limestone; thickness 150+ feet. **Sierra Diablo**, Mississippian rocks, mostly shale, black, purplish, and dark gray; lenses and beds of fossiliferous, earthy limestone; small phosphatic and pyritic nodules in shale; maximum exposed thickness 135 feet (Barnett Shale of P. B. King). Devonian rocks, mostly bedded chert, yellowish brown, brown, white, gray, black, and green; thin interbeds of black and brown siliceous shale in upper part; dolomitic limestone in lower part; thickness 125± feet

Middle Silurian



Fusselman Dolomite

Dolomite, dolomitic limestone, and locally limestone, aphanitic to coarse grained, thick to very thick bedded, massive, white to light gray, some beds medium dark gray; marine fossils in a few limestone beds. Thickness: **Franklin Mountains**, 600-900+ feet; **Hueco Mountains**, 630+ feet; **Sierra Diablo** and **Baylor Mountains**, 300-450 feet



Paleozoic rocks undivided

Fusselman Dolomite, Montoya Dolomite, and a small outcrop of the Magdalena Formation in **Crazy Cat Mountain** near south end of **Franklin Mountains**

Upper & Middle Ordovician



Montoya Dolomite

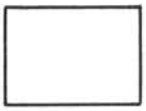
Dolomite, limestone, and sandstone, four units not separately mapped: Cutter Member, Aleman Chert Member, Upham Member, and Cable Canyon Sandstone Member. Upper part, dolomite and limestone, aphanitic to medium grained, thin to thick bedded, white to dark gray, cherty. Lower part, limestone and dolomite, aphanitic to very coarse grained, light to medium gray, local mottled zones near base, chert scarce to absent, thin sandstone bed locally at base. Thickness: **Franklin Mountains**, 250-430 feet; **Hueco Mountains**, 320± feet; **Sierra Diablo**, 250-500 feet. **Southeastern Baylor Mountains**, includes Middle Ordovician Simpson Group rocks not separately mapped

PENNSYLVANIAN
MISSISSIPPIAN & DEVONIAN
SILURIAN
PENNSYLVANIAN, SILURIAN, & ORDOVICIAN
ORDOVICIAN

Upper & Middle Ordovician

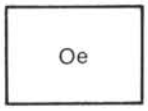
Lower Ordovician

Lower Ordovician & Upper Cambrian(?)



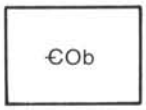
Simpson Group rocks not separately mapped

Sandstone, green shale, and dolomite; thickness 60-80 feet; mapped with Montoya Dolomite



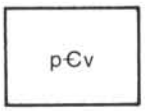
El Paso Formation

Limestone, dolomite, and sandstone. **Franklin Mountains**, upper 1,050 feet, mostly limestone, inequigranular, in part cherty; lower 540 feet, dolomite, in part sandy; thickness 1,590 feet. **Hueco Mountains**, upper two-thirds, mostly limestone, granular, impure; lower one-third, mostly dolomite, some sandy intervals; thickness 1,300± feet. **Beach Mountain**, mostly dolomite; upper 50 feet, earthy, locally sandy; next 813 feet, very fine grained to microgranular, scattered sand grains in several beds, in part cherty; lower 252 feet, sandstone, limestone, and dolomite; thickness 1,115 feet



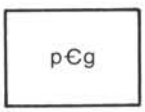
Bliss Sandstone

Franklin Mountains, sandstone, mostly fine grained, medium to thick bedded, a few beds quartzitic, some glauconitic beds in upper half; weathers dark reddish brown; maximum thickness 250 feet, locally absent. **Hueco Mountains**, sandstone, in part coarse grained, thick bedded; weathers reddish brown; thickness 200 feet. Beach and **Baylor Mountains**, sandstone, in part argillaceous, very fine to coarse grained, conglomeratic near base, friable to indurated, pinkish to yellowish gray, grades to dull maroon and green, some interbeds of green and purple sandy shale; thickness 105-160 feet



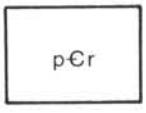
Van Horn Sandstone

Feldspathic sandstone, arkose, and conglomerate. Upper part, mostly sandstone and arkose, medium to coarse grained, thick bedded, crossbedded, yellowish brown to purplish red; scattered pebbles and cobbles; a few beds of conglomerate. Lower part, mostly conglomerate, well-rounded pebbles to boulders, closely packed to widely dispersed in an arkosic sandy matrix; some sandstone beds. Shows angular discordance with overlying Bliss. Thickness of Van Horn Sandstone variable, maximum 800 feet



Granite

Franklin Mountains, Red Bluff Granite, medium to coarse grained, massive, pink to red, disintegrates readily on weathering; intrudes all other Precambrian rocks. **Southern Hueco Mountains**, granite, coarse grained, red



Rhyolite

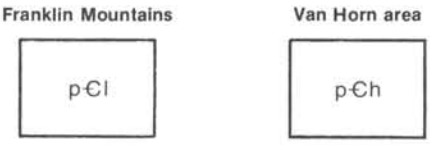
Franklin Mountains, rhyolite, porphyritic, feldspar and quartz phenocrysts, widely spaced but well-defined layering, massive, dark red to black, rounded quartzite pebbles near base; thickness 1,400 feet maximum. **Pump Station Hills**, rhyolite porphyry, phenocrysts of pink

ORDOVICIAN

ORDOVICIAN & CAMBRIAN(?)

PRECAMBRIAN

feldspar up to 1 cm across and clear, glassy quartz, aphanitic groundmass, massive, maroon to dark red; base not exposed



Lanoria Quartzite and Hazel Formation (possibly correlative)

Lanoria Quartzite, p-Cl, sandstone, quartzite, siltstone, and shale. Upper part, sandstone, fine grained, thin bedded, gray, weathers brown; siltstone, thin bedded; and shale; metamorphism slight; thickness 550-700 feet. Middle part, quartzite, fine grained, thick bedded, crossbedded, white; brown-weathering zone near middle, forms conspicuous bluffs; thickness 600-800 feet. Lower part, upper half, baked sandstone, siltstone, and shale, thin bedded, forms moderate slope; lower half, quartzite, medium grained, crossbedded; thickness 1,000± feet

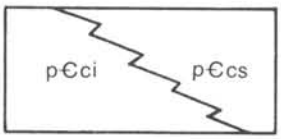
Hazel Formation, p-Ch, interbedded sandstone and conglomerate. Mostly indistinctly bedded sandstone in northern outcrops, conglomeratic in basal part; mostly conglomerate in southern outcrops, sandstone in upper part. Sandstone, mostly fine to very fine grained, mostly tightly cemented, brick red to maroon red. Conglomerate, poorly sorted, composed of slightly rounded pebbles to angular blocks more than 6 feet across, derived mostly from Allamoore Formation. Thickness of formation 5,000± feet



Mundy Breccia and Castner Limestone undivided and Allamoore Formation (possibly in part correlative)

Mundy Breccia and Castner Limestone undivided, p-Cmc. Mundy Breccia, randomly oriented, black basalt boulders, angular to slightly rounded, in matrix of dark-gray mudstone; thickness 250 feet maximum. Castner Limestone, limestone, hornfels, conglomerate, dolomite, and diabase. Mostly limestone, fine to coarse grained, light-gray chert lenses, thin bedded, irregularly bedded in upper one-third, light gray, green, blue; metamorphic minerals such as serpentine, tremolite, and garnet abundant in green limestone beds. In upper third, hornfels, very fine grained, numerous thin beds, dark gray, laminated and a few beds of conglomerate. Dolomite in basal part of exposure, white to light gray, one bed contains algal structures. Diabase, dark greenish gray, thin-to-thick sills near base and middle, constitutes about one-third of outcrop. Thickness of formation 1,100+ feet, base not exposed

Allamoore Formation, p-Ca, interbedded cherty limestone, limestone-pebble conglomerate, phyllite, pyroclastic rock, and lava flows; numerous shallow intrusions of igneous rock; thickness several thousand feet



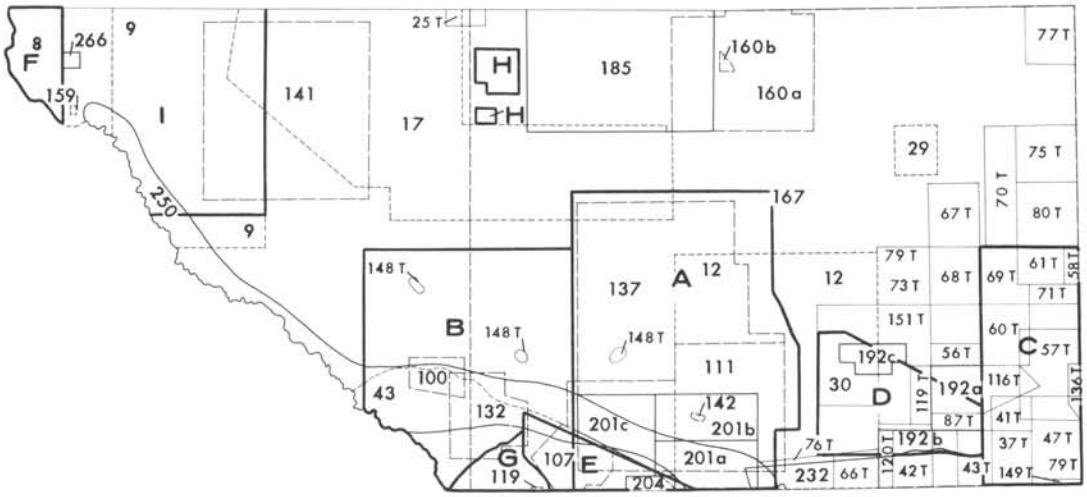
Carrizo Mountain Group

Meta-igneous rocks, p-Cci, include granodiorite, amphibolite, and metarhyolite. Granodiorite, fine grained, brown to bronze, cataclastically altered, small outcrops. Amphibolite, fine to coarse grained, massive to schistose, green to black; intrudes metasedimentary rock and metarhyolite. Metarhyolite, blocky and slabby, red, pink, brown, brownish yellow, and gray, cataclastically altered, some mylonitized zones; intrudes metasedimentary rock. Thickness of group 7,700± feet

Metasedimentary rocks, p-Ccs, include units of limestone, fine grained, hard, brown; chlorite-quartz-albite-calcite rock; phyllite, locally slaty, blue gray; feldspathic metaquartzite and meta-arkose; chlorite-mica schist, mostly fine grained, dark colored; and units of interlayered sericite schist, metaquartzite, chert, phyllite, slate, and limestone; thickness 19,000± feet

INDEX OF GEOLOGIC MAPPING

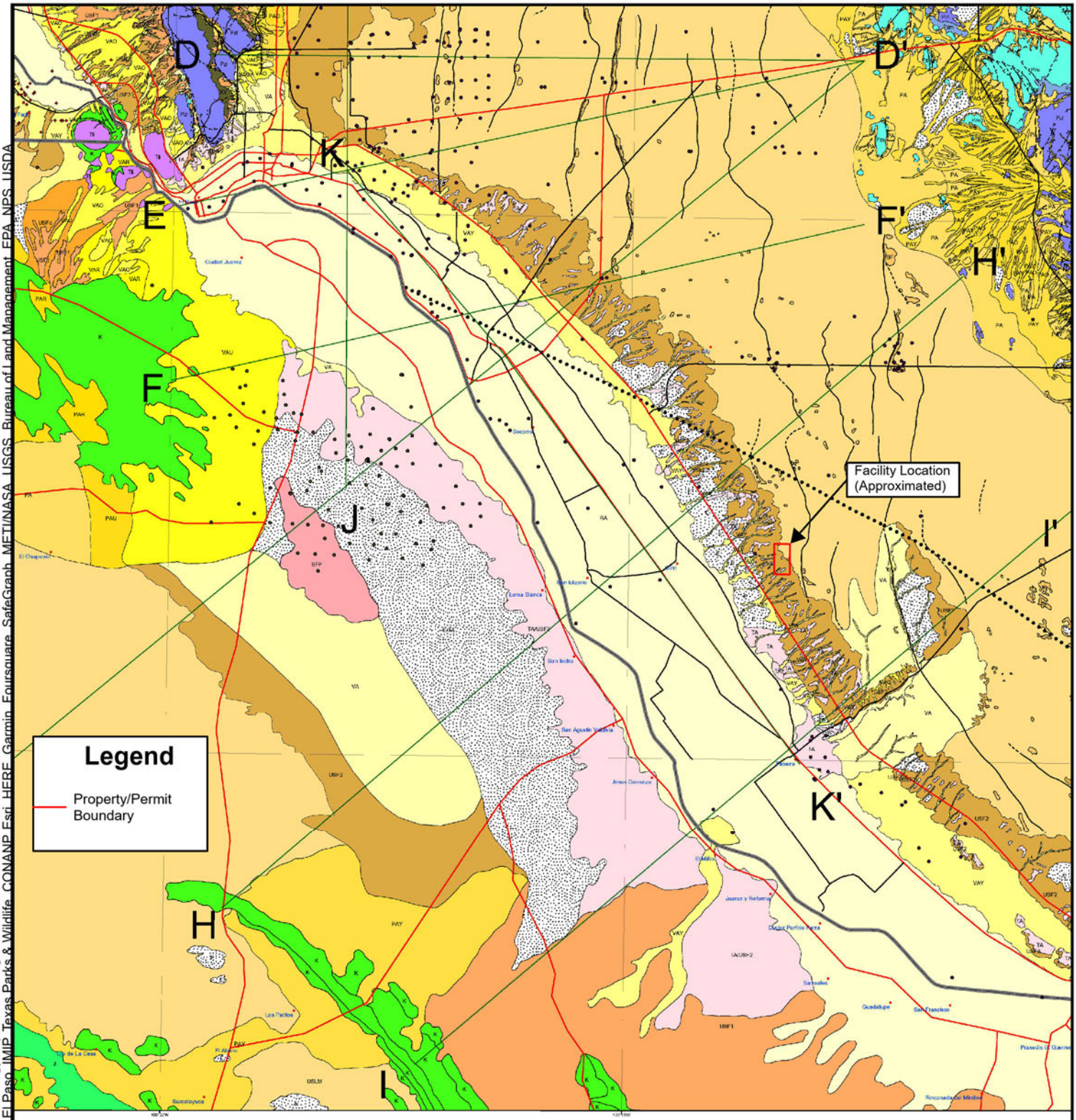
Numbers in outlined areas refer to items in bibliography in "Index to Areal Geologic Maps in Texas, 1891-1961," by T. E. Brown (1963), Univ. Texas, Austin, Bur. Econ. Geology. For area **A**, see P. B. King (1965) Geology of the Sierra Diablo region, Texas, U.S. Geol. Survey Prof. Paper 480, Plate I; for area **B**, see C. C. Albritton, Jr., and J. F. Smith, Jr. (1965) Geology of the Sierra Blanca area, Hudspeth County, Texas, U.S. Geol. Survey Prof. Paper 479, Plate I; for area **C**, see J. P. Brand and R. K. DeFord (1962) Geology of eastern half of Kent Quadrangle, Culberson, Reeves, and Jeff Davis Counties, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 24; for area **D**, see J. W. Wood (1968) Geology of Apache Mountains, Trans-Pecos Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 35; for area **E**, see J. R. Underwood (1963) Geology of Eagle Mountains and vicinity, Hudspeth County, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 26; for area **F**, see R. L. Harbour, Geology of the northern Franklin Mountains, Texas and New Mexico, U.S. Geol. Survey Bull. 1298, 129 p., plates in pocket; for area **G**, see B. R. Jones and D. F. Reaser (1970) Geology of the southern Quitman Mountains, Hudspeth County, Texas, Univ. Texas, Austin, Bur. Econ. Geology Geol. Quad. Map No. 39; for area **H**, see R. O. Gross (1965) Geology of Sierra Tinaja Pinta and Cornudas Station areas, northern Hudspeth County, Texas, Univ. Texas, Austin, M.A. thesis; and for area **I**, see W. R. Seager (1980) Quaternary fault system in the Tularosa and Hueco Basins, southern New Mexico and West Texas, New Mexico Geological Society, 31st Field Conference, p. 131-135, and C. D. Henry and J. K. Gluck (1981) A preliminary assessment of the geologic setting, hydrology, and geochemistry of the Hueco Tanks geothermal area, Texas and New Mexico, Univ. Texas, Austin, Bur. Econ. Geology Geol. Circ. 81-1, 48 p.



VIRGIL E. BARNES, PROJECT DIRECTOR

Geologic mapping mostly from sources shown on index map. Mapping received from Shell Oil Company and Cities Service Petroleum Company gratefully acknowledged. Geology of unmapped areas compiled and field checked by J. W. Dietrich, D. E. Owen, and C. A. Shelby, using high-altitude aerial photographs. Mapping compiled and scribed by J. W. Macon and cartographic revision by M. R. Day. Mapping reviewed by West Texas Geological Society, Geologic Atlas Committee, L. W. Bridges (Shell Oil Company), Chairman; G. L. Evans (Louisiana Land and Exploration Company), Robert Pavlovic (Mobil Oil Company), Sam Bishop (Humble Oil & Refining Company), T. S. Jones (Union Oil Company of California), and Walter Amman (Pan American Petroleum Corporation).

ATTACHMENT III.E.4 – REGIONAL GEOLOGIC CROSS-SECTION



John W. Hawley and John F. Kennedy
December 2009

For Permitting Purposes Only

Notes:
1. Source: Hawley, J.W., Kennedy, J.F., Granados-Olivas, A., & Ortiz, M. A., 2009. Hydro-geologic Framework of the Binational Western Hueco Bolson-Paso del Norte Area, Texas, New Mexico, and Chihuahua: Overview and Progress Report on Digital-Model Development. Technical Report.
2. Refer to "Plate 1" of above publication for additional details
3. Refer to Attachment III.E.4B for Regional Geologic Cross Section.

NORTH

3 1.5 0 3 Miles

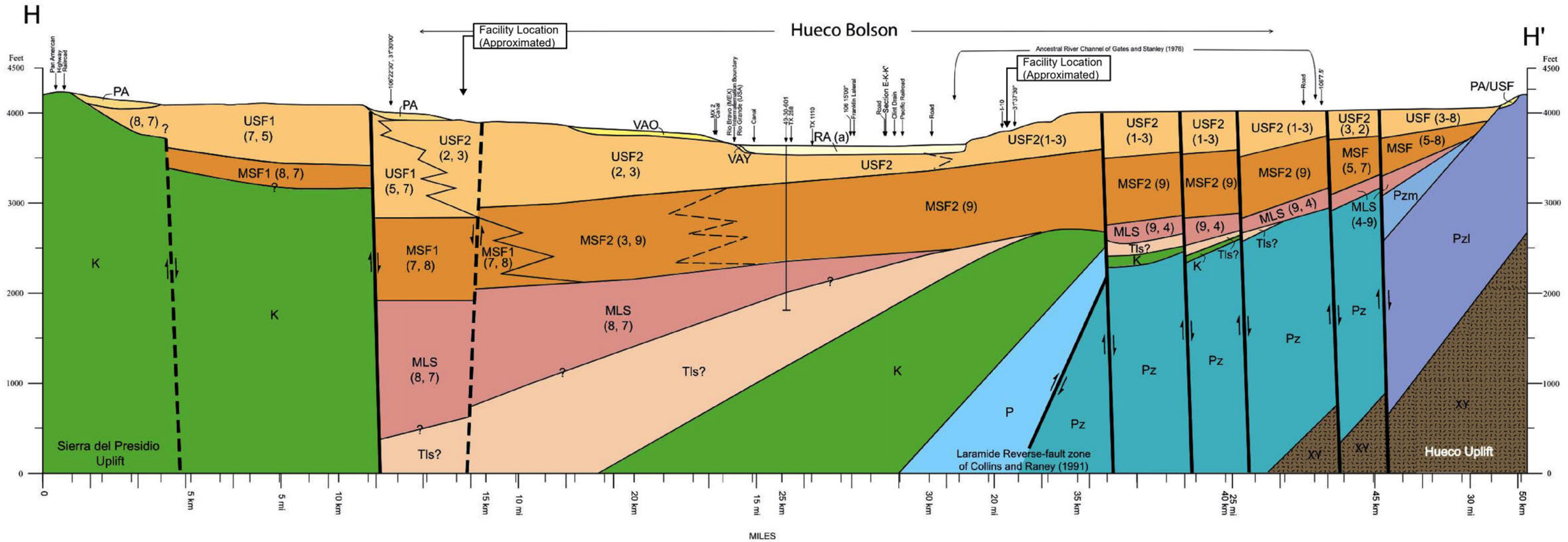
BURNS McDONNELL

Attachment III.E.4A
Regional Geologic Cross Section Map
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits: World Topographic Map| City of El Paso, IMIP, Texas Parks & Wildlife, CONANP, Esri, HERE, Garmin, Foursquare, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Source: Esri, BMcD

Issued: 11/30/2023



Schematic Hydrogeologic Section -- H-H' - from western Sierra del Presidio to Hueco uplift, across San Elizario area of southwestern Hueco Bolson

10X Vertical Exaggeration

John W. Hawley

December, 2009

For Permitting Purposes Only

Notes:
1. Source: Hawley, J.W., Kennedy, J.F., Granados-Olivas, A., & Ortiz, M. A., 2009. Hydro-geologic Framework of the Binational Western Hueco Bolson-Paso del Norte Area, Texas, New Mexico, and Chihuahua: Overview and Progress Report on Digital-Model Development. Technical Report.
2. Refer to Attachment III.E.4C for legend.

NORTH

BURNS McDONNELL

Attachment III.E.4B
Regional Geologic Cross Section
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Issued: 11/30/2023

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Service Layer Credits:

Source: Esri, BMcD

CROSS SECTION EXPLANATION (PLATE 2)

Hueco Bolson Hydrostratigraphic Units (HSUs)

RIO GRANDE VALLEY FILL

RA — **Rio Grande Alluvium --** River-channel and floodplain deposits of the Rio Grande; up to 100 ft (30 m) saturated thickness; mostly facies a1 and a2; Late Quaternary. ***Upper shallow aquifer zone***

VA — **Valley-Border Alluvium --** Channel, fan and terrace deposits of tributary arroyo systems; Undifferentiated deposits of (VAY and VAO) of major ephemeral tributaries to the Rio Grande; facies b (like 5 and 6); Middle and Late Quaternary

VAY — **Younger Valley-Border Alluvium --** Valley fill deposits associated with entrenchment and backfilling of major arroyo tributaries to the Rio Grande; facies b (like 5 and 6); Late Quaternary

TA — **Rio Grande Terrace Deposits, undivided --** Channel and overbank sediments of the ancestral Rio Grande; as much as 150 ft above the present floodplain; mostly facies a1 entirely in the vadose zone; Middle and Late Quaternary

TAO — **Older Rio Grande Terrace Deposits --**High-level river deposits; as much as 200 ft above the present floodplain; mostly facies a2, entirely in the vadose zone; Middle Pleistocene

YOUNGER BASIN FILL

PAU — **Piedmont-Slope Alluvium --** Older and younger piedmont-slope deposits and correlative Upper Santa Fe piedmont facies (5 to 8), undivided; Middle Pleistocene

PA — **Piedmont-Slope Deposits --** Younger and older (PAO) piedmont-slope deposits, undivided, stippeled where up to 10 ft (3 m) of Late Quaternary eolian cover is present; Middle and Late Quaternary mostly facies 5 and 6

BF — **Basin-Floor Deposits, undivided --** alluvial flat and small playa depression fills; mostly facies c and 3; entirely in vadose zone; Middle and Late Quaternary

EBF — **Basin-Floor Deposits --** with thin eolian cover, undivided

BFP — **Basin-Floor Playa-lake Deposits --** local depressions on basin-floor alluvial plains (unit BF); as much as 20 ft (6 m) thick and entirely in vadose zone; fine- grained with thin sandy layers; mostly facies c

SANTA FE GROUP BASIN FILL

USF — **Upper Santa Fe HSUs, undivided --** medial to distal piedmont facies5 and 6 that grade to basin-floor facies 1 to 4; Early Pleistocene to Late Miocene

USF1 — **Upper Santa Fe HSUs --** medial to distal piedmont facies, mostly facies 5 and 6; includes Camp Rice Formation; up to 10 ft (3 m) of upper Quaternary eolian cover is locally present; Early Pleistocene to Late Miocene

USF2 — **Upper Santa Fe HSUs --** basin-floor facies 1 to 4, undivided; includes Camp Rice Formation subdivisions; up to 10 ft (3 m) of upper Quaternary eolian cover is locally present; Early to Late Miocene

USFc — **Upper Santa Fe HSUs --** mostly proximal piedmont facies 6 and 8; includes Camp Rice Formation subdivisions; Pliocene to Late Miocene

MSF — **Middle Santa Fe HSUs, undivided --** primarily conglomeratic piedmont facies 7 and 8 that grade to basin-floor facies 3 and 4; includes Fort Hancock and Rincon Valley Fm correlatives. Note that unit only occurs in the subsurface beneath the central basin areas and is saturated; Upper Cenozoic-Miocene

MSF1 — **Middle Santa Fe HSUs --** primarily conglomeratic piedmont facies 7 and 8; includes Fort Hancock and Rincon Valley Fm correlatives;

MSF2 — **Middle Santa Fe HSUs --** basin-floor facies undivided; primarily weakly to moderately indurated pebbley sandstones, sandstones and mudstones of facies 3, 4, and 9 (mostly in the zone of saturation); includes Rincon Valley Fm correlatives.

MLS — **Middle and Lower Santa Fe HSUs -- undivided**

LSF — **Lower Santa Fe HSUs --** undivided piedmont and basin-floor facies 4, 7, 8, 9, and 10; fanglomerate, conglomerate, conglomeratic sandstone, siltstone, and mudstone with thin, limestone and gypsite (facies 10) layers. Note that unit only occurs in subsurface; Upper Cenozoic-Miocene

LSF1 — **Lower Santa Fe HSUs --** piedmont facies 7 and 8

LSF2 — **Lower Santa Fe HSUs --** basin floor facies 3, 4, 9, and 10

BEDROCK UNITS

Tli — Intermediate Intrusive igneous rocks, undivided (Lower Cenozoic)

Tls — Mostly lower Eocene-Paleocene (Lower Cenozoic) sedimentary rocks, sandstones, mudstones and conglomerates with minor or no volcaniclastic constituents

K — Upper Cretaceous marine sedimentary rocks, undifferentiated -- Limestone, silty to shaly Limestone, and shale

P — Permian Rocks, Undifferentiated - Primarily limestone, sandstone and red-bed mudstones

lP — Pennsylvanian and Lower Permian Rocks, Undifferentiated-Primarily Limestone and redbeds, sandy mudstone, with shale, sandstone and gypsite

Pz — Paleozoic Rocks, Undifferentiated

Pzu — Upper Paleozoic Rocks, Undifferentiated -- Primarily limestone, with shale, sandstone, red-bed mudstones and gypsite

Pzm — Middle Paleozoic Rocks, Devonian and Mississipian, primarily carbonate types, with shale

Pzl — Lower Paleozoic Rocks, Cambrian to Silurian, primarily carbonate types

X\Y — Precambrian Rocks, Undifferentiated

Textural-Class Symbols -- Dominant Clast-size Range

c — Coarse-grained -- Gravel and gravelly sand

m — Medium-grained -- Sand and pebbly sand

f — Fined-grained -- Silty to fine sandy clay

fine-grained

medium- to fne-grained

medium-grained

medium- to coarse-grained

Fault -- Dashed where approximate, question mark where inferred

At 1 — Mi 1

Well Control, including City of El Paso and CD. Juearz water-supply wells -- solid within 5000 ft of section line; dashed when 5000-7000 ft from section line

X-sec (1.6pt)
Major tics (0.8pt)
Surface (1pt)
Certain contact (1pt)
Uncertain contact (1pt, dashed: 8pt, 2.5pt)
Fault (2.8pt)
Well on section (1.4pt)
Well off section (1.4, dashed: 5pt, 2pt)
Leaders (.50pt)

For Permitting Purposes Only

Notes:
1. Source: Hawley, J.W., Kennedy, J.F., Granados-Olivas, A., & Ortiz, M. A., 2009. Hydro-geologic Framework of the Binational Western Hueco Bolson-Paso del Norte Area, Texas, New Mexico, and Chihuahua: Overview and Progress Report on Digital-Model Development. Technical Report.
2. Refer to Attachment III.E.4B for Regional Geologic Cross Section.

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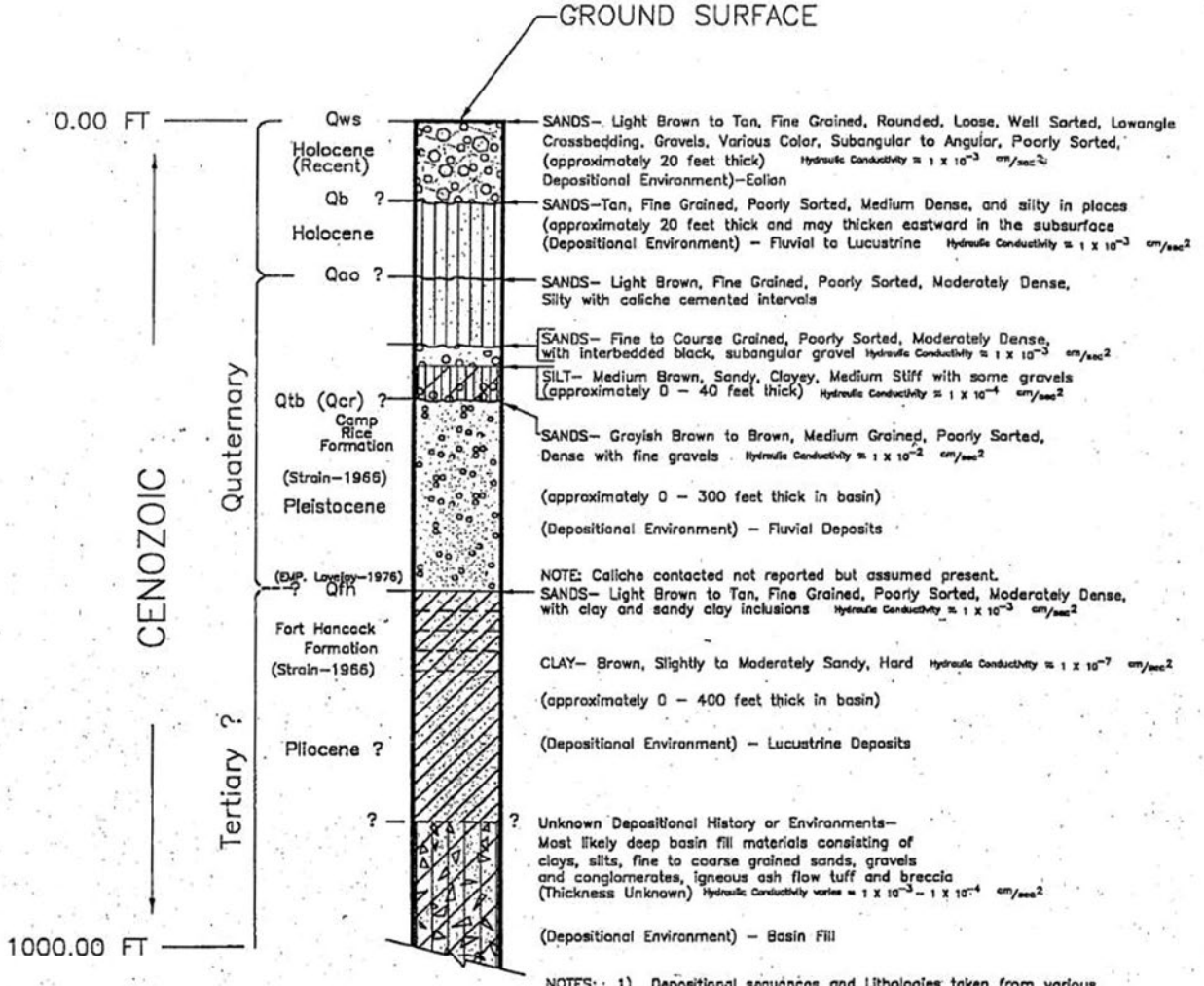
Attachment III.E.4C
Regional Geologic Cross Section Legend
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits: World Topographic Map| Esri, Garmin, FAO, NOAA, USGS, EPA

Source: Esri, BMcD

Issued: 11/30/2023

ATTACHMENT III.E.5 – GENERALIZED STRATIGRAPHIC COLUMN



NOTES:
1) Depositional sequences and Lithologies taken from various soil borings in the landfill proper and publications to develop the stratographic column.
2) Geologic Atlas – indicates Miocene and Pliocene Series are not present in El Paso Region.
3) Pliocene – Pleistocene contact is undefined and problematic. EMP. Lovejoy published report questioning contact at top of Fort Hancock Formation – Therefore dashed lines on column section are included to represent this potential contact.

LEGEND
- SAND
- CLAY
- SILT
- GRAVEL
- FINE GRAVEL
- LOWANGLE CROSSBEDDING
- CONGLOMERATES AND BRECCIA

SCALE
1" = 200 FEET
0 100 200

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER
11/09/00

Raba Kistner
Engineers Geologists Scientists Chemists

GENERALIZED STRATIGRAPHIC COLUMN	FIGURE 12
	PAGE 13
SCALE: 1" = 200'	PROJECT NO.: AEA98-182-00
GRAPHICS BY: AA	CHK. BY: JR APPD.: ALW
DATE: 7/6/00	ACAD No.: FIGURE 12
REVISION DATE: 11/09/00	

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

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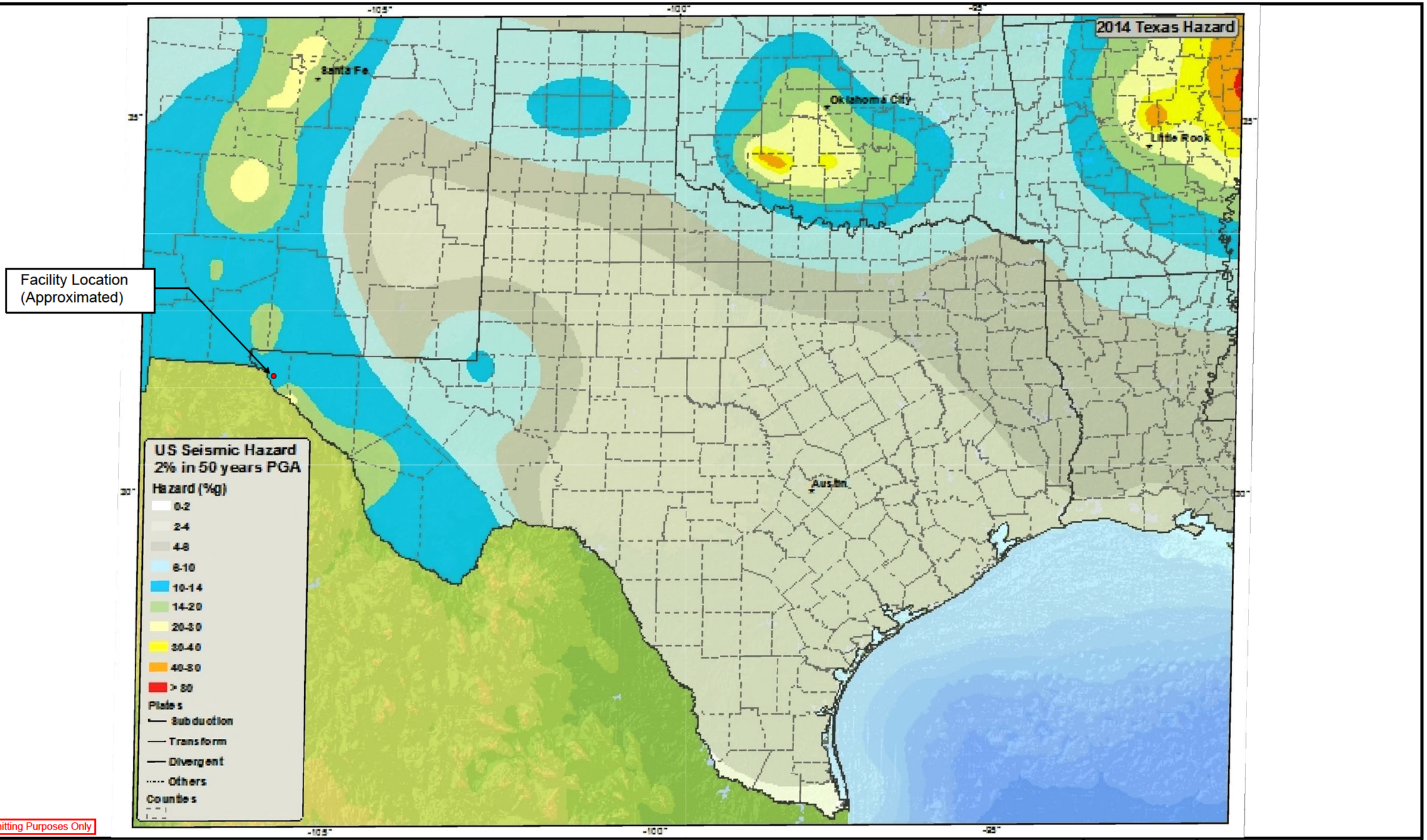
Attachment III.E.5
Generalized Stratigraphic Column
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023

ATTACHMENT III.E.6 – SEISMIC HAZARD MAP



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Approximate Facility Location

Notes:
1. Source: 2014 Seismic Hazard Map-Texas. Earthquake Hazards Program, U.S. Geological Survey.

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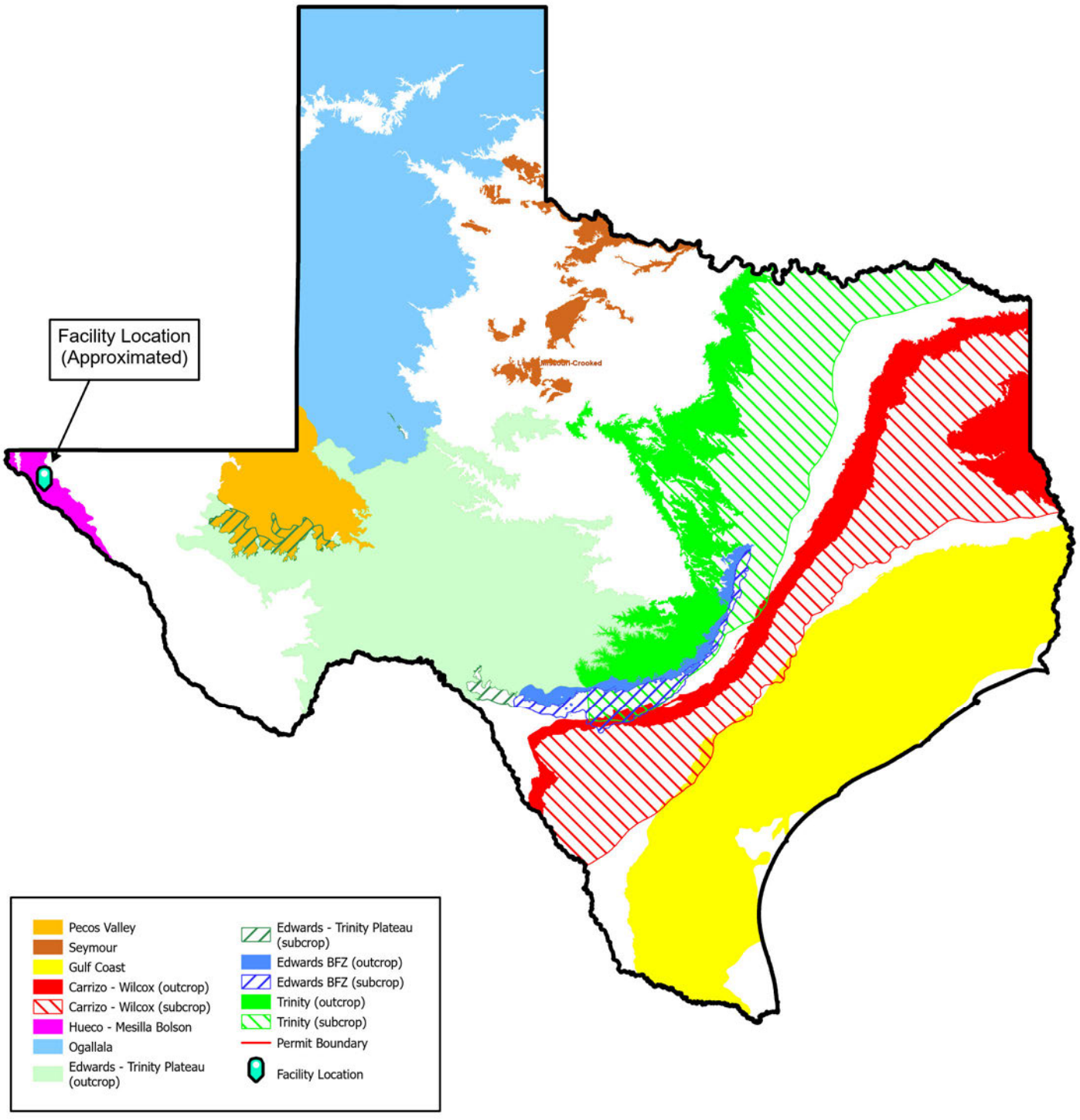
Attachment III.E.6
Seismic Hazard Map
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\El Paso Geology\El Paso Geology2.aprx amfriasfraire 5/1/2024
Service Layer Credits:
Source: Esri, BMcD

Issued: 5/1/2024

ATTACHMENT III.E.7 – TEXAS MAJOR AQUIFERS MAP



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Notes:
1. Source: Texas Water Development Board (2023)

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Attachment III.E.7
Texas Major Aquifers
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023

ATTACHMENT III.E.8 – HUECO BOLSON CONCEPTUAL CROSS-SECTION

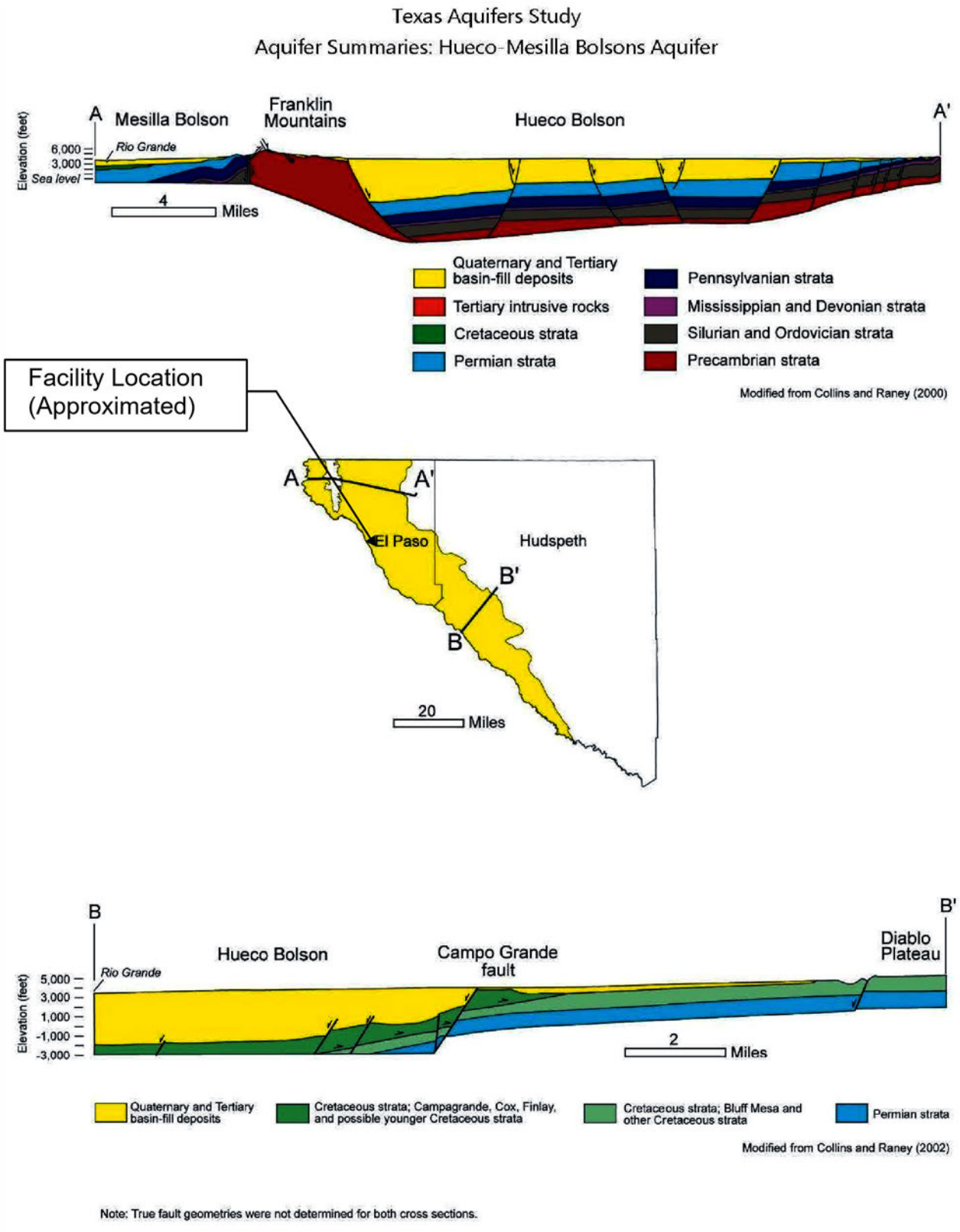

Figure 6-21. Cross-sections across the Hueco-Mesilla Bolsons Aquifer (modified from Collins and Raney, 2000, 2002).

For Permitting Purposes Only

Notes:
1. Source: Texas Water Development Board (TWDB). (2016). Texas Aquifer Study: Groundwater Quantity, Quality, Flow, and Contributions to Surface Water. Retrieved from [https://www.twdb.texas.gov/groundwater/docs/studies/TexasAquifersStudy_2016.pdf]

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Attachment III.E.8
Regional Aquifer Cross Section
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023

ATTACHMENT III.E.9 – REGIONAL POTENTIOMETRIC SURFACE MAP

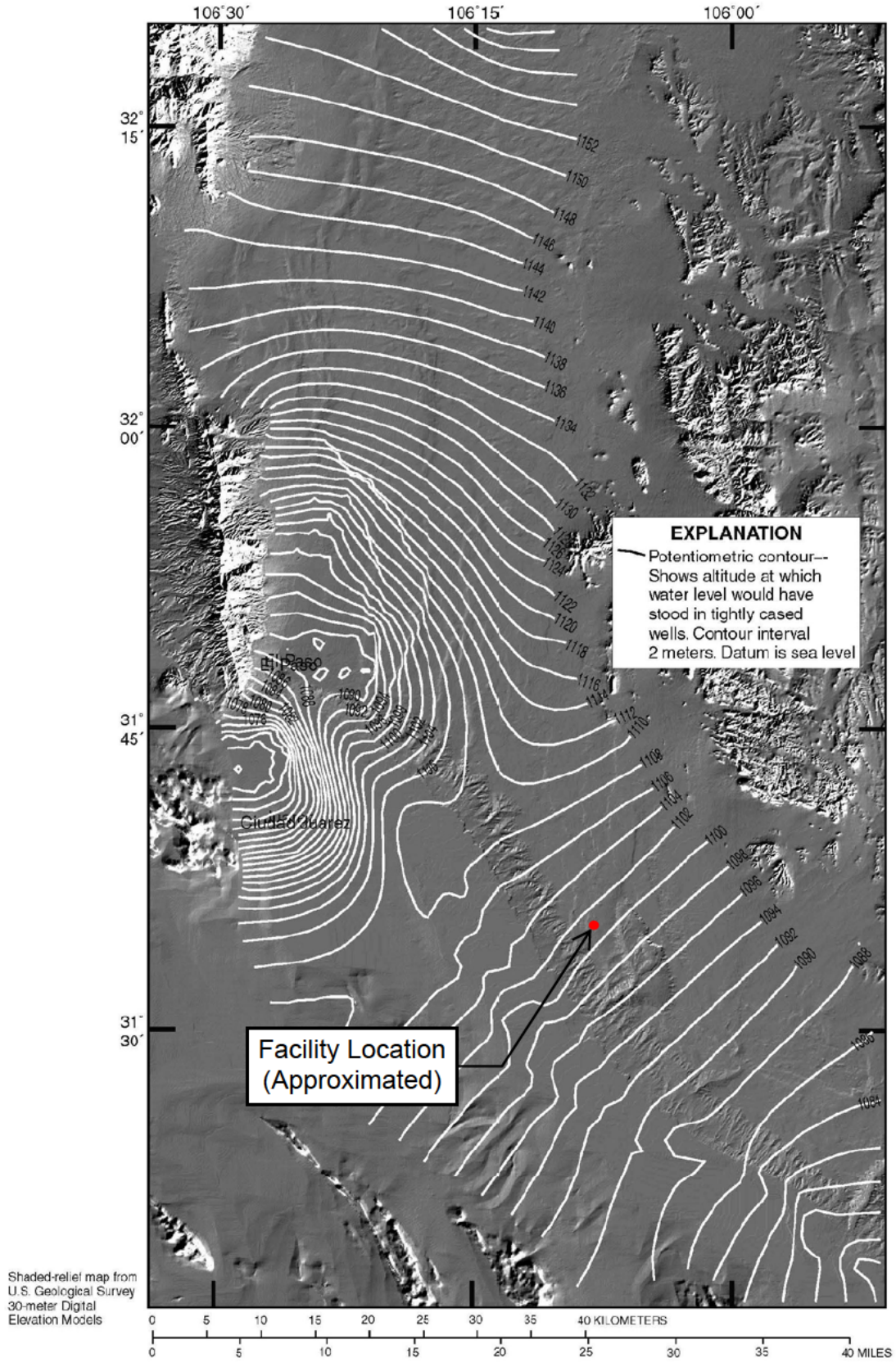

Figure 15D. Simulated potentiometric surface in model layer 5 in 1996.

For Permitting Purposes Only

Notes:
1. Source: Heywood, C. E., Yager, R. M. (2003). Simulated ground-water flow in the Hueco Bolson, an alluvial-basin aquifer system near El Paso, Texas. U.S. Geological Survey Water-Resources Investigations Report 02-4108, 55p.

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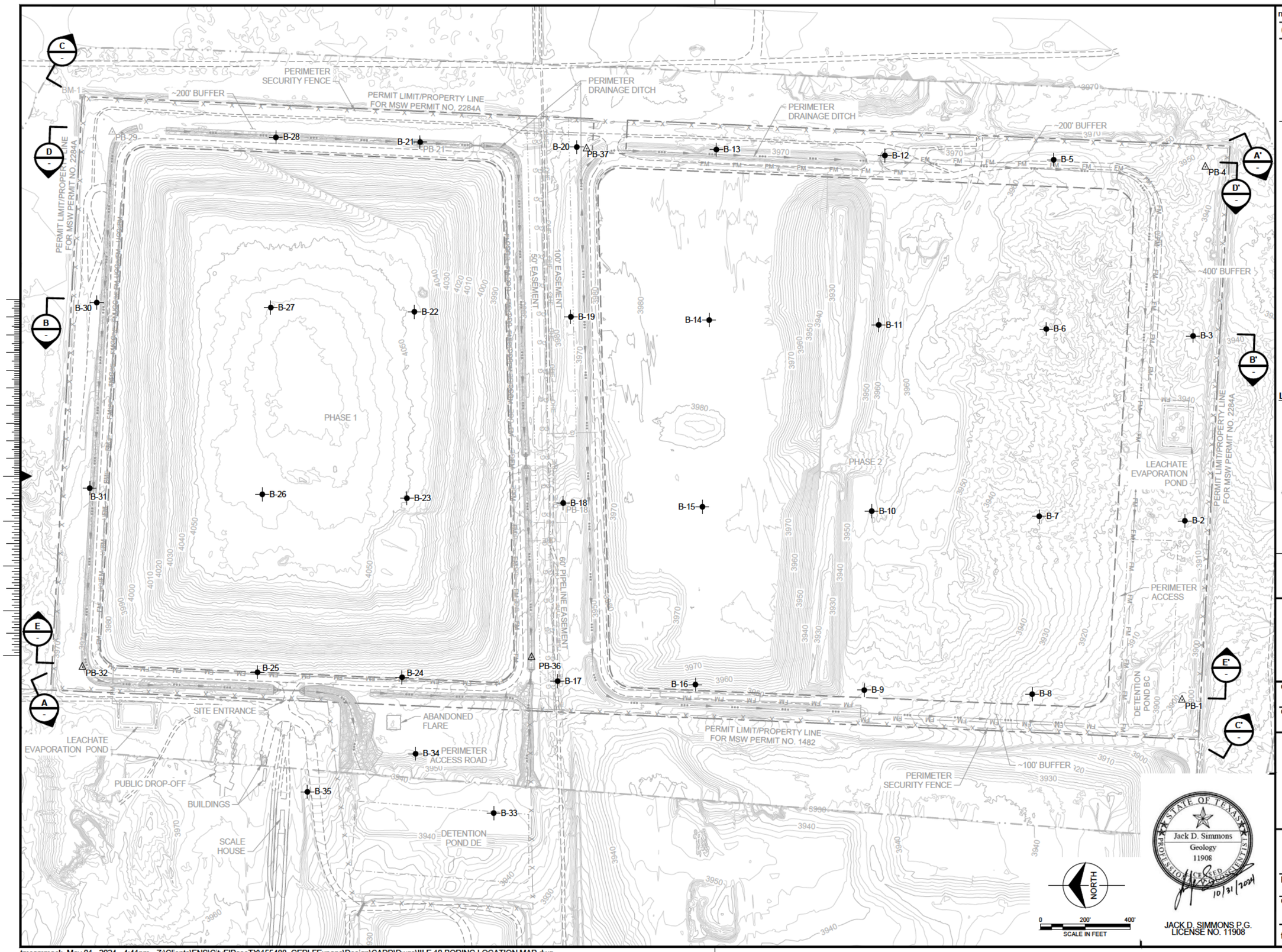
Attachment III.E.9
Region Pot Map
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\El Paso Geology\El Paso Geology2.aprx amfriasfraire 5/1/2024
Service Layer Credits:
Source: Esri, BMcD

Issued: 5/1/2024

ATTACHMENT III.E.10 – BORING LOCATIONS MAP



no.	date	by	ckd	description
0	5/1/24	TMC	JDS	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. BORING LOCATIONS ARE APPROXIMATED FROM HISTORICAL DATA.

LEGEND:

△ PB-32	EXISTING PIEZOMETER
△ PB-29	ABANDONED PIEZOMETER
⊕ B-2	EXISTING SOIL BORING, APPROXIMATE LOCATION
A	CROSS-SECTION TRANSECT LINE

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	J. SIMMONS

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

BORING AND CROSS-SECTION LOCATION MAP

project	contract
155488	-

drawing **III.E.10** rev. **0**

file III.E.10 BORING LOCATION MAP.dwg

STATE OF TEXAS — Jack D. Simmons — Geology — 11908 — LICENSED PROFESSIONAL GEOSCIENTIST — 10/31/2024

JACK D. SIMMONS P.G.
LICENSE NO. 11908

Scale For Microfilming
Millimeters
Inches

ATTACHMENT III.E.11 – BORING LIST

Summary Boring Ground Surface Elevations

Boring No.	Ground Surface Elevations Prior to Drilling Activities (msl)
PB-1	3886.37
B-2	3900.56
B-3	3940.93
PB-4	3934.29
B-5	3946.46
B-6	3933.91
B-7	3918.80
B-8	3913.93
B-9	3920.66
B-10	3955.04
B-11	3958.04
B-12	3963.88
B-13	3965.28
B-14	3965.40
B-15	3953.26
B-16	3930.45
B-17	3941.41
PB-18	3954.55
B-19	3968.26
B-20	3968.50
PB-21	3973.10
B-22	3973.66
B-23	3959.51
B-24	3955.24
B-25	3960.66
B-26	3961.56
B-27	3971.12
B-28	3973.42
PB-29	3973.70
B-30	3971.66
B-31	3964.76
PB-32	3963.34
B-33	3947.80
B-34	3956.60
B-35	3950.60
PB-36	3941.10
PB-37	3968.50

Note: All elevations provided above reflect ground surface elevations prior to drilling activities. Piezometer Boring Logs in this Appendix indicate elevations after installation of Piezometers. Please note that the locations of the Borings are shown in Attachment No. 4, Appendix A, Plate 2 (Page 3) and Attachment No. 5, Appendix F, Plate 1 (Page 2).

Summary Piezometer Boring Ground Surface Elevations

Boring No.	Ground Surface Elevations After Piezometer Boring Installation (msl)
PB-1	3886.48
PB-4	3935.96
PB-18	3954.57
PB-21	3975.83
PB-29	3973.42
PB-32	3963.34
PB-36	3941.10
PB-37	3968.50

Note: Elevations provided above reflect ground surface elevations after installation. Please note that the locations of the Piezometer Borings are shown in Attachment No. 4, Appendix A, Plate 2 (Page 3) and Attachment No. 5, Appendix F, Plate 1 (Page 2).

ATTACHMENT III.E.12 – HISTORICAL BORING LOGS

LOG OF BORING NO. PB-1

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S Sampler LOCATION: N -14332.5137, E -1170.4699

SURFACE ELEVATION: 3886.48
TOC ELEVATION:

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SAND, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt and some calcareous sand				
5							
10							
15			% - 200: 5% P.I. = NP Classification: SP-SM Fraction Organic Carbon = 0.0147 g/g K = 1.1 x 10-02 cm/sec		2.628	0.95	48.7 %
20							
25							
30							
35							
40							
45							
50			-with sand clay, hard, moist % - 200: 88% P.I. =50 Classification= CH Fraction Organic Carbon = 0.0186 g/g -silty sand, very dense		2.683		
55							
60							
65			-clay seam from 65 to 66 feet				
70							

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER

12/12/00

For pages 2 to 96

Page 2

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	343.0 ft.	DEPTH TO WATER:	286.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	1/20/99	PLATE	1

LOG OF BORING NO. PB-1 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S Sampler LOCATION: N -14332.5137, E -1170.4699

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3886.48 TOC ELEVATION:				
80							
85							
90							
95							
100							
105			-sandy clay lenses at 107 1/2 feet				
110							
115							
120							
125							
130							
135							
140							
145							

Page 3

DEPTH DRILLED:	343.0 ft.	DEPTH TO WATER:	286.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	1/20/99	PLATE	1 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-1 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S Sampler LOCATION: N -14332.5137, E -1170.4699

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: TOC ELEVATION: 3886.48				
155			CLAY, Brown, Hard, Moist with sand -perched water at 156 feet % - 200: 76% P.I. =27 Classification= CL Fraction Organic Carbon = 0.0186 g/g				
160					2.683	0.57	36.3%
165			SAND, Fine Grained, Tan, Poorly Graded, Very Dense, Dry				
170							
175							
180							
185							
190							
195							
200							
205							
210							
215							
220							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 4

DEPTH DRILLED: 343.0 ft. | DEPTH TO WATER: 286.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 8/25/98 | DATE MEASURED: 1/20/99 | PLATE 1 (continued)

LOG OF BORING NO. PB-1 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S Sampler LOCATION: N-14332.5137, E-1170.4699

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3886.48 TOC ELEVATION:						
230									
235									
240									
245									
250									
255									
260									
265									
270									
275									
280									
285									
290									
295									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	343.0 ft.	DEPTH TO WATER:	286.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	1/20/99	PLATE	1 (continued)

LOG OF BORING NO. PB-1 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S Sampler

LOCATION: N -14332.5137, E -1170.4699

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3886.48 TOC ELEVATION:				
			-with sand clay lenses below 300 feet				
305							
310							
315							
320							
325							
330							
335							
340							
345							
350							
355							
360							
365							
370							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 6

DEPTH DRILLED:	343.0 ft.	DEPTH TO WATER:	286.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	1/20/99	PLATE	1 (continued)

LOG OF BORING NO. B-2

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -14317.3054, E -351.9075

SURFACE ELEVATION: 3900.56

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine to Medium Grained, Light Brown, Poorly Graded, Medium Dense, Dry with silt and some gravel			
5			-silty salt below 5 feet Fraction Organic Carbon = 0.009 g/g	SM	13	NP
10			-dense below 10 feet			
15			Fraction Organic Carbon = 0.011 g/g K = 2.3 x10-03 cm/sec	SM	12	NP
20			-fine grained sand below 20 feet			
25						
30			Wet Unit Weight = 102.6 pcf Dry Unit Weight = 101.9 pcf Fraction Organic Carbon = 0.007 g/g S.G. = 2.598 e = 0.59 n = 37.1%	SP-SM	6	NP
35						
40						
45						
50						
55						
60						
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 7

DEPTH DRILLED:	31.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/27/98	DATE MEASURED:	N/A	PLATE	2

LOG OF BORING NO. B-3

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -14317.3054, E -464.9392

SURFACE ELEVATION: 3940.93

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
5			SAND, Medium Grained, Light Brown, Poorly Graded, Medium Dense, Dry with gravel			
10			-silty sand below 10 feet Fraction Organic Carbon = 0.01 g/g	SW-SM	11	NP
15			SAND, Fine Grained, Light Brown, Poorly Graded, Dense, Dry			
20			-very dense from 20 to 26 1/2 feet			
25			Dry Unit Weight = 77.8 pcf Fraction Organic Carbon = 0.007 g/g e = 1.12 n = 52.7% K = 2.0 x10-03 cm/sec	SP-SM	8	NP
30						
35						
40						
45			SILT, Light Brown, Firm, Wet, with gypsiferous material Fraction Organic Carbon = 0.052 g/g	MH	95	32
50			SAND, Fine Grained, Light Brown, Poorly Graded, Medium Dense, Dry with silt -loose from 50 to 51 1/2 feet			
55			-very dense below 55 feet			
60						
65						

BLOWS PER FT.
5 10 15 20 25 30 35
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

87.0

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 8

DEPTH DRILLED: 91.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/28/98 | DATE MEASURED: N/A | PLATE 3

LOG OF BORING NO. B-3 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -14317.3054, E -464.9392

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3940.93				
70							
75							
80							
85							
90			Dry Unit Weight = 76.4 pcf Fraction Organic Carbon = 0.008 g/g e = 1.16 n = 53.7% K = 1.82 x10-03 cm/sec	SM	13	NP	
95							
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 9

DEPTH DRILLED:	91.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/28/98	DATE MEASURED:	N/A	PLATE	3 (continued)

LOG OF BORING NO. PB-4

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -14316.2729, E.-1291.6442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3935.96 TOC ELEVATION:				
0			SAND, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense to Very Dense, Dry with some calcareous sand				
40			-with sandy clay lenses from 40 to 60 feet % - 200: 80% P.I. = 61 Classification: CH Fraction Organic Carbon = 0.0042 g/g		2.630	0.62	38.3%
60			-fine grained sand below 60 feet % - 200: 3% P.I. = NP Classification: SP Fraction Organic Carbon = 0.0057 g/g K = 4.7 x 10-03 cm/sec		2.630	1.13	52.2%
70			-with sandy clay lenses at 70 feet				

Page 10

DEPTH DRILLED:	390.0 ft.	DEPTH TO WATER:	330.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/13/98	DATE MEASURED:	1/20/99	PLATE	4

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-4 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -14316.2729, E -1291.6442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3935.96 TOC ELEVATION:						
80									
85									
90			-sandy clay lenses below 90 feet						
95									
100									
105									
110									
115									
120									
125									
130									
135									
140									
145									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	390.0 ft.	DEPTH TO WATER:	330.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/13/98	DATE MEASURED:	1/20/99	PLATE	4 (continued)

LOG OF BORING NO. PB-4 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -14316.2729, E -1291.6442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3935.96 TOC ELEVATION:				
155							
160							
165							
170							
175							
180							
185							
190							
195							
200							
205							
210							
215							
220			CLAY, Sandy, Brown, Hard, Moist				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 12

DEPTH DRILLED: 390.0 ft. | DEPTH TO WATER: 330.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 10/13/98 | DATE MEASURED: 1/20/99 | PLATE 4 (continued)

LOG OF BORING NO. PB-4 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler

LOCATION: N -14316.2729, E -1291.6442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3935.96 TOC ELEVATION:				
230			SAND, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Moist				
235							
240							
245							
250		X					
255							
260							
265							
270							
275							
280							
285							
290							
295							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 13

DEPTH DRILLED:	390.0 ft.	DEPTH TO WATER:	330.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/13/98	DATE MEASURED:	1/20/99	PLATE	4 (continued)

LOG OF BORING NO. PB-4 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -14316.2729, E -1291.6442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3935.96 TOC ELEVATION:				
305			-with sandy clay seams from 335 - 390 feet % - 200: 75% P.I. = 31 Classification: CH				
310							
315							
320							
325							
330							
335		X					
340							
345							
350							
355							
360							
365							
370							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 14

DEPTH DRILLED:	390.0 ft.	DEPTH TO WATER:	330.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/13/98	DATE MEASURED:	1/20/99	PLATE	4 (continued)

LOG OF BORING NO. B-5

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-13583.1438, E 1290.4549

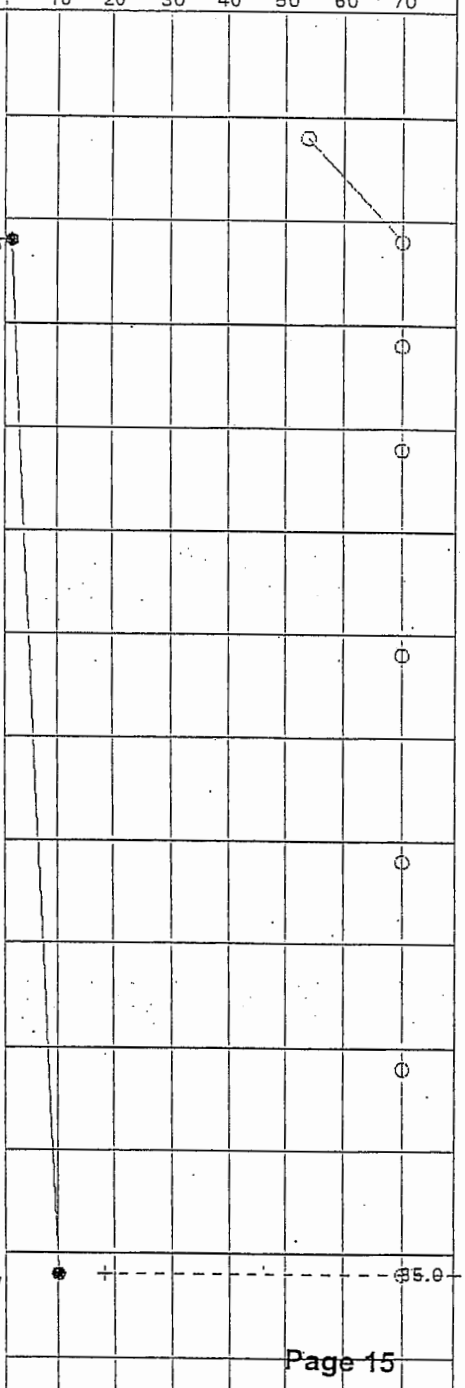
SURFACE ELEVATION: 3946.46

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry			
5			(N=27)			
10			(N=50/4")	SP-SM	12	NP
			Dry Unit Weight = 96.4 pcf			
			S.G. = 2.643			
15			e = 0.71			
			n = 41.6 percent			
			-medium grained, very dense below 12 feet			
20			(N=50/5")			
			(N=50/1")			
25						
30			-fine grained below 30 feet			
			(N=50)			
			-with some sandy clay lenses at 31 feet			
35						
40			-moist at 40 feet			
45						
50			-with some clay lenses at 51 feet			
			(N=50/4")			
55						
60			(N=50/3")			
			-with sandy clay and some calcareous material at 60-61 1/2 feet	CH	71	67
			Fraction Organic Carbon = 0.0250 g/g			
65			Dry Unit Weight = 115.8 pcf			

BLOWS PER FT. 5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 15

DEPTH DRILLED:	101.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/12/98	DATE MEASURED:	N/A	PLATE	5

LOG OF BORING NO. B-5 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -13583.1438, E 1290.4549

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3946.46				
70			S.G. = 2.676 e = 0.44 n = 30.7 percent -with sandy clay lenses at 70 feet (N=43)				
75							
80			-with sandy clay lenses and some calcareous material at 81 feet (N=37)				
85							
90			(N=36)				
95							
100			(N=50/2")	SM	18	NP	
105			Fraction Organic Carbon = 0.044 g/g Dry Unit Weight = 95.0 pcf S.G. = 2.659 e = 0.75 n = 42.7 percent k = 4.5 x 10-04 cm/sec				
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 16

DEPTH DRILLED:	101.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/12/98	DATE MEASURED:	N/A	PLATE	5 (continued)

LOG OF BORING NO. B-6

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -13601.6631, E 459.8127

SURFACE ELEVATION: 3933.91

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Medium Grained, Tan, Poorly Graded, Medium Dense to Very Dense, Dry			
30			-with fine grained sand with sandy clay and clay lenses from 30 to 31 1/2 feet (N=50/2")	CH	62	39
40			(N=50/1")			
50			-sand with clay or sandy clay lenses from 50 to 51 1/2 feet (N=50/1")	SM	16	NP
60			Fraction Organic Carbon = 0.005 g/g Dry Unit Weight = 100.9 pcf S.G. = 2.632 e = 0.63 n = 38.6 percent	SP		

BLOWS PER FT. 5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

DEPTH DRILLED: 61.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/25/98 | DATE MEASURED: N/A | PLATE 6

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NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-6 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -13601.6631, E 459.8127

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3933.91				
			k = 3.48 x 10-03 cm/sec				
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	61.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	N/A	PLATE	6 (continued)

LOG OF BORING NO. B-7

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

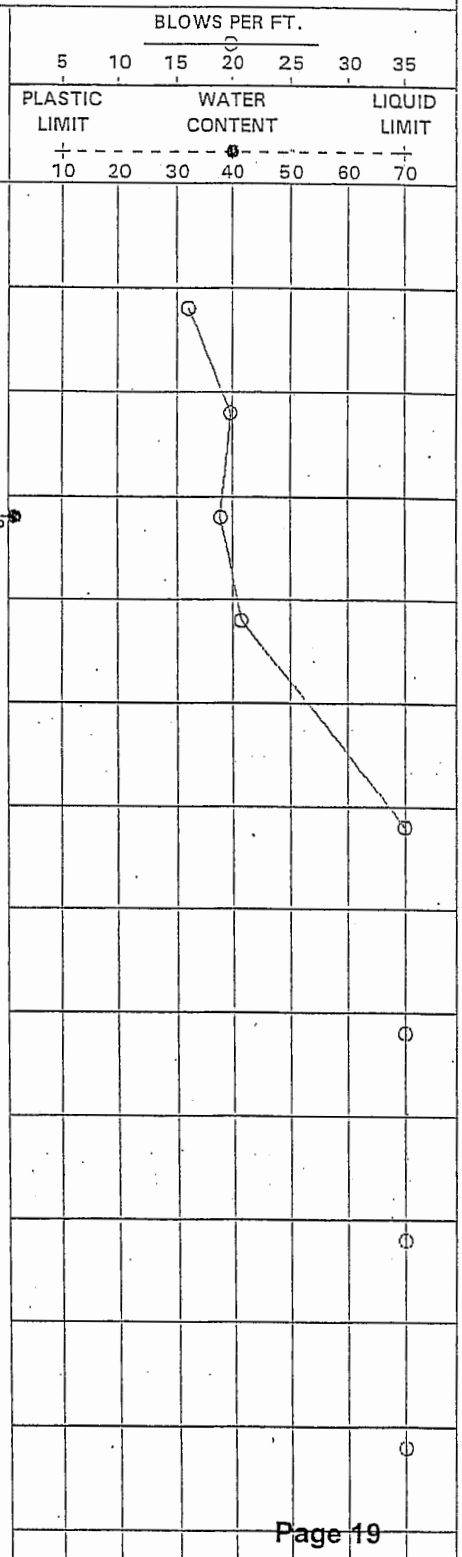
Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N -13609.6921, E -362.3597

SURFACE ELEVATION: 3918.80

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt			
5						
10						
15				SP-SM	5	NP
20						
25						
30			-medium grained sand below 30 to 31 1/2 feet (N=50/1")			
35						
40			(N=50/2")			
45						
50			(N=50/2")			
55						
60			(N=50/3")			
65						



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 19

DEPTH DRILLED:	71.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	N/A	PLATE	7

LOG OF BORING NO. B-7 (continued)

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-13609.6921, E-362.3597

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3918.80				
70			Fraction Organic Carbon = 0.010 g/g Dry Unit Weight = 87.61 pcf S.G. = 2.642 e = 0.88 n = 46.9 percent		25		
75							
80							
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							

Page 20

DEPTH DRILLED:	71.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/25/98	DATE MEASURED:	N/A	PLATE	7 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-8

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N -13613.7459, E -1175.6924

SURFACE ELEVATION: 3913.93

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Silty, Tan, Dense to Very Dense, Dry			
5			(N=24)			
10			-sandy clay from 10 to 12 feet (N=50)	CL	72	13
15			Dry Unit Weight = 80.1 pcf Fracrion Organic Carbon = 0.032 g/g S.G. 2.656 e = 1.07 n = 51.7%			
20			SAND, Fine Grained, Tan, Poorly Graded, Dense, Dry (N=50/3") (N=39)			
25			-medium grained, dense below 26 feet (N=44)	SP	4	NP
30			Fraction Organic Carbon = 0.0087 g/g S.G. 2.614 e = 0.65 n = 39.2% K = 9.27 x10-03 cm/sec			
35			(N=50) (N=50/2")			
40			Dry Unit Weight = 91.4 pcf Fraction Organic Carbon = 0.008 g/g S.G. 2.612 e = 0.78 n = 43.9% K = 1.37 x10-02 cm/sec (N=50/2")	SP	3	NP
45						
50						
55						
60						
65						

BLOWS PER FT.

5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 21

DEPTH DRILLED:	41.5 ft.	DEPTH TO WATER:	N/A
DATE DRILLED:	8/26/98	DATE MEASURED:	N/A

PROJ. No. AEA96-182-00

PLATE 8

LOG OF BORING NO. B-9

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N -12910.1864, E -1182.6305

SURFACE ELEVATION: 3920.66

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense to Dense, Dry			
5			(N=24)			
10			(N=35)	SP-SM	7	NP
			Fraction Organic Carbon = 0.008 g/g			
			K = 1.1 x10-02 cm/sec			
15			-with some gravel at 15 feet (N=43)			
20			-calcareous clay lenses at 20 feet (N=31)			
			-silty sand from 20 to 21 1/2 feet			
25			-medium grained sand, very dense below 23 feet (N=50)			
30			-with some gravel at 30 feet (N=50/5")			
35			(N=50/4")			
			-with some sandy clay lenses from 30 to 36 1/2 feet			
40			(N=50/2")			
45			(N=50/2")		2	NP
			Fraction Organic Carbon = 0.005 g/g			
50			(N=50/6")			
55			(N=50/3")			
			-sandy clay lenses from 55 to 56 1/2 feet			
60			SAND, Fine Grained, Tan, Silty, Poorly Graded, Very Dense, Dry (N=50)			
65			-clay lenses at 65 to 71 feet			

BLOWS PER FT.

5	10	15	20	25	30	35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10	20	30	40	50	60	70

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DEPTH DRILLED:	76.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/26/98	DATE MEASURED:	N/A	PLATE	9

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-9 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E -1182.6305

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3920.66				
			(N=50)				
70			Dry Unit Weight = 121.4 pcf S.G. 2.692 e = 0.38 n = 27.7%		88		
75			(N=50) -sandy clay lenses from 75 to 76 1/2 feet Fraction Organic Carbon = 0.029 g/g				
80			(N=50)				
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							

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DEPTH DRILLED:	76.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/26/98	DATE MEASURED:	N/A	PLATE	9 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-10

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E -365.7837

SURFACE ELEVATION: 3955.04

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense to Very Dense, Dry			
5						
10						
15			Dry Unit Weight = 86.7 pcf Fraction Organic Carbon = 0.004 g/g S.G. = 2.632 e = 0.89 n = 47.2% K = 1.47 X10-02 cm/sec (N=50/3")	SP-SM	6	NP
20						
25			(N=50/3")			
30			(N=50/6")			
35			(N=50/3")			
40			Fraction Organic Carbon = 0.008 g/g	SP-SM	6	NP
45						
50			(N=50/2")			
55						
60			(N=50/5")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

DEPTH DRILLED: 86.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/29/98 | DATE MEASURED: N/A | PLATE 10

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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LOG OF BORING NO. B-10 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E -365.7837

SURFACE ELEVATION: 3955.04

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
70			-with sandy clay lenses from 63 to 66 1/2 feet		72		
			(N=50/2")				
			Dry Unit Weight = 88.6 pcf				
			Fraction Organic Carbon = 0.033 g/g				
			S.G. = 2.650				
75			e = 0.87				
			n = 46.4%				
			-clay lenses from 70 to 71 1/2 feet				
			(N=50/3")				
80			(N=50/6")				
			(N=50/6")				
85			-with sandy clay lenses from 85 to 86 1/2 feet	SM	14	NP	
			Dry Unit Weight = 102.1 pcf				
			Fraction Organic Carbon = 0.015 g/g				
90			S.G. = 2.641				
			e = 0.61				
			n = 38.0%				
95			K = 7.1 X10-03 cm/sec				
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	86.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/29/98	DATE MEASURED:	N/A	PLATE	10 (continued)

LOG OF BORING NO. B-11

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E 451.0630

SURFACE ELEVATION: 3958.04

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
0			SAND, Medium Grained, Tan, Poorly Graded, Medium Dense, Dry with gravel and calcareous nodules				
5							
10			-coarse grained, gravelly below 10 feet				
15							
20			-medium grained below 20 feet				
25							
30							
35							
40							
45							
50			(N=50/5")				
55							
60			(N=50/1")				
65							

DEPTH DRILLED: 111.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 9/14/98 | DATE MEASURED: N/A | PLATE 11

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-11 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E 451.0630

SURFACE ELEVATION: 3958.04

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
70			(N=50/3")				
75							
80			-fine grained, very dense, with sandy clay at 80-81 1/2 feet Fraction Organic Carbon = 0.0493 g/g Dry Unit Weight = 104.2 pcf S.G. = 2.675 e = 0.60 n = 37.6 percent k = 1.98 x 10-03 cm/sec	CH	71	66	38.0
85							
90			-sandy clay lenses from 90 to 91 1/2 feet				
95							
100			(N=50/1")				
105							
110			Fraction Organic Carbon = 0.0078 g/g Dry Unit Weight = 75.9 pcf S.G. = 2.653 e = 1.18 n = 54.2 percent k = 3.91 x 10-04 cm/sec -with sandy clay (N=50/6")		66		
115							
120							
125							
130							

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DEPTH DRILLED:	111.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/14/98	DATE MEASURED:	N/A	PLATE	11 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-12

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

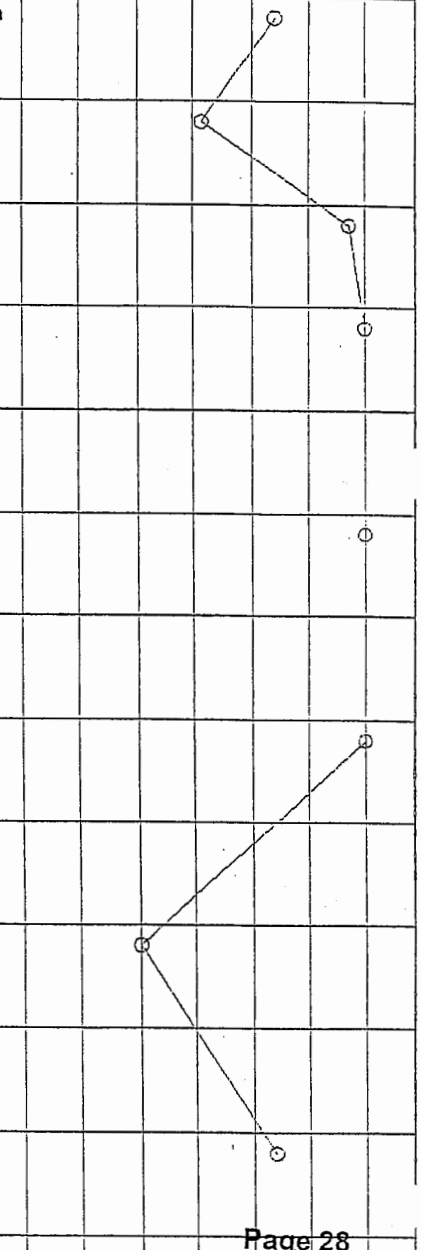
DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-12910.1864, E 1267.9098

SURFACE ELEVATION: 3963.88

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Silty, Tan-Whitish, Medium Dense, Dry			
5			-gravelly sand at 5 to 6 1/2 feet Fraction Organic Carbon = 0.033 g/g	SM	22	NP
10			SAND, Medium Grained, Tan, Poorly Graded, Medium Dense, Dry with silt			
15						
20			-very dense below 20 feet (N=50/1")			
25						
30			(N=50/2")			
35						
40						
45						
50			-medium dense below 50 feet			
55						
60						
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	116.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/15/98	DATE MEASURED:	N/A	PLATE	12

LOG OF BORING NO. B-12 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12910.1864, E 1267.9098

SURFACE ELEVATION: 3963.88

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
70			-very dense at 70 feet				
75							
80			(N=50/1")				
85							
90			-sandy clay at 90 to 91 1/2 feet Dry Unit Weight = 101.0 pcf Fraction Organic Carbon = 0.037 g/g S.G. = 2.651 e = 0.64 n = 38.9% (N=50/6") -with some calcareous material below 91 1/2 feet	CH	54	73	91.0
95							
100							
105							
110			-medium dense below 110 feet				
115			-very dense at 115 feet (N=50/6")				
120							
125							
130							

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DEPTH DRILLED:	116.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/15/98	DATE MEASURED:	N/A	PLATE	12 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-13

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

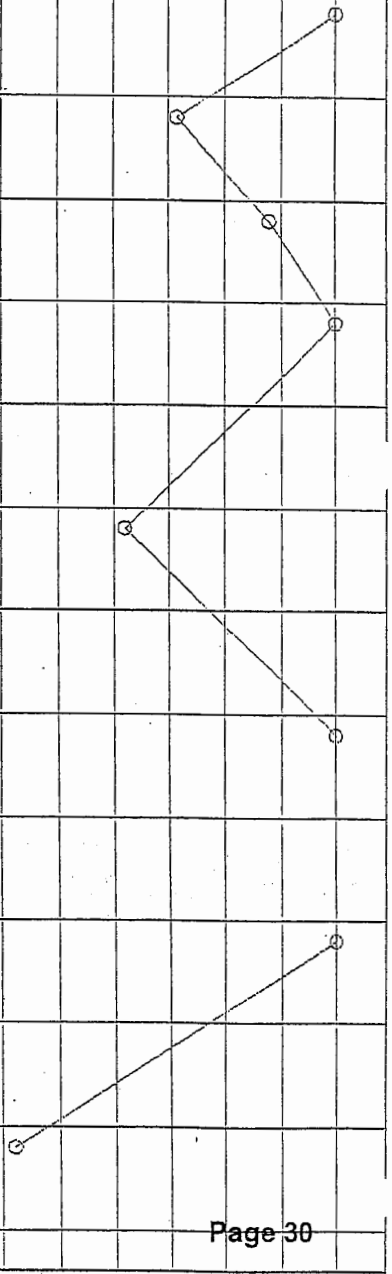
Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12206.6269, E 1260.9717

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	% -200	PLASTICITY INDEX
			SURFACE ELEVATION: 3965.28			
0			SAND, Fine Grained, Tan, Medium Dense, Dry with calcareous material and clay			
5						
10			-medium grained below 8 feet			
15			-with gravel below 15 feet			
20						
25						
30						
35						
40						
45						
50			-very dense at 50 - 51 1/2 feet Dry Unit Weight = 79.5 pcf	SP-SM	6	NP
55						
60			-loose from 60 to 61 1/2 feet			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 30

DEPTH DRILLED:	121.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/14/98	DATE MEASURED:	N/A	PLATE	13

LOG OF BORING NO. B-13 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N 12206.6269, E 1260.9717

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3965.28				
70							
75							
80							
85							
90			-sandy clay lenses from 90 to 91 1/2 feet				
95							
100							
105							
110							
115							
120			Fraction Organic Carbon = 0.0082 g/g Dry Unit Weight = 91.0 pcf e = 0.82 n = 44.9 percent k = 2.57 x 10-04 cm/sec	SP	4	NP	
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	121.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/14/98	DATE MEASURED:	N/A	PLATE	13 (continued)

LOG OF BORING NO. B-14

Clint Landfill Permit Amendment
Clint, El Paso County, Texas .

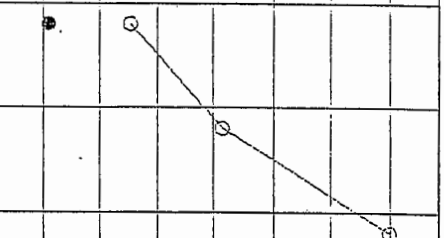
Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12206.6269, E 444.1249

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3965.40			
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt			
5				SM	32	NP
10			-fine to medium grained, medium to very dense below 8 feet			
15			(N=50)			
20			-with silt and interbedded sandy clay below 20 to 21 1/2 feet (N=50)			
25						
30			(N=50)			
35						
40						
45						
50						
55						
60			(N=50/9")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT . WATER CONTENT . LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 32

DEPTH DRILLED:	96.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	14

LOG OF BORING NO. B-14 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12206.6269, E 444.1249

SURFACE ELEVATION: 3965.40

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
70			-with sandy clay lenses from 70 to 71 1/2 feet (N=50/10")		96		
75							
80			(N=50/11")				
85							
90			(N=50/11")				
95			Dry Unit Weight = 91.8 lb/ft3 Fraction Organic Carbon = 0.014 g/g K = 1.04 x10-03 cm/sec	SP-SM	5	NP	
100							
105							
110							
115							
120							
125							
130							

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DEPTH DRILLED:	96.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	14 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-15

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

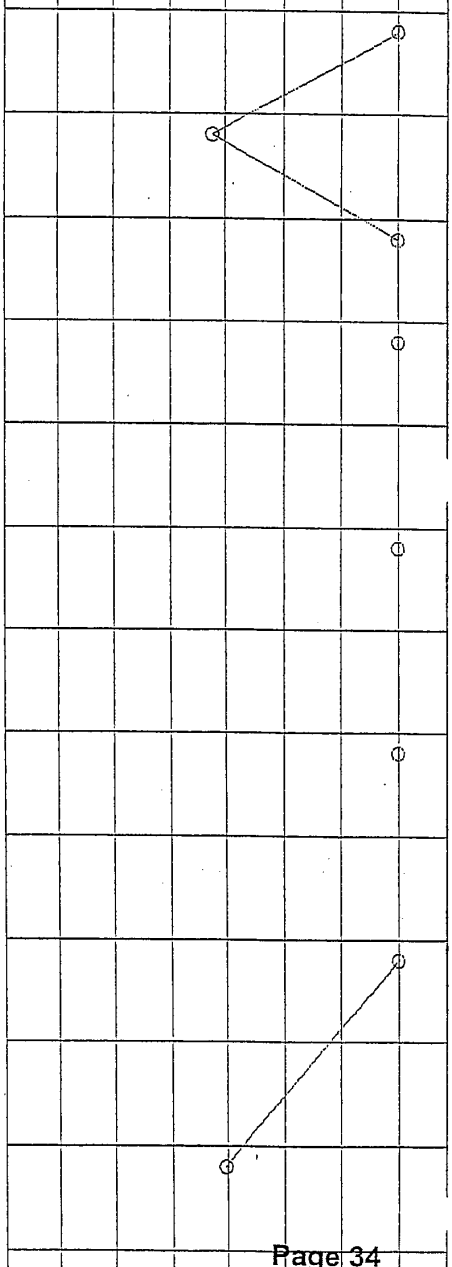
DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12191.4867, E -375.5442

SURFACE ELEVATION: 3953.26

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
5			SAND, Medium Grained, Tan, Poorly Graded, Medium Dense to Very Dense, Dry with clay			
			-with sandy clay lenses from 5 to 6 1/2 feet (N=37)			
10						
15			-with gravel from 15 to 16 1/2 feet (N=50/9")			
20			(N=50/8")			
25						
30			-with silt below 30 feet (N=50/9")			
35						
40			(N=39)			
45						
50			(N=50/11")			
55						
60						
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

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DEPTH DRILLED:	106.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	15

LOG OF BORING NO. B-15 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N -12191.4867, E -375.5442

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3953.26				
70			-fine grained below 70 feet (N=50)				
75							
80			-with sandy clay lenses and some calcareous material from 80 to 81 1/2 feet				
85							
90			(N=50/11")				
95							
100							
105			(N=50/6") Dry Unit Weight = 103.50 lb/ft3 Fraction Organic Carbon = 0.004 g/g K = 1.12 x10-03 cm/sec				
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	106.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	15 (continued)

LOG OF BORING NO. B-16

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12207.2965, E -1204.4156

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT
			SURFACE ELEVATION: 3930.45				5 10 15 20 25 30 35 / 10 20 30 40 50 60 70
			SAND, Medium Grained, Tan, Poorly Graded, Dense to Very Dense, Dry				
5							
10			Fraction Organic Carbon = 0.069 g/g	SP	2		
15			-medium grained, very dense with clay below 17 feet				
20							
25			-clayey sand with gravel at 25 to 26 1/2 feet Fraction Organic Carbon = 0.012 g/g -medium grained below 27 feet	SC	16	40	
30			Fraction Organic Carbon = 0.007 g/g K = 1.45 x10-02 cm/sec	SP	3		
35							
40			-fine grained below 40 feet				
45							
50							
55			-sandy clay lenses from 55 to 56 1/2 feet				
60			-clay lenses from 60 to 61 1/2 feet Dry Unit Weight = 113.1 pcf Fraction Organic Carbon = 0.011 g/g S.G. = 2.638 e = 0.46		7		
65							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	61.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/27/98	DATE MEASURED:	N/A	PLATE	16

LOG OF BORING NO. B-16 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -12207.2965, E -1204.4156

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3930.45				
			n = 31.3%				
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							

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DEPTH DRILLED: 61.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/27/98 | DATE MEASURED: N/A | PLATE 16 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-17

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11485.1482, E -1197.0874

SURFACE ELEVATION: 3941.41

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt			
5			-dense below 5 feet Fraction Organic Carbon = 0.011 g/g	SP-SM	8	NP
10			(N=42)			
15			(N=39)			
20			(N=42)			
25			(N=50/4")			
30			(N=50/2") Dry Unit Weight = 84.5 pcf Fraction Organic Carbon = 0.011 g/g S.G. = 2.630 e = 0.94 n = 48.5% K = 1.4 x10-02 cm/sec	SP-SM	5	NP
35						
40			(N=50/3")			
45			(N=50/4")			
50			-fine to medium grained with silt below 48 feet (N=50/6") Dry Unit Weight = 77.2 pcf Fraction Organic Carbon = 0.01 g/g S.G. = 2.631 e = 1.13 n = 53.0% K = 2.4 x10-03 cm/sec	SP-SM	8	NP
55						
60			-loose below 60 feet			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 71.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/29/98 | DATE MEASURED: N/A | PLATE 17

LOG OF BORING NO. B-17 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas.

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11485.1482, E -1197.0874

SURFACE ELEVATION: 3941.41

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
70			-dense below 70 feet Dry Unit Weight = 100.7 pcf Fraction Organic Carbon = 0.014 g/g S.G. = 2.633 e = 0.63 n = 38.7% K = 4.6 x10-04 cm/sec (N=50/4")	SP-SM	7	NP	
75							
80							
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	71.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/29/98	DATE MEASURED:	N/A	PLATE	17 (continued)

LOG OF BORING NO. PB-18

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -11520.8285, E -378.0872

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3954.57 TOC ELEVATION:				
0			SAND, Fine to Coarse Grained, Tan, Poorly Graded, Medium Dense, Dry				
5		X					
10		X	-with fine gravel and dense at 10 feet				
15		X					
20		X					
25							
30		X					
35							
40		X					
45							
50		X					
55							
60		X					
65							
70		X					

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	370.0 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/5/98	DATE MEASURED:	N/A	PLATE	18

LOG OF BORING NO. PB-18 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -11520.8285, E -378.0872

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3954.57 TOC ELEVATION:						
80									
85									
90									
95									
100									
105									
110									
115									
120									
125									
130									
135									
140									
145									

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DEPTH DRILLED: 370.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/5/98 | DATE MEASURED: N/A | PLATE 18 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-18 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -11520.8285, E -378.0872

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3954.57 TOC ELEVATION:						
155									
160									
165									
170									
175									
180									
185									
190									
195									
200									
205									
210									
215									
220									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 42

DEPTH DRILLED:	370.0 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/5/98	DATE MEASURED:	N/A	PLATE	18 (continued)

LOG OF BORING NO. PB-18 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -11520.8285, E -378.0872

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3954.57 TOC ELEVATION:						
230									
235									
240									
245									
250									
255									
260									
265									
270									
275									
280									
285									
290									
295									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 43

DEPTH DRILLED:	370.0 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/5/98	DATE MEASURED:	N/A	PLATE	18 (continued)

LOG OF BORING NO. PB-18 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A. /S.S Sampler LOCATION: N -11520.8285, E -378.0872

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3954.57 TOC ELEVATION:				
			-with sandy clay seams at 300 to 370 feet				
305							
310							
315							
320							
325							
330							
335							
340							
345							
350							
355							
360			Bottom of Well				
365							
370							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 370.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/5/98 | DATE MEASURED: N/A | PLATE 18 (continued)

LOG OF BORING NO. B-19

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N -11503.0675, E 437.1868

SURFACE ELEVATION: 3968.26

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Silty, Tan, Medium Dense, Dry			
5			(N=36)			
10			Dry Unit Weight = 80.8 pcf Fraction Organic Carbon = 0.0134 g/g S.G. 2.659 e = 1.05 n = 51.3% -medium grained sand with interbedded gravel	SM	20	NP
15						
20			(N=38)		3	NP
			K = 1.0 x10-02 cm/sec Dry Unit Weight = 102.4 pcf Fraction Organic Carbon = 0.0067 g/g S.G. 2.644 e = 0.61 n = 37.9%			
25			(N=47)			
30			(N=38)			
35			-lenses of sandy clay at 35 feet (N=41)			
40			(N=50/10")			
			SAND, Fine Grained, Tan, Poorly Graded, Dense to Very Dense, Dry with silt			
45			(N=50/8")	SP-SM	6	NP
			K = 2.0 x10-03 cm/sec Fraction Organic Carbon = 0.0051 g/g			
50			(N=37)			
55			-sandy clay lense at 55 feet (N=50/11")			
60			-medium dense at 60 feet			
65			-very dense at 65 feet			

BLOWS PER FT.

5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	96.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/29/98	DATE MEASURED:	N/A	PLATE	19

LOG OF BORING NO. B-19 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11503.0675, E 437.1868

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3968.26				
			(N=50/11")				
70			-medium dense at 70 feet				
75			(N=50/8") -very dense at 75 feet				
80			(N=50/9")				
85			(N=50/6") -with sandy clay lenses from 85 to 86 1/2 feet Dry Unit Weight = 91.4 pcf Fraction Organic Carbon = 0.0423 g/g S.G. 2.686 e = 0.83 n = 45.5%	CH	83	69	85.0
90			(N=50)				
95			(N=50/9")				
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	96.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/29/98	DATE MEASURED:	N/A	PLATE	19 (continued)

LOG OF BORING NO. B-20

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

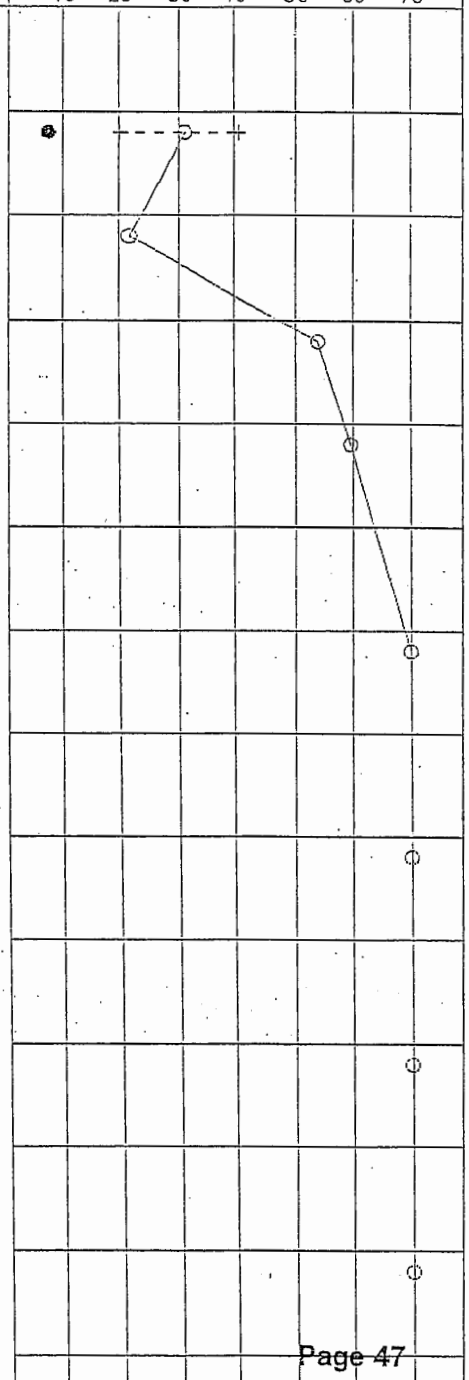
DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11503.0675, E 1254.0336

SURFACE ELEVATION: 3968.50

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Light Brown, Poorly Graded, Medium Dense, Dry with silt and calcareous material			
5			-clayey sand from 5 to 6 1/2 feet (N=16) Ftraction Organic Carbon = 0.04 g/g Dry Unit Weight = 89.4 pcf	SC	25	21
10			(N=11)			
15			-medium grained, brown, medium to very dense below 15 feet (N=27)			
20			(N=30)			
25						
30			-very dense below 30 feet (N=50/6")			
35						
40			(N=50/2")			
45						
50			-fine grained sand below 50 feet (N=50/6")			
55						
60			(N=50/6")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT WATER CONTENT LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	121.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/26/98	DATE MEASURED:	N/A	PLATE	20

LOG OF BORING NO. B-20 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11503.0675, E 1254.0336

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.50	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT 10 20 30 40 50 60 70
70			(N=50/8")				
75							
80			(N=50/6")				
85							
90			-sandy clay lenses from 90 to 91 1/2 feet (N=50/5")				
95							
100			(N=50/3")				
105							
110			-sandy clay lenses from 110 to 111 1/2 feet (N=50/6")				
115							
120			(N=50/3") Fraction Organic Carbon = 0.014 g/g Dry Unit Weight = 99.6 lb/ft3 K = 3.89 x10-04 cm/sec	SM	24	NP	
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	121.5 ft.	DEPTH TO WATER:	N/A	PROJ. No:	AEA96-182-00
DATE DRILLED:	9/26/98	DATE MEASURED:	N/A	PLATE	20 (continued)

LOG OF BORING NO. PB-21

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -10799.5080, E 1247.0955

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3975.83 TOC ELEVATION:				
5			SAND, Medium Grained, Silty, Tan, Medium Dense, Dry with some calcareous sand				
10							
15			SAND, Fine to Medium Grained, Tan, Poorly Graded, Dense to Very Dense, Dry with some calcareous material and interbedded clay lenses				
20							
25							
30							
35							
40							
45							
50							
55							
60							
65							
70							

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DEPTH DRILLED: 390.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/3/98 | DATE MEASURED: 1/25/99 | PLATE 21

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-21 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N.=10799.5080,-E-1247.0955

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3975.83 TOC ELEVATION:						
80									
85									
90									
95									
100									
105									
110									
115									
120									
125									
130									
135									
140									
145									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 390.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/3/98 | DATE MEASURED: 1/25/99 | PLATE 21 (continued)

LOG OF BORING NO. PB-21 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -10799.5080, E 1247.0955

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3975.83 TOC ELEVATION:						
155									
160									
165									
170									
175									
180									
185									
190									
195									
200									
205									
210									
215									
220									

Page 51

DEPTH DRILLED: 390.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/3/98 | DATE MEASURED: 1/25/99 | PLATE 21 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-21 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -10799.5080, E 1247.0955

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3975.83 TOC ELEVATION:						
230									
235									
240									
245									
250									
255									
260									
265									
270									
275									
280									
285									
290									
295									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	390.0 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/3/98	DATE MEASURED:	1/25/99	PLATE	21 (continued)

LOG OF BORING NO. PB-21 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N-10799.5080, E 1247.0955

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3975.83 TOC ELEVATION:				
			-with sandy clay seams at 300 to 390 feet				
305							
310							
315							
320							
325							
330							
335							
340							
345							
350							
355							
360			Bottom of Piezometer Well				
365							
370							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 390.0 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 12/3/98 | DATE MEASURED: 1/25/99 | PLATE 21 (continued)

LOG OF BORING NO. B-22
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-10799.5080, E 430.2487

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3973.66			
5			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense to Very Dense, Dry with some calcareous material and sandy clay lenses			
			(N=20)			
10			(N=30)			
15			-medium grained sand, brown below 15 1/2 feet			
20			(N=33)			
25						
30			-gravel with cobbles from 30 to 31 1/2 feet			
			(N=39)			
35						
40			(N=50/3")			
45						
50			(N=50/5")			
55						
60			(N=33)			
65						

BLOWS PER FT.
5 10 15 20 25 30 35
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	126.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	22

LOG OF BORING NO. B-22 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-10799.5080, E 430.2487

SURFACE ELEVATION: 3973.66

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
70			-sandy clay lenses from 70 to 71 1/2 feet (N=31)		36	
75						
80			-fine grained sand, very dense below 80 feet (N=50/4")			
85						
90			(N=50/5")			
95						
100			-with sandy clay lenses from 100 to 101 1/2 feet (N=50/4")			
105						
110			(N=50/3")			
115						
120						
125			-with sandy clay lenses at 125 to 126 feet (N=50/5") Fraction Organic Carbon = 0.015 g/g Dry Unit Weight = 97.3 lb/ft3 K = 1.58x10-05 cm/sec		75	
130						

BLOWS PER FT. 5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	126.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/30/98	DATE MEASURED:	N/A	PLATE	22 (continued)

LOG OF BORING NO. B-23

Clint Landfill Permit Amendment
Clint, El Paso County, Texas.

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10799.5080, E -386.5980

SURFACE ELEVATION: 3959.51

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Medium Grained, Tan, Poorly Graded, Medium Dense, Dry, with some calcareous material and clay or silt			
5			Fraction Organic Carbon = 0.0191 g/g	SC-SM	35	4
10			-medium to coarse grained, brown dense with gravel below 7 feet			
15			Dry Unit Weight = 96.8 pcf S.G. 2.646 e = 0.71 n = 43.1% K = 1.25 x10-02 cm/sec (N=50/4")		3	NP
20						
25			(N=50/4")			
30			-medium grained with some clay nodules below 30 feet -sandy clay lenses at 33 feet -fine grained silty sand below 34 feet			
35						
40			(N=40) Fraction Organic Carbon = 0.0217 g/g	SP-SM	9	NP
45			(N=39)			
50			-fine gravel and calcareous nodules at 50 feet (N=50/3") -light brown sand below 51 1/2 feet			
55			(N=50/9")			
60			-interbedded sand clay seams at 59 feet (N=48) Dry Unit Weight = 118.7 pcf Fraction Organic Carbon = 0.015 g/g S.G. = 2.633	SP-SM	12	NP
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 56

DEPTH DRILLED:	86.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/12/98	DATE MEASURED:	N/A	PLATE	23

LOG OF BORING NO. B-23 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas.

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10799.5080, E -386.5980

SURFACE ELEVATION: 3959.51

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
70			e = 0.38 n = 27.5% K = 1.3 x10-03 cm/sec (N=50) (N=50/5")				
75			(N=50/3")				
80			(N=50/3") K = 5.83 x10-03 cm/sec	SP-SM	6	NP	
85			(N=45) Boring Terminated at 86 1/2 feet				
90							
95							
100							
105							
110							
115							
120							
125							
130							

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DEPTH DRILLED:	86.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/12/98	DATE MEASURED:	N/A	PLATE	23 (continued)

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-24

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10799.5080, E -1203.4448

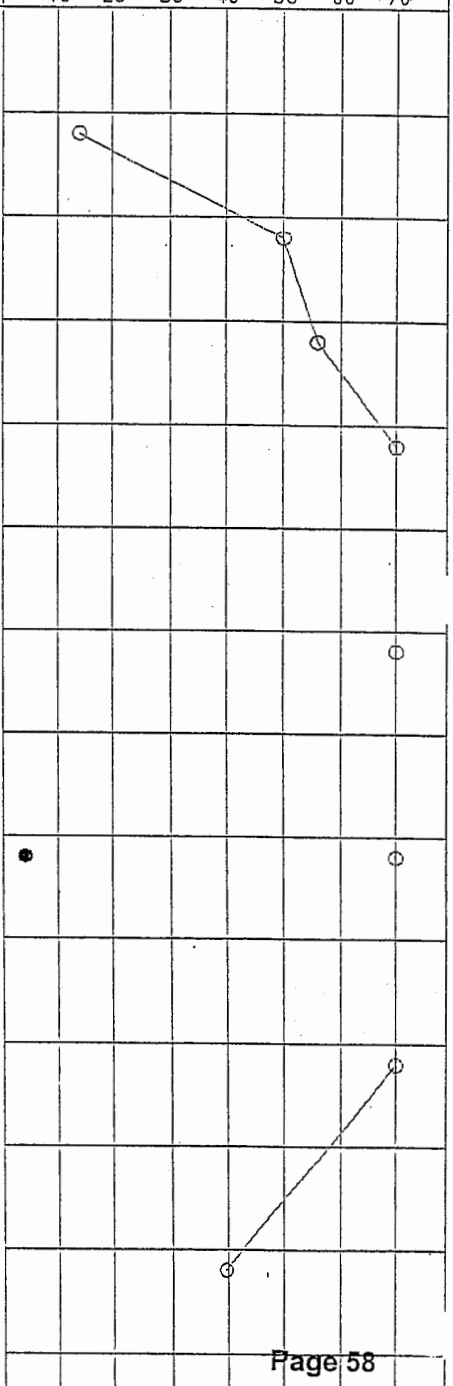
DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3955.24			
0			SAND, Fine Grained, Brown, Poorly Graded, Loose to Medium Dense, Dry with silt			
5						
10			-medium grained, brown to tan, medium dense to dense with some gravel below 8 feet			
15						
20			-fine grained, tan, loose to very dense with silt below 21 1/2 feet			
25						
30						
35						
40			-sandy clay lenses with some calcareous material from 40 to 41 1/2 feet		27	
45						
50			-medium grained sand from 50 to 51 1/2 feet			
55						
60						
65						

BLOWS PER FT.

5 10 15 20 25 30 35

PLASTIC LIMIT WATER CONTENT LIQUID LIMIT

10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 58

DEPTH DRILLED:	101.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/27/98	DATE MEASURED:	N/A	PLATE	24

LOG OF BORING NO. B-24 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10799.5080, E -1203.4448

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3955.24			
70						
75						
80						
85						
90						
95						
100			Fraction Organic Carbon = 0.014 g/g Dry Unit Weight = 91.5 lb/ft3 K = 1.24 x10-03 cm/sec	SM	13	NP
105						
110						
115						
120						
125						
130						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 59

DEPTH DRILLED:	101.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	10/27/98	DATE MEASURED:	N/A	PLATE	24 (continued)

LOG OF BORING NO. B-25

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E -1210.3829

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3960.66	UNIFIED SOIL CLASSIFICATION	% -200	PLASTICITY INDEX
0			SAND, Fine Grained, Brown, Poorly Graded, Dense, Dry, with some calcareous material and clay			
5		X				
10		X	SAND, Medium Grained, Brown, Poorly Graded, Dense, Dry (N=38)			
15		X	-fine gravel below 14 feet (N=50/11") Fraction Organic Carbon = 0.0057 g/g	SW	4	NP
20		X	(N=50/11")			
25		X	(N=45)			
30		X				
35		X	(N=35)			
40		X	(N=36)			
45		X				
50		X	-sand with silt below 50 feet (N=50/9") Dry Unit Weight = 106.8 pcf	SP-SM	9	NP
55		X	(N=50)			
60		X	-lenses of sandy clay at 60 feet Dry Unit Weight = 104.8 pcf Fraction Organic Carbon = 0.0173 g/g S.G. 2.725 e = 0.62	CH	78	48
65		X				

BLOWS PER FT. 5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE U... SEPARATELY FROM THE PROJECT REPORT.

Page 60

DEPTH DRILLED:	91.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/4/98	DATE MEASURED:	N/A	PLATE	25

LOG OF BORING NO. B-25 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E -1210.3829

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3960.66			
70			n = 38.3% qu = 43.6 psi -fine grained sand below 62 feet (N=45) -very dense at 70 feet (N=50/11") Fraction Organic Carbon = 0.0052 g/g (N=50/9")	SP-SM	12	NP
75						
80			CLAY, Brown, Hard, Moist (N=50/10") qu = 188.6 pci	CH	96	87
85			SAND, Fine Grained, Light Brown, Poorly Graded, Very Dense, Dry with silt (N=50/10")			
90			(N=50/6")			
95						
100						
105						
110						
115						
120						
125						
130						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	91.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/4/98	DATE MEASURED:	N/A	PLATE	25 (continued)

LOG OF BORING NO. B-26

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

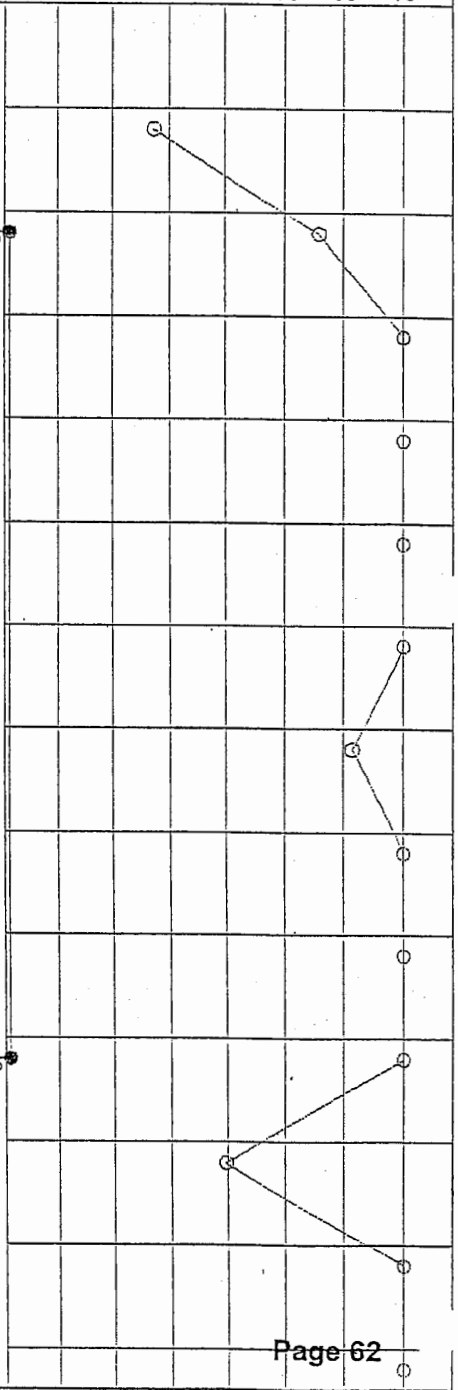
Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E -393.5361

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3961.56			
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry			
5			-medium grained sand below 7 feet			
10			K=8.1 x10-03 cm/sec Fraction Organic Carbon = 0.0057 g/g		1	NP
15			-fine grained sand below 15 feet (N=40)			
20			(N=39)			
25			(N=50/11")			
30			(N=40)			
35						
40			(N=50/9")			
45			(N=50)			
50			-medium grained sand below 50 feet -with sandy clay lense at 50 1/2 feet Fraction Organic Carbon = 0.0044 g/g K=1.0 x10-02 cm/sec	SP	2	NP
55			(N=44)			
60			-fine grained sand below 60 feet (N=50/10")			
65			(N=50/6")			

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 62

DEPTH DRILLED:	116.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/15/98	DATE MEASURED:	N/A	PLATE	26

LOG OF BORING NO. B-26 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E -393.5361

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3961.56			
70			(N=43)			
75			-sandy clay lenses from 75 to 76 feet (N=50) Dry Unit Weight = 116.8 pcf Fraction Organic Carbon = 0.0216 g/g	CH	84	60
80			(N=50/6")			
85			(N=50/7")			
90			-silty sand at 90 to 91 1/2 feet (N=50/8") Fraction Organic Carbon = 0.0134 g/g	SM	22	NP
95			(N=50/6")			
100			(N=50/6")			
105			(N=50/6")			
110						
115			K=8.0 x10-02 cm/sec (N=50/6")			
120						
125						
130						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

Page 63

DEPTH DRILLED: 116.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 9/15/98 | DATE MEASURED: N/A | PLATE 26 (continued)

LOG OF BORING NO. B-27

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N-10095.9485, E 423.3106

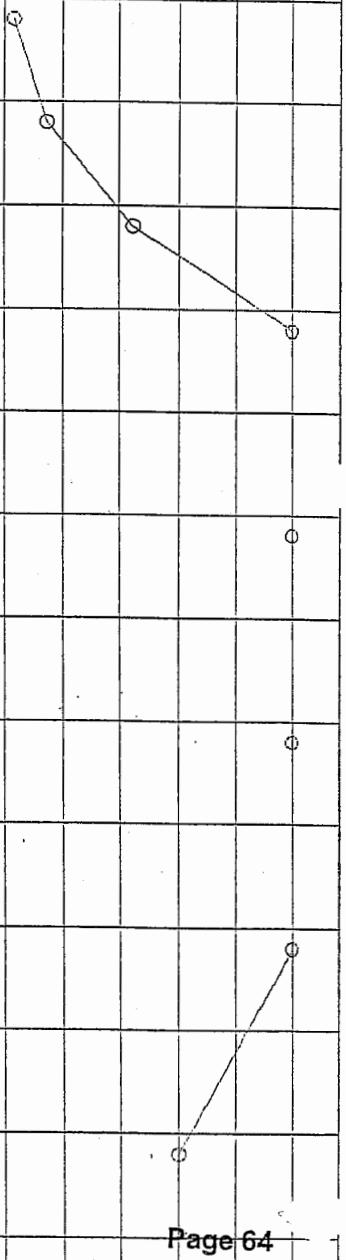
DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3971.12			
0			SAND, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense, Dry with clay, some calcareous material and silt			
5						
10			-medium to coarse grained sand below 12 feet			
15						
20			(N=50/9")			
25			-fine grained sand below 28 feet			
30			(N=50/4")			
35						
40			(N=50/3")			
45						
50			(N=50/3")			
55						
60			-sandy clay lenses at 60 feet (N=43)			
65						

BLOWS PER FT.

5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT

10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	111.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/29/98	DATE MEASURED:	N/A	PLATE	27

LOG OF BORING NO. B-27 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas.

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E -423.3106

SURFACE ELEVATION: 3971.12

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
70			(N=50/6")				
75							
80							
85							
90			(N=15/2")				
95							
100			(N=50/6")	SP	4	NP	
105			Fraction Organic Carbon = 0.04 g/g Dry Unit Weight = 100.5 K = 1.22 x10-03 cm/sec				
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED: 111.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 9/29/98 | DATE MEASURED: N/A | PLATE 27 (continued)

LOG OF BORING NO. B-28

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler

LOCATION: N-10095.9485, E 1240.1574

SURFACE ELEVATION: 3973.42

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
5			SAND, Fine Grained, Tan to Brown, Poorly Graded, Medium Dense to Very Dense, Dry with some calcareous material			
10			-with sandy clay lenses from 10 to 21 1/2 feet			
15						
20						
25						
30			(N=50)			
35						
40			(N=50/3") -medium to fine grained sand, tan, dense to very dense below 41 1/2 feet			
45						
50			(N=50/1")			
55						
60			(N=50/4")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	126.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/28/98	DATE MEASURED:	N/A	PLATE	28

LOG OF BORING NO. B-28 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10095.9485, E 1240.1574

SURFACE ELEVATION: 3973.42

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT 10 20 30 40 50 60 70
70			(N=50/6")				
75							
80			(N=50/1")				
85							
90			-with sandy clay lenses from 90 to 91 1/2 feet (N=50/3")				
95							
100			(N=50/6") Fraction Organic Carbon = 0.05 g/g Dry Unit Weight = 90.2 pcf K = 3.93 x10-04 cm/sec	SP	4	NP	
105							
110			-with sandy clay lenses from 110 to 111 1/2 feet (N=50/4")	SC	20	46	
115							
120							
125			(N=50/6")				
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	126.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/28/98	DATE MEASURED:	N/A	PLATE	28 (continued)

LOG OF BORING NO. PB-29

Clint Landfill Permit Amendment

Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E 1233.2193

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	FORMATION	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		%
			SURFACE ELEVATION: 3973.42 TOC ELEVATION:							
0			SAND, Fine Grained, Tan to Whitish Brown, Clayey, Dense, Dry calcareous							
5										
10										
15			SAND, Fine Grained, Brown, Poorly Graded, Dense, Dry with some gravel							
20										
25										
30										
35										
40										
45										
50										
55										
60										
65										
70										

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DEPTH DRILLED: 400.0 ft. | DEPTH TO WATER: 375.00 | PROJ. No. AEA96-182-00

DATE DRILLED: 11/13/98 | DATE MEASURED: 1/25/99 | PLATE 29

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-29 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E 1233.2193

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	FORMATION	Piezometer Backfill	SOIL PROPERTIES S.G.	e	n(%)			%
			SURFACE ELEVATION: 3973.42 TOC ELEVATION:								
80											
85											
90											
95											
100											
105											
110											
115											
120											
125											
130											
135											
140											
145											

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	400.0 ft.	DEPTH TO WATER:	375.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	11/13/98	DATE MEASURED:	1/25/99	PLATE	29 (continued)

LOG OF BORING NO. PB-29 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E 1233.2193

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	FORMATION	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)			%
			SURFACE ELEVATION: 3973.42 TOC ELEVATION:								
155											
160											
165											
170											
175											
180											
185											
190											
195											
200											
205											
210											
215											
220											

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED:	400.0 ft.	DEPTH TO WATER:	375.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	11/13/98	DATE MEASURED:	1/25/99	PLATE	29 (continued)

LOG OF BORING NO. PB-29 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E 1233.2193

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	FORMATION	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)			%
			SURFACE ELEVATION: 3973.42 TOC ELEVATION:								
230											
235											
240											
245											
250											
255											
260											
265											
270											
275											
280											
285											
290											
295											

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 400.0 ft. | DEPTH TO WATER: 375.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 11/13/98 | DATE MEASURED: 1/25/99 | PLATE 29 (continued)

LOG OF BORING NO. PB-29 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8" O.D. H.S.A./S.S. Sampler LOCATION: N-9392.3890, E 1233.2193

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	FORMATION	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)			%
			SURFACE ELEVATION: 3973.42 TOC ELEVATION:								
			-with sandy clay seams at 310 to 400 feet								
305											
310											
315											
320											
325											
330											
335											
340											
345											
350											
355											
360											
365											
370											

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DEPTH DRILLED: 400.0 ft. | DEPTH TO WATER: = 375.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 11/13/98 | DATE MEASURED: 1/25/99 | PLATE 29 (continued)

LOG OF BORING NO. B-30

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -9392.3890, E 416.3725

SURFACE ELEVATION: 3971.66

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt and traces of calcareous material			
5						
10						
15			-medium grained sand, brown, medium dense to very dense below 15 feet			
20			(N=50/11")			
25						
30			(N=50/9")			
35						
40			(N=50/9")			
45						
50			(N=50/10")			
55						
60			-clayey sand at 60 to 61 1/2 feet		14	88
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

-140.0

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DEPTH DRILLED:	126.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/28/98	DATE MEASURED:	N/A	PLATE	30

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-30 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -9392.3890, E 416.3725

SURFACE ELEVATION: 3971.66

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
70			-fine grained sand, dense to very dense below 70 feet (N=50/6")			
75						
80			(N=50/11")			
85						
90			-with sandy clay lenses at 90 feet (N=50/8")			
95						
100			-silty sand at 100 to 101 1/2 feet (N=50/6") Fraction Organic Carbon = 0.04 g/g Dry Unit Weight = 89.7 lb/ft3 K = 3.69 x10-03 cm/sec		9	NP
105						
110			(N=50/8")			
115						
120			(N=50/8")			
125			(N=50/8")			
130						

BLOWS PER FT.
5 10 15 20 25 30 35
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

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DEPTH DRILLED: 126.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 9/28/98 | DATE MEASURED: N/A | PLATE 30 (continued)

THIS LOG SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-31

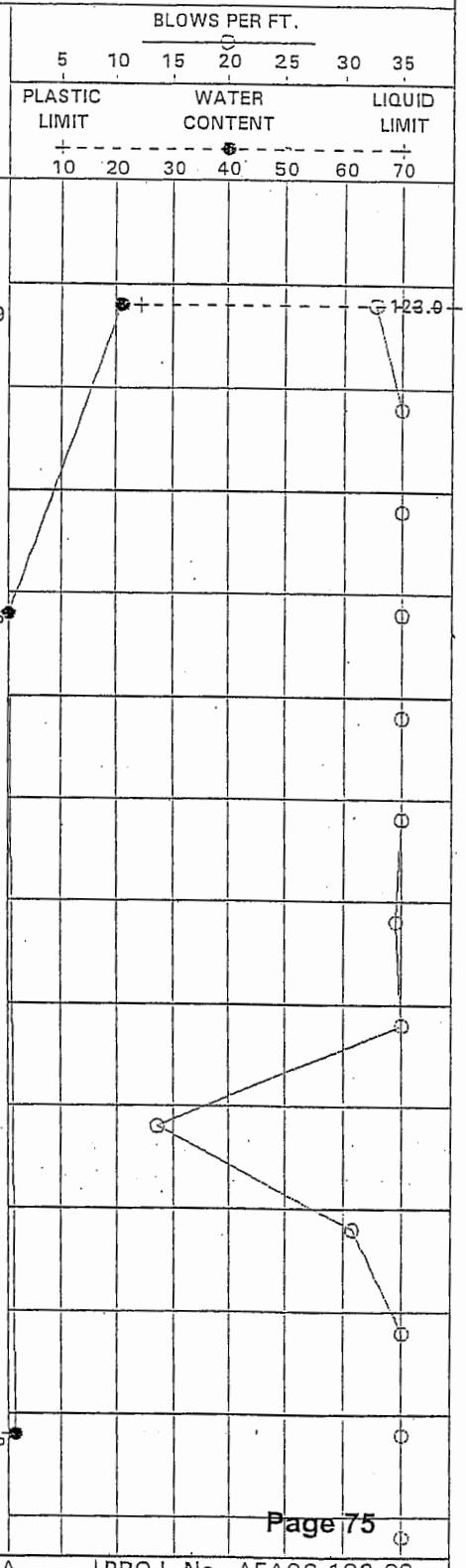
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -9392.3890, E -400.4743

SURFACE ELEVATION: 3964.76

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SAND, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense, Dry with some calcareous material and silt			
5			-with interbedded sandy clay from 5 to 6 1/2 feet	CH	73	99
			Dry Unit Weight = 91.8 pcf			
			Fraction Organic Carbon = 0.036 g/g			
10			S.G. 2.657			
			e = 0.55			
			n = 35%			
			qu = 234.6 psi			
15			-medium to coarse grained sand with some gravel			
			(N=38)			
			-trace of gravel below 15 feet			
20			(N=53)			
			(N=40)	SP-SM	5	NP
			Dry Unit Weight = 91.8 pcf			
			Fraction Organic Carbon = 0.043 g/g			
25			S.G. 2.641			
			e = 0.80			
			n = 44%			
			K = 1.95 x10-02 cm/sec			
30			(N=49)			
			-sandy clay lenses from 30 to 31 1/2 feet			
			(N=52)			
35			(N=50/5")			
40			(N=48)			
45			(N=59)			
50			-fine grained sand below 50 feet			
55			(N=54)			
60			(N=50/2")	SP	4	NP
			Fraction Organic Carbon = 0.071 g/g			
			Dry Unit Weight = 82.8 pcf			
65			S.G. 2.64			
			e = 0.99			



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	91.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/3/98	DATE MEASURED:	N/A	PLATE	31

LOG OF BORING NO. B-31 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -9392.3890, E -400.4743

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3964.76				
			n = 50 %				
			K = 3.05 x10-03 cm/sec				
70			(N=50/3")				
			(N=50/5")				
			-trace of gravel at 74 feet				
75			(N=50/4")				
80			(N=50/2")				
85			(N=50/5")				
90			(N=50/6")				
95							
100							
105							
110							
115							
120							
125							
130							

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DEPTH DRILLED:	91.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/3/98	DATE MEASURED:	N/A	PLATE	31 (continued)

NOTE: THIS LOG SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-32

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8' O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E -1271.3210

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)
			SURFACE ELEVATION: 3963.34 TOC ELEVATION:				
5			SAND, Fine to Medium Grained, Tan, Medium Dense to Very Dense, Dry with calcareous material and interbedded clay lenses				
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							
65							
70							

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DEPTH DRILLED:	380.0 ft.	DEPTH TO WATER:	365.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/23/98	DATE MEASURED:	1/25/99	PLATE	32

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. PB-32 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8' O.D. H.S.A./S.S. Sampler LOCATION: N-9392.3890, E-1271.3210

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3963.34 TOC ELEVATION:						
80									
85									
90									
95									
100									
105									
110									
115									
120									
125									
130									
135									
140									
145									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	380.0 ft.	DEPTH TO WATER:	365.00	PROJ. No.	AEA96-182-00
DATE DRILLED:	12/23/98	DATE MEASURED:	1/25/99	PLATE	32 (continued)

LOG OF BORING NO. PB-32 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8' O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E -1271.3210

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3963.34 TOC ELEVATION:						
155									
160									
165									
170									
175									
180									
185									
190									
195									
200									
205									
210									
215									
220									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 380.0 ft. | DEPTH TO WATER: 365.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 12/23/98 | DATE MEASURED: 1/25/99 | PLATE 32 (continued)

LOG OF BORING NO. PB-32 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8' O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E -1271.3210

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3963.34 TOC ELEVATION:						
230									
235									
240									
245									
250									
255									
260									
265									
270									
275									
280									
285									
290			-clayey sand below 290 feet						
295									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 380.0 ft. | DEPTH TO WATER: 365.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 12/23/98 | DATE MEASURED: 1/25/99 | PLATE 32 (continued)

LOG OF BORING NO. PB-32 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary w/8' O.D. H.S.A./S.S. Sampler LOCATION: N -9392.3890, E -1271.3210

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	SOIL PROPERTIES S.G.	e	n(%)		
			SURFACE ELEVATION: 3963.34 TOC ELEVATION:						
305			-clay, brown, very stiff to hard, dry to moist with interbedded sand at 355 to 380feet						
310									
315									
320									
325									
330									
335									
340									
345									
350									
355									
360									
365									
370									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 380.0 ft. | DEPTH TO WATER: 365.00 | PROJ. No. AEA96-182-00
DATE DRILLED: 12/23/98 | DATE MEASURED: 1/25/99 | PLATE 32 (continued)

LOG OF BORING NO. B-33

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

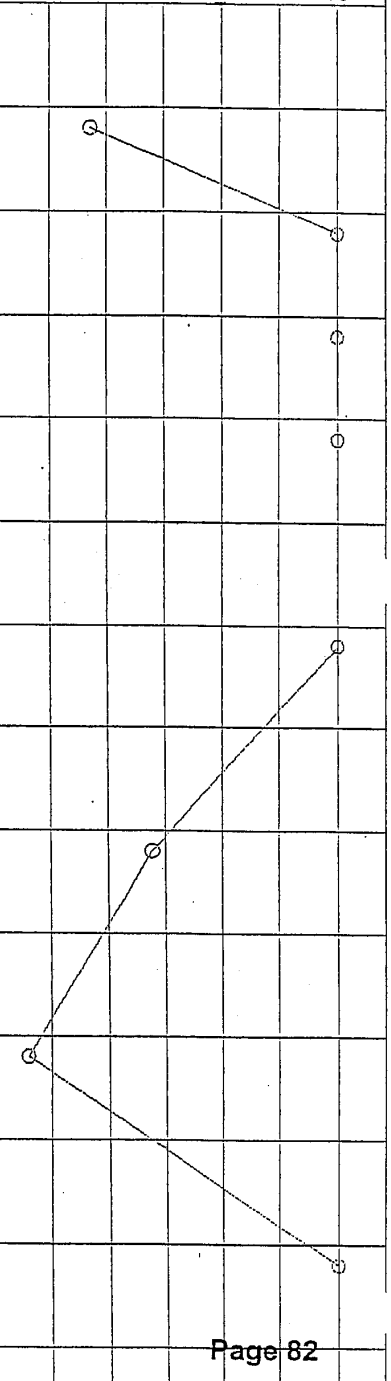
DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11284.6014, E -1778.9422

SURFACE ELEVATION: 3947.80

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry			
5						
10			(N=42)			
15			(N=41)			
20			-medium grained sand, dense below 20 feet -with sandy clay lenses at 21 feet (N=44)			
25						
30			-with sandy clay and silt below 30 feet			
35						
40			-with sandy clay lenses at 41 feet			
45						
50			-medium grained sand, loose to very dense with traces of calcareous material below 50 feet			
55						
60			(N=50/7")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	101.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	9/18/98	DATE MEASURED:	N/A	PLATE	33

LOG OF BORING NO. B-33 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

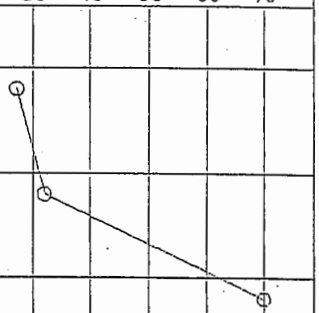
Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -11284.6014, E -1778.9422

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3947.80			
70						
75						
80			-with sandy clay lenses at 81 feet (N=50/4")			
85						
90			(N=50/9")			
95						
100			(N=38) Fraction Organic Carbon = 0.059 g/g Dry Unit Weight = 117 pcf K = 8.19 x10-03 cm/sec S.G. = 2.650		11	NP
105						
110						
115						
120						
125						
130						

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED: 101.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 9/18/98 | DATE MEASURED: N/A | PLATE 33 (continued)

LOG OF BORING NO. B-34

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10900.2960, E -1525.7352

SURFACE ELEVATION: 3956.60

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
0			SAND, Fine Grained, Light Brown, Poorly Graded, Dense, Dry			
5						
10			(N=49)			
15			-medium grained sand, very dense with some fine gravel below 15 feet (N=50/11") Fraction Organic Carbon = 0.007 g/g K=1.6 x10-02 cm/sec	SP	3	NP
20			(N=50)			
25			(N=50)			
30			(N=50)			
35			-dense at 35 feet			
40			-sandy clay seams a 41 feet (N=50/10")			
45			-sandy clay lenses from 45 to 46 1/2 feet			
			CLAY, Sandy, Brown, Hard, Moist			
50			SAND, Fine Grained, Brown, Poorly Graded, Dense, Dry (N=50/11") (N=38)			
55			-medium dense at 55 feet Fraction Organic Carbon = 0.011 g/g K=4.67 x10-02 cm/sec		30	
60			-clayey sand mix with fine gravel at 55 feet (N=50/11")			
65			-very dense below 65 feet			

BLOWS PER FT.
5 10 15 20 25 30 35

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	86.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/13/98	DATE MEASURED:	N/A	PLATE	34

LOG OF BORING NO. B-34 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10900.2960, E -1525.7352

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX	BLOWS PER FT. 5 10 15 20 25 30 35 / PLASTIC LIMIT WATER CONTENT LIQUID LIMIT 10 20 30 40 50 60 70
			SURFACE ELEVATION: 3950.60				
			(N=50/9")				
70			(N=50/10")				
75			(N=50/9")				
80			-clayey sand below 80 feet (N=50)				
85			(N=50)				
90							
95							
100							
105							
110							
115							
120							
125							
130							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

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DEPTH DRILLED:	86.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/13/98	DATE MEASURED:	N/A	PLATE	34 (continued)

LOG OF BORING NO. B-35
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10418.9970, E -1699.0293

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3950.60			
5			SAND, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense to Dense, Dry with some calcareous material and silt			
			-caliche cemented at 5 1/2 feet			
10			-with black gravel below 10 feet			
15			-with sandy silt or clay lenses from 15 to 20 1/2 feet Dry Unit Weight = 105.7 pcf Fraction Organic Carbon = 0.01 g/g S.G. = 2.649 e = 0.56 n = 36.1% (N=40)		35	
20						
25			-very dense below 25 feet (N=49)			
30			(N=50/3")			
35			-with fine gravel below 35 feet (N=50/3")			
40			-medium grained sand below 40 feet (N=50)			
45			(N=45) K = 1.0 x10-03 cm/sec	SP	4	NP
50			(N=42)			
55			(N=50/5")			
60			(N=50/5")			
65						

BLOWS PER FT.
5 10 15 20 25 30 35
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

DEPTH DRILLED:	106.5 ft.	DEPTH TO WATER:	N/A	PROJ. No.	AEA96-182-00
DATE DRILLED:	8/13/98	DATE MEASURED:	N/A	PLATE	35

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

LOG OF BORING NO. B-35 (continued)
Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: 8"O.D. H.S.A./2"O.D. Split Spoon Sampler LOCATION: N -10418.9970, E -1699.0293

DEPTH, ft.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIFIED SOIL CLASSIFICATION	%-200	PLASTICITY INDEX
			SURFACE ELEVATION: 3948.00			
70			(N=50/3")			
			(N=50)			
75			(N=50/3")			
80			(N=50/3")			
85			(N=50/4")			
90			-clayey sand at 91 feet (N=50/5")			
95			-sandy clay seams from 95 to 101 1/2 feet (N=50) Dry Unit Weight = 113.3 pcf Fraction Organic Carbon = 0.032 g/g S.G. = 2.651 e = 0.46 n = 31.5%	CH	57	51
100						
105			(N=50)			
			-sandy clay lenses from 105 to 106 1/2 feet (N=50/4")	SM	26	NP
110						
115						
120						
125						
130						

BLOWS PER FT.
5 10 15 20 25 30 35
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT.

DEPTH DRILLED: 106.5 ft. | DEPTH TO WATER: N/A | PROJ. No. AEA96-182-00
DATE DRILLED: 8/13/98 | DATE MEASURED: N/A | PLATE 35 (continued)

LOG OF BORING NO. PB-36

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11487.2192; E-1015.6741

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1 1.5 2 2.5 3 3.5 4 4.5) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	96-2(
0			SURFACE ELEVATION: 3941.10				
			SAND, Coarse Grained, Silty, Light Brown				
15							
30							
45							
			CLAY, Sandy, Brown				
60			SAND, Fine Grained, Silty, Light Brown				
75							
90							
105							
			CLAY, Sandy, Reddish-brown				
120							

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DEPTH DRILLED:	405'	DEPTH TO WATER:	347'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	7/25/00 - 8/1/00	DATE MEASURED:	8/21/00	PLATE	36

LOG OF BORING NO. PB-36 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11487.2192; E-1015.6741

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT²	%-200
			SURFACE ELEVATION: 3941.10			0.5 1 1.5 2 2.5 3 3.5 4 4.5	
						PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	
						10 20 30 40 50 60 70 80 90	
135							
150							
165							
180							
195							
210							
225							
240							

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DEPTH DRILLED:	405'	DEPTH TO WATER:	347'	PROJ. NO:	AEA96-182-01
DATE DRILLED:	7/25/00 - 8/1/00	DATE MEASURED:	8/21/00	PLATE	36 (continued)

LOG OF BORING NO. PB-36 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11487.2192; E-1015.6741

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1 1.5 2 2.5 3 3.5 4 4.5) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	%-200
			SURFACE ELEVATION: 3941.10				
255							
270							
285							
300			- with gravel at 303 to 325 feet				
315							
			SAND, Fine Grained, Clayey, Light Brown, calcareous				
330							
345							
							25
360							
			SAND, Fine to Medium Grained, Brown,				

DEPTH DRILLED: 405' | DEPTH TO WATER: 347' | PROJ. NO. AEA96-182-01
DATE DRILLED: 7/25/00 - 8/1/00 | DATE MEASURED: 8/21/00 | PLATE 36 (continued)

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LOG OF BORING NO. PB-36 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11487.2192; E-1015.6741

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1 1.5 2 2.5 3 3.5 4 4.5) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	%-200
			SURFACE ELEVATION: 3941.10				
375			Poorly Graded				
390							
			CLAY, Reddish-brown with traces of sand				75
405							
420							
435							
450							
465							
480							
495							

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DEPTH DRILLED:	405'	DEPTH TO WATER:	347'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	7/25/00 - 8/1/00	DATE MEASURED:	8/21/00	PLATE	36 (continued)

LOG OF BORING NO. PB-37

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11555.3294; E-1218.3549

SURFACE ELEVATION: 3968.50

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL
0			SAND, Fine Grained, Clayey, Light Brown-Whittish, Calcareous
			SAND, Fine Grained, Reddish
15			SAND, Fine to Coarse Grained, Light Brown, Poorly Graded
30			
45			
60			
75			
90			
			CLAY, Reddish-Brown
105			SAND, Fine to Coarse Grained, Clayey, Light Brown,
120			

Piezometer Boring

UNIT DRY WEIGHT, pcf

SHEAR STRENGTH, TONS/FT^2
0.5 1 1.5 2 2.5 3 3.5 4 4.5

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
10 20 30 40 50 60 70 80 90

%-200

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DEPTH DRILLED:	403'	DEPTH TO WATER:	370'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	8/8/00 - 8/11/00	DATE MEASURED:	8/18/00	PLATE	37

LOG OF BORING NO. PB-37 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11555.3294; E-1218.3549

SURFACE ELEVATION: 3968.50

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1 1.5 2 2.5 3 3.5 4 4.5) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	%-200
			CLAY, Reddish-Brown with sand				
			SAND, Medium Grained, Clayey, Light Brown				
135			CLAY, Reddish-Brown with sand				
			SAND, Fine Grained, Light Brown				
150							
165							
180							
195							
210			CLAY, Reddish-Brown				
			SAND, Fine Grained, Light Brown				
225							
240			SAND, Fine Grained, Light Brown, Poorly Graded with cemented sand				

DEPTH DRILLED:	403'	DEPTH TO WATER:	370'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	8/8/00 - 8/11/00	DATE MEASURED:	8/18/00	PLATE	37 (continued)

LOG OF BORING NO. PB-37 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11555.3294; E-1218.3549

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1 1.5 2 2.5 3 3.5 4 4.5) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	%-200
			SURFACE ELEVATION: 3968.50				
255							
270			SAND, Fine Grained, Light Brown, Dense, Poorly Graded				
285							
300							
315							
330							
345							
360			SAND, Fine Grained, Reddish-Brown, Dense, Poorly Graded				

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DEPTH DRILLED:	403'	DEPTH TO WATER:	370'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	8/8/00 - 8/11/00	DATE MEASURED:	8/18/00	PLATE	37 (continued),

LOG OF BORING NO. PB-37 (continued)

Clint Landfill Permit Amendment
Clint, El Paso County, Texas

Raba-Kistner

DRILLING METHOD: Mud Rotary

LOCATION: N-11555.3294; E-1218.3549

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	Piezometer Boring	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT² (0.5 1 1.5 2 2.5 3 3.5 4 4.5) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80 90)	%-200
			SURFACE ELEVATION: 3968.50				
375							
390							
			CLAY, Reddish-Brown with sand				78
405							
420							
435							
450							
465							
480							
495							

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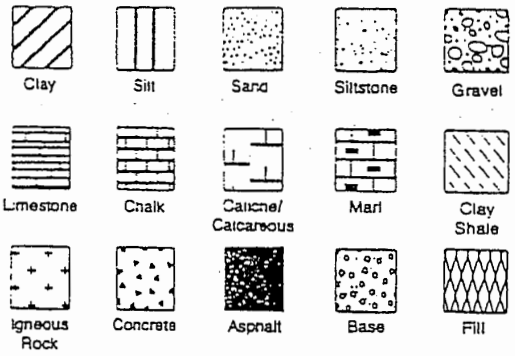
DEPTH DRILLED:	403'	DEPTH TO WATER:	370'	PROJ. NO.	AEA96-182-01
DATE DRILLED:	8/8/00 - 8/11/00	DATE MEASURED:	8/18/00	PLATE	37 (continued)

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES

(shown in symbols column)



(Predominate Soil Types Shown Heavy)

SAMPLER TYPES

(shown in sample column)



STRENGTH TEST RESULTS

- ⊗ - Estimated Strength
- ◇ - Torvane
- ○ - Unconfined Compression

TRIAXIAL COMPRESSION

- △ - Unconsolidated-undrained
- □ - Consolidated-undrained

- C - Cohesion (Total)
- Φ - Angle of Internal Friction (Total)

- C′ - Cohesion (Effective)
- Φ′ - Angle of Internal Friction (Effective)

NOTE:

Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or condition are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per foot	Relative Density	Penetration Resistance, blows per foot	Consistency	Cohesion, TSF	Plasticity Index	Degree of Plasticity
0-4	Very Loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
> 50	Very Dense	15-30	Very Stiff	1.0-2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

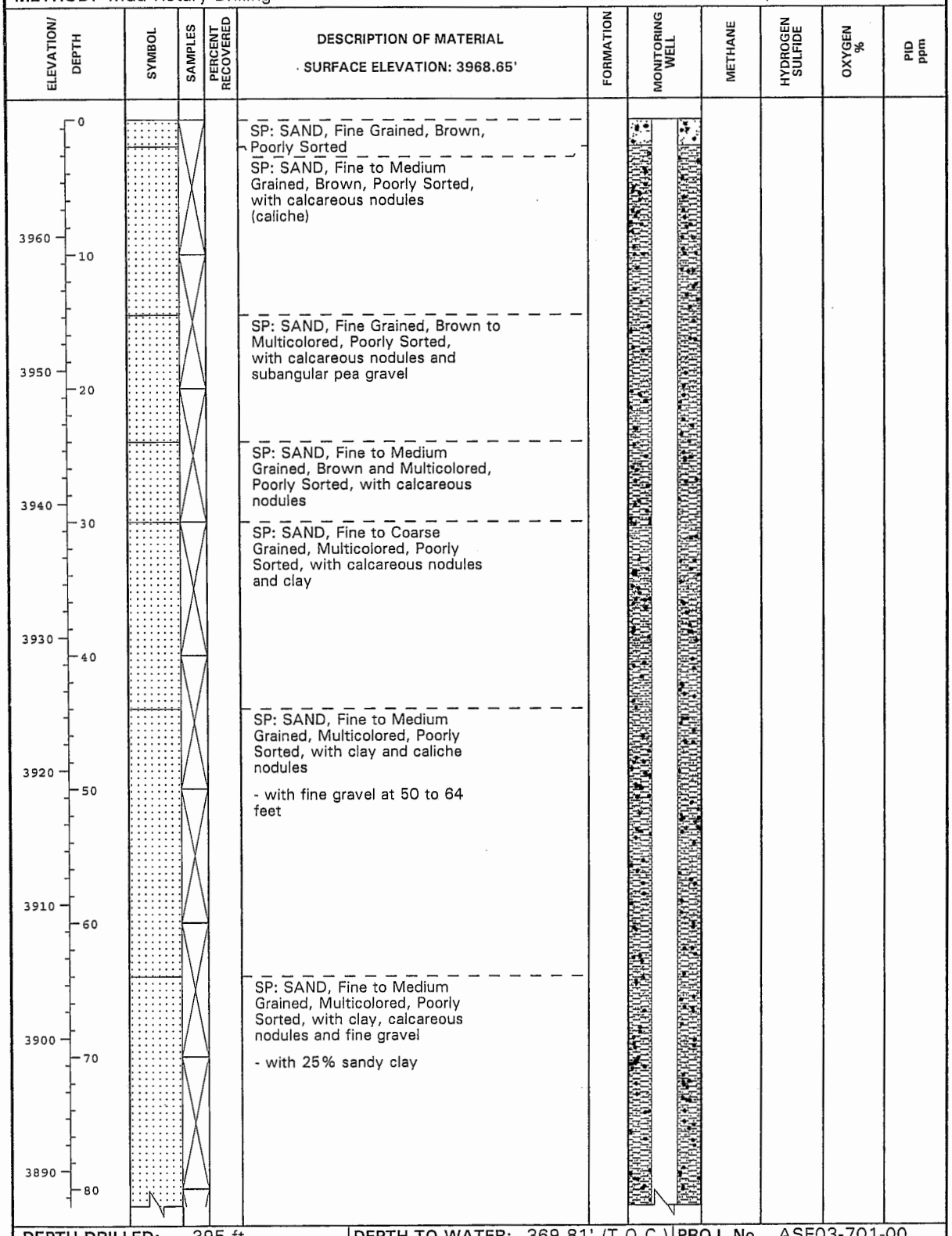
LOG OF BORING NO. MW-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 30+46.34, L+78.94



DEPTH DRILLED:	395 ft	DEPTH TO WATER: 369.81' (T.O.C.)	PROJ. No. ASF03-701-00
DATE DRILLED:	6/01/04-6/03/04	DATE MEASURED: 6/23/04	FIGURE 1

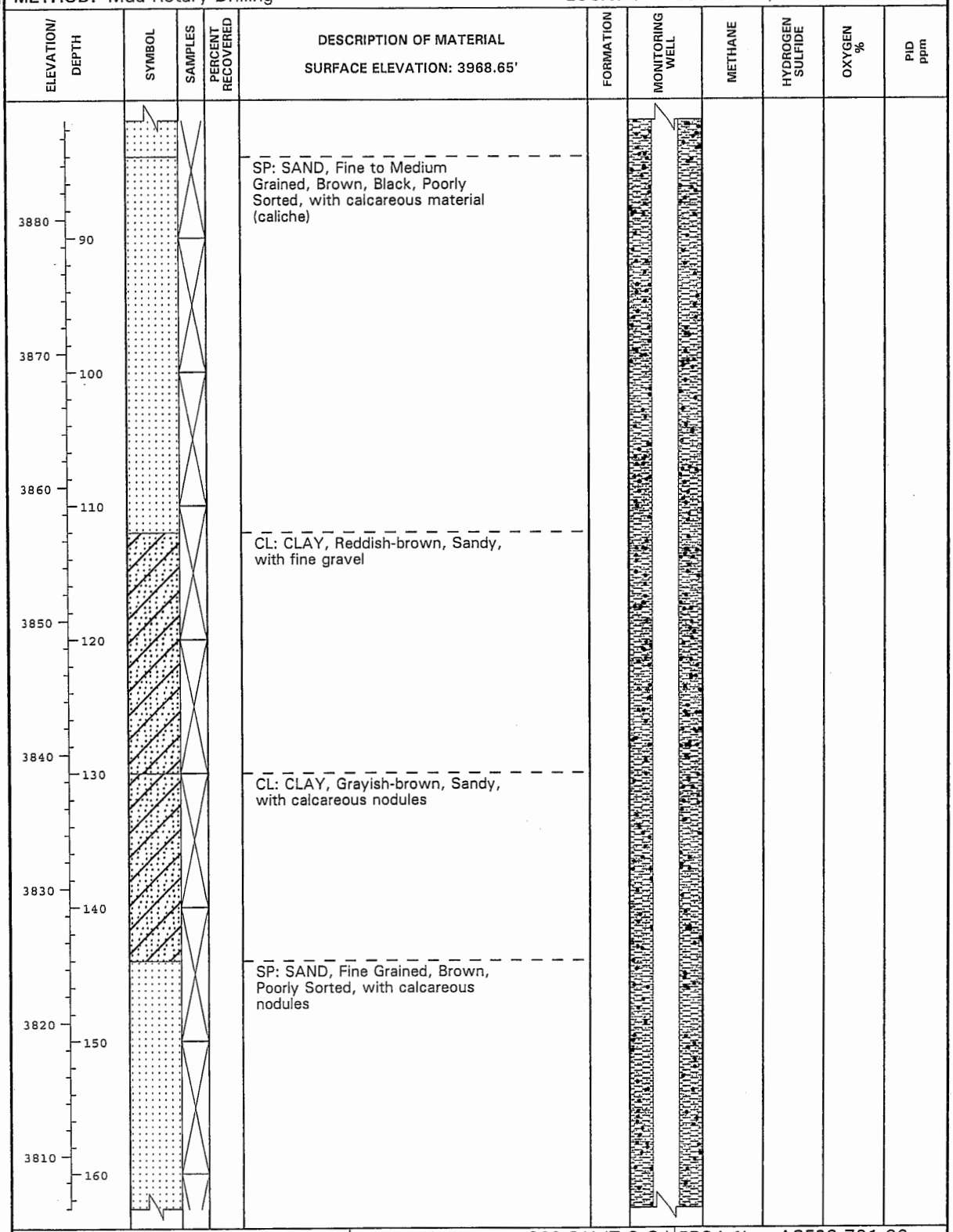
LOG OF BORING NO. MW-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 30+46.34, L+78.94



DEPTH DRILLED:	395 ft	**DEPTH TO WATER:**	369.81' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/01/04-6/03/04	**DATE MEASURED:**	6/23/04	**FIGURE**	1

LOG OF BORING NO. MW-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 30+46.34, L+78.94

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.65'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3800 – 170										
3790 – 180				CL: CLAY, Brown, Sandy, with intermittent sand lenses						
3780 – 190				SP: SAND, Fine Grained, Brown						
3770 – 200										
3760 – 210				CL: CLAY, Brown, Sandy						
3750 – 220										
3740 – 230				SP: SAND, Fine to Medium Grained, Brown, Poorly Sorted, with calcareous nodules						
3730 – 240				CL: CLAY, Brown, Sandy SP: SAND, Fine to Medium Grained, Brown, Poorly Sorted, with calcareous nodules						

DEPTH DRILLED:	395 ft	**DEPTH TO WATER:**	369.81' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/01/04-6/03/04	**DATE MEASURED:**	6/23/04	**FIGURE**	1

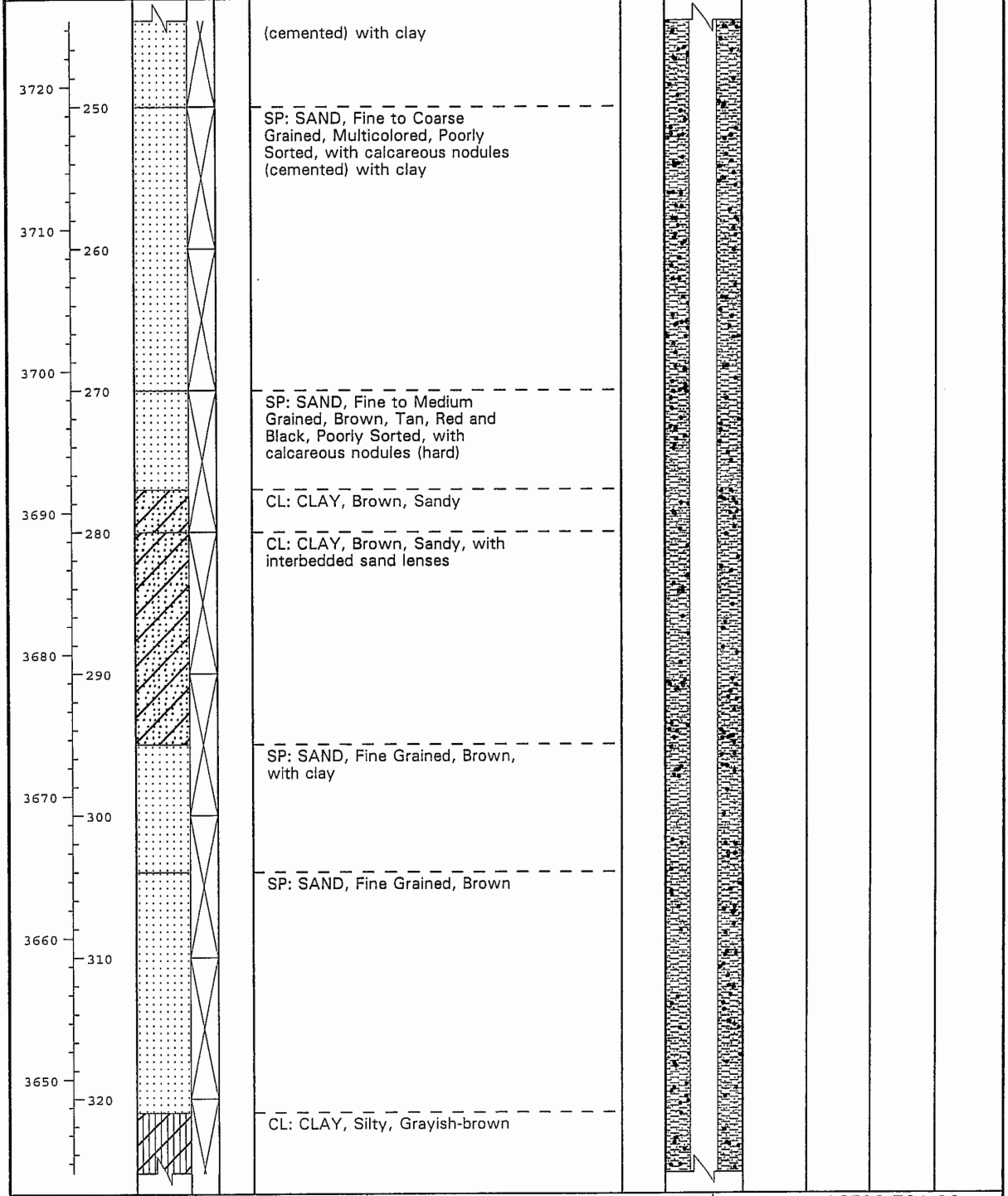
LOG OF BORING NO. MW-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 30+46.34, L+78.94



DEPTH DRILLED:	395 ft	DEPTH TO WATER: 369.81' (T.O.C.)	PROJ. No. ASF03-701-00
DATE DRILLED:	6/01/04-6/03/04	DATE MEASURED: 6/23/04	FIGURE 1

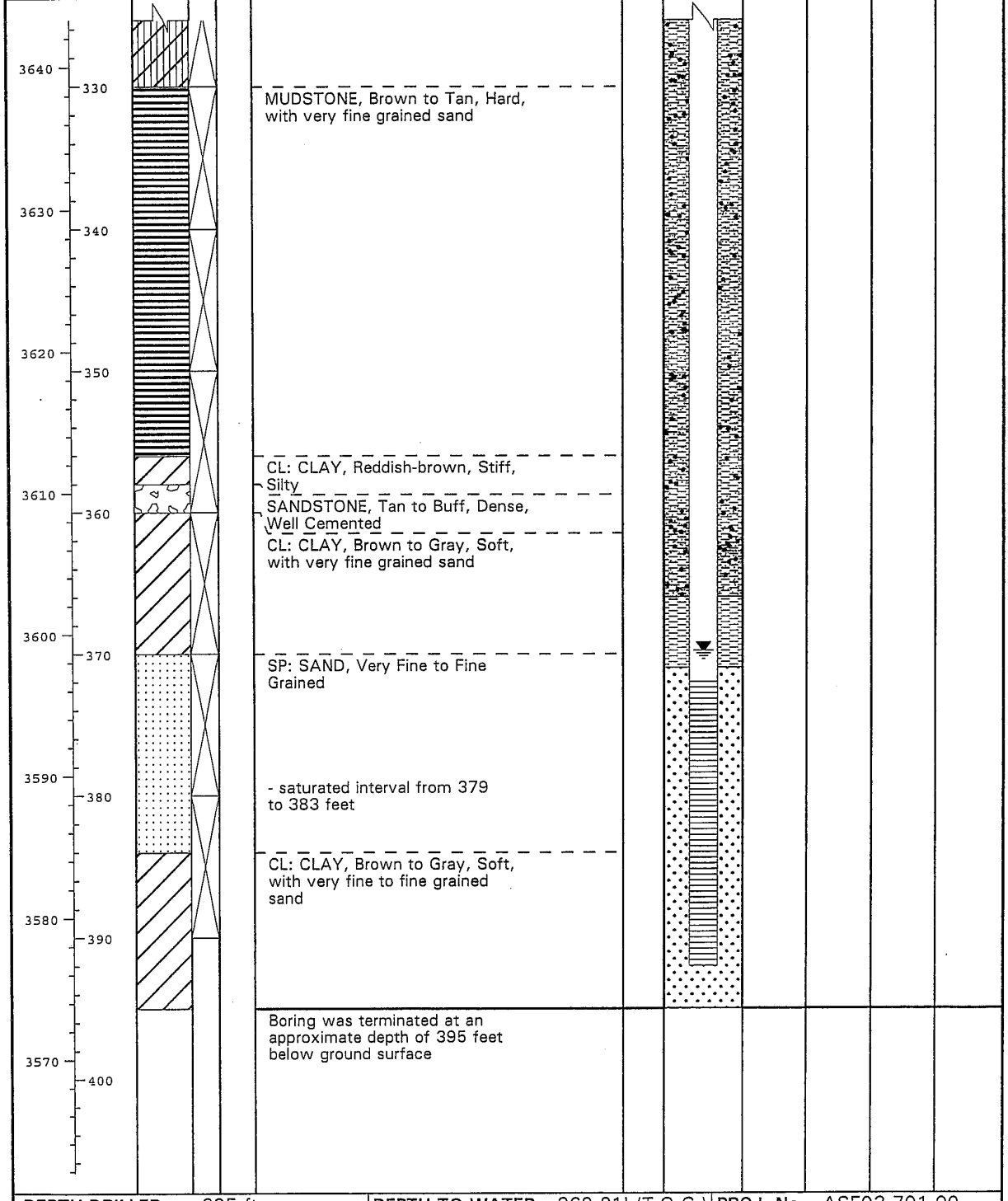
LOG OF BORING NO. MW-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 30+46.34, L+78.94



DEPTH DRILLED:	395 ft	**DEPTH TO WATER:**	369.81' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/01/04-6/03/04	**DATE MEASURED:**	6/23/04	**FIGURE**	1

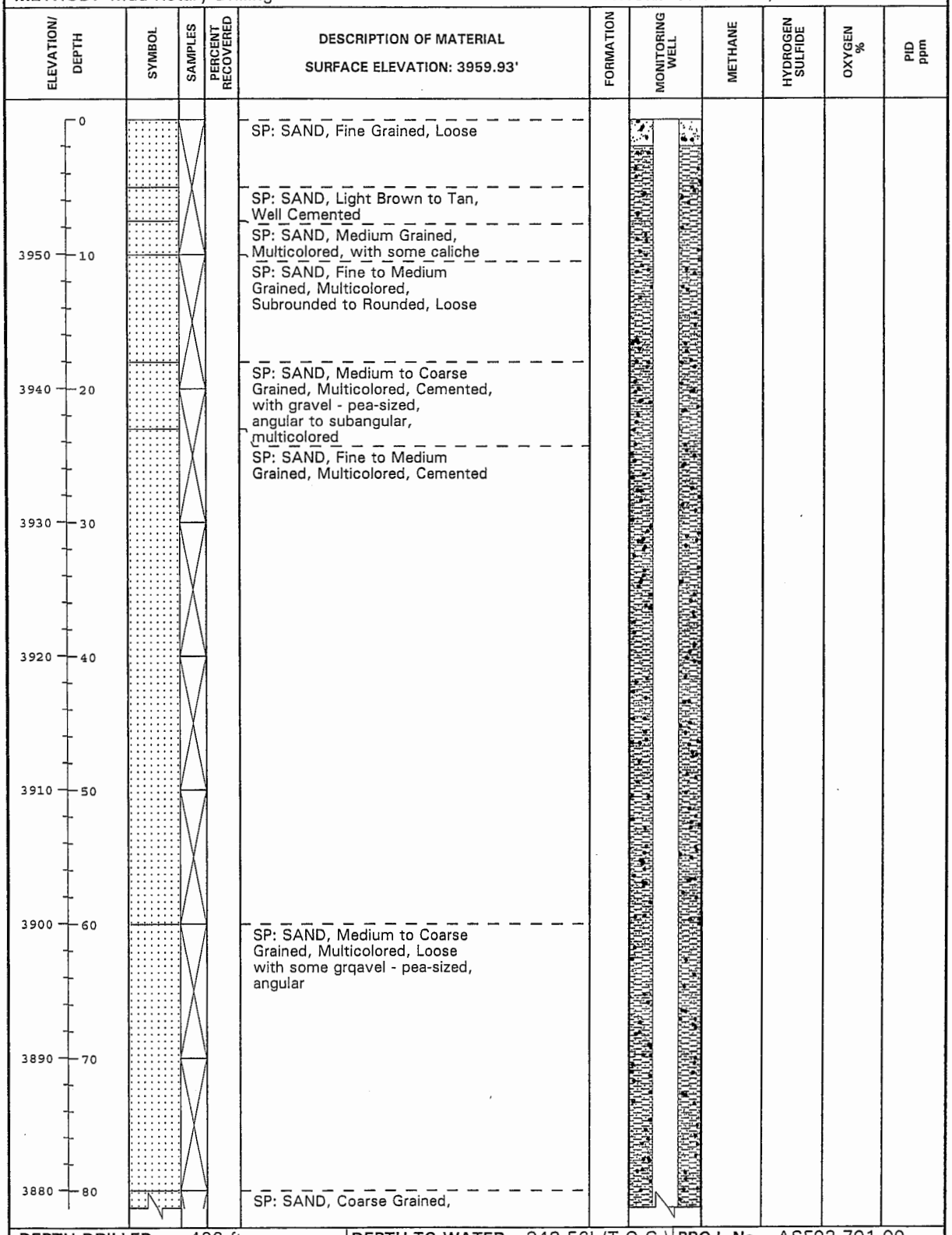
LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83



DEPTH DRILLED:	422 ft	**DEPTH TO WATER:**	348.56' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/16/04-6/18/04	**DATE MEASURED:**	6/23/04	**FIGURE**	2

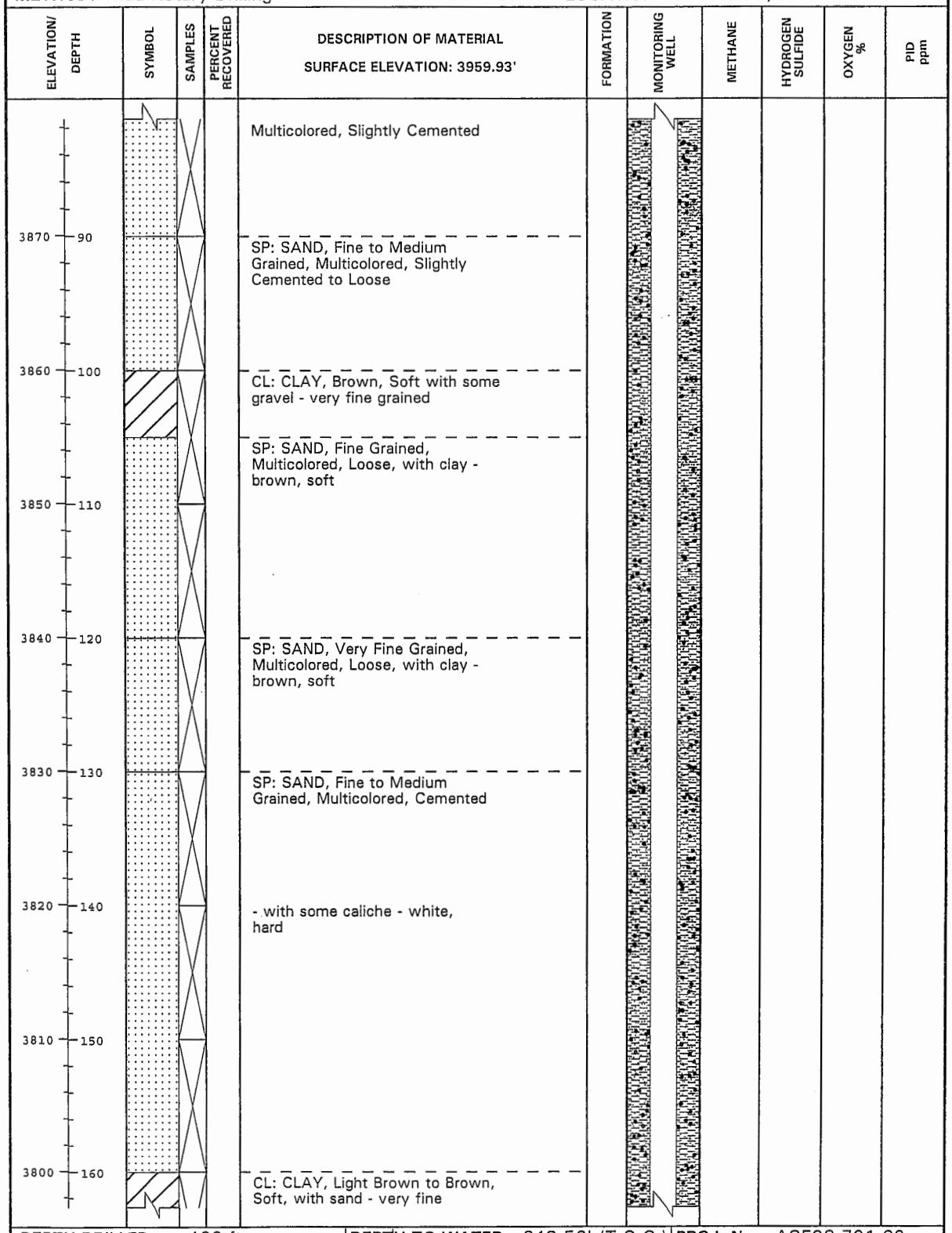
LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83



DEPTH DRILLED: 422 ft	DEPTH TO WATER: 348.56' (T.O.C.)	PROJ. No. ASF03-701-00
DATE DRILLED: 6/16/04-6/18/04	DATE MEASURED: 6/23/04	FIGURE 2

LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3959.93'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3790 — 170				grained						
3780 — 180										
3770 — 190										
3760 — 200										
3750 — 210				CL: CLAY, Brown, with sand - very fine to fine grained						
3740 — 220										
3730 — 230				- with sand, coarse grained, multicolored, cemented						
3720 — 240				CL: CLAY, Brown, with sand - fine to medium grained, multicolored						

DEPTH DRILLED:	422 ft	DEPTH TO WATER:	348.56' (T.O.C.)	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/16/04-6/18/04	DATE MEASURED:	6/23/04	FIGURE	2

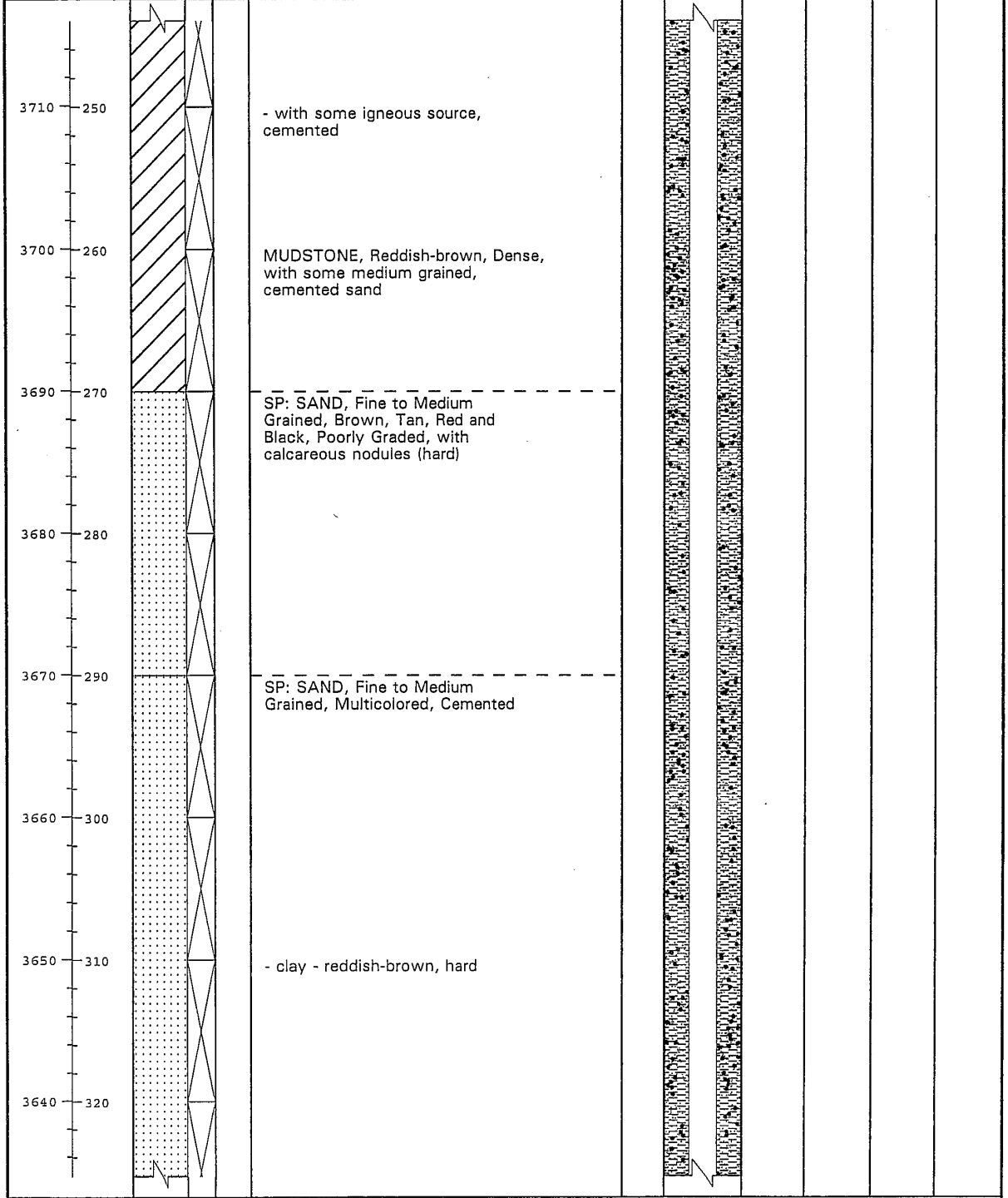
LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83



DEPTH DRILLED:	422 ft	DEPTH TO WATER: 348.56' (T.O.C.)	PROJ. No. ASF03-701-00
DATE DRILLED:	6/16/04-6/18/04	DATE MEASURED: 6/23/04	FIGURE 2

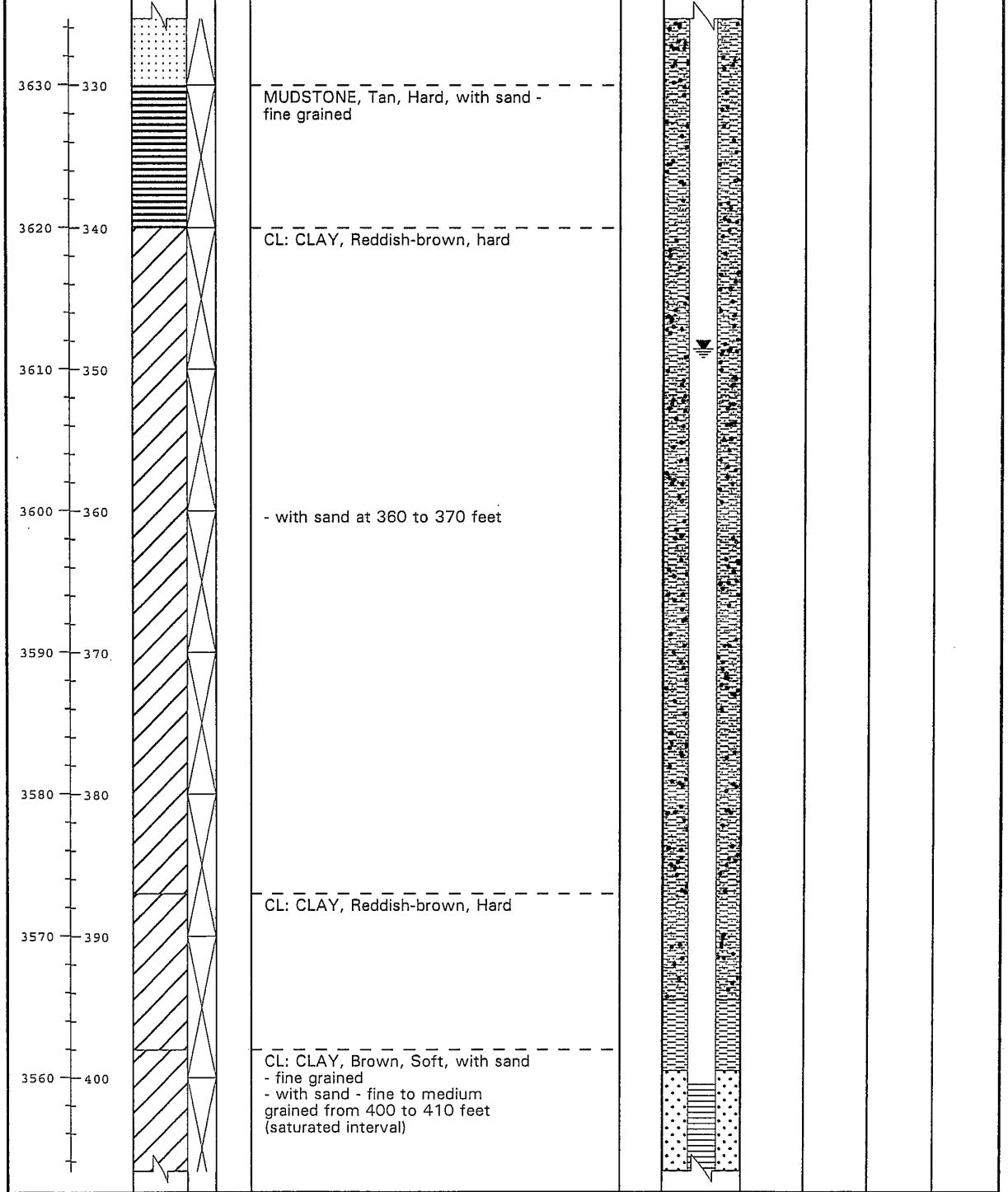
LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83



DEPTH DRILLED:	422 ft	DEPTH TO WATER:	348.56' (T.O.C.)	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/16/04-6/18/04	DATE MEASURED:	6/23/04	FIGURE	2

LOG OF BORING NO. MW-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 39+95.07, A+43.83

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3959.93'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3550 — 410 3540 — 420				Boring was terminated at an approximate depth of 422 feet below ground surface						
3530 — 430 3520 — 440 3510 — 450 3500 — 460 3490 — 470 3480 — 480										

DEPTH DRILLED:	422 ft	DEPTH TO WATER:	348.56' (T.O.C.)	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/16/04-6/18/04	DATE MEASURED:	6/23/04	FIGURE	2

LOG OF BORING NO. MW-3

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 49+99.86/ M+37.15

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3964.37'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
0 / 3960				SP: SAND, Fine to Coarse Grained, Multicolored, Poorly Sorted, with fine to medium gravels, subangular						
10 / 3950				SP: SAND, Fine to Medium Grained, Multicolored, Poorly Graded						
20 / 3940										
30 / 3930				SP: SAND, Fine to Medium Grained, Multicolored, Poorly Sorted, with fine gravel, subangular						
40 / 3920				SP: SAND, Fine to Medium Grained, Multicolored, Poorly Sorted, with fine gravel, subangular and calcareous nodules						
50 / 3910				SP: SAND, Fine to Medium Grained, Multicolored, Poorly Sorted, with fine and medium gravel, subangular and calcareous nodules						
60 / 3900				SP: SAND, Fine to Medium Grained, Brown to Multicolored, Poorly Sorted, with calcareous nodules						
70 / 3890				SP: SAND, Fine Grained (Calcareous) and Coarse Grained, Tan and Multicolored, Poorly Sorted						
				CL: CLAY, Sandy, Brown						
80				SP: SAND, Medium and Coarse Grained, Multicolored, Poorly Sorted, Angular with calcareous						

DEPTH DRILLED:	390 ft	**DEPTH TO WATER:**	362.66' (T.O.C.)	**PROJ. No.** ASF03-701-00
DATE DRILLED:	5/21/04-5/24/04	**DATE MEASURED:**	6/23/04	**FIGURE** 3

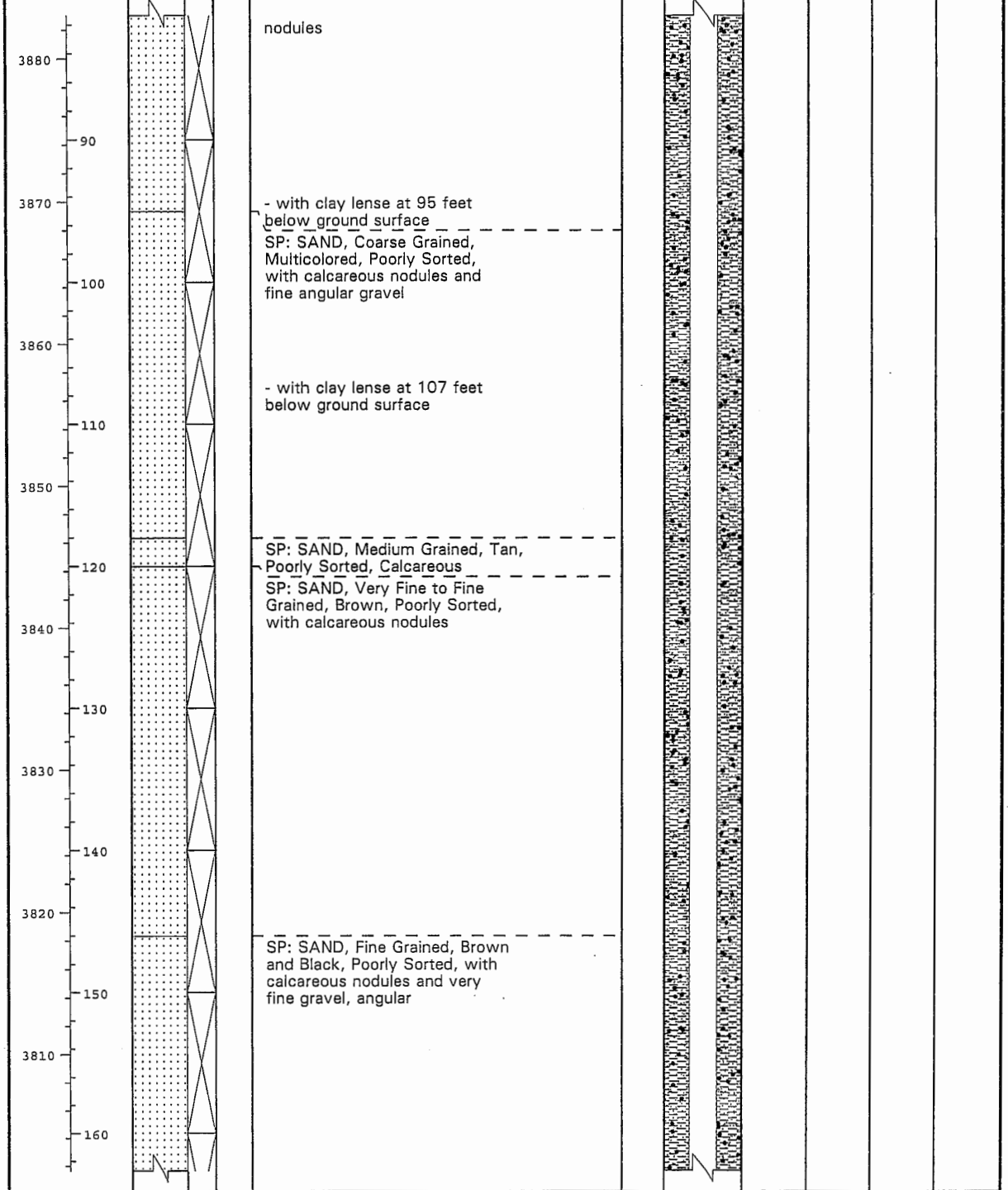
LOG OF BORING NO. MW-3

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 49+99.86' M+37.15'



DEPTH DRILLED:	390 ft	DEPTH TO WATER:	362.66' (T.O.C.)	PROJ. No. ASF03-701-00
DATE DRILLED:	5/21/04-5/24/04	DATE MEASURED:	6/23/04	FIGURE 3

LOG OF BORING NO. MW-3

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 49+99.86' M+37.15'

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3964.37'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3800				- with clay lenses at 165 feet						
170				CL: CLAY, Silty, Brown						
3790				SP: SAND, Fine Grained, Brown, Poorly Sorted						
180										
3780										
				CL: CLAY, Brown						
190				SP: SAND, Fine Grained, Brown, Black and Tan, Poorly Sorted, with calcareous material						
3770										
				CL: CLAY, Brown						
200										
3760				SP: SAND, Fine Grained, Brown, Poorly Sorted						
210										
3750										
220										
3740										
230										
3730										
240										

DEPTH DRILLED: 390 ft | DEPTH TO WATER: 362.66' (T.O.C.) | PROJ. No. ASF03-701-00

DATE DRILLED: 5/21/04-5/24/04 | DATE MEASURED: 6/23/04 | FIGURE 3

LOG OF BORING NO. MW-3

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 49+99.86' M+37.15'

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3964.37'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3720				SP: SAND, Coarse Grained, Tan, Brown, Black and Gray, Poorly Sorted, with calcareous nodules						
250										
3710										
260				SP: SAND, Fine Grained, Brown, Poorly Sorted, with calcareous material						
3700										
270				SP: SAND, Fine to Medium Grained, Brown, Tan, Red and Black, Poorly Sorted, with calcareous nodules (hard)						
3690										
280										
3680				SP: SAND, Fine Grained, Brown, Poorly Sorted, with calcareous nodules						
290				SP: SAND, Medium to Coarse Grained, Poorly Sorted, with calcareous nodules (hard), with some chert-gravels, with intermittent fine grained sand						
3670										
300				SP: SAND, Fine to Medium Grained, Clayey, Multicolored, with calcareous materials, brown						
3660										
310				SP: SAND, Fine to Medium Grained, Multicolored, with clay layers						
3650										
320				SP: SAND, Fine Grained, Tan and Black, Loose						
3640										

DEPTH DRILLED: 390 ft | **DEPTH TO WATER:** 362.66' (T.O.C.) | **PROJ. No.** ASF03-701-00

DATE DRILLED: 5/21/04-5/24/04 | **DATE MEASURED:** 6/23/04 | **FIGURE** 3

LOG OF BORING NO. MW-3

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 49+99.86' M+37.15

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3964.37'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
330 / 3630				SP: SAND, Medium Grained, Tan, Dense, with some calcareous material-with white, soft, mudstone						
				MUDSTONE, Tan, Dense, Angular						
340 / 3620				SP: SAND, Very Fine to Fine Grained, with clay						
350 / 3610										
360 / 3600				- clay increasing at 360 to 370 feet - (saturated interval) from 363 feet						
370 / 3590				CL: CLAY, Brown, Soft						
380 / 3580				CL: CLAY, Brown						
390 / 3570				Boring was terminated at an approximate depth of 390 feet below ground surface						
400 / 3560										

DEPTH DRILLED:	390 ft	DEPTH TO WATER:	362.66' (T.O.C.)	PROJ. No.	ASF03-701-00
DATE DRILLED:	5/21/04-5/24/04	DATE MEASURED:	6/23/04	FIGURE	3

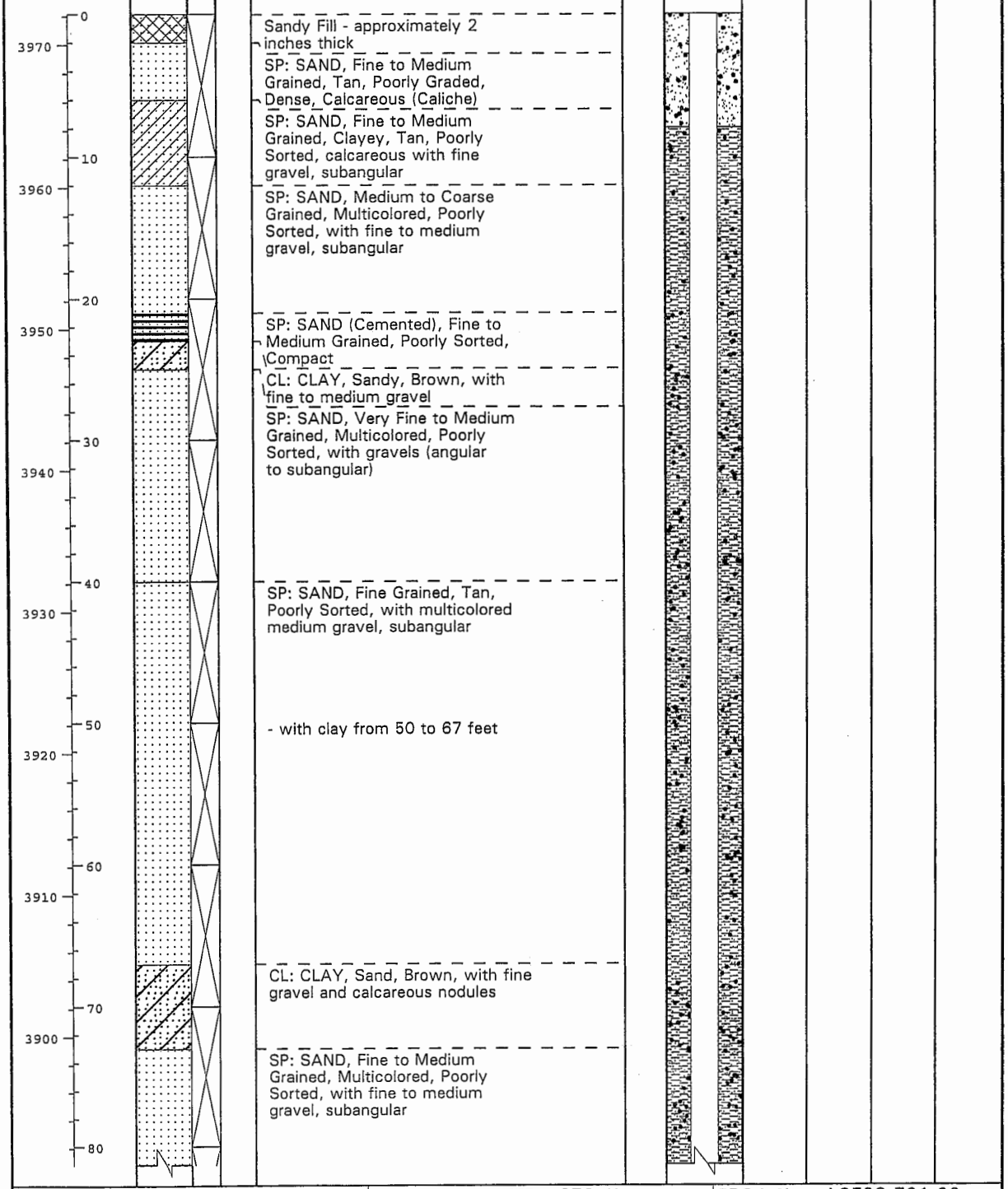
LOG OF BORING NO. MW-4

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 40+98.33, 2+00.49



DEPTH DRILLED: 400 ft	DEPTH TO WATER: 378.4'	PROJ. No. ASF03-701-00
DATE DRILLED: 5/4/04-5/6/04	DATE MEASURED: 5/17/04	FIGURE 4

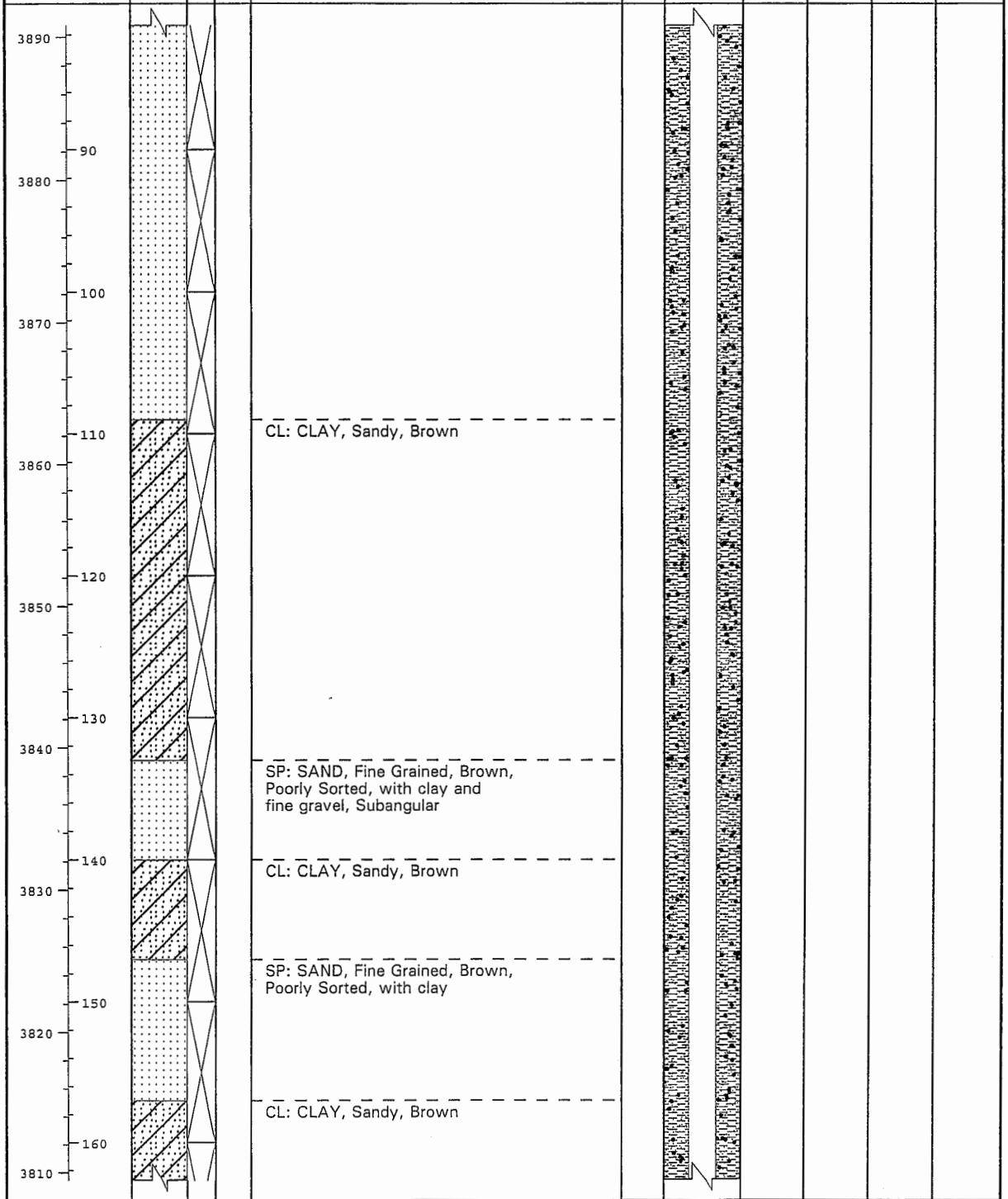
LOG OF BORING NO. MW-4

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 40+98.33, 2+00.49



DEPTH DRILLED: 400 ft	DEPTH TO WATER: 378.4'	PROJ. No. ASF03-701-00
DATE DRILLED: 5/4/04-5/6/04	DATE MEASURED: 5/17/04	FIGURE 4

LOG OF BORING NO. MW-4

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 40+98.33, 2+00.49

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3972.16'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
170 / 3800				SP: SAND, Fine Grained, Brown, Poorly Sorted						
180 / 3790										
190 / 3780										
200 / 3770				SP: SAND, Fine Grained, Brown, Poorly Sorted (cemented) (calcareous)						
210 / 3760				SP: SAND, Fine Grained, Brown, Poorly Sorted (calcareous) (cemented)						
				SP: SAND, Fine Grained, Brown, Poorly Sorted with silt						
220 / 3750										
230 / 3740										
240 / 3730										

DEPTH DRILLED:	400 ft	**DEPTH TO WATER:** 378.4'	**PROJ. No.** ASF03-701-00
DATE DRILLED:	5/4/04-5/6/04	**DATE MEASURED:** 5/17/04	**FIGURE** 4

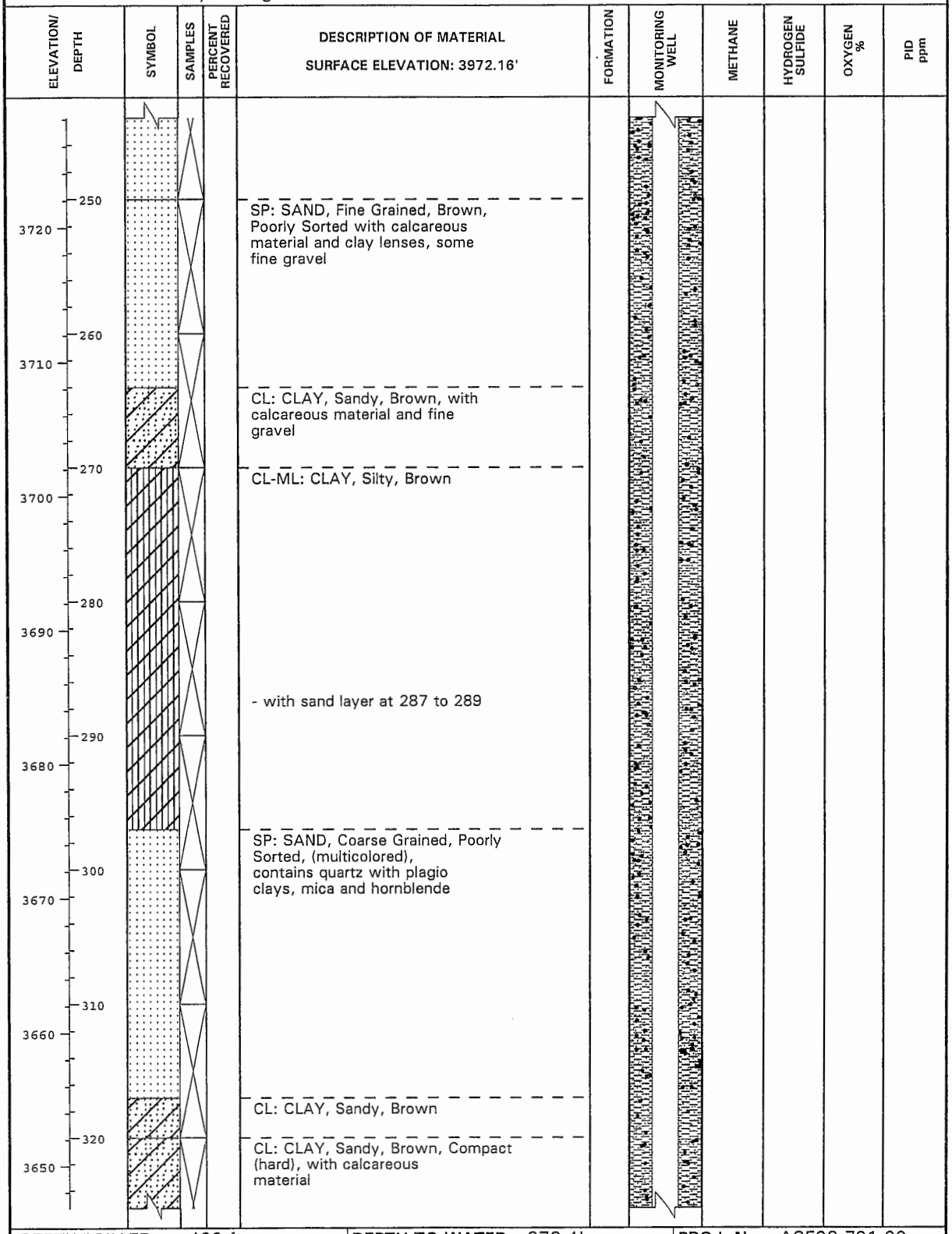
LOG OF BORING NO. MW-4

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 40+98.33, Z+00.49



DEPTH DRILLED: 400 ft	DEPTH TO WATER: 378.4'	PROJ. No. ASF03-701-00
DATE DRILLED: 5/4/04-5/6/04	DATE MEASURED: 5/17/04	FIGURE 4

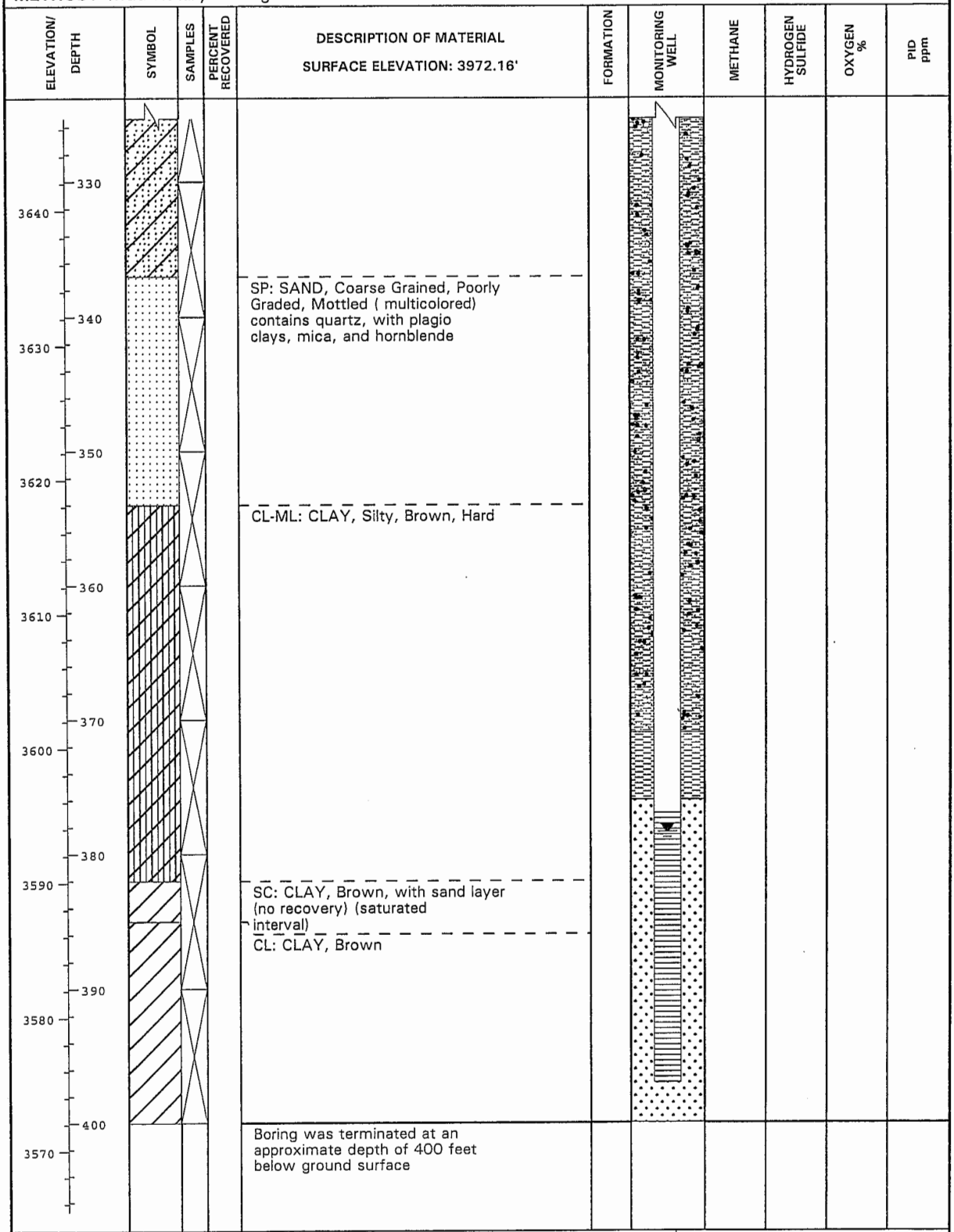
LOG OF BORING NO. MW-4

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 40+98.33, 2+00.49



DEPTH DRILLED: 400 ft	**DEPTH TO WATER:** 378.4'	**PROJ. No.** ASF03-701-00
DATE DRILLED: 5/4/04-5/6/04	**DATE MEASURED:** 5/17/04	**FIGURE** 4

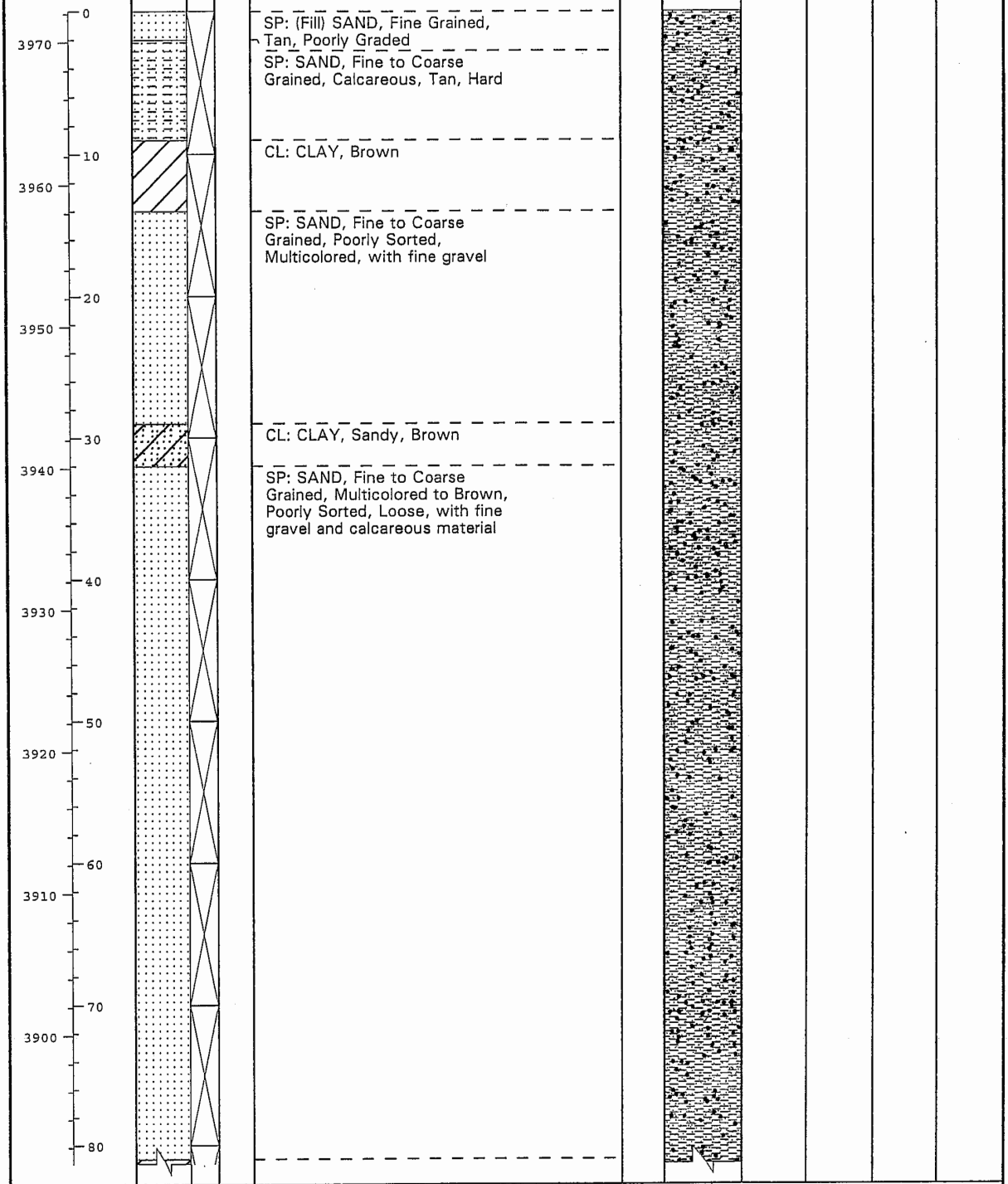
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, 2+00



DEPTH DRILLED:	556 ft	**DEPTH TO WATER:** Dry	**PROJ. No.** ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	**DATE MEASURED:** N/A	**FIGURE** 5

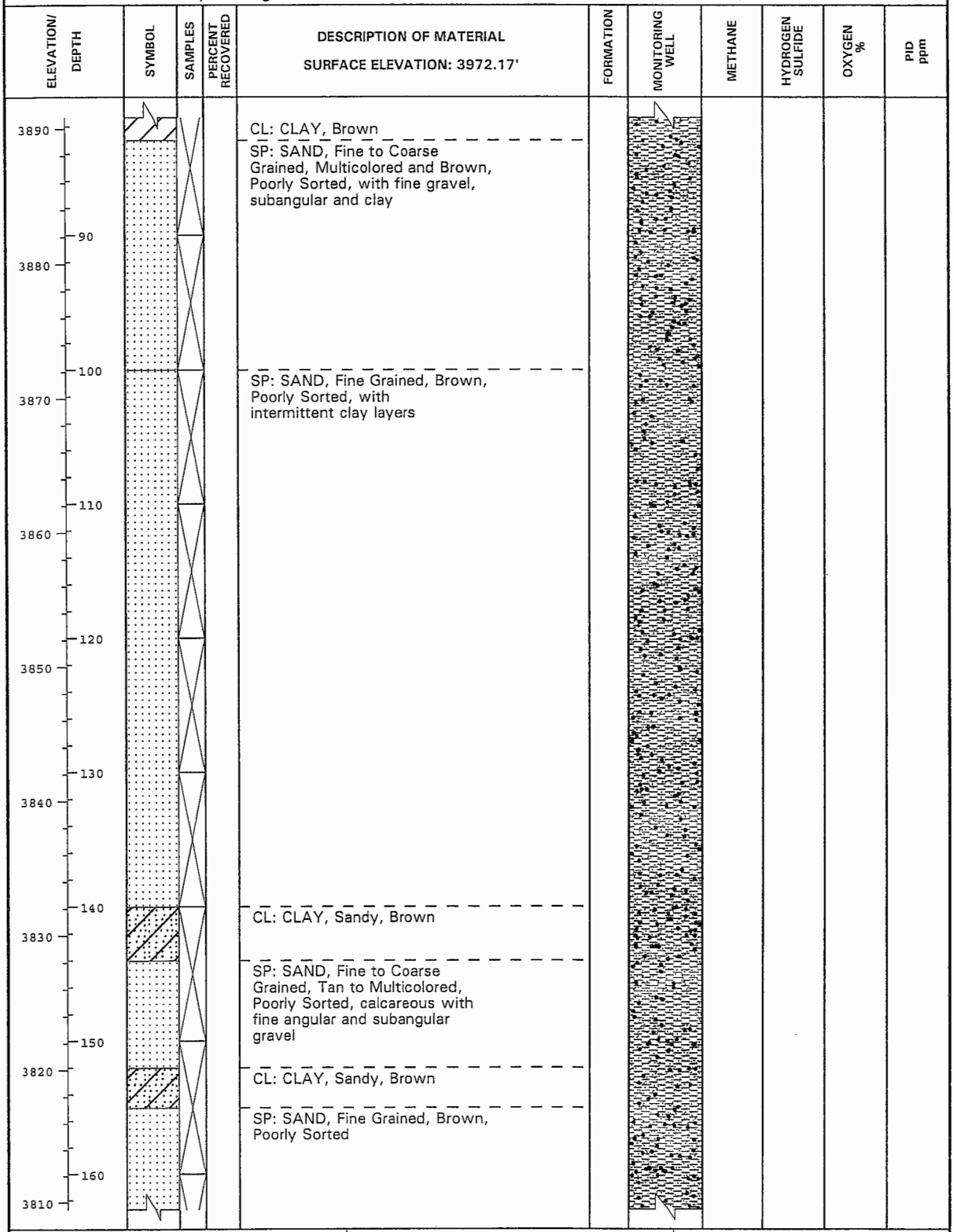
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, Z+00



DEPTH DRILLED:	556 ft	**DEPTH TO WATER:**	Dry	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	**DATE MEASURED:**	N/A	**FIGURE**	5

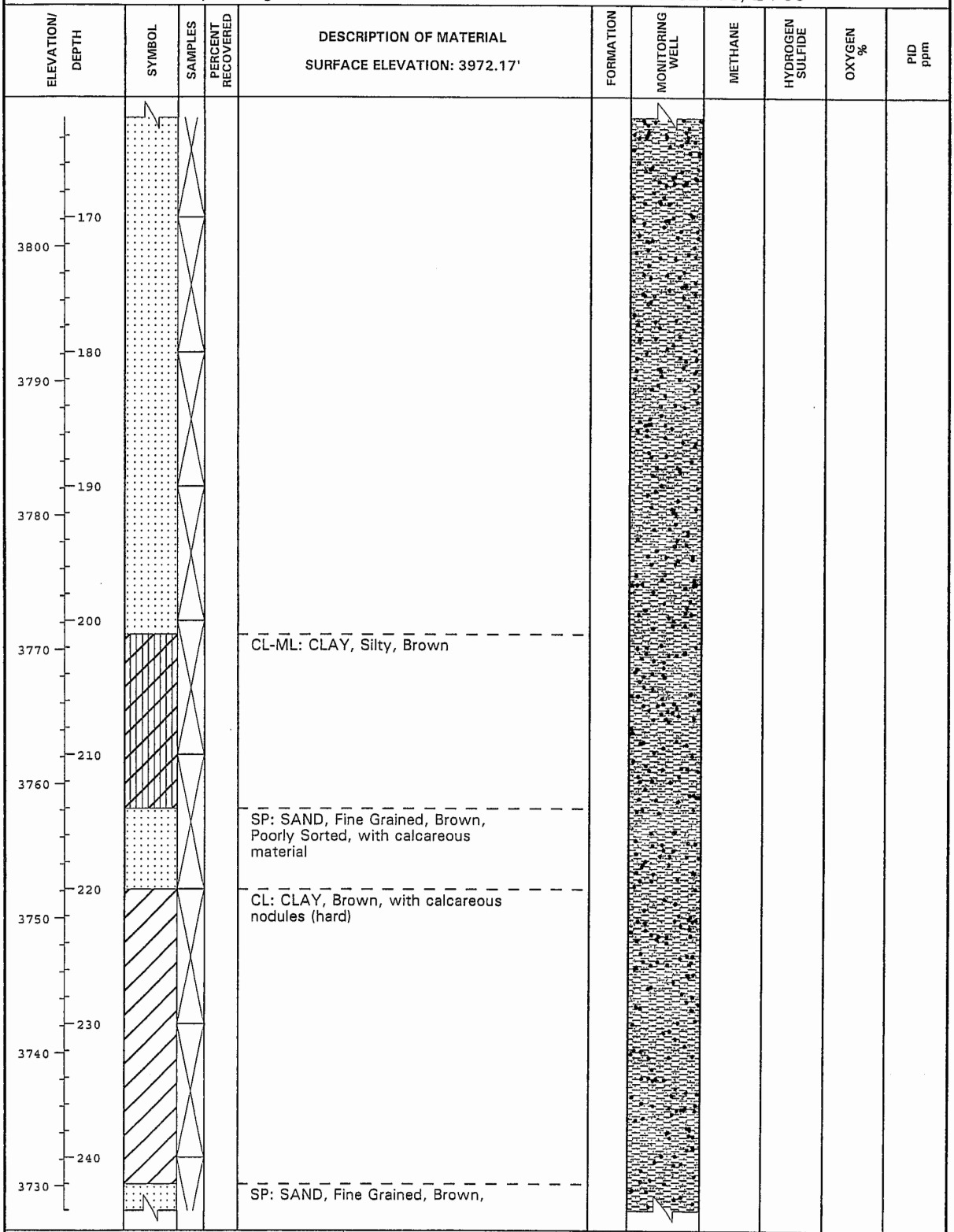
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, 2+00



DEPTH DRILLED:	556 ft	DEPTH TO WATER: Dry	PROJ. No. ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	DATE MEASURED: N/A	FIGURE 5

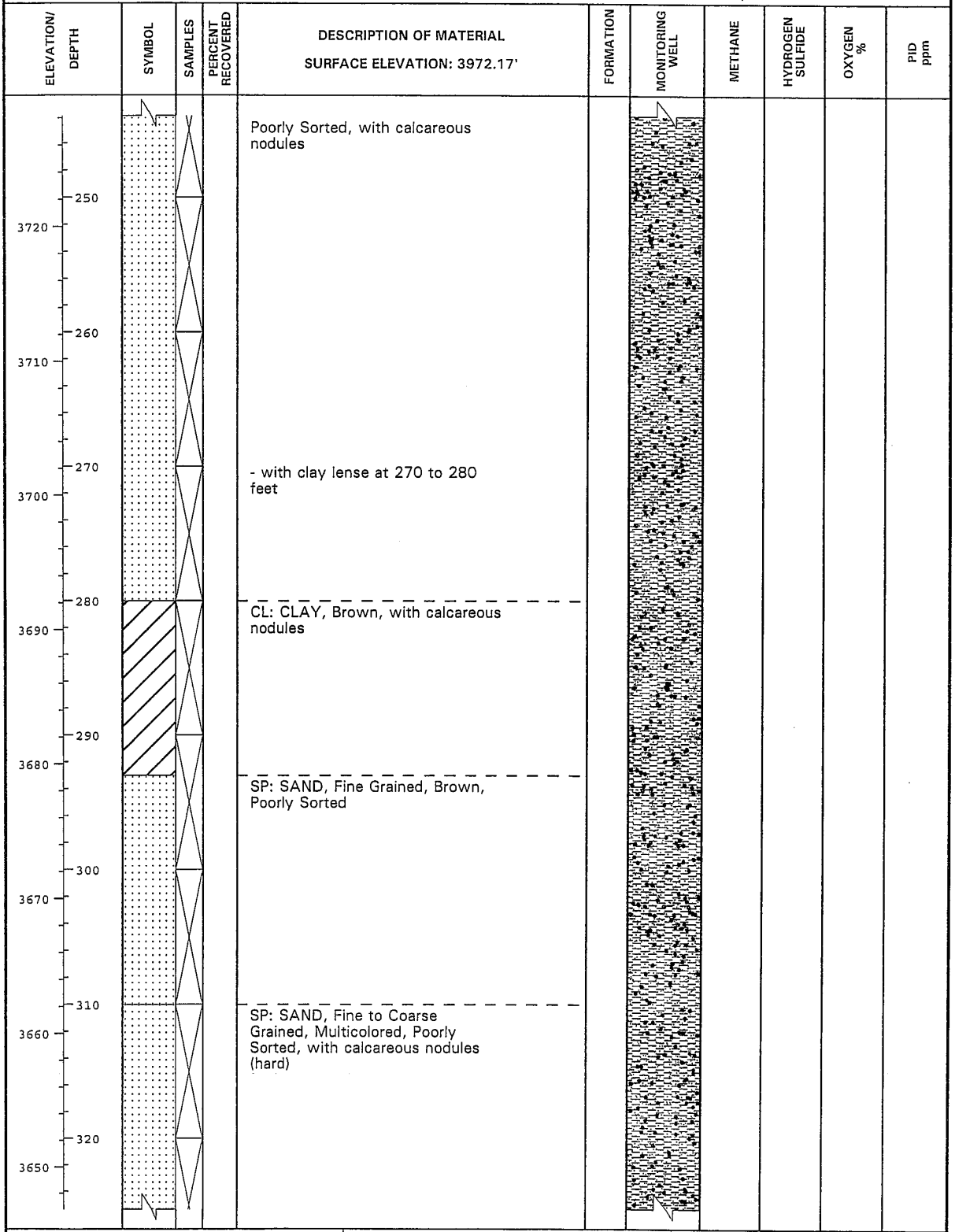
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, Z+00



DEPTH DRILLED:	556 ft	DEPTH TO WATER: Dry	PROJ. No. ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	DATE MEASURED: N/A	FIGURE 5

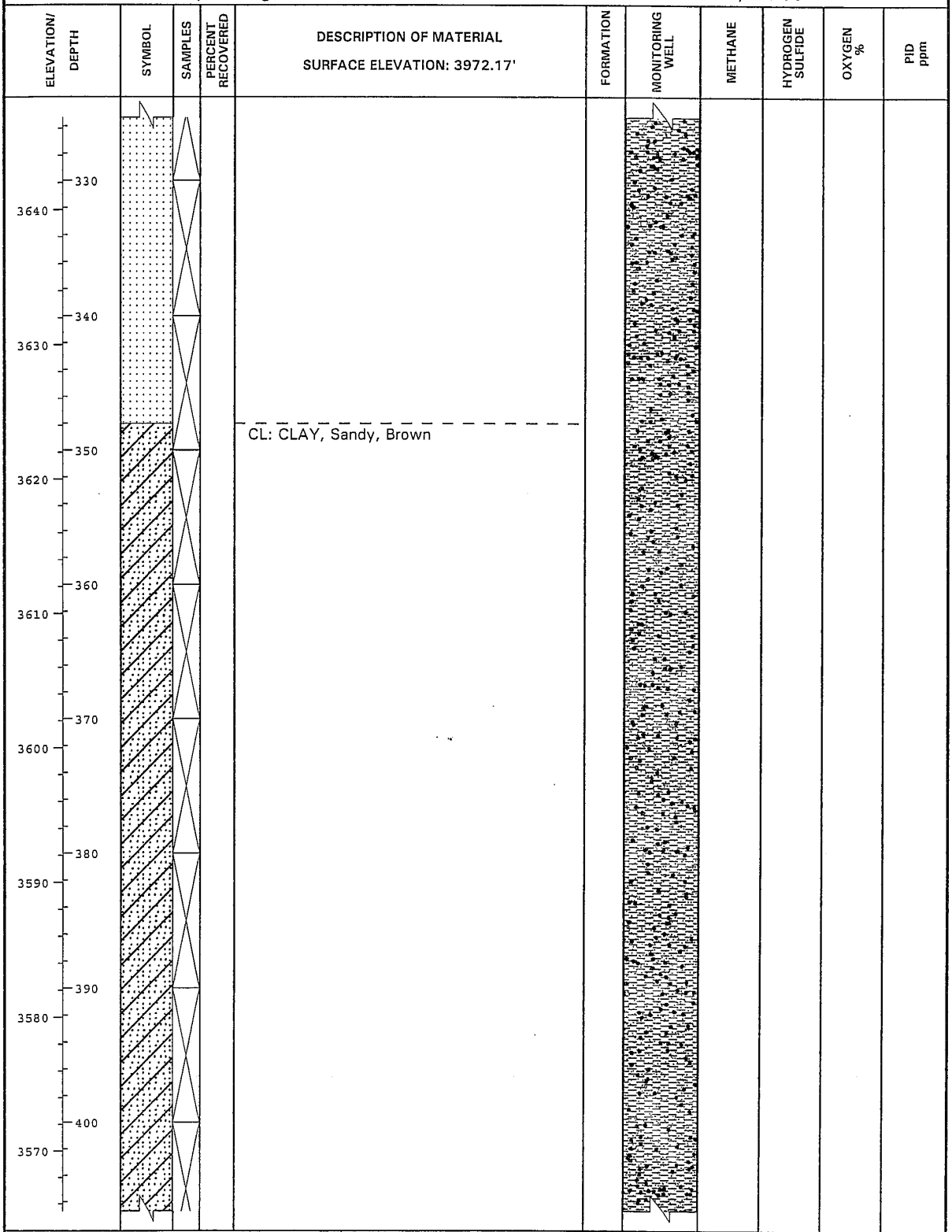
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, Z+00



DEPTH DRILLED:	556 ft	DEPTH TO WATER:	Dry	PROJ. No.	ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	DATE MEASURED:	N/A	FIGURE	5

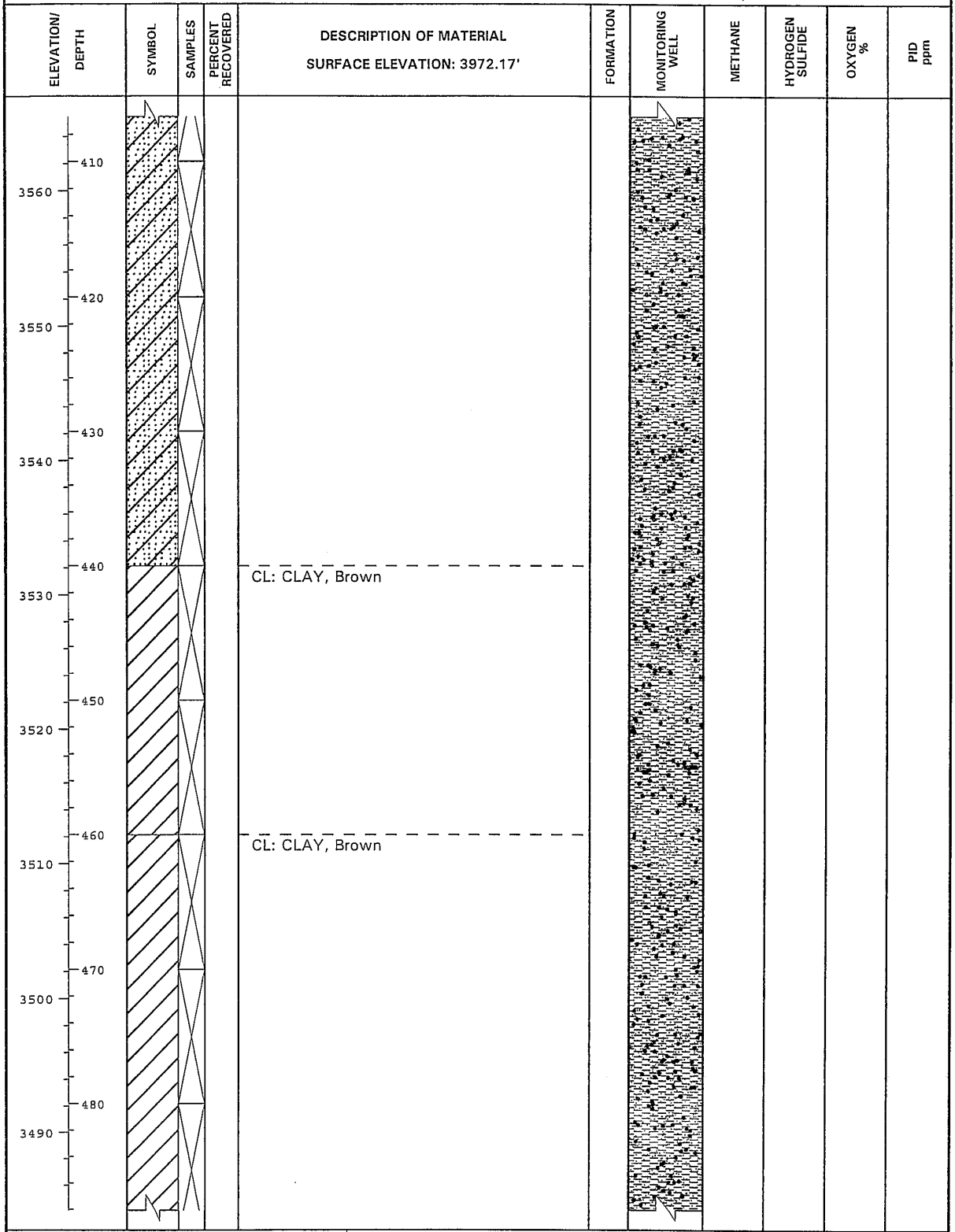
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, Z+00



DEPTH DRILLED:	556 ft	DEPTH TO WATER:	Dry	PROJ. No.	ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	DATE MEASURED:	N/A	FIGURE	5

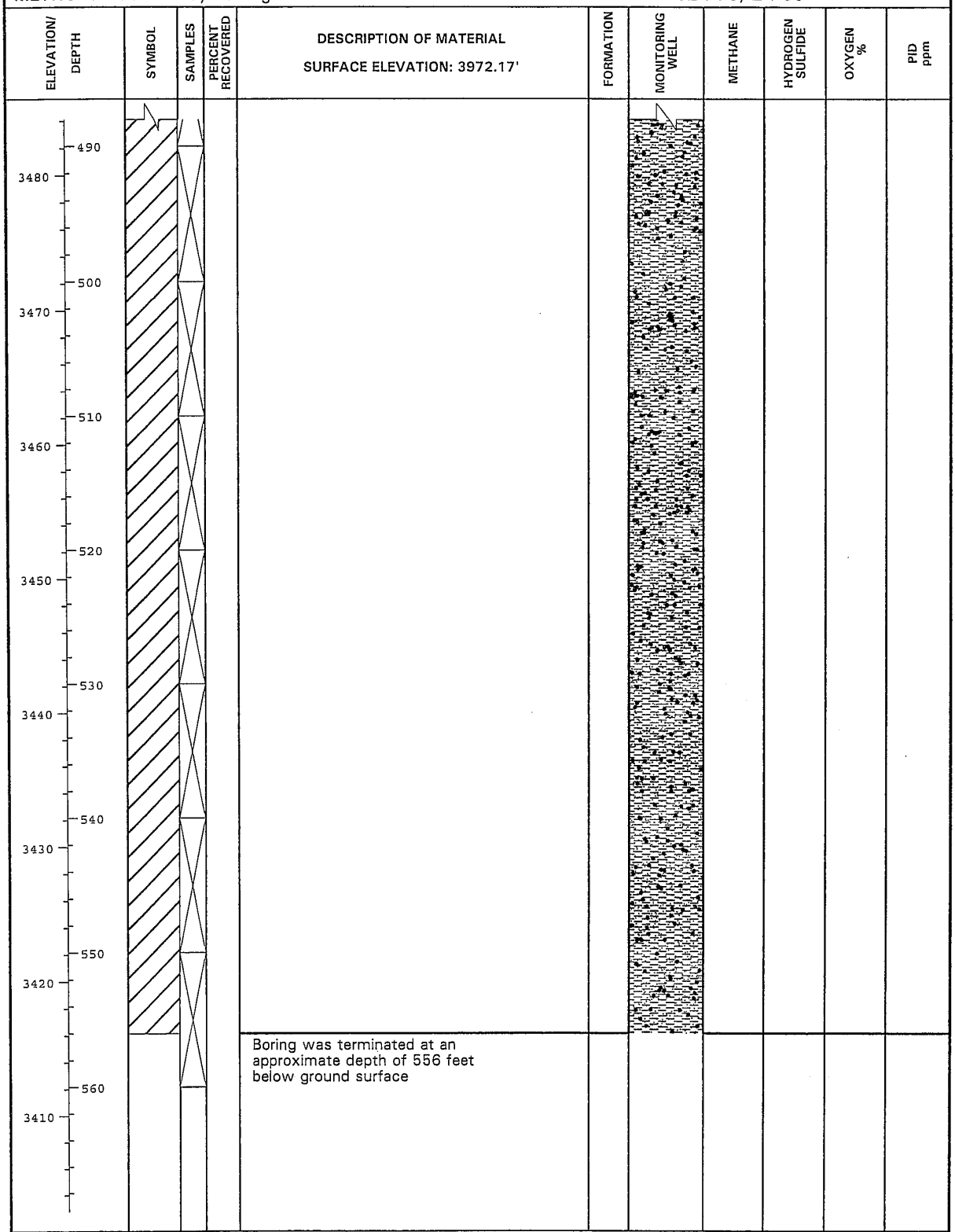
LOG OF BORING NO. MW-5

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 32+75, Z+00



DEPTH DRILLED:	556 ft	DEPTH TO WATER:	Dry	PROJ. No.	ASF03-701-00
DATE DRILLED:	5/12/04-5/18/04	DATE MEASURED:	N/A	FIGURE	5

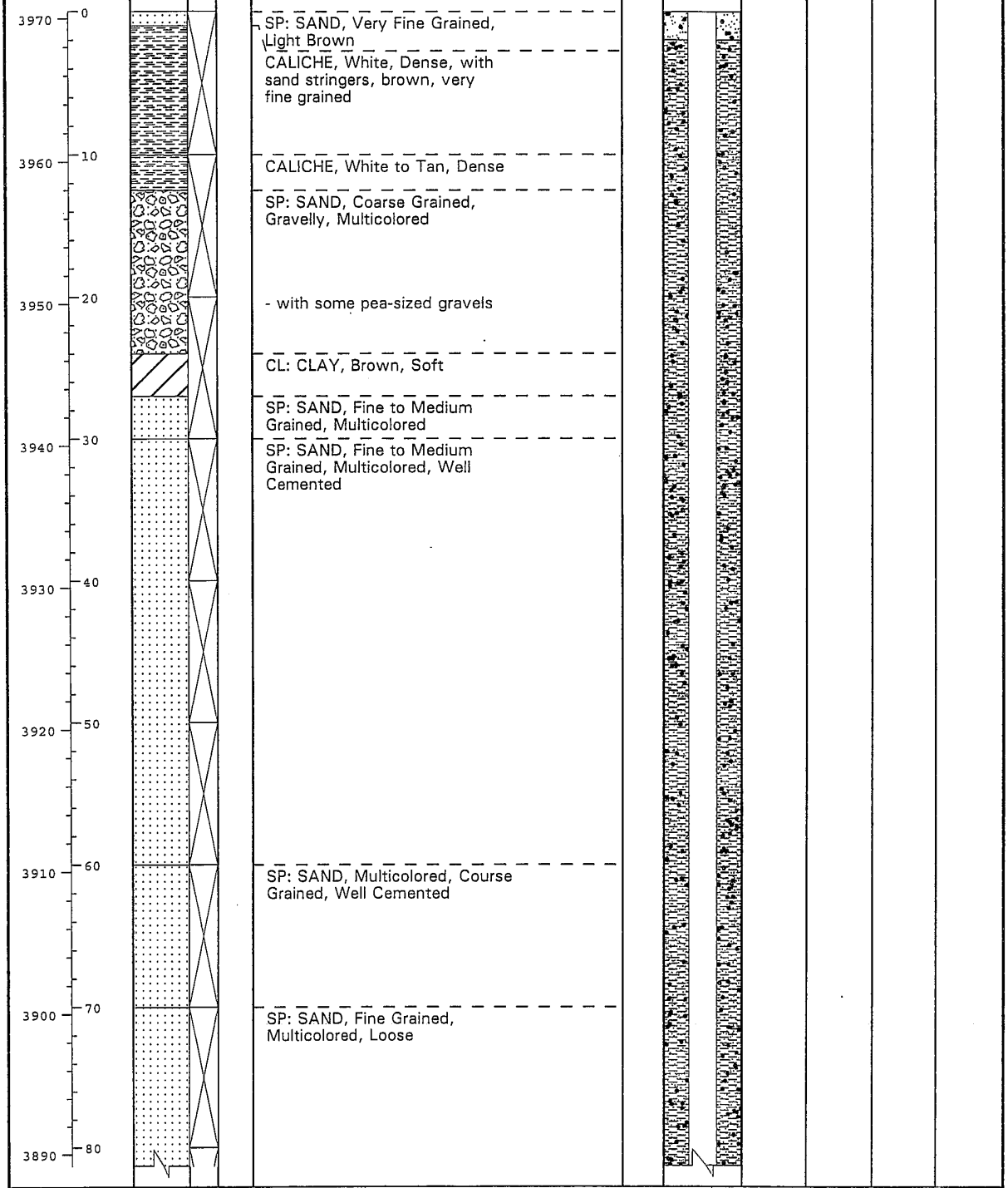
LOG OF BORING NO. MW-5A

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 31+54.82, Z+19.46



DEPTH DRILLED:	556 ft	**DEPTH TO WATER:**	373.48' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/09/04-6/10/04	**DATE MEASURED:**	6/23/04	**FIGURE**	6

LOG OF BORING NO. MW-5A

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 31+54.82, 2+19.46

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3970.50'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3880 — 90				CL: CLAY, Brown, Soft, with sand stringers						
3870 — 100				SP: SAND, Fine Grained, Multicolored, with clay - redish-brown, hard						
3860 — 110				CL: CLAY, Reddish-brown, with sand stringers SAND, Very Fine Grained, Multicolored						
3850 — 120				CL: CLAY, Brown, Stiff, with very fine sands						
3840 — 130				SP: SAND, Very Fine Grained, Multicolored, with some igneous source, loose						
3830 — 140				SP: SAND, Fine Grained, Multicolored, Subrounded						
3820 — 150				SP: SAND, Fine Grained, Multicolored, with some igneous source, well cemented, with some clay - brown, soft						
3810 — 160										

DEPTH DRILLED: 556 ft

DATE DRILLED: 6/09/04-6/10/04

DEPTH TO WATER: 373.48' (T.O.C.)

DATE MEASURED: 6/23/04

PROJ. No. ASF03-701-00

FIGURE 6

LOG OF BORING NO. MW-5A

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 31+54.82, Z+19.46

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3970.50'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3800 – 170				CL: CLAY, Brown to Reddish-brown - soft with some very fine grained sand						
3790 – 180				CL: CLAY, Brown, Soft with some very fine to fine grained sand						
3780 – 190				SP: SAND, Fine to Medium Grained, Multicolored, wel cemented						
3770 – 200				CL: CLAY, Light Brown to Brown, Soft						
3760 – 210				CL: CLAY, Reddish-brown, Soft to Hard, with fine grained sand						
3750 – 220				SP: SAND, Fine Grianed, Multicolored, Well Cemented with some clay						
3740 – 230										
				CL: CLAY, Light Brown, Soft						
3730 – 240				CL: CLAY, Light Brown to Reddish-brown, Soft with sand - very fine grained						

DEPTH DRILLED: 556 ft | DEPTH TO WATER: 373.48' (T.O.C.) | PROJ. No. ASF03-701-00

DATE DRILLED: 6/09/04-6/10/04 | DATE MEASURED: 6/23/04 | FIGURE 6

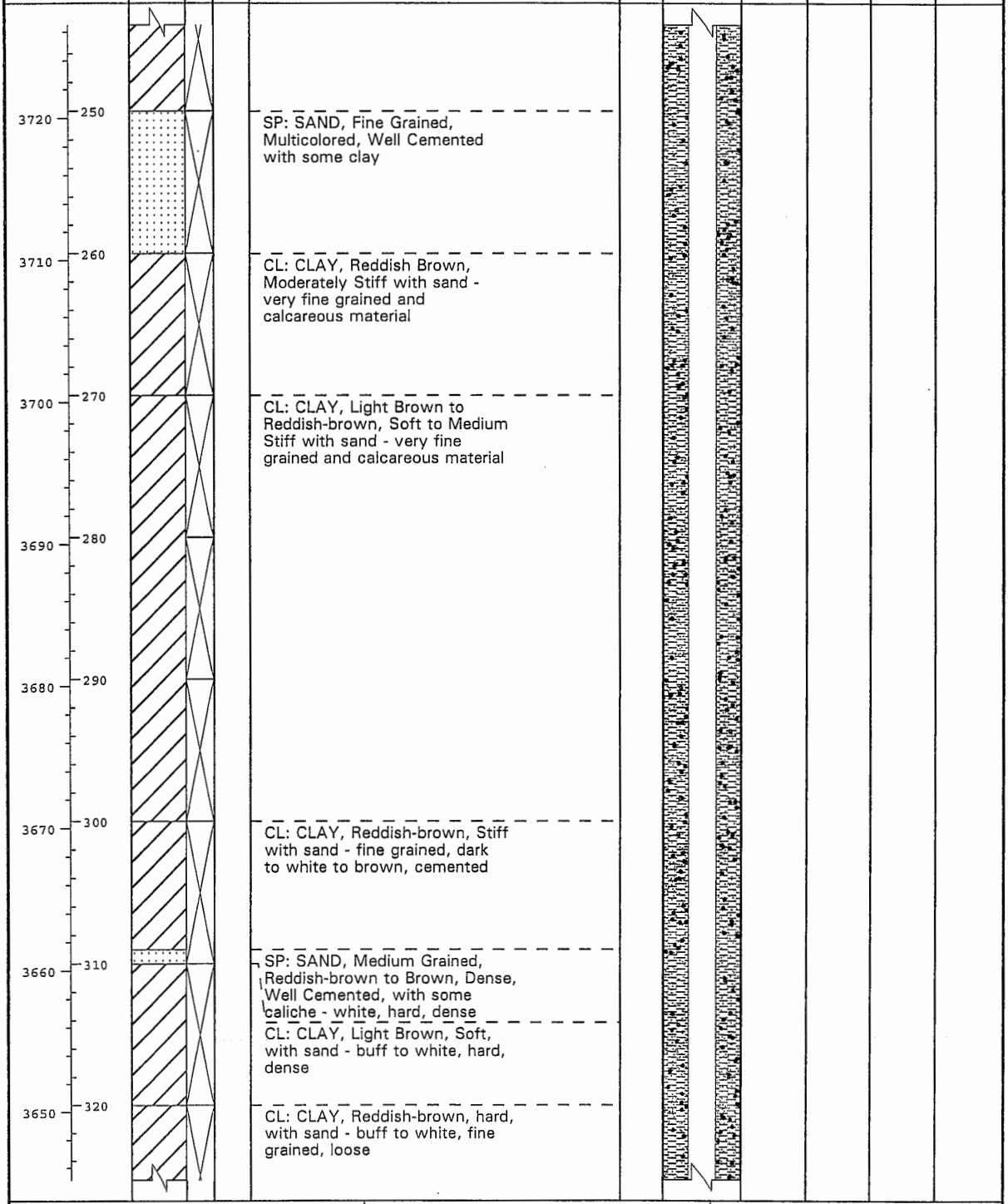
LOG OF BORING NO. MW-5A

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 31+54.82, 2+19.46



DEPTH DRILLED:	556 ft	DEPTH TO WATER:	373.48' (T.O.C.)	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/09/04-6/10/04	DATE MEASURED:	6/23/04	FIGURE	6

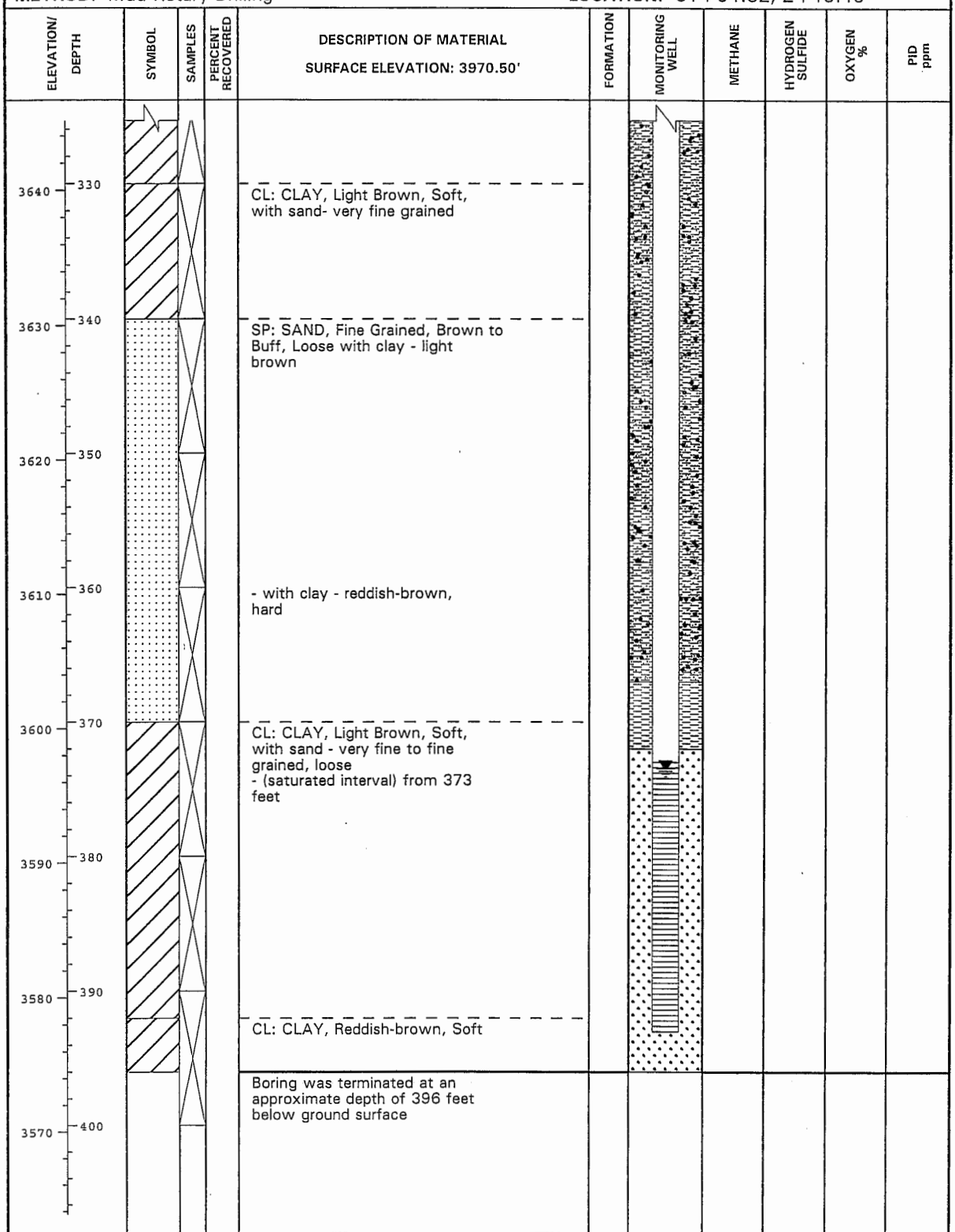
LOG OF BORING NO. MW-5A

Clint Landfill - MSW-2284

Raba-Kistner
Consultants, Inc.

DRILLING METHOD: Mud Rotary Drilling

LOCATION: 31+54.82, Z+19.46



DEPTH DRILLED:	556 ft	**DEPTH TO WATER:**	373.48' (T.O.C.)	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/09/04-6/10/04	**DATE MEASURED:**	6/23/04	**FIGURE**	6

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Sand
	Calcareous Sand
	Clay
	Clay with Sand
	Silty Clay
	Caliche
	Gravelly Sand
Misc. Symbols	
	Boring continues
	Water table at boring completion
Soil Samplers	
	Sample Interval
Monitor Well Details	
	cement/bentonite grout
	concrete seal
	bentonite grout with pipe
	hydrated bentonite pellets with pipe
	silica sand, blank PVC

Symbol	Description
	slotted pipe w/ sand
	silica sand, no pipe (end plug)

Figure: 7

KEY TO SYMBOLS

Notes:

DEFINITION OF DESCRIPTIVE TERMS

DENSITY OF GRANULAR SOILS		CONSISTENCY OF COHESIVE SOILS	
SPT N Value	Relative Density	SPT N Value	Consistency
< 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
11 - 30	Med. Dense	5 - 8	Medium Stiff
31 - 50	Dense	9 - 15	Stiff
50 - 80	Very Dense	16 - 50	Very Stiff
> 80	Hard	50 - 80	Hard
		> 80	Very Hard

DEGREE OF PLASTICITY

Non Plastic - Has no cohesion; will not roll into a thread.
Trace of Plasticity - Barely hold its shape when rolled into a thread.
Low Plasticity - Has sufficient cohesion to form a thread but will quickly rupture when deformed.
Med. Plasticity - Has considerable cohesion. Can be molded into a thread and will withstand considerable deformation without rupture.
High Plasticity - Can be kneaded like dough without trace of rupture.

MOISTURE DESCRIPTIONS

	Granular Soils	Cohesive Soils
Dry	No Apparent Moisture	No Apparent Moisture
Slightly Moist	< Than 3% by Weight	<Less Than Plastic Limit
Moist	3% to 9% by Weight	Approximatley Plastic Limit
Very Moist	>9% by Weight	> than PL but < than LL
Wet	Submerged or Saturated	Submerged or Saturated

ABBBREVATIONS

V. - Very Fl.- Fairly Sl. - Slightly Med. - Medium
Tr. - Trace < - Less than > - Greater Than PL - Plastic Limit
Mod. - Moderately

Figure: 7

LOG OF MONITOR WELL NO. MW-6

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 402 feet
Date Boring Started: 7/10/2009
Date Boring Completed: 7/13/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–5			SILTSTONE, light pink to tan Hard drilling at 2' bgs		Concrete from 0' to 2' bgs
5–10					
10–15			SAND, light to medium gray, very fine to silty grained, sub–angular, poorly sorted, unconsolidated With some volcanic minerals (mafic, feldspars, arkosic) at 12' bgs Sand is quartz rich with potassium feldspar (arkosic) at 13' bgs Easier drilling at 14' bgs		
15–20					
20–25					
25–30			With some volcanic rock fragments, quartz, some mafic minerals, feldspar fragments, somewhat arkosic at 22' bgs		
30–35			SAND, gray, very fine to fine grained, sub–rounded, moderately sorted With volcanic rock fragments, mafic minerals, sand predominately composed of quartz and potassium feldspar at 32' bgs Unconsolidated at 35' bgs		
35–40					
40–45			SAND, gray–brown, silty to fine grained, sub–rounded, sub–angular, poorly sorted Quartz sand with ferrous mafic fragments at 42' bgs Unconsolidated at 44' bgs		
45–50					
50–55			GRAVEL, light brown, 3/8" to 1/2" gravel, mixed layers in sand		Bentonite grout from 2' to 340' bgs
55–60			SAND with gravel, medium brown, silty to 3/8"–3/4" gravel, sub–angular, sub–rounded, very poorly sorted, unconsolidated		
60–65			SAND, brown, silty to fine grained, sub–angular to sub–rounded, moderately sorted, quartz sand, unconsolidated		
65–70					
70–75			SAND, brown, silty to fine grained, sub–angular to sub–rounded, moderately sorted, quartz sand Unconsolidated with interbedded 3/8" to 3/4" gravel at 72' bgs		
75–80					
80–85			SAND, light brown, very fine to fine grained, sub–rounded, moderately sorted, quartz sand Some interbedded gravel at 83' bgs		
85–90					
90–95			SAND, brown, fine to medium grained, sub–rounded, moderately sorted Unconsolidated at 92' bgs		
95–100					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/14/09	371.38
7/15/09	378.11
7/16/09	372.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CARELGDT 8/7/09

LOG OF MONITOR WELL NO. MW-6
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-6

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 402 feet
Date Boring Started: 7/10/2009
Date Boring Completed: 7/13/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			SAND, gray-brown, very fine to fine grained, sub-rounded, moderately sorted		
110			CLAY, red-brown Hard drilling at 106' bgs		
115			SAND, light brown, silty to fine grained, sub-rounded, moderately well sorted, unconsolidated		
120			6" wet sand zone from 199.6" to 200" bgs Slightly moist at 122' bgs		
125					
130			SAND, light gray, silty to very fine grained, sub-rounded, well-sorted, unconsolidated		
135					
140			SAND, gray-brown, very fine to fine grained, sub-angular to sub-rounded, moderately sorted Unconsolidated at 142' bgs		
145					
150			Quartz sand with some volcanic fragments, mafics, and iron stained sand grains at 152' bgs		Bentonite grout
155					
160			GRAVEL with sand, brown, 1/4" to 3/4" gravel, sub-angular, poorly sorted		
165					
170			CLAY, red-brown, sandy in part, plastic clay with laminations		
175			SAND, red-gray to brown, very fine to fine grained, sub-rounded, moderately sorted, unconsolidated Quartz sand at 174' bgs		
180			CLAY, red-brown, plastic and laminated, sandy		
185			Sandy CLAY, red-brown Hard drilling at 186' bgs		
190					
195					
200			SAND, red-brown, very fine to fine grained, sub-rounded, moderately sorted, mixed layer of clays, unconsolidated Acid reactive/effervescence, calcareous at 201' bgs		

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/14/09	371.38
7/15/09	378.11
7/16/09	372.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-6
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-6

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 402 feet
Date Boring Started: 7/10/2009
Date Boring Completed: 7/13/2009

Depth, feet	Material Description	Monitor Well Construction Details	Monitor Well Description
205	Quartz with sodium feldspars, plagioclase, arkosic at 203' bgs		
210	SILT, tan, silt, sub- to well rounded, well sorted, partially unconsolidated		
215	SAND, brown to light brown, very fine to fine grained, sub-rounded, moderately well sorted, unconsolidated		
220			
225	Unconsolidated, quartz rich potassium feldspar (arkosic) at 224' bgs Slightly moist at 225' bgs		
230			
235	Slightly moist to moist at 237' bgs		
240			
245	Interbedded with red-brown clay and gray-brown 1/4" or less gravel at 246' bgs		
250	SAND, brown, very fine to fine grained, sub-rounded, poorly sorted Partially silicified and lithic (hard) at 252' bgs		Bentonite grout
255	GRAVEL, dark red-brown, sub-angular to sub-rounded Silt stone gravel at 254' bgs		
260	Composed of limestone gravel, mixed with light red-brown sand, fine to medium grained, sub-angular to sub-rounded at 258' bgs		
265	GRAVEL, light gray-brown, sub-angular, poorly sorted		
270	Silty CLAY, slightly moist		
275	SAND, light gray-brown, silty to very fine grained, sub-rounded, moderately well sorted With some red-brown clay and nodules at 267' bgs Slightly moist at 268' bgs Hard drilling at 269' bgs		
280			
285	SAND, brown, very fine to fine grained, sub-rounded, moderately well sorted, some mafic and some iron staining of quartz grains Slightly moist to moist at 278' bgs		
290			
295	SILT, light brown to tan, silt size grains, well rounded, well sorted Hard drilling at 283' bgs		
300	CLAY, red-brown, 1-2 feet thick		
305	Silty SAND, brown, silty to very fine grained,		

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/14/09	371.38
7/15/09	378.11
7/16/09	372.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-6
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-6

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 402 feet
Date Boring Started: 7/10/2009
Date Boring Completed: 7/13/2009

Depth, feet	Material Description	Monitor Well Construction Details	Monitor Well Description
310	sub-rounded, well sorted With clay particles and some red-brown clay nodules at 301' bgs		
315	SILT, light gray, silt size grains, well rounded, moderately well sorted		
320	Silty SAND, brown, silty to very fine grained, sub-rounded, moderately well sorted,		
325	SAND, gray brown to brown, very fine to fine grained, sub-rounded, moderately well sorted With some mixed layers of red-brown clay lenses at 325' bgs		Bentonite grout from 2' to 341' bgs
330	Silty SAND, light gray, silt sized grains, rounded, moderately well sorted		
335			
340	SAND, light brown, very fine to fine grained, sub-rounded, moderately well sorted Interbedded with red-brown clay lenses at 343' bgs		
345			Bentonite seal from 340' to 376' bgs
350	SAND, light brown, very fine to fine grained, sub-rounded, moderately sorted Interbedded with red-brown clay lenses at 353' bgs		
355			
360			
365			
370	CLAY, red-brown, somewhat plastic		
375	Silty SAND, red-brown, silty to very fine grained, sub-rounded, moderately sorted Moist to slightly wet at 378' bgs		
380	CLAY, red-brown, plastic clay Injected water into hole while drilling at 385' bgs		
385			
390			Silica sand from 376' to 402' bgs Slotted screen from 379' to 399' bgs
395			
400			
405			

STATE OF TEXAS
MICHAEL J. HULL
GEOLOGY
4152
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PROFESSIONAL GEOSCIENTIST

10/28/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/14/09	371.38
7/15/09	378.11
7/16/09	372.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CARELGDT 8/7/09

LOG OF MONITOR WELL NO. MW-6
PAGE 4 of 4

LOG OF MONITOR WELL NO. MW-7

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 401 feet
Date Boring Started: 7/8/2009
Date Boring Completed: 7/9/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–5			Unconsolidated SAND, light brown, silty to very fine grained, sub–rounded, moderately well sorted		Concrete from 0' to 2' bgs
5–20			SAND and gravel, light gray–brown, very fine grained to 3/8"–1/2" gravel, sub–rounded to sub–angular, poorly sorted, unconsolidated		
20–30			SAND, light gray, very fine to medium grained, sub–rounded, moderately to poorly sorted, unconsolidated		
30–50			SAND, light gray and tan to light gray, very fine to fine grained, sub–rounded, moderately sorted, unconsolidated		Bentonite grout from 2' to 341' bgs
50–70			SAND, light brown, very fine to fine grained, sub–rounded, moderately well sorted, unconsolidated		
70–80			SAND, light gray–brown, very fine to fine grained, sub–rounded, moderately sorted, unconsolidated Volcanic material at 73' bgs		
80–90			SAND, tan, very fine to fine grained, sub–rounded, moderately sorted, with caliche nodules Volcanic material and mafic minerals at 83' bgs		
90–100			SAND, light gray–brown, very fine to fine grained, sub–rounded, moderately sorted, with caliche nodules Volcanic material mixed at 93' bgs		

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/8/09	371.00
7/9/09	386.60
7/10/09	372.64

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-7
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-7

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 401 feet
Date Boring Started: 7/8/2009
Date Boring Completed: 7/9/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			SAND, light brown to brown, very fine to fine grained, sub-rounded to sub-angular, moderately sorted, unconsolidated		
110			GRAVEL, gray-brown, fine grained to 3/8"-1/2" gravel, poorly sorted		
115			CLAY, brown		
120			SAND, brown, silty to very fine grained, sub-rounded, moderately sorted, partially unconsolidated		
125					
130			SAND, tan to light brown, silty to very fine grained, sub-rounded, moderately sorted, unconsolidated Slightly moist at 133' bgs		
135					
140					
145					
150					Bentonite grout
155			SAND, red-brown, very fine to medium grained, sub-rounded, moderately sorted, unconsolidated		
160			SAND, light red-brown, silt, rounded, well sorted, unconsolidated		
165					
170			SAND, tan to red-brown/light red-brown, fine-grained, sub-rounded, moderately to moderately well sorted, Unconsolidated at 172' bgs		
175					
180			With some gravel at 182' bgs Mixed volcanic minerals at 183' bgs		
185					
190					
195			GRAVEL, gray, sub-angular, poorly sorted		
200			Clay, red-brown		

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/8/09	371.00
7/9/09	386.60
7/10/09	372.64

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

LOG OF MONITOR WELL NO. MW-7
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▽ Water level after drilling.

LOG OF MONITOR WELL NO. MW-7

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 401 feet
Date Boring Started: 7/8/2009
Date Boring Completed: 7/9/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
205			Silty SAND, light gray, silty to very fine grained, sub-rounded to rounded, moderately well sorted, unconsolidated		
210			SAND, red-brown, fine grained, sub-rounded, moderately sorted, unconsolidated		
215					
220					
225			Slightly moist at 224' bgs		
230			SAND, light gray to light gray-brown, very fine to fine grained, sub-rounded, moderately sorted, unconsolidated		
235					
240					
245					
250			Silty CLAY and silt, red gray brown and red-brown, clays are dark red-brown		Bentonite grout
255					
260			SILT, red-brown and brown		
265					
270			SAND, light red-brown to light brown/tan, very fine to fine grained, sub-angular to sub-rounded, moderately sorted, unconsolidated Slightly moist at 276' bgs		
275					
280					
285					
290			SAND, fine to medium grained, sub-rounded, moderately well sorted, unconsolidated Slightly moist to moist at 294' bgs		
295					
300					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/8/09	371.00
7/9/09	386.60
7/10/09	372.64

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-7
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-7

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 401 feet
Date Boring Started: 7/8/2009
Date Boring Completed: 7/9/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
305			Dry sand at 304' bgs Silty SAND, light gray, silty to very fine grained, sub-rounded, moderately sorted		
310			SAND, light red-brown, fine to medium grained, sub-angular to sub-rounded, moderately sorted Slightly moist at 314' bgs		
315					
320			Silty SAND, brown, silty to very fine grained, sub-rounded, moderately sorted, unconsolidated		Bentonite grout from 2' to 341' bgs
325					
330			SAND, red-brown, very fine to fine grained, sub-rounded, moderately sorted, unconsolidated Slightly moist at 334' bgs		
335					
340					
345			CLAY, dark red-brown to red-brown		
350					
355					
360			SAND, brown/red-brown, very fine to fine grained, sub-rounded, moderately sorted Moist at 364' bgs		Bentonite seal from 341' to 374' bgs
365					
370			Appears wet at 371' bgs	▽▼	
375					
380			CLAY, dark red-brown		
385				▼	
390					Silica sand from 374' to 401' bgs Slotted screen from 377' to 397' bgs
395					
400					

STATE OF TEXAS
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10/28/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/8/09	371.00
7/9/09	386.60
7/10/09	372.64

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CARELGDT 8/7/09

LOG OF MONITOR WELL NO. MW-7
PAGE 4 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-8

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 400 feet
Date Boring Started: 6/30/2009
Date Boring Completed: 7/7/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–5			Silty SAND, buff, well rounded, moderately well sorted		Concrete from 0' to 2' bgs
5–10			SAND, gray-brown, very fine to silty grained, sub-rounded		
10–15					
15–20			Gravelly SAND, gray to red-brown, sub-angular, poorly sorted, contains some limestone fragments		
20–25			SAND, gray-brown, silty to very fine grained, sub-rounded, moderately well sorted		
25–30					
30–35			SAND, slightly red-brown, very fine to medium grained, sub-angular, moderately to poorly sorted		
35–40					
40–45			GRAVEL, gray-brown, sub-angular, poorly sorted, some limestone pebbles		
45–50			Gravelly SAND, gray-brown, fine grained to 3/4" gravel, sub-angular to angular, poorly sorted, unconsolidated		
50–55			GRAVEL, medium gray, limestone cobble gravel,		Bentonite grout from 2' to 342' bgs
55–60			Gravelly SAND, brown, fine grained gravel, sub-angular to angular, poorly sorted Limestone gravel at 58' bgs		
60–65			SAND, light tan to light gray with red-brown, very fine to medium grained, sub-rounded, moderately sorted, unconsolidated		
65–70					
70–75					
75–80			GRAVEL lense, limestone pebbles		
80–85			SAND, buff/tan, very fine grained, rounded, well sorted		
85–90					
90–95			SAND, gray-brown, very fine to fine grained, with pebble size gravel, sub-rounded, poorly sorted Gravel with gray limestone at 95' bgs		
95–100					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
6/30/09	368.00
7/2/09	399.50
7/6/09	370.95

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-8
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▽ Water level after drilling.

LOG OF MONITOR WELL NO. MW-8

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 400 feet
Date Boring Started: 6/30/2009
Date Boring Completed: 7/7/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			SAND, red-brown, very fine to medium grained, sub-angular, moderately sorted, unconsolidated		
110			CLAY, brown, slightly silty		
			SAND, light brown, very fine grained, sub-rounded, moderately to well sorted, unconsolidated		
115					
120			CLAY, red-brown to gray-green		
			SAND, light gray, fine grained, sub-rounded, well sorted		
125					
130			SAND, silty to very fine grained, rounded, well sorted, unconsolidated		
135					
140					
145			CLAY, red-brown		
150					Bentonite grout
155			SAND, light gray, very fine to fine grained, sub-rounded to well rounded, well sorted to moderately well sorted, unconsolidated		
160					
165			Multi-colored sand at 165' bgs		
170					
175			Trace of moisture at 174' bgs		
180			Gravel and SAND, gray, fine grained to 3/4" gravel, sub-angular, poorly sorted Some igneous rocks and limestone gravel at 180' bgs		
185			SAND, red-brown to light gray, very fine to fine grained, sub-rounded, well sorted, unconsolidated Unconsolidated with trace of moisture at 182' bgs Trace of gravel at 192' bgs		
190					
195					
200					

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CARELGDT 8/7/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations

Date	Depth
6/30/09	368.00
7/2/09	399.50
7/6/09	370.95

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-8

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 400 feet
Date Boring Started: 6/30/2009
Date Boring Completed: 7/7/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
205			CLAY, red-brown		
210			CLAY, red-brown, silty/sandy, clay to very fine grained, mixed layer of silty sands and clay		
215			SAND, light gray, very fine to fine grained, sub-rounded, moderately to moderately well sorted, unconsolidated Multi-colored in part, igneous rocks, some feldspar, mafic minerals, and quartz (arkosic) at 216' bgs		
250			CLAY, gray-brown Hard drilling at 253' bgs		Bentonite grout
255			SAND, light gray to light brown, very fine to fine grained, sub-rounded, moderately well sorted Multi-color minerals at 258' bgs		
260			Unconsolidated at 262' bgs		
270			Unconsolidated at 273' bgs		
280			CLAY, red-brown		
285			SAND, light gray to brown, very fine to fine grained, sub-rounded, moderately well sorted		
290			Unconsolidated at 292' bgs Slightly moist at 294' bgs		
300					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
6/30/09	368.00
7/2/09	399.50
7/6/09	370.95

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGS.GPJ CARLGDT 8/7/09

LOG OF MONITOR WELL NO. MW-8
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-8

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 400 feet
Date Boring Started: 6/30/2009
Date Boring Completed: 7/1/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
305			GRAVEL, gray-brown, igneous rocks and limestone		
310			SAND, brown to light gray-brown to light gray, fine to medium grained, sub-angular to sub-rounded, moderately sorted, with calcareous cement Slightly moist at 304' bgs		
315					
320					
325			GRAVEL, light brown, fine grained with 3/4" limestone gravel, sub-rounded to sub-angular, poorly sorted Slightly moist at 329' bgs		Bentonite grout from 2' to 342' bgs
330					
335			SAND, light brown to brown (some multicolored sand grains), very fine to fine grained, sub-rounded, moderately sorted Slightly moist at 339' bgs		
340			Sand grains composed of quartz, feldspar, mafic minerals at 342' bgs Slightly moist at 345'		
345					
350			SAND, brown to red-brown, fine grained, sub-rounded to sub-angular, moderately sorted Slightly moist at 356' bgs		Bentonite seal from 342' to 376' bgs
355					
360					
365			CLAY, red-brown		
370			SAND, red-brown, fine to medium grained, sub-rounded, moderately sorted Wet sand at 368' bgs		
375					
380			Silty CLAY, red-brown		
385					
390			CLAY, dark brown		Silica sand from 376' to 400' bgs Slotted screen from 378' to 398' bgs
395					
400					

STATE OF TEXAS
MICHAEL J. HULL
GEOLOGY
4158
LICENSED
PROFESSIONAL GEOSCIENTIST

10/28/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: Mike Hull
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
6/30/09	368.00
7/2/09	399.50
7/6/09	370.95

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

MW WITH WELL DETAILS AND LOGO BORING LOGS.PJ CARLOGT 8/7/09

LOG OF MONITOR WELL NO. MW-8
PAGE 4 of 4

LOG OF MONITOR WELL NO. MW-9

Project Description: MW-9 Installation

CAREL

Location: Clint Landfill
Top of PVC El.: 3979.58 feet MSL
Surface El.: 3976.62 feet MSL
Completion Depth: 397 feet
Date Boring Started: 5/16/2011
Date Boring Completed: 5/18/2011
Northing: 10591290.64
Easting: 482094.15

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–5			GRAVELLY SAND, tan and light brown, poorly sorted, subangular to subrounded, very fine to pebble grained, dry, loose, and silt, with tuff, quartz rich with plagioclase and orthoclase feldspar		Concrete from surface to 2' bgs
5–25			GRAVELLY SAND, light frosted brown and translucent tan, poorly sorted, subangular to subrounded, very fine to pebble grained, dry to slightly moist, loose, with volcanic rock fragments, quartz rich with feldspar		
25–30			SAND, light frosted brown to brown, well sorted, well rounded, very fine grained, dry, loose, quartz rich with feldspar		
30–40			ARKOSIC SAND, light frosted brown and translucent rose yellow, poorly sorted, subangular to well rounded, fine to pebble grained, dry, loose, with gravel, quartz rich with feldspar		
40–50			SANDY GRAVEL, dark light brown and, poorly sorted, subangular to well rounded, fine to pebble grained, dry, loose, quartz rich with feldspar		
50–60			SAND, light brown, moderately well sorted, subrounded, very fine to coarse grained, dry, loose, trace tuff, quartz rich with feldspar and volcanic tuff		
60–75			SAND, light brown, well sorted, rounded, fine grained, dry, loose, quartz rich		
75–80			SILTY CLAY, light pinkish brown, dry		
80–90			SAND, light reddish brown with red, well sorted, rounded, very fine to fine grained, dry, loose, quartz rich with feldspar and some iron stained sand		
90–100			SAND, light brown, well sorted, rounded, very fine grained, dry, loose, quartz rich with feldspar		

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-04-37

Groundwater Observations	
Date	Elevation (ft. MSL)
05/17/11	3611.62
05/18/11	3612.19
06/06/11	3611.41

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" schedule 80 PVC casing. Hammer casing drive occasionally from surface to 100' bgs. Hammer casing drive continuous from 100' to total depth.

EL PASO WELLS CLINT GPJ CAREL GDT 07/19/11

LOG OF MONITOR WELL NO. MW-9
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-9

Project Description: MW-9 Installation

Location: Clint Landfill
Top of PVC El.: 3979.58 feet MSL
Surface El.: 3976.62 feet MSL
Completion Depth: 397 feet
Date Boring Started: 5/16/2011
Date Boring Completed: 5/18/2011
Northing: 10591290.64
Easting: 482094.15

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			CLAY, reddish brown, dry		
			SAND, light brown with reddish brown, well sorted, rounded, very fine to fine grained, dry, loose, quartz rich with some iron stained sand		
110			CLAY, red, slightly moist, slightly plastic		
			SAND, light brown, well sorted, rounded, very fine grained, dry, loose, quartz rich		
130			SAND, light grayish brown and clear rose brown, well sorted, rounded, very fine to fine grained, dry, loose, quartz rich with some feldspar and mafic minerals		
140			SAND, reddish brown and clear rose brown, well sorted, rounded, fine grained, dry, loose, quartz rich with traces of feldspar and mafic minerals		
150			SAND, brown and clear rose brown, well sorted, rounded, very fine grained, slightly moist, loose, quartz rich with minor amounts of feldspar and mafic minerals slightly damp from 155' to 160' bgs		
160			SAND, light grayish brown and clear rose yellow, well sorted, rounded, fine grained, dry, loose, quartz rich with some feldspar and mafic minerals		
170			CLAY, reddish brown, dry		
175			SAND, light grayish brown and clear rose brown, well sorted, rounded, very fine grained, dry, loose, quartz rich with some feldspar and mafic minerals		
200					

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-04-37

Groundwater Observations

Date	Elevation (ft. MSL)
05/17/11	3611.62
05/18/11	3612.19
06/06/11	3611.41

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" schedule 80 PVC casing. Hammer casing drive occasionally from surface to 100' bgs. Hammer casing drive continuous from 100' to total depth.

EL PASO WELLS CLINT GPJ CAREL GDT 07/19/11

LOG OF MONITOR WELL NO. MW-9
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-9

Project Description: MW-9 Installation

CAREL

Location: Clint Landfill
Top of PVC El.: 3979.58 feet MSL
Surface El.: 3976.62 feet MSL
Completion Depth: 397 feet
Date Boring Started: 5/16/2011
Date Boring Completed: 5/18/2011
Northing: 10591290.64
Easting: 482094.15

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
205			SAND, light grayish brown and clear rose yellow, moderately well sorted, rounded, fine grained, dry, hard, quartz rich with some feldspar and mafic minerals		
210			SILTY CLAY, reddish brown, dry, hard drilling		
215			ARKOSIC SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich with feldspar and some mafic minerals		
220					
225			ARKOSIC SAND, light reddish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich with abundant feldspar and mafic minerals with some iron stained sand		
230					
235					
240					
245					
250			ARKOSIC SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich with abundant feldspar and mafic minerals		Bentonite grout from 2' to 358' bgs
255					
260					
265			SILTY CLAY, reddish brown, slightly moist		
270			SAND, reddish brown and clear rose yellow, well sorted, rounded, fine grained, slightly moist, loose, quartz rich with abundant feldspar and mafic minerals		
275			ARKOSIC SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich with abundant feldspar and mafic minerals		
280					
285			SILTSTONE, light gray, dry, very hard, strong cementation, silicified		
			SILTY CLAY, reddish brown, dry		
290			ARKOSIC SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, hard, quartz rich with feldspar and mafic minerals		
295			GRAVEL, light gray, poorly sorted, subangular, dry		
300					

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-04-37

Groundwater Observations	
Date	Elevation (ft. MSL)
05/17/11	3611.62
05/18/11	3612.19
06/06/11	3611.41

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring. 4" schedule 80 PVC casing. Hammer casing drive occasionally from surface to 100' bgs. Hammer casing drive continuous from 100' to total depth.

EL PASO WELLS CLINT GPJ CAREL GDT 07/19/11

LOG OF MONITOR WELL NO. MW-9
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-9

Project Description: MW-9 Installation

CAREL CORPORATION

Location: Clint Landfill
Top of PVC El.: 3979.58 feet MSL
Surface El.: 3976.62 feet MSL
Completion Depth: 397 feet
Date Boring Started: 5/16/2011
Date Boring Completed: 5/18/2011
Northing: 10591290.64
Easting: 482094.15

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
305			SILTY SAND, light grayish brown, moderately well to well sorted, rounded, very fine grained, dry slightly moist at 305' bgs		
310					
315					
320			LIMESTONE, light gray, dry, gravel size fragments		
325			ARKOSIC SAND, light grayish brown and clear rose yellow, well sorted, rounded, fine grained, dry, quartz rich with feldspar and mafic minerals		
330			SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich		
335					
340			SAND, light brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich with some mafic mineral		
345					
350			SAND, light grayish brown and clear rose yellow, well sorted, rounded, very fine grained, dry, loose, quartz rich		
355					
360			CLAY, reddish brown, dry		Hydrated bentonite seal from 358' to 369' bgs
365			SAND, light gray and clear rose yellow, well sorted, rounded, fine grained, dry, loose, 100% quartz reddish brown and wet at 365' bgs		
370			CLAY, reddish brown, dry		10/20 Silica sand from 369' to 397' bgs
375			SAND, light reddish brown and clear rose yellow, well sorted, rounded, fine grained, wet, loose, 100% quartz		
380					
385			Hard drilling - added water to boring at 386' bgs		0.01" Slotted screen from 374' to 394' bgs
390					
395			CLAY, reddish brown, dry		Two foot sediment trap
400					

STATE OF TEXAS
KEVIN T. CAREL
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#960
LICENSED
PROFESSIONAL GEOSCIENTIST
7-19-11

EL PASO WELLS CLINT GPJ CAREL.GDT 07/19/11

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist: Michael J. Hull, P.G.
Project No.: 10-04-37

Groundwater Observations	
Date	Elevation (ft. MSL)
05/17/11	3611.62
05/18/11	3612.19
06/06/11	3611.41

Remarks: Speedstar 50K Drilling Rig. 10" diameter boring, 4" schedule 80 PVC casing. Hammer casing drive occasionally from surface to 100' bgs. Hammer casing drive continuous from 100' to total depth.

LOG OF MONITOR WELL NO. MW-9
PAGE 4 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-10

Site Name:	Greater El Paso Landfill	Drilling Contractor:	Cascade Drilling
Well Location:		Drilling Method:	Air Rotary Casing Hammer
Northing:	31 D 35 M 35.23514 S	Sampling Method:	Continuous Cyclone Return
Easting:	-106 D 09 M 48.73597 S	Drilled Depth (ft):	398
L.S. Elevation (ft):	3976.33 NAVD	Cased Depth (ft):	386
Drill Start Date:	2/21/2019	Drilled Hole Diameter (inches)	11
Compleiton Date:	3/21/2019	Casing ID (inches):	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
0	Blank well casing 4" PVC Sch 80 Flush Joint 364 ft below land surface to 3 ft above grade	Portland Cement 23 ft - 2 ft	Fill, sand, gravelly, caliche, 50% gravel 45% sand 5% fines, nonplastic, dry reddish grey 2.5 YR 8/2	GW	
10			Fill, sand, gravelly, caliche, 30% coarse rounded gravel 65% sand 5% fines nonplastic, dry light grey 2.5 YR 7/1	SW	
20			Sand, medium, gravelly, 10% gravel 90% sand, nonplastic, dry greyish yellow 2.5 Y 7/1	SW	
30			Sand, medium, gravelly, 10% coarse gravel 90% sand, nonplastic, dry greyish yellow 2.5 Y 7/3	SW	
40			Sand, medium, gravelly, 5% coarse gravel 95% sand, nonplastic, dry greyish yellow 2.5 Y 7/3	SW	
50		Annular grout seal Powdered Bentonite Slurry 328 ft - 23 ft	Sand, medium, gravelly, 10% coarse gravel 90% sand, nonplastic, dry greyish yellow 2.5 Y 7/3	SW	
60			Sand, medium to fine, gravelly, 5% gravel 95% sand, nonplastic, dry greyish yellow 2.5 Y 7/3	SW	
70			Sand, medium, 100% sand, nonplastic, dry greyish yellow 2.5 Y 7/3	SW	
80			Clay, silty, 100% fines, medium plasticity, slightly moist dull reddish brown 2.5 YR 5/4	CL	
90			Sand, fine, 95% sand, 5% fines, low plasticity, slightly moist light grey 2.5 Y 8/2	SW	
100			Silt, clayey sandy, 5% sand, 95% fines, low plasticity, slightly moist dull orange 2.5 YR 7/4	ML	
110					

STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED
PROFESSIONAL GEOSCIENTIST
4-11-19

Water Level Data:

Date	Depth to Water (ft)
3/12/2019	367.25 ft below ground level

Rig Type and Remarks:
Speedstar 50KCH

Top PVC Casing Elev (measuring Point)	3979.38
Top Locking Shroud Elev	3979.63
Survey Pin Elevation	3976.59
Land Surface Elevation	3976.33

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-10

Site Name:	Greater El Paso Landfill	**Drilling Contractor:**	Cascade Drilling
Well Location:		**Drilling Method:**	Air Rotary Casing Hammer
Northing:	31 D 35 M 35.23514 S	**Sampling Method:**	Continuous Cyclone Return
Easting:	-106 D 09 M 48.73597 S	**Drilled Depth (ft):**	398
L.S. Elevation (ft):	3976.33 NAVD	**Cased Depth (ft):**	386
Drill Start Date:	2/21/2019	**Drilled Hole Diameter (inches)**	11
Completion Date:	3/21/2019	**Casing ID (inches):**	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
110	Blank well casing -4" PVC Sch 80 Flush Joint 364 ft below land surface to 2.75 ft above grade		Sand, fine to medium, 90% sand, 10% fines, nonplastic, dry light grey, 7.5 YR 7/3	SW	
120			Sand, fine, 95% sand, 5% fines, nonplastic, very slightly moist light grey, 7.5 YR 7/3	SW	
130					
140			Sand, fine, silt interbeds, 50% sand, 50% fines, low plasticity, slightly moist reddish brown, 5 YR 5/6	ML	
150			Sand, fine, 95% sand, 5% fines, nonplastic, slightly moist Light brownish grey, 7.5 YR 7/2	SW	
160		Annular grout seal Powdered Bentonite Slurry 328 ft - 23 ft			
170			Silt, clayey sandy, 5% sand, 95% fines, medium plasticity, slightly moist dull reddish brown, 5 YR 5/2	ML	
180					
190					
200					
210			Silt, sandy, 40% sand, 60% fines, medium plasticity, moist dull orange, 5 YR 5/4	ML	
220			Sand, fine, silty, 85% sand, 15% fines, nonplastic, moist dull orange, 7.5 YR 7/3	SM	

STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED
PROFESSIONAL GEOSCIENTIST

4-11-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
▽	3/12/2019	367.25 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3979.38
			Top Locking Shroud Elev	3979.63
			Survey Pin Elevation	3976.59
			Land Surface Elevation	3976.33

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-10

Site Name:	Greater El Paso Landfill	Drilling Contractor:	Cascade Drilling
Well Location:		Drilling Method:	Air Rotary Casing Hammer
Northing:	31 D 35 M 35.23514 S	Sampling Method:	Continuous Cyclone Return
Easting:	-106 D 09 M 48.73597 S	Drilled Depth (ft):	398
L.S. Elevation (ft):	3976.33 NAVD	Cased Depth (ft):	386
Drill Start Date:	2/21/2019	Drilled Hole Diameter (inches)	11
Completion Date:	3/21/2019	Casing ID (inches):	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
220	Blank well casing -4" PVC Sch 80 Flush Joint 364 ft below land surface to 2.75 ft above grade				
230			Sand, fine, silty, 80% sand, 20% fines, nonplastic, moist dull orange, 7.5 YR 7/3	SM	
240					
250					
260		Annular grout seal Powdered Bentonite Slurry 328 ft - 23 ft	Sand, silty, 80% sand, 20% fines, nonplastic, moist dull orange, 7.5 YR 7/3	SM	
270					
280			Sand, silty, 75% sand, 25% fines, nonplastic, moist dull orange, 7.5 YR 7/4	SM	
			Silt, sandy, clayey laminae, 10% sand, 90% fines, low plasticity, moist dull reddish brown, 5 YR 5/4	ML	
290					
300			Sand, fine, silty, 90% sand, 10% fines, nonplastic, moist brown, 7.5 YR 6/3	SP	
310			Sand, fine, silty, 90% sand, 10% fines, nonplastic, moist light brown, 7.5 YR 7/3	SP	
320					
330		3/8-in Bentonite Chips - Hydrated 358.1 ft - 328 ft	Silt, sandy, clayey laminae, 15% sand, 85% fines, low plasticity, moist brown, 7.5 YR 6/3	ML	

STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED PROFESSIONAL GEOSCIENTIST

4-16-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
▽	3/12/2019	367.25 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3979.38
			Top Locking Shroud Elev	3979.63
			Survey Pin Elevation	3976.59
			Land Surface Elevation	3976.33

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-10

Site Name:	Greater El Paso Landfill	Drilling Contractor:	Cascade Drilling
Well Location:		Drilling Method:	Air Rotary Casing Hammer
Northing:	31 D 35 M 35.23514 S	Sampling Method:	Continuous Cyclone Return
Easting:	-106 D 09 M 48.73597 S	Drilled Depth (ft):	398
L.S. Elevation (ft):	3976.33 NAVD	Cased Depth (ft):	386
Drill Start Date:	2/21/2019	Drilled Hole Diameter (inches)	11
Completion Date:	3/21/2019	Casing ID (inches):	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing / Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
330	Blank well casing -4" PVC Sch 80 FJ, 364 ft below land surface to 2.75 ft above grade	Sand, fine, silty, 90% sand, 10% fines, nonplastic, moist light grey, 7.5 YR 7/2	SM	
340	3/8-in Bentonite Chips - Hydrated 358.1 ft - 328 ft	Sand, fine, interbedded silt/clay, 80% sand, 20% fines, low plasticity, moist brown, 7.5 YR 6/3	SM	
350		Sand, fine, silty, 90% sand, 10% fines, nonplastic, moist brown, 7.5 YR 6/3	SM	
360	12/20 Colorado Silica Sand 386.4 ft - 358.1 ft	Sand, fine, silty, 90% sand, 10% fines, nonplastic, wet brown, 7.5 YR 6/3	SM	
370	4-inch Sch 80 PVC screen - 0.010 slot 384 ft - 364 ft			
380	Blank sump 386 ft to 384 ft	Silt, clayey, sandy, 5% sand 95% fines, plastic, wet dull reddish brown, 5 YR 5/4	ML	
390	3/8-in Bentonite Chips - Hydrated 398 ft - 386.4 ft			
400		Total Depth Drilled: 398 ft		
410		**Well Development Notes:** Well swabbed and balled prior to development pumping Water level: 370.20 ft below casing top (2.75 ft above GL) Pumped 3 gpm for 65 minutes Water level drawdown = 0.60 ft Well specific capacity = 5.0 gpm/ft		
420				
430				
440				

STATE OF TEXAS
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Geology
12594
LICENSED PROFESSIONAL GEOSCIENTIST

4-11-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
	3/12/2019	367.25 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3979.38
			Top Locking Shroud Elev	3979.63
			Survey Pin Elevation	3976.59
			Land Surface Elevation	3976.33

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-11

Site Name:	Greater El Paso Landfill	**Drilling Contractor:**	Cascade Drilling
Well Location:		**Drilling Method:**	Air Rotary Casing Hammer
Northing:	31D 35 M 29.37438 S	**Sampling Method:**	Continuous Cyclone Return
Easting:	-106 D 09 M 48.63206 S	**Drilled Depth (ft):**	388
L.S. Elevation (ft):	3974.67	**Cased Depth (ft):**	385
Drill Start Date:	2/26/2019	**Drilled Hole Diameter (inches)**	11
Completion Date:	3/29/2019	**Casing ID (inches):**	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
0	Blank well casing -4" PVC Sch 80 Flush Joint 363 ft below land surface to 2.75 ft above grade		Sand, fine, sity, gravelly, caliche, 5% fine gravel, 90% sand, 5% fines, nonplastic, dr light brownish grey 7.5 YR 7/1	SW	
10		Portland Cement 18 ft - 2 ft	Sand, gravelly, 20% gravel, 80% sand, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
20			Sand, gravelly, 5% gravel, 90% sand, 5% fines, nonplastic dry brownish grey 7.5 YR 6/1	SW	
30			Sand, gravelly, interbedded silt, 5% gravel, 90% med sand, 5% fines, nonplastic, dr brownish grey 7.5 YR 6/1	SW	
40			Sand, gravelly, interbedded silt, 5% gravel, 90% med sand, 5% fines, nonplastic, dr brownish grey 7.5 YR 5/1	SW	
50		Annular grout seal Powdered Bentonite Slurry 327 ft - 18 ft	Sand, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
70			Silt, clayey, sandy, 10% sand, 95% fines, plastic, dry dull reddish brown 5 YR 5/4	ML	
90			Sand, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
100			Sand, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
110					

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Geology
12594
LICENSED
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4-11-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
▽	3/14/2019	365.45 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3977.44
			Top Locking Shroud Elev	3977.85
			Survey Pin Elevation	3975.01
			Land Surface Elevation	3974.67

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-11

Site Name:	Greater El Paso Landfill	Drilling Contractor:	Cascade Drilling
Well Location:		Drilling Method:	Air Rotary Casing Hammer
Northing:	31D 35 M 29.37438 S	Sampling Method:	Continuous Cyclone Return
Easting:	-106 D 09 M 48.63206 S	Drilled Depth (ft):	388
L.S. Elevation (ft):	3974.67	Cased Depth (ft):	385
Drill Start Date:	2/26/2019	Drilled Hole Diameter (inches)	11
Compleiton Date:	3/29/2019	Casing ID (inches):	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
110	Blank well casing -4" PVC Sch 80 Flush Joint 363 ft below land surface to 2.75 ft above grade		Sand, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
			Silt, clayey, sandy, 10% sand, 90% fines, plastic, dry, dull reddish brown, 5 YR 5/4	ML	
120			Sand, fine, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
130					
140			Sand, fine, gravelly, silty, 5% gravel, 90% sand, 5% fines, nonplastic, dry brown 7.5 YR 6/3	SW	
150			Sand, fine, silty, 95% sand, 5% fines, nonplastic, dry brown 7.5 YR 4/3	SW	
160		Annular grout seal Powdered Bentonite Slurry 327 ft - 18 ft	Sand, fine, silty laminae, 95% sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
170					
180					
190					
200					
210			Sand, fine, silty laminae, 95% sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/3	SW	
220					

STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED
PROFESSIONAL GEOSCIENTIST
4-11-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
▽	3/14/2019	365.45 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3977.44
			Top Locking Shroud Elev	3977.85
			Survey Pin Elevation	3975.01
			Land Surface Elevation	3974.67

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
915.533.6811

GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-11

Site Name:	Greater El Paso Landfill	**Drilling Contractor:**	Cascade Drilling
Well Location:		**Drilling Method:**	Air Rotary Casing Hammer
Northing:	31D 35 M 29.37438 S	**Sampling Method:**	Continuous Cyclone Return
Easting:	-106 D 09 M 48.63206 S	**Drilled Depth (ft):**	388
L.S. Elevation (ft):	3974.67	**Cased Depth (ft):**	385
Drill Start Date:	2/26/2019	**Drilled Hole Diameter (inches)**	11
Completion Date:	3/29/2019	**Casing ID (inches):**	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
220	Blank well casing -4" PVC Sch 80 Flush Joint 363 ft below land surface to 2.75 ft above grade		Silt, clayey, sandy, 5% sand, 95% fines, plastic, dry, dull reddish brown, 5 YR 5/4	ML	
230			Sand, fine, silty, 95% med sand, 5% fines, nonplastic, dry dull orange 7.5 YR 6/4	SW	
240					
250			Sand, fine, silty, 95% med sand, 5% fines, nonplastic, dry greyish brown 7.5 YR 6/2	SW	
260		Annular grout seal Powdered Bentonite Slurry 327 ft - 18 ft	Sand, fine, silty, 95% med sand, 5% fines, nonplastic, dry brown 7.5 YR 6/3	SW	
270			Sand, gravelly, silty, 5% medium gravel, 85% med sand, 10% fines, nonplastic, dry brown 7.5 YR 6/3	SP	
280					
290			Silt, clayey, sandy, 5% sand, 95% fines, plastic, moist dark brown, 7.5 YR 3/3	ML	
			Silt, clayey, as above, with siltstone stringers	ML	
300			Silt, clayey, sandy, 5% sand, 95% fines, plastic, moist brown 5 YR 3/4	ML	
310			Sand, fine, silty, 95% sand, 5% fines, nonplastic, dry grey 7.5 YR 7/2	SW	
320		3/8-in Bentonite Chips - Hydrated 357 ft - 327 ft	Sand, fine, silty, 95% sand, 5% fines, nonplastic, dry dull orange 7.5 YR 6/4	SW	
330					

STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED PROFESSIONAL GEOSCIENTIST

4-11-19

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
	3/14/2019	365.45 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3977.44
			Top Locking Shroud Elev	3977.85
			Survey Pin Elevation	3975.01
			Land Surface Elevation	3974.67

PARKHILLSMITH&COOPER
501 West San Antonio
El Paso, Texas 79901
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GROUNDWATER MONITORING WELL LOG

Monitoring Well MW-11

Site Name:	Greater El Paso Landfill	**Drilling Contractor:**	Cascade Drilling
Well Location:		**Drilling Method:**	Air Rotary Casing Hammer
Northing:	31D 35 M 29.37438 S	**Sampling Method:**	Continuous Cyclone Return
Easting:	-106 D 09 M 48.63206 S	**Drilled Depth (ft):**	388
L.S. Elevation (ft):	3974.67	**Cased Depth (ft):**	385
Drill Start Date:	2/26/2019	**Drilled Hole Diameter (inches)**	11
Compleiton Date:	3/29/2019	**Casing ID (inches):**	4
Geologist:	L Kilmer		
Project Number:			

Depth (ft) Below Land Surface	WELL Completion Details (depths, ft below gl) Casing	Annular Fill	Lithologic Descriptions Drill notes, moisture content, water-bearing properties, etc.	USCS SYMBOL	WELL COMPLETION REMARKS
330	Blank well casing 4" PVC Sch 80 Fl 363 ft below land surface to 2.75 ft above grade		Sand, fine, silty, 95% sand, 5% fines, nonplastic, moist grey 7.5 YR 7/2	SW	
340		3/8-in Bentonite Chips - Hydrated 357 ft - 327 ft			
350			Sand, fine, silty, 95% sand, 5% fines, nonplastic, moist grey 7.5 YR 7/2	SW	
360		12/20 Colorado Silica Sand 386 ft - 357 ft	Sand, fine, silty, 90% sand, 10% fines, nonplastic, moist brown 7.5 YR 6/3	SP	
▽					
370	4-inch Sch 80 PVC screen - 0.010 slot 383 ft - 363 ft		Sand, fine, interbedded silt, 90% sand, 10% fines, nonplastic, moist brown 7.5 YR 6/3	SP	
			Sand, fine, silt-clay, 80% sand, 20% fines, nonplastic, wet, dull reddish brown, 5YR	SC	
380			Silt, clayey, sandy, 50% sand, 50% fines, plastic wet, dull reddish brown, 5 YR 5/4	ML	
	Blank sump 385 ft to 383 ft		Silt, clayey, sandy, 5% sand, 95% fines, plastic wet, dull reddish brown, 5 YR 5/4	ML	
			Silt, clayey, sandy, 40% sand, 60% fines, plastic wet, dull orange, 5 YR 7/3	ML	
390			**Total Depth Drilled: 386 ft**		
			Well Development Notes: Well swabbed and bailed prior to development pumping Water level: 368.20 ft below casing top (2.75 ft above GL) Pumped 1.9 gpm for 83 minutes Water level drawdown = 0.58 ft Well specific capacity = 3.76 gpm/ft		
400					
410					STATE OF TEXAS Leland Clay Kilmer Geology 12594 LICENSED PROFESSIONAL GEOSCIENTIST 4-11-19
420					
430					
440					

Water Level Data:	Date	Depth to Water (ft)	Rig Type and Remarks:	
▽	3/14/2019	365.45 ft below ground level	Speedstar 50KCH	
			Top PVC Casing Elev (measuring Point)	3977.44
			Top Locking Shroud Elev	3977.85
			Survey Pin Elevation	3975.01
			Land Surface Elevation	3974.67

LOG OF MONITOR WELL NO. MW-13

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 397 feet
Date Boring Started: 7/16/2009
Date Boring Completed: 7/18/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–5			SILT with very fine grained sand, tan, unconsolidated, quartz rich potassium feldspar (arkosic) Sub-angular gravel present at 5' bgs		Concrete from 0' to 2' bgs
5–15			Gravelly SAND, tan, medium to coarse grained, dry, sub-rounded, well sorted, quratz rich sand with potassium feldspar (arkosic) Unconsolidated, sub-angular gravel at 15' bgs		
15–25			Gravelly SAND, light gray, medium to coarse grained, dry, sub-rounded, well sorted Unconsolidated, sub-angular gravel at 25' bgs		
25–30			SAND with some gravel, light gray, fine to meldum grained, dry, sub-angular, moderately to well sorted, unconsolidated Sand is quartz rich with potassium feldspar at 34' bgs		
30–40			Very fine to fine grained sand at 40' bgs		
40–50					Bentonite grout from 2' to 341' bgs
50–65					
65–70			Tan sand at 65' bgs		
70–80			Caliche nodules and tan to light gray sand at 70' bgs		
80–100			SAND with some gravel, tan, dry, very fine to fine grained, sub-angular to sub-rounded, moderately well sorted, quartz rich with potassium feldspar (arkosic)		

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/16/09	368.00
7/18/09	368.80

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-13
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-13

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 397 feet
Date Boring Started: 7/16/2009
Date Boring Completed: 7/18/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			Sandy SILT with some gravel, tan to light brown, very fine grained, dry, sub-rounded, moderately well sorted, unconsolidated		
110			SILT, tan, dry, unconsolidated		
115					
120			Hard drilling at 120' bgs		
125			SAND, tan, fine to coarse grained, dry, sub-rounded, poorly sorted, unconsolidated Quartz rich with potassium feldspar (arkosic) at 123' bgs		
130			Gravelly SAND, tan, very fine to fine grained, dry, poorly sorted, unconsolidated Quartz with potassium feldspar (arkosic) at 133' bgs		
135					
140			SAND, light gray to tan, very fine to fine grained, dry, moderately well sorted, unconsolidated, quartz with potassium feldspar (arkosic)		
145					
150					
155			Some gravel from 155' to 170' bgs		
160					
165					
170			Sandy SILT, light gray to tan, very fine grained, dry to slightly moist, sub-rounded to sub-angular, moderately well sorted, unconsolidated, quartz rich		
175					
180			SAND, tan, medium grained to coarse grained, slightly moist, sub-angular, poorly sorted, quartz rich, potassium feldspar (arkosic), unconsolidated		
185					
190					
195					
200					

MW WITH WELL DETAILS AND LOGD BORING LOGS.GPJ CAREL.GDT 8/7/09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/16/09	368.00
7/18/09	368.80

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

LOG OF MONITOR WELL NO. MW-13
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-13

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 397 feet
Date Boring Started: 7/16/2009
Date Boring Completed: 7/18/2009

Depth, feet	Material Description	Monitor Well Construction Details	Monitor Well Description
205	Clayey SAND, dark brown to red, medium to coarse grained, slightly moist, sub-angular, poorly sorted, unconsolidated, plastic clay Hard drilling at 200' bgs		
210	CLAY, dark brown to red, slightly moist-plastic, calcareous		
215	SAND, light brown, very fine grained, dry, sub-rounded, well sorted, unconsolidated, quartz rich Some calcareous gravel fragments at 215' bgs		
220	SAND, light brown, very fine to fine grained, dry, sub-angular to sub-rounded, poorly sorted, unconsolidated, quartz rich with potassium feldspar (arkosic)		
225			
230			
235	Slightly moist at 235' bgs		
240			
245	Dry at 245' bgs		
250			
255	Minor gravel fragments at 255' bgs		
260	Clayey SAND, dark brown, fine grained, slightly moist, sub-angular, moderately well sorted, unconsolidated, quartz rich with potassium feldspar		
265	GRAVEL with some sand and clay, dark brown, dry, angular, poorly sorted		
270	Sandy SILT, dark brown to red, very fine to coarse grained, slightly moist to moist, poorly sorted, unconsolidated		
275	SAND, tan, fine grained, slightly moist, angular to sub-angular, moderately well sorted, unconsolidated Quartz rich with potassium feldspar at 280'		
280			
285	Sand grading to a light brown at 288' bgs Fine to medium grained at 290' bgs		
290			
295	Clay lense at 296' bgs		
300			

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/16/09	368.00
7/18/09	368.80

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-13
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-13

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 397 feet
Date Boring Started: 7/16/2009
Date Boring Completed: 7/18/2009

Depth, feet	Material Description	Monitor Well Construction Details	Monitor Well Description
305	SAND, tan, very fine to fine grained, slightly moist to moist, sub-rounded, well sorted, unconsolidated Quartz rich with potassium feldspar at 303' bgs		
310			
315			
320	Clay, calcareous lense from 321' to 324' bgs		
325			
330			
335	Clayey SAND, light brown, very fine grained, slightly moist, sub-angular, poorly sorted, unconsolidated Quartz rich with potassium feldspar at 338' bgs		
340			
345	Some silt at 347' bgs		
350	Sandy CLAY, dark brown to red, very fine grained, moist, sub-rounded, well sorted, unconsolidated Clay is calcareous		Bentonite seal from 341' to 372' bgs
355			
360	Silty SAND, dark brown to red, very fine to fine grained, moist, sub-rounded, well sorted, unconsolidated		
365			
370	SAND, dark brown to red, fine to medium grained, moist to wet, sub-rounded, well sorted, unconsolidated, quartz rich with potassium feldspar (arkosic)		
375			
380	Hard drilling and injecting water at 380' bgs		
385	Clayey SAND, dark brown to red, very fine to fine grained, sub-rounded, well sorted, unconsolidated Quartz rich at 384' bgs		Silica sand from 372' to 397' bgs
390	Sandy CLAY, dark brown to red, very fine to fine grained, sub-rounded, well sorted, unconsolidated, quartz rich		Slotted screen from 374' to 394' bgs
395	CLAY, dark brown to red Hard drilling at		
400			

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
960
LICENSED
PROFESSIONAL GEOSCIENTIST

10-28-09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/16/09	368.00
7/18/09	368.80

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

MW WITH WELL DETAILS AND LOGS BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. MW-13
PAGE 4 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-14

Project Description: MW-14 and MW-15 Well Installations

Location: Greater El Paso Landfill
Top of PVC El.: 3974.64 feet MSL
Surface El.: 3971.66 feet MSL
Completion Depth: 403 feet
Date Boring Started: 2/23/2015
Date Boring Completed: 2/25/2015

Northing: 10593499.70
Easting: 479591.02

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–35			GRAVELLY SAND, tan, poorly sorted, subrounded, fine to gravel grained, dry, quartz rich with feldspar and mafics, some silt in top 5 feet		Concrete from surface to 2' bgs
35–40			SAND, tan, well sorted, subrounded, fine grained, dry, quartz rich with feldspar and mafics		
40–80			GRAVELLY SAND, light brown, poorly sorted, subrounded, fine to gravel grained, dry, quartz rich with feldspar and mafics		
80–105			SAND, light brown, well sorted, subrounded to well rounded, fine grained, dry, quartz rich with feldspar and mafics some minor reddish brown clay		

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
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4-9-15

Drilling Contractor: Yellow Jacket
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Continuous/Cuttings
Geologist: SJW/KTC
Project No.: 15-01-17

Groundwater Observations	
Date	Depth to Water (ft)
2/25/15	Dry
3/3/15	359
3/16/15	358.77

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

LOG OF MONITOR WELL NO. MW-14
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-14

Project Description: MW-14 and MW-15 Well Installations

CAREL CORPORATION

Location: Greater El Paso Landfill
Top of PVC El.: 3974.64 feet MSL
Surface El.: 3971.66 feet MSL
Completion Depth: 403 feet
Date Boring Started: 2/23/2015
Date Boring Completed: 2/25/2015
Northing: 10593499.70
Easting: 479591.02

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
110			CLAYEY SAND, light brown and reddish brown, well sorted, subrounded, fine grained, dry, quartz rich with feldspar and mafics		
115					
120					
125					
130			minor gravel		
135					
140					
145			SAND, minor gravel, light brown, well sorted, subrounded, fine grained, dry, quartz rich with feldspar and mafics		
150					
155					
160					
165			minor clay		
170					Bentonite grout from 2' to 340' bgs
175					
180					
185					
190			CLAY, reddish brown, slightly moist		
195					
200					
205			CLAYEY/SILTY SAND, medium brown, well sorted, rounded, very fine to fine grained, slightly moist,		
210					

STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
4-9-15

Drilling Contractor: Yellow Jacket
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Continuous/Cuttings
Geologist: SJW/KTC
Project No.: 15-01-17

Groundwater Observations	
Date	Depth to Water (ft)
2/25/15	Dry
3/3/15	359
3/16/15	358.77

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

LOG OF MONITOR WELL NO. MW-14
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▼ Water level after drilling.

LOG OF MONITOR WELL NO. MW-14

Project Description: MW-14 and MW-15 Well Installations

CAREL CORPORATION

Location: Greater El Paso Landfill
Top of PVC El.: 3974.64 feet MSL
Surface El.: 3971.66 feet MSL
Completion Depth: 403 feet
Date Boring Started: 2/23/2015
Date Boring Completed: 2/25/2015

Northing: 10593499.70
Easting: 479591.02

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
215			quartz rich SAND, light brown, well sorted, subrounded, fine to medium grained, dry, quartz rich with feldspar and mafics		
220					
225					
230					
235			some gravel slightly moist		
240					
245					
250					
255			some clay very fine to fine grained, slightly moist to moist		
260					
265					
270					
275					
280					
285					
290					
295			some gravel		
300					
305			CLAYEY SAND, medium brown, well sorted, subrounded, fine grained, slightly moist, quartz rich with feldspar		
310					
315					

STATE OF TEXAS
KEVIN T. CAREL
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4-9-15

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

Drilling Contractor: Yellow Jacket
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Continuous/Cuttings
Geologist: SJW/KTC
Project No.: 15-01-17

Groundwater Observations	
Date	Depth to Water (ft)
2/25/15	Dry
3/3/15	359
3/16/15	358.77

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

LOG OF MONITOR WELL NO. MW-14
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-14

Project Description: MW-14 and MW-15 Well Installations

Location: Greater El Paso Landfill
Top of PVC El.: 3974.64 feet MSL
Surface El.: 3971.66 feet MSL
Completion Depth: 403 feet
Date Boring Started: 2/23/2015
Date Boring Completed: 2/25/2015

Northing: 10593499.70
Easting: 479591.02

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
320			SAND, light brown, well sorted, subrounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
325			silty		
330					
335					
340			moist, light brown to medium brown		
345					
350			CLAY, some sand, some silt, reddish brown, moist to slightly moist, hard		
355					Hydrated bentonite seal from 340' to 370' bgs
360			interbedded very fine to fine grained sand to total depth		
365					
370					10/20 Silica sand from 370' to 403' bgs
375					
380					
385					0.01" Slotted screen from 375' to 395' bgs
390					
395					Two foot sediment trap
400					
405					
410					
415					
420					

STATE OF TEXAS
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#960
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4-9-15

Drilling Contractor:	Yellow Jacket
Drilling Method:	Air Rotary w/ Casing Advance
Sampling Method:	Continuous/Cuttings
Geologist:	SJW/KTC
Project No.:	15-01-17

Groundwater Observations	
Date	Depth to Water (ft)
2/25/15	Dry
3/3/15	359
3/16/15	358.77

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

LOG OF MONITOR WELL NO. MW-14
PAGE 4 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-15

Project Description: MW-14 and MW-15 Well Installations

CAREL CORPORATION

Location: Greater El Paso Landfill
Top of PVC El.: 3966.6 feet MSL
Surface El.: 3963.63 feet MSL
Completion Depth: 395 feet
Date Boring Started: 3/3/2015
Date Boring Completed: 3/5/2015

Northing: 10592320.98
Easting: 479605.59

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
0–50			GRAVELLY SAND, tan, poorly sorted, subangular to subrounded, fine to gravel grained, slightly moist, quartz rich with feldspar and mafics		Concrete from surface to 2' bgs
50–60			SAND, light brown, well sorted, subrounded, fine grained, slightly moist, quartz rich with feldspar and mafics		
60–85			some reddish brown clay, moist		
85–100			SAND, light brown, well sorted, subrounded, fine grained, moist, quartz rich with feldspar and mafics		

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4-9-15

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

Drilling Contractor: Yellow Jacket
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Continuous/Cuttings
Geologist: SJW/KTC
Project No.: 15-01-17

Groundwater Observations	
Date	Depth to Water (ft)
3/17/15	350.86

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

LOG OF MONITOR WELL NO. MW-15
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-15

Project Description: MW-14 and MW-15 Well Installations

Location: Greater El Paso Landfill
Top of PVC El.: 3966.6 feet MSL
Surface El.: 3963.63 feet MSL
Completion Depth: 395 feet
Date Boring Started: 3/3/2015
Date Boring Completed: 3/5/2015
Northing: 10592320.98
Easting: 479605.59

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			CLAY, reddish brown, moist		
110			SAND, light brown, well sorted, subrounded, very fine to fine grained, moist, quartz rich with feldspar and mafics trace gravel to 113' bgs		
115					
120			moist to slightly moist		
125					
130					
135					
140			moist		
145					
150					Bentonite grout from 2' to 326' bgs
155					
160			some reddish brown clay, moist		
165			CLAYEY SAND, light brown and reddish brown, well sorted, subrounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
170			CLAY, reddish brown, moist to slightly moist		
175					
180			CLAYEY SAND, light brown and reddish brown, well sorted, subrounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
185					
190			SAND, minor clay, light brown, moderately well sorted, subangular, fine to coarse grained, slightly moist, quartz rich with feldspar and mafics		
195			CLAY, reddish brown, slightly moist		
200					

STATE OF TEXAS
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4-9-15

Drilling Contractor: Yellow Jacket	
Drilling Method: Air Rotary w/ Casing Advance	
Sampling Method: Continuous/Cuttings	
Geologist: SJW/KTC	
Project No.: 15-01-17	

Groundwater Observations

Date	Depth to Water (ft)
3/17/15	350.86

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

LOG OF MONITOR WELL NO. MW-15
PAGE 2 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▽ Water level after drilling.

LOG OF MONITOR WELL NO. MW-15

Project Description: MW-14 and MW-15 Well Installations

Location: Greater El Paso Landfill
Top of PVC El.: 3966.6 feet MSL
Surface El.: 3963.63 feet MSL
Completion Depth: 395 feet
Date Boring Started: 3/3/2015
Date Boring Completed: 3/5/2015

Northing: 10592320.98
Easting: 479605.59

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
205			CLAY, reddish brown, slightly moist		
			SILTY SAND, medium brown, well sorted, rounded, very fine grained, moist, quartz rich with feldspar		
210			SAND, light brown, well sorted, subrounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
215					
220			CLAY, some gravel, reddish brown, slightly moist		
225			SAND, medium brown, well sorted, rounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
230			SILTY SAND, medium brown, well sorted, rounded, very fine grained, moist, quartz rich with feldspar		
235					
240			CLAYEY/SILTY SAND, medium brown and reddish brown, moderately well sorted, subrounded, very fine to medium grained, slightly moist to moist, quartz rich with feldspar and mafics		
245					
250			SAND, medium brown, well sorted, subrounded, fine to medium grained, slightly moist, quartz rich with feldspar and mafics		
255					
260			CLAYEY SAND, medium brown to dark brown, moderately well sorted, subrounded, very fine to medium grained, moist, quartz rich with feldspar and mafics		
265					
270			SAND, light brown, well sorted, rounded, very fine to fine grained, slightly moist, quartz rich with feldspar and mafics		
275					
280			slightly moist to dry		
285					
290			moderately well sorted, fine to medium grained		
295			harder drilling		
300					

STATE OF TEXAS
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4-9-15

Drilling Contractor: Yellow Jacket	
Drilling Method: Air Rotary w/ Casing Advance	
Sampling Method: Continuous/Cuttings	
Geologist: SJW/KTC	
Project No.: 15-01-17	

Groundwater Observations

Date	Depth to Water (ft)
3/17/15	350.86

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

LOG OF MONITOR WELL NO. MW-15
PAGE 3 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

Water level at time of drilling.
Water level at end of drilling.
Water level after drilling.

LOG OF MONITOR WELL NO. MW-15

Project Description: MW-14 and MW-15 Well Installations

CAREL CORPORATION

Location: Greater El Paso Landfill
Top of PVC El.: 3966.6 feet MSL
Surface El.: 3963.63 feet MSL
Completion Depth: 395 feet
Date Boring Started: 3/3/2015
Date Boring Completed: 3/5/2015

Northing: 10592320.98
Easting: 479605.59

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
305			CLAYEY SAND, medium brown, well sorted, rounded, very fine to fine grained, moist, quartz rich with feldspar and mafics		
310					
315					
320			moderately well sorted, fine to medium grained, slightly moist to dry		
325					
330			SILTY SAND, light brown, well sorted, rounded, very fine grained, moist, quartz rich with feldspar and mafics		
335			slightly moist to dry at 335' bgs		
340			SAND, medium brown, moderately well sorted, subrounded, fine to medium grained, slightly moist to moist, quartz rich with feldspar and mafics		Hydrated bentonite seal from 326' to 356' bgs
345			moist at 345' bgs		
350			wet		▼
355			CLAYEY SAND, medium brown to dark brown, moderately well sorted, subrounded, very fine to medium grained, wet, quartz rich with feldspar and mafics		10/20 Silica sand from 356' to 395' bgs
360			CLAY, reddish brown, hard		
365					
370					0.01" Slotted screen from 361.5' to 381.5' bgs
375					
380					Two foot sediment trap
385					
390					
395					
400					

STATE OF TEXAS
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4-8-15

GROUNDWATER WELL - B&W CLINT.GPJ CAREL2.GDT 4/2/15

Drilling Contractor: Yellow Jacket
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Continuous/Cuttings
Geologist: SJW/KTC
Project No.: 15-01-17

Groundwater Observations

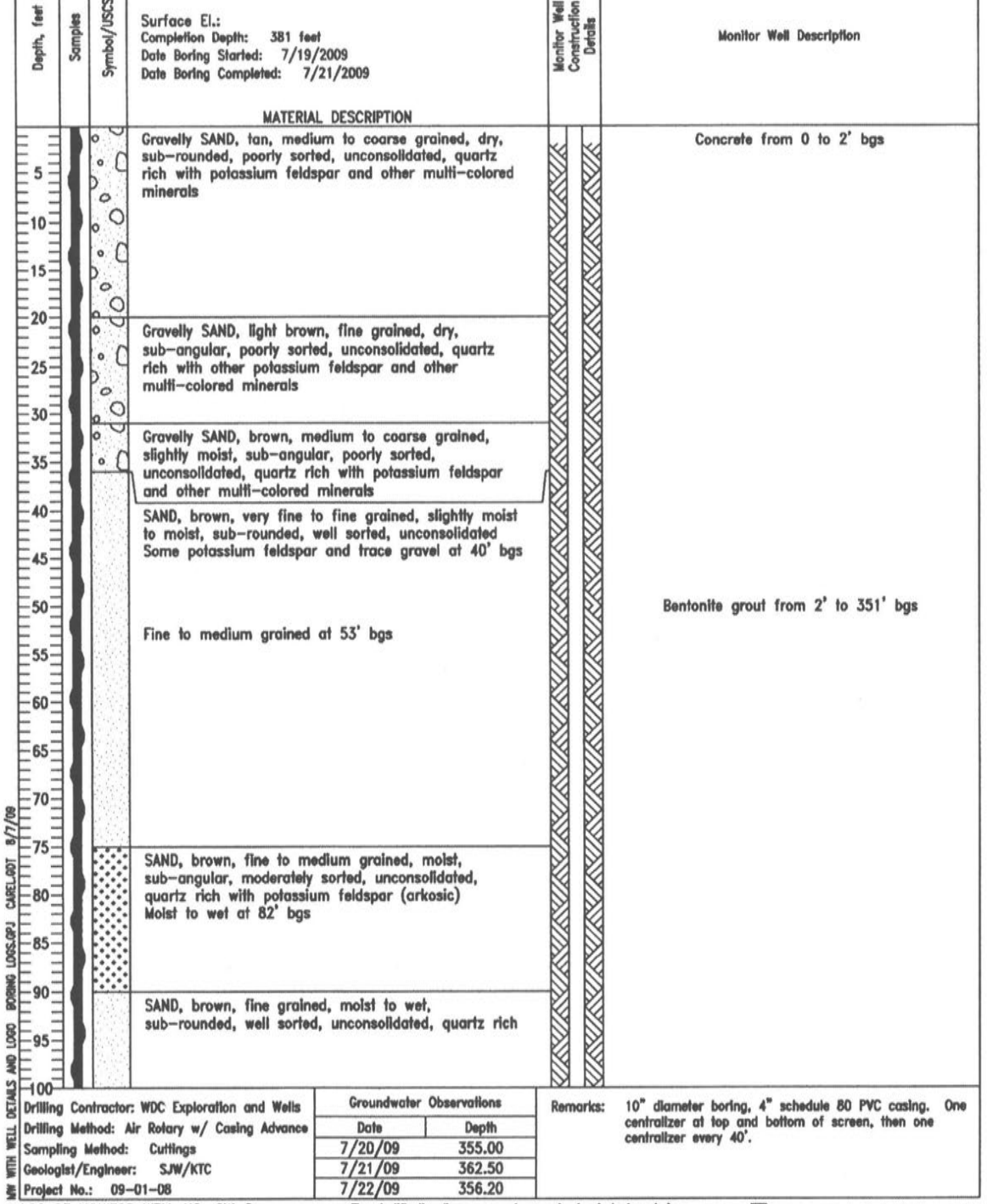
Date	Depth to Water (ft)
3/17/15	350.86

Remarks: Star 50K-CH Drilling Rig. 10" diameter boring, 4" diameter Schedule 80 PVC casing. Centralizers every 40 feet from bottom of screen to ground surface.

LOG OF MONITOR WELL NO. MW-15
PAGE 4 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▼ Water level at end of drilling.
▽ Water level after drilling.



LOG OF MONITOR WELL NO. OW-2
PAGE 1 of 4

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▽ Water level after drilling.

LOG OF MONITOR WELL NO. OW-2

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 381 feet
Date Boring Started: 7/19/2009
Date Boring Completed: 7/21/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
105			SAND, brown, fine grained, moist to wet, sub-rounded, well sorted, unconsolidated, quartz rich		
110			SAND with trace gravel, brown, fine to medium grained, moist, sub-rounded, moderately well sorted, unconsolidated		
120			Clayey SAND, brown, fine grained, slightly moist to moist, sub-rounded, well sorted, Trace gravel present at 122' bgs		
145			SAND, brown, fine grained, moist, sub-rounded, well sorted, unconsolidated, potassium feldspar and other multi-colored minerals Fine to medium grained at 155' bgs		Bentonite grout
165			Clayey SAND, brown, fine grained, slightly moist, sub-rounded, well sorted, unconsolidated, quartz rich with some potassium feldspar		
180			Silty SAND, brown, very fine to fine grained, slightly moist to moist, sub-rounded, well sorted, unconsolidated, quartz rich with some potassium feldspar Fine to coarse grained at 183' bgs		
190			Clayey SAND, brown, fine to medium grained, slightly moist, sub-angular, moderately well sorted, unconsolidated Quartz rich with some potassium feldspar at 188' bgs		
200					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/20/09	355.00
7/21/09	362.50
7/22/09	356.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CAREL.GDT 8/7/09

LOG OF MONITOR WELL NO. OW-2

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 381 feet
Date Boring Started: 7/19/2009
Date Boring Completed: 7/21/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
205			Sandy CLAY, brown, medium to coarse grained, slightly moist to moist, sub-rounded, unconsolidated, quartz rich		
210			CLAY, brown to reddish brown, slightly moist, trace of coarse grained sand Hard drilling		
215			SAND, tan to brown, very fine to fine grained, slightly moist, sub-angular, well sorted, unconsolidated, quartz rich with some potassium feldspar		
220			Sandy SILT, brown to dark brown, very fine grained, moist to wet, sub-rounded, well sorted, unconsolidated, quartz rich		
225			Clayey SAND, coarse grained, slightly moist to moist, sub-angular, moderately well sorted, quartz rich with potassium feldspar		
230			SAND, brown, medium grained, slightly moist, sub-angular, well sorted, unconsolidated, quartz rich with some potassium feldspar and other multi-colored minerals		
235					
240					
245					
250					Bentonite grout
255			Silty SAND, tan, very fine grained, slightly moist, sub-rounded, well sorted, unconsolidated		
260					
265			Slightly moist to moist with trace clay at 265' bgs		
270			Moist to wet at 270' bgs		
275			Clayey SAND, dark brown, medium grained, moist to wet, sub-angular, moderately well sorted, unconsolidated, arkosic, some other multi-colored minerals present, trace of clay		
280					
285					
290					
295					
300					

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations	
Date	Depth
7/20/09	355.00
7/21/09	362.50
7/22/09	356.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▽ Water level after drilling.

MW WITH WELL DETAILS AND LOGO BORING LOGS.GPJ CARELGDT 8/7/09

LOG OF MONITOR WELL NO. OW-2

Project Description: Clint Landfill

Location: Clint Landfill

Surface El.:
Completion Depth: 381 feet
Date Boring Started: 7/19/2009
Date Boring Completed: 7/21/2009

Depth, feet	Samples	Symbol/USCS	MATERIAL DESCRIPTION	Monitor Well Construction Details	Monitor Well Description
305					
310			Silty SAND, brown, very fine grained, moist to wet sand, well rounded, well sorted, unconsolidated		
315					
320					Bentonite grout from 2' to 351' bgs
325					
330					
335			Clayey SAND, brown, medium to coarse grained, slightly moist to wet, poorly sorted, unconsolidated, quartz rich with potassium feldspar (arkosic), some other multi-colored minerals present		
340			SAND, brown, medium to coarse grained, moist, sub-rounded, moderately well sorted, arkosic with some other multi-colored minerals present		
345					
350					
355			Wet at 355' bgs		Bentonite seal from 351' to 357' bgs
360			Sandy CLAY, reddish brown, medium to coarse grained, moist to wet, poorly sorted		
365			CLAY, brown to reddish brown Hard drilling		Slotted screen from 359' to 379' bgs
370					
375					
380					Silica sand from 357' to 388' bgs
385					
390					
395					
400					

STATE OF TEXAS
KEVIN T. CAREL
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PROFESSIONAL GEOSCIENTIST
10-28-09

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary w/ Casing Advance
Sampling Method: Cuttings
Geologist/Engineer: SJW/KTC
Project No.: 09-01-08

Groundwater Observations

Date	Depth
7/20/09	355.00
7/21/09	362.50
7/22/09	356.20

Remarks: 10" diameter boring, 4" schedule 80 PVC casing. One centralizer at top and bottom of screen, then one centralizer every 40'.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

▽ Water level at time of drilling.
▽ Water level at end of drilling.
▼ Water level after drilling.

MW WELL DETAILS AND LOGS BORING LOGS.GPJ CAREL.GDT 8/7/09

ATTACHMENT III.E.13 – HISTORICAL BORING LOG NOTES

PROJECT NO. 96-182-00 BORING NO: PC DATE: 8-2-98

DRILL CREW: MD/VM/JSM RIG: CME-75 WEATHER:

PROJECT NAME: Clint Landfill - Project PAGE: 1 OF 2

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	SAMPLE B	SAMPLE Q	SAMPLE CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	DEPTH TO	DESCRIPTION: COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
5 – 6½		Hollow Stem			9 14 24	SPT Data		0'	10'	Light bra SAND. FINE FAN. poorly graded. DENSE. DRY
10 – 11½		Auger			5 8 12	41				w/ some CALCAREOUS NODULES @ 11'
15 – 16½					6 21 27	73				- clay PARTING @ 11½
20 – 21½					4 14 19	68				
25 – 26½					26 20 30	73				
30 – 31½					5 18 32	73				
35 – 36½					12 40 60/2"	73		10'	–	SAND, fine, light bra, poorly graded, very dense, dry
40 – 41½					20 50/6"	73				- dense below 20 ft.
45 – 46½	15				15 25 25/4"	73				- silty below 25 ft.
50 – 51½					24 26	73				- very dense below 35 ft.
55 – 56½					12 26 24/5"	73				
60 – 61½					16 50/3"			50½	51½	Clay, bra, hard, dry
65 – 66½					28 50/8"			51½	65	SAND, fine grained, light bra, silty dense, dry, slightly silty
70 – 71½					20 50/6"			65	66	Clay, bra, hard, dry
75 – 76½					10 50/3"			66	106	SAND, fine grained, silty, light bra very dense, dry
80 – 81½					27 50/6"					- poorly graded below 80 ft.
85 – 86½					22 50/6"			106	106½	tan Clay lense (seam), bra, hard, moist.
90 – 91½					10 40 10/1"			106½	110	SAND, fine grained, silty, light bra, poorly graded, very dense, dry
95 – 96½					4 40 10/1"				155	- wet. drained below 110 feet
100 – 101½					50/6"					
105 – 106½					4 22 21	68				
110 – 111½					50/6"	73				

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						

PROJECT NO.: 96-182-00 BORING NO.: 3-1 DATE: 8/25

DRILL CREW: MD + VAL / JSM RIG: CME WEATHER: Clear / hot 85-95

PROJECT NAME: Clint Landfill Permit Amendment PAGE: 2 OF 2

Raba Kistner

DRILLING METHOD: ☑ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☐ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS		POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
115-116½	SPT Data				17	50/6"			155	162	Clay, brn, hard, ~~moist~~ wet (Sandy ~~bel~~ (Perched water at 156 ft)
120-121½					13	~~30~~ 50/6"					
125-126½					28	50/6"			162	166	SAND, fine grained, light brn, poorly graded, very dense, ~~dry~~ moist
130-131½					10	50/6"					
135-136½					25	50/4"			166	~~[illegible]~~	SAND, fine grained, light brn, poorly graded, very dense, dry
140-141½					35	50/4"					
145-146½					28	50/6"					
150-151½					18	16 34		156'	197		- ~~sand stone~~ were encountered at 170 ft (very dense sands
155-156½					30	50/3"					
160-161½					30	50/4"					
165-166½					26	50/6"	(Auger Boring)		197	—	SAND, Fine Grained, Brown
170-171½					50/2"		(Auger boring)				
175-176½					50/6"		(Auger boring)		300	—	w/ Clay seams below 300 ft. bgs ~340 ft
180-181½					50/6"						Boring terminated at ~~[illegible]~~ feet
185-186½					50/6"						
190-191½					50/6"						perched water at ~155 feet
195-196½					50/3"						
200-201½	Mud rotary ~200'										

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
			~340		~280	Moist
WATER LEVEL						
WATER LEVEL		Verify After Well Development				
WATER LEVEL						

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PROJECT NO: AEA96-182-CO BORING NO: J-4 DATE: 10/13/98

DRILL CREW: MD/CV/Manny Danny RIG: CME-75 WEATHER: ~~Sunny~~ Partly Cloudy

PROJECT NAME: Clintland Fill PAGE: ____ OF ____

Raba Kistner

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS			POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
5-6½					6	5	9	14				
10-11½	Hollow				10	19	24	43		0	60	SAND, fine to mud grained, Tan, poorly graded,
15-16½	stem Auger				2	9	9	18				med dense to very dense, dry
20-21½	Drilling				11	34	16/3"	50/3"				
30-31½					12	43	7/1"	50/1"				
40-41½					17	19	31	50				- with some calcareous material at 11 feet
50-51½					5	8	25	33				
60-61½					6	31	19/4"	50/4"				- with clay lenses from 40 to 60 feet
70-71½					12	29	21/5"	50/5"				
80-81½					13	32	18/3"	50/3"		60	218	SAND, fine grained, Tan, poorly graded,
90-91½					23	50/6"		50/6"				very dense, dry
100-101½					40	40	10/2"	50/2"				
110-111½					12	32	18/3"	50/3"				- with clay lenses at 70 feet
120-121½					25	50/5"		50/5"				
130-131½					27	38	12/3"	50/3"				- with some calcareous material and clay lenses
140-141½					27	50/5"		50/5"				below 90 feet.
150-151½					32	50/4"		50/4"				
160-161½					37	50/3"		50/3"	Approx	218	224	Clay, Sandy, Brown, Hard, Moist
170-171½					41	50/2"		50/2"				
180-181½						50/2"		50/2"		224	375	SAND, fine to mud grained, tan, poorly graded, very
200-201½						50/4"		50/4"				dense, ~~dry~~ moist
~~[illegible]~~	~Mud Rotary*											
250-251½						50/6"						- with clay lenses ranging from 1" to 4" below 335'

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
			~388-393		—	
WATER LEVEL						
WATER LEVEL		* Measured after Weull installation				
WATER LEVEL		to confirm depth.				

• ~~[illegible]~~ H_2O - Approx. ~325-335 Visco

X - Albino, please include N-values on boring log.

PROJECT NO. AEA96-182-00 BORING NO: PB-4 DATE: 10/13/88

DRILL CREW: MD/CV/Manny/Danny RIG: CME-75 WEATHER: Partly Cloudy

PROJECT NAME: Clinton Landfill PAGE: OF

Raba Kistner

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT, FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☐ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	SAMPLE B	SAMPLE Q	SAMPLE CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	DEPTH TO	DESCRIPTION: COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
335		S			50/4"	Visual		~		SPT sampling with S.P. and mudrotary drilling.
375		S			50/+"	Visual				Termination ~ 388' (Need to Continue)

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						

PROJECT NO. AEA96-182-00 BORING NO: Piezometer Boring - PB-18 DATE: 12-5-98

DRILL CREW: MD/VM/DG/JR/JSM RIG: CME-75 WEATHER:

PROJECT NAME: Clint Landfill - Permit App PAGE: 1 OF

DRILLING METHOD: ☒ HOLLOW STEM AUGER / Mud-Rotary ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

Raba Kistner

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS			POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
SPT Data												
5-6½					5	10	12	H.O.	Drilling			- Calcareous material, gravel scattered on surface. Fine sands on surface
10-11½					4	14	20					Note in area with dunes or hilly topo.
15-16½					7	26	33					
20-21½					6	15	23					SAND
30-31½					9	30	44			0	18'	~~SAND~~, Fine Grained, Poorly Graded,
40-41½					5	16	19					Med. Dense, Dry
50-51½					5	18	31					
60-61½					10	30	50/5"					~ w/ coarse grained sands
70-71½					6	18	35					
80-81½					8	28	33					w/ Fine gravels + dense @ 10 feet bgs.
90-91½					7	35	50					
100-101½					12	17	20			18'	92'	SAND, Fine Grained, Silty, Poorly Graded
110-111½					10	15	18					
120-121½		(VP)			25	50/5"		SPT-Refusal				~ Med to Coarse grained sands
130-131½					27	50/4"						w/ interbedded clayey seams
140-141½					18	50/5"						
150-151½					12	38	34			92'		CLAY, Sandy, Brown, V. Hard
160-161½					23	42	50/5"					~ 111 ft. bgs
170-171½					25	50/3"		(200')				
180-181½					35	50/3"				120'	200	SAND, F to M.G., Poorly Graded, Very Dense
190-191.5					30	50/2"		Mud Rotary				with traces of cal. material ~~sand~~, fine gravel and lenses of clay.
										200 ~		+ SAND...
										~300		- Based on Mud Cutting - Clay stratum, very dense or hard
												Approx. Termination Depth 366 ±

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
		~366-375			Moist - ?	
WATER LEVEL						
WATER LEVEL		Need to Confirm ? AD				
WATER LEVEL	* Confirm After Development!					

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PROJECT NO. 96-182-00 BORING NO: B-21 DATE: 12/3/98 / 12/5/98

DRILL CREW: MD / VM / JSM RIG: CME-75 WEATHER: Clear-cool

PROJECT NAME: Clint landfill Permit App. PAGE: OF

Raba Kistner

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	SAMPLE B	SAMPLE Q	SAMPLE CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	DEPTH TO	DESCRIPTION: COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
5-6½		SPT	Data		7 ~~12~~ 14					
10-11½					8 16 ~~20~~			0	–	SAND, Fine to Med. G., Silty, Brown to Tan, P.G., med. Dense with traces of cal. material.
15-16½	o	Holl Stem			6 11 20					
20-21½		Drilling			8 12 20					
30-31½					4 12 26					
40-41½					14 32 ~~28~~					
50-51½					11 25 48					~ traces of cal. material at 13 ft.
60-61½					18 38 48					
70-71½					~~50/3"~~ 12	42/50/4" (V.P.)		13'	~	SAND, Fine Grained, Brown with traces of fine gravel
80-81½					42 50/3"					
90-91½					12 50/4"			70'	±	~ w/ traces of cal. nodules at 70 ft. Very loose, ~~apparent~~ apparent cemented balls.
100-101½					18 50/6"					
110-111½					10 30 38					
120-121½					32 50/6"					
130-131½					~~50/6"~~ ~~50/6"~~ 11	15/50/6"	V.P.			
140-141½					~~50/6"~~ ~~50/6"~~ 28	50/5"		111'	~	clay seams at 111 ft. bgs.
150-151½					50/6"					
160-161½					50/4"					
170-171½					50/6"			200'	~	SAND, Fine to Med., Brown
180-181½					11 32	50/5"				→ View of Mud Rotary Cuttings:
190-191½					50/4"					~ SAND (Yellow) 200 ft.
200-201½		Mud Rotary								~ w/ traces of interbedded clays (layers)

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
			~390 ft.		*	
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						

~~*~~ Measured after completion of Piezometer ~ Wet below 365 ft.

~ Clay seams noted below 300 feet

Page 102

PROJECT N. AEA96-182-CO BORING NO: S-21 DATE: 12/3 12/5/98

DRILL CREW: MD / VM / JSM RIG: CME WEATHER:

PROJECT NAME: Clive Landfill PAGE: OF

DRILLING METHOD: ☐ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

Raba Kistner

Seal

SAMPLE DEPTH	SAMPLE J	SAMPLE B	SAMPLE Q	SAMPLE CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	DEPTH TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
200 ↓					Mud Rotary ↓			200	+	Mud Rotary Sples from Cuttings – primarily sands with traces of clay lumps
								250	–	Sple – * Sples have ~~bentonite~~
								270	–	sple
								300	–	Sple
								350	–	Sple
								390		Sple
										385 – 390 Visual Observation
										* Visual Sples in lab for descriptions

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						

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PROJECT NO: Chat – AEA96-182-CO BORING NO: P1 ~~[illegible]~~ 29 DATE: 11/13/98

DRILL CREW: VM / RA / AC / JSM RIG: CME-75 ~~[illegible]~~ WEATHER:

PROJECT NAME: Clintlandfill – Project PAGE: 1 OF —

Raba Kistner

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS			POCKET PEN	CORE % REC
~~0 – 5~~ 5-6½	SPT-Data				10	20	20		
10 – 11½	Hollow Stem				15	15	18		
15 – 16½	Auger				8	21	29		
20 – 21½					12	9	15		
30 – 31½					7	21	29		
40 – 41½					7	14	21		
50 – 51½					7	30	20/4"		
60 – 61½					8	22	28		
70 – 71½					12	44	6/2"		
80 – 81½					9	18	32		
90 – 91½					7	27	23		
100 – 101½					12	21	29		
110 – 111½					7	33	17/3"		
	Mud Rotary Below 200 ft.								

DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
0 –	5'	SAND, fine grained, light brown – whitish, clay whitish Dense, dry, calcareous
5 –	13'	SAND, fine grained, brown, clayey, Dense, moist.
13' –	38'	SAND, fine grained, brown, poorly graded Dense, dry
		– Gravelly below 14 feet
38' –	~~111½~~ ~~[illegible]~~	SAND, fine grained, brown, poorly graded Dense, dry
		~~Silty below 100 ft~~
		Auger Cuttings:
111½' –		– ~~Start~~ Silty Sands below 111½ – with traces of clay
310'		– Clay seams below 310', based on clay lumps from mud rotary cutting
		H_2O – confirmed with a split-spoon ~Moist ~~[illegible]~~ Below ~370'
		→ Boring Terminated at ~396'

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
			~396		~370'	
WATER LEVEL	* Confirm during well development?					
WATER LEVEL						
WATER LEVEL						
BORING FILLED						

PROJECT NO. AEA76-182-00 BORING NO: 3-32 DATE: 12-23-98

DRILL CREW: RK-MD/DG/JW RIG: CME-75 WEATHER:

PROJECT NAME: Clint Landfill Project PAGE: 1 OF

Raba Kistner

DRILLING METHOD: ☒ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
	Piezometer Boring									— Traces of gravel and cal. material at the surface
					Hollow Stem Auger Drilling			0		SAND, Fine Grained, Tan, Med. Dense to Very Dense Slightly Moist to Dry
										— traces of cal. nodules & clayey lenses
								190	155	— with some fine gravel @ 190' ft
					* Mud Rotary below ~200 - 210 ft.					— ~~w/ some clay at 240 ft.~~
								~195		SAND, F to Med. G., Brown, P.G., Dense, Slightly Moist
										w/ some clay at 240 ft.
										~ Hard and Slow Drilling ~~below~~ to 260 - 280 ft. (possible cal. material)
								290		SAND, Clayey, Fine G., App. Brown, with fine gravel and traces of dg. lumps
								355		Cl. Brown, Very Stiff to Hard with

* Ref: Drillers Notes for Well Info. ..

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
			~400 - ~~405~~ 407		~376 - ~~380~~ 385 ft	
WATER LEVEL	Need to Confirm - AD					
WATER LEVEL						
WATER LEVEL						

PROJECT NO: EA 96-182-01 BORING NO: B-6 B-36 DATE: 7/25/00 – 8/1

DRILL CREW: LISARA DRILLING – JSM RIG: Lisara Drilling WEATHER: Clear

PROJECT NAME: Clint Landfill – Permit Project PAGE: ____ OF ____

Raba Kistner

DRILLING METHOD: ☐ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
	No SPT Data							0	25'	SAND, coarse grained, silty, light brown
								25'	55'	—
	Mud Rotary Drilling							55'	57'	CLAY, sandy, brown
								57'	108	SAND, ~~coarse~~ grained, silty, light brown
								108'	303'	CLAY, sandy, reddish brown.
								~~303'~~	~~325'~~	
								(303		Undisturb sample 150 blows/6")
								303	325	~~CLAY, sandy, reddish brown w/~~ w/gravel
								325	370	SAND, fine grained, clayey light brown, calcareous
								(at 353		Undisturb sample 150 blows/6")
								370'	400'	SAND, fine to medium grained, brown poorly graded.
								(400'		Undisturb sample 150 blows/4")
								400'	405'	CLAY, sandy, reddish brown.
										Boring terminated at 405 feet
								*		Water level measured after water well development. ~345 ft.

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
		~	405 ft.		?	
WATER LEVEL						
WATER L						
WATER LEVEL						

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PROJECT NO: IH76-102-01 BORING NO: ~~3~~ ~~2~~ JB 37 DATE: 8/8 - 8/11 Miguel Glayer 594-194-

DRILL CREW: Lisara Drilling - JSM RIG: Laisson Drilling WEATHER: Clear

PROJECT NAME: Clint Landfill Permit PAGE: 1 OF 2

Raba Kistner

DRILLING METHOD: ☐ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	B	Q	CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
	No SPT Data							0	6'	SAND, fine grained, Clayey, light brown - whitish, calcareous.
	Mud Rotary Drilling							6'	16'	SAND, fine grained, reddish.
								16'	102'	SAND, fine to coarse grained, light brown, poorly graded.
								102'	103	Clay, Reddish brown
								103	126'	SAND, fine to coarse grained, light brown, Clayey.
								126'	129'	CLAY, Reddish brown, w/sand.
								129'	133	SAND, medium grained, light brown, Clayey
								133	143	CLAY, Reddish brown, w/sand.
								143	160'	SAND, ~~medium~~ fine to grained, light brown,
										~~Stop at 160' for 8/8/00.~~
					Stop 265 8/9/00			160'	210'	SAND, fine grained, light brown
								210	212	Clay, Reddish brown.
								212	240	SAND, fine grained, light brown
										232 → Cemented sand / conglomerate 238
								240		SAND, fine grained, light brown poorly graded w/ cemented ~~conti~~ sand

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						
BORING FILLED						

PROJECT NO: UEA 96-182-01 BORING NO: 1-39 DATE: 8/10/00 8/8-8/11 (2)

DRILL CREW: CISAKA Drilling - JSM RIG: WEATHER:

PROJECT NAME: Clint Landfill - Permit Application PAGE: 2 OF 2

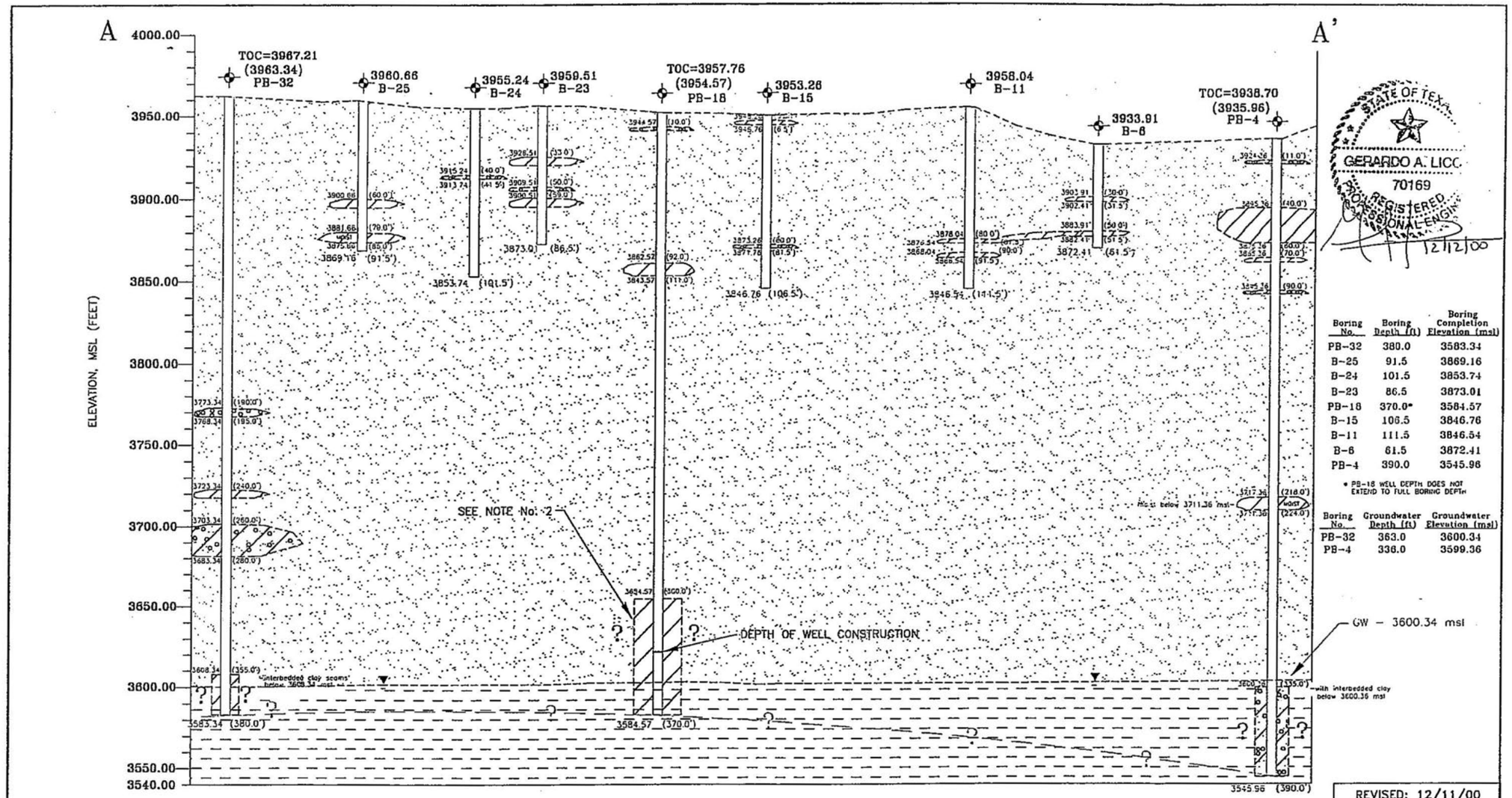
Raba Kistner

DRILLING METHOD: ☐ HOLLOW STEM AUGER ☐ STRAIGHT FLIGHT AUGER ☐ CORE ☐ AIR ROTARY ☒ MUD ROTARY

SAMPLE DEPTH	SAMPLE J	SAMPLE B	SAMPLE Q	SAMPLE CB	BLOW COUNTS	POCKET PEN	CORE % REC	DEPTH FROM	DEPTH TO	DESCRIPTION COMPOSITION, STRUCTURE, CONSISTENCY, COLOR, DEGREE, OF MOISTURE
		Note: caving in at 220' recorded 8/10/00						265	365	SAND, fine grained, light brn, dense, poorly graded.
								365	403	~~SAND, fine grained w/ clayey~~ Clayey below 365' ↳ Reddish brown clay nodules
										* Depth to Water Measured after Well Development ≈ 365-370 ft.

BORING DEPTH AND WATER LEVELS AT COMPLETION	DATE	TIME	TOTAL DEPTH	BORING BAILED TO	DEPTH TO WATER	DEPTH TO BOTTOM
		≈400			≈ 370	(See Note *)
WATER LEVEL						
WATER LEVEL						
WATER LEVEL						

ATTACHMENT III.E.14 – FACILITY CROSS SECTIONS



Boring No.	Boring Depth (ft)	Boring Completion Elevation (msl)
PB-32	380.0	3583.34
B-25	91.5	3869.16
B-24	101.5	3853.74
B-23	86.5	3873.01
PB-18	370.0*	3584.57
B-15	106.5	3846.76
B-11	111.5	3846.54
B-6	61.5	3872.41
PB-4	390.0	3545.96

* PB-18 WELL DEPTH DOES NOT EXTEND TO FULL BORING DEPTH

Boring No.	Groundwater Depth (ft)	Groundwater Elevation (msl)
PB-32	363.0	3600.34
PB-4	336.0	3599.36

STATE OF TEXAS
GERARDO A. LICC
70169
REGISTERED PROFESSIONAL ENGINEER
12/12/00

REVISED: 12/11/00

PLATE 3 PAGE 4

LEGEND

- BORING AND SURFACE ELEVATION
- GROUNDWATER ELEVATION
- AQUIFER
- CLAYEY SOILS (USCS: CH, CL)
- SANDY SOILS (USCS: SM, SP, SP-SM, SC, SW)
- SAND (poorly graded, silty sands and/or clayey sands)
- CLAY
- CALCAREOUS SANDS WITH CLAY
- FINE GRAVEL
- WATER

CROSS SECTION A - A'

VERTICAL SCALE
SCALE (1"=60')
0 60' 120'

NOTES:
1. CROSS SECTIONS SHOWS ONLY PROJECTED BORINGS ONTO CROSS SECTION A-A'
2. PB-18 DEPTH OF WELL CONSTRUCTION DID NOT INTERSECT GROUNDWATER
3. TOC= TOP OF CASING ELEVATION FOR PIEZOMETER BORINGS
4. —?— — LITHOLOGY IS INFERRED BELOW TOTAL DEPTH OF PB-4, PB-18 AND PB-32
5. PIEZOMETER BORINGS REPORT SURFACE ELEVATIONS AFTER PIEZOMETER BORING INSTALLATION
6. ALL OTHER BORINGS INDICATE ELEVATIONS PRIOR TO DRILLING ACTIVITIES

SECTION A - A'
PROPOSED CLINT
LANDFILL SITE
CLINT, EL PASO COUNTY, TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

PROJECT NO.: AEA96-162-00
DRAWN BY: AR
CHK BY: JR
APP'D: ALW
SCALE: 1"=60'
ACAD NO.: AEA96182
DATE: 05-16-98

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

NORTH

BURNS McDONNELL

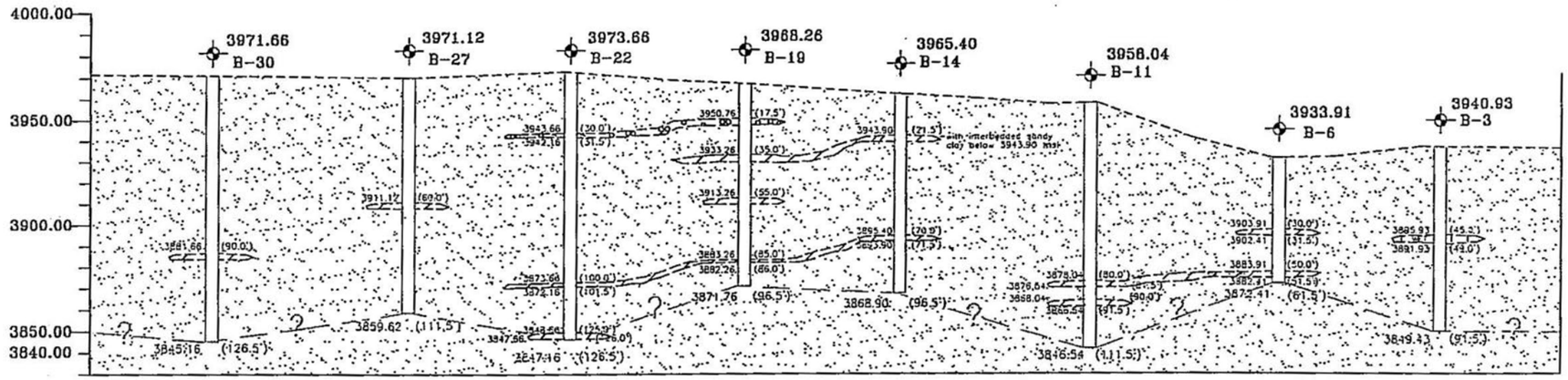
Attachment III.E.14A
Facility Cross Section A-A'
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023

B

B'



Boring No.	Boring Depth (ft)	Boring Completion Elevation (msl)
B-30	126.5	3845.16
B-27	111.5	3859.62
B-22	126.5	3847.16
B-19	96.5	3871.76
B-14	96.5	3868.90
B-11	111.5	3846.54
B-6	61.5	3872.41
B-3	91.5	3849.43

CROSS SECTION B - B'

LEGEND

- BORING AND SURFACE ELEVATION
- CLAYEY SOILS (USCS: CH, CL)
- SANDY SOILS (USCS: SM, SP, SP-SM, SC, SW)
- SILT SOILS (USCS: ML)
- SAND (poorly graded, silty sands and/or clayey sands)
- CLAY
- SILT
- FINE GRAVEL

NOTES:

1. CROSS SECTIONS SHOW ONLY PROJECTED BORINGS ON TO CROSS SECTION B-B'
2. —?— - LITHOLOGY IS INFERRED BELOW TOTAL DEPTH OF BORINGS B-30, B-27, B-22, B-19, B-14, B-11, B-6 AND B-3
3. BORINGS INDICATE ELEVATIONS PRIOR TO DRILLING ACTIVITIES

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED
PROFESSIONAL ENGINEER
12/12/00

VERTICAL SCALE
SCALE (1"=60')
0 60' 120'

REVISED: 12/11/00

PLATE 4 PAGE 5

BORING CROSS-SECTION
SECTION B - B'
PROPOSED CLINT
LANDFILL SITE
CLINT, EL PASO COUNTY, TEXAS

THE CITY OF EL PASO TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

PROJECT NO: ALA96-182-00
CHK BY: JR
REVISED BY: AA
SCALE: 1"=60'
ACAD NO: ALA96182
APPRD: ALW
DATE: 06-27-00

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

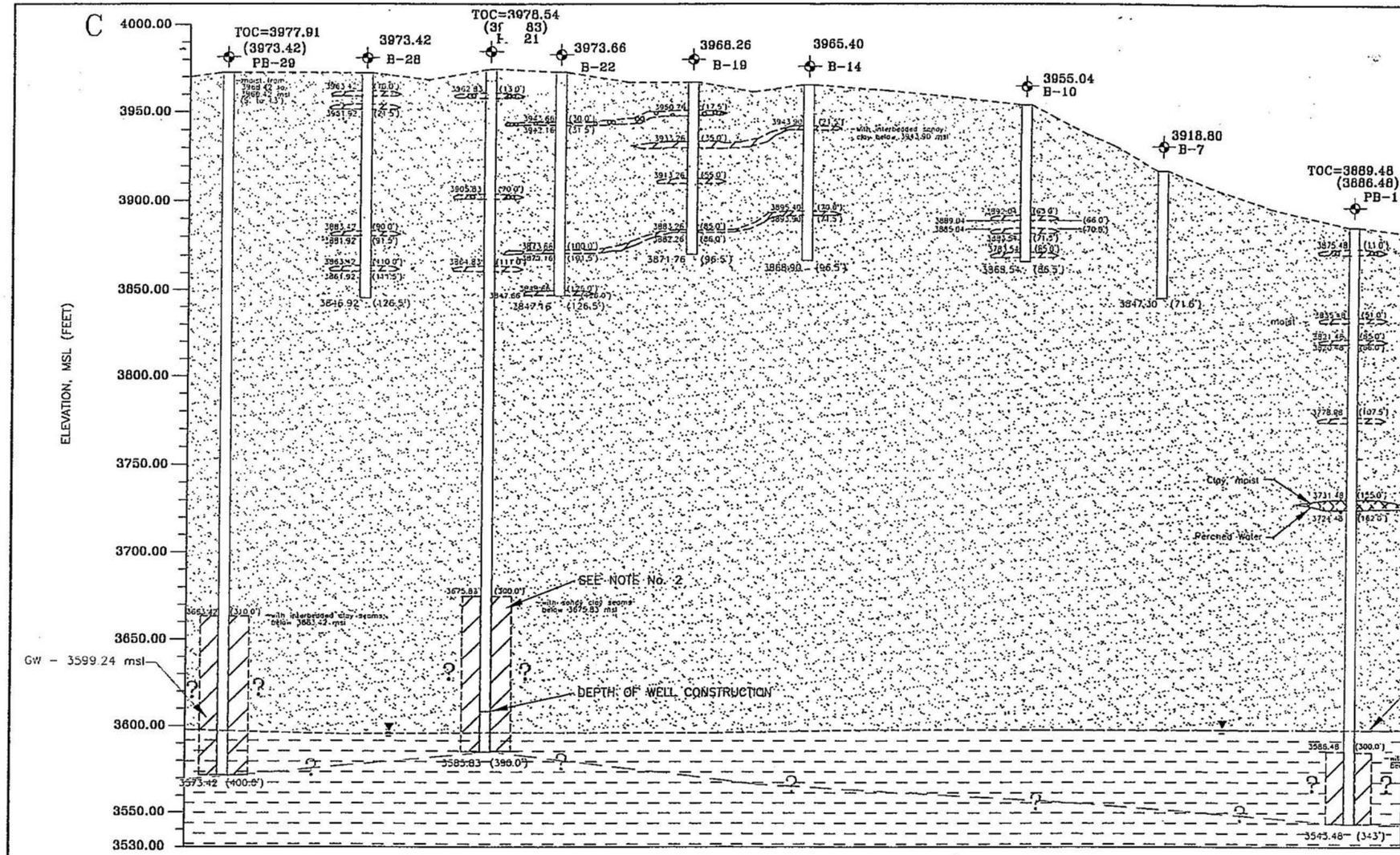
NORTH

BURNS McDONNELL

Attachment III.E.14B
Facility Cross Section B-B'
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023



Boring No.	Boring Depth (ft)	Boring Completion Elevation (msl)
PB-29	400.0	3573.42
B-28	126.5	3846.92
PB-21	390*	3585.83
B-22	126.5	3847.16
B-19	96.5	3871.76
B-14	96.5	3868.90
B-10	86.5	3868.54
B-7	71.5	3847.30
PB-1	343.0	3543.48

* - PB-21 WELL DEPTH DOES NOT EXTEND TO FULL BORING DEPTH

Boring No.	Groundwater Depth (ft)	Groundwater Elevation (msl)
PB-29	374.0	3599.24
PB-1	286.0	3600.48

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER
12/12/00

CROSS SECTION C - C'

VERTICAL SCALE
SCALE (1"=60')
0 60' 120'

LEGEND:

- BORING AND SURFACE ELEVATION
- GROUND WATER ELEVATION
- CLAYEY SOILS (USCS: CH, CL)
- SANDY SOILS (USCS: SM, SP, SP-SM, SC, SW)
- PERCHED WATER (Encountered during our drilling activities)
- SAND (poorly graded, silty sands and/or clayey sands)
- CLAY
- GRAVEL
- CALCAREOUS SANDS WITH CLAY
- WATER

NOTES:

1. CROSS SECTIONS SHOWS ONLY PROJECTED BORINGS ONTO CROSS SECTION C-C'
2. PB-21 DEPTH OF WELL CONSTRUCTION DID NOT INTERSECT GROUNDWATER
3. TOC= TOP OF CASING ELEVATION FOR PIEZOMETER BORINGS
4. —?— - LITHOLOGY IS INFERRED BELOW TOTAL DEPTH OF PB-29 and PB-1
5. PIEZOMETER BORINGS REPORT ELEVATIONS AFTER PIEZOMETER BORING INSTALLATION
6. ALL OTHER BORINGS INDICATE ELEVATIONS PRIOR TO DRILLING ACTIVITIES

REVISED: 12/11/00

PLATE 5 PAGE 6

BORING CROSS-SECTION
SECTION C - C'
PROPOSED CLINT
LANDFILL SITE
CLINT, EL PASO COUNTY, TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

NORTH

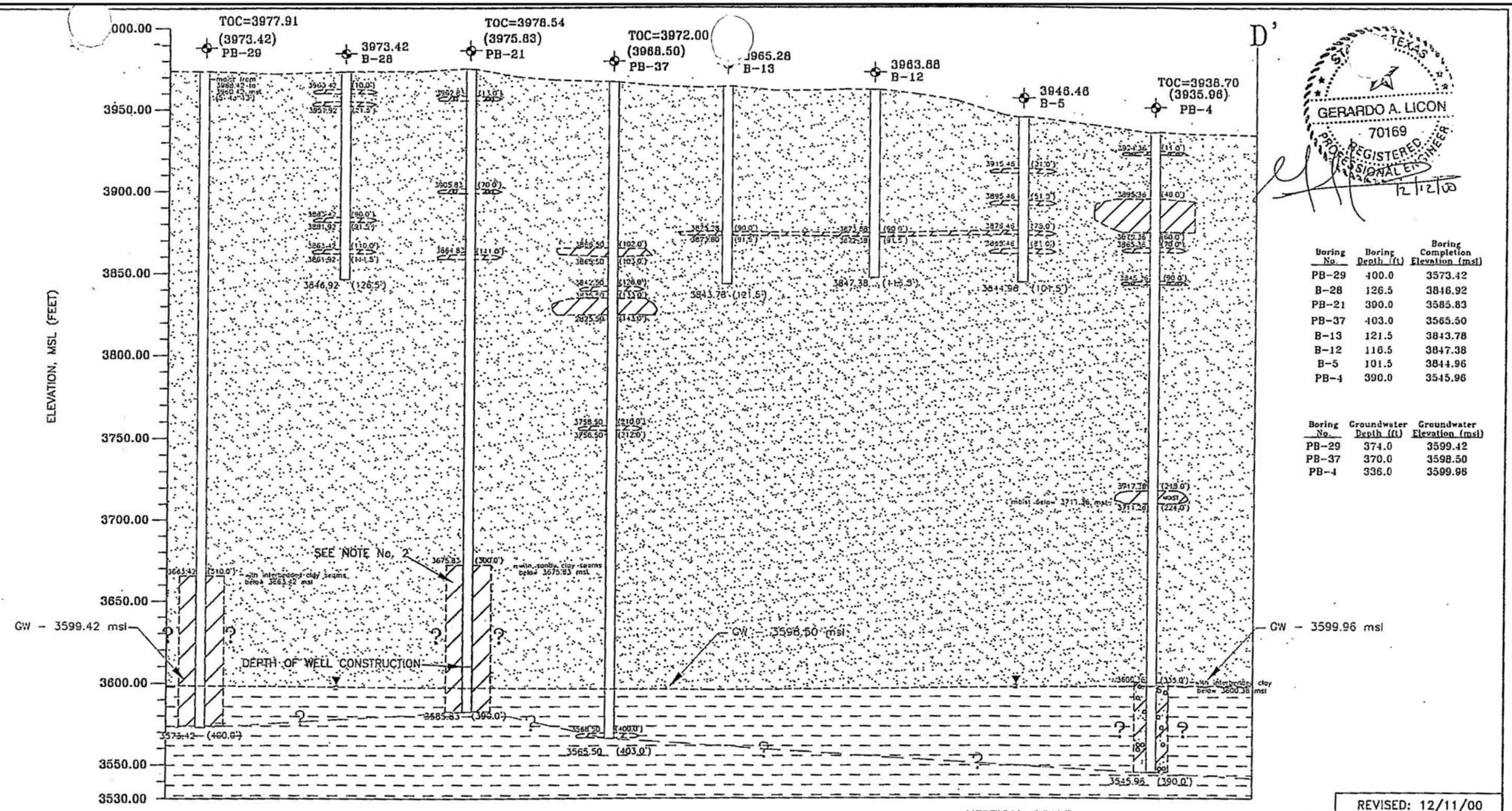
BURNS McDONNELL

Attachment III.E.14C
Facility Cross Section C-C'
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:

Source: Esri, BMcD

Issued: 11/30/2023



GERADO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
12/12/00

Boring No.	Boring Depth (ft)	Boring Completion Elevation (msl)
PB-29	400.0	3573.42
B-28	126.5	3846.92
PB-21	390.0	3585.83
PB-37	403.0	3565.50
B-13	121.5	3843.78
B-12	116.5	3847.38
B-5	101.5	3844.96
PB-4	390.0	3545.96

Boring No.	Groundwater Depth (ft)	Groundwater Elevation (msl)
PB-29	374.0	3599.42
PB-37	370.0	3598.50
PB-4	336.0	3599.96

REVISED: 12/11/00

LEGEND:

- BORING AND SURFACE ELEVATION
- GROUND WATER ELEVATION
- CLAYEY SOILS (USCS: CH, CL)
- SANDY SOILS (USCS: SM, SP, SP-SM, SC, SW)
- SAND (poorly graded, silty sands and/or clayey sands)
- CLAY
- WATER
- CALCAREOUS SANDS WITH CLAY

CROSS SECTION D- D'

VERTICAL SCALE
SCALE (1"=60')
0 60' 120'

NOTES:
1. CROSS SECTIONS SHOWS ONLY PROJECTED BORINGS ONTO CROSS SECTION D-D'
2. PB-21 DEPTH OF WELL CONSTRUCTION DID NOT INTERSECT GROUNDWATER
3. TOC= TOP OF CASING ELEVATION FOR PIEZOMETER BORINGS
4. —?— – LITHOLOGY IS INFERRED BELOW TOTAL DEPTH OF PB-29, PB-37 and PB-4
5. PIEZOMETER BORINGS REPORT ELEVATIONS AFTER PIEZOMETER BORING INSTALLATION
6. ALL OTHER BORINGS INDICATE ELEVATIONS PRIOR TO DRILLING ACTIVITIES
7. BORING B-20 WAS OMITTED FROM THE CROSS-SECTION DUE TO THE CLOSE PROXIMITY OF PB-37

PLATE 6 PAGE 7

BORING CROSS-SECTION
SECTION D – D'
PROPOSED CLINT
LANDFILL SITE
CLINT, EL PASO COUNTY, TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

PROJECT NO. 0618-182-00
DRWN BY: JW
CHK BY: ALW
APPR'D BY: ALW
REVISED BY: AA
DATE: 06-28-00
SCALE: 1"=60'

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

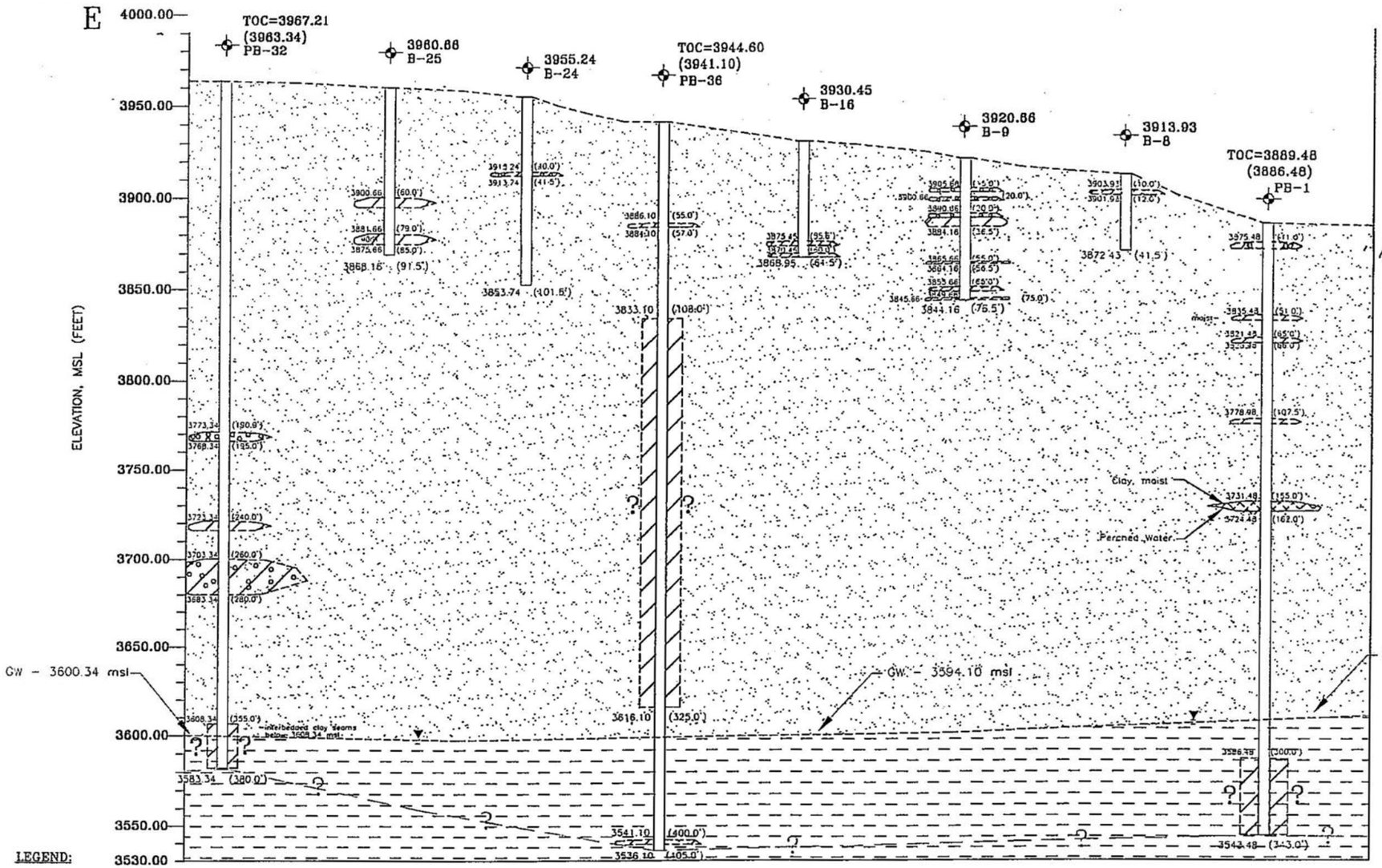
NORTH

BURNS McDONNELL

Attachment III.E.14D
Facility Cross Section D-D'
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023



STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED
PROFESSIONAL ENGINEER
12/12/00

Boring No.	Boring Depth (ft)	Boring Completion Elevation (msl)
PB-32	380.0	3583.34
B-25	91.5	3869.16
B-24	101.5	3853.90
PB-36	405.0	3536.10
B-16	61.5	3868.95
B-9	76.5	3844.16
B-8	41.5	3872.43
PB-1	343.0	3543.48

Boring No.	Groundwater Depth (ft)	Groundwater Elevation (msl)
PB-32	363.0	3600.34
PB-36	347.0	3594.10
PB-1	286.0	3600.48

NOTES:
1. CROSS SECTIONS SHOWS ONLY PROJECTED BORINGS ONTO CROSS SECTION E-E'
2. TOC= TOP OF CASING ELEVATION FOR PIEZOMETER BORINGS
3. —?— – LITHOLOGY IS INFERRED BELOW TOTAL DEPTH OF PB-32, PB-36 and PB-1
4. PIEZOMETER BORINGS REPORT ELEVATIONS AFTER PIEZOMETER BORING INSTALLATION
5. ALL OTHER BORINGS INDICATE ELEVATIONS PRIOR TO DRILLING ACTIVITIES
6. BORING B-17 WAS OMITTED FROM THE CROSS-SECTION DUE TO THE CLOSE PROXIMITY OF PB-36

CROSS SECTION E-E'

VERTICAL SCALE
SCALE (1"=60')
0 60' 120'

REVISED: 12/11/00

PLATE 7 PAGE 8

BORING CROSS-SECTION
SECTION E - E'
PROPOSED CLINT
LANDFILL SITE
CLINT, EL PASO COUNTY, TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

PROJECT NO: AEA96-182-09
CHK BY: JJR
APPD: ALW
DATE: 05-15-99
SCALE: 1"=60'
DRAWN BY: AR

For Permitting Purposes Only

Notes:
1. Drawing was previously produced and approved and is included for reference purposes only.

NORTH

BURNS McDONNELL

Attachment III.E.14E
Facility Cross Section E-E'
Greater El Paso Landfill
MSW Auth #2284A
El Paso County, Texas

Path: C:\GIS Projects\El Paso\El Paso Geology\El Paso Geology2.aprx embillings 11/30/2023
Service Layer Credits:
Source: Esri, BMcD

Issued: 11/30/2023

ATTACHMENT III.E.15 – MONITORING WELL SURVEYS

EXISTING PIEZOMETER ELEVATIONS AND LOCATIONS
CLINT LANDFILL TCEQ PERMIT NUMBER 2284

PB	LATITUDE NAD83	LONGITUDE NAD83	TOP OF CASING ELEV. "CITY DATUM"	TOP OF PROTECTIVE COLLAR LID ELEV. "CITY DATUM"	CHIS. X ELEV. "CITY DATUM"	TOP OF GROUND ELEV. "CITY DATUM"	GRID STATIONING
1	N 31°35'16.30682"	W 106°10'18.11317"	3889.38'	3889.76'	3886.86'	3886.57'	00+96.27 A+51.09
4	N 31°35'16.48553"	W 106°09'49.07538"	3938.53'	3938.96'	3935.88'	3935.47'	01+14.44 Z+63.28
18	N 31°35'43.97847"	W 106°10'08.36018"	3956.10'	3957.14'	3953.65'	3953.41'	28+93.01 I+94.79
21	N 31°35'51.16832"	W 106°09'49.62166"	3977.08'	3977.52'	3974.46'	3973.91'	36+19.76 Z+15.76
29	N 31°36'05.05356"	W 106°09'49.74076"	3976.73'	3977.29'	3974.54'	3974.04'	50+23.12 Z+05.35
32	N 31°36'05.13520"	W 106°10'18.08531"	3966.86'	3967.22'	3964.50'	3963.92'	50+31.27 A+53.48
36	N 31°35'44.52854"	W 106°10'16.28545"	3950.23'	3950.69'	3947.42'	3947.07'	29+48.59 C+09.19
37	N 31°35'43.68396"	W 106°09'49.95499"	3972.09'	3973.10'	3969.31'	3968.97'	28+63.33 Y+86.98

SURVEY MARKER IS A SET CHISELED "X" ON CONCRETE SLAB AT BASE OF PROTECTIVE COLLAR
CASING SHOTS ARE TAKEN ON A SET BLACK ARROW ON NORTH END EDGE OF TOP OF PVC PIPE

ELEVATIONS REPORTED HEREON ARE "CITY DATUM" AND ARE APPROXIMATELY 10.45 FEET LOWER IN ELEVATION THAN VALUES EXPRESSED IN NAVD88 DATUM

STATE OF TEXAS
REGISTERED
STEPHEN EARL COBB
4297
PROFESSIONAL
LAND SURVEYOR

9/3/2004

STEPHEN EARL COBB TX4297 NM10472 AZ25068
Huitt-Zollars

MONITOR WELL ELEVATIONS AND LOCATIONS
CLINT LANDFILL TCEQ PERMIT NUMBER 2284

MONITOR WELL	LATITUDE (NAD 83)	LONGITUDE (NAD 83)	TOP OF CASING ELEV. "CITY DATUM"	TOP OF PROTECTIVE COLLAR ELEV. (TUBE) "CITY DATUM"	TOP OF PROTECTIVE COLLAR LID ELEV. (CALC.) "CITY DATUM"	CHIS. X ELEV. "CITY DATUM"	TOP OF GROUND ELEV. "CITY DATUM"	GRID STATIONING
1	N 31°35'45.49545"	W 106°10'05.07538"	3971.31'	3971.52'	3971.85'	3969.31'	3968.74'	30+46.34 L+78.94
2	N 31°35'54.88274"	W 106°10'18.19697"	3962.19'	3962.24'	3962.57'	3960.19'	3959.37'	39+95.07 A+43.83
3	N 31°36'04.82422"	W 106°10'04.40160"	3967.48'	3967.52'	3967.85'	3965.30'	3964.69'	49+99.86 M+37.15
4	N 31°35'55.90347"	W 106°09'49.79769"	3975.54'	3975.33'	3975.65'	3973.31'	3972.63'	40+98.33 Z+00.49
5	N 31°35'46.56809"	W 106°09'49.57923"	3973.70'	3973.74	3974.07'	3971.60'	3970.92'	31+54.82 Z+19.46

SURVEY MARKER IS A SET CHISELED "X" ON CONCRETE SLAB AT BASE OF PROTECTIVE COLLAR
CASING SHOTS ARE TAKEN ON A SET BLACK ARROW ON NORTH END EDGE OF TOP OF PVC PIPE

ELEVATIONS REPORTED HEREON ARE "CITY DATUM" AND ARE APPROXIMATELY 10.45 FEET LOWER IN ELEVATION THAN VALUES EXPRESSED IN NAVD88 DATUM

6/30/2004
REV. 7/30/2004

STEPHEN EARL COBB TX4297 NM10472 AZ25068
Huitt-Zollars

STATE OF TEXAS REGISTERED STEPHEN EARL COBB 4297 PROFESSIONAL LAND SURVEYOR

DORADO ENGINEERING, INC,

2717 E. YANDELL ST. EL PASO, TX 79903 (915) 562-0002 FAX (915) 562-7743

October 18, 2007

RE: Clint Landfill-revised

I hereby certify that the following coordinates and elevations are a result of a survey performed by me on October 17,2007, and that they are a true and correct representation of location of the Monitoring Wells, Piezometers, and Survey Permanent Benchmarks, shown hereon to the best of my knowledge and belief. The values shown for the north and east coordinates are based on the Texas State Plane Coordinate System, Central Zone, NAD 1983. The elevations shown are mean sea level elevations based on NAVD 1988.

Ground Water Monitoring Wells

DESC.	NAD 83		NAVD 88	CITY DATUM		CITY DATUM
	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION
MW-1	10592031.4110	480791.6340	3981.6280	10592031.4110	480791.6340	3971.2080
MW-2	10593038.0010	479708.5280	3972.6510	10593038.0010	479708.5280	3962.2310
MW-3	10593978.5260	480952.4980	3977.9510	10593978.5260	480952.4980	3967.5310
MW-4	10593012.2080	482166.2750	3985.9780	10593012.2080	482166.2750	3975.5580
MW-5A	10592069.1780	482135.9860	3984.1500	10592069.1780	482135.9860	3973.7300

Conversion Factor

NAVD 88 – 10.42 = CITY DATUM

Piezometer

DESC.	NAD 83		NAVD 88	CITY DATUM		CITY DATUM
	NORTHING	EASTING	ELEVATION	NORTHING	EASTING	ELEVATION
PB-1	10589145.1470	479511.2610	3899.8940	10589145.1470	479511.2610	3889.4740
PB-4	10589031.5340	482020.5560	3949.0390	10589031.5340	482020.5560	3938.6190
PB-29	10593934.9770	482219.7630	3987.2470	10593934.9770	482219.7630	3976.8270
PB-32	10594071.9560	479772.5260	3977.5520	10594071.9560	479772.5260	3967.1320
PB-36	10591984.6350	479818.7620	3960.6990	10591984.6350	479818.7620	3950.2790
PB-37	10591780.0210	482088.4430	3982.5870	10591780.0210	482088.4430	3972.1670

SURVEY PERMANENT BENCHMARKS

MSW PERMIT NO. 1482

DESCRIPTION	NAD 83		NAVD 88	CITY DATUM
	NORTHING	EASTING	ELEVATION	ELEVATION
NORTHWEST MONUMENT	10594540.6790	477035.5890	3905.2000	3894.7800
OLD FEE HOUSE MONUMENT	10593350.9770	477549.5180	3929.2270	3918.8070
NORTHEAST MONUMENT	10594401.0350	479683.7490	3956.2310	3945.8110
EASEMENT MONUMENT	10591736.9300	479567.8560	3936.4720	3926.0520
SOUTHEAST MONUMENT	10589051.6540	479453.1980	3892.1250	3881.7050
SOUTHWEST MONUMENT	10589196.2980	476806.8090	3842.2190	3831.7990

Conversion Factor

NAVD 88 – 10.42 = CITY DATUM

MSW PERMIT NO. 2284

DESCRIPTION	NAD 83		NAVD 88	CITY DATUM
	NORTHING	EASTING	ELEVATION	ELEVATION
NORTHEAST BRASS CAP	10594030.2990	482320.1910	3986.8400	3976.4200

If you have any questions please call me.

Thank you,

Fermin Dorado, R.P.L.S. # 3190

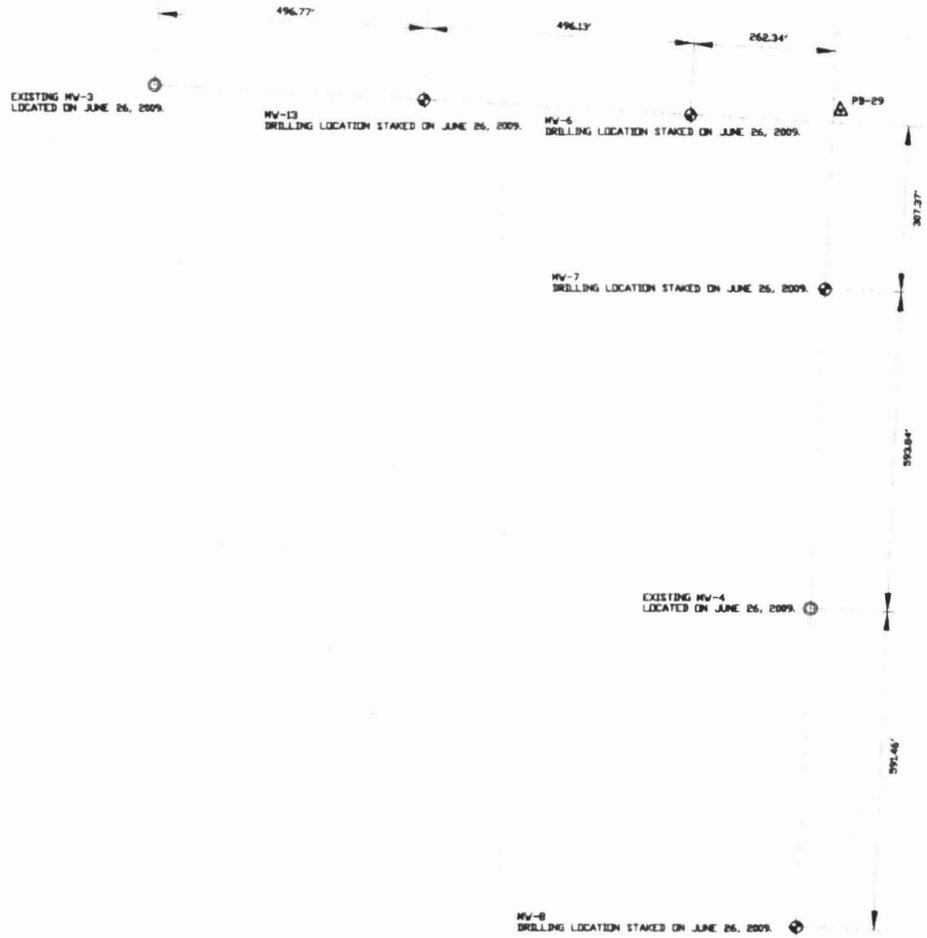


MONITOR WELL COORDINATE DATA

WELL NO.	North	East	Elevation	Desc.
DW-2	10592960.10	479709.19	3969.72	BRASS DISK (PUNCH MARK)
			3972.85	TOP OF 8" STEEL CASING
			3972.56	TOP OF 4" P.V.C.
MW-13	10593955.87	481449.14	3981.46	BRASS DISK (PUNCH MARK)
			3984.66	TOP OF 8" STEEL CASING
			3984.38	TOP OF 4" P.V.C.
MW-6	10593924.65	481944.25	3984.61	BRASS DISK (PUNCH MARK)
			3987.78	TOP OF 8" STEEL CASING
			3987.49	TOP OF 4" P.V.C.
MW-7	10593604.91	482192.27	3984.22	BRASS DISK (PUNCH MARK)
			3987.42	TOP OF 8" STEEL CASING
			3987.23	TOP OF 4" P.V.C.
MW-8	10592420.51	482142.20	3983.76	BRASS DISK (PUNCH MARK)
			3986.54	TOP OF 8" STEEL CASING
			3985.95	TOP OF 4" P.V.C.



NO SCALE



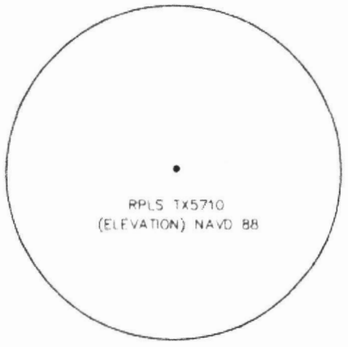
SURVEY NOTES

COORDINATES ARE TEXAS STATE PLANE CENTRAL ZONE NAD 83 (1993) GRID IN U.S. SURVEY FEET. COMBINED SCALE FACTOR USED WAS 0.99980117

ELEVATIONS ARE BASED ON NAVD 88 DATUM AND ARE IN IN U.S. SURVEY FEET.

HORIZONTAL COORDINATES AND ELEVATIONS ARE AT PUNCH MARK IN 3" DIAMETER BRASS DISK SET IN CONCRETE AT BASE OF WELL.

BRASS DISK DETAIL



3" BRASS DISK SET IN CONCRETE
AT BASE OF EACH WELL STAMPED AS SHOWN.

I hereby certify that the foregoing location and improvement survey was made by me or under my supervision and substantially complies with the current Texas Society of Professional Surveyors minimum Standards and Specifications.

Kenneth R. Kindle, R.P.L.S.
Texas 5710

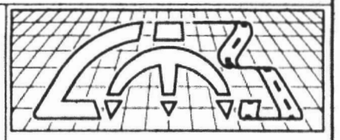


Date of Survey: June 26, 2009.
Survey Updated: August 24, 2009.

PLAT OF SURVEY

NEW MONITOR WELL LOCATIONS AS STAKED AND EXISTING MONITOR WELLS AS LOCATED AT THE CLINT LANDFILL EL PASO COUNTY, TEXAS

Job No. 09-01-26705 | Date: JULY 9, 2009.



Land-Mark Surveying
1420 Bessemer Drive "Suite A"
El Paso, Texas 79936
(915) 598-1300
email: bob@Land-Marksurvey.com
"Serving Texas, New Mexico & Arizona"

LEGEND

PROJECT BOUNDARY

GAS LINE — G — G —

OVERHEAD ELECTRIC LINE — OE — OE —

MONUMENT TIE LINE

MARKER POST ⓜ

MONITOR/TEST WELL Ⓐ

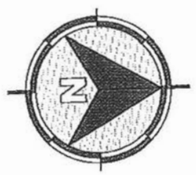
POWER/UTILITY POLE

GUY ANCHOR FOR WOOD POLE FENCE

NATURAL GAS PIPELINE SIGN G

MONITOR WELL NUMBER MW-9

GAS MONITOR PROBE GMP-12



GRAPHIC SCALE

0 300'

(IN FEET)

1 inch = 300 FT.

COORDINATE TABLE				
WELL NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
MW-9	10,591,290.64	482,094.15	3976.95	BRASS DISK AT MW NO. 9
MW-9	10,591,290.86	482,095.39	3979.96	TOP OF ALUMINUM CASING
MW-9	10,591,290.86	482,095.39	3979.58	TOP OF 4" PVC PIPE
GMP-12	10,591,833.11	482,195.70	3982.90	TOP OF VALVE
GMP-13	10,592,555.59	482,226.96	3989.08	TOP OF VALVE
GMP-14	10,593,278.95	482,258.58	3988.63	TOP OF VALVE
GMP-15	10,594,003.08	482,279.47	3990.15	TOP OF VALVE

SUPPLEMENTAL NOTES

1. BASIS OF BEARING IS THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE NO. 4203 DETERMINED THROUGH G.P.S. OBSERVATION AT NATIONAL GEODETIC SURVEY (N.G.S.) TRIANGULATION STATION "CLINT" (P.I.D. CE0479), A BRASS CAP MONUMENT LOCATED 3 MILES NORTHEAST ALONG DARRINGTON ROAD FROM THE INTERSECTION OF IH-10 AND F.M. 1110 , 0.5 MILES WEST ON ROARING SPRINGS DRIVE AND 0.3 MILES NORTH ON CASCADE DRIVE TO A DIRT ROAD ON THE LEFT FOR 0.25 MILES TO THE STATION. COORDINATES SHOWN ARE NAD 83 TEXAS CENTRAL ZONE STATE PLANE SURFACE COORDINATES, IN U.S. SURVEY FEET.

2. ELEVATIONS AND CONTOURS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (N.A.V.D. 88) DETERMINED THROUGH G.P.S. OBSERVATION AT A NATIONAL GEODETIC SURVEY (N.G.S.) MONUMENT "Z 1392" (P.I.D. CE0373), A STAINLESS STEEL ROD LOCATED 1.75 MILES NORTHWEST FROM THE INTERSECTION OF F.M. 1110 AND THE SOUTHERN PACIFIC RAILROAD IN CLINT, TEXAS, APPROXIMATELY 100 FEET EAST-SOUTHEAST OF MILEPOST 809. ELEVATION = 3638.32' (N.A.V.D.88.).

3. CONVERGENCE ANGLE FROM TEXAS CENTRAL ZONE NO. 4203 TO TRUE NORTH AT TRIANGULATION STATION "CLINT" IS -03°00'50".

4. TO ARRIVE AT GRID COORDINATES APPLY A SCALE FACTOR OF 0.9997474032 AT THE G.P.S. BASE CONTROL POINT SHOWN.

5. SURFACE COORDINATES FOR TRIANGULATION STATION "CLINT" ARE N: 10,605122.549 sft, E: 476,297.451 sft. WITH AN ELEVATION OF 4014.87. GRID COORDINATES FOR TRIANGULATION STATION "CLINT" ARE N: 10,605119.411 sft, E: 476,298.450 sft.

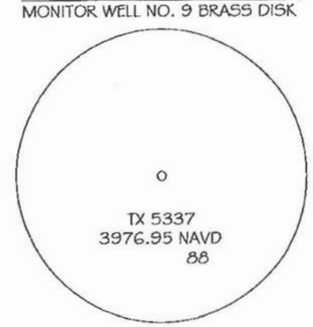
REFERENCE DOCUMENTS

1. BOUNDARY & TOPOGRAPHIC SURVEY FOR TCEQ MSW PERMIT NO. 2284, PHASE I-CELLS 3-6 AND SCALE HOUSE, PAGE NO. C-001, SHEET 4 OF 67, DATED 8-17-05.

2. NGS DATASHEETS FOR "CLINT" (PID NO. CE0479) & "Z 1392" (PID NO. 0373) DOWNLOADED FROM THE NATIONAL GEODETIC SURVEY WEBSITE.

DETAIL:

MONITOR WELL NO. 9 BRASS DISK



CERTIFICATION;

I HEREBY CERTIFY THAT THIS SURVEY PLAT AND THE ACTUAL SURVEY ON THE GROUND UPON WHICH IT IS BASED WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION; THAT I AM RESPONSIBLE FOR THIS SURVEY; THAT THIS SURVEY MEETS THE MINIMUM STANDARDS FOR SURVEYING IN THE STATE OF TEXAS; AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Isaac Camacho 07/01/11

ISAAC CAMACHO, TX. R.P.L.S. NO. 5337

DRAWN BY: J.M.	CLINT LANDFILL-CELLS 7, 8, 9, & 10
APPROVED BY: I.C.	NEW MONITOR WELL NO. 9 AND GMP NO.'s 12, 13, 14 & 15
DATE: 06/30/2011	CITY OF EL PASO PROPERTY IN SECTION 16, BLOCK 78, TOWNSHIP 4, TEXAS & PACIFIC RAILWAY COMPANY SURVEYS, EL PASO COUNTY, TEXAS.
SCALE: 1"=300'	
JOB NO. 06315-010	

⚠	.	DATE:	.

BROCK & BUSTILLOS INC.
CONSULTING CIVIL ENGINEERS
LAND SURVEYORS
TBPE REG. NO. F-737

417 EXECUTIVE CENTER
EL PASO, TX 79902
PH (915) 542-4900
FAX (915) 542-2867
www.brockbustillos.com

STATE OF TEXAS REGISTERED ISAAC CAMACHO 5337 PROFESSIONAL LAND SURVEYOR

CADD5
Jun 30, 2011 - 4:37pm
U:\06315-010-CLINT LANDFILL\06315-010-LDD\dwg\06315-010-CLINT LANDFILL-NEW MONITOR WELL EXHIBIT.dwg

	CLINT LANDFILL GROUND WATER MONITOR WELLS				18-Mar-2015	
	TEXAS CENTRAL ZONE, NO. 4203, NAD 1983				NAVD 88	
	GEODETIC COORDINATES		STATE PLANE COORDINATES			
			SURFACE	SURFACE	ELEV.	POINT
TOP OF LID	LATITUDE	LONGITUDE	NORTHING, FT.	EASTING, FT.	FT.	NO.
BRASS CAP RPLS TX 5710	31ø36'02.03203"N	106ø10'19.00466"W	10,593,500.85	479,591.12	3,971.91	10014
MW 14-TOP OF STEEL CASING	31ø36'02.02148"N	106ø10'19.00599"W	10,593,499.78	479,591.00	3,974.88	10014A
TOP PVC WELL CASING	31ø36'02.02067"N	106ø10'19.00575"W	10,593,499.70	479,591.02	3,974.64	10014B
BRASS CAP RPLS TX 5710	31ø35'50.37229"N	106ø10'18.83720"W	10,592,322.42	479,605.56	3,963.88	10015
MW 15-TOP OF STEEL CASING	31ø35'50.35989"N	106ø10'18.83711"W	10,592,321.17	479,605.57	3,966.81	10015A
TOP PVC WELL CASING	31ø35'50.35803"N	106ø10'18.83691"W	10,592,320.98	479,605.59	3,966.60	10015B

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	CLINT LANDFILL GROUND WATER MONITOR WELLS & GAS PROBES				26-Mar-2019	JOB NO.
	TEXAS CENTRAL ZONE, NO. 4203, NAD 1983				NAVD 88	06315-034
	GEODETIC COORDINATES		STATE PLANE COORDINATES			
			SURFACE	SURFACE	ELEV.	POINT
BRASS CAP	LATITUDE	LONGITUDE	NORTHING, FT.	EASTING, FT.	FT.	NO.
BRASS CAP GMP NO. 3	31d35'31.50004"	-106d10'18.90043"	10,590,479.60	479,512.45	3,944.89	20001
SURFACE ELEVATION					3,944.70	
TOP OF STEM					3,947.83	
TOP OF PROTECTIVE COLLAR					3,947.84	
BRASS CAP GMP NO. 4	31d35'24.18041"	-106d10'18.80594"	10,589,740.41	479,481.80	3,915.10	20002
SURFACE ELEVATION					3,914.98	
TOP OF STEM					3,917.99	
TOP OF PROTECTIVE COLLAR					3,918.05	
BRASS CAP GMP NO. 10	31d35'32.15931"	-106d09'48.66502"	10,590,409.01	482,128.03	3,975.89	20003
SURFACE ELEVATION					3,975.64	
TOP OF CASING					3,978.65	
TOP OF PROTECTIVE COLLAR					3,978.76	
BRASS CAP GMP NO. 11	31d35'40.15944"	-106d09'48.75309"	10,591,216.86	482,162.78	3,975.64	20004
SURFACE ELEVATION					3,975.46	
TOP OF CASING					3,978.50	
TOP OF PROTECTIVE COLLAR					3,978.61	
BRASS CAP MW NO. 10	31d35'35.23514"	-106d09'48.73597"	10,590,719.78	482,138.19	3,976.59	20005
SURFACE ELEVATION					3,976.33	
TOP OF CASING					3,979.38	
TOP OF PROTECTIVE COLLAR					3,979.63	
BRASS CAP MW NO. 11	31d35'29.37438"	-106d09'48.63206"	10,590,127.78	482,116.13	3,975.01	20006
SURFACE ELEVATION					3,974.67	
TOP OF CASING					3,977.44	
TOP OF PROTECTIVE COLLAR					3,977.85	
BRASS CAP MW NO. 8 (BM)	31d35'52.04262"	-106d09'49.71766"	10,592,420.59	482,142.37	3,983.76	30008

NOTES:

1. ALL COORDINATES SHOWN ARE REFERENCED TO THE TEXAS STATE PLANE COORDINATE SYSTEM,CENTRAL ZONE, No. 4203, NORTH AMERICAN DATUM OF 1983 (N.A.D. 83), DETERMINED VIA THE EL PASO COUNTY VIRTUAL REFERENCE STATION (V.R.S.) NETWORK.

2. NORTHINGS AND EASTINGS HAVE BEEN SCALED TO SURFACE CENTERED AT N=10,592,420.59', E=482,142.37' USING A GRID TO GROUND SCALE FACTOR OF 1.0002511300.

3. ELEVATIONS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (N.A.V.D. 88) AS SHOWN ON A PLAT OF SURVEY PREPARED BY LANDMARK SURVEYING, JOB NO. 09-01-26705, DATED JULY 9, 2009 CERTIFIED BY KENNETH R. KINDLE, R.P.L.S. NO. 5710. THE BENCHMARK USED FOR THIS SURVEY WAS A BRASS CAP AT MW NO. 8, WITH ELEVATION STAMPED "3983.76".

4. ELEVATIONS STAMPED ON NEW WELLS WERE ESTABLISHED VIA LEVEL LOOP METHOD FROM MW NO. 8 HAVING A STAMPED ELEVATION OF 3983.76'. LEVEL LOOP WAS PERFORMED ON MARCH 14, 2019.

5. ELEVATIONS TO SURFACE, TOP OF STEM, TOP OF CASING AND TOP OF PROTECTIVE COLLAR WERE MEASURED WITH A LEVEL ON MARCH 26, 2019

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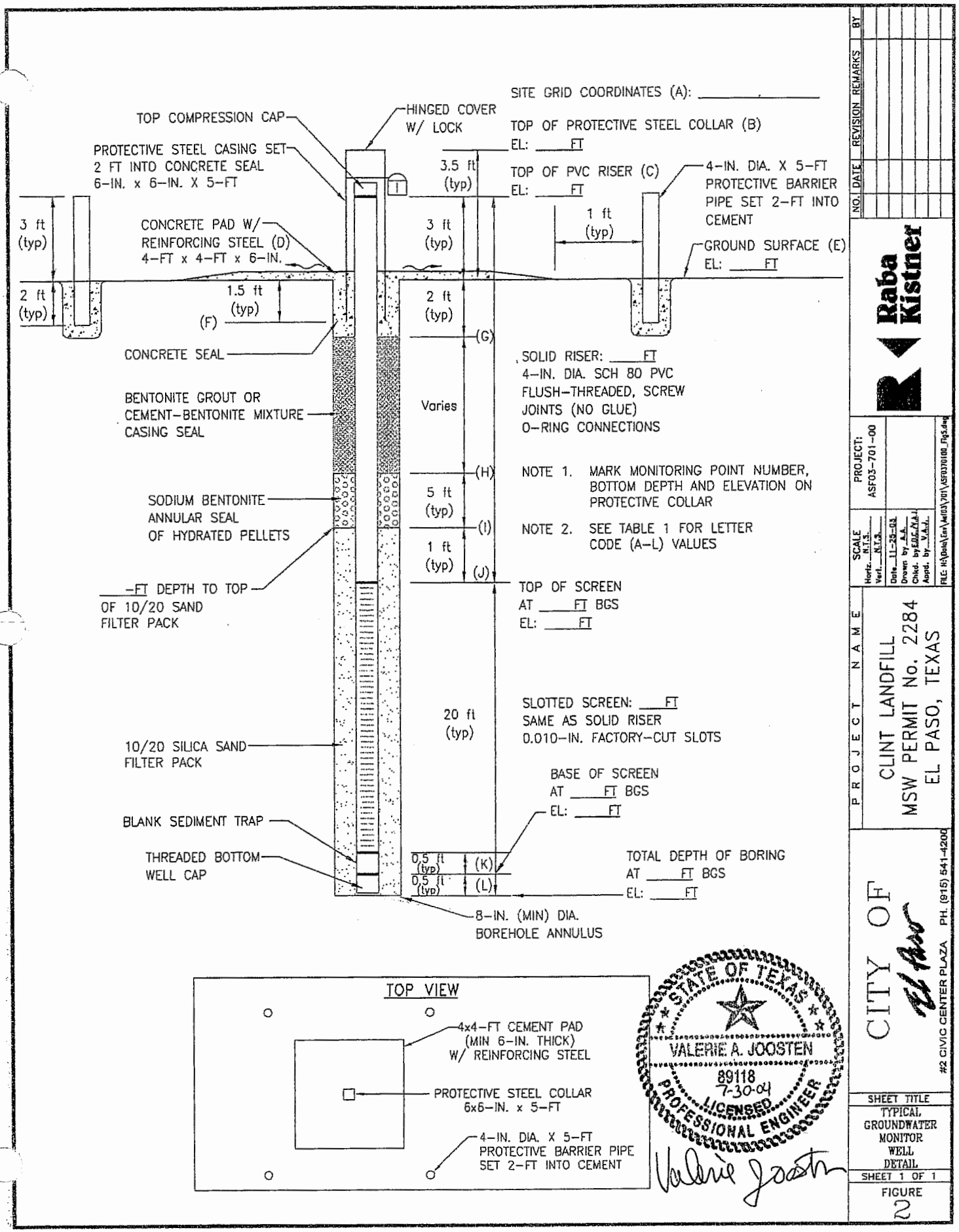
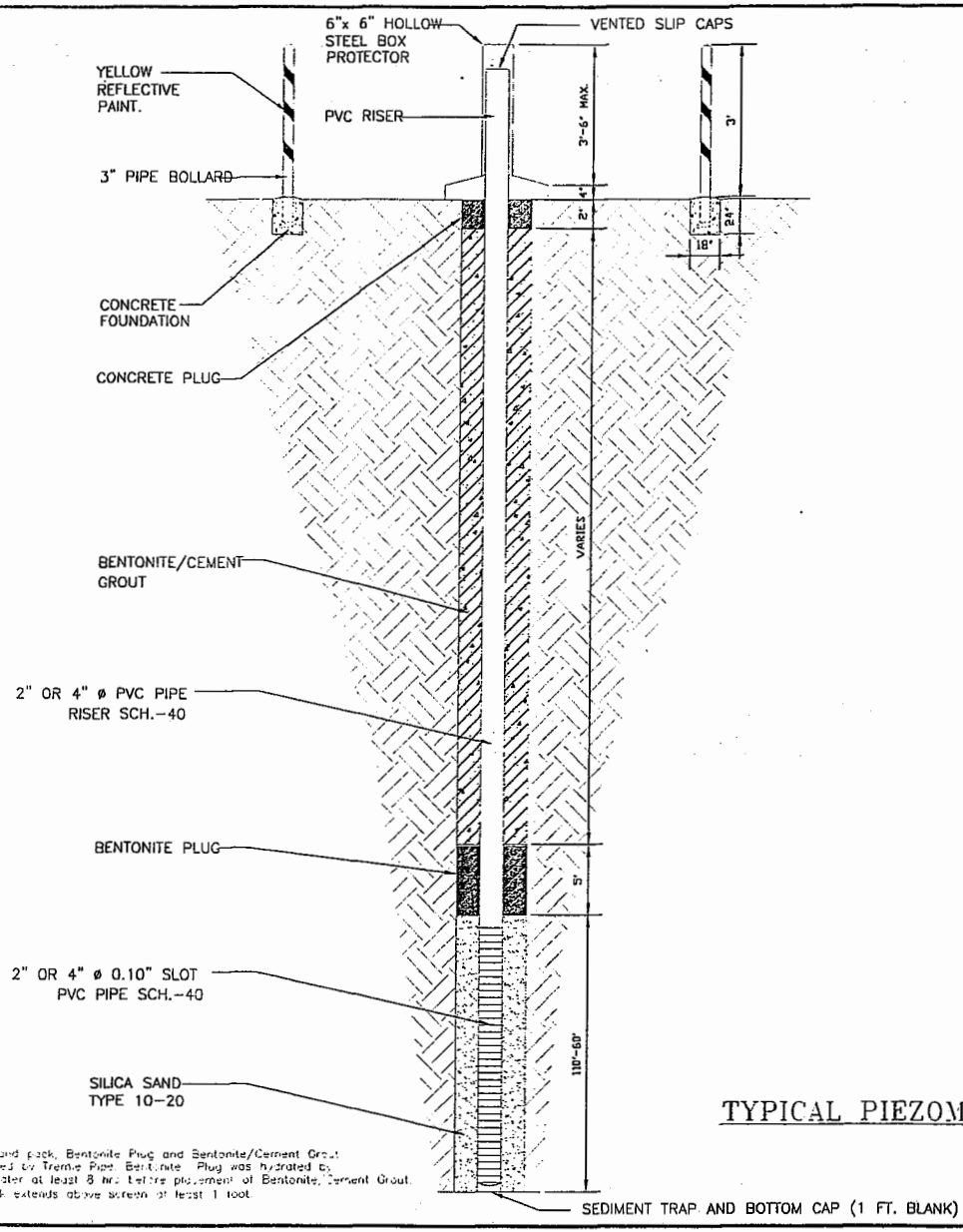
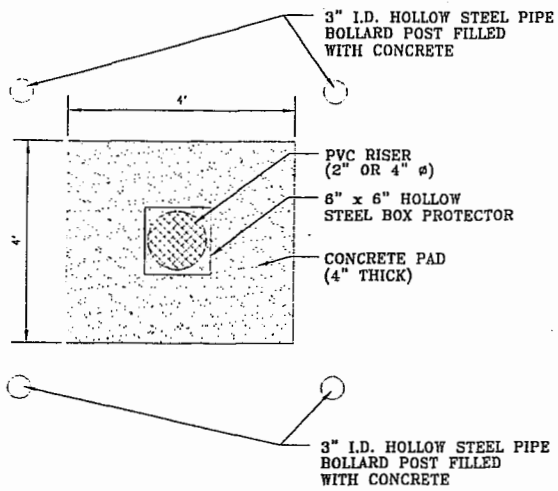
ATTACHMENT III.E.16 – MONITORING WELL AND PIEZOMETER BORING DIAGRAMS


SITE GRID COORDINATES (A): _____
TOP COMPRESSION CAP
HINGED COVER W/ LOCK
TOP OF PROTECTIVE STEEL COLLAR (B) EL: ___FT
PROTECTIVE STEEL CASING SET 2 FT INTO CONCRETE SEAL 6-IN. x 6-IN. X 5-FT
3.5 ft (typ)
TOP OF PVC RISER (C) EL: ___FT
4-IN. DIA. X 5-FT PROTECTIVE BARRIER PIPE SET 2-FT INTO CEMENT
3 ft (typ)
CONCRETE PAD W/ REINFORCING STEEL (D) 4-FT x 4-FT x 6-IN.
1 ft (typ)
3 ft (typ)
GROUND SURFACE (E) EL: ___FT
2 ft (typ)
1.5 ft (typ)
(F)
2 ft (typ)
(G)
CONCRETE SEAL
SOLID RISER: ___FT
4-IN. DIA. SCH 80 PVC
FLUSH-THREADED, SCREW JOINTS (NO GLUE)
O-RING CONNECTIONS
BENTONITE GROUT OR CEMENT-BENTONITE MIXTURE CASING SEAL
Varies
(H)
NOTE 1. MARK MONITORING POINT NUMBER, BOTTOM DEPTH AND ELEVATION ON PROTECTIVE COLLAR
5 ft (typ)
SODIUM BENTONITE ANNULAR SEAL OF HYDRATED PELLETS
(I)
NOTE 2. SEE TABLE 1 FOR LETTER CODE (A-L) VALUES
1 ft (typ)
(J)
___-FT DEPTH TO TOP OF 10/20 SAND FILTER PACK
TOP OF SCREEN AT ___FT BGS EL: ___FT
20 ft (typ)
SLOTTED SCREEN: ___FT
SAME AS SOLID RISER
0.010-IN. FACTORY-CUT SLOTS
10/20 SILICA SAND FILTER PACK
BASE OF SCREEN AT ___FT BGS EL: ___FT
BLANK SEDIMENT TRAP
THREADED BOTTOM WELL CAP
0.5 ft (typ)
(K)
0.5 ft (typ)
(L)
TOTAL DEPTH OF BORING AT ___FT BGS EL: ___FT
8-IN. (MIN) DIA. BOREHOLE ANNULUS
TOP VIEW
4x4-FT CEMENT PAD (MIN 6-IN. THICK) W/ REINFORCING STEEL
PROTECTIVE STEEL COLLAR 6x6-IN. x 5-FT
4-IN. DIA. X 5-FT PROTECTIVE BARRIER PIPE SET 2-FT INTO CEMENT
STATE OF TEXAS
VALERIE A. JOOSTEN
89118
7-30-04
LICENSED
PROFESSIONAL ENGINEER
NO. DATE REVISION REMARKS BY
Raba Kistner
PROJECT: ASF03-701-00
SCALE Horiz. N.T.S. Vert. N.T.S.
Date 11-25-03
Drawn by A.A.
Chkd. by E.M.C./V.A.J.
Appd. by V.A.J.
FILE: H:\Data\Env\wd03\701\ASF030100_Fig2.dwg
PROJECT NAME
CLINT LANDFILL
MSW PERMIT No. 2284
EL PASO, TEXAS
CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4200
SHEET TITLE
TYPICAL GROUNDWATER MONITOR WELL DETAIL
SHEET 1 OF 1
FIGURE 2



NOTES: Sand pack, Bentonite Plug and Bentonite/Cement Grout were placed by Tremie Pipe. Bentonite Plug was hydrated by potable water at least 8 hrs before placement of Bentonite/Cement Grout. Sand pack extends above screen at least 1 foot.

TYPICAL PIEZOMETER CROSS SECTION



TOP VIEW OF PIEZOMETER ARRANGEMENT

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER
12/12/00

REVISED: 12/04/00

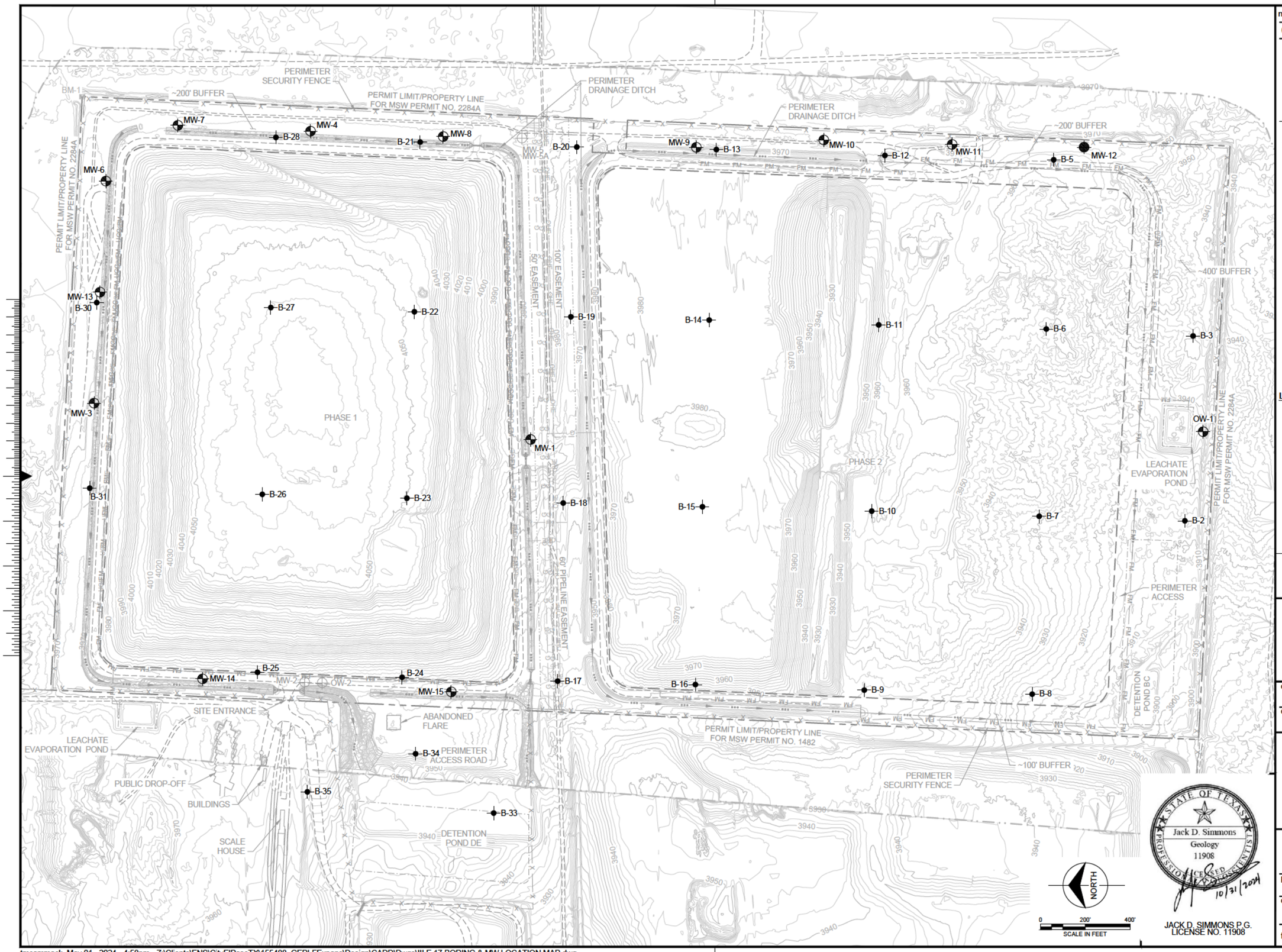
PLATE 1	PAGE 2

PROPOSED CLINT LANDFILL SITE
PERMIT AMENDMENT
PIEZOMETER DETAIL
CITY OF EL PASO
EL PASO, TEXAS

Raba Kistner
Raba-Kistner Consultants (SW), Inc.
7002 COMMERCE EL PASO TX. 79915 (915) 778-5233

SCALE: NO SCALE | PROJECT NO: AEA96-182-00 | AEA96182
REVISED BY: AA | CHK BY: JR | APPR.: ALW | DATE: 12-04-00

ATTACHMENT III.E.17 – MONITORING WELL LOCATION MAP



no.	date	by	ckd	description
0	5/1/24	TMC	JDS	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. BORING LOCATIONS ARE APPROXIMATED FROM HISTORICAL DATA.

LEGEND:

MW-2	ABANDONED GROUNDWATER MONITORING WELL
MW-3	EXISTING GROUNDWATER MONITORING WELL
MW-12	FUTURE GROUNDWATER MONITORING WELL
B-2	EXISTING SOIL BORING, APPROXIMATE LOCATION

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	J. SIMMONS

City of El Paso, Texas

2284A PERMIT AMENDMENT

BORING AND MONITORING WELL LOCATION MAP

project	contract
155488	-

drawing **III.E.17** rev. **0**

file III.E.17 BORING & MW LOCATION MAP.dwg

STATE OF TEXAS
Jack D. Simmons
Geology
11908
LICENSED PROFESSIONAL GEOSCIENTIST
10/31/2024

JACK D. SIMMONS P.G.
LICENSE NO. 11908

Scale For Microfilming
Millimeters
Inches

tmcammack May 01, 2024 - 4:58pm - Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\CADD\Dwgs\III.E.17 BORING & MW LOCATION MAP.dwg

ATTACHMENT III.E.18 – MONITORING WELL DATA SHEETS

Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - Clint Landfill
County: El Paso County
Date of Monitor Well Installation: 6/1/04 - 6/5/04
Monitor Well Latitude: N31 35'45.49545" Longitude: W106 10'05.07538"
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient __X___

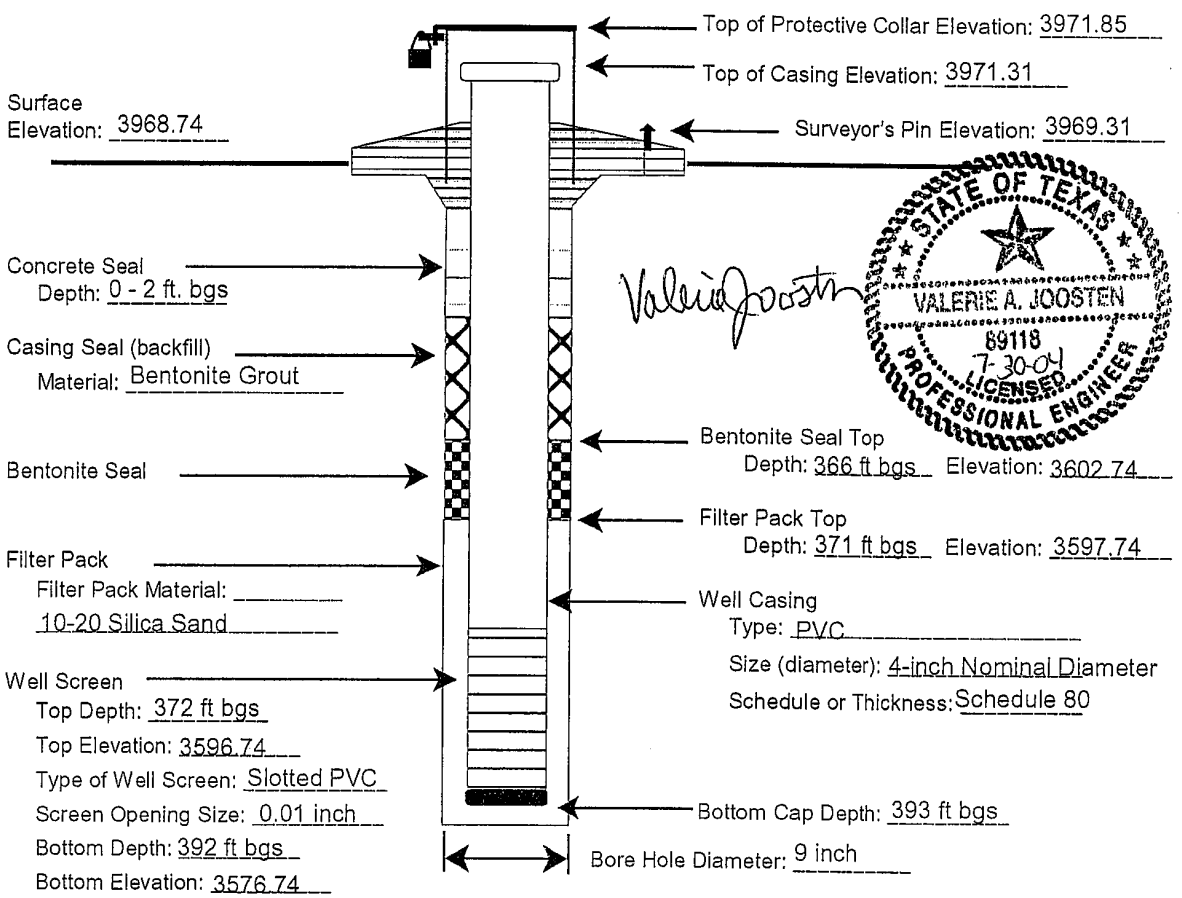
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-1
Date of Monitor Well Development: 6/7/04
Monitor Well Driller Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3601.50'
Name of Geologic Formation(s) in which Well is completed: Fort Hancock

Type of Locking Device: Padlock Type of Casing Protection: 6-inch Square Steel Protective Casing
Concrete Surface Pad (with steel reinforcement) Dimensions: 4-FT x 4-FT x 6-IN



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - Clint Landfill
County: El Paso County
Date of Monitor Well Installation: 6/16/04 - 6/21/04
Monitor Well Latitude N31 35'45.49545'Longitude: W106 10'18.19597"
Monitor Well Groundwater Gradient Position:
Upgradient X Downgradient _____

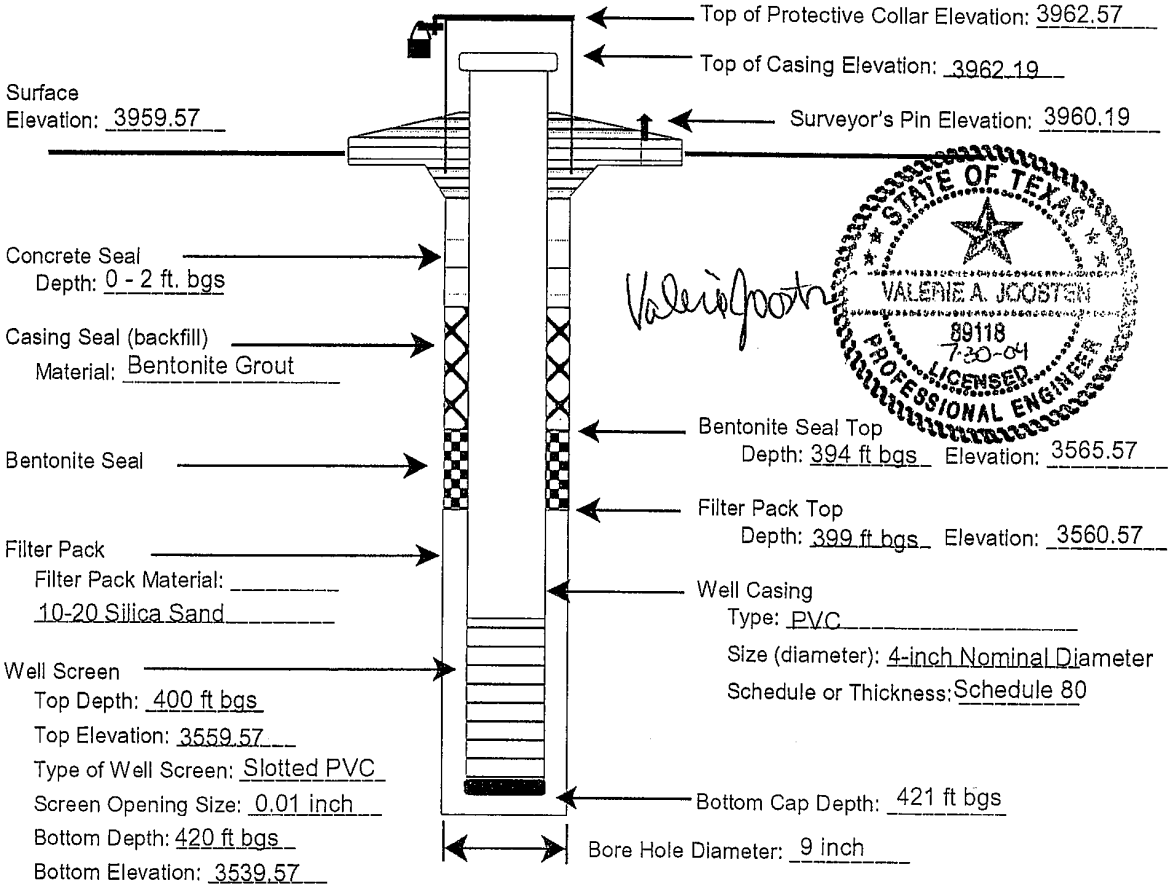
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-2
Date of Monitor Well Development: 6/22/04
Monitor Well Driller Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Patrick F.Welsh, P.G.
Static Water Level Elevation (with respect to MSL) after Well Development: 3613.63'
Name of Geologic Formation(s) in which Well is completed: Fort Hancock

Type of Locking Device: Padlock Type of Casing Protection: 6-inch Square Steel Protective Casing
Concrete Surface Pad (with steel reinforcement) Dimensions: 4-FT x 4-FT x 6-IN



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - Clint Landfill
County: El Paso County
Date of Monitor Well Installation: 5/21/04 - 5/26/04
Monitor Well Latitude: N31 36'04.82422" Longitude: W106 10'04.40160
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

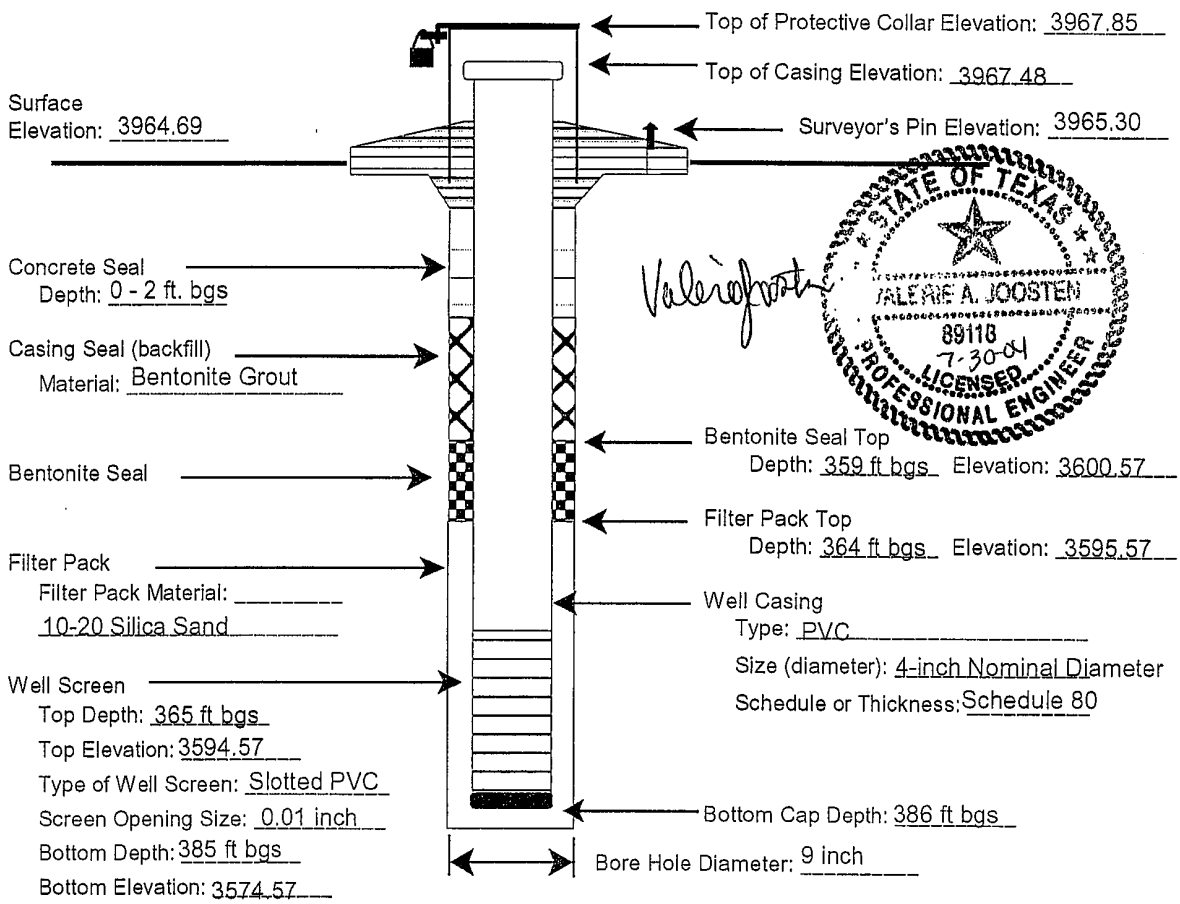
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-3
Date of Monitor Well Development: 5/28/04
Monitor Well Driller Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3604.82
Name of Geologic Formation(s) in which Well is completed: Fort Hancock

Type of Locking Device: Padlock Type of Casing Protection: 6-inch Square Steel Protective Casing
Concrete Surface Pad (with steel reinforcement) Dimensions: 4-FT x 4-FT x 6-IN



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - Clint Landfill
County: El Paso County
Date of Monitor Well Installation: 5/4/04 - 5/8/04
Monitor Well Latitude: N31 35'55.90347" Longitude: W106 0949.79769"
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

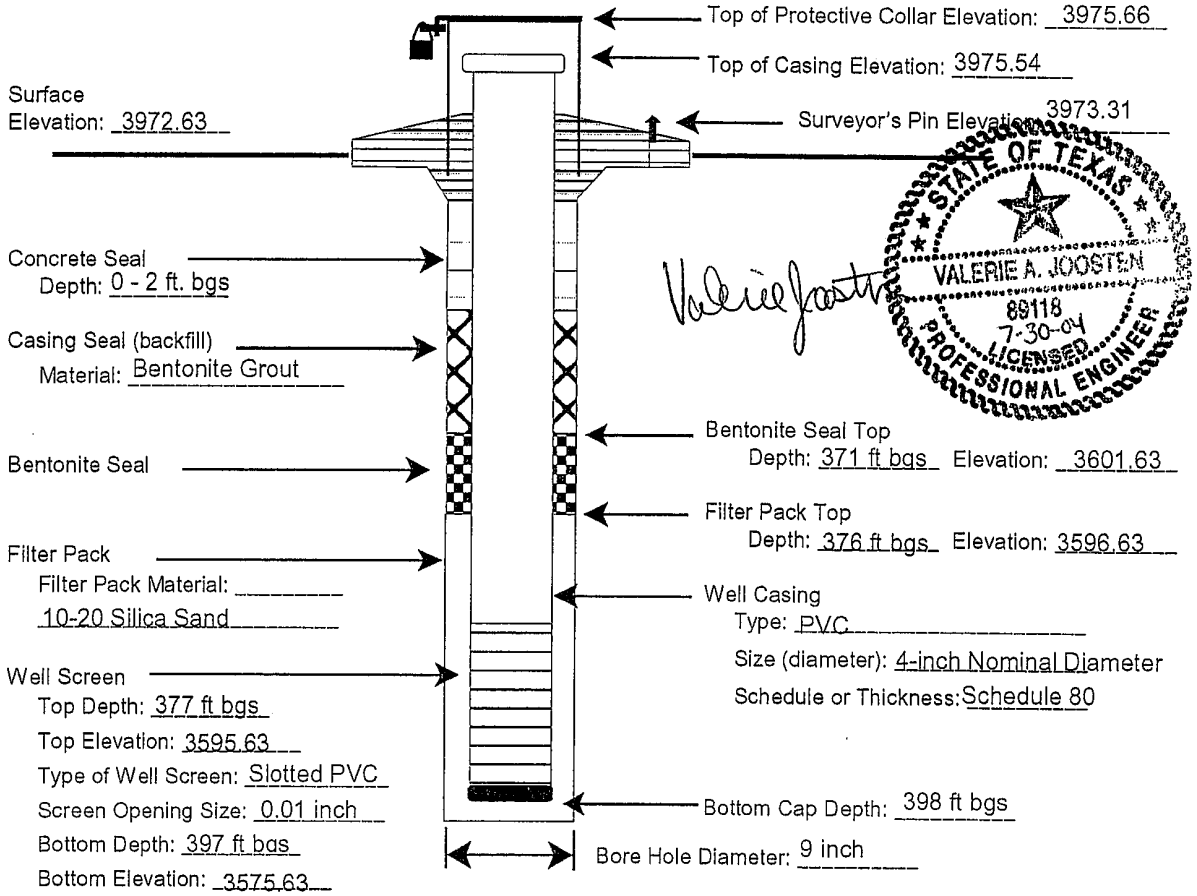
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-4
Date of Monitor Well Development: 5/10/04 & 5/11/04
Monitor Well Driller Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Valerie A. Joosten, P.E.
Static Water Level Elevation (with respect to MSL) after Well Development: 3601.13
Name of Geologic Formation(s) in which Well is completed: Fort Hancock

Type of Locking Device: Padlock
Type of Casing Protection: 6-inch Square Steel Protective Casing
Concrete Surface Pad (with steel reinforcement) Dimensions: 4-FT x 4-FT x 6-IN



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: City of El Paso - Clint Landfill
County: El Paso County
Date of Monitor Well Installation: 6/9/04 - 6/12/04
Monitor Well Latitude: N31 35'46.56809" Longitude: W106 09'49.57923"
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient _X_

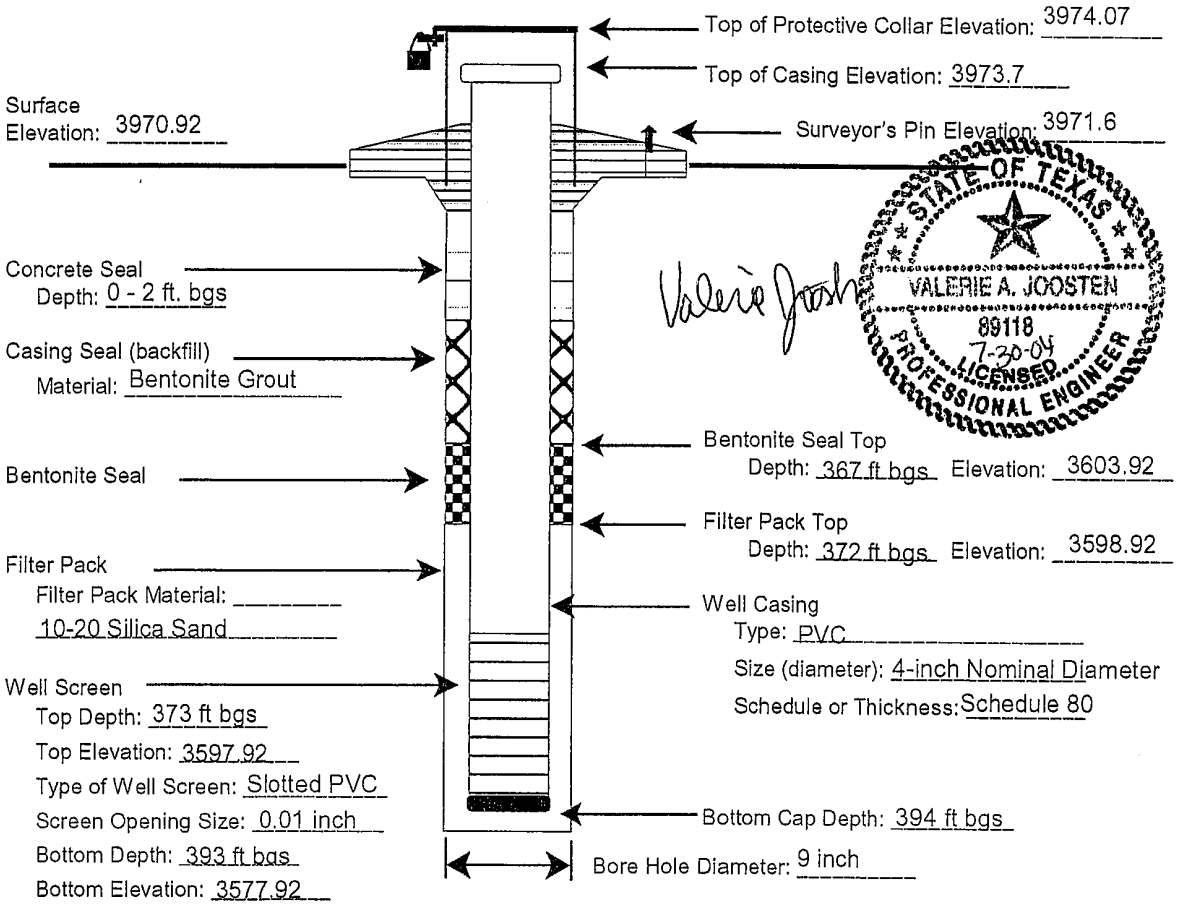
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-5A
Date of Monitor Well Development: 6/15/04
Monitor Well Driller Name: R.C. Corona
License No.: 4709M

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Patrick F. Welsh, P.G.
Static Water Level Elevation (with respect to MSL) after Well Development: 3600.22
Name of Geologic Formation(s) in which Well is completed: Fort Hancock

Type of Locking Device: Padlock Type of Casing Protection: 6-inch Square Steel Protective Casing
Concrete Surface Pad (with steel reinforcement) Dimensions: 4-FT x 4-FT x 6-IN



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso
Date of Monitor Well Installation: 07-24-09
Monitor Well Latitude: 31.602043° Longitude: 106.164637°
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

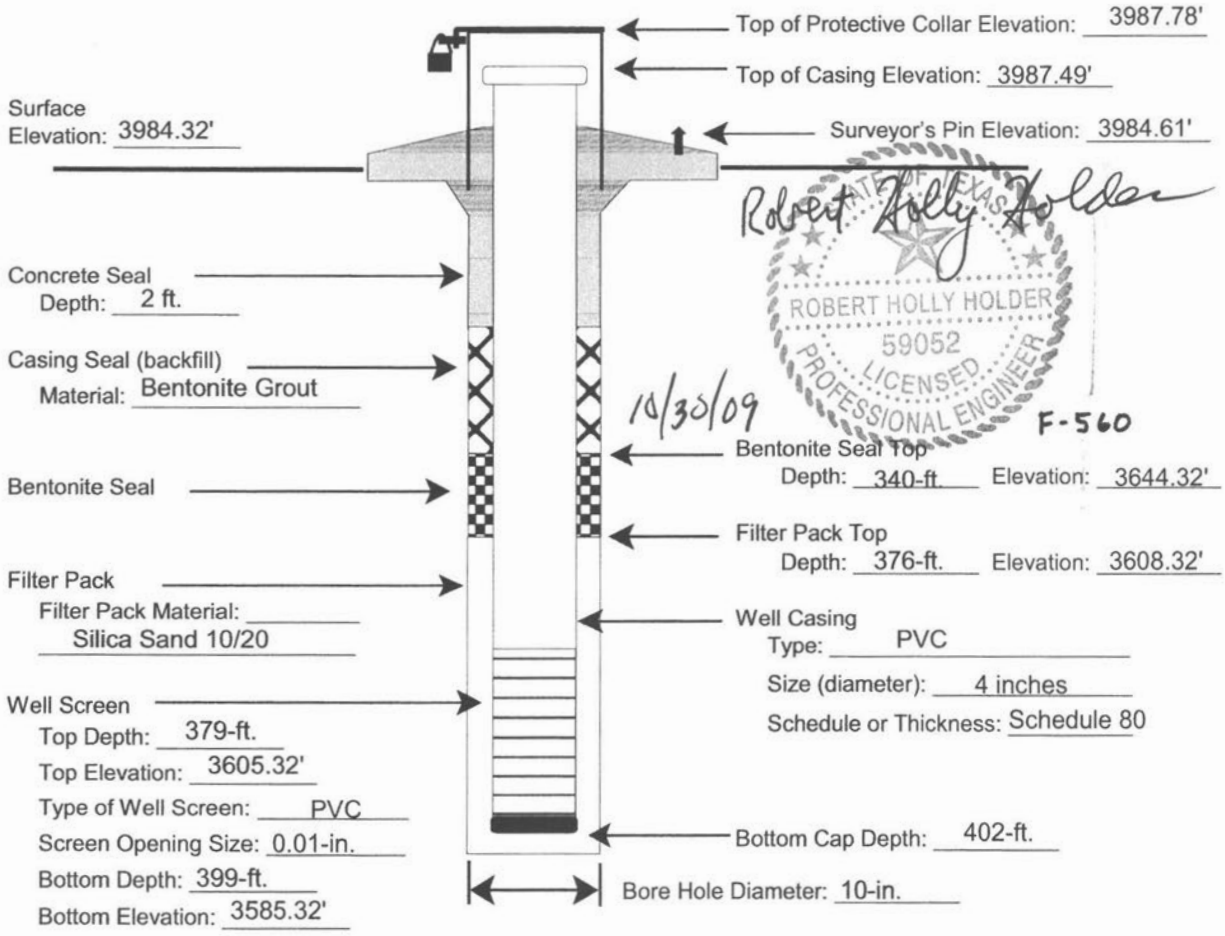
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-6
Date of Monitor Well Development: 08-07-09
Monitor Well Driller Name: William F. Kelton
License No.: 2758 AKP

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: The Carel Corporation (Mike Hull)
Static Water Level Elevation (with respect to MSL) after Well Development: 3612.12'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Keyed Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4 ft. x 4 ft. x 6 inches



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso
Date of Monitor Well Installation: 07-23-09
Monitor Well Latitude: 31.601059° Longitude: 106.163732°
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

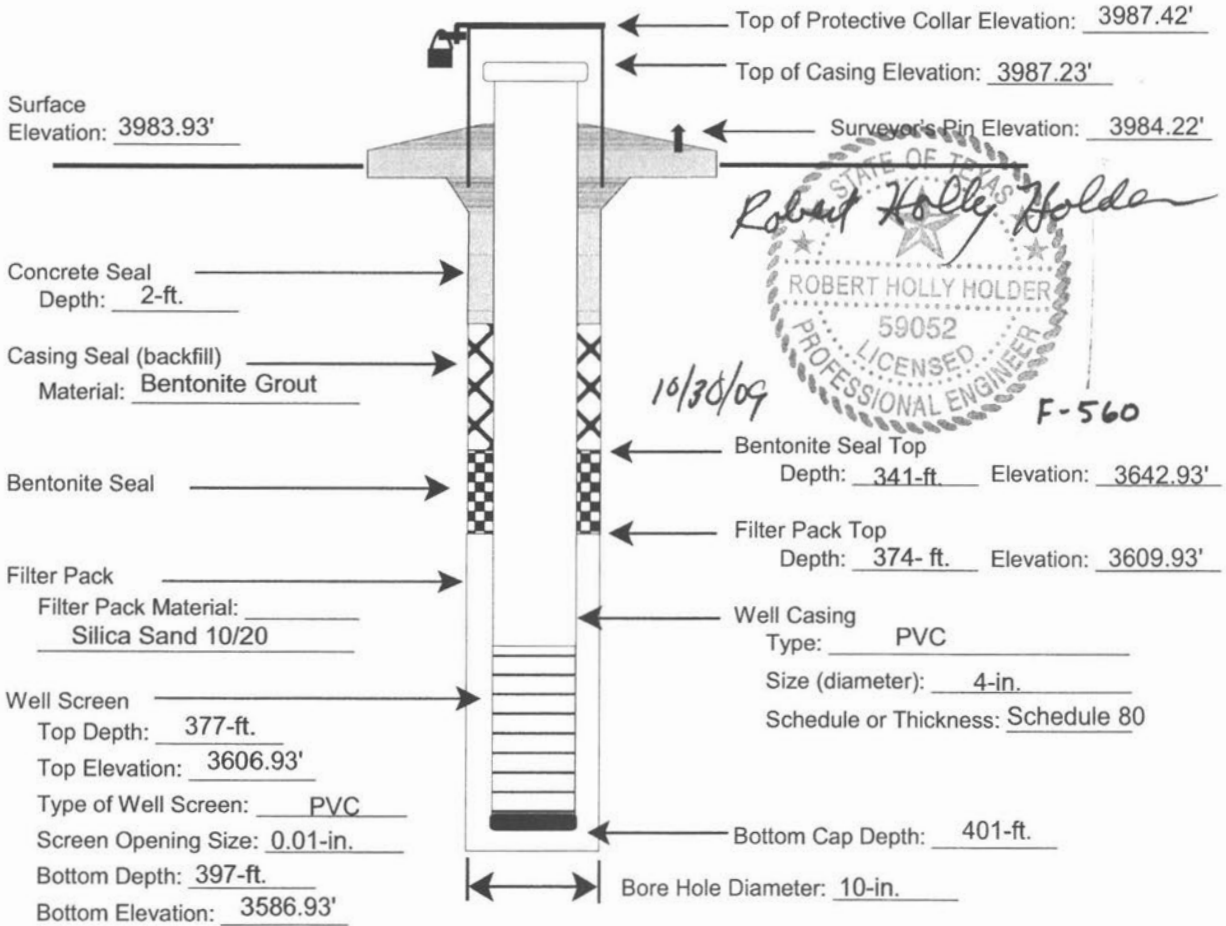
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-7
Date of Monitor Well Development: 07-24-09
Monitor Well Driller Name: William F. Kelton
License No.: 2758 AKP

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: The Carel Corporation (Mike Hull)
Static Water Level Elevation (with respect to MSL) after Well Development: 3611.29'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Keyed Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4 ft. x 4 ft. x 6 inches



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso
Date of Monitor Well Installation: 07-10-09
Monitor Well Latitude: 31.597764° Longitude: 106.163694°
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

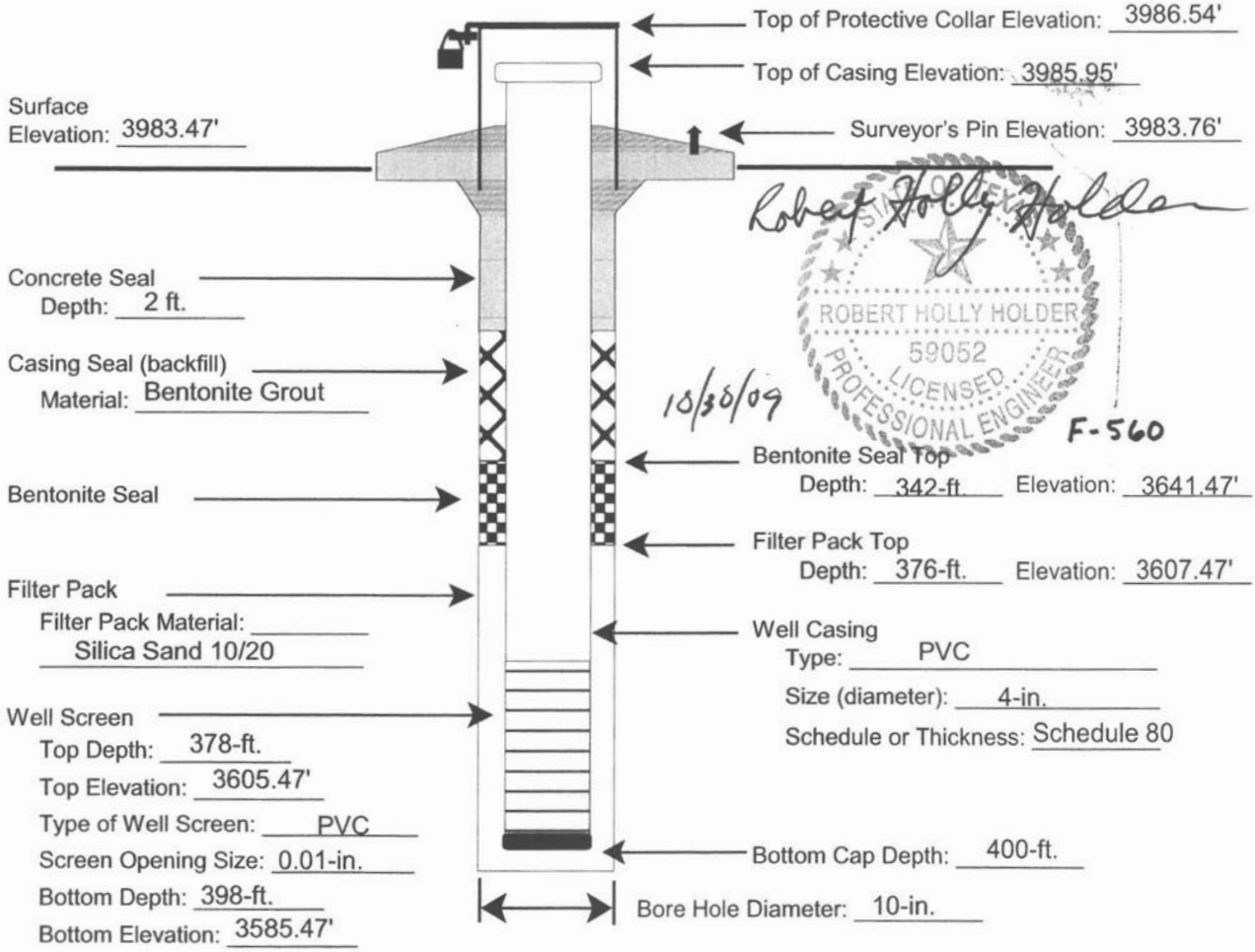
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-8
Date of Monitor Well Development: 07-23-09
Monitor Well Driller Name: William F. Kelton
License No.: 2758 AKP

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: The Carel Corporation (Mike Hull)
Static Water Level Elevation (with respect to MSL) after Well Development: 3612.52'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Keyed Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4 ft. x 4 ft. x 6 inches



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso County
Date of Monitor Well Installation: May 18, 2011
Northing: 10591290.64 Easting: 482094.15
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: X

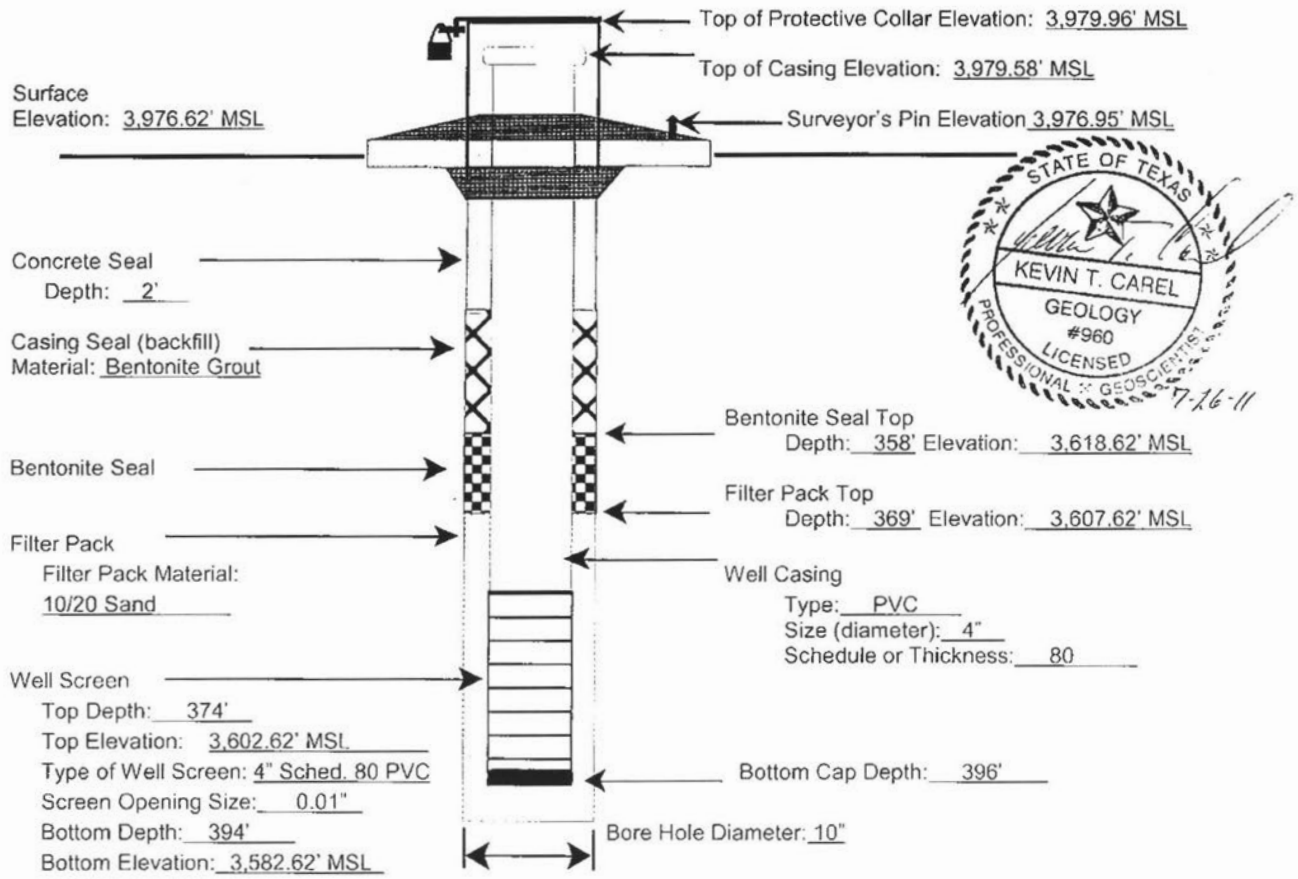
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-9
Date of Monitor Well Development: June 6, 2011
Monitor Well Driller
Name: William B. Bludworth
License No. 4885

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: Michael J. Hull, PG
Static Water Level Elevation (with respect to MSL) after Well Development: 3,611.41' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Pad Lock Type of Casing Protection: 6" x 6" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"



TCEQ-10308

Monitor Well Data Sheet

Texas Commission on Environmental Quality
Waste Permits Division

Permittee or Site Name: Greater El Paso Landfill - Clint
County: El Paso County
Date of Monitor Well Installation: _____
Monitor Well Latitude: 31/35/35.23 Longitude: -106/09/48.735
Monitor Well Hydraulic Position:
Upgradient X Downgradient ___

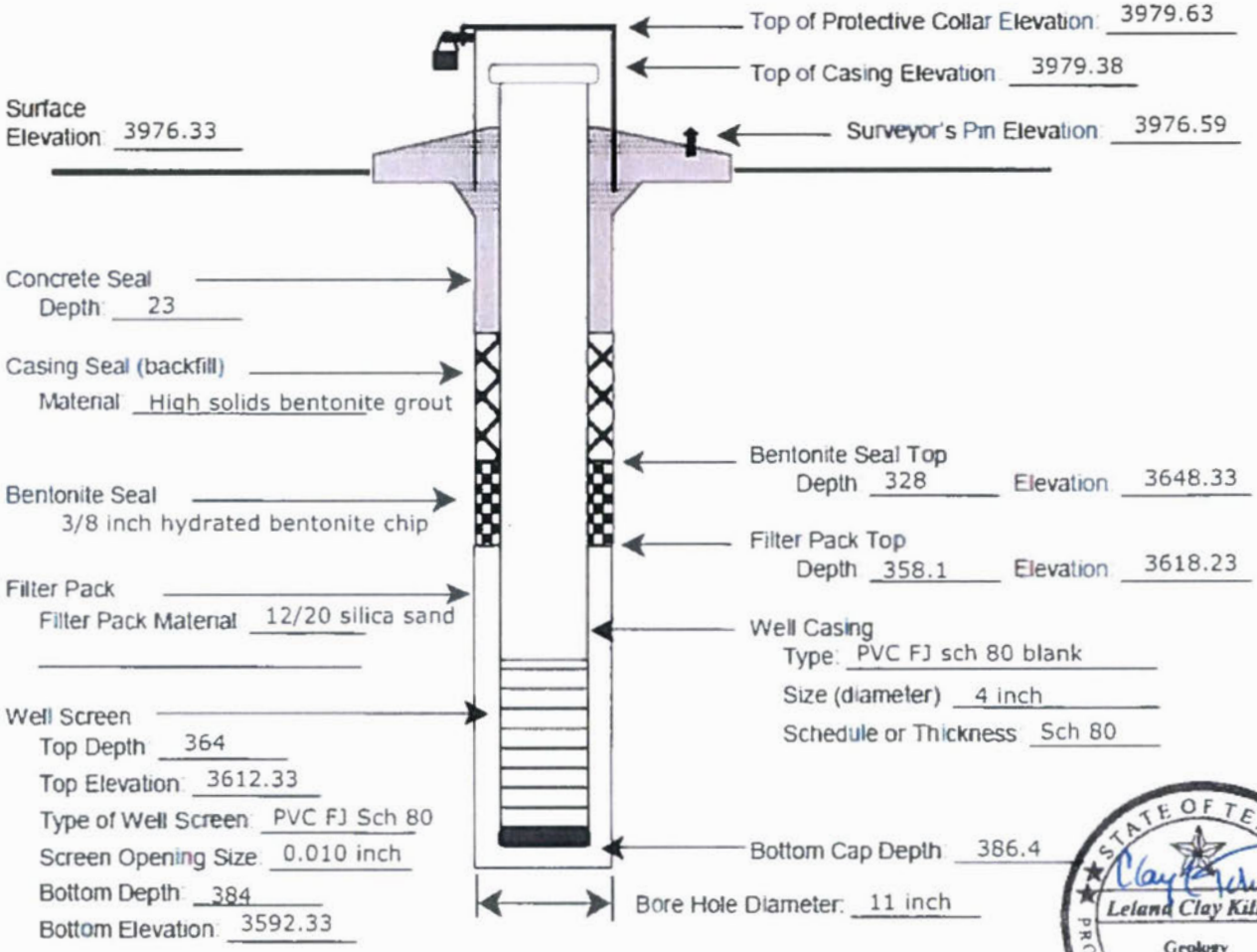
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-10
Date of Well Development: 3/12/2019
Monitor Well Driller
Name: William B. Bludworth
License No.: 4885M

Geologist, Hydrologist, or Engineer Supervising Well Installation: Leland C Kilmer
Static Water Level Elevation (with respect to MSL) after Well Development: 367.45
Name of Geologic Formation(s) in which Well is completed: Quaternary Bolson Deposits

Locking Device: 2-piece aluminum Type of Casing Protection: Steel Shroud-ConcreteSurface Pad
(with steel reinforcement) Dimensions: 5' X 5' X 6"

Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.



STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED
PROFESSIONAL GEOSCIENTIST

4-11-19

TCEQ-10308 (Rev. 11/18/11)

Monitor Well Data Sheet

Texas Commission on Environmental Quality
Waste Permits Division

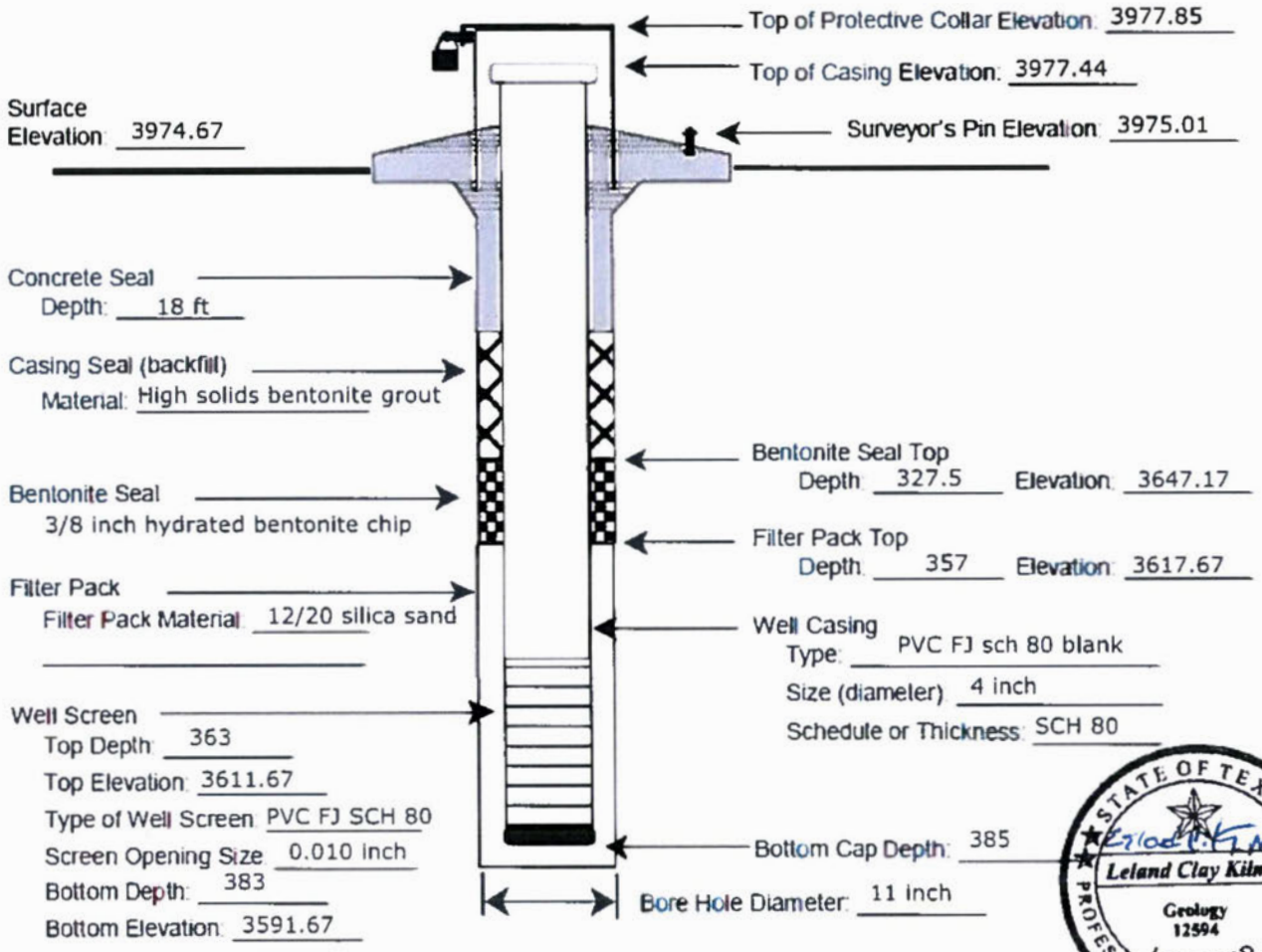
Permittee or Site Name: Greater El Paso Landfill - Clint
County: El Paso
Date of Monitor Well Installation: 3/12/2019
Monitor Well Latitude: 31/35/52.04 Longitude: -106/09/49.717
Monitor Well Hydraulic Position:
Upgradient X Downgradient _____

MSW Permit No.: 2284
Monitor Well I.D. No.: MW-11
Date of Well Development: 3/14/2019
Monitor Well Driller Name: William Bloodworth
License No.: 4885 M

Geologist, Hydrologist, or Engineer Supervising Well Installation: Leland C. Kilmer
Static Water Level Elevation (with respect to MSL) after Well Development: 365.45
Name of Geologic Formation(s) in which Well is completed: Quaternary Bolson Deposits
Type of Locking Device: 2-piece cast alumunum Type of Casing Protection: Steel shroud, concrete surface pad
Concrete Surface Pad (with steel reinforcement) Dimensions: 5' X 5' X 6"

Notes:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.



STATE OF TEXAS
Leland Clay Kilmer
Geology
12594
LICENSED PROFESSIONAL GEOSCIENTIST

4-22-2019

TCEQ-10308 (Rev. 11/18/11)

Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso
Date of Monitor Well Installation: 08-08-09
Monitor Well Latitude: 31.602044° Longitude: 106.171724°
Monitor Well Groundwater Gradient Position:
Upgradient _____ Downgradient X

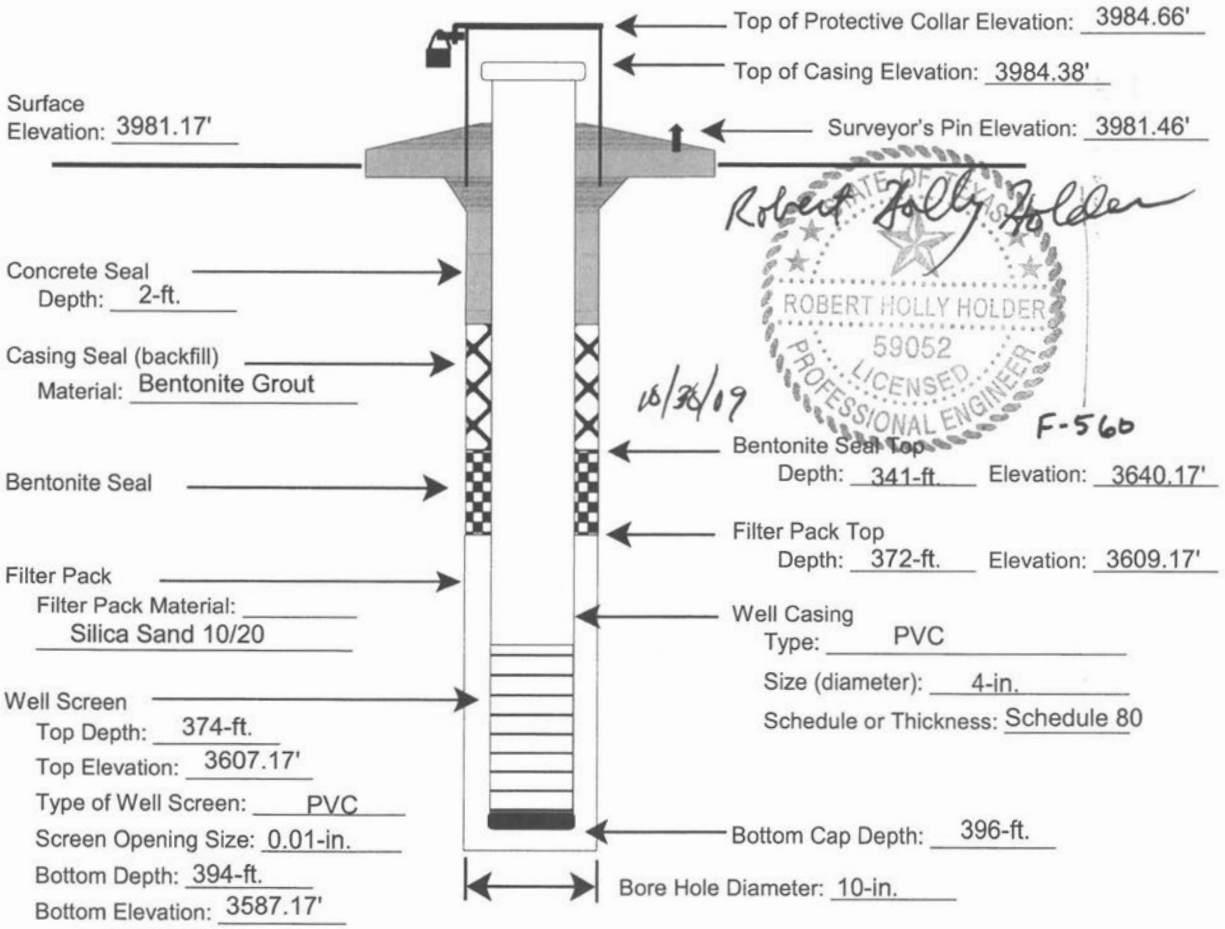
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-13
Date of Monitor Well Development: 08-07-09
Monitor Well Driller Name: William F. Kelton
License No.: 2758 AKP

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: The Carel Corporation (Kevin Carel & Steve Wimmer)
Static Water Level Elevation (with respect to MSL) after Well Development: 3612.37'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Keyed Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4 ft. x 4 ft. x 6 inches



TCEQ-10308

Monitor Well Data Sheet

Permittee or Site Name: Greater El Paso Landfill
County: El Paso County
Date of Monitor Well Installation: February 26, 2015
Latitude: N 31°36'02.02" Longitude: W 106°10'19.01"
Monitor Well Groundwater Gradient Position:
Upgradient: _____ Downgradient: X

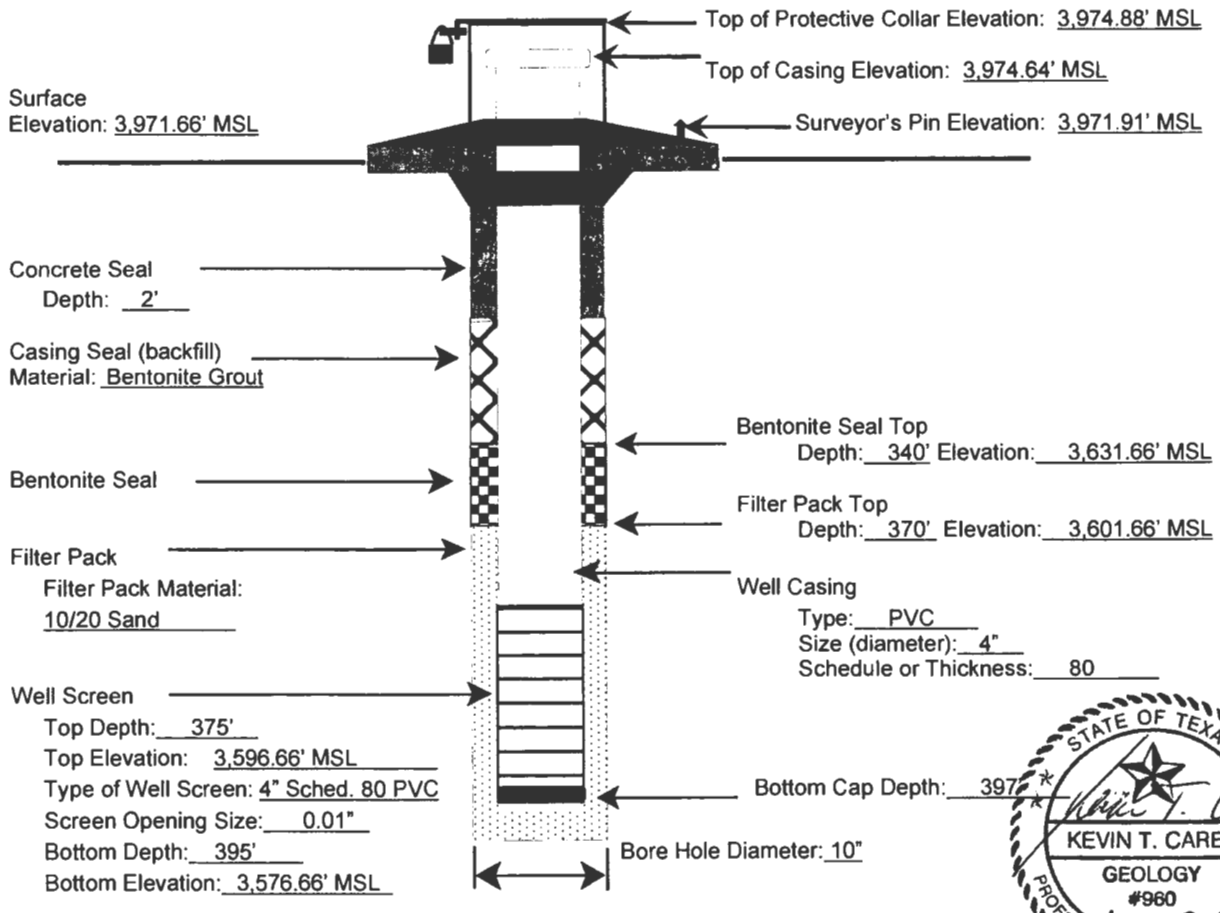
MSW Permit No.: 2284
Monitor Well I.D. No.: MW-14
Date of Monitor Well Development: March 16, 2015
Monitor Well Driller
Name: Quentin Stevens
License No. 59375

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

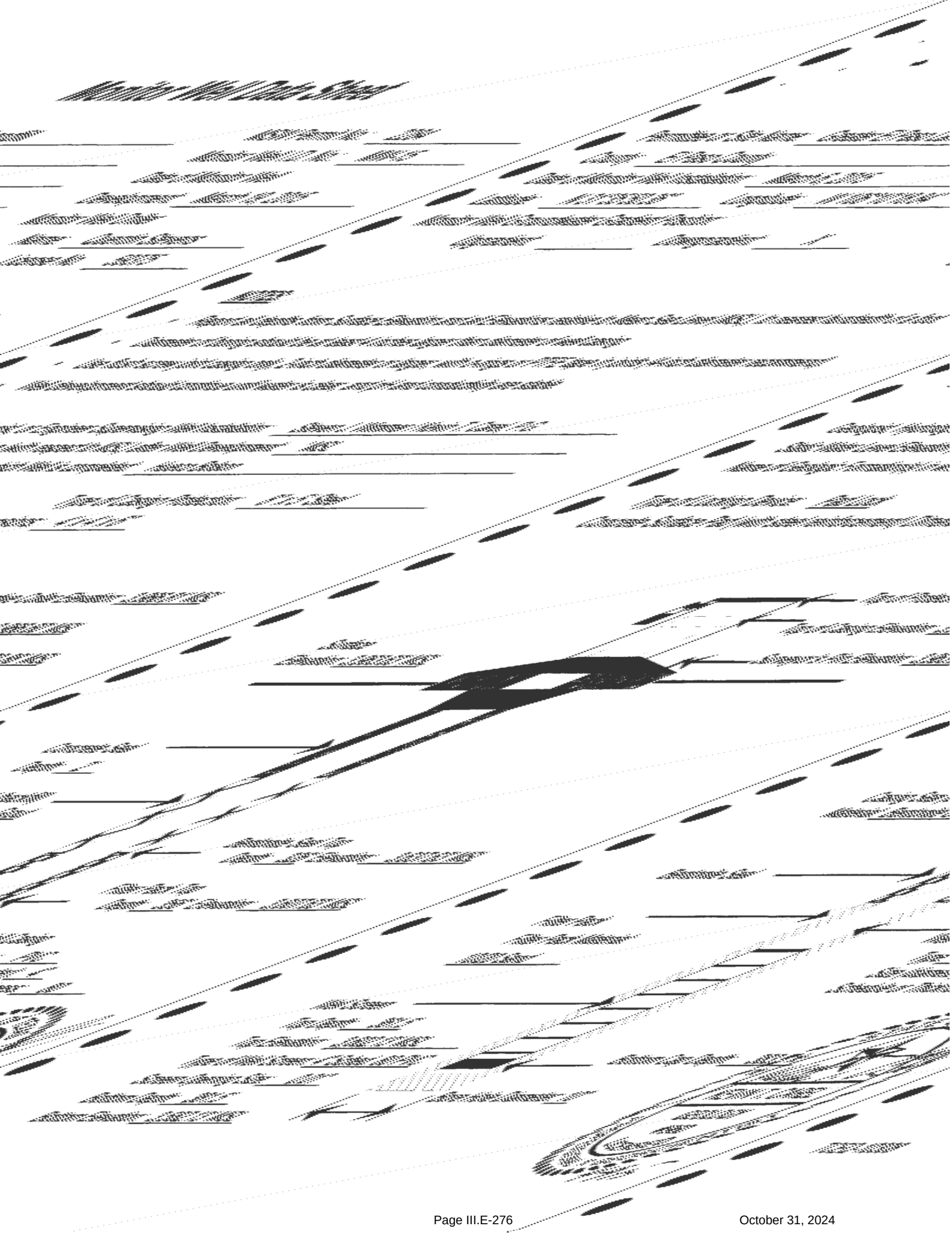
Geologist, Hydrologist, or Engineer Supervising Well Installation: Steven J. Wimmer / Kevin T. Carel, P.G.
Static Water Level Elevation (with respect to MSL) after Well Development: ' MSL
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Pad Lock Type of Casing Protection: 8" x 5' Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4' x 4' x 6"



STATE OF TEXAS
KEVIN T. CAREL
GEOLOGY
#960
LICENSED
PROFESSIONAL GEOSCIENTIST
4-9-15

TCEQ-10308



Monitor Well Data Sheet

Permittee or Site Name: Clint Landfill
County: El Paso
Date of Monitor Well Installation: 07-21-09
Monitor Well Latitude: 31.599134° Longitude: 106.171724°
Monitor Well Groundwater Gradient Position:
Upgradient X Downgradient _____

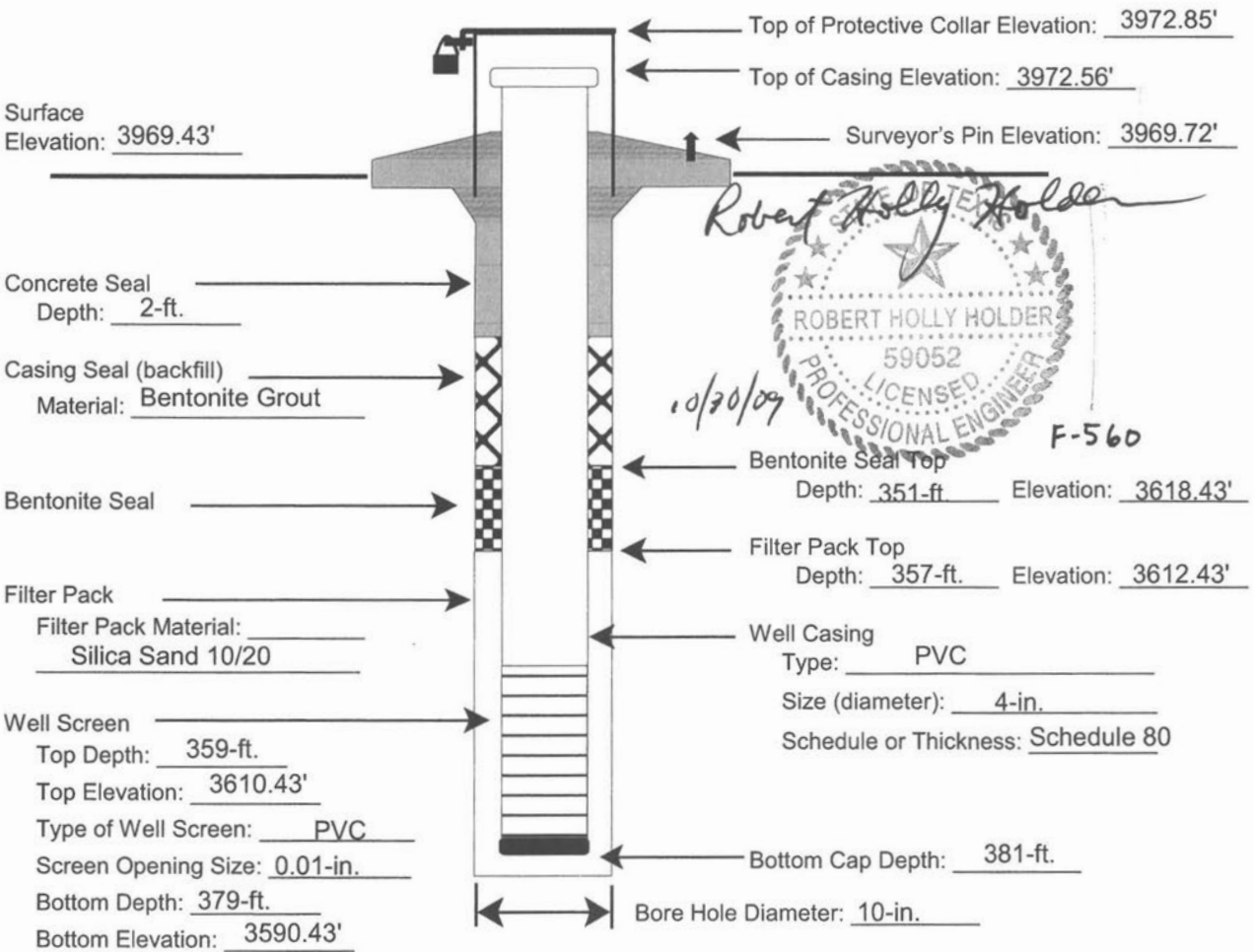
MSW Permit No.: 2284
Monitor Well I.D. No.: OW-2
Date of Monitor Well Development: 08-08-09
Monitor Well Driller Name: William F. Kelton
License No.: 2758 AKP

NOTES:

- Report all depths from Surface Elevation and all Elevations relative to Mean Sea Level (MSL), to nearest hundredth of a foot.
- Diameter of boring should be at least 4 inches larger than diameter of well casing.
- Use flush screw joint casing only, 2-inch diameter or larger, with o-rings or PTFE tape in joints (4-inch diameter recommend).
- Well development should continue until water is clear, and pH and conductivity are stable.

Geologist, Hydrologist, or Engineer Supervising Well Installation: The Carel Corporation (Kevin Carel & Steven Wimmer)
Static Water Level Elevation (with respect to MSL) after Well Development: 3613.23'
Name of Geologic Formation(s) in which Well is completed: Hueco Bolson

Type of Locking Device: Keyed Lock Type of Casing Protection: Steel
Concrete Surface Pad (with steel reinforcement) Dimensions: 4 ft. x 4 ft. x 6 inches



TCEQ-10308

ATTACHMENT III.E.19 – MONITORING WELL PLUGGING REPORTS

Please use black ink. File WHITE COPY with: Texas Water Commission P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7897	State of Texas **PLUGGING REPORT** (This form must be completed and filed with the TWC within 30 days following the date the well is plugged as required by current statutory law.)	Texas Water Well Drillers Board P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907

A. Well Identification and Location Data

1) Owner City of El Paso (Name) Address 2300 Darrington Clint Texas 79928 (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number MW-2

3) Location of Well: County El Paso 2 miles in North (N.E., S.W., etc.) direction from Clint Tex (Town)

☐ Legal description:

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. Block No. Township

Abstract No. Survey Name

Distance and direction from two intersecting section lines or survey lines:

☒ See Attached map.

B. Historical Data on Well To Be Plugged (if available) See exhibit "A"

4) Driller License Number City

5) Drilled 19 81 Diameter of hole inches. 7) Total depth of well feet.

C. Current Plugging Data

8) Date well plugged July 2009

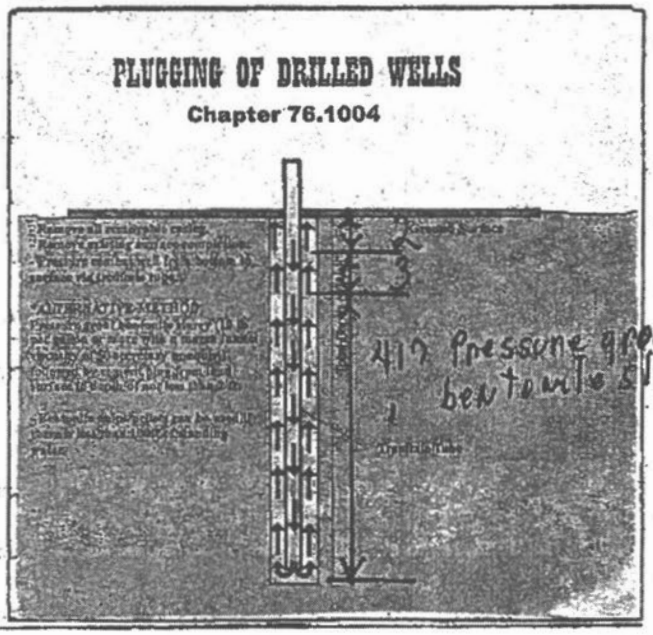
9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations Jim Ward
Juan Leon, Javier Leon
If a water well driller plugged the well, give the driller's license no.

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)
4	3	422

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	
3	5	10 sacks
5	422	383 sacks



D. Validation of Information Included in Form

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name William F. Helton (Type or Print)

Address 4011 Helton Ct. El Paso (Street or RFD) (City) Texas 79938 (State) (Zip)

(Signed) William F Helton (Person performing plugging operations) (Signed) (Owner of Well)

For TWC use only
Well No.
Location on map

WWD-008 (Rev. 07/27/88) TEXAS WATER COMMISSION'S COPY

***Note: Disregard References to Exhibits A-D

Please use black ink. File WHITE COPY with: Texas Water Commission P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7897	State of Texas **PLUGGING REPORT** (This form must be completed and filed with the TWC within 30 days following the date the well is plugged as required by current statutory law.)	Texas Water Well Drillers Board P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907

A. Well Identification and Location Data

1) Owner City of El Paso Address 2300 Darrington Clint Texas 79928
(Name) (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number 5A

3) Location of Well: County El Paso 2 miles in North direction from Clint Tex
(N.E., S.W., etc.) (Town)

☐ Legal description:

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. Block No. Township

Abstract No. Survey Name

Distance and direction from two intersecting section lines or survey lines:

☒ See Attached map: See exhibit 'B'

B. Historical Data on Well To Be Plugged (if available) See exhibit "A"

4) Driller License Number City

5) Drilled 19 ; 6) Diameter of hole inches; 7) Total depth of well feet.

C. Current Plugging Data

8) Date well plugged July 23 2009

9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations William Helton
Jim Ward, Juan Leos, Javier Leos
If a water well driller plugged the well, give the driller's license no. 2738 AIP

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)
4	3	396

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	
396-378	20	31 sacks
20	3	8 sacks
2	2	Cement plug



D. Validation of Information Included in Report:

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name William F. Helton (Type or Print)

Address 4011 Helton Ct. El Paso (City) Texas (State) 79938 (Zip)
(Street or RFD)

(Signed) William F Helton (Signed)
(Person performing plugging operations) (Owner of Well)

For TWC use only
Well No.
Location on map

WWD-009 (Rev. 07/27/98) TEXAS WATER COMMISSION'S COPY

***Note: Disregard References to Exhibits A-D

Please use black ink. File WHITE COPY with: Texas Water Commission P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907	State of Texas **PLUGGING REPORT** (This form must be completed and filed with the TWC within 30 days following the date the well is plugged as required by current statutory law.)	Texas Water Well Drillers Board P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907

A. Well Identification and Location Data

1) Owner City of El Paso Address 2300 Darrington Clint Texas 79928
(Name) (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number PB21

3) Location of Well: County El Paso 2 miles in North direction from Clint Tex
(N.E., S.W., etc.) (Town)

☐ Legal description:

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. Block No. Township

Abstract No. Survey Name

Distance and direction from two intersecting section lines or survey lines:

X See Attached map: See exhibit B

B. Historical Data on Well To Be Plugged (if available) See exhibit "A"

4) Driller License Number City

5) Drilled 19 6) Diameter of hole inches. 7) Total depth of well feet.

C. Current Plugging Data

8) Date well plugged July 28, 2009

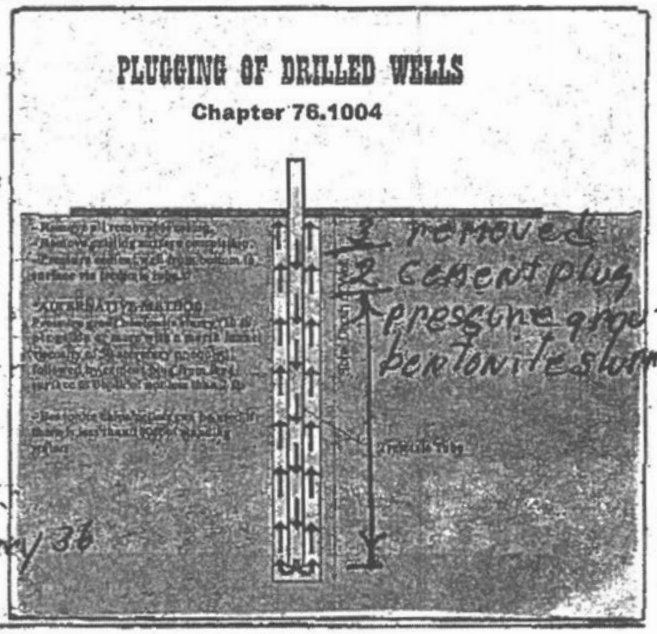
9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations Jim Wood
Brian Michaelson William Kelton
If a water well driller plugged the well, give the driller's license no. 2758 AKP

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)
4	380	3

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	
3	5	3 Cement
5	380	bentonite slurry 36



D. Validation of Information Included in Form:

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name William F. Kelton (Type or Print)

Address 4011 Kelton Ct. El Paso Texas 79938
(Street or RFD) (City) (State) (Zip)

(Signed) William F Kelton (Signed)
(Person performing plugging operations) (Owner of Well)

For TWC use only
Well No.
Location on map

WWD-009 (Rev. 07/27/88) TEXAS WATER COMMISSION'S COPY

***Note: Disregard References to Exhibits A-D

Please use black ink. File WHITE COPY with: Texas Water Commission P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907	State of Texas **PLUGGING REPORT** (This form must be completed and filed with the TWC within 30 days following the date a well is plugged as required by current statutory law.)	Texas Water Well Drillers Board P.O. Box 13087 Austin, Texas 78711 Phone (512) 463-7907

A. Well Identification and Location Data

1) Owner City of El Paso Address 2300 Darrington Clint Texas 79928
(Name) (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number PB-18

3) Location of Well: County El Paso 2 miles in: North direction from: Clint Tex
(N.E., S.W., etc.) (Town)

☐ Legal description:

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. Block No. Township

Abstract No. Survey Name

Distance and direction from two intersecting section lines or survey lines:

☒ See Attached map: See exhibit 'B'

B. Historical Data on Well To Be Plugged (if available) See exhibit "A"

4) Driller License Number City

5) Drilled 19 6) Diameter of hole inches; 7) Total depth of well feet.

C. Current Plugging Data

8) Date well plugged July 28 2009

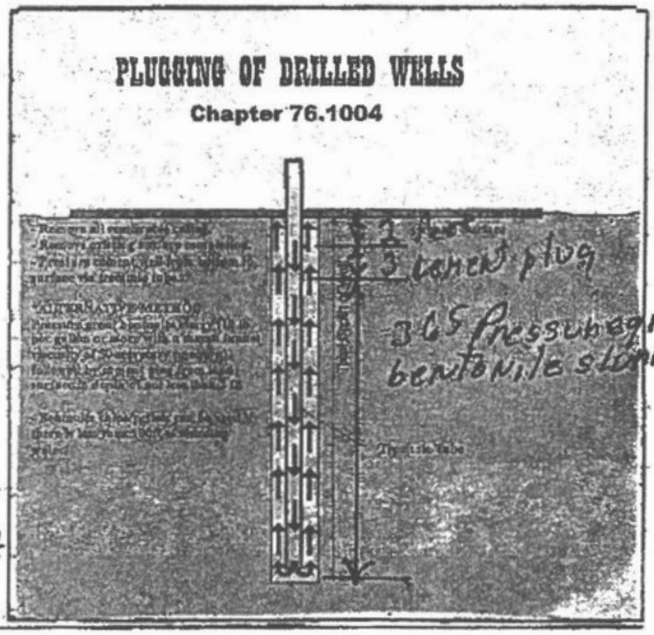
9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations Jin Wand
Javier Leon, JUANLEON
If a water well driller plugged the well, give the driller's license no.

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)
4	3	320

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	
3	5	8 cement
5	320	31 bent. grout



D. Validation of Information Included in Report

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name William F. Helton (Type or Print)

Address 4011 Helton Ct. El Paso Texas 79938
(Street or RFD) (City) (State) (Zip)

(Signed) William F. Helton (Signed)
(Person performing plugging operations) (Owner of Well)

For TWC use only
Well No.
Location on map

WWD-009 (Rev. 07/27/88) TEXAS WATER COMMISSION'S COPY

***Note: Disregard References to Exhibits A-D

Please use black ink. File WHITE COPY with: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711, Phone (512) 463-7997	State of Texas **PLUGGING REPORT** (This form must be completed and filed with the TWC within 30 days following the date the well is plugged as required by current statutory law.)	Texas Water Well Drillers Board, P.O. Box 13087, Austin, Texas 78711, Phone (512) 463-7997

A. Well Identification and Location Data

1) Owner City of El Paso (Name) Address 2300 Darrington Clint Texas 79928 (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number PB 29

3) Location of Well: County El Paso 2 miles in North (N.E., S.W., etc.) direction from Clint Tex (Town)

☐ Legal description:

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. Block No. Township

Abstract No. Survey Name

Distance and direction from two intersecting section lines or survey lines:

☒ See Attached map: See exhibit "B"

B. Historical Data on Well To Be Plugged (if available) See exhibit "A"

4) Driller License Number City

5) Drilled 19 6) Diameter of hole inches. 7) Total depth of well feet.

C. Current Plugging Data

8) Date well plugged July 27, 2009

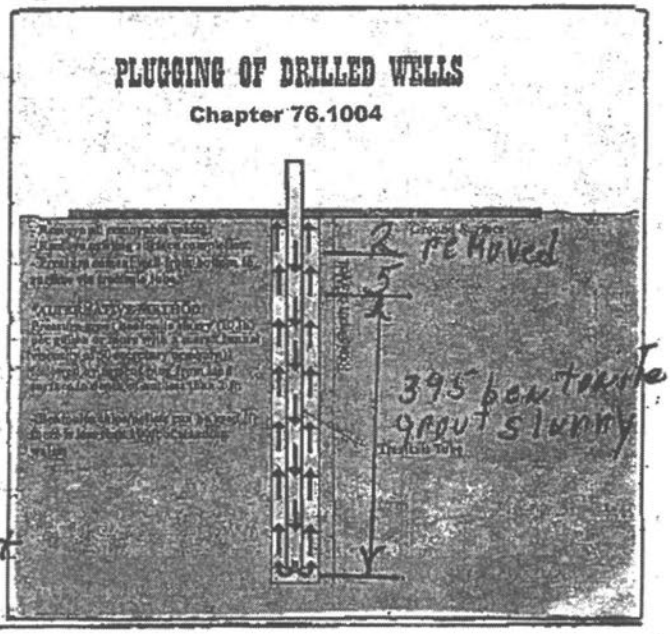
9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations Jim Wand
Daniel Beacon
If a water well driller plugged the well, give the driller's license no.

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)
4"	3	400

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	
3	5	B cement
5	400	38 ben. grout



D. Validation of Information Included in Form:

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name William F. Helton (Type or Print)

Address 4011 Helton Ct. El Paso (Street or RFD) (City) Texas (State) 79938 (Zip)

(Signed) William F Helton (Person performing plugging operations) (Signed) (Owner of Well)

For TWC use only
Well No.
Location on map

WWD-009 (Rev. 07/27/88) TEXAS WATER COMMISSION'S COPY

***Note: Disregard References to Exhibits A-D

ATTACHMENT III.E.20 – GROUNDWATER ELEVATIONS TABLE

Historical Groundwater Elevations
MSW 2284A

Well ID	MW-1		OW-2		MW-3		MW-4		MW-6		MW-7		MW-8		MW-9		MW-10	
TOC Elevation	3981.63		3972.56		3977.95		3985.98		3987.49		3987.23		3985.95		3979.58		3979.38	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
9/1/2004	369.90	3611.73	-	-	366.09	3611.86	374.57	3611.41	-	-	-	-	-	-	-	-	-	-
9/17/2004	369.79	3611.84	-	-	366.57	3611.38	374.45	3611.53	-	-	-	-	-	-	-	-	-	-
9/23/2004	369.90	3611.73	-	-	367.21	3610.74	374.57	3611.41	-	-	-	-	-	-	-	-	-	-
12/1/2004	366.50	3615.13	-	-	376.70	3601.25	374.50	3611.48	-	-	-	-	-	-	-	-	-	-
1/26/2005	369.25	3612.38	-	-	366.70	3611.25	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
2/11/2005	369.38	3612.25	-	-	366.25	3611.70	374.11	3611.87	-	-	-	-	-	-	-	-	-	-
2/24/2005	369.22	3612.41	-	-	366.00	3611.95	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
3/14/2005	369.14	3612.49	-	-	365.70	3612.25	373.89	3612.09	-	-	-	-	-	-	-	-	-	-
3/28/2005	-	-	-	-	-	-	374.13	3611.85	-	-	-	-	-	-	-	-	-	-
4/14/2005	-	-		-	379.70	3598.25	374.00	3611.98	-	-	-	-	-	-	-	-	-	-
5/12/2005	-	-		-	375.10	3602.85	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
5/25/2005	-	-		-	372.00	3605.95	374.00	3611.98	-	-	-	-	-	-	-	-	-	-
6/16/2005	380.50	3601.13	-	-	367.40	3610.55	374.00	3611.98	-	-	-	-	-	-	-	-	-	-
6/24/2005	372.40	3609.23	-	-	367.00	3610.95	374.20	3611.78	-	-	-	-	-	-	-	-	-	-
7/13/2005	369.70	3611.93	-	-	366.20	3611.75	374.10	3611.88	-	-	-	-	-	-	-	-	-	-
7/19/2005	369.50	3612.13			366.80	3611.15	374.02	3611.96	-	-	-	-	-	-	-	-	-	-
7/27/2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8/12/2005	372.20	3609.43	-	-	375.00	3602.95	374.20	3611.78	-	-	-	-	-	-	-	-	-	-
8/26/2005	369.53	3612.10	-	-	373.30	3604.65	373.98	3612.00	-	-	-	-	-	-	-	-	-	-
9/9/2005	369.40	3612.23	-	-	369.21	3608.74	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
10/14/2005	369.39	3612.24	-	-	369.20	3608.75	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
11/18/2005	369.40	3612.23	-	-	365.80	3612.15	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
12/16/2005	369.50	3612.13	-	-	372.25	3605.70	373.99	3611.99	-	-	-	-	-	-	-	-	-	-
1/26/2006	369.33	3612.30	-	-	367.35	3610.60	373.96	3612.02	-	-	-	-	-	-	-	-	-	-
2/27/2006	369.30	3612.33	-	-	366.50	3611.45	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
3/24/2006	369.32	3612.31	-	-	366.50	3611.45	374.15	3611.83	-	-	-	-	-	-	-	-	-	-
4/17/2006	369.30	3612.33	-	-	366.85	3611.10	373.85	3612.13	-	-	-	-	-	-	-	-	-	-
5/11/2006	369.30	3612.33	-	-	366.97	3610.98	373.88	3612.10	-	-	-	-	-	-	-	-	-	-
6/22/2006	369.31	3612.32	-	-	367.00	3610.95	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
7/12/2006	369.30	3612.33	-	-	367.40	3610.55	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
8/7/2006	369.33	3612.30	-	-	366.70	3611.25	373.60	3612.38	-	-	-	-	-	-	-	-	-	-
9/6/2006	369.32	3612.31	-	-	367.00	3610.95	373.80	3612.18	-	-	-	-	-	-	-	-	-	-
10/18/2006	369.25	3612.38	-	-	367.10	3610.85	373.85	3612.13	-	-	-	-	-	-	-	-	-	-
11/16/2006	369.50	3612.13	-	-	366.40	3611.55	373.80	3612.18	-	-	-	-	-	-	-	-	-	-
12/8/2006	370.00	3611.63	-	-	366.40	3611.55	373.80	3612.18	-	-	-	-	-	-	-	-	-	-
1/3/2007	369.50	3612.13	-	-	367.00	3610.95	373.85	3612.13	-	-	-	-	-	-	-	-	-	-
2/7/2007	369.30	3612.33	-	-	367.20	3610.75	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
3/23/2007	369.30	3612.33	-	-	366.20	3611.75	373.80	3612.18	-	-	-	-	-	-	-	-	-	-
4/17/2007	369.30	3612.33	-	-	366.10	3611.85	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
5/15/2007	369.30	3612.33	-	-	366.10	3611.85	373.95	3612.03	-	-	-	-	-	-	-	-	-	-
6/19/2007	369.30	3612.33	-	-	366.15	3611.80	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
7/25/2007	369.30	3612.33	-	-	366.10	3611.85	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
8/10/2007	369.30	3612.33	-	-	366.10	3611.85	373.90	3612.08	-	-	-	-	-	-	-	-	-	-

Historical Groundwater Elevations
MSW 2284A

Well ID	MW-1		OW-2		MW-3		MW-4		MW-6		MW-7		MW-8		MW-9		MW-10	
TOC Elevation	3981.63		3972.56		3977.95		3985.98		3987.49		3987.23		3985.95		3979.58		3979.38	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
9/20/2007	369.30	3612.33	-	-	366.10	3611.85	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
10/17/2007	369.40	3612.23	-	-	367.00	3610.95	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
11/28/2007	369.40	3612.23	-	-	367.00	3610.95	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
12/14/2007	369.40	3612.23	-	-	367.00	3610.95	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
1/18/2008	369.30	3612.33	-	-	365.80	3612.15	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
4/7/2008	369.30	3612.33	-	-	366.30	3611.65	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
7/22/2008	369.30	3612.33	-	-	365.60	3612.35	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
10/13/2008	369.25	3612.38	-	-	365.10	3612.85	373.89	3612.09	-	-	-	-	-	-	-	-	-	-
4/28/2009	369.25	3612.38	-	-	364.50	3613.45	373.90	3612.08	-	-	-	-	-	-	-	-	-	-
11/2/2009	369.35	3612.28	359.50	3613.06	364.70	3613.25	373.90	3612.08	375.50	3611.99	375.90	3611.33	373.90	3612.05	-	-	-	-
2/23/2010	369.35	3612.28	359.50	3613.06	364.70	3613.25	373.90	3612.08	375.50	3611.99	375.90	3611.33	373.90	3612.05	-	-	-	-
6/7/2010	369.30	3612.33	359.90	3612.66	364.82	3613.13	374.00	3611.98	375.50	3611.99	376.10	3611.13	374.80	3611.15	-	-	-	-
9/1/2010	369.25	3612.38	359.50	3613.06	365.40	3612.55	373.80	3612.18	375.40	3612.09	375.80	3611.43	373.60	3612.35	-	-	-	-
11/8/2010	369.25	3612.38	359.15	3613.41	364.80	3613.15	373.80	3612.18	375.20	3612.29	375.80	3611.43	373.30	3612.65	-	-	-	-
2/11/2011	369.20	3612.43	355.70	3616.86	364.90	3613.05	373.90	3612.08	375.30	3612.19	375.70	3611.53	374.10	3611.85	-	-	-	-
6/2/2011	369.20	3612.43	359.40	3613.16	364.45	3613.50	373.85	3612.13	375.35	3612.14	375.70	3611.53	373.60	3612.35	-	-	-	-
8/15/2011	364.70	3616.93	359.40	3613.16	364.70	3613.25	374.00	3611.98	375.40	3612.09	375.80	3611.43	373.61	3612.34	-	-	-	-
11/29/2011	369.23	3612.40	359.71	3612.85	364.80	3613.15	373.90	3612.08	375.60	3611.89	376.21	3611.02	373.85	3612.10	374.70	3604.88	-	-
3/13/2012	369.25	3612.38	359.20	3613.36	364.55	3613.40	373.75	3612.23	375.35	3612.14	375.80	3611.43	373.50	3612.45	374.45	3605.13	-	-
5/15/2012	-	-	-	-	-	-	-	-	375.40	3612.09	375.90	3611.33	373.65	3612.30	-	-	-	-
6/27/2012	-	-	-	-	-	-	-	-	375.55	3611.94	376.00	3611.23	373.70	3612.25	-	-	-	-
7/18/2012	-	-	-	-	-	-	-	-	375.15	3612.34	-	-	373.70	3612.25	-	-	-	-
8/16/2012	368.92	3612.71	359.30	3613.26	364.40	3613.55	373.85	3612.13	375.41	3612.08	376.08	3611.15	373.93	3612.02	374.50	3605.08	-	-
10/1/2012	369.15	3612.48	359.31	3613.25	364.10	3613.85	373.75	3612.23	375.25	3612.24	375.90	3611.33	373.60	3612.35	374.60	3604.98	-	-
12/3/2012	369.05	3612.58	359.23	3613.33	364.36	3613.59	373.90	3612.08	375.64	3611.85	376.27	3610.96	373.85	3612.10	373.90	3605.68	-	-
3/7/2013	368.91	3612.72	358.99	3613.57	364.32	3613.63	374.01	3611.97	375.23	3612.26	375.93	3611.30	373.81	3612.14	373.98	3605.60	-	-
6/3/2013	369.01	3612.62	359.33	3613.23	364.08	3613.87	373.70	3612.28	375.31	3612.18	375.82	3611.41	373.82	3612.13	374.00	3605.58	-	-
8/19/2013	369.00	3612.63	359.61	3612.95	364.46	3613.49	373.67	3612.31	375.30	3612.19	375.90	3611.33	373.73	3612.22	373.94	3605.64	-	-
11/19/2013	369.00	3612.63	359.61	3612.95	364.46	3613.49	373.67	3612.31	375.29	3612.20	375.90	3611.33	373.90	3612.05	373.90	3605.68	-	-
12/2/2013	368.83	3612.80	360.00	3612.56	364.40	3613.55	373.71	3612.27	375.52	3611.97	375.93	3611.30	374.01	3611.94	373.89	3605.69	-	-
3/26/2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.15	3612.43	-	-
6/24/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.58	3612.00	-	-
12/3/2014	369.05	3612.58	-	-	364.70	3613.25	373.55	3612.43	375.16	3612.33	375.40	3611.83	373.81	3612.14	367.51	3612.07	-	-
2/25/2015	369.12	3612.51	-	-	-	-	373.43	3612.55	375.06	3612.43	375.29	3611.94	373.42	3612.53	367.50	3612.08	-	-
6/18/2015	369.22	3612.41	-	-	364.74	3613.21	373.70	3612.28	375.18	3612.31	375.51	3611.72	373.64	3612.31	367.62	3611.96	-	-
10/12/2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/25/2015	369.10	3612.53	-	-	364.65	3613.30	373.40	3612.58	375.04	3612.45	375.15	3612.08	373.49	3612.46	367.44	3612.14	-	-
2/16/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.51	3612.07	-	-
6/1/2016	369.06	3612.57	-	-	364.62	3613.33	373.43	3612.55	375.07	3612.42	-	-	-	-	367.55	3612.03	-	-
6/20/2016	-	-	-	-	-	-	-	-	-	-	375.40	3611.83	373.72	3612.23	-	-	-	-
11/8/2016	369.03	3612.60	-	-	364.62	3613.33	373.45	3612.53	375.09	3612.40	375.38	3611.85	373.80	3612.15	367.44	3612.14	-	-
2/28/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9/12/2017	-	-	-	-	-	-	-	-	-	-	-	-	373.79	3612.16	-	-	-	-

Historical Groundwater Elevations
MSW 2284A

Well ID	MW-1		OW-2		MW-3		MW-4		MW-6		MW-7		MW-8		MW-9		MW-10	
TOC Elevation	3981.63		3972.56		3977.95		3985.98		3987.49		3987.23		3985.95		3979.58		3979.38	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
2/12/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/14/2018	369.05	3612.58	-	-	364.61	3613.34	373.46	3612.52	375.11	3612.38	375.34	3611.89	373.75	3612.20	367.59	3611.99	-	-
2/8/2019	-	-	-	-	364.61	3613.34	-	-	-	-	-	-	-	-	-	-	-	-
6/12/2019	369.06	3612.57	-	-	364.60	3613.35	373.42	3612.56	375.11	3612.38	375.32	3611.91	373.72	3612.23	367.60	3611.98	367.26	3612.12
12/11/2019	369.06	3612.57	-	-	364.62	3613.33	373.44	3612.54	375.10	3612.39	375.32	3611.91	373.71	3612.24	367.61	3611.97	367.26	3612.12
2/17/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.60	3611.98	-	-
3/6/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.26	3612.12
6/16/2020	369.06	3612.57	-	-	364.61	3613.34	373.43	3612.55	375.11	3612.38	375.33	3611.90	373.71	3612.24	367.61	3611.97	367.26	3612.12
9/23/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.28	3612.10
12/8/2020	369.05	3612.58	-	-	364.61	3613.34	373.41	3612.57	375.13	3612.36	375.32	3611.91	373.71	3612.24	367.63	3611.95	367.27	3612.11
3/25/2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	367.27	3612.11
6/15/2021	369.03	3612.60	-	-	364.61	3613.34	373.41	3612.57	375.12	3612.37	375.32	3611.91	373.71	3612.24	367.63	3611.95	367.27	3612.11
12/21/2021	369.03	3612.60	-	-	364.62	3613.33	373.41	3612.57	375.12	3612.37	375.32	3611.91	373.70	3612.25	367.62	3611.96	367.27	3612.11
6/23/2022	369.02	3612.61	-	-	364.61	3613.34	373.41	3612.57	375.11	3612.38	375.32	3611.91	373.70	3612.25	367.62	3611.96	367.26	3612.12
12/13/2022	369.02	3612.61	-	-	364.59	3613.36	373.41	3612.57	375.11	3612.38	375.32	3611.91	373.69	3612.26	367.64	3611.94	367.24	3612.14

Notes:

1. "-": No measurement obtained.
2. TOC: Top of casing.
3. DTW: Depth to water. Measured from TOC.
4. Elev.: Groundwater elevation.
5. All elevations are in North American Verical Datum of 1988 (NAVD88).

Historical Groundwater Elevations
MSW 2284A

Well ID	MW-11		MW-13		MW-14		MW-15		PB-1		PB-4		PB-32		PB-36		PB-37	
TOC Elevation	3977.44		3984.38		3974.64		3966.60		3899.89		3949.04		3977.55		3960.70		3982.59	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
9/1/2004	-	-	-	-	-	-	-	-	288.06	3611.83	338.48	3610.56	364.76	3612.79	348.56	3612.14	372.02	3610.57
9/17/2004	-	-	-	-	-	-	-	-	288.45	3611.44	338.35	3610.69	364.75	3612.80	348.47	3612.23	372.04	3610.55
9/23/2004	-	-	-	-	-	-	-	-	288.27	3611.62	338.49	3610.55	364.81	3612.74	348.60	3612.10	372.09	3610.50
12/1/2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/26/2005	-	-	-	-	-	-	-	-	287.40	3612.49	337.90	3611.14	364.21	3613.34	347.92	3612.78	371.53	3611.06
2/11/2005	-	-	-	-	-	-	-	-	287.80	3612.09	331.10	3617.94	364.26	3613.29	347.98	3612.72	371.62	3610.97
2/24/2005	-	-	-	-	-	-	-	-	287.50	3612.39	337.90	3611.14	364.32	3613.23	347.86	3612.84	371.45	3611.14
3/14/2005	-	-	-	-	-	-	-	-	287.87	3612.02	337.88	3611.16	364.20	3613.35	347.83	3612.87	371.44	3611.15
3/28/2005	-	-	-	-	-	-	-	-	287.84	3612.05	337.90	3611.14	364.18	3613.37	347.90	3612.80	371.40	3611.19
4/14/2005	-	-	-	-	-	-	-	-	287.70	3612.19	337.94	3611.10	364.20	3613.35	347.95	3612.75	371.50	3611.09
5/12/2005	-	-	-	-	-	-	-	-	287.80	3612.09	337.90	3611.14	364.20	3613.35	348.00	3612.70	371.50	3611.09
5/25/2005	-	-	-	-	-	-	-	-	287.70	3612.19	337.91	3611.13	364.20	3613.35	347.90	3612.80	371.52	3611.07
6/16/2005	-	-	-	-	-	-	-	-	287.72	3612.17	338.00	3611.04	364.20	3613.35	347.90	3612.80	371.50	3611.09
6/24/2005	-	-	-	-	-	-	-	-	287.00	3612.89	338.00	3611.04	364.20	3613.35	347.85	3612.85	371.50	3611.09
7/13/2005	-	-	-	-	-	-	-	-	287.50	3612.39	338.00	3611.04	364.20	3613.35	348.00	3612.70	371.50	3611.09
7/19/2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/27/2005	-	-	-	-	-	-	-	-	287.30	3612.59	338.20	3610.84	364.20	3613.35	348.00	3612.70	371.50	3611.09
8/12/2005	-	-	-	-	-	-	-	-	287.50	3612.39	338.10	3610.94	364.20	3613.35	348.00	3612.70	371.50	3611.09
8/26/2005	-	-	-	-	-	-	-	-	287.50	3612.39	338.10	3610.94	364.20	3613.35	348.10	3612.60	371.50	3611.09
9/9/2005	-	-	-	-	-	-	-	-	287.50	3612.39	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.50	3611.09
10/14/2005	-	-	-	-	-	-	-	-	287.50	3612.39	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.50	3611.09
11/18/2005	-	-	-	-	-	-	-	-	287.45	3612.44	337.93	3611.11	364.20	3613.35	347.90	3612.80	371.50	3611.09
12/16/2005	-	-	-	-	-	-	-	-	287.65	3612.24	337.95	3611.09	364.20	3613.35	347.83	3612.87	371.50	3611.09
1/26/2006	-	-	-	-	-	-	-	-	287.58	3612.31	337.95	3611.09	364.18	3613.37	347.60	3613.10	371.50	3611.09
2/27/2006	-	-	-	-	-	-	-	-	287.60	3612.29	337.95	3611.09	364.10	3613.45	347.90	3612.80	371.50	3611.09
3/24/2006	-	-	-	-	-	-	-	-	287.57	3612.32	337.98	3611.06	364.20	3613.35	347.95	3612.75	371.52	3611.07
4/17/2006	-	-	-	-	-	-	-	-	287.60	3612.29	337.95	3611.09	364.20	3613.35	347.92	3612.78	371.52	3611.07
5/11/2006	-	-	-	-	-	-	-	-	287.61	3612.28	337.95	3611.09	364.20	3613.35	347.95	3612.75	371.52	3611.07
6/22/2006	-	-	-	-	-	-	-	-	287.60	3612.29	337.93	3611.11	364.19	3613.36	347.92	3612.78	371.52	3611.07
7/12/2006	-	-	-	-	-	-	-	-	287.63	3612.26	337.90	3611.14	364.20	3613.35	347.92	3612.78	371.50	3611.09
8/7/2006	-	-	-	-	-	-	-	-	287.45	3612.44	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.50	3611.09
9/6/2006	-	-	-	-	-	-	-	-	287.60	3612.29	337.88	3611.16	364.20	3613.35	347.90	3612.80	371.50	3611.09
10/18/2006	-	-	-	-	-	-	-	-	287.70	3612.19	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.40	3611.19
11/16/2006	-	-	-	-	-	-	-	-	287.67	3612.22	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.44	3611.15
12/8/2006	-	-	-	-	-	-	-	-	287.67	3612.22	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.45	3611.14
1/3/2007	-	-	-	-	-	-	-	-	287.67	3612.22	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.45	3611.14
2/7/2007	-	-	-	-	-	-	-	-	287.67	3612.22	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.45	3611.14
3/23/2007	-	-	-	-	-	-	-	-	287.55	3612.34	337.90	3611.14	364.20	3613.35	347.80	3612.90	371.40	3611.19
4/17/2007	-	-	-	-	-	-	-	-	287.60	3612.29	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.45	3611.14
5/15/2007	-	-	-	-	-	-	-	-	287.75	3612.14	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.40	3611.19
6/19/2007	-	-	-	-	-	-	-	-	287.90	3611.99	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.40	3611.19
7/25/2007	-	-	-	-	-	-	-	-	287.66	3612.23	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.40	3611.19
8/10/2007	-	-	-	-	-	-	-	-	287.70	3612.19	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.40	3611.19

Historical Groundwater Elevations
MSW 2284A

Well ID	MW-11		MW-13		MW-14		MW-15		PB-1		PB-4		PB-32		PB-36		PB-37	
TOC Elevation	3977.44		3984.38		3974.64		3966.60		3899.89		3949.04		3977.55		3960.70		3982.59	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
9/20/2007	-	-	-	-	-	-	-	-	287.90	3611.99	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.40	3611.19
10/17/2007	-	-	-	-	-	-	-	-	287.90	3611.99	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.36	3611.23
11/28/2007	-	-	-	-	-	-	-	-	287.90	3611.99	338.00	3611.04	364.20	3613.35	347.95	3612.75	371.36	3611.23
12/14/2007	-	-	-	-	-	-	-	-	287.90	3611.99	338.00	3611.04	364.20	3613.35	347.95	3612.75	371.40	3611.19
1/18/2008	-	-	-	-	-	-	-	-	287.90	3611.99	338.00	3611.04	364.20	3613.35	348.10	3612.60	371.40	3611.19
4/7/2008	-	-	-	-	-	-	-	-	287.90	3611.99	338.00	3611.04	364.20	3613.35	347.85	3612.85	371.40	3611.19
7/22/2008	-	-	-	-	-	-	-	-	287.70	3612.19	338.00	3611.04	364.25	3613.30	347.90	3612.80	371.40	3611.19
10/13/2008	-	-	-	-	-	-	-	-	287.82	3612.07	337.95	3611.09	364.20	3613.35	347.90	3612.80	371.36	3611.23
4/28/2009	-	-	-	-	-	-	-	-	287.80	3612.09	338.00	3611.04	364.20	3613.35	347.90	3612.80	371.40	3611.19
11/2/2009	-	-	372.85	3611.53	-	-	-	-	287.90	3611.99	338.00	3611.04	364.00	3613.55	347.89	3612.81	371.40	3611.19
2/23/2010	-	-	372.85	3611.53	-	-	-	-	287.90	3611.99	338.00	3611.04	364.00	3613.55	347.89	3612.81	371.40	3611.19
6/7/2010	-	-	370.20	3614.18	-	-	-	-	287.80	3612.09	337.58	3611.46	364.35	3613.20	348.00	3612.70	372.08	3610.51
9/1/2010	-	-	371.30	3613.08	-	-	-	-	287.70	3612.19	337.90	3611.14	364.10	3613.45	347.50	3613.20	371.40	3611.19
11/8/2010	-	-	371.30	3613.08	-	-	-	-	287.40	3612.49	337.95	3611.09	364.10	3613.45	347.75	3612.95	372.10	3610.49
2/11/2011	-	-	371.60	3612.78	-	-	-	-	287.80	3612.09	337.90	3611.14	363.90	3613.65	347.80	3612.90	371.30	3611.29
6/2/2011	-	-	371.50	3612.88	-	-	-	-	287.60	3612.29	337.50	3611.54	364.00	3613.55	347.80	3612.90	371.80	3610.79
8/15/2011	-	-	371.70	3612.68	-	-	-	-	287.65	3612.24	337.82	3611.22	364.00	3613.55	347.81	3612.89	371.30	3611.29
11/29/2011	-	-	371.55	3612.83	-	-	-	-	287.70	3612.19	337.90	3611.14	364.20	3613.35	347.90	3612.80	371.30	3611.29
3/13/2012	-	-	371.50	3612.88	-	-	-	-	287.60	3612.29	337.70	3611.34	364.20	3613.35	347.80	3612.90	371.40	3611.19
5/15/2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/27/2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/18/2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8/16/2012	-	-	371.43	3612.95	-	-	-	-	287.61	3612.28	337.75	3611.29	364.00	3613.55	347.98	3612.72	371.35	3611.24
10/1/2012	-	-	371.40	3612.98	-	-	-	-	287.70	3612.19	338.10	3610.94	364.05	3613.50	347.85	3612.85	371.30	3611.29
12/3/2012	-	-	371.57	3612.81	-	-	-	-	287.85	3612.04	338.00	3611.04	364.26	3613.29	348.00	3612.70	371.23	3611.36
3/7/2013	-	-	371.43	3612.95	-	-	-	-	288.01	3611.88	338.07	3610.97	364.00	3613.55	347.96	3612.74	371.29	3611.30
6/3/2013	-	-	371.44	3612.94	-	-	-	-	288.00	3611.89	338.07	3610.97	364.03	3613.52	348.01	3612.69	370.91	3611.68
8/19/2013	-	-	371.32	3613.06	-	-	-	-	287.60	3612.29	338.03	3611.01	364.44	3613.11	347.94	3612.76	371.33	3611.26
11/19/2013	-	-	371.40	3612.98	-	-	-	-	287.60	3612.29	338.02	3611.02	364.44	3613.11	347.94	3612.76	371.33	3611.26
12/2/2013	-	-	371.60	3612.78	-	-	-	-	287.54	3612.35	338.01	3611.03	364.34	3613.21	346.67	3614.03	371.20	3611.39
3/26/2024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/24/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	371.20	3611.39
12/3/2014	-	-	371.33	3613.05	-	-	-	-	-	-	-	-	363.98	3613.57	347.80	3612.90	371.28	3611.31
2/25/2015	-	-	-	-	-	-	-	-	-	-	-	-	363.96	3613.59	347.78	3612.92	-	-
6/18/2015	-	-	371.29	3613.09	361.87	3612.77	353.62	3612.98	-	-	-	-	364.06	3613.49	347.96	3612.74	371.21	3611.38
10/12/2015	-	-	-	-	-	-	-	-	-	-	-	-	364.11	3613.44	-	-	-	-
11/25/2015	-	-	371.19	3613.19	361.72	3612.92	353.51	3613.09	-	-	-	-	363.94	3613.61	347.72	3612.98	371.14	3611.45
2/16/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/1/2016	-	-	371.30	3613.08	-	-	-	-	-	-	-	-	363.93	3613.62	347.82	3612.88	371.22	3611.37
6/20/2016	-	-	-	-	361.81	3612.83	354.20	3612.40	-	-	-	-	-	-	-	-	-	-
11/8/2016	-	-	371.20	3613.18	361.75	3612.89	354.20	3612.40	-	-	-	-	363.90	3613.65	347.71	3612.99	371.20	3611.39
2/28/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	347.70	3613.00	-	-
9/12/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Historical Groundwater Elevations
MSW 2284A

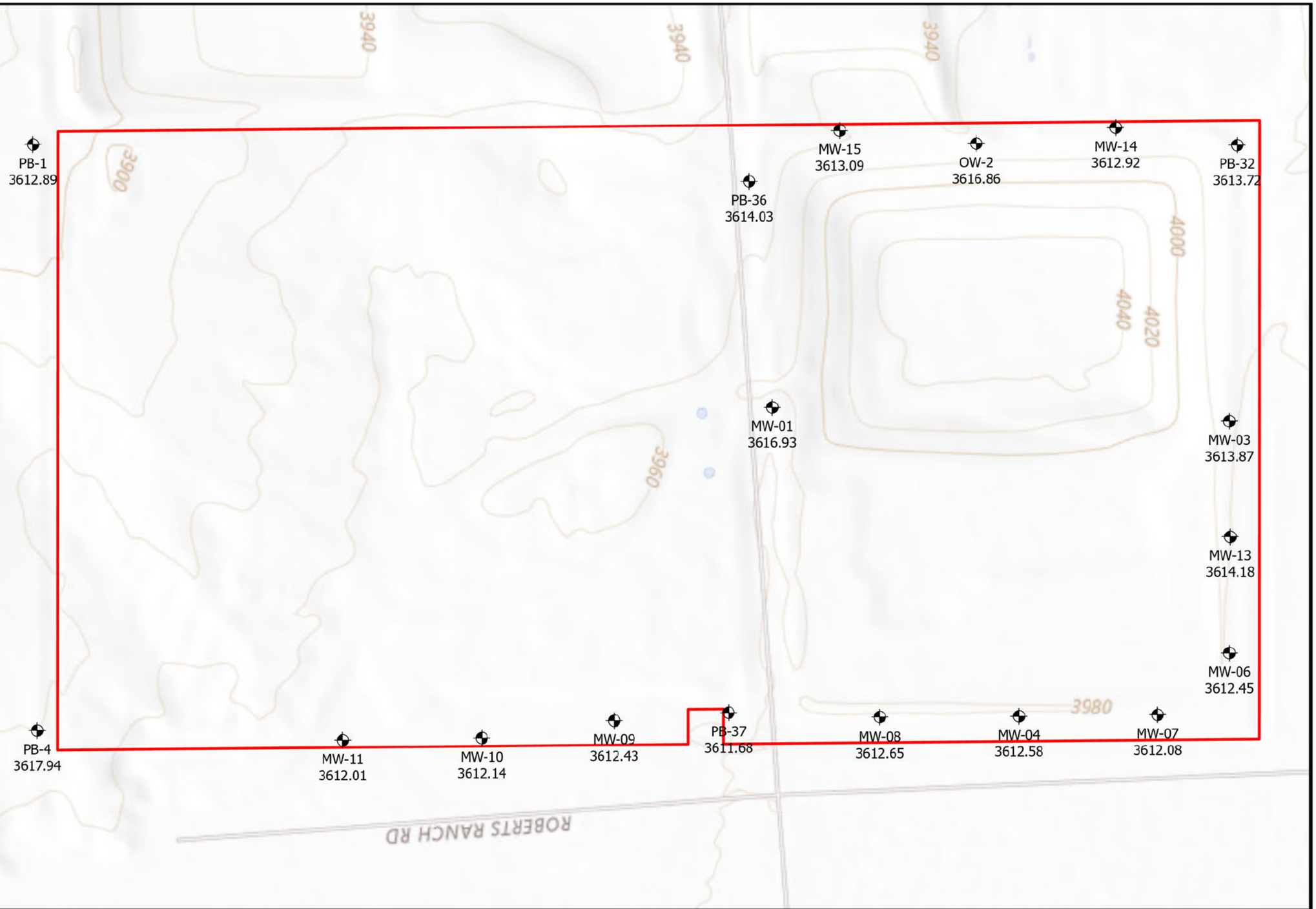
Well ID	MW-11		MW-13		MW-14		MW-15		PB-1		PB-4		PB-32		PB-36		PB-37	
TOC Elevation	3977.44		3984.38		3974.64		3966.60		3899.89		3949.04		3977.55		3960.70		3982.59	
Date	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.	DTW	Elev.
2/12/2018	-	-	-	-	-	-	-	-	-	-	-	-	363.98	3613.57	-	-	371.20	3611.39
6/14/2018	-	-	371.20	3613.18	361.73	3612.91	354.17	3612.43	-	-	-	-	363.86	3613.69	347.71	3612.99	371.17	3611.42
2/8/2019	-	-	371.20	3613.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/12/2019	365.45	3611.99	371.20	3613.18	361.75	3612.89	354.19	3612.41	-	-	-	-	363.86	3613.69	347.73	3612.97	371.14	3611.45
12/11/2019	365.44	3612.00	371.21	3613.17	361.74	3612.90	354.20	3612.40	-	-	-	-	363.86	3613.69	347.73	3612.97	371.15	3611.44
2/17/2020	-	-	-	-	-	-	354.20	3612.40	-	-	-	-	-	-	347.73	3612.97	371.15	3611.44
3/6/2020	365.44	3612.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/16/2020	365.44	3612.00	371.21	3613.17	361.74	3612.90	354.20	3612.40	-	-	-	-	363.86	3613.69	347.72	3612.98	371.14	3611.45
9/23/2020	365.45	3611.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/8/2020	365.45	3611.99	371.22	3613.16	361.74	3612.90	354.21	3612.39	-	-	-	-	363.85	3613.70	347.72	3612.98	371.14	3611.45
3/25/2021	365.44	3612.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/15/2021	365.43	3612.01	371.22	3613.16	361.74	3612.90	354.21	3612.39	-	-	-	-	363.85	3613.70	347.73	3612.97	371.14	3611.45
12/21/2021	365.43	3612.01	371.22	3613.16	361.74	3612.90	354.21	3612.39	-	-	-	-	363.85	3613.70	347.74	3612.96	371.14	3611.45
6/23/2022	365.43	3612.01	371.21	3613.17	361.74	3612.90	354.22	3612.38	-	-	-	-	363.85	3613.70	347.73	3612.97	371.14	3611.45
12/13/2022	365.44	3612.00	371.20	3613.18	361.74	3612.90	354.22	3612.38	-	-	-	-	363.83	3613.72	347.74	3612.96	371.14	3611.45

Notes:

1. "-": No measurement obtained.
2. TOC: Top of casing.
3. DTW: Depth to water. Measured from TOC.
4. Elev.: Groundwater elevation.
5. All elevations are in North American Verical Datum of 1988 (NAVD88).

ATTACHMENT III.E.21 –SEASONAL HIGH POTENTIOMETRIC SURFACE MAP AND TABLE

Well ID	MaxElev	Date Measured
MW-01	3616.93	8/15/2011
PB-01	3612.89	6/24/2005
OW-02	3616.86	2/11/2011
MW-03	3613.87	6/3/2013
MW-04	3612.58	11/25/2015
PB-04	3617.94	2/11/2005
MW-06	3612.45	11/25/2015
MW-07	3612.08	11/25/2015
MW-08	3612.65	11/8/2010
MW-09	3612.43	3/26/2024
MW-10	3612.14	12/13/2022
MW-11	3612.01	6/15/2021
MW-13	3614.18	6/7/2010
MW-14	3612.92	11/25/2015
MW-15	3613.09	11/25/2015
PB-32	3613.72	12/13/2022
PB-36	3614.03	12/2/2013
PB-37	3611.68	6/3/2013



Jack D. Simmons
Geology
11908
LICENSED
PROFESSIONAL GEOSCIENTIST
STATE OF TEXAS
10/31/2024

For Permitting Purposes Only

Permitted Boundary

Monitoring Well / Piezometer

Notes:
1. Groundwater elevations are in measured in feet above mean sea level.
2. "MaxElev" represents the highest, measured groundwater elevation at a location.
3. Seasonal high groundwater elevations may not be representative of the groundwater potentiometric surface at the facility at a single point in time; therefore no contour lines are displayed.

NORTH

0.25 0.13 0 0.25

Miles

BURNS McDONNELL

Attachment III.E.21
Seasonal High Groundwater Map
Greater El Paso Landfill Expansion
MSW Auth #2284A
El Paso County, Texas

Issued: 10/23/2024

Source: Esri, BMcD, TxDOT, TWDB, Texas Railroad Commission

Path: C:\GIS Projects\El Paso\El Paso Figures\El Paso Figures.aprx emblings 10/23/2024

Service Layer Credits: USGS/Esri USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data, USFS Road data, Natural Earth Data; U.S. Department of State INT, NOAA National Centers for Environmental Information

ATTACHMENT III.E.22 – TOTAL DISSOLVED SOLIDS LAB RESULTS

TRACE ANALYSIS, INC.

6701 Aberdeen Avenue, Suite 9 Lubbock, Texas 79424 800•378•1296 806•794•1296 FAX 806•794•1298
El Paso, Texas 79922 888•588•3443 915•585•3443 FAX 915•585•4944
E-Mail: lab@traceanalysis.com

ANALYTICAL REPORT

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990702
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-29-1*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-12-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2900	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

Page 1

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E-Mail: lab@traceanalysis.com

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990703
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY: V.
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-29-2*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-12-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2900	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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SAMPLE NO. : 990704
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-32-1
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-12-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

D A T A T A B L E

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2500	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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E-Mail: lab@traceanalysis.com

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990705
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY: K
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-32-2*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-12-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2400	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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ANALYTICAL REPORT

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990706
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-4-1*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-13-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2700	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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CLIENT RABA KISTNER CONSULTANTS
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EL PASO, TX 79915

SAMPLE NO. : 990707
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-4-2*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-13-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2600	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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ANALYTICAL REPORT

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990708
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-1-1*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-13-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

DATA TABLE

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2000	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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ANALYTICAL REPORT

CLIENT RABA KISTNER CONSULTANTS
7002 COMMERCE AVE.
EL PASO, TX 79915

SAMPLE NO. : 990709
INVOICE NO.: 22103698
REPORT DATE: 02-24-99
REVIEWED BY:
PAGE : 1 OF 1

CLIENT SAMPLE ID : PB-1-2*
SAMPLE TYPE .....: water
SAMPLED BY .....: J.R.
SUBMITTED BY ....: R.Kincaid
SAMPLE SOURCE ...: Clint El Paso County Tx

AUTHORIZED BY : J. Rojas
CLIENT P.O. : --
SAMPLE DATE ...: 02-13-99
SUBMITTAL DATE : 02-16-99
EXTRACTION DATE: --

Inorganic Non-Metals

D A T A T A B L E

Parameter	Result	Unit	Detection Limit	Analysis Date	Test Method	Analyst
Total Dissolved Solids .....:	2000	mg/L	50.	02-18-99	STD METH 2540 C	A. Myers

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E-Mail: lab@traceanalysis.com

Analytical and Quality Control Report

Johanes Mokahabe
Raba Kistner Consultants (SW), Inc.
7002 Commerce
El Paso, TX 79915

Report Date: 9/7/00

Project Number: AEA96-182-01 8/30/00
Project Name: Clint Landfill
Project Location: Clint Landfill

Order ID Number: 00083013

Enclosed are the Analytical Results and Quality Control Data Reports for the following samples submitted to TraceAnalysis, Inc. for analysis:

Sample Number	Sample Description	Matrix	Date Taken	Time Taken	Date Received
20003974	PB-36	Liquid	8/30/00	13:05	8/30/00
20003975	PB-37	Liquid	8/30/00	13:55	8/30/00
20003976	El Paso City Well Clint Landfill	Liquid	8/30/00	14:10	8/30/00

These results represent only the samples received in the laboratory. The Quality Control Report is generated on a batch basis. All information contained in this report is for the analytical batch(es) in which your sample(s) were analyzed.

This report consists of a total of 10 pages and shall not be reproduced except in its entirety, without written approval of TraceAnalysis, Inc.

Laboratory analyses were performed on samples utilizing procedures published in Standards Methods for the Examination of Water and Wastewater, 18th Edition 1992; EPA Test Methods for Evaluating Solid Waste 3rd Edition, through December 1996 revisions; or EPA Methods for the Chemical Analysis of Water and Wastes[EPA-600/4-79-020], March 1983, and the latest promulgated updates. This is an integral part of the report and must be included with all copies.

Temperature acceptance range for most analyses is 2 to 6 degrees Celcius.

Jerrod Hohman

Jerrod Hohman, QA Manager

Analytical Results Report

Sample Number: 20003974
Description: PB-36

Param	Result	Dilution	Analytical Method	Date Prepared	Date Analyzed	Analyst	Prep Batch #	QC Batch #	RDL
TDS (mg/L)									
Total Dissolved Solids	2400	1	SM 2540C	8/30/00	8/29/00	DG	PB00315	QC00362	50

Sample Number: 20003975
Description: PB-37

Param	Result	Dilution	Analytical Method	Date Prepared	Date Analyzed	Analyst	Prep Batch #	QC Batch #	RDL
TDS (mg/L)									
Total Dissolved Solids	2700	1	SM 2540C	8/30/00	8/31/00	DG	PB00315	QC00393	50

Sample Number: 20003976
Description: El Paso City Well Clint Landfill

Param	Result	Dilution	Analytical Method	Date Prepared	Date Analyzed	Analyst	Prep Batch #	QC Batch #	RDL
Ca, Total (mg/L)									
Total Calcium	140	20	SM 3111B	8/31/00	9/1/00	NM	PB00300	QC00345	1
Cl (mg/L)									
Chloride	1300	50	E 300.0	9/1/00	9/1/00	DG	PB00343	QC00397	-
CO3 Alkalinity (mg/L as CaCo3)									
Carbonate Alkalinity	<5.0	1	E 310.1	9/1/00	9/1/00	DG	PB00337	QC00386	5
Conductivity (uMHOS/cm)									
Specific Conductance	4700	1	SM 2510B	8/31/00	8/31/00	DG	PB00304	QC00350	
Fl (mg/L)									
Fluoride	4.4	20	E 300.0	8/31/00	8/31/00	DG	PB00306	QC00353	0.2
HCO3 Alkalinity (mg/L as CaCo3)									
Bicarbonate Alkalinity	55.	1	E 310.1	9/1/00	9/1/00	DG	PB00337	QC00387	5
K, Total (mg/L)									
Total Potassium	5.9	1	SM 3111B	8/31/00	9/1/00	NM	PB00302	QC00347	1
Mg, Total (mg/L)									
Total Magnesium	41	5	SM 3111B	8/31/00	9/1/00	NM	PB00301	QC00346	1
Na, Total (mg/L)									
Total Sodium	760	1	SM 3111B	8/31/00	9/1/00	NM	PB00299	QC00342	-

pH (s.u.)									
pH	7.9	1	SM 4500-H+	8/30/00	8/31/00	DG	PB00308	QC00355	
SO4 (mg/L)									
Sulfate	180	20	E 300.0	8/31/00	8/31/00	DG	PB00306	QC00353	1
TDS (mg/L)									
Total Dissolved Solids	2700	1	SM 2540C	8/30/00	8/31/00	DG	PB00315	QC00394	50

Quality Control Report
Method Blanks

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Total Calcium (mg/L)		<1.0	1	9/1/00	PB00300	QC00345

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Chloride (mg/L)		<2.0	2	9/1/00	PB00343	QC00397

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Carbonate Alkalinity (mg/L as CaCo3)		<5.0	5	9/1/00	PB00337	QC00386

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Specific Conductance (uMHOS/cm)		<1.0		8/31/00	PB00304	QC00350

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Sulfate (mg/L)		<1.0	1	8/31/00	PB00306	QC00353
luoride (mg/L)		<0.2	0.2	8/31/00	PB00306	QC0035?

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Bicarbonate Alkalinity (mg/L as CaCo3)		<5.0	5	9/1/00	PB00337	QC00387

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Total Potassium (mg/L)		<1.0	1	9/1/00	PB00302	QC00347

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Total Magnesium (mg/L)		<1.0	1	9/1/00	PB00301	QC00346

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Total Sodium (mg/L)		<1.0	1	9/1/00	PB00299	QC00342

Param	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Sulfate (mg/L)		<1.0	1	8/31/00	PB00306	QC00353
luoride (mg/L)		<0.2	0.2	8/31/00	PB00306	QC0035?

aram	Flag	Blank Result	Reporting Limit	Date Analyzed	Prep Batch #	QC Batch #
Total Dissolved Solids (mg/L)		<50.	50	8/29/00	PB00315	QC00362
Total Dissolved Solids (mg/L)		<50.	50	8/31/00	PB00315	QC00393
Total Dissolved Solids (mg/L)		<50.	50	8/31/00	PB00315	QC00394

Quality Control Report
Matrix Spike and Matrix Duplicate Spike

Standard	Param		Sample Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
MS	Total Sodium (mg/L)	*	760	1	20	752	-40		75 - 125	-	QC00342
* Total Sodium - Spike result is not practical.											
MSD	Total Sodium (mg/L)	*	760	1	20	769	45	3400	-	0 - 20	QC00342
* Total Sodium - Spike result is not practical.											

Standard	Param		Sample Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
MS	Total Calcium (mg/L)	*	140	1	5	156	320		75 - 125	-	QC00345
* Total Calcium - Spike result is not practical.											
MSD	Total Calcium (mg/L)	*	140	1	5	149	180	56	-	0 - 20	QC00345
* Total Calcium - Spike result is not practical.											

Standard	Param		Sample Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
MS	Total Magnesium (mg/L)	*	41	1	5	48.2	144		75 - 125	-	QC00
* Total Magnesium - Spike result is not practical.											
MSD	Total Magnesium (mg/L)	*	41	1	5	47.8	136	6	-	0 - 20	QC00346
* Total Magnesium - Spike result is not practical.											

Standard	Param	Sample Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
MS	Total Potassium (mg/L)	5.9	1	10	14.5	86		75 - 125	-	QC00347
MSD	Total Potassium (mg/L)	5.9	1	10	14.6	87	1	-	0 - 20	QC00347

Quality Control Report
Duplicates

Standard	Param	Flag	Duplicate Result	Sample Result	Dilution	RPD	RPD Limit	QC Batch #
Duplicate	Specific Conductance (uMHOS/cm)		4700	4700	1	0	0 - 20	QC00350

Standard	Param	Flag	Duplicate Result	Sample Result	Dilution	RPD	RPD Limit	QC Batch #
Duplicate	pH (s.u.)		7.9	7.9	1	0	0 - 0.1	QC00355

Standard	Param	Flag	Duplicate Result	Sample Result	Dilution	RPD	RPD Limit	QC Batch #
Duplicate	Total Dissolved Solids (mg/L)		2500	2400	1	4	0 - 20	QC00362

Standard	Param	Flag	Duplicate Result	Sample Result	Dilution	RPD	RPD Limit	QC Batch #
Duplicate	Total Dissolved Solids (mg/L)		2800	2700	1	4	0 - 20	QC00393

Standard	Param	Flag	Duplicate Result	Sample Result	Dilution	RPD	RPD Limit	QC Batch #
Duplicate	Total Dissolved Solids (mg/L)		2700	2700	1	0	0 - 20	QC00394

Quality Control Report
Lab Control Spikes and Duplicate Spike

	Param	Blank Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
LCS	Total Calcium (mg/L)	<1.0	1	5	4.67	93		85 - 115	-	QC00345
LCSD	Total Calcium (mg/L)	<1.0	1	5	4.89	98	5	-	0 - 20	QC00345

	Param	Blank Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
LCS	Total Potassium (mg/L)	<1.0	1	10	9.19	92		85 - 115	-	QC00347
LCSD	Total Potassium (mg/L)	<1.0	1	10	9.28	93	1	-	0 - 20	QC00347

	Param	Blank Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
LCS	Total Magnesium (mg/L)	<1.0	1	5	5.16	103		85 - 115	-	QC00346
CSD	Total Magnesium (mg/L)	<1.0	1	5	5.22	104	1	-	0 - 20	QC00346

	Param	Blank Result	Dil.	Spike Amount Added	Matrix Spike Result	% Rec.	RPD	% Rec. Limit	RPD Limit	QC Batch #
LCS	Total Sodium (mg/L)	<1.0	1	20	20.5	102		85 - 115	-	QC00342
LCSD	Total Sodium (mg/L)	<1.0	1	20	19.8	99	3	-	0 - 20	QC00342

Quality Control Report
Continuing Calibration Verification Standard

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Calcium (mg/L)		5	4.96	99	95 - 105	9/1/00	QC00345
CCV 1	Total Calcium (mg/L)		5	5.27	105	90 - 110	9/1/00	QC00345

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
CCV 1	Carbonate Alkalinity (mg/L as CaCo3)		1	96.6	9660	90 - 110	9/1/00	QC00386

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Specific Conductance (uMHOS/cm)		1413	1395	99	80 - 120	8/31/00	QC00350
CCV 1	Specific Conductance (uMHOS/cm)		1413	1388	98	80 - 120	8/31/00	QC00350

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
CCV 1	Bicarbonate Alkalinity (mg/L as CaCo3)		100	96.6	97	90 - 110	9/1/00	QC00387

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Potassium (mg/L)		50	9.56	19	95 - 105	9/1/00	QC00347
CCV 1	Total Potassium (mg/L)		50	9.48	19	90 - 110	9/1/00	QC00347

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Magnesium (mg/L)		10	10.4	104	95 - 105	9/1/00	QC00346
CCV 1	Total Magnesium (mg/L)		10	9.77	98	90 - 110	9/1/00	QC00346

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Sodium (mg/L)		50	53.6	107	95 - 105	9/1/00	QC00342
CCV 1	Total Sodium (mg/L)		50	53.9	108	90 - 110	9/1/00	QC00342

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	pH (s.u.)		8	7.96	100	99 - 101	8/31/00	QC00355
CCV 1	pH (s.u.)		8	7.97	100	99 - 101	8/31/00	QC00355

Quality Control Report
Continuing Calibration Verification Standard

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Dissolved Solids (mg/L)		1000	1010	101	95 - 105	8/29/00	QC00362

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Dissolved Solids (mg/L)		1000	1010	101	95 - 105	8/31/00	QC00393

Standard	Param	Flag	CCVs TRUE Conc.	CCVs Found Conc.	CCVs Percent Recovery	Percent Recovery Limits	Date Analyzed	QC Batch #
ICV	Total Dissolved Solids (mg/L)		1000	1010	101	95 - 105	8/31/00	QC00394

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4725 Ripley Dr., Ste A
El Paso, Texas 79922-1028
Tel (915) 585-3443
Fax (915) 585-4944
1 (888) 588-3443

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

LAB Order ID #: 83013

ANALYSIS REQUEST
(Circle or Specify Method No.)

LAB # (LAB USE ONLY)	FIELD CODE	# CONTAINERS	Volume/Amount	MATRIX: WATER	SOIL	AIR	SLUDGE	PRESERVATIVE METHOD: HCL	HNO3	NaHSO4	H_2SO_4	NaOH	ICE	NONE	SAMPLING: DATE	TIME
3914	PB-36	1		X										X	8/30/00	13:05
3915	PB-37	1		X										X	8/30/00	13:35
3916	El Paso City well field Landfill	2		X					X					X	8/30/00	14:10

MTBE 8021B/602	BTEX 8021B/602	TPH 418.1/TX1005	PAH 8270C	Total Metals Ag As Ba Cd Cr Pb Se Hg 6010B/200.7	TCLP Metals Ag As Ba Cd Cr Pb Se Hg	TCLP Volatiles	TCLP Semi Volatiles	TCLP Pesticides	RCI	GC-MS Vol. 8260B/624	GC/MS Semi. Vol. 8270C/625	PCB's 8082/608	Pesticides 8081A/608	BOD, TSS, pH	TDS	Drinking Water	Turn Around Time if different from standard	Hold
															X			
															X			
																X		

Company Name: Robin Kistler
Phone #: (915) 778-5233
Address: (Street, City, Zip) 1002 Commerce
Fax #: (915) 779-8701
Contact Person: Johanes Makahebe
Invoice to: (If different from above) P.O. # E-16906
Project #: AEA96-182-01
Project Name: City Landfill
Project Location: City Landfill
Sampler Signature:

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
	8/30/00	15:20			
Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received at Laboratory by: Anna Glenn	8/31/00	15:20

LAB USE ONLY
Intact (Y) / N
Headspace Y / (N)
Temp 4°C
Log-In Review

REMARKS:
PLEASE RUSH
RUN TDS W/ DUPLICATE
Cl, SO4 (CO3) (HCO3), F
Na, K, Ca, Mg, TDS
ph, (Cond)

Carrier # Walk In

Initial of samples constitutes agreement to Terms and Conditions listed on reverse side of C.O.C.

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ATTACHMENT III.E.23 – TEXAS WATER WELL DEVELOPMENT BOARD WATER WELL MAP

4931205

4931204

4931301

Lat. 31° 36' 06.04583°N
Long. 106° 09' 48.64117°W

Lat. 31° 35' 17.38022°N
Long. 106° 10' 18.71737°W

For Permitting Purposes Only

Water Well: Withdrawal of Water

Water Well: Plugged or Destroyed

1-mile radius

Property/Permit Boundary

Fence Line

Railroad

Notes:
1. Map source: Texas Department of Transportation (TxDOT) Roadways, El Paso District, 2022.
2. Water Wells source: Texas Water Development Board (TWDB) Water Data Interactive Viewer, accessed on August 8, 2023.
3. Railroad layer source: TxDOT, Texas Railroads, 2023

NORTH

0.7 0.35 0 0.7

Miles

BURNS McDONNELL

Attachment III.E.22
TWDB Water Well Map
Greater El Paso Landfill Expansion
MSW Auth #2284A
El Paso County, Texas

Issued: 10/22/2024

Path: C:\GIS Projects\El Paso\El Paso Figures\El Paso Figures.aprx embillings 10/22/2024

Service Layer Credits: World Imagery, Maxar

Source: Esri, BMcD, TxDOT, TWDB, Texas Railroad Commission

ATTACHMENT III.E.24 – TEXAS WATER DEVELOPMENT BOARD WELL DATA

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 49-31-204

GWDB Reports and Downloads

Well Basic Details

Scanned Documents

State Well Number	4931204
County	El Paso
River Basin	Rio Grande
Groundwater Management Area	5
Regional Water Planning Area	E - Far West Texas
Groundwater Conservation District	GCD Does Not Exist
Latitude (decimal degrees)	31.598889
Latitude (degrees minutes seconds)	31° 35' 56" N
Longitude (decimal degrees)	-106.181944
Longitude (degrees minutes seconds)	106° 10' 55" W
Coordinate Source	+/- 1 Second
Aquifer Code	112HCBL - Hueco Bolson
Aquifer	Hueco-Mesilla Bolson
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	3905
Land Surface Elevation Method	Digital Elevation Model -DEM
Well Depth (feet below land surface)	570
Well Depth Source	Unknown
Drilling Start Date	
Drilling End Date	
Drilling Method	
Borehole Completion	

Well Type	Withdrawal of Water
Well Use	Industrial
Water Level Observation	None
Water Quality Available	Yes
Pump	
Pump Depth (feet below land surface)	
Power Type	
Annular Seal Method	
Surface Completion	
Owner	City of El Paso Clint Landfill Well
Driller	
Other Data Available	
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	
Previous State Well Number	
Reporting Agency	
Created Date	6/16/1999
Last Update Date	3/4/2020

Remarks	

Casing - No Data

Well Tests - No Data

Lithology - No Data

Annular Seal Range - No Data

Borehole - No Data

Plugged Back - No Data

Filter Pack - No Data

Packers - No Data

Water Level Measurements

No Data Available

Water Quality Analysis

Sample Date: 9/8/1983 **Sample Time:** 1300 **Sample Number:** 1 **Collection Entity:** Municipal Water Agency or Public Water Supply Corp

Sampled Aquifer: Hueco Bolson

Analyzed Lab: El Paso Water Utilities Lab **Reliability:** Reliability unknown or not available

Collection Remarks: No Data

Parameter Code	Parameter Description	Flag	Value*	Units	Plus/Minus
00415	ALKALINITY, PHENOLPHTHALEIN (MG/L)		0	mg/L	
00410	ALKALINITY, TOTAL (MG/L AS CACO3)		47	mg/L	
00440	BICARBONATE ION, CALCULATED (MG/L AS HCO3)		57.36	mg/L	
00910	CALCIUM (MG/L)		164	mg/L	
00445	CARBONATE ION, CALCULATED (MG/L AS CO3)		0	mg/L	
00940	CHLORIDE, TOTAL (MG/L AS CL)		1530	mg/L	
00950	FLUORIDE, DISSOLVED (MG/L AS F)		0.5	mg/L	
00900	HARDNESS, TOTAL, CALCULATED (MG/L AS CACO3)		507	mg/L	
00920	MAGNESIUM (MG/L)		24	mg/L	
01055	MANGANESE, TOTAL (UG/L AS MN)		60	ug/L	
71851	NITRATE NITROGEN, DISSOLVED, CALCULATED (MG/L AS NO3)		27	mg/L	
00937	POTASSIUM, TOTAL (MG/L AS K)		9.7	mg/L	
71860	RESIDUAL SODIUM CARBONATE, CALCULATED		0		
00955	SILICA, DISSOLVED (MG/L AS SI02)		29	mg/L	
00931	SODIUM ADSORPTION RATIO, CALCULATED (SAR)		16.39		
00932	SODIUM, CALCULATED, PERCENT		78	PCT	
00929	SODIUM, TOTAL (MG/L AS NA)		849	mg/L	
00094	SPECIFIC CONDUCTANCE, FIELD (UMHOS/CM AT 25C)		5870	MICR	
00945	SULFATE, TOTAL (MG/L AS SO4)		133	mg/L	
00010	TEMPERATURE, WATER (CELSIUS)		27	C	
70301	TOTAL DISSOLVED SOLIDS , SUM OF CONSTITUENTS (MG/L)		2794	mg/L	

Water Quality Analysis

Sample Date: 11/13/1996 **Sample Time:** 1000 **Sample Number:** 1 **Collection Entity:** Municipal Water Agency or Public Water Supply Corp

Sampled Aquifer: Hueco Bolson

Analyzed Lab: El Paso Water Utilities Lab **Reliability:** Not filtered; temp., cond., & pH measured in field; Alkal. in lab

Collection Remarks: No Data

Parameter Code	Parameter Description	Flag	Value*	Units	Plus/Minus
00415	ALKALINITY, PHENOLPHTHALEIN (MG/L)		0	mg/L	
00410	ALKALINITY, TOTAL (MG/L AS CACO3)		52	mg/L	
01105	ALUMINUM, TOTAL (UG/L AS AL)	<	50	ug/L	
01095	ANTIMONY, DISSOLVED (UG/L AS SB)	<	10	ug/L	
01002	ARSENIC, TOTAL (UG/L AS AS)		10	ug/L	
01005	BARIUM, DISSOLVED (UG/L AS BA)		67	ug/L	
01012	BERYLLIUM, TOTAL (UG/L AS BE)	<	0.5	ug/L	
00440	BICARBONATE ION, CALCULATED (MG/L AS HCO3)		63.46	mg/L	
01022	BORON, TOTAL (UG/L AS B)		591	ug/L	
01027	CADMIUM, TOTAL (UG/L)	<	0.5	ug/L	
00915	CALCIUM, DISSOLVED (MG/L AS CA)		144.4	mg/L	
00445	CARBONATE ION, CALCULATED (MG/L AS CO3)		0	mg/L	
00941	CHLORIDE, DISSOLVED (MG/L AS CL)		1300	mg/L	
01034	CHROMIUM, TOTAL (UG/L AS CR)		5.3	ug/L	
01042	COPPER, TOTAL (UG/L AS CU)	<	5	ug/L	
00950	FLUORIDE, DISSOLVED (MG/L AS F)		0.6	mg/L	
00900	HARDNESS, TOTAL, CALCULATED (MG/L AS CACO3)		450	mg/L	
01045	IRON, TOTAL (UG/L AS FE)	<	20	ug/L	
01051	LEAD, TOTAL (UG/L AS PB)	<	5	ug/L	
01132	LITHIUM, TOTAL (UG/L AS LI)		175	ug/L	
00925	MAGNESIUM, DISSOLVED (MG/L AS MG)		21.1	mg/L	
01055	MANGANESE, TOTAL (UG/L AS MN)		33	ug/L	
71900	MERCURY, TOTAL (UG/L AS HG)	<	1	ug/L	
01062	MOLYBDENUM, TOTAL (UG/L AS MO)	<	20	ug/L	
01067	NICKEL, TOTAL (UG/L AS NI)	<	5	ug/L	
71851	NITRATE NITROGEN, DISSOLVED, CALCULATED (MG/L AS NO3)		0.1	mg/L	
00400	PH (STANDARD UNITS), FIELD		7.97	SU	
00935	POTASSIUM, DISSOLVED (MG/L AS K)		9	mg/L	
71860	RESIDUAL SODIUM CARBONATE, CALCULATED		0		
01147	SELENIUM, TOTAL (UG/L)	<	10	ug/L	
00955	SILICA, DISSOLVED (MG/L AS SI02)		33	mg/L	
01077	SILVER, TOTAL (UG/L AS AG)	<	1	ug/L	
00931	SODIUM ADSORPTION RATIO, CALCULATED (SAR)		15.22		
00932	SODIUM, CALCULATED, PERCENT		78	PCT	
00930	SODIUM, DISSOLVED (MG/L AS NA)		740	mg/L	

Texas Water Development Board

Texas Water Development Board (TWDB) Groundwater Database (GWDB) Well Information Report for State Well Number 49-31-204

groundwater division

Parameter Code	Parameter Description	Flag	Value*	Units	Plus/Minus
00094	SPECIFIC CONDUCTANCE, FIELD (UMHOS/CM AT 25C)		4130	MICR	
01080	STRONTIUM, DISSOLVED (UG/L AS SR)		2840	ug/L	
00946	SULFATE, DISSOLVED (MG/L AS SO4)		197	mg/L	
01059	THALLIUM, TOTAL (UG/L AS TL)	<	1	ug/L	
70301	TOTAL DISSOLVED SOLIDS , SUM OF CONSTITUENTS (MG/L)		2479	mg/L	
01085	VANADIUM, DISSOLVED (UG/L AS V)	<	50	ug/L	
01092	ZINC, TOTAL (UG/L AS ZN)		62	ug/L	

** Value may not display all significant digits for parameter in results, check Scanned Documents for laboratory paperwork..*

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Texas Water Development Board

Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 49-31-205

groundwater division

GWDB Reports and Downloads

Well Basic Details

Scanned Documents

State Well Number	4931205
County	El Paso
River Basin	Rio Grande
Groundwater Management Area	5
Regional Water Planning Area	E - Far West Texas
Groundwater Conservation District	GCD Does Not Exist
Latitude (decimal degrees)	31.610001
Latitude (degrees minutes seconds)	31° 36' 36" N
Longitude (decimal degrees)	-106.183889
Longitude (degrees minutes seconds)	106° 11' 02" W
Coordinate Source	+/- 1 Second
Aquifer Code	112HCBL - Hueco Bolson
Aquifer	Hueco-Mesilla Bolson
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	3880
Land Surface Elevation Method	Interpolated From Topo Map
Well Depth (feet below land surface)	325
Well Depth Source	Driller's Log
Drilling Start Date	
Drilling End Date	3/16/1987
Drilling Method	Mud (Hydraulic) Rotary
Borehole Completion	Gravel Pack w/Perforations

Well Type	Withdrawal of Water
Well Use	De-watering
Water Level Observation	Miscellaneous Measurements
Water Quality Available	Yes
Pump	Submersible
Pump Depth (feet below land surface)	
Power Type	Electric Motor
Annular Seal Method	
Surface Completion	
Owner	Clint Joint Venture
Driller	Cole Drilling Co.
Other Data Available	Drillers Log
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	
Previous State Well Number	
Reporting Agency	U.S. Geological Survey
Created Date	4/26/1988
Last Update Date	3/4/2020

Remarks	Reported yield 12 GPM with 15 feet drawdown after pumping 48 hours. Cemented from 0 to 60 feet.

Casing

Diameter (in.)	Casing Type	Casing Material	Schedule	Gauge	Top Depth (ft.)	Bottom Depth (ft.)
6	Blank	Plastic (PVC)			0	280
6	Screen	Plastic (PVC)			280	320
6	Blank	Plastic (PVC)			320	325

Well Tests - No Data

Lithology - No Data

Annular Seal Range - No Data

Borehole - No Data

Plugged Back - No Data

Filter Pack - No Data

Packers - No Data

Water Level Measurements



Status Code	Date	Time	Water Level (ft. below land surface)	Change value in ( ) indicates rise in level	Water Elevation (ft. above sea level)	Meas #	Measuring Agency	Method	Remark ID	Comments
P	3/16/1987		269		3611	1	Registered Water Well Driller	Unknown		

Code Descriptions

Status Code	Status Description
P	Publishable

Water Quality Analysis

Sample Date: 4/9/1987 **Sample Time:** 0000 **Sample Number:** 1 **Collection Entity:** Registered Water Well Driller

Sampled Aquifer: Hueco Bolson

Analyzed Lab: El Paso Water Utilities Lab **Reliability:** Reliability unknown or not available

Collection Remarks: No Data

Parameter Code	Parameter Description	Flag	Value*	Units	Plus/Minus
00415	ALKALINITY, PHENOLPHTHALEIN (MG/L)		0	mg/L	
00410	ALKALINITY, TOTAL (MG/L AS CACO3)		132	mg/L	
00440	BICARBONATE ION, CALCULATED (MG/L AS HCO3)		161.09	mg/L	
00445	CARBONATE ION, CALCULATED (MG/L AS CO3)		0	mg/L	
00940	CHLORIDE, TOTAL (MG/L AS CL)		485	mg/L	
00950	FLUORIDE, DISSOLVED (MG/L AS F)		1.1	mg/L	
00900	HARDNESS, TOTAL, CALCULATED (MG/L AS CACO3)		500	mg/L	
00400	PH (STANDARD UNITS), FIELD		7.9	SU	
00937	POTASSIUM, TOTAL (MG/L AS K)		9.9	mg/L	
00955	SILICA, DISSOLVED (MG/L AS SI02)		42	mg/L	
00931	SODIUM ADSORPTION RATIO, CALCULATED (SAR)		8.8		
00929	SODIUM, TOTAL (MG/L AS NA)		454	mg/L	
00094	SPECIFIC CONDUCTANCE, FIELD (UMHOS/CM AT 25C)		3200	MICR	
00945	SULFATE, TOTAL (MG/L AS SO4)		635	mg/L	
70301	TOTAL DISSOLVED SOLIDS , SUM OF CONSTITUENTS (MG/L)		1889	mg/L	

** Value may not display all significant digits for parameter in results, check Scanned Documents for laboratory paperwork..*

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Texas Water Development Board (TWDB)
Groundwater Database (GWDB)
Well Information Report for State Well Number 49-31-301

GWDB Reports and Downloads | **Well Basic Details** | Scanned Documents

State Well Number	4931301
County	El Paso
River Basin	Rio Grande
Groundwater Management Area	5
Regional Water Planning Area	E - Far West Texas
Groundwater Conservation District	GCD Does Not Exist
Latitude (decimal degrees)	31.595556
Latitude (degrees minutes seconds)	31° 35' 44" N
Longitude (decimal degrees)	-106.167222
Longitude (degrees minutes seconds)	106° 10' 02" W
Coordinate Source	+/- 1 Second
Aquifer Code	112HCBL - Hueco Bolson
Aquifer	Hueco-Mesilla Bolson
Aquifer Pick Method	
Land Surface Elevation (feet above sea level)	3977
Land Surface Elevation Method	Interpolated From Topo Map
Well Depth (feet below land surface)	450
Well Depth Source	Another Government Agency
Drilling Start Date	
Drilling End Date	
Drilling Method	
Borehole Completion	

Well Type	Withdrawal of Water
Well Use	Plugged or Destroyed
Water Level Observation	Miscellaneous Measurements
Water Quality Available	No
Pump	Piston
Pump Depth (feet below land surface)	
Power Type	Windmill
Annular Seal Method	
Surface Completion	
Owner	Orr
Driller	Anderson
Other Data Available	
Well Report Tracking Number	
Plugging Report Tracking Number	
U.S. Geological Survey Site Number	
Texas Commission on Environmental Quality Source Id	
Groundwater Conservation District Well Number	
Owner Well Number	
Other Well Number	
Previous State Well Number	
Reporting Agency	U.S. Geological Survey
Created Date	12/12/1973
Last Update Date	3/4/2020

Remarks	Destroyed.

Casing

Diameter (in.)	Casing Type	Casing Material	Schedule	Gauge	Top Depth (ft.)	Bottom Depth (ft.)
10	Blank	Steel				

Well Tests - No Data

Lithology - No Data

Annular Seal Range - No Data

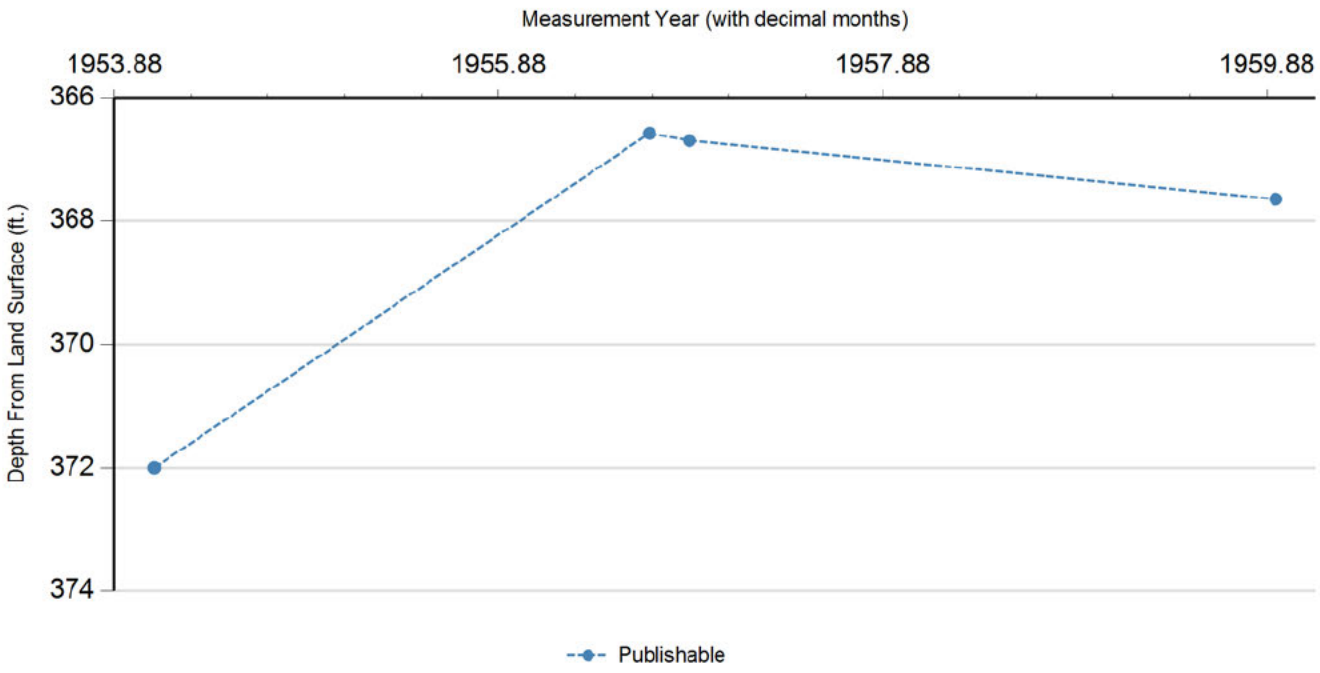
Borehole - No Data

Plugged Back - No Data

Filter Pack - No Data

Packers - No Data

Water Level Measurements



Status Code	Date	Time	Water Level (ft. below land surface)	Change value in ( ) indicates rise in level	Water Elevation (ft. above sea level)	Meas #	Measuring Agency	Method	Remark ID	Comments
P	2/3/1954		372		3605	1	Other or Source of Measurement Unknown	Unknown		
P	9/4/1956		366.58	(5.42)	3610.42	1	Texas Water Development Board	Steel Tape		
P	11/20/1956		366.7	0.12	3610.3	1	Other or Source of Measurement Unknown	Unknown		
P	12/9/1959		367.65	0.95	3609.35	1	U.S. Geological Survey	Steel Tape		

Code Descriptions

Status Code	Status Description
P	Publishable

Water Quality Analysis - No Data Available

GWDB DISCLAIMER: Except where noted, all of the information provided in the Texas Water Development Board (TWDB) Groundwater Database (https://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp) is believed to be accurate and reliable; however, the TWDB assumes no responsibility for any errors appearing in rules or otherwise. Further, TWDB assumes no responsibility for the use of the information provided. PLEASE NOTE that users of these data are responsible for checking the accuracy, completeness, currency and/or suitability of all information themselves. TWDB makes no guarantees or warranties as to the accuracy, completeness, currency, or suitability of the information provided via the Groundwater Database (GWDB). TWDB specifically disclaims any and all liability for any claims or damages that may result from providing GWDB data or the information it contains. For additional information or answers to questions concerning the TWDB GWDB, contact the Groundwater Data Team at GroundwaterData@twdb.texas.gov.

ATTACHMENT III.E.25 – ASTM PROCEDURE FOR SLUG TEST

Standard Test Method for (Analytical Procedure) Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head (Slug)[1]

This standard is issued under the fixed designation D 5912; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE—Note 5 was added editorially in December 1996.

1. Scope

1.1 This test method covers the determination of hydraulic conductivity from the measurement of inertial force free (overdamped) response of a well-aquifer system to a sudden change in water level in a well. Inertial force free response of the water level in a well to a sudden change in water level is characterized by recovery to initial water level in an approximate exponential manner with negligible inertial effects.

1.2 The analytical procedure in this test method is used in conjunction with the field procedure in Test Method D 4044 for collection of test data.

1.3 *Limitations*—Slug tests are considered to provide an estimate of hydraulic conductivity. The determination of storage coefficient is not possible with this test method. Because the volume of aquifer material tested is small, the ilues obtained are representative of materials very near the pen portion of the control well.

NOTE 1—Slug tests are usually considered to provide estimates of the lower limit of the actual hydraulic conductivity of an aquifer because the test results are so heavily influenced by well efficiency and borehole skin effects near the open portion of the well. The portion of the aquifer that is tested by the slug test is limited to an area near the open portion of the well where the aquifer materials may have been altered during well installation, and therefore may significantly effect the test results. In some cases the data may be misinterpreted and result in a higher estimate of hydraulic conductivity. This is due to the reliance on early time data that is reflective of the hydraulic conductivity of the filter pack surrounding the well. This effect was discussed by Bouwer.[2] In addition, because of the reliance on early time data, in aquifers with medium to high hydraulic conductivity, the early time portion of the curve that is useful for this data analyses is too short (for example, <10 s) for accurate measurement; therefore, the test results begin to greatly underestimate the true hydraulic conductivity.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[3]

D 4043 Guide for Selection of Aquifer-Test Methods in Determining Hydraulic Properties by Well Techniques[3]

D 4044 Test Method (Field Procedure) for Instantaneous Change in Head (Slug Test) for Determining Hydraulic Properties of Aquifers[3]

D 4104 Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Test)[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology D 653.

3.2 *Symbols and Dimensions:*

3.2.1 A [*nd*]—coefficient that is a function of L/r_w and is determined graphically.

3.2.2 B [*nd*]—coefficient that is a function of L/r_w and is determined graphically.

3.2.3 C [*nd*]—coefficient that is a function of L/r_w and is determined graphically.

3.2.4 D [L]—aquifer thickness.

3.2.5 H [L]—distance between static water level and the base of open interval of the well.

3.2.6 L [L]—length of well open to aquifer.

3.2.7 rc [L]—inside diameter of the portion of the well casing in which the water level changes.

3.2.8 R_e [L]—effective radius, determined empirically based on the geometry of the well, over which y is dissipated.

3.2.9 r_w [L]—radial distance from well center to original undisturbed aquifer.

3.2.10 t_f [T]—time at end point of straight-line portion of graph.

3.2.11 t_0 [T]—time at beginning of straight-line portion of graph.

[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Feb. 10, 1996. Published June 1996.

[2] Bouwer, H., and Rice, R. C., "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," *Water Resources Research*, Vol 12, No. 3, 1976, pp. 423–428.

[3] *Annual Book of ASTM Standards*, Vol 04.08.

3.2.12 y_f [L]—head difference at end point of straight-line portion of graph.

3.2.13 y_0 [L]—head difference at beginning of straight-line portion of graph.

4. Summary of Test Method

4.1 This test method describes the analytical procedure for analyzing data collected following an instantaneous change in head (slug) test in an overdamped well. The field procedures in conducting a slug test are given in Test Method D 4044. The analytical procedure consists of analyzing the recovery of water level in the well following the change in water level induced in the well.

4.2 *Solution*—The solution given by Bouwer and Rice[2] follows:

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L} \frac{1}{(t_f - t_0)} \ln \frac{y_0}{y_f} \quad (1)$$

where:

if $D > H$

$$\ln(R_e/r_w) = \left[\frac{1.1}{\ln(H/r_w)} + \frac{A + B \ln[(D-H)/r_w]}{L/r_w}\right]^{-1} \quad (2)$$

if $D = H$

$$\ln R_e/r_w = \left[\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right]^{-1} \quad (3)$$

NOTE 2—Other analytical solutions are given by Hvorslev[4] and Cooper et al;[5] however, they may differ in their assumptions and applicability.

NOTE 3—Bouwer[2] provided discussion of various applications and observations of the procedure described in this test method.

NOTE 4—Test Method D 4104 describes the analytical solution following Cooper et al.[5]

NOTE 5—The use of the symbol K for the term hydraulic conductivity is the predominant usage in ground-water literature by hydrogeologists, whereas, the symbol k is commonly used for this term in soil and rock mechanics and soil science.

5. Significance and Use

5.1 *Assumptions of Solution:*

5.1.1 Drawdown (or mounding) of the water table around the well is negligible.

5.1.2 Flow above the water table can be ignored.

5.1.3 Head losses as the water enters or leaves the well are negligible.

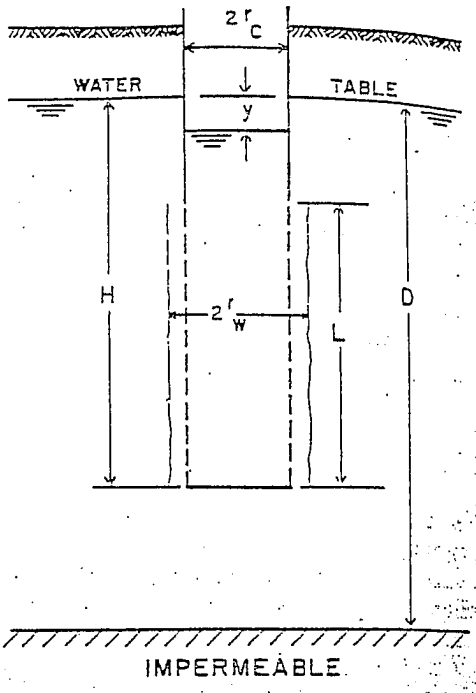
5.1.4 The aquifer is homogeneous and isotropic.

5.2 *Implications of Assumptions:*

5.2.1 The mathematical equations applied ignore inertial effects and assume that the water level returns to the static level in an approximate exponential manner.

5.2.2 The geometric configuration of the well and aquifer are shown in Fig. 1, that is after Fig. 1 of Bouwer and Rice.[2]

5.2.3 For filter-packed wells, Eq 1 applies to cases in



NOTE—See Fig. 1 of Footnote 2.

FIG. 1 Geometry and Symbols of a Partially Penetrating, tially Perforated Well in Unconfined Aquifer with Gravel Pac Developed Zone Around Perforated Section

which the filter pack remains saturated. If some of the f pack is dewatered during testing, r_c^2 should be replace the following:

$$r_c\,(corrected) = [(1-n)r_a^2 + nr_w^2]^{0.5}$$

where:

n = short-term specific yield of the filter pack,
r_a = uncorrected well casing radius, and
r_w = borehole radius.

NOTE 6—Short term refers to the duration of the slug test.

6. Procedure

6.1 The overall procedure consists of conducting the test field procedure (see Test Method D 4044) and analy the field data that is addressed in this test method.

6.2 The water level data are corrected so that the c ence between the original static water level and the level during the test is known. This difference in water at time "t" is denoted as "y_t".

6.3 The dimensionless coefficients of A, B, and determined graphically based on their relationship with An example of the curves relating A, B, and C to L given in Fig. 2, that is after Fig. 3 of Bouwer and Rice

7. Calculation

7.1 Determine $\ln(R_e/r_w)$ using Eqs 2 or 3, as appro

7.2 Plot at a semilogarithmic scale the relationship on the log scale versus elapsed time on the arithmetic

7.3 Determine the straight-line portion of the graph

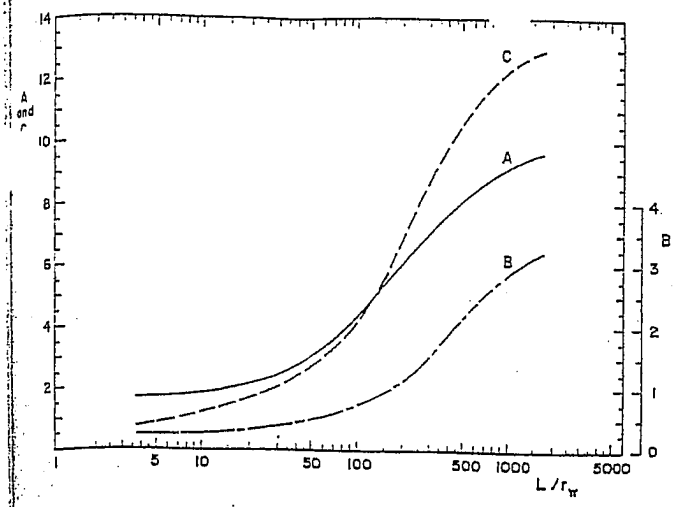
7.4 Determine the end point values of the straig portion of the graph and substitute along with val $\ln(R_e/r_w)$ determined in 7.1, into Eq 1.

Page 11

[4] Hvorslev, M. J., "Time Lag and Soil Permeability in Ground-Water Observations," Waterways Experiment Station, Corps of Engineers, *U.S. Army, Bulletin No. 36*, 1951.

[5] Cooper, H. H., Jr., Bredehoeft, J. D., and Papadopulos, I. S., "Response of a Finite-Diameter Well to an Instantaneous Change in Water," *Water Resources Research*, Vol 3, No. 1, 1967, pp. 263–269.

[6] Bouwer, H., "The Bouwer-Rice Slug Test—An Update," *Ground Water*, Vol 27, No. 3, 1989, pp. 304–309.



NOTE—See Fig. 3 of Footnote 2.

FIG. 2 Curves Relating Coefficients *A*, *B*, and *C* to L/r_w

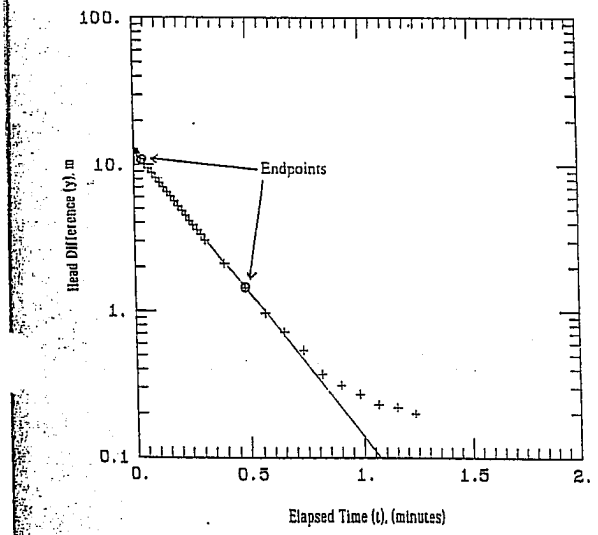


FIG. 3 Sample Plot of Slug Test Data

NOTE 7—An example of the plot of this test method is given in Fig. 3. The data used to prepare the plot is presented in Table 1. Table 1 also presents the well configuration data and the corresponding values of *A*, *B*, and *C*.

TABLE 1 Sample Slug Test Data[A,B]

NOTE 1—*A* and *B* are not used since $D = H$.
NOTE 2—Endpoint values are highlighted.

Elapsed Time, min	Head Difference, m
0.0034	12.86
0.0067	12.71
0.0100	12.40
0.0134	12.13
0.0167	11.96
0.0334	10.94
0.0500	10.15
0.0667	9.45
0.0834	8.80
0.1000	8.16
0.1167	7.05
0.1334	6.54
0.1500	6.10
0.1667	5.64
0.1834	5.21
0.2000	4.85
0.2167	4.51
0.2334	4.14
0.2500	3.88
0.2667	3.59
0.2834	3.35
0.3000	3.06
0.3167	2.12
0.4001	1.45
0.4834	0.97
0.5667	0.72
0.6501	0.54
0.7334	0.37
0.8167	0.31
0.9001	0.27
1.0667	0.23
1.1501	0.22
1.2334	0.20

[A] Well configuration data, m: $Rc = 0.0833$, $Rw = 0.1615$, $D = 41.5$, $L = 8$, and $H = 41.5$.
[B] Coefficients (dimensionless): A = n/a, B = n/a, and $C = 2.624$.

8. Report

8.1 Prepare a report including the information described in this section. The final report of the analytical procedure will include information from the report on the test method selection (see Guide D 4043) and the field testing procedure (see Test Method D 4044).

8.1.1 *Introduction*—The introductory section is intended to present the scope and purpose of the slug test method for determining hydraulic conductivity. Summarize the field hydrogeologic conditions and field equipment and instrumentation including the construction of the control well, and the method of measurement and of effecting a change in head. Discuss the rationale for selecting the method used (see Guide D 4043).

8.1.2 *Hydrogeologic Setting*—Review information available on the hydrogeology of the site; interpret and describe the hydrogeology of the site as it pertains to the method selected for selected for conducting and analyzing an aquifer test. Compare hydrogeologic characteristics of the site as it conforms and differs from the assumptions made in the solution to the aquifer test method.

8.1.3 *Equipment*—Report the field installation and equipment for the aquifer test. Include in the report, well construction information, diameter, depth, and open interval to the aquifer, and location of control well. Include a list of measuring devices used during the test; the manufacturer's name, model number, and basic specifications for each major item; and the name and date of the last calibration, if applicable.

8.1.4 *Test Procedures*—Report the steps taken in conducting the pretest and test phases. Include the frequency of head measurements made in the control well and other environmental data recorded before and during the test procedure.

8.1.5 *Presentation and Interpretation of Test Results:*

8.1.5.1 *Data*—Present tables of data collected during the test.

8.1.5.2 *Data Plots*—Present data plots used in analysis of the data.

8.1.5.3 Show calculation of hydraulic conductivity.

8.1.5.4 Evaluate the overall quality of the test on the basis of the adequacy of instrumentation and observations of

stress and response and the conformance of the hydrogeologic conditions and the performance of the test to the assumptions (see 5.1).

9. Precision and Bias

9.1 It is not practical to specify the precision of this test method because the response of aquifer systems during aquifer tests is dependent on ambient stresses. No statement can be made about the bias because no true reference value exist.

10. Keywords

10.1 aquifers; aquifer tests; control wells; ground water; hydraulic conductivity; slug test

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ATTACHMENT III.E.26 – SLUG TEST RESULTS

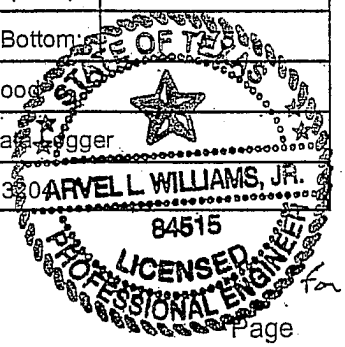
Report of Instantaneous Change in Head
(Slug) Test for Determining Properties of Aquifers
ASTM D 4044 and D 5912

Test Location:	PB-1	Personnel:	JR/JM
Test Type:	Slug In	Date of Test:	2/25/99
Diameter of Casing	4 inches	Volume of Slug (cu.ft.):	0.67
Depth to Water	286	Depth to Bottom:	343
Quality of Test Data:		Good	
Method of Measurement:		Digital Data Logger	
File Name:		PB102	

Test Location:	PB-4	Personnel:	JR/JM
Test Type:	Slug In	Date of Test:	2/27/99
Diameter of Casing	4 inches	Volume of Slug (cu.ft.):	0.67
Depth to Water	336	Depth to Bottom:	375
Quality of Test Data:		Poor (This test not included in analysis)	
Method of Measurement:		Digital Data Logger	
File Name:		PB401	

Test Location:	PB-29	Personnel:	JR/JM
Test Type:	Slug In	Date of Test:	2/25/99
Diameter of Casing	2 inches	Volume of Slug (cu.ft.):	0.67
Depth to Water	373	Depth to Bottom:	375
Quality of Test Data:		Good	
Method of Measurement:		Digital Data Logger	
File Name:		PB2903	

Test Location:	PB-32	Personnel:	JR/JM
Test Type:	Slug In	Date of Test:	2/26/99
Diameter of Casing	4 inches	Volume of Slug (cu.ft.):	0.67
Depth to Water	367	Depth to Bottom:	
Quality of Test Data:		Good	
Method of Measurement:		Digital Data Logger	
File Name:		PB3204	



PROJECT NO. A 96-182-00 TASK NO. __ SHEET 1 OF 5

PROJECT Clint Landfill

SUBJECT Slug Tests by Bouwer & Rice BY __ CC __ DATE 3/29/99

MTG ☐ PHONE: TO ☐ FROM ☐ FIELD ☐ CALC ☐ OTHER ☐

Bouwer & Rice pg. 115-117

Take off From Piezometer

For all Piezometers:

r_w = 3.5" = 0.2917 ft

r_c = 1" or 2" = 0.083 or 0.167

$L_e = L_w$

	L_w	r_c	r_w	L_w/R_w	A	B
PB1 =	286-343	0.0167	0.2917	195.4	6	1.25
PB9 =	Dry	0.0167	0.2917	Not	Tested	
PB16 =	<6"	0.0167	0.2917	Not	Tested	
PB29 =	373-375	0.083	0.2917	6.85	1.9	0.5
PB-4 =	373-375	0.083	0.2917	99.4	4.75	0.95
PB-32 =	361-375	0.0167	0.2917	47.95	3.25	0.60

Calcs for Wells

$$\ln\frac{R_e}{r_w} = \frac{1.1}{\ln(L_w/r_w)} + \frac{A+B\ln[(H-L_w)/r_w]}{L_e/r_w}$$

$L_e = L_w$

$$= \frac{1}{\frac{1.1}{5.27} + \frac{6+7.5}{195.4}} = \frac{1}{.208 + 0.07}$$

$$\ln\frac{R_e}{r_w} = \boxed{3.597}$$

PB-4

$$\ln \frac{R_e}{r_w} = \frac{1}{\frac{1.1}{4.16} + \frac{4.75 + 0.95(1)}{99.4}}$$

$$= \frac{1}{0.259 \quad 0.072} = \boxed{1.955}$$

PB-29

$$\ln \frac{R_e}{R_w} = \frac{1}{\frac{1.1}{1.92} + \frac{1.9 + 3}{6.85}} = \frac{1}{0.572 + 0.715}$$

$$= \boxed{0.777}$$

PB-32

$$\ln \frac{R_e}{R_w} = \frac{1}{\frac{1.1}{3.87} + \frac{3.25 + 6(0.60)}{47.99}}$$

$$= \frac{1}{0.28 + \frac{6.88}{47.99}} = \frac{1}{0.28 + .142} = \boxed{2.37}$$

Summary

Pier	$\ln \frac{R_e}{r_w}$
PB-1	3.597
PB-4	1.955
PB-29	0.777
PB-32	2.37

Use Soln of Form.

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

or

$$t_{70\%} = 0.0537 \frac{r_c^2}{KL_e} \ln \frac{R_e}{r_w}$$

PROJECT NO. ___ TASK NO. ___ SHEET 3 OF 5

PROJECT ___

SUBJECT ___ BY ___ CC ___ DATE ___

MTG ☐ PHONE: TO ☐ FROM ☐ FIELD ☐ CALC ☐ OTHER ☐

PB-401

Linear Portion.

$y_0 = 2.173$ $t_0 = 1.2$ min

$y_t = 5.367$ $t_s = 4.8$ min $= 3.216$ sec.

0.004186 1/sec.

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2 f_e} \left[\frac{1}{t} \ln \frac{y_0}{y_t}\right]$$

for PB-4 $r_c = 0.083$) $\ln(R_e/r_w) = 1.955$

$f_e = 29$

$$K = \frac{(0.083)^2 (1.955)}{2(29)} (0.004186)$$

$= 9.72018 \times 10^{-7}$ ft/sec

$= 2.5 \times 10^{-5}$ cm/sec. $= \boxed{K}$

Instantaneous

PROJECT NO. ___ TASK NO. ___ SHEET ___ OF ___

PROJECT ___

SUBJECT ___ BY ___ CC ___ DATE ___

MTG ☐ PHONE: TO ☐ FROM ☐ FIELD ☐ CALC ☐ OTHER ☐

PB29-03

Linear Pad

1.640 $y_0 = 0.028$ $t_0 = 1.6$

$y_t = 1.632$ $t_t = 6.4$ min

2.84 min $\Rightarrow \frac{1}{t} \ln \frac{y}{y_0} =$

0.0142/sec

$$K = \frac{r_c^2 \ln(R_e/R_w)}{2 t_c} \frac{1}{t} \ln \frac{y}{y_0}$$

$$= \frac{(0.0833)(0.777)}{(2)(2)} (0.0142)$$

$$= \boxed{4.8 \times 10^{-4} \text{ cm/sec}} \; K$$

PROJECT NO. ___ TASK NO. ___ SHEET 4 OF 5

PROJECT ___

SUBJECT ___ BY ___ CC ___ DATE ___

MTG ☐ PHONE: TO ☐ FROM ☐ FIELD ☐ CALC ☐ OTHER ☐

PB32-04

$y_t = 0.43$ $t_e = 81\,m$ = 4620 sec.

$y_o = 2.662$ 4 min

$= 0.000395$ 1/sec

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2 t_o} \boxed{\frac{1}{t} \ln \frac{y_o}{y_t}}$$

$$= \frac{0.1167^2 (2.37)}{2(14)} \left(0.000395 / \text{sec}\right)$$

$$= \frac{0.032277}{28} \left(0.000395\right)$$

$= 4.54631 \times 10^{-7}$ ft/sec

$= \boxed{1.2 \times 10^{-5}\ \text{cm/sec}}$ K

PB 1-02

$y_1 = 2.045$

$y_2 = 0.106$

$t = \frac{9.18}{0.153} = 537$ sec.

$= \frac{2.95}{537} = 0.005512$

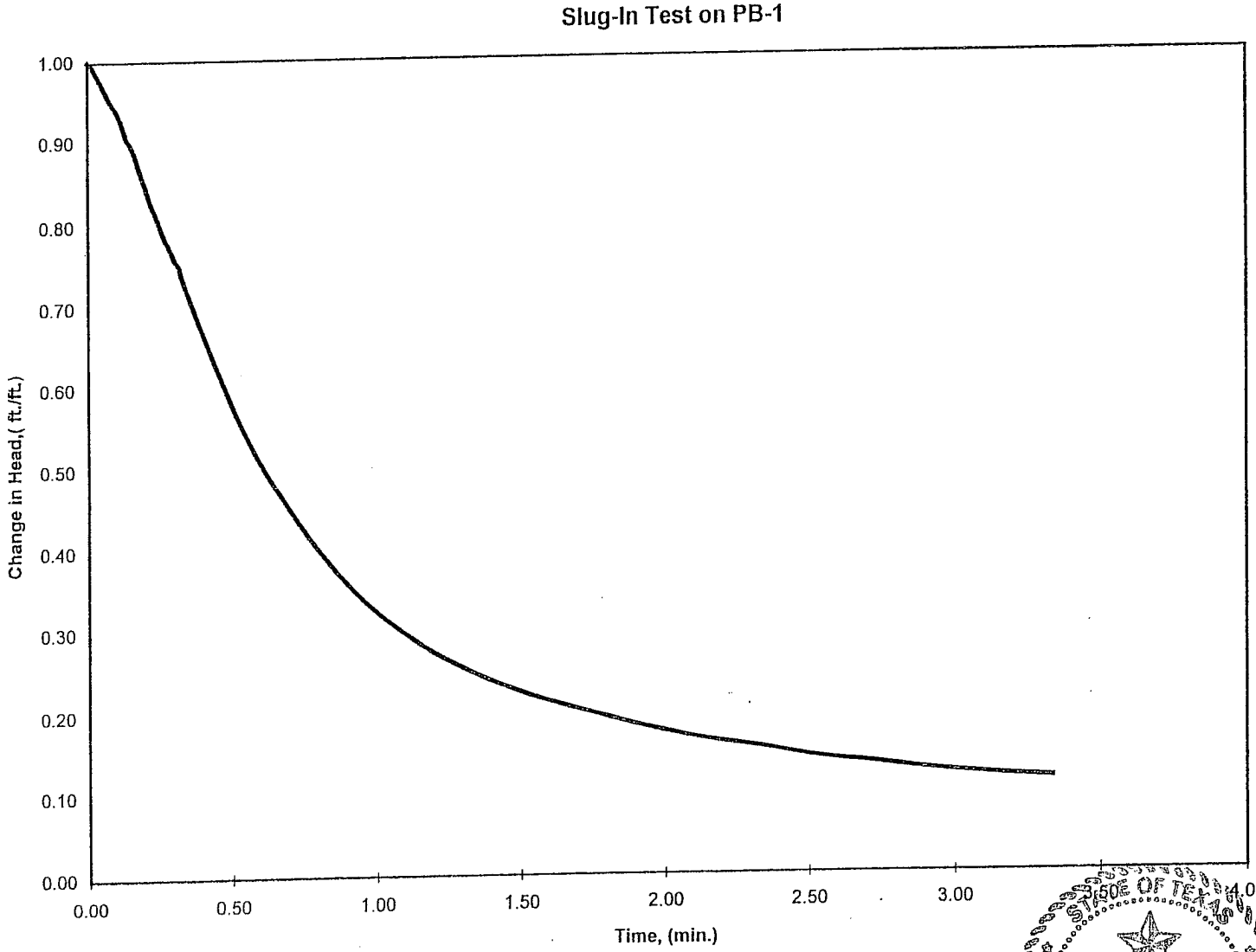
$K = \frac{(0.0167^2)(3.597)}{(2)(57)} \quad 0.005512$

1×10^{-6} cm/sec = K

Summary of Results —

Piezometer	K
PB-1	1.0×10^{-6} cm/sec.
PB-4	2.5×10^{-5} cm/sec.
PB-29	4.8×10^{-4} cm/sec.
PB-32	1.2×10^{-5} cm/sec.

Normalized Slug Test Data



Rab istner

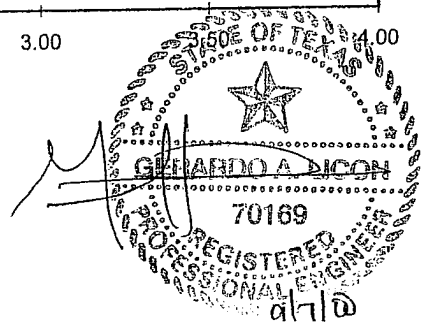
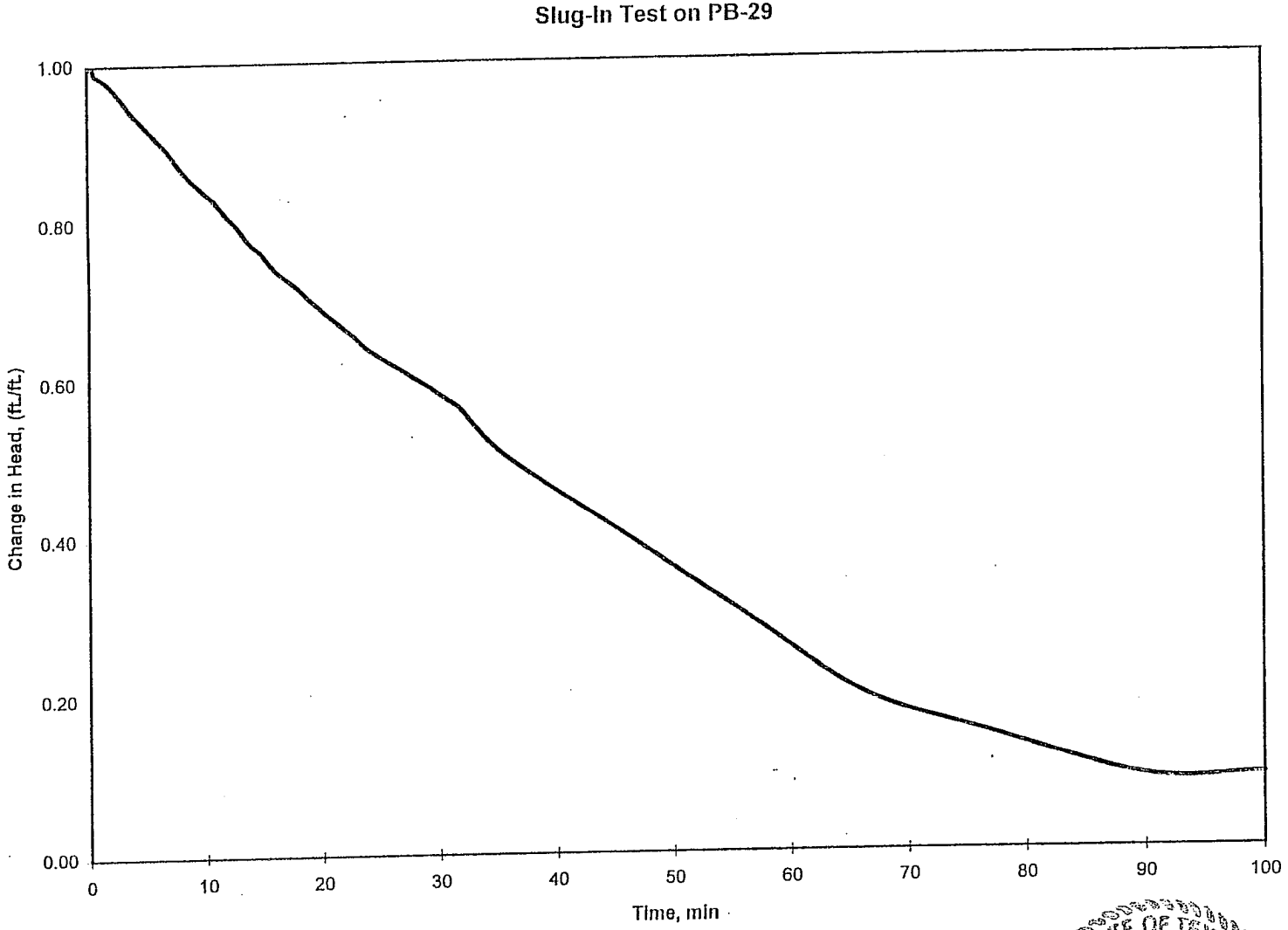


Plate G1

Normalized Slug Test Data



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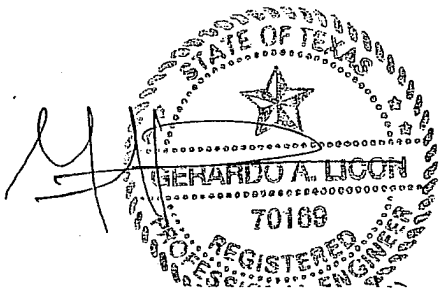
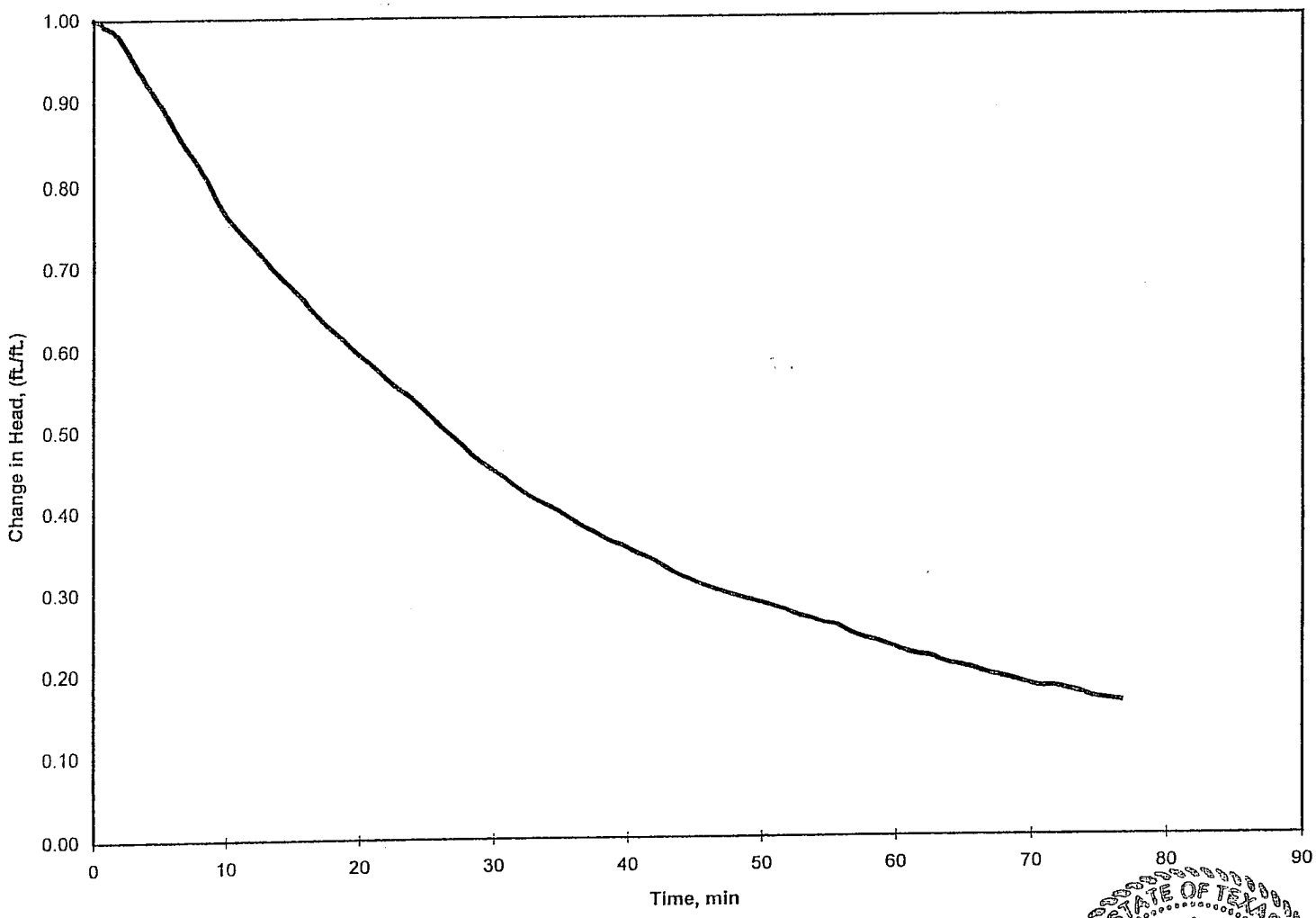


Plate G2

Normalized Slug Test Data

Slug-In Test on PB-32



Ral istner

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED
PROFESSIONAL ENGINEER

Plate G3

Piezometer - PB-1

Time (min.)	Transducer Reading		Time (min.)	Head Diff. (ft./ft.)
0.6666	-1.998	1.998	0.00	1.00
0.6833	-1.986	1.986	0.02	0.99
0.7	-1.964	1.964	0.03	0.98
0.7166	-1.942	1.942	0.05	0.97
0.7333	-1.917	1.917	0.07	0.96
0.75	-1.895	1.895	0.08	0.95
0.7666	-1.876	1.876	0.10	0.94
0.7833	-1.848	1.848	0.12	0.92
0.8	-1.811	1.811	0.13	0.91
0.8166	-1.792	1.792	0.15	0.90
0.8333	-1.764	1.764	0.17	0.88
0.85	-1.729	1.729	0.18	0.87
0.8666	-1.695	1.695	0.20	0.85
0.8833	-1.66	1.66	0.22	0.83
0.9	-1.632	1.632	0.23	0.82
0.9166	-1.601	1.601	0.25	0.80
0.9333	-1.57	1.57	0.27	0.79
0.95	-1.545	1.545	0.28	0.77
0.9666	-1.517	1.517	0.30	0.76
0.9833	-1.495	1.495	0.32	0.75
1	-1.457	1.457	0.33	0.73
1.2	-1.104	1.104	0.53	0.55
1.4	-0.863	0.863	0.73	0.43
1.6	-0.691	0.691	0.93	0.35
1.8	-0.575	0.575	1.13	0.29
2	-0.497	0.497	1.33	0.25
2.2	-0.441	0.441	1.53	0.22
2.4	-0.4	0.4	1.73	0.20
2.6	-0.362	0.362	1.93	0.18
2.8	-0.331	0.331	2.13	0.17
3	-0.309	0.309	2.33	0.15
3.2	-0.281	0.281	2.53	0.14
3.4	-0.265	0.265	2.73	0.13
3.6	-0.247	0.247	2.93	0.12
3.8	-0.234	0.234	3.13	0.12
4	-0.225	0.225	3.33	0.11
4.2	-0.215	0.215	3.53	0.11
4.4	-0.206	0.206	3.73	0.10
4.6	-0.2	0.2	3.93	0.10
4.8	-0.193	0.193	4.13	0.10
5	-0.193	0.193	4.33	0.10
5.2	-0.187	0.187	4.53	0.09
5.4	-0.181	0.181	4.73	0.09
5.6	-0.178	0.178	4.93	0.09
5.8	-0.175	0.175	5.13	0.09
6	-0.171	0.171	5.33	0.09
6.2	-0.165	0.165	5.53	0.08
6.4	-0.162	0.162	5.73	0.08

6.6	-0.153	0.153	5.93	0.08
6.8	-0.153	0.153	6.13	0.08
7	-0.147	0.147	6.33	0.07
7.2	-0.14	0.14	6.53	0.07
7.4	-0.137	0.137	6.73	0.07
7.6	-0.131	0.131	6.93	0.07
7.8	-0.137	0.137	7.13	0.07
8	-0.131	0.131	7.33	0.07
8.2	-0.128	0.128	7.53	0.06
8.4	-0.125	0.125	7.73	0.06
8.6	-0.125	0.125	7.93	0.06
8.8	-0.118	0.118	8.13	0.06
9	-0.115	0.115	8.33	0.06
9.2	-0.112	0.112	8.53	0.06
9.4	-0.109	0.109	8.73	0.05
9.6	-0.106	0.106	8.93	0.05
9.8	-0.106	0.106	9.13	0.05
10	-0.103	0.103	9.33	0.05
11	-0.09	0.09	10.33	0.05
12	-0.081	0.081	11.33	0.04
13	-0.081	0.081	12.33	0.04
14	-0.084	0.084	13.33	0.04
15	-0.081	0.081	14.33	0.04
16	-0.068	0.068	15.33	0.03

Page

Piezometer - PB-29

Time (min.)	Transducer Reading		Time (min.)	Head Diff. (ft./ft.)
9.2	-2.17	0	2.17	1.00
9.4	-2.164	0.2	2.164	1.00
9.6	-2.164	0.4	2.164	1.00
9.8	-2.148	0.6	2.148	0.99
10	-2.142	0.8	2.142	0.99
11	-2.12	1.8	2.12	0.98
12	-2.083	2.8	2.083	0.96
13	-2.042	3.8	2.042	0.94
14	-2.008	4.8	2.008	0.93
15	-1.973	5.8	1.973	0.91
16	-1.939	6.8	1.939	0.89
17	-1.895	7.8	1.895	0.87
18	-1.857	8.8	1.857	0.86
19	-1.826	9.8	1.826	0.84
20	-1.798	10.8	1.798	0.83
21	-1.76	11.8	1.76	0.81
22	-1.726	12.8	1.726	0.80
23	-1.682	13.8	1.682	0.78
24	-1.654	14.8	1.654	0.76
25	-1.613	15.8	1.613	0.74
26	-1.585	16.8	1.585	0.73
27	-1.56	17.8	1.56	0.72
28	-1.529	18.8	1.529	0.70
29	-1.501	19.8	1.501	0.69
30	-1.473	20.8	1.473	0.68
31	-1.448	21.8	1.448	0.67
32	-1.423	22.8	1.423	0.66
33	-1.391	23.8	1.391	0.64
34	-1.369	24.8	1.369	0.63
35	-1.348	25.8	1.348	0.62
36	-1.329	26.8	1.329	0.61
37	-1.307	27.8	1.307	0.60
38	-1.288	28.8	1.288	0.59
39	-1.266	29.8	1.266	0.58
40	-1.244	30.8	1.244	0.57
41	-1.222	31.8	1.222	0.56
		36	0	0.50
		56	0	0.30
		66	0	0.20
		76	0	0.15
		90	0	0.09
		100	0	0.09

Piezometer - PB-32

Time (min.)	Transducer Reading		Time (min.)	Head Diff. (ft./ft.)
4.4	-2.662	2.662	0	1.00
4.6	-2.659	2.659	0.2	1.00
4.8	-2.656	2.656	0.4	1.00
5	-2.649	2.649	0.6	1.00
5.2	-2.64	2.64	0.8	0.99
5.4	-2.637	2.637	1	0.99
5.6	-2.631	2.631	1.2	0.99
5.8	-2.628	2.628	1.4	0.99
6	-2.618	2.618	1.6	0.98
6.2	-2.612	2.612	1.8	0.98
6.4	-2.599	2.599	2	0.98
6.6	-2.587	2.587	2.2	0.97
6.8	-2.574	2.574	2.4	0.97
7	-2.559	2.559	2.6	0.96
7.2	-2.543	2.543	2.8	0.96
7.4	-2.528	2.528	3	0.95
7.6	-2.515	2.515	3.2	0.94
7.8	-2.5	2.5	3.4	0.94
8	-2.487	2.487	3.6	0.93
8.2	-2.471	2.471	3.8	0.93
8.4	-2.456	2.456	4	0.92
8.6	-2.443	2.443	4.2	0.92
8.8	-2.431	2.431	4.4	0.91
9	-2.415	2.415	4.6	0.91
9.2	-2.403	2.403	4.8	0.90
9.4	-2.39	2.39	5	0.90
9.6	-2.378	2.378	5.2	0.89
9.8	-2.362	2.362	5.4	0.89
10	-2.35	2.35	5.6	0.88
11	-2.275	2.275	6.6	0.85
12	-2.215	2.215	7.6	0.83
13	-2.144	2.144	8.6	0.81
14	-2.062	2.062	9.6	0.77
15	-2.003	2.003	10.6	0.75
16	-1.953	1.953	11.6	0.73
17	-1.903	1.903	12.6	0.71
18	-1.853	1.853	13.6	0.70
19	-1.81	1.81	14.6	0.68
20	-1.766	1.766	15.6	0.66
21	-1.716	1.716	16.6	0.64
22	-1.672	1.672	17.6	0.63
23	-1.635	1.635	18.6	0.61
24	*-1.591*	1.591	19.6	0.60
25	-1.557	1.557	20.6	0.58
26	-1.516	1.516	21.6	0.57
27	-1.476	1.476	22.6	0.55
28	-1.444	1.444	23.6	0.54
29	-1.404	1.404	24.6	0.53

30	-1.36	1.36	25.6	0.51
31	-1.32	1.32	26.6	0.50
32	-1.282	1.282	27.6	0.48
33	-1.241	1.241	28.6	0.47
34	-1.21	1.21	29.6	0.45
35	-1.179	1.179	30.6	0.44
36	-1.145	1.145	31.6	0.43
37	-1.114	1.114	32.6	0.42
38	-1.089	1.089	33.6	0.41
39	-1.067	1.067	34.6	0.40
40	-1.039	1.039	35.6	0.39
41	-1.011	1.011	36.6	0.38
42	-0.989	0.989	37.6	0.37
43	-0.964	0.964	38.6	0.36
44	-0.948	0.948	39.6	0.36
45	-0.926	0.926	40.6	0.35
46	-0.908	0.908	41.6	0.34
47	-0.883	0.883	42.6	0.33
48	-0.858	0.858	43.6	0.32
49	-0.839	0.839	44.6	0.32
50	-0.817	0.817	45.6	0.31
51	-0.801	0.801	46.6	0.30
52	-0.786	0.786	47.6	0.30
53	-0.773	0.773	48.6	0.29
54	-0.761	0.761	49.6	0.29
55	-0.748	0.748	50.6	0.28
56	-0.733	0.733	51.6	0.28
57	-0.714	0.714	52.6	0.27
58	-0.702	0.702	53.6	0.26
59	-0.686	0.686	54.6	0.26
60	-0.677	0.677	55.6	0.25
61	-0.652	0.652	56.6	0.24
62	-0.636	0.636	57.6	0.24
63	-0.624	0.624	58.6	0.23
64	-0.608	0.608	59.6	0.23
65	-0.592	0.592	60.6	0.22
66	-0.58	0.58	61.6	0.22
67	-0.574	0.574	62.6	0.22
68	-0.555	0.555	63.6	0.21
69	-0.546	0.546	64.6	0.21
70	-0.536	0.536	65.6	0.20
71	-0.521	0.521	66.6	0.20
72	-0.511	0.511	67.6	0.19
73	-0.502	0.502	68.6	0.19
74	-0.489	0.489	69.6	0.18
75	-0.477	0.477	70.6	0.18
76	-0.477	0.477	71.6	0.18
77	-0.468	0.468	72.6	0.18
78	-0.458	0.458	73.6	0.17
79	-0.443	0.443	74.6	0.17
80	-0.436	0.436	75.6	0.16
81	-0.43	0.43	76.6	0.16

ATTACHMENT III.E.27 – CONSTANT HEAD PERMEABILITY TEST AND CALCULATION

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/16/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: PB-1 **Sample Depth:** 15-16½ feet

Sample Date: 8/25/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.7 cm

Average Flow: 100 ml **Head Difference:** 79.6 cm **Temp:** 22°C

Coefficient of Permeability

1. Time Collection = 119 sec; $k = 1.1 \times 10^{-2}$ cm/sec
2. Time Collection = 119 sec; $k = 1.1 \times 10^{-2}$ cm/sec
3. Time Collection = 119 sec; $k = 1.1 \times 10^{-2}$ cm/sec
4. Time Collection = 119 sec; $k = 1.1 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.1×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/27/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-2 **Sample Depth:** 15-16½ feet

Sample Date: 8/27/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.3 cm

Average Flow: 100 ml **Head Difference:** 84.0 cm **Temp:** 23.3°C

Coefficient of Permeability

1. Time Collection = 316 sec; $k = 2.3 \times 10^{-3}$ cm/sec
2. Time Collection = 316 sec; $k = 2.3 \times 10^{-3}$ cm/sec
3. Time Collection = 316 sec; $k = 2.3 \times 10^{-3}$ cm/sec
4. Time Collection = 316 sec; $k = 2.3 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 2.3×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/7/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-3 **Sample Depth:** 25-26½ feet

Sample Date: 8/28/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.7 cm

Average Flow: 100 ml **Head Difference:** 78.6 cm **Temp:** 23.3°C

Coefficient of Permeability

1. Time Collection = 706 sec; $k = 2.0 \times 10^{-3}$ cm/sec
2. Time Collection = 706 sec; $k = 2.0 \times 10^{-3}$ cm/sec
3. Time Collection = 706 sec; $k = 2.0 \times 10^{-3}$ cm/sec
4. Time Collection = 706 sec; $k = 2.0 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 2.0×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/7/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-3 **Sample Depth:** 90-91½ feet

Sample Date: 8/28/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 12.1 cm

Average Flow: 100 ml **Head Difference:** 78.2 cm **Temp:** 23.3°C

Coefficient of Permeability

1. Time Collection = 826 sec; $k = 1.82 \times 10^{-3}$ cm/sec
2. Time Collection = 826 sec; $k = 1.82 \times 10^{-3}$ cm/sec
3. Time Collection = 826 sec; $k = 1.82 \times 10^{-3}$ cm/sec
4. Time Collection = 826 sec; $k = 1.82 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.82×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-4

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/17/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: PB-4 **Sample Depth:** 60-61½ feet

Sample Date: 10/13/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.6 cm

Average Flow: 100 ml **Head Difference:** 83.7 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 163 sec; $k = 4.7 \times 10^{-3}$ cm/sec
2. Time Collection = 163 sec; $k = 4.7 \times 10^{-3}$ cm/sec
3. Time Collection = 163 sec; $k = 4.7 \times 10^{-3}$ cm/sec
4. Time Collection = 163 sec; $k = 4.7 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 4.7 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plat 4-

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/18/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-5 **Sample Depth:** 100-101½ feet

Sample Date: 9/12/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.4 cm

Average Flow: 100 ml **Head Difference:** 81.9 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 1439 sec; $k = 4.5 \times 10^{-4}$ cm/sec
2. Time Collection = 1439 sec; $k = 4.5 \times 10^{-4}$ cm/sec
3. Time Collection = 1439 sec; $k = 4.5 \times 10^{-4}$ cm/sec
4. Time Collection = 1439 sec; $k = 4.5 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, $k = 4.5 \times 10^{-4}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-6

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/18/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-6 **Sample Depth:** 60-61½ feet

Sample Date: 8/25/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.2 cm

Average Flow: 100 ml **Head Difference:** 82.1 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 36 sec; $k = 3.48 \times 10^{-3}$ cm/sec
2. Time Collection = 36 sec; $k = 3.48 \times 10^{-3}$ cm/sec
3. Time Collection = 36 sec; $k = 3.48 \times 10^{-3}$ cm/sec
4. Time Collection = 36 sec; $k = 3.48 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 3.48 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate -7

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/7/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-8 **Sample Depth:** 25-26½ feet

Sample Date: 8/26/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.9 cm

Average Flow: 100 ml **Head Difference:** 78.4 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 159 sec; $k = 9.27 \times 10^{-3}$ cm/sec
2. Time Collection = 159 sec; $k = 9.27 \times 10^{-3}$ cm/sec
3. Time Collection = 159 sec; $k = 9.27 \times 10^{-3}$ cm/sec
4. Time Collection = 159 sec; $k = 9.27 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 9.27 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/7/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-8 **Sample Depth:** 40-41½ feet

Sample Date: 8/26/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.5 cm

Average Flow: 100 ml **Head Difference:** 78.78 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 103 sec; $k = 1.37 \times 10^{-2}$ cm/sec
2. Time Collection = 103 sec; $k = 1.37 \times 10^{-2}$ cm/sec
3. Time Collection = 103 sec; $k = 1.37 \times 10^{-2}$ cm/sec
4. Time Collection = 103 sec; $k = 1.37 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.37×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plat -9

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/7/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-9 **Sample Depth:** 10-11½ feet

Sample Date: 8/26/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.7 cm

Average Flow: 100 ml **Head Difference:** 78.6 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 128 sec; $k = 1.1 \times 10^{-2}$ cm/sec
2. Time Collection = 128 sec; $k = 1.1 \times 10^{-2}$ cm/sec
3. Time Collection = 128 sec; $k = 1.1 \times 10^{-2}$ cm/sec
4. Time Collection = 128 sec; $k = 1.1 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, $k = 1.1 \times 10^{-2}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-1(

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 11/4/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-10 **Sample Depth:** 15-16½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.1 cm

Average Flow: 100 ml **Head Difference:** 82.2 cm **Temp:** 21.1°C

Coefficient of Permeability

1. Time Collection = 65 sec; $k = 1.47 \times 10^{-2}$ cm/sec
2. Time Collection = 65 sec; $k = 1.47 \times 10^{-2}$ cm/sec
3. Time Collection = 65 sec; $k = 1.47 \times 10^{-2}$ cm/sec
4. Time Collection = 65 sec; $k = 1.47 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.47×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 1

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/8/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-10 **Sample Depth:** 85-86½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.8 cm

Average Flow: 100 ml **Head Difference:** 78.5 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 207 sec; $k = 7.1 \times 10^{-3}$ cm/sec
2. Time Collection = 207 sec; $k = 7.1 \times 10^{-3}$ cm/sec
3. Time Collection = 207 sec; $k = 7.1 \times 10^{-3}$ cm/sec
4. Time Collection = 207 sec; $k = 7.1 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 7.1 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-12

CONSTANT HEAD PERMEABILITY TEST

CLIENT:	City of El Paso Engineering Department 2 Civic Center Plaza, 4th Floor El Paso, Texas 79901	**DATE:**	12/18/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-11 **Sample Depth:** 80-81½ feet

Sample Date: 8/29/98
Soil Description: Sandy Clay

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.9 cm

Average Flow: 50 ml **Head Difference:** 83.4 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 203 sec; $k = 1.98 \times 10^{-3}$ cm/sec
2. Time Collection = 203 sec; $k = 1.98 \times 10^{-3}$ cm/sec
3. Time Collection = 203 sec; $k = 1.98 \times 10^{-3}$ cm/sec
4. Time Collection = 203 sec; $k = 1.98 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.98×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 13

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/18/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-11 **Sample Depth:** 110 -111½ feet

Sample Date: 9/14/98
Soil Description: Poorly Graded Clayey Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.5 cm

Average Flow: 36 ml **Head Difference:** 81.8 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 930 sec; $k = 3.91 \times 10^{-4}$ cm/sec
2. Time Collection = 930 sec; $k = 3.91 \times 10^{-4}$ cm/sec
3. Time Collection = 930 sec; $k = 3.91 \times 10^{-4}$ cm/sec
4. Time Collection = 930 sec; $k = 3.91 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, $k = 3.91 \times 10^{-4}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-1

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/18/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-13 **Sample Depth:** 120 -121½ feet

Sample Date: 9/14/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.2 cm

Average Flow: 40 ml **Head Difference:** 81.1 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 1717 sec; $k = 2.57 \times 10^{-4}$ cm/sec
2. Time Collection = 1717 sec; $k = 2.57 \times 10^{-4}$ cm/sec
3. Time Collection = 1717 sec; $k = 2.57 \times 10^{-4}$ cm/sec
4. Time Collection = 1717 sec; $k = 2.57 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, k = 2.57×10^{-4} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate -1

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-14 **Sample Depth:** 95-96½ feet

Sample Date: 9/30/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.4 cm

Average Flow: 116 ml **Head Difference:** 83.9 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 782 sec; $k = 1.04 \times 10^{-3}$ cm/sec
2. Time Collection = 782 sec; $k = 1.04 \times 10^{-3}$ cm/sec
3. Time Collection = 782 sec; $k = 1.04 \times 10^{-3}$ cm/sec
4. Time Collection = 782 sec; $k = 1.04 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.04×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-16

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-15 **Sample Depth:** 105-106½ feet

Sample Date: 9/30/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.2 cm

Average Flow: 106 ml **Head Difference:** 84.1 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 678 sec; $k = 1.12 \times 10^{-3}$ cm/sec
2. Time Collection = 678 sec; $k = 1.12 \times 10^{-3}$ cm/sec
3. Time Collection = 678 sec; $k = 1.12 \times 10^{-3}$ cm/sec
4. Time Collection = 678 sec; $k = 1.12 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 1.12 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 17

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/8/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-16 **Sample Depth:** 30-31½ feet

Sample Date: 8/27/98
Soil Description: Poorly Graded Sand

Specimen Data

nitial Area: 10.3 cm^2 **Initial Height:** 11.6 cm

Average Flow: 100 ml **Head Difference:** 77.68 cm **Temp:** 25.6°C

Coefficient of Permeability

1. Time Collection = 100 sec; $k = 1.45 \times 10^{-2}$ cm/sec
2. Time Collection = 100 sec; $k = 1.45 \times 10^{-2}$ cm/sec
3. Time Collection = 100 sec; $k = 1.45 \times 10^{-2}$ cm/sec
4. Time Collection = 100 sec; $k = 1.45 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, $k = 1.45 \times 10^{-2}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-18

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/8/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-17 **Sample Depth:** 30-31½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.8 cm

Average Flow: 100 ml **Head Difference:** 78.5 cm **Temp:** 25.6°C

Coefficient of Permeability

1. Time Collection = 105 sec; $k = 1.4 \times 10^{-2}$ cm/sec
2. Time Collection = 105 sec; $k = 1.4 \times 10^{-2}$ cm/sec
3. Time Collection = 105 sec; $k = 1.4 \times 10^{-2}$ cm/sec
4. Time Collection = 105 sec; $k = 1.4 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.4×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 19

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/9/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-17 **Sample Depth:** 50-51½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.4 cm

Average Flow: 100 ml **Head Difference:** 78.9 cm **Temp:** 22.8°C

Coefficient of Permeability

1. Time Collection = 577 sec; $k = 2.4 \times 10^{-3}$ cm/sec
2. Time Collection = 577 sec; $k = 2.4 \times 10^{-3}$ cm/sec
3. Time Collection = 577 sec; $k = 2.4 \times 10^{-3}$ cm/sec
4. Time Collection = 577 sec; $k = 2.4 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 2.4×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-20

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/9/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-17 **Sample Depth:** 70-71½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.5 cm

Average Flow: 100 ml **Head Difference:** 78.8 cm **Temp:** 23.3°C

Coefficient of Permeability

1. Time Collection = 3060 sec; $k = 4.6 \times 10^{-4}$ cm/sec
2. Time Collection = 3060 sec; $k = 4.6 \times 10^{-4}$ cm/sec
3. Time Collection = 3060 sec; $k = 4.6 \times 10^{-4}$ cm/sec
4. Time Collection = 3060 sec; $k = 4.6 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, k = 4.6×10^{-4} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate -2

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/9/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-19 **Sample Depth:** 20-21½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.8 cm

Average Flow: 100 ml **Head Difference:** 79.5 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 130 sec; $k = 1.0 \times 10^{-2}$ cm/sec
2. Time Collection = 130 sec; $k = 1.0 \times 10^{-2}$ cm/sec
3. Time Collection = 130 sec; $k = 1.0 \times 10^{-2}$ cm/sec
4. Time Collection = 130 sec; $k = 1.0 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, $k = 1.0 \times 10^{-2}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-2

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/9/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-19 **Sample Depth:** 45-46½ feet

Sample Date: 8/29/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.3 cm

Average Flow: 100 ml **Head Difference:** 79.0 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 699 sec; $k = 2.0 \times 10^{-3}$ cm/sec
2. Time Collection = 699 sec; $k = 2.0 \times 10^{-3}$ cm/sec
3. Time Collection = 699 sec; $k = 2.0 \times 10^{-3}$ cm/sec
4. Time Collection = 699 sec; $k = 2.0 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 2.0 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 23

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-20 **Sample Depth:** 120-121½ feet

Sample Date: 9/26/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 6.5 cm

Average Flow: 50 ml **Head Difference:** 70.2 cm **Temp:** 22.0°C

Coefficient of Permeability

1. Time Collection = 1156 sec; $k = 3.89 \times 10^{-4}$ cm/sec
2. Time Collection = 1156 sec; $k = 3.89 \times 10^{-4}$ cm/sec
3. Time Collection = 1156 sec; $k = 3.89 \times 10^{-4}$ cm/sec
4. Time Collection = 1156 sec; $k = 3.89 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, k = 3.89×10^{-4} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-24

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-22 **Sample Depth:** 125-126½ feet

Sample Date: 9/30/98
Soil Description: Sandy Clay

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.2 cm

Average Flow: 4 ml **Head Difference:** 73.9 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 3382 sec; $k = 1.58 \times 10^{-5}$ cm/sec
2. Time Collection = 3382 sec; $k = 1.58 \times 10^{-5}$ cm/sec
3. Time Collection = 3382 sec; $k = 1.58 \times 10^{-5}$ cm/sec
4. Time Collection = 3382 sec; $k = 1.58 \times 10^{-5}$ cm/sec

Average Coefficient of Permeability, k = 1.58×10^{-5} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C 5

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/16/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-23 **Sample Depth:** 15-16½ feet

Sample Date: 8/12/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.5 cm

Average Flow: 100 ml **Head Difference:** 78.8 cm **Temp:** 22.0°C

Coefficient of Permeability

1. Time Collection = 113 sec; $k = 1.25 \times 10^{-2}$ cm/sec
2. Time Collection = 113 sec; $k = 1.25 \times 10^{-2}$ cm/sec
3. Time Collection = 113 sec; $k = 1.25 \times 10^{-2}$ cm/sec
4. Time Collection = 113 sec; $k = 1.25 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.25×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-26

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/16/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-23 **Sample Depth:** 60-61½ feet

Sample Date: 8/12/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.9 cm

Average Flow: 100 ml **Head Difference:** 79.4 cm **Temp:** 22.0°C

Coefficient of Permeability

1. Time Collection = 1007 sec; $k = 1.3 \times 10^{-3}$ cm/sec
2. Time Collection = 1007 sec; $k = 1.3 \times 10^{-3}$ cm/sec
3. Time Collection = 1007 sec; $k = 1.3 \times 10^{-3}$ cm/sec
4. Time Collection = 1007 sec; $k = 1.3 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.3×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 27

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/16/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-23 **Sample Depth:** 80-81½ feet

Sample Date: 8/12/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.7 cm

Average Flow: 100 ml **Head Difference:** 79.6 cm **Temp:** 22.8°C

Coefficient of Permeability

1. Time Collection = 224 sec; $k = 5.83 \times 10^{-3}$ cm/sec
2. Time Collection = 224 sec; $k = 5.83 \times 10^{-3}$ cm/sec
3. Time Collection = 224 sec; $k = 5.83 \times 10^{-3}$ cm/sec
4. Time Collection = 224 sec; $k = 5.83 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 5.83×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-2

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-24 **Sample Depth:** 100-101½ feet

Sample Date: 10/27/98
Soil Description: Poorly Graded Silty Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.3 cm

Average Flow: 100 ml **Head Difference:** 73.0 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 100 sec; $k = 1.24 \times 10^{-3}$ cm/sec
2. Time Collection = 100 sec; $k = 1.24 \times 10^{-3}$ cm/sec
3. Time Collection = 100 sec; $k = 1.24 \times 10^{-3}$ cm/sec
4. Time Collection = 100 sec; $k = 1.24 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.24×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 29

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/10/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-26 **Sample Depth:** 10-11½ feet

Sample Date: 9/15/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 10.9 cm

Average Flow: 100 ml **Head Difference:** 79.4 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 16 sec; $k = 8.1 \times 10^{-2}$ cm/sec
2. Time Collection = 16 sec; $k = 8.1 \times 10^{-2}$ cm/sec
3. Time Collection = 16 sec; $k = 8.1 \times 10^{-2}$ cm/sec
4. Time Collection = 16 sec; $k = 8.1 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, $k = 8.1 \times 10^{-2}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-30

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/10/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-26 **Sample Depth:** 50-51½ feet

Sample Date: 9/15/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.4 cm

Average Flow: 100 ml **Head Difference:** 78.9 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 136 sec; $k = 1.0 \times 10^{-2}$ cm/sec
2. Time Collection = 136 sec; $k = 1.0 \times 10^{-2}$ cm/sec
3. Time Collection = 136 sec; $k = 1.0 \times 10^{-2}$ cm/sec
4. Time Collection = 136 sec; $k = 1.0 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.0×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C 31

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/9/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-26 **Sample Depth:** 115-116½ feet

Sample Date: 9/15/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 11.5 cm

Average Flow: 100 ml **Head Difference:** 78.8 cm **Temp:** 24.4°C

Coefficient of Permeability

1. Time Collection = 1772 sec; $k = 8.0 \times 10^{-4}$ cm/sec
2. Time Collection = 1772 sec; $k = 8.0 \times 10^{-4}$ cm/sec
3. Time Collection = 1772 sec; $k = 8.0 \times 10^{-4}$ cm/sec
4. Time Collection = 1772 sec; $k = 8.0 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, k = 8.0×10^{-4} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-3

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-27 **Sample Depth:** 100-101½ feet

Sample Date: 9/29/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.2 cm

Average Flow: 100 ml **Head Difference:** 71.9 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 91 sec; $k = 1.22 \times 10^{-2}$ cm/sec
2. Time Collection = 91 sec; $k = 1.22 \times 10^{-2}$ cm/sec
3. Time Collection = 91 sec; $k = 1.22 \times 10^{-2}$ cm/sec
4. Time Collection = 91 sec; $k = 1.22 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.22×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 33

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-28 **Sample Depth:** 100-101½ feet

Sample Date: 9/28/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.6 cm

Average Flow: 44 ml **Head Difference:** 73.3 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 1422 sec; $k = 3.93 \times 10^{-4}$ cm/sec
2. Time Collection = 1422 sec; $k = 3.93 \times 10^{-4}$ cm/sec
3. Time Collection = 1422 sec; $k = 3.93 \times 10^{-4}$ cm/sec
4. Time Collection = 1422 sec; $k = 3.93 \times 10^{-4}$ cm/sec

Average Coefficient of Permeability, k = 3.93×10^{-4} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-34

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-30 **Sample Depth:** 100-101½ feet

Sample Date: 9/28/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.2 cm

Average Flow: 60 ml **Head Difference:** 72.9 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 199 sec; $k = 3.69 \times 10^{-3}$ cm/sec
2. Time Collection = 199 sec; $k = 3.69 \times 10^{-3}$ cm/sec
3. Time Collection = 199 sec; $k = 3.69 \times 10^{-3}$ cm/sec
4. Time Collection = 199 sec; $k = 3.69 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 3.69×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 3

CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/23/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-31 **Sample Depth:** 20-21½ feet

Sample Date: 8/3/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.9 cm

Average Flow: 100 ml **Head Difference:** 80.4 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 61 sec; $k = 1.95 \times 10^{-2}$ cm/sec
2. Time Collection = 61 sec; $k = 1.95 \times 10^{-2}$ cm/sec
3. Time Collection = 61 sec; $k = 1.95 \times 10^{-2}$ cm/sec
4. Time Collection = 61 sec; $k = 1.95 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.95×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-36

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/23/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-31 **Sample Depth:** 60-61½ feet

Sample Date: 8/3/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.1 cm

Average Flow: 100 ml **Head Difference:** 81.2 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 355 sec; $k = 3.05 \times 10^{-3}$ cm/sec
2. Time Collection = 355 sec; $k = 3.05 \times 10^{-3}$ cm/sec
3. Time Collection = 355 sec; $k = 3.05 \times 10^{-3}$ cm/sec
4. Time Collection = 355 sec; $k = 3.05 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 3.05×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 37

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 12/15/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-33 **Sample Depth:** 100-101½ feet

Sample Date: 9/18/98
Soil Description: Poorly Graded Sand with silt

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.3 cm

Average Flow: 100 ml **Head Difference:** 73.0 cm **Temp:** 20.0°C

Coefficient of Permeability

1. Time Collection = 151 sec; $k = 8.19 \times 10^{-3}$ cm/sec
2. Time Collection = 151 sec; $k = 8.19 \times 10^{-3}$ cm/sec
3. Time Collection = 151 sec; $k = 8.19 \times 10^{-3}$ cm/sec
4. Time Collection = 151 sec; $k = 8.19 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, $k = 8.19 \times 10^{-3}$ cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-38

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/23/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-34 **Sample Depth:** 15-16½ feet

Sample Date: 8/13/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 9.8 cm

Average Flow: 100 ml **Head Difference:** 80.5 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 72 sec; $k = 1.6 \times 10^{-2}$ cm/sec
2. Time Collection = 72 sec; $k = 1.6 \times 10^{-2}$ cm/sec
3. Time Collection = 72 sec; $k = 1.6 \times 10^{-2}$ cm/sec
4. Time Collection = 72 sec; $k = 1.6 \times 10^{-2}$ cm/sec

Average Coefficient of Permeability, k = 1.6×10^{-2} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C 9

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/23/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-34 **Sample Depth:** 55-56½ feet

Sample Date: 8/13/98
Soil Description: Poorly Graded Sand with clay

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 5.4 cm

Average Flow: 100 ml **Head Difference:** 84.9 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 132 sec; $k = 4.67 \times 10^{-3}$ cm/sec
2. Time Collection = 132 sec; $k = 4.67 \times 10^{-3}$ cm/sec
3. Time Collection = 132 sec; $k = 4.67 \times 10^{-3}$ cm/sec
4. Time Collection = 132 sec; $k = 4.67 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 4.67×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate C4-40

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CONSTANT HEAD PERMEABILITY TEST

CLIENT: City of El Paso
Engineering Department
2 Civic Center Plaza, 4th Floor
El Paso, Texas 79901

DATE: 10/23/98

PROJECT NAME: Clint Landfill Expansion

PROJECT NO.: AEA96-182-00

CONSTANT HEAD PERMEABILITY TEST DATA NO.

Sample Obtained From: B-35 **Sample Depth:** 45-46½ feet

Sample Date: 8/13/98
Soil Description: Poorly Graded Sand

Specimen Data

Initial Area: 10.3 cm^2 **Initial Height:** 8.5 cm

Average Flow: 60 ml **Head Difference:** 81.8 cm **Temp:** 21.0°C

Coefficient of Permeability

1. Time Collection = 600 sec; $k = 1.0 \times 10^{-3}$ cm/sec
2. Time Collection = 600 sec; $k = 1.0 \times 10^{-3}$ cm/sec
3. Time Collection = 600 sec; $k = 1.0 \times 10^{-3}$ cm/sec
4. Time Collection = 600 sec; $k = 1.0 \times 10^{-3}$ cm/sec

Average Coefficient of Permeability, k = 1.0×10^{-3} cm/sec

This test was performed in general accordance with ASTM D2434 "Standard Test Method for Permeability of Granular Soils".

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Plate 1

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PROJECT NO. A 96-182-OC TASK NO. ___ SHEET ___ OF ___

PROJECT Clint Landfill Permit Amendement

SUBJECT ___ BY ___ CC ___ DATE ___

MTG ☐ PHONE: TO ☐ FROM ☐ FIELD ☐ CALC ☒ OTHER ☐

Coefficient of Permeability

Sample Calculation

Sample : PB-1, Depth: 15-16½ feet

Soil Description: Poorly Graded Sand with silt (SP-SM)

Height of Sample : 10.7 cm (L)

Diameter : 3.63 cm (D)

Area : 10.3 cm^2 (A)

Head Difference : 79.6 cm (h)

Flow : 100 ml (Q)

Time of Collection: 119 sec. (t)

Water Temp. → 22 °C

Coefficient of Permeability

$$k = \frac{QL}{Ath}$$

$$K = \frac{(100)(10.7)}{(10.3)(119)(79.6)} = 0.0110 \text{ cm/sec}$$

$$= 1.1 \times 10^{-2} \text{ cm/sec}$$

STATE OF TEXAS
GERARDO A. LICON
70169
REGISTERED PROFESSIONAL ENGINEER
9/7/00

References:

- Standard test method for Permeability of Granular Soils (Constant Head) - ASTM D 2364

ATTACHMENT III.E.28 – GEOTECHNICAL RESULTS

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
PB-1	343.0																	
		15-16.5	0.9	100	100	81	5	-	-	NP	SP-SM	0.0147	83.2	2.628	0.95	48.7	1.10e-02	-
		50-51.5	15.1	100	99	94	75	77	27	50	CH	0.0186	-	2.683	-	-	-	-
		105-106.5	2.3	99	99	87	4	-	-	NP	SP	-	-	-	-	-	-	-
		155-156.5	18.4	100	100	100	88	40	13	27	CL	0.0186	106.9	-	0.57	36.3	-	-
B-2	31.5																	
		5-6.5	0.8	99	97	67	13	-	-	NP	SM	0.009	-	-	-		-	-
		15-16.5	2.3	100	100	95	12	-	-	NP	SP-SM	0.011	-	-	-		2.30e-03	-
		30-31.5	0.7	100	100	97	6	-	-	NP	SP-SM	0.007	101.9	2.598	0.59	37.1	-	-
B-3	91.5																	
		10-11.5	1.7	91	84	48	11	-	-	NP	SP-SM	0.01	-	-	-	-	-	-
		25-26.5	0.9	100	100	97	8	-	-	NP	SP-SM	0.007	77.8	2.638	1.12	52.7	2.00e-03	-
		45-46.5	49.9	100	100	99	95	87	55	32	MH	0.052	-	-	-	-	-	-
		90-91.5	1.1	100	100	98	13	-	-	NP	SM	0.008	76.4	2.643	1.16	53.7	1.82e-03	-
PB-4	390																	
		40-41.5	13.2	91	87	84	80	90	29	61	CH	0.0042	76.9	2.726	0.62	38.3	-	-
		60-61.5	1.6	100	100	99	3	-	-	NP	SP	0.0057	76.9	2.630	1.13	53.2	4.70e-03	-
		335-336.5	22.2	100	97	94	75	54	23	31	CH	0.0278	103.7	2.663	0.60	37.6	-	24.6

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
B-5	101.5																	
		10-11.5	1.3	80	70	44	12	-	-	NP	SP-SM	-	96.4	2.647	0.71	41.6	-	-
		60-61.5	9.8	90	88	84	71	85	18	67	CH	0.0250	115.8	2.676	0.44	30.7	-	-
		100-101.5	2.7	100	100	100	18	-	-	NP	SM	0.044	95.0	2.659	0.75	42.7	4.5e-04	-
B-6	61.5																	
		30-31.5	1.3	100	98	94	62	55	16	39	CH	-	-	-	0.71	41.6	-	-
		50-51.5	1.0	100	99	95	16	-	-	NP	SM	-	-	-	0.44	30.7	-	-
		60-61.5	0.9	100	100	97	1	-	-	NP	SP	0.005	100.9	2.632	0.63	38.6	3.48e-03	-
B-7	71.5																	
		15-16.5	1.0	100	99	88	5	-	-	NP	SP-SM	-	-	-	-	-	-	-
		70-71.5	4.3	100	98	91	25	NT	NT	NT	-	0.010	87.6	2.642	0.88	46.9	-	-
B-8	41.5																	
		10-11.5	4.1	91	89	86	73	27	14	13	CL	0.032	80.1	2.656	1.07	51.7	-	-
		25-26.5	0.4	94	89	61	4	-	-	NP	SP	0.0087	-	2.614	0.65	39.2	9.27e-03	-
		40-41.5	0.6	100	100	92	3	-	-	NP	SP	0.008	91.4	2.612	0.78	43.9	1.37e-02	-
B-9	76.5																	
		10-11.5	1.4	100	98	75	7	-	-	NP	SP-SM	0.008	-	-	-	-	1.10e-02	-
		45-46.5	0.9	94	92	70	2	-	-	NP	SP	0.005	-	-	-	-	-	-
		70-71.5	-	100	100	99	88	NT	NT	NT	-	-	-	-	-	-	-	-
		75-76.5	21.9	-	-	-	-	NT	NT	NT	-	0.029	121.4	2.692	0.38	27.7	-	-

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
B-10	86.5																	
		15-16.5	1.7	98	96	58	6	-	-	NP	SP-SM	0.004	86.7	2.632	0.89	47.2	1.47e-02	-
		40-41.5	1.9	94	93	84	6	-	-	NP	SP-SM	0.008	88.6	-	-	-	-	-
		65-66.5	26.7	100	100	92	72	NT	NT	NT	-	0.033	-	2.65	0.87	46.4	-	-
		85-86.5	4.5	100	99	83	14	-	-	NP	SM	0.015	102.1	2.641	0.61	38	7.10e-03	-
B-11	111.5																	
		80-81.5	18.3	97	96	92	71	88	22	66	CH	0.0493	104.2	2.675	0.60	37.6	1.98e-03	-
		110-111.5	6.7	100	100	100	66	NT	NT	NT	-	0.0078	75.9	2.653	1.18	54.2	3.91e-04	-
B-12	116.5																	
		5-6.5	4.8	83	76	65	22	-	-	NP	SM	0.033	-	-	-	-	-	-
		90-91.5	15	100	100	97	54	91	18	73	CH	0.037	101	2.651	0.64	38.9	-	-
B-13	121.5																	
		50-51.5	1.5	100	99	97	6	-	-	NP	SP-SM	-	79.5	-	-	-	-	-
		120-121.5	0.9	100	93	85	4	-	-	NP	SP	0.0082	91.0	2.648	0.82	44.9	2.57e-04	-
B-14	96.5																	
		5-6.5	10.7	98	92	77	32	-	-	NP	SM	-	-	-	-	-	-	-
		70-71.5	2.1	100	100	99	96	NT	NT	NT	CL or CH	-	-	-	-	-	-	-
		95-96.5	6.3	100	100	92	5	-	-	NP	SP-SM	0.014	91.8	-	-	-	1.04e-03	-

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
B-15	106.5																	
		105-106.5	-	-	-	-	-	-	-	-	-	0.004	103.5	-	-	-	1.12e-03	-
B-16	61.5																	
		10-11.5	0.7	100	99.8	85	2	-	-	NP	SP	0.069	-	-	-	-	-	-
		25-26.5	2.9	79	71	53	16	56	16	40	SC	0.012	-	-	-	-	-	-
		30-31.5	0.4	97	90	53	3	-	-	NP	SP	0.007	-	-	-	-	1.45e-02	-
		60-61.5	2.4	99	98	92	7	NT	NT	NT	-	0.011	113.1	2.638	0.46	31.3	-	-
B-17	71.5																	
		5-6.5	1.2	89	77	43	8	-	-	NP	SP-SM	0.011	-	-	-	-	-	-
		30-31.5	1.6	94	93	84	5	-	-	NP	SP-SM	0.011	84.5	2.63	0.94	48.5	1.40e-02	-
		50-51.5	1.2	100	100	96	8	-	-	NP	SP-SM	0.01	77.2	2.631	1.13	53	2.40e-03	-
		70-71.5	2.3	100	100	86	7	-	-	NP	SP-SM	0.014	100.7	2.633	0.63	38.7	4.60e-04	-
PB-18	370																	
B-19	96.5																	
		10-11.5	2	100	99	89	20	-	-	NP	SM	0.0134	80.8	2.659	1.05	51.3	-	-
		20-21.5	0.5	77	64	32	3	-	-	NP	SM	0.0067	102.4	2.644	0.61	37.9	1.00e-02	-
		45-46.5	0.7	100	100	85	6	-	-	NP	SP-SM	0.0051	-	-	-	-	2.00e-03	-
		85-86.5	24.9	92	90	88	83	95	26	69	CH	0.0423	91.4	2.686	0.83	45.5	-	-

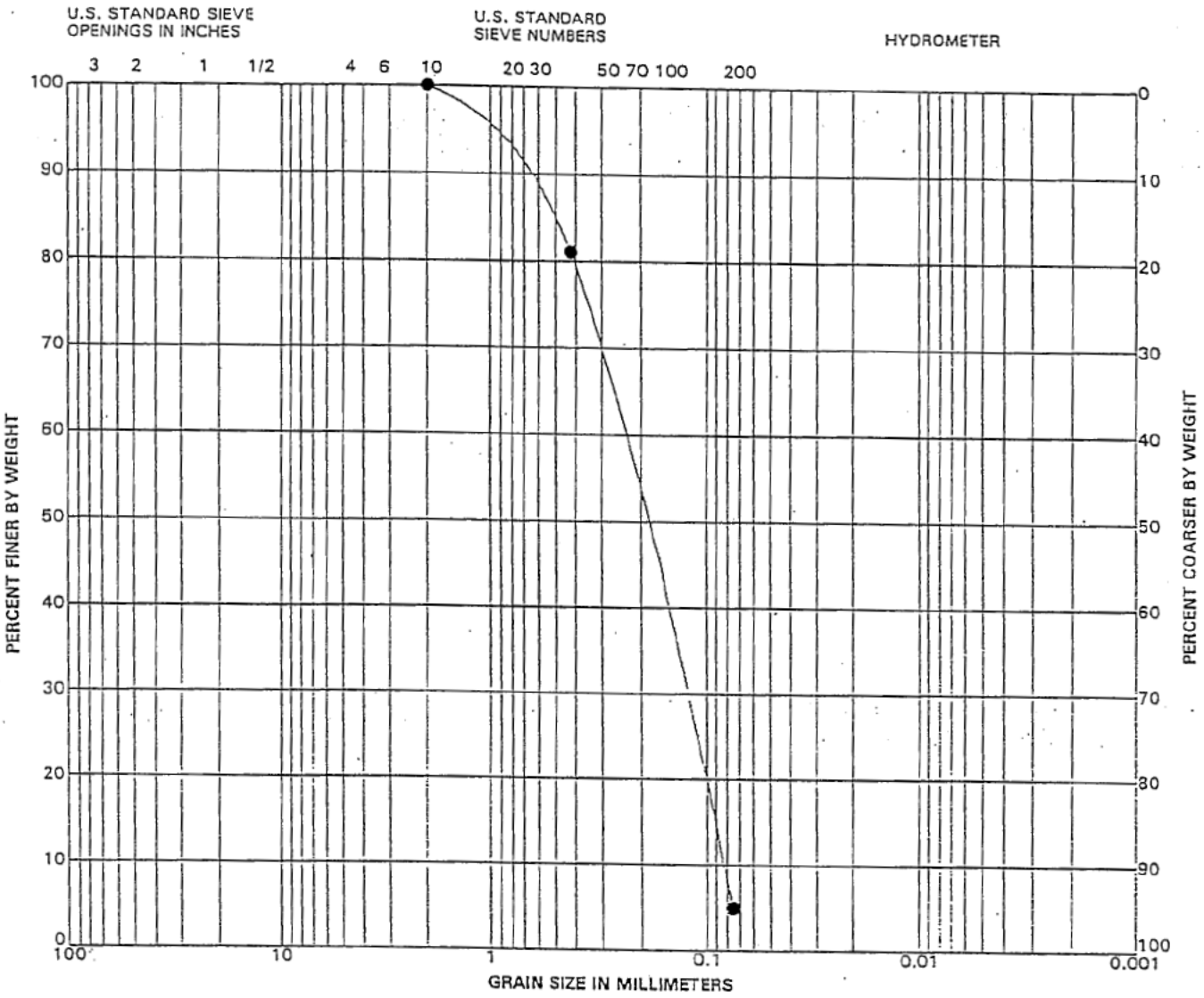
Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis Percent Passing				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
B-20	121.5																	
		5-6.5	7.1	80	74	63	25	41	20	21	SC	0.04	89.4	-	-	-		-
		120-121.5	4.7	100	100	100	24	-	-	NP	SM	0.014	99.6	-	-	-	3.89e-04	-
PB-21	390																	
B-22	126.5																	
		70-71.5	16.3	100	100	82	36	NT	NT	NT	-	-	-	-	-	-	-	-
		125-126.5	11.2	100	100	100	79	NT	NT	NT	CL or CH	0.015	97.3	-	-	-	1.58e-05	-
B-23	86.5																	
		5-6.5	5	97	95	86	35	19	15	4	SC-SM	0.0191	-	-	-	-		-
		15-16.5	2.6	74	66	35	3	-	-	NP	SP	-	96.8	2.646	0.71	41.3	1.25e-02	-
		40-41.5	3.6	92	89	60	9	-	-	NP	SP-SM	0.0217	-	-	-	-	-	-
		60-61.5	2.5	99	98	83	12	-	-	NP	SM	0.015	118.7	2.633	0.38	27.5	1.30e-03	-
		80-81.5	2.7	93	93	85	6	-	-	NP	SP-SM	-	-	-	-	-	5.83e-03	-
B-24	101.5																	
		40-41.5	3.9	96	89	61	27	NT	NT	NT	-	-	-	-	-	-	-	-
		100-101.5	19.4	100	100	93	13	-	-	NP	SM	0.014	91.4	-	-	-	1.24e-03	-
B-25	91.5																	
		15-16.5	12.2	100	79	32	4	-	-	NP	SP	0.0057	-	-	-	-	-	-

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
		50-51.5	3.5	100	100	89	9	-	-	NP	SP-SM	-	106.8	-	-	-	-	-
		60-61.5	18.6	94	90	87	78	64	16	48	CH	0.0173	104.8	2.725	0.62	38.3	-	43.6
		70-71.5	1.7	100	100	94	12	-	-	NP	SP-SM	0.0052	-	-	-	-	-	-
		80-81.5	20.9	100	100	99	96	110	23	87	CH	-	-	-	-	-	-	188.6
B-26	116.5																	
		10-11.5	0.8	96	87	21	1	-	-	NP	SP	0.0057	-	-	-	-	8.10e-02	-
		50-51.5	0.8	100	99	65	2	-	-	NP	SP	0.0044	-	-	-	-	1.0e-02	-
		75-76.5	10.2	96	95	92	84	78	18	60	CH	0.0216	116.8	-	-	-	-	-
		90-91.5	3.8	100	100	99	22	-	-	NP	SM	0.0134	-	-	-	-	-	-
		115-116..5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.0e-04	-
B-27	111.5																	
		100-101.5	3.2	100	100	92	4	-	-	NP	SP	0.04	100.5	-	-	-	1.22e-02	-
B-28	126.5																	
		100-101.5	1.8	100	100	97	4	-	-	NP	SP	0.05	90.2	-	-	-	3.93e-04	-
		110-111.5	5.8	100	100	98	20	61	15	46	SC	-	-	-	-	-	-	-
PB-29	400																	
B-30	126.5																	
		60-61.5	5.8	100	99	82	14	110	22	88	SC	-	-	-	-	-	-	-
		100-101.5	1.3	100	100	100	9	-	-	NP	SP-SM	0.04	89.7	-	-	-	3.69e-03	-

Boring No.	Boring Depth (feet)	Sample Depth (feet)	Moisture Content (%)	Sieve Analysis				Atterberg Limits			Soil Classification	Fraction Organic Carbon (gram/gram)	Dry Unit Weight (pcf)	Specific Gravity	Void Ratio	Total Porosity (%)	Permeability (cm/sec)	Unconfined Compressive Strength (psi)
				Percent Passing														
				No. 4	No.10	No. 40	No. 200	L.L.	P.L.	P.I.								
B-31	91.5																	
		5-6.5	20.8	100	100	98	73	123	24	99	CH	0.036	107.3	2.657	0.55	35	-	234.6
		20-21.5	0.2	98	93	80	5	-	-	NP	SP-SM	0.043	91.8	2.641	0.8	44	1.95e-02	-
		60-61.5	1.2	99	97	79	4	-	-	NP	SP	0.071	82.8	2.64	0.99	50	3.05e-03	-
PB-32	380																	
B-33	101.5																	
		100-101.5	12.6	100	100	98	11	-	-	NP	SP-SM	0.059	117	-	-	-	8.19e-03	-
B-34	86.5																	
		15-16.5	1.1	80	75	42	3	-	-	NP	SP	0.007	-	-	-	-	1.60e-02	-
		55-56.5	7.7	93	88	61	30	NT	NT	NT	-	0.011	-	-	-	-	4.67e-03	-
B-35	106.5																	
		15-16.5	13.8	91	88	75	35	NT	NT	NT	-	0.01	105.7	2.649	0.56	36.1	-	-
		45-46.5	4.1	100	100	96	4	-	-	NP	SP	-	-	-	-	-	1.00e-03	-
		95-96.5	13.7	100	99	93	57	67	16	51	CH	0.032	113.3	2.651	0.46	31.5	-	-
		105-106.5	19.9	100	100	99	26	-	-	NP	SM	-	-	-	-	-	-	-

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

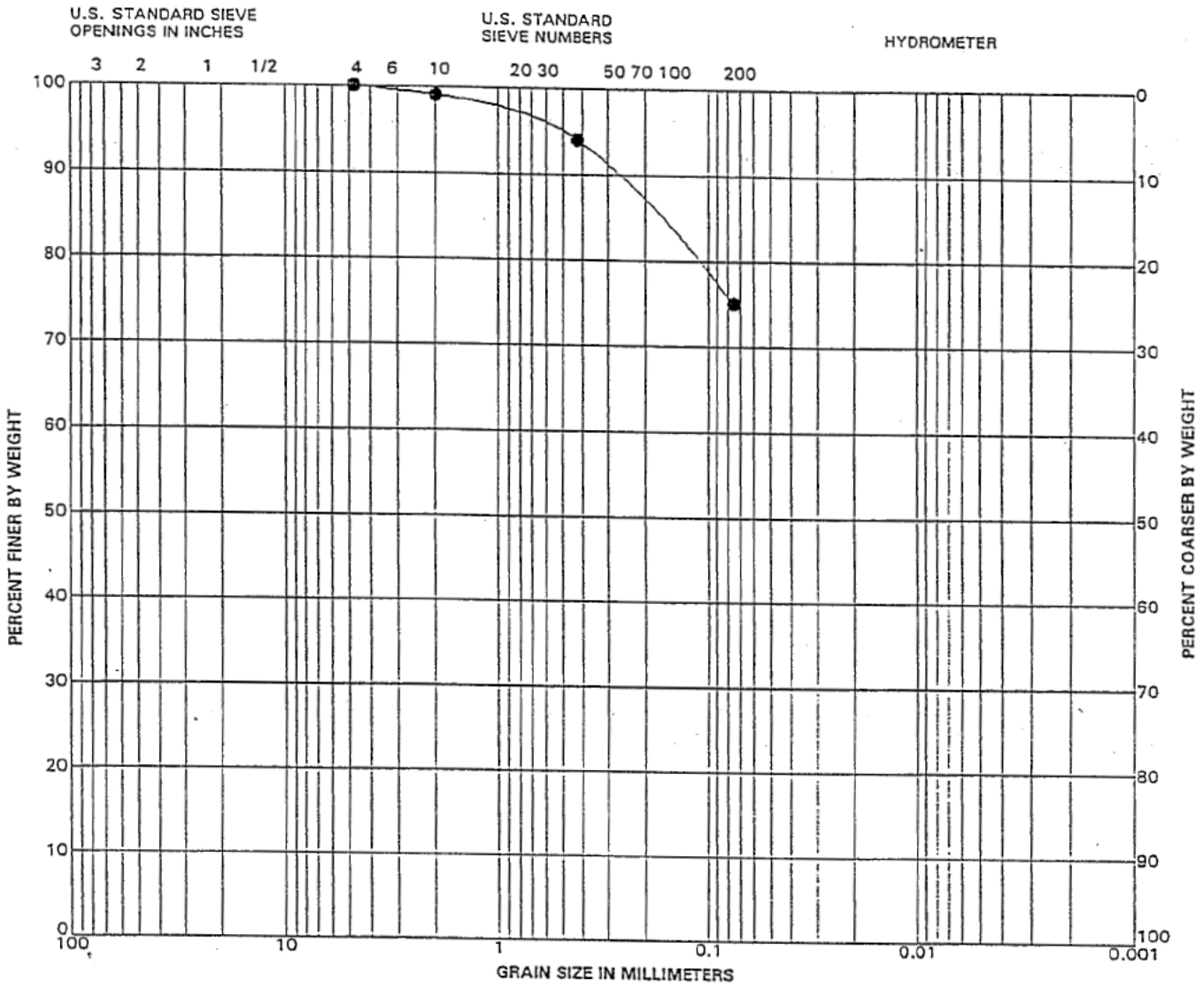
Sample No.: PB-1
Sample Depth: 15 to 16 1/2 feet
Moisture Content: 0.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

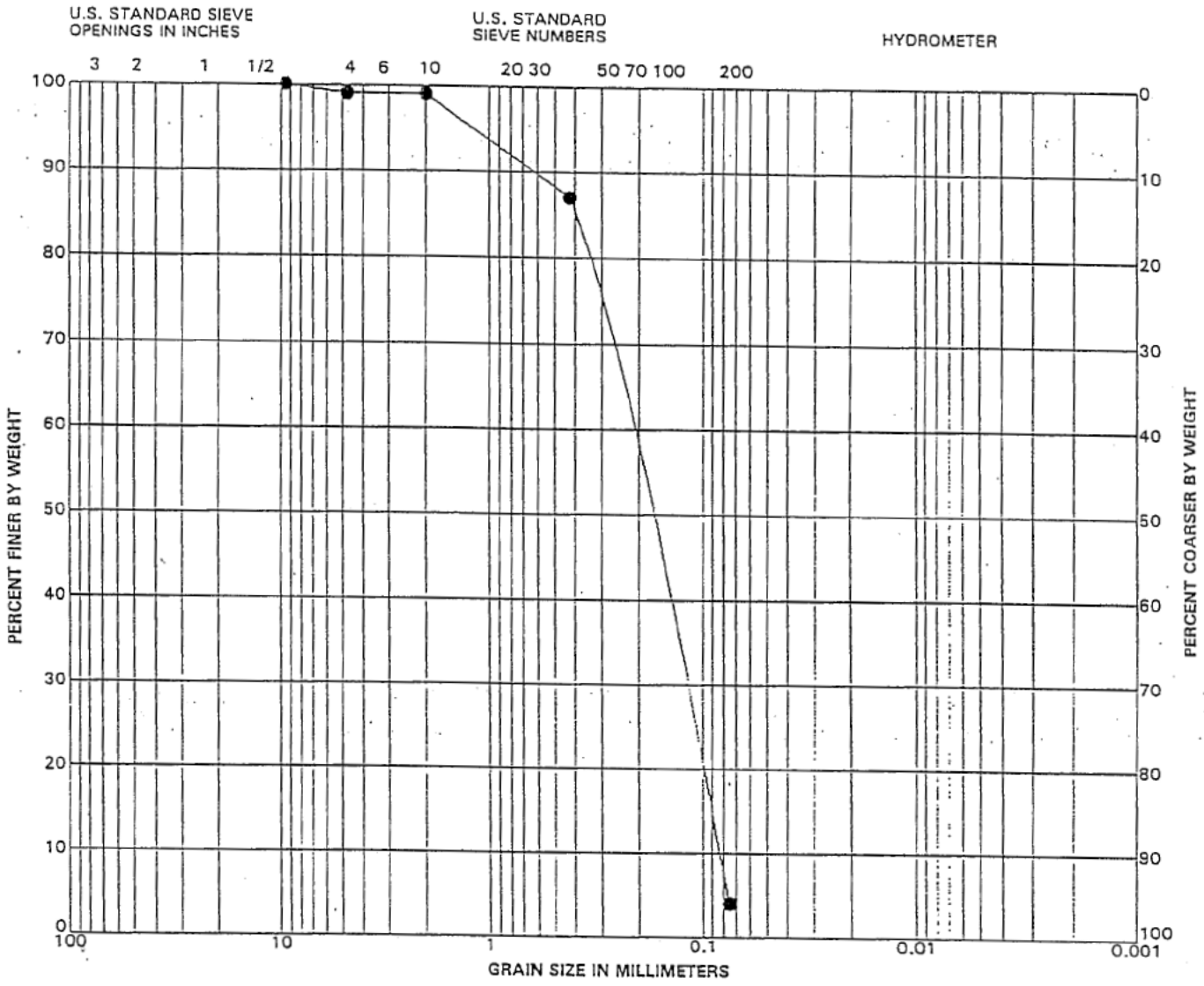
Sample No.:	PB-1
Sample Depth:	50 to 51 1/2 feet
Moisture Content:	15.1%
Liquid Limit:	77
Plastic Limit:	27
Plasticity Index:	50
Material Classification:	CH
Material Description:	Clay, Sand, Brown, Hard, Dry, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

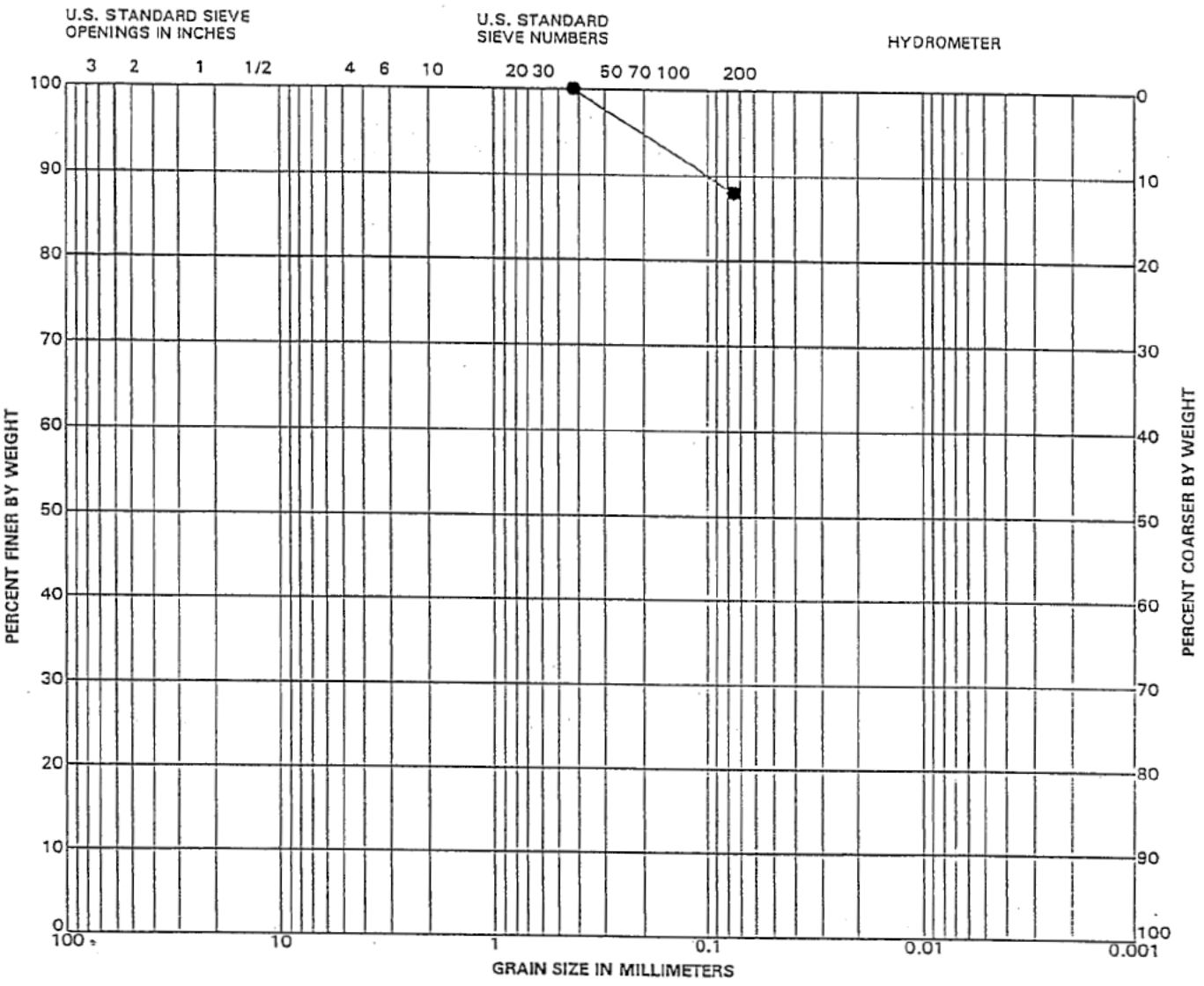
Sample No.: PB-1
Sample Depth: 105 to 106 1/2 feet
Moisture Content: 2.3%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

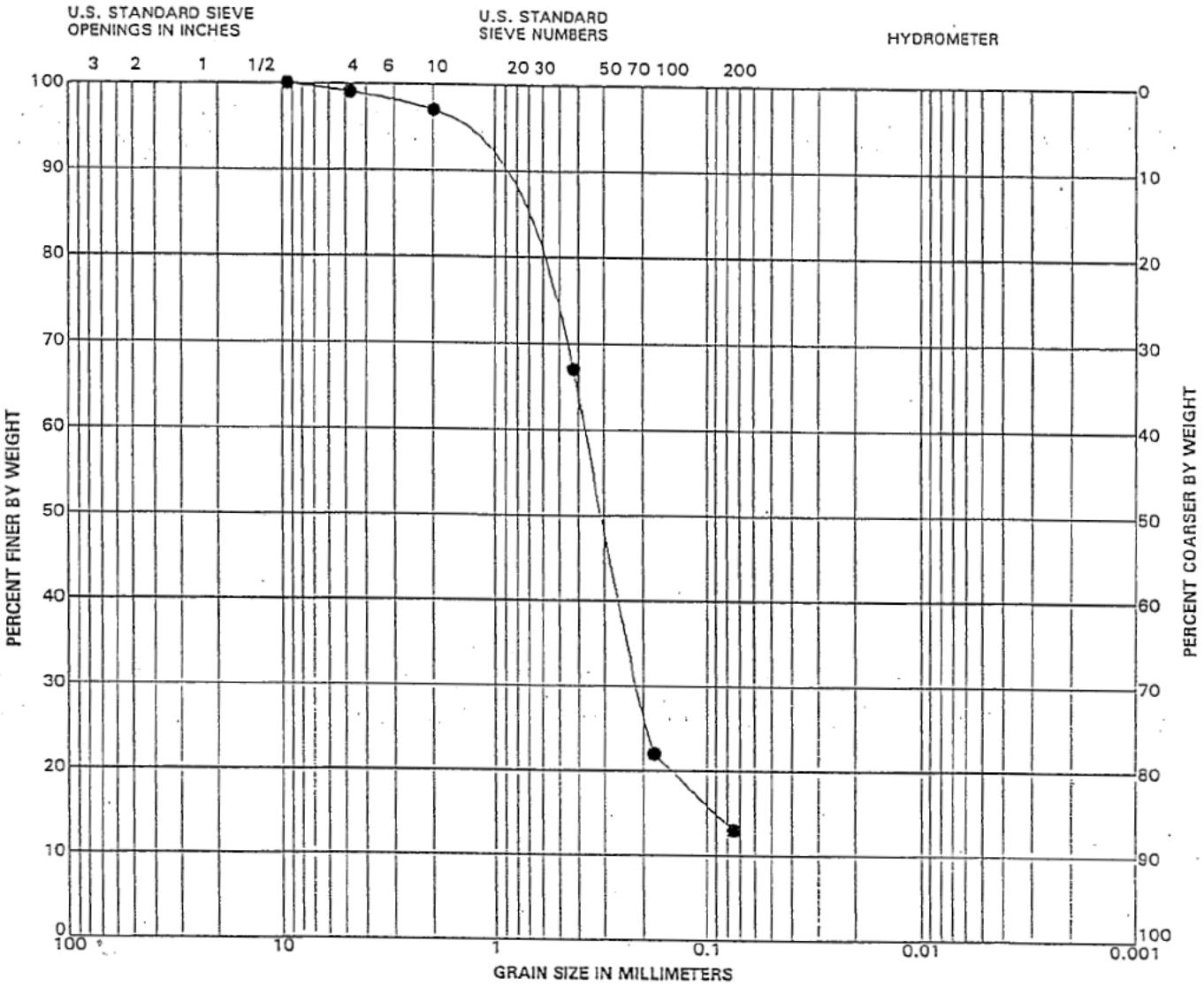
Sample No.:	PB-1
Sample Depth:	155 to 156 1/2 feet
Moisture Content:	18.4%
Liquid Limit:	40
Plastic Limit:	13
Plasticity Index:	27
Material Classification:	CL
Material Description:	Clay, Brown, Hard, Moist with sand
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

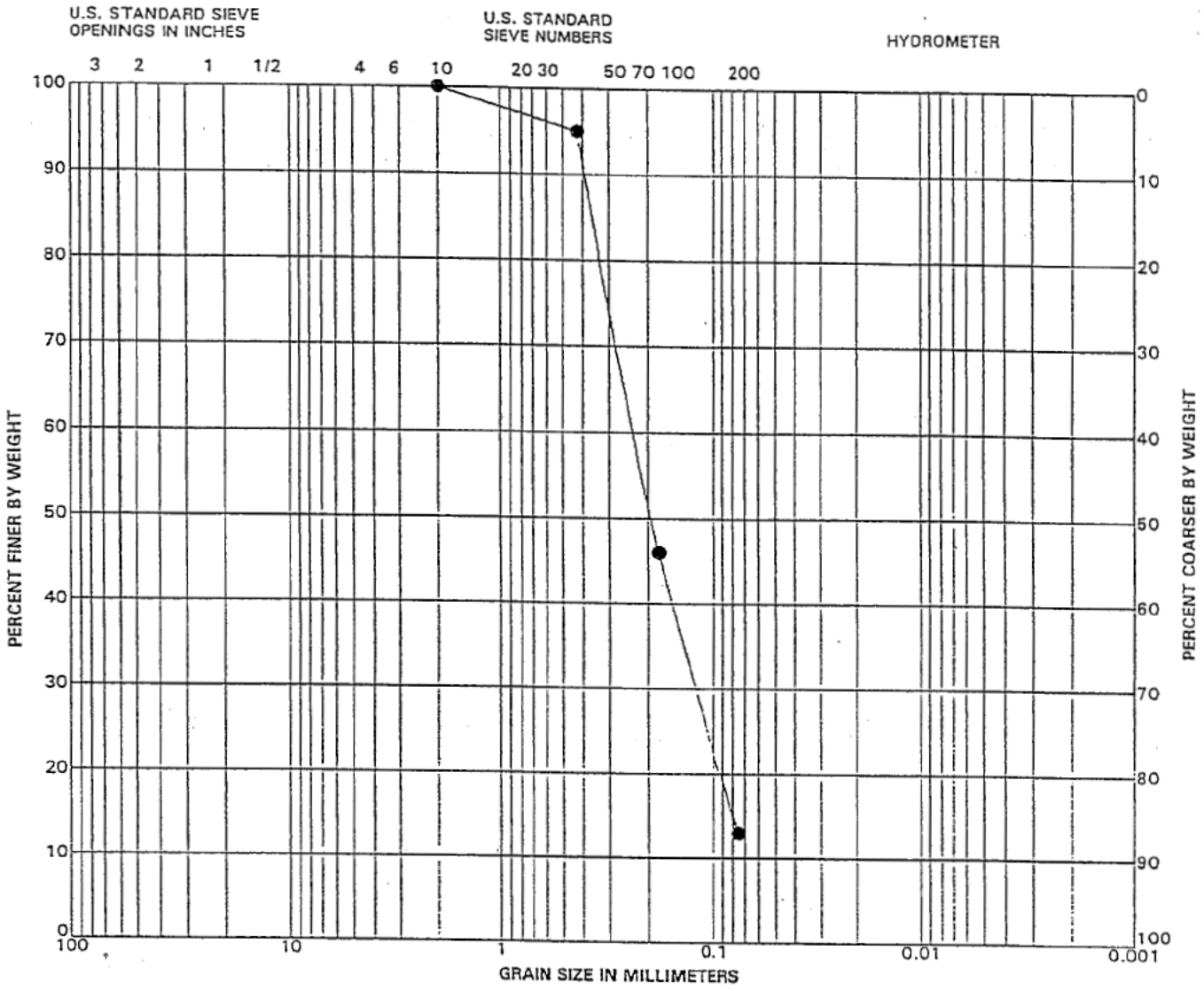
Sample No.: B-2
Sample Depth: 5 to 6 1/2 feet
Moisture Content: 0.8%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SM
Material Description: Sand, Fine Grained, Silty, Tan, Medium Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

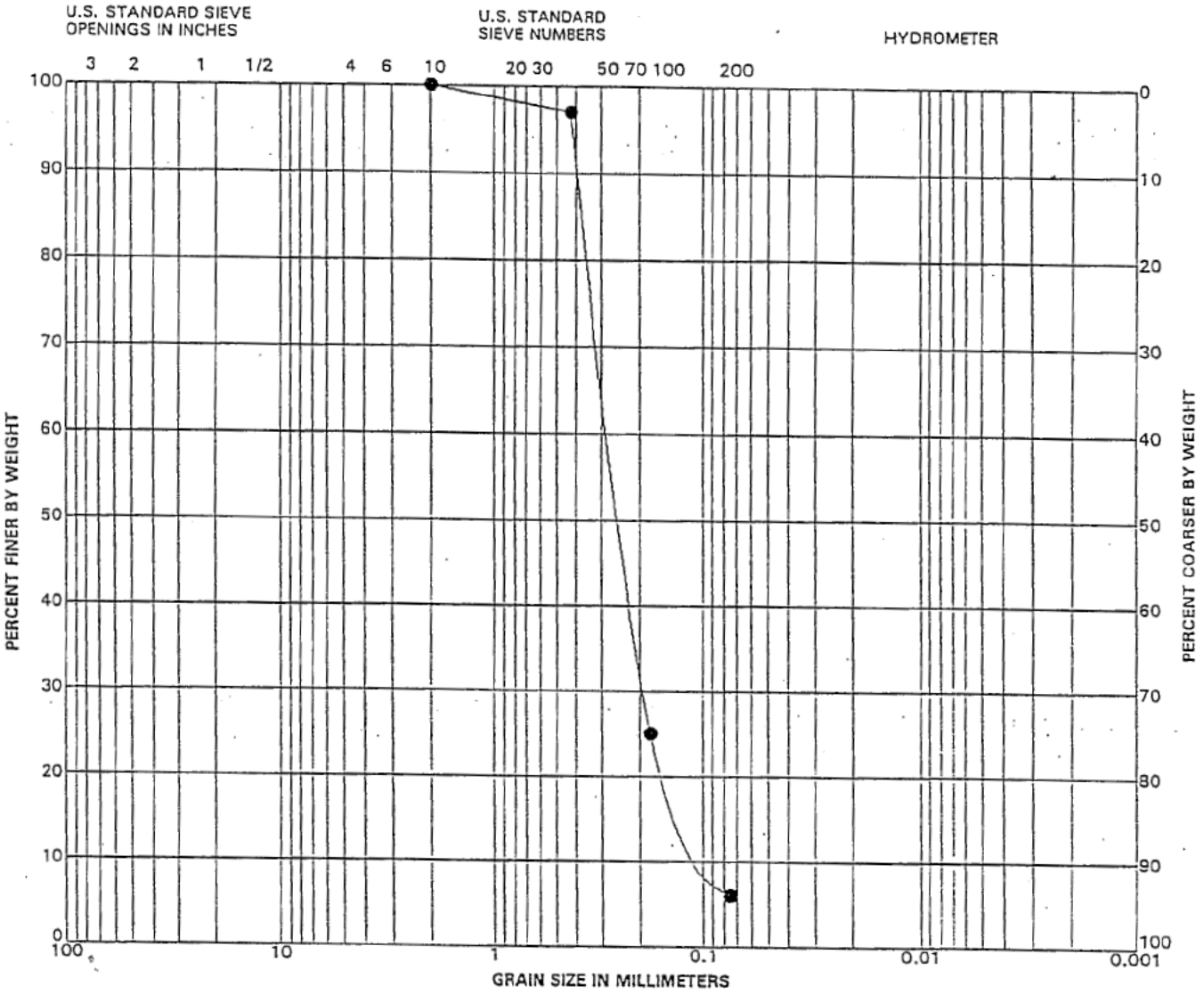
Sample No.: B-2
Sample Depth: 15 to 16 1/2 feet
Moisture Content: 2.3%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-0

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.:	B-2
Sample Depth:	30 to 31 1/2 feet
Moisture Content:	0.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

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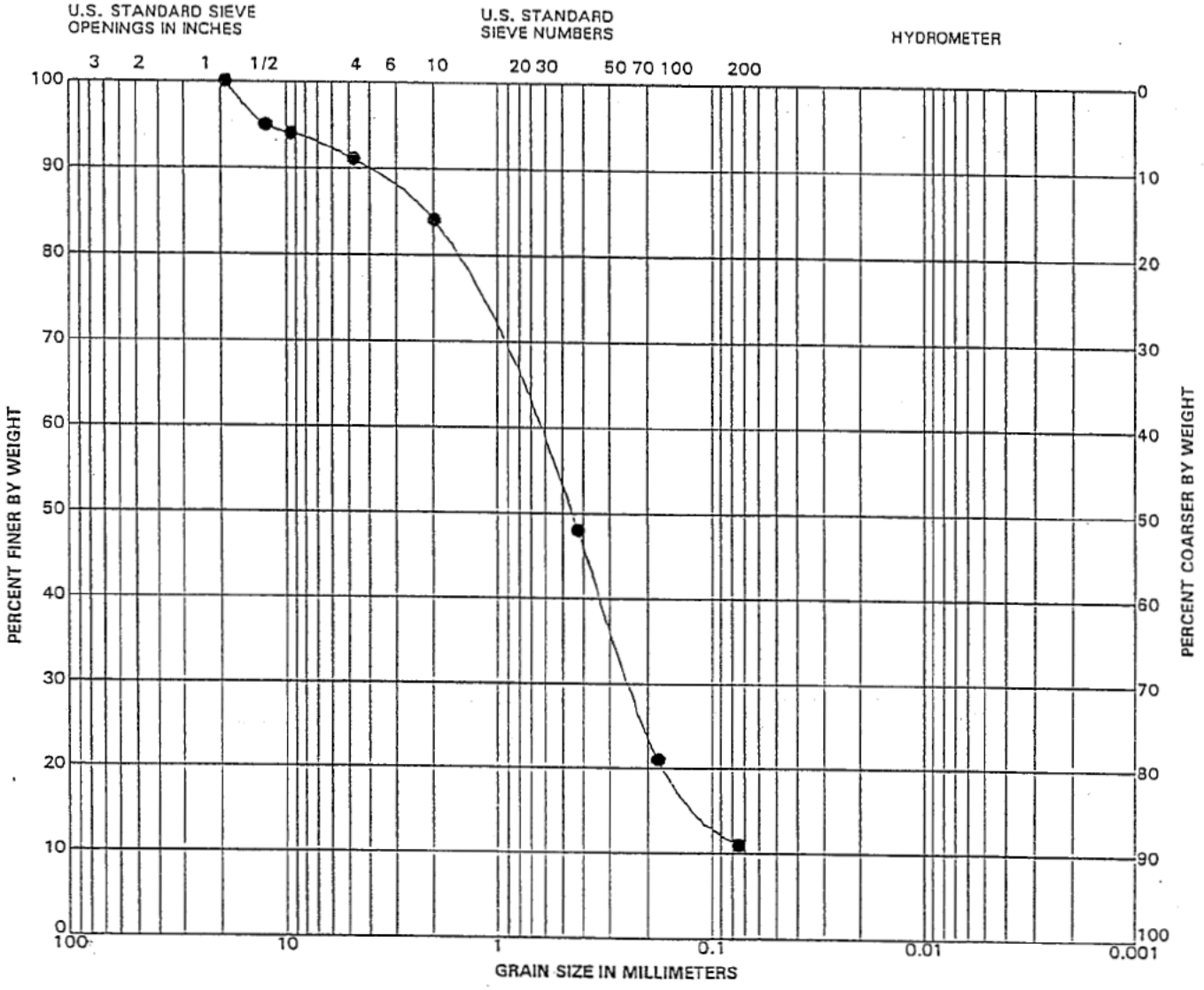
Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

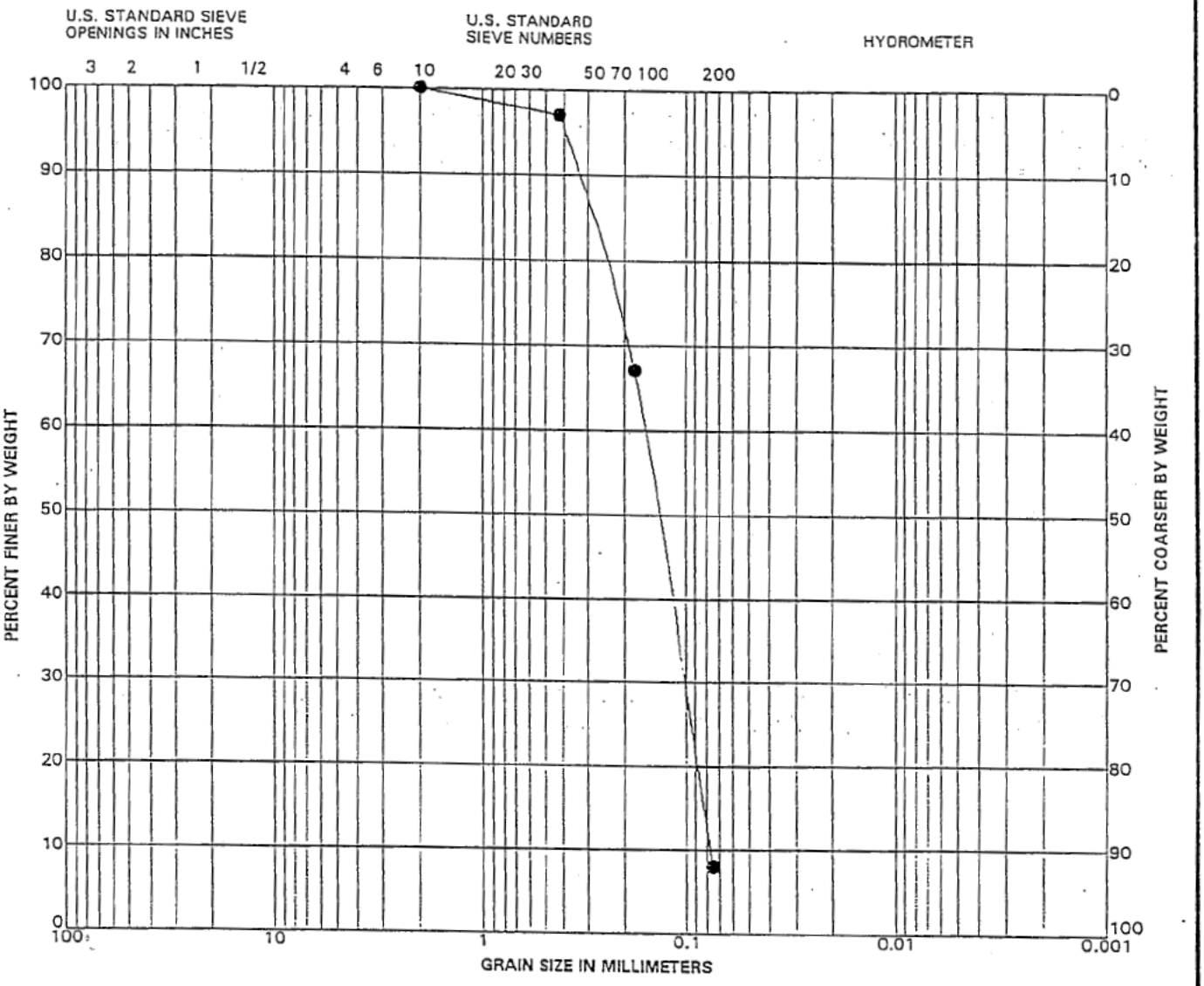
Sample No.: B-3
Sample Depth: 10 to 11 1/2 feet
Moisture Content: 1.7%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

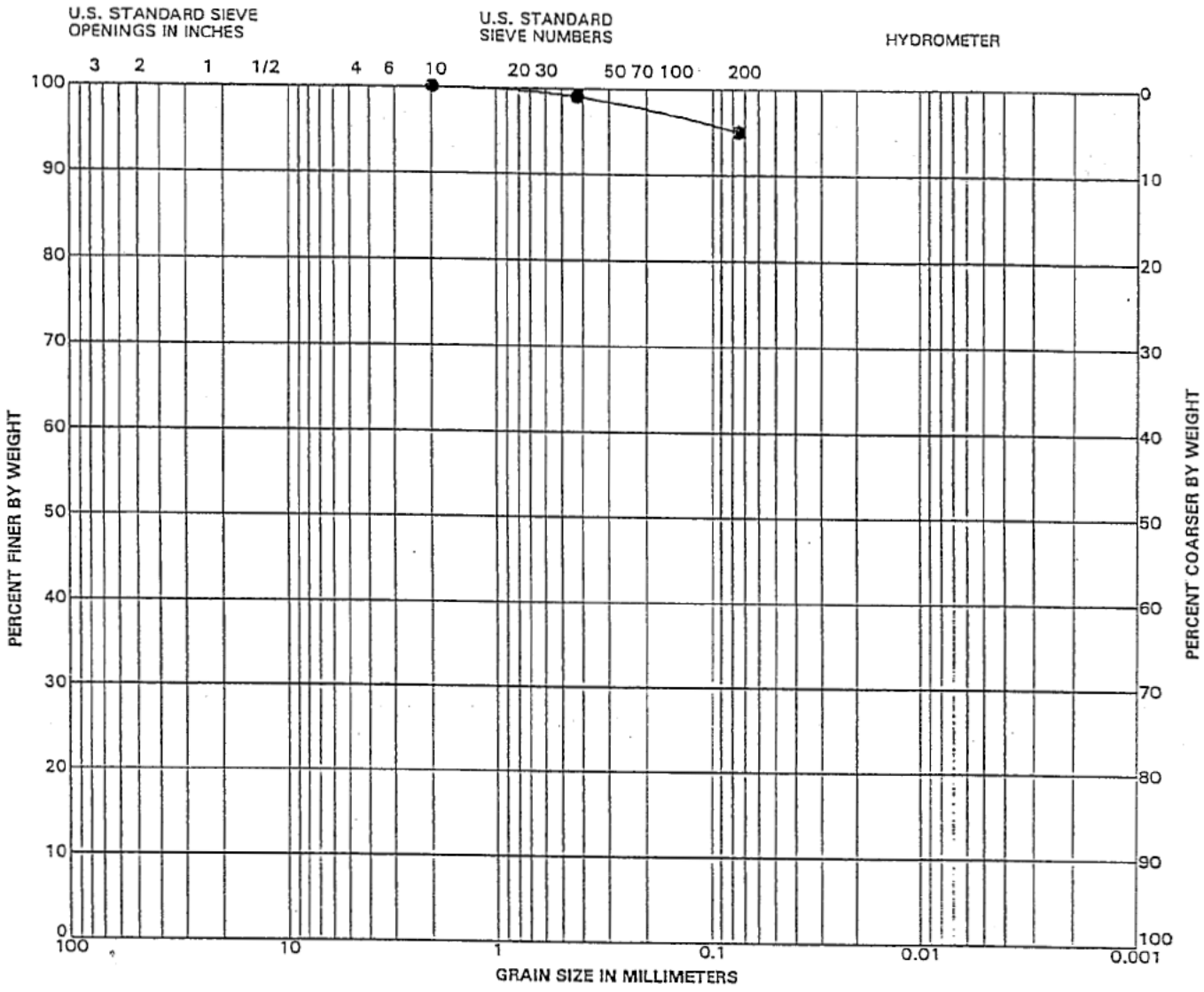
Sample No.: B-3
Sample Depth: 25 to 26 1/2 feet
Moisture Content: 0.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.:	B-3
Sample Depth:	45 to 46 1/2 feet
Moisture Content:	49.9%
Liquid Limit:	87
Plastic Limit:	55
Plasticity Index:	32
Material Classification:	MH
Material Description:	Silt, Light Brown, Firm, Wet with gypsiferous material
ASTM Procedures:	D2216, D2487, D4318

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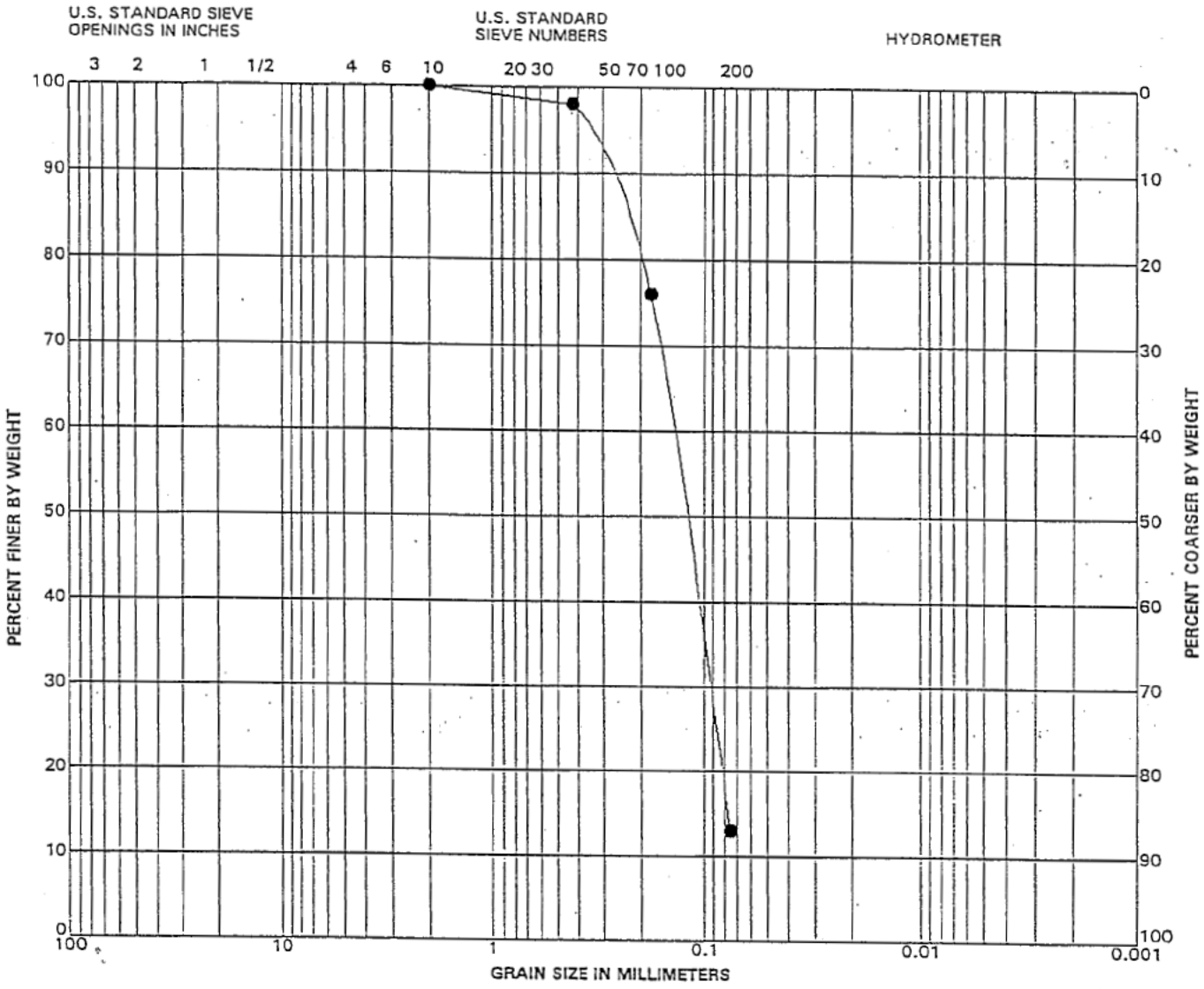
Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.:	B-3
Sample Depth:	90 to 91 1/2 feet
Moisture Content:	1.1%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

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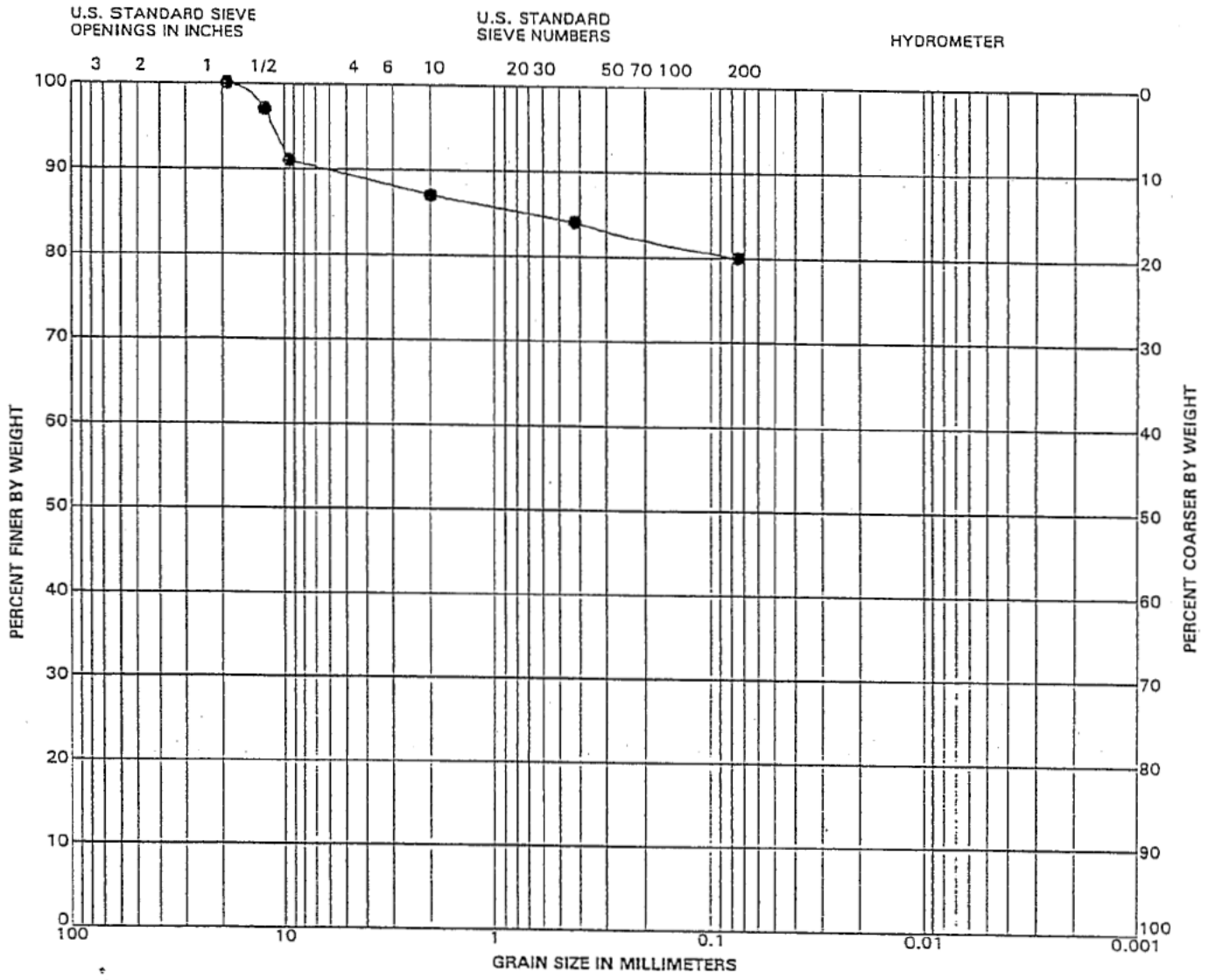
Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

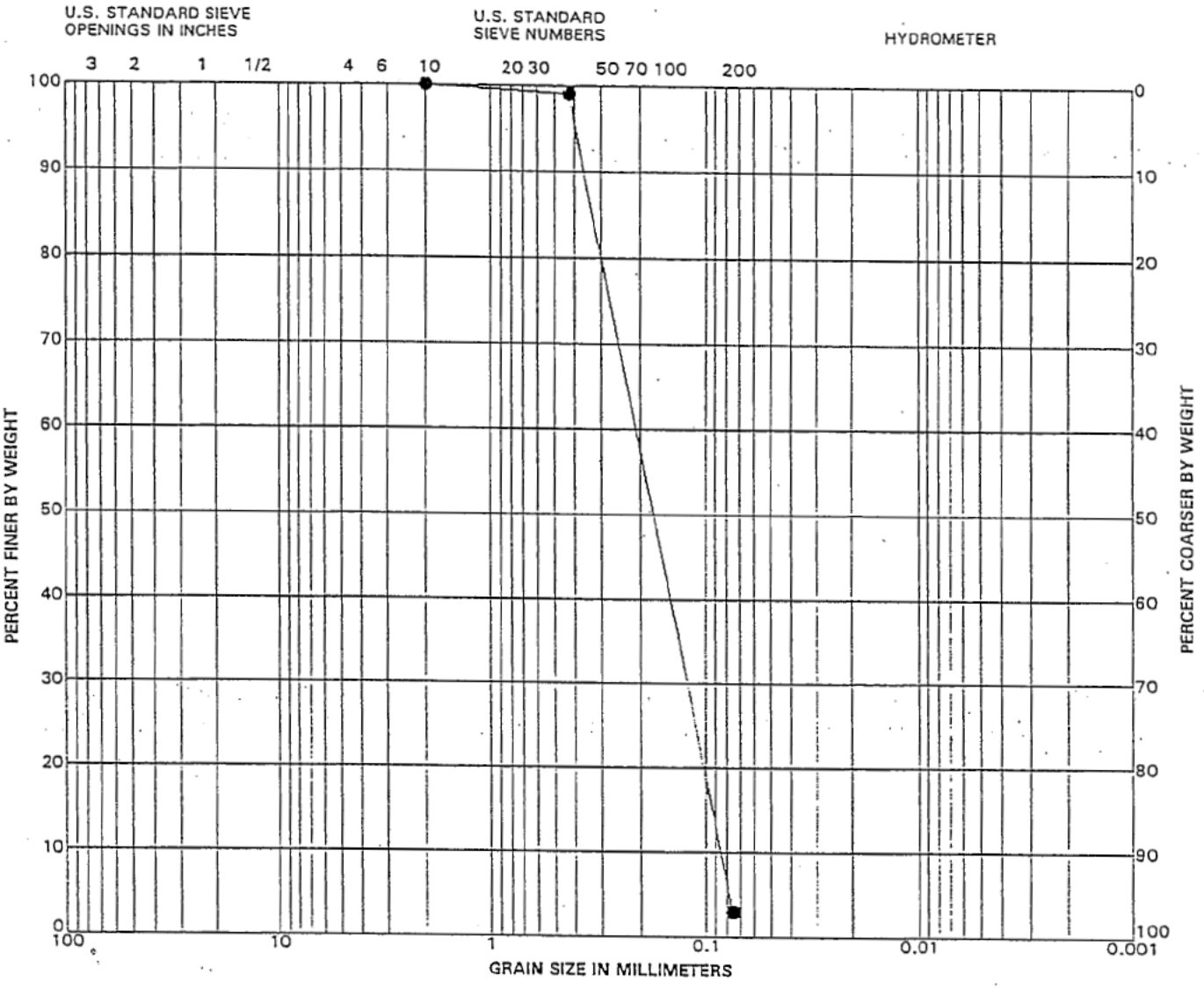
Sample No.:	PB-4
Sample Depth:	40 to 41 1/2 feet
Moisture Content:	13.2%
Liquid Limit:	90
Plastic Limit:	29
Plasticity Index:	61
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

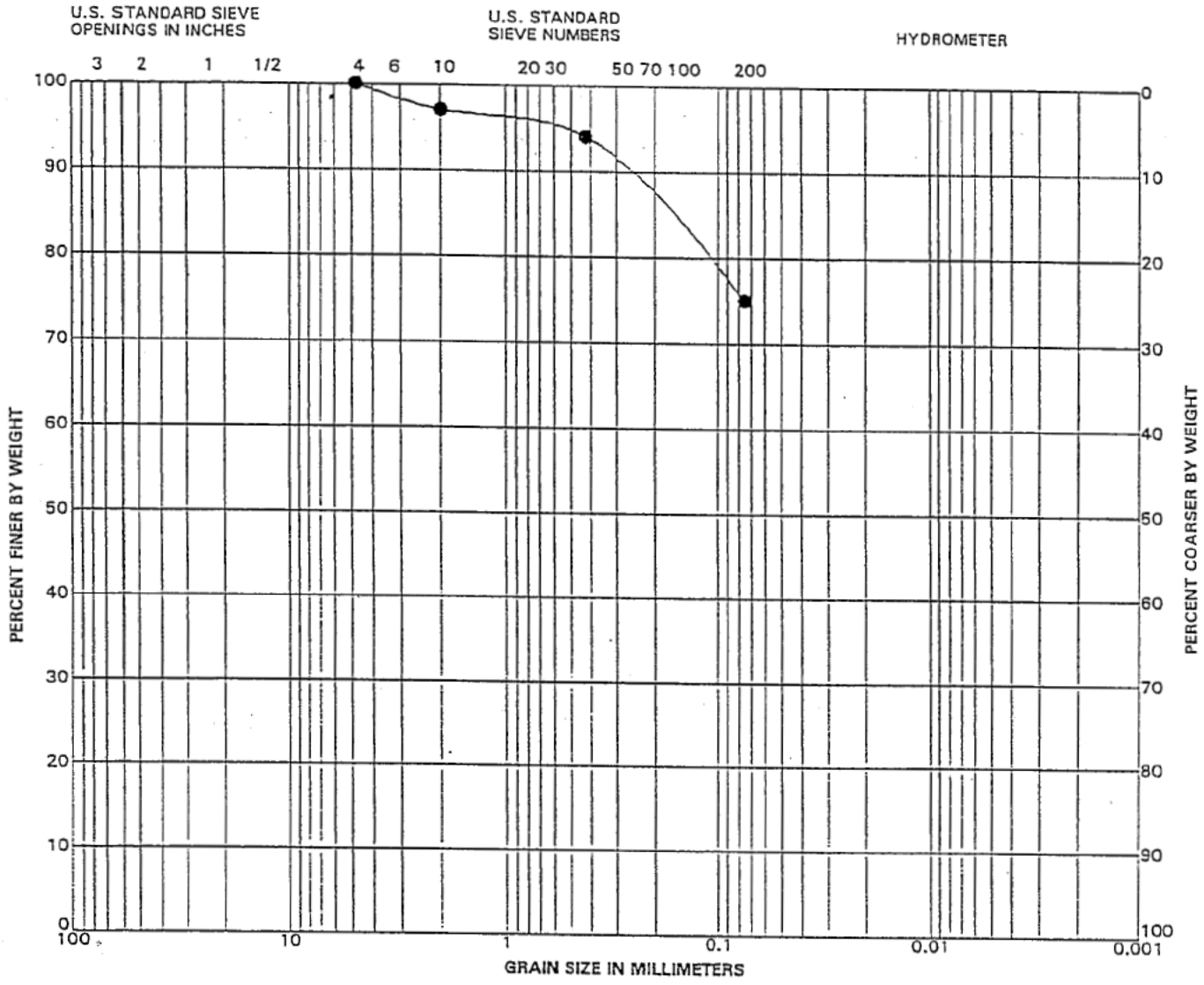
Sample No.: PB-4
Sample Depth: 60 to 61 1/2 feet
Moisture Content: 1.6%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

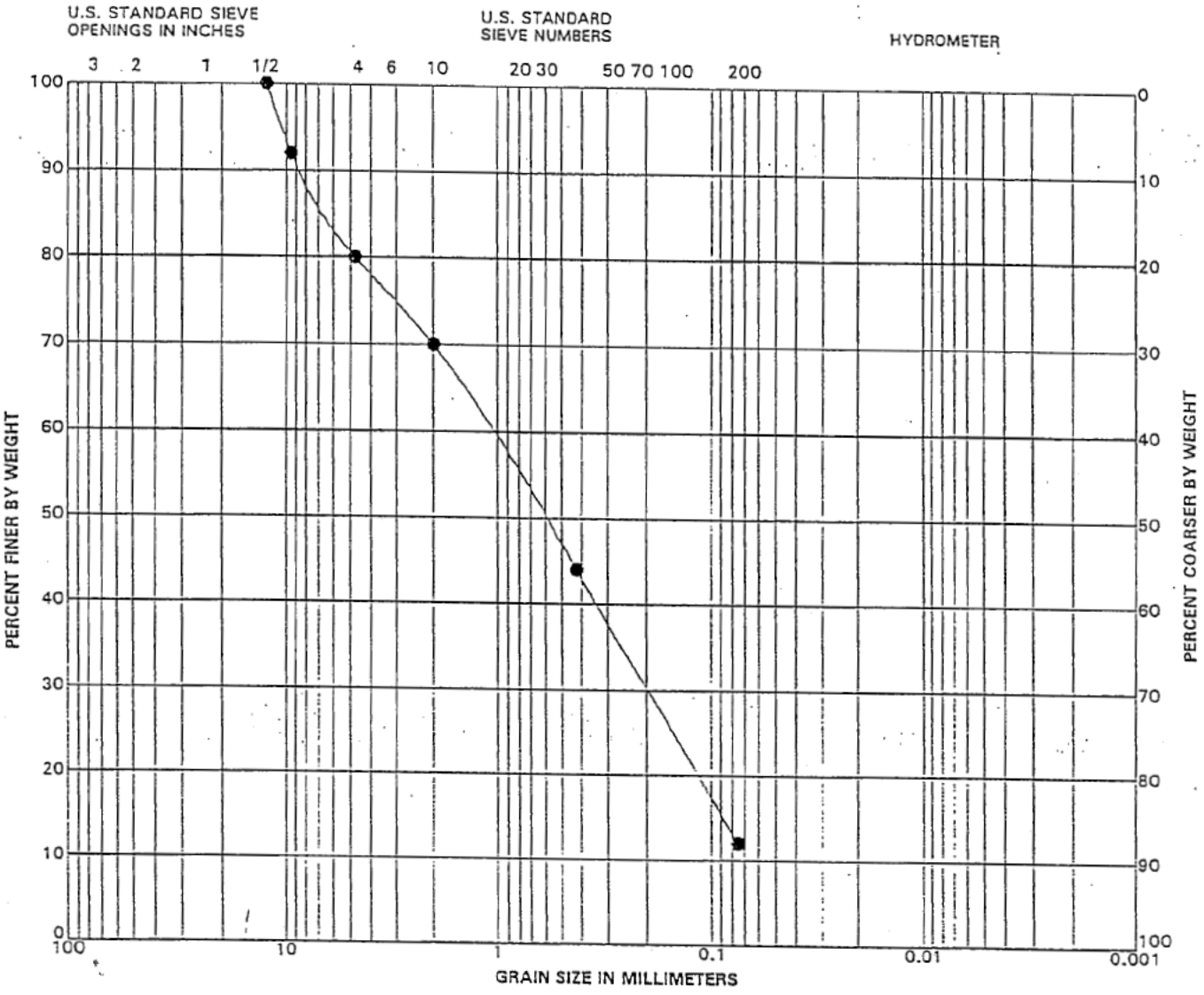
Sample No.:	PB-4
Sample Depth:	335 to 336 1/2 feet
Moisture Content:	22.2%
Liquid Limit:	54
Plastic Limit:	23
Plasticity Index:	31
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

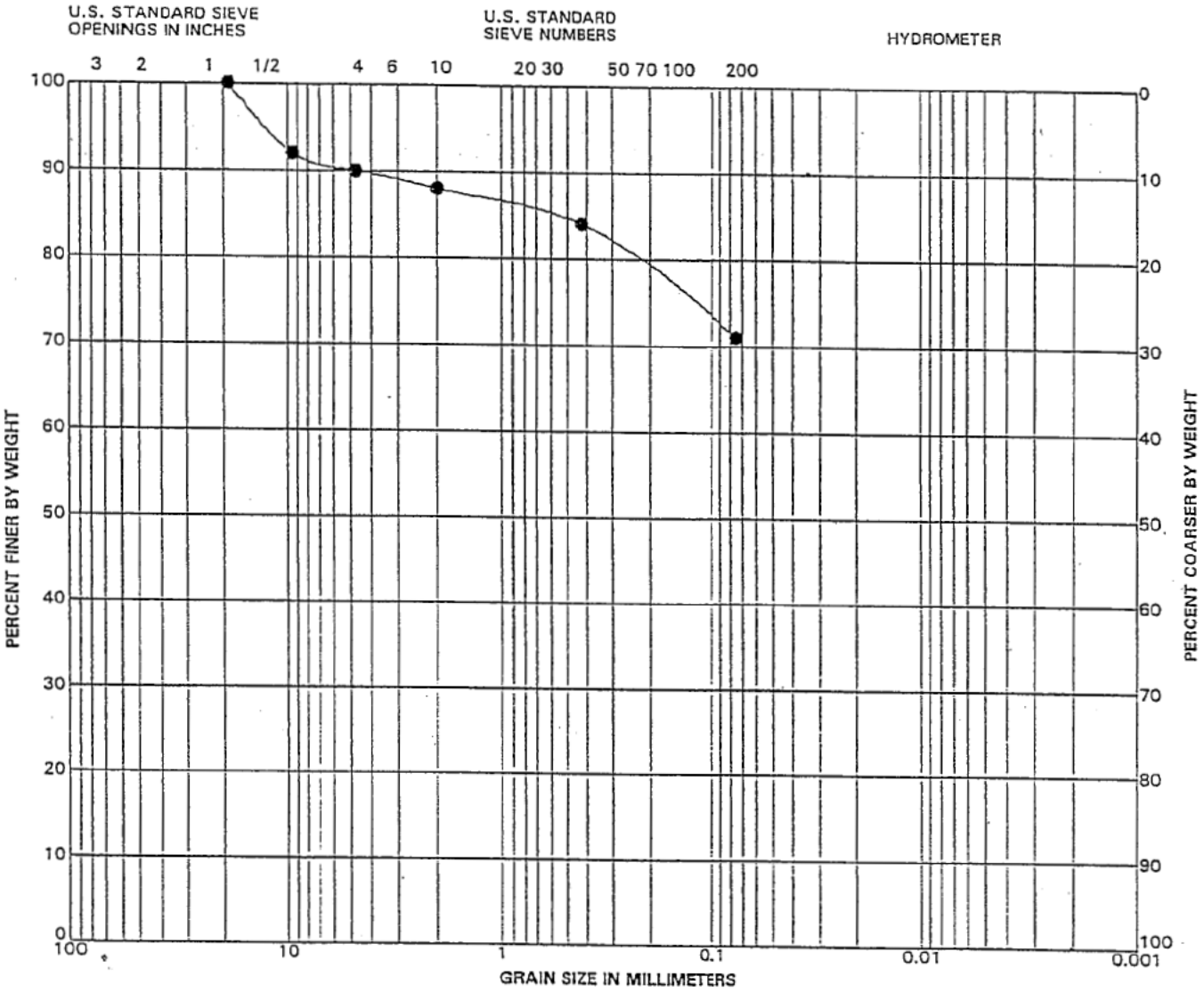
Sample No.: B-5
Sample Depth: 10 to 11 1/2 feet
Moisture Content: 1.4%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

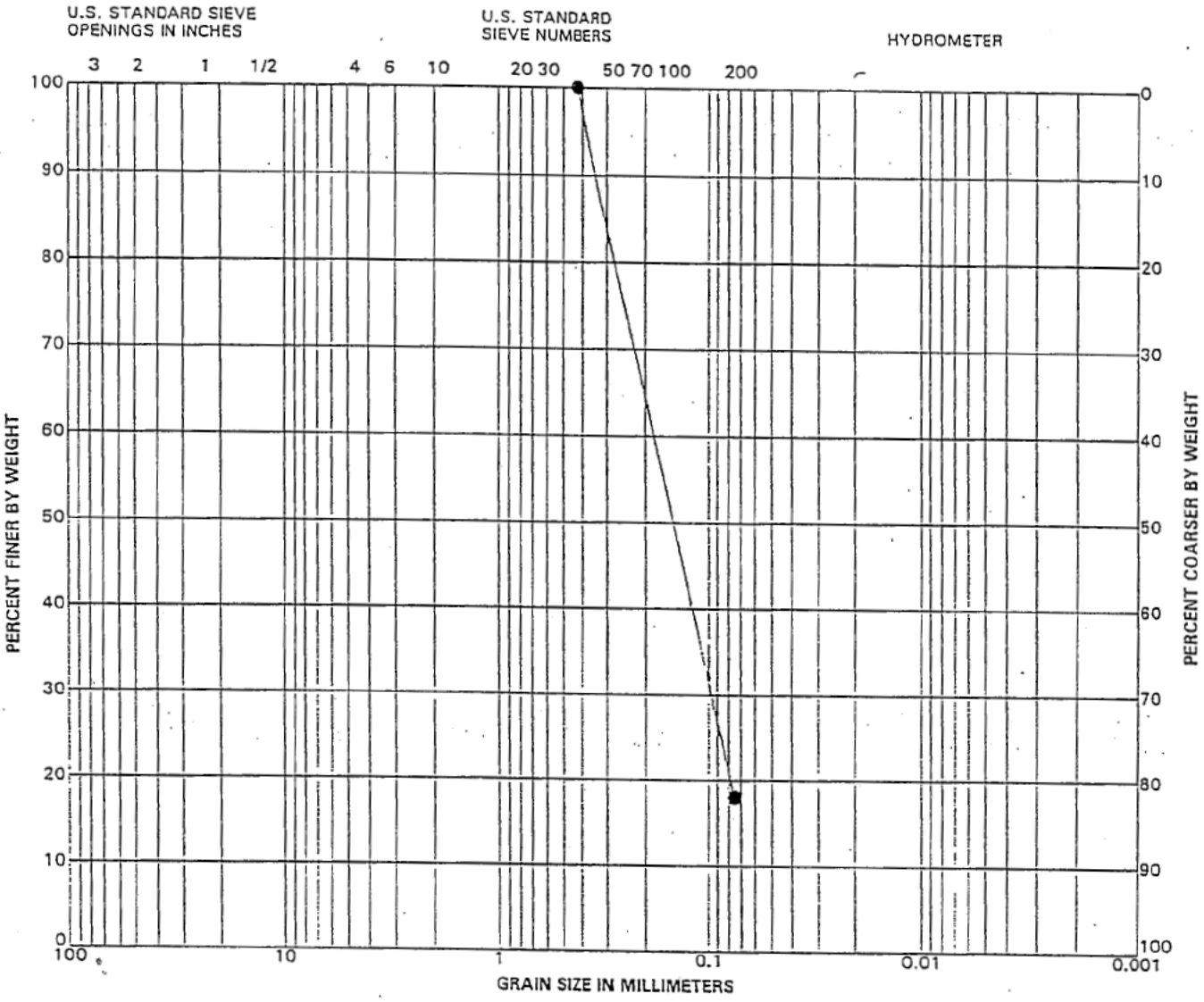
Sample No.:	B-5
Sample Depth:	60 to 61 1/2 feet
Moisture Content:	9.8%
Liquid Limit:	85
Plastic Limit:	18
Plasticity Index:	67
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Dry with some gravel
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

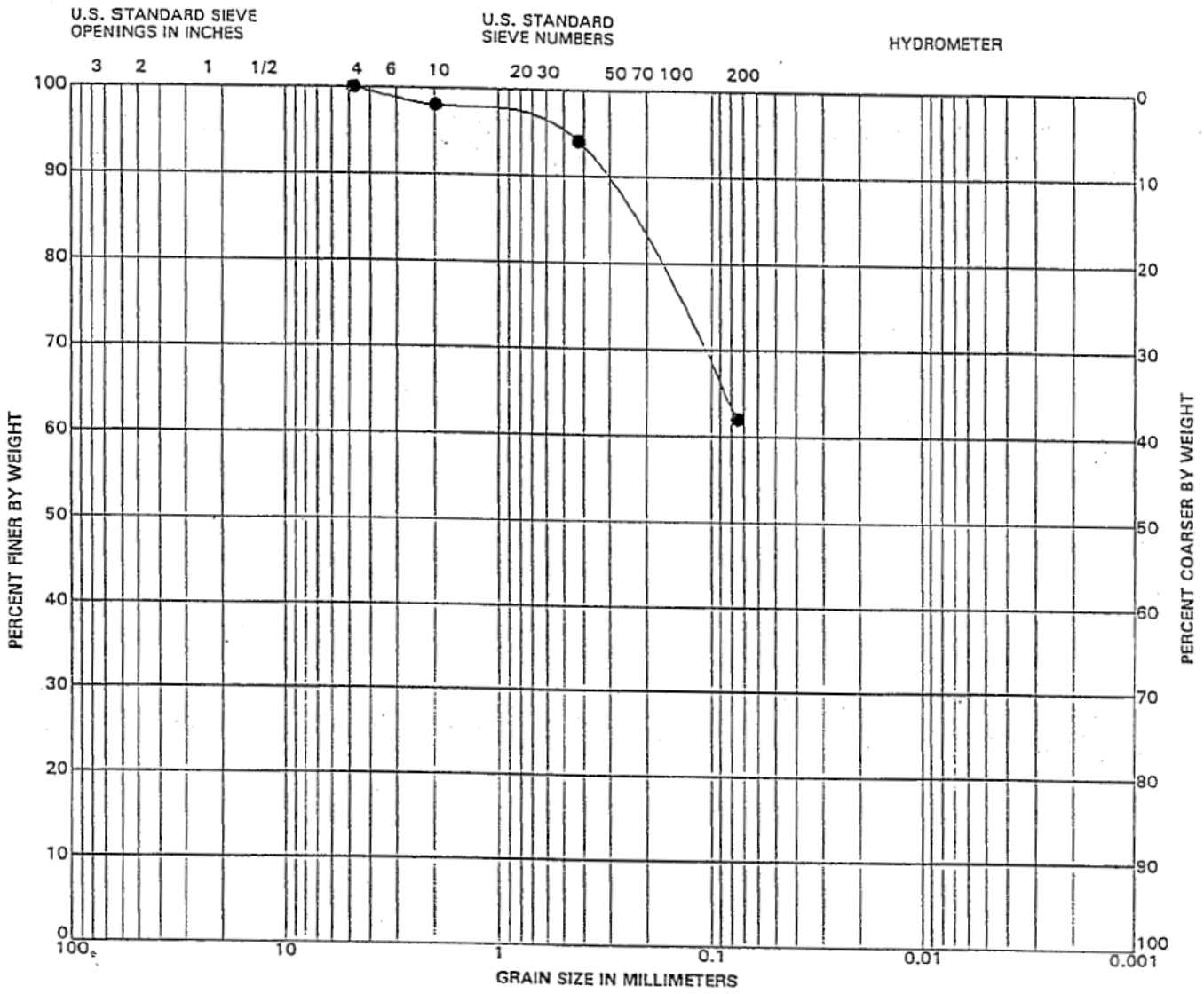
Sample No.:	B-5
Sample Depth:	100 to 101 1/2 feet
Moisture Content:	2.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

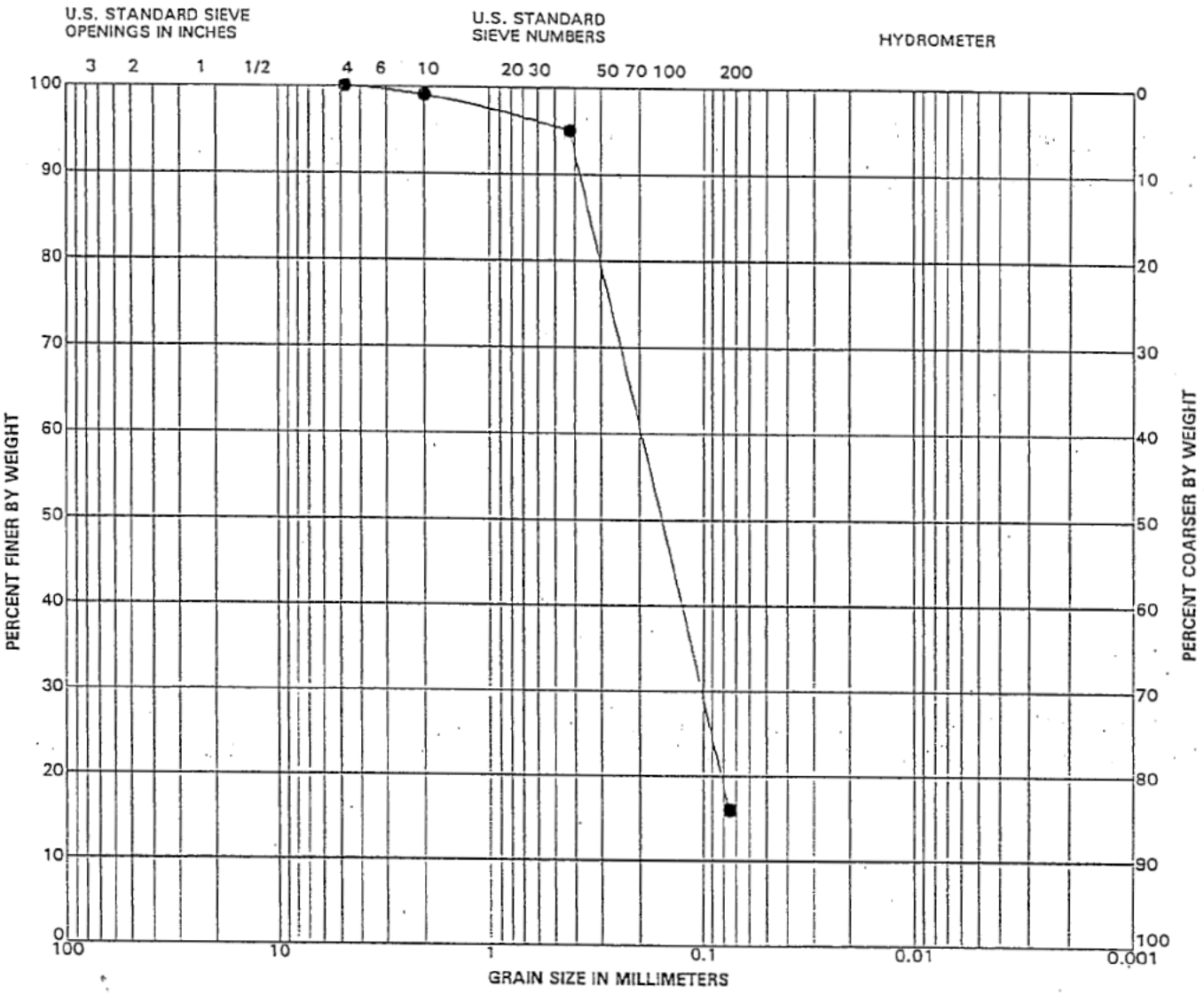
Sample No.:	B-6
Sample Depth:	30 to 31 1/2 feet
Moisture Content:	1.3%
Liquid Limit:	55
Plastic Limit:	16
Plasticity Index:	39
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

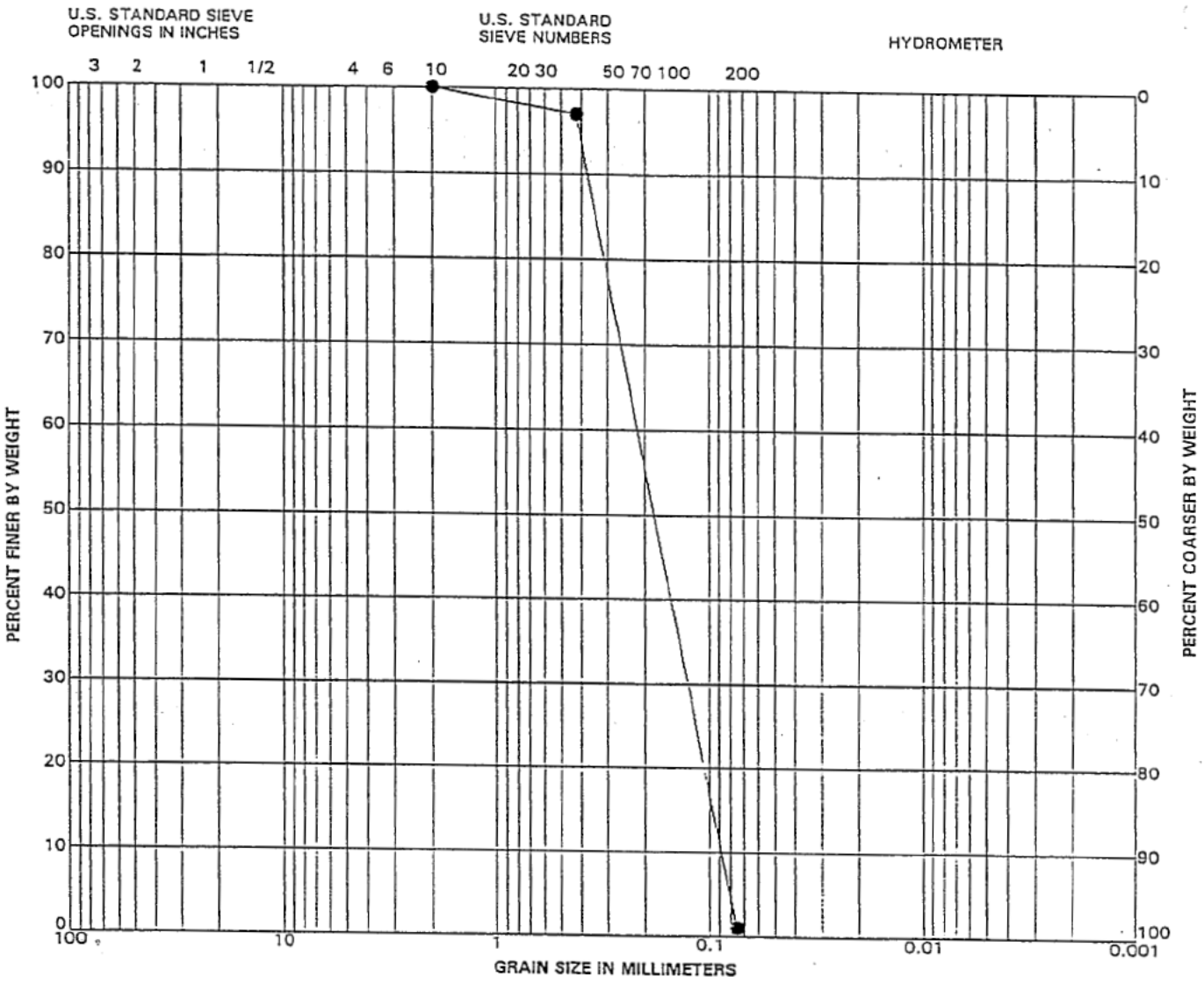
Sample No.:	B-6
Sample Depth:	50 to 51 1/2 feet
Moisture Content:	1.0%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

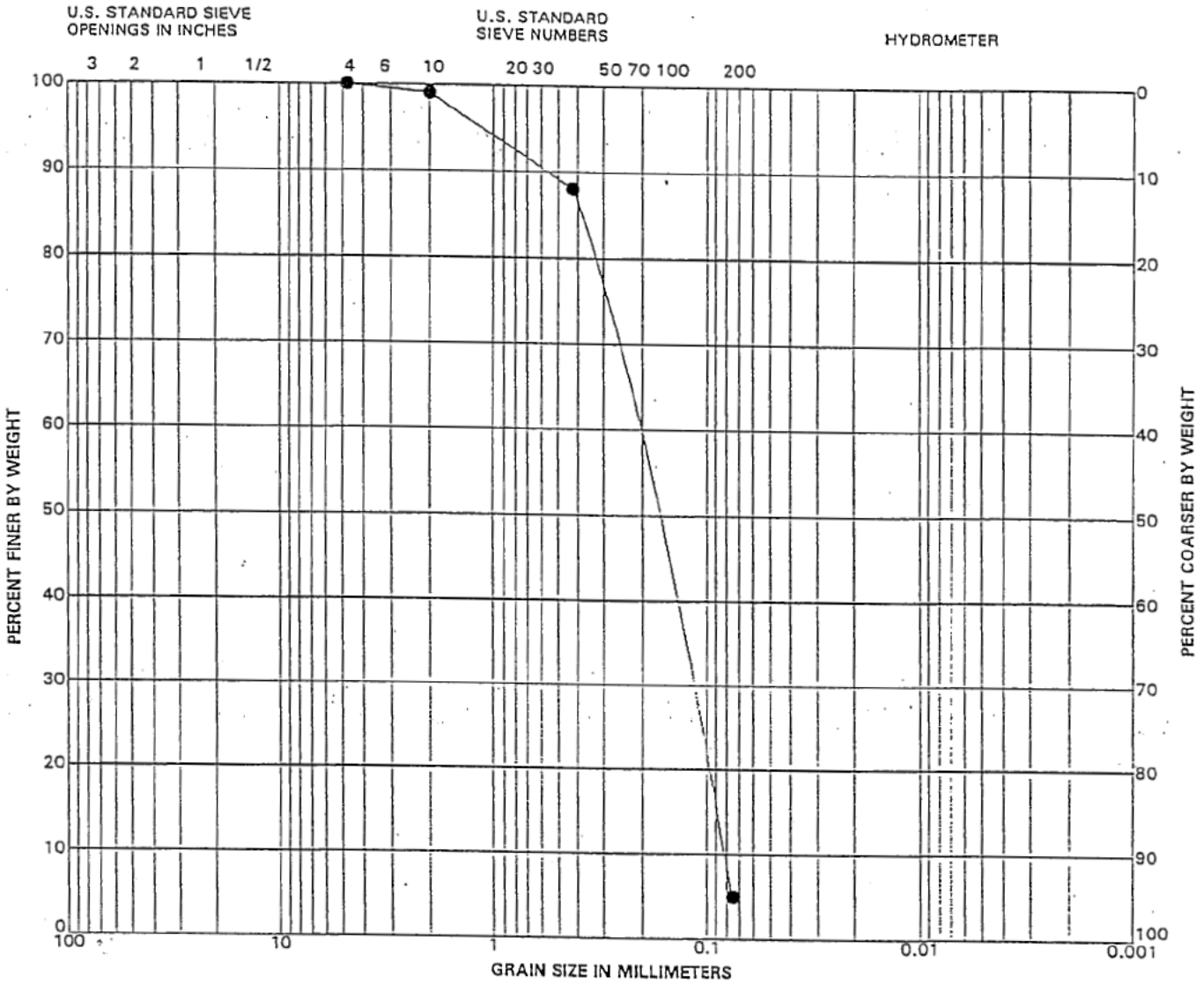
Sample No.: B-6
Sample Depth: 60 to 61 1/2 feet
Moisture Content: 0.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

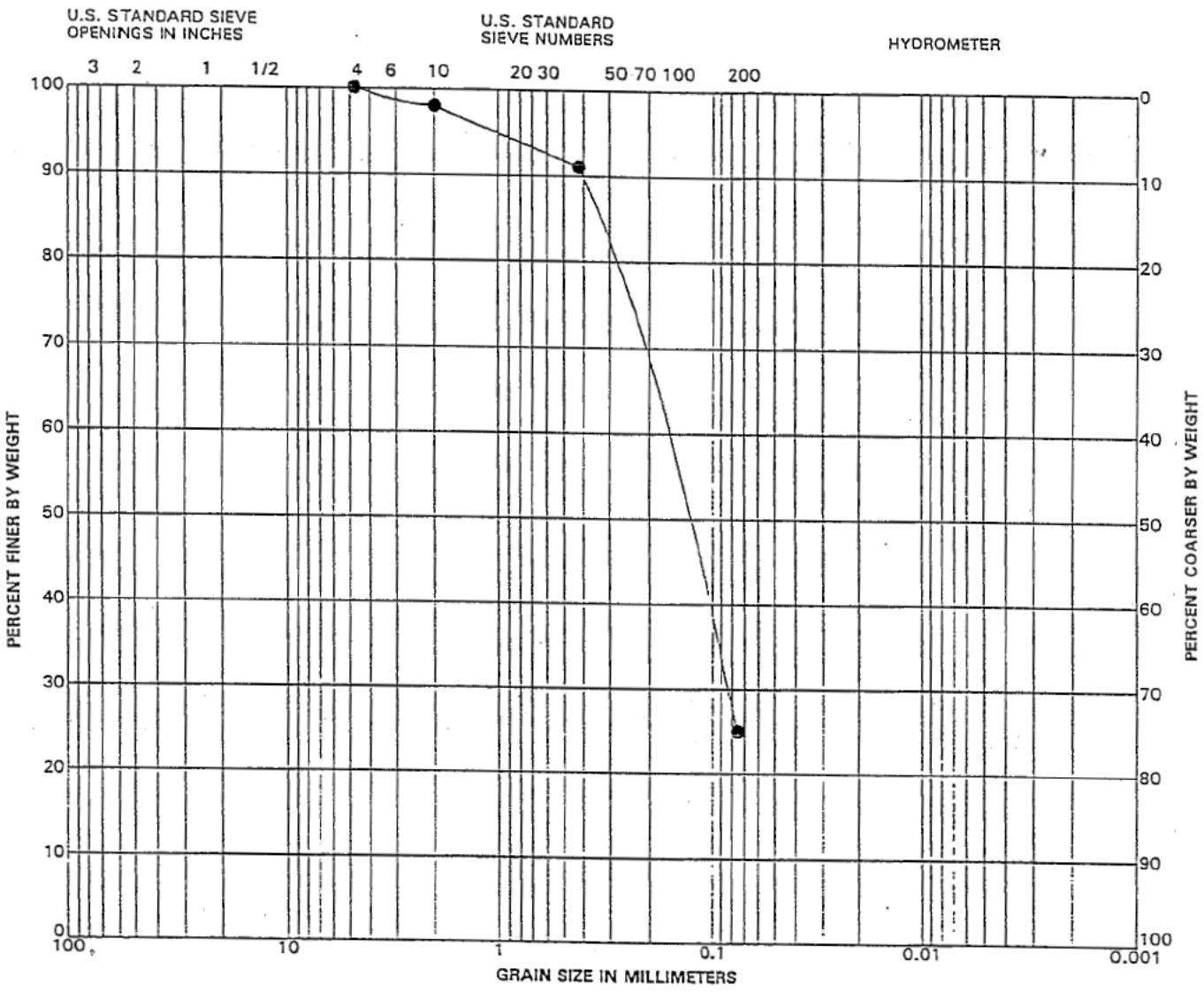
Sample No.:	B-7
Sample Depth:	15 to 16 1/2 feet
Moisture Content:	1.0%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

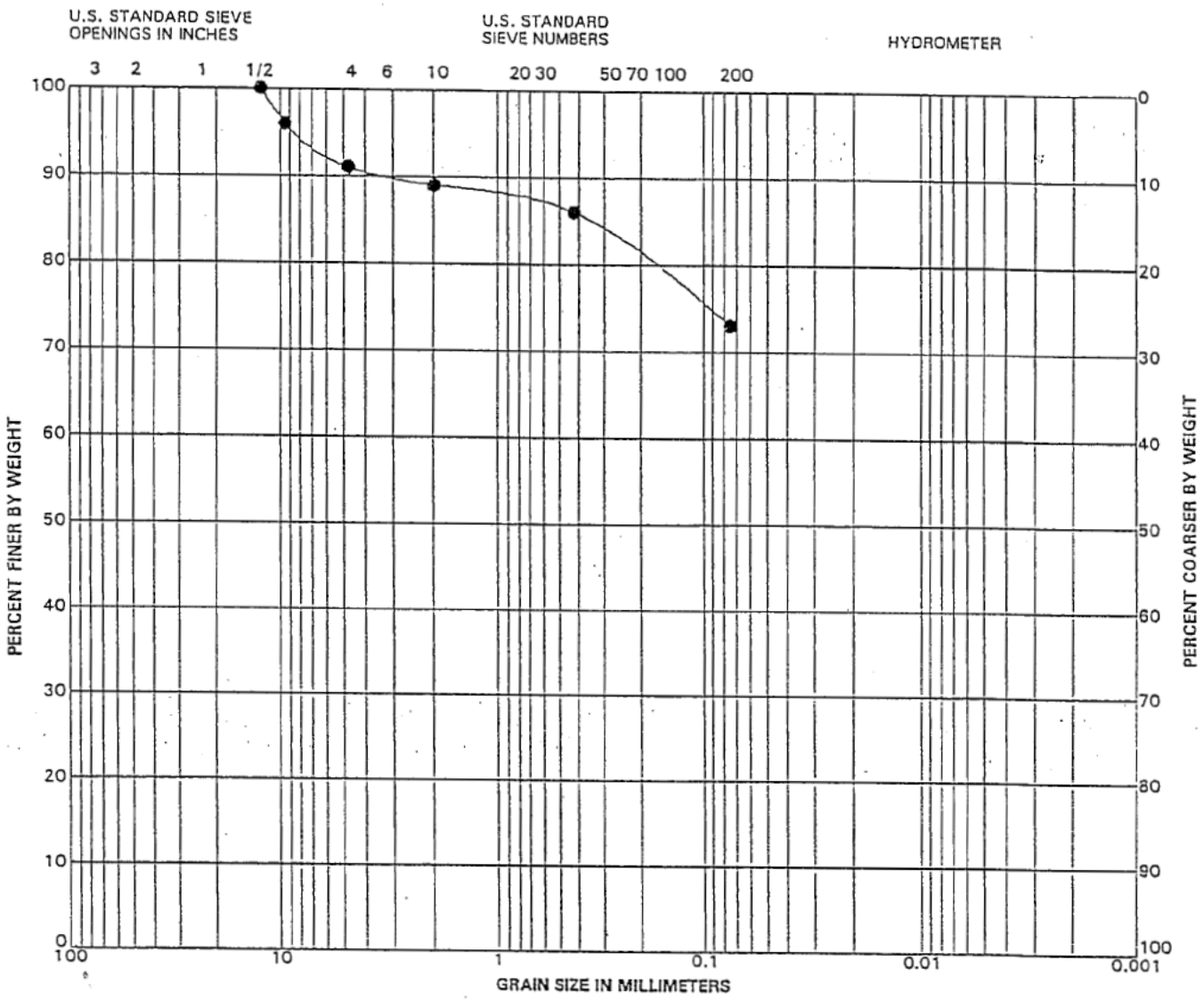
Sample No.: B-7
Sample Depth: 70 to 71 1/2 feet
Moisture Content: 4.3%
Liquid Limit: Not Tested
Plastic Limit: Not Tested
Plasticity Index: Not Tested
Material Classification: -
Material Description: Sand, Fine Grained, Tan, Poorly Ggraded, Dense, Dry with silt and clay
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

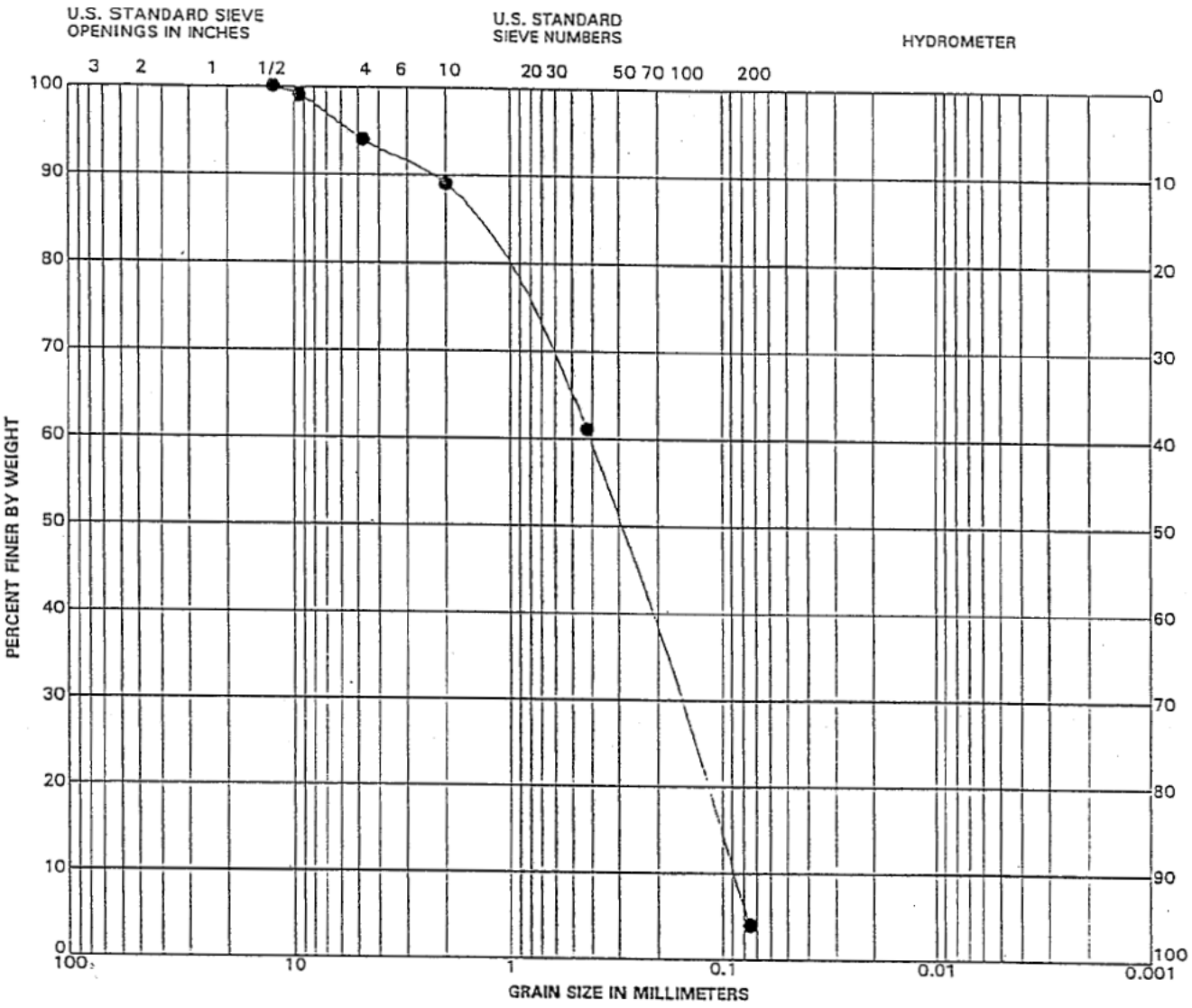
Sample No.:	B-8
Sample Depth:	10 to 11 1/2 feet
Moisture Content:	4.1%
Liquid Limit:	27
Plastic Limit:	14
Plasticity Index:	13
Material Classification:	CL
Material Description:	Clay, Sandy, Brown, Vary Stiff, Dry with some gravel
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

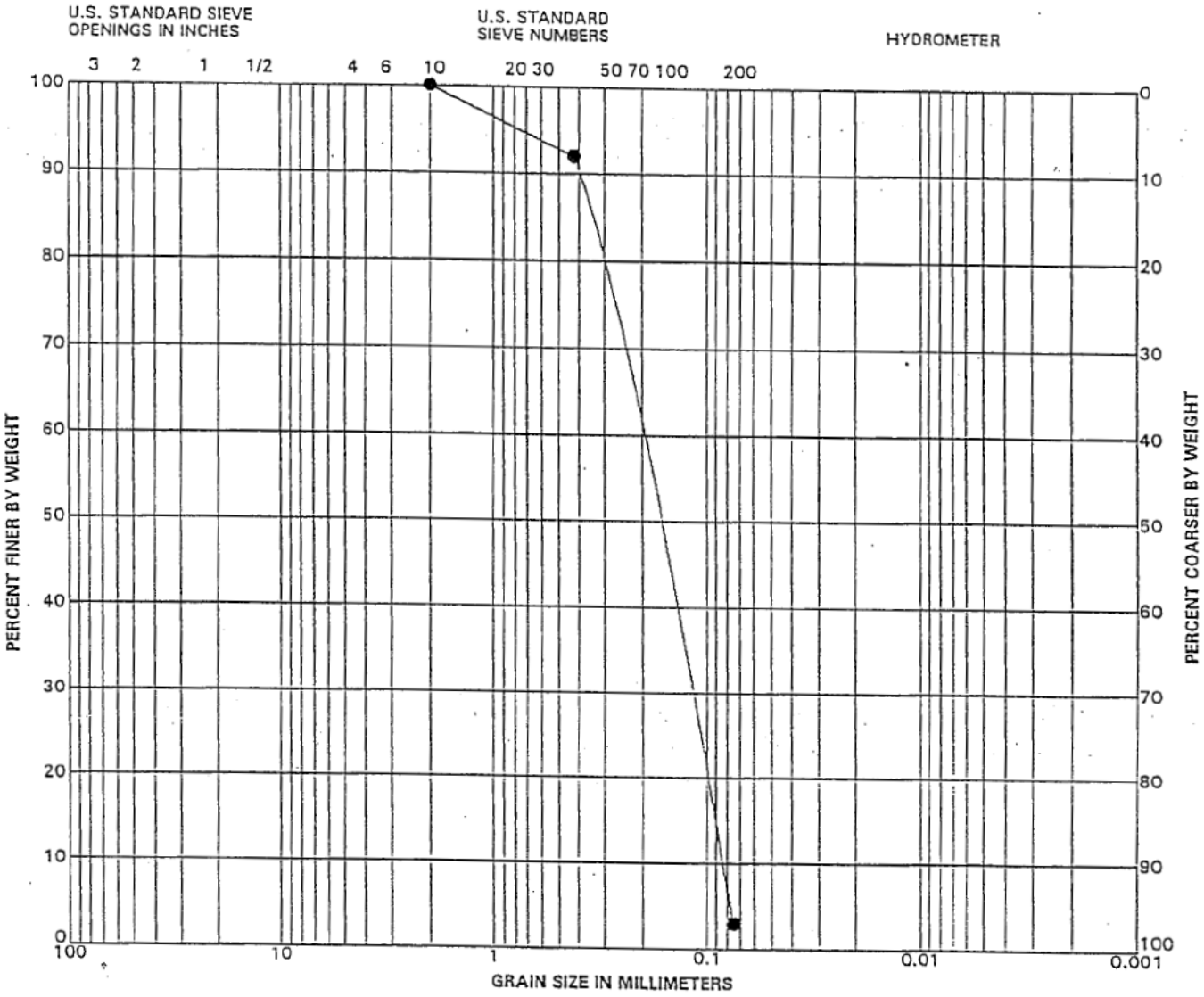
Sample No.:	B-8
Sample Depth:	25 to 26 1/2 feet
Moisture Content:	0.4%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Dense, Dry w/ gravel
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

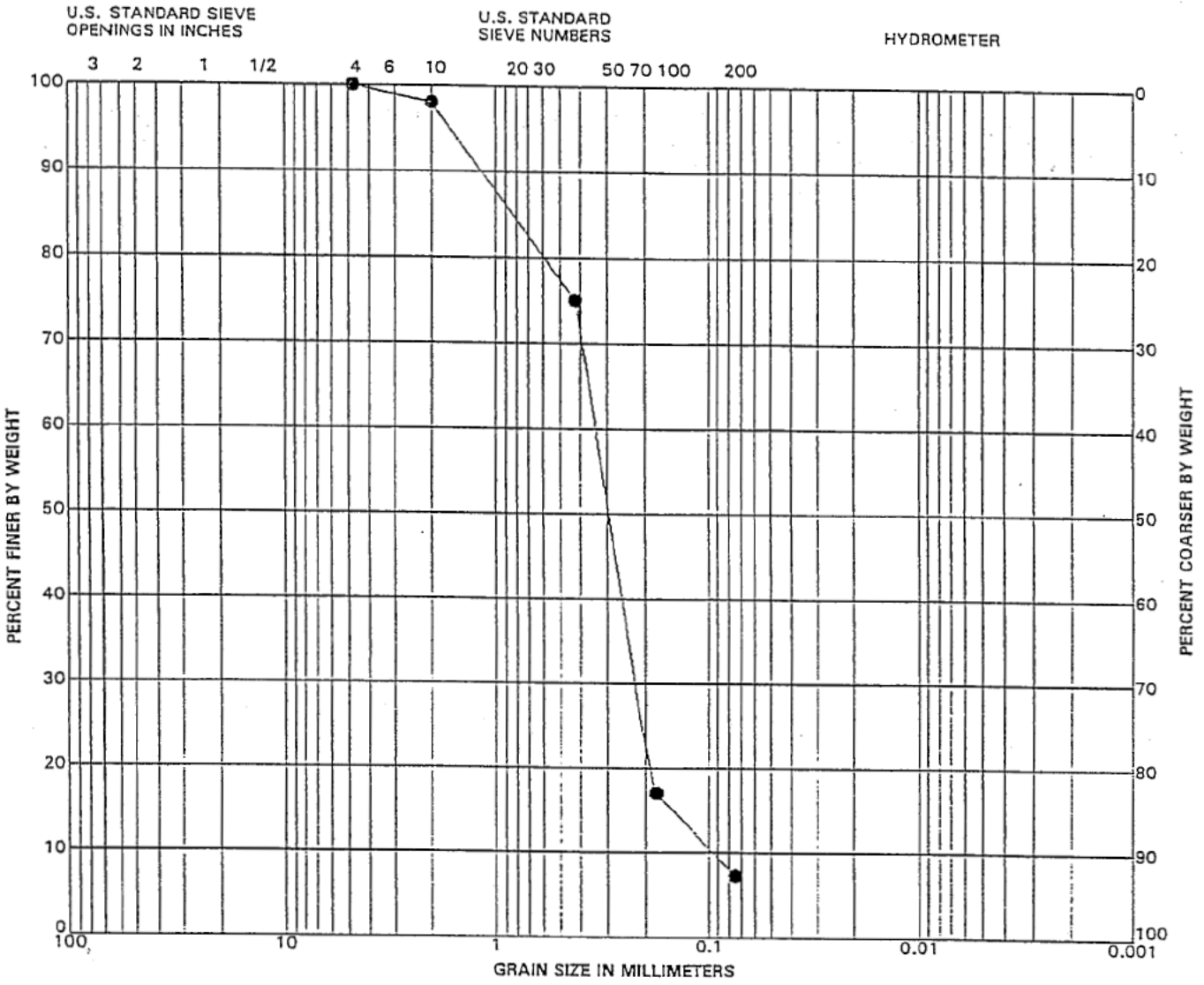
Sample No.: B-8
Sample Depth: 40 to 41 1/2 feet
Moisture Content: 0.6%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

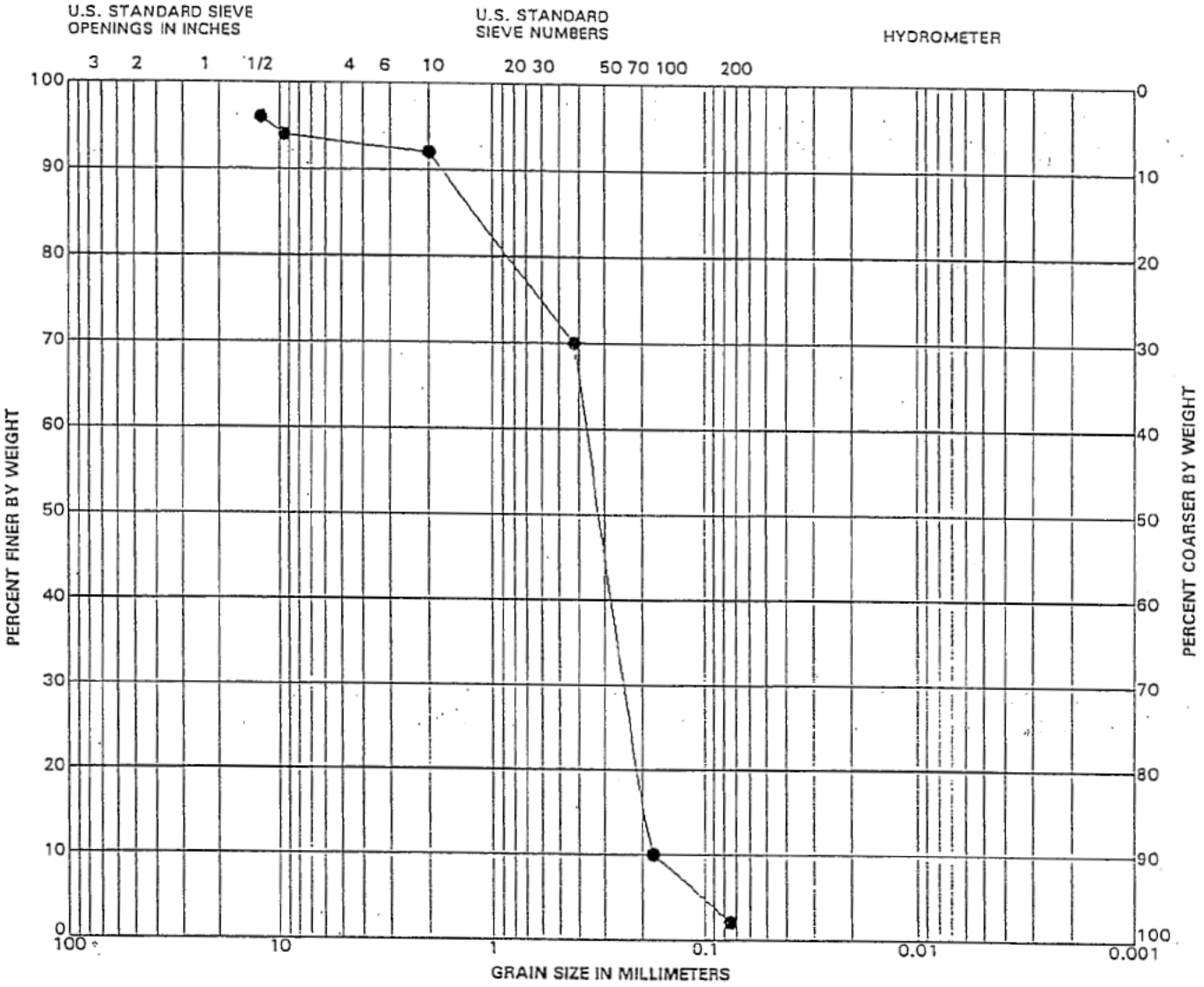
Sample No.: B-9
Sample Depth: 10 to 11 1/2 feet
Moisture Content: 1.4%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.: B-9
Sample Depth: 45 to 46 1/2 feet
Moisture Content: 0.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

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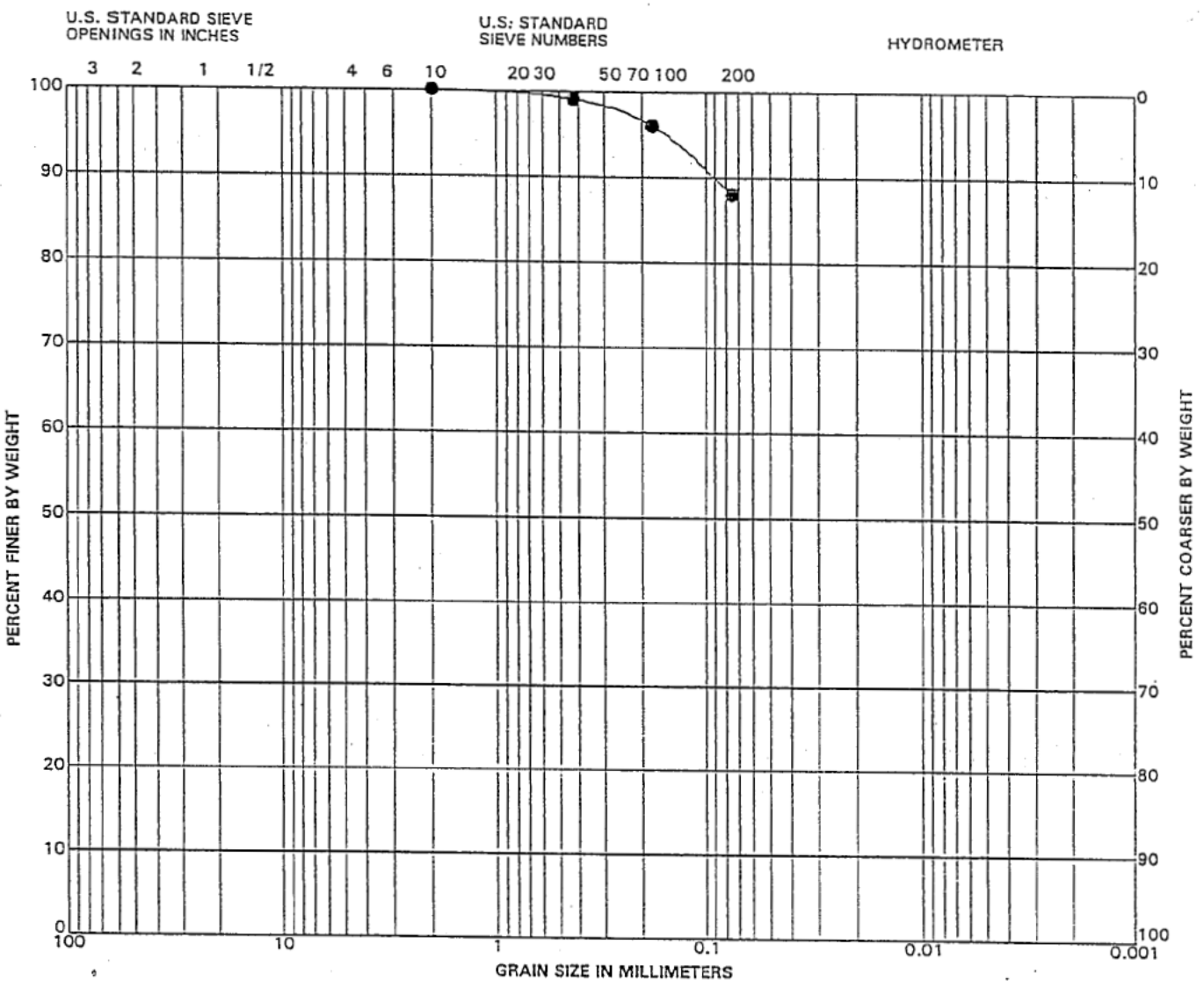
Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

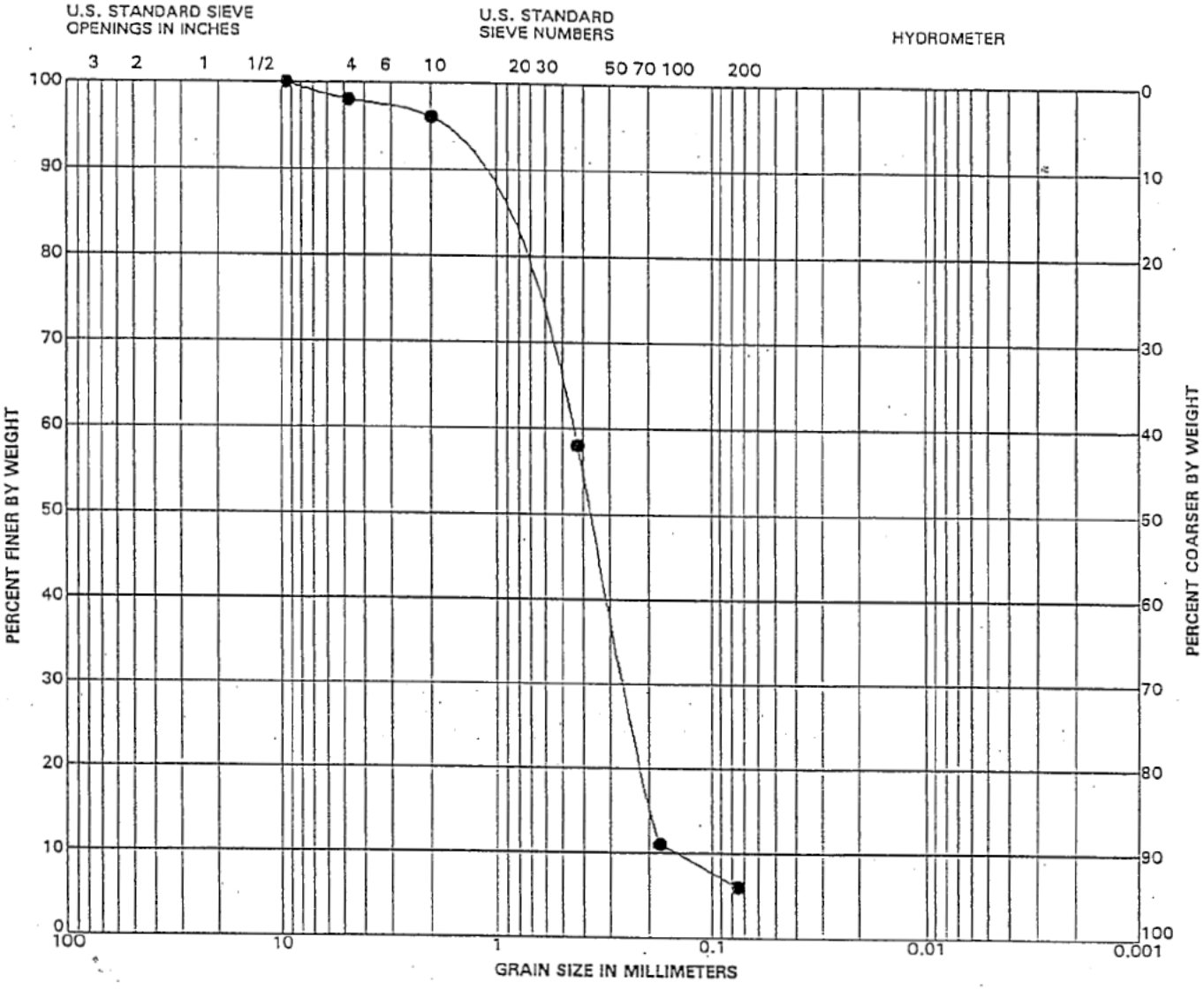
Sample No.: B-9
Sample Depth: 70 to 71 1/2 feet
Moisture Content: Not Tested
Liquid Limit: Not Tested
Plastic Limit: Not Tested
Plasticity Index: Not Tested
Material Classification:
Material Description: Clay, Brown, Hard, Dry with sand
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

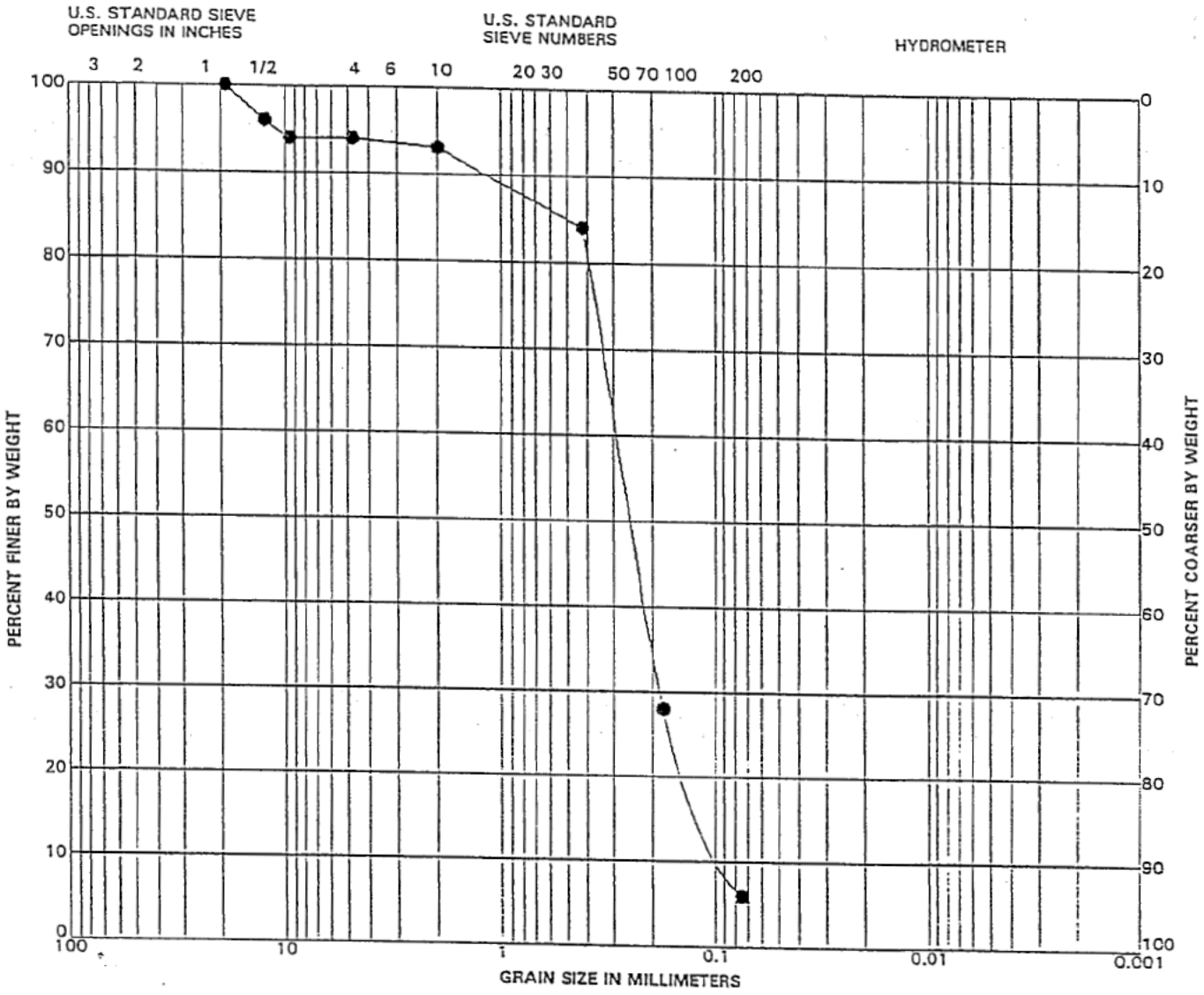
Sample No.: B-10
Sample Depth: 15 to 16 1/2 feet
Moisture Content: 1.7%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine to Medium Grained, Tan, Poorly Graded, Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

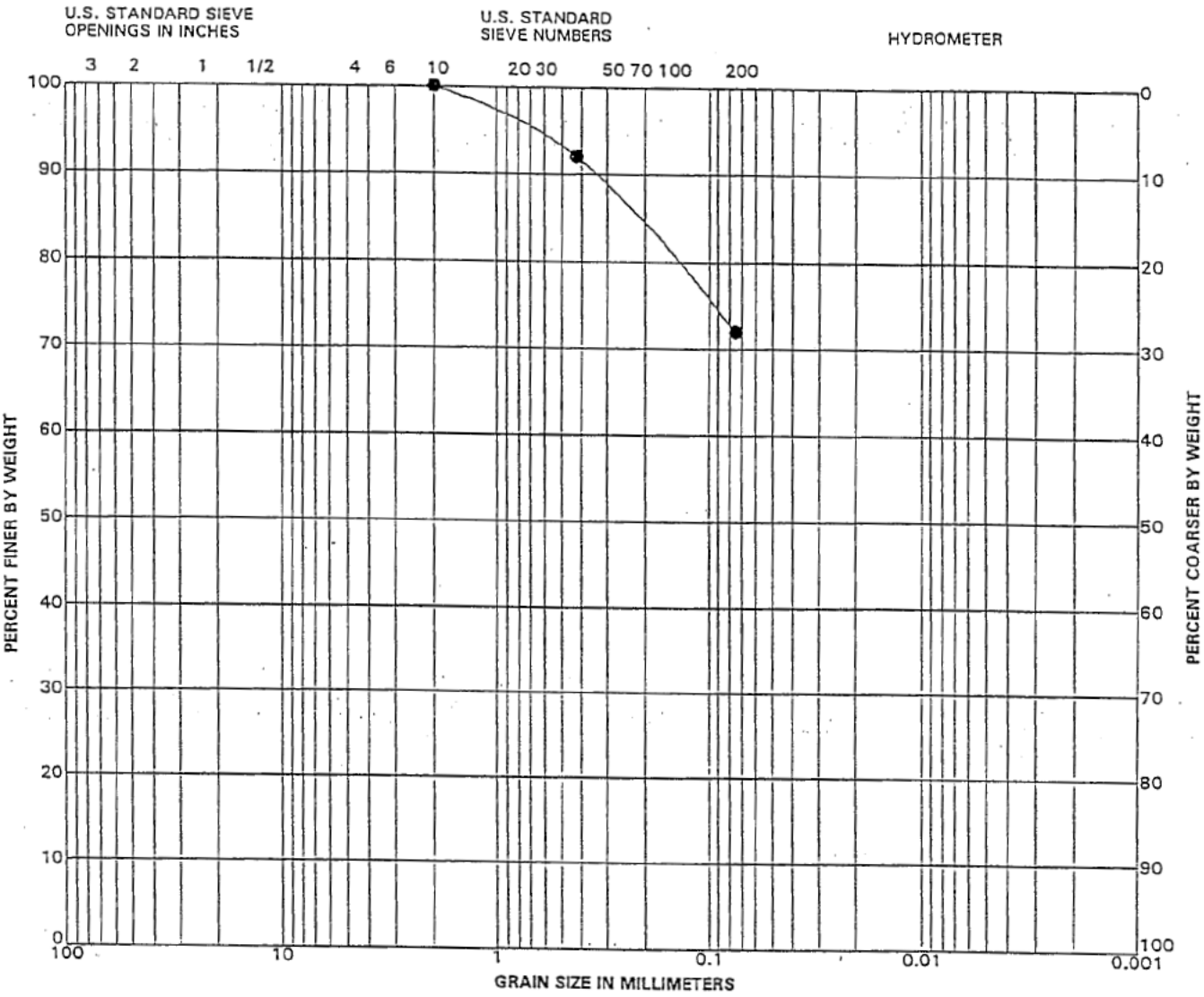
Sample No.: B-10
Sample Depth: 40 to 41 1/2 feet
Moisture Content: 1.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry w/sil
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

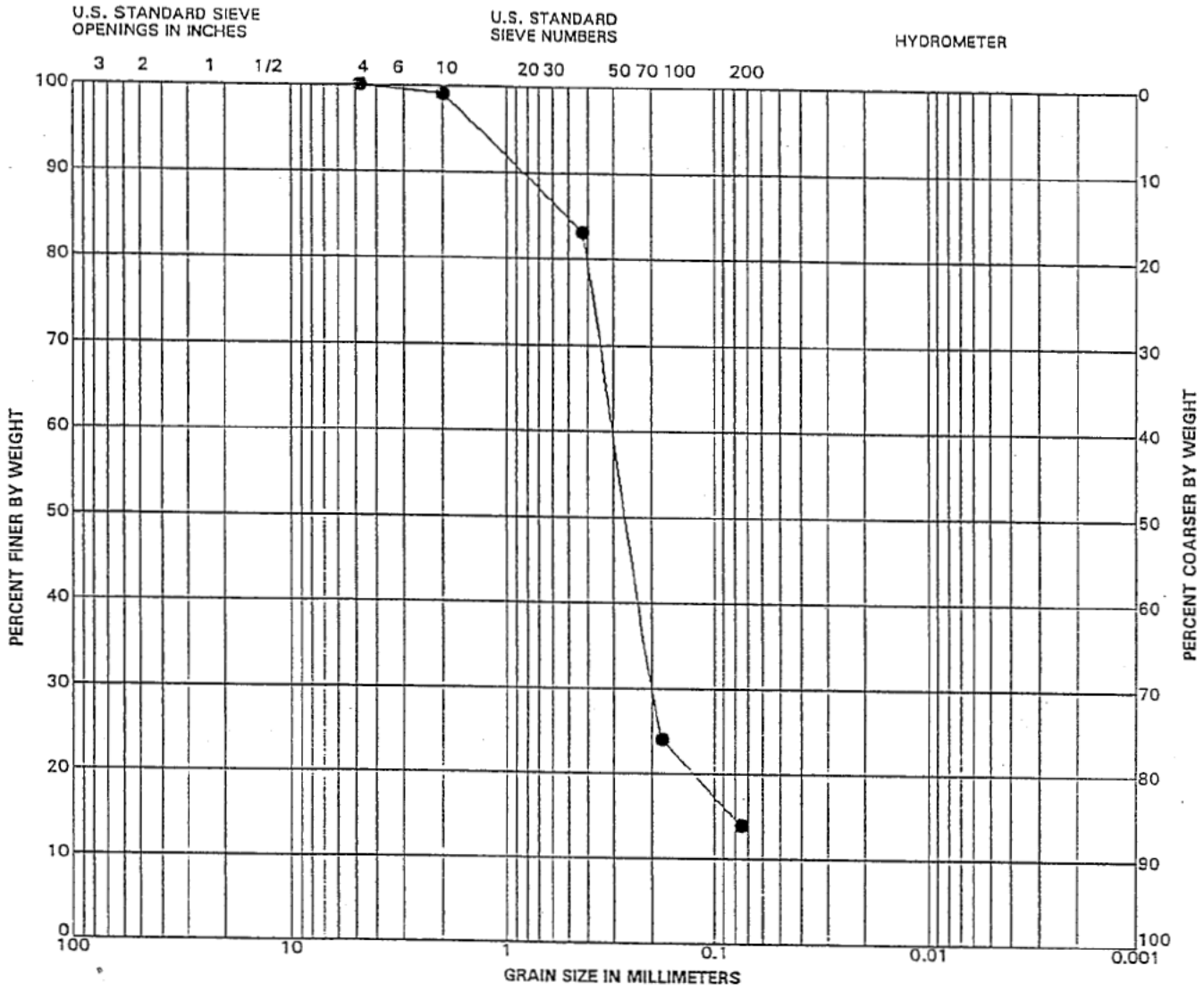
Sample No.: B-10
Sample Depth: 65 to 66 1/2 feet
Moisture Content: 26.7%
Liquid Limit: Not Tested
Plastic Limit: Not Tested
Plasticity Index: Not Tested
Material Classification:
Material Description: Clay, Sandy, Brown, Hard, Moist
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

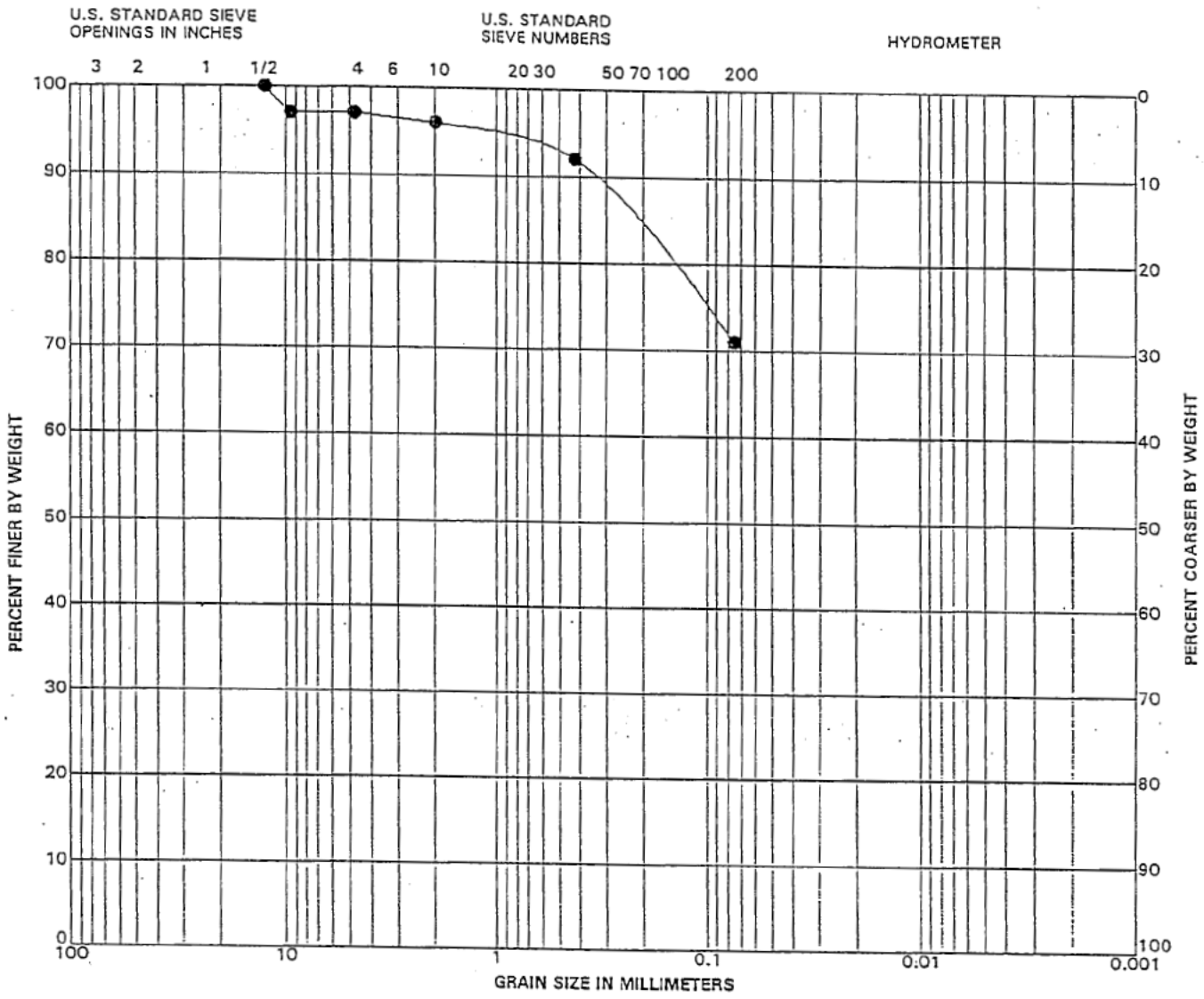
Sample No.: B-10
Sample Depth: 85 to 86 1/2 feet
Moisture Content: 4.5%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SM
Material Description: Sand, Fine Grained, Silty, Tan, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-0

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

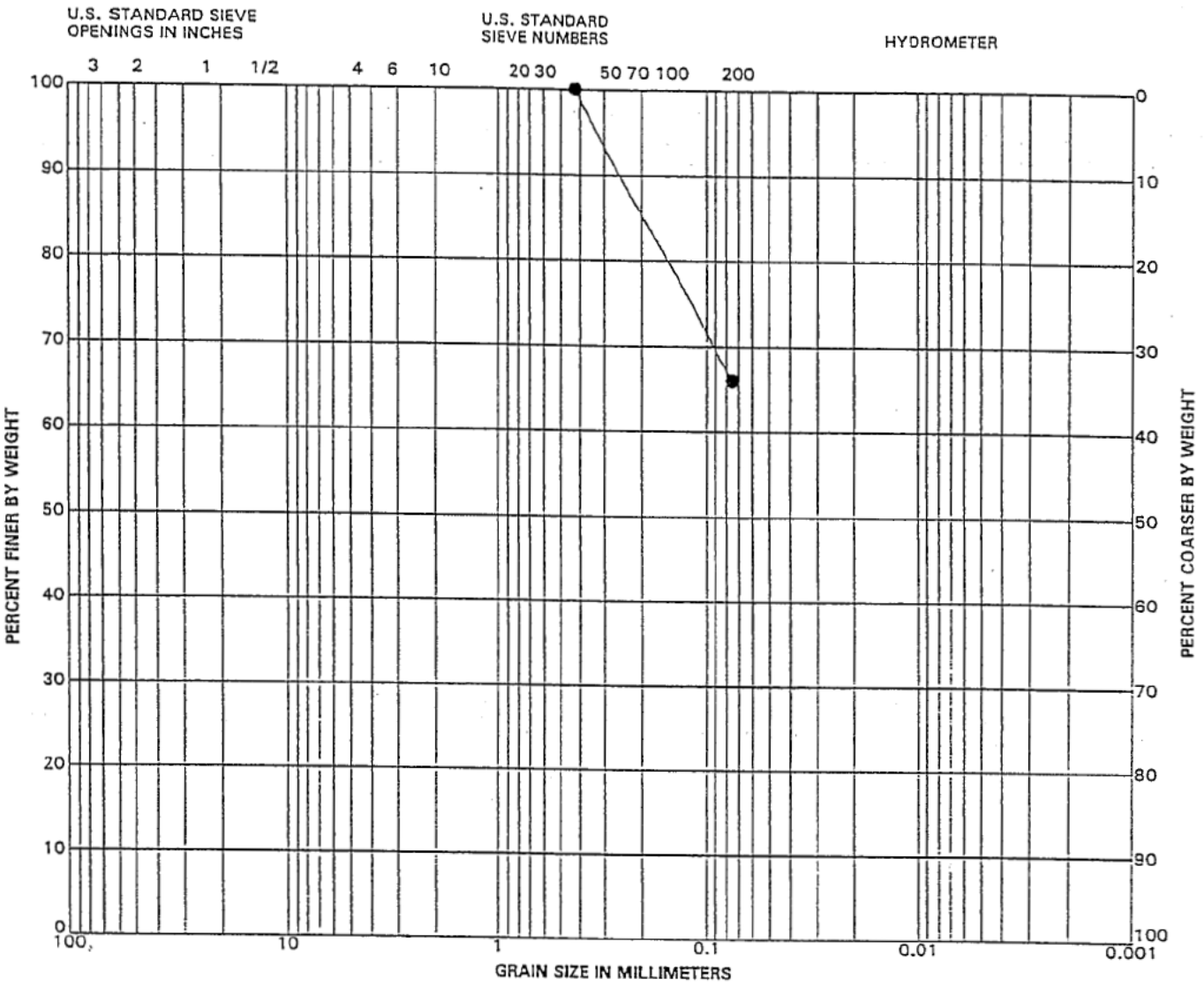
Sample No.: B-11
Sample Depth: 80 to 81 1/2 feet
Moisture Content: 18.3%
Liquid Limit: 88
Plastic Limit: 22
Plasticity Index: 66
Material Classification: CH
Material Description: Clay, Sandy, Brown, Hard, Moist
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

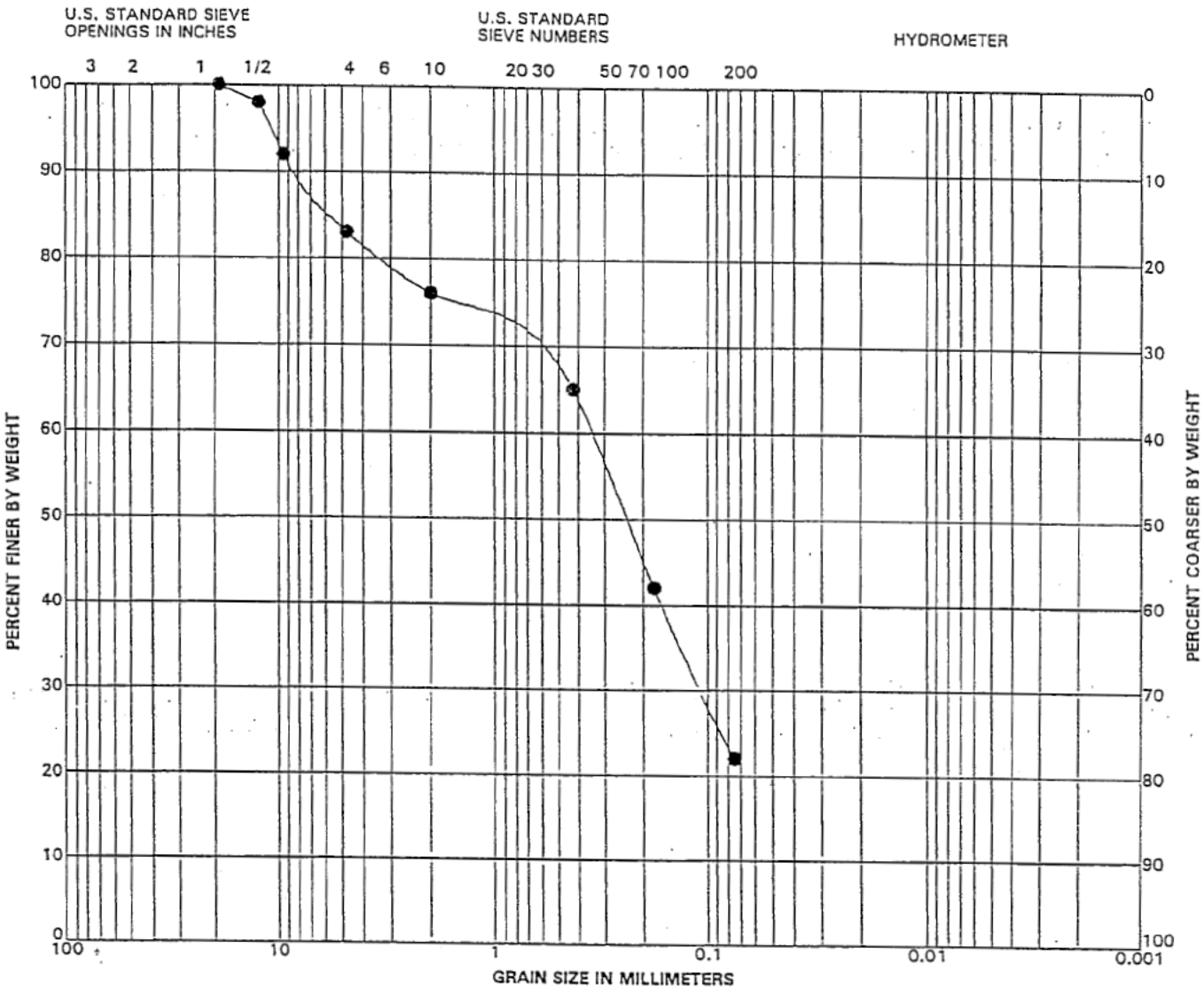
Sample No.:	B-11
Sample Depth:	110 to 111 1/2 feet
Moisture Content:	6.7%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Clay, Sandy, Brown, Hard, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

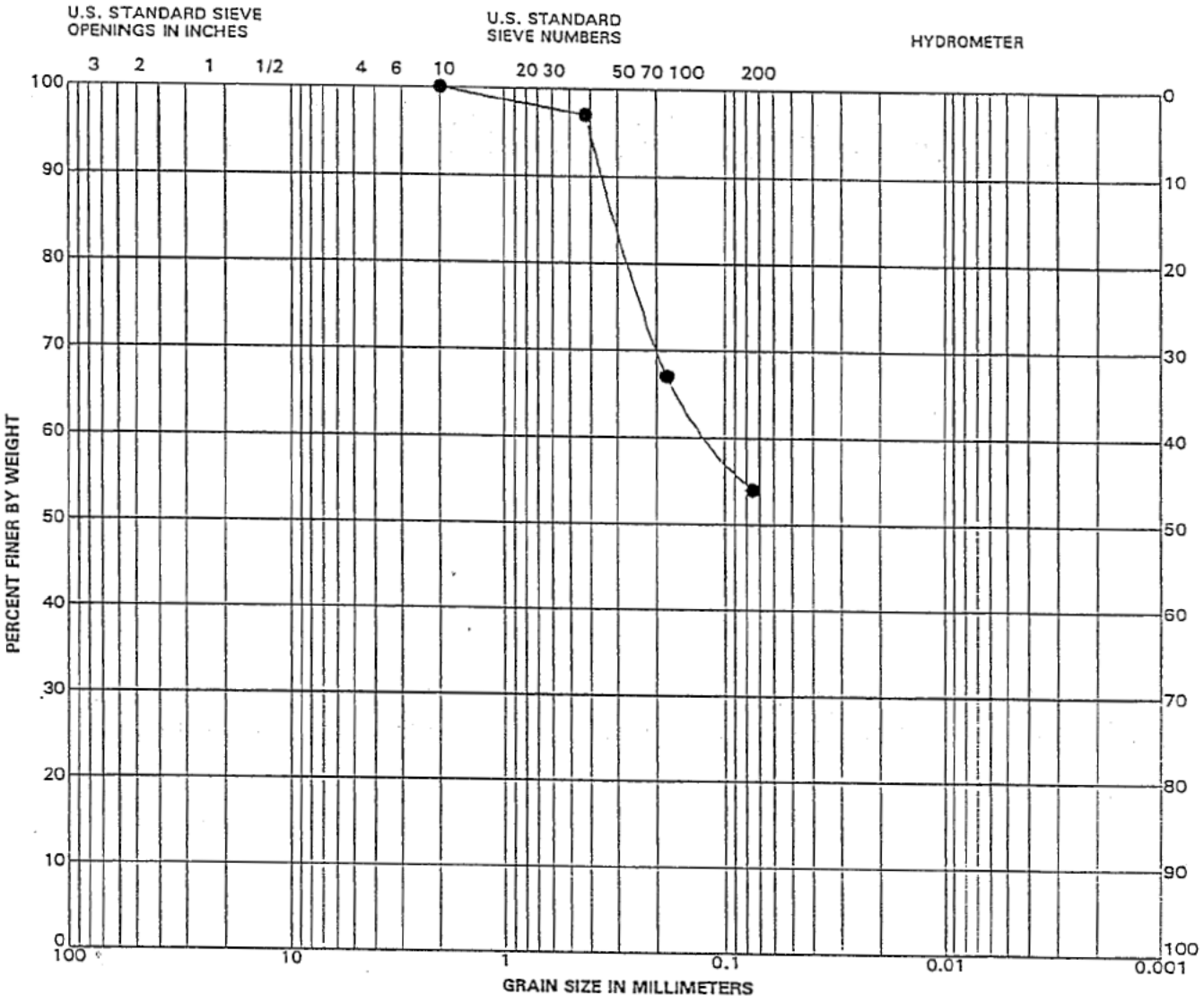
Sample No.:	B-12
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	4.8%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Medium Dense, Dry with gravel
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

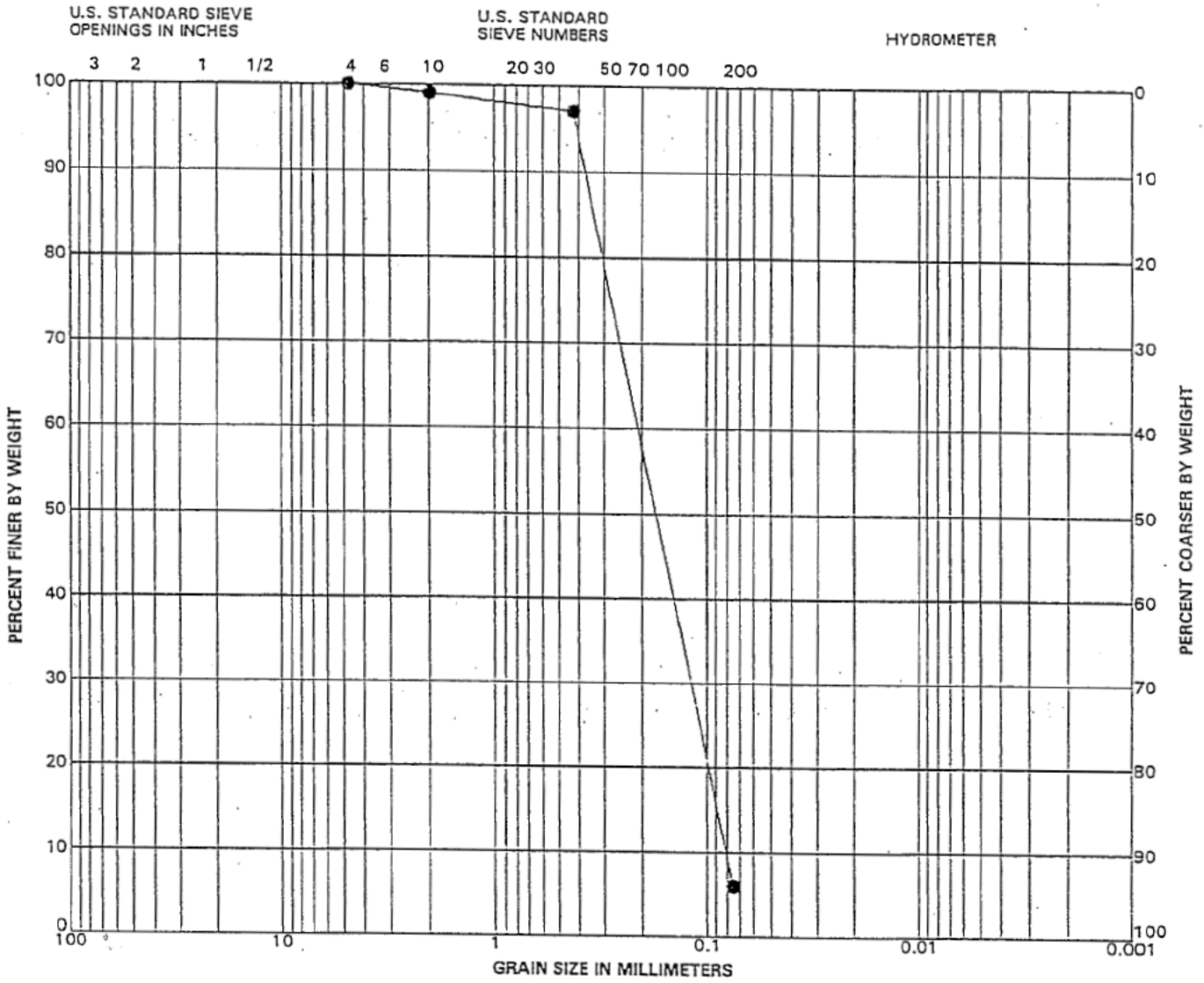
Sample No.:	B-12
Sample Depth:	90 to 91 1/2 feet
Moisture Content:	15.0%
Liquid Limit:	91
Plastic Limit:	18
Plasticity Index:	73
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

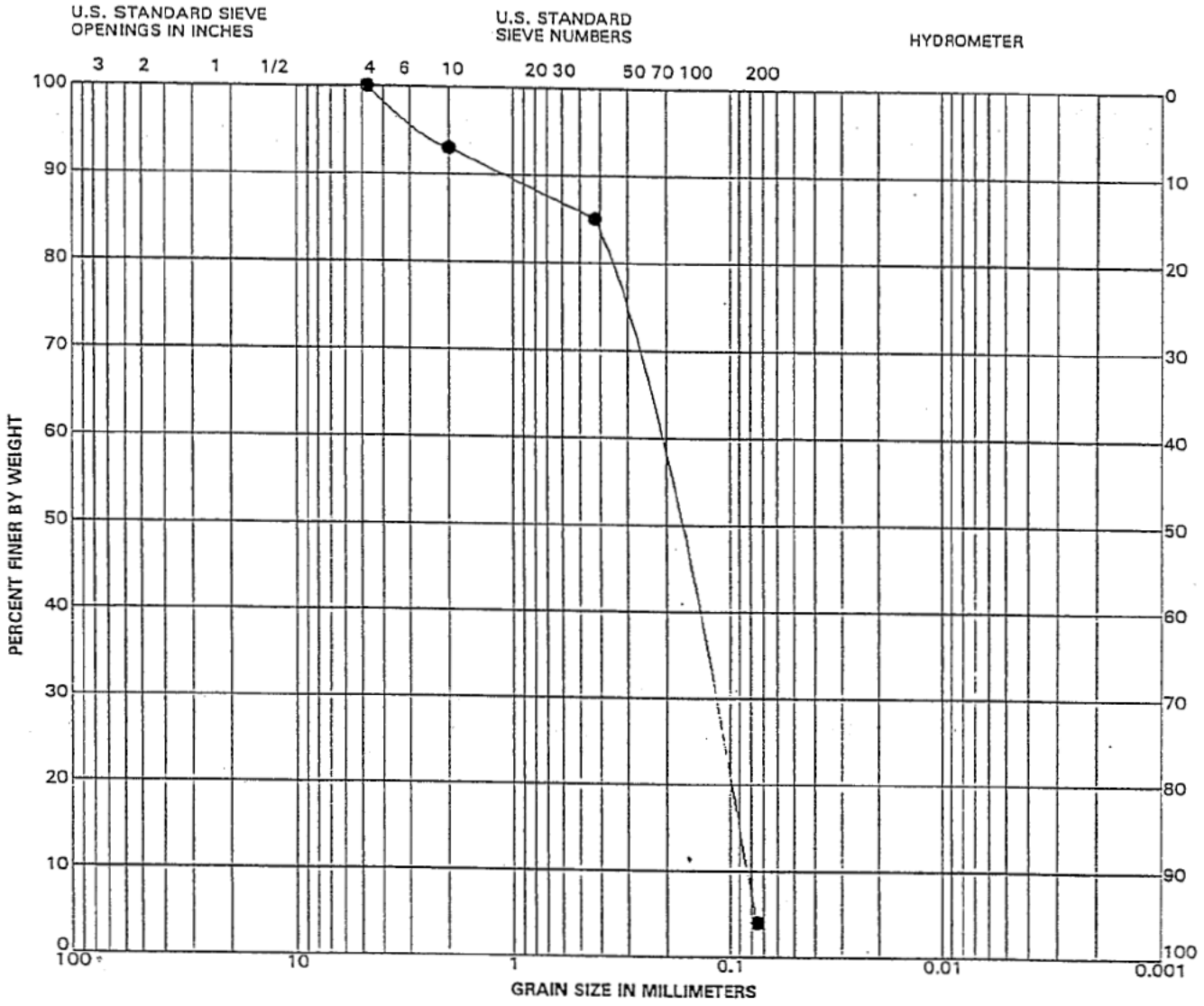
Sample No.:	B-13
Sample Depth:	50 to 51 1/2 feet
Moisture Content:	1.5%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

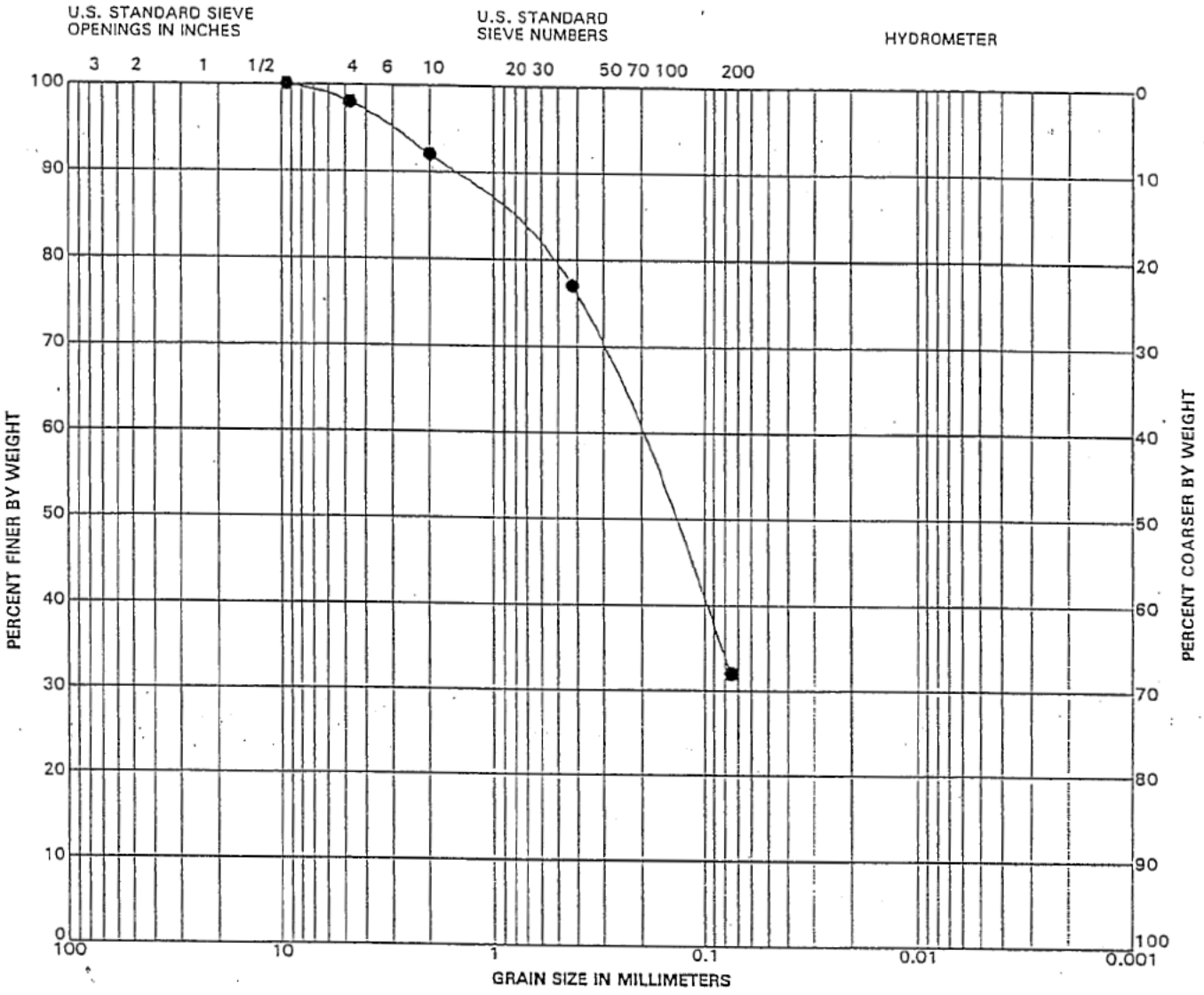
Sample No.:	B-13
Sample Depth:	120 to 121 1/2 feet
Moisture Content:	0.9%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

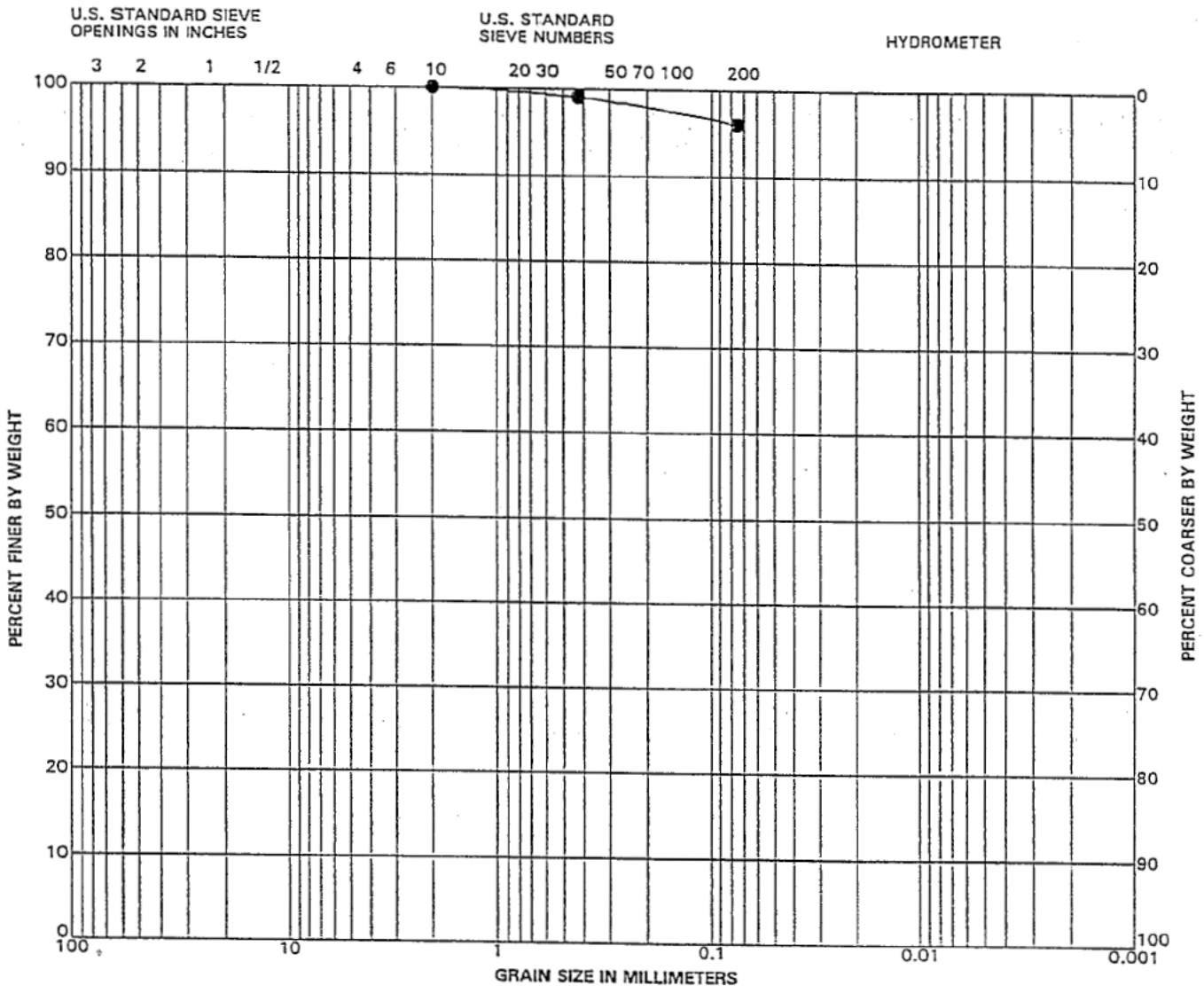
Sample No.:	B-14
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	10.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Medium Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

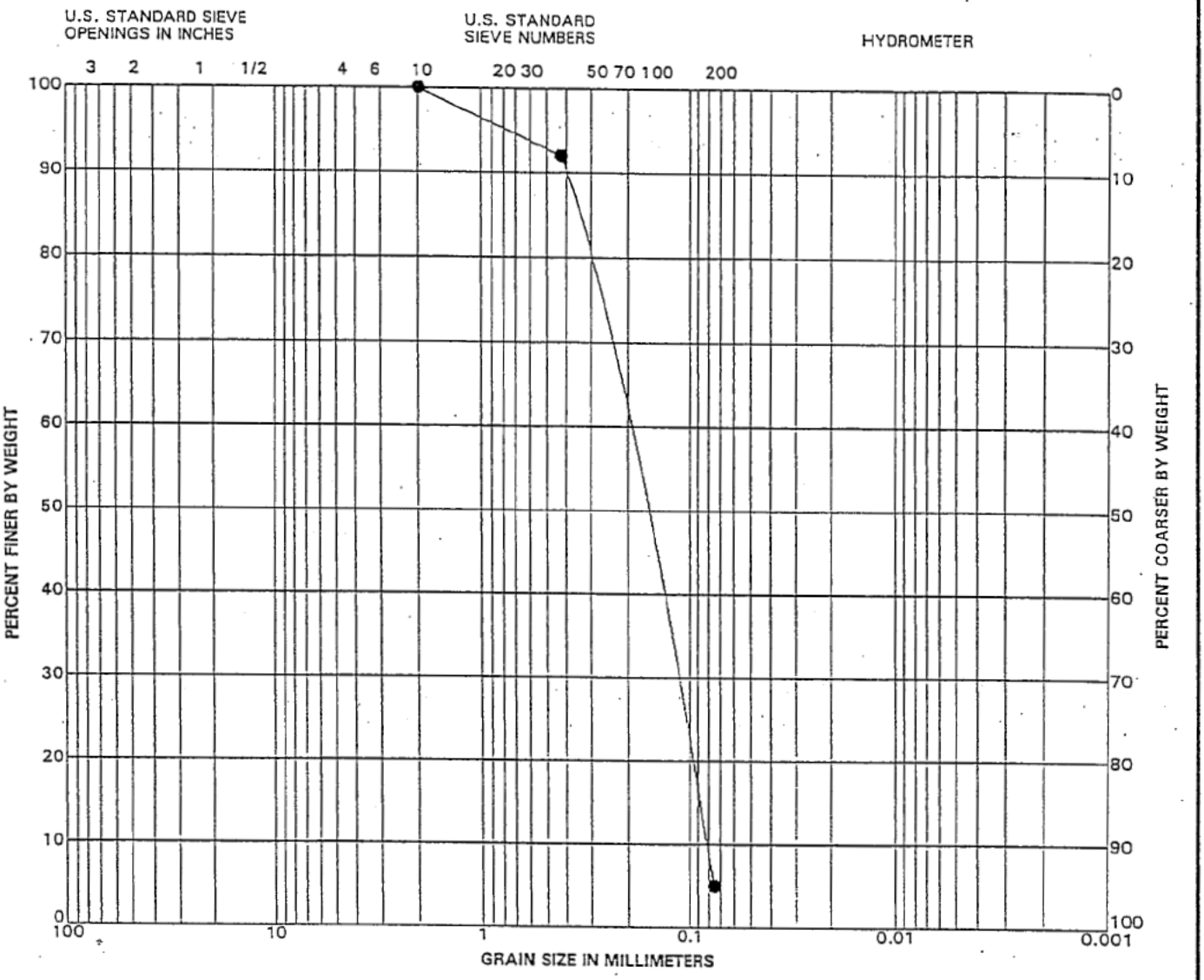
Sample No.:	B-14
Sample Depth:	70 to 71 1/2 feet
Moisture Content:	2.1%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Clay, Brown, Hard, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

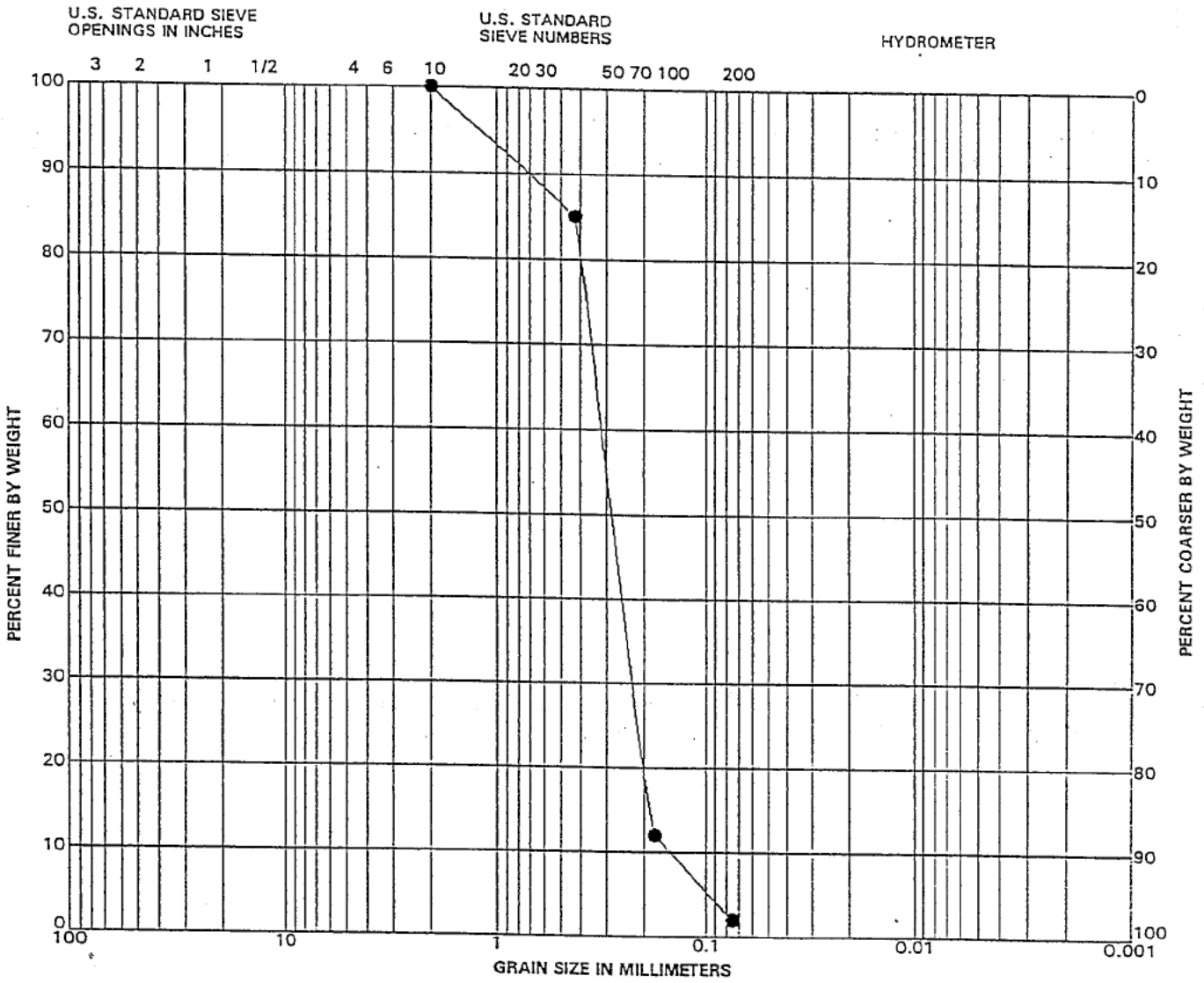
Sample No.: B-14
Sample Depth: 95 to 96 1/2 feet
Moisture Content: 6.3%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

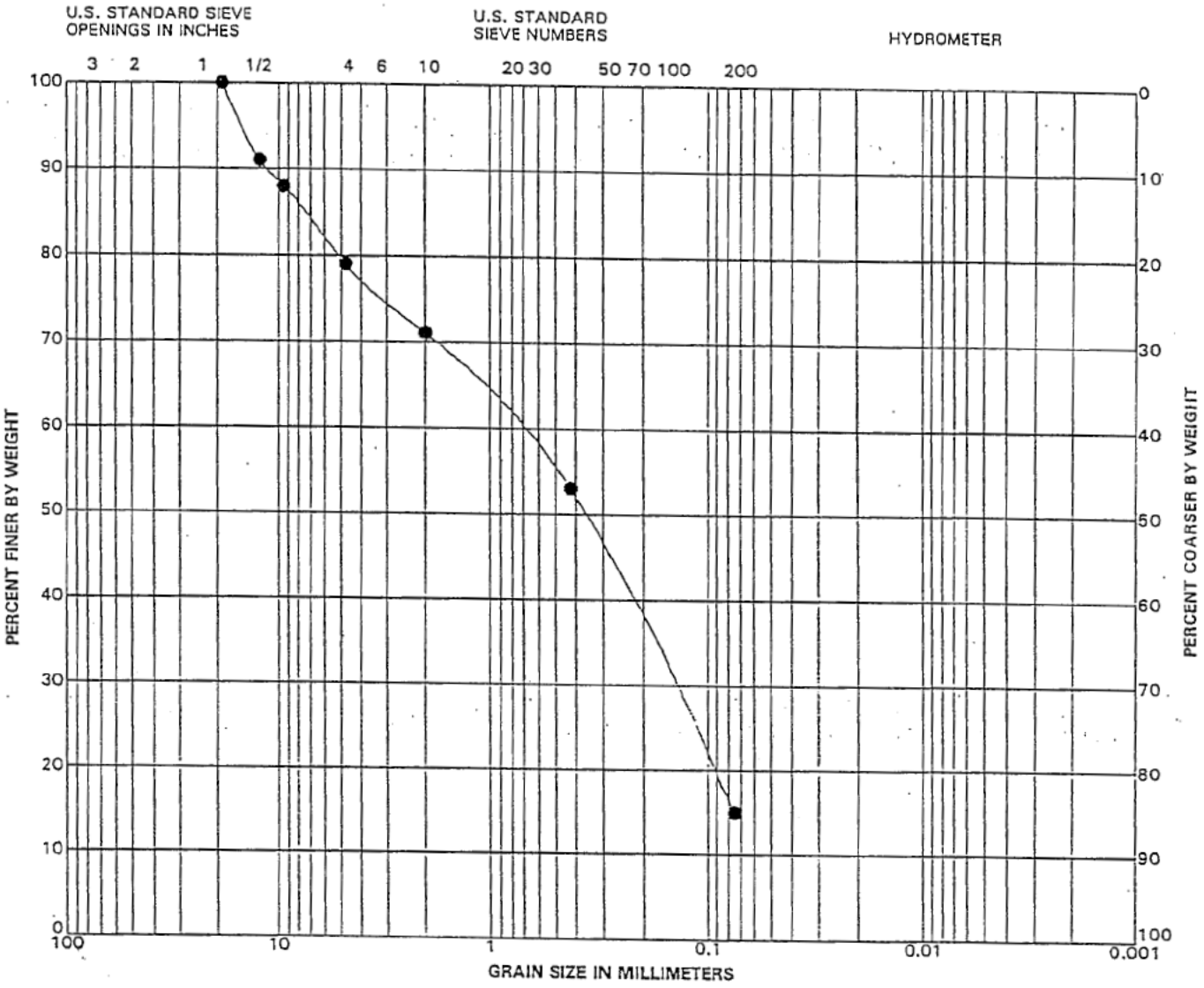
Sample No.:	B-16
Sample Depth:	10 to 11 1/2 feet
Moisture Content:	0.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

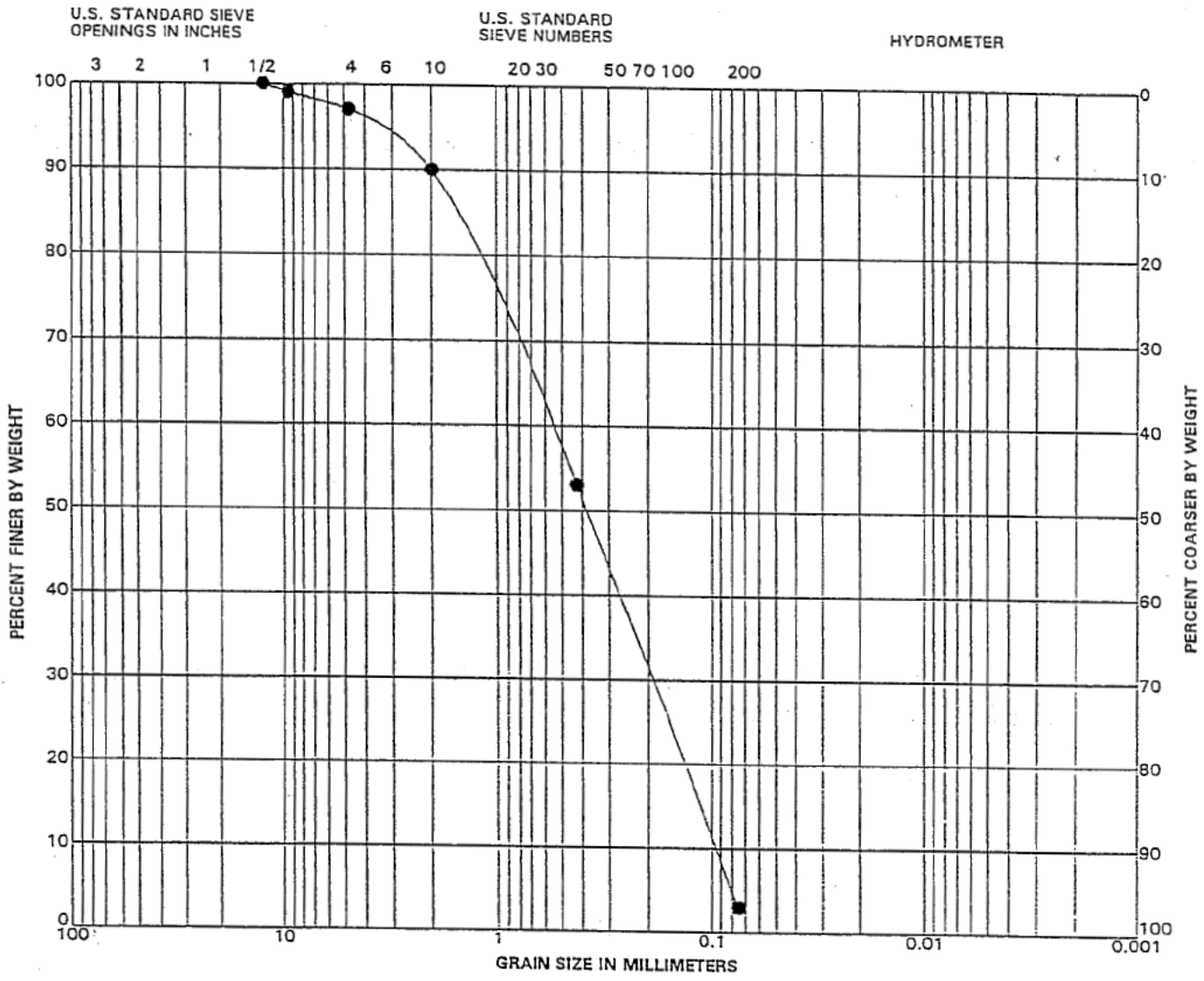
Sample No.:	B-16
Sample Depth:	25 to 26 1/2 feet
Moisture Content:	2.9%
Liquid Limit:	56
Plastic Limit:	16
Plasticity Index:	40
Material Classification:	SC
Material Description:	Sand, Fine to Medium Grained, Clayey, Tan, Very Dense, Dry with gravel
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

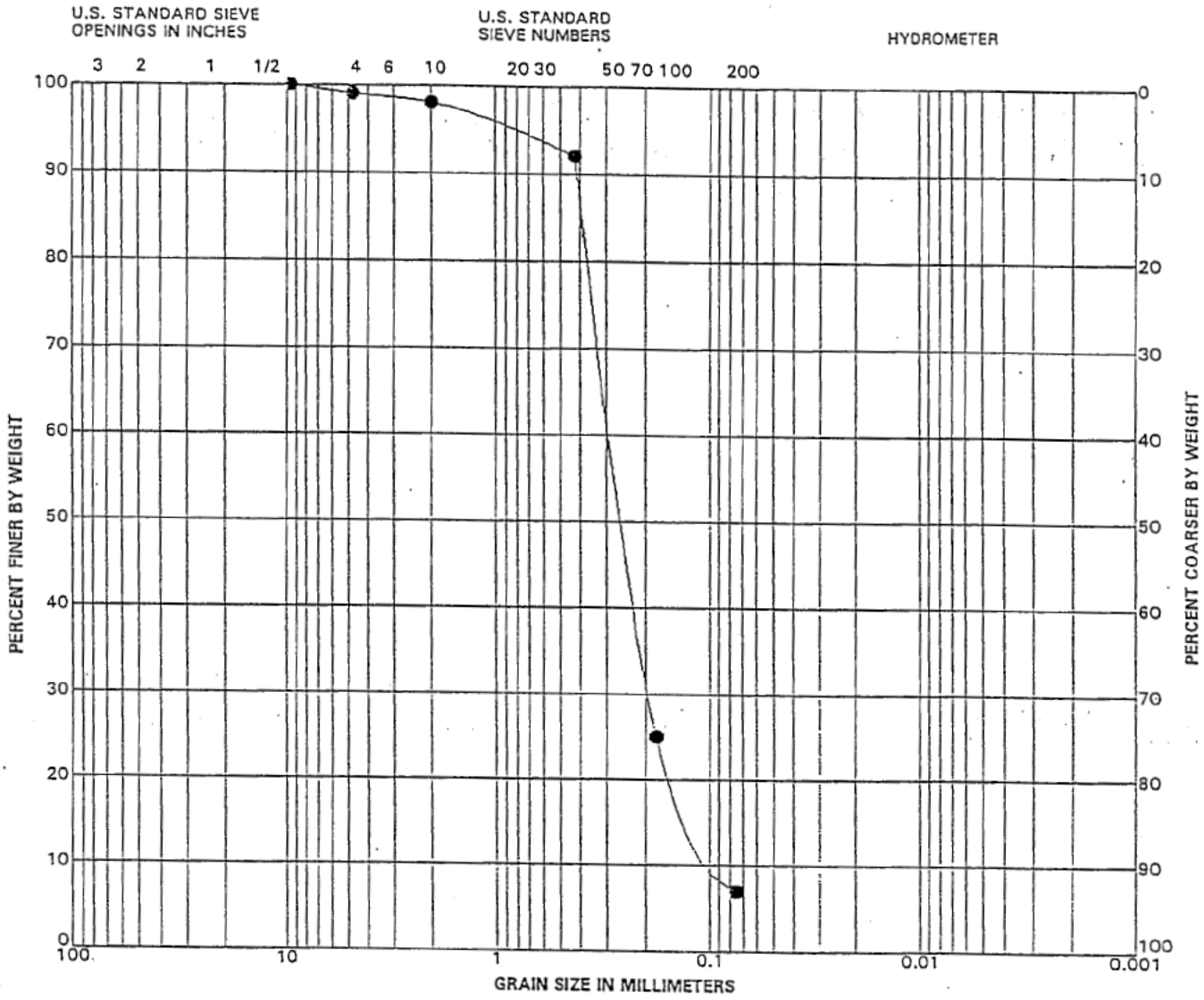
Sample No.:	B-16
Sample Depth:	30 to 31 1/2 feet
Moisture Content:	0.4%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

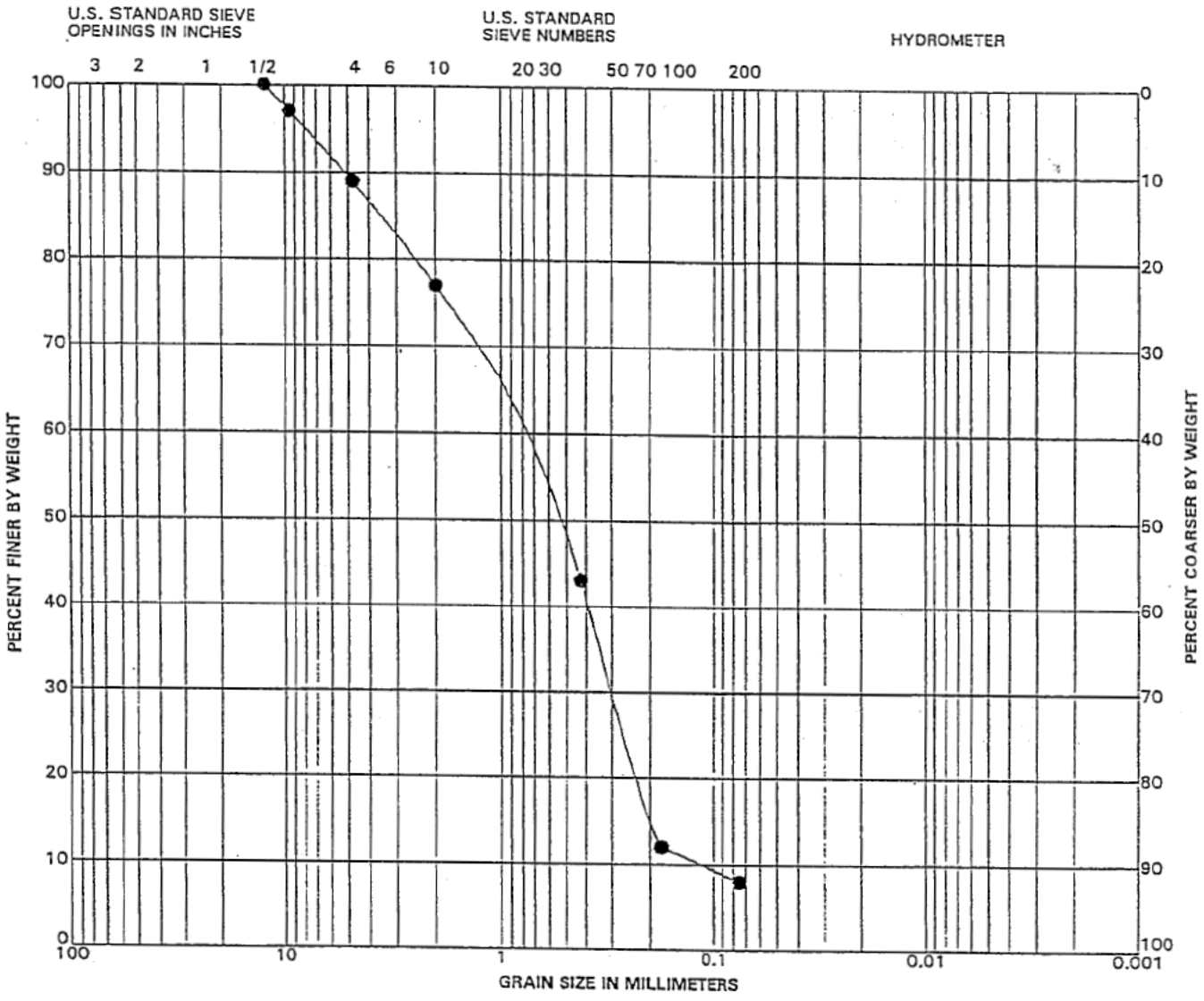
Sample No.:	B-16
Sample Depth:	60 to 61 1/2 feet
Moisture Content:	2.4%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt or clay
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

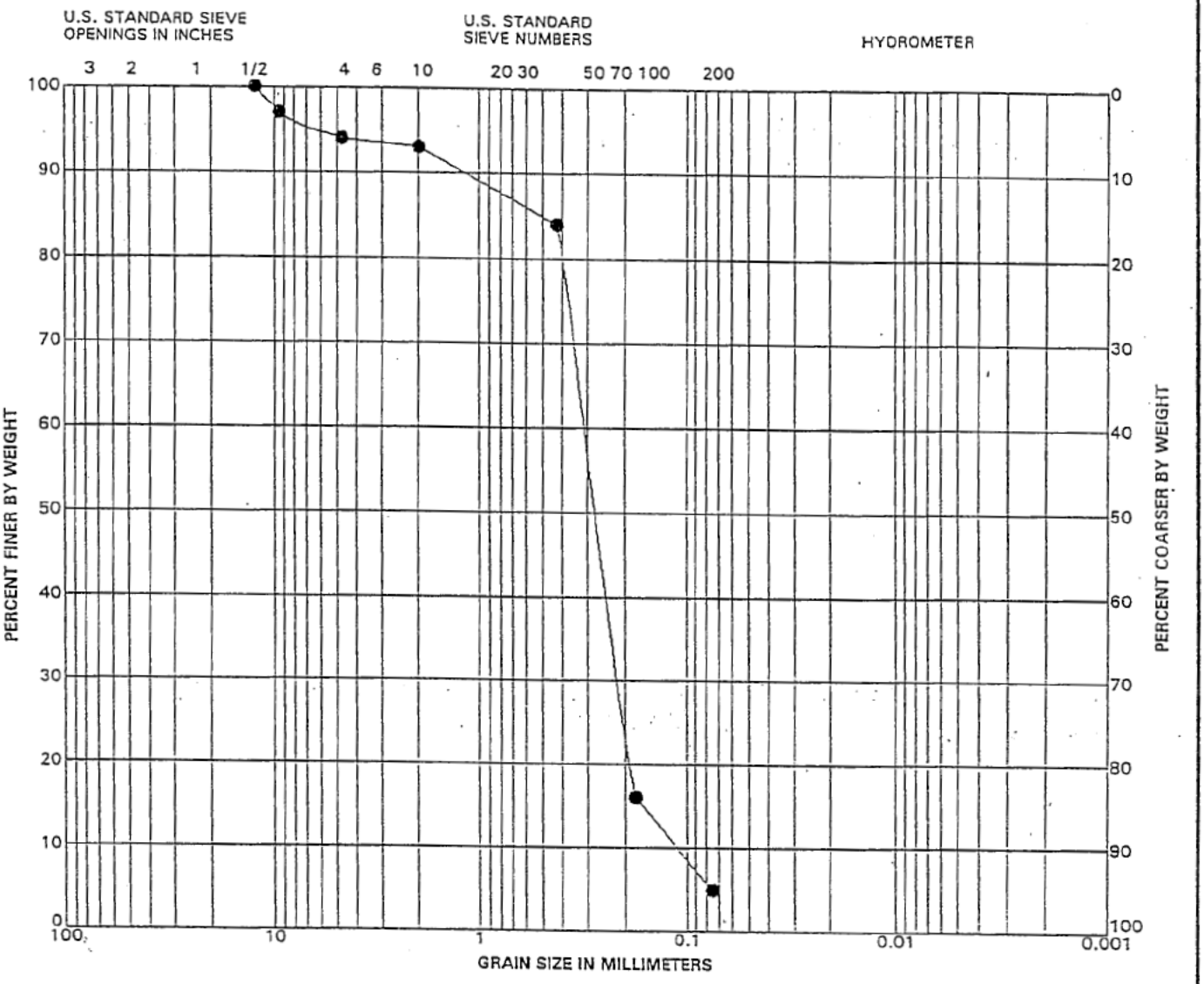
Sample No.:	B-17
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	1.2%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-0U

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

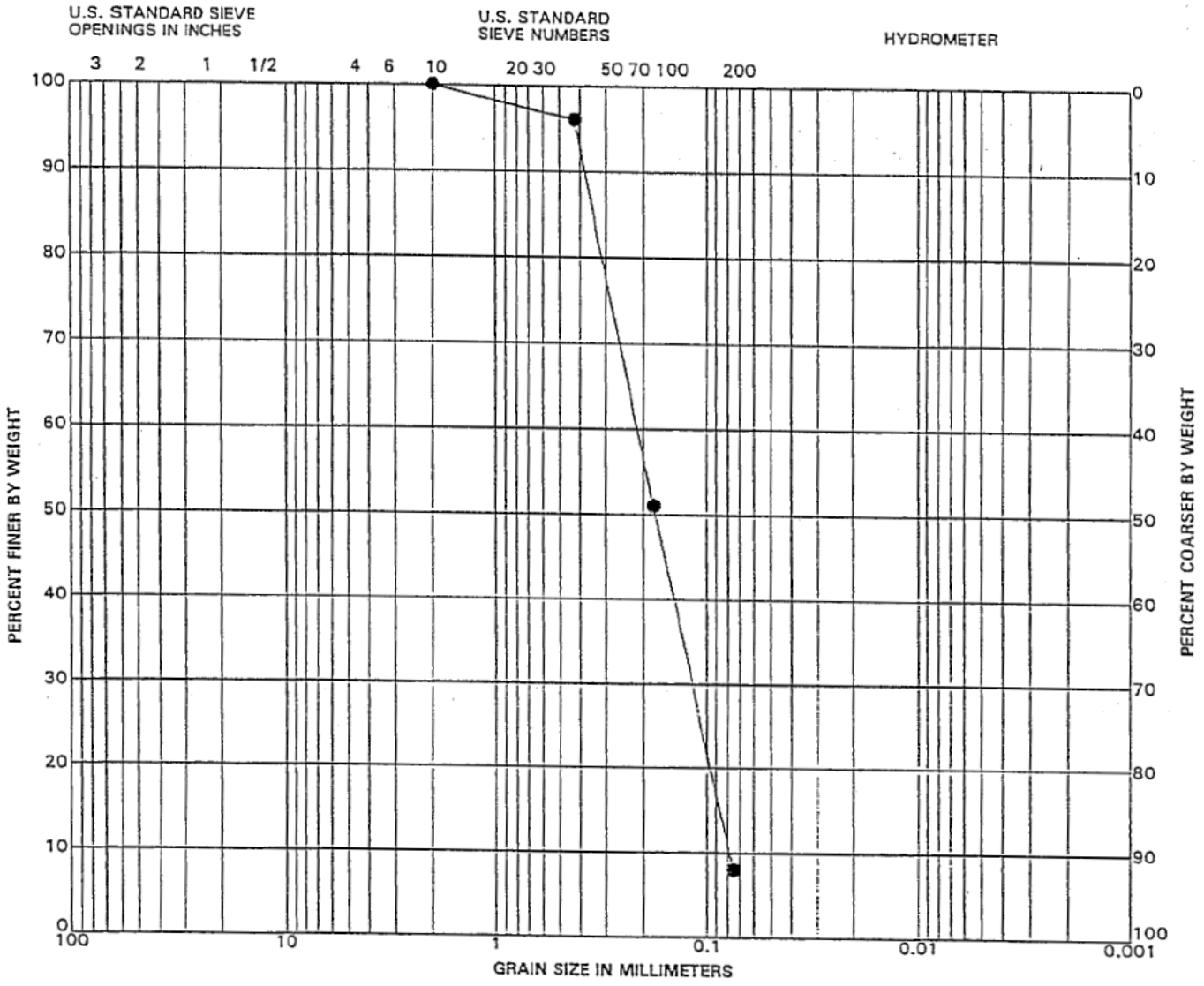
Sample No.:	B-17
Sample Depth:	30 to 31 1/2 feet
Moisture Content:	1.6%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

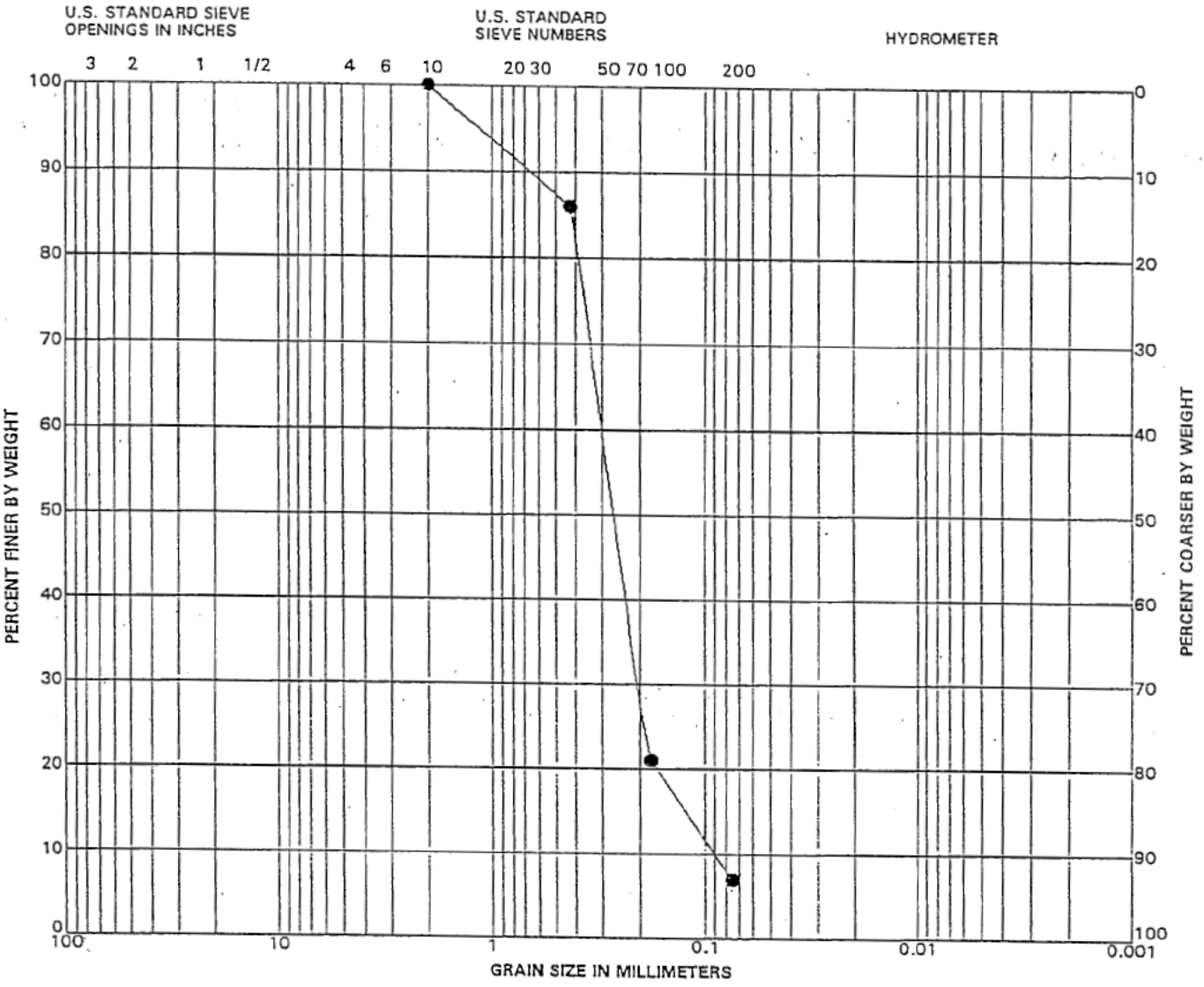
Sample No.:	B-17
Sample Depth:	50 to 51 1/2 feet
Moisture Content:	1.2%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense,Dry w/silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

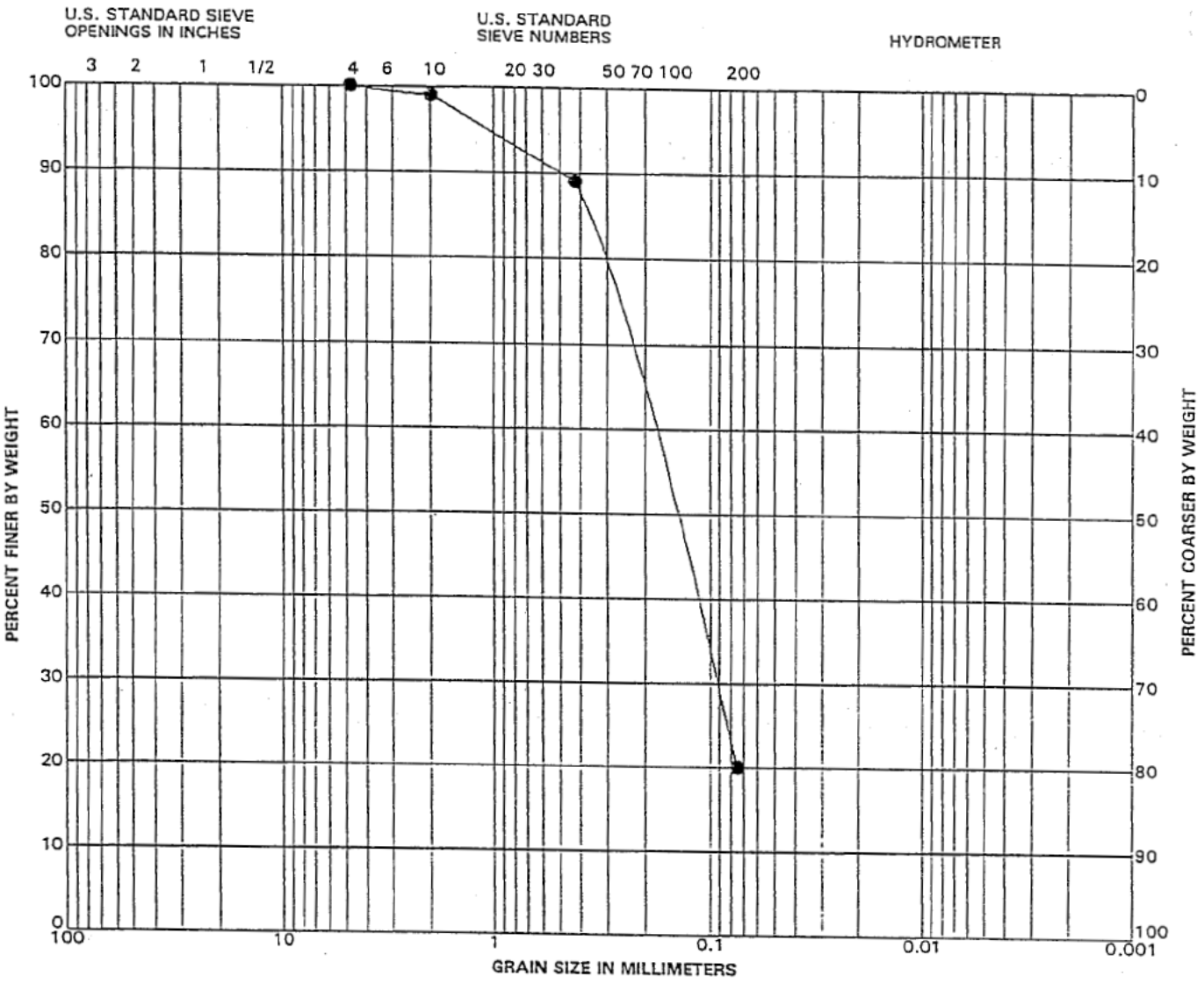
Sample No.:	B-17
Sample Depth:	70 to 71 1/2 feet
Moisture Content:	3.2%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

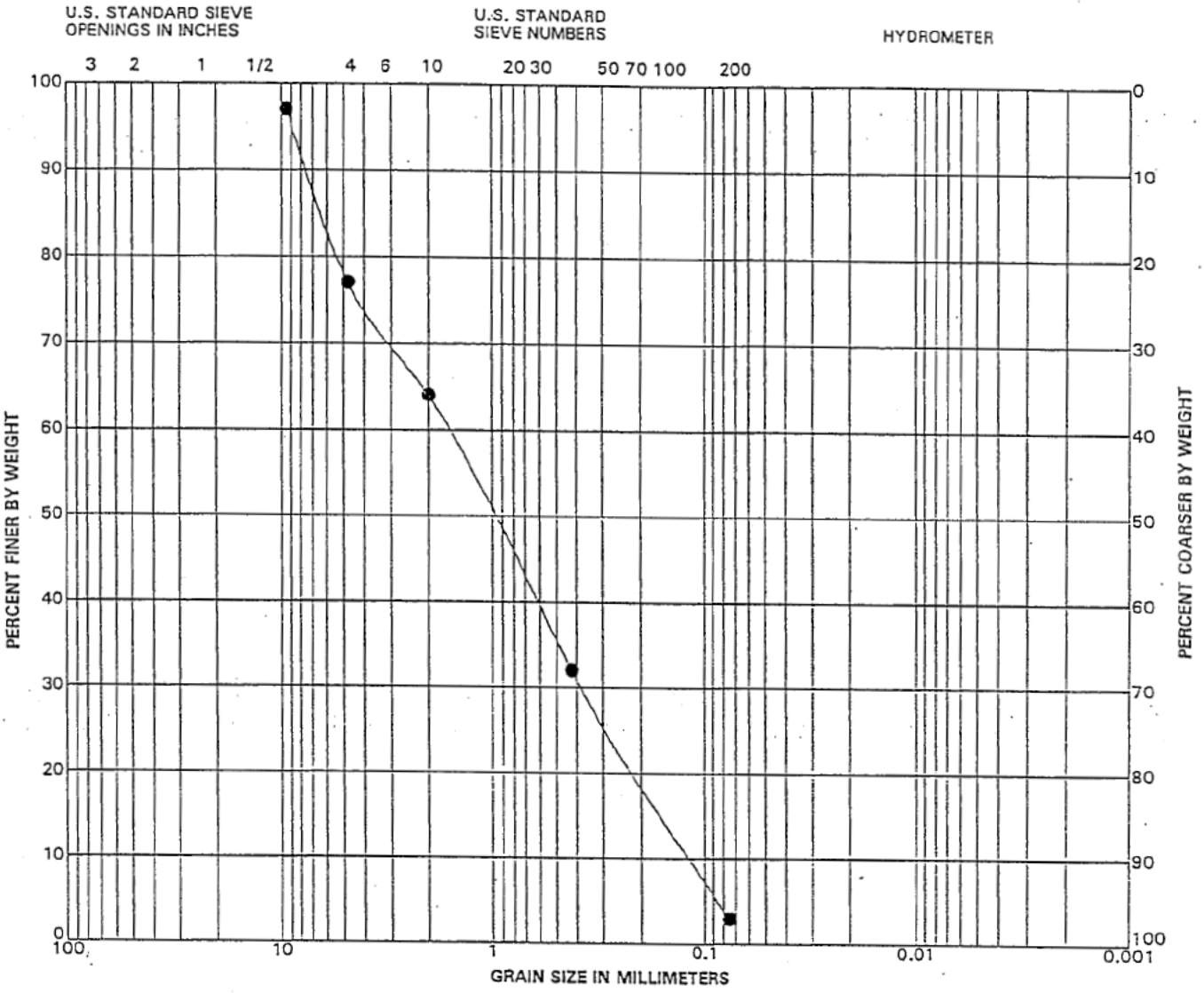
Sample No.:	B-19
Sample Depth:	10 to 11 1/2 feet
Moisture Content:	2.0%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Medium Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-[illegible]

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

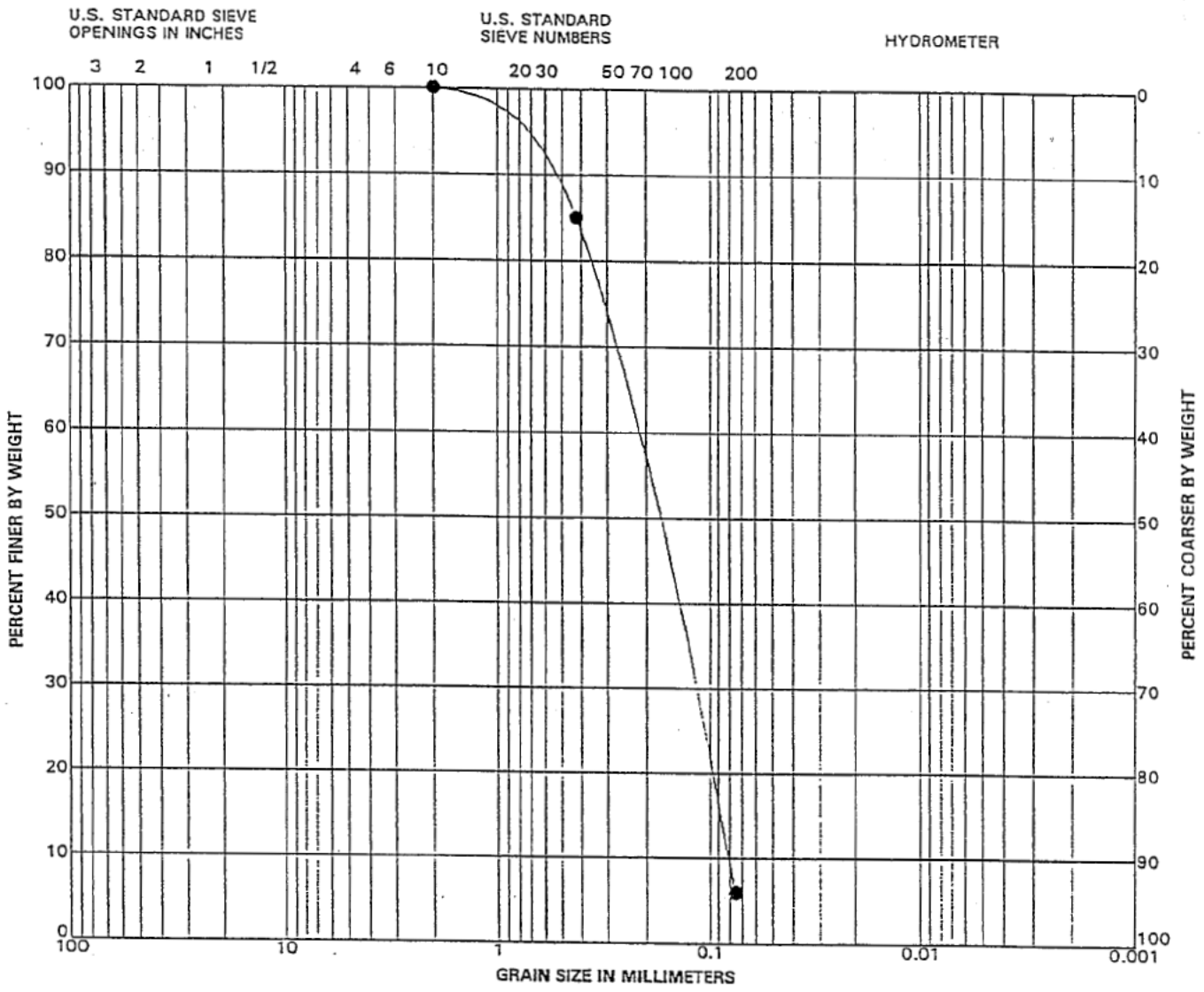
Sample No.: B-19
Sample Depth: 20 to 21 1/2 feet
Moisture Content: 0.5%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SM
Material Description: Sand, Fine Grained, Silty, Tan, Medium Dense, Dry with gravel
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

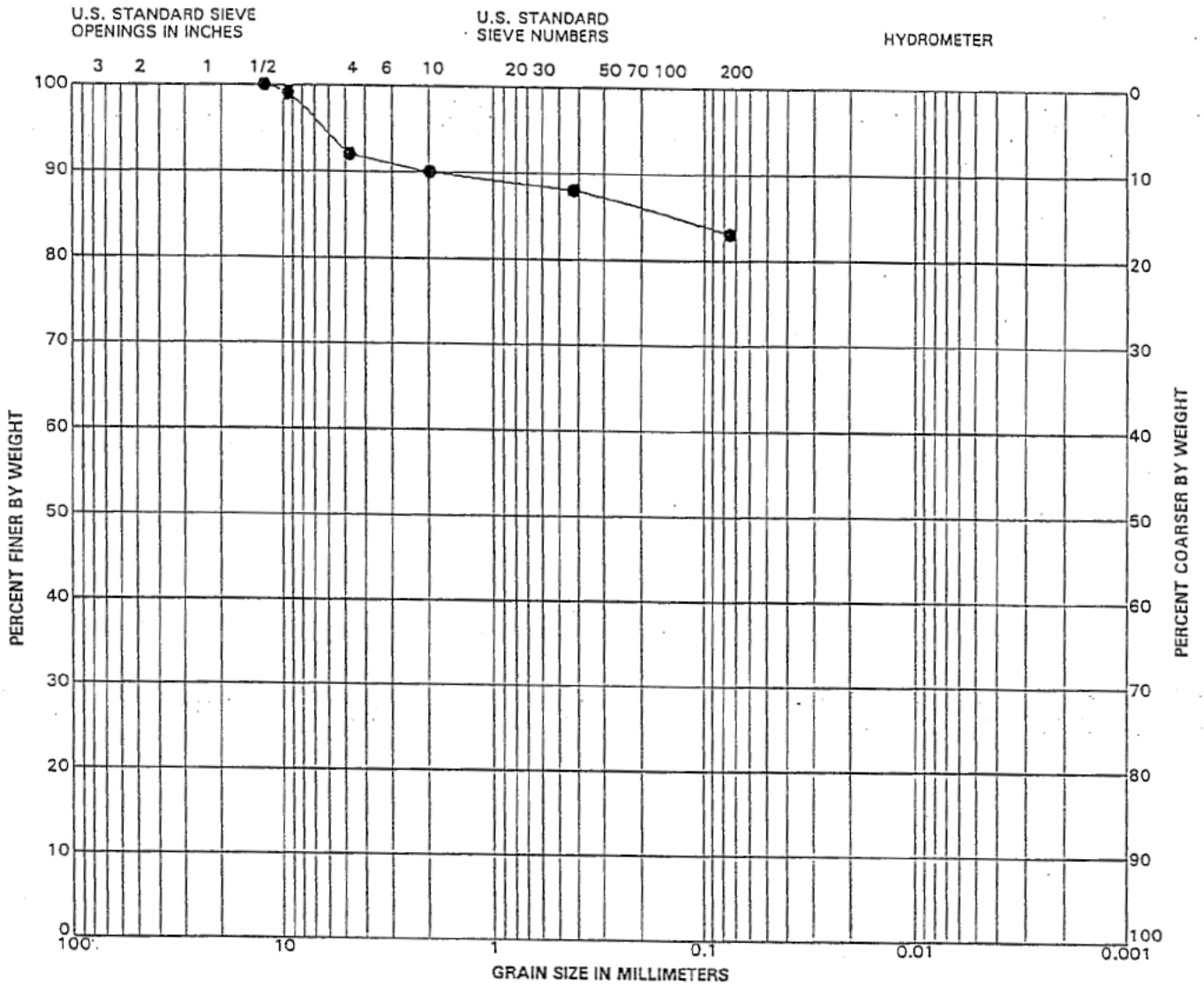
Sample No.: B-19
Sample Depth: 45 to 46 1/2 feet
Moisture Content: 0.7%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification:
Material Description:
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

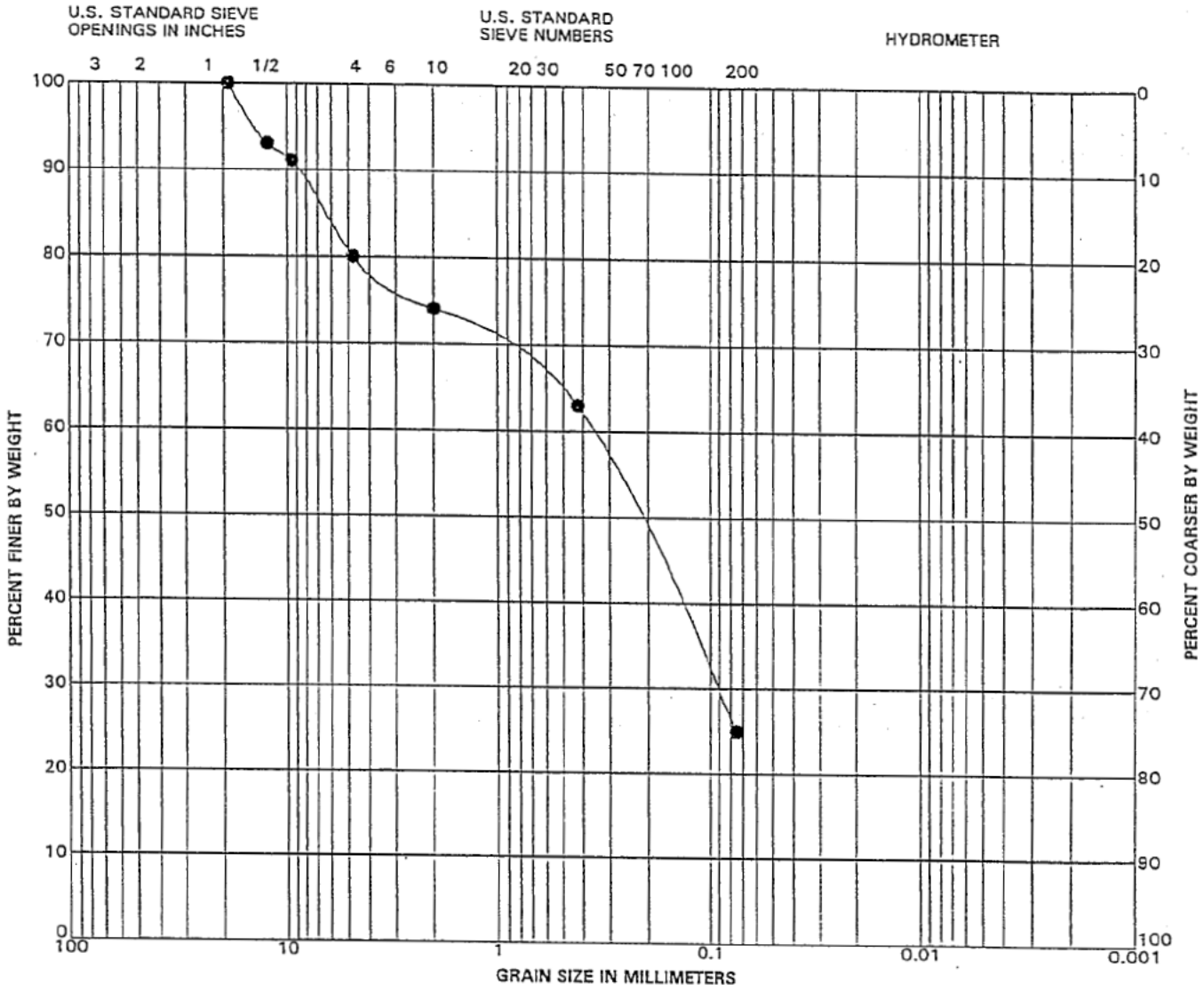
Sample No.:	B-19
Sample Depth:	85 to 86 1/2 feet
Moisture Content:	24.9%
Liquid Limit:	95
Plastic Limit:	26
Plasticity Index:	69
Material Classification:	CH
Material Description:	Clay, Brown, Hard, Moist with sand
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

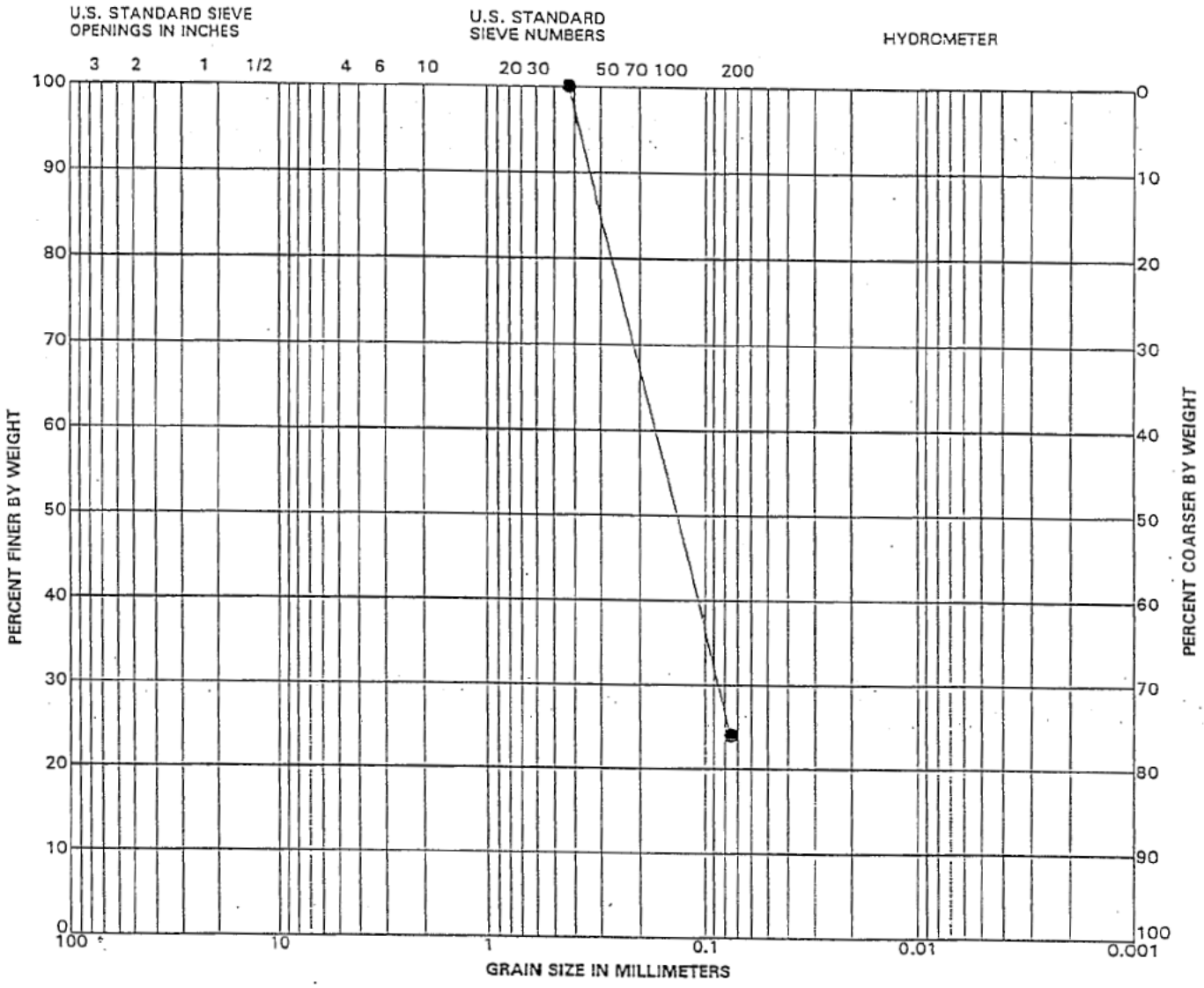
Sample No.:	B-20
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	7.1%
Liquid Limit:	41
Plastic Limit:	20
Plasticity Index:	21
Material Classification:	SC
Material Description:	Sand, Fine Grained, Clayey, Tan, Medium Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

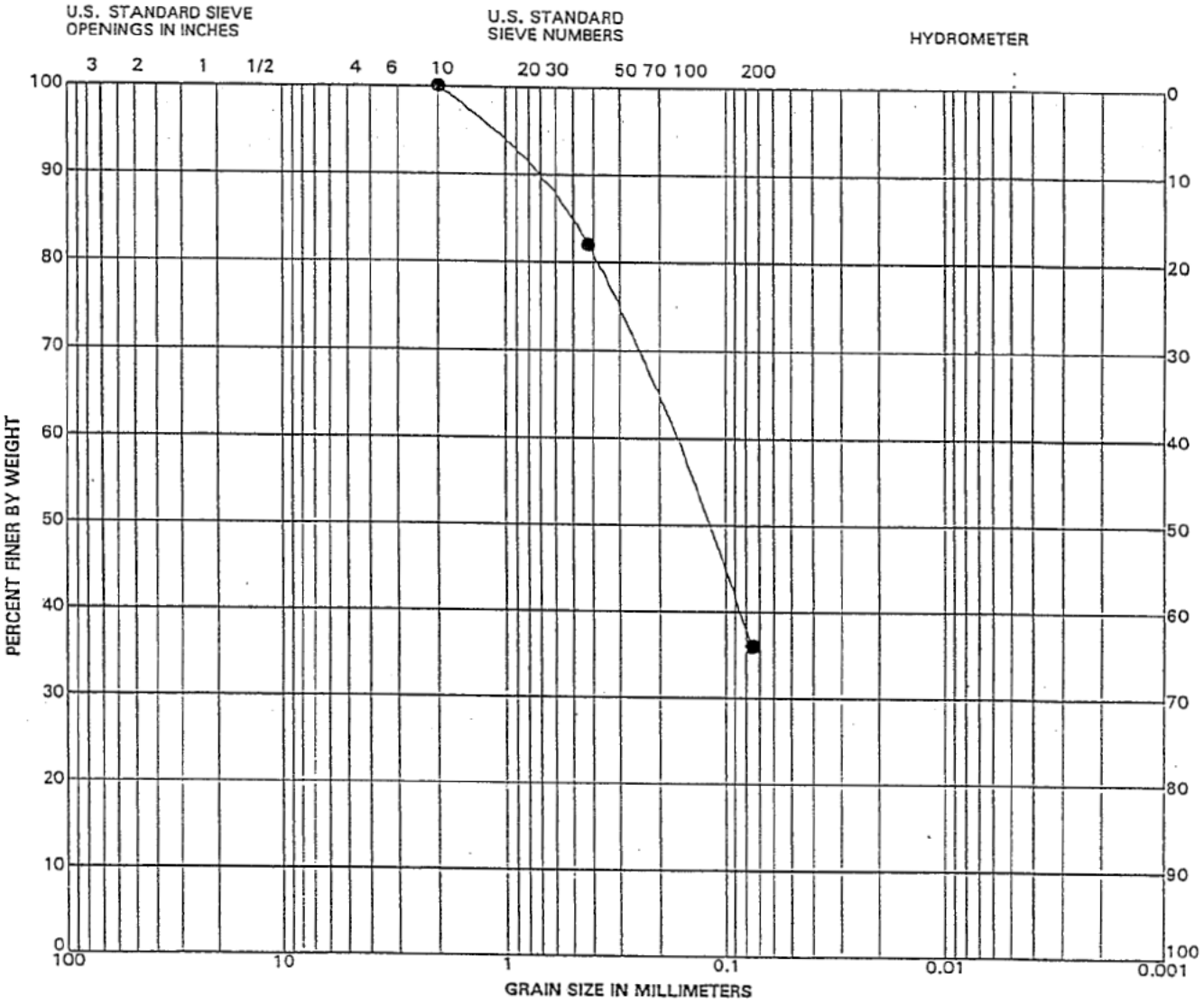
Sample No.:	B-20
Sample Depth:	120 to 121 1/2 feet
Moisture Content:	4.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

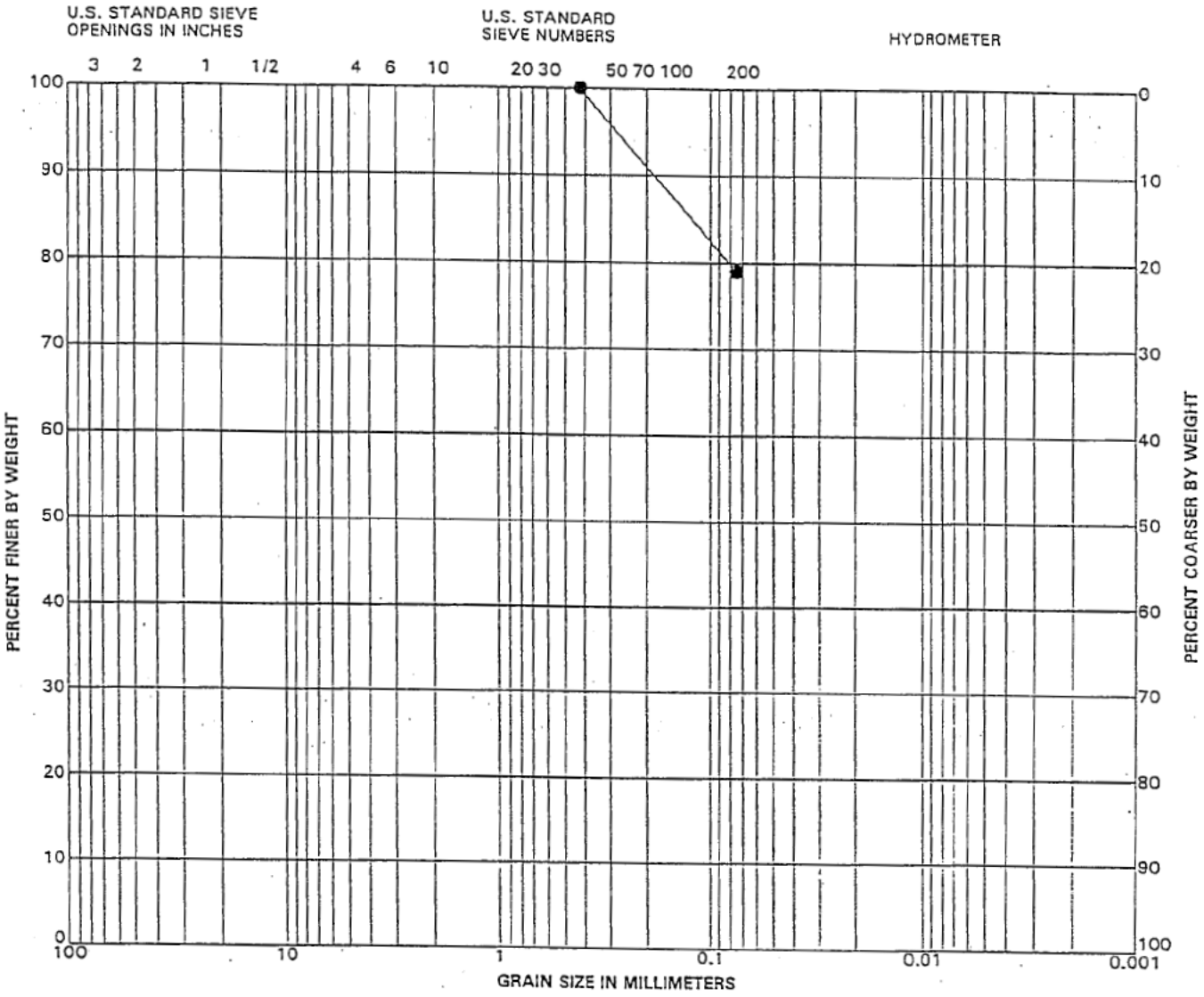
Sample No.:	B-22
Sample Depth:	70 to 71 1/2 feet
Moisture Content:	16.3%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Sand, Fine Grained, Clayey, Tan, Very Dense, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

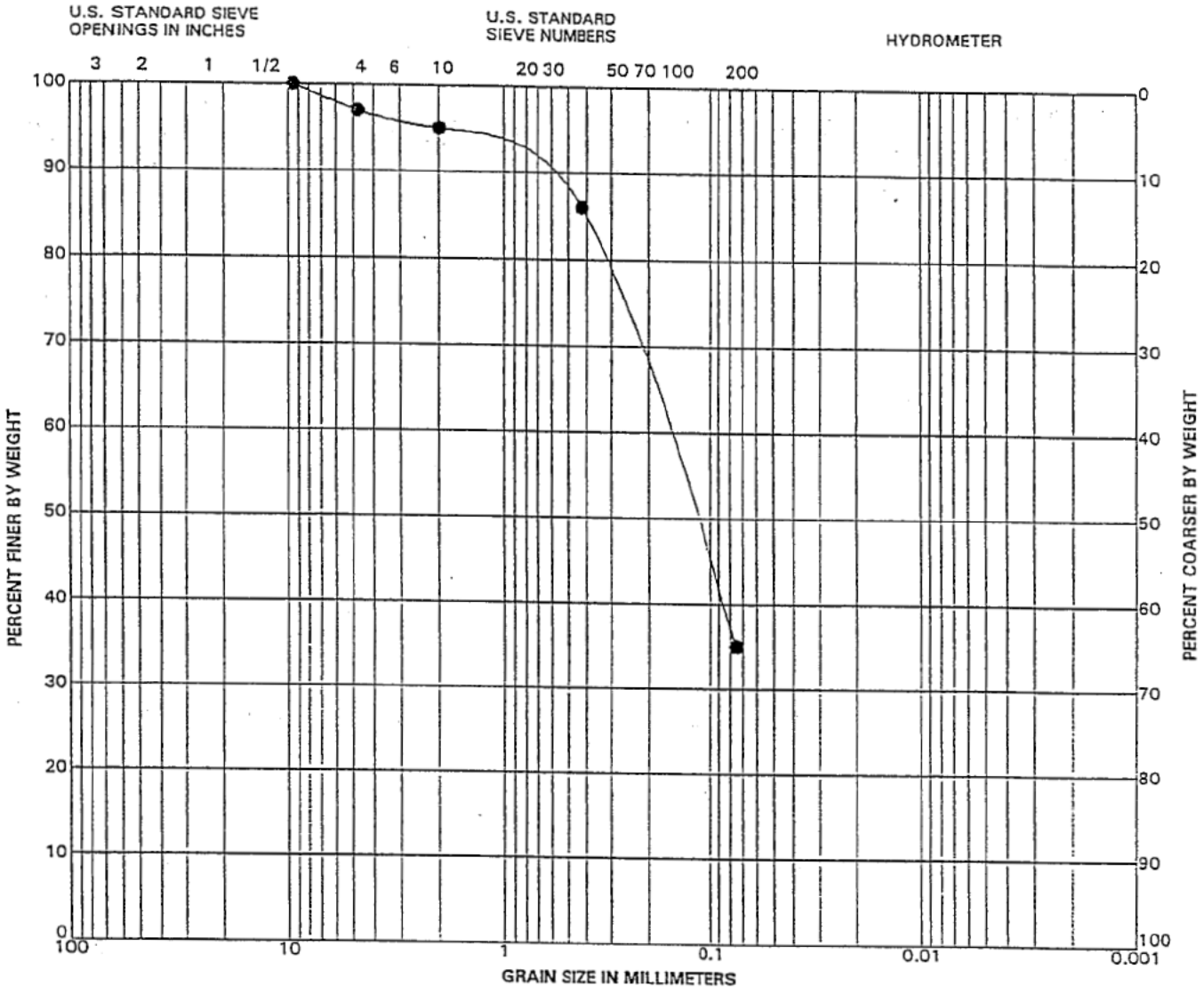
Sample No.:	B-22
Sample Depth:	125 to 126 1/2 feet
Moisture Content:	11.2%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.:	B-23
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	5.0%
Liquid Limit:	19
Plastic Limit:	15
Plasticity Index:	4
Material Classification:	SC-SM
Material Description:	Sand, Fine Grained, Clayey, Tan, Medium Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

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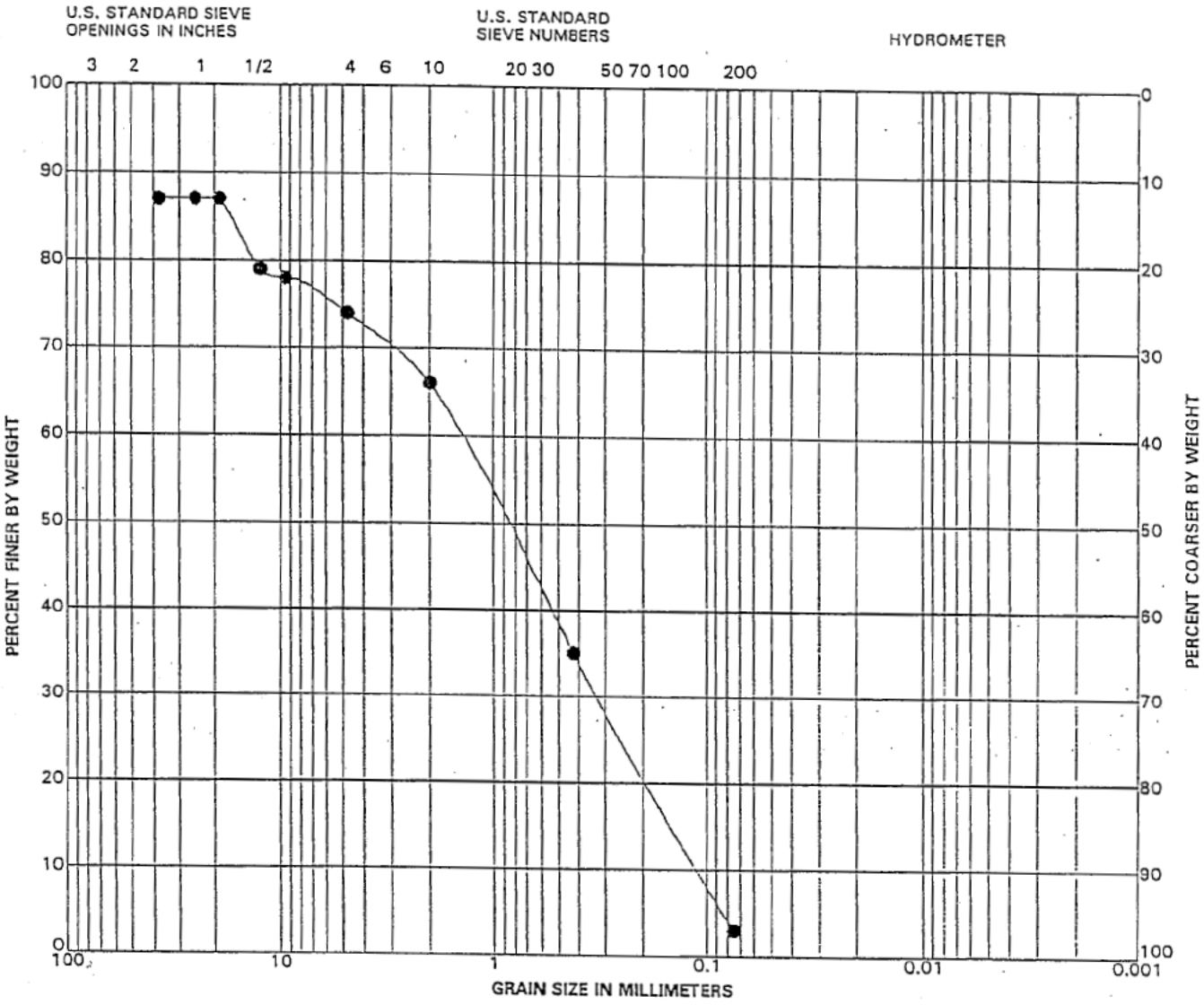
Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

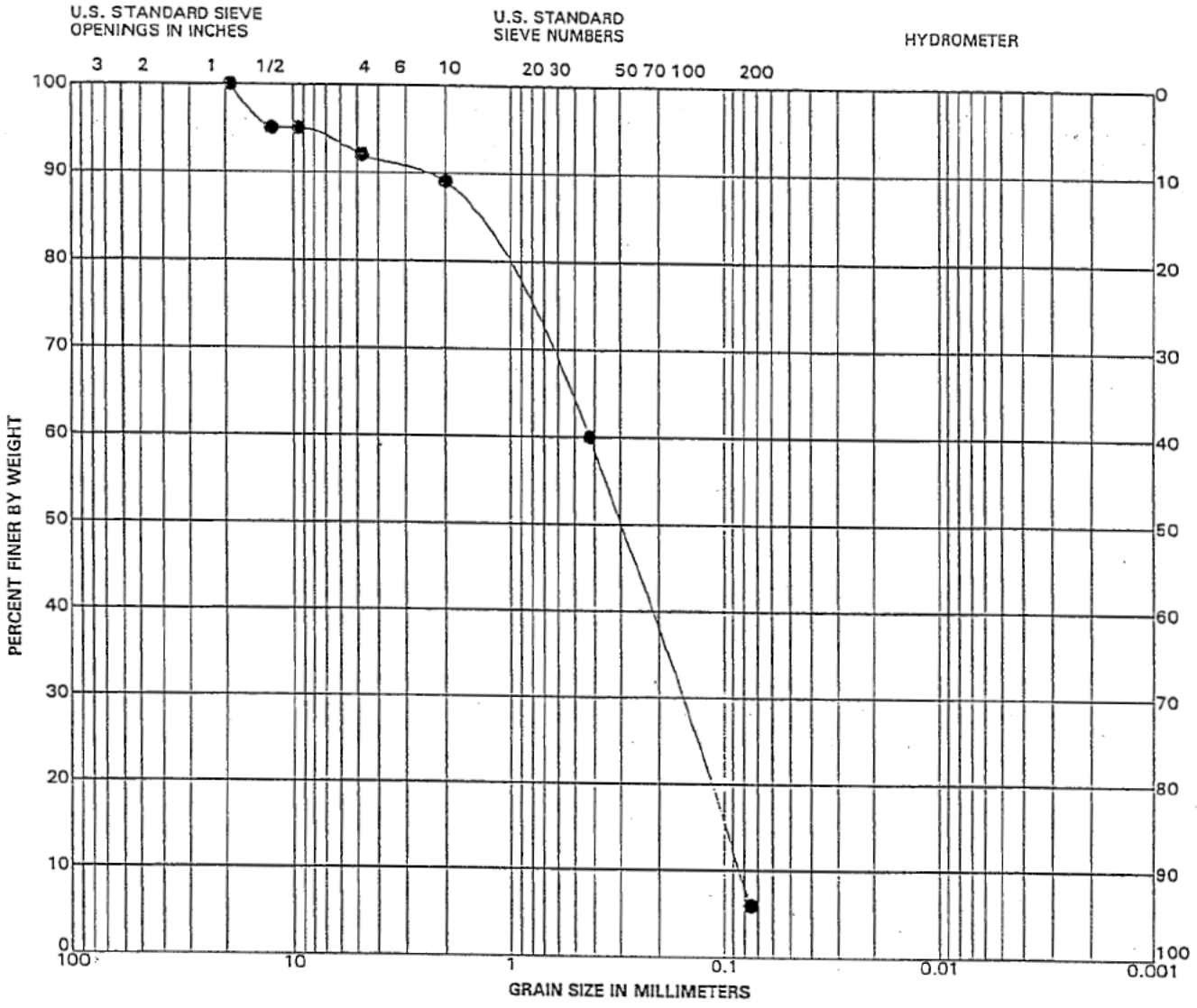
Sample No.:	B-23
Sample Depth:	15 to 16 1/2 feet
Moisture Content:	2.6%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Medium to Coarse Grained, Gravelly, Tan, Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

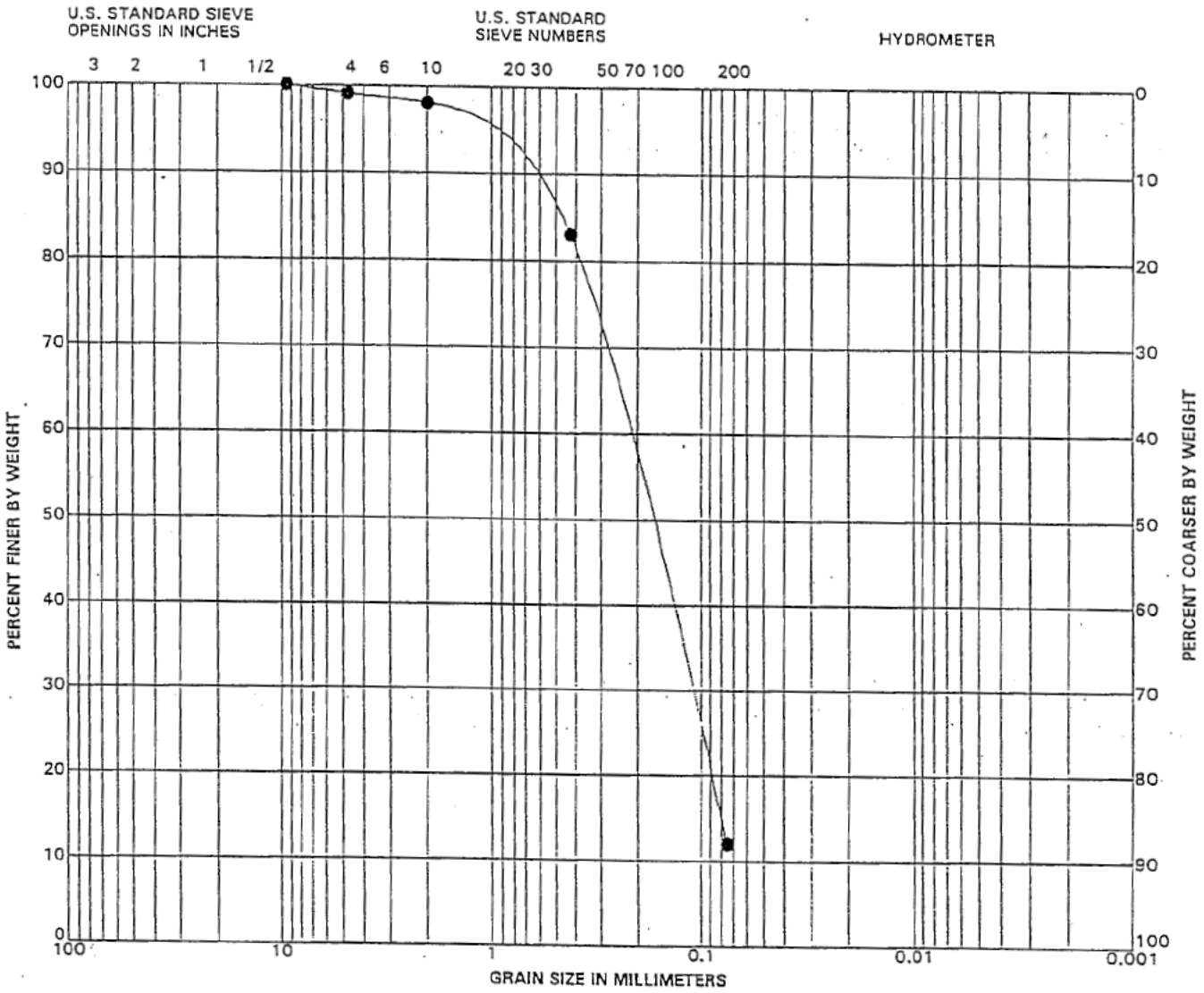
Sample No.:	B-23
Sample Depth:	40 to 41 1/2 fet
Moisture Content:	3.6%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

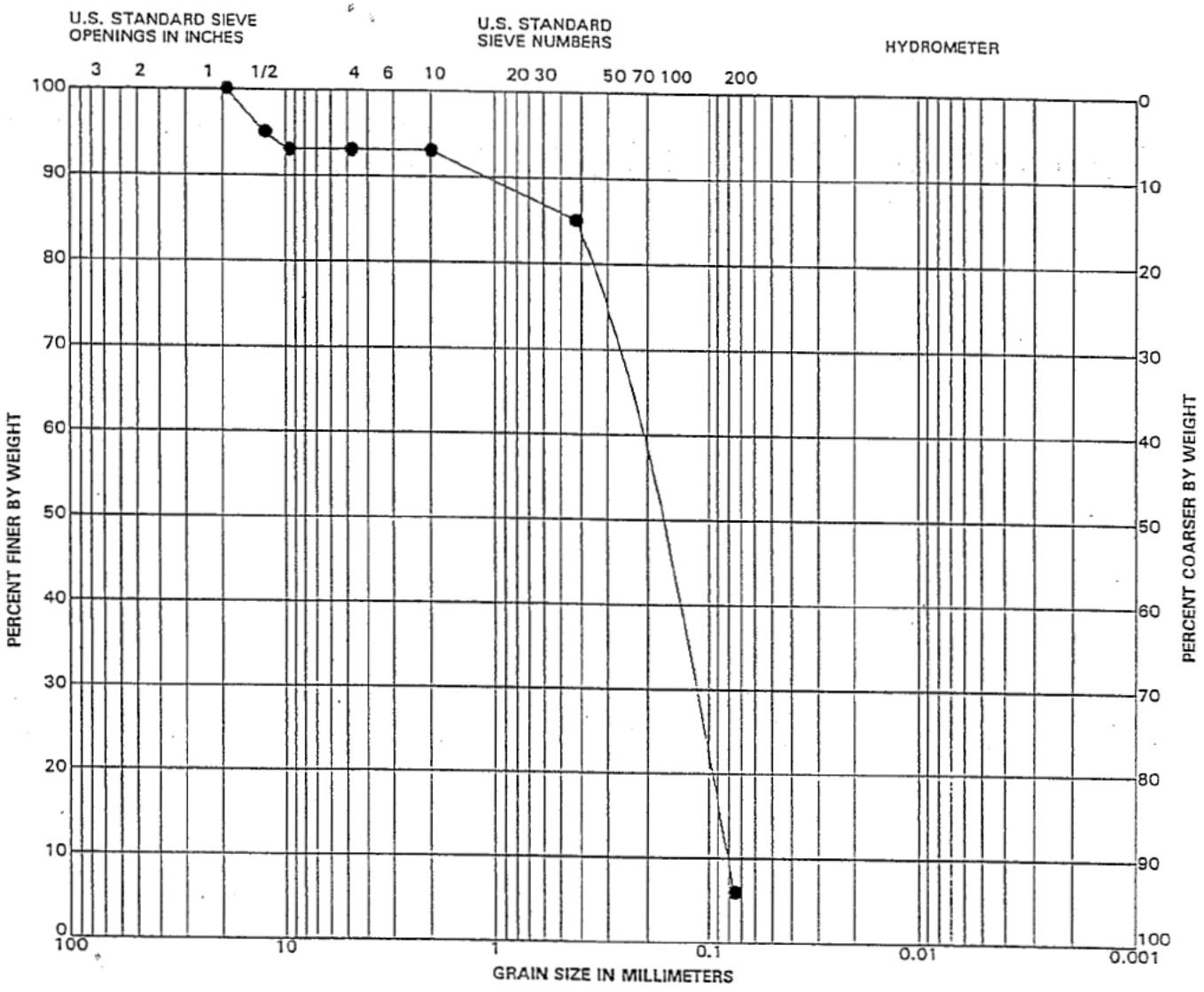
Sample No.: B-23
Sample Depth: 60 to 61 1/2 feet
Moisture Content: 2.5%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SM
Material Description: Sand, Fine Grained, Light Brown, Silty, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

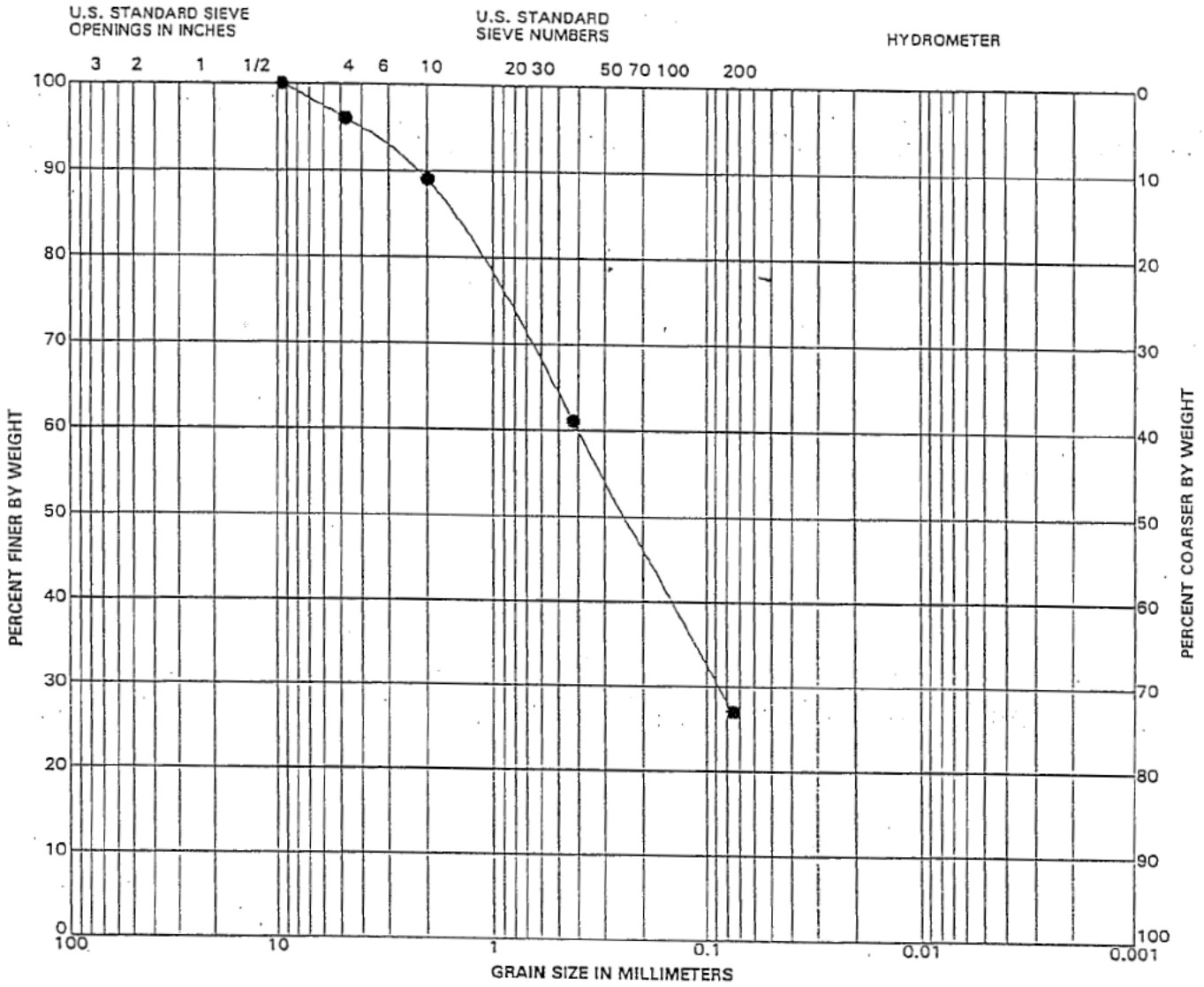
Sample No.:	B-23
Sample Depth:	80 to 81 1/2 feet
Moisture Content:	2.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

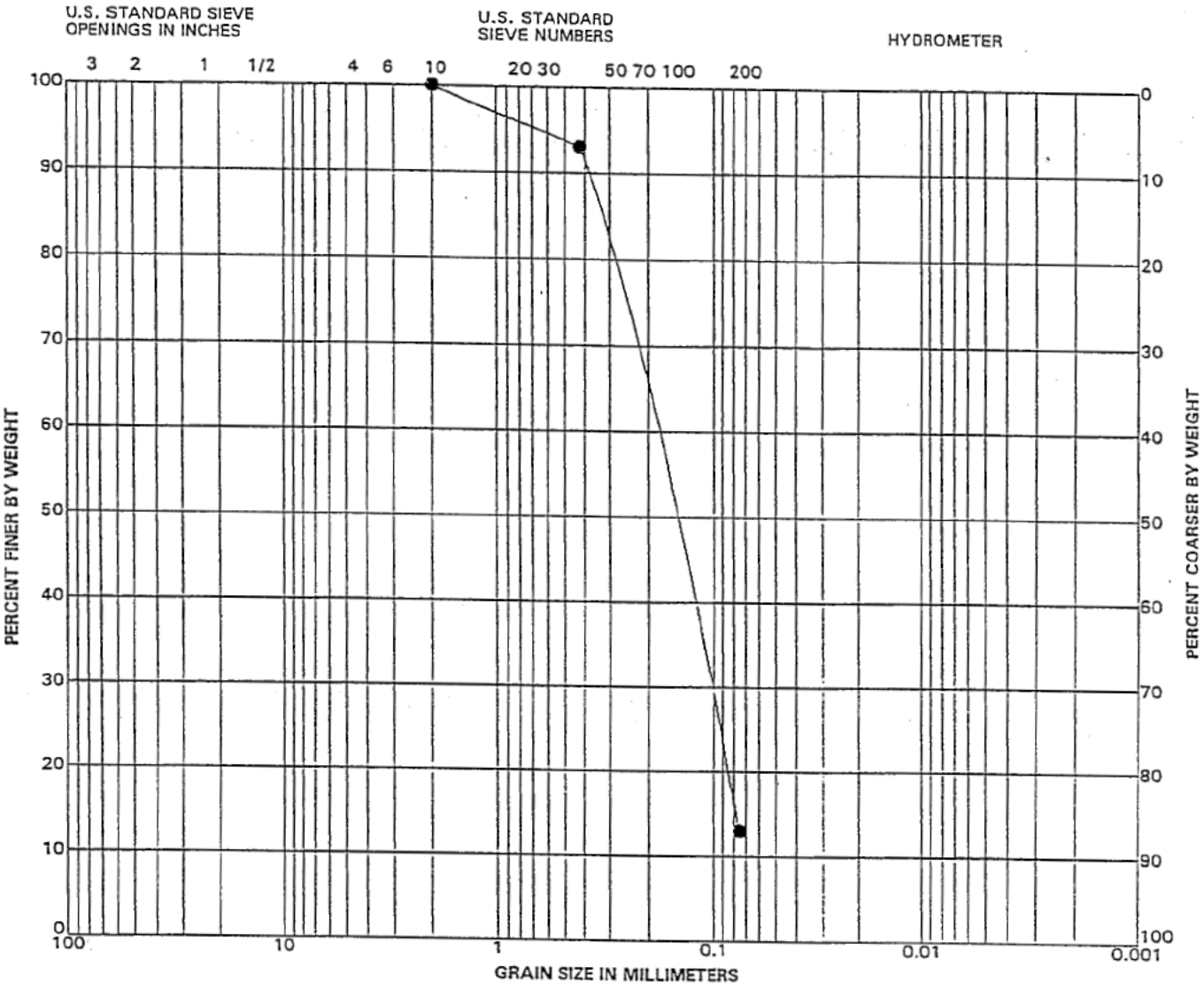
Sample No.: B-24
Sample Depth: 40 to 41 1/2 feet
Moisture Content: Not Tested
Liquid Limit: Not Tested
Plastic Limit: Not Tested
Plasticity Index: -
Material Classification:
Material Description:
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

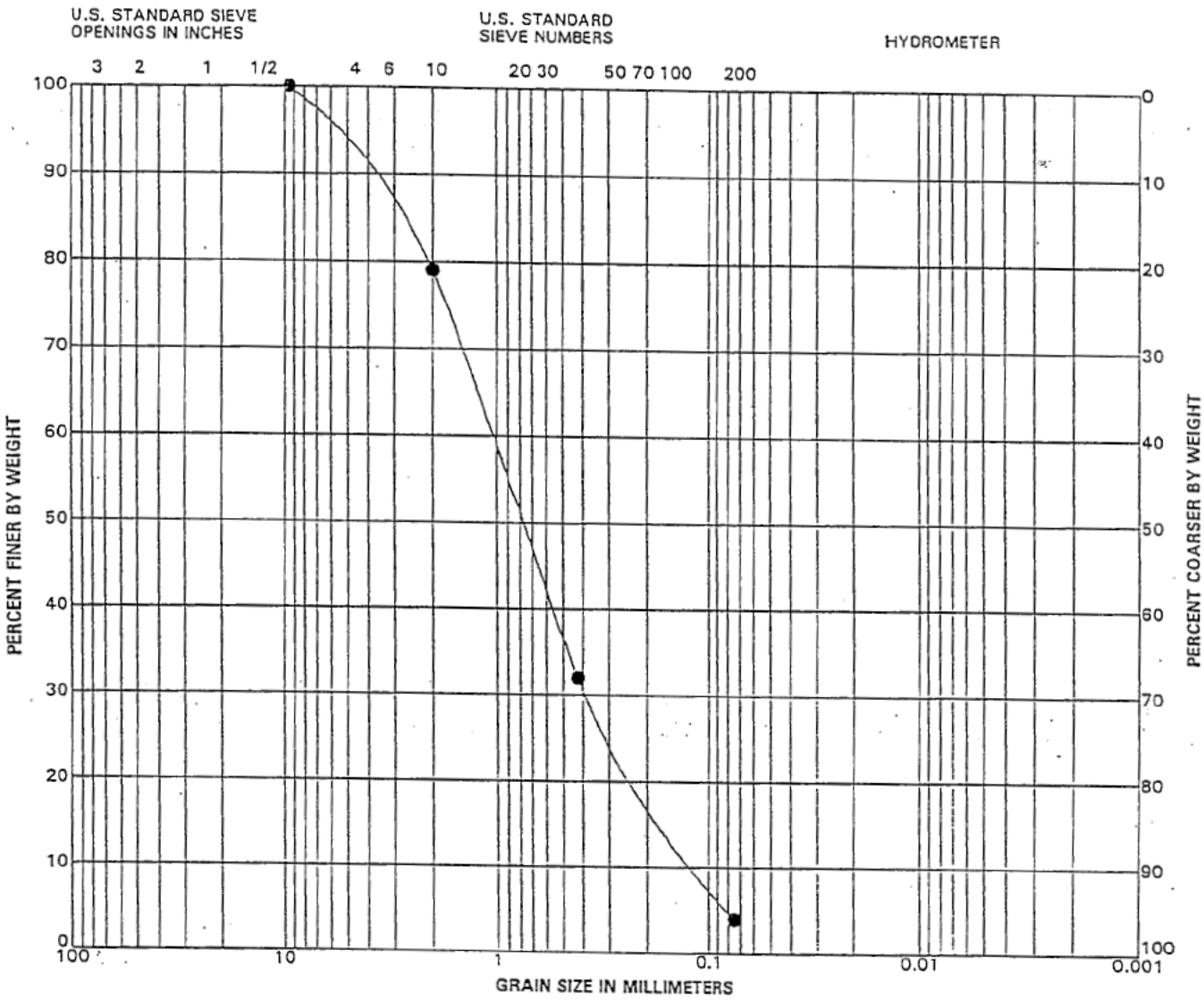
Sample No.:	B-24
Sample Depth:	100 to 101 1/2 feet
Moisture Content:	19.4%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Tan, Very Dense, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

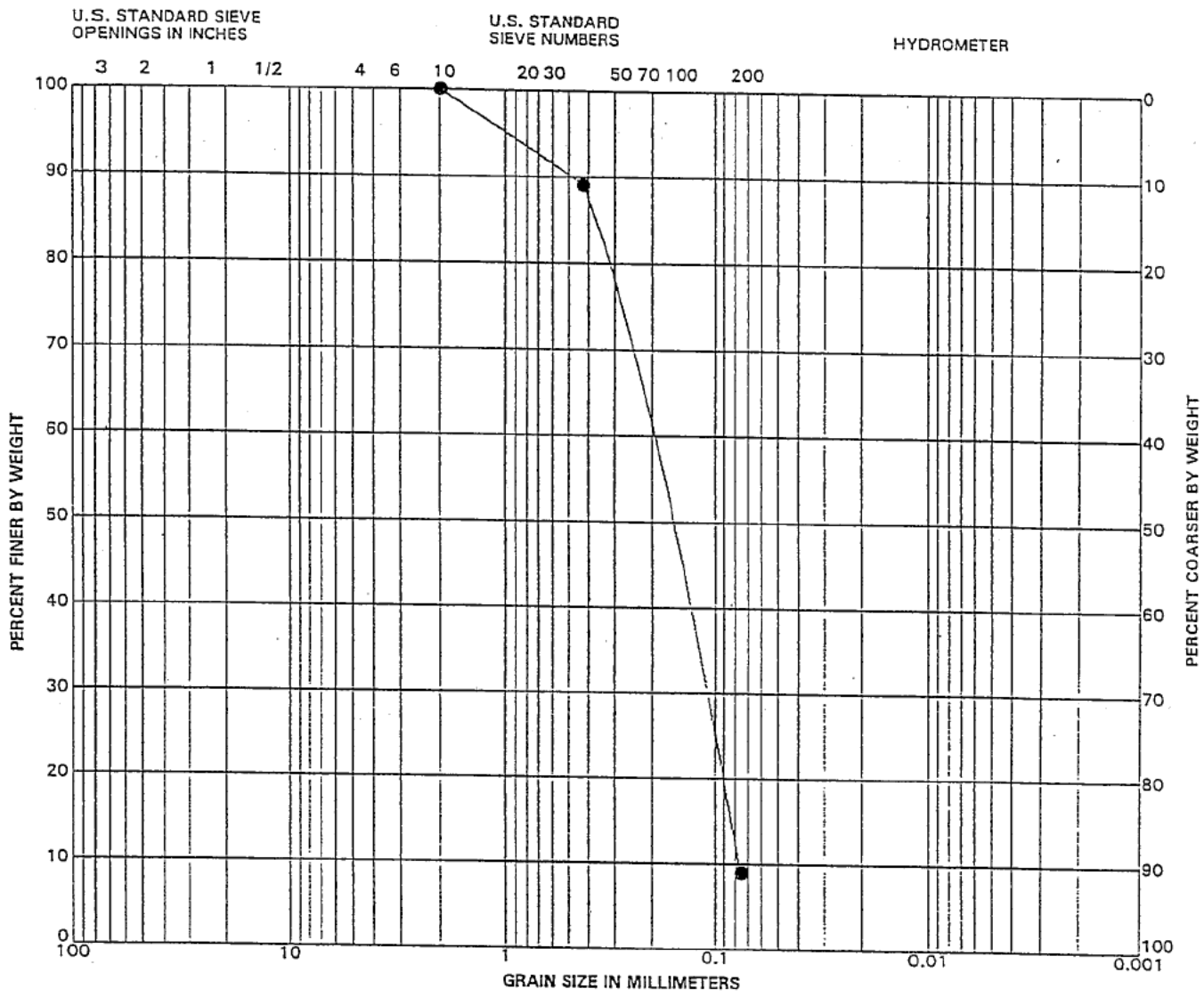
Sample No.:	B-25
Sample Depth:	15 to 16 1/2 feet
Moisture Content:	12.2%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Medium Grained, Tan, Poorly Graded, Dense, Moist with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

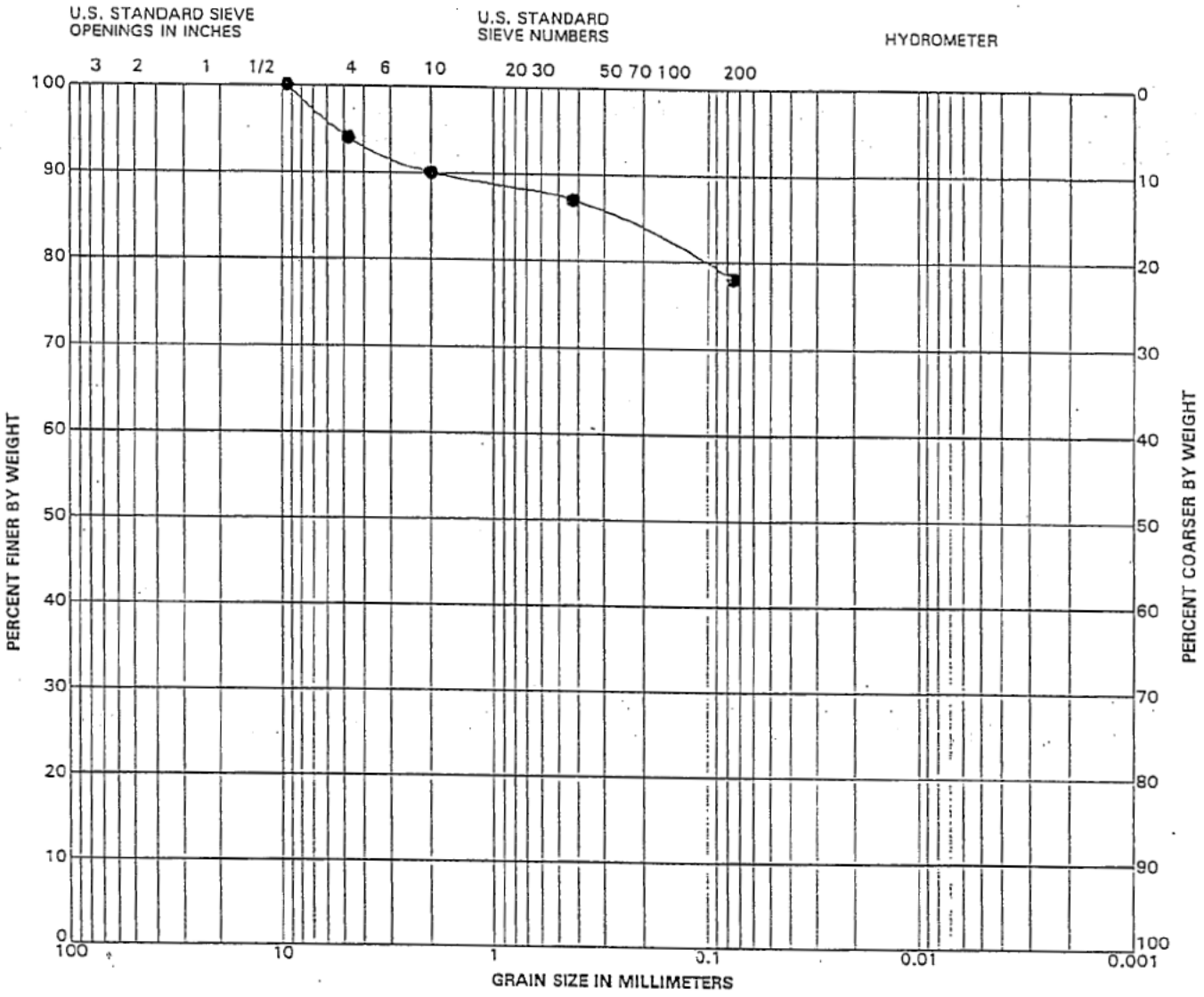
Sample No.: B-25
Sample Depth: 50 to 51 1/2 feet
Moisture Content: 3.5%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP-SM
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

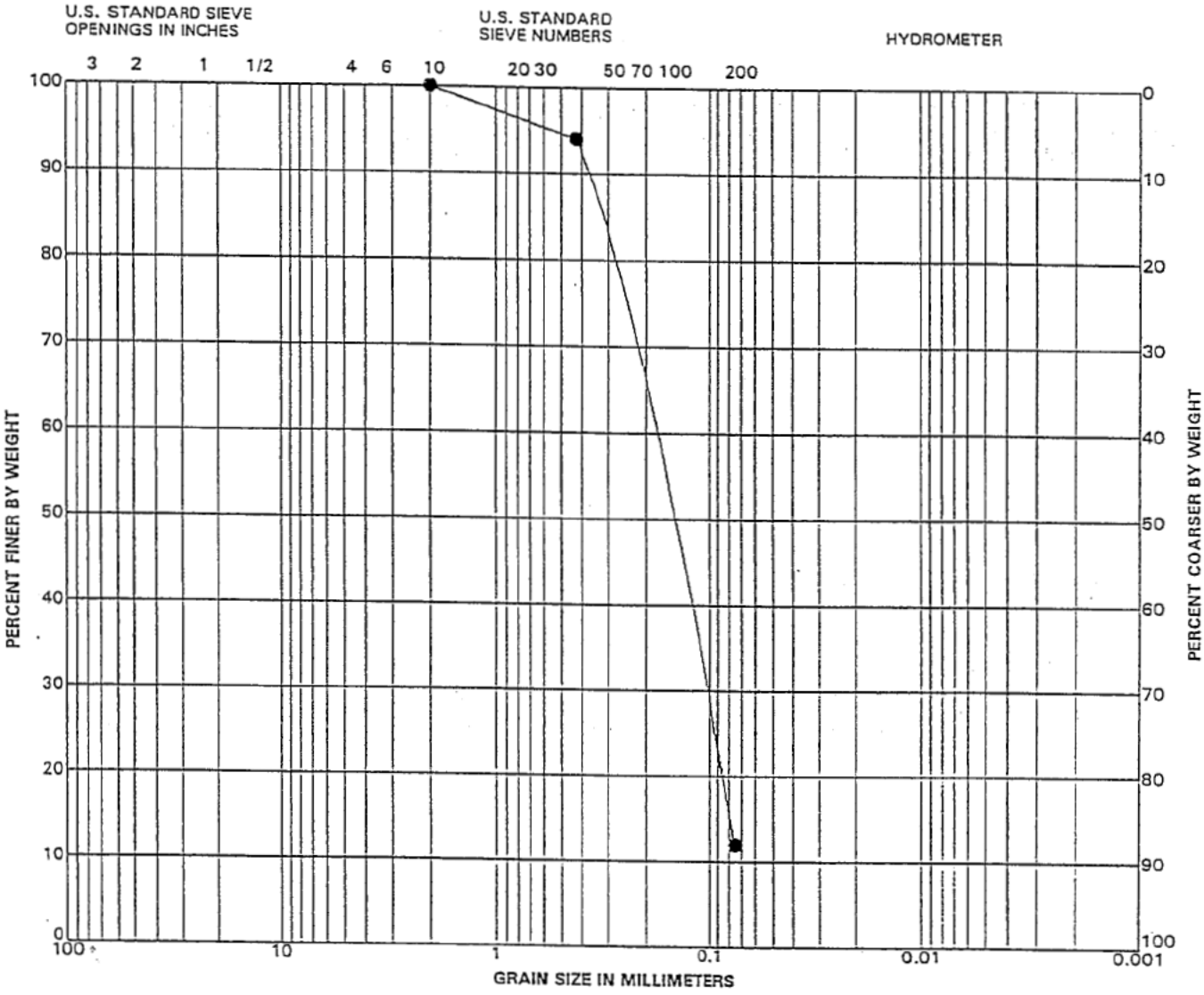
Sample No.:	B-25
Sample Depth:	60 to 61 1/2 feet
Moisture Content:	18.6%
Liquid Limit:	64
Plastic Limit:	16
Plasticity Index:	48
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

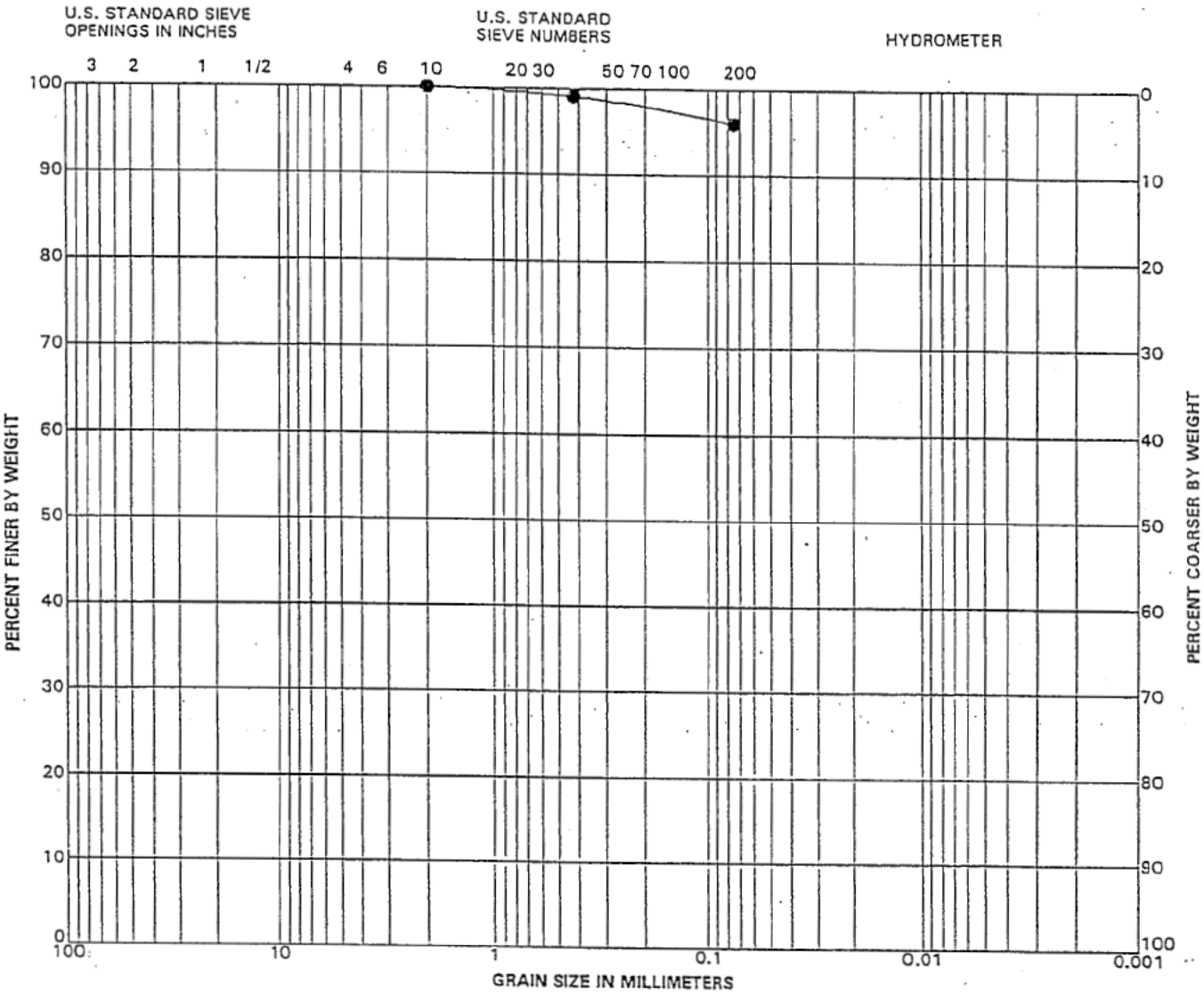
Sample No.:	B-25
Sample Depth:	70 to 71 1/2 feet
Moisture Content:	1.7%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

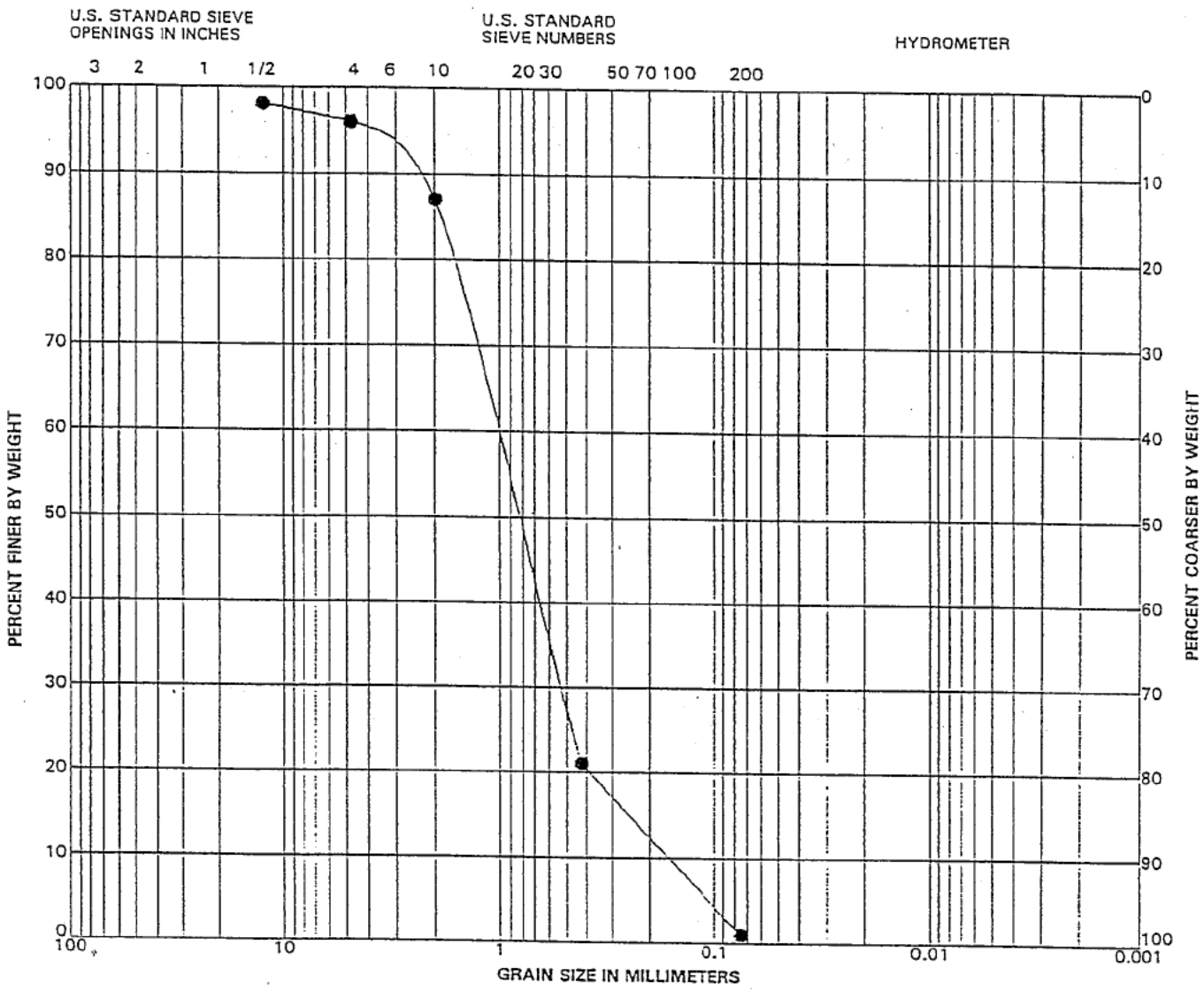
Sample No.:	B-25
Sample Depth:	80 to 81 1/2 feet
Moisture Content:	20.9%
Liquid Limit:	110
Plastic Limit:	23
Plasticity Index:	87
Material Classification:	CH
Material Description:	Clay, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

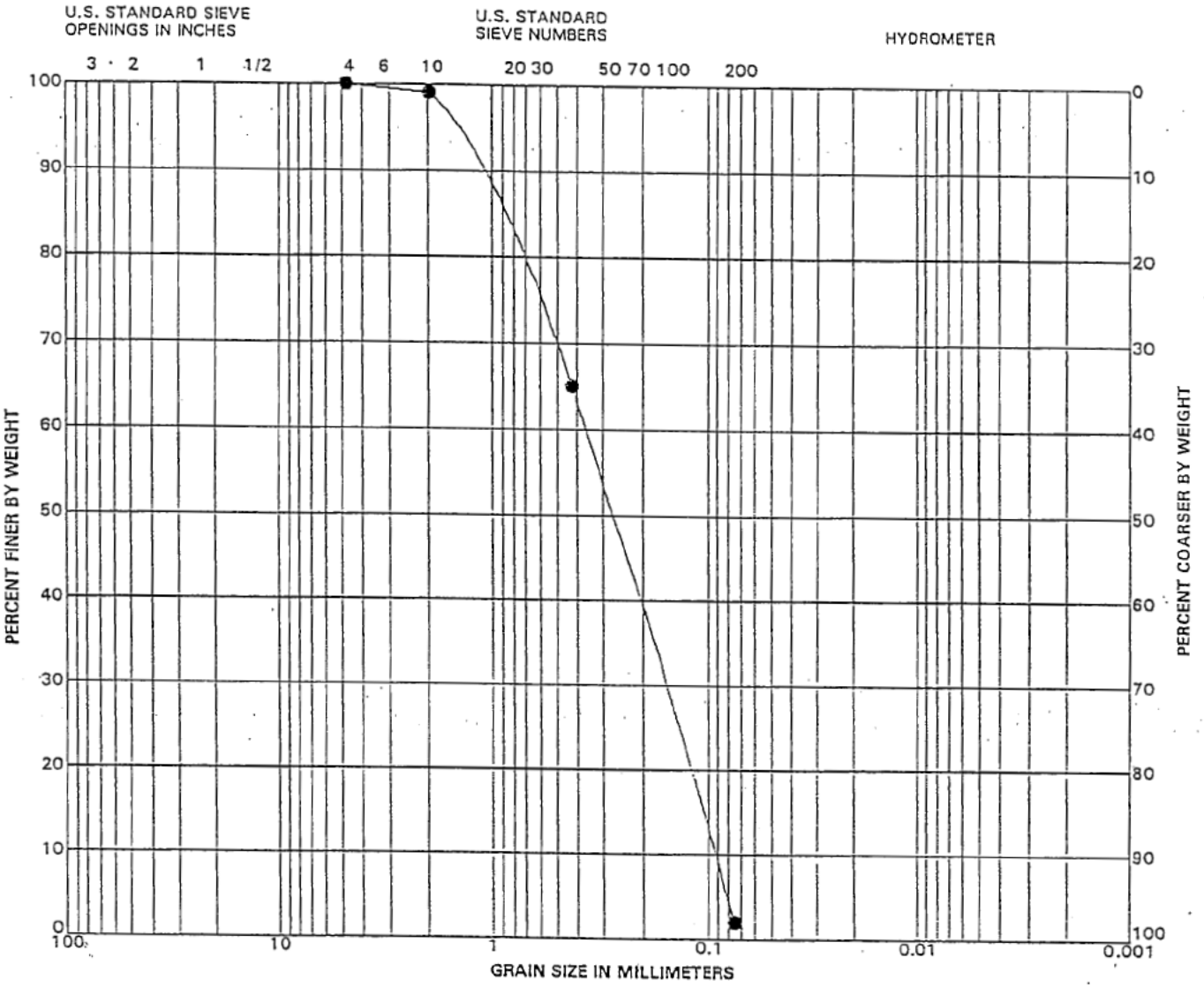
Sample No.:	B-26
Sample Depth:	10 to 11 1/2 feet
Moisture Content:	0.8%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Medium Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

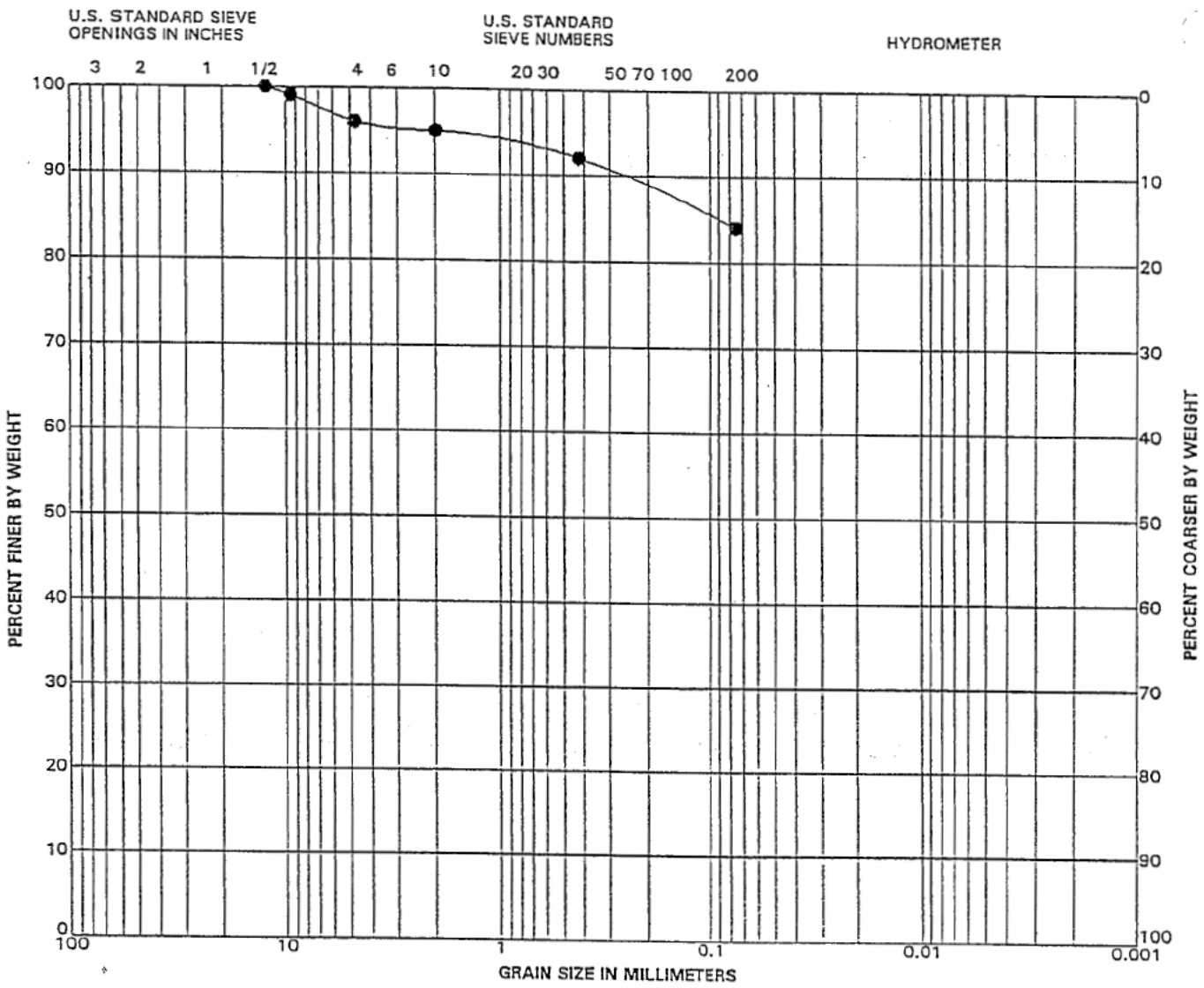
Sample No.:	B-26
Sample Depth:	50 to 51 1/2 feet
Moisture Content:	0.8%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

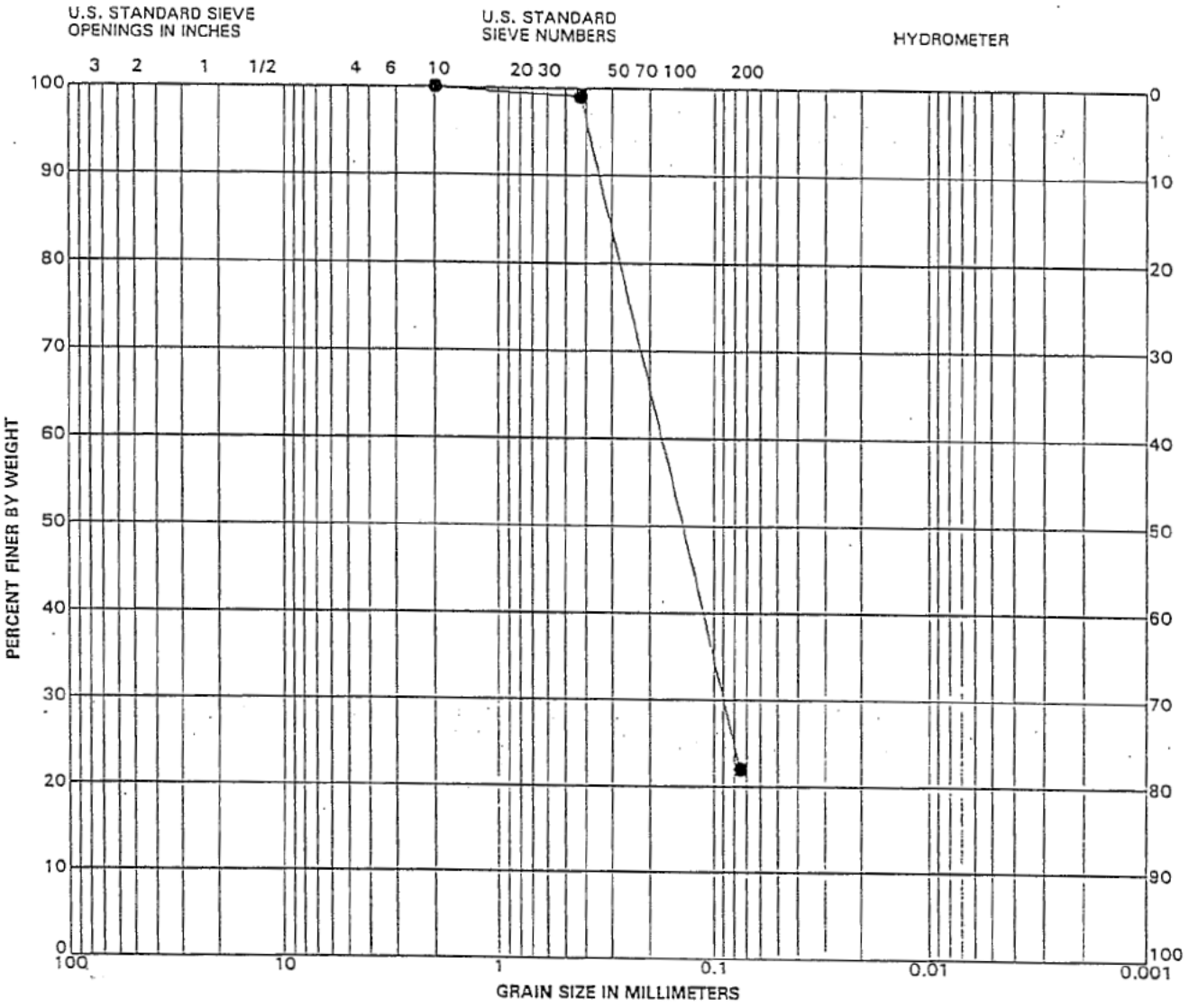
Sample No.:	B-26
Sample Depth:	75 to 76 1/2 feet
Moisture Content:	10.2%
Liquid Limit:	78
Plastic Limit:	18
Plasticity Index:	60
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Dry with sand
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

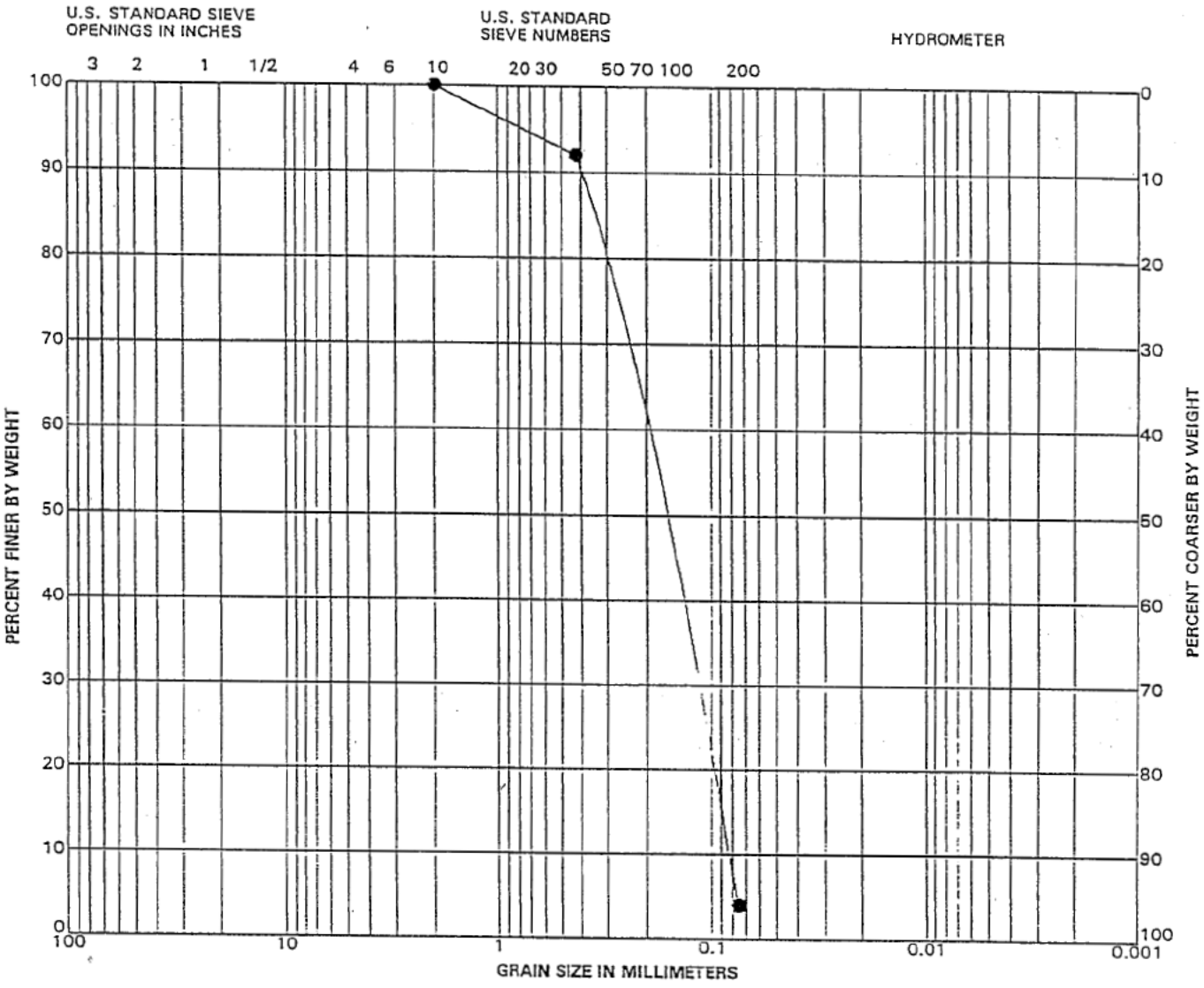
Sample No.:	B-26
Sample Depth:	90 to 91 1/2 feet
Moisture Content:	3.8%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SM
Material Description:	Sand, Fine Grained, Silty, Very Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

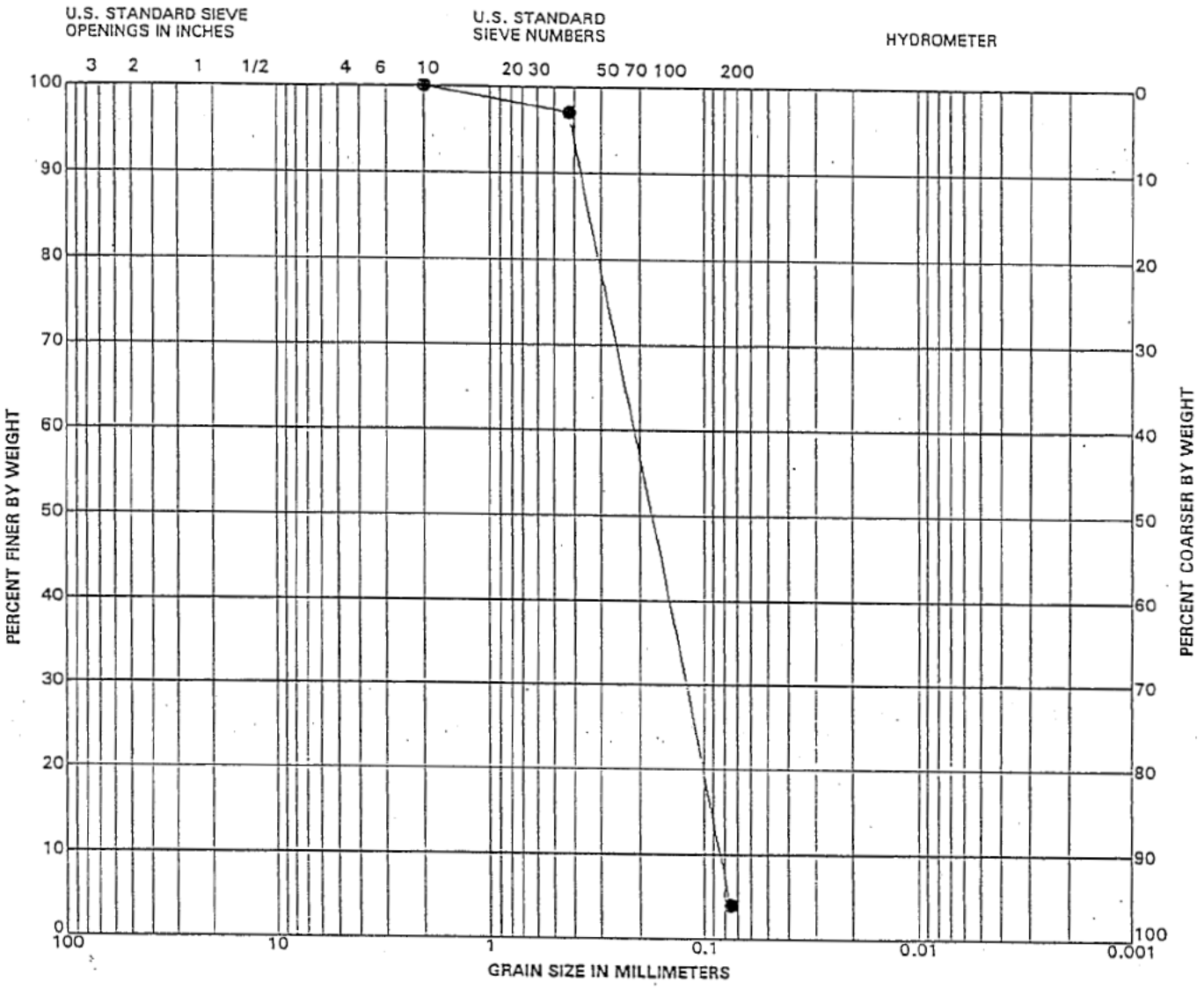
Sample No.: B-27
Sample Depth: 100 to 101 1/2 feet
Moisture Content: 3.2%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

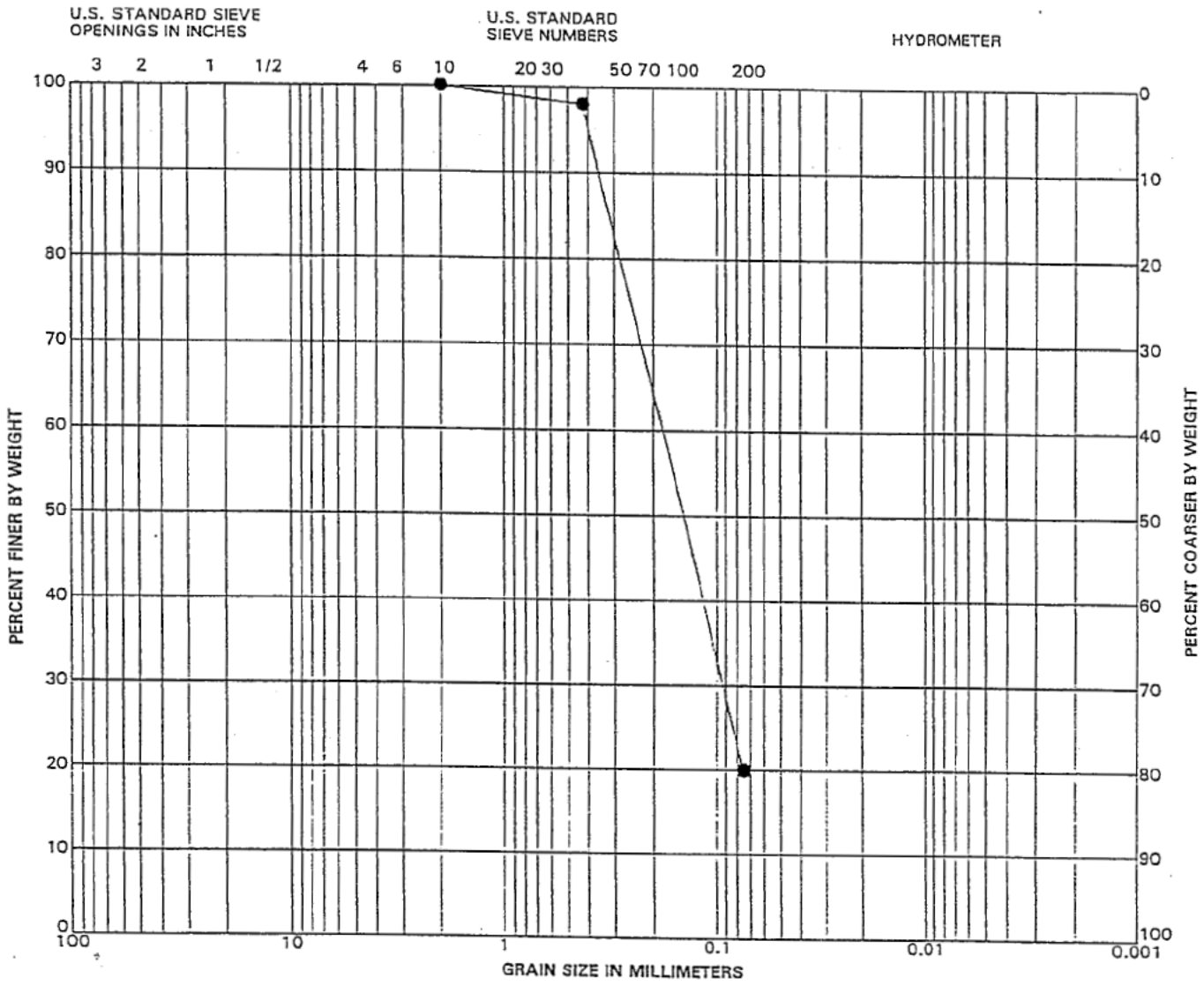
Sample No.:	B-28
Sample Depth:	100 to 101 1/2 feet
Moisture Content:	1.8%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

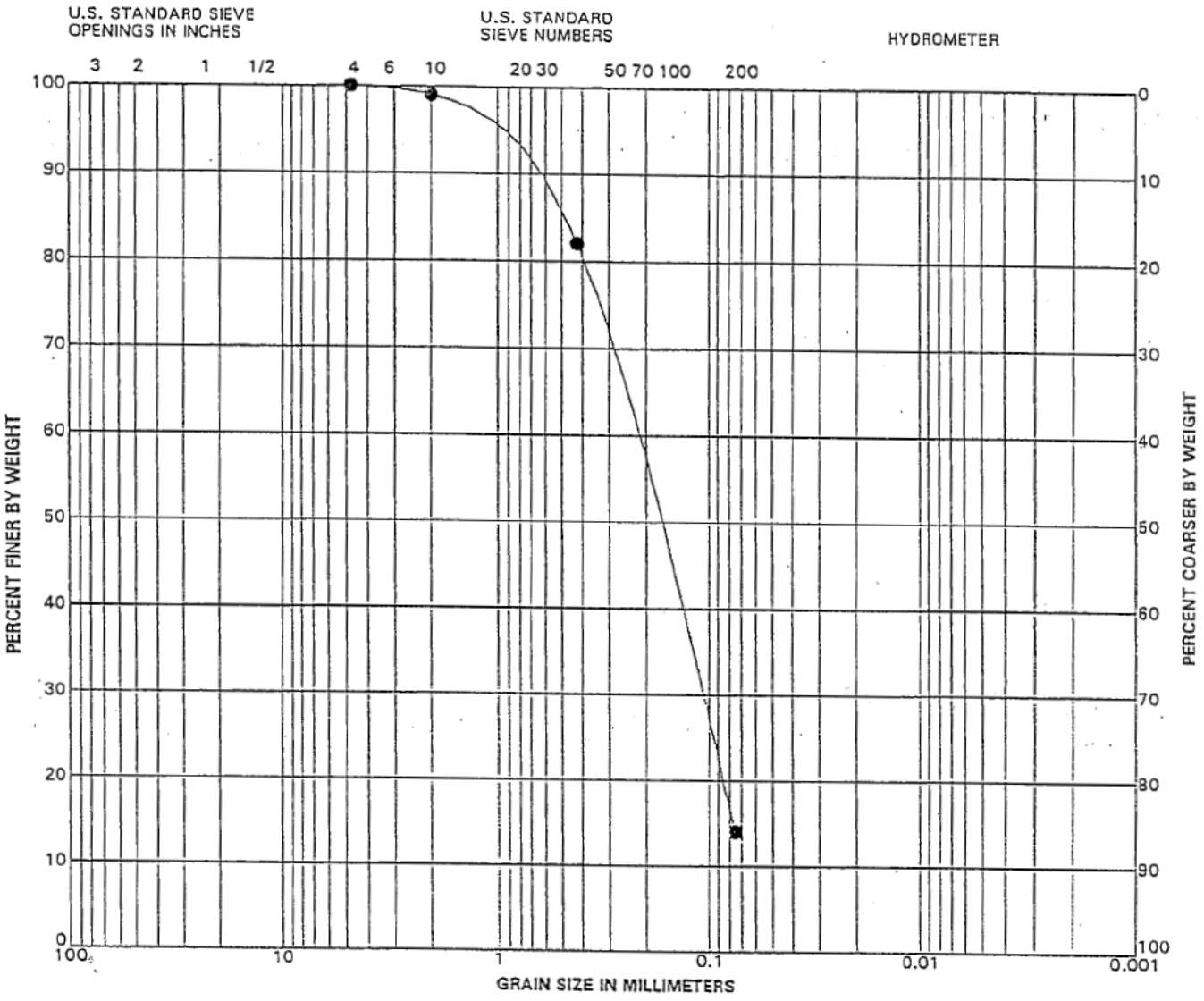
Sample No.: B-28
Sample Depth: 110 to 111 1/2 feet
Moisture Content: 5.8%
Liquid Limit: 61
Plastic Limit: 15
Plasticity Index: 46
Material Classification: SC
Material Description: Sand, Fine Grained, Clayey, Tan, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-0[illegible]

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

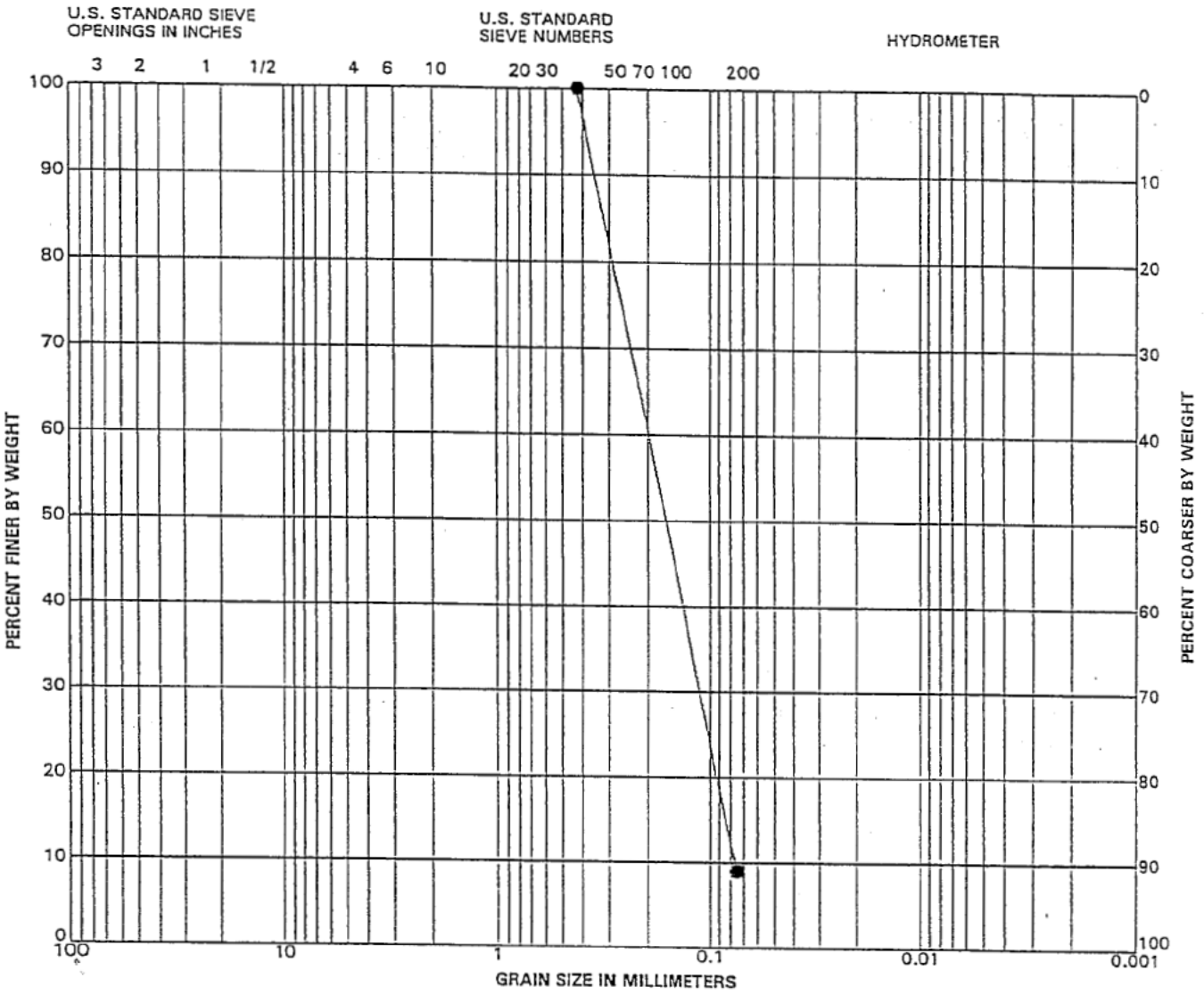
Sample No.:	B-30
Sample Depth:	60 to 61 1/2 feet
Moisture Content:	5.85%
Liquid Limit:	110
Plastic Limit:	22
Plasticity Index:	88
Material Classification:	SC
Material Description:	Sand, Fine Grained, Clayey, Tan, Dense, Dry
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

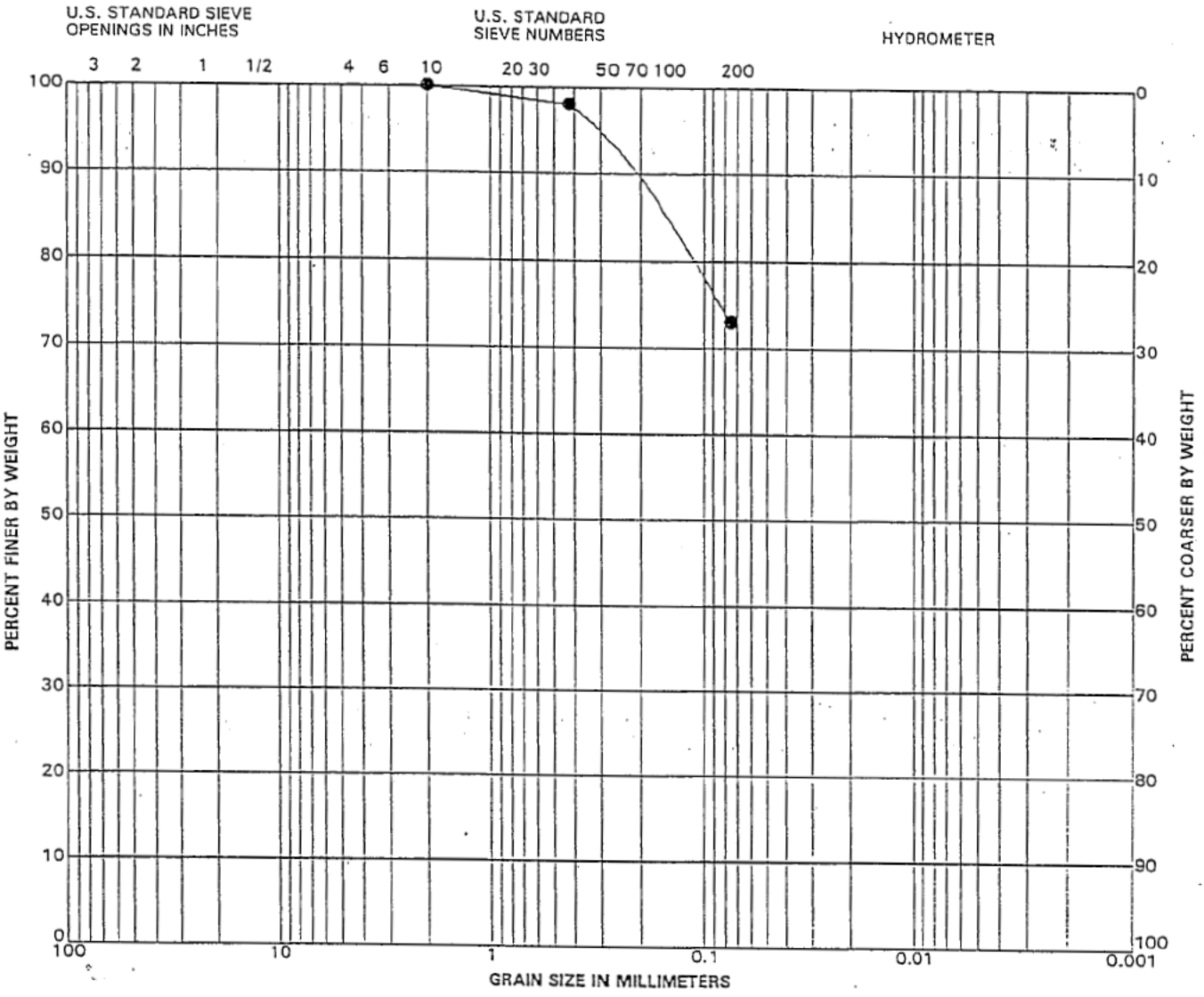
Sample No.:	B-30
Sample Depth:	100 to 101 1/2 feet
Moisture Content:	1.3%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

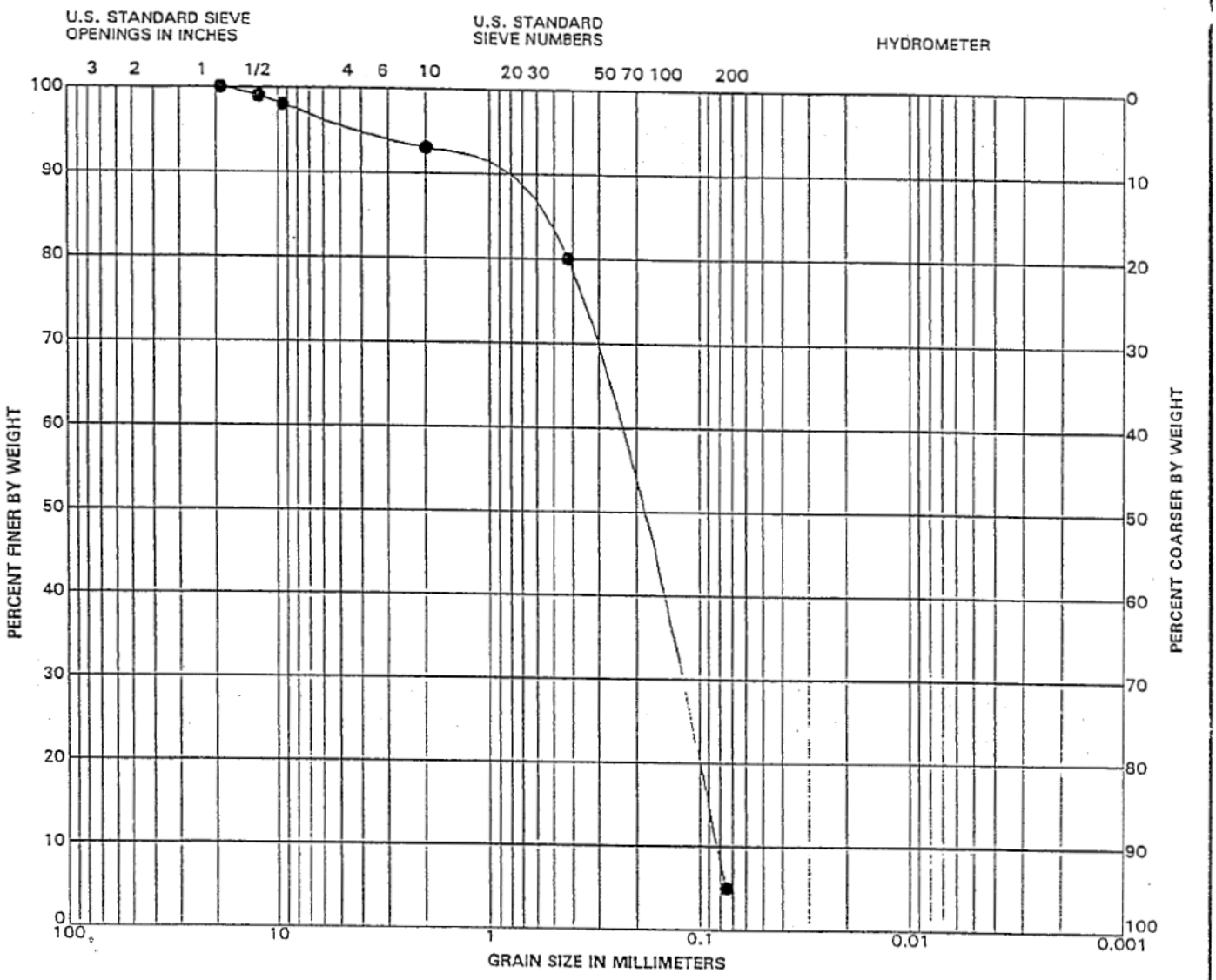
Sample No.:	B-31
Sample Depth:	5 to 6 1/2 feet
Moisture Content:	20.8%
Liquid Limit:	123
Plastic Limit:	24
Plasticity Index:	99
Material Classification:	CH
Material Description:	Clay, Sandy, Brown, Hard, Moist
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

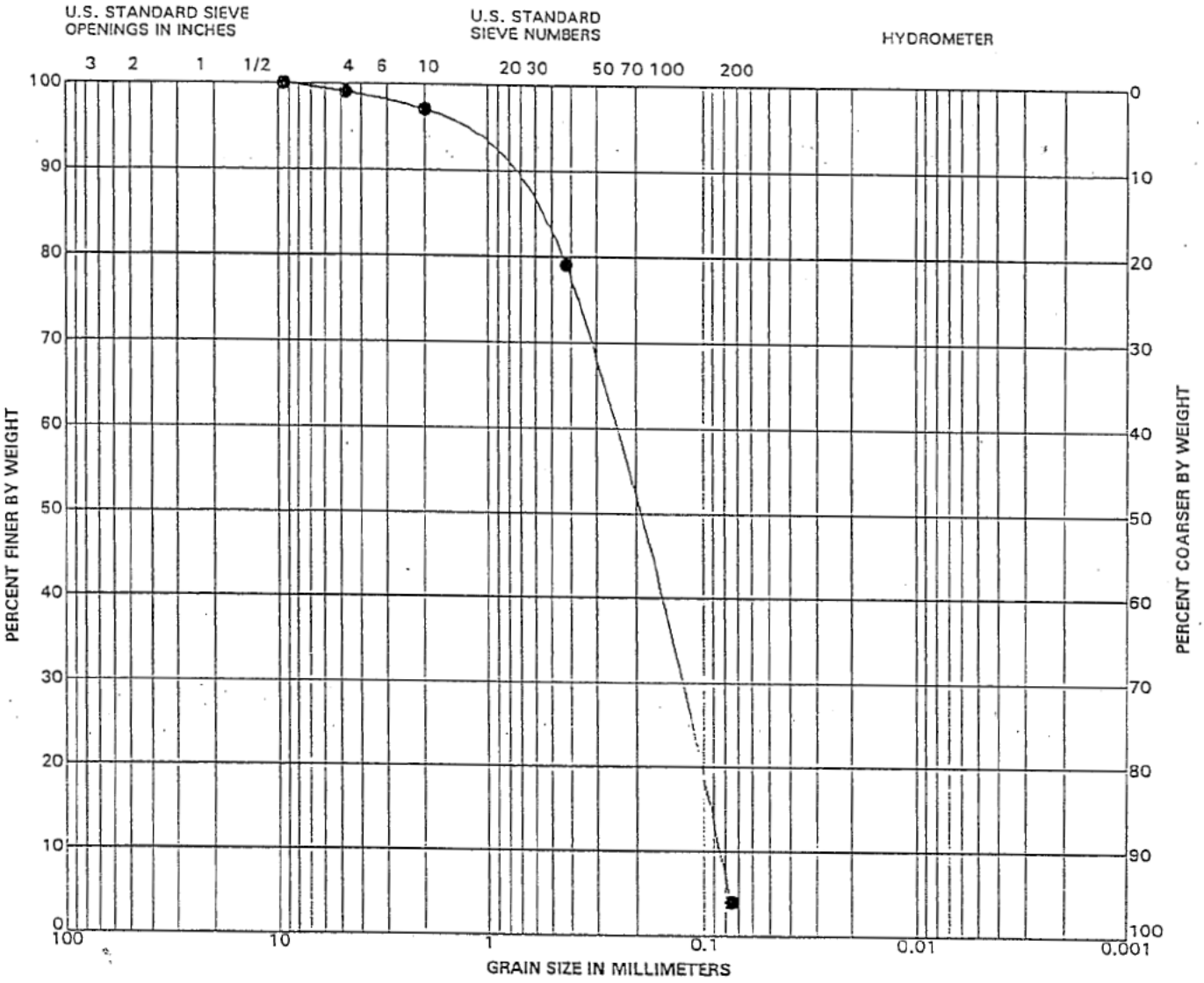
Sample No.:	B-31
Sample Depth:	20 to 21 1/2 feet
Moisture Content:	0.2%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Medium Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

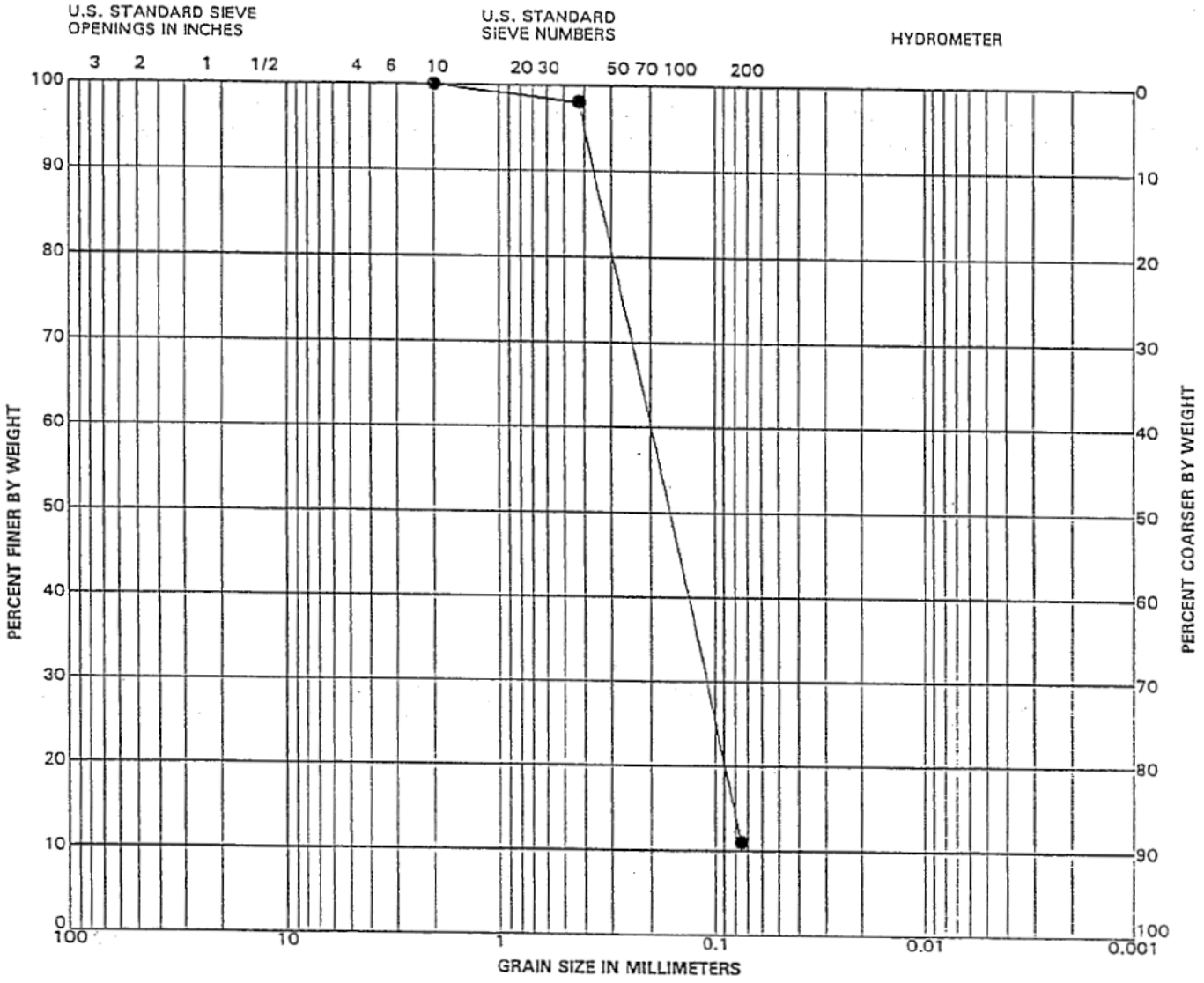
Sample No.: B-31
Sample Depth: 60 to 61 1/2 feet
Moisture Content: 1.2%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

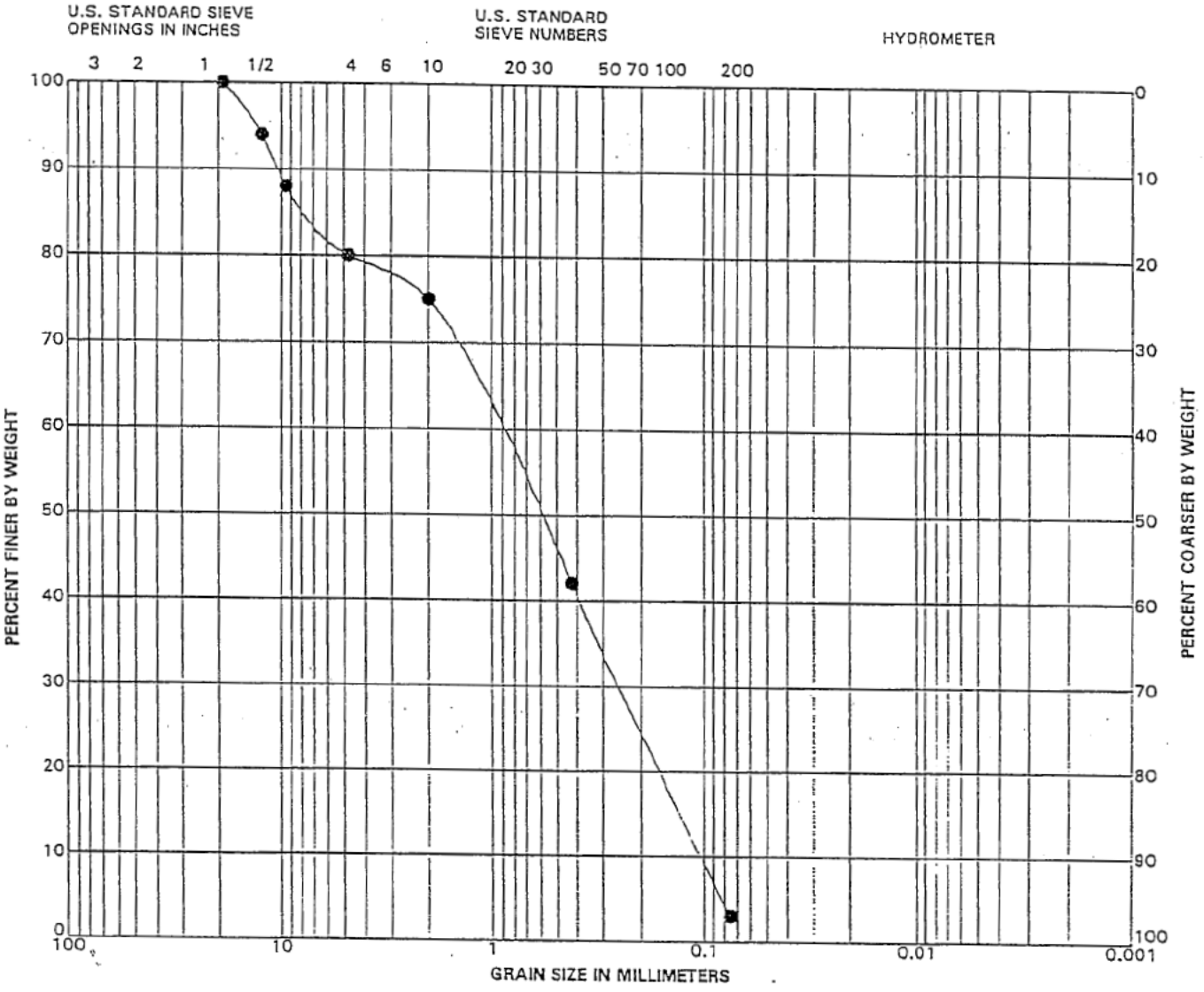
Sample No.:	B-33
Sample Depth:	100 to 101 1/2 feet
Moisture Content:	12.6%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP-SM
Material Description:	Sand, Fine Grained, Tan, Poorly Graded, Very Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

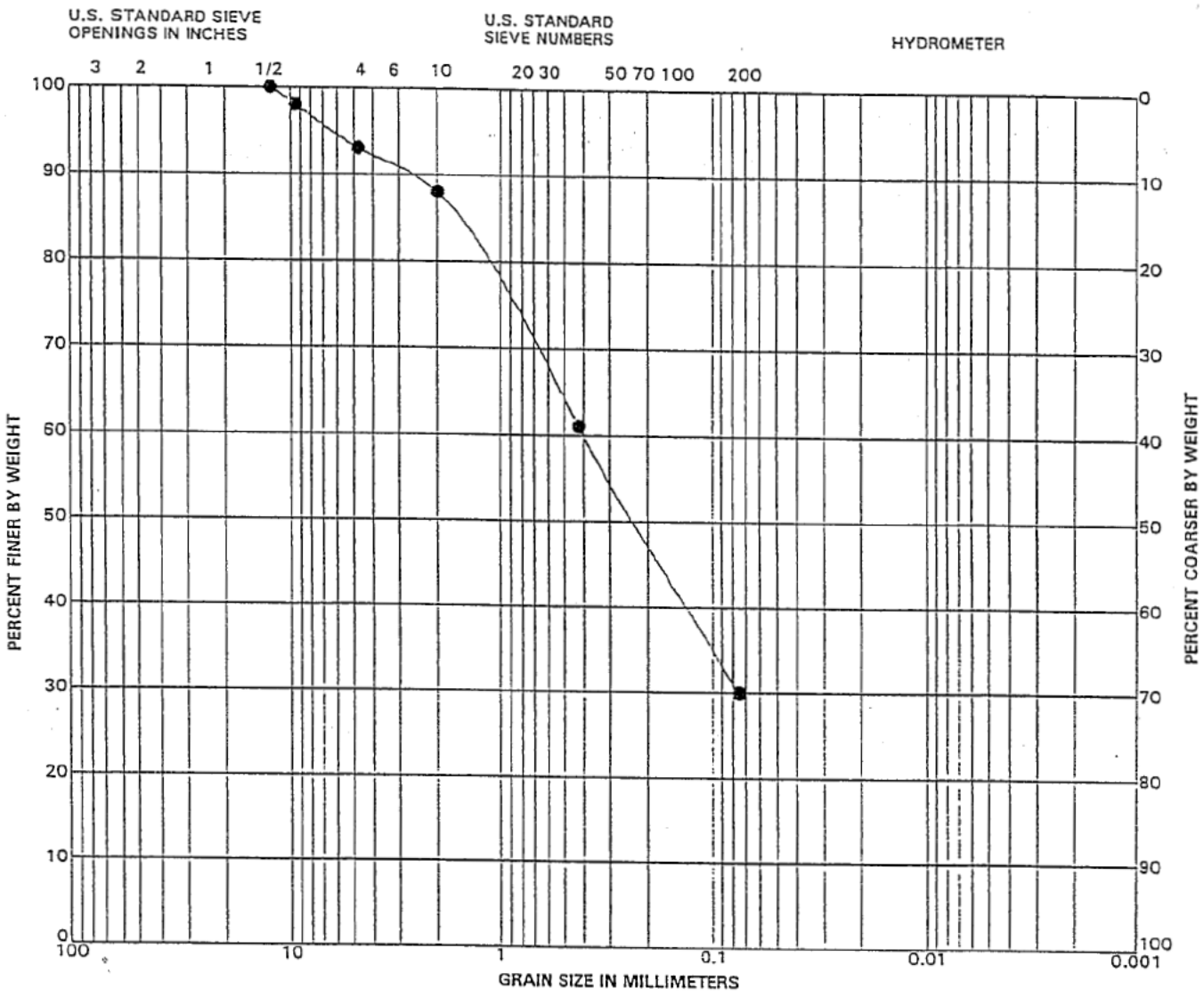
Sample No.: B-34
Sample Depth: 15 to 16 1/2 feet
Moisture Content: 1.1%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SP
Material Description: Sand, Fine to Medium Grained, Tan, Poorly Graded, Very Dense, Dry
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

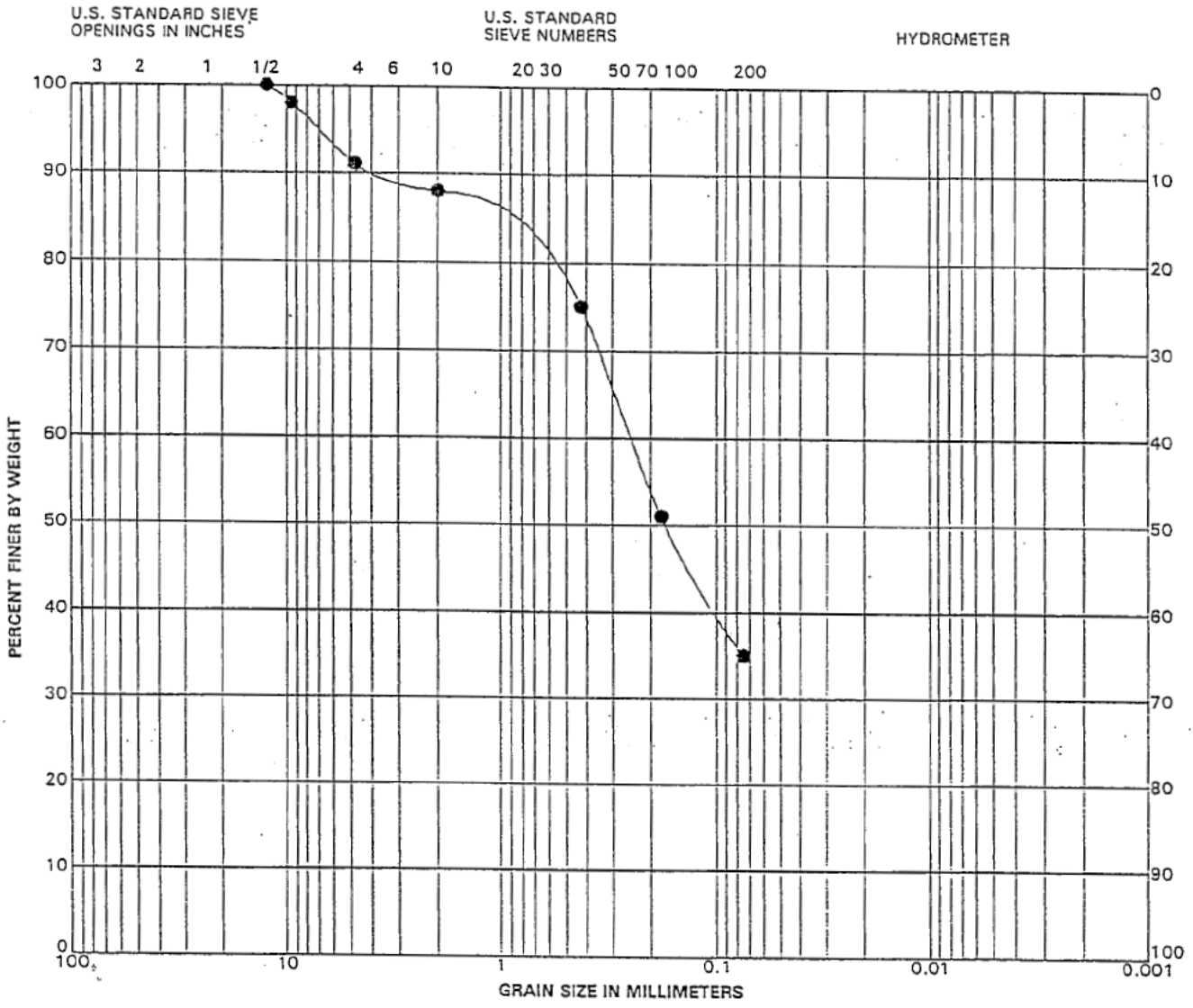
Sample No.:	B-34
Sample Depth:	55 to 56 1/2 feet
Moisture Content:	7.7%
Liquid Limit:	Not Tested
Plastic Limit:	Not Tested
Plasticity Index:	Not Tested
Material Classification:	-
Material Description:	Sand, Fine Grained, Clayey, Tan, Dense, Dry with traces of silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

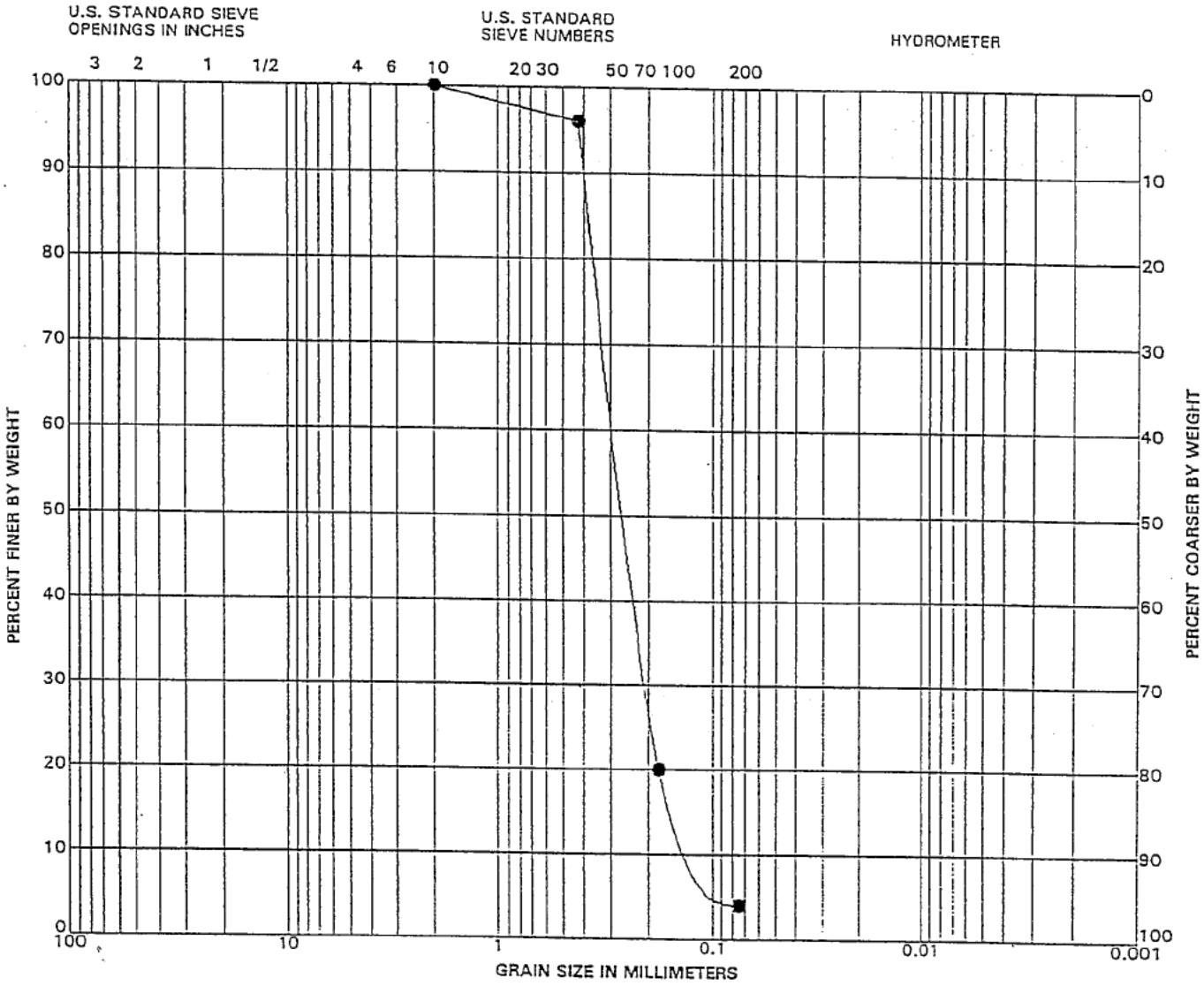
Sample No.: B-35
Sample Depth: 15 to 16 1/2 feet
Moisture Content: 13.8%
Liquid Limit: Not Tested
Plastic Limit: Not Tested
Plasticity Index: Not Tested
Material Classification: -
Material Description: Sand, Fine Grained, Clayey, Tan, Dense, Moist with silt
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

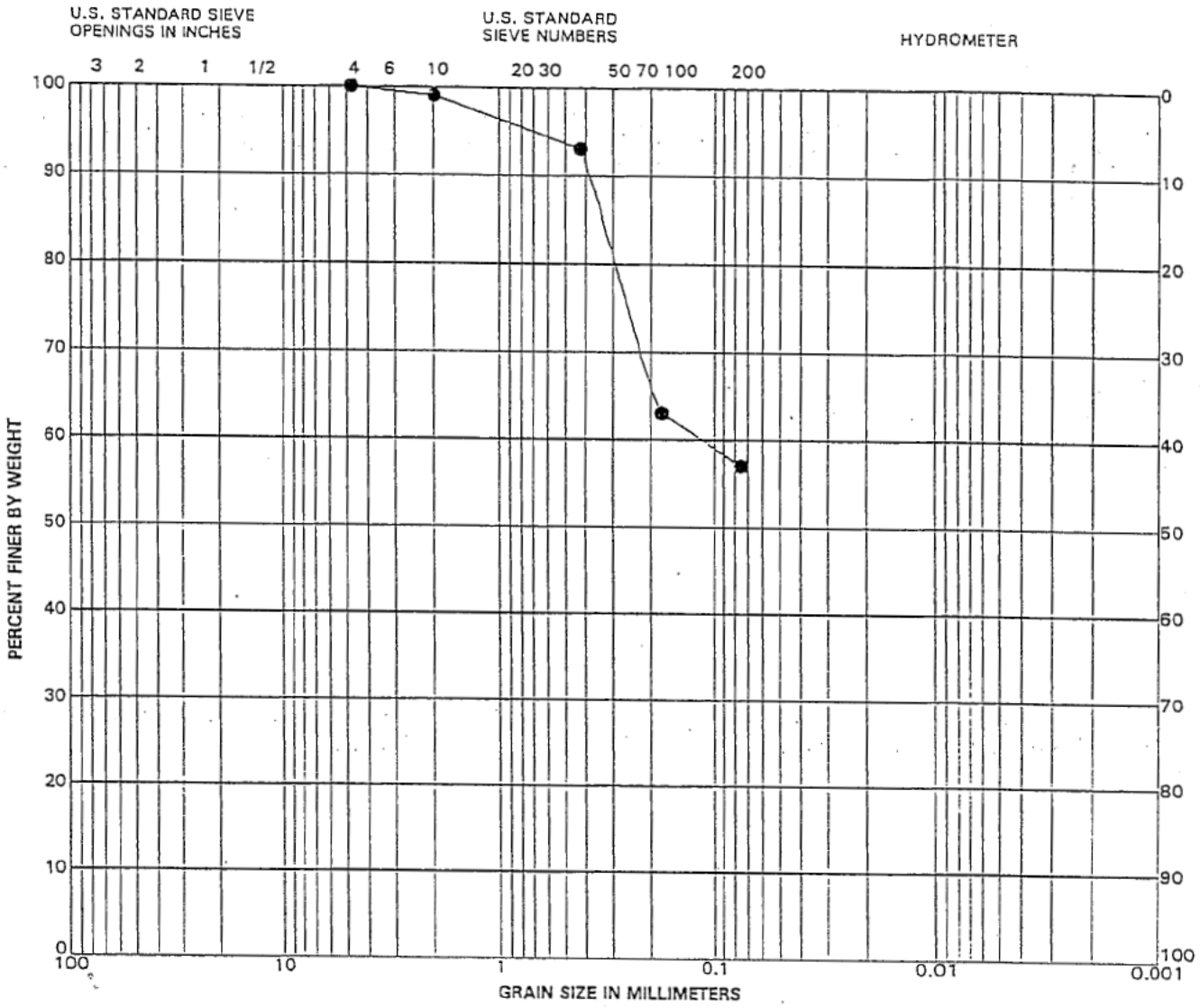
Sample No.:	B-35
Sample Depth:	45 to 46 1/2 feet
Moisture Content:	4.1%
Liquid Limit:	None
Plastic Limit:	None
Plasticity Index:	Nonplastic
Material Classification:	SP
Material Description:	Sand, Fine to Medium Grained, Tan, Poorly Graded, Dense, Dry with silt
ASTM Procedures:	D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

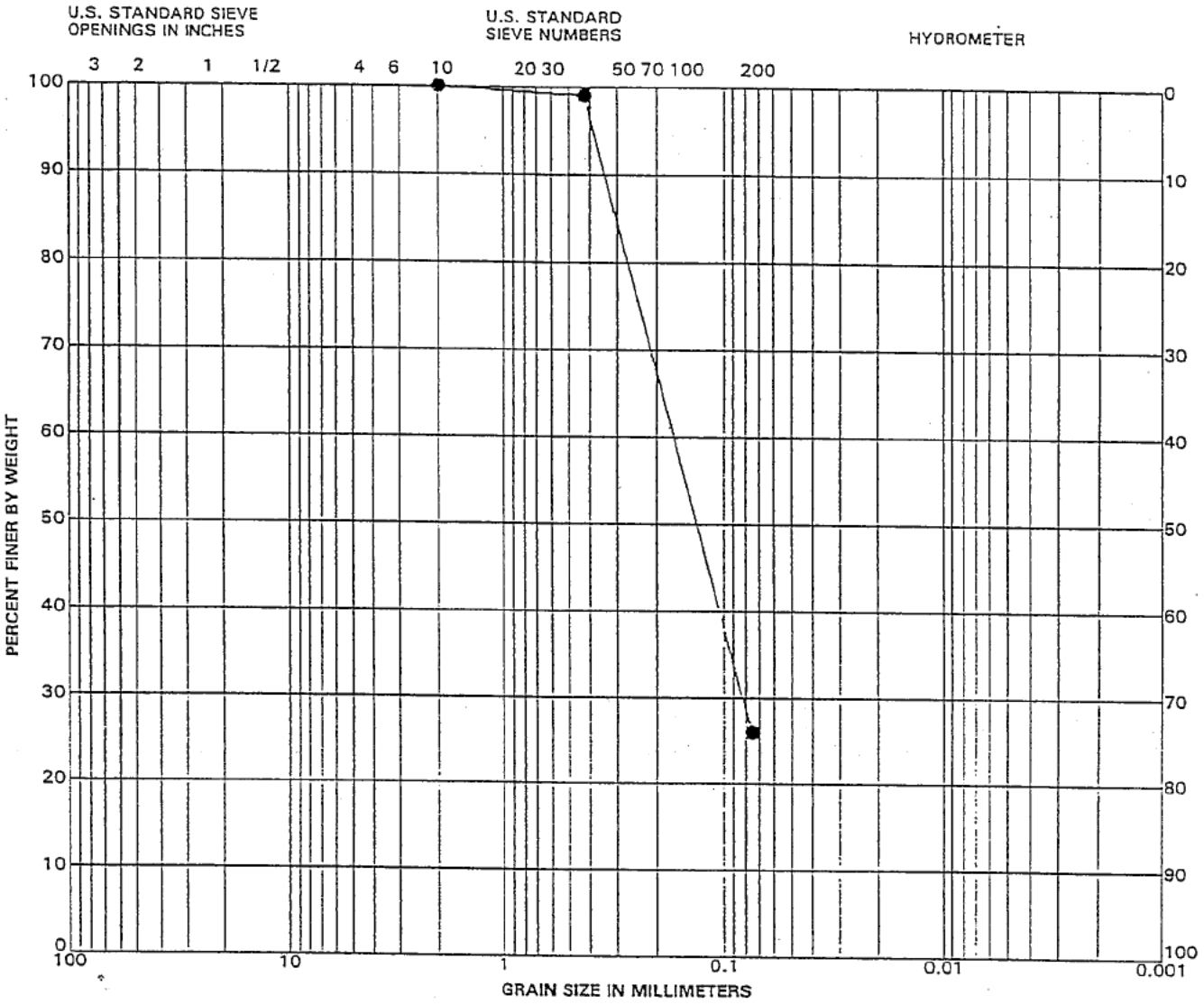
Sample No.: B-35
Sample Depth: 95 to 96 1/2 feet
Moisture Content: 13.7%
Liquid Limit: 67
Plastic Limit: 16
Plasticity Index: 51
Material Classification: CH
Material Description: Clay, Sandy, Brown, Hard, Moist
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

GRAIN SIZE DISTRIBUTION CURVE

Clint Landfill Permit Amendment
Clint, El Paso County, Texas



GRAVEL		SAND			SILT or CLAY
Coarse	*Fine*	*Coarse*	*Medium*	*Fine*	

Sample No.: B-35
Sample Depth: 105 to 106 1/2 feet
Moisture Content: 19.9%
Liquid Limit: None
Plastic Limit: None
Plasticity Index: Nonplastic
Material Classification: SM
Material Description: Sand, Fine Grained, Silty, Tan, Very Dense, Moist
ASTM Procedures: D2216, D2487, D4318

Raba-Kistner

Project No. AEA96-182-00

UNCONFINED COMPRESSIVE TEST (ASTM D-1266)

Date:12/16/98 Project No. AEA96-182-00
Project:Clint Landfill Permit Amendment Sample Location: PB-4 @ 335 feet

Soil Description: Clay,Sandy,Brown, Hard, Moist

Initial Sample Length: 3.28 in.
Initial Sample Area: 1.61 $in.^2$
Sample Weight: 0.38 lbf
Wet Density: 126.7 pcf
Dry Density: 103.7 pcf
Moisture Content: 22.2 %

Axial Load (lbs.)	Axial Deformation (in.)	Axial Strain (%)	Average Cross-Sectional Area ($in.^2$)	Normal Stress (psi)
0	0.00	0	1.61	0.00
11	0.01	0.34	1.61	6.8
19	0.02	0.61	1.62	11.8
28	0.03	0.88	1.62	17.3
40	0.04	1.34	1.63	24.6
52	0.06	1.86	1.64	31.8
58.6	0.08	2.44	1.65	35.6
67.9	0.10	3.05	1.66	41.0
74.3	0.12	3.66	1.67	44.6
78.7	0.14	4.36	1.68	46.9
83	0.17	5.12	1.69	49.0
87	0.19	5.79	1.70	51.0
89	0.22	6.55	1.72	51.8
91.4	0.24	7.16	1.73	52.8
84.2	0.26	7.93	1.74	48.3
86.6	0.29	8.69	1.76	49.2
97.5	0.32	9.60	1.78	54.9
99.6	0.34	10.43	1.79	55.6
101	0.37	11.28	1.81	55.8
102.3	0.40	12.20	1.83	55.9
103.5	0.43	13.02	1.85	56.1
104.4	0.45	13.84	1.86	56.0
106.7	0.48	14.63	1.88	56.7
107.3	0.51	15.40	1.90	56.5
108.7	0.53	16.28	1.92	56.7
108.4	0.57	17.23	1.94	55.9

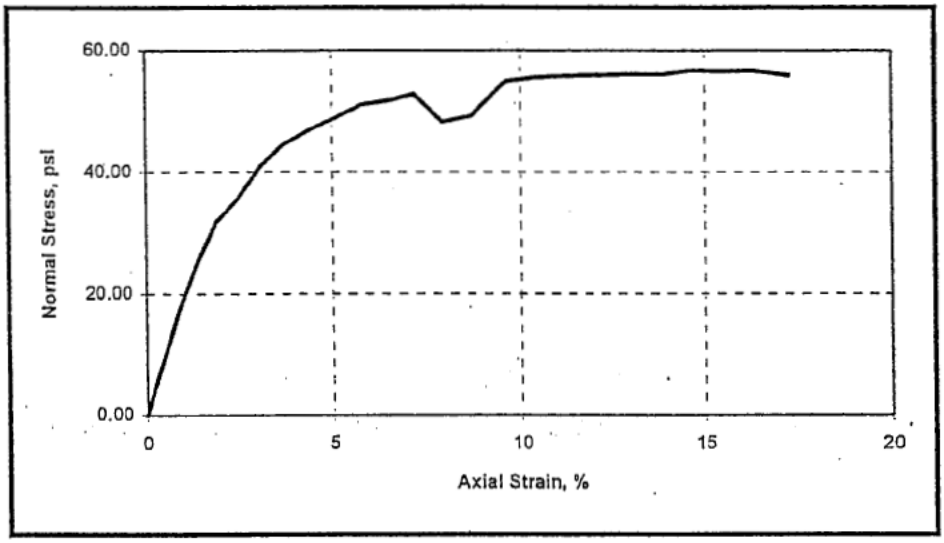
Ultimate Unconfined Strength,qu,psi	24.6
Undrained Shear Strength,Su,psi	12.3
Axial Strain at Failure, %	0.04

UNCONFINED COMPRESSIVE TEST (ASTM D-1266)

Date:12/16/98 Project No. AEA96-182-00
Project:Clint Landfill Permit Amendment Sample Location: PB-4 @ 335 feet

Soil Description: Clay,Sandy,Brown, Hard, Moist

Initial Sample Length:	3.28 in.
Initial Sample Area:	1.61 $in.^2$
Sample Weight:	0.38 lbf
Wet Density:	126.7 pcf
Dry Density:	103.7 pcf
Moisture Content:	22.2 %



UNCONFINED COMPRESSIVE TEST (ASTM D-1266)

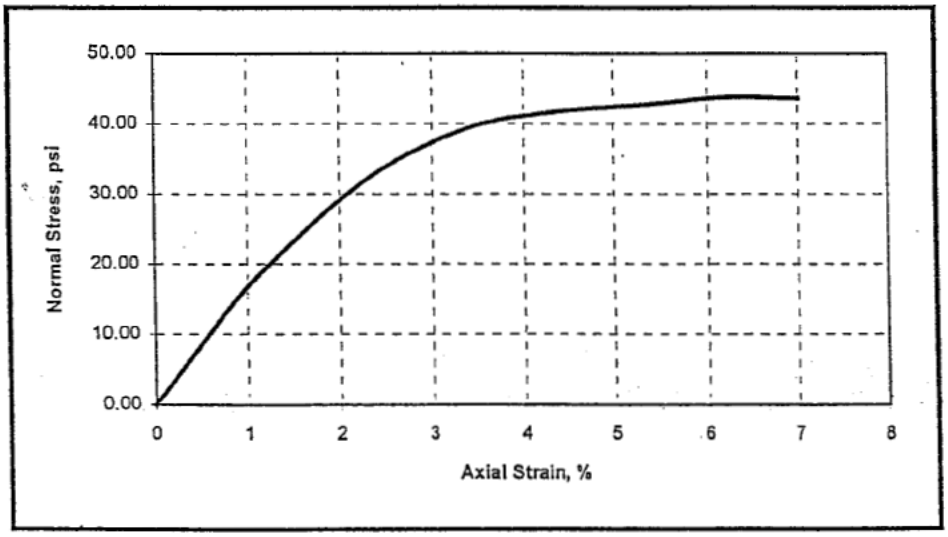
Date:9/17/98 Project No. AEA96-182-00
Project:Clint Landfill Permit Amendment Sample Location: B-25 @ 60 feet

Soil Description: Clay, Sandy,Brown, Hard, Moist

Initial Sample Length:	2.54 in.
Initial Sample Area:	1.54 $in.^2$
Sample Weight:	0.27 lbf
Wet Density:	121.0 pcf
Dry Density:	96.9 pcf
Moisture Content:	24.5 %

Axial Load (lbs.)	Axial Deformation (in.)	Axial Strain (%)	Average Cross-Sectional Area ($in.^2$)	Normal Stress (psi)
0	0.00	0	1.54	0.00
29.2	0.03	1.14	1.56	18.8
51.5	0.06	2.36	1.58	32.7
62.6	0.09	3.39	1.59	39.3
67	0.11	4.33	1.61	41.6
69.4	0.14	5.31	1.63	42.7
71.8	0.16	6.18	1.64	43.8
72.2	0.18	7.01	1.65	43.6

Ultimate Unconfined Strength,Qu,psi	43.6
Undrained Shear Strength,Su,psi	21.8
Axial Strain at Failure, %	7.0



UNCONFINED COMPRESSIVE TEST (ASTM D-1266)

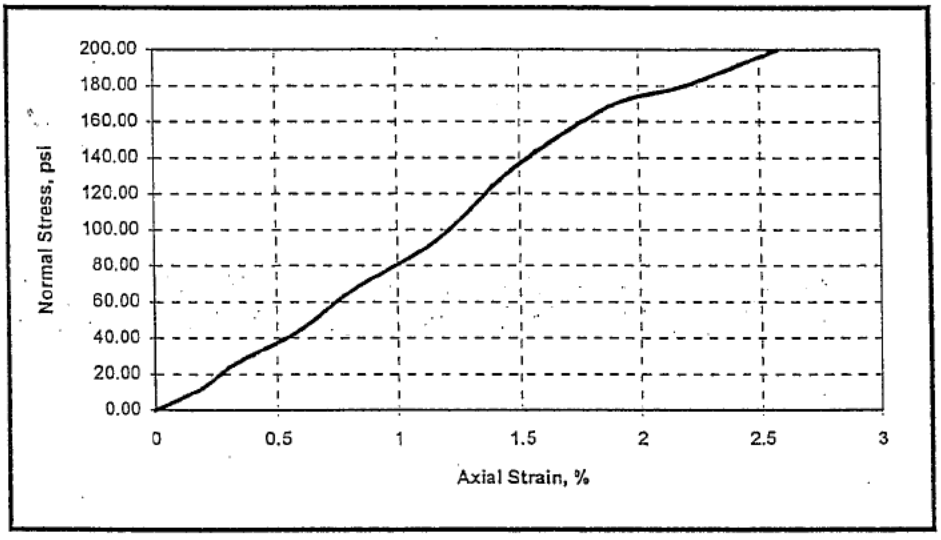
Date:9/17/98 Project No. AEA96-182-00
Project:Clint Landfill Permit Amendment Sample Location: B-25 @ 80-81.5 feet

Soil Description: Clay,Brown, Hard, Moist

Initial Sample Length:	3.11 in.
Initial Sample Area:	1.41 $in.^2$
Sample Weight:	0.32 lbf
Wet Density:	127.6 pcf
Dry Density:	103.7 pcf
Moisture Content:	23 %

Axial Load (lbs.)	Axial Deformation (in.)	Axial Strain (%)	Average Cross-Sectional Area ($in.^2$)	Normal Stress (psi)
0	0.00	0	1.41	0.00
17.4	0.01	0.19	1.41	12.3
35.4	0.01	0.32	1.41	25.0
61.4	0.02	0.58	1.42	43.3
93.4	0.03	0.80	1.42	65.7
134	0.04	1.16	1.43	93.9
192	0.05	1.48	1.43	134.2
241.3	0.06	1.86	1.44	167.9
259.5	0.07	2.19	1.44	180.0
288.6	0.08	2.57	1.45	199.4

Ultimate Unconfined Strength,qu,psi	199.4
Undrained Shear Strength,Su,psi	99.7
Axial Strain at Failure, %	2.6



UNCONFINED COMPRESSIVE TEST (ASTM D-1266)

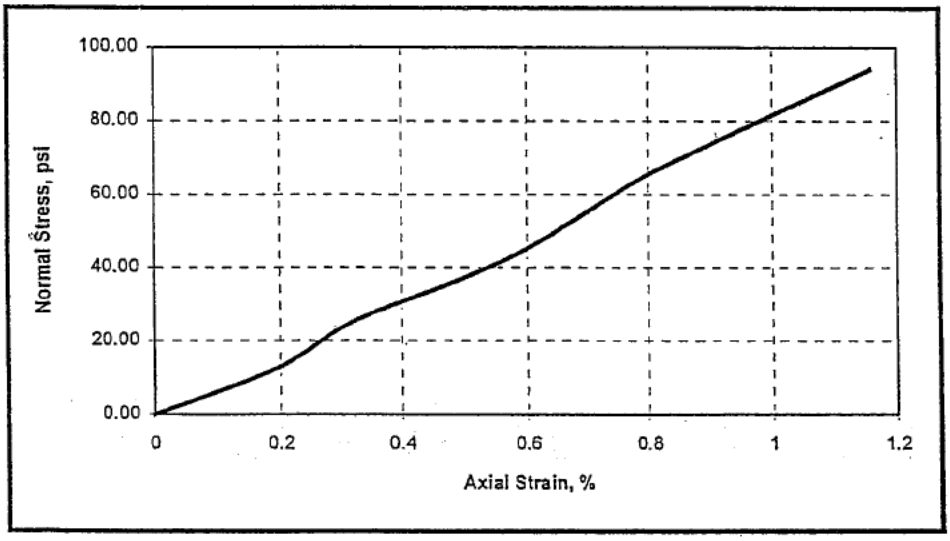
Date:9/17/98 | Project No. AEA96-182-00
Project:Clint Landfill Permit Amendment | Sample Location: B-31 @ 5-6.5 feet

Soil Description: Clay, Brown, Hard, Moist

Initial Sample Length:	2.92 in.
Initial Sample Area:	1.43 $in.^2$
Sample Weight:	0.31 lbf
Wet Density:	129.6 pcf
Dry Density:	107.3 pcf
Moisture Content:	20.8 %

Axial Load (lbs.)	Axial Deformation (in.)	Axial Strain (%)	Average Cross-Sectional Area ($in.^2$)	Normal Stress (psi)
0	0.00	0	1.43	0.00
64.4	0.04	1.27	1.45	44.5
174	0.07	2.40	1.47	118.8
270	0.11	3.70	1.48	181.8
325	0.15	5.07	1.51	215.8
359	0.19	6.51	1.53	234.7

Ultimate Unconfined Strength,Qu,psi	234.7
Undrained Shear Strength,Su,psi	117.4
Axial Strain at Failure, %	6.5



APPENDIX III.F – GROUNDWATER SAMPLING AND ANALYSIS PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

APPENDIX III.F – GROUNDWATER SAMPLING AND ANALYSIS PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 1
MAY 16, 2025

Part III, Appendix III.F
Groundwater Sampling and Analysis Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024
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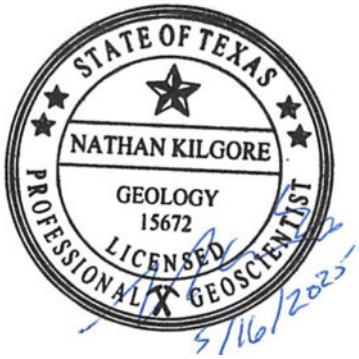

prepared by

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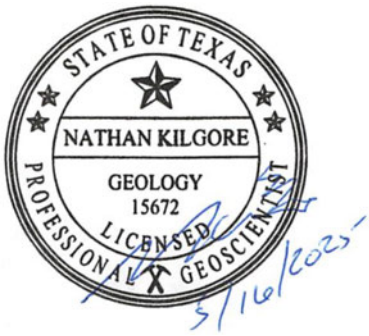

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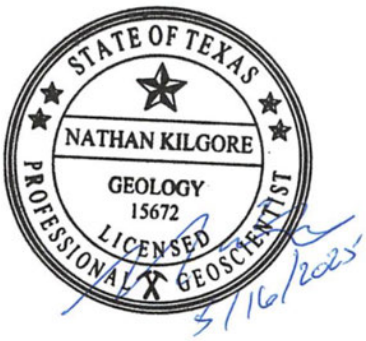


List of Abbreviations

Abbreviation	Term/Phrase/Name
30 TAC	Texas Administrative Code, Title 30
ASD	alternate source demonstration
Bgs	Below ground surface
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DOT	Department of Transportation
ED	Texas Commission on Environmental Quality Executive Director
EPA	United States Environmental Protection Agency
Facility, GEP Landfill	Greater El Paso Landfill, MSW Authorization No. 2284A
Ft	Feet
GWSAP	Groundwater Sampling and Analysis Plan
GWPS	groundwater protection standard
HDPE	High-density polyethylene
HNO3	Nitric acid
LCN	Laboratory Case Narrative
LOQ	Limit of Quantitation
LSOP	Laboratory Standard Operating Procedures
MCL	maximum contaminant level
MDL	method detection limit
MS/MSD	matrix spike and matrix spike duplicate
MSW	Municipal Solid Waste
NELAC	National Environmental Laboratory Accreditation Conference
PQL	practical quantitation limits
QA/QC	quality assurance/quality control
RL	reporting limit
semi-VOCs	semi-volatile organic compounds
SSI	Statistically Significant Increase
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

III.F.1.0 Introduction

This Groundwater Sampling and Analysis Plan (GWSAP) addresses the groundwater monitoring and sampling program at the existing Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill or Facility) in El Paso County, Texas. This GWSAP has been previously approved and has been updated to comply with Title 30 of the Texas Administrative Code (30 TAC) Chapter 330, Subchapter J: Groundwater Monitoring and Corrective Action. The GWSAP covers the procedures for collecting representative samples from groundwater monitoring wells and the basic laboratory requirements for obtaining valid, defensible data. The GWSAP is limited to sampling and analysis requirements and does not include monitoring well siting, design, construction, or well development procedures. Groundwater monitoring will be conducted at the facility throughout the active life of the facility and through the post-closure care period, pursuant to 30 TAC §330.401(f).

In accordance with 30 TAC §330.403(d), all parts of the previously approved groundwater monitoring system will be operated and maintained so that they perform at least to design specifications through the life of the groundwater monitoring program. Certification of the previously approved groundwater monitoring system is provided in **Attachment III.F.7**.

In accordance with 30 TAC §330.403(e)(3), the owner/operator shall promptly notify the executive director, and any local pollution agency with jurisdiction that has requested to be notified, in writing of changes in facility construction or operations or changes in adjacent property that affect or are likely to affect the direction and rate of groundwater flow and the potential for detecting groundwater contamination from a solid waste management unit and that may require the installation of additional monitoring wells or sampling points. Such additional wells or sampling points require a modification of the site development plan.

There are no known contamination plumes at the facility; however, if contamination plumes are identified, in accordance with 30 TAC §330.63(f)(2), a description of any plume of contamination that has entered the groundwater from an MSW management unit will be included. Additionally, the extent of the plume will be delineated on a map and the concentration of each assessment constituent will be identified.

This is an existing facility. Based on historical groundwater monitoring results of the facility and previous geological investigation of the subsurface of the facility, the most likely pollutant pathway for pollutant migration in the event that the primary barrier liner system is penetrated would be from the waste to the underlying soils and then to the groundwater which has been historically measured at depths ranging from approximately 286 to 378 feet (ft) below ground surface (bgs) at the facility, with an average depth to groundwater measured at approximately 359 ft bgs.

III.F.2.0 Groundwater Elevation Monitoring

III.F.2.1 Groundwater Monitoring Well Inspection

During each groundwater monitoring event, the groundwater monitoring wells will be inspected for damage to the well casing, protective cover, lock, well cap, concrete pad and well number designation. In addition, the ground surface around the well pads will be inspected for erosion. A topographic map with the existing groundwater monitoring well and piezometer locations is provided in **Attachment III.F.1**. If any problems are discovered, they will be repaired or replaced as soon as practicable. Information regarding the monitoring well's integrity will be recorded on the Groundwater Sampling Field Data Sheet (or an equivalent form) provided in **Attachment III.F.2**. Only those items that require repair or replacement will be included on the Field Data Sheet. If the monitoring well appears to be in adequate shape, then it will be recorded on the Field Data Sheet that the well components are in acceptable condition.

III.F.2.2 Water-Level Measurement Procedures

Groundwater-level measurements will be collected using an electronic water-level indicator marked in 1-foot and 0.01-foot increments. The total well depth will also be measured and recorded on the Groundwater Sampling Field Data Sheet (or an equivalent form) provided in **Attachment III.F.2**. To minimize the potential effects of water-level variation across the site, the water levels in the monitoring wells will be measured before purging or bailing of groundwater in the monitoring wells. Groundwater level and total well depth measurements will be recorded to the nearest 0.01 foot from an established and surveyed location that is permanently marked on top of the monitoring well casing, as described in 30 TAC §330.421(d). Water-level measurements will be collected over a period of time short enough to avoid temporal variations in the water levels. When a measurement is collected, the measuring device will be raised and lowered several times to be sure the correct reading is read off the measuring device.

If an obvious discrepancy is observed during water-level measurement, the water level will be measured again to ensure the measurement was recorded correctly.

Prior to collecting water-level measurements, the measuring device will be checked for damage, including bends or kinks in the tape, and accuracy.

III.F.3.0 Decontamination Procedures

Prior to beginning each groundwater sampling event, as well as prior to sampling each groundwater monitoring well, all non-dedicated equipment, including the water-level measuring device, will be decontaminated thoroughly to minimize the potential for cross contamination. The decontamination procedures will consist of cleaning all components of the equipment that may come in contact with groundwater with an environmentally safe detergent or solution that does not contain the constituents of concern at the facility. After the detergent has been adequately applied, the equipment will be thoroughly flushed or rinsed with deionized water. Equipment may need to be fully or partially disassembled for adequate decontamination. The decontamination procedures will be performed at least one time and may be repeated if contamination is thought to remain on the equipment after initial decontamination. Additional decontamination and rinsing may be performed at the discretion of the sampling personnel based on groundwater monitoring data. Decontamination of larger items may be accomplished by steam cleaning. During decontamination, a container will be used to containerize all liquids generated during the decontamination process. Containerized liquids generated from decontamination activities will be stored in approved Department of Transportation (DOT) drums, or equivalent, and stored in a designated area at the facility, sampled, and managed according to laboratory analytical results. Each container will be typically labeled with the well identification number, the date of collection and the contents of the specific container. The method of management of the liquids will be based on analytical results.

The method of disposal of the container contents will be based on analytical results. If the analytical results indicate that the contents in the containers are not contaminated, then the contents will be discharged in the vicinity of the well.

III.F.4.0 Groundwater Sample Collection

Groundwater samples may be collected via the snap sampler (passive) method, which is the preferred method of groundwater sampling at the facility, or via the monitoring well purging method. This section describes the two methods, as well as proper groundwater sample collection, preservation, quality control, and water management from groundwater sampling and equipment decontamination activities. Field filtering of groundwater samples will not be performed, in accordance with 30 TAC §330.405(c)

Prior to conducting the sampling activities, all water quality instrumentation will be calibrated. Calibration of the instruments will be conducted in accordance with the manufacturer's suggested procedures or other industry standard best practices. Calibration shall occur at a minimum of once per day during sampling events, prior to commencement of the scheduled sampling activities. Any malfunctioning instrumentation will be repaired or replaced prior to sampling activities.

III.F.4.1 Snap Sampling Procedures (Passive)

Prior to each sampling event, the groundwater level in each monitoring well and the total well depth will be measured as described in **Section III.F.2.0**. The snap sampling method involves collecting groundwater samples passively without disturbing the groundwater within the well. The monitoring well's groundwater flows in and through the open ends of the sample containers held within the snap sampler assembly until the samples are ready to be collected.

Groundwater samples are collected by closing the deployed sample containers held within the snap sampler assembly using a pneumatic battery powered electric pump. The pump pressurizes the hollow lift tube attached to the snap sampler assembly, to a pressure of above 50 psi which triggers the sampler caps to close, collecting an undisturbed real time sample at each monitoring well. Snap samples must not be collected after any disturbance of groundwater within the monitoring well (i.e. purging), without letting groundwater restabilize. Restabilization refers to the period of time required for groundwater within the monitoring well to reach its ambient state following physical agitation.

The closed snap sampler will be reeled out of the monitoring well using the hollow lift tube attached to the sampler assembly. Samples are collected by detaching the 350-mL polypropylene sample containers from the body of the snap sampler assembly and filling the sample containers. Sample container filling order and procedures are detailed in **Section III.F.4.3**.

The remaining groundwater in the snap sample will be poured in a graduated cylinder, or similar container, and groundwater quality parameters will be recorded. Parameters to be recorded include temperature, specific conductivity, and pH. Excess groundwater and decontamination water will be managed according to the procedures outlined in **Section III.F.3.0**.

Procedures performed after sample collection are described in **Section III.F.4.3**.

Finally, the sample containers will be reattached to the body of the snap sampler assembly, reset to the open position, and redeployed into the monitoring well. As described in **Section III.F.3.0**, the sampler will be decontaminated thoroughly and deployed into the monitoring well, with sample container caps in the open position for the next sampling event, where it must remain a minimum of 2 weeks before the next sampling event. The time period for restabilization is necessary to allow groundwater to reach its ambient state following physical agitation and to reach chemical equilibrium with formation water. Recommended

sample containers, preservation, and holding times for the analyses listed in this GWSAP are presented in **Section III.F.5.5**.

III.F.4.2 Monitoring Well Purging Procedures

Prior to each groundwater sampling event, the groundwater level in each groundwater monitoring well and the total well depth will be measured as described in **Section III.F.2.0**. Groundwater sampling will consist of purging or bailing a calculated amount of groundwater from each well, while collecting groundwater quality data, prior to groundwater sample collection. The volume of water to be removed from each well will be based on the well casing volume and the calculated amount of groundwater in the well casing.

The wells will be purged or bailed of at least three calculated well casing volumes or until the well is purged or bailed dry before collecting a groundwater sample. If the well is purged or bailed dry, the sampling personnel will allow the groundwater to adequately recover in the monitoring well before collecting a representative sample. The purging process will continue until the readings stabilize and three volumes have been removed or until the well is purged dry. Parameter stabilization is defined as:

- Specific Conductivity = +/-10% for three (3) consecutive measurements
- pH = +/-0.2 standard pH units for three (3) consecutive measurements
- Temperature = +/-10% for three (3) consecutive measurements

During purging of the well, water quality parameters, including temperature, conductivity, pH, and any other relevant parameters will be collected. The parameters will be measured after each well calculated volume that is removed and prior to sample collection. In the event that a given well is known to purge to dryness prior to removal of three volumes, parameters will be measured at an appropriate rate for the collection of multiple readings prior to the well purging dry (e.g., every one-half well volume).

Well parameter data will be recorded during purging on the Groundwater Sampling Field Data Sheet (or an equivalent form) provided in **Attachment III.F.2**. The Field Data Sheet will include, at a minimum, fields to record the temperature, pH, and specific conductivity. Wells that dewater prior to achieving the three well casing volumes will be evacuated until dry then allowed to recharge. If sufficient recharge occurs the same day as purging, the well will be purged at least a second time. In the event that monitoring wells recharge very slowly, wells will be purged to dryness in order to remove stagnant water from the well casing. Wells will be allowed sufficient time to recover such a groundwater sample is collected. Whenever possible the groundwater level shall be allowed to recover to within 90 percent of the original water-level measurement prior to sampling. In the event that sufficient well volume is not available within seven days of purging, the well will be considered “dry”, and samples will not be collected. The calculated and actual purge volume achieved as well as the field parameters will be recorded on the groundwater sampling report form (or an equivalent form).

The method of well purging for this site will consist of using a portable submersible pump, or equivalent, system for each well. The pump intake will be gently placed within the uppermost part of the well screen to minimize agitating any residual sediment that has collected in the bottom of the well. For wells that sustain continuous pumping without dewatering, the discharge rate on the pump will be set so as to maintain a drawdown in the well of no more than 1-2 feet. Water-level measurements should be collected to determine the amount of drawdown that has occurred during purging. If the drawdown significantly exceeds the groundwater recharge rate, then the pump rate should be reduced until the drawdown in the well is in the range of 1-2 feet. This procedure will minimize any cascading effects that may volatilize constituents in the groundwater entering the well casing and will also minimize agitating sediment collected in the bottom of the well. Proper cleaning of the portable pump, or non-disposable equipment

used during sampling activities, will occur to minimize the potential of cross contamination. Decontamination procedures are detailed in **Section III.F.3.0**.

The monitoring wells will be purged of groundwater in a particular order, based on the recharge time required (i.e., wells with slow recharge will be purged prior to wells with faster recharge time in order to allow for adequate recharge time prior to sampling). If the groundwater is suspected to contain contaminants, then the order of purging and sampling will proceed from the well with the lowest contaminant concentrations to the well with the highest concentrations of contaminants, as approved by the executive director.

During the purging operations, a record of the climatic conditions, condition of the wells and surrounding ground surface, water turbidity (visual inspection), color, odors, water level, depth of well and purge rate will be maintained and recorded on the Groundwater Sampling Field Data Sheet (or an equivalent form) provided in **Attachment III.F.2**. The information will be recorded in ink and the field data sheets from each sampling event will be provided in the required groundwater monitoring reports.

Groundwater samples will be collected from the pump discharge or with a bailer. The pump discharge will be regulated at the time of sampling to maintain as slow of a discharge rate as possible (generally 0.1 liter per minute) to minimize cascading and volatilization of potential contaminants as the sample containers are being filled. Once the discharge rate is set for sampling, it will be maintained throughout sample collection. When a bailer is used for sample collection, the bailer will be slowly lowered into the water column to avoid agitation of the groundwater. The bailer will then be removed from the well and water will be slowly released from the bailer directly into the required sample containers. The sample containers will be held as close to the pump discharge or bailer as possible without touching to minimize the potential loss of any volatile organic compounds (VOCs).

Additional groundwater sample collection and handling procedures, including the order of filling sample container and labeling, are described in **Section III.F.4.3**.

III.F.4.3 Groundwater Sample Collection and Handling Procedures

During groundwater sample collection, disposable latex gloves will be worn, and disposed between monitoring wells to minimize cross contamination of samples and to reduce the possibility of sampling personnel coming into direct contact with groundwater containing contaminants. Groundwater samples will be collected using either the purging method (as described in **Section III.F.4.2**) or the snap sampling method (as described in **Section III.F.4.1**).

In accordance with 30 TAC §330.405(b)(2), the monitoring wells will be sampled from the well with the highest groundwater elevation to the well with the lowest groundwater elevation, unless previous analytical data indicates the presence of contaminants in the groundwater. If contamination is suspected, the sampling order may vary upon approval by the executive director. Groundwater samples will be collected within 24 hours following collection of water-level measurements, unless wells do not adequately recover within that timeframe after following the purging procedures detailed in **Section III.F.4.2**. If sufficient recharge does not occur within 7 days following purging, then the well will be considered dry, and a sample will not be collected.

Sample containers, preservation methods, and holding times for the requested analyses will be approved by the laboratory, prior to sample collection. The sample containers will be filled in the following order: 1) VOCs; 2) semi-VOCs, if collected; 3) total metals and 4) inorganics, if collected. A list of the parameters to

be analyzed is provided in **Attachment III.F.3**. In accordance with 30 TAC §330.405(c), no field filtering of the groundwater samples will be performed.

Aqueous samples for VOC analyses will be collected without any headspace or air bubbles, or as otherwise prescribed by the laboratory. Sample containers used for VOC analysis will be filled slowly until the liquid forms a meniscus on the rim of the container. The cap will then be gently placed on the container, taking care not to disturb the crown of the liquid (positive meniscus), and firmly closed. The vial will then be examined to verify the absence or minimal presence of all air bubbles. In the event that significant air bubbles, per the laboratory standards, are present, the sample will be recollected. Glass or fragile sample containers will be packaged in foam padding, bubble wrap, or an equivalent material to prevent breakage. All other sample containers will be filled according to laboratory instructions.

Following the filling of each sample container, the container will be labeled with a unique identification number, date and time collected, preservatives used, analyses to be run, and sampler's initials. Sample containers will be placed in zip-locked plastic bags which will be placed in a cooler for delivery to the laboratory.

Once the collected samples have been properly sealed and labeled as described above, they will be recorded on a Chain-of-Custody (COC) form, signed, and dated by the sampling technician(s). COCs will be approved by the laboratory that will be performing the analysis. An example of a typical COC is provided in **Attachment III.F.4**. The COC will accompany the samples to the laboratory. The readings of temperature, conductivity, and pH will be submitted to the laboratory with the samples, upon request. Prior to delivery of the samples to the laboratory, the samples will be placed in a cooler or ice chest (similar to an Igloo ice chest) with ice and will be maintained as close as possible to 4°C until the laboratory analyses are performed. Dry ice is not permitted due to the potential of freezing the samples and breaking the containers. Precautions will be taken to secure the samples in the ice chest to prevent them from breaking during transport. In order to verify that the samples have been maintained at or near 4°C, a temperature blank will be included with the sample shipment, if provided by the laboratory. The samples will be delivered to the laboratory within the respective hold times of the sampling parameters, after collection. For compliance with holding times, samples should be delivered to the laboratory within 24 hours after collection.

III.F.4.4 Quality Assurance and Quality Control Samples

To provide screening of field procedures, additional samples will be collected for quality assurance/quality control (QA/QC). At least one equipment blank will be collected each day of sampling. If dedicated equipment is used for sampling, then an equipment blank will not be collected. The purpose of the equipment blank is to evaluate if non-dedicated sampling equipment is free of contaminants as it was manufactured or decontaminated. Typically, the equipment blank will be collected after sampling the well with the highest concentration of contaminants each day. If contaminants are not detected from any of the wells, then the equipment blank will be taken randomly. The equipment blank will consist of filling laboratory-provided containers with deionized water that has been flushed through or over surfaces of the sampling equipment after decontamination. In addition to the equipment blank, a trip blank will be prepared by the laboratory and will accompany the empty sample containers and collected samples to and from the laboratory. The purpose of the trip blank is to assess whether any of the sample containers or collected samples have been contaminated during the sampling event. Also, a field blank will be collected each day in the field during sampling. The field blanks will consist of filling laboratory-provided containers with deionized water at a sampling location. The purpose of the field blank is to assess whether air-borne contaminants have potentially affected the samples during sample collection. The QA/QC samples will be collected and handled in a similar fashion to the other samples and will be analyzed for VOCs only.

At least one field duplicate sample will be collected for every ten normal samples collected or once per sampling event when fewer than ten normal samples are collected to assess the precision of the

sampling methods and laboratory analytical methods. The duplicate sample(s) will usually be collected from well(s) with the highest concentrations of contaminants, as previously reported. When a duplicate sample is collected, it will be handled in a similar fashion as the other samples but will be labeled in such a manner that the laboratory does not know it is a duplicate sample and cannot associate it with a normal sample for QA/QC purposes. The duplicate sample will be collected immediately after collection of the normal sample. This procedure is to provide for some assurance that the groundwater collected for the duplicate sample is relatively similar to the groundwater collected for the normal sample. Additionally, matrix spike and matrix spike duplicate (MS/MSD) samples may be collected at a rate of 1 MS/MSD per 20 normal samples. MS/MSD samples are typically triple the volume of a normal sample and are labeled with the same information as the associated normal sample. The laboratory may request that MS/MSD samples are collected, or the sampling personnel may decide to collect MS/MSD samples if certain groundwater characteristics (pH, total dissolved solids (TDS), etc.) may interfere with sample analysis.

III.F.4.5 Weather Protocol

Sampling of the monitoring wells will not be permitted during inclement weather, sandstorms, or thunderstorms. Caution should be taken by the sampling personnel when the temperature is below freezing or exceeds 100 ° F.

III.F.4.6 Purged or Decontamination Water Handling Procedures

Purged water during groundwater sample collection and decontamination water will be collected in approved DOT containers and stored at the facility for subsequent disposal. The analytical data will be reviewed to determine the proper disposal procedures.

III.F.5.0 Laboratory Procedures/Performance Standards

Laboratory data and analyses will be performed and submitted by a laboratory approved by the Texas Commission on Environmental Quality (TCEQ) in accordance with the National Environmental Laboratory Accreditation Conference Standards.

All analytical data submitted under the requirements of this permit will be examined by the owner and/or operator to ensure that the data quality objectives are considered and met prior to submittal for the commission to review. The owner or operator will determine if the analytical results represent the collected samples accurately and completely. The quality control results, supporting data, and data review by the laboratory will be included when the owner/operator reviews the data. Any identified issues will be reported such as the bias on the quality of the data, footnotes in the report, and anything of concern that was identified in the laboratory report.

The owner or operator will verify that the laboratory documents and reports all problems and observed anomalies associated with the sample analyses. If analysis of the data indicates that the data fails to meet the quality control goals for the laboratory's analytical data analysis program, the owner or operator will determine if the data is usable. If the owner and/or operator determines the analytical data may be utilized, any and all problems and corrective action that the laboratory identified during the analysis will be included in the report submitted to the TCEQ.

A Laboratory Case Narrative (LCN), or equivalent, for all problems and anomalies observed, will be submitted by the owner and/or operator, if applicable. The LCN will typically report the following information, if applicable:

1. State the exact number of samples, testing parameters, and sample matrix.
2. The name of the laboratory involved in the analysis of samples. If more than one laboratory is used, all laboratories shall be identified in the case narrative.
3. State the test objective regarding samples.
4. Explain each failed precision and accuracy measurement determined to be outside of the laboratory and/or method control limits.
5. Explain if the effect of the failed precision and accuracy measurements on the results induces a positive or negative bias.
6. Identify and explain problems associated with the sample results, along with the limitations these problems have on data usability.
7. A statement on the estimated uncertainty of analytical results of the samples when appropriate and/or when requested.
8. A statement of compliance and/or noncompliance with the requirements and specifications. Exceedance(s) of holding times and identification of matrix interferences will be identified. Dilutions shall be identified and if dilutions are necessary, they will be done to the smallest dilution possible to effectively minimize matrix interferences and bring the sample into control for analysis.
9. Identify any and all applicable QA/QC samples that will require special attention by the reviewer.
10. A statement on the QA/QC of the analytical method of the permit and the analytical recoveries information shall be provided when appropriate and/or when requested.

In addition to the LCN, the following information will be submitted for all analytical data:

1. A Table identifying the field sample name with the sample identification in the laboratory report.
2. Chain of custody will be provided.
3. Analytical Report that documents the results and methods for each sample collected and analytes to be included for every analytical testing event. These test reports will document the reporting limit (RL)/method detection limit (MDL) the laboratory used. The reporting limit for each analyte will be less than the maximum contaminant level (MCL) or as low as practically feasible per 30 TAC §330.263(b) for each of the analytes. In accordance with Appendix B of 40 Code of Federal Regulations (CFR) Part 136, the MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
4. A release statement will be submitted from the laboratory, in accordance with applicable regulations, including those regulations of 30 TAC Chapter 25.
5. Include a laboratory review checklist in the laboratory data package. An example of the laboratory review checklist is provided as **Attachment III.F.5**. For every response of "No, NA, or NR" that is reported on the checklist, the permittee will ensure the laboratory provides a detailed description of the "exception report" in the summary of the LCN. The phrase "exception report" in the checklist is meant to clue the owner/operator to include the exceptions and any potential bias in the data will be in the LCN. The permittee will ask the laboratory to use the checklist and do an equivalent of an Environmental Protection Agency Level 3 review regarding quality control analysis.

The laboratory review checklist is intended to aid the permittee in ensuring the laboratory did a quality control analysis and to alert one of any potential problems, bias, or anomalies during the analysis of the sample. The analytical report, LCN, and the checklist are to be included along with the TCEQ-00312 forms, or updated forms, for all monitoring events for groundwater.

III.F.5.2 Laboratory Performing the Analyses

Laboratory data and analyses will be performed and submitted by a laboratory approved by the TCEQ in accordance with the National Environmental Laboratory Accreditation Conference Standards. Once a laboratory is selected, a Quality Assurance/Quality Control Plan and laboratory procedures document will be submitted to the TCEQ for approval prior to implementing the sampling program. The Laboratory Standard Operating Procedures (LSOP) should describe a detailed program of how the laboratory will proceed to provide data of a stated quality with a stated probability of being correct including all procedures to handle and analyze the samples from receipt until the results are reported. An LSOP should also address determination of MDLs, practical quantitation limits (PQLs), and proper reporting of results.

III.F.5.3 Laboratory Procedures

The laboratory will follow appropriate QA/QC protocol as developed for the specific laboratory. At a minimum, upon receipt of the samples by the laboratory, the sample lot will be verified with the information on the COC. In addition, the integrity of the sample containers will be verified. If there is a discrepancy with the samples, the responsible party that collected the samples will be notified and the problem will be resolved. All concerns noted about the sample containers (i.e., breakage, elevated temperature) will be recorded by the receiving personnel on the COC and/or the LCN at the time of receipt of the samples. The COC will be signed and dated by the designated receiving personnel at the laboratory. The COC will remain with the laboratory until the analyses are completed, then a copy of the finalized COC will be attached to the completed laboratory report. The COC will accompany the sample container(s) and be delivered to the laboratory and a copy of the bill of lading will be supplied by the

transporter, if applicable. After the analyses are completed and the laboratory report finalized, the complete COC with the bill of lading or receipt if sent by certified mail will be included in the laboratory report. The laboratory will keep a copy of the COC and laboratory results for a period of at least three years.

The laboratory personnel responsible for performing the analyses and generating the data will have the necessary training in analytical testing. An example of typical laboratory personnel is provided below:

- Laboratory Services Coordinator – Responsible for overall quality performance and the daily operations of the laboratory.
- Quality Assurance Officer – Responsible for quality performance of the laboratory, independent of the analysis management. Defines project and field QA/QC. Reviews all statistical data to verify the laboratory is meeting stated quality control goals.
- Instrumentation Chemist – Responsible for supervising the instrumental analysis department and reviews data with laboratory director and QA officer that lie outside acceptable limits.
- Methods Development and Training Chemist – Responsible for sample preparation and chemistry department. Reviews all chemical and quality data and co-responsible for developing and implementing the staff training program.
- Technicians – Responsible for operation of analytical equipment and work with senior level personnel to ensure a quality product.

III.F.5.4 Laboratory Quality Assurance and Quality Control Samples

During analytical testing, additional samples are analyzed by the laboratory for the purpose of assessing instrument calibration, precision, and adequate decontamination of the instruments between sample batches. As a general procedure for most laboratories, method blanks, matrix spikes, and matrix spike duplicates are analyzed during the course of analyses. For example, method blanks, matrix spikes, and matrix spike duplicates may be analyzed after every batch of 15 to 20 samples. The specific procedures for the laboratory selected will be included in their QA/QC plan that will be furnished to TCEQ prior to implementing the program.

III.F.5.4.1 Practical Quantitation Limits

The PQL is defined as the lowest concentration reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions and is analogous to the Limit of Quantitation (LOQ) definition in the most recent NELAC Standard (National Environmental Laboratory Accreditation Conference, 2016). The PQL is method-, instrument-, and analyte-specific and may be updated as more data becomes available. The PQL must be below the groundwater protection standard established for that analyte as defined by 30 TAC §330.409(h) unless approved otherwise by the TCEQ. The precision and accuracy of the PQL shall be initially determined from the PQLs reported over the course of a minimum of eight groundwater monitoring events. The PQL will be supported by analysis of a PQL check sample, which is a laboratory reagent grade sample matrix spiked with chemicals of concern at concentrations equal to or less than the PQL. At a minimum, a PQL check sample will be performed quarterly during the calendar year to demonstrate that the PQL continues to meet the specified limits for precision and accuracy as defined in **Table III.F.5-1**.

Table III.F.5-1: QC Specification Limits for the PQL and Lower Limit of Quantitation Check Samples

COC	Precision (% Relative Standard Deviation)	Accuracy (% Recovery)
Metals	10	70-130
Volatiles	20	50-150
Semi-Volatiles	30	50-150

For analytes that the established PQL cannot meet the precision and accuracy requirements in **Table III.F.5-1**, the owner/operator will ensure the laboratory will submit sufficient documentation and information to the TCEQ for alternate precision and accuracy limits on a case-by-case basis. An analytical result reported below the MDL will be reported as less than the established PQL limit that meets these precision and accuracy requirements.

III.F.5.5 Constituents to be Analyzed and Test Methods

III.F.5.5.1 Detection Monitoring Program

In accordance with 30 TAC §330.407(a), groundwater at the facility will be monitored at least semi-annually during the active life of the facility and throughout the closure and post-closure care period as a part of the detection monitoring program. Water levels in all available wells and piezometers will be measured during each sampling event, and groundwater contour maps will be constructed. In order to comply with all applicable rules, the groundwater monitoring system may be modified if future updated groundwater flow direction is not compatible with the current proposed system.

Samples collected as part of the facility's detection monitoring program, as outlined in 30 TAC §330.407, will be analyzed for the constituents specified in 30 TAC §330.419 and 40 CFR 258, Appendix I, as presented in **Attachment III.F.3**. Analyses will be performed using the methods listed on **Table III.F.5-2**, equivalent methods, or updated methods approved by the United States Environmental Protection Agency (EPA).

The sample containers will be filled in the following order:

1. VOCs
2. Total Metals

In the event a Statistically Significant Increase (SSI) is confirmed (see **Section III.F.6.0**), an assessment monitoring program will be established in alignment with 30 TAC §330.409. Constituents and analytical methods associated with the assessment monitoring program are discussed in **Section III.F.5.5.2**.

Statistical methods used to evaluate detection monitoring data are presented in **Section III.F.6.0**. Reporting requirements are presented in **Section III.F.7.0**.

III.F.5.5.2 Assessment Monitoring Program

Within 90 days of determining that a statistically significant increase has occurred, in accordance with 407(b), and not less than annually thereafter, the facility will sample and analyze the groundwater monitoring system for the full set of constituents listed in Appendix II to 40 CFR Part 258, in accordance with assessment monitoring program requirements outlined in 30 TAC §330.409.

A minimum of one (1) sample shall be collected from each point of compliance well and analyzed for the 40 CFR Part 258, Appendix II constituents during each sampling event. The full list of Appendix II constituents is presented in **Attachment III.F.3.** Analyses will be performed using the methods listed on **Table III.F.5-2**, equivalent methods, or updated methods approved by the United States Environmental Protection Agency (EPA).

Table III.F.5-2 presents the analytical methods, recommended containers, preservatives, and holding times for the various analyses. The sample containers will be filled in the following order for collection of Appendix II constituents:

1. VOCs
2. SVOCs
3. Total Metals
4. Inorganics
5. Other

Table III.F.5-2: Sample Collection Guidelines: Containers, Preservatives, and Holding Times

Analysis Type	Constituent Appendix	Method	Recommended Containers	Preservatives	Holding Times
VOCs	Appendix I & Appendix II	8260	40 mL VOA (Volatile Organic Analysis) glass vials	No headspace, sometimes preserved with HCl to pH <2	14 days (refrigerated)
SVOCs	Appendix II	8270	Amber glass jars	Cool and dark storage, sometimes with sodium bisulfate	7 days (refrigerated)
Total Metals	Appendix I & Appendix II	6020	HDPE (high-density polyethylene) or polypropylene sample containers	Preserved with nitric acid (HNO3) to pH <2	180 days (refrigerated)
Herbicides	Appendix II	8151	Amber glass jars, Teflon cap	Cool to at least 6 degrees C	7 days (refrigerated)
Pesticides	Appendix II	8081	Amber glass jars, Teflon cap	Cool to at least 6 degrees C	7 days (refrigerated)
Organophosphorus Pesticides	Appendix II	8141	Amber glass jars	Cool to at least 4 degrees C	7 days (refrigerated)
PCBs	Appendix II	8082	Amber glass jars, Teflon cap	Cool to at least 6 degrees C	1 year (refrigerated)

After sampling all point of compliance wells for Appendix II constituents, the executive director may specify an appropriate subset of wells to be sampled and analyzed for the Appendix II constituents during assessment monitoring and may delete any of the Appendix II constituents for a municipal solid waste

management unit if the owner or operator can document that the removed constituents are not reasonably expected to be in or derived from the waste contained in the unit.

The executive director may specify an appropriate alternative frequency for repeated sampling and analysis for the full set of 40 CFR Part 258, Appendix II constituents during the active life and the closure and post-closure care period of the unit considering the following factors:

1. Lithology and hydraulic conductivity of the aquifer and unsaturated zone;
2. Groundwater flow rates;
3. Minimum distance of travel from the waste nearest to any point of compliance monitoring well;
4. Resource value of the uppermost aquifer; and
5. Nature (fate and transport) of any constituents detected in response to this section.

The owner/operator shall, within 90 days of submittal of the results from a sampling event and on at least a semiannual basis thereafter, resample all wells specified by 30 TAC §330.409(a) and conduct analyses for all constituents in 30 TAC §330.419, and for those additional constituents in 40 CFR Part 258, Appendix II that are detected in response to a statistically significant increase per 30 TAC §330.409(b) (see **Section III.F.6.0**). The results must be submitted to the executive director not later than 60 days after the sampling event and shall also be placed in the operating record. At least one sample must be collected and analyzed from each background and point of compliance well at each sampling event. The executive director may specify an alternative monitoring frequency during the active life and the closure and post-closure care period for the constituents referred to in this paragraph. The alternative frequency during the active life and the closure and post-closure care period shall be not less than annual. The alternative frequency shall be based on consideration of the factors described previously.

The facility will establish background concentrations for any additional Appendix II constituents detected in accordance with subsection 30 TAC §330.409(b) and 30 TAC §330.409(d)(1) (see **Section III.F.5.6**).

The facility will establish groundwater protection standards for all constituents in point of compliance wells detected in accordance with 30 TAC §330.409(b) or 30 TAC §330.409(d)(1). The groundwater protection standards shall be established in accordance with 30 TAC §330.409(h) or 30 TAC §330.409(i).

If the concentrations of all 40 CFR Part 258, Appendix II constituents are shown to be at or below background values, using the statistical procedures in 30 TAC §330.405(f) (see **Section III.F.6.0** for more information on statistical methods), for two consecutive sampling events, the facility will notify the executive director in writing and return to detection monitoring if approved.

If the concentrations of any 40 CFR Part 258, Appendix II constituents are above background values, but all concentrations are below the groundwater protection standard established under subsection 30 TAC §330.409(h) or 30 TAC §330.409(i), using the statistical procedures in 30 TAC §330.405(f), the owner or operator will continue assessment monitoring in accordance with this section.

Not later than 60 days after each sampling event, the facility will determine if any 40 CFR Part 258, Appendix II constituents were detected at statistically significant levels above the groundwater protection standard established under subsection 30 TAC §330.409(h) or 30 TAC §330.409(i). If one or more groundwater protection standards have been exceeded, the owner or operator shall notify the executive director and appropriate local government officials in writing within seven days of the determination. The owner/operator shall also:

1. Characterize the nature and extent of the release by installing additional monitoring wells as necessary;

2. Install at least one additional monitoring well between the monitoring well with the statistically significant level and the next adjacent wells along the point of compliance before the next sampling event and sample these wells in accordance with 30 TAC §330.409(d)(1);
3. Notify in writing all persons that own or occupy the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site as indicated by sampling of wells in accordance with 30 TAC §330.409 (d)(1); and
4. Initiate an assessment of corrective measures as required by 30 TAC §330.411 within 90 days of the notice to the executive director.

The owner or operator may demonstrate that a source other than the monitored solid waste management unit caused the contamination or that the statistically significant level results from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, as outlined in 30 TAC §330.409(g)(2). The demonstration requires the following:

1. Notification of the ED in writing within 14 days of determining a statistically significant level above the groundwater protection standard at the point of compliance that the facility intends to make a demonstration;
2. Submittal of a report to the ED within 90 days of determining a statistically significant level above the groundwater protection standard that demonstrates that source other than the monitored solid waste management unit caused the contamination or that the statistically significant event resulted from error in sampling, analysis, statistical evaluation or natural variation in groundwater quality. The report will be prepared and certified by a qualified groundwater scientist;
3. No filtration of the groundwater samples for constituents addressed by the demonstration prior to laboratory analysis. Analysis of landfill leachate may be required by the ED to support the demonstration; and,
4. Continued monitoring in accordance with the assessment monitoring program.

If a successful demonstration is made, the facility will continue monitoring in accordance with 30 TAC §330.409 and may return to detection monitoring if the 40 CFR Part 258, Appendix II constituents are at or below background. If the facility determines that the assessment monitoring program no longer satisfies the requirements of 30 TAC §330.409, the facility will submit an application for a permit amendment or modification within 90 days to make any appropriate changes to the program.

The owner or operator shall establish a groundwater protection standard for each 40 CFR Part 258, Appendix II constituent detected in the point of compliance monitoring wells. The groundwater protection standard must be:

1. For constituents for which a maximum contaminant level (MCL) has been promulgated under 40 CFR Part 141, Safe Drinking Water Act (codified), §1412, the MCL for that constituent;
2. For constituents for which MCLs have not been promulgated, the background concentration for the constituent established from wells in accordance with 30 TAC §330.405(d); or
3. For constituents for which the background level is higher than the MCL identified under paragraph (1) of this subsection or health-based levels identified under subsection 30 TAC §330.409(i), the background concentration.

III.F.5.6 Establishment and Updating of Background Data

Per 30 TAC §330.405(b)(3)(A), the number of samples to be collected to establish groundwater quality data will be consistent with the appropriate statistical procedures determined pursuant to 30 TAC §330.405(f).

In accordance with 30 TAC §330.407(a)(1), a minimum of four statistically independent samples from each background and each point of compliance well will be collected and analyzed for the constituents listed in **Attachment III.F.3** to establish background groundwater quality. Initial background sampling will be completed on a quarterly basis unless an alternative schedule is approved by the executive director.

Background datasets may be updated once every two years with semiannual detection monitoring results that are demonstrated to be representative of background groundwater quality. Upon completion of background monitoring and during background updates, the owner or operator will evaluate the background data to ensure that the data are representative of background groundwater constituent concentrations and are not impacted by waste management activities or other sources of contamination.

The background evaluation will be documented in a report and submitted to the executive director before the next groundwater monitoring event following the updated background period. At least one sample from each background and point of compliance well will be collected and analyzed during each subsequent semiannual sampling event.

In the event assessment monitoring is required and constituents from the list provided in 40 CFR Part 258, Appendix II (see **Attachment III.F.3**) are detected during assessment monitoring sampling, a minimum of four statistically independent samples from each background well will be collected and analyzed to establish background levels for the additional constituents, as outlined in 30 TAC §330.409(b).

III.F.5.6.1 Detection Monitoring Sampling Frequency

The detection monitoring sampling schedule will consist of collecting samples from each monitoring well for the constituents presented in **Attachment III.F.3** on a semi-annual basis and after background groundwater quality has been established.

III.F.5.6.2 Groundwater Monitoring System

The groundwater monitoring system is designed to monitor the uppermost saturated zone within the Hueco Bolson Aquifer and was designed in accordance with 30 TAC §330.403. The monitoring well system is comprised of fifteen (15) wells: MW-1, MW-3, MW-4, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-13, MW-14, MW-15, PB-32, PB-36, and PB-37. The following provides information of the current groundwater monitoring system and a summary of historical details.

The groundwater monitoring system wells were installed in phases based on the timeline for waste placement in designated cells. A permit modification request to revise the groundwater monitoring system was submitted in November 2007 and approved on October 14, 2009. The proposed groundwater monitoring system included existing monitoring wells PB-32, PB-36, PB-37, MW-1, MW-3, and MW-4 and the installation of four (4) new monitoring wells MW-6, MW-7, MW-8, and MW-13. Monitoring well MW-9, which is downgradient of portions of Phase I and adjacent to Phase II, was installed prior to waste placement in Cell 7.

Monitoring wells MW-14 and MW-15 were installed in 2015 following a request for a permit modification in January 2014. The permit modification request was made to redefine the point of compliance boundary based on groundwater flow direction information obtained over a two-year monitoring event outlined in the 2014 modification request. Monitoring well MW-3 was reclassified from a point of compliance well to a background well for Phase II of the system, and PB-32 and PB-36 were reclassified from background wells to point of compliance wells. The request was approved by TCEQ on April 16, 2014.

Monitoring wells MW-10 and MW-11 were installed in 2019, prior to the acceptance of waste in the landfill's Phase II area.

All remaining wells are point of compliance wells.

All point of compliance wells are located no more than 500 feet from the hydraulically downgradient limit of the waste management unit, as defined in 30 TAC §330.3. Well spacing does not exceed 600 feet between any of the point of compliance wells, with the exception of the spacing between PB-37 and MW-8 (see discussion later in this section). The average design distance between point of compliance wells is approximately 562 feet, in compliance with 30 TAC §330.402(a)(2).

Table III.F.5-3 presents a summary of monitoring wells by categorical use.

Table III.F.5-3: Monitoring Well Categories

Point of Compliance Well(s)	Background (Upgradient) Well(s)	Observation/Sidegradient Well(s)
MW-13, MW-6, MW-7, MW-4, MW-8, PB-37, MW-9, MW-10, MW-11, MW-14, MW-15, PB-32, PB-36	MW-3	MW-1

As discussed in the permit modification application submitted on September 3, 2010 to TCEQ, MW-8 was installed along with several wells in June-July 2009. Per 30 TAC §330.403(a)(2), the wells had planned spacing of 600-feet. However, a subsequent field verification event revealed that the distance between MW-8 and the adjacent well, PB-37, is 642-feet. A compete review of the documentation showed that PB-37 was not accurately located on the installation drawing for this well, resulting in the 642-foot spacing.

Due to the installation of MW-9 following the installation of MW-8, relocation of PB-37 the minor distance of 42-feet closer to MW-8 was demonstrated to be impractical and unnecessary. A review of groundwater flow and time of travel characteristics found that the current location of PW-37 is as protective of human health and the environment as a revised location within 600-feet of MW-8. An Alternate Well Spacing Demonstration was performed and concluded that a release from the facility will not be detected in PB-37 during the active life of the facility and the post-closure care period. Likewise, a release will not be detected from a new well located 600-feet south of MW-8. TCEQ accepted the proposed alternate spacing between MW-8 and PB-37 in a letter dated October 26, 2010.

Monitoring well MW-1 was originally used as a point of compliance well when waste placement was limited to cells 1-6 of the Phase I portion of the landfill. Additional wells were installed prior to placement of waste in cells 7-9 of Phase I and cells 11-14 of Phase II. Due to the placement of MW-1 between Phase I and Phase II of the landfill and the addition of more representative point of compliance wells (MW-8 through MW-11), MW-1 is now used as an observation well.

All designs and modifications of the groundwater monitoring system presented in this document were previously sealed and approved by TCEQ. Certification of the approved groundwater monitoring system is provided in **Attachment III.F.7,** including certifications for the additional wells added in 2015 (MW-14 & MW-15) and 2019 (MW-10 & MW-11). Note that certification of this GWSAP does not indicate a recertification of the groundwater monitoring system by the licensed professional. Any modifications proposed in the future, including the addition of new background or point of compliance wells, will be conducted in alignment with 30 TAC §330.403(e)(3), as discussed in **Section III.F.1.0**.

III.F.6.0 Statistical Method to Evaluate Analytical Data

Statistical analyses of groundwater data will be performed in accordance with 30 TAC §§330.405 through 330.409. A statistical analysis plan has been included as **Attachment III.F.6** and has been prepared using generally accepted statistical analysis principles and practices. However, it is not possible to predict all potential future circumstances. Therefore, alternative methods, described in 30 TAC §330.405(e), may be used if deemed more appropriate for the data distribution of the constituents being evaluated. Historical statistical analysis is described and illustrated in groundwater monitoring reports associated with the facility.

III.F.6.1 Statistical Analysis for Detection Monitoring

Not later than 60 days after each detection monitoring sampling event, statistical analyses for the constituents listed in **Attachment III.F.3** will be performed to determine if a statistically significant increase over background of any tested constituent at any monitoring well has occurred. The statistical limit for each constituent will be set equal to the laboratory reporting limit, as presented in **Attachment III.F.3**. If a statistically significant increase over background of any tested constituent at any monitoring well has occurred, a notice will be made to the TCEQ Executive Director (ED), and any local pollution agency with jurisdiction that has requested to be notified, in writing within 14 days of the determination.

Groundwater sampling data will be evaluated using one of the following methods, as presented in 30 TAC §330.405(e)(1-5):

1. A parametric analysis of variance followed by multiple-comparisons procedures, including estimation and testing of the contrasts between each point of compliance well's mean and background mean levels for each constituent;
2. An analysis of variance based on ranks followed by multiple-comparisons procedures to identify statistically significant evidence of contamination, including estimation and testing of the contrasts between each point of compliance well's median and background median levels for each constituent;
3. A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each point of compliance well is compared to the upper tolerance prediction limit;
4. A control-chart approach that gives control limits for each constituent; or,
5. Another statistical test method that meets the performance standards of 30 TAC §330.405(f). Satisfactory justification for an alternative method must be provided to the executive director.

Any selected statistical method will comply with the performance standards described in TAC §330.405(f)(1-6). The statistical method used to evaluate groundwater monitoring data will be appropriate for the distribution of the tested constituents. Per 30 TAC §330.405(f)(2), if an individual well (or sampling point) comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple-comparisons procedure is used, each testing period shall be no less than 0.05, but the Type I error of no less than 0.01 for individual well comparisons shall be maintained. This performance standard does not apply to tolerance intervals, prediction interval, or control charts.

III.F.6.2 Statistically Significant Constituent Concentrations Observed

An initial statistically significant increase (SSI) will be based on any constituent detected in any monitoring well at a concentration above the specific constituent's statistical limit. In the event of an initial SSI for constituents listed in **Attachment III.F.3**, one of the following options will be implemented: verification resampling in accordance with §330.407(b)(2), an alternate source demonstration (ASD) in accordance with §330.407(b)(3), or both. An initial SSI will be considered a confirmed SSI if no verification resampling is performed or if an ASD is not made to the satisfaction of the executive director within 90 days after the date of the notice. If an ASD is to be prepared, a written notice will be made to the ED, and any local pollution agency with jurisdiction that has requested to be notified, within 14 days of the determination of the SSI.

In the event that one or more constituents are confirmed through verification resampling as an SSI at any monitoring well location and the source cannot be attributed to an error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or another source per 30 TAC §330.407(b)(3), then an assessment monitoring program will be established in accordance with 30 TAC §330.407(b)(1) and 30 TAC §330.409 no later than ninety (90) days from the date of the SSI notice to the ED. The assessment monitoring requirements are discussed in detail in **Section III.5.5.2**.

III.F.7.0 Reporting Requirements

Statistical analysis will be performed no later than 60 days after each semi-annual sampling event of detection monitoring. In the event that statistical analysis of the groundwater analytical results indicates an initial SSI from background of any tested constituent at any monitor well, a notice in writing to the executive director and any local pollution agency with jurisdiction that has requested to be notified, will be submitted within 14 days after the determination of the SSI (30 TAC §330.407(b)).

Three (3) copies (triplicate) of an annual detection monitoring report describing groundwater sampling and analyses results will be completed on state reporting forms (e.g. TCEQ-0312 or subsequent versions) and will be submitted to the TCEQ no later than ninety (90) days after the facility's last groundwater sampling event in a calendar year and will include information determined since the previously submitted annual report (30 TAC §330.407(c)). In accordance with 30 TAC §§330.407(c)(1) through (c)(6), the following information will be included in the annual detection monitoring report:

- A statement regarding whether a statistically significant increase has occurred over background values in any well during the previous calendar year period and the status of any statistically significant increase events.
- The results of all groundwater monitoring, testing, and analytical work obtained or prepared under the permit requirements, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings.
- The groundwater flow rate and direction in the uppermost aquifer. The groundwater flow rate and direction of groundwater flow shall be established using the data collected during the preceding calendar year's sampling events from the monitoring wells of the Detection Monitoring Program. All documentation used to determine the groundwater flow rate and direction of groundwater flow shall also be included in the annual report.
- A contour map of piezometric water levels in the uppermost aquifer based, at a minimum, upon concurrent measurement in all monitoring wells. All data or documentation used to establish the contour map will be included in the annual report.
- Recommendations for any changes.
- Any other items requested by the executive director.

In the event the facility has an established assessment monitoring program, three copies (triplicate) of an annual assessment monitoring report describing groundwater sampling and analyses results will be completed on state reporting forms (e.g., TCEQ-0312 or subsequent versions) and will be submitted to the TCEQ no later than 60 days after the facility's last groundwater sampling event in a calendar year and will include information determined since the previously submitted annual report (30 TAC §330.409(k)). Data may also be required to be submitted to the TCEQ by an electronic or other format as specified by the TCEQ. In accordance with 30 TAC §§330.409(k)(1) to (k)(6), the following information will be included in the annual assessment monitoring report:

- A statement whether a statistically significant level above a groundwater protection standard (GWPS) established in 30 TAC §330.409(h) or §330.409(i) has occurred in any well during the previous calendar year period and the status of any statistically significant level events.
- The results of all groundwater monitoring, testing, and analytical work obtained or prepared under the permit requirements, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings.

- The groundwater flow rate and direction in the uppermost aquifer. The groundwater flow rate and direction of groundwater flow shall be established using the data collected during the preceding calendar year's sampling events from the monitoring wells of the Assessment Monitoring Program. All documentation used to determine the groundwater flow rate and direction of groundwater flow shall also be included in the annual report.
- A contour map of piezometric water levels in the uppermost aquifer based, at a minimum, upon concurrent measurement in all monitoring wells. All data or documentation used to establish the contour map will be included in the annual report.
- Recommendations for any changes.
- Any other items requested by the ED.

In accordance with 30 TAC §330.407(d), if the detection monitoring program no longer satisfies the requirements of this section, the facility will, within 90 days of the determination, submit an application for a permit amendment or modification to make any appropriate changes to the program. Examples of amendments or modifications may include, but are not limited to, repair of damaged wells or replacement of an existing well, proposed changes in monitoring frequency, or proposed installation of additional monitoring wells. Additional requirements under 30 TAC §330.407 are presented in the appropriate sections of this plan. Any amendments or modifications to this plan will also be conducted in accordance with the additional permitting and registration conditions for municipal solid waste facilities, as outlined in 30 TAC §§330.73, 305.62, and 305.70.

III.F.8.0 Monitoring Well Construction Specifications

In accordance with 30 TAC §330.421(a), the owner/operator will ensure proper construction of monitoring wells at the facility. This involves maintaining borehole integrity, collecting representative groundwater samples, and preventing water migration within the borehole. The wells will be drilled by a Texas-licensed driller, supervised by a licensed professional familiar with the area's geology. The drilling method will prevent contamination, using clean, treated city water or other approved fluids. The borehole's diameter will be at least four inches larger than the casing, and a detailed log of the boring, prepared by or under the supervision of a licensed professional geoscientist or engineer who is familiar with the geology of the area, will be sealed, signed, and dated by the professional and will be maintained in the operating record.

Casing, screen, filter pack, and annular seals will be installed in accordance with 30 TAC §330.421(a)(2). A high-quality structural-type concrete pad will be installed in accordance with 30 TAC §330.421(a)(3). A protective collar will be installed in accordance with 30 TAC §330.421(a)(4). A protective barrier will be installed in accordance with 30 TAC §330.421(a)(5).

In accordance with 30 TAC §330.421(b), in unusual installation conditions, the owner/operator will obtain written approval from the executive director.

In accordance with 30 TAC §330.421(c), after installation, the well will be developed to remove drilling artifacts and facilitate maximum water flow, continuing until specific field measurements have stabilized.

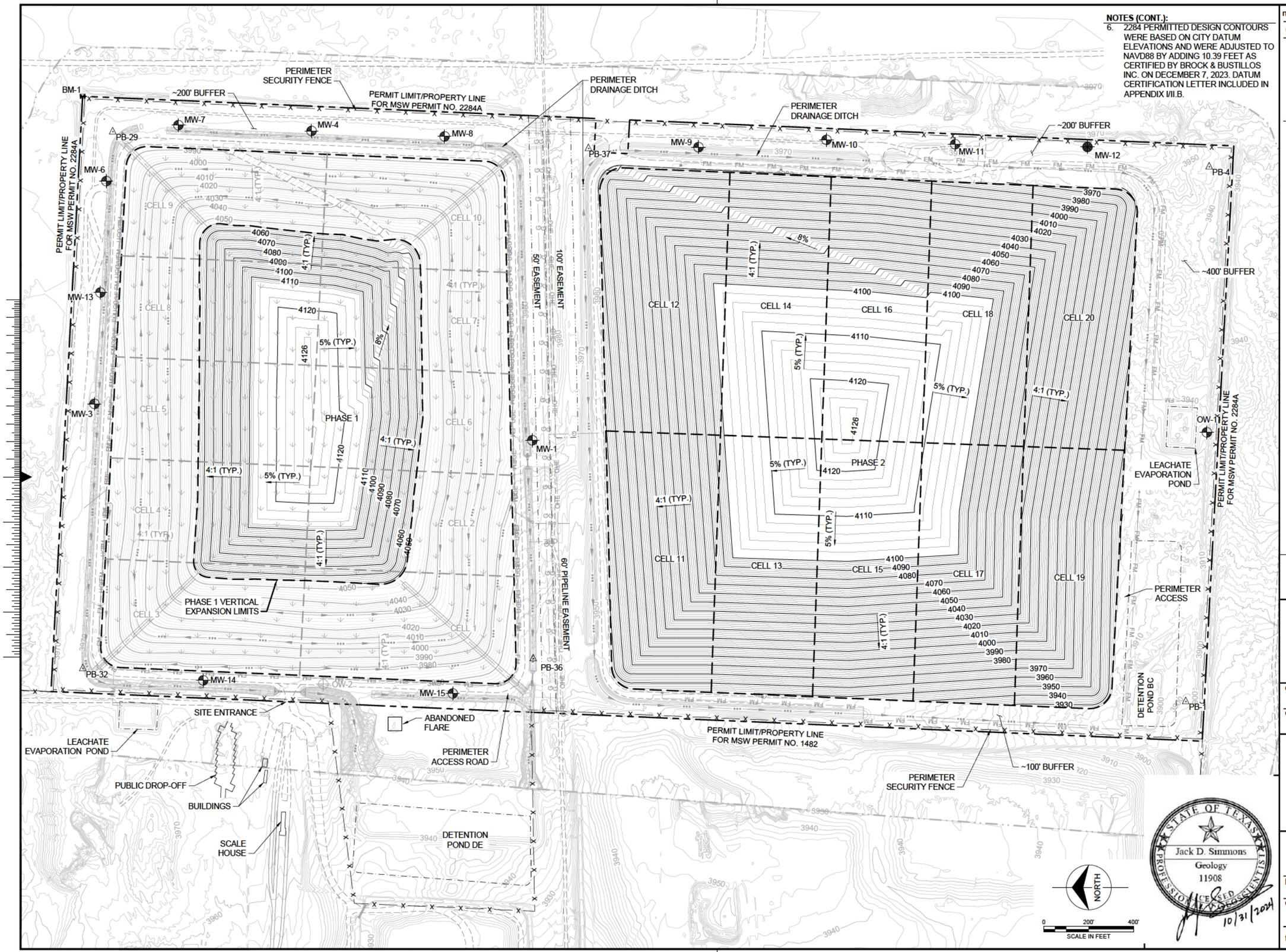
In accordance with 30 TAC §330.421(d), the owner/operator will have the well's location and elevation surveyed post-construction, with precise measurements relative to mean sea level.

In accordance with 30 TAC §330.421(e), detailed installation and construction reports will be submitted within 60 days of completion along with other required documentation.

In accordance with 30 TAC §330.421(f), if a monitoring well is damaged and becomes unsuitable for sampling, the owner/operator will report this to the executive director for a decision on repair or replacement.

In accordance with 30 TAC §330.421(g), the owner/operator will properly abandon and plug any monitoring well that is no longer in use, following specific technical requirements, in accordance with applicable regulations of Title 16 of the TAC, Chapter 76, and with prior written authorization from the executive director.

ATTACHMENT III.F.1 – GROUNDWATER WELL TOPOGRAPHY MAP



NOTES (CONT.):

6. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008. SURVEY LIMITS SHOWN ON DRAWING I/II.B.2.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

FINAL GROUNDWATER MONITORING PLAN

project	contract
155488	-

drawing **III.F.2** – rev. **0**

file III.F.2 FINAL GROUNDWATER MONITORING PLAN.dwg

STATE OF TEXAS
Jack D. Simmons
Geology
11908
LICENSED PROFESSIONAL GEOSCIENTIST
10/31/2024

ATTACHMENT III.F.2 – GROUNDWATER SAMPLING FORM

Greater El Paso Landfill
Permit No. MSW 2284A
El Paso County, Texas

GROUNDWATER SAMPLING
FIELD DATA SHEET

Well Number:_____
Project Number:_____

Project:_____
Personnel:_____

Date: _____
Weather Conditions: _____ Air Temp: _____

WELL DATA:

Casing Diameter: _____ (in) ☐ PVC ☐ Other: _____
DEPTH TO: Static Water Level (WL): _____ (ft)
DATUM: ☐ Top of Well Casing ☐ Top of Protective Casing ☐ Other: _____
CONDITION: Is well clearly labeled? ☐ Yes ☐ No
Is prot. casing in good cond.? (not bent or corroded) ☐ Yes ☐ No
Is concrete pad intact? (not cracked or frost heaved) ☐ Yes ☐ No-
Is padlock functional? ☐ Yes ☐ No Is inner casing intact? ☐ Yes ☐ No
Is inner casing properly capped and vented? ☐ Yes ☐ No

PURGE DATA: Low-Flow Purging Used? ☐ Yes ☐ No

METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____ {if no – Water Standing in Well _____ (gal)
MATERIALS: Type of Pump: _____ To be Purged _____ (gal)
Tubing: ☐ Teflon® ☐ Polyethylene ☐ Polypropylene ☐ Other: _____
PURGING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐ Field-Cleaned
PROCEDURES: Pump & Tubing Vol.: _____(ml) Pumping Rate: _____ (ml/min)
CALIBRATION: pH Meter Model: _____ Meter S/N: _____ Time: _____
Cond. Meter Model: _____ Meter S/N: _____ Time: _____

TIME SERIES DATA:

Time:							
Cum. Volume Removed (ml)	Start						
Temp. (ºC):	---						
pH (s.u.):	---						
Spec. Cond. (µmhos/cm):	---						
Turbidity (NTU):	---						
Water Level (ft.)	---						
Other:_____	---						

SAMPLING DATA:

Sample Collection Time: _____
Water Level at Time of Sample: _____
METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____
SAMPLING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐ Field-Cleaned ☐ Disposable
APPEARANCE: ☐ Clear Turbid (NTU): _____Color: _____☐ Contains Immiscible Liquid
FIELD DETERMINATIONS: Temp. (ºC):_____pH (s.u.):_____Spec. Cond. (µmhos/cm): _____
☐ Background ☐ Detection ☐ Assessment ☐ Quarterly ☐ Other

REMARKS:_____

I certify that this sample was collected and handled in accordance with applicable regulatory and project protocols.

Signature:_____ Date:_____

ATTACHMENT III.F.3 – PARAMETER LIST

Appendix I
Groundwater Monitoring Well Sampling Parameters
Greater El Paso Landfill

Parameter	Notes	Method [(1) (2)]	Reporting Limit (RL) [3] (µg/l)
Antimony	(total)	EPA 6020	1
Arsenic	(total)	EPA 6020	5
Barium	(total)	EPA 6020	5
Beryllium	(total)	EPA 6020	1
Cadmium	(total)	EPA 6020	5
Chromium	(total)	EPA 6020	5
Cobalt	(total)	EPA 6020	1
Copper	(total)	EPA 6020	1
Lead	(total)	EPA 6020	1
Nickel	(total)	EPA 6020	1
Selenium	(total)	EPA 6020	5
Silver	(total)	EPA 6020	1
Thallium	(total)	EPA 6020	1
Vanadium	(total)	EPA 6020	2
Zinc	(total)	EPA 6020	10

Volatile Organic Compounds	Method[1] [2]	RL [3](µg/l)
Acetone	8260	10
Acrylonitrile	8260	10
Benzene	8260	2
Bromochloromethane	8260	2
Bromodichloromethane	8260	2
Bromoform	8260	2
Carbon Disulfide	8260	2
Carbon Tetrachloride	8260	2
Chlorobenzene	8260	2
Chloroethane	8260	2
Chloroform	8260	2
Dibromochloromethane	8260	2
1,2-Dibromo-3-chloropropane	8260	5 [4]
1,2-Dibromoethane	8260	1 [4]
1,2-Dichlorobenzene	8260	2
1,4-Dichlorobenzene	8260	2
Trans-1,4-Dichloro-2-Butene	8260	20
1,1-Dichloroethane	8260	2
1,2-Dichloroethane	8260	2
1,1-Dichloroethylene	8260	2
Cis-1,2-Dichloroethylene	8260	2
Trans-1,2-Dichloroethylene	8260	2
1,2-Dichloropropane	8260	2
Cis-1,3-Dichloropropene	8260	2

Volatile Organic Compounds	Method[(1) (2)]	RL [(3)] (µg/l)
Trans-1,3-Dichloropropene	8260	2
Ethylbenzene	8260	2
2-Hexanone	8260	5
Bromomethane	8260	2
Chloromethane	8260	2
Methylene Bromide	8260	2
Methylene Chloride	8260	2
Methyl ethyl ketone	8260	10
Iodomethane	8260	2
4-Methyl-2-Pentanone	8260	5
Styrene	8260	2
1,1,1,2-Tetrachloroethane	8260	2
1,1,2,2-Tetrachloroethane	8260	2
Tetrachloroethylene	8260	2
Toluene	8260	2
1,1,1-Trichloroethane	8260	2
1,1,2-Trichloroethane	8260	2
Trichloroethylene	8260	2
Trichlorofluoromethane	8260	2
1,2,3-Trichloropropane	8260	2
Vinyl Acetate	8260	10
Vinyl Chloride	8260	2
Xylenes (Total)	8260	3

(1) Analyses will be performed using the above listed methods or an equivalent or better EPA-approved method.
(2) Test Methods for Evaluating Solid Waste, Physical/Chemical Method, November, 1986, Third Edition, USEPA, SW-846 and additions thereto.
(3) In order to maintain statistical consistency and prevent potential false positive or false negative errors, the majority of RLs are equal to historical values.
(4) The EPA 8260 method RL is above the established MCL, detectable amounts below the RL and above the MCL will be flagged.

Appendix II
List of Hazardous Inorganic and Organic Constituents
Greater El Paso Landfill

Common Name[1]	CAS RN[2]	Chemical Abstracts Service Index Name[3]
Acenaphthene	83-32-9	Acenaphthylene, 1,2-dihydro-
Acenaphthylene	208-96-8	Acenaphthylene
Acetone	67-64-1	2-Propanone
Acetonitrile; Methyl cyanide	75-05-8	Acetonitrile
Acetophenone	98-86-2	Ethanone, 1-phenyl-
2-Acetylaminofluorene; 2-AAF	53-96-3	Acetamide, N-9H-fluoren-2-yl-
Acrolein	107-02-8	2-Propenal
Acrylonitrile	107-13-1	2-Propenenitrile
Aldrin	309-00-2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1,4,4a,5,8,8a)-
Allyl chloride	107-05-1	1-Propene, 3-chloro-
4-Aminobiphenyl	92-67-1	[1,1′-Biphenyl]-4-amine
Anthracene	120-12-7	Anthracene
Antimony	(Total)	Antimony
Arsenic	(Total)	Arsenic
Barium	(Total)	Barium
Benzene	71-43-2	Benzene
Benzo[a]anthracene; Benzanthracene	56-55-3	Benz[a]anthracene
Benzo[b]fluoranthene	205-99-2	Benz[e]acephenanthrylene
Benzo[k]fluoranthene	207-08-9	Benzo[k]fluoranthene
Benzo[ghi]perylene	191-24-2	Benzo[ghi]perylene
Benzo[a]pyrene	50-32-8	Benzo[a]pyrene
Benzyl alcohol	100-51-6	Benzenemethanol
Beryllium	(Total)	Beryllium
alpha-BHC	319-84-6	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2α,3β,4α,5β,6β)-

beta-BHC	319-85-7	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2β,3α,4β,5α,6β)-
delta-BHC	319-86-8	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2α,3α,4β,5α,6β)-
gamma-BHC; Lindane	58-89-9	Cyclohexane, 1,2,3,4,5,6- hexachloro-,(1α,2α, 3β, 4α,5α,6β)-
Bis(2-chloroethoxy)methane	111-91-1	Ethane, 1,1′-[methylenebis (oxy)]bis [2-chloro-
Bis(2-chloroethyl)ether; Dichloroethyl ether	111-44-4	Ethane, 1,1′-oxybis[2-chloro-
Bis(2-chloro-1-methylethyl) ether; 2,2′-Dichlorodiisopropyl ether; DCIP, See footnote 4	108-60-1	Propane, 2,2′-oxybis[1-chloro-
Bis(2-ethylhexyl) phthalate	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester
Bromochloromethane; Chlorobromethane	74-97-5	Methane, bromochloro-
Bromodichloromethane; Dibromochloromethane	75-27-4	Methane, bromodichloro-
Bromoform; Tribromomethane	75-25-2	Methane, tribromo-
4-Bromophenyl phenyl ether	101-55-3	Benzene, 1-bromo-4-phenoxy-
Butyl benzyl phthalate; Benzyl butyl phthalate	85-68-7	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester
Cadmium	(Total)	Cadmium
Carbon disulfide	75-15-0	Carbon disulfide
Carbon tetrachloride	56-23-5	Methane, tetrachloro-
Chlordane	See footnote 5	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
p-Chloroaniline	106-47-8	Benzenamine, 4-chloro-
Chlorobenzene	108-90-7	Benzene, chloro-
Chlorobenzilate	510-15-6	Benzeneacetic acid, 4-chloro-
		-(4-chlorophenyl)-
		-hydroxy-, ethyl ester.
p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7	Phenol, 4-chloro-3-methyl-
Chloroethane; Ethyl chloride	75-00-3	Ethane, chloro-

Chloroform; Trichloromethane	67-66-3	Methane, trichloro-
2-Chloronaphthalene	91-58-7	Naphthalene, 2-chloro-
2-Chlorophenol	95-57-8	Phenol, 2-chloro-
4-Chlorophenyl phenyl ether	7005-72-3	Benzene, 1-chloro-4-phenoxy-
Chloroprene	126-99-8	1,3-Butadiene, 2-chloro-
Chromium	(Total)	Chromium
Chrysene	218-01-9	Chrysene
Cobalt	(Total)	Cobalt
Copper	(Total)	Copper
m-Cresol; 3-Methylphenol	108-39-4	Phenol, 3-methyl-
o-Cresol; 2-Methylphenol	95-48-7	Phenol, 2-methyl-
p-Cresol; 4-Methylphenol	106-44-5	Phenol, 4-methyl-
Cyanide	57-12-5	Cyanide
2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7	Acetic acid, (2,4-dichlorophenoxy)-
4,4′-DDD	72-54-8	Benzene 1,1′-(2,2-dichloroethylidene) bis[4-chloro-
4,4′-DDE	72-55-9	Benzene, 1,1′-(dichloroethenylidene) bis[4-chloro-
4,4′-DDT	50-29-3	Benzene, 1,1′-(2,2,2-trichloroethylidene) bis[4-chloro-
Diallate	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S- (2,3-dichloro-2-propenyl) ester.
Dibenz[a,h]anthracene	53-70-3	Dibenz[a,h]anthracene
Dibenzofuran	132-64-9	Dibenzofuran
Dibromochloromethane; Chlorodibromomethane	124-48-1	Methane, dibromochloro-
1,2-Dibromo-3-chloropropane; DBCP	96-12-8	Propane, 1,2-dibromo-3-chloro-
1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4	Ethane, 1,2-dibromo-
Di-n-butyl phthalate	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester

o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1	Benzene, 1,2-dichloro-
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1	Benzene, 1,3-dichloro-
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	Benzene, 1,4-dichloro-
3,3′-Dichlorobenzidine	91-94-1	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dichloro-
trans-1,4-Dichloro-2-butene	110-57-6	2-Butene, 1,4-dichloro-, (E)-
Dichlorodifluoromethane; CFC 12	75-71-8	Methane, dichlorodifluoro-
1,1-Dichloroethane; Ethyldidene chloride	75-34-3	Ethane, 1,1-dichloro-
1,2-Dichloroethane; Ethylene dichloride	107-06-2	Ethane, 1,2-dichloro-
1,1-Dichloroethylene; 1,1-Dichloroethene;	75-35-4	Ethene, 1,1-dichloro-
Vinylidene chloride cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	Ethene, 1,2-dichloro-(Z)-
trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5	Ethene, 1,2-dichloro-, (E)-
2,4-Dichlorophenol	120-83-2	Phenol, 2,4-dichloro-
2,6-Dichlorophenol	87-65-0	Phenol, 2,6-dichloro-
1,2-Dichloropropane	78-87-5	Propane, 1,2-dichloro-
1,3-Dichloropropane; Trimethylene dichloride	142-28-9	Propane, 1,3-dichloro-
2,2-Dichloropropane; Isopropylidene chloride	594-20-7	Propane, 2,2-dichloro-
1,1-Dichloropropene	563-58-6	1-Propene, 1,1-dichloro-
cis-1,3-Dichloropropene	10061-01-5	1-Propene, 1,3-dichloro-, (Z)-
trans-1,3-Dichloropropene	10061-02-6	1-Propene, 1,3-dichloro-, (E)-
Dieldrin	60-57-1	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα,2β,2aα,3β,6β,6aα,7β,7aα)-
Diethyl phthalate	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester.

Dimethoate	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
p-(Dimethylamino)azobenzene	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
7,12-Dimethylbenz[a]anthracene	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
3,3′-Dimethylbenzidine	119-93-7	[1,1′-Biphenyl]-4,4′-diamine, 3,3′-dimethyl-
alpha, alpha-Dimethylphenethylamine	122-09-8	Benzeneethanamine, α,α-dimethyl-
2,4-Dimethylphenol; m-Xylenol	105-67-9	Phenol, 2,4-dimethyl-
Dimethyl phthalate	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
m-Dinitrobenzene	99-65-0	Benzene, 1,3-dinitro-
4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	534-52-1	Phenol, 2-methyl-4,6-dinitro-
2,4-Dinitrophenol	51-28-5	Phenol, 2,4-dinitro-
2,4-Dinitrotoluene	121-14-2	Benzene, 1-methyl-2,4-dinitro-
2,6-Dinitrotoluene	606-20-2	Benzene, 2-methyl-1,3-dinitro-
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
Di-n-octyl phthalate	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
Diphenylamine	122-39-4	Benzenamine, N-phenyl-
Disulfoton	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
Endosulfan I	959-98-8	6,9-Methano-2,4,3-benzodiox-athiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide,
Endosulfan II	33213-65-9	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro- 1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aα,6β,9β, 9aα)-
Endosulfan sulfate	1031-07-8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide
Endrin	72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα, 2β,2aβ, 3α,6α,6aβ,7β,7aα)-
Endrin aldehyde	7421-93-4	1,2,4-Methenocyclo-penta[cd]pentalene-5-carboxaldehyde,2,2a,3,3,4,7-hexachlorodecahydro-(1α,2β,2aβ,4β,4aβ,5β,6aβ,6bβ,7R*)-

Ethylbenzene	100-41-4	Benzene, ethyl-
Ethyl methacrylate	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
Ethyl methanesulfonate	62-50-0	Methanesulfonic acid, ethyl ester
Famphur	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl]-O,O-dimethyl ester
Fluoranthene	206-44-0	Fluoranthene
Fluorene	86-73-7	9H-Fluorene
Heptachlor	76-44-8	4,7-Methano-1H-indene,1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
Heptachlor epoxide	1024-57-3	2,5-Methano-2H-indeno[1,2-b]oxirene,
		2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a,-hexahydro-,(1aα,1bβ,2α,5α,5aβ,6β,6aα)
Hexachlorobenzene	118-74-1	Benzene, hexachloro-
Hexachlorobutadiene	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
Hexachlorocyclopentadiene	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
Hexachloroethane	67-72-1	Ethane, hexachloro-
Hexachloropropene	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
2-Hexanone; Methyl butyl ketone	591-78-6	2-Hexanone
Indeno(1,2,3-cd)pyrene	193-39-5	Indeno[1,2,3-cd]pyrene
Isobutyl alcohol	78-83-1	1-Propanol, 2-methyl-
Isodrin	465-73-6	1,4,5,8-Dimethanonaphthalene,1,2,3,4,1 0,10-hexachloro-1,4,4a,5,8,8a hexahydro-(1α, 4α, 4aβ,5β,8β,8aβ)-
Isophorone	78-59-1	2-Cyclohexen-1-one, 3,5,5-trimethyl-
Isosafrole	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
Kepone	143-50-0	1,3,4-Metheno-2H-cyclobuta-[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
Lead	(Total)	Lead
Mercury	(Total)	Mercury
Methacrylonitrile	126-98-7	2-Propenenitrile, 2-methyl-
Methapyrilene	91-80-5	1,2,Ethanediamine, N,N-dimethyl-N′-2-pyridinyl-N′-(2-thienylmethyl)-
Methoxychlor	72-43-5	Benzene, 1,1′-(2,2,2,trichloroethylidene)bis [4-methoxy-

Methyl bromide; Bromomethane	74-83-9	Methane, bromo-
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-
3-Methylcholanthrene	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3	2-Butanone
Methyl iodide; Iodomethane	74-88-4	Methane, iodo-
Methyl methacrylate	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester
Methyl methanesulfonate	66-27-3	Methanesulfonic acid, methyl ester
2-Methylnaphthalene	91-57-6	Naphthalene, 2-methyl-
Methacrylonitrile	126-98-7	2-Propenenitrile, 2-methyl-
Methapyrilene	91-80-5	1,2,Ethanediamine, N,N-dimethyl-N′-2-pyridinyl-N′-(2-thienylmethyl)-
Methoxychlor	72-43-5	Benzene, 1,1′-(2,2,2,trichloroethylidene)bis [4-methoxy-
Methyl bromide; Bromomethane	74-83-9	Methane, bromo-
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-
3-Methylcholanthrene	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3	2-Butanone
Methyl iodide; Iodomethane	74-88-4	Methane, iodo-
Methyl methacrylate	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester
Methyl methanesulfonate	66-27-3	Methanesulfonic acid, methyl ester
2-Methylnaphthalene	91-57-6	Naphthalene, 2-methyl-
Methyl parathion; Parathion methyl	298-00-0	Phosphorothioic acid, O,O-dimethyl
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	2-Pentanone, 4-methyl-
Methylene bromide; Dibromomethane	74-95-3	Methane, dibromo-
Methylene chloride; Dichloromethane	75-09-2	Methane, dichloro-
Naphthalene	91-20-3	Naphthalene
1,4-Naphthoquinone	130-15-4	1,4-Naphthalenedione
1-Naphthylamine	134-32-7	1-Naphthalenamine

2-Naphthylamine	91-59-8	2-Naphthalenamine
Nickel	(Total)	Nickel
o-Nitroaniline; 2-Nitroaniline	88-74-4	Benzenamine, 2-nitro-
m-Nitroaniline; 3-Nitroaniline	99-09-2	Benzenamine, 3-nitro-
p-Nitroaniline; 4-Nitroaniline	100-01-6	Benzenamine, 4-nitro-
Nitrobenzene	98-95-3	Benzene, nitro-
o-Nitrophenol; 2-Nitrophenol	88-75-5	Phenol, 2-nitro-
p-Nitrophenol; 4-Nitrophenol	100-02-7	Phenol, 4-nitro-
N-Nitrosodi-n-butylamine	924-16-3	1-Butanamine, N-butyl-N-nitroso-
N-Nitrosodiethylamine	55-18-5	Ethanamine, N-ethyl-N-nitroso-
N-Nitrosodimethylamine	62-75-9	Methanamine, N-methyl-N-nitroso-
N-Nitrosodiphenylamine	86-30-6	Benzenamine, N-nitroso-N-phenyl-
N-Nitrosodipropylamine; N-Nitroso-N-dipropylamine; Di-n-propylnitrosamine	621-64-7	1-Propanamine, N-nitroso-N-propyl-
N-Nitrosomethylethalamine	10595-95-6	Ethanamine, N-methyl-N-nitroso-
N-Nitrosopiperidine	100-75-4	Piperidine, 1-nitroso-
N-Nitrosopyrrolidine	930-55-2	Pyrrolidine, 1-nitroso-
5-Nitro-o-toluidine	99-55-8	Benzenamine, 2-methyl-5-nitro-
Parathion	56-38-2	Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl) ester
Pentachlorobenzene	608-93-5	Benzene, pentachloro-
Pentachloronitrobenzene	82-68-8	Benzene, pentachloronitro-
Pentachlorophenol	87-86-5	Phenol, pentachloro-
Phenacetin	62-44-2	Acetamide, N-(4-ethoxyphenyl)
Phenanthrene	85-01-8	Phenanthrene
Phenol	108-95-2	Phenol
p-Phenylenediamine	106-50-3	1,4-Benzenediamine
Phorate	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester

Polychlorinated biphenyls; PCBs	See footnote 6	1,1′-Biphenyl, chloro derivatives
Pronamide	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
Propionitrile; Ethyl cyanide	107-12-0	Propanenitrile
Pyrene	129-00-0	Pyrene
Safrole	94-59-7	1,3-Benzodioxole, 5-(2- propenyl)-
Selenium	(Total)	Selenium
Silver	(Total)	Silver
Silvex; 2,4,5-TP	93-72-1	Propanoic acid, 2-(2,4,5- trichlorophenoxy)-
Styrene	100-42-5	Benzene, ethenyl-
Sulfide	18496-25-8	Sulfide
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	93-76-5	Acetic acid, (2,4,5- trichlorophenoxy)-
2,3,7,8-TCDD; 2,3,7,8-Tetrachlorodibenzo- p-dioxin	1746-01-6	Dibenzo[b,e][1,4]dioxin, 2,3,7,8-tetrachloro-
1,2,4,5-Tetrachlorobenzene	95-94-3	Benzene, 1,2,4,5-tetrachloro-
1,1,1,2-Tetrachloroethane	630-20-6	Ethane, 1,1,1,2-tetrachloro-
1,1,2,2-Tetrachloroethane	79-34-5	Ethane, 1,1,2,2-tetrachloro-
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	Ethene, tetrachloro-
2,3,4,6-Tetrachlorophenol	58-90-2	Phenol, 2,3,4,6-tetrachloro-
Thallium	(Total)	Thallium
Tin	(Total)	Tin
Toluene	108-88-3	Benzene, methyl-
o-Toluidine	95-53-4	Benzenamine, 2-methyl-
Toxaphene	See footnote 7	Toxaphene
1,2,4-Trichlorobenzene	120-82-1	Benzene, 1,2,4-trichloro-
1,1,1-Trichloroethane; Methylchloroform	71-55-6	Ethane, 1,1,1-trichloro-
1,1,2-Trichloroethane	79-00-5	Ethane, 1,1,2-trichloro-

Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-
Trichlorofluoromethane; CFC-11	75-69-4	Methane, trichlorofluoro-
2,4,5-Trichlorophenol	95-95-4	Phenol, 2,4,5-trichloro-
2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-
O,O,O-Triethyl phosphorothioate	126-68-1	Phosphorothioic acid, O,O,O-triethyl ester
sym-Trinitrobenzene	99-35-4	Benzene, 1,3,5-trinitro-
Vanadium	(Total)	Vanadium
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester
Vinyl chloride; Chloroethene	75-01-4	Ethene, chloro-
Xylene (total)	See footnote 8	Benzene, dimethyl-
Zinc	(Total)	Zinc
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-
Trichlorofluoromethane; CFC-11	75-69-4	Methane, trichlorofluoro-
2,4,5-Trichlorophenol	95-95-4	Phenol, 2,4,5-trichloro-
2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-
O,O,O-Triethyl phosphorothioate	126-68-1	Phosphorothioic acid, O,O,O-triethyl ester
sym-Trinitrobenzene	99-35-4	Benzene, 1,3,5-trinitro-
Vanadium	(Total)	Vanadium
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester
Vinyl chloride; Chloroethene	75-01-4	Ethene, chloro-
Xylene (total)	See footnote 8	Benzene, dimethyl-
Zinc	(Total)	Zinc
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-
Trichlorofluoromethane; CFC-11	75-69-4	Methane, trichlorofluoro-
2,4,5-Trichlorophenol	95-95-4	Phenol, 2,4,5-trichloro-

2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-
O,O,O-Triethyl phosphorothioate	126-68-1	Phosphorothioic acid, O,O,O-triethyl ester
sym-Trinitrobenzene	99-35-4	Benzene, 1,3,5-trinitro-
Vanadium	(Total)	Vanadium
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester
Vinyl chloride; Chloroethene	75-01-4	Ethene, chloro-
Xylene (total)	See footnote 8	Benzene, dimethyl-
Zinc	(Total)	Zinc

(1) Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.
(2) Chemical Abstracts Service registry number.
(3) CAS Index names are those used in the 9th Cumulative Index.
(4) Analytical methods for Appendix II constituents are located in **Appendix III.F – Table III.F.5-2.**

ATTACHMENT III.F.4 – EXAMPLE CHAIN OF CUSTODY

Eurofins Houston
6310 Rothway Street

Houston, TX 77040-5062
phone 713.690.4444 fax 713.690.5646

Chain of Custody Record

eurofins | Environment Testing America

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Eurofins Environment Testing America

	Project Manager:		COC No:
Client Contact	**Email:**	**Site Contact:**	**Date:**	_____ of _____ COCs
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	TALS Project #:
Address	**Analysis Turnaround Time**			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx Phone	TAT if different from Below _____			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for_____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:_____ Corr'd:_____ Therm ID No.:_____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

ATTACHMENT III.F.5 – EXAMPLE LABORATORY CHECKLIST

Municipal Solid Waste Laboratory Review Checklist

This data package consists of:

☐ This signature page, and the laboratory review checklist consisting of Table 1, Reportable Data (which includes the reportable data identified on this page), Table 2, Supporting Data, and Table 3, Exception Reports.

☐ R1 Field chain-of-custody documentation

☐ R2 Sample identification cross-reference

☐ R3 Test reports (analytical data sheets) for each environmental sample that includes:
- (a) Items specified in NELAC Chapter 5 for reporting results, e.g., Section 5.5.10 in 2003 NELAC Standard
- (b) Dilution factors
- (c) Preparation methods
- (d) Cleanup methods
- (e) If required for the project, tentatively identified compounds (TICs)

☐ R4 Surrogate recovery data including:
- (a) Calculated recovery (%R)
- (b) The laboratory's surrogate QC limits

☐ R5 Test reports/summary forms for blank samples

☐ R6 Test reports/summary forms for laboratory control samples (LCSs) including:
- (a) LCS spiking amounts
- (b) Calculated %R for each analyte
- (c) The laboratory's LCS QC limits

☐ R7 Test reports for project matrix spike/matrix spike duplicates (MS/MSDs) including:
- (a) Samples associated with the MS/MSD clearly identified
- (b) MS/MSD spiking amounts
- (c) Concentration of each MS/MSD analyte measured in the parent and spiked samples
- (d) Calculated %Rs and relative percent differences (RPDs)
- (e) The laboratory's MS/MSD QC limits

☐ R8 Laboratory analytical duplicate (if applicable) recovery and precision:
- (a) The amount of analyte measured in the duplicate
- (b) The calculated RPD
- (c) The laboratory's QC limits for analytical duplicates

☐ R9 List of method quantitation limits (MQLs) for each analyte for each method and matrix

☐ R10 Other problems or anomalies

☐ The Exception Report for every item for which the result is "No" or "NR" (Not Reviewed)

Release Statement: I am responsible for the release of this laboratory data package. This data package as been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge, all problems/anomalies, observed by the laboratory as having the potential to affect the quality of the data, have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data.

Check, if applicable: [ ] This laboratory is an in-house laboratory controlled by the person responding to rule. The official signing the cover page of the rule-required report in which these data are used is responsible for releasing this data package and is by signature affirming the above release statement is true.

_____	_____	_____	_____
Name (printed)	Signature	Official Title	Date

Table 1. Reportable Data.

Laboratory Name: _____

Project Name: _____

Reviewer Name: _____

LRC Date: _____

Laboratory Job Number: _____

Prep Batch Number(s): _____

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
R1	O, I	**Chain-of-custody (COC)**		
		Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?		
		Were all departures from standard conditions described in an exception report?		
R2	O, I	**Sample and quality control (QC) identification**		
		Are all field sample ID numbers cross-referenced to the laboratory ID numbers?		
		Are all laboratory ID numbers cross-referenced to the corresponding QC data?		
R3	O, I	**Test reports**		
		Were all samples prepared and analyzed within holding times?		
		Other than those results < MQL, were all other raw values bracketed by calibration standards?		
		Were calculations checked by a peer or supervisor?		
		Were all analyte identifications checked by a peer or supervisor?		
		Were sample quantitation limits reported for all analytes not detected?		
		Were all results for soil and sediment samples reported on a dry weight basis?		
		Was % moisture (or solids) reported for all soil and sediment samples?		
		If required for the project, TICs reported?		
R4	O	**Surrogate recovery data**		
		Were surrogates added prior to extraction?		
		Were surrogate percent recoveries in all samples within the laboratory QC limits?		
R5	O, I	**Test reports/summary forms for blank samples**		
		Were appropriate type(s) of blanks analyzed?		
		Were blanks analyzed at the appropriate frequency?		

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
		Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures?		
		Were blank concentrations < MQL?		
R6	O, I	**Laboratory control samples (LCS):**		
		Were all COCs included in the LCS?		
		Was each LCS taken through the entire analytical procedure, including prep and cleanup steps?		
		Were LCSs analyzed at the required frequency?		
		Were LCS (and LCSD, if applicable) %Rs within the laboratory QC limits?		
		Does the detectability data document the laboratory's capability to detect the COCs at the MDL used to calculate the SQLs?		
		Was the LCSD RPD within QC limits?		
R7	O, I	**Matrix spike (MS) and matrix spike duplicate (MSD) data**		
		Were the project/method specified analytes included in the MS and MSD?		
		Were MS/MSD analyzed at the appropriate frequency?		
		Were MS (and MSD, if applicable) %Rs within the laboratory QC limits?		
		Were MS/MSD RPDs within laboratory QC limits?		
R8	O, I	**Analytical duplicate data**		
		Were appropriate analytical duplicates analyzed for each matrix?		
		Were analytical duplicates analyzed at the appropriate frequency?		
		Were RPDs or relative standard deviations within the laboratory QC limits?		
R9	O, I	**Method quantitation limits (MQLs):**		
		Are the MQLs for each method analyte included in the laboratory data package?		
		Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?		
		Are unadjusted MQLs included in the laboratory data package?		
R10	O, I	**Other problems/anomalies**		
		Are all known problems/anomalies/special conditions noted in this LRC and ER?		
		Were all necessary corrective actions performed for the reported data?		
		Was applicable and available technology used to lower the SQL minimize the matrix interference affects on the sample results?		

Table 2. Supporting Data.

Laboratory Name: _____

Project Name: _____

Reviewer Name: _____

LRC Date: _____

Laboratory Job Number: _____

Prep Batch Number(s): _____

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
S1	O, I	**Initial calibration (ICAL)**		
		Were response factors and/or relative response factors for each analyte within QC limits?		
		Were percent RSDs or correlation coefficient criteria met?		
		Was the number of standards recommended in the method used for all analytes?		
		Were all points generated between the lowest and highest standard used to calculate the curve?		
		Are ICAL data available for all instruments used?		
		Has the initial calibration curve been verified using an appropriate second source standard?		
S2	O, I	**Initial and continuing calibration verification (ICCV and CCV) and continuing calibration blank (CCB):**		
		Was the CCV analyzed at the method-required frequency?		
		Were percent differences for each analyte within the method-required QC limits?		
		Was the ICAL curve verified for each analyte?		
		Was the absolute value of the analyte concentration in the inorganic CCB < MDL?		
S3	O	**Mass spectral tuning:**		
		Was the appropriate compound for the method used for tuning?		
		Were ion abundance data within the method-required QC limits?		
S4	O	**Internal standards (IS):**		
		Were IS area counts and retention times within the method-required QC limits?		
S5	O, I	**Raw data (NELAC section 1 appendix A glossary, and section 5.)**		
		Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?		
		Were data associated with manual integrations flagged on the raw data?		

Item[1]	Analytes[2]	Description	Result (Yes, No, NA, NR)[3]	Exception Report No.[4]
S6	O	**Dual column confirmation**		
		Did dual column confirmation results meet the method-required QC?		
S7	O	**Tentatively identified compounds (TICs):**		
		If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?		
S8	I	**Interference Check Sample (ICS) results:**		
		Were percent recoveries within method QC limits?		
S9	I	**Serial dilutions, post digestion spikes, and method of standard additions**		
		Were percent differences, recoveries, and the linearity within the QC limits specified in the method?		
S10	O, I	**Method detection limit (MDL) studies**		
		Was a MDL study performed for each reported analyte?		
		Is the MDL either adjusted or supported by the analysis of DCSs?		
S11	O, I	**Proficiency test reports:**		
		Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?		
S12	O, I	**Standards documentation**		
		Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources?		
S13	O, I	**Compound/analyte identification procedures**		
		Are the procedures for compound/analyte identification documented?		
S14	O, I	**Demonstration of analyst competency (DOC)**		
		Was DOC conducted consistent with NELAC Chapter 5C?		
		Is documentation of the analyst's competency up-to-date and on file?		
S15	O, I	**Verification/validation documentation for methods (NELAC Chap 5n 5)**		
		Are all the methods used to generate the data documented, verified, and validated, where applicable?		
S16	O, I	**Laboratory standard operating procedures (SOPs):**		
		Are laboratory SOPs current and on file for each method performed?		

Table 3. Exception Reports.

Laboratory Name: _____

Project Name: _____

Reviewer Name: _____

LRC Date: _____

Laboratory Job Number: _____

Prep Batch Number(s): _____

Exception Report No.	Description

[1] Items identified by the letter "R" must be available as a hard copy or as a .pdf file. Items identified by the letter "S" should be retained and made available upon request for the appropriate retention period.
[2] O - organic analyses; I - inorganic analyses (including general chemistry constituents, when applicable).
[3] NA - Not applicable; NR - Not reviewed.
[4] Exception Report identification number; an Exception Report should be completed for an item if the result is "No" or "NR."

ATTACHMENT III.F.6 – STATISTICAL ANALYSIS PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

STATISTICAL ANALYSIS PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 0
OCTOBER 31, 2024

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ATTACHMENT III.F.6.3 – CONTROL CHART FLOWCHART

ATTACHMENT III.F.6.4 – PREDICTION LIMIT FLOWCHART

ATTACHMENT III.F.6.5 – CONFIDENCE INTERVAL FLOWCHART

List of Abbreviations

Abbreviation	Term/Phrase/Name
CUSUM	Cumulative Sum
ED	Executive Director
GWPS	Groundwater Protection Standard
GWSAP	Groundwater Sampling and Analysis Plan
LCL	Lower Confidence Limit
MCL	Maximum Contaminant level
MSW	Municipal Solid Waste
RL	Reporting Limit
SSC	Statistically Significant Change
VOC	Volatile Organic Compounds

1.0 Introduction

This document was prepared by a previous consultant upon the collection of the data dated in this document.

This document provides a statistical methodology for groundwater monitoring at the Greater El Paso Landfill operating under Municipal Solid Waste (MSW) Permit No. 2284A. Review of historical background data from March 2005 to April 2007 was performed to determine an appropriate statistical methodology. December 2004 background data was excluded from the review due to anomalously high laboratory reporting limits. A summary of the data review and the ultimate selection of the appropriate statistical method is as follows.

Spatial variability is known to be a potential issue when performing inter-well statistics due to the possibility that upgradient wells do not account for all natural spatial differences in groundwater chemistry that may occur in a localized area (Gibbons, 1994). **Attachment III.F.6.1** contains "box and whisker" plots for routinely detected parameters from March 2005 to April 2007. The "box and whisker" plots present several pieces of information. The endpoints of the vertical lines are the historic high and low concentrations for the parameters of interest in that well. The plus sign plots the average historical concentration (mean) and the box represents the "spread" or variability of historic concentrations. Box limits represent the 25th and 75th percentile locations. The line within the box plots the median (50th percentile) location. As can be observed from the plots, concentration levels are not homogenous across the site and spatial variability is a significant factor. Due to the presence and significance of spatial variability at the facility, interwell statistical analyses were deemed inappropriate for the determination of statistically significant changes over background.

Intrawell statistical methods are only appropriate when predisposal data are available or it can be demonstrated that the facility has not affected a well in the past (Gibbons et al., 2001). **Attachment III.F.6.2** contains Sen's Slope Estimator Plots for routinely detected parameters from March 2005 to April 2007 in hydraulically downgradient wells MW-1, MW-4, and MW-5A and hydraulically side gradient well MW-3. Groundwater hydraulically upgradient of the facility was representative of naturally occurring conditions unaffected by a potential facility release. Therefore, Sen's Slope Estimator Plots were not prepared for hydraulically upgradient wells MW-2, PB-32, or PB-36. Sen's Slope Estimator Plots were not prepared for PB-29 because only one data point was available at the time of the analysis. A constituent produces a statistically significant upward trend if the calculated Mann Kendall statistic exceeds the critical value. It is noted that the statistical software package used for this evaluation (WQStatPlus™) provides critical values at four different alpha levels: 0.2, 0.1, 0.05, and 0.01. The 80% level (0.2 alpha) and 90% level (0.1 alpha) may be used; however, the false positive rate would be higher. Higher false positive rates can result in reporting a trend when no trend actually exists. The 99% confidence level (0.01 alpha) may also be used; however, the false negative rate would be higher. Higher false negative rates can result in trends that go undetected. Based on conversions with developers of the statistical software Sanitas™, the 95% level (0.05 alpha) was recommended as it generally balances both the false positives and false negatives. Statistically significant upward trends of detected parameters may be indicative of facility impact; whereas, the lack of statistically significant upward trends most likely indicates lack of facility impact. Of the routinely detected parameters from March 2005 to April 2007 in MW-1, only 1 of 19 (5.3%) produced statistically significant increasing trends at the 95% level. Of the routinely detected parameters from March 2005 to April 2007 in MW-5A, only 3 of 19 (16%) produced statistically significant increasing trends at the 95% level. No parameters produced statistically significant increasing trends at the 95% level in MW-3 or MW-4. The Sen's Slope Estimator Plots provided in **Attachment III.F.6.2** did not provide evidence of facility impact as the vast majority of routinely detected parameters

did not produce statistically significant upward trends. Furthermore, no confirmed volatile organic compounds (VOC) detections have occurred in facility wells, except for chloroform in MW-5A, throughout facility monitoring history. Chloroform was detected in MW-5A at low concentrations for three consecutive quarterly monitoring events from April 2005 to December 2005. Chloroform has not been detected in MW-5A since December 2005. The early chloroform detections in MW-5A are believed to be a result of a laboratory or field artifact as evidenced by the lack of chloroform detections from April 2006 to April 2007. Although, the absence of VOC detections is, by itself, not definitive evidence of the lack of a potential landfill impact, it is a key indicator of landfill impacts and is believed to be significant combined with the overall general lack of statistically significant increases of routinely detected parameters.

The maximum groundwater velocity for the water bearing zone was calculated at 0.135 feet/year. The Greater El Paso Landfill first accepted waste in November 2004. Given the groundwater velocity and years of operation through November 2007 (3), any potential facility impacted groundwater would have moved less than one half of a foot since initial waste acceptance. Each of the existing hydraulically downgradient (MW-1, MW-4, and MW-5A) and side gradient wells (MW-3) are much further away from waste than 0.5 feet. Therefore, current observed constituent concentrations and trends can not be a result of facility impact.

Results of the data review indicate facility wells have not been affected by a facility impact. In summary, there was an overall general lack of statistically significant increasing trends of routinely detected parameters, lack of VOC detections, and a slow groundwater velocity combined with sufficient distances between wells and waste. Therefore, intrawell statistical analysis was deemed appropriate for the facility.

Intrawell comparisons of heavy metals will be conducted using Shewhart-CUSUM control charts. The advantage of Shewhart-CUSUM control charts is that the method is sensitive to both immediate and gradual releases; whereas; other intrawell statistical analyses (e.g. prediction limits and tolerance limits) are only sensitive to immediate releases (Gibbons et al, 2001). Non-parametric prediction limits combined with Sen's Slope/MannKendall trend analysis will be applied to those parameters with greater than 50 percent non-detections (25 percent under ASTM standards) in the background data set. The combined methods provide a non-parametric control chart equivalent to allow detection of both major and gradual releases from the facility independent of spatial variation. Statistical limits for VOCs in detection monitoring wells will be based on laboratory reporting limits (RLs). Assessment monitoring constituents will be statistically evaluated using detection monitoring statistics and 95 percent confidence interval analysis. Details of each method are provided in the following sections. Statistical comparisons will be performed using Sanitas™, a commercial software program developed by Intelligent Decision Technologies, Inc. or another comparable computer program or method.

This document was prepared using generally accepted statistical analysis principals and practices. However, it is not possible to predict all of the potential future circumstances. Therefore, alternative methods may be used that are more appropriate for the data distribution of the constituents being evaluated.

2.0 Detection Monitoring Statistical Analyses

2.1 Heavy Metals

2.1.1 Shewhart-CUSUM Control Charts

Heavy metals will be statistically evaluated using combined Shewhart-CUSUM control charts. This procedure assumes that the data are independent and normally distributed with a fixed mean and constant variance. The most important assumption is independence, therefore wells should be sampled no more frequently than quarterly (Gibbons, 1994). The assumption of normality is less of a concern and natural log or ladder of powers transformations are adequate for most applications. The analysis was only applied to constituents that have greater than 50 percent detections (25 percent under ASTM standards) in the background data. For those heavy metals with fewer than 50 percent detections in the background data set, a non-parametric prediction limit/Sen's Slope/Mann Kendall trend analysis will be used.

Shewhart-CUSUM control charts allow detection of both major and gradual releases from the facility independent of spatial variation. This procedure was specifically recommended in the USEPA document *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (April 1989).

2.1.2 Procedure

Control charts are a form of time-series graph, on which a parametric statistical representation of concentrations of a given constituent are plotted at intervals over time. The statistics are computed and plotted together with an upper and/or lower control limit on a chart where the x-axis represents time.

The Procedure for conducting the intrawell analysis using combined Shewhart-CUSUM control charts was provided below and a flow chart illustrating the decision making process is provided as **Attachment III.F.6.3**.

Three parameters were selected prior to plotting:

- **h** - The control limit to which the cumulative sum (CUSUM) values were compared. The EPA recommended value for **h** is 5 units of standard deviation.
- **k** - A reference value that establishes the upper limit for the acceptable displacement of the standardized mean. The EPA recommended value for k is 1.
- **SCL** - The upper Shewhart control limit to which the standardized mean will be compared. The EPA recommended value for **SCL** is 4.5.

For each time period, T_i, take n_i independent samples (n_i may be one), and calculate the mean, $\bar{x}_i$. Compute the standardized mean Z_i of the measured concentrations where only a single new measurement is obtained for each constituent at each event as:

$$Z_i = \left(X_i - \overline{X}\right)\sqrt{n_i} / S$$

Where:

x_i = value obtained for a constituent during monitoring event i.

s = The standard deviation obtained from prior monitoring data from the same well.

When applicable, for each time period, T_i, compute the cumulative sum, S_i, as:

$$S_i = \max\{0, (Z_i - k) + S_{i-1}\}$$

Where max {A,B} is the maximum of A and B, and $S_o = 0$.

Plot Z_i and S_i against Ti on the control chart. The results may be plotted in standardized units or converted to the concentration units of the constituents being evaluated. An “out-of-control” situation (potential contamination) occurs whenever $Z_i \geq$ SCL or $S_i \geq h$. Two different types of situation were controlled by the limits. Too large a standardized mean will occur if there is a rapid increase in concentration in the well. Too large a cumulative sum may also occur for a more gradual trend. A verified statistically significant change (SSC) will occur if both the initial result *and* a verification sample result consecutively exceed one of the above mentioned statistical limits. Upgradient wells will be monitored for informational purposes only and will not be part of the verification resampling program.

2.1.2.1 Verification Resamples

The Shewhart and CUSUM portions of the control chart are affected differently by initial statistically significant changes from background (SSCs). The Shewhart portion of the control chart compares each individual new measurement to the control limit, therefore the next monitoring event constitutes an independent verification of the original result. However, the CUSUM procedure incorporates all historical values in the computation, therefore, the effect of the apparent SSC will be present in both the initial and verification sample. Hence, the statistical test will be invalid unless the verification sample value replaces the initial SSC value. Therefore, initial SSC values will be replaced by verification resample results in order to confirm a SSC (Gibbons, 1994).

2.1.2.2 Updating Control Charts

As detection monitoring continues, the background mean and variance will be updated periodically to incorporate new data. At a minimum of every two years all new data that are in control will be pooled with the initial eight background samples and the mean and variance will be recomputed and used in constructing future control charts. TCEQ approval will be obtained prior to updating the background data pool.

2.1.2.3 Censored Data

If less than 15 percent of the background observations are less than the detection limit, these will be replaced with one-half of the laboratory reporting limit prior to running the analysis (U.S. EPA, April 1989).

If more than 15 percent but less than 50 percent of the background data are less than the detection limit, the data’s sample mean and sample standard deviation are adjusted according to the method of Cohen or Aitchison.

If more than 50 percent of the background data are less than the detection limit, a nonparametric prediction limit will be computed.

2.1.3 Non-Parametric Prediction Limits and Sen’s Slope/Mann Kendall Trend Analysis

For those heavy metals with fewer than 50-percent detections within the background pool, a combined non-parametric upper prediction limit/Sen’s Slope/MannKendall trend analysis will be applied. Parameters will be initially tested using the non-parametric prediction limit analysis. Constituents exceeding the non-parametric prediction limit will then be tested using the Sen’s Slope/Mann Kendall trend analysis. An

initial statistical exceedence will be indicated if the measured concentration exceeds both the non-parametric prediction limit and exhibits a significant upward trend. The combined methods provide a non-parametric control chart equivalent to allow detection of both major and gradual releases from the facility independent of spatial variation.

2.1.3.1 Non-Parametric Prediction Limit Analysis

An upper prediction limit is a statistical limit calculated to include one or more observations from the same population with a specified confidence. In groundwater monitoring, an upper prediction limit approach may be used to make comparisons between background and compliance well data. The limit is constructed to contain all **k** observations with stated confidence. Any observation exceeding the upper prediction limit provides statistically significant evidence that the observation is not representative of the background group. The number of observations, **k**, to be compared to the limit must be specified in advance. A flow chart illustrating the decision making process during the analysis is provided as **Attachment III.F.6.4**.

The highest value from the background data is used to set the upper prediction limit. In the case of a two-tailed test, the lowest value from the background data is used to set the lower prediction limit. Under EPA Standards, the false positive rate is based upon the formula:

$$1-(n/(n+k))$$

Where:

N = The background sample size, and

k = The number of future values being compared to the limit.

2.1.3.2 Sen's Slope/Mann Kendall Trend Analysis

The Sen's Slope/Mann Kendall trend analysis procedure determines the significance of an apparent trend and evaluates the magnitude (slope) of that trend (IDT, 2002). The Mann Kendall test for temporal trend is a non-parametric procedure designed to test the null hypothesis, H_0:

H_0: No significant trend of a constituent exists over time.

And the alternative hypothesis, H_A:

H_A: A significant upward trend of a constituent concentration exists over time.

Wells for which less than 41 data points are available, the exact test is applied. For 41 or more data points, the Normal Approximation test is used.

The Sen's Slope estimator portion of the combined method provides an estimate of the true slope. The method is a non-parametric procedure not greatly affected by gross data errors or outliers, and can be computed when data are missing.

2.2 Volatile Organic Compounds

VOCs will be routinely monitored during the detection monitoring program. The statistical limit for VOCs detected in wells under detection monitoring will be set equal to the laboratory RL. RLs are provided in Table 2 of the facility's Groundwater Sampling and Analysis Plan (GWSAP). If an initial statistical exceedence of any VOC is indicated during any detection monitoring event, a notice will be made to the TCEQ Executive Director (ED) within fourteen (14) days of the determination.

2.3 Verification Resampling

Verification resampling is an integral part of the presented statistical methodology. Results for constituents that exceed statistical limits will not be considered statistically significant unless they are confirmed through verification resampling.

If a SSC from background of any tested constituent at any monitor well has occurred (i.e. is confirmed) and there is reasonable cause that a sampling or laboratory error occurred or a source other than the landfill exists, then a report will be submitted documenting the source as per applicable TCEQ regulations. Otherwise, assessment monitoring will be implemented in accordance with applicable TCEQ regulations.

3.0 Assessment Monitoring Statistical Analysis

For assessment wells, 30 TAC 330.419 constituents exceeding detection monitoring statistical limits and that have a maximum contaminant level (MCL) or groundwater protection standard (GWPS) established by the USEPA or the TCEQ, and/or any VOC detections will be statistically compared to the MCL or GWPS using one-sided 95-percent lower confidence limits (LCL). Evaluations were conducted per Gibbons and Coleman (2001). The method constructed a normal confidence interval on the mean concentration of a constituent incorporating, at a minimum, the four most recent semi-annual measurements. A separate interval is constructed for each constituent of interest in each well of interest. A confidence interval is generally used when downgradient samples are being compared to a GWPS. A flow chart depicting the decision making process during the analysis is provided as **Attachment III.F.6.5**.

The lower 95-percent confidence limit on the mean will be compared to a MCL or GWPS to decide initially whether the mean concentration of a constituent of interest has exceeded a MCL or GWPS. If the lower 95-percent confidence limit on the mean exceeds the MCL or GWPS, then there is statistically significant evidence that the mean concentration of that constituent exceeds the MCL or GWPS. Upper 95-percent confidence limit analyses may be applied to constituents in which it's 95 percent LCL has exceeded a MCL or GWPS. If the upper 95-percent confidence limit on the mean is lower than the MCL or GWPS, then there is statistically significant evidence that the mean concentration of that constituent has returned to less than the MCL or GWPS.

3.1 Assumptions

The sample data used to construct the limits must be normally or transformed-normally distributed. In the case of a transformed-normal distribution, the confidence limit must be constructed on the transformed sample concentration values. In addition to the limit construction, the comparison must be made to the transformed GWPS value. When none of the transformed models can be justified, a nonparametric version of each limit may be utilized.

3.2 Distribution

The distribution of the data is evaluated by applying the Shapiro-Wilk or Shapiro-Francia test for normality to the raw data or, when applicable, to the Ladder of Powers (Helsel & Hirsch, 1992) transformed data. The null hypothesis, $\mathbf{H_O}$, to be tested is:

H_O: The population has a normal (or transformed-normal) distribution.

The alternative hypothesis, $\mathbf{H_A}$, is:

H_A: The population does not have a normal (or transformed-normal) distribution.

3.3 Censored Data

If less than 15 percent of the observations are less than the detection limit, these will be replaced with one-half the method detection limit prior to running the normality test and constructing the confidence limit.

If more than 15 percent, but less than 50 percent, of the data are less than the detection limit, the data's sample mean and standard deviation are adjusted according to the method of Cohen or Aitchison (U.S. EPA, April 1989). This adjustment is made prior to construction of the confidence limit.

If more than 50 percent of the data are less than the detection limit, these values are replaced with one half the method detection limit and a nonparametric confidence limit is constructed.

3.4 Parametric Confidence Limit Procedures

A minimum of four sample values is required for the construction of the parametric confidence limit. The mean, **X**, and standard deviation, **S**, of the sample concentration values are calculated separately for each compliance well. For each well, the confidence limit is calculated as:

$$\mathbf{X} \quad \pm t_{(1-a,\, n-1)} \frac{S}{\sqrt{n}}$$

Where:

S = The compliance point's standard deviation;

n = The number of observations for the compliance point; and

$t_{(1-\alpha,,n-1)}$ is obtained from the Student's t-Distribution (appendix B; U.S. EPA, April 1989) with (n-1) degrees of freedom.

The use of the 95th percentile of the t-Distribution is consistent with the 5 percent α - level of individual well comparisons. If the lower limit is above the compliance limit, there is statistically significant evidence that the constituent exceeds a GWPS.

3.5 Nonparametric Confidence Limit Procedure

The nonparametric confidence limit procedure requires at least seven observations in order to obtain a one-sided significance level of 1 percent. The observations are ordered from smallest to largest and ranks are assigned separately within each well. Average ranks are assigned to tied values. The critical values of the order statistics are determined as follows.

If the minimum seven observations are used, the critical values are the first and seventh values. Otherwise, the smallest integer, **M**, is found such that the cumulative binomial distribution with parameters **n** (sample size) and probability of success, p=0.5, is at least 0.99.

The exact confidence coefficient for sample sizes from 4 to 11 are given by the EPA (Table 6-3; U.S. EPA, April 1989). For larger samples, take as an approximation the nearest integer value to:

$$\mathbf{M} = \frac{n}{2} + 1 + \mathbf{Z}_{(1-\alpha)} \sqrt{\frac{n}{4}}$$

Where:

$\mathbf{Z}_{(1-\alpha)}$ The 1-α percentile from the normal distribution found in Table 4 (appendix B; U.S. EPA, April 1989); and

n = The number of observations in the sample.

Once **M** has been determined, (**n+1-M**) is computed and the confidence limits are taken as the order statistics, **X(M)** and **X(n+1-M)**.

4.0 References

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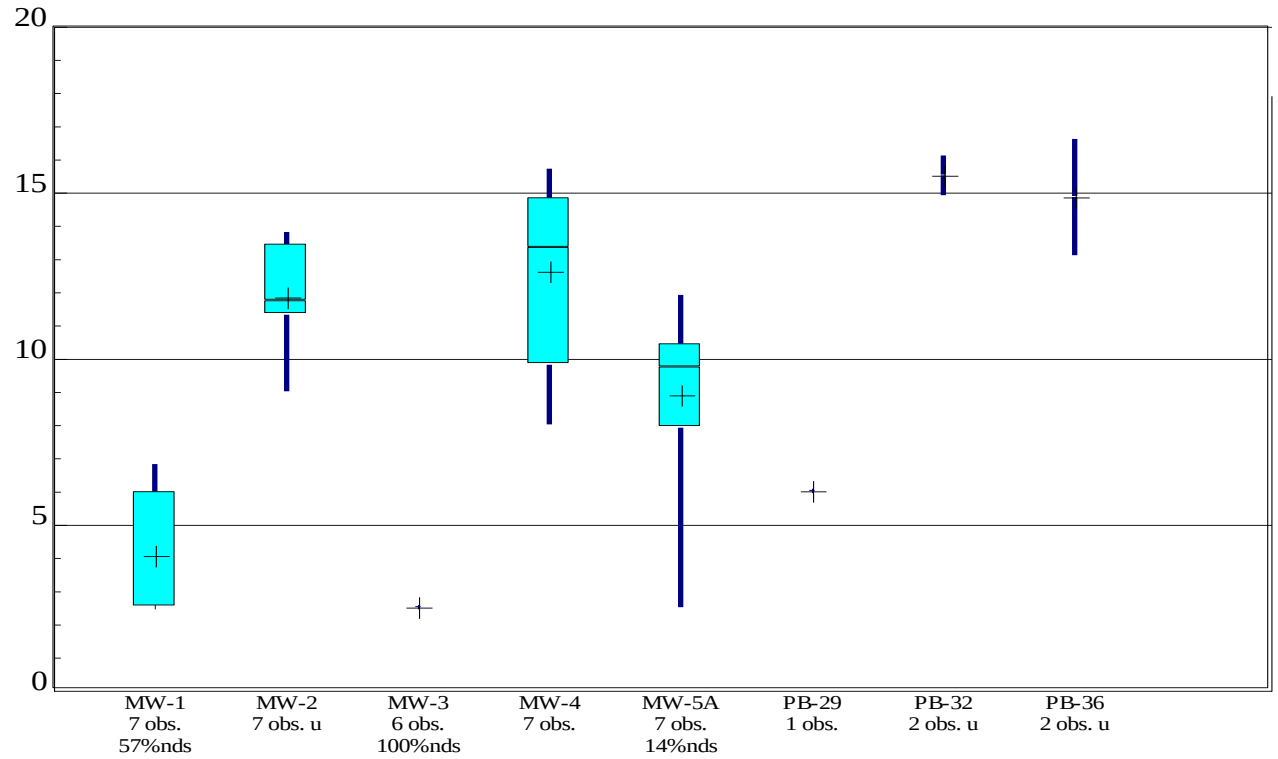
ATTACHMENT III.F.6.1 – BOX AND WHISKER PLOTS

Box and Whisker Plots

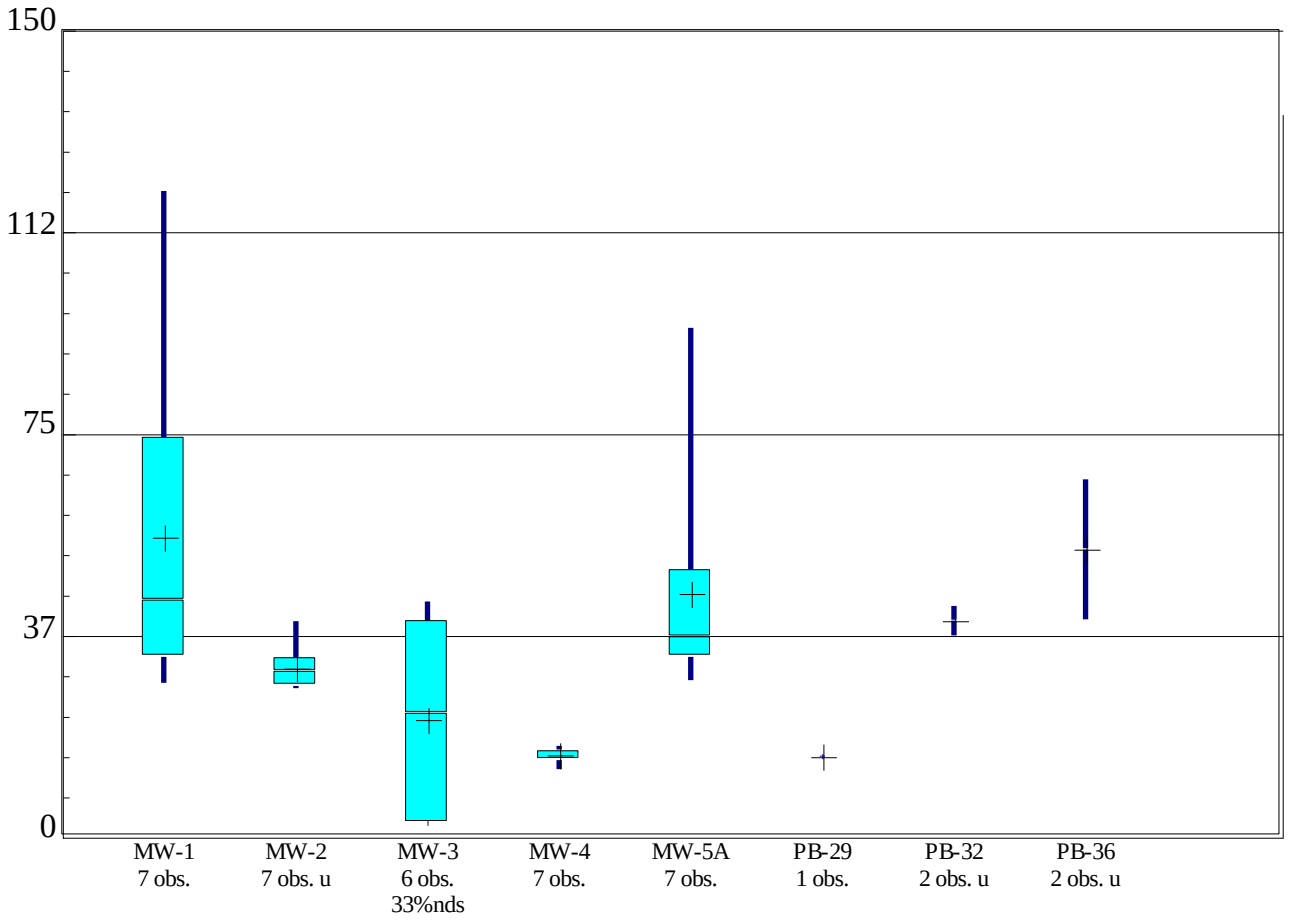
BOX & WHISKERS PLOT



Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:44 PM View: Box and Whisker

BOX & WHISKERS PLOT



Constituent: Barium (ug/L) Facility: Clint Data File: CLINTD~1

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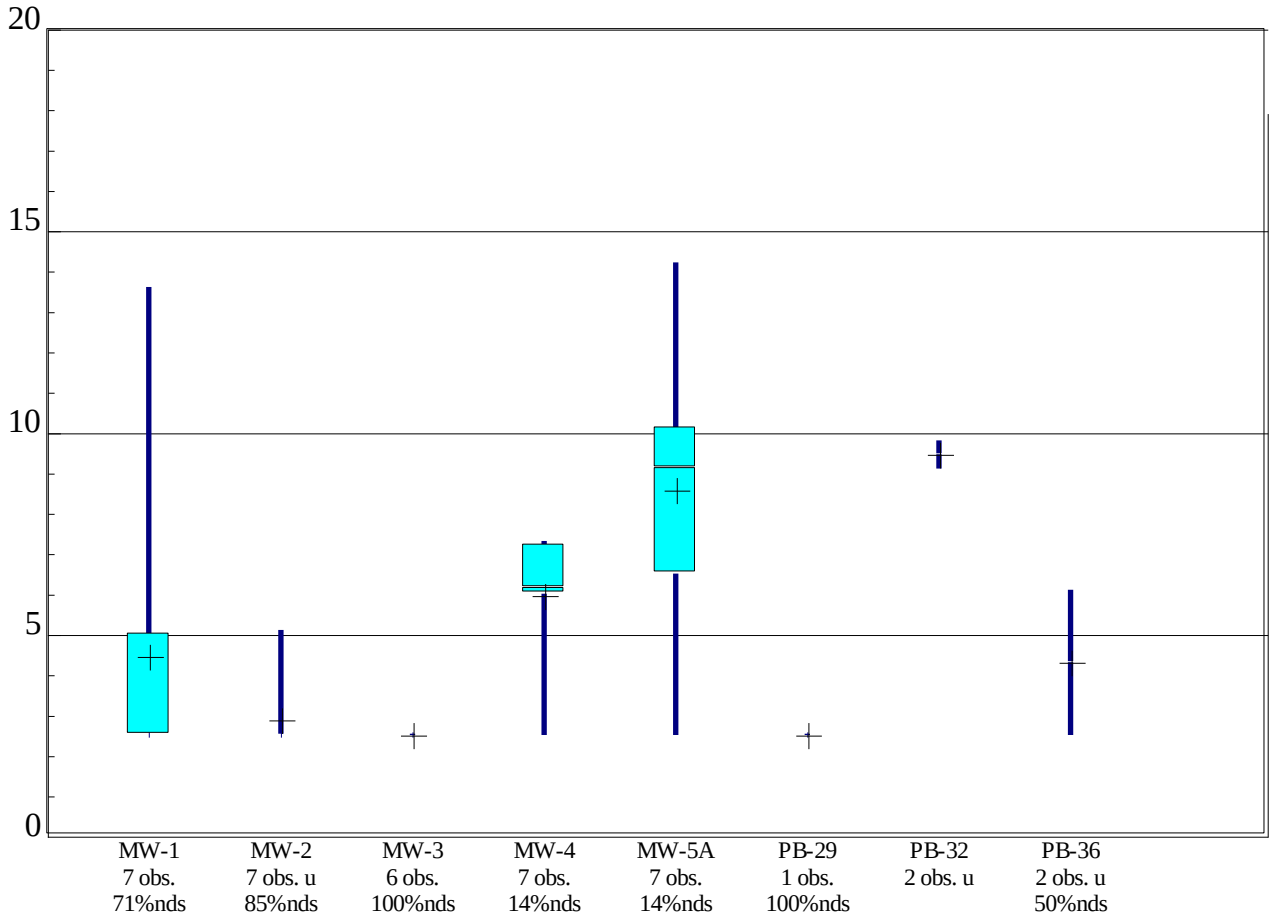

Constituent: Chromium (ug/L) Facility: Clint Data File: CLINTD~1

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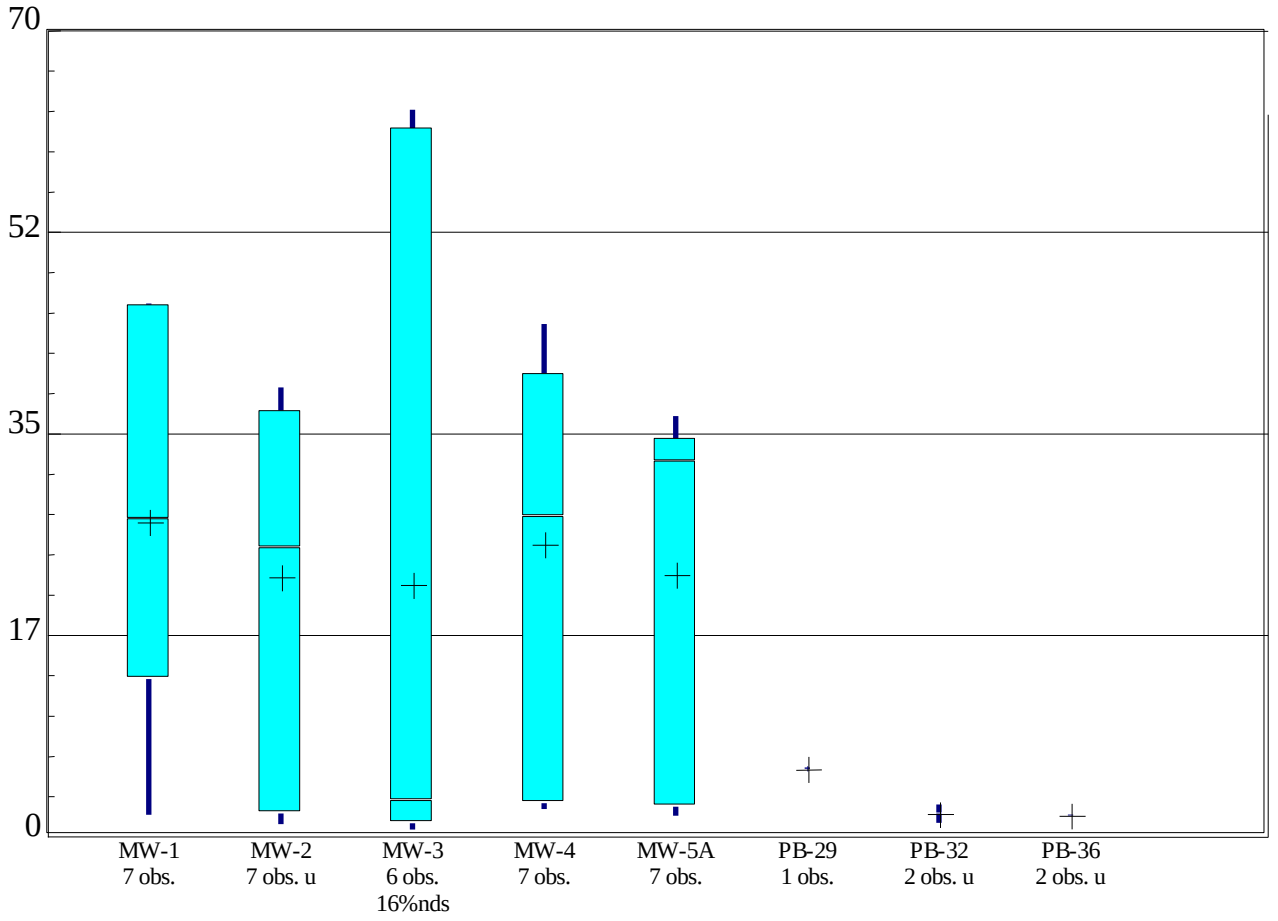
BOX & WHISKERS PLOT



Constituent: Copper (ug/L)

Facility: Clint

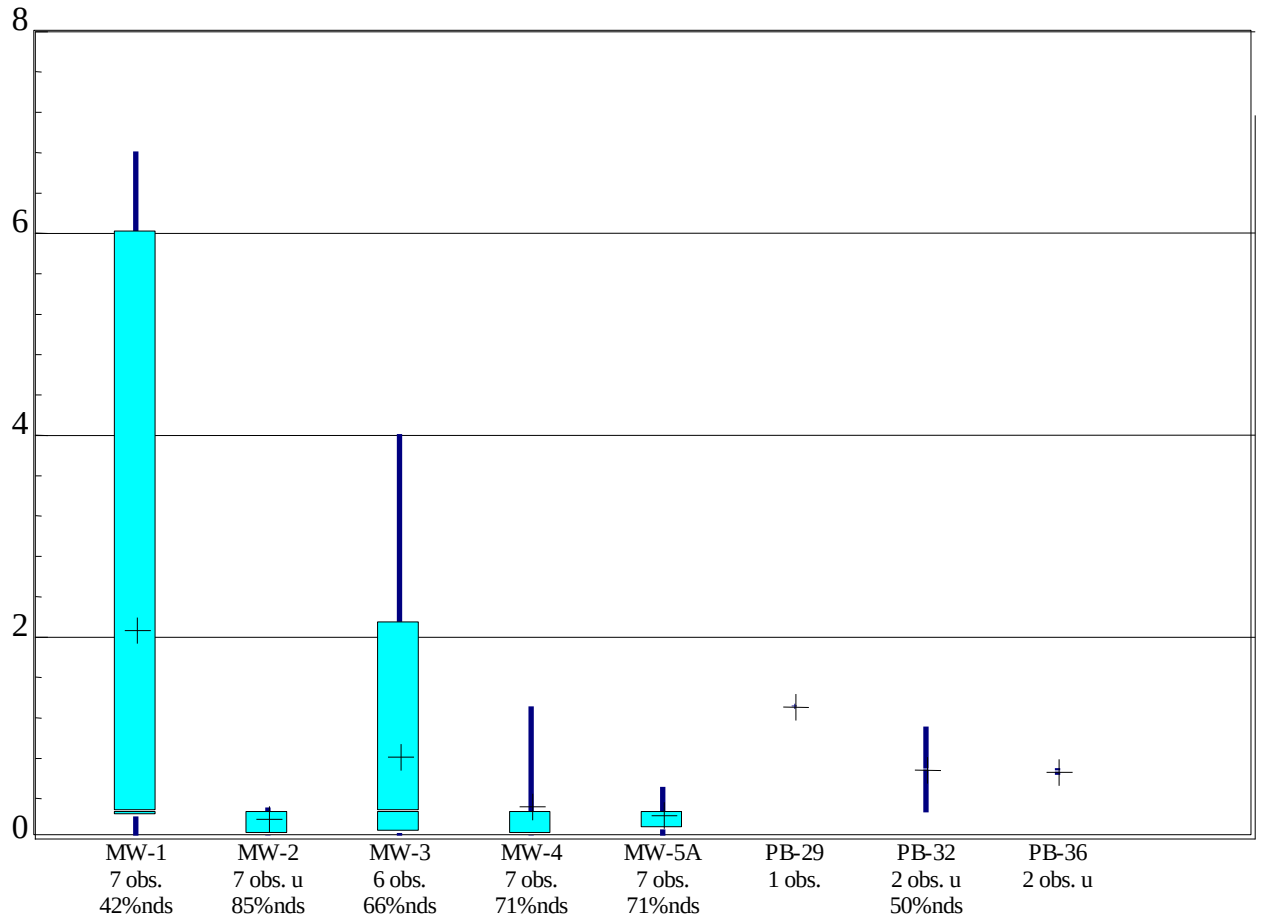
Data File: CLINTD~1

Date: 10/26/07

Time: 3:49 PM

View: Box and Whisker

BOX & WHISKERS PLOT



Constituent: Lead (ug/L) Facility: Clint Data File: CLINTD~1

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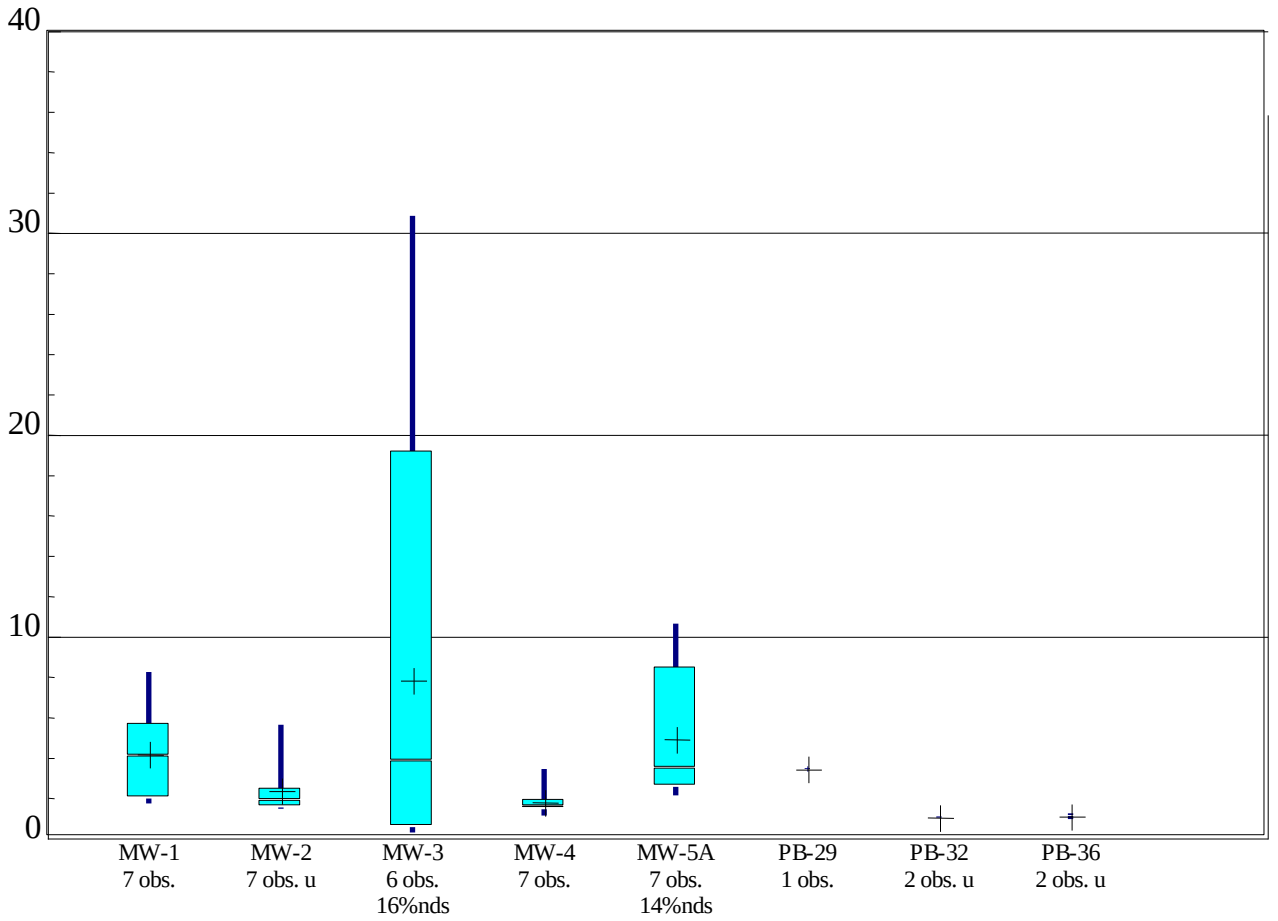
BOX & WHISKERS PLOT



Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1

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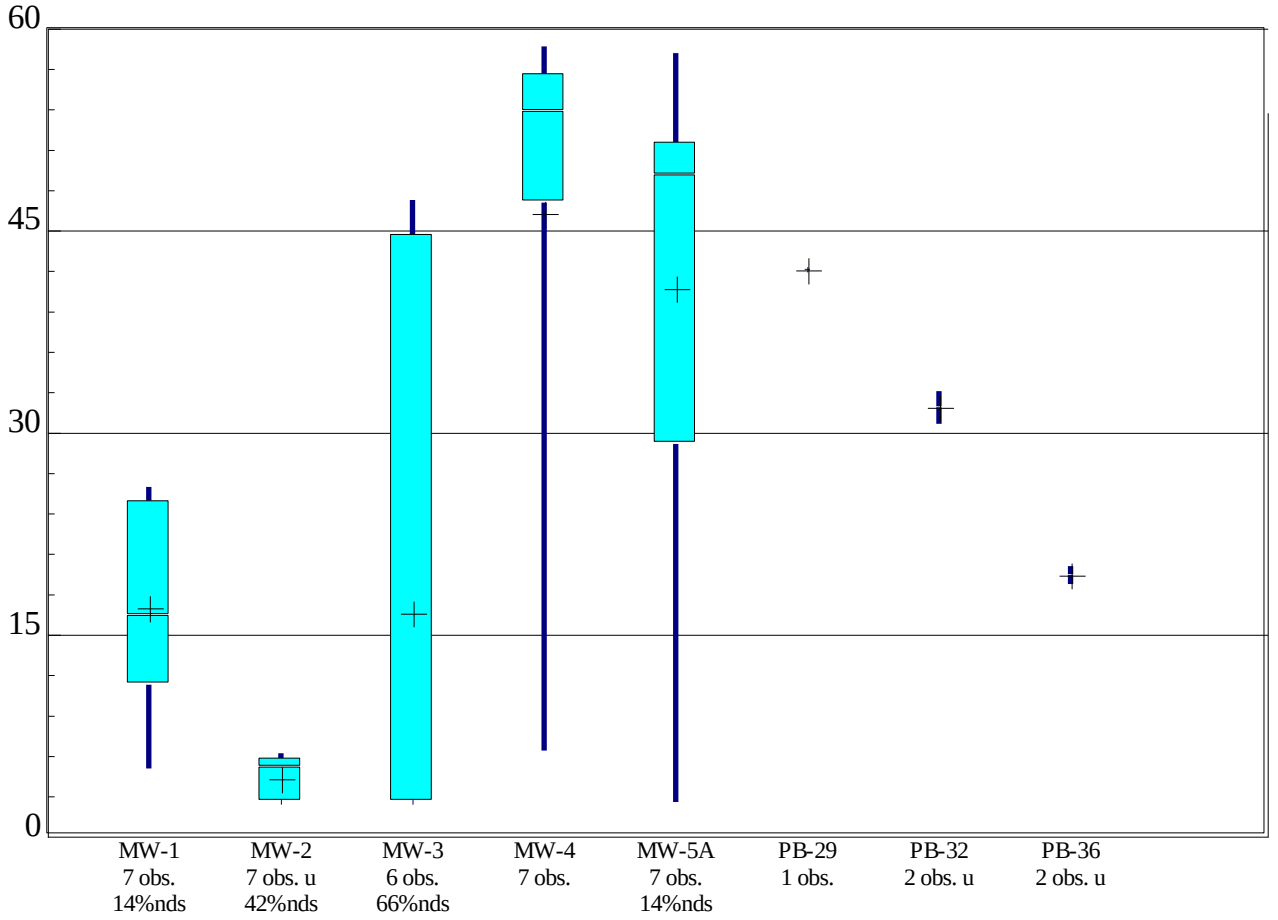
BOX & WHISKERS PLOT



Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1

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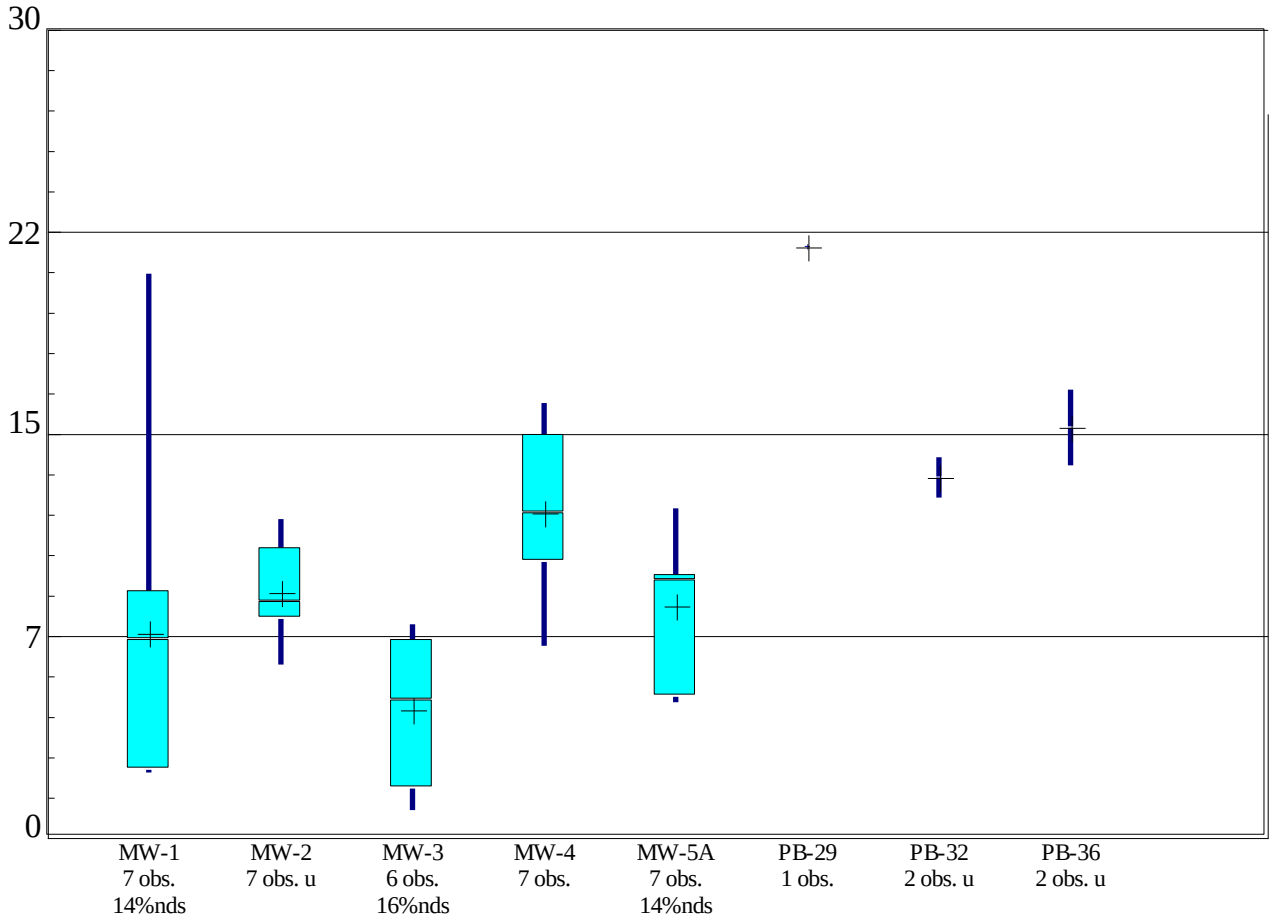
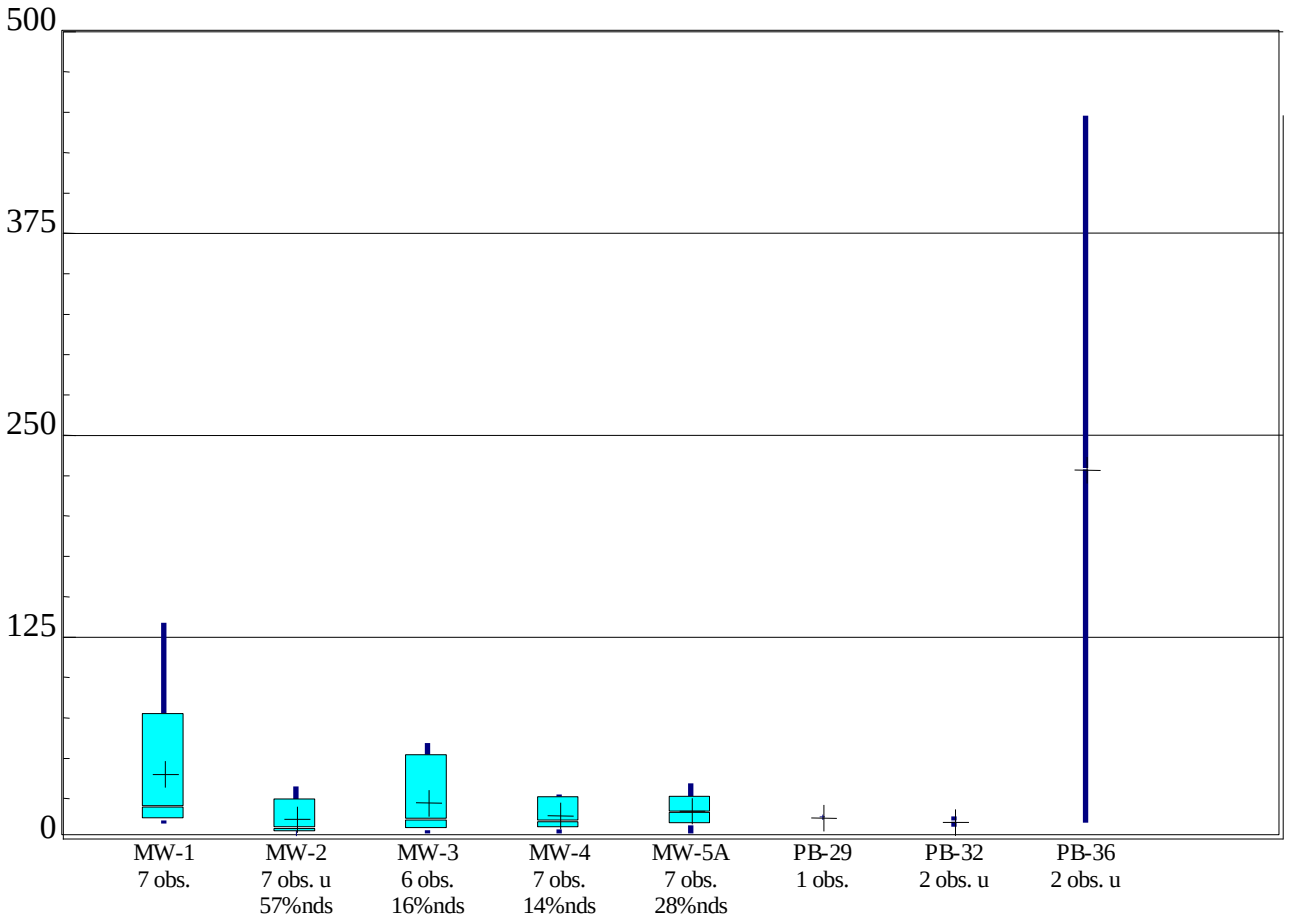
BOX & WHISKERS PLOT



Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:52 PM View: Box and Whisker

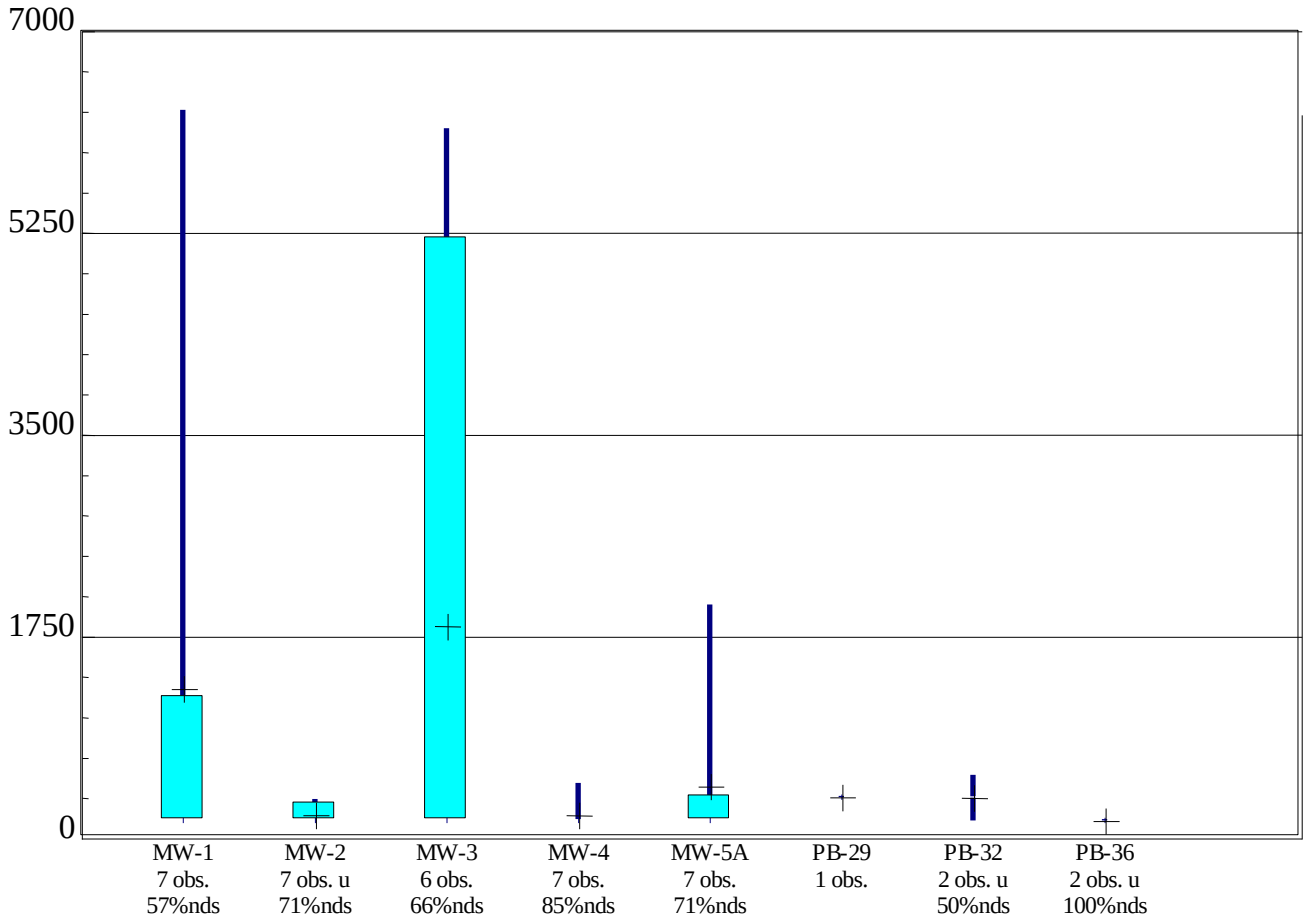
BOX & WHISKERS PLOT



Constituent: Zinc (ug/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:53 PM View: Box and Whisker

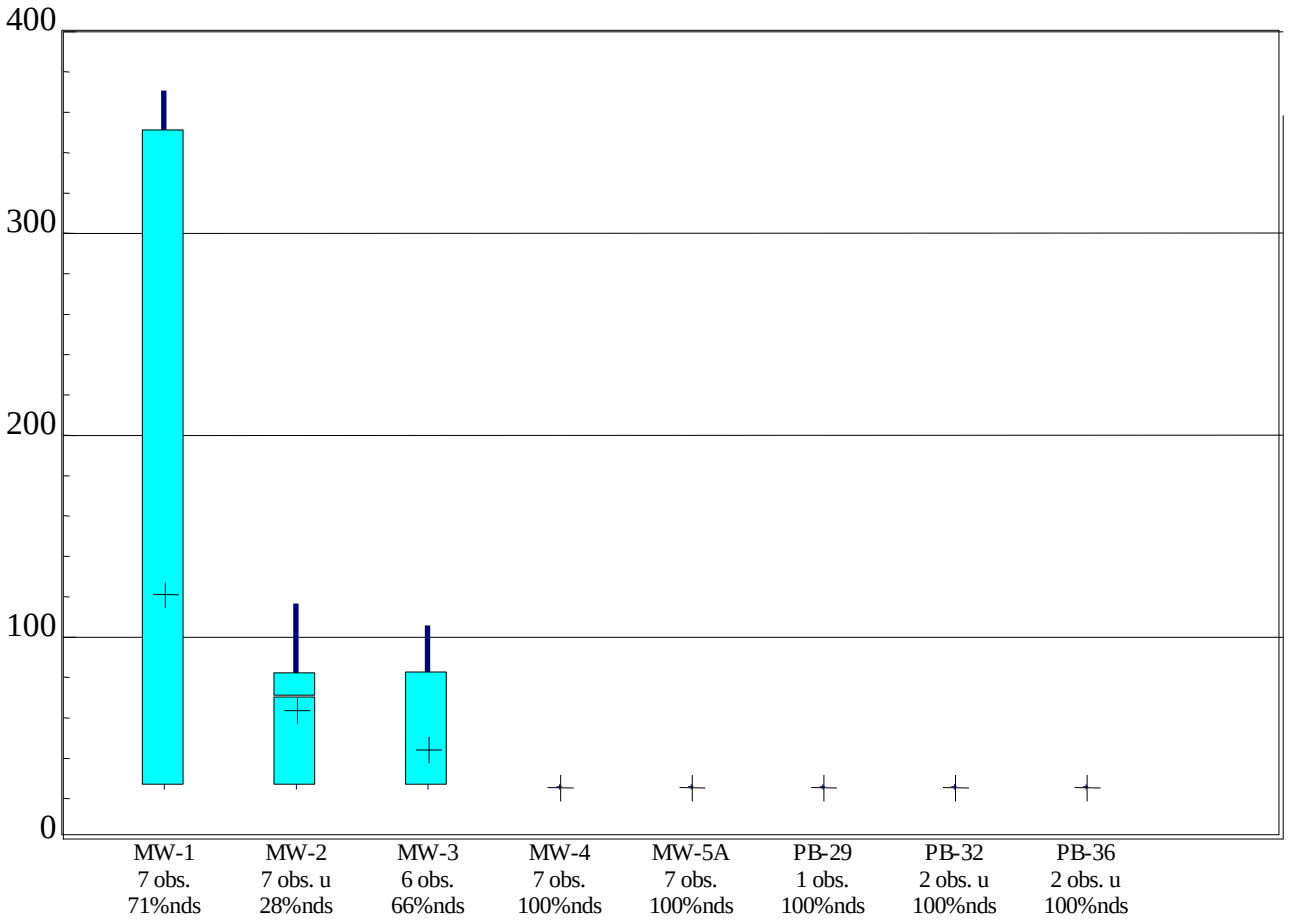
BOX & WHISKERS PLOT



Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:54 PM View: Box and Whisker

BOX & WHISKERS PLOT



Constituent: Manganese (ug/L) Facility: Clint Data File: CLINTD~1

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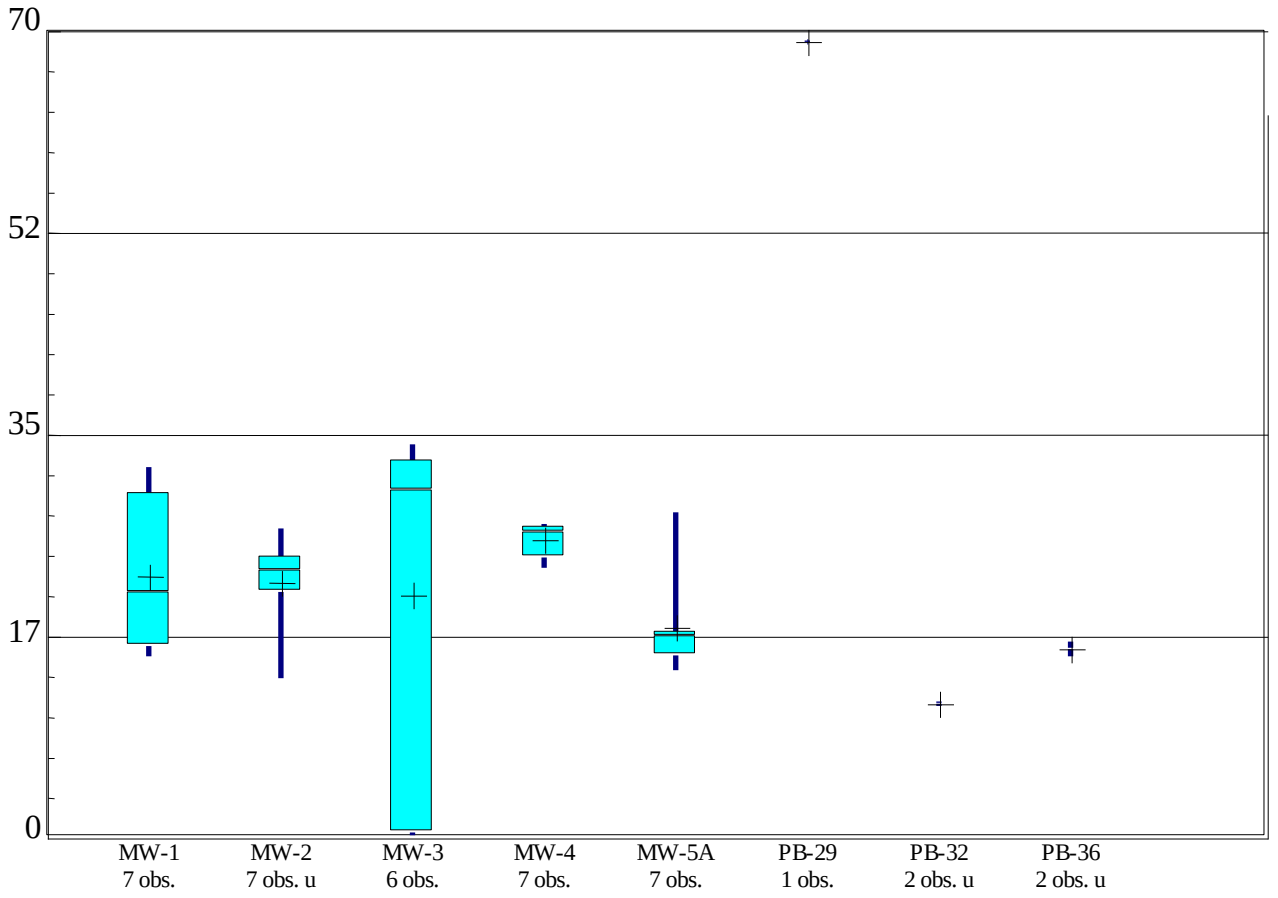
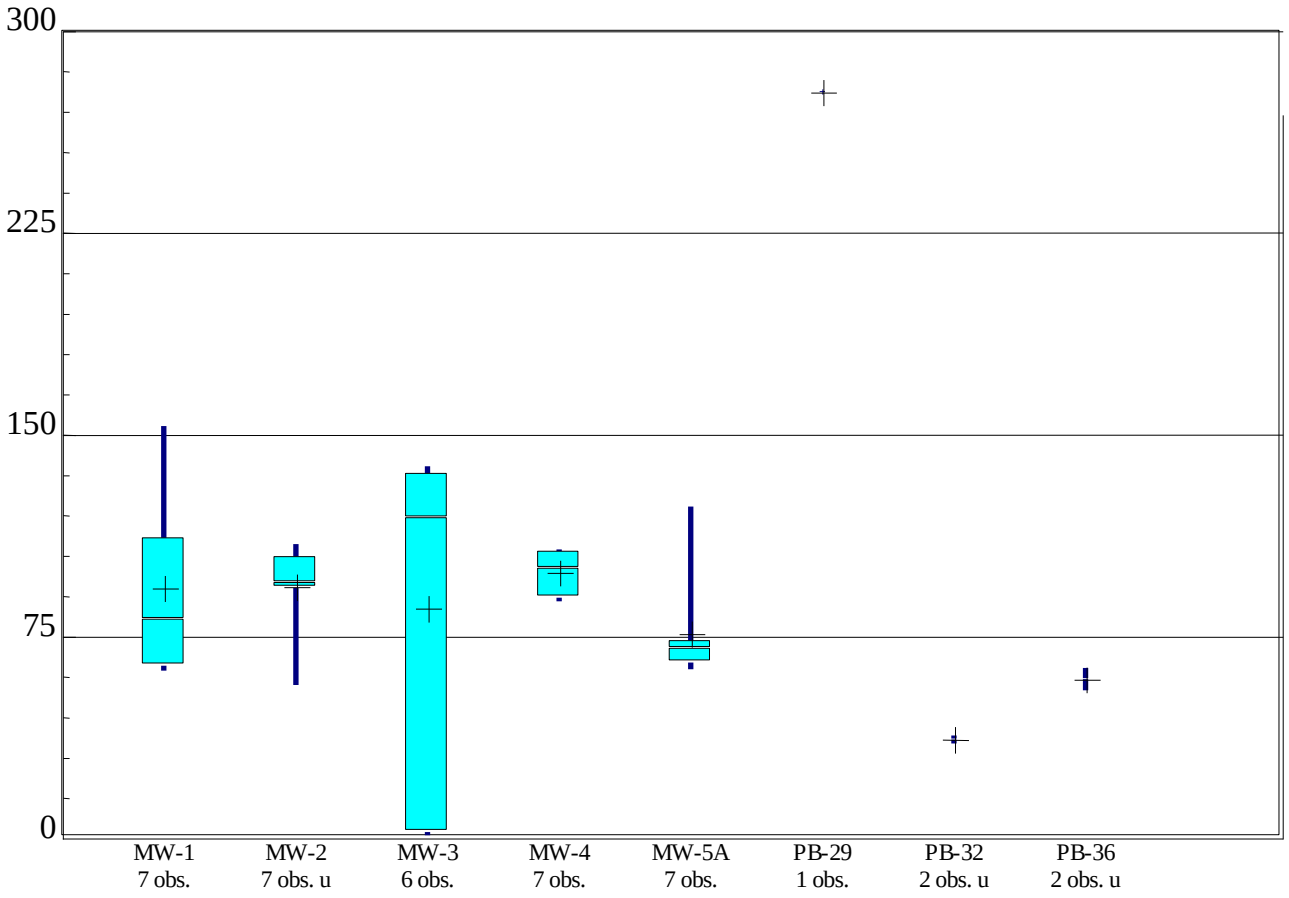
BOX & WHISKERS PLOT



Constituent: Magnesium (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:56 PM View: Box and Whisker

BOX & WHISKERS PLOT



Constituent: Calcium (mg/L) Facility: Clint Data File: CLINTD~1

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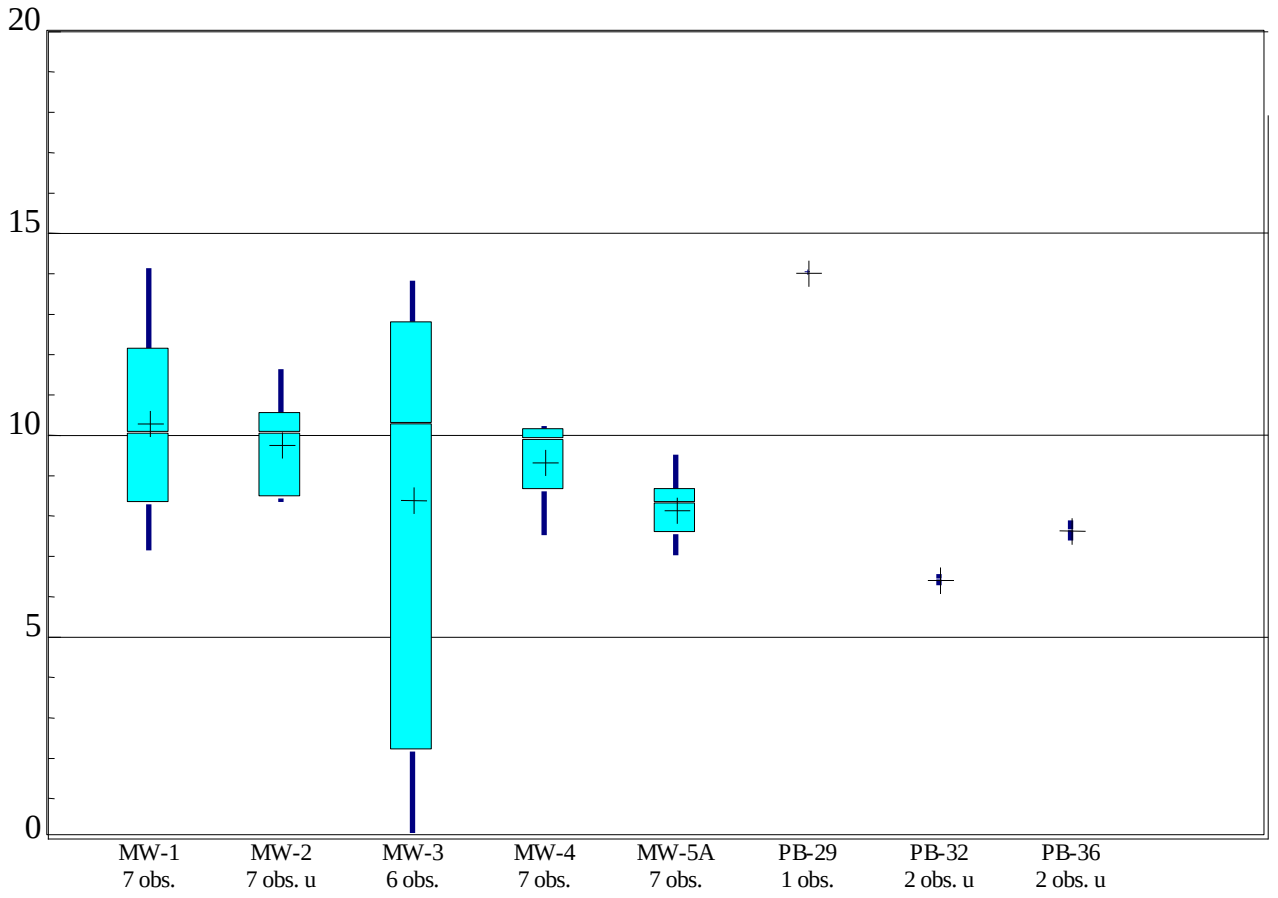
BOX & WHISKERS PLOT



Constituent: Potassium (mg/L) Facility: Clint Data File: CLINTD~1

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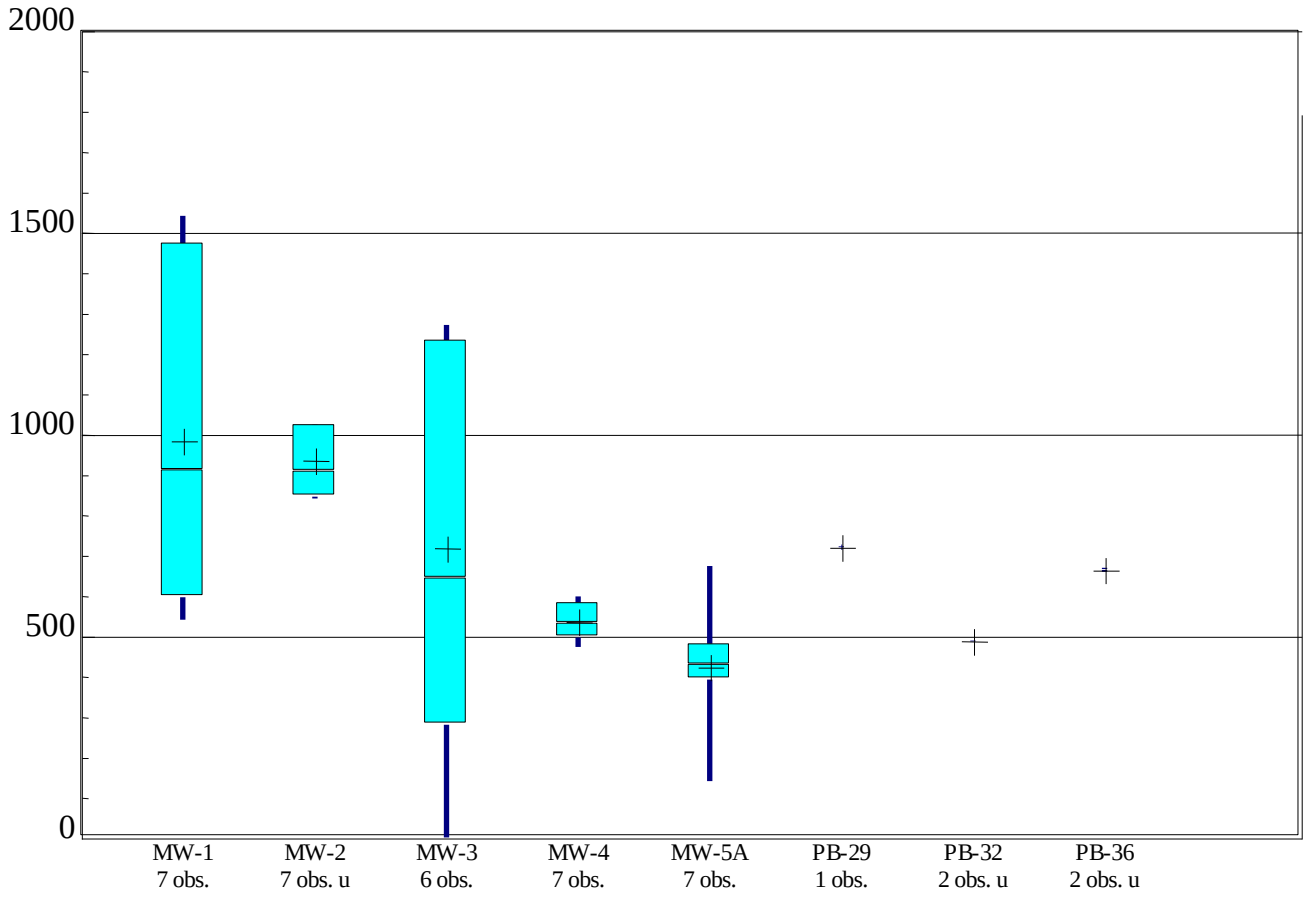
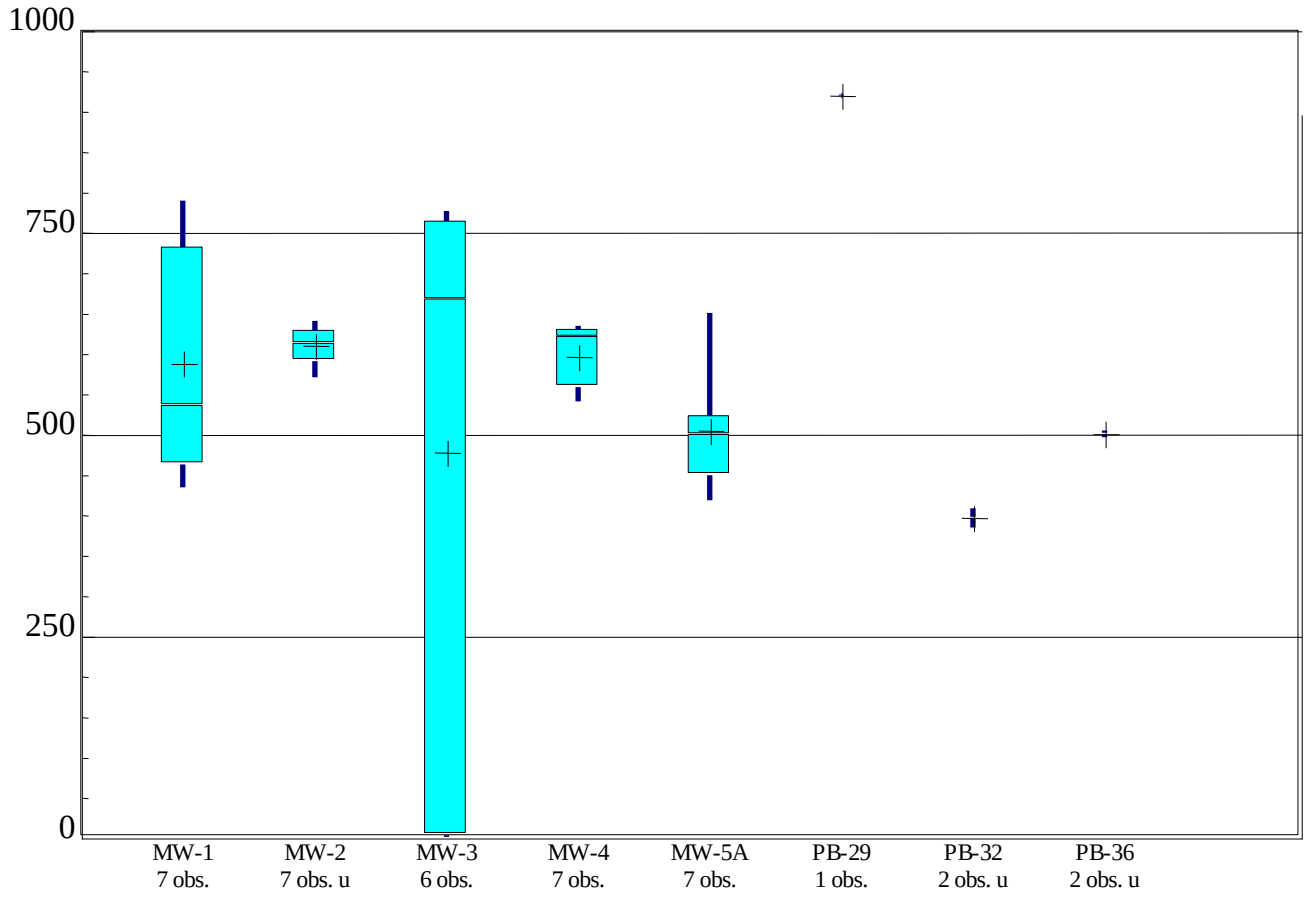
BOX & WHISKERS PLOT



Constituent: Chloride (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:58 PM View: Box and Whisker

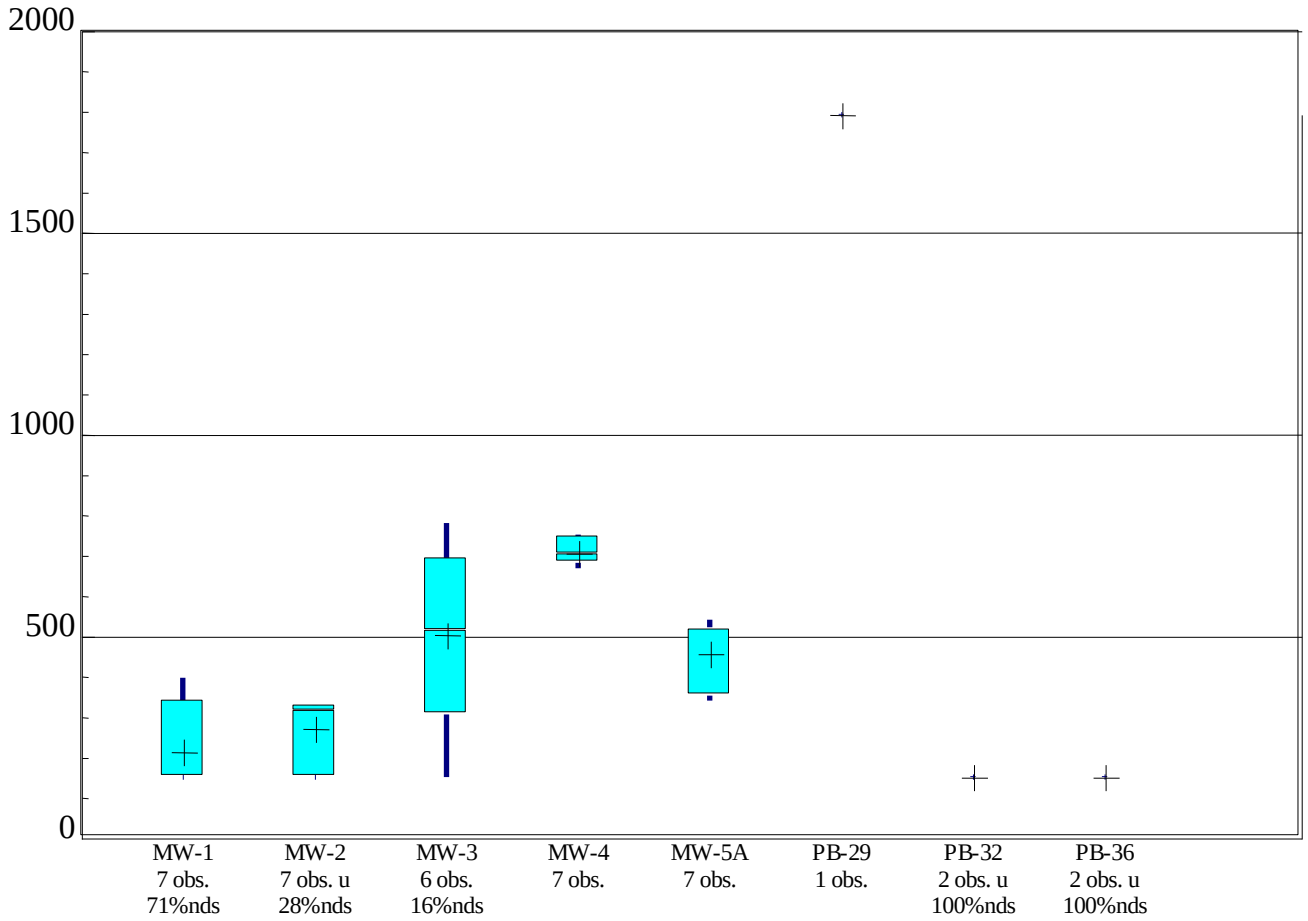
BOX & WHISKERS PLOT



Constituent: Sodium (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 3:59 PM View: Box and Whisker

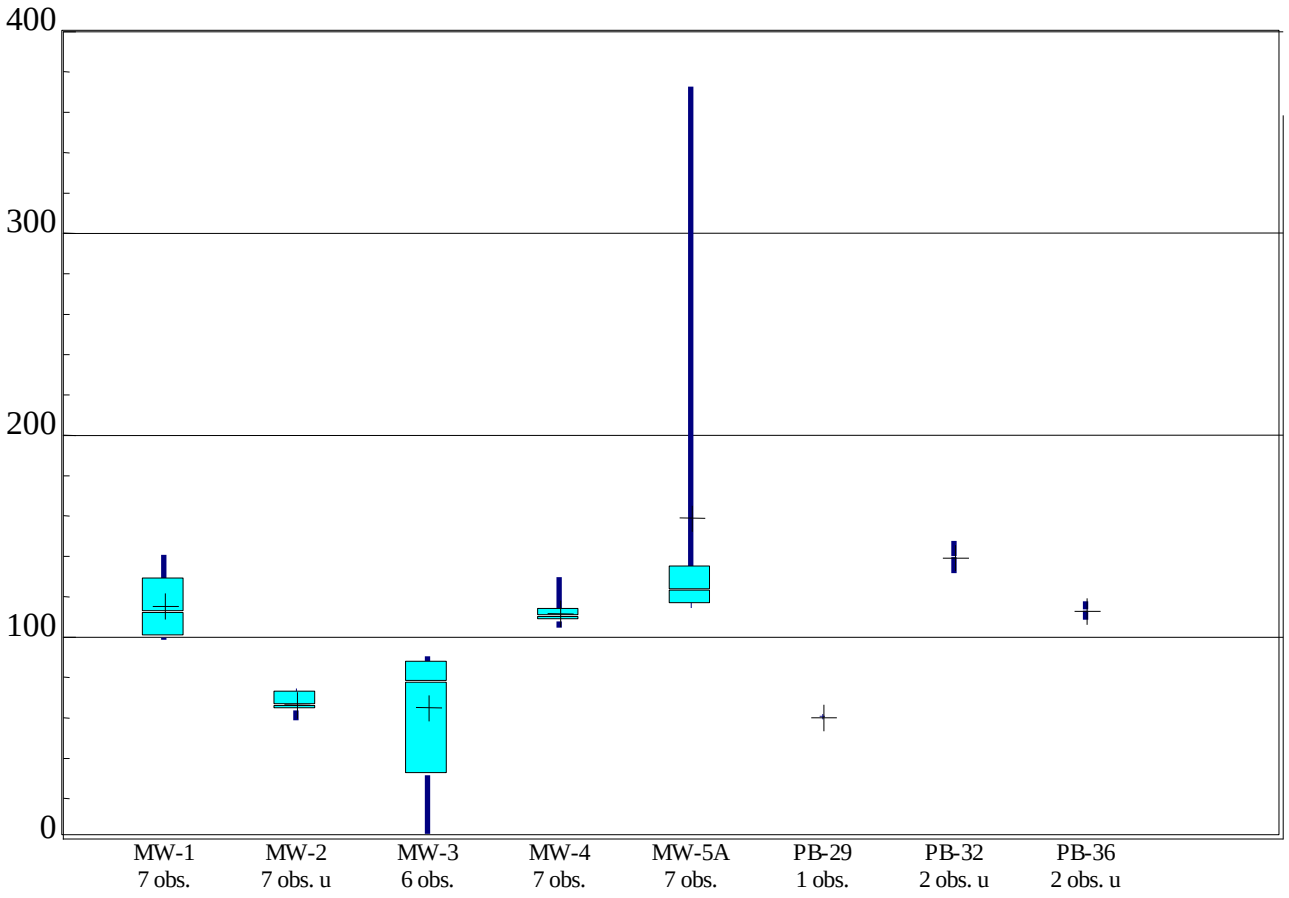
BOX & WHISKERS PLOT



Constituent: Sulfate (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 4:00 PM View: Box and Whisker

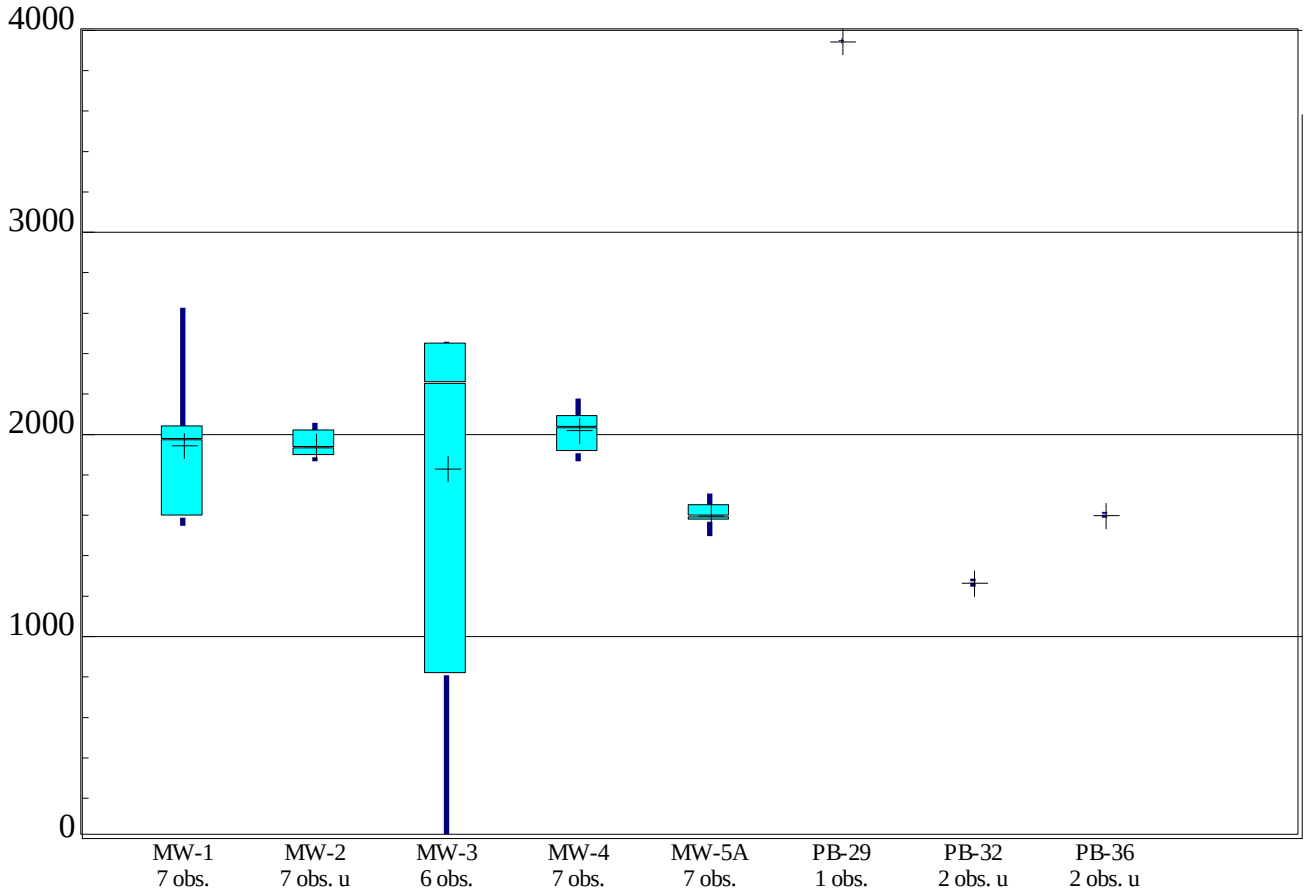
BOX & WHISKERS PLOT



Constituent: Alkalinity, Total (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 4:00 PM View: Box and Whisker

BOX & WHISKERS PLOT

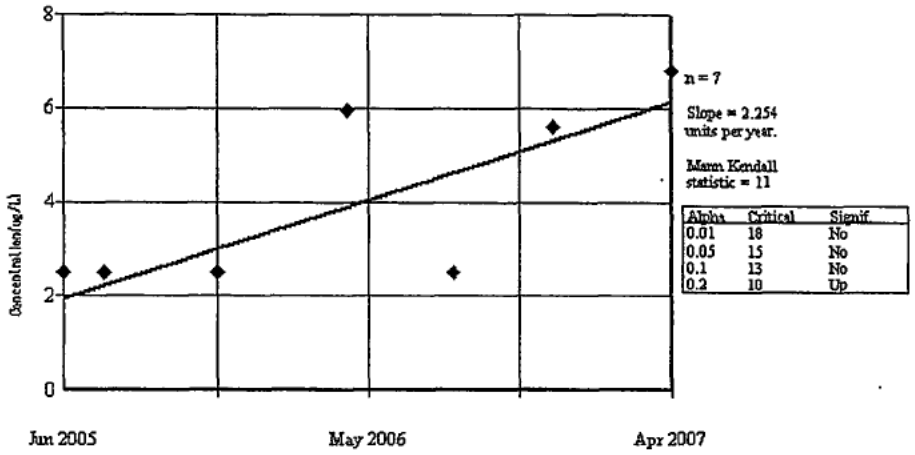


Constituent: Total Dissolved Solids (mg/L) Facility: Clint Data File: CLINTD~1

Date: 10/26/07 Time: 4:01 PM View: Box and Whisker

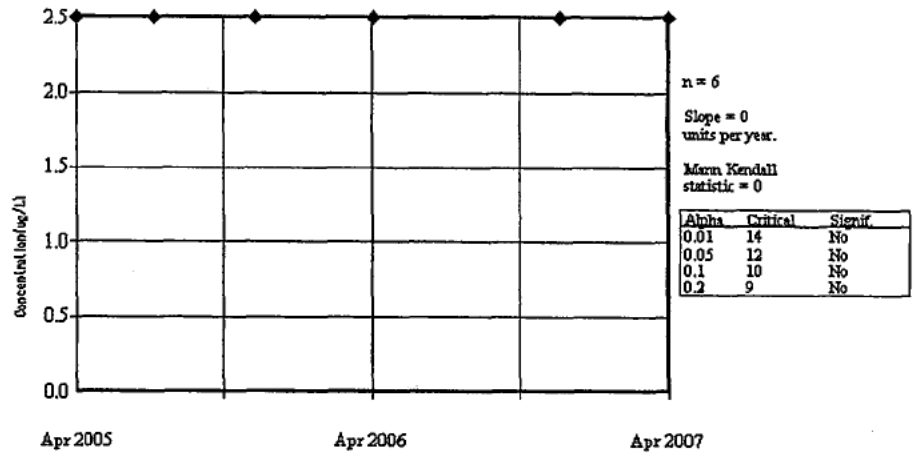
ATTACHMENT III.F.6.2 – SEN'S SLOPE GRAPHS

SEN'S SLOPE ESTIMATOR
MW-1



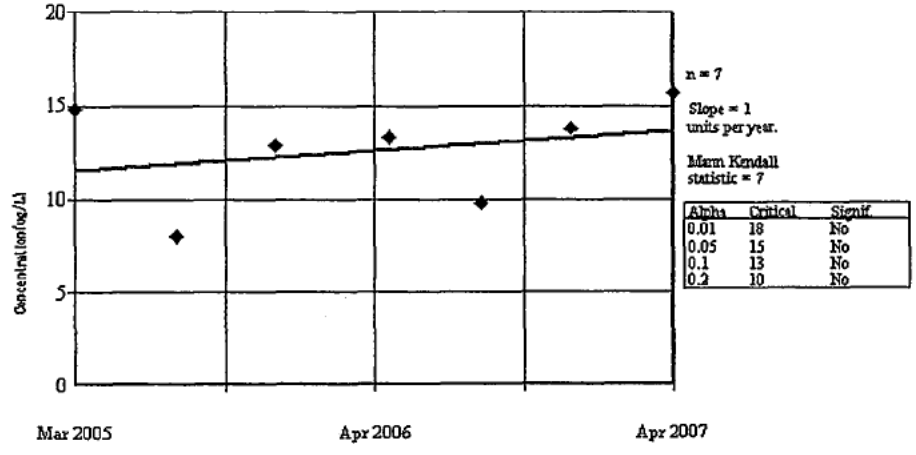
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



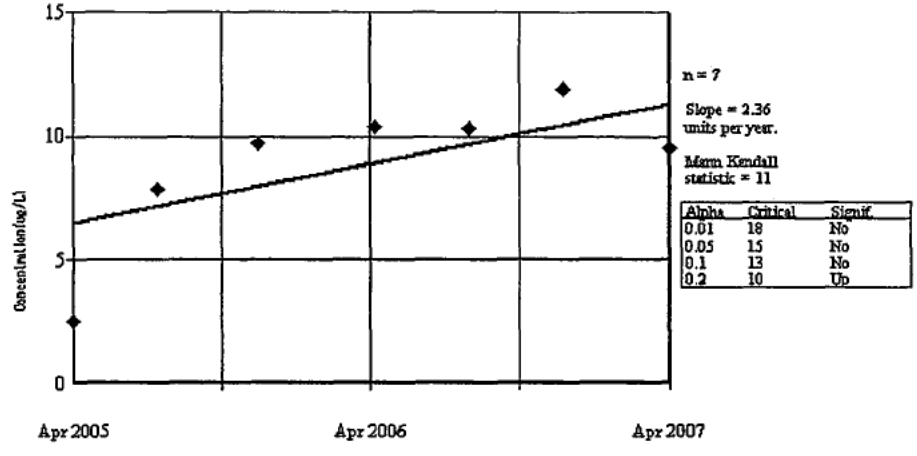
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



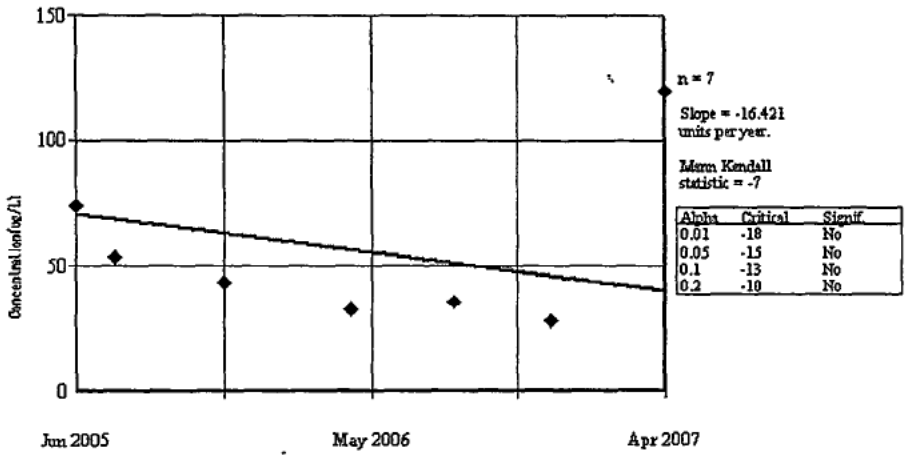
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



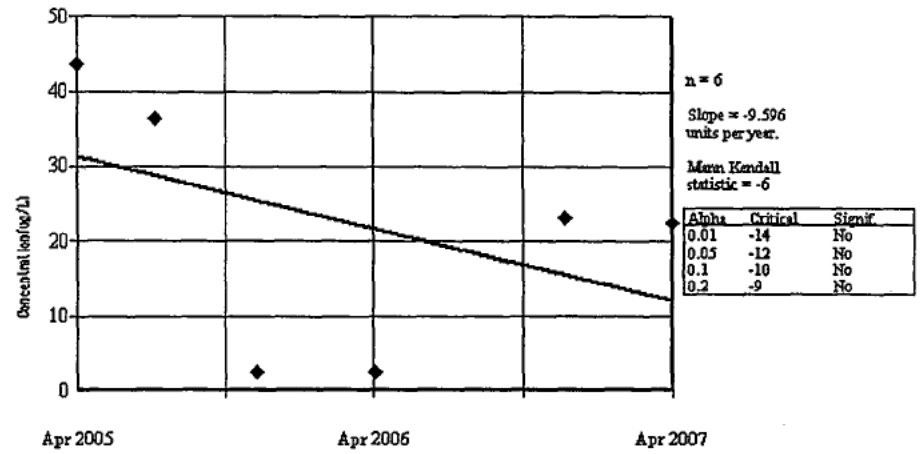
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:55 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



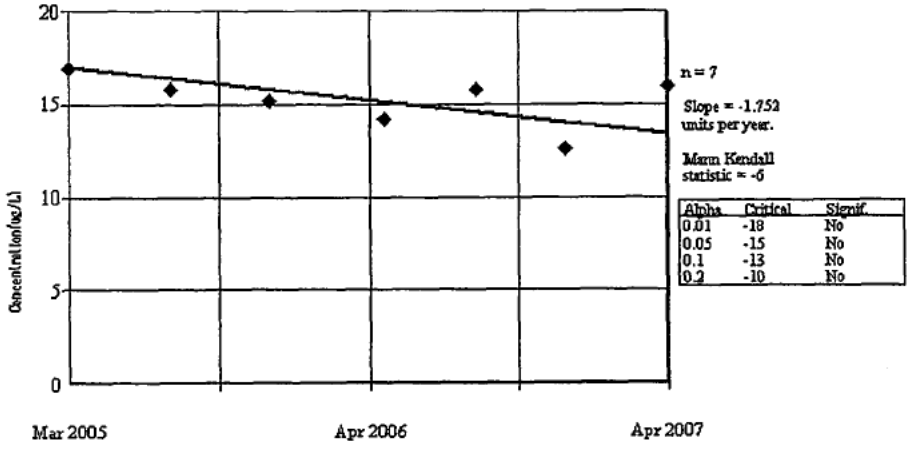
Constituent: Barium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:56 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



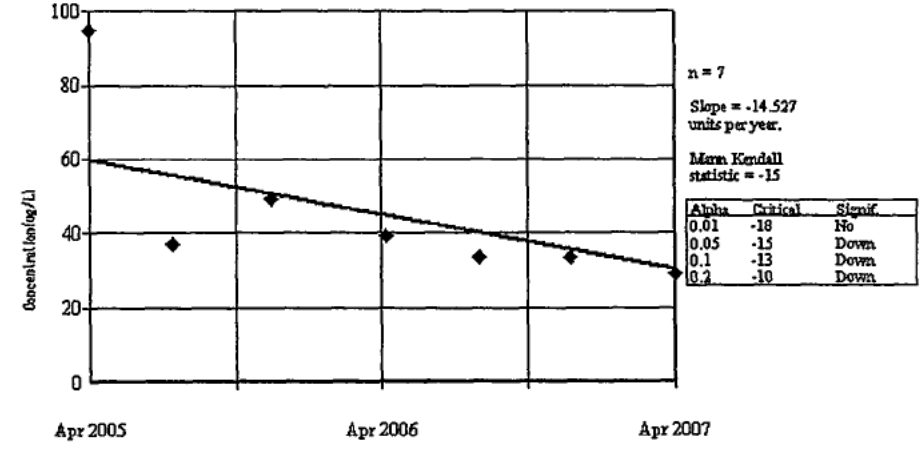
Constituent: Barium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



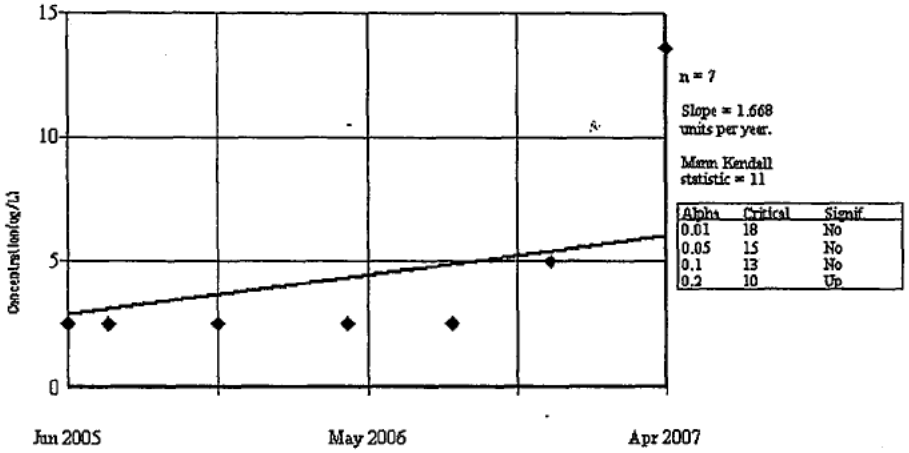
Constituent: Barium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



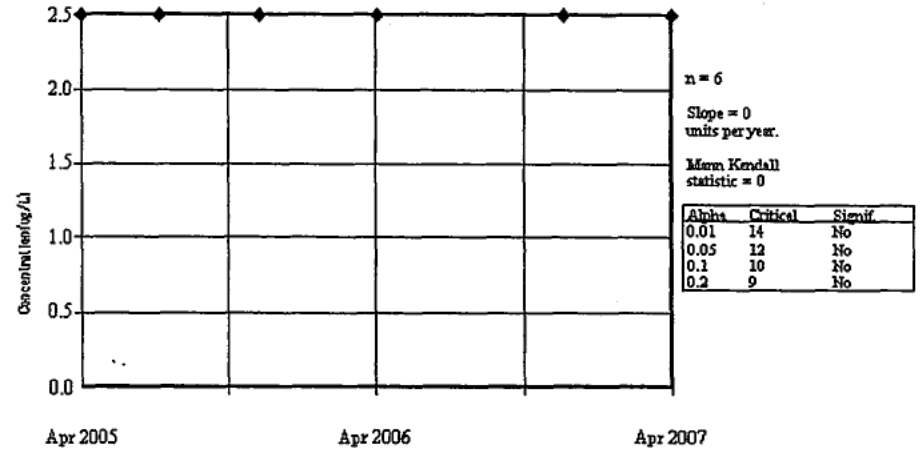
Constituent: Barium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



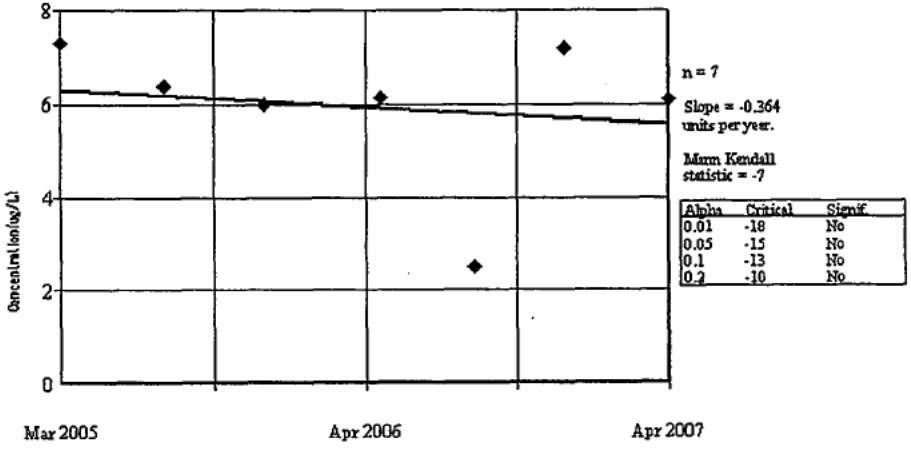
Constituent: Chromium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



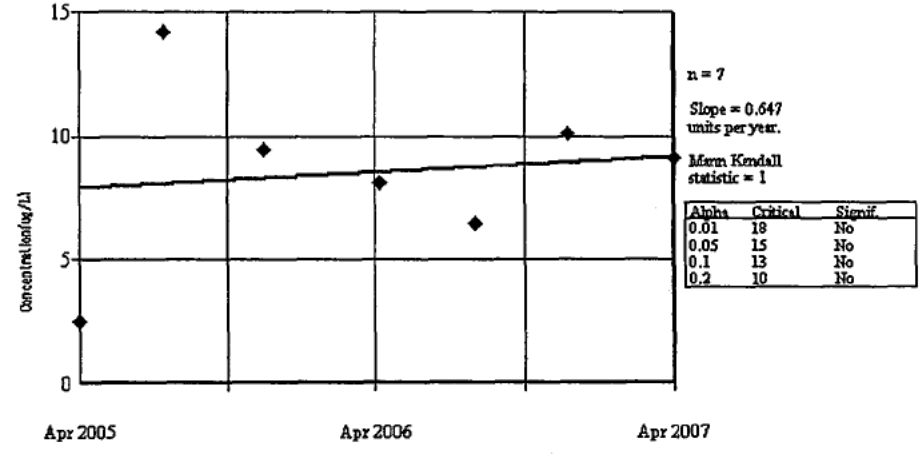
Constituent: Chromium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



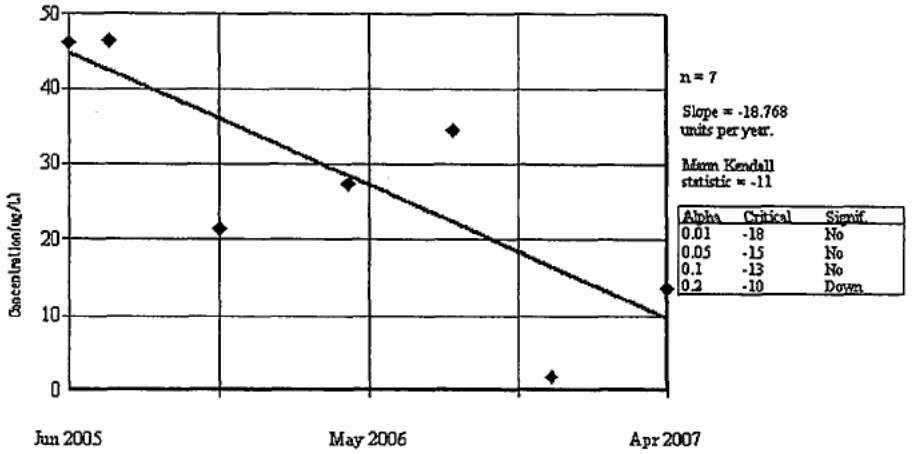
Constituent: Chromium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



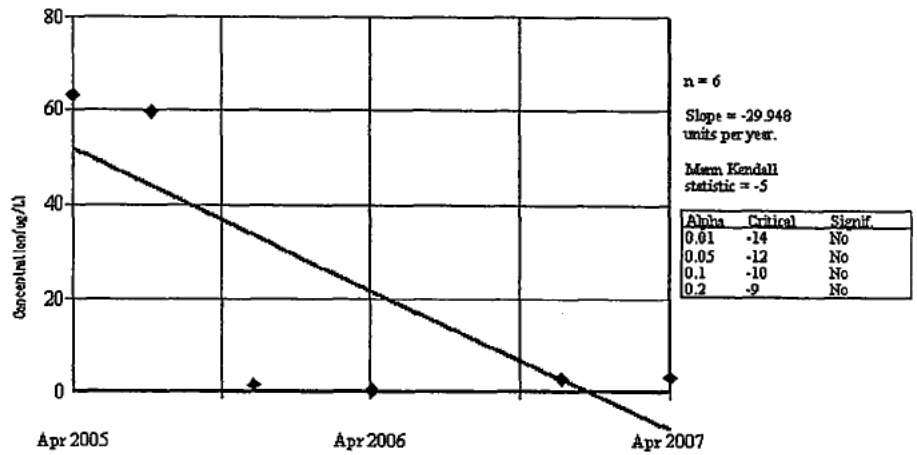
Constituent: Chromium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:57 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



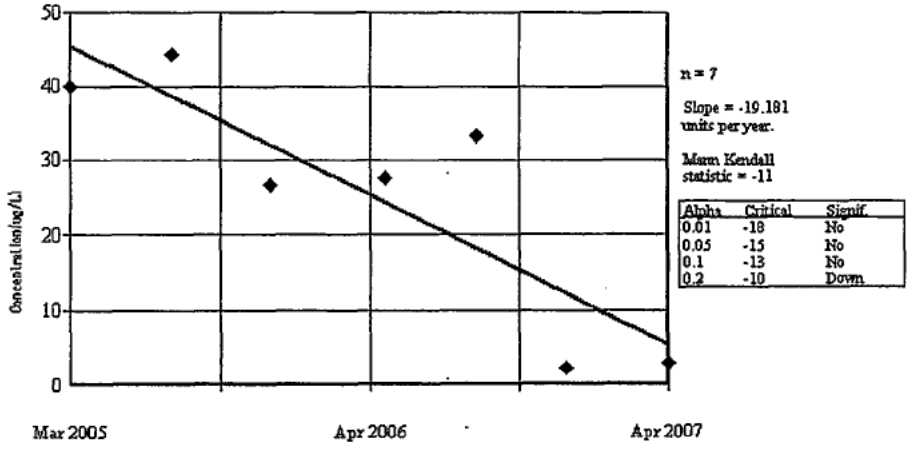
Constituent: Copper (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:58 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



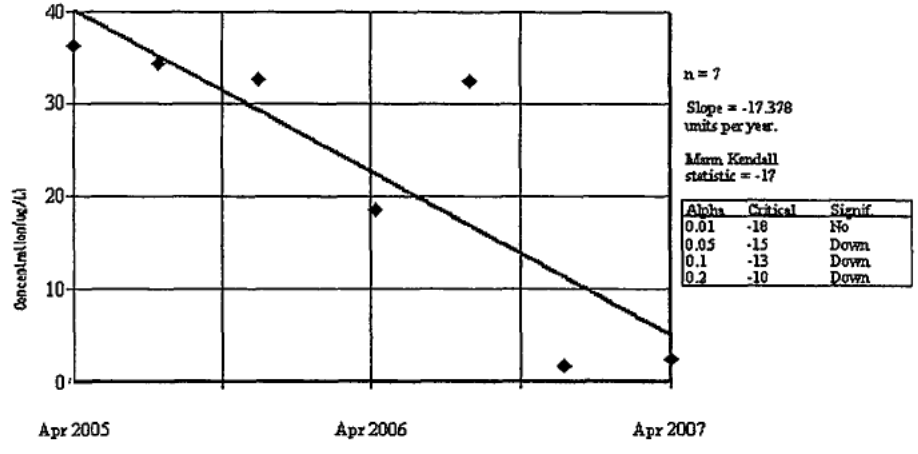
Constituent: Copper (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:58 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



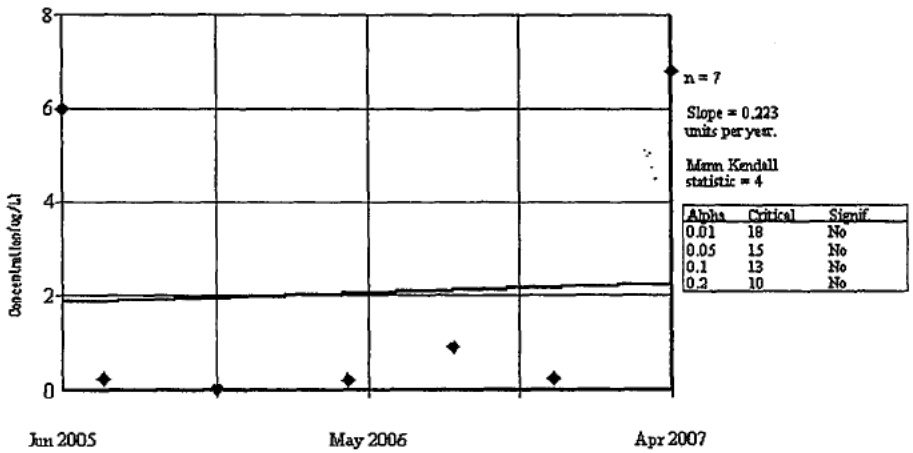
Constituent: Copper (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:58 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



Constituent: Copper (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:58 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1

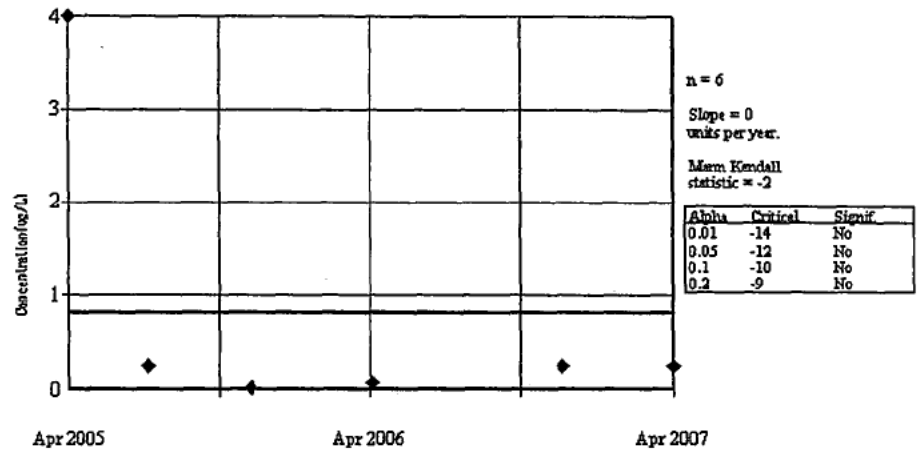


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3

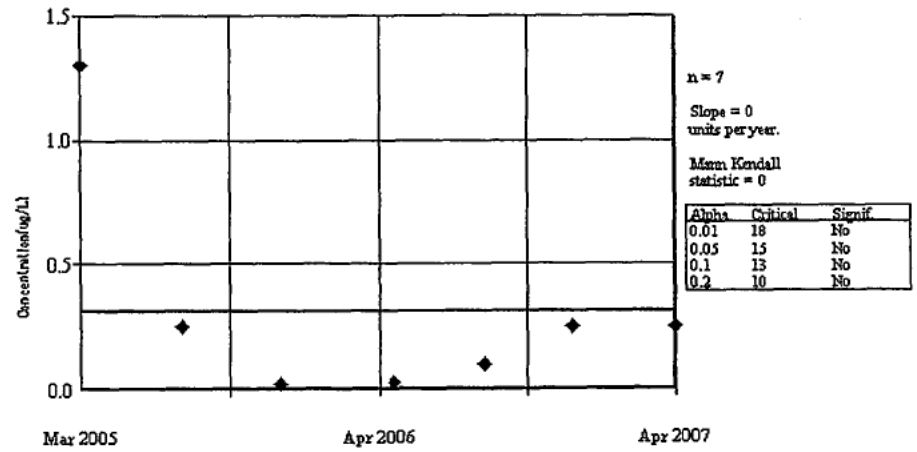


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4

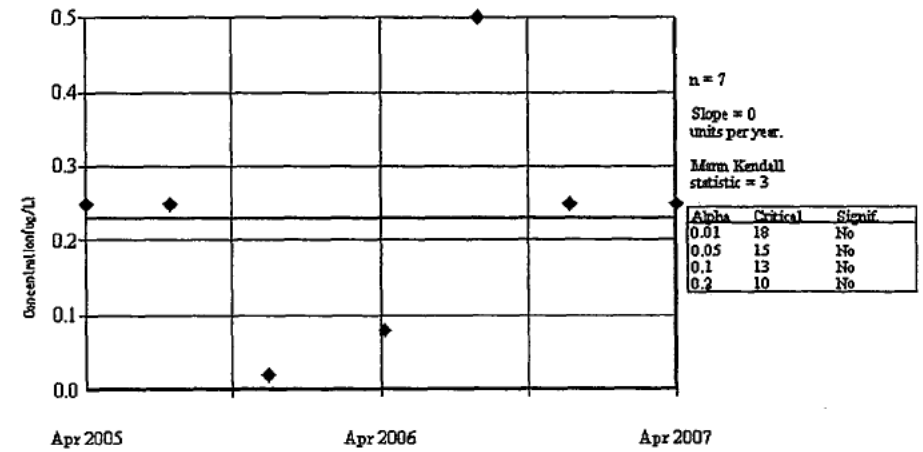


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A

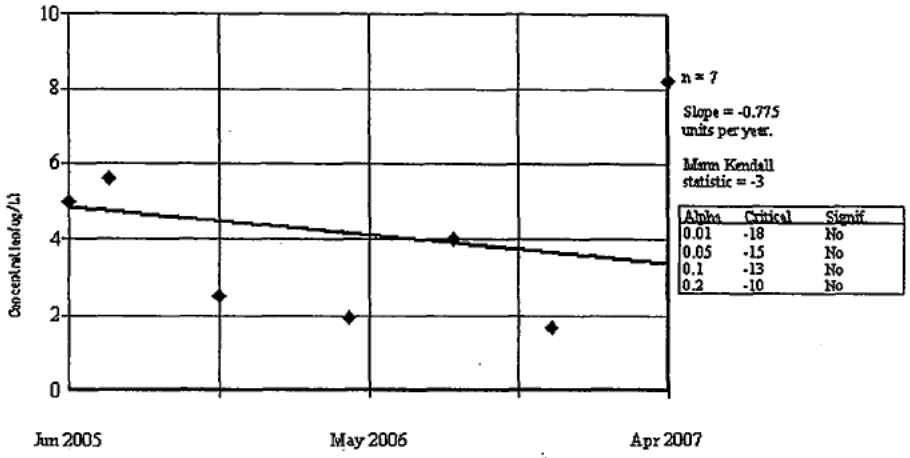


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

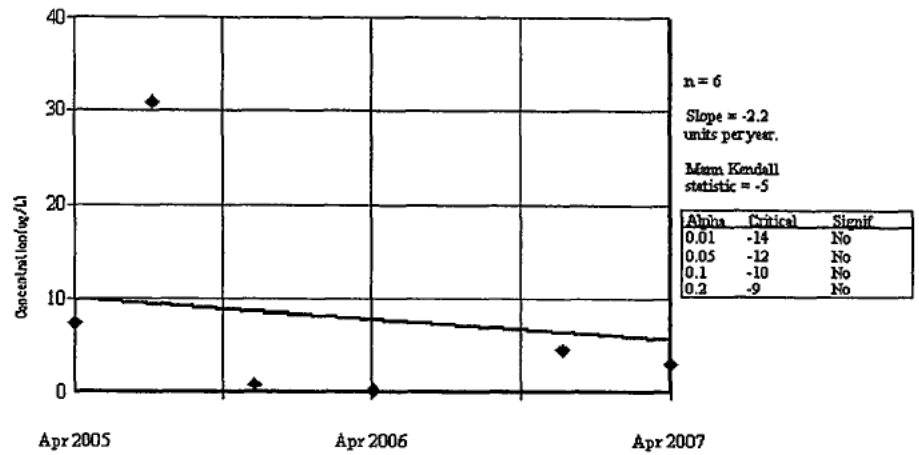
Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



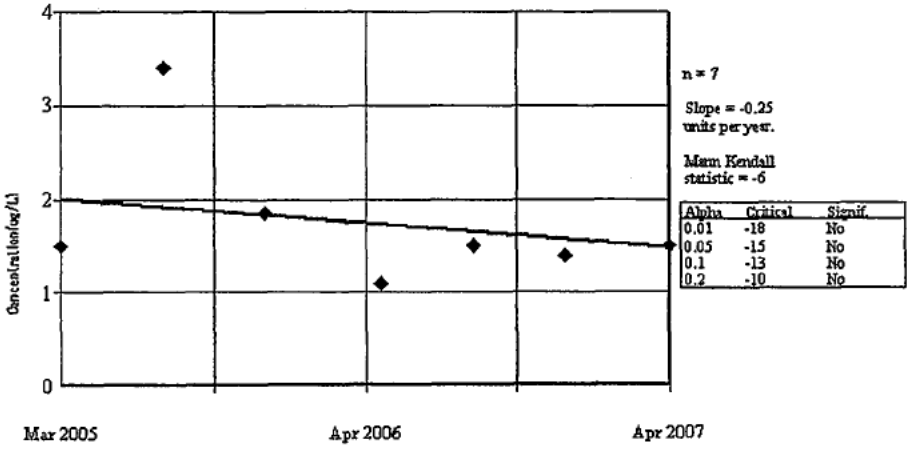
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



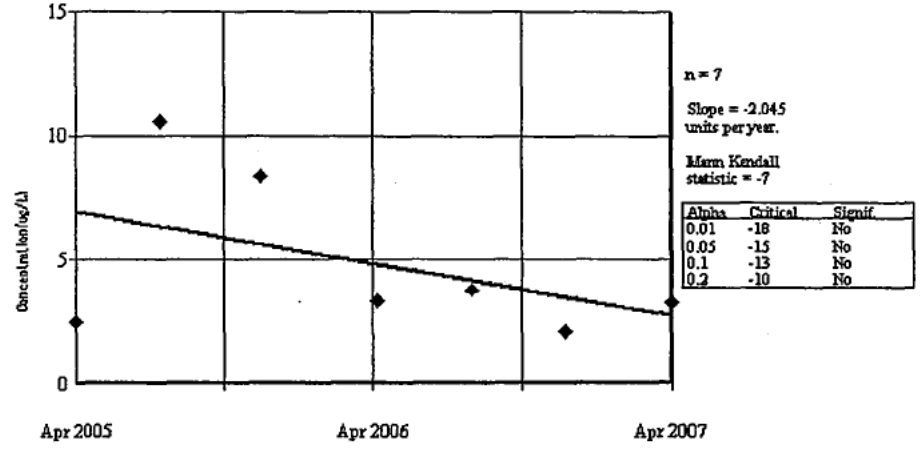
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



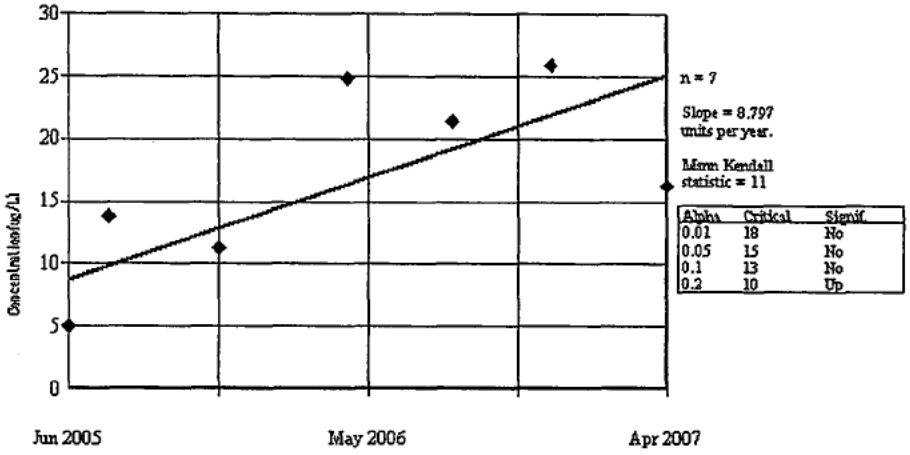
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



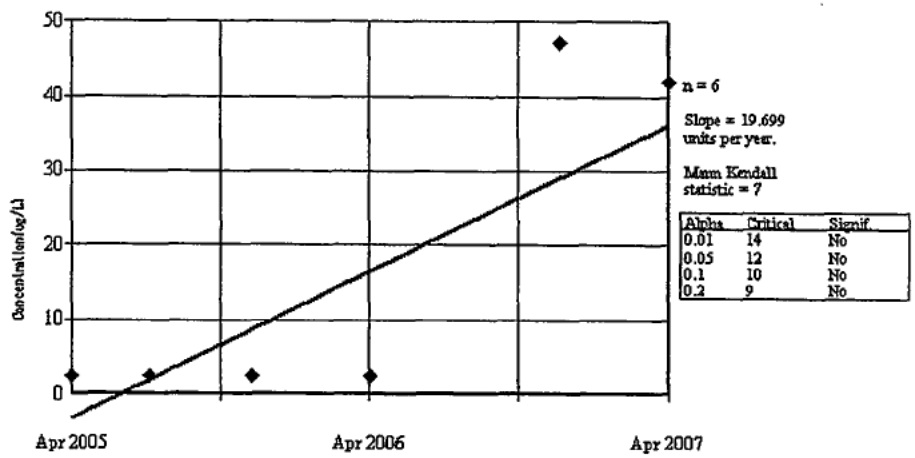
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



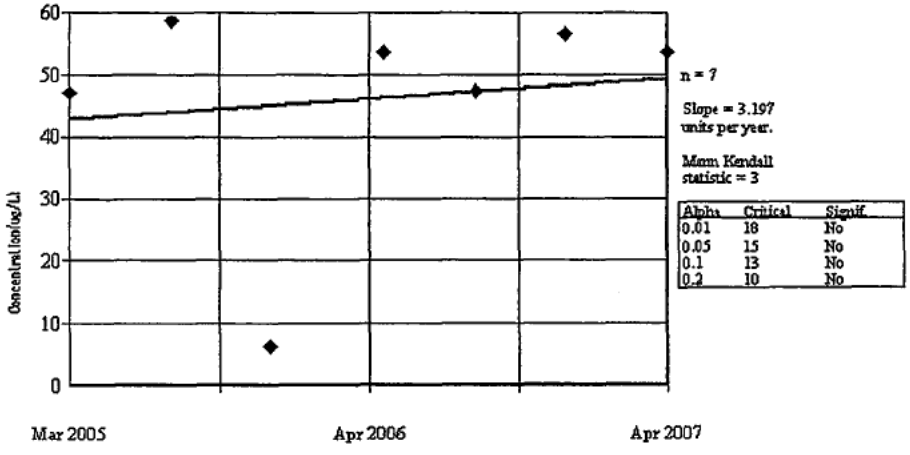
Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



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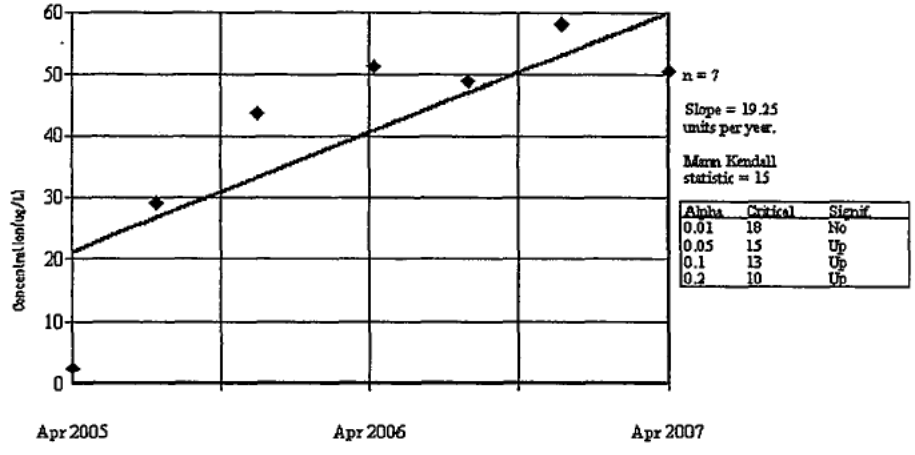
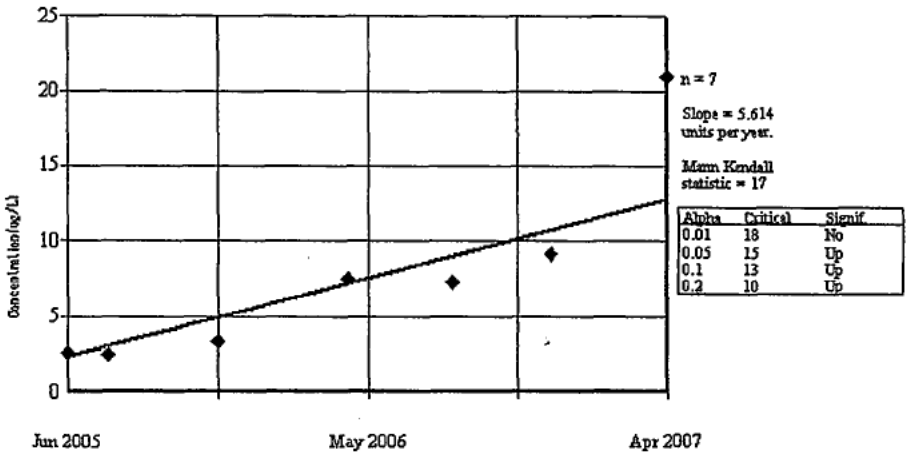
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



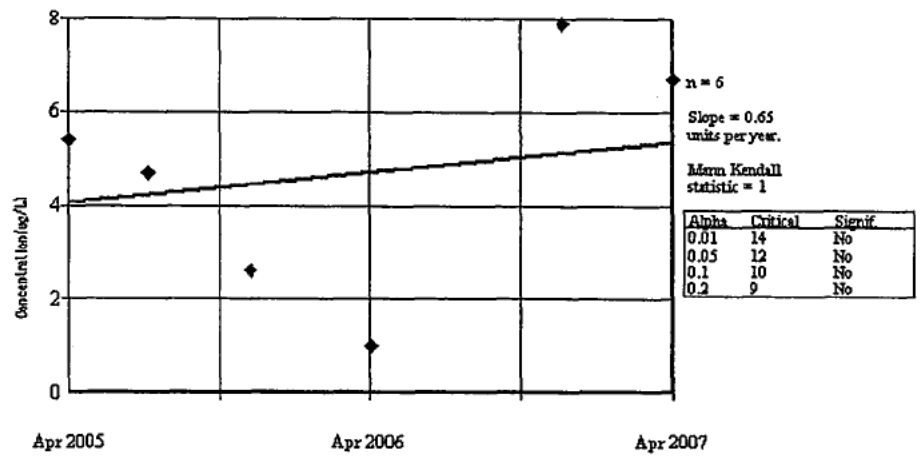
Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
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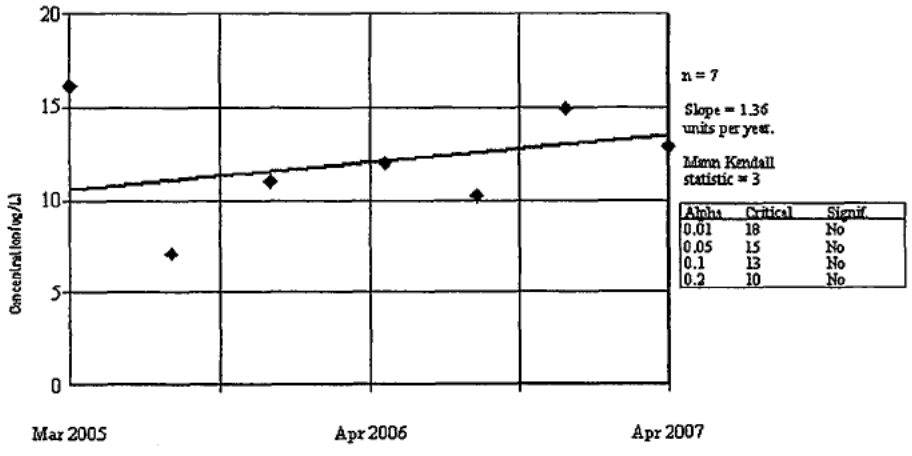
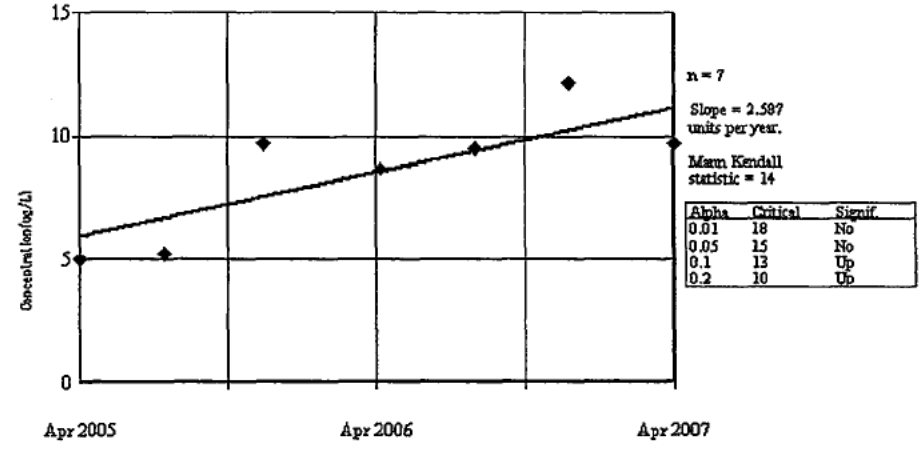
SEN'S SLOPE ESTIMATOR
MW-4



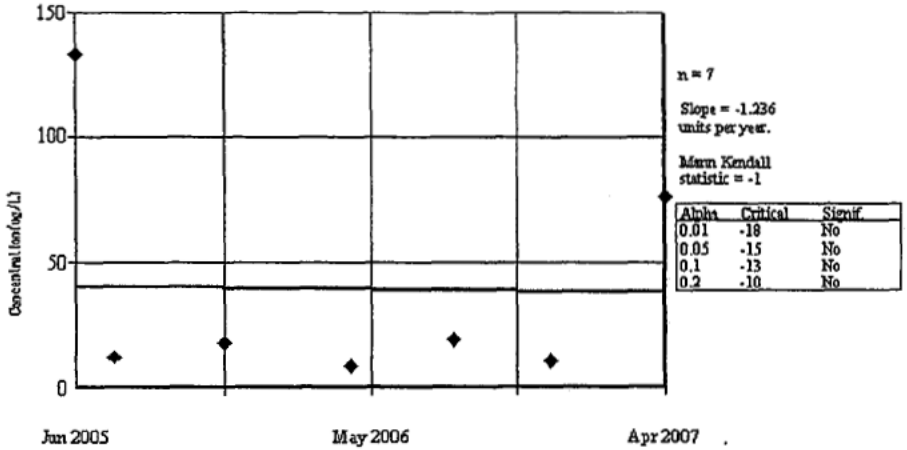
Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



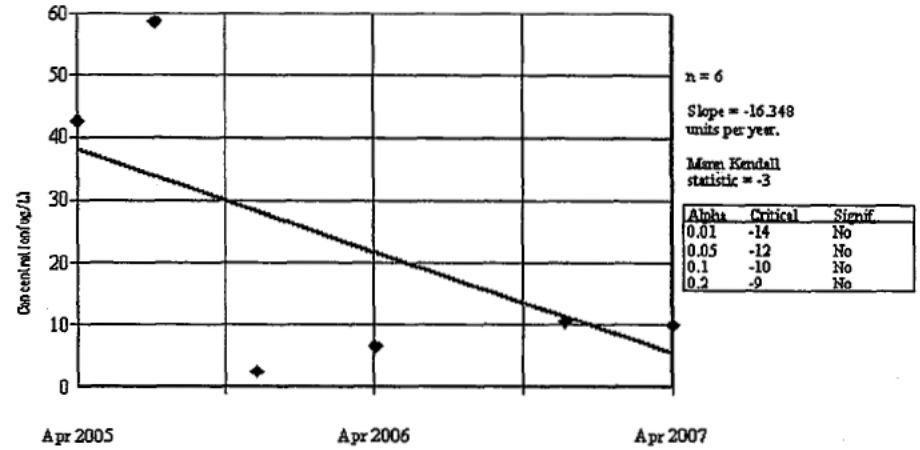
Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



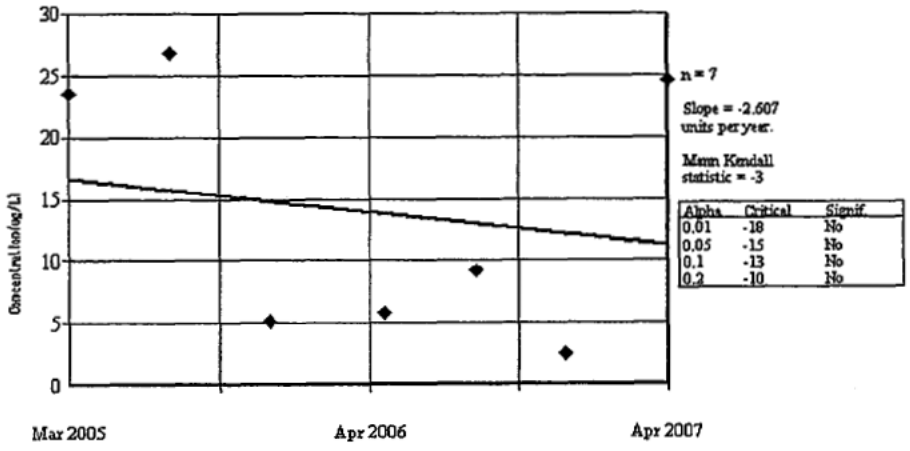
Constituent: Zinc (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



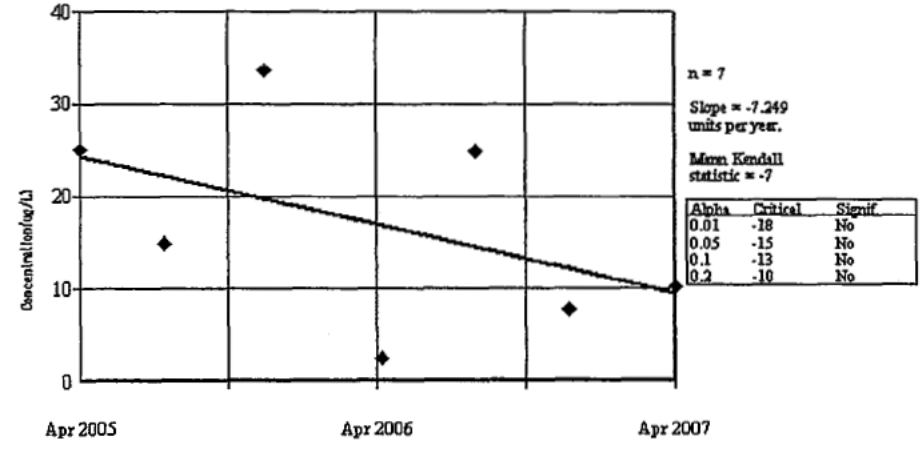
Constituent: Zinc (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



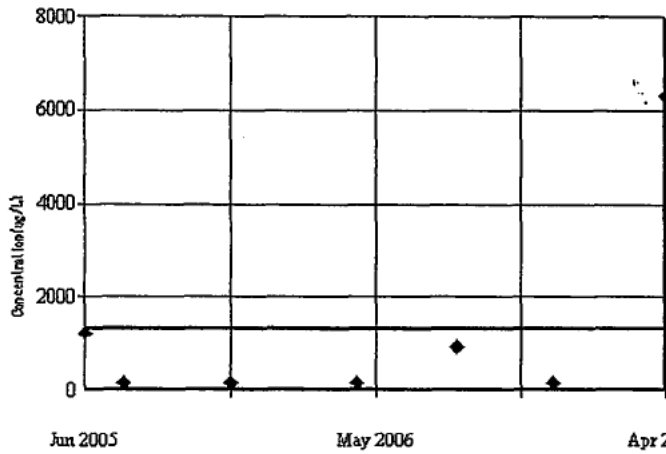
Constituent: Zinc (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



Constituent: Zinc (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



n = 7

Slope = 0 units per year.

Mann Kendall statistic = 3

Alpha	Critical	Signif.
0.01	18	No
0.05	15	No
0.1	13	No
0.2	10	No

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



n = 6

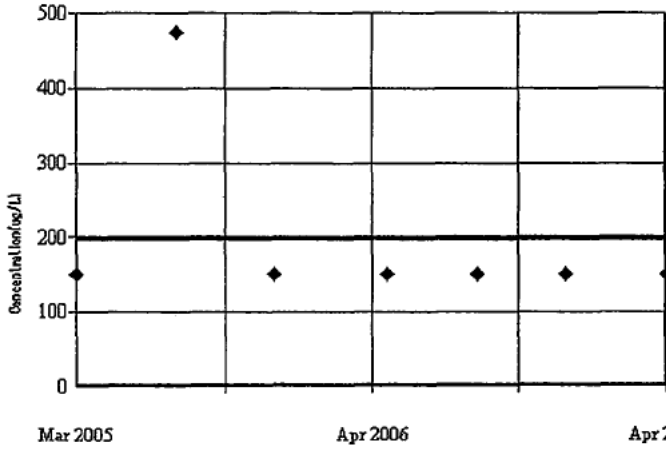
Slope = -2980.955 units per year.

Mann Kendall statistic = -9

Alpha	Critical	Signif.
0.01	-14	No
0.05	-12	No
0.1	-10	No
0.2	-9	Down

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



n = 7

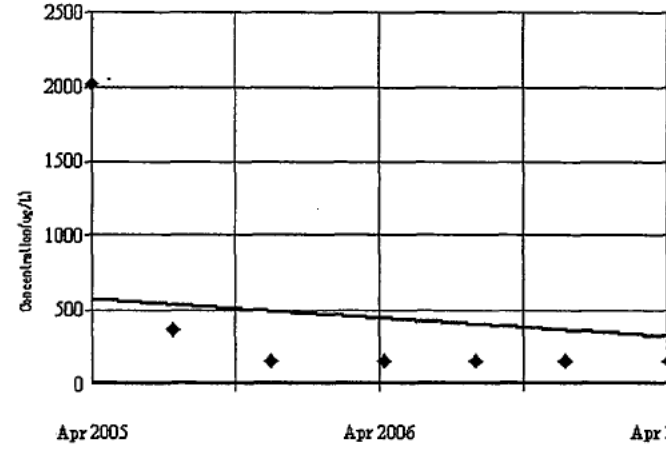
Slope = 0 units per year.

Mann Kendall statistic = -4

Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	No

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



n = 7

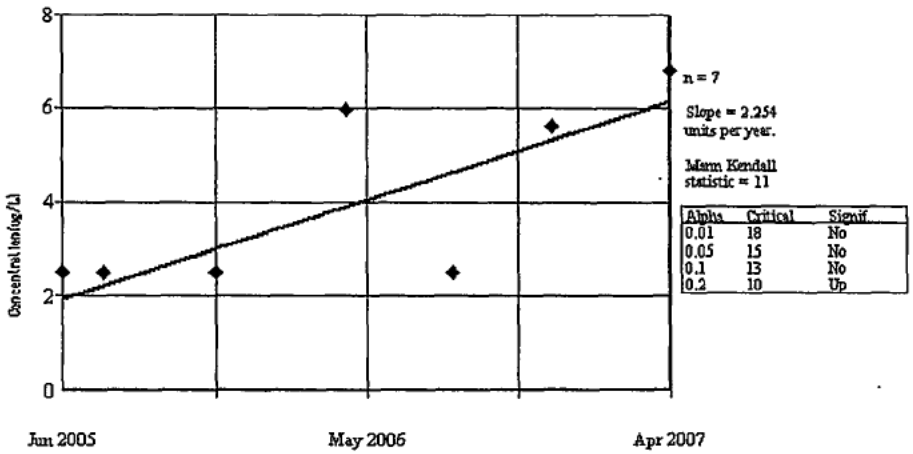
Slope = -120.706 units per year.

Mann Kendall statistic = -11

Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	Down

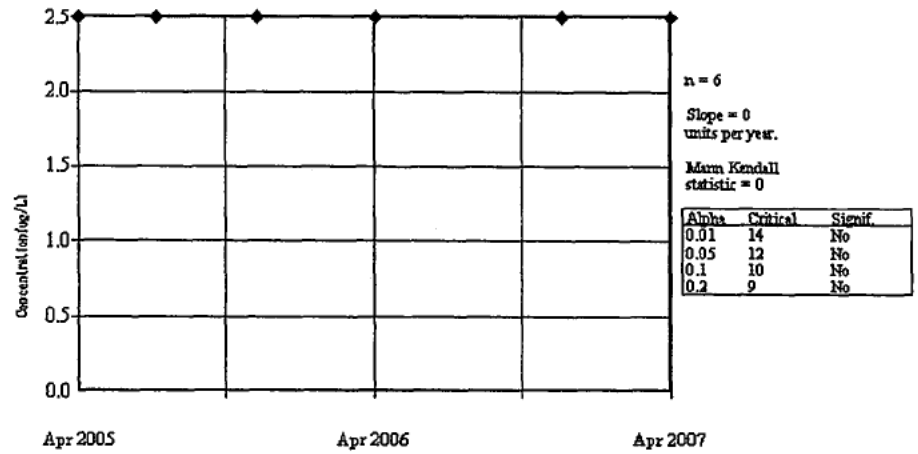
Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



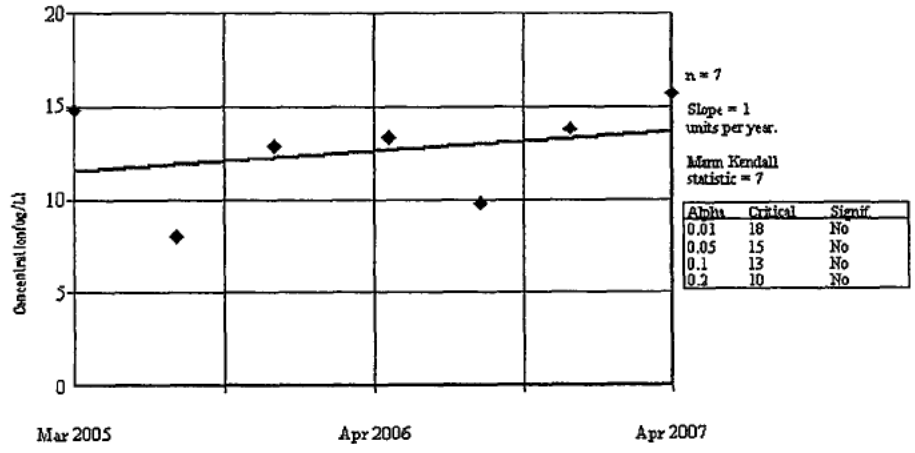
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



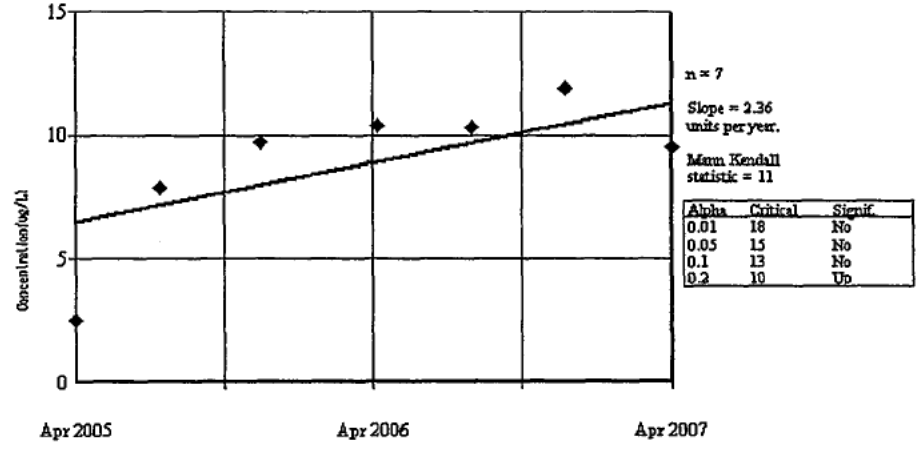
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



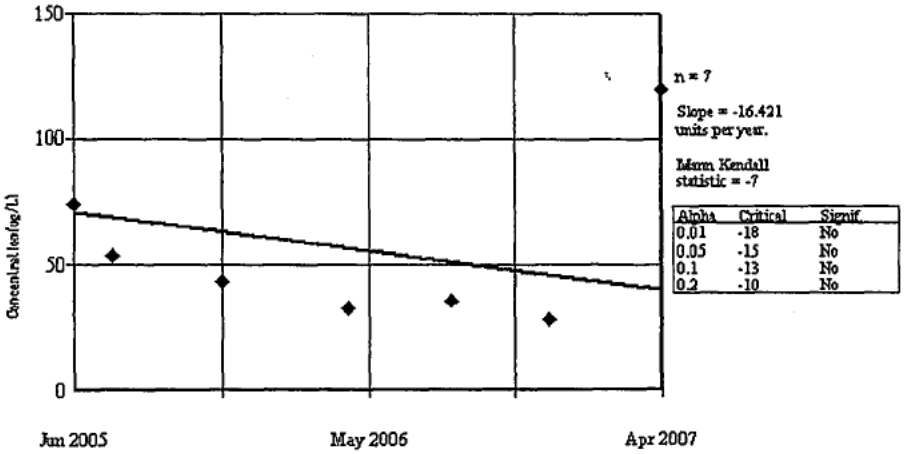
Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:54 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



Constituent: Arsenic (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:55 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1

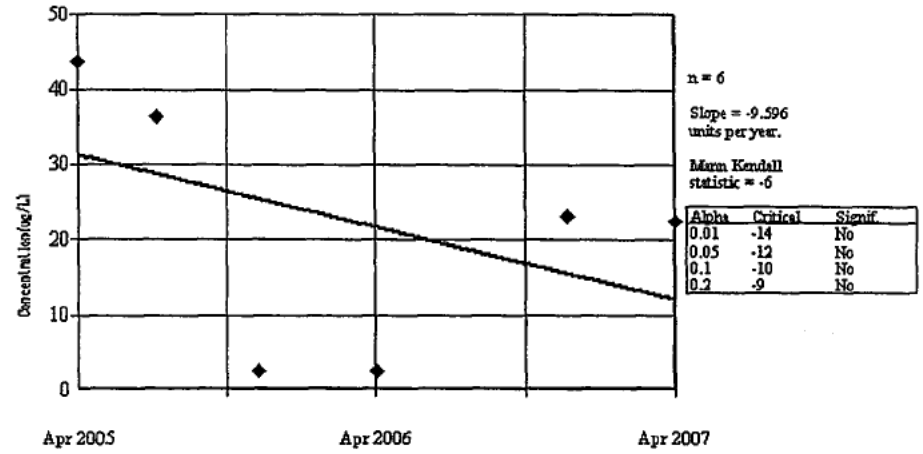


Constituent: Barium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:56 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3

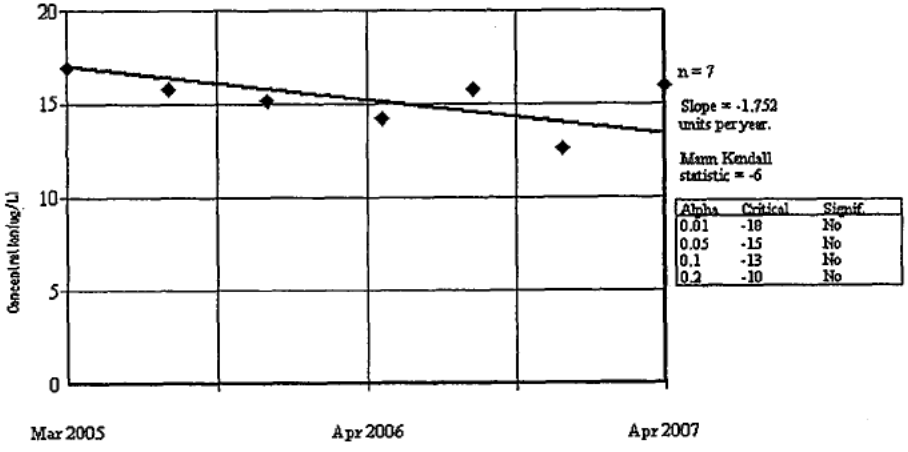


Constituent: Barium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4

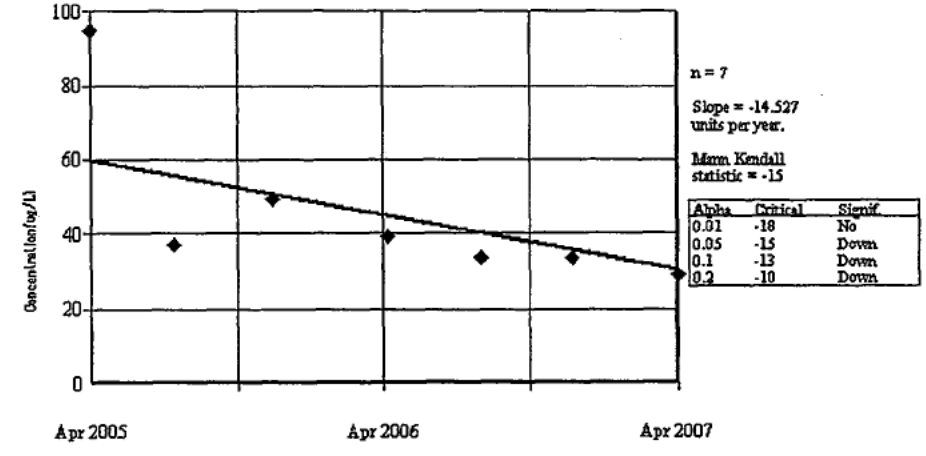


Constituent: Barium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A

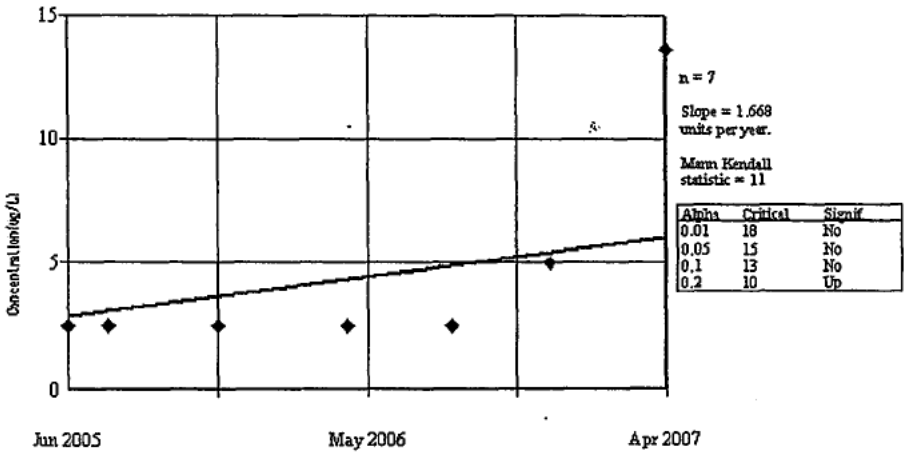


Constituent: Barium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1

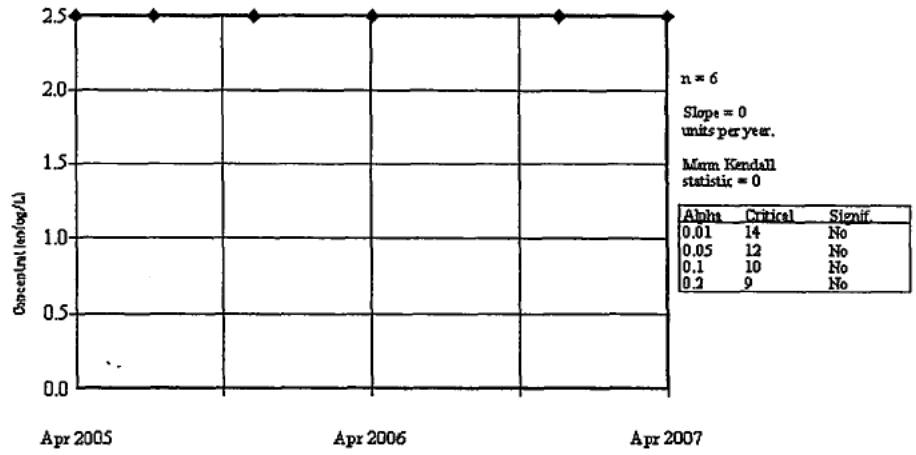


Constituent: Chromium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3

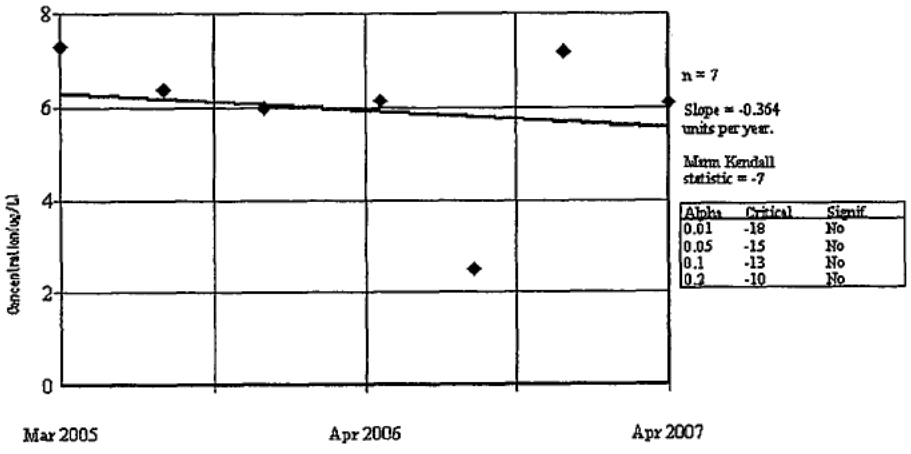


Constituent: Chromium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4

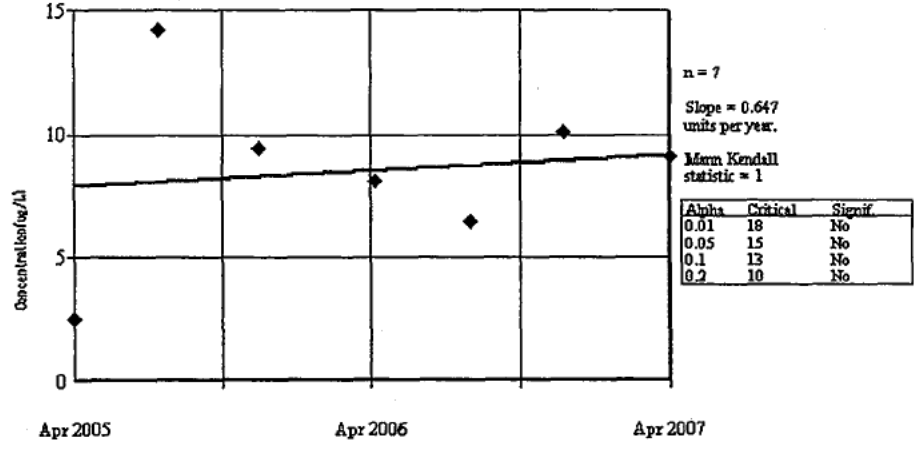


Constituent: Chromium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A

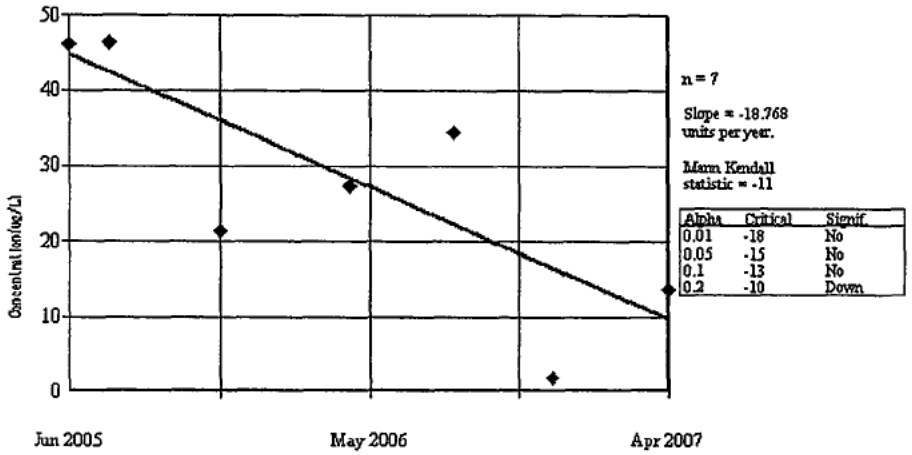


Constituent: Chromium (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:57 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



n = 7

Slope = -18.768 units per year.

Mann Kendall statistic = -11

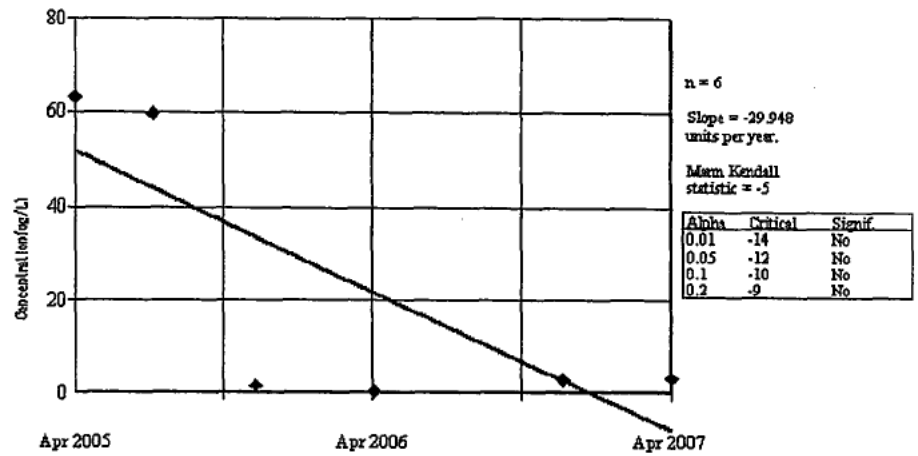
Alpha	Critical	Signif
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	Down

Constituent: Copper (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



n = 6

Slope = -29.948 units per year.

Mann Kendall statistic = -5

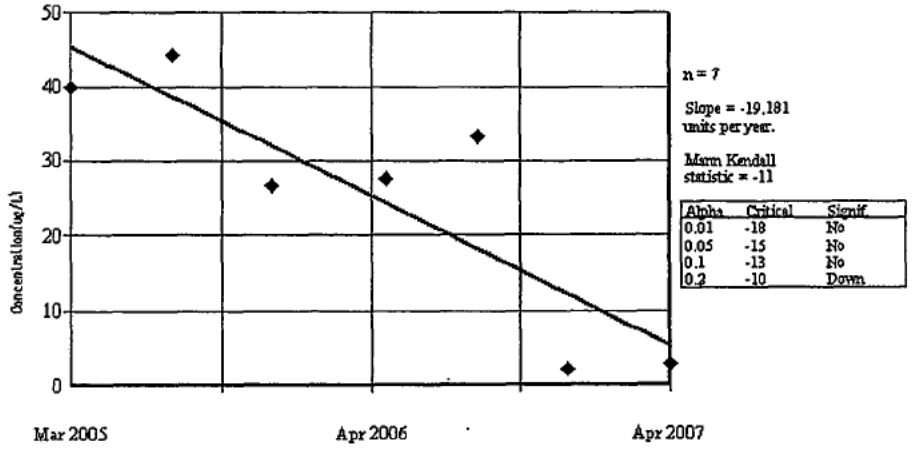
Alpha	Critical	Signif
0.01	-14	No
0.05	-12	No
0.1	-10	No
0.2	-9	No

Constituent: Copper (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



n = 7

Slope = -19.181 units per year.

Mann Kendall statistic = -11

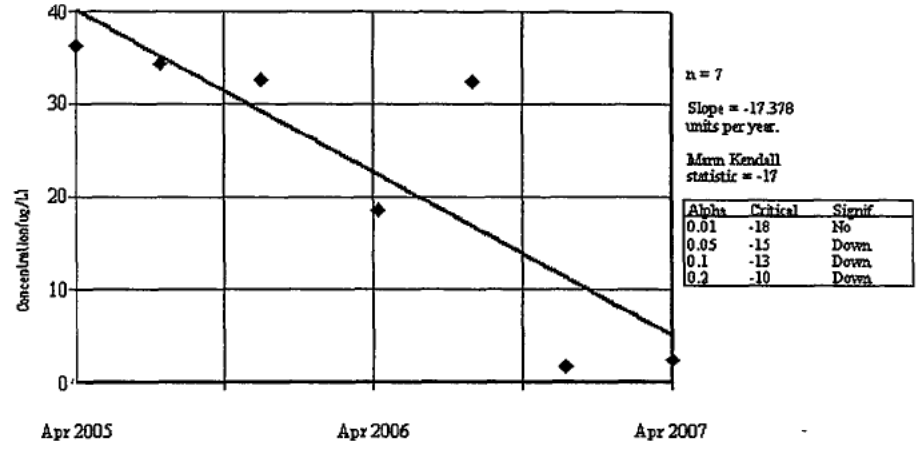
Alpha	Critical	Signif
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	Down

Constituent: Copper (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



n = 7

Slope = -17.378 units per year.

Mann Kendall statistic = -17

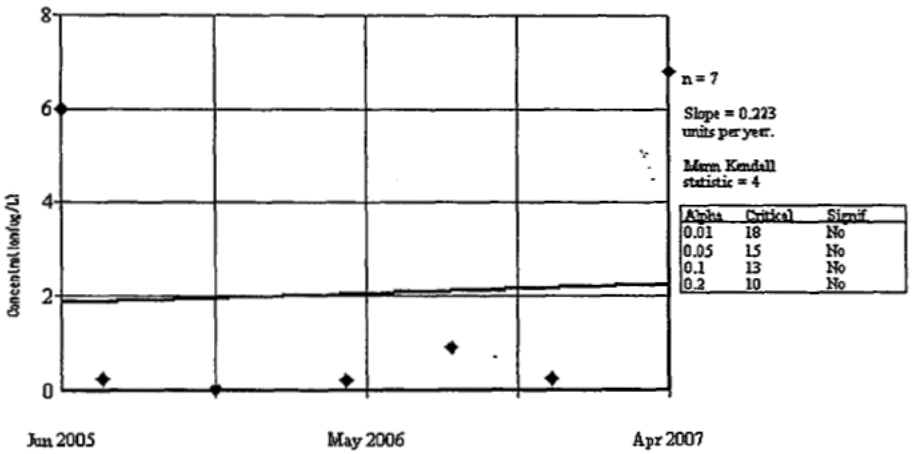
Alpha	Critical	Signif
0.01	-18	No
0.05	-15	Down
0.1	-13	Down
0.2	-10	Down

Constituent: Copper (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1

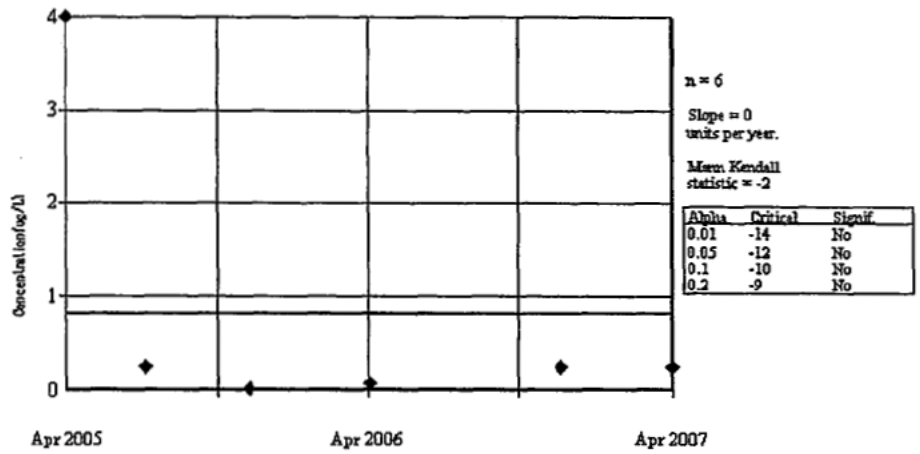


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3

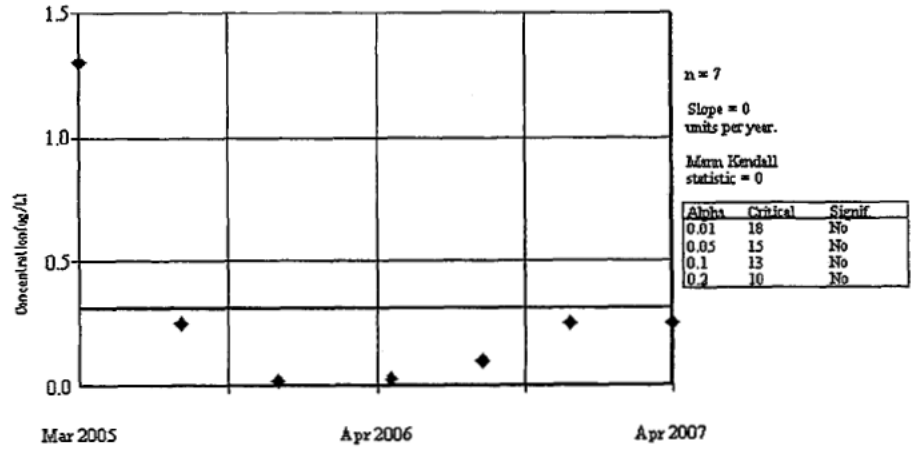


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4

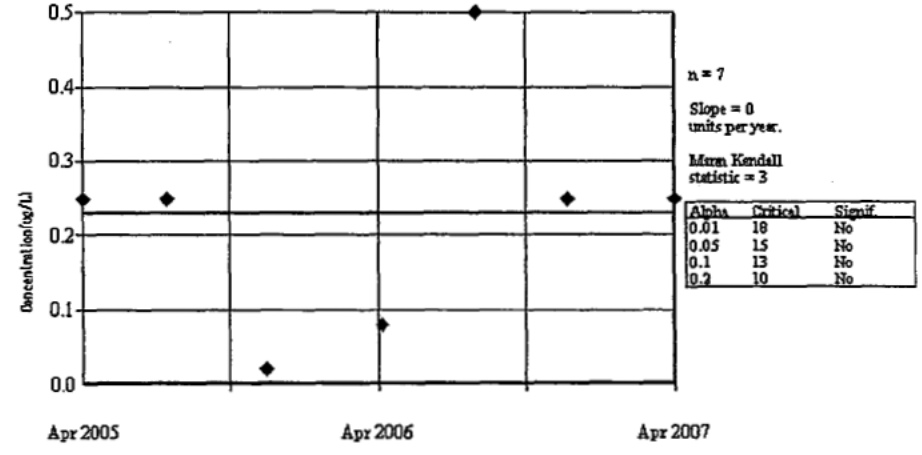


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A

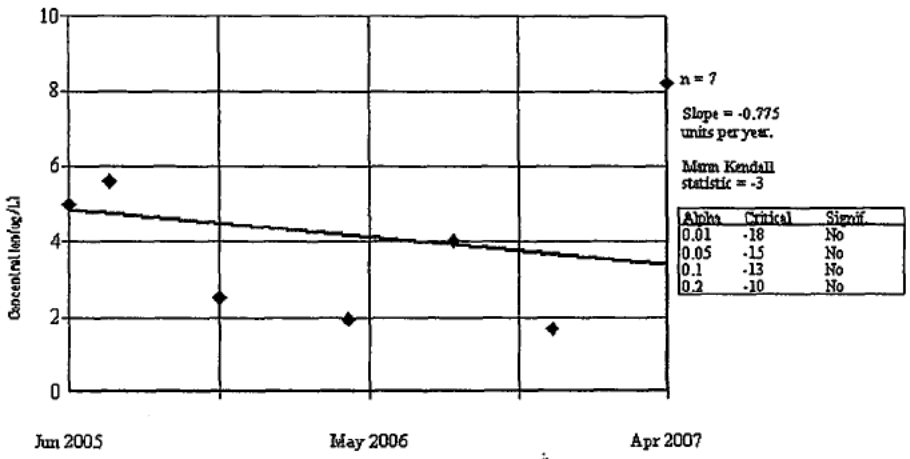


Constituent: Lead (ug/L)
Date: 10/25/07

Facility: Clint
Time: 10:58 AM

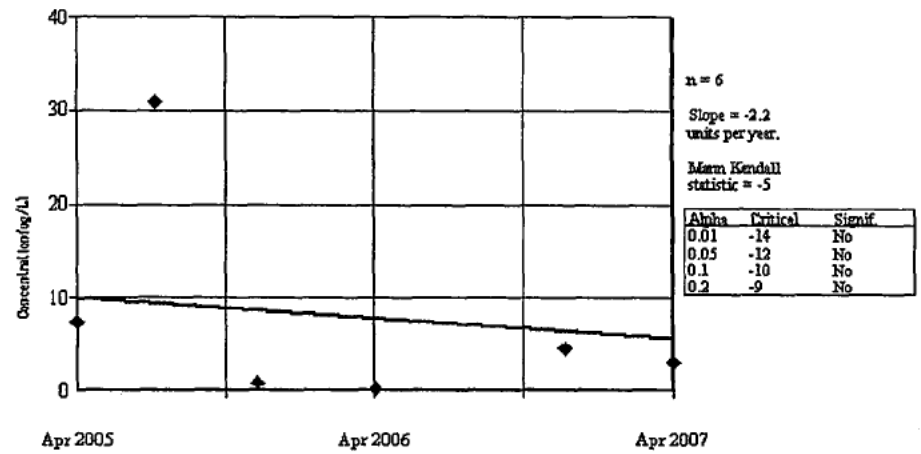
Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



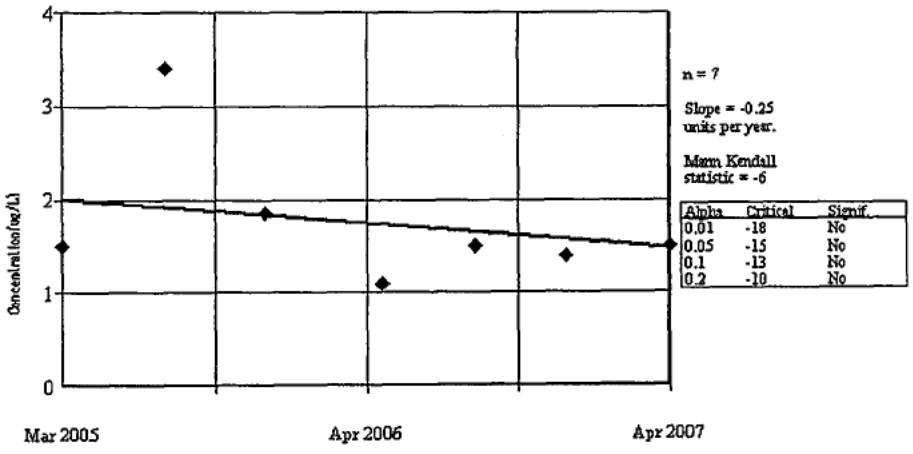
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



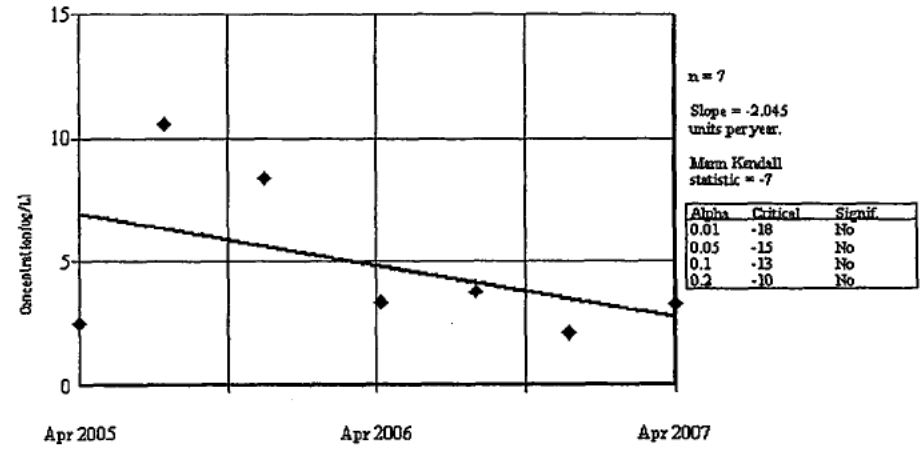
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



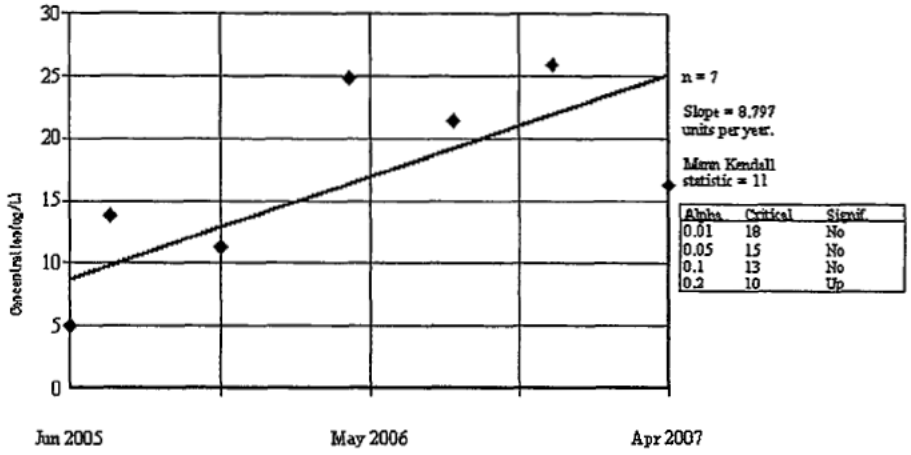
Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



Constituent: Nickel (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

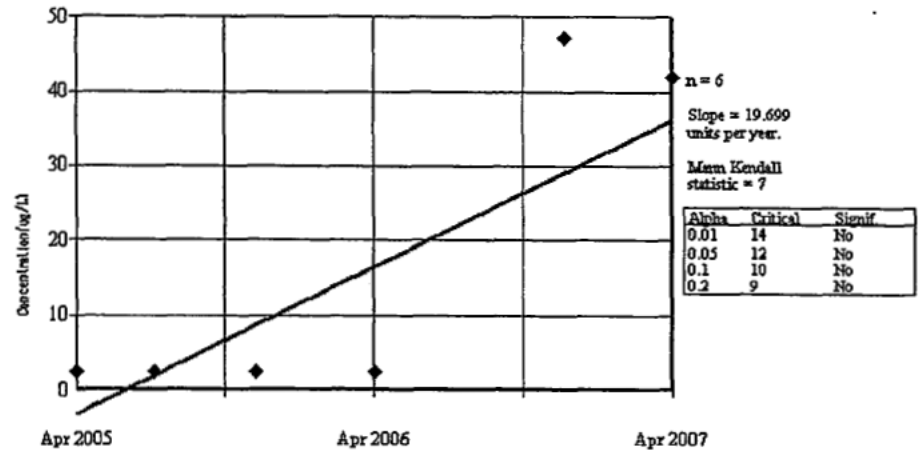
SEN'S SLOPE ESTIMATOR
MW-1



Alpha	Critical	Signif.
0.01	18	No
0.05	15	No
0.1	13	No
0.2	10	Up

Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

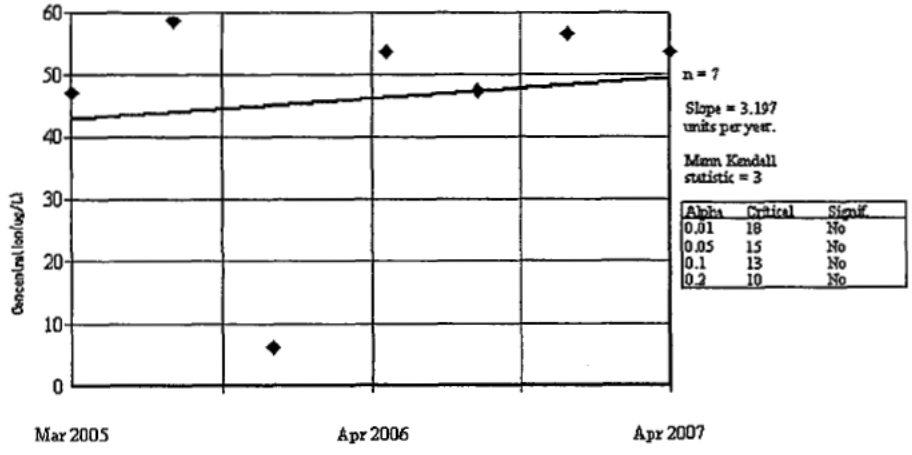
SEN'S SLOPE ESTIMATOR
MW-3



Alpha	Critical	Signif.
0.01	14	No
0.05	12	No
0.1	10	No
0.2	9	No

Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

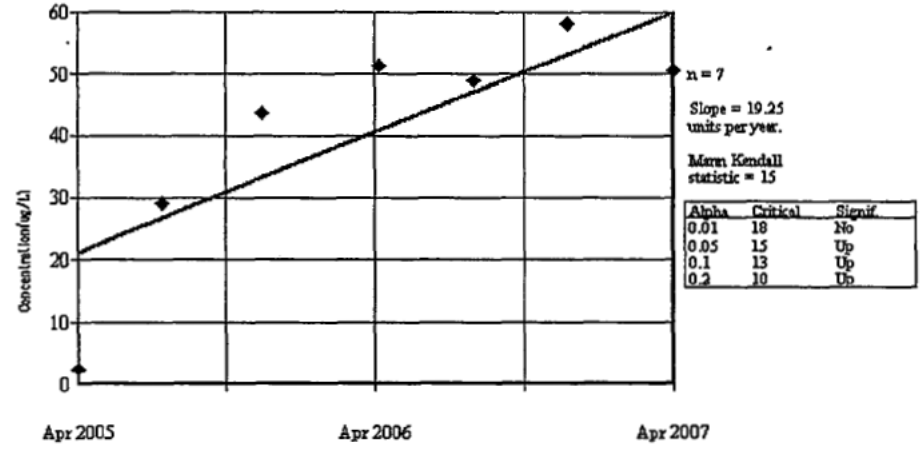
SEN'S SLOPE ESTIMATOR
MW-4



Alpha	Critical	Signif.
0.01	18	No
0.05	15	No
0.1	13	No
0.2	10	No

Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

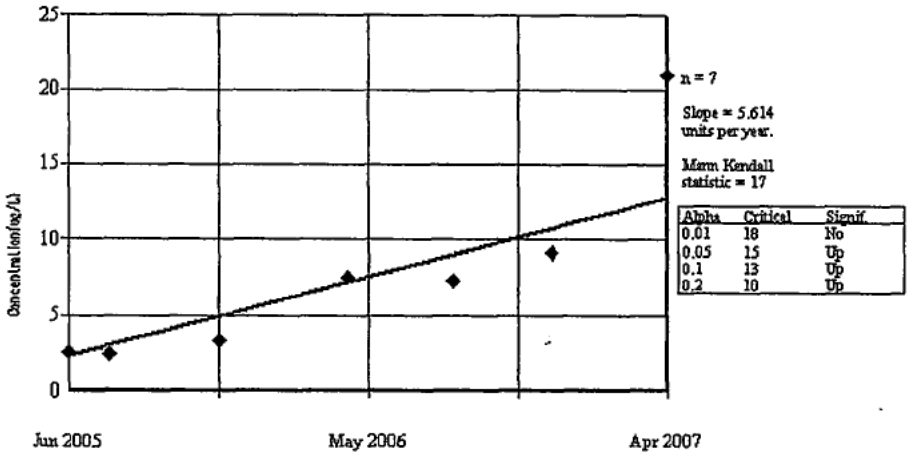
SEN'S SLOPE ESTIMATOR
MW-5A



Alpha	Critical	Signif.
0.01	18	No
0.05	15	Up
0.1	13	Up
0.2	10	Up

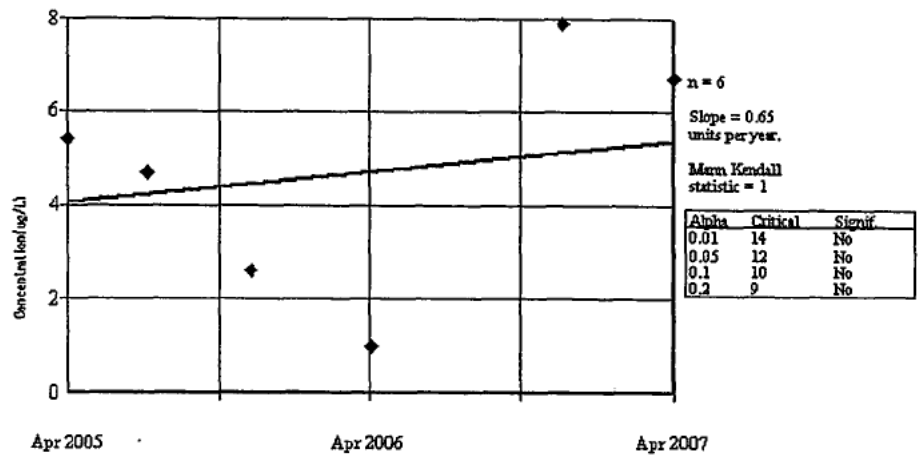
Constituent: Selenium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 10:59 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



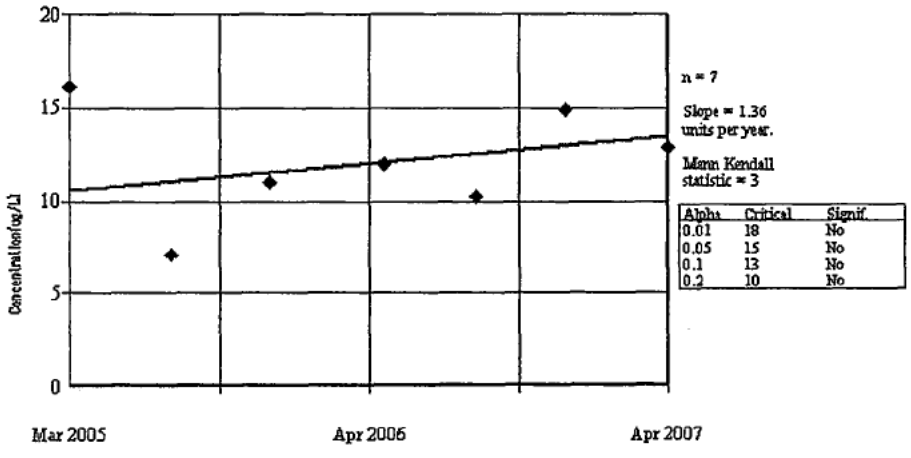
Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



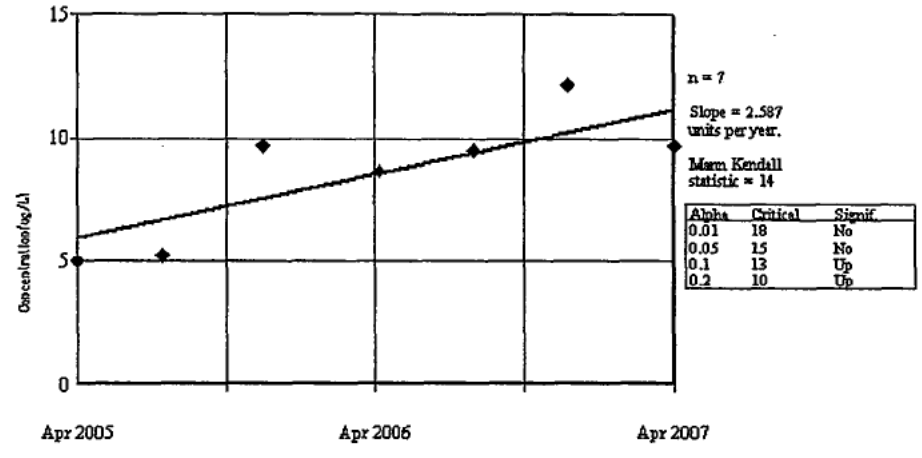
Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



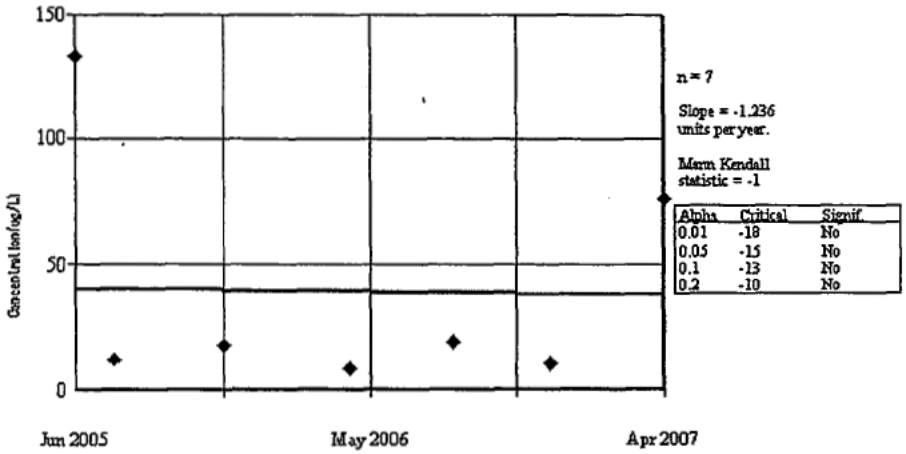
Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



Constituent: Vanadium (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:00 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-1



n = 7

Slope = -1.236 units per year.

Mann Kendall statistic = -1

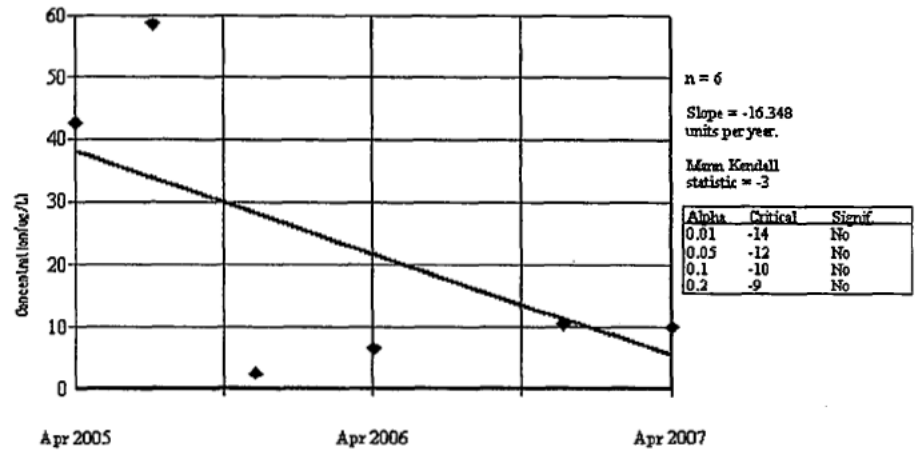
Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	No

Constituent: Zinc (ug/L)
Date: 10/25/07

Facility: Clint
Time: 11:00 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-3



n = 6

Slope = -16.348 units per year.

Mann Kendall statistic = -3

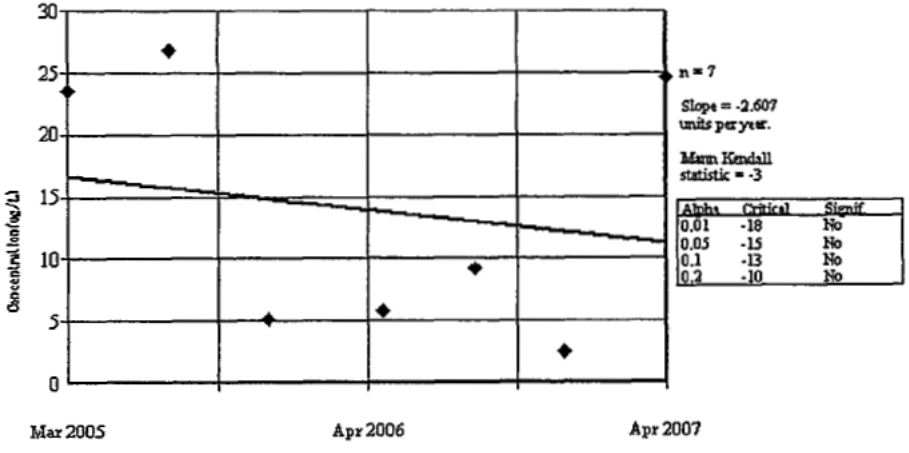
Alpha	Critical	Signif.
0.01	-14	No
0.05	-12	No
0.1	-10	No
0.2	-9	No

Constituent: Zinc (ug/L)
Date: 10/25/07

Facility: Clint
Time: 11:00 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-4



n = 7

Slope = -2.607 units per year.

Mann Kendall statistic = -3

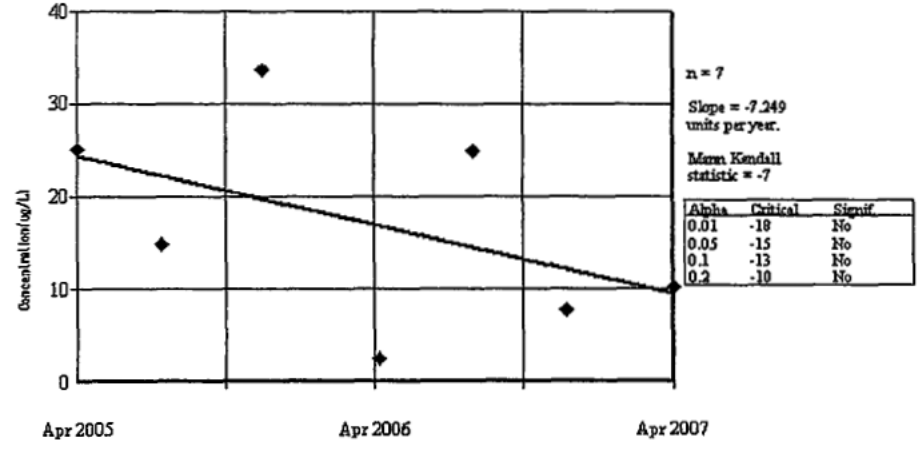
Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	No

Constituent: Zinc (ug/L)
Date: 10/25/07

Facility: Clint
Time: 11:00 AM

Data File: CLINTD~1
View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A



n = 7

Slope = -7.249 units per year.

Mann Kendall statistic = -7

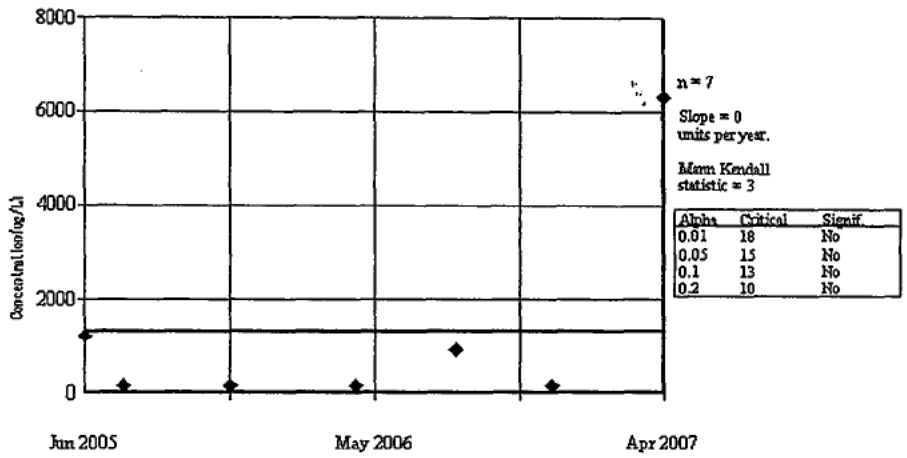
Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	No

Constituent: Zinc (ug/L)
Date: 10/25/07

Facility: Clint
Time: 11:00 AM

Data File: CLINTD~1
View: Time Series

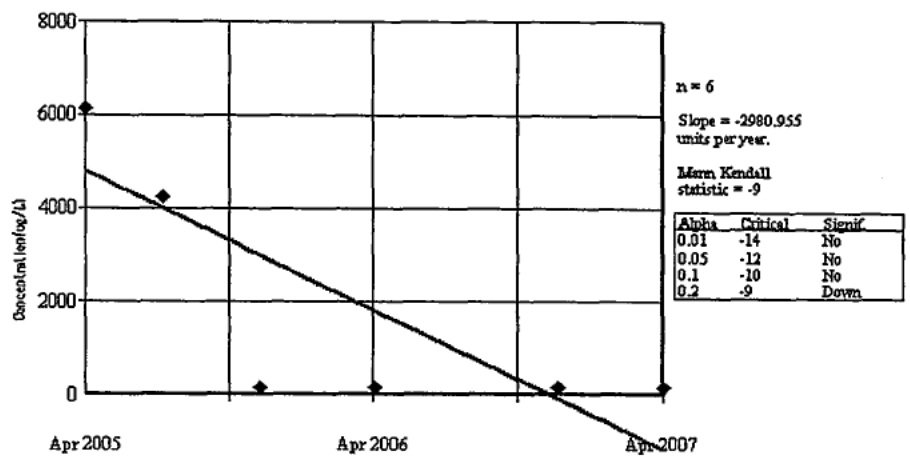
SEN'S SLOPE ESTIMATOR
MW-1



Alpha	Critical	Signif.
0.01	18	No
0.05	15	No
0.1	13	No
0.2	10	No

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

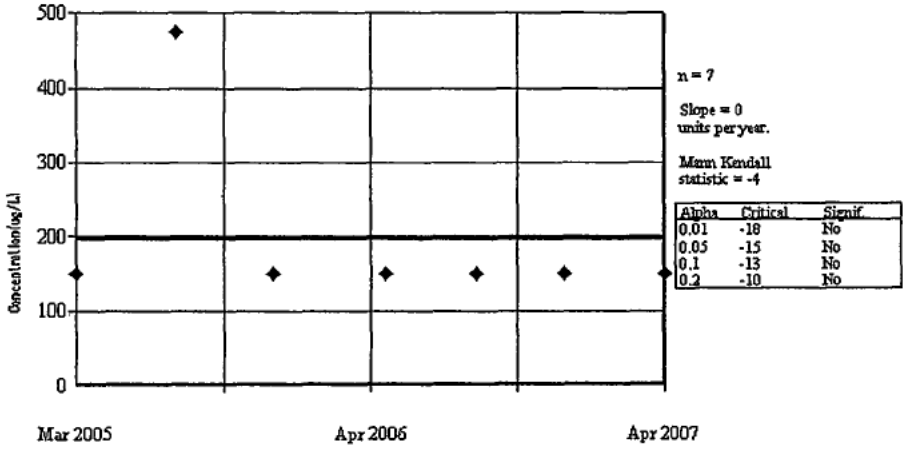
SEN'S SLOPE ESTIMATOR
MW-3



Alpha	Critical	Signif.
0.01	-14	No
0.05	-12	No
0.1	-10	No
0.2	-9	Down

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

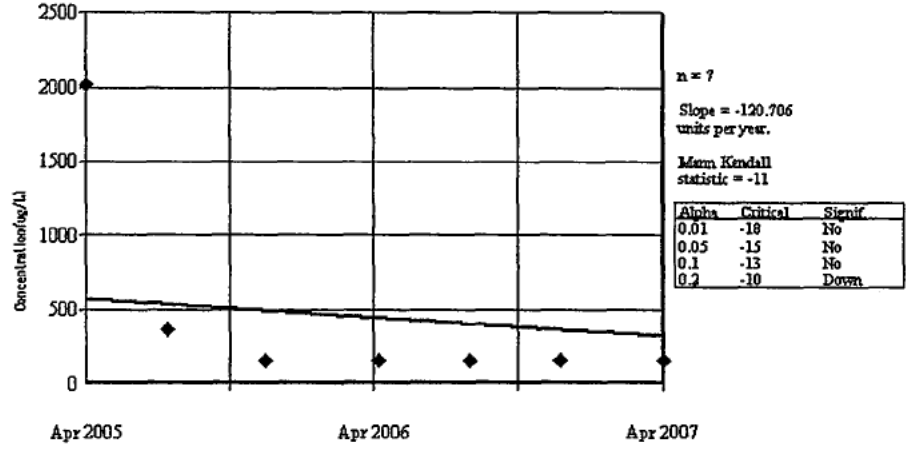
SEN'S SLOPE ESTIMATOR
MW-4



Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	No

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

SEN'S SLOPE ESTIMATOR
MW-5A

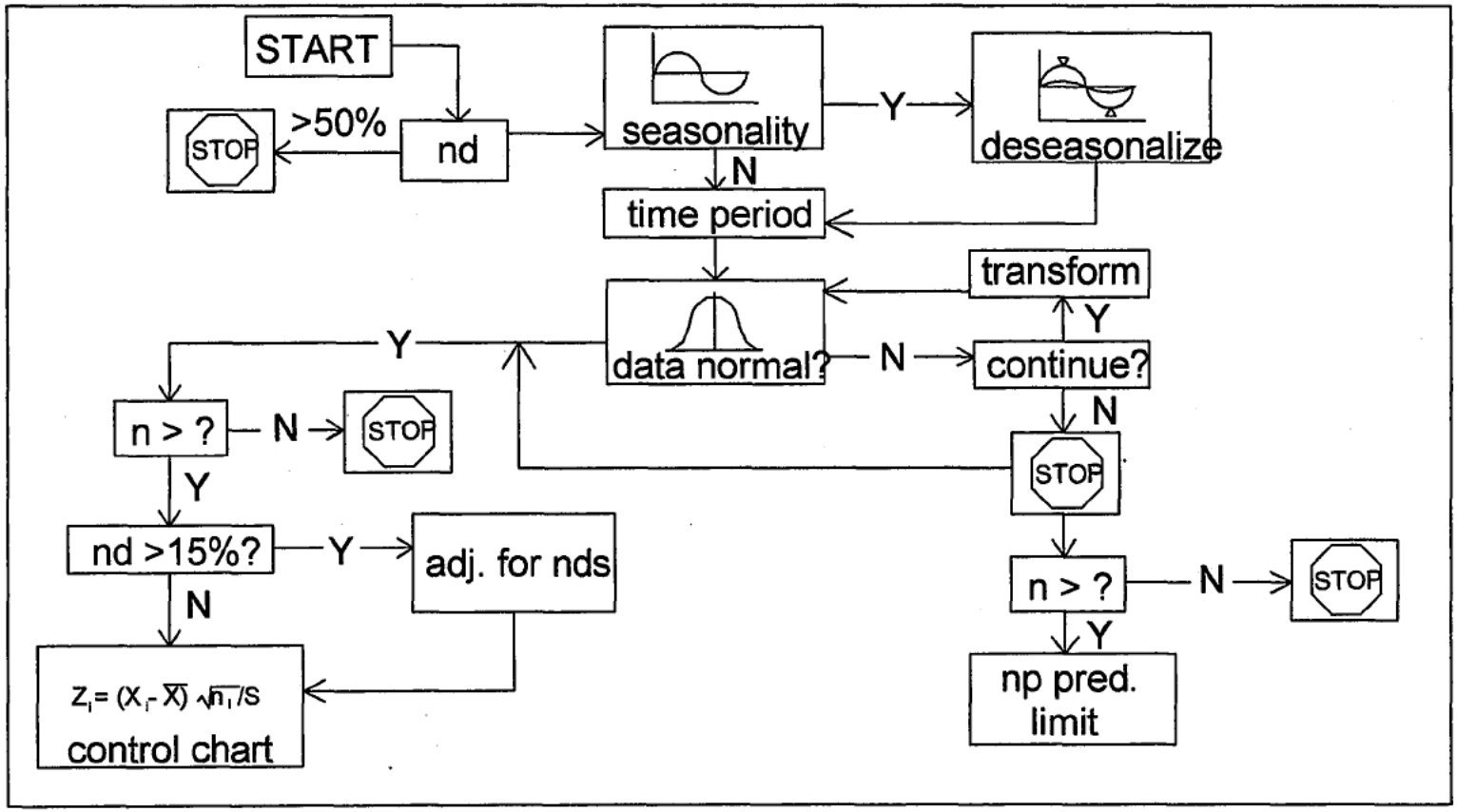


Alpha	Critical	Signif.
0.01	-18	No
0.05	-15	No
0.1	-13	No
0.2	-10	Down

Constituent: Iron (ug/L) Facility: Clint Data File: CLINTD~1
Date: 10/25/07 Time: 11:01 AM View: Time Series

ATTACHMENT III.F.6.3 – CONTROL CHART FLOWCHART

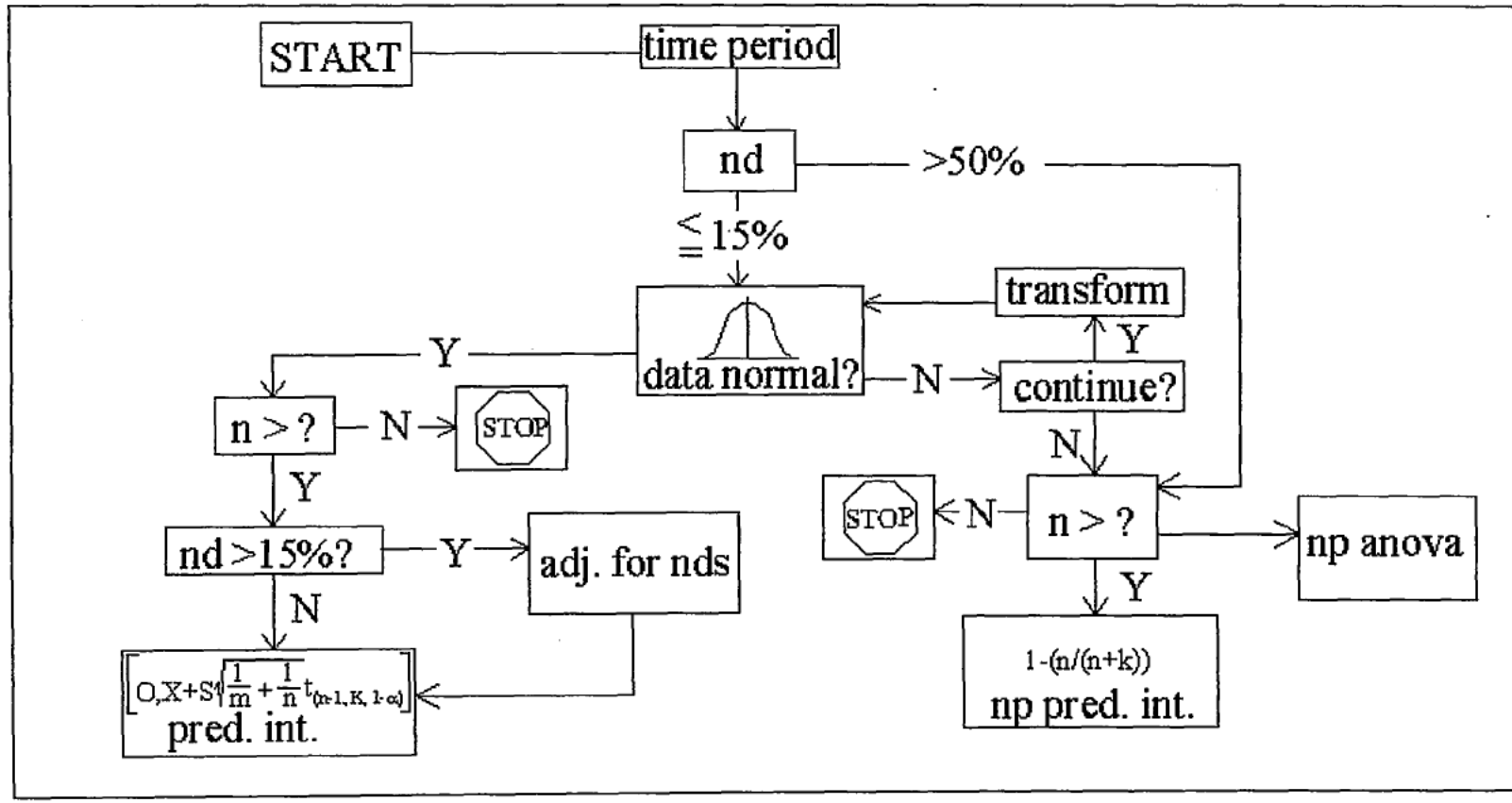
FIGURE 4-1
CONTROL CHART FLOWCHART



Source: Sanitas™ version 7.5

ATTACHMENT III.F.6.4 – PREDICTION LIMIT FLOWCHART

FIGURE 4-2
PREDICTION LIMIT FLOWCHART

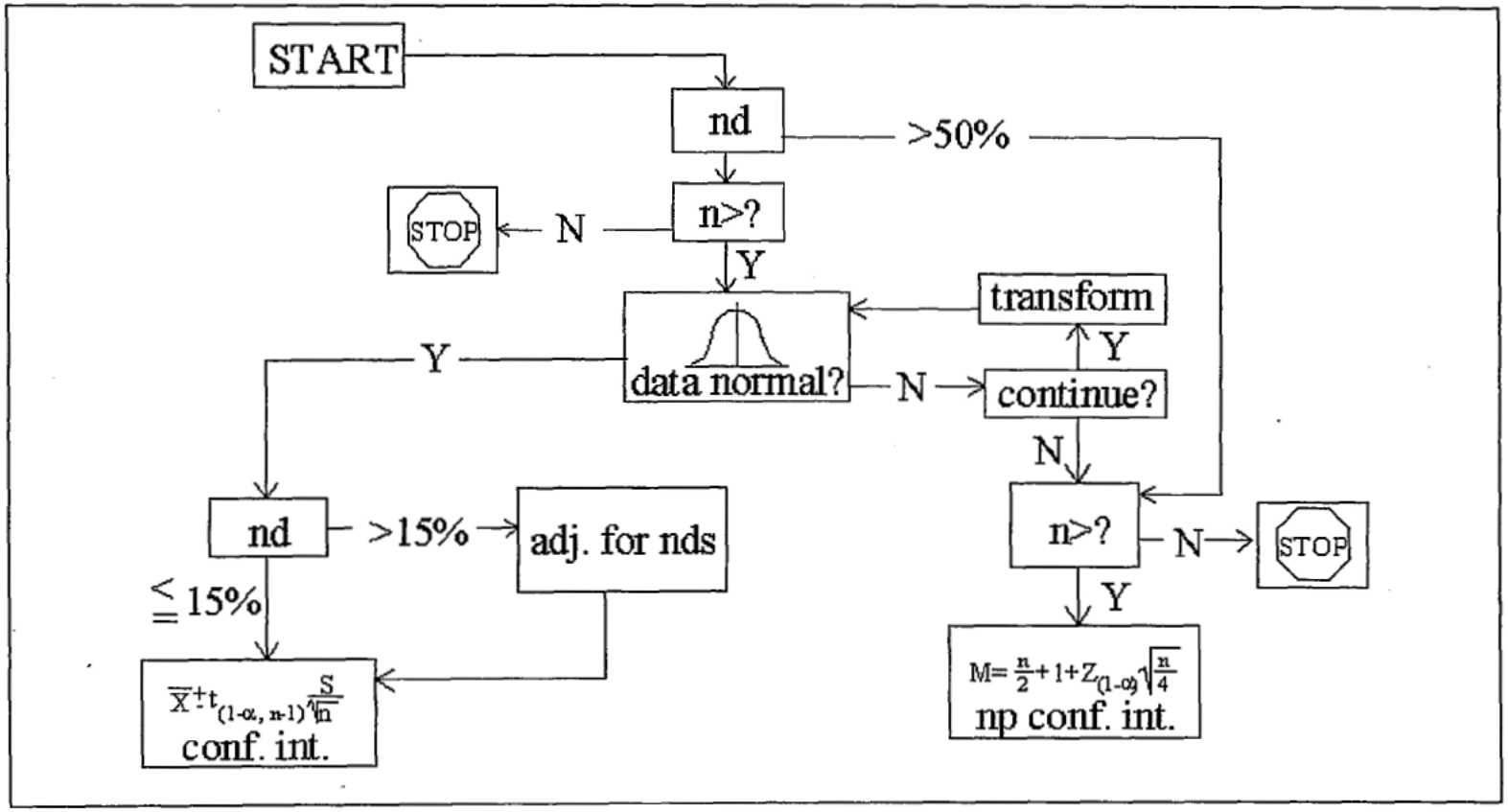


Source: Sanitas™ version 7.5

ATTACHMENT III.F.6.5 – CONFIDENCE INTERVAL FLOWCHART

FIGURE 4-3

95% CONFIDENCE INTERVAL FLOWCHART



Source: Sanitas™ version 8.0

ATTACHMENT III.F.7 – CERTIFICATION OF GROUNDWATER MONITORING SYSTEM

(Excerpt from Permit No. 2284 Permit Modification, and Monitor Wells #14 and 15 Installation Report)

GROUNDWATER MONITORING SYSTEM DESIGN CERTIFICATION

General Site Information

Site: The City of El Paso Clint Landfill

Site Location: Three and one-half miles east of the town of Clint, Texas.

MSW Permit No.: 2284

Qualified Groundwater Scientist Statement

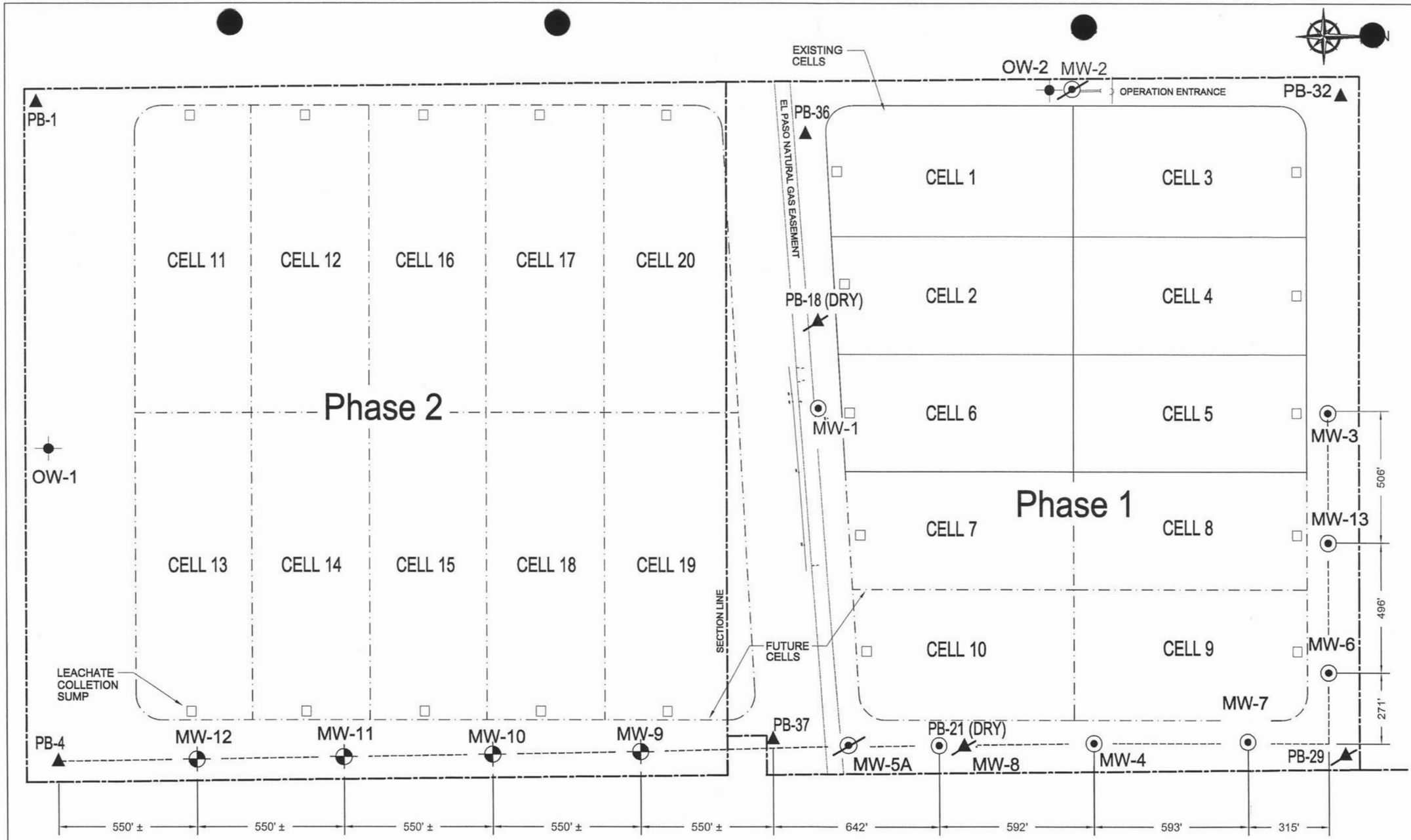
I, Heather R. Keister, am a licensed professional engineer in the State of Texas and a qualified groundwater scientist as defined in 30 TAC §330.3. I have reviewed the groundwater monitoring system and supporting data contained herein. In my professional opinion, the groundwater monitoring system is in compliance with the groundwater monitoring requirements specified in 30 TAC §330.401 through §330.421.

Firm Address: Parkhill, Smith & Cooper, Inc.
4222 85th Street
Lubbock, Texas 79423

Signature: Heather Keister
Heather R. Keister, P.E.

Date: 3/24/2009





PARKHILL SMITH & COOPER

The CAREL CORPORATION

136 Pecan Street, Keller, TX 76248

SCALE

0 200 400

FEET

PROPOSED MONITORING NETWORK

CITY OF EL PASO GROUNDWATER PERMIT MODIFICATIONS FOR CLINT LANDFILL

7969 SAN PAULO DRIVE
EL PASO, TEXAS 79907

LEGEND:

- LANDFILL BOUNDARY
- EXISTING GROUNDWATER MONITORING WELL
- PIEZOMETERS
- FUTURE GROUNDWATER MONITORING WELL
- FUTURE OBSERVATION WELL
- DECOMMISSIONED WELL
- POINT OF COMPLIANCE

NO	DATE	DESCRIPTION
1	09/02/10	RESET SPACING ON EXIST MW's LAYOUT PROPOSED MW's

ISSUING OFFICE: CITY PROJECT NO: 07-05-50

FILENAME: L:\TEXAS\Clint\SITE MAPpoc.dwg

DRAWN BY: KTC

DRAFTED BY: TDW

PLATE: 8

ROBERT HOLLY HOLDER
59052
LICENSED PROFESSIONAL ENGINEER
STATE OF TEXAS
F-560
09/02/10

Drawing File: X:\2010\5151.10\CADD\Z_FROM\Carel Corp\SITE MAPpoc.dwg (GEORGE-M) 9/2/2010 16:43:45

- Monitoring Well Data Sheets
- Geologic Boring Logs
- TCEQ Correspondence
- Material Information and MSDS Safety Sheets
- Groundwater Monitor Well Construction Specifications
- Figure 1 – Vicinity Location Map
- Figure 2 – Monitor Well Layout
- Figure 3 – Typical Well Construction Details
- Figure 4 – Survey

6.0 CERTIFICATION OF GROUNDWATER MONITORING SYSTEM

In the professional opinion of R. Matt Dyer, P.E. as a registered professional engineer in the State of Texas (License No. 92189), the groundwater monitoring system was designed in accordance with TCEQ rules and regulations as published in 30 TAC §330, Subchapter J. To the best of my knowledge, no significant alterations were made by the contractor during actual construction of the wells.

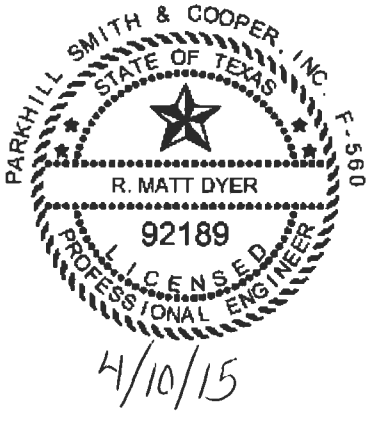
Sincerely,

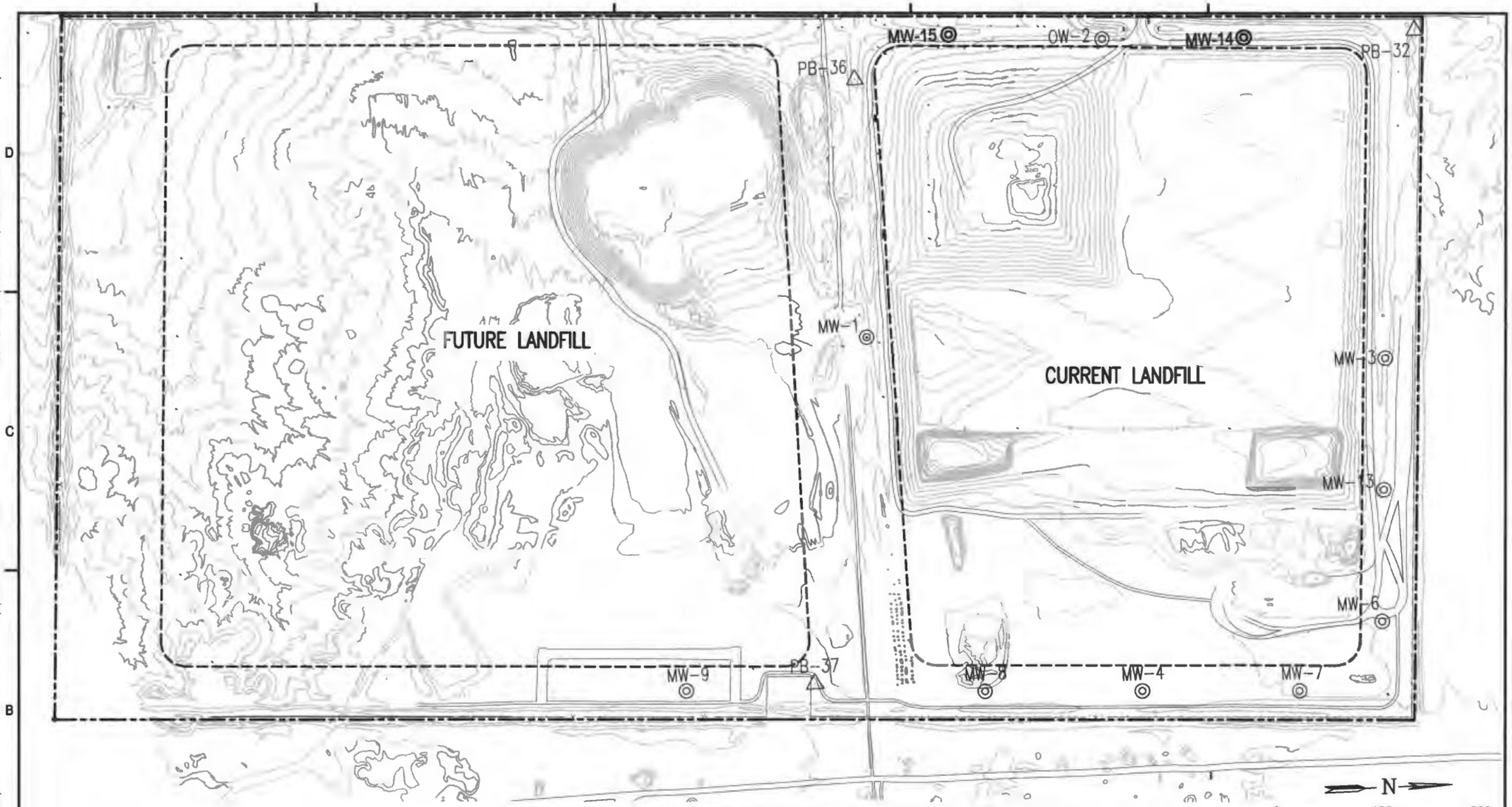
PARKHILL, SMITH & COOPER, INC.

By R. Matt Dyer

R. Matt Dyer, P.E.

Firm Principal





WELL COORDINATES					
WELL ID	LAT.	LONG.	NORTHING	EASTING	SURFACE ELEV.
NEW WELLS					
MW-14	31°36'01.400"	106°10'18.300"	10,593,494.38	479,723.46	3969.70
MW-15	31°35'50.400"	106°10'18.300"	10,592,384.44	479,665.15	3958.20
EXISTING WELLS					
PB-32	31°36'07.132"	106°10'18.085"	10,594,072.15	479,772.34	3974.82
OW-2	31°35'56.119"	106°10'18.151"	10,592,960.87	479,708.20	3969.29

LEGEND

- PERMITTED BOUNDARY (PERMIT NO. 2284)
- EXISTING FENCE
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING PIEZOMETER WELL
- NEW 4" GROUNDWATER MONITORING WELL

NOTES:

1. COORDINATES ARE BASED ON THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, GRID, NAD 83. COMBINED SCALE FACTOR USED WAS 0.99980117. ELEVATIONS ARE NAVD 88 VERTICAL DATUM.
2. DRILLER SHALL COORDINATE WITH ENGINEER ON EXACT LOCATION FOR EACH WELL PRIOR TO MOBILIZATION.

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
R. MATT DYER
92189
LICENSED PROFESSIONAL ENGINEER
08/01/14

PSC
PARKHILL SMITH & COOPER

THE CITY OF EL PASO TEXAS

GROUNDWATER MONITORING WELLS 14 & 15

GREATER EL PASO LANDFILL
TCEQ MSW PERMIT NO. 2284

7968 SAN PAULO DRIVE
EL PASO, TEXAS 79907

KEY PLAN

NO	DATE	DESCRIPTION

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5153.14

WELL CONSTRUCTION LAYOUT PLAN

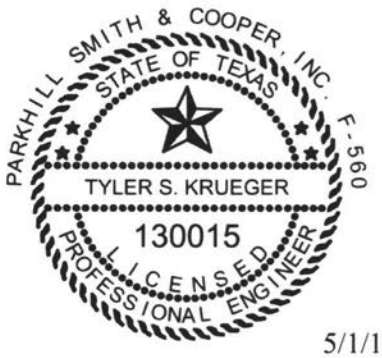
Rev 1, May 16, 2025

C-101

Xref's: XTB-5153-14, XSV-5153-14, XGSP-5151-CLINT
8/1/2014
Drawing File: X:\2014\5153.14\BIM_CAD\00_SHEETS\C-101-5153-14.dwg (GEORGE-M)

6.0 GROUNDWATER MONITORING SYSTEM CERTIFICATION

In the professional opinion of Tyler S. Krueger, P.E., as a registered professional engineer in the State of Texas (License No. 130015), the groundwater monitoring system was designed in accordance with TCEQ rules and regulations as published in 30 TAC §330, Subchapter J. To the best of my knowledge, no significant alterations were made by the contractor during actual construction of wells.



5/1/19

Sincerely,

PARKHILL, SMITH & COOPER INC.

By _____

Tyler S. Krueger, P.E.
Project Engineer

APPENDIX III.G – SLOPE STABILITY AND SETTLEMENT ANALYSIS

MSW AUTH NO. 2284A

APPENDIX III.G – SLOPE STABILITY AND SETTLEMENT

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 0
OCTOBER 31, 2024

Part III, Appendix G
Slope Stability and Settlement
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024



prepared by

Burns & McDonnell Engineering Company, Inc.
6200 Bridge Point Pkwy, Building 4, Suite 400, Austin, TX 78730
Texas Firm Registration No. F-845

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Attachment III.G.3 – Liner Strength Determination..... III.G-29
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Introduction

This project involves the permitting and design of a vertical expansion of the existing Greater El Paso Landfill (Landfill) near Clint, Texas. The Landfill is made up of two cells that will both have vertical expansions. For Phase 1 (north cell), the vertical expansion will be from elevations 4,066.07 feet to 4,127.42 feet. For Phase 2 (south cell), the vertical expansion will be from elevations 4,050.07 feet to 4,128.07 feet. All municipal solid waste (MSW) slopes are 4H:1V. Base liner side slopes are 3H:1V.

The existing base liner system is a geosynthetic liner with 2-feet protective cover, geocomposite, geomembrane and geosynthetic clay liner (GCL). Per existing drawings, the geomembrane is textured along the base liner sidewalls and smooth along the base liner floor.

The cover system will be made up of a soil cap made up of a 6-inch base layer, 18-inch infiltration layer, geotextile and 4-inches of rock armoring.

This packet contains slope stability, settlement evaluations and cover stability for the vertical expansions for both phases.

Subsurface Information

As part of initial siting of the Landfill in 1999 and 2000, 37 borings and piezometers were drilled. Borings PB-1 to B-20 and PB-37 were roughly within the footprint of Phase 2. Borings PB-21 to B-32 and PB-36 were roughly within the footprint of Phase 1. Borings B-33 to B-35 were within the detention pond perimeter to the south of the Phase 1. Based on a review of the data, this information was deemed adequate for this evaluation.

For piezometer borings, denoted as “PB-“, drill depths were between 343 feet and 405 feet. Piezometer boring logs only provided visual classification of the materials encountered. No standard penetration (SPT) testing results were included.

For borings, denoted as “B-“, drill depths were between 31.5 feet and 126.5 feet. Boring logs provided visual classification of materials encountered, SPT blow counts and limited laboratory testing results. In reviewing these logs, the maximum reported blow count was 35 blows per foot.

The materials were almost exclusively sands. Blow counts in the borings were reviewed to understand the consistency of the materials and any trends in values per area or depth. Blow counts were corrected for hammer efficiency assuming 75-percent efficiency and depth. There was not a significant variation in the blow counts between the different areas with different ground surface elevations. Average blow counts were found to decrease with depth as a product of the depth correction.

Groundwater was only encountered in piezometer borings. The minimum depth of groundwater was 284.5 feet below original ground surface.

A plan view with borings, boring fence diagram and SPT blow counts are included in Attachment III.G.1.

Soil Design Parameters

For determining soil design parameters, boring logs, SPT blow counts, published correlations and published interface shear strengths were reviewed. Discussions for each design parameter and how they were determined are below.

Unit Weight

For sand, the density was based on blow counts and the correlation shown in Table 3-1 of the *United States Army Corps of Engineer (USACE) EM 1110-2-2504, Design of Sheet Pile Walls*.

Drained Strength

To determine drained shear strength, SPT blow counts were reviewed. As noted previously, blow counts generally decreased from an average of 25 to 35 in the upper 50 feet to 15 to 25 from 50 to 125 feet. The decrease in blow count with depth is caused by the depth correction used. However, as noted, the maximum field blow counts reported were limited to 35 blows per foot based on the information on the boring logs. It is likely that actual field blow counts are higher than 35 blows per foot, especially for the deeper samples.

For the purposes of the slope stability calculations, the sands in the upper 50 feet of the profile are most important. These upper sands were noted as having higher blow counts. That being said, it is likely that the lower blow counts noted at depth were higher based on the ceiling in report blow counts. Based on this, a single friction angle will be used for all sands at the site. The correlated values in Table 3-1 of *USACE EM 1110-2-2504* were reviewed. Based on a median SPT blow count of greater than 30 blow per foot, a drained friction angle of 34 degrees was used for all sands at the site.

Modulus

Modulus values for the sands are needed to estimate settlements. Modulus values were determined based on SPT blow counts and correlated values. Table 5-5 of the *EPRI Manual on Estimating Soil Properties for Foundation Design* was utilized to determine the drained modulus of sands. It recommends a Modulus to Atmospheric Pressure ratio between 500 and 1,000 for dense sands. Using a ratio of 750 corresponded to a modulus value of 1,500 ksf.

MSW

Design parameters for MSW were determined based off published shear strength parameters and estimated densities based on previous information at the Landfill. The paper by Diaz-Beltran, Iguaran-Fernandez, Larrahondo and Jaramillo entitled *Shear Strength of Municipal Solid Waste (MSW): Beyond the Raw Values of "Cohesion" and Friction Angles* provides a detailed review of available literature on measurements of shear strength of MSW. There is a significant variation in the cohesion and friction angle values measured by different researchers, with no apparent correlation between the parameters (i.e. higher cohesion does not correlate with higher friction angles). Based on this paper, the most frequently measured shear strength parameters are 300 to 600 psf for cohesion and 30 degrees for friction angle. Based on this, a cohesion of 300 psf and a friction angle of 30 degrees were used for MSW shear strength parameters.

No previous measurements of MSW at the site are available. Based on general experience with MSW, a design unit weight of 50 pounds per cubic foot for MSW was used.

Design Parameters

Material	Design N_{60} (blows/ft)	Unit Weight (pcf)	Friction Angle (deg)	Drained Cohesion (psf)	E (ksf)
Sands	30	120	34	450	1,500
MSW		50	30	300	

References, strength testing and consolidation results and the MSW shear strength reference are included in Attachment III.G.2.

Geosynthetic Design Parameters

During previous development of the Landfill, geosynthetic materials were utilized as part of the base liner. Interface shear strengths of geosynthetics for the base liner and cover can control slope stability and require special evaluation.

Existing drawings for the liners were reviewed. The system is made up of the following materials, from top to bottom:

- 24 inches of protective cover soil (assumed sand)
- Geocomposite
- HDPE Geomembrane
  - Noted as being smooth along liner floor and textured along liner sideslopes
- GCL
  - Drawings for Cells 7 to 10 indicate that liner floor GCL is non-reinforced. Drawings for Cells 11 to 14 indicate all the GCL is reinforced.
- Sand subgrade

For the cover system, only one layer of geosynthetic was a part of the design. The cover system is made up of the following materials, from top to bottom:

- 4 inches of rock armoring
- Non-woven geotextile
- 18-inches infiltration layer (assumed cohesive)
- 6-inch bas layer

To estimate these different interface strengths, published values in the *GRI Report #30* were reviewed. For each interface, both peak and residual strengths will be noted. Base liner interfaces and strengths for the existing and new cells will be noted separately.

The estimated interface information for the existing cell base liner are noted in Table III.G.1:

Table III.G.1. Cell Base Liner Interfaces and Strengths

Interface	Peak		Residual	
	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)
Cover Material – Geocomposite	27	280	21	160
Geocomposite – HDPE (textured)	26	0	15	0
Geocomposite – HDPE (smooth)	15	0	12	0
HDPE (textured) - GCL	23	160	13	0
HDPE (smooth) - GCL	11	0	9	0
GCL Reinforced	16	760	6	240
GCL Unreinforced	6	240	6	240
GCL – Sand Subgrade	33	0	33	0

Note that GRI Report #30 did not provide results for the HDPE (smooth) – GCL and GCL – Sand Subgrade interfaces. HDPE (smooth) – GCL was approximated using the HDPE (smooth) – NW-NP Geotextile interface. GCL – Sand Subgrade was approximated using the NW-NP Geotextile – Sand interface.

The estimated interface information for the cover system are listed in Table III.G.2:

Table III.G.2. Cover Interfaces and Strengths

Interface	Peak		Residual	
	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)
Rock Armoring - Geotextile	33	0	33	0
Geotextile – Infiltration Layer	33	0	33	0

For determining the controlling strength for the base liner, the interface shear strength for every interface was calculated for a range of effective stresses. This was done because different interfaces control for different effective stress ranges. Note that the strengths were then broken up between the base liner floor and side slopes given the difference in materials used. For the base floor, only unreinforced GCL was considered given the uncertainty on which type of GCL was used.

Based on this evaluation, the design strength envelope in Table III.G.3 was determined for the floor of the base liner:

Table III.G.3. Floor of Base Liner Design Strength Envelope

Peak		Residual	
Effective Stress (psf)	Interface Shear Strength (psf)	Effective Stress (psf)	Interface Shear Strength (psf)
0	0	0	0
2500	486	4500	713
10000	1291	10000	1291

The design strength envelope in Table III.G.4 was determined for the sideslopes of the base liner:

Table III.G.4. Side Slopes of Base Liner Design Strength Envelope

Peak		Residual	
Effective Stress (psf)	Interface Shear Strength (psf)	Effective Stress (psf)	Interface Shear Strength (psf)
0	0	0	0
2500	1219	1500	346
4000	1858	10000	1291
10000	3628	[redacted]	[redacted]

For the cover system, all interface strength values will be evaluated using the parameters listed in Table III.G.2.

Excerpt from the *GRI Report #30* and base liner strength determinations are included are included in Attachment III.G.3.

Sections

Sections were drawn for Phases 1 and 2. The following considerations were made in determining the design sections:

- Section must be parallel to base liner downward slope,
- Section should minimize the base liner side slope as the upward slope and higher interface shear strength will increase stability,
- Section should maximize height of MSW above toe crest.

For Phase 1, the base liner slopes in the north-south direction. For Phase 2, the base liner slopes in the east-west direction. All base liners were evaluated along the sump trenches which have a 1-percent slope.

For Phase 1, the southwest corner of the base liner was found to have no side slope indicating that the liner essentially ties into the existing grade around the Landfill. This is a controlling condition for the base liner as it removes any upslope and higher strength zone of the liner (utilization of textured HDPE geomembrane and reinforced GCL). This area of the Landfill was then reviewed on the cover grading plan. The area was not directly perpendicular to the cover crest which is the area of maximum loading. It was determined to model this section assuming the cover did rise to the maximum elevation of 4,114.07 feet so the calculations would apply to all parts of Phase 1.

For the vertical expansion of Phase 1, the design slope will be 4H:1V up to elevation 4,114.07 feet and then 20H:1V up to the maximum landfill height elevation of 4,126.07 feet. In reviewing the existing survey data, the current landfill cover is at a shallower slope. For this evaluation, it was assumed that the entire cover system was constructed at the permitted 4H:1V slope.

For Phase 2, the section was drawn east-west across the maximum height of the 4H:1V slope (elevation 4100.07 feet) and that minimized the base liner side slope. This section generally maximized the height of MSW while minimizing the liner upslope. The same consideration was made for the existing cover slope.

Nearby borings for each section are included on the sections.

Section information is included in Attachment III.G.4.

Slope Stability

Slope stability calculations were performed for Phases 1 and 2 using UTexas4. Calculations were performed for the following conditions:

- Long-term Steady State 1 (LTSS-1) – Effective Shear Strength envelope for all soils, full MSW height
- Long-term Steady State 2 (LTSS-2) – Noncircular Surface Through Liner, Effective Shear Strength envelope for all soils, peak and residual liner strengths, full MSW height
- Seismic – Evaluated for controlling LTSS case

Note that no end-of-construction case was evaluated as all materials are drained.

For the LTSS–2 case, the stability factor of safety was controlled by the interface shear strength of the base liner. As noted, the interface shear strengths for the base liners vary between the floor and side slopes of the base liner. This difference was considered in the Phase 2 evaluation. It was not considered for Phase 1 as there was little to no base liner side slope at the section evaluated.

Base liner evaluations will consider both peak shear strength and residual shear strength. Residual shear strengths can be caused by settlement induced liner movement or strain compatibility of the MSW shear strength (peak strength developed at high strains) and the liner system (peak strength developed at low strains).

The 2014 USGS Deaggregation and the SEAOC/OSHPD U.S. Seismic Design Maps online programs were utilized for determining the design seismic event peak ground acceleration. Using the 2014 USGS Deaggregation program and for a Site Class B/C, which represents acceleration on bedrock, was 0.13g. This acceleration needs to be applied up to the ground surface to apply to the Landfill. This was done using the SEAOC/OSHPD U.S. Seismic Design Maps program for a Site Class D. The ground surface peak ground acceleration was 0.20g.

For LTSS-1 cases, a "floating grid" search method was used for calculating the stability factor of safety. This method involves setting a gridded location of circular centers and then choosing a point along the surface to run all the circular surfaces through. UTexas4 will then cycle through all the circles based on the different circular centers. Multiple points along the surface were evaluated to determine the lowest factor of safety.

For the LTSS-2 case, noncircular surfaces are evaluated. Since this case is to evaluate surfaces along the liner interface, the surface must stay within the base liner system. This requires a noncircular surface. Multiple different points along the slope surface and base liner were evaluated to determine the controlling factor of safety.

Results of the slope stability analyses are listed in Table III.G.5 below:

Table III.G.5. Slope Stability Factors of Safety

Section	Case	Factor of Safety
North	LTSS – 1	3.02
	LTSS – 2 – Peak	1.57
	LTSS – 2 – Residual	1.50
	Seismic – Residual	0.78
South	LTSS – 1	2.63
	LTSS – 2 – Peak	1.57
	LTSS – 2 – Residual	1.49



No direct guidance for slope stability factors of safety is included in TCEQ regulations for MSW landfills. Therefore, generally accepted minimum factors of safety for slope stability were relied upon and are listed below:

- LTSS-1 and LTSS-2 peak liner strength – 1.5
- LTSS-2 residual liner strength – 1.0

Factors of safety for LTSS cases are based off generally accepted values for slope stability evaluations of MSW landfills. For LTSS-2 with residual liner strength, the paper by Stark and Poeppel entitled *Landfill Liner Interface Strengths from Torsional-Ring-Shear Tests* was reviewed. Direction in this paper is to consider a case with fully residual strengths for the liner with a target factor of safety of 1.0.

Inputs and outputs from the UTexas4 program, the 2014 USGS deaggregation for the site and the Stark and Poeppel paper are included in Attachment III.G.5.

For the Seismic evaluation, the initial screening evaluation using the peak ground acceleration of 0.15g was performed for the LTSS – 2 – Residual model for Phase 1. Note the peak ground acceleration of 0.20g was initially used but the models were not converging. The lower acceleration results showed that the factor of safety was below 1.0 indicating that factors of safety for higher accelerations were also below acceptable values.

This evaluation is termed a "pseudostatic screening" evaluation as it is a conservative approach to modeling the seismic loading on the Landfill by applying the maximum seismic acceleration as a sustained horizontal load oriented away from the slope. In actuality, the maximum acceleration for an earthquake only occurs over short time periods and during the peak shaking of the seismic event. Additionally, earthquakes are bi-directional, where the direction of loading alternates in horizontal directions. This means that approximately half of the acceleration will be oriented towards the landfill slope.

Based on the limitations of the seismic pseudostatic screening stability calculations, the more robust Makdisi and Seed method was utilized. The output of this method is an estimated deformation during a seismic event that occurs along the controlling shear surface. The Makdisi and Seed method approximates the seismic response by accounting for the amplification of seismic acceleration between the base of the Landfill and the crest and comparing this to a yield acceleration that corresponds to a slope stability factor of safety of 1.0. Based on this ratio, a relationship that considers earthquake magnitude provides a total deformation estimate that will occur during a seismic event. Inputs for this evaluation are listed below:

- Yield acceleration = 0.085g,
- y/h = 1.0 (ratio of depth of shear surface to height of landfill),
- k_{max}/u_{max} = 0.5 (upper bound value from Figure 9),
- PGA = 0.2g
- Peak crest acceleration = 0.52g (Figure 10),
- u_{max} = 0.26g (k_{max} times k_{max}/u_{max} ratio),
- K_y/k_{max} = 0.33,
- Earthquake magnitude = 6.5 (see mean and modal values from USGS deaggregation),
- Max deformation = 15 centimeters for upper end estimate (Figure 11).

Allowable deformations for a landfill are generally 100 centimeters, with some references indicating landfill base liners allowable deformation as low as 15 centimeters. This evaluation indicated a maximum deformation of approximately 15 centimeters as an upper end estimate. Based on this, the Landfill is considered stable during a seismic event. Seismic deformation calculations were performed for Phase 1. Initial calculations for Phase 2 indicated that results will be the same as the Phase 1 results. Based on this, only Phase 1 seismic deformation calculations are included.

Phase 1 slope stability calculations are included in Attachment III.G.5 and Phase 2 slope stability calculations are included in Attachment III.G.6.

Settlement

Total and differential settlements were evaluated to confirm that the settlements do not affect design base liner grades such that leachate flow towards the sumps is disrupted.

Settlement is controlled by the specific settlement characteristics of the soils as well as the thickness of the deposits. Based on site conditions in this area of Texas, the soil deposits are known to be very deep (thousands of feet). While these deep soils are very dense, they will still experience some strain caused by the loading from the Landfill. Given the size of the Landfill, the depth of stress from the MSW will be deep, on the order of 1,000 to 2,000 feet.

For the upper 125 feet, soils were drilled and sampled with SPT blow counts. From 125 to 400 feet, soils were drilled and visually classified but no information was available on the consistency of the material. Below 400 feet, the specific makeup and consistency of the soils is unknown. Per geologic references, it is expected that the depth of sands in this area are between 1,000 and 3,000 feet total.

For soils in the upper 125 feet that were sampled with SPT, a design modulus of 1,500 psf was used as discussed above. Assumptions for soils below this depth were required. For soils from 125 to 500 feet, a design modulus of 2,000 psf was used. Soils below 500 feet were modeled to a depth of 2,000 feet and a modulus of 4,000 psf. The total depth was based on the average expected depth of sands in the area. The modulus values for the soils from 125 to 500 feet and below 500 feet were based on a review of recommended values for dense sand and gravel provided in Table D-3 of the *USACE EM 1110-1-1904 Settlement Analysis*.

To model loading from the Landfill, an approximate cross section of the Landfill was created. The square loading in the center has a stress of 9.3 ksf which is approximately 185 feet of 50 pcf MSW. This is to represent the relatively flat upper portion of the Landfill. On earth side of this are loadings that have 9.3 ksf loading along the inside corners and then 0 ksf loading along the outside corners. These two loads approximate load from the side slopes. Since the subsurface materials and landfill geometry are approximately the same in both directions (north-south and east-west), only one direction was evaluated and will be applied to the entire Landfill.

Settlement estimates for the Landfill are listed below:

- Beneath the high point of the Landfill: 4.0 feet,
- Beneath crest of Landfill slope: 3.5 feet,
- At Landfill toe: 0.5 feet.

Results from the Settle3D analysis and references are included in Attachment III.G.7.

Cover Stability

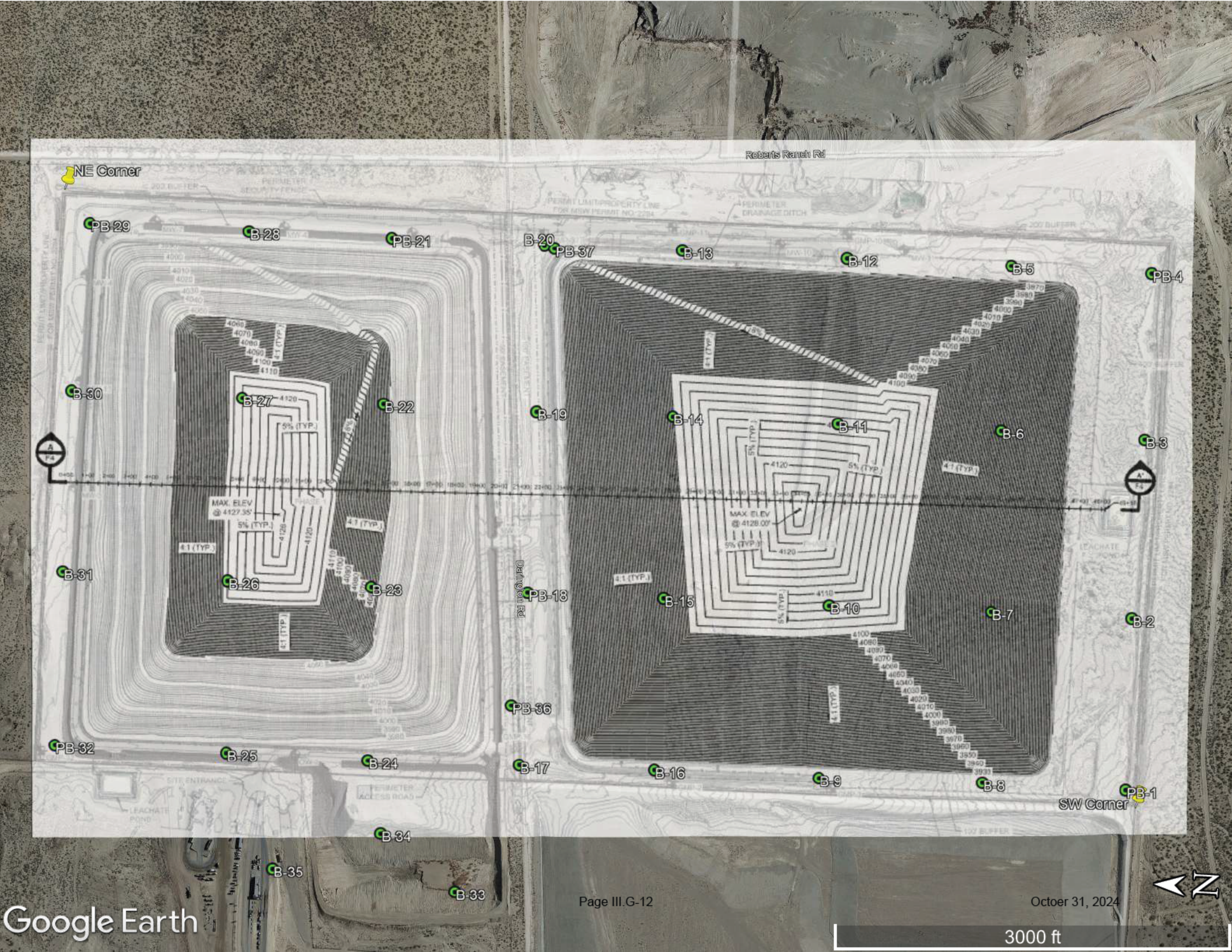
Stability was also evaluated for cover. The only geosynthetic interface involved the geotextile against cohesionless soils (rock armoring and infiltration layer). Since the interface is recommended to be modeled with just friction and no adhesion, the factor of safety is calculated using the infinite slope calculation noted below:

$$Factor\ of\ Safety = \frac{\tan\varphi}{\tan\beta}$$

Based on an interface friction angle of 33 degrees and slope angle of 14 degrees, the cover stability factor of safety is 2.6.



Attachment III.G.1 – Subsurface Information



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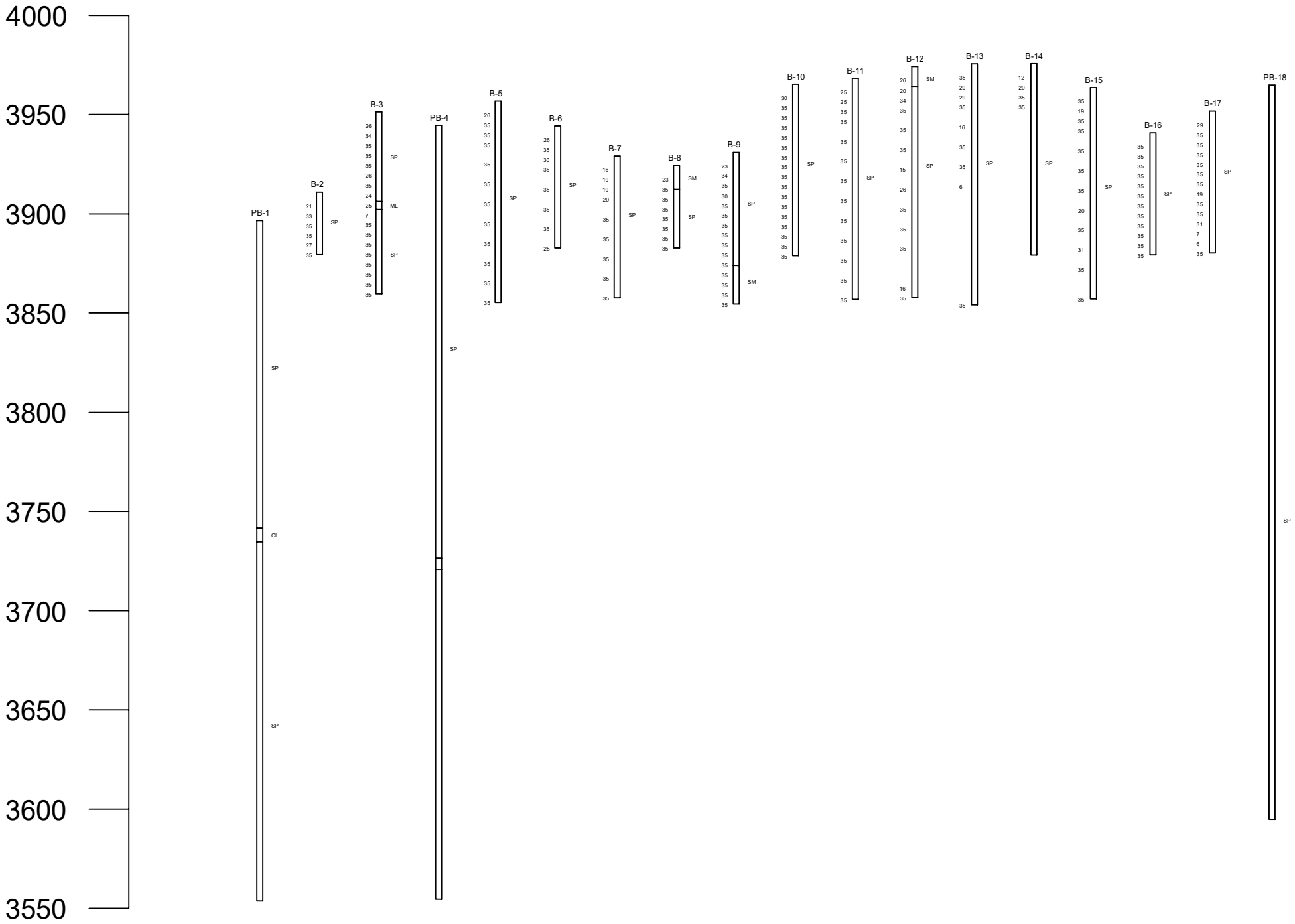
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PB-36
SP/SM
CL
SP
SP
CL
PB-37
SP
CL/SC
SP
CL

Depth (ft)				B-2		B-3		B-5		B-6		B-7		B-8		B-9		B-10		B-11		B-12	
	Effective Stress	Depth Correction	Hammer Eff Correction	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected
6.5	780	1.32	1.25	21	34.6	26	42.8	26	42.8	26	42.8	16	26.3	23	37.9	23	37.9	30	49.4	25	41.1	26	42.8
11.5	1380	1.13	1.25	33	46.4	34	47.8	35	49.3	35	49.3	19	26.7	35	49.3	34	47.8	35	49.3	25	35.2	20	28.1
16.5	1980	1.01	1.25	35	44.0	35	44.0	35	44.0	30	37.7	19	23.9	35	44.0	35	44.0	35	44.0	35	44.0	34	42.7
21.5	2580	0.92	1.25	35	40.1	35	40.1	35	40.1	35	40.1	20	22.9	35	40.1	30	34.4	35	40.1	35	40.1	35	40.1
26.5	3180	0.85	1.25	27	28.6	35	37.0							35	37.0	35	37.0	35	37.0				
31.5	3780	0.79	1.25	35	34.5	26	25.6	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5
36.5	4380	0.74	1.25			35	32.4							35	32.4	35	32.4	35	32.4				
41.5	4980	0.70	1.25			24	20.9	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5
46.5	5580	0.66	1.25			25	20.6									35	28.8	35	28.8				
51.5	6180	0.62	1.25			7	5.5	35	27.3	35	27.3	35	27.3			35	27.3	35	27.3	35	27.3	15	11.7
56.5	6780	0.59	1.25			35	26.0									35	26.0	35	26.0				
61.5	7380	0.57	1.25			35	24.7	35	24.7	25	17.7	35	24.7			35	24.7	35	24.7	35	24.7	26	18.4
66.5	7980	0.54	1.25			35	23.6									35	23.6	35	23.6				
71.5	8580	0.51	1.25			35	22.5	35	22.5			35	22.5			35	22.5	35	22.5	35	22.5	35	22.5
76.5	9180	0.49	1.25			35	21.5									35	21.5	35	21.5				
81.5	9780	0.47	1.25			35	20.6	35	20.6									35	20.6	35	20.6	35	20.6
86.5	10380	0.45	1.25			35	19.7											35	19.7				
91.5	10980	0.43	1.25			35	18.9	35	18.9											35	18.9	35	18.9
96.5	11580	0.41	1.25																				
101.5	12180	0.40	1.25					35	17.4											35	17.4		
106.5	12780	0.38	1.25																				
111.5	13380	0.37	1.25																	35	16.0	16	7.3
116.5	13980	0.35	1.25																			35	15.4
121.5	14580	0.34	1.25																				
126.5	15180	0.32	1.25																				

Depth (ft)	B-13		B-14		B-15		B-16		B-17		B-19		B-20		B-22		B-23		B-24		B-25	
	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected
6.5	35	57.6	12	19.8	35	57.6	35	57.6	29	47.7	26	42.8	15	24.7	20	32.9	28	46.1	6	9.9	32	52.7
11.5	20	28.1	20	28.1	19	26.7	35	49.3	35	49.3	8	11.3	11	15.5	30	42.2	31	43.6	25	35.2	35	49.3
16.5	29	36.4	35	44.0	35	44.0	35	44.0	35	44.0	12	15.1	27	33.9			31	38.9	28	35.2	35	44.0
21.5	35	40.1	35	40.1	35	40.1	35	40.1	35	40.1	21	24.1	24	27.5	32	36.7	35	40.1	35	40.1	35	40.1
26.5							35	37.0	35	37.0	25	26.5					35	37.0			35	37.0
31.5	16	15.8			35	34.5	35	34.5	35	34.5	20	19.7	35	34.5	35	34.5	29	28.6	35	34.5	31	30.6
36.5							35	32.4	35	32.4	21	19.4					26	24.0			34	31.4
41.5	35	30.5			35	30.5	35	30.5	19	16.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5
46.5							35	28.8	35	28.8	35	28.8					30	24.7			14	11.5
51.5	35	27.3			35	27.3	35	27.3	35	27.3	35	27.3	35	27.3	35	27.3	35	27.3	35	27.3	35	27.3
56.5							35	26.0	31	23.0	35	26.0					35	26.0			21	15.6
61.5	6	4.2			20	14.1	35	24.7	7	4.9	17	12.0	35	24.7	35	24.7	35	24.7	20	14.1	35	24.7
66.5									6	4.0	35	23.6					35	23.6			35	23.6
71.5					35	22.5			35	22.5	16	10.3	35	22.5	35	22.5	35	22.5	35	22.5	35	22.5
76.5											35	21.5					35	21.5			35	21.5
81.5					31	18.3					35	20.6	35	20.6	35	20.6	35	20.6	9	5.3	35	20.6
86.5											35	19.7					35	19.7			35	19.7
91.5					35	18.9					35	18.9	35	18.9	35	18.9			35	18.9	35	18.9
96.5											35	18.1										
101.5													35	17.4	35	17.4			35	17.4		
106.5					35	16.7																
111.5													35	16.0	35	16.0						
116.5																						
121.5	35	14.8											35	14.8								
126.5															35	14.2						

Depth (ft)	B-26		B-27		B-28		B-30		B-31		B-33		B-34		B-35	
	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected
6.5	14	23.0	11	18.1	12	19.8	12	19.8	32	52.7	14	23.0	30	49.4	20	32.9
11.5	28	39.4	14	19.7	32	45.0	16	22.5	35	49.3	35	49.3	35	49.3	33	46.4
16.5	35	44.0	21	26.4	25	31.4	19	23.9	35	44.0	35	44.0	35	44.0	30	37.7
21.5	35	40.1	35	40.1	25	28.6	35	40.1	35	40.1	35	40.1	35	40.1	35	40.1
26.5	35	37.0							35	37.0			35	37.0	35	37.0
31.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5	35	34.5
36.5	31	28.7							34	31.4			30	27.7	35	32.4
41.5	35	30.5	35	30.5	35	30.5	35	30.5	35	30.5	19	16.5	35	30.5	35	30.5
46.5	35	28.8							14	11.5			35	28.8	35	28.8
51.5	35	27.3	35	27.3	35	27.3	35	27.3	31	24.2	8	6.2	35	27.3	35	27.3
56.5	20	14.8							35	26.0			28	20.8	35	26.0
61.5	35	24.7	25	17.7	20	14.1	32	22.6	35	24.7	35	24.7	35	24.7	35	24.7
66.5	35	23.6							35	23.6			35	23.6	35	23.6
71.5	22	14.2	35	22.5	35	22.5	35	22.5	35	22.5	14	9.0	35	22.5	35	22.5
76.5	35	21.5							35	21.5	16	9.8	35	21.5	35	21.5
81.5	35	20.6	35	20.6	35	20.6	35	20.6	35	20.6	35	20.6	35	20.6	35	20.6
86.5	35	19.7							35	19.7			35	19.7	35	19.7
91.5	35	18.9	35	18.9	35	18.9	35	18.9	35	18.9	35	18.9			35	18.9
96.5	35	18.1													35	18.1
101.5	35	17.4	35	17.4	35	17.4	35	17.4			35	17.4			35	17.4
106.5	35	16.7													35	16.7
111.5					35	16.0	35	16.0								
116.5																
121.5							35	14.8								
126.5					35	14.2	35	14.2								

Average	Median	StDev	COV	Number
37.5	41.1	13.5	0.36	29
38.9	45.0	12.0	0.31	29
38.8	44.0	7.9	0.20	28
37.8	40.1	5.1	0.14	29
35.7	37.0	3.5	0.10	14
32.6	34.5	4.7	0.14	28
29.9	32.4	4.1	0.14	13
29.1	30.5	4.1	0.14	27
24.9	28.8	6.7	0.27	12
25.0	27.3	6.4	0.26	26
23.5	26.0	4.2	0.18	12
20.6	24.7	6.4	0.31	26
21.8	23.6	5.9	0.27	11
21.0	22.5	4.0	0.19	23
20.5	21.5	3.5	0.17	11
19.7	20.6	3.4	0.17	20
19.7	19.7	0.0	0.00	9
18.9	18.9			17
18.1	18.1			3
17.4	17.4	0.0	0.00	11
16.7	16.7			3
14.6	16.0	3.6	0.24	6
15.4	15.4			1
14.8	14.8	0.0	0.00	3
14.2	14.2	0.0	0.00	3

Attachment III.G.2 – Design Parameters Determination

Table 3-1
Granular Soil Properties (after Teng 1962)

Compactness	Relative Density (%)	SPT N (blows per ft)	Angle of Internal Friction (deg)	Unit Weight	
				Moist (pcf)	Submerged (pcf)
Very Loose	0-15	0-4	<28	<100	<60
Loose	16-35	5-10	28-30	95-125	55-65
Medium	36-65	11-30	31-36	110-130	60-70
Dense	66-85	31-50	37-41	110-140	65-85
Very Dense	86-100	>51	>41	>130	>75

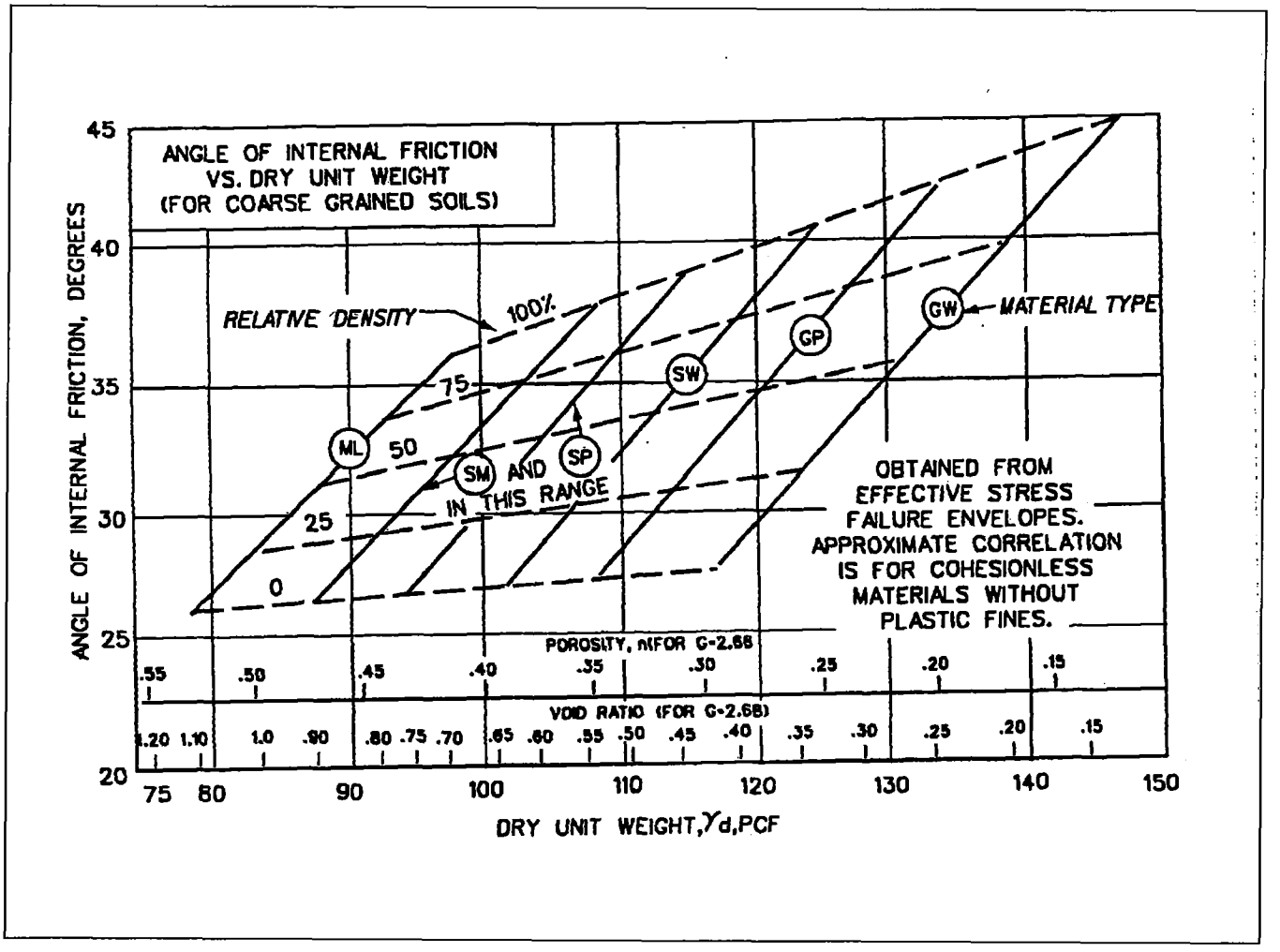

Figure 3-1. Cohesionless Soil Properties (after U.S. Department of the Navy 1971)

EM 1110-2-2504
31 March 1994

US Army Corps
of Engineers

ENGINEERING AND DESIGN

Design of Sheet Pile Walls

ENGINEER MANUAL

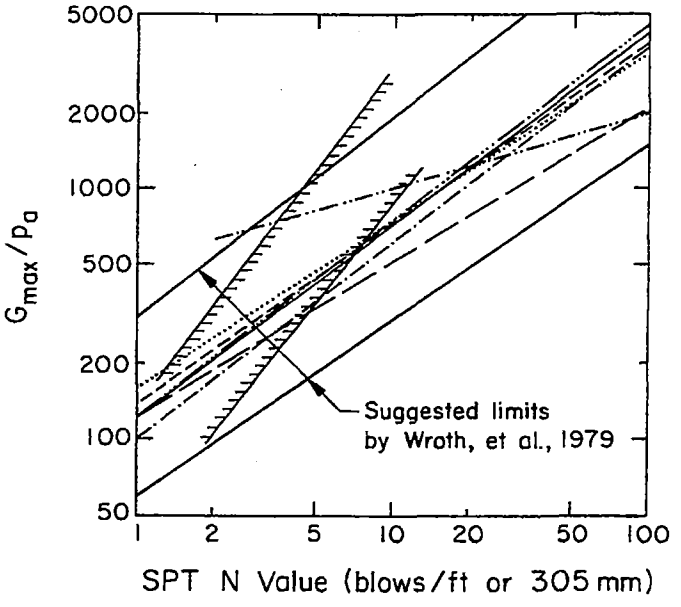

Figure 5-12. Dynamic Shear Modulus versus N for Cohesive Soils

Source: Wroth, et al. (9), p. 96.

is considered for drained conditions. However, for finer-grained silts, some significant time-dependency may develop which will have to be considered on a case-by-case basis.

For drained loading, the modulus can be described by the drained elastic modulus (E_d), the shear modulus (G), or the drained constrained modulus (M_d). E and G commonly are evaluated in triaxial compression, while M is evaluated in one-dimensional compression. All of these are interrelated through Poisson's ratio, as noted previously in Equations 5-3 and 5-6. Unless otherwise stated, the moduli will be secant values given by E_{ds} and M_{ds}.

Typical Values

A number of authors have given typical ranges for the modulus of cohesionless soils. Table 5-5 is representative of these ranges for sands in general and for driven piles in particular. These values generally would be representative of secant moduli within common design stress levels.

Alternatively, Duncan and Chang (18) suggested a hyperbolic model to estimate the drained tangent modulus, starting from an initial isotropic stress, as follows:

Table 5-5

TYPICAL RANGES OF DRAINED MODULUS FOR SAND

Consistency	Normalized Elastic Modulus, E_d/p_a	
	Typical	Driven Piles[a]
loose	100 to 200	275 to 550
medium	200 to 500	550 to 700
dense	500 to 1000	700 to 1100

a - Source: Poulos (17), p. 207.

$$E_t = \kappa p_a \, (\bar{\sigma}_3/p_a)^n \, [1 - R_f \, (1 - \sin \bar{\phi}_{tc})(\bar{\sigma}_1 - \bar{\sigma}_3)/(2 \, \bar{\sigma}_3 \sin \bar{\phi}_{tc})]^2 \qquad (5\text{-}21)$$

in which $\bar{\sigma}_1$ and $\bar{\sigma}_3$ = effective major and minor principal stresses, respectively, $\bar{\phi}_{tc}$ = effective stress friction angle in triaxial compression, and κ, n, and R_f = modulus parameters given in Table 5-6. For convenience in computer code implementation, Trautmann and Kulhawy (1) approximated κ as follows:

$$\kappa \approx 300 + 900 \, \phi_{rel} \qquad (5\text{-}22)$$

with ϕ_{rel} defined in Equation 5-8.

Correlations with Strength

The shear modulus commonly is correlated to the effective soil strength through the rigidity index (I_r), as defined below for drained loading:

$$I_r = G/(\bar{\sigma} \tan \bar{\phi}_{tc}) \qquad (5\text{-}23)$$

Selected values for I_r are given in Table 5-7. Of particular interest to note is that I_r increases with increasing relative density and decreases with increasing normal stress. It also is lower with more compressible soil minerals.

When using the rigidity index (I_r) for drained loading, volume changes normally have to be considered. Therefore, I_r must be corrected for the volumetric strains (ϵ_v) to yield a reduced rigidity index (I_{rr}), as given below by Vesić (20):

Table 5-6

TYPICAL DRAINED HYPERBOLIC MODULUS PARAMETERS

Unified Soil Classification	κ	n	R_f
GW	300 to 1200	1/3	0.7
GP	500 to 1800	1/3	0.8
SW	300 to 1200	1/2	0.7
SP	300 to 1200	1/2	0.8
ML	300 to 1200	2/3	0.8

Source: Kulhawy, et al. (6), p. 10-19.

Table 5-7

VALUES OF RIGIDITY INDEX FOR SELECTED COHESIONLESS SOILS

Soil	Relative Density D_r (%)	Normalized Mean Normal Stress, $\bar{\sigma}_o/p_a$	Rigidity Index, I_r
Chattahoochee sand	80	0.1	200
	80	1	118
	80	10	52
	80	100	12
	20	0.1	140
	20	1	85
Ottawa sand	82	0.05	265
	21	0.05	89
Piedmont silt	-	0.70	10 to 30

Source: Vesić (20), p. 68.

$$I_{rr} = I_r/(1 + I_r\ \epsilon_v) \qquad (5\text{-}24)$$

Vesić (20) noted that ϵ_v would be zero for dense soils and range from 0 to 0.05 for

loose soils in the stress range from 1 to 10 atmospheres. For convenience in computer code implementation, Trautmann and Kulhawy (1) approximated ϵ_v as follows:

$$\epsilon_v \approx 0.005(\bar{\sigma}_v/p_a)(1 - \phi_{rel}) \qquad (5\text{-}25)$$

in which $\bar{\sigma}_v$ = vertical effective stress (up to 10 atmospheres), and ϕ_{rel} is defined in Equation 5-8.

Correlations with SPT N Value

Young's Modulus. Early correlations in the literature related E_{ds} of sands directly to the standard penetration test (SPT) N value. Several of these correlations are shown in Figure 5-13. Others within the same ranges are given by Mitchell and Gardner (23). Later correlations attempted to relate the constrained modulus (M) and N as a function of overburden stress (e.g., 24).

However, all attempts to date which correlate a modulus with N show considerable scatter. This lack of correlation is to be expected because the SPT N value varies with many factors, as described in Section 2, and these factors have yet to be incorporated in these correlations. Therefore, as a first order estimator, the following may be used:

$$E/p_a \approx 5\ N_{60} \qquad \text{(sands with fines)} \qquad (5\text{-}26a)$$

$$\approx 10\ N_{60} \qquad \text{(clean NC sands)} \qquad (5\text{-}26b)$$

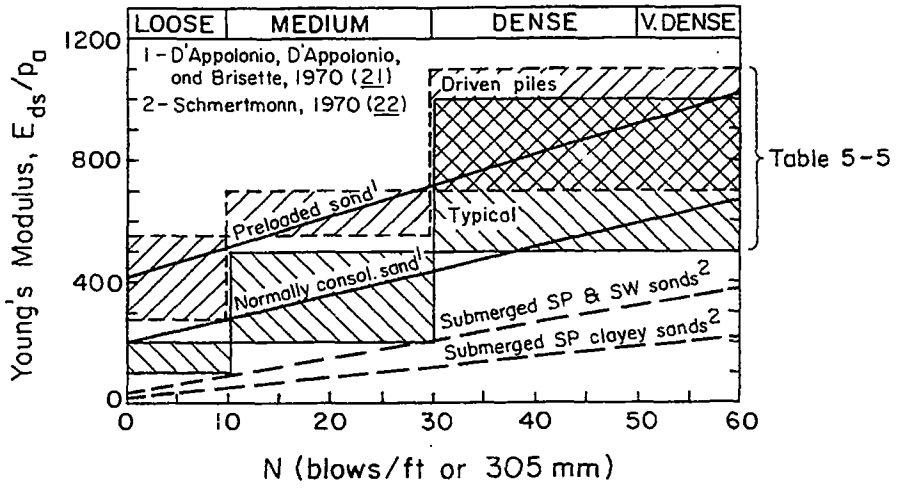

Figure 5-13. Comparative Plot of Drained Modulus Correlations for Sand

Source: Callanan and Kulhawy (13), p. 3-16.

$$\approx 15\ N_{60} \qquad \text{(clean OC sands)} \qquad (5\text{-}26c)$$

in which N_{60} is the N value corrected for field procedures to an average energy ratio of 60 percent. Equation 2-11 gives the appropriate correction factors.

Pressuremeter Modulus. The pressuremeter test (PMT) provides a direct measurement of the horizontal modulus of cohesionless soils. This modulus (E_{PMT}) often is presumed to be roughly equivalent to Young's modulus (E). Correlations between the N value and E_{PMT} have been developed, as shown in Figure 5-14. The scatter shown is typical of other N correlations because of the reasons noted above.

Dilatometer Modulus. The dilatometer test (DMT) also provides a direct modulus measurement for cohesionless soils. The dilatometer modulus (E_D) is related to Young's modulus as follows:

$$E_D = E/(1 - \nu^2) \qquad (5\text{-}27)$$

No general correlations of E_D with N have been presented at this time. However, the DMT and other in-situ tests can be used effectively to develop convenient

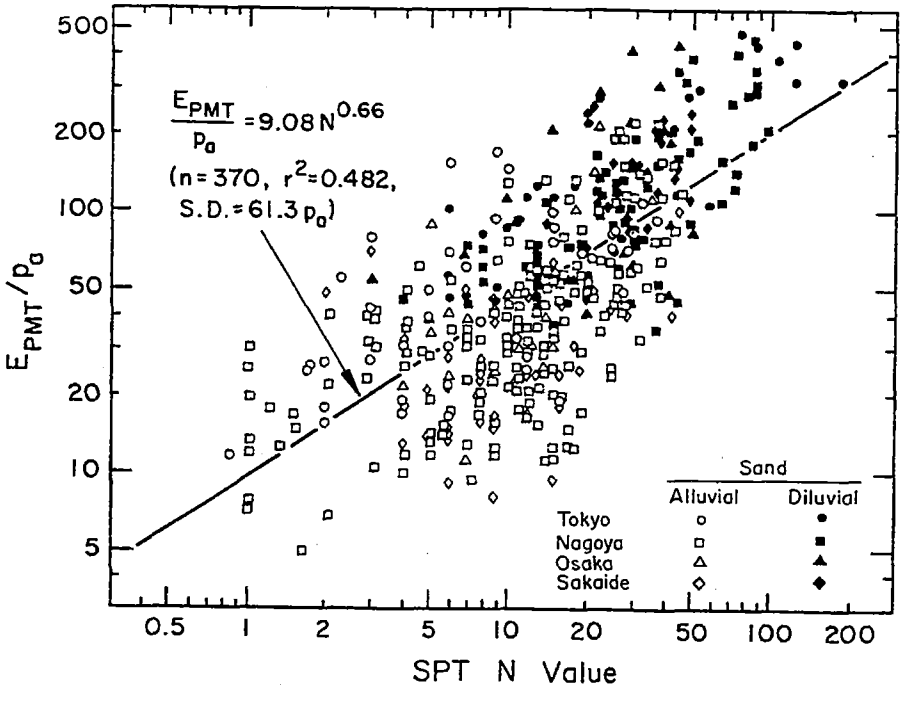

Figure 5-14. PMT Modulus of Sand versus N Value

Source: Ohya, et al. (11), p. 129.

EPRI

Topics:
Soils
Testing
Foundations
Transmission towers
Transmission lines
Design

EPRI EL-6800
Project 1493-6
Final Report
August 1990

Manual on Estimating Soil Properties for Foundation Design

Prepared by
Cornell University
Ithaca, New York

Octoer 31, 2024

Shear Strength of Municipal Solid Waste (MSW): Beyond the Raw Values of "Cohesion" and Friction Angles

Jaime J. Díaz-Beltrán[1]; Juan J. Iguarán-Fernández[2];
Joan M. Larrahondo, Ph.D., A.M.ASCE[3]; and Luis A. Jaramillo[4]

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Assistant Professor, Dept. of Civil Engineering, Pontificia Universidad Javeriana, Bogotá-Colombia. E-mail: [redacted]

Abstract: Understanding the mechanical behavior of municipal solid waste (MSW) is still a major challenge in engineering. The purpose of this paper is to critically review published literature on MSW shear strength from the past 20 years, including the major strength mechanisms and failure criteria, so a landfill engineer can access key behavioral concepts, beyond just the raw values of friction angle and "cohesion" parameters that are required for design. In addition, this paper explores the relationship of shear strength parameters with MSW composition and urban population, which are useful proxies for economic development. To revisit the state of the practice since the introduction of commonly used design charts, an enhanced database of shear strength parameters as well as Mohr-Coulomb envelopes was compiled. Also, a relationship was developed between strength parameters, MSW composition, and population data for a number of cities in a developing country. This study supports the concept that the consumption habits of an urban area are very relevant when it comes to designing landfills. Furthermore, instead of introducing a new recommended range of design parameters or a new strength envelope, the compiled data are interpreted under a simple statistical basis, so the designer can make informed decisions on which parameters to choose for design.

INTRODUCTION

Municipal solid wastes (MSW) are typically disposed of in engineered landfills obeying geotechnical design criteria. The characterization of MSW normally includes determining or estimating geotechnical-equivalent properties and strength parameters, including unit weight, friction angle, and the "cohesion" intercept. In reality, MSW are highly complex materials of strong spatial and temporal variability. The factors that influence MSW shear strength include composition, age or degree of

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probabilities of exceedance, calculated using the 181 data points compiled. The cohesion histogram clearly skews towards the left-hand side of the distribution, the mean is around 15 kPa, the standard deviation is 22 kPa, and the coefficient of variation is 94.3%. On the other hand, unlike the cohesion histogram, the friction angle distribution appears significantly more symmetrical, with mean around 27°, standard deviation of 9°, and coefficient of variation of 34.2%. This simple representation of strength parameters may allow engineers to make more informed decisions about which design parameters to use, perhaps over the traditional *c*'-ϕ' charts, or even the strength envelope plots.

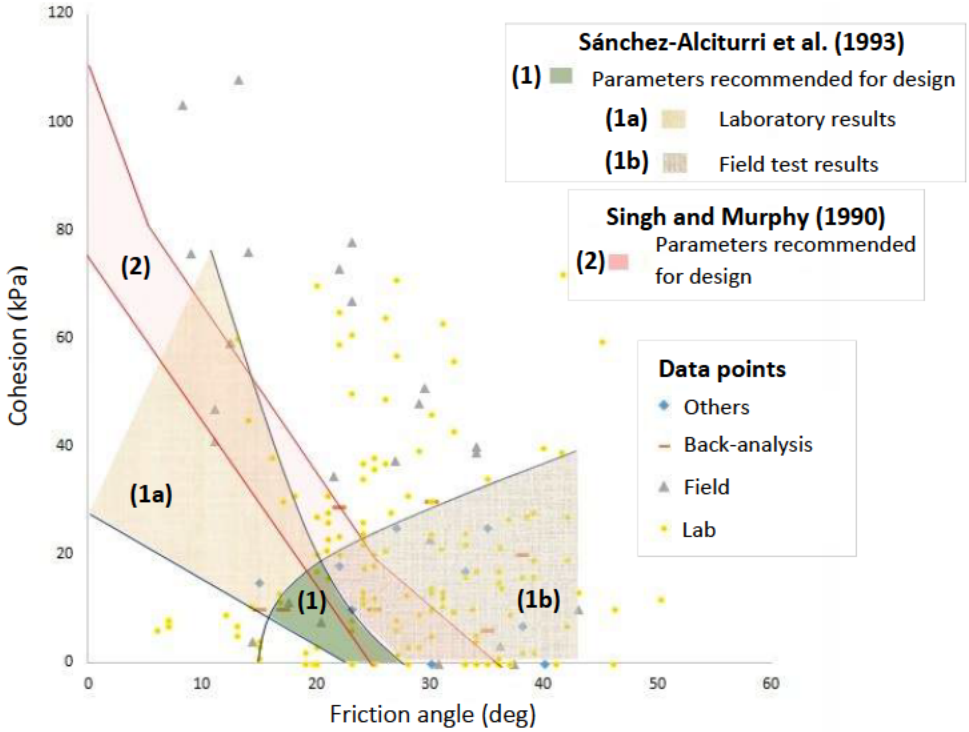

FIG 8. Compilation of *c*' vs. ϕ' parameters. Data are classified according to their method of determination. Common design regions are superimposed.

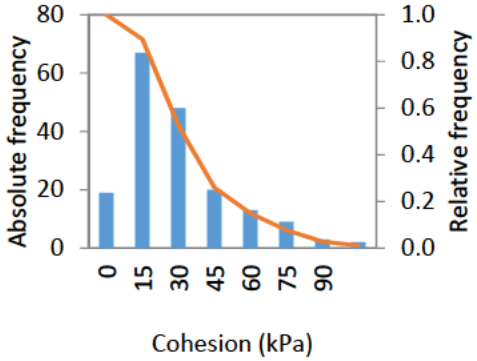

FIG 9. Histogram and probability of exceedance for cohesion

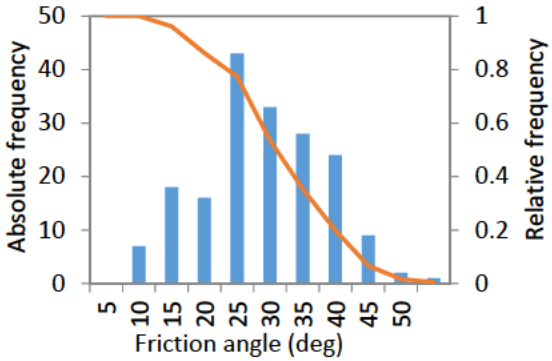

FIG 10. Histogram and probability of exceedance for friction angle

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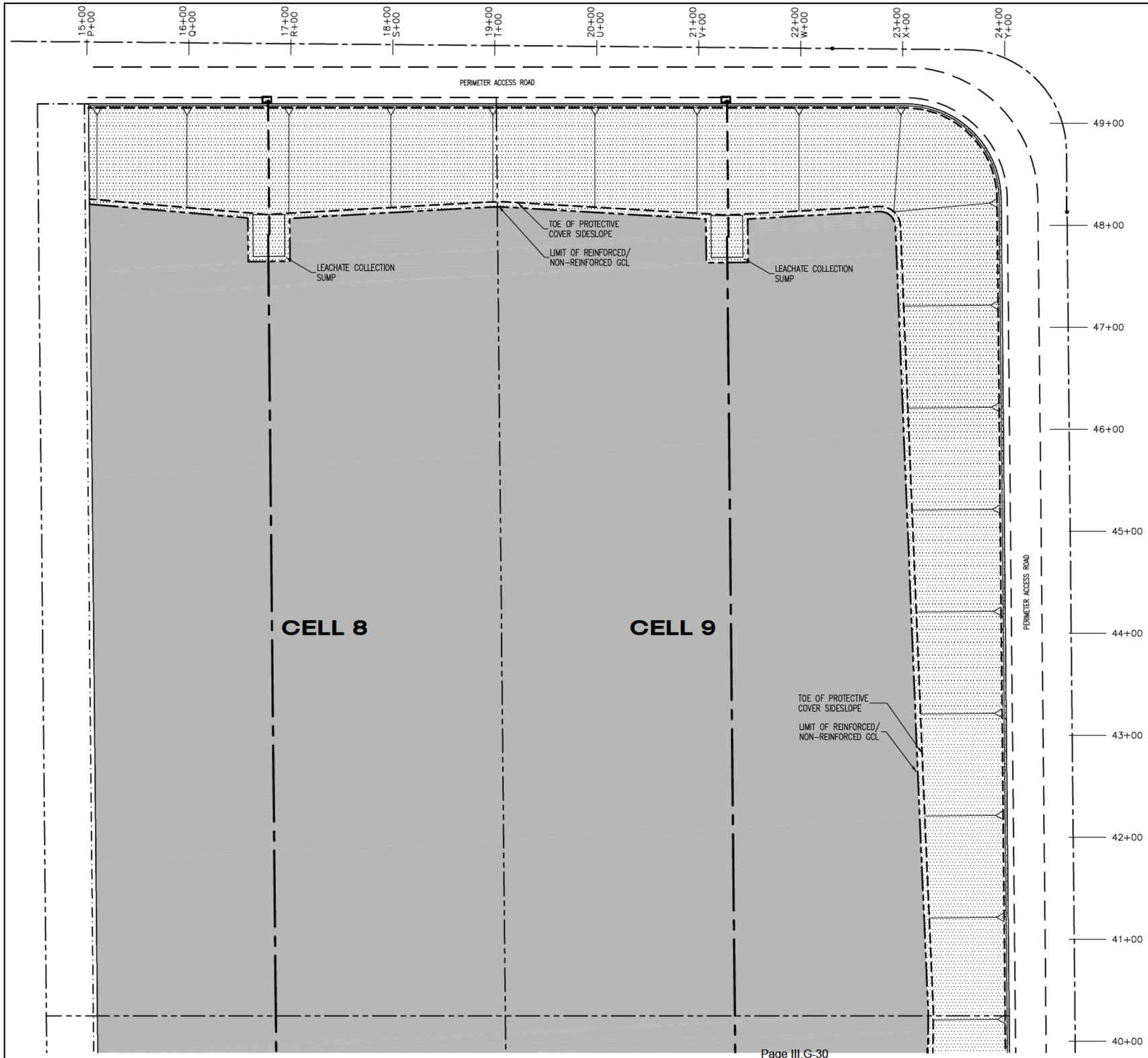
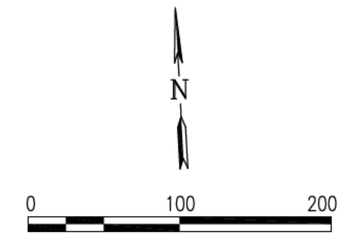
Attachment III.G.3 –Liner Strength Determination





LEGEND

- ANCHOR TRENCH
- GRADE BREAK LINE
- PERIMETER ACCESS ROAD
- CENTERLINE OF NEW DITCH
- EXISTING FMLER EDGE
- SMOOTH/TEXTURED HDPE CONNECTION
- 6" LEACHATE PIPE
- 12" COLLECTION PIPE
- NON-REINFORCED GCL
- REINFORCED GCL

AREA TABLE (S.F.) *	
SIDE SLOPE	338,801
BOTTOM	1,218,830
TOTAL	1,557,631

* TOTAL FOR ALL CELLS (7-10)

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
R. MATT DYER
92189
LICENSED
PROFESSIONAL ENGINEER
R Matt Dyer
03/26/12

PSC

THE CITY OF EL PASO TEXAS

CITY OF EL PASO

CITY OF EL PASO, TEXAS
CLINT LANDFILL
TCEQ MSW NO. 2284
CELLS 7-10, PHASE 1 REPORT
GEOSYNTHETIC CLAY LINER
PLAN VIEW – CELLS 8 & 9

DATE: MAR 2012

FIGURE: 3A

Octoer 31, 2024

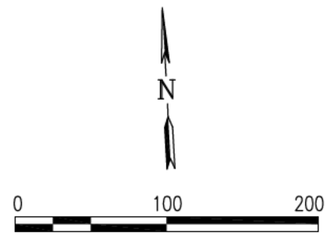
Drawing File: X:\2010\5130.10\CADD\01_CIVIL\LINER-RPT\GCL\FIG03A-5130-LR.dwg (GEORGE-M)
3/21/2012 16:59:18
Xrefs: XCSP-5130.10, XTB2, x-ex-site

Xrefs: XCSP-5130.10, XTB2, x-ex-site

3/26/2012 10:56:52

Drawing File: X:\2010\5130.10\CADD\01_CIVIL\LINER-RPT\GCL\FIG03B-5130-LR.dwg (GEORGE-M)





LEGEND

- ANCHOR TRENCH
- GRADE BREAK LINE
- PERIMETER ACCESS ROAD
- CENTERLINE OF NEW DITCH
- EXISTING FML/ER EDGE
- SMOOTH/TEXTURED HDPE CONNECTION
- 6" LEACHATE PIPE
- 12" COLLECTION PIPE
- NON-REINFORCED GCL
- REINFORCED GCL

AREA TABLE (S.F.) *	
SIDE SLOPE	338,801
BOTTOM	1,218,830
TOTAL	1,557,631

* TOTAL FOR ALL CELLS (7-10)

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
R. MATT DYER
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LICENSED PROFESSIONAL ENGINEER
R Matt Dyer
03/26/12

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CLINT LANDFILL
TCEQ MSW NO. 2284
CELLS 7-10, PHASE 1 REPORT
GEOSYNTHETIC CLAY LINER
PLAN VIEW - CELLS 7 & 10

DATE: MAR 2012

FIGURE: 3B

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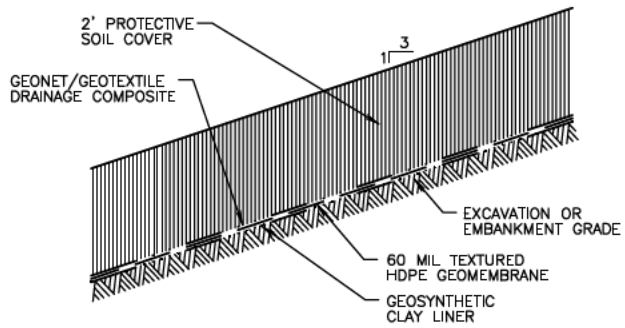
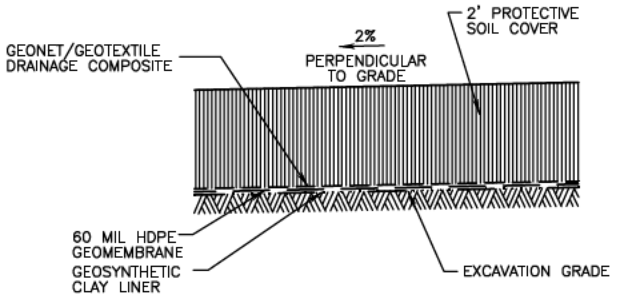


TYPICAL LINER DETAIL – LANDFILL SIDESLOPE (1/7)
NO SCALE



TYPICAL LINER DETAIL – LANDFILL BOTTOM (2/7)
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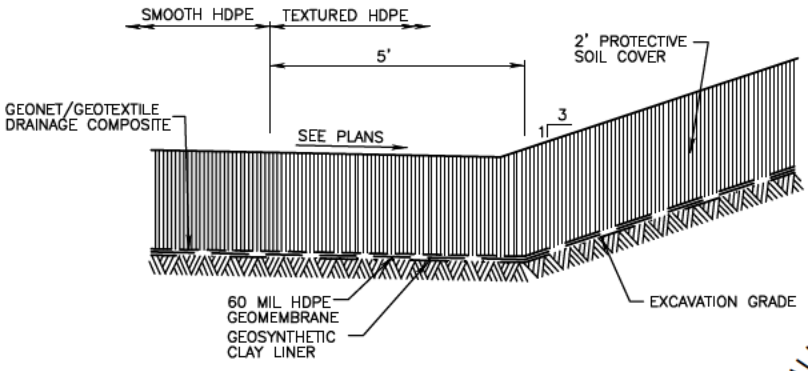

TOE OF SIDESLOPE (3/7)
NO SCALE

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TCEQ MSW NO. 2284
CELLS 7–10, PHASE 1 REPORT
GEOSYNTHETIC CLAY LINER TYPICAL DETAILS

DATE: MAR 2012
FIGURE: 7

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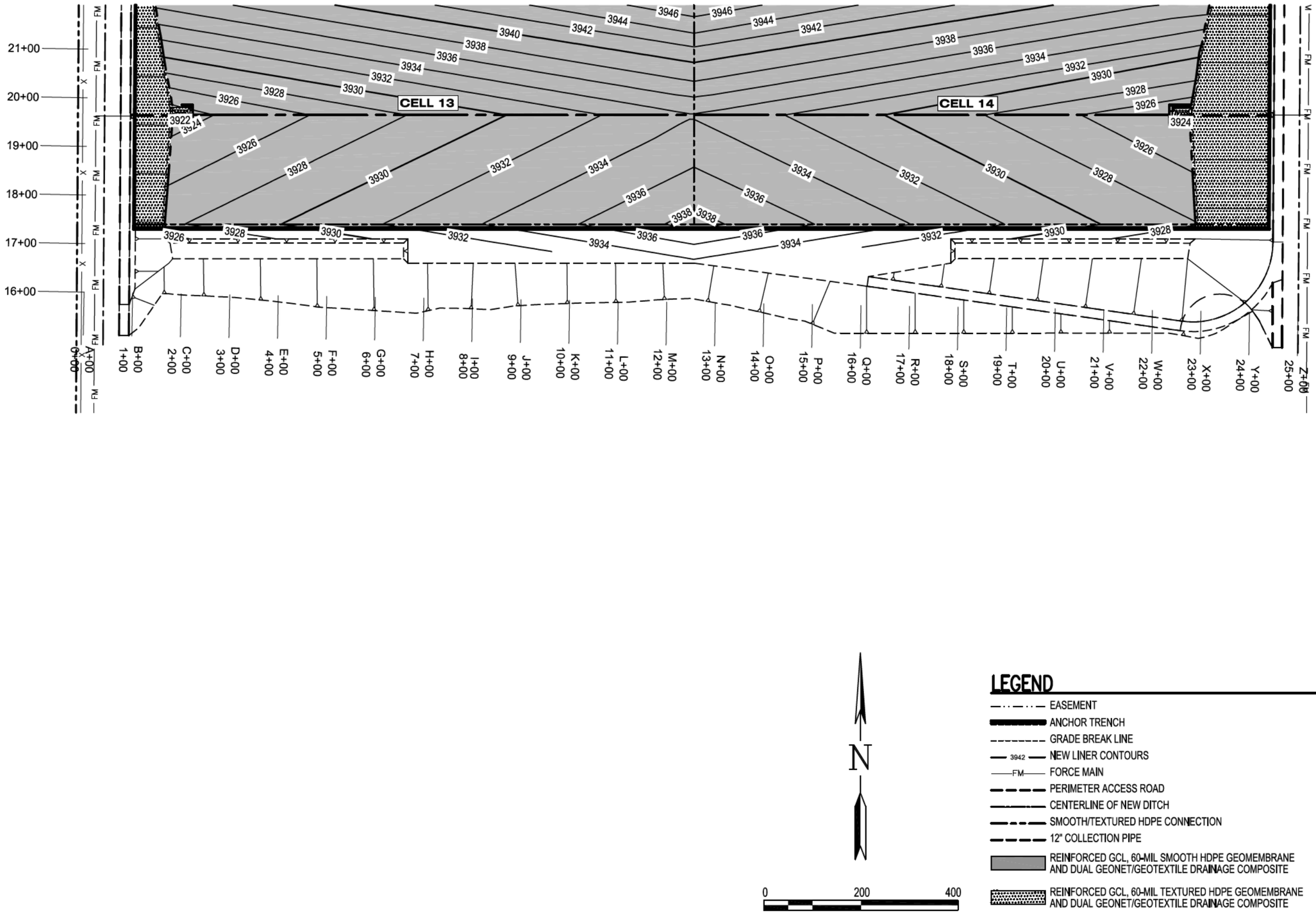

REFERENCES --- BENCH MARKS

DATE	REVISIONS	BY

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SCALE
Hor. AS SHOWN
Ver. AS SHOWN

DATE 11/13/17

DESIGN BY —
DRAWN BY —
CHKD. BY —
APPD. BY —

PROJECT NAME
GREATER EL PASO LANDFILL
PHASE 2 - CELLS 11-14
GEOMEMBRANE LINER
EVALUATION REPORT

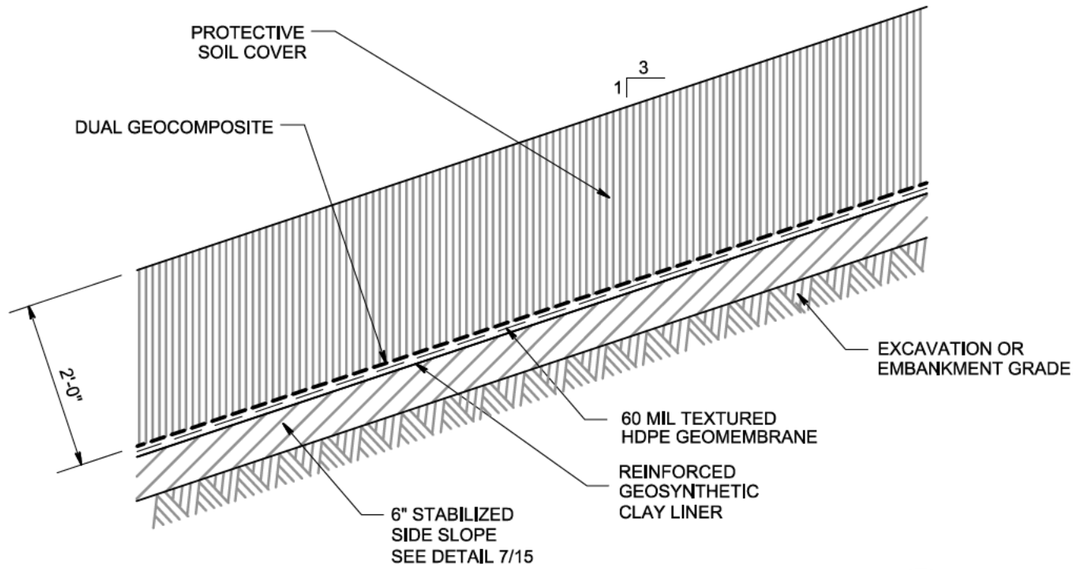
CITY OF EL PASO

SHEET TITLE
PLAN VIEW CELL 13-14

FILE No.

FIGURE 5

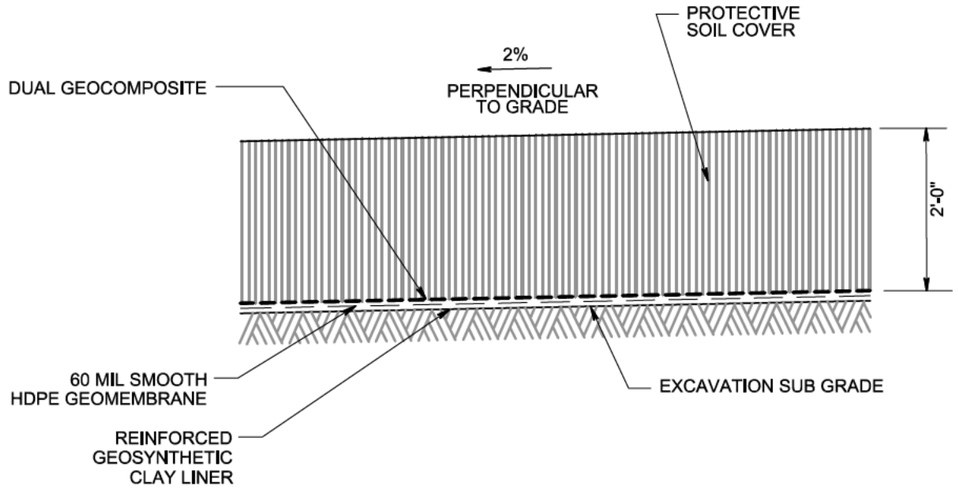
Octoer 31, 2024



TYPICAL SIDE SLOPE LINER DETAIL

SCALE: 1/2 " = 1'-0"

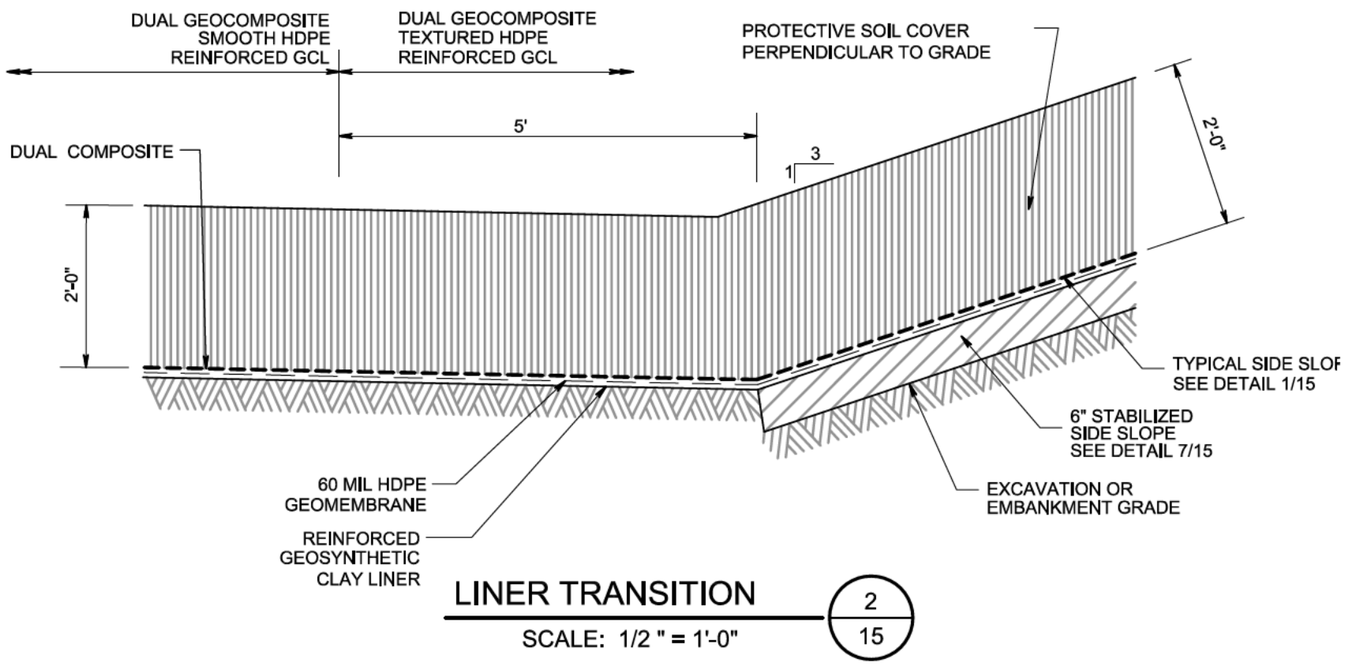
1 / 15



TYPICAL BOTTOM LINER DETAIL

SCALE: 1/2 " = 1'-0"

4 / 15



LINER TRANSITION

SCALE: 1/2 " = 1'-0"

2 / 15

REFERENCES -- BENCH MARKS

REVISIONS

BY	DATE

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PROJECT NAME

GREATER EL PASO LANDFILL
PHASE 2 - CELLS 11-14
GEOMEMBRANE LINER
EVALUATION REPORT

CITY OF EL PASO

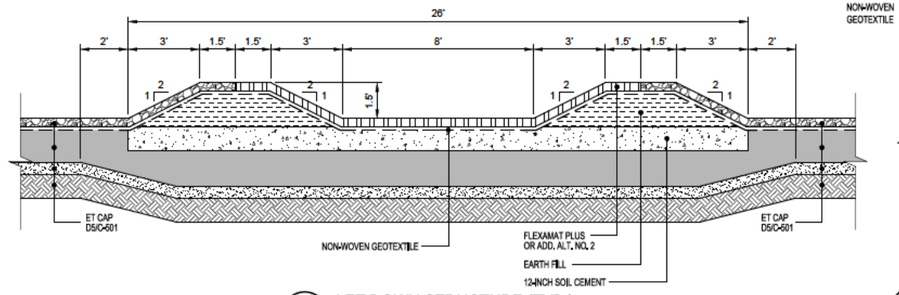
SHEET TITLE

TYPICAL
DETAILS

FILE No.

FIGURE 10

Octoer 31, 2024



D1 LET DOWN STRUCTURE (TYP.)
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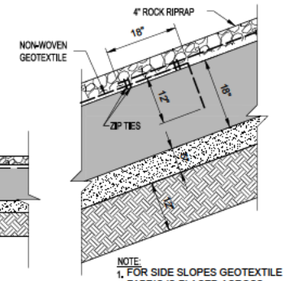
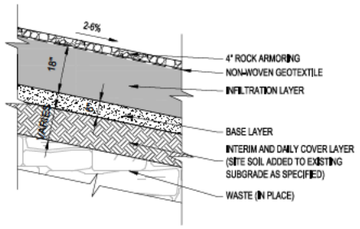


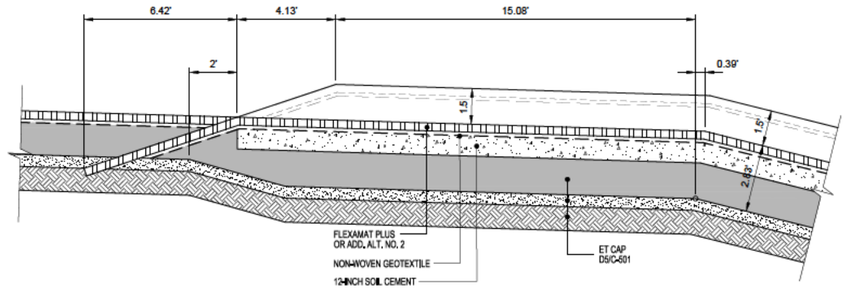
NOTE:
1. FOR SIDE SLOPES GEOTEXTILE FABRIC IS PLACED ACROSS THE SLOPE, OVERLAPPED IN A "SHINGLE" FASHION.
2. FOR OTHER LOCATIONS GEOTEXTILE FABRIC MAY BE PLACED IN DIRECTION OF SLOPE AND OVERLAPPED IN A "SHINGLE" FASHION.
3. AT OVERLAP THE LOWER SHEET MUST BE TURNED DOWN 12" MIN PERPENDICULAR TO SLOPE, THE UPPER SHEET MUST BE OVERLAPPED 12" MIN, AND THE SHEETS MUST BE ZIP TIED TOGETHER.
4. AT TERMINATION OF GEOTEXTILE THE SHEET MUST BE TURNED DOWN 12" MIN PERPENDICULAR INTO THE CAP.

D3 ROCK ARMOR
NO SCALE



NOTE:
THICKNESSES ARE MEASURED PERPENDICULAR TO SURFACE

D5 ET CAP
NO SCALE



C1 LET DOWN STRUCTURE (TYP.)
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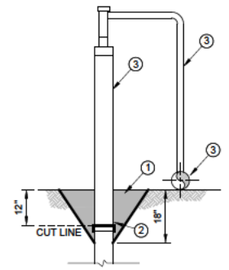
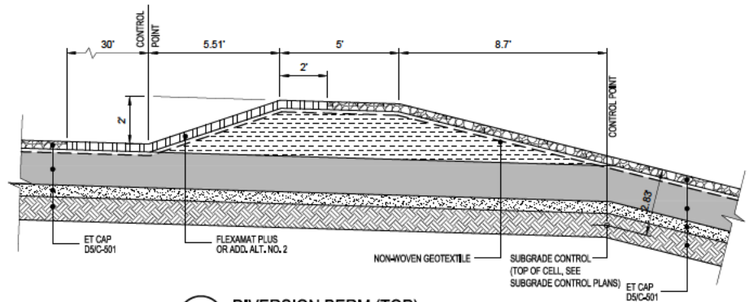
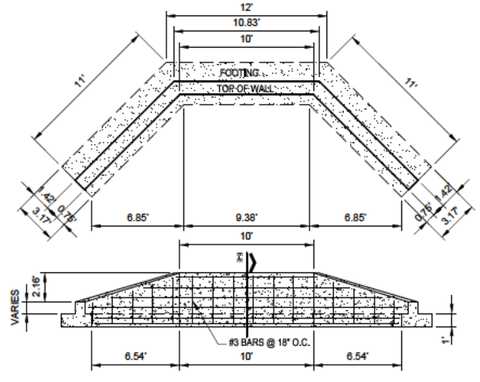


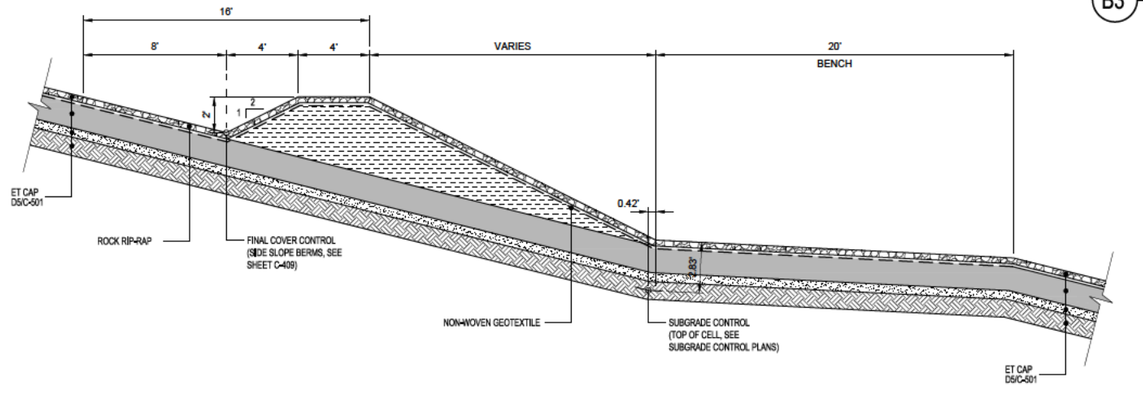
KEY NOTES
AS INDICATED BY: (06)
1. REMOVE 18" OF SOIL AROUND EXISTING GAS WELL
2. CUT AND CAP WELL BELOW GRADE AND ABANDON IN PLACE
3. REMOVE AND DISPOSE EXISTING GAS WELL HEAD AND LATERALS

C5 GAS WELL ABANDONMENT
1/2" = 1'-0"

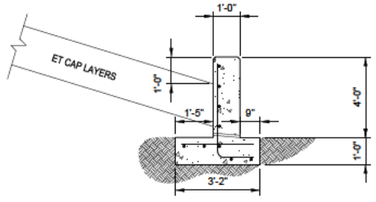


B3 DIVERSION BERM (TOP)
NO SCALE





A1 SIDE SLOPE TIE TO EXISTING GROUND
NO SCALE



SECTION E-E

A5 RETAINING WALL
NO SCALE

REFERENCES – BENCH MARKS
BENCHMARK:

REVISIONS		
DATE		BY
03/12/2020	ISSUED FOR BIDS	TSK

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03/12/2020

SCALE: Hor. AS SHOWN Ver. AS SHOWN
DATE
DESIGN BY
DRAWN BY GM
CHKD. BY
APPD. BY TSK

PROJECT NAME
GREATER EL PASO LANDFILL
TCEQ MSW PERMIT NO. 2284
PHASE 1
FINAL CLOSURE

CITY OF EL PASO

SHEET TITLE
MISCELLANEOUS DETAILS

C-501

FILE No.
Sht. 40 of 45

October 31, 2024

FILE NAME: X:\2019\5126.19\03_DSGN\01_DWG\050_CIVIL\C-501-5126-19.dwg LAYOUT NAME: Layout1 PRINTED: Thursday, March 12, 2020 - 6:27pm USER: gmollinar

Appendix Table 1. Summary of interface shear strengths.

Interface 1*	Interface 2*	Peak Strength					Residual Strength				
		Fig. No.	δ (deg)	Ca (kPa)	Points	R^2	Fig. No.	δ (deg)	Ca (kPa)	Points	R^2
HDPE-S	Granular Soil	1a	21	0	162	0.93	1b	17	0	128	0.92
HDPE-S	Cohesive Soil										
	Saturated	1c	11	7	79	0.94	1d	11	0	59	0.95
	Unsaturated	1c	22	0	44	0.93	1d	18	0	32	0.93
HDPE-S	NW-NP GT	1e	11	0	149	0.93	1f	9	0	82	0.96
HDPE-S	Geonet	1g	11	0	196	0.90	1h	9	0	118	0.93
HDPE-S	Geocomposite	1i	15	0	36	0.97	1j	12	0	30	0.93
HDPE-T	Granular Soil	2a	34	0	251	0.98	2b	31	0	239	0.96
HDPE-T	Cohesive Soil										
	Saturated	2c	18	10	167	0.93	2d	16	0	150	0.90
	Unsaturated	2c	19	23	62	0.91	2d	22	0	35	0.93
HDPE-T	NW-NP GT	2e	25	8	254	0.96	2f	17	0	217	0.95
HDPE-T	Geonet	2g	13	0	31	0.99	2h	10	0	27	0.99
HDPE-T	Geocomposite	2i	26	0	168	0.95	2j	15	0	164	0.94
LLDPE-S	Granular Soil	3a	27	0	6	1.00	3b	24	0	9	1.00
LLDPE-S	Cohesive Soil	3c	11	12.4	12	0.94	3d	12	3.7	9	0.93
LLDPE-S	NW-NP GT	3e	10	0	23	0.63	3f	9	0	23	0.49
LLDPE-S	Geonet	3g	11	0	9	0.99	3h	10	0	9	1.00
LLDPE-T	Granular Soil	4a	26	7.7	12	0.95	4b	25	5.2	12	0.95
LLDPE-T	Cohesive Soil	4c	21	5.8	12	1.00	4d	13	7.0	9	0.98
LLDPE-T	NW-NP GT	4e	26	8.1	9	1.00	4f	17	9.5	9	0.96
LLDPE-T	Geonet	4g	15	3.6	6	0.97	4h	11	0	6	0.98
PVC-S	Granular Soil	5a	26	0.4	6	0.99	5b	19	0	6	0.99
PVC-S	Cohesive Soil	5c	22	0.9	11	0.88	5d	15	0	9	0.95
PVC-S	NW-NP GT	5e	20	0	89	0.91	5f	16	0	83	0.74
PVC-S	NW-HB GT	5g	18	0	3	1.00	5h	12	0.1	3	1.00
PVC-S	Woven GT	5i	17	0	6	0.54	5j	7	0	6	0.93
PVC-S	Geonet	5k	18	0.1	3	1.00	5l	16	0.6	3	1.00

Appendix Table 1. (continued)

Interface 1*	Interface 2*	Peak Strength					Residual Strength				
		Fig. No.	δ (deg)	Ca (kPa)	Points	R^2	Fig. No.	δ (deg)	Ca (kPa)	Points	R^2
PVC-F	NW-NP GT	6a	27	0.2	26	0.95	6b	23	0	26	0.95
PVC-F	NW-HB GT	6c	30	0	8	0.97	6d	27	0	8	0.90
PVC-F	Woven GT	6e	15	0	6	0.78	6f	10	0	6	0.76
PVC-F	Geonet	6g	25	0	11	1.00	6h	19	0	11	0.99
PVC-F	Geocomposite	6i	27	1.1	5	1.00	6j	22	4.7	6	1.00
CSPE-R	Granular Soil	7a	36	0	3	1.00	7b	16	0	3	1.00
CSPE-R	Cohesive Soil	7c	31	5.7	6	0.71	7d	18	0	6	0.99
CSPE-R	NW-NP GT	7e	14	0	6	0.97	7f	10	0	6	0.98
CSPE-R	NW-HB GT	7g	21	0	3	1.00	7h	10	0	3	1.00
CSPE-R	Woven GT	7i	11	0	6	0.92	7j	11	0	3	1.00
CSPE-R	Geonet	7k	28	0	9	0.87	7l	16	0	9	0.80
NW-NP GT	Granular Soil	8a	33	0	290	0.97	8b	33	0	117	0.96
NW-HB GT	Granular Soil	8c	28	0	6	0.99	8d	16	0	6	0.91
Woven GT	Granular Soil	8e	32	0	81	0.99	8f	29	0	28	0.98
NW-NP GT	Cohesive Soil	9a	30	5	79	0.96	9b	21	0	28	0.79
NW-HB GT	Cohesive Soil	9c	29	0.9	15	0.71	9d	10	0	15	0.83
Woven GT	Cohesive Soil	9e	29	0	34	0.94	9f	19	0	16	0.86
GCL Reinforced (internal)	N/A	10a	16	38	406	0.85	10b	6	12	182	0.91
GCL (NW-NP GT)	HDPE-T	11a	23	8	180	0.95	11b	13	0	157	0.90
GCL (W-SF GT)	HDPE-T	11c	18	11	196	0.96	11d	12	0	153	0.92
Geonet	NW-NP GT	12a	23	0	52	0.97	12b	16	0	32	0.97
Geocomposite (NW-NP GT)	Granular Soil	13a	27	14	14	0.86	13b	21	8	10	0.92

Geosynthetic Research Institute
475 Kedron Avenue
Folsom, PA 19033-1208 USA
TEL (610) 522-8440
FAX (610) 522-8441

Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces

by

George R. Koerner, Ph.D., P.E.
Geosynthetic Research Institute
Folsom, PA 19033-1208
[redacted]

and

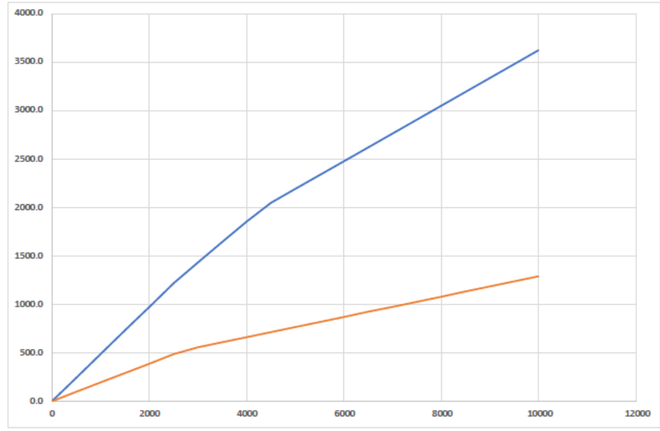
Dhani Narejo, Ph.D.
GSE Lining Technology, Inc.
Houston, TX 77073
[redacted]

GRI Report #30

June 14, 2005

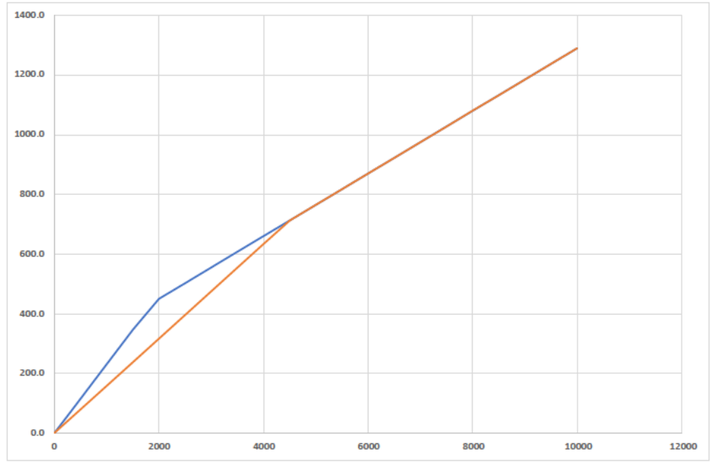
	Cover Material - Geocomposite		Geocomposite - Textured HDPE		Geocomposite - Smooth HDPE		Textured HDPE - GCL		Smooth HDPE - GCL (Nonwoven Needle Punched)		GCL (internal) - Reinforced		GCL (internal) - Unreinforced		GCL - Sand Subgrade	
	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angl	Cohesion	Friction Angle
	280	27	0	26	0	15	160	23	0	11	760	16	240	6	0	33
Effective Stress (psf)	Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)	
0	280.0		0.0		0.0		160.0		0.0		760.0		240.0		0.0	
100	331.0		48.8		26.8		202.4		19.4		788.7		250.5		64.9	
200	381.9		97.5		53.6		244.9		38.9		817.3		261.0		129.9	
300	432.9		146.3		80.4		287.3		58.3		846.0		271.5		194.8	
400	483.8		195.1		107.2		329.8		77.8		874.7		282.0		259.8	
500	534.8		243.9		134.0		372.2		97.2		903.4		292.6		324.7	
600	585.7		292.6		160.8		414.7		116.6		932.0		303.1		389.6	
700	636.7		341.4		187.6		457.1		136.1		960.7		313.6		454.6	
800	687.6		390.2		214.4		499.6		155.5		989.4		324.1		519.5	
900	738.6		439.0		241.2		542.0		174.9		1018.1		334.6		584.5	
1000	789.5		487.7		267.9		584.5		194.4		1046.7		345.1		649.4	
1500	1044.3		731.6		401.9		796.7		291.6		1190.1		397.7		974.1	
2000	1299.1		975.5		535.9		1008.9		388.8		1333.5		450.2		1298.8	
2500	1553.8		1219.3		669.9		1221.2		486.0		1476.9		502.8		1623.5	
3000	1808.6		1463.2		803.8		1433.4		583.1		1620.2		555.3		1948.2	
3500	2063.3		1707.1		937.8		1645.7		680.3		1763.6		607.9		2272.9	
4000	2318.1		1950.9		1071.8		1857.9		777.5		1907.0		660.4		2597.6	
4500	2572.9		2194.8		1205.8		2070.1		874.7		2050.4		713.0		2922.3	
5000	2827.6		2438.7		1339.7		2282.4		971.9		2193.7		765.5		3247.0	
5500	3082.4		2682.5		1473.7		2494.6		1069.1		2337.1		818.1		3571.7	
6000	3337.2		2926.4		1607.7		2706.8		1166.3		2480.5		870.6		3896.4	
6500	3591.9		3170.3		1741.7		2919.1		1263.5		2623.8		923.2		4221.1	
7000	3846.7		3414.1		1875.6		3131.3		1360.7		2767.2		975.7		4545.9	
7500	4101.4		3658.0		2009.6		3343.6		1457.9		2910.6		1028.3		4870.6	
8000	4356.2		3901.9		2143.6		3555.8		1555.0		3054.0		1080.8		5195.3	
8500	4611.0		4145.7		2277.6		3768.0		1652.2		3197.3		1133.4		5520.0	
9000	4865.7		4389.6		2411.5		3980.3		1749.4		3340.7		1185.9		5844.7	
9500	5120.5		4633.5		2545.5		4192.5		1846.6		3484.1		1238.5		6169.4	
10000	5375.3		4877.3		2679.5		4404.7		1943.8		3627.5		1291.0		6494.1	

Sideslopes of Base Liner		Floor of Base Liner	
0.0		0.0	
48.8	Geocomposite - Textured HDPE	19.4	Smooth HDPE - GCL
97.5		38.9	
146.3		58.3	
195.1		77.8	
243.9		97.2	
292.6		116.6	
341.4		136.1	
390.2		155.5	
439.0		174.9	
487.7		194.4	
731.6		291.6	
975.5		388.8	
1219.3		486.0	
1433.4	Textured HDPE - GCL	555.3	
1645.7		607.9	
1857.9		660.4	
2050.4	GCL Internal	713.0	GCL Internal
2193.7		765.5	
2337.1		818.1	
2480.5		870.6	
2623.8		923.2	
2767.2		975.7	
2910.6		1028.3	
3054.0		1080.8	
3197.3		1133.4	
3340.7		1185.9	
3484.1		1238.5	
3627.5		1291.0	

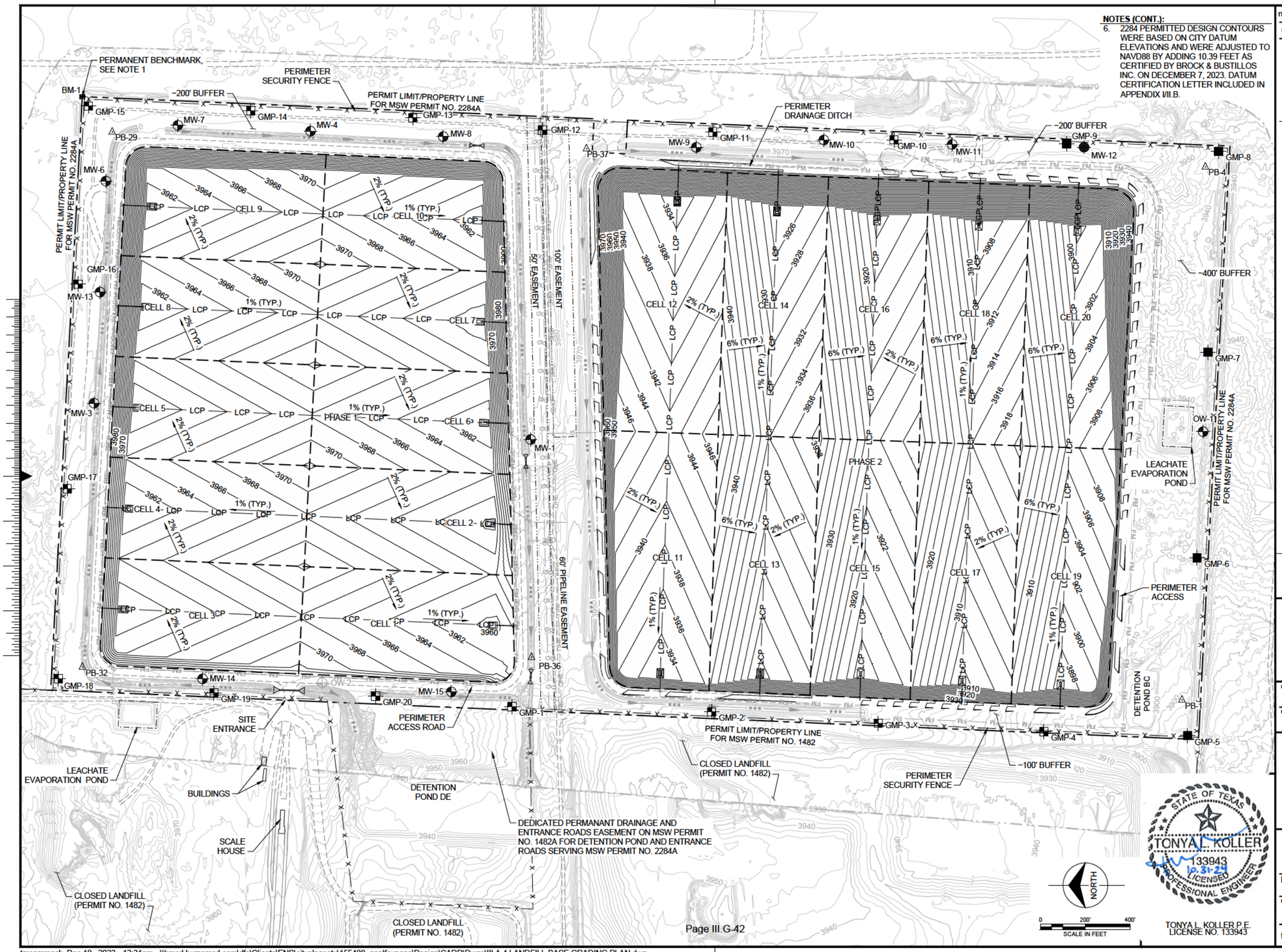


	Cover Material - Geocomposite		Geocomposite - Textured HDPE		Geocomposite - Smooth HDPE		Textured HDPE - GCL		Smooth HDPE - GCL (Nonwoven Needle Punched)		GCL (internal) Reinforced & Unreinforced		GCL - Sand Subgrade	
	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle	Cohesion	Friction Angle
	160	21	0	15	0	12	0	13	0	9	240	6	0	33
Effective Stress (psf)	Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)		Liner Strength (psf)	
0	160.0		0.0		0.0		0.0		0.0		240.0		0.0	
100	198.4		26.8		21.3		23.1		15.8		250.5		64.9	
200	236.8		53.6		42.5		46.2		31.7		261.0		129.9	
300	275.2		80.4		63.8		69.3		47.5		271.5		194.8	
400	313.5		107.2		85.0		92.3		63.4		282.0		259.8	
500	351.9		134.0		106.3		115.4		79.2		292.6		324.7	
600	390.3		160.8		127.5		138.5		95.0		303.1		389.6	
700	428.7		187.6		148.8		161.6		110.9		313.6		454.6	
800	467.1		214.4		170.0		184.7		126.7		324.1		519.5	
900	505.5		241.2		191.3		207.8		142.5		334.6		584.5	
1000	543.9		267.9		212.6		230.9		158.4		345.1		649.4	
1500	735.8		401.9		318.8		346.3		237.6		397.7		974.1	
2000	927.7		535.9		425.1		461.7		316.8		450.2		1298.8	
2500	1119.7		669.9		531.4		577.2		396.0		502.8		1623.5	
3000	1311.6		803.8		637.7		692.6		475.2		555.3		1948.2	
3500	1503.5		937.8		743.9		808.0		554.3		607.9		2272.9	
4000	1695.5		1071.8		850.2		923.5		633.5		660.4		2597.6	
4500	1887.4		1205.8		956.5		1038.9		712.7		713.0		2922.3	
5000	2079.3		1339.7		1062.8		1154.3		791.9		765.5		3247.0	
5500	2271.3		1473.7		1169.1		1269.8		871.1		818.1		3571.7	
6000	2463.2		1607.7		1275.3		1385.2		950.3		870.6		3896.4	
6500	2655.1		1741.7		1381.6		1500.6		1029.5		923.2		4221.1	
7000	2847.0		1875.6		1487.9		1616.1		1108.7		975.7		4545.9	
7500	3039.0		2009.6		1594.2		1731.5		1187.9		1028.3		4870.6	
8000	3230.9		2143.6		1700.5		1846.9		1267.1		1080.8		5195.3	
8500	3422.8		2277.6		1806.7		1962.4		1346.3		1133.4		5520.0	
9000	3614.8		2411.5		1913.0		2077.8		1425.5		1185.9		5844.7	
9500	3806.7		2545.5		2019.3		2193.2		1504.7		1238.5		6169.4	
10000	3998.6		2679.5		2125.6		2308.7		1583.8		1291.0		6494.1	
	New and Existing		Existing		New		New		New		New		Existing	

Sideslopes of Base Liner		Floor of Base Liner	
0.0		0.0	
23.1	Geomembrane (textured) - GCL	15.8	
46.2		31.7	
69.3		47.5	
92.3		63.4	Geomembrane (smooth) - GCL
115.4		79.2	
138.5		95.0	
161.6		110.9	
184.7		126.7	
207.8		142.5	
230.9		158.4	
346.3		237.6	
450.2		316.8	
502.8		396.0	
555.3		475.2	
607.9		554.3	
660.4		633.5	
713.0		712.7	
765.5	GCL Internal	765.5	
818.1		818.1	
870.6		870.6	
923.2		923.2	
975.7		975.7	GCL Internal
1028.3		1028.3	
1080.8		1080.8	
1133.4		1133.4	
1185.9		1185.9	
1238.5		1238.5	
1291.0		1291.0	



Attachment III.G.4 – Sections



NOTES (CONT.):

6. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

no.	date	by	ckd	description
0	12/31/23	TMC	TLK	2284A PERMIT MOD

NOTES:

1. PERMANENT BENCHMARK 3" Ø BRASS CAP SET IN CONCRETE (NAD83)
   N: 10594030.76
   E: 482320.66
   EL: 3986.67 (NAVD88)
2. INDEX CONTOUR INTERVAL, 2 FEET.
3. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
4. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
5. DESIGN CONTOURS PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS TOP OF PROTECTIVE COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
DECEMBER 2023	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL BASE GRADING PLAN

project	contract
155488	-

drawing **III.A.4** – rev. **0**

October 31, 2024

file III.A.4 LANDFILL BASE GRADING PLAN.dwg

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NOTES (CONT.):

6. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

no.	date	by	ckd	description
0	12/31/23	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
DECEMBER 2023	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL SECTION KEY MAP

project	contract
155488	-

drawing **III.A.12** rev. **0**

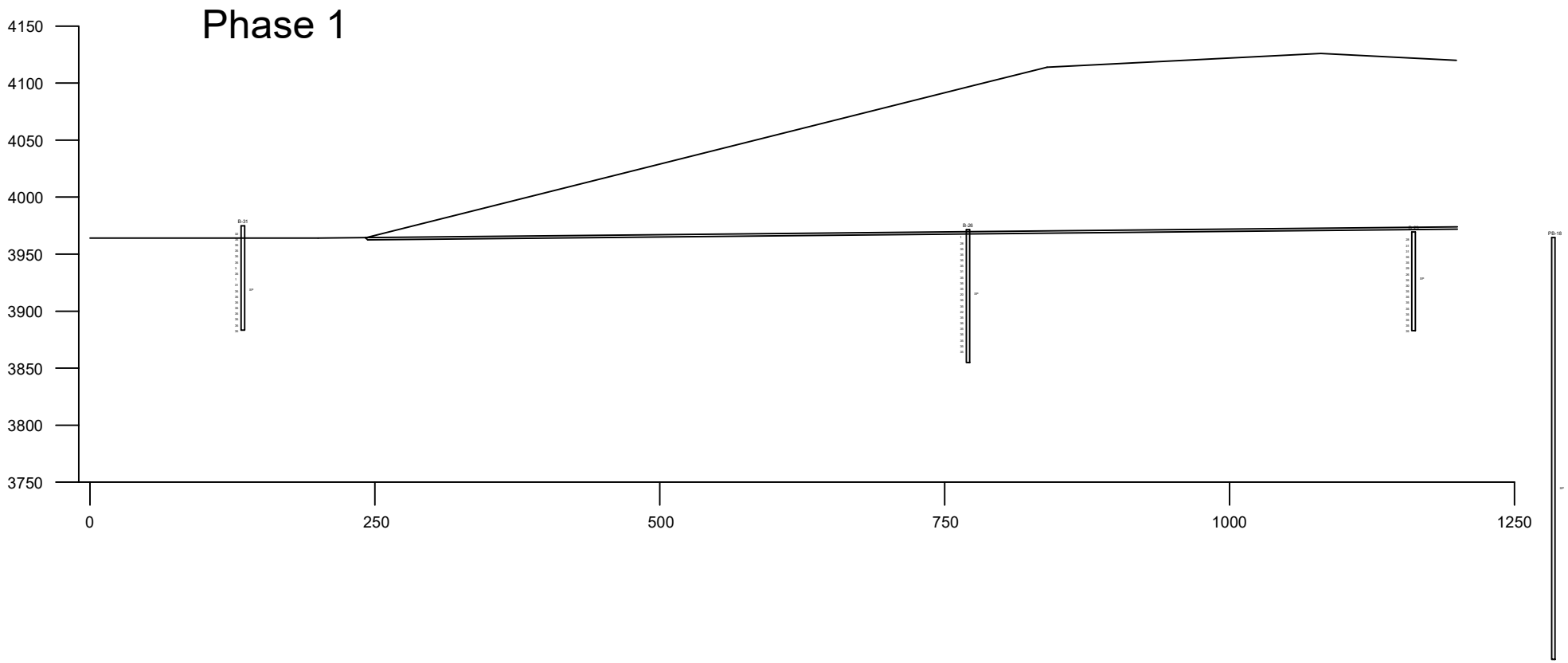
October 31, 2024

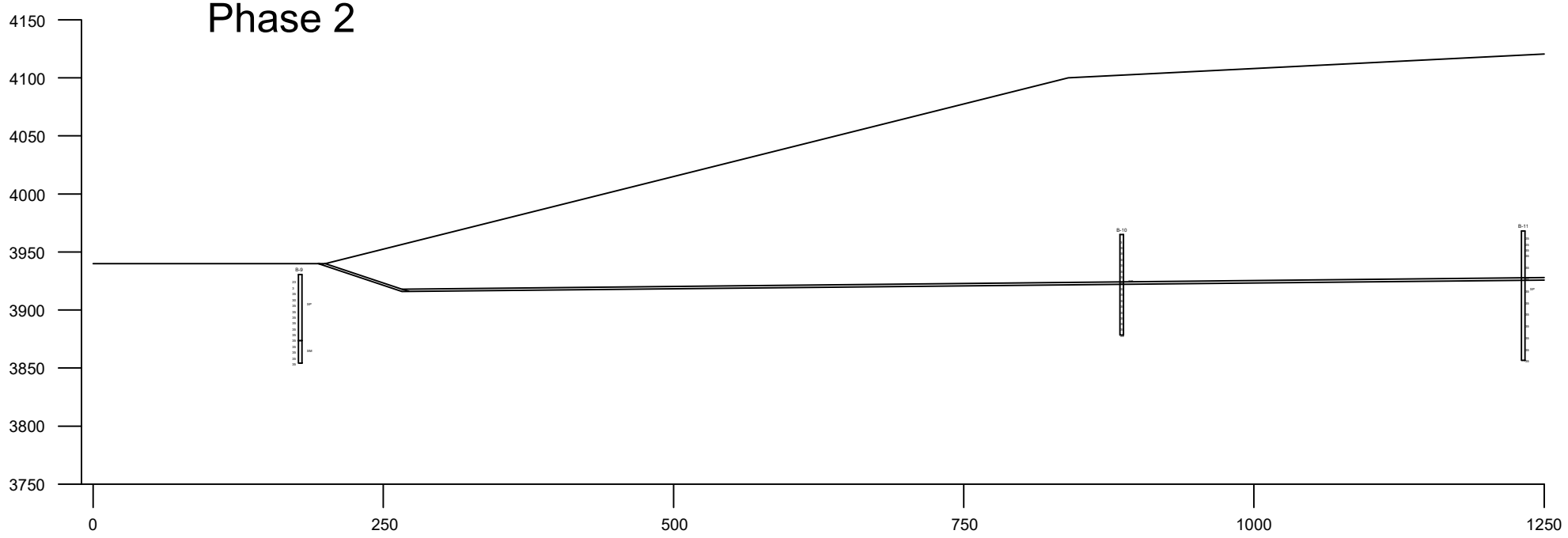
file III.A.12 LANDFILL SECTION KEY MAP.dwg

STATE OF TEXAS — TONYA L. KOLLER — 133943 — 10-31-24 — LICENSED PROFESSIONAL ENGINEER

TONYA L. KOLLER P.E.
LICENSE NO. 133943

tmcammack Dec 18, 2023 - 12:34pm - \\bmcd.burnsmcd.com\dfs\Clients\ENS\cityelpasotx\155488_geplfexpans\Design\CADD\Dwgs\III.A.12 LANDFILL SECTION KEY MAP.dwg


Phase 1
4150
4100
4050
4000
3950
3900
3850
3800
3750
0
250
500
750
1000
1250
B-31
B-26
PB-18


Phase 2
4150
4100
4050
4000
3950
3900
3850
3800
3750
0
250
500
750
1000
1250
B-9
B-10
B-11

Attachment III.G.5 – Utexas4 Input/Output and Seismic Deformation for Phase 1 (North)

Profile: North Case: LTSS INCLUDED

Unit Weight Average Effective Average Total Average

Fixed Grid Coordinates

x	y
200	1110
200	1610
840	1610
840	1110

Circle Exit

x	y
840	1114

Tangent

Search Grid Subdivisions
15

Crack Depth
4

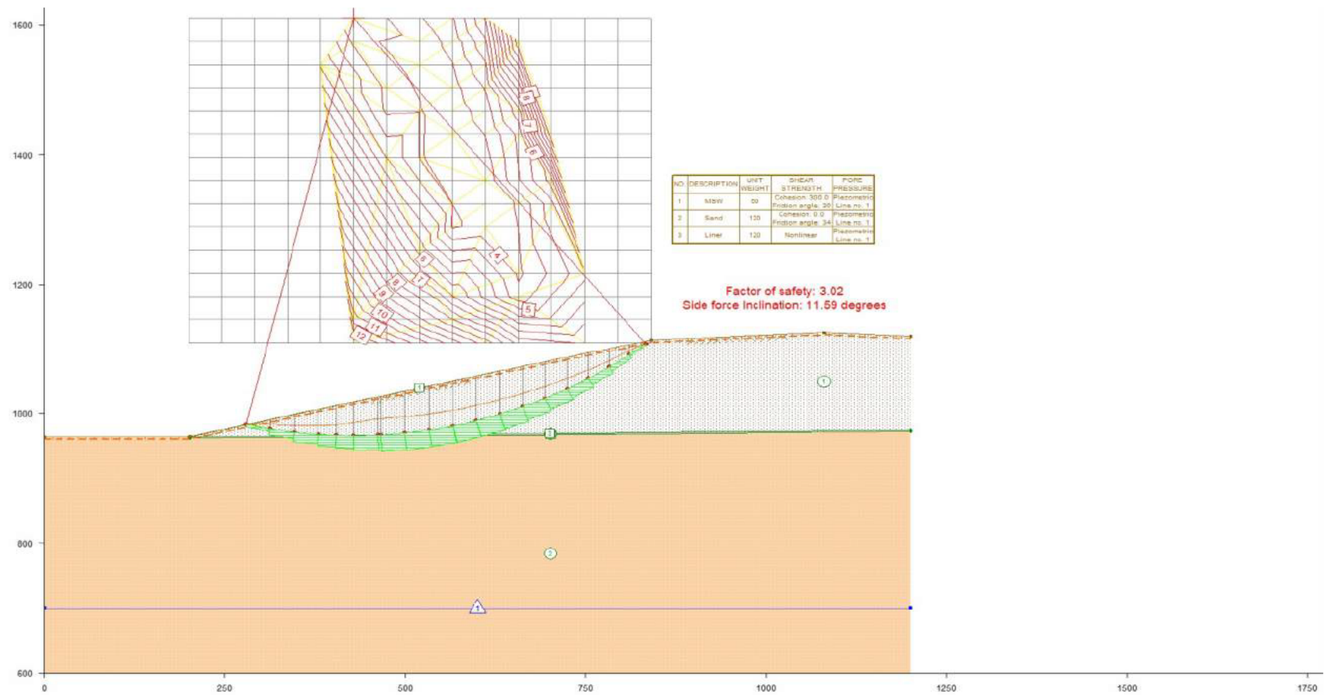
Seismic Acceleration

Minimum Weight
10000

Results

		Circle Center		Circle Exit	
Circles Attempted	Circles Completed	x	y	x	y
225	46	428.6	1610	280.4	982.8

Factor of Safety	Errors
3.02	



Profile: North Case: LTSS

Unit Weight Average Effective Average Total Average

Fixed Grid Coordinates

x	y
200	1110
200	1610
840	1610
840	1110

Circle Exit

x	y
200	964

Tangent

Search Grid Subdivisions
15

Crack Depth
4

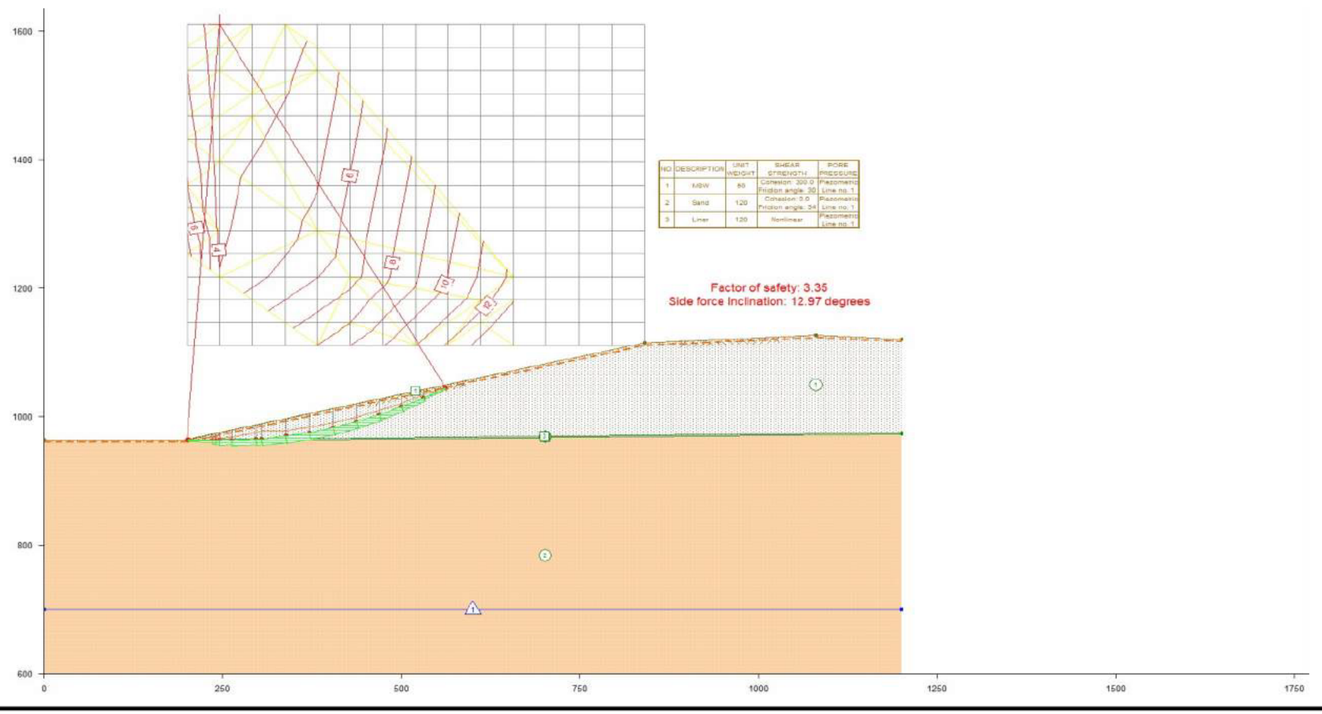
Seismic Acceleration

Minimum Weight
10000

Results

		Circle Center		Circle Exit	
Circles Attempted	Circles Completed	x	y	x	y
225	36	245.7	1610	561.9	1044.8

Factor of Safety	Errors
3.35	



```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - North LTSS Circular
#155488

PROfile lines
   1 1 MSW
         200 964
         840 1114
         1080 1126
         1200 1120

   2 2 Sand
         0 964
         200 964
         202 962
         1200 972

   3 3 Liner
          200 964
        1200 974


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 486
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1200 700


LABel
El Paso, TX Landfill Evaluation - North LTSS Circular
ANALYSIS/COMPUTATION
   Circular Search 2
     15 15
     200 1110 200 1610 840 1610 840 1110
     5 5
   Point
     840 1114

   Minimum
     10000
   Crack
     4 D
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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```

```
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TABLE NO. 3

************************

* NEW PROFILE LINE DATA *

************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      964.00

   2      840.00     1114.00

   3     1080.00     1126.00

   4     1200.00     1120.00



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y



   1        0.00      964.00
```

```
   2      200.00      964.00

   3      202.00      962.00

   4     1200.00      972.00


------------------------------------------------------------

----- Profile Line No. 3 - Material Type (Number): 3 -----

------------------------------------------------------------

Description: Liner


Point        X           Y


   1      200.00      964.00

   2     1200.00      974.00
```

```
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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

Constant unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

DATA FOR MATERIAL NUMBER 3

Description: Liner

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	486.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1200.00      700.00
```

```
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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************




Search will be conducted using a fixed grid.

Number of Points Across Grid: 15

Number of Points Up Grid: 15


Grid Corner

   Number           X              Y


     1           200.00        1110.00

     2           200.00        1610.00

     3           840.00        1610.00

     4           840.00        1110.00


----- Control Parameters for Finding "Critical" Radius -----

Initial number of subdivisions between maximum and minimum

radius for finding a critical radius/radii: 5


Minimum radius increment for terminating subdivision of radii: 5.000


The following criteria will be used for determining
```

```
the maximum and minimum radii:

     Point circles pass through - X: 840.00     Y: 1114.00

Minimum weight required for computations to be performed: 10000


Depth of crack: 4.000

Automatic search output will be in short form.


------------------------------------------------------------------------------

The following represent default values or values that were prevously defined:

Subtended angle for slice subdivision: 3.00(degrees)

There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Search will be continued after the initial mode to find a most critical circle.

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Radii for each grid point will be sorted in the order of increasing radius.

Critical circles for grid points will be output in the order of increasing factor of safety.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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TABLE NO. 26

************************************

* NEW, COMPUTED SLOPE GEOMETRY DATA *

************************************



These slope geometry were generated from the Profile Lines.


     Point       X           Y


        1        0.00      964.00

        2      200.00      964.00

        3      202.00      964.47

        4      840.00     1114.00

        5     1080.00     1126.00

        6     1200.00     1120.00
```

```
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TABLE NO. 38

************************************************

* FINAL SUMMARY OF COMPUTATIONS WITH FIXED-GRID *

************************************************




Number of circles attempted: 225

Number of circles for which F calculated: 46

Circle with Lowest Factor of Safety:

     X coordinate for center: 428.57

     Y coordinate for center: 1610.00

     Radius of circle: 644.430

Factor of safety: 3.020

Side force inclination: 11.59

Time Required for Computations: 1.0 seconds
```

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TABLE NO. 43

****

* Coordinate, Weight, Strength and Pore Water Pressure *

* Information for Individual Slices for Conventional *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the *

* case of an automatic search.) *

****

Slice No.	X	Y	Slice Weight	Matl. No.	Friction Angle	Cohesion	Pore Pressure
	280.38	982.84					
1	296.90	979.39	12085	1	300.0	30.00	0.0
	313.41	975.94					
2	330.08	973.36	35214	1	300.0	30.00	0.0
	346.75	970.79					
3	363.53	969.08	55796	1	300.0	30.00	0.0
	380.32	967.38					
4	392.15	966.71	50076	1	300.0	30.00	0.0
	403.98	966.04					
5	416.28	965.81	60722	3	NONLINEAR ENVELOPE		0.0
	428.57	965.57					
6	445.43	966.01	94656	3	NONLINEAR ENVELOPE		0.0
	462.30	966.45					
7	464.17	966.56	11114	3	NONLINEAR ENVELOPE		0.0

	466.04	966.66					
8	482.84	968.08	104571	1	300.0	30.00	0.0
	499.65	969.50					
9	516.37	971.80	110877	1	300.0	30.00	0.0
	533.08	974.10					
10	549.65	977.27	113788	1	300.0	30.00	0.0
	566.21	980.44					
11	582.59	984.47	113342	1	300.0	30.00	0.0
	598.97	988.51					
12	615.12	993.39	109636	1	300.0	30.00	0.0
	631.27	998.28					
13	647.14	1004.00	102823	1	300.0	30.00	0.0
	663.00	1009.72					
14	678.55	1016.27	93113	1	300.0	30.00	0.0
	694.10	1022.82					
15	709.28	1030.17	80770	1	300.0	30.00	0.0
	724.47	1037.52					
16	739.24	1045.65	66105	1	300.0	30.00	0.0
	754.02	1053.79					
17	768.35	1062.69	49477	1	300.0	30.00	0.0
	782.69	1071.58					
18	796.53	1081.22	31284	1	300.0	30.00	0.0
	810.38	1090.85					
19	821.76	1099.62	11499	1	300.0	30.00	0.0
	833.15	1108.39					

No water in crack.

```
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TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  13

Allowable moment imbalance for convergence: 7398



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887  -7.427e+003   9.146e+006

First-order corrections to F and Theta .............    0.0053    -6.5832

Reduced values - Deltas were too large .............    0.0023    -2.8648



   2   3.00231    14.3239  -4.297e+003   5.142e+006

First-order corrections to F and Theta .............    0.0141    -2.9950

Reduced values - Deltas were too large .............    0.0134    -2.8648



   3   3.01576    11.4592  -2.791e+002   1.631e+005

First-order corrections to F and Theta .............    0.0043     0.1366
```

```
Second-order corrections to F and Theta ...........    0.0043     0.1356


   4   3.02006    11.5948   1.038e-003  -1.068e+000

First-order corrections to F and Theta ............   -0.0000     0.0000


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.275 (percent)

     Maximum change occurred for slice 5

     Normal stress where max. change occurred:      2515.42

     Old strength at this slice:       489.00

     New strength at this slice:       487.66
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  13

Allowable moment imbalance for convergence: 7398


        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)


   1   3.00000    17.1887  -7.398e+003   9.123e+006

First-order corrections to F and Theta .............    0.0053    -6.5785

Reduced values - Deltas were too large .............    0.0023    -2.8648


   2   3.00230    14.3239  -4.278e+003   5.126e+006

First-order corrections to F and Theta .............    0.0140    -2.9937

Reduced values - Deltas were too large .............    0.0134    -2.8648


   3   3.01568    11.4592  -2.759e+002   1.604e+005

First-order corrections to F and Theta .............    0.0043     0.1365
```

```
Second-order corrections to F and Theta ...........    0.0043     0.1356


   4   3.01994    11.5948   1.016e-003  -1.041e+000

First-order corrections to F and Theta ............   -0.0000     0.0000


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:      0.000 (percent)

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  13

Allowable moment imbalance for convergence: 7398



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887  -7.398e+003   9.123e+006

First-order corrections to F and Theta .............    0.0053    -6.5785

Reduced values - Deltas were too large .............    0.0023    -2.8648



   2   3.00230    14.3239  -4.278e+003   5.126e+006

First-order corrections to F and Theta .............    0.0140    -2.9937

Reduced values - Deltas were too large .............    0.0134    -2.8648



   3   3.01568    11.4592  -2.759e+002   1.604e+005

First-order corrections to F and Theta .............    0.0043     0.1365
```

```
Second-order corrections to F and Theta ...........    0.0043     0.1356


   4   3.01994    11.5948   1.016e-003  -1.041e+000

First-order corrections to F and Theta ............   -0.0000     0.0000
```

```
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TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 4.92193e-011



Summation of Vertical Forces: 1.07320e-010



Summation of Moments: -1.86265e-009



Mohr Coulomb Shear Force/Shear Strength Check Summation: 3.14913e-011
```

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TABLE NO. 58

****

* Final Results for Stresses Along the Shear Surface *

* (Results are for the critical shear surface in the case of a search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 3.020 Side Force Inclination: 11.59

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	296.90	979.39	463.6	463.6	188.0
2	330.08	973.36	1213.9	1213.9	331.4
3	363.53	969.08	1838.8	1838.8	450.9
4	392.15	966.71	2283.1	2283.1	535.8
5	416.28	965.81	2515.3	2515.3	161.5
6	445.43	966.01	2822.2	2822.2	172.4
7	464.17	966.56	2966.7	2966.7	177.5
8	482.84	968.08	3140.4	3140.4	699.7
9	516.37	971.80	3274.0	3274.0	725.3
10	549.65	977.27	3313.9	3313.9	732.9
11	582.59	984.47	3265.1	3265.1	723.6

12	615.12	993.39	3132.6	3132.6	698.2
13	647.14	1004.00	2921.3	2921.3	657.8
14	678.55	1016.27	2636.5	2636.5	603.4
15	709.28	1030.17	2283.5	2283.5	535.9
16	739.24	1045.65	1868.0	1868.0	456.5
17	768.35	1062.69	1396.0	1396.0	366.2
18	796.53	1081.22	874.1	874.1	266.5
19	821.76	1099.62	354.6	354.6	167.1

```
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TABLE NO. 59

**************************************************************************

* Final Results for Side Forces and Stresses Between Slices             *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


       ---------------- VALUES AT RIGHT SIDE OF SLICE ----------------


                                Y-Coord. of   Fraction    Sigma      Sigma

Slice                   Side    Side Force       of         at         at

  No.    X-Right       Force     Location      Height      Top       Bottom


   1      313.41          9601       982.78     0.467       515.5      769.6

   2      346.75         27273       981.30     0.381       276.5     1658.8

   3      380.32         49117       981.22     0.356       168.8     2306.1

   4      403.98         65182       981.90     0.347       111.1     2679.1

   5      428.57         70441       985.56     0.384       406.5     2247.5

   6      462.30         73832       991.42     0.423       659.5     1791.3

   7      466.04         73883       992.17     0.427       684.2     1740.8

   8      499.65         88784       994.45     0.385       419.5     2267.8

   9      533.08         98163       998.81     0.364       257.1     2572.6

  10      566.21        101504      1004.79     0.351       151.2     2714.7

  11      598.97         98814      1012.16     0.343        79.2     2726.5

  12      631.27         90589      1020.79     0.337        29.0     2627.9

  13      663.00         77766      1030.60     0.333        -5.9     2432.3
```

14	694.10	61683	1041.55	0.329	-28.9	2149.5
15	724.47	44025	1053.60	0.326	-40.9	1786.8
16	754.02	26771	1066.74	0.323	-39.5	1348.7
17	782.69	12127	1081.07	0.327	-15.2	834.9
18	810.38	2464	1097.29	0.397	57.0	241.0
19	833.15	0	1108.39	Below	-0.0	0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

Profile: North Case: LTSS NC - Peak INCLUDED

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y		
200	964	fixed	
202	963	fixed	
600	966.9	0.5729387	deg
840	1114		

Shifting Points
5
1

Crack Depth
6

Seismic Acceleration

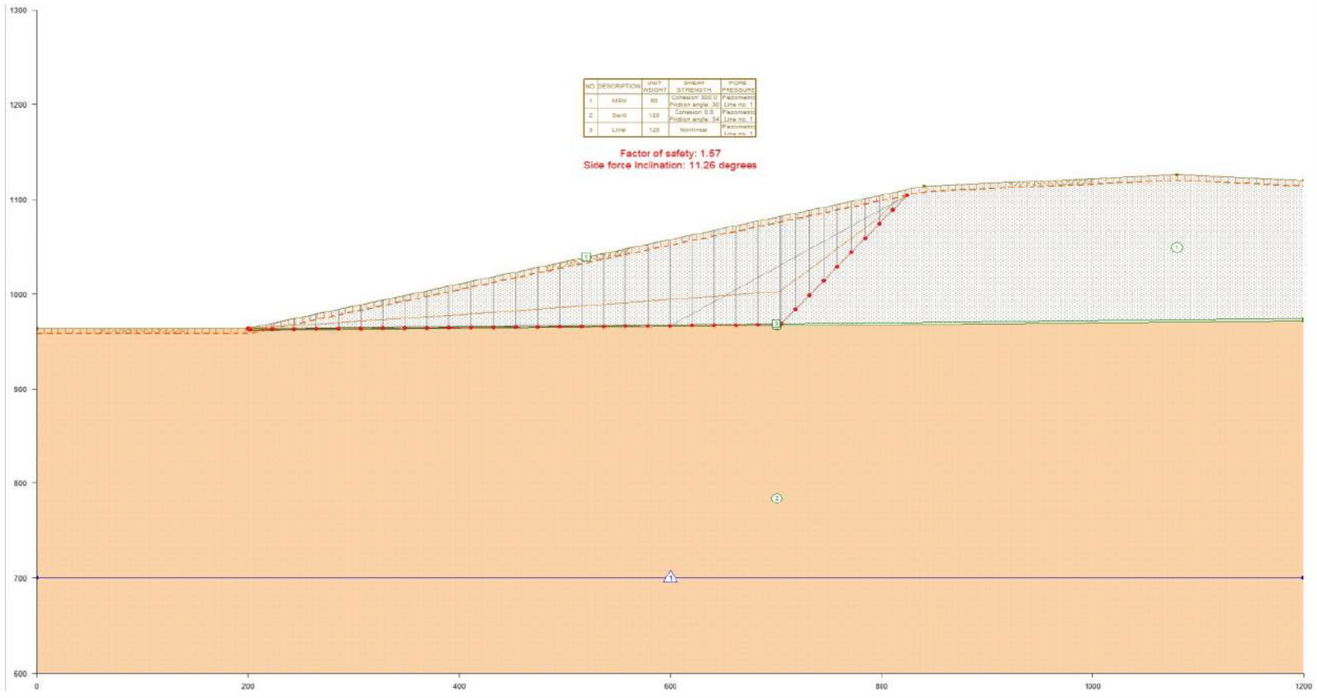
Minimum Weight

Results

Noncircular Shear Surface

200	964
202	963
704.4	967.9
824.2	1104.3

Factor of Safety
1.57



Profile: North Case: LTSS NC - Residual INCLUDED

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y		
200	964	fixed	
202	963	fixed	
600	966.9	0.5729387	deg
840	1114		

Shifting Points
5
1

Crack Depth
7

Seismic Acceleration

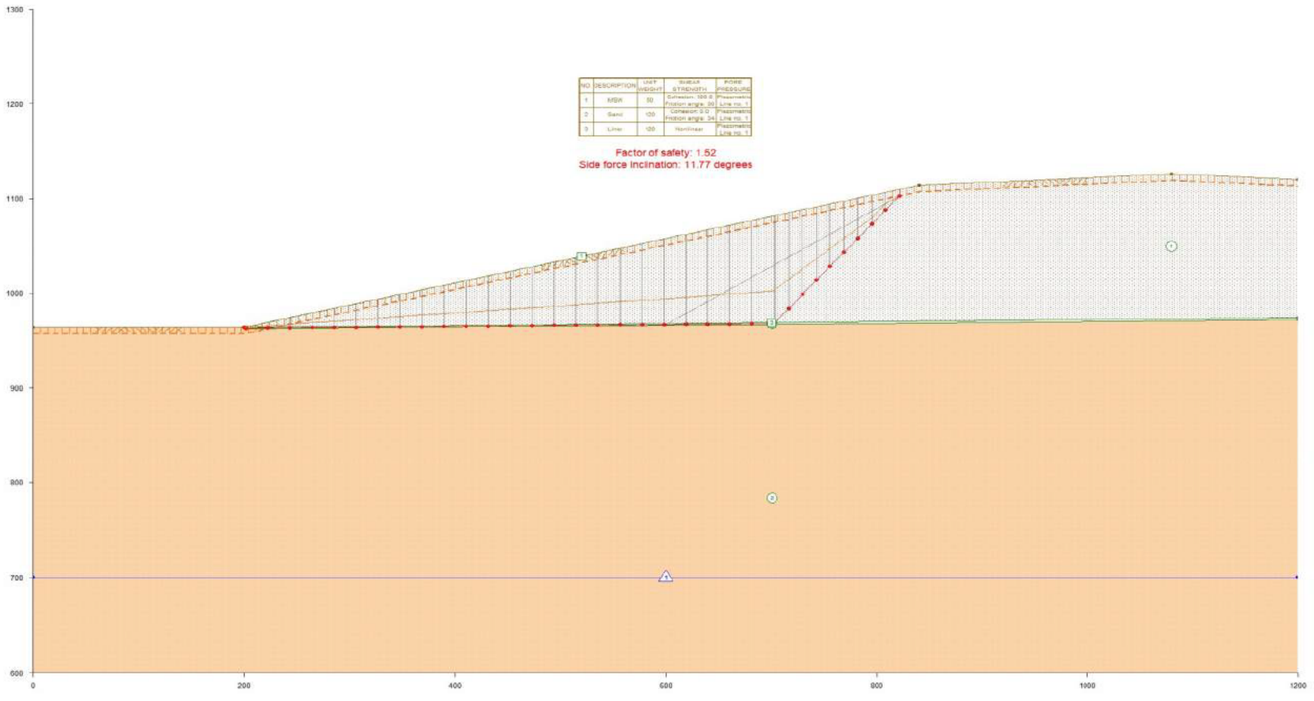
Minimum Weight

Results

Noncircular Shear Surface

200	964
202	963
702.5	967.9
821.5	1102.7

Factor of Safety
1.52



```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)
#155488

PROfile lines
   1 1 MSW
         200 964
         840 1114
         1080 1126
         1200 1120

   2 2 Sand
         0 964
         200 964
         202 962
         1200 972

   3 3 Liner
           200 964
        1200 974


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 486
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1200 700


LABel
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)
ANALYSIS/COMPUTATION
   Noncircular Search 2
     200 964 fixed
     202 963 fixed
     600 966.9 0.5729387
     840 1114 fixed

     5 1
   Crack
     6 D
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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approval of Stephen G. Wright

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```

```
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TABLE NO. 3

************************

* NEW PROFILE LINE DATA *

************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      964.00

   2      840.00     1114.00

   3     1080.00     1126.00

   4     1200.00     1120.00



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y



   1        0.00      964.00
```

```
   2      200.00      964.00

   3      202.00      962.00

   4     1200.00      972.00


------------------------------------------------------------

----- Profile Line No. 3 - Material Type (Number): 3 -----

------------------------------------------------------------

Description: Liner


Point        X           Y


   1      200.00      964.00

   2     1200.00      974.00
```

```
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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

Constant unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

DATA FOR MATERIAL NUMBER 3

Description: Liner

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	486.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1200.00      700.00
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************



Coordinates of points on shear surface which are to be shifted



Point         X              Y      Shift Angle



   1         200.00         964.00                        - fixed

   2         202.00         963.00                        - fixed

   3         600.00         966.90      0.57              - moveable

   4         840.00        1114.00                        - fixed



Initial distance for shifting points on shear surface = 5.000

Final distance for shifting points on shear surface = 1.000

Maximum steepness permitted for toe of shear surface = 50.00





Depth of crack: 6.000

Automatic search output will be in short form.



---------------------------------------------------------------------------

The following represent default values or values that were prevously defined:

Maximum increment for slice subdivision: 30
```

```
There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Maximum number of passes for noncircular search: 50

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Minimum weight required for computations to be performed: 100

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

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TABLE NO. 26

****

* NEW, COMPUTED SLOPE GEOMETRY DATA *

****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	0.00	964.00
2	200.00	964.00
3	202.00	964.47
4	840.00	1114.00
5	1080.00	1126.00
6	1200.00	1120.00

Right end point on noncircular shear surface adjusted to:

X: 824.15, Y: 1104.29

Adjustment was made to put end point at bottom of crack.

Noncircular Shear Surface Points After End Point Adjustment

Coordinates of points on shear surface which are to be shifted

Point	X	Y	Shift Angle

```
   1         200.00         964.00                       - fixed

   2         202.00         963.00                       - fixed

   3         600.00         966.90      0.57             - moveable

   4         824.15        1104.29                       - fixed

Computed crack depth: 6.00
```

```
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TABLE NO. 41

****************************************

*  Critical Noncircular Shear Surface  *

****************************************



***** CRITICAL NONCIRCULAR SHEAR SURFACE *****

X:     200.00     Y:     964.00

X:     202.00     Y:     963.00

X:     704.37     Y:     967.94

X:     824.15     Y:    1104.29



Minimum factor of safety: 1.571

Side force inclination: 11.26



Time required to find most critical surface:      0.0 seconds

Number of passes required to find most critical surface: 25

Total number of shear surfaces attempted: 75

Total number of shear surfaces for which the factor of safety

was successfully calculated: 75



      |   Shift    |      Max. Dist.| Minimum |   n        n    |

 Pass | Distance   | Pt.    Moved   |    F    | Tried  Computed |

      |            |                |         |                 |

    1 |     5.0000 |  3       5.000 |  1.7634 |     3        3  |

    2 |     5.0000 |  3       5.000 |  1.7476 |     6        6  |
```

3	5.0000	3	5.000	1.7323	9	9
4	5.0000	3	5.000	1.7176	12	12
5	5.0000	3	5.000	1.7033	15	15
6	5.0000	3	5.000	1.6895	18	18
7	5.0000	3	5.000	1.6763	21	21
8	5.0000	3	5.000	1.6636	24	24
9	5.0000	3	5.000	1.6516	27	27
10	5.0000	3	5.000	1.6401	30	30
11	5.0000	3	5.000	1.6294	33	33
12	5.0000	3	5.000	1.6194	36	36
13	5.0000	3	5.000	1.6101	39	39
14	5.0000	3	5.000	1.6017	42	42
15	5.0000	3	5.000	1.5940	45	45
16	5.0000	3	5.000	1.5873	48	48
17	5.0000	3	5.000	1.5817	51	51
18	5.0000	3	5.000	1.5773	54	54
19	5.0000	3	5.000	1.5738	57	57
20	5.0000	3	5.000	1.5717	60	60
21	5.0000	3	5.000	1.5711	63	63
22	5.0000	0	0.000	1.5711	66	66
23	2.5000	0	0.000	1.5711	69	69
24	1.2500	0	0.000	1.5711	72	72
25	0.6250	3	0.625	1.5711	75	75

```
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TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y        Weight   No.    Cohesion    Angle    Pressure

        200.00    964.00

   1    201.00    963.50          145    3   NONLINEAR ENVELOPE         0.0

        202.00    963.00

   2    212.47    963.10         5494    3   NONLINEAR ENVELOPE         0.0

        222.93    963.21

   3    233.40    963.31        10418    3   NONLINEAR ENVELOPE         0.0

        243.86    963.41

   4    254.33    963.51        15341    3   NONLINEAR ENVELOPE         0.0

        264.80    963.62

   5    275.26    963.72        20265    3   NONLINEAR ENVELOPE         0.0

        285.73    963.82

   6    296.19    963.93        25189    3   NONLINEAR ENVELOPE         0.0

        306.66    964.03

   7    317.13    964.13        30113    3   NONLINEAR ENVELOPE         0.0
```

	327.59	964.24				
8	338.06	964.34	35037	3	NONLINEAR ENVELOPE	0.0
	348.52	964.44				
9	358.99	964.54	39961	3	NONLINEAR ENVELOPE	0.0
	369.46	964.65				
10	379.92	964.75	44885	3	NONLINEAR ENVELOPE	0.0
	390.39	964.85				
11	400.85	964.96	49809	3	NONLINEAR ENVELOPE	0.0
	411.32	965.06				
12	421.79	965.16	54733	3	NONLINEAR ENVELOPE	0.0
	432.25	965.27				
13	442.72	965.37	59656	3	NONLINEAR ENVELOPE	0.0
	453.18	965.47				
14	463.65	965.57	64580	3	NONLINEAR ENVELOPE	0.0
	474.12	965.68				
15	484.58	965.78	69504	3	NONLINEAR ENVELOPE	0.0
	495.05	965.88				
16	505.52	965.99	74428	3	NONLINEAR ENVELOPE	0.0
	515.98	966.09				
17	526.45	966.19	79352	3	NONLINEAR ENVELOPE	0.0
	536.91	966.30				
18	547.38	966.40	84276	3	NONLINEAR ENVELOPE	0.0
	557.85	966.50				
19	568.31	966.60	89200	3	NONLINEAR ENVELOPE	0.0
	578.78	966.71				
20	589.24	966.81	94124	3	NONLINEAR ENVELOPE	0.0
	599.71	966.91				
21	610.18	967.02	99048	3	NONLINEAR ENVELOPE	0.0
	620.64	967.12				
22	631.11	967.22	103971	3	NONLINEAR ENVELOPE	0.0
	641.57	967.33				
23	652.04	967.43	108895	3	NONLINEAR ENVELOPE	0.0
	662.51	967.53				
24	672.97	967.63	113819	3	NONLINEAR ENVELOPE	0.0

	683.44	967.74						
25	693.90	967.84	118743	3	NONLINEAR ENVELOPE			0.0
	704.37	967.94						
26	704.86	968.50	5586	3	NONLINEAR ENVELOPE			0.0
	705.34	969.05						
27	711.95	976.57	70901	1	300.0	30.00		0.0
	718.55	984.08						
28	725.15	991.59	63025	1	300.0	30.00		0.0
	731.75	999.10						
29	738.35	1006.62	55150	1	300.0	30.00		0.0
	744.95	1014.13						
30	751.55	1021.64	47275	1	300.0	30.00		0.0
	758.15	1029.16						
31	764.75	1036.67	39399	1	300.0	30.00		0.0
	771.35	1044.18						
32	777.95	1051.70	31524	1	300.0	30.00		0.0
	784.55	1059.21						
33	791.15	1066.72	23649	1	300.0	30.00		0.0
	797.75	1074.23						
34	804.35	1081.75	15773	1	300.0	30.00		0.0
	810.95	1089.26						
35	817.55	1096.77	7898	1	300.0	30.00		0.0
	824.15	1104.29						

No water in crack.

```
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TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  19

Allowable moment imbalance for convergence: 10631



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.459e+005  -1.076e+008

First-order corrections to F and Theta .............   -2.5054    -1.1926

Reduced values - Deltas were too large .............   -0.5000    -0.2380



   2   2.50000    16.9507   1.111e+005  -8.175e+007

First-order corrections to F and Theta .............   -1.3582    -1.4275

Reduced values - Deltas were too large .............   -0.5000    -0.5255



   3   2.00000    16.4252   6.038e+004  -4.369e+007

First-order corrections to F and Theta .............   -0.4987    -1.9899
```

```
Second-order corrections to F and Theta ...........   -0.4347    -4.1008

Reduced values - Deltas were too large ............   -0.3037    -2.8648


   4   1.69631    13.5604   1.970e+004  -1.474e+007

First-order corrections to F and Theta ............   -0.1269    -1.5327

Second-order corrections to F and Theta ...........   -0.1244    -2.2267


   5   1.57194    11.3337  -1.158e+002   1.368e+005

First-order corrections to F and Theta ............    0.0001    -0.0661

Second-order corrections to F and Theta ...........    0.0001    -0.0659


   6   1.57201    11.2677   1.380e-004  -8.139e-002

First-order corrections to F and Theta ............   -0.0000    -0.0000


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:    -18.545 (percent)

     Maximum change occurred for slice 26

     Normal stress where max. change occurred:      4266.77

     Old strength at this slice:       829.46

     New strength at this slice:       675.63
```

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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North\20231019 North LTSS - Peak.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  19

Allowable moment imbalance for convergence: 10631



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.460e+005  -1.077e+008

First-order corrections to F and Theta .............   -2.5078    -1.1942

Reduced values - Deltas were too large .............   -0.5000    -0.2381



   2   2.50000    16.9506   1.112e+005  -8.181e+007

First-order corrections to F and Theta .............   -1.3599    -1.4292

Reduced values - Deltas were too large .............   -0.5000    -0.5255



   3   2.00000    16.4251   6.049e+004  -4.378e+007

First-order corrections to F and Theta .............   -0.4999    -1.9917
```

```
Second-order corrections to F and Theta ...........   -0.4357    -4.1064

Reduced values - Deltas were too large ............   -0.3039    -2.8648


   4   1.69606    13.5604   1.980e+004  -1.482e+007

First-order corrections to F and Theta ............   -0.1276    -1.5374

Second-order corrections to F and Theta ...........   -0.1251    -2.2368


   5   1.57099    11.3235  -1.177e+002   1.389e+005

First-order corrections to F and Theta ............    0.0001    -0.0671

Second-order corrections to F and Theta ...........    0.0001    -0.0669


   6   1.57106    11.2566   1.452e-004  -8.637e-002

First-order corrections to F and Theta ............   -0.0000    -0.0000


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:      0.000 (percent)

     Maximum change occurred for slice 14

     Normal stress where max. change occurred:      3145.95

     Old strength at this slice:       555.33

     New strength at this slice:       555.33

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  19

Allowable moment imbalance for convergence: 10631



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.460e+005  -1.077e+008

First-order corrections to F and Theta .............   -2.5078    -1.1942

Reduced values - Deltas were too large .............   -0.5000    -0.2381



   2   2.50000    16.9506   1.112e+005  -8.181e+007

First-order corrections to F and Theta .............   -1.3599    -1.4292

Reduced values - Deltas were too large .............   -0.5000    -0.5255



   3   2.00000    16.4251   6.049e+004  -4.378e+007

First-order corrections to F and Theta .............   -0.4999    -1.9917
```

```
Second-order corrections to F and Theta ...........   -0.4357    -4.1064

Reduced values - Deltas were too large ............   -0.3039    -2.8648


   4   1.69606    13.5604   1.980e+004  -1.482e+007

First-order corrections to F and Theta ............   -0.1276    -1.5374

Second-order corrections to F and Theta ...........   -0.1251    -2.2368


   5   1.57099    11.3235  -1.177e+002   1.389e+005

First-order corrections to F and Theta ............    0.0001    -0.0671

Second-order corrections to F and Theta ...........    0.0001    -0.0669


   6   1.57106    11.2566   1.452e-004  -8.637e-002

First-order corrections to F and Theta ............   -0.0000    -0.0000
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

#155488



TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 9.48432e-011



Summation of Vertical Forces: 1.56433e-010



Summation of Moments: -6.98492e-008



Mohr Coulomb Shear Force/Shear Strength Check Summation: 4.02487e-011
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

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TABLE NO. 58

**************************************************************************

* Final Results for Stresses Along the Shear Surface                    *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 1.571     Side Force Inclination:  11.26


       -------- VALUES AT CENTER OF BASE OF SLICE --------

                                Total     Effective

Slice                           Normal     Normal       Shear

  No.    X-Center   Y-Center     Stress     Stress       Stress


   1       201.00     963.50        89.0        89.0        11.0

   2       212.47     963.10       268.2       268.2        33.2

   3       233.40     963.31       508.6       508.6        62.9

   4       254.33     963.51       749.0       749.0        92.7

   5       275.26     963.72       989.4       989.4       122.4

   6       296.19     963.93      1229.8      1229.8       152.2

   7       317.13     964.13      1470.1      1470.1       181.9

   8       338.06     964.34      1710.5      1710.5       211.7

   9       358.99     964.54      1950.9      1950.9       241.4

  10       379.92     964.75      2191.3      2191.3       271.1

  11       400.85     964.96      2431.7      2431.7       300.9
```

12	421.79	965.16	2670.3	2670.3	321.0
13	442.72	965.37	2908.1	2908.1	337.2
14	463.65	965.57	3145.9	3145.9	353.5
15	484.58	965.78	3383.8	3383.8	369.7
16	505.52	965.99	3621.6	3621.6	386.0
17	526.45	966.19	3859.5	3859.5	402.2
18	547.38	966.40	4097.3	4097.3	418.5
19	568.31	966.60	4335.1	4335.1	434.7
20	589.24	966.81	4573.0	4573.0	451.0
21	610.18	967.02	4810.8	4810.8	467.2
22	631.11	967.22	5048.7	5048.7	483.5
23	652.04	967.43	5286.5	5286.5	499.7
24	672.97	967.63	5524.3	5524.3	516.0
25	693.90	967.84	5762.2	5762.2	532.2
26	704.86	968.50	4338.5	4338.5	434.9
27	711.95	976.57	3303.2	3303.2	1404.8
28	725.15	991.59	2923.6	2923.6	1265.4
29	738.35	1006.62	2544.0	2544.0	1125.9
30	751.55	1021.64	2164.5	2164.5	986.4
31	764.75	1036.67	1784.9	1784.9	846.9
32	777.95	1051.70	1405.3	1405.3	707.4
33	791.15	1066.72	1025.7	1025.7	567.9
34	804.35	1081.75	646.1	646.1	428.4
35	817.55	1096.77	266.6	266.6	288.9

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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Peak)

#155488

TABLE NO. 59

****

* Final Results for Side Forces and Stresses Between Slices *

* (Results are for the critical shear surface in the case of a search.) *

****

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	202.00	113	963.70	0.476	64.7	86.5
2	222.93	765	965.58	0.385	37.9	205.4
3	243.86	2001	967.06	0.335	2.3	359.0
4	264.80	3822	968.54	0.316	-24.5	506.0
5	285.73	6227	970.04	0.307	-47.9	650.6
6	306.66	9217	971.55	0.301	-69.9	793.9
7	327.59	12790	973.06	0.297	-91.0	936.6
8	348.52	16948	974.58	0.295	-111.6	1078.9
9	369.46	21691	976.09	0.293	-131.9	1220.9
10	390.39	27018	977.61	0.292	-151.9	1362.7
11	411.32	32929	979.13	0.290	-171.8	1504.4
12	432.25	39218	980.72	0.291	-184.8	1631.7
13	453.18	45805	982.38	0.292	-191.4	1744.0

14	474.12	52688	984.08	0.294	-194.2	1846.0
15	495.05	59868	985.80	0.296	-194.9	1940.7
16	515.98	67345	987.54	0.298	-194.5	2030.0
17	536.91	75119	989.28	0.300	-193.5	2115.4
18	557.85	83190	991.02	0.301	-192.3	2197.7
19	578.78	91558	992.77	0.303	-191.2	2277.9
20	599.71	100222	994.51	0.304	-190.4	2356.2
21	620.64	109183	996.25	0.305	-189.9	2433.2
22	641.57	118441	997.98	0.306	-189.8	2509.1
23	662.51	127996	999.71	0.307	-190.1	2584.2
24	683.44	137848	1001.44	0.308	-190.7	2658.5
25	704.37	147997	1003.16	0.308	-191.8	2732.3
26	705.34	143520	1004.44	0.312	-158.6	2641.4
27	718.55	111822	1015.33	0.308	-163.8	2325.8
28	731.75	84062	1026.24	0.303	-167.2	2009.1
29	744.95	60239	1037.14	0.297	-167.9	1690.8
30	758.15	40355	1048.05	0.288	-164.6	1370.2
31	771.35	24408	1058.98	0.275	-154.9	1046.0
32	784.55	12399	1069.93	0.257	-134.1	716.0
33	797.75	4328	1080.99	0.226	-91.3	375.6
34	810.95	195	1095.46	0.346	0.8	20.6
35	824.15	0	1104.29	Below	-0.0	0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)
#155488

PROfile lines
   1 1 MSW
         200 964
         840 1114
         1080 1126
         1200 1120

   2 2 Sand
         0 964
         200 964
         202 962
         1200 972

   3 3 Liner
           200 964
        1200 974


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         4500 713
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1200 700


LABel
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)
ANALYSIS/COMPUTATION
   Noncircular Search 2
     200 964 fixed
     202 963 fixed
     600 966.9 0.5729387
     840 1114 fixed

     5 1
   Crack
     7 D
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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It is provided for confidential use only on an approved non-disclosure basis.

Posession and use of this software is only permitted with the express, written

approval of Stephen G. Wright

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*****************************************************************

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* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *

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```

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 3

*************************

* NEW PROFILE LINE DATA *

*************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      964.00

   2      840.00     1114.00

   3     1080.00     1126.00

   4     1200.00     1120.00



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y
```

1	0.00	964.00
2	200.00	964.00
3	202.00	962.00
4	1200.00	972.00

----- Profile Line No. 3 - Material Type (Number): 3 -----

Description: Liner

Point	X	Y
1	200.00	964.00
2	1200.00	974.00

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 --------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 --------------------

----------------------------------------------------------------------

Description: Sand
```

Constant unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

---------- DATA FOR MATERIAL NUMBER 3 ----------

Description: Liner

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	4500.0	713.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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Time and date of run: Wed Dec 06 14:23:08 2023

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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4



Point        X           Y



  1        0.00      700.00

  2     1200.00      700.00
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************



Coordinates of points on shear surface which are to be shifted



Point         X              Y      Shift Angle



   1         200.00         964.00                        - fixed

   2         202.00         963.00                        - fixed

   3         600.00         966.90      0.57              - moveable

   4         840.00        1114.00                        - fixed



Initial distance for shifting points on shear surface = 5.000

Final distance for shifting points on shear surface = 1.000

Maximum steepness permitted for toe of shear surface = 50.00




Depth of crack: 7.000

Automatic search output will be in short form.



---------------------------------------------------------------------------

The following represent default values or values that were prevously defined:
```

```
Maximum increment for slice subdivision: 30

There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Maximum number of passes for noncircular search: 50

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Minimum weight required for computations to be performed: 100

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 26

************************************

* NEW, COMPUTED SLOPE GEOMETRY DATA *

************************************



These slope geometry were generated from the Profile Lines.


     Point       X           Y


        1        0.00      964.00

        2      200.00      964.00

        3      202.00      964.47

        4      840.00     1114.00

        5     1080.00     1126.00

        6     1200.00     1120.00


Right end point on noncircular shear surface adjusted to:

X: 821.51, Y: 1102.67

Adjustment was made to put end point at bottom of crack.


Noncircular Shear Surface Points After End Point Adjustment

Coordinates of points on shear surface which are to be shifted


Point         X             Y      Shift Angle
```

```
   1         200.00         964.00                       - fixed

   2         202.00         963.00                       - fixed

   3         600.00         966.90      0.57             - moveable

   4         821.51        1102.67                       - fixed

Computed crack depth: 7.00
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 41

****************************************

*  Critical Noncircular Shear Surface  *

****************************************



***** CRITICAL NONCIRCULAR SHEAR SURFACE *****

X:     200.00     Y:     964.00

X:     202.00     Y:     963.00

X:     702.49     Y:     967.92

X:     821.51     Y:    1102.67



Minimum factor of safety: 1.524

Side force inclination: 11.77



Time required to find most critical surface:      1.0 seconds

Number of passes required to find most critical surface: 25

Total number of shear surfaces attempted: 75

Total number of shear surfaces for which the factor of safety

was successfully calculated: 75



      |   Shift    |      Max. Dist.| Minimum |   n        n    |

 Pass | Distance   | Pt.    Moved   |    F    | Tried  Computed |

      |            |                |         |                 |

    1 |     5.0000 |  3       5.000 |  1.7041 |     3        3  |
```

2	5.0000	3	5.000	1.6891	6	6
3	5.0000	3	5.000	1.6746	9	9
4	5.0000	3	5.000	1.6603	12	12
5	5.0000	3	5.000	1.6466	15	15
6	5.0000	3	5.000	1.6335	18	18
7	5.0000	3	5.000	1.6210	21	21
8	5.0000	3	5.000	1.6088	24	24
9	5.0000	3	5.000	1.5973	27	27
10	5.0000	3	5.000	1.5865	30	30
11	5.0000	3	5.000	1.5764	33	33
12	5.0000	3	5.000	1.5669	36	36
13	5.0000	3	5.000	1.5582	39	39
14	5.0000	3	5.000	1.5504	42	42
15	5.0000	3	5.000	1.5435	45	45
16	5.0000	3	5.000	1.5373	48	48
17	5.0000	3	5.000	1.5324	51	51
18	5.0000	3	5.000	1.5285	54	54
19	5.0000	3	5.000	1.5259	57	57
20	5.0000	3	5.000	1.5245	60	60
21	5.0000	0	0.000	1.5245	63	63
22	2.5000	3	2.500	1.5243	66	66
23	2.5000	0	0.000	1.5243	69	69
24	1.2500	0	0.000	1.5243	72	72
25	0.6250	0	0.000	1.5243	75	75

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y       Weight   No.    Cohesion    Angle    Pressure

        200.00    964.00

   1    201.00    963.50         145    3   NONLINEAR ENVELOPE         0.0

        202.00    963.00

   2    212.43    963.10        5464    3   NONLINEAR ENVELOPE         0.0

        222.85    963.21

   3    233.28    963.31       10351    3   NONLINEAR ENVELOPE         0.0

        243.71    963.41

   4    254.13    963.51       15239    3   NONLINEAR ENVELOPE         0.0

        264.56    963.62

   5    274.99    963.72       20126    3   NONLINEAR ENVELOPE         0.0

        285.42    963.82

   6    295.84    963.92       25013    3   NONLINEAR ENVELOPE         0.0

        306.27    964.03
```

7	316.70	964.13	29900	3	NONLINEAR ENVELOPE	0.0
	327.12	964.23				
8	337.55	964.33	34787	3	NONLINEAR ENVELOPE	0.0
	347.98	964.44				
9	358.40	964.54	39675	3	NONLINEAR ENVELOPE	0.0
	368.83	964.64				
10	379.26	964.74	44562	3	NONLINEAR ENVELOPE	0.0
	389.69	964.85				
11	400.11	964.95	49449	3	NONLINEAR ENVELOPE	0.0
	410.54	965.05				
12	420.97	965.15	54336	3	NONLINEAR ENVELOPE	0.0
	431.39	965.26				
13	441.82	965.36	59224	3	NONLINEAR ENVELOPE	0.0
	452.25	965.46				
14	462.67	965.57	64111	3	NONLINEAR ENVELOPE	0.0
	473.10	965.67				
15	483.53	965.77	68998	3	NONLINEAR ENVELOPE	0.0
	493.96	965.87				
16	504.38	965.98	73885	3	NONLINEAR ENVELOPE	0.0
	514.81	966.08				
17	525.24	966.18	78773	3	NONLINEAR ENVELOPE	0.0
	535.66	966.28				
18	546.09	966.39	83660	3	NONLINEAR ENVELOPE	0.0
	556.52	966.49				
19	566.94	966.59	88547	3	NONLINEAR ENVELOPE	0.0
	577.37	966.69				
20	587.80	966.80	93434	3	NONLINEAR ENVELOPE	0.0
	598.23	966.90				
21	608.65	967.00	98322	3	NONLINEAR ENVELOPE	0.0
	619.08	967.10				
22	629.51	967.21	103209	3	NONLINEAR ENVELOPE	0.0
	639.93	967.31				

23	650.36	967.41	108096	3	NONLINEAR ENVELOPE			0.0
	660.79	967.51						
24	671.21	967.62	112983	3	NONLINEAR ENVELOPE			0.0
	681.64	967.72						
25	692.07	967.82	117870	3	NONLINEAR ENVELOPE			0.0
	702.49	967.92						
26	702.99	968.48	5596	3	NONLINEAR ENVELOPE			0.0
	703.48	969.03						
27	710.03	976.46	70217	1	300.0	30.00		0.0
	716.59	983.88						
28	723.15	991.31	62496	1	300.0	30.00		0.0
	729.70	998.73						
29	736.26	1006.15	54775	1	300.0	30.00		0.0
	742.82	1013.58						
30	749.38	1021.00	47054	1	300.0	30.00		0.0
	755.93	1028.43						
31	762.49	1035.85	39334	1	300.0	30.00		0.0
	769.05	1043.27						
32	775.61	1050.70	31613	1	300.0	30.00		0.0
	782.16	1058.12						
33	788.72	1065.55	23892	1	300.0	30.00		0.0
	795.28	1072.97						
34	801.84	1080.39	16171	1	300.0	30.00		0.0
	808.39	1087.82						
35	814.95	1095.24	8451	1	300.0	30.00		0.0
	821.51	1102.67						

No water in crack.

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  18

Allowable moment imbalance for convergence: 10543



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.506e+005  -1.116e+008

First-order corrections to F and Theta .............   -2.6747    -0.9778

Reduced values - Deltas were too large .............   -0.5000    -0.1828



   2   2.50000    17.0060   1.170e+005  -8.652e+007

First-order corrections to F and Theta .............   -1.4768    -1.1671

Reduced values - Deltas were too large .............   -0.5000    -0.3951



   3   2.00000    16.6108   6.795e+004  -4.970e+007
```

```
First-order corrections to F and Theta ............   -0.5741    -1.6174

Reduced values - Deltas were too large ............   -0.5000    -1.4086


   4   1.50000    15.2022  -1.014e+004   9.846e+006

First-order corrections to F and Theta ............    0.0144    -4.8064

Reduced values - Deltas were too large ............    0.0086    -2.8648


   5   1.50858    12.3375  -4.135e+003   3.748e+006

First-order corrections to F and Theta ............    0.0154    -0.6412

Second-order corrections to F and Theta ...........    0.0160    -0.5681


   6   1.52460    11.7694   6.852e-001  -1.985e+002

First-order corrections to F and Theta ............   -0.0000    -0.0007


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.481 (percent)

     Maximum change occurred for slice 20

     Normal stress where max. change occurred:      4565.23

     Old strength at this slice:       723.34

     New strength at this slice:       719.85
```

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  18

Allowable moment imbalance for convergence: 10543



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.506e+005  -1.116e+008

First-order corrections to F and Theta .............   -2.6756    -0.9779

Reduced values - Deltas were too large .............   -0.5000    -0.1827



   2   2.50000    17.0060   1.171e+005  -8.654e+007

First-order corrections to F and Theta .............   -1.4776    -1.1672

Reduced values - Deltas were too large .............   -0.5000    -0.3950



   3   2.00000    16.6110   6.799e+004  -4.973e+007
```

```
First-order corrections to F and Theta ............   -0.5747    -1.6173

Reduced values - Deltas were too large ............   -0.5000    -1.4072


   4   1.50000    15.2039  -1.007e+004   9.791e+006

First-order corrections to F and Theta ............    0.0143    -4.7969

Reduced values - Deltas were too large ............    0.0085    -2.8648


   5   1.50853    12.3391  -4.093e+003   3.715e+006

First-order corrections to F and Theta ............    0.0152    -0.6438

Second-order corrections to F and Theta ...........    0.0158    -0.5711


   6   1.52435    11.7680   6.702e-001  -1.922e+002

First-order corrections to F and Theta ............   -0.0000    -0.0007


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:      0.000 (percent)

     Maximum change occurred for slice 25

     Normal stress where max. change occurred:      5750.34

     Old strength at this slice:       844.40

     New strength at this slice:       844.40

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  18

Allowable moment imbalance for convergence: 10543



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   1.506e+005  -1.116e+008

First-order corrections to F and Theta .............   -2.6756    -0.9779

Reduced values - Deltas were too large .............   -0.5000    -0.1827



   2   2.50000    17.0060   1.171e+005  -8.654e+007

First-order corrections to F and Theta .............   -1.4776    -1.1672

Reduced values - Deltas were too large .............   -0.5000    -0.3950



   3   2.00000    16.6110   6.799e+004  -4.973e+007
```

```
First-order corrections to F and Theta ............   -0.5747    -1.6173

Reduced values - Deltas were too large ............   -0.5000    -1.4072


   4   1.50000    15.2039  -1.007e+004   9.791e+006

First-order corrections to F and Theta ............    0.0143    -4.7969

Reduced values - Deltas were too large ............    0.0085    -2.8648


   5   1.50853    12.3391  -4.093e+003   3.715e+006

First-order corrections to F and Theta ............    0.0152    -0.6438

Second-order corrections to F and Theta ...........    0.0158    -0.5711


   6   1.52435    11.7680   6.702e-001  -1.922e+002

First-order corrections to F and Theta ............   -0.0000    -0.0007
```

```
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North\20231019 North LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 7.12959e-011



Summation of Vertical Forces: 1.67347e-010



Summation of Moments: -1.56624e-002



Mohr Coulomb Shear Force/Shear Strength Check Summation: 3.40066e-011
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 58

**************************************************************************

* Final Results for Stresses Along the Shear Surface                    *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************



SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 1.524     Side Force Inclination:  11.77



       -------- VALUES AT CENTER OF BASE OF SLICE --------

                                Total     Effective

Slice                           Normal     Normal       Shear

  No.    X-Center   Y-Center     Stress     Stress       Stress



   1       201.00     963.50        88.1        88.1         9.2

   2       212.43     963.10       267.0       267.0        27.8

   3       233.28     963.31       505.8       505.8        52.6

   4       254.13     963.51       744.6       744.6        77.4

   5       274.99     963.72       983.4       983.4       102.2

   6       295.84     963.92      1222.1      1222.1       127.0

   7       316.70     964.13      1460.9      1460.9       151.9

   8       337.55     964.33      1699.7      1699.7       176.7

   9       358.40     964.54      1938.5      1938.5       201.5

  10       379.26     964.74      2177.3      2177.3       226.3
```

11	400.11	964.95	2416.1	2416.1	251.1
12	420.97	965.15	2654.9	2654.9	276.0
13	441.82	965.36	2893.7	2893.7	300.8
14	462.67	965.57	3132.5	3132.5	325.6
15	483.53	965.77	3371.3	3371.3	350.4
16	504.38	965.98	3610.1	3610.1	375.2
17	525.24	966.18	3848.9	3848.9	400.1
18	546.09	966.39	4087.6	4087.6	424.9
19	566.94	966.59	4326.4	4326.4	449.7
20	587.80	966.80	4564.8	4564.8	472.2
21	608.65	967.00	4801.9	4801.9	488.6
22	629.51	967.21	5039.0	5039.0	504.9
23	650.36	967.41	5276.1	5276.1	521.3
24	671.21	967.62	5513.2	5513.2	537.6
25	692.07	967.82	5750.3	5750.3	553.9
26	702.99	968.48	4286.3	4286.3	445.5
27	710.03	976.46	3261.7	3261.7	1432.2
28	723.15	991.31	2890.4	2890.4	1291.6
29	736.26	1006.15	2519.2	2519.2	1151.0
30	749.38	1021.00	2147.9	2147.9	1010.3
31	762.49	1035.85	1776.7	1776.7	869.7
32	775.61	1050.70	1405.4	1405.4	729.1
33	788.72	1065.55	1034.2	1034.2	588.5
34	801.84	1080.39	662.9	662.9	447.9
35	814.95	1095.24	291.7	291.7	307.3

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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North\20231019 North LTSS - Residual.dat


El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488


TABLE NO. 59

**************************************************************************

* Final Results for Side Forces and Stresses Between Slices             *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


       ---------------- VALUES AT RIGHT SIDE OF SLICE ----------------


                                Y-Coord. of   Fraction    Sigma      Sigma

Slice                   Side    Side Force       of         at         at

  No.    X-Right      Force     Location      Height      Top       Bottom


   1      202.00          109       963.71     0.482        64.7       80.1

   2      222.85          644       965.74     0.413        48.8      156.2

   3      243.71         1658       967.27     0.356        20.6      279.0

   4      264.56         3150       968.80     0.334         1.3      396.2

   5      285.42         5121       970.36     0.324       -14.6      511.1

   6      306.27         7571       971.92     0.317       -29.0      624.8

   7      327.12        10500       973.48     0.313       -42.6      738.0

   8      347.98        13907       975.05     0.310       -55.7      850.8

   9      368.83        17793       976.63     0.308       -68.4      963.3

  10      389.69        22157       978.20     0.306       -80.9     1075.6

  11      410.54        27000       979.78     0.305       -93.2     1187.9

  12      431.39        32322       981.36     0.304      -105.4     1300.0
```

13	452.25	38123	982.94	0.303	-117.5	1412.1
14	473.10	44402	984.52	0.302	-129.5	1524.1
15	493.96	51160	986.10	0.302	-141.5	1636.1
16	514.81	58397	987.68	0.301	-153.4	1748.0
17	535.66	66112	989.26	0.301	-165.3	1859.9
18	556.52	74306	990.84	0.300	-177.2	1971.8
19	577.37	82978	992.43	0.300	-189.0	2083.6
20	598.23	92080	994.02	0.300	-199.8	2193.4
21	619.08	101481	995.66	0.300	-207.4	2296.3
22	639.93	111180	997.33	0.301	-212.5	2393.8
23	660.79	121177	999.03	0.302	-215.9	2486.7
24	681.64	131473	1000.74	0.303	-218.0	2576.0
25	702.49	142068	1002.47	0.303	-219.1	2662.4
26	703.48	137655	1003.77	0.307	-185.1	2571.0
27	716.59	107372	1014.59	0.303	-186.3	2263.8
28	729.70	80837	1025.41	0.298	-185.6	1955.6
29	742.82	58048	1036.24	0.292	-182.1	1645.9
30	755.93	39006	1047.08	0.283	-174.6	1334.0
31	769.05	23711	1057.93	0.271	-160.5	1018.7
32	782.16	12163	1068.83	0.253	-135.6	698.2
33	795.28	4362	1079.88	0.226	-89.8	369.4
34	808.39	307	1093.88	0.323	-1.0	33.1
35	821.51	0	1102.67	Above	-0.0	0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

Profile: North Case: Seismic

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y		
200	964	fixed	
202	963	fixed	
750	968.5	0.5729387	deg
840	1114		

Shifting Points
5
1

Crack Depth
0

Seismic Acceleration
0.15

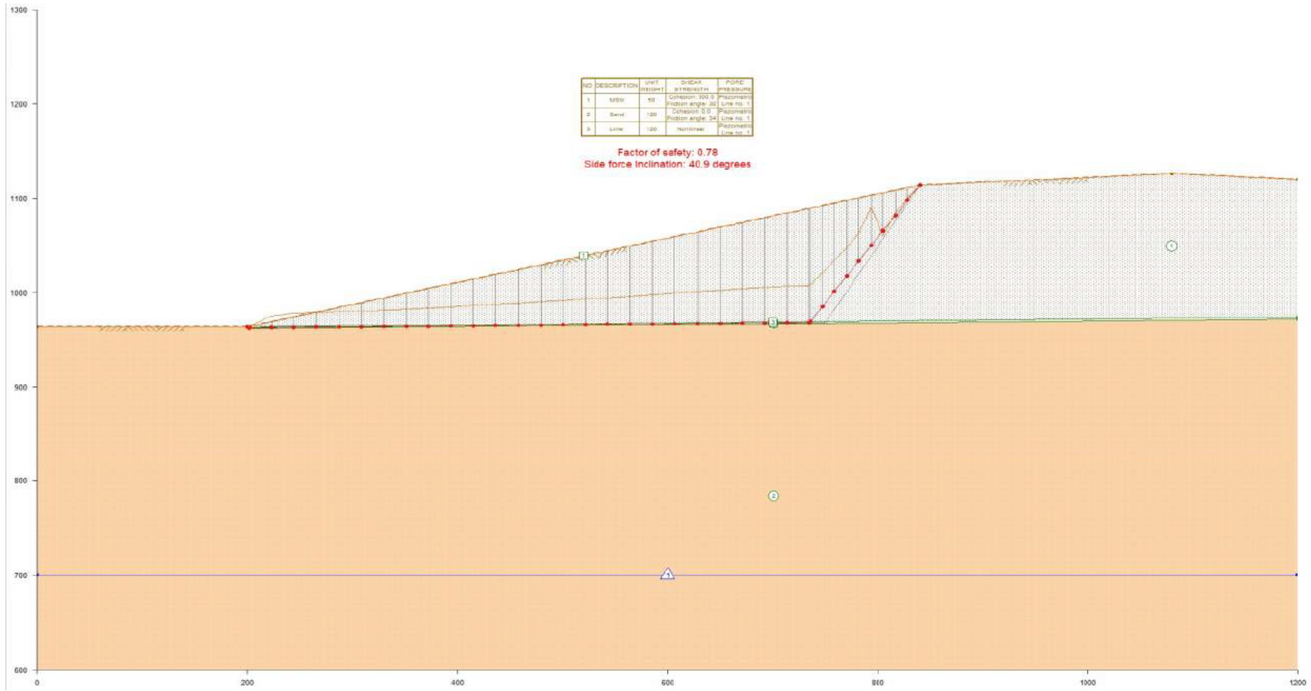
Minimum Weight

Results

Noncircular Shear Surface

200	964
202	963
735	968.4
840	1114

Factor of Safety
0.78



Profile: North Case: Seismic - Yield Acceleration INCLUDED

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y		
200	964	fixed	
202	963	fixed	
750	968.5	0.5729387	deg
840	1114		

Shifting Points
5
1

Crack Depth
20

Seismic Acceleration
0.085

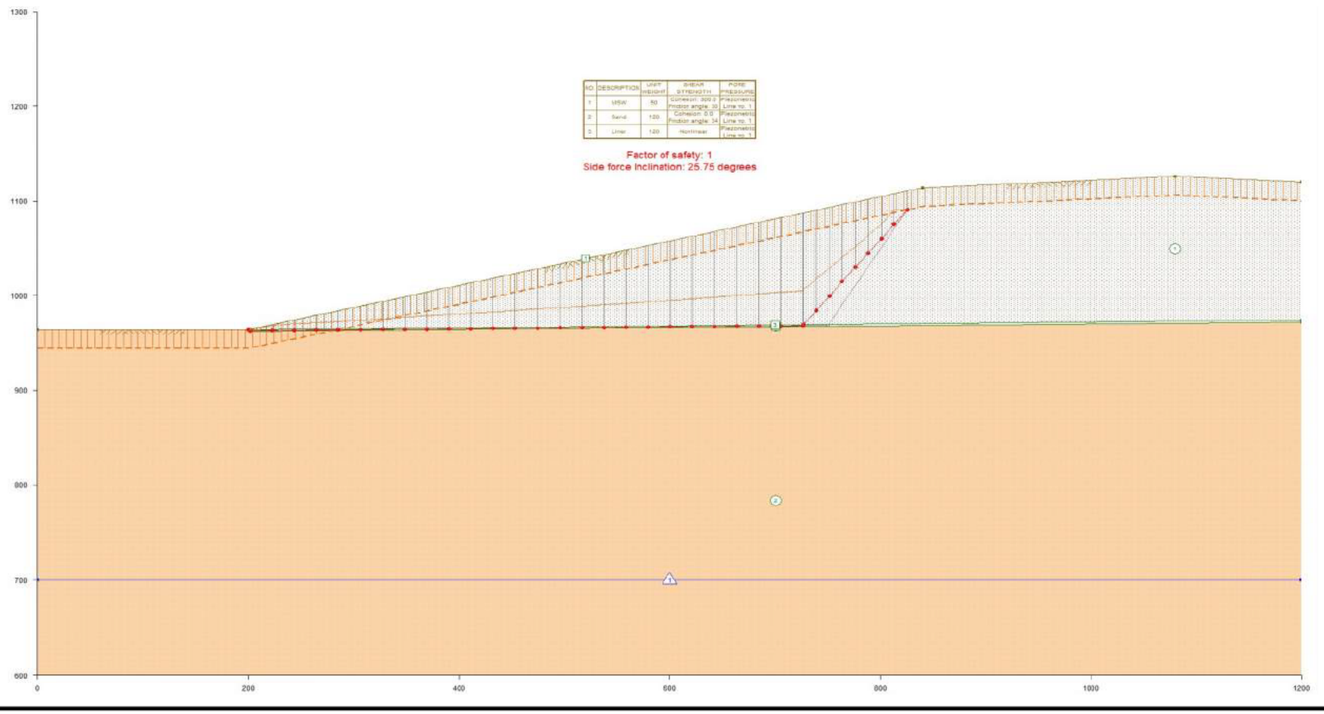
Minimum Weight

Results

Noncircular Shear Surface

200	964
202	963
726.3	968.3
825.5	1090.6

Factor of Safety
1



```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)
#155488

PROfile lines
   1 1 MSW
         200 964
         840 1114
         1080 1126
         1200 1120

   2 2 Sand
         0 964
         200 964
         202 962
         1200 972

   3 3 Liner
           200 964
        1200 974


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         4500 713
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1200 700


LABel
El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)
ANALYSIS/COMPUTATION
   Noncircular Search 2
     200 964 fixed
     202 963 fixed
     750 968.5 0.5729387
     840 1114 fixed

     5 1
   Crack
     20 D
   Seismic
     0.085
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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```

```
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North\20231019 North LTSS - Residual Seismic fy.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

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TABLE NO. 3

************************

* NEW PROFILE LINE DATA *

************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      964.00

   2      840.00     1114.00

   3     1080.00     1126.00

   4     1200.00     1120.00



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y



   1        0.00      964.00
```

```
   2      200.00      964.00

   3      202.00      962.00

   4     1200.00      972.00


------------------------------------------------------------

----- Profile Line No. 3 - Material Type (Number): 3 -----

------------------------------------------------------------

Description: Liner


Point        X           Y


   1      200.00      964.00

   2     1200.00      974.00
```

```
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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

```
Constant unit weight of soil (material): 120.0


CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)


Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.


---------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 3 -------------------

---------------------------------------------------------------------

Description: Liner


Constant unit weight of soil (material): 120.0


---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

     Point     Normal Stress     Shear Stress


       1                0.0              0.0

       2             4500.0            713.0

       3            10000.0           1291.0


Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.
```

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1200.00      700.00
```

```
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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************



Coordinates of points on shear surface which are to be shifted



Point         X              Y      Shift Angle



   1         200.00         964.00                       - fixed

   2         202.00         963.00                       - fixed

   3         750.00         968.50      0.57             - moveable

   4         840.00        1114.00                       - fixed



Initial distance for shifting points on shear surface = 5.000

Final distance for shifting points on shear surface = 1.000

Maximum steepness permitted for toe of shear surface = 50.00





Depth of crack: 20.000

Seismic coefficient: 0.085

Seismic force acts at center of gravity.

Automatic search output will be in short form.



--------------------------------------------------------------------------------
```

```
The following represent default values or values that were prevously defined:

Maximum increment for slice subdivision: 30

There is no water in a crack.

Conventional (single-stage) computations will be performed.

Unit weight of water (or other fluid) in crack: 62.4

Maximum number of passes for noncircular search: 50

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Minimum weight required for computations to be performed: 100

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

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TABLE NO. 26

****

* NEW, COMPUTED SLOPE GEOMETRY DATA *

****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	0.00	964.00
2	200.00	964.00
3	202.00	964.47
4	840.00	1114.00
5	1080.00	1126.00
6	1200.00	1120.00

Right end point on noncircular shear surface adjusted to:

X: 825.53, Y: 1090.61

Adjustment was made to put end point at bottom of crack.

Noncircular Shear Surface Points After End Point Adjustment

Coordinates of points on shear surface which are to be shifted

Point	X	Y	Shift Angle

```
   1         200.00         964.00                       - fixed

   2         202.00         963.00                       - fixed

   3         750.00         968.50      0.57             - moveable

   4         825.53        1090.61                       - fixed

Computed crack depth: 20.00
```

```
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TABLE NO. 41

****************************************

*  Critical Noncircular Shear Surface  *

****************************************



***** CRITICAL NONCIRCULAR SHEAR SURFACE *****

X:     200.00     Y:     964.00

X:     202.00     Y:     963.00

X:     726.25     Y:     968.26

X:     825.53     Y:    1090.61



Minimum factor of safety: 1.005

Side force inclination: 25.75



Time required to find most critical surface:      0.0 seconds

Number of passes required to find most critical surface: 11

Total number of shear surfaces attempted: 33

Total number of shear surfaces for which the factor of safety

was successfully calculated: 33



      |   Shift    |      Max. Dist.| Minimum |   n        n    |

 Pass | Distance   | Pt.    Moved   |    F    | Tried  Computed |

      |            |                |         |                 |

    1 |     5.0000 |  3       5.000 |  1.0147 |     3        3  |

    2 |     5.0000 |  3       5.000 |  1.0099 |     6        6  |
```

3	5.0000	3	5.000	1.0068	9	9
4	5.0000	3	5.000	1.0052	12	12
5	5.0000	3	5.000	1.0050	15	15
6	5.0000	0	0.000	1.0050	18	18
7	2.5000	3	2.500	1.0049	21	21
8	2.5000	0	0.000	1.0049	24	24
9	1.2500	3	1.250	1.0049	27	27
10	1.2500	0	0.000	1.0049	30	30
11	0.6250	0	0.000	1.0049	33	33

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

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TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y        Weight   No.    Cohesion    Angle    Pressure

       200.00    964.00

   1   201.00    963.50          145    3   NONLINEAR ENVELOPE         0.0

       202.00    963.00

   2   212.49    963.11         5503    3   NONLINEAR ENVELOPE         0.0

       222.97    963.21

   3   233.46    963.32        10434    3   NONLINEAR ENVELOPE         0.0

       243.94    963.42

   4   254.43    963.53        15366    3   NONLINEAR ENVELOPE         0.0

       264.91    963.63

   5   275.40    963.74        20297    3   NONLINEAR ENVELOPE         0.0

       285.88    963.84

   6   296.37    963.95        25228    3   NONLINEAR ENVELOPE         0.0

       306.85    964.05

   7   317.34    964.16        30160    3   NONLINEAR ENVELOPE         0.0
```

	327.82	964.26				
8	338.31	964.37	35091	3	NONLINEAR ENVELOPE	0.0
	348.79	964.47				
9	359.28	964.58	40022	3	NONLINEAR ENVELOPE	0.0
	369.76	964.68				
10	380.25	964.79	44954	3	NONLINEAR ENVELOPE	0.0
	390.73	964.89				
11	401.22	965.00	49885	3	NONLINEAR ENVELOPE	0.0
	411.70	965.11				
12	422.19	965.21	54816	3	NONLINEAR ENVELOPE	0.0
	432.67	965.32				
13	443.16	965.42	59748	3	NONLINEAR ENVELOPE	0.0
	453.64	965.53				
14	464.13	965.63	64679	3	NONLINEAR ENVELOPE	0.0
	474.61	965.74				
15	485.10	965.84	69611	3	NONLINEAR ENVELOPE	0.0
	495.58	965.95				
16	506.07	966.05	74542	3	NONLINEAR ENVELOPE	0.0
	516.55	966.16				
17	527.04	966.26	79473	3	NONLINEAR ENVELOPE	0.0
	537.52	966.37				
18	548.01	966.47	84405	3	NONLINEAR ENVELOPE	0.0
	558.49	966.58				
19	568.98	966.68	89336	3	NONLINEAR ENVELOPE	0.0
	579.46	966.79				
20	589.95	966.89	94267	3	NONLINEAR ENVELOPE	0.0
	600.43	967.00				
21	610.92	967.10	99199	3	NONLINEAR ENVELOPE	0.0
	621.40	967.21				
22	631.89	967.32	104130	3	NONLINEAR ENVELOPE	0.0
	642.37	967.42				
23	652.86	967.53	109061	3	NONLINEAR ENVELOPE	0.0
	663.34	967.63				
24	673.83	967.74	113993	3	NONLINEAR ENVELOPE	0.0

	684.31	967.84						
25	694.80	967.95	118924	3	NONLINEAR ENVELOPE			0.0
	705.28	968.05						
26	715.77	968.16	123855	3	NONLINEAR ENVELOPE			0.0
	726.25	968.26						
27	726.66	968.77	4883	3	NONLINEAR ENVELOPE			0.0
	727.07	969.27						
28	733.22	976.85	68997	1	300.0	30.00		0.0
	739.38	984.44						
29	745.53	992.02	61439	1	300.0	30.00		0.0
	751.68	999.61						
30	757.84	1007.19	53880	1	300.0	30.00		0.0
	763.99	1014.77						
31	770.15	1022.36	46321	1	300.0	30.00		0.0
	776.30	1029.94						
32	782.45	1037.52	38763	1	300.0	30.00		0.0
	788.61	1045.11						
33	794.76	1052.69	31204	1	300.0	30.00		0.0
	800.92	1060.27						
34	807.07	1067.86	23646	1	300.0	30.00		0.0
	813.22	1075.44						
35	819.38	1083.03	16087	1	300.0	30.00		0.0
	825.53	1090.61						

No water in crack.

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TABLE NO. 44

****

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the *

* case of an automatic search.) *

****

FORCES DUE TO DISTRIBUTED LOADS

Slices No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	201.00	-12	963.81	0	0	201.00	964.23
2	212.49	-468	964.63	0	0	212.49	966.93
3	233.46	-887	967.04	0	0	233.46	971.84
4	254.43	-1306	969.55	0	0	254.43	976.76
5	275.40	-1725	972.08	0	0	275.40	981.67
6	296.37	-2144	974.63	0	0	296.37	986.59
7	317.34	-2564	977.18	0	0	317.34	991.50
8	338.31	-2983	979.73	0	0	338.31	996.42
9	359.28	-3402	982.29	0	0	359.28	1001.33
10	380.25	-3821	984.85	0	0	380.25	1006.25
11	401.22	-4240	987.41	0	0	401.22	1011.16

12	422.19	-4659	989.97	0	0	422.19	1016.07
13	443.16	-5079	992.53	0	0	443.16	1020.99
14	464.13	-5498	995.09	0	0	464.13	1025.90
15	485.10	-5917	997.65	0	0	485.10	1030.82
16	506.07	-6336	1000.21	0	0	506.07	1035.73
17	527.04	-6755	1002.77	0	0	527.04	1040.65
18	548.01	-7174	1005.33	0	0	548.01	1045.56
19	568.98	-7594	1007.90	0	0	568.98	1050.48
20	589.95	-8013	1010.46	0	0	589.95	1055.39
21	610.92	-8432	1013.02	0	0	610.92	1060.31
22	631.89	-8851	1015.58	0	0	631.89	1065.22
23	652.86	-9270	1018.15	0	0	652.86	1070.14
24	673.83	-9689	1020.71	0	0	673.83	1075.05
25	694.80	-10109	1023.27	0	0	694.80	1079.97
26	715.77	-10528	1025.83	0	0	715.77	1084.88
27	726.66	-415	1027.75	0	0	726.66	1087.44
28	733.22	-5865	1032.91	0	0	733.22	1088.97
29	745.53	-5222	1041.94	0	0	745.53	1091.86
30	757.84	-4580	1050.97	0	0	757.84	1094.74
31	770.15	-3937	1059.99	0	0	770.15	1097.63
32	782.45	-3295	1069.02	0	0	782.45	1100.51
33	794.76	-2652	1078.04	0	0	794.76	1103.40
34	807.07	-2010	1087.07	0	0	807.07	1106.28
35	819.38	-1367	1096.10	0	0	819.38	1109.17

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  20

Allowable moment imbalance for convergence: 11488



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   3.237e+005  -2.484e+008

First-order corrections to F and Theta .............   -5.6400     0.7554

Reduced values - Deltas were too large .............   -0.5000     0.0670



   2   2.50000    17.2557   2.896e+005  -2.223e+008

First-order corrections to F and Theta .............   -3.5722     0.8184

Reduced values - Deltas were too large .............   -0.5000     0.1145



   3   2.00000    17.3703   2.397e+005  -1.842e+008

First-order corrections to F and Theta .............   -1.9421     0.9403
```

```
Reduced values - Deltas were too large .............   -0.5000     0.2421


   4   1.50000    17.6123   1.591e+005  -1.229e+008

First-order corrections to F and Theta .............   -0.7519     1.2745

Reduced values - Deltas were too large .............   -0.5000     0.8475


   5   1.00000    18.4599   5.416e+003  -7.259e+006

First-order corrections to F and Theta .............    0.0021     6.2764

Reduced values - Deltas were too large .............    0.0010     2.8648


   6   1.00096    21.3247   2.888e+003  -4.003e+006

First-order corrections to F and Theta .............    0.0032     4.0854

Reduced values - Deltas were too large .............    0.0022     2.8648


   7   1.00317    24.1895   7.905e+002  -1.228e+006

First-order corrections to F and Theta .............    0.0020     1.5321

Second-order corrections to F and Theta ............    0.0021     1.5631


   8   1.00529    25.7526  -1.112e+000   1.210e+002

First-order corrections to F and Theta .............    0.0000     0.0012


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.970 (percent)

     Maximum change occurred for slice 20

     Normal stress where max. change occurred:      4633.53

     Old strength at this slice:       734.16

     New strength at this slice:       727.03
```

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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North\20231019 North LTSS - Residual Seismic fy.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  20

Allowable moment imbalance for convergence: 11488



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   3.237e+005  -2.483e+008

First-order corrections to F and Theta .............   -5.6396     0.7555

Reduced values - Deltas were too large .............   -0.5000     0.0670



   2   2.50000    17.2557   2.896e+005  -2.223e+008

First-order corrections to F and Theta .............   -3.5721     0.8184

Reduced values - Deltas were too large .............   -0.5000     0.1146



   3   2.00000    17.3703   2.397e+005  -1.842e+008

First-order corrections to F and Theta .............   -1.9423     0.9403
```

```
Reduced values - Deltas were too large .............   -0.5000     0.2421


   4   1.50000    17.6123   1.591e+005  -1.229e+008

First-order corrections to F and Theta .............   -0.7522     1.2744

Reduced values - Deltas were too large .............   -0.5000     0.8471


   5   1.00000    18.4594   5.524e+003  -7.338e+006

First-order corrections to F and Theta .............    0.0017     6.2554

Reduced values - Deltas were too large .............    0.0008     2.8648


   6   1.00077    21.3242   2.938e+003  -4.038e+006

First-order corrections to F and Theta .............    0.0030     4.0781

Reduced values - Deltas were too large .............    0.0021     2.8648


   7   1.00285    24.1890   8.022e+002  -1.235e+006

First-order corrections to F and Theta .............    0.0019     1.5309

Second-order corrections to F and Theta ............    0.0021     1.5626


   8   1.00492    25.7516  -1.108e+000   1.221e+002

First-order corrections to F and Theta .............    0.0000     0.0012


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.000 (percent)

     Maximum change occurred for slice 22

     Normal stress where max. change occurred:      5102.23

     Old strength at this slice:       776.29

     New strength at this slice:       776.29

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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North\20231019 North LTSS - Residual Seismic fy.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  20

Allowable moment imbalance for convergence: 11488



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   3.237e+005  -2.483e+008

First-order corrections to F and Theta .............   -5.6396     0.7555

Reduced values - Deltas were too large .............   -0.5000     0.0670



   2   2.50000    17.2557   2.896e+005  -2.223e+008

First-order corrections to F and Theta .............   -3.5721     0.8184

Reduced values - Deltas were too large .............   -0.5000     0.1146



   3   2.00000    17.3703   2.397e+005  -1.842e+008

First-order corrections to F and Theta .............   -1.9423     0.9403
```

```
Reduced values - Deltas were too large .............   -0.5000     0.2421


   4   1.50000    17.6123   1.591e+005  -1.229e+008

First-order corrections to F and Theta .............   -0.7522     1.2744

Reduced values - Deltas were too large .............   -0.5000     0.8471


   5   1.00000    18.4594   5.524e+003  -7.338e+006

First-order corrections to F and Theta .............    0.0017     6.2554

Reduced values - Deltas were too large .............    0.0008     2.8648


   6   1.00077    21.3242   2.938e+003  -4.038e+006

First-order corrections to F and Theta .............    0.0030     4.0781

Reduced values - Deltas were too large .............    0.0021     2.8648


   7   1.00285    24.1890   8.022e+002  -1.235e+006

First-order corrections to F and Theta .............    0.0019     1.5309

Second-order corrections to F and Theta ............    0.0021     1.5626


   8   1.00492    25.7516  -1.108e+000   1.221e+002

First-order corrections to F and Theta .............    0.0000     0.0012
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

#155488



TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 7.71472e-011



Summation of Vertical Forces: 1.55524e-010



Summation of Moments: -3.46765e-002



Mohr Coulomb Shear Force/Shear Strength Check Summation: 5.40084e-011
```

```
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Time and date of run: Wed Dec 06 14:23:08 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\Phase 1 -
North\20231019 North LTSS - Residual Seismic fy.dat


El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

#155488


TABLE NO. 58

**************************************************************************

* Final Results for Stresses Along the Shear Surface                    *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 1.005     Side Force Inclination:  25.75


       -------- VALUES AT CENTER OF BASE OF SLICE --------

                                Total     Effective

Slice                           Normal     Normal       Shear

  No.    X-Center   Y-Center     Stress     Stress       Stress


   1       201.00     963.50       115.0       115.0        18.1

   2       212.49     963.11       270.5       270.5        42.6

   3       233.46     963.32       512.9       512.9        80.9

   4       254.43     963.53       755.3       755.3       119.1

   5       275.40     963.74       997.7       997.7       157.3

   6       296.37     963.95      1240.1      1240.1       195.5

   7       317.34     964.16      1482.5      1482.5       233.7

   8       338.31     964.37      1724.9      1724.9       272.0

   9       359.28     964.58      1967.3      1967.3       310.2

  10       380.25     964.79      2209.7      2209.7       348.4

  11       401.22     965.00      2452.1      2452.1       386.6
```

12	422.19	965.21	2694.5	2694.5	424.8
13	443.16	965.42	2936.9	2936.9	463.1
14	464.13	965.63	3179.3	3179.3	501.3
15	485.10	965.84	3421.7	3421.7	539.5
16	506.07	966.05	3664.1	3664.1	577.7
17	527.04	966.26	3906.5	3906.5	615.9
18	548.01	966.47	4148.9	4148.9	654.1
19	568.98	966.68	4391.3	4391.3	692.4
20	589.95	966.89	4630.2	4630.2	723.1
21	610.92	967.10	4866.2	4866.2	747.8
22	631.89	967.32	5102.2	5102.2	772.5
23	652.86	967.53	5338.3	5338.3	797.2
24	673.83	967.74	5574.3	5574.3	821.9
25	694.80	967.95	5810.3	5810.3	846.5
26	715.77	968.16	6046.4	6046.4	871.2
27	726.66	968.77	3341.9	3341.9	526.9
28	733.22	976.85	2543.9	2543.9	1760.1
29	745.53	992.02	2253.1	2253.1	1593.0
30	757.84	1007.19	1962.3	1962.3	1425.9
31	770.15	1022.36	1671.5	1671.5	1258.9
32	782.45	1037.52	1380.7	1380.7	1091.8
33	794.76	1052.69	1089.9	1089.9	924.7
34	807.07	1067.86	799.1	799.1	757.7
35	819.38	1083.03	508.4	508.4	590.6

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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El Paso, TX Landfill Evaluation - North LTSS Noncircular Seismic (Residual)

#155488


TABLE NO. 59

**************************************************************************

* Final Results for Side Forces and Stresses Between Slices             *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


       ---------------- VALUES AT RIGHT SIDE OF SLICE ----------------


                                Y-Coord. of   Fraction    Sigma      Sigma

Slice                   Side    Side Force       of         at         at

  No.    X-Right       Force     Location      Height      Top       Bottom


   1      202.00          154       963.95     0.650       179.8        9.4

   2      222.97          565       968.37     0.836       248.4      -83.7

   3      243.94         1343       969.89     0.595       174.7       47.7

   4      264.91         2489       971.24     0.488       133.8      153.9

   5      285.88         4003       972.61     0.432       105.6      249.8

   6      306.85         5884       974.02     0.399        83.3      340.8

   7      327.82         8134       975.45     0.377        64.4      429.0

   8      348.79        10751       976.91     0.361        47.4      515.5

   9      369.76        13736       978.37     0.350        31.8      600.9

  10      390.73        17088       979.85     0.341        17.1      685.6

  11      411.70        20809       981.34     0.335         3.0      769.7

  12      432.67        24897       982.83     0.329       -10.6      853.3

  13      453.64        29353       984.33     0.325       -23.8      936.7
```

14	474.61	34177	985.83	0.321	-36.7	1019.8
15	495.58	39369	987.34	0.318	-49.4	1102.7
16	516.55	44928	988.84	0.315	-62.0	1185.5
17	537.52	50855	990.35	0.313	-74.3	1268.1
18	558.49	57150	991.87	0.310	-86.6	1350.6
19	579.46	63813	993.38	0.309	-98.7	1433.1
20	600.43	70671	994.95	0.308	-107.9	1509.1
21	621.40	77582	996.59	0.308	-113.3	1575.8
22	642.37	84548	998.27	0.308	-116.8	1635.8
23	663.34	91568	999.95	0.308	-119.8	1691.2
24	684.31	98642	1001.62	0.308	-123.2	1743.4
25	705.28	105771	1003.25	0.308	-127.7	1793.6
26	726.25	112953	1004.85	0.307	-133.8	1842.5
27	727.07	109230	1006.23	0.313	-103.9	1767.7
28	739.38	83931	1017.57	0.313	-88.7	1515.3
29	751.68	61959	1028.95	0.313	-72.1	1263.3
30	763.99	43314	1040.39	0.315	-53.8	1012.2
31	776.30	27997	1051.94	0.318	-33.1	762.6
32	788.61	16007	1063.70	0.327	-9.6	516.8
33	800.92	7344	1075.95	0.352	16.5	280.4
34	813.22	2008	1089.94	0.449	38.9	73.2
35	825.53	0	1090.61	Above	-0.0	0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

The Makdisi and Seed approach includes the following steps:

(1) Determine k_y using the limit equilibrium method (e.g. UTEXAS4 with the Spencer method of analysis). Failure surfaces that disrupt the crest and involve progressively larger portions of the embankment should be considered (e.g., critical surfaces that pass through the upper fourth, upper half, and the full embankment may be analyzed). The *y/h* ratio for each failure surface is determined, where *y* is the maximum depth of the sliding mass and *h* is the height of the embankment.

The yield acceleration should be calculated using soil strengths that are appropriate for rapid cyclic loading. The consolidated undrained strength is generally the most realistic for saturated materials of relatively low permeability. It may be appropriate to limit the undrained strength of dense, dilatant material to no more than the drained strength. Drained strengths are typically used for unsaturated materials and for very pervious materials with unobstructed drainage (e.g. clean gravels at the ground surface). For compacted clayey materials, Makdisi and Seed recommend using 80% of the yield strength measured in typical monotonic shear tests.

[For example, assume k_y = 0.15g, y/h = 0.5, M = 7.5, and PGA = 0.3g.]

(2) The graph shown in Fig. 9 is used to determine the ratio k_{max} / u_{max}, where k_{max} is the maximum average acceleration for the potential sliding mass extending to depth *y* and u_{max} is the maximum crest acceleration.

[For y/h = 0.5, $k_{max} / u_{max} \approx 0.75$ for upper bound]

(3) The maximum crest acceleration u_{max} may be estimated using a number of techniques. Makdisi and Seed developed a hand-calculation procedure based on a simplifying assumption regarding the structural behavior. A finite element analysis may also be performed, although this defeats the simple nature of this approach. Alternatively, trends of u_{max} versus base acceleration derived from actual recordings of transverse crest acceleration may be used, such as shown in Fig. 10.

[For PGA = 0.3g, $u_{max} \approx 0.6$g for upper bound]

(4) Calculate the maximum average acceleration k_{max} for the potential sliding mass from steps 3 and 4.

[For $k_{max} / u_{max} \approx 0.75$ and $u_{max} \approx 0.6$g, $k_{max} = 0.45$g]

(5) Calculate k_y / k_{max} from steps 1 and 4.

[For k_y = 0.15g and k_{max} = 0.45g, $k_y / k_{max} = 0.33$]

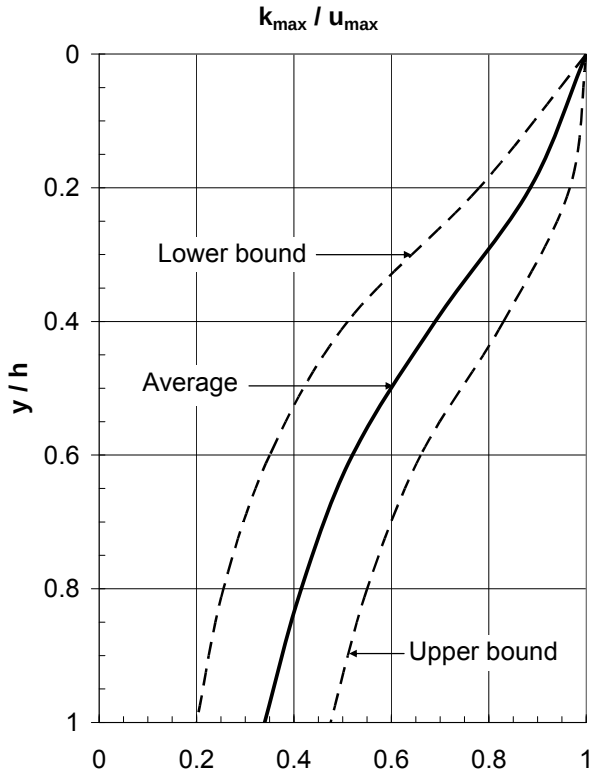


Fig. 9. Variation of maximum acceleration ratio with depth of sliding mass (based on Makdisi and Seed 1978).

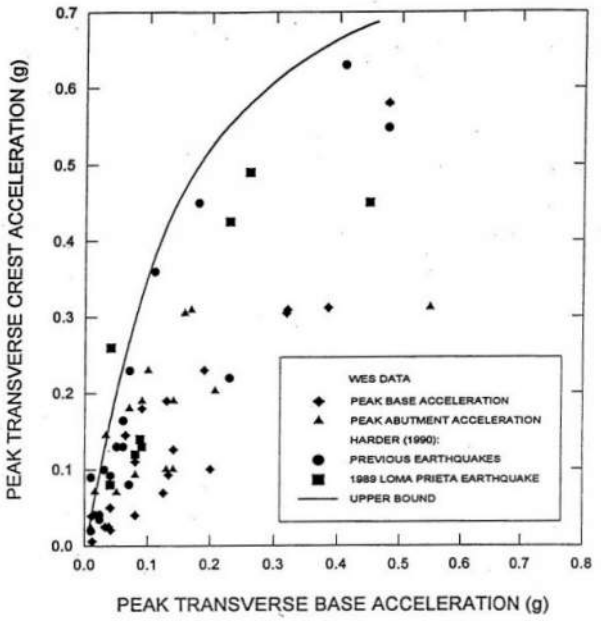


Fig. 10. Comparison of peak base and crest transverse accelerations measured at earth dams (from US Army Corps of Engineers, 2000).

(6) For the expected earthquake magnitude and the known k_y / k_{max} ratio, use the graph in Fig. 11 to estimate the range in potential permanent displacement. These ranges are given for three earthquake magnitudes, as magnitude is generally related to duration of ground shaking and, consequently, more acceleration cycles exceeding the yield acceleration.

[For M = 7.5 and k_y / k_{max} = 0.33, u = 60 cm]

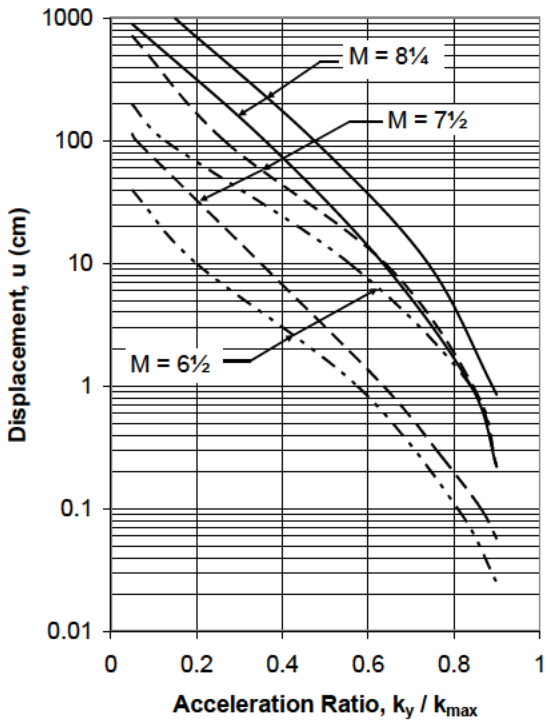


Fig. 11. Variation in permanent displacement with yield acceleration (based on Makdisi and Seed 1978)

There are a number of restrictions or limitations to the Makdisi and Seed procedure that must be regarded when the approach is used for an initial estimate of displacement. The procedure only applies to dams built of materials experiencing little or no strength loss during earthquake shaking, such as well-compacted sands or clays. Due to the assumption of no strength loss during shaking, and the application of equivalent linear principles in the underlying analyses, the procedure may be questionable for severe ground shaking. In addition, the analyses used to develop the curves were based on a very limited set of earthquake records and dam geometries that may not suitably represent a specific site. The approach is also very sensitive to the estimate of crest acceleration (Bureau 1997).

Category 3 – Post Earthquake Limit Equilibrium Analysis

Limit equilibrium analysis can be used for the preliminary evaluation of deformations including the effects of liquefaction. This method assesses the stability of the dam for gravity loads after any strength degradation caused by the earthquake. The analysis is most useful for identifying cases where the anticipated deformations are large and controlled by general instability. In these cases, the displacements that occur during the earthquake tend to be implicitly addressed in the evaluation. In some cases this approach may be used to estimate the final deformed shape of the dam.

The following steps are used to perform the analysis:

(1) The potential for liquefaction and development of excess pore pressure in the embankment and foundation is evaluated using a standard methodology. The simplified 1-D Seed-Idriss procedure can sometimes be used for preliminary estimates, although these results should be considered very approximate for dam evaluations. (Youd et al. 2001). A site response analysis may also be performed using a 1-D or 2-D computer program to model the propagation of earthquake motions through the foundation and embankment, such as SHAKE (Schnabel et al. 1972) or QUAD4M (Hudson et al., 1994). 2-D analyses are generally preferred. The predicted cyclic shear stresses are then compared to estimates of the available cyclic shear resistance obtained from empirical formulations or laboratory tests. Evaluating the response of moderately plastic soils is addressed by considering the work of Bray and Sancio (2006) and Boulanger and Idriss (2004). Refined studies will generally require laboratory testing of these soils to better define their anticipated behavior.

(2) Appropriate post-earthquake shear strengths should be selected for zones identified to liquefy or experience strength loss. For liquefaction, empirical estimates of the residual strength S_r as back-calculated from documented flow failures are typically used. These empirical estimates are formulated in terms of the residual strength S_r (e.g., Seed and Harder, 1990; Idriss and Boulanger, 2007) or a normalized strength S_r/σ'_{vo} (e.g., Olson and Stark, 2002; Idriss and Boulanger, 2007). The Corps does not currently prefer one approach over the other, and both may be considered in a sensitivity study of critical facilities. Some soils may also be appropriate for laboratory testing of post-earthquake strength, such as fine-grained soils with low permeability.

(3) Post-earthquake shear strengths for non-liquefied zones should still consider the generation of residual excess pore pressures. Relationships between the factor of safety for liquefaction and residual excess pore pressure may be used (Marcuson et al., 1990, see Figure 16). The strength of cohesive soils that may suffer significant shear strains should be reduced. If large strains are anticipated, the strength should be reduced to either the remolded or residual strength value.

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

ease do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (4.1.4)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

31.595

Time Horizon

Return period in years

2475

Longitude

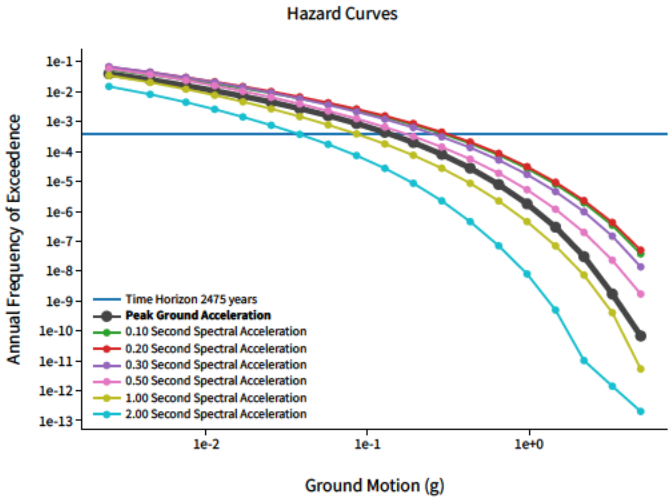
Decimal degrees, negative values for western longitudes

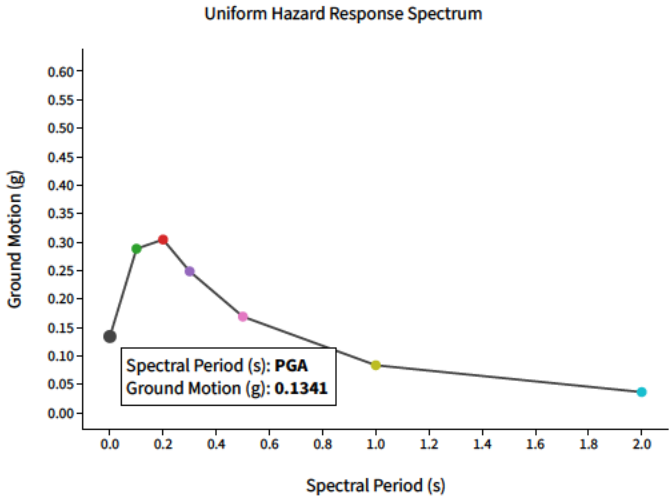
-106.169

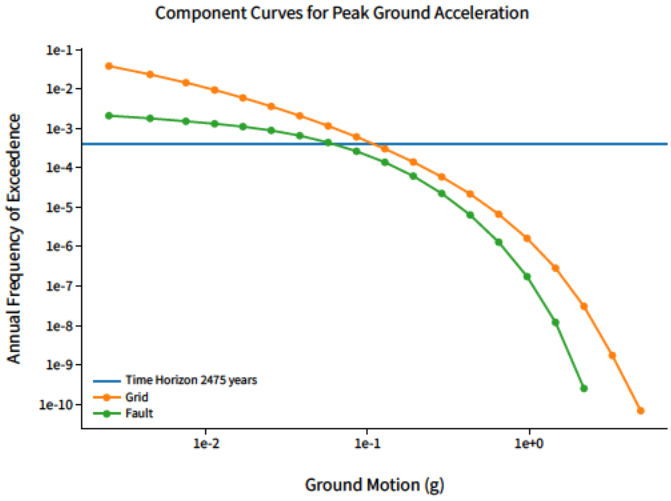
Site Class

760 m/s (B/C boundary)

Hazard Curve





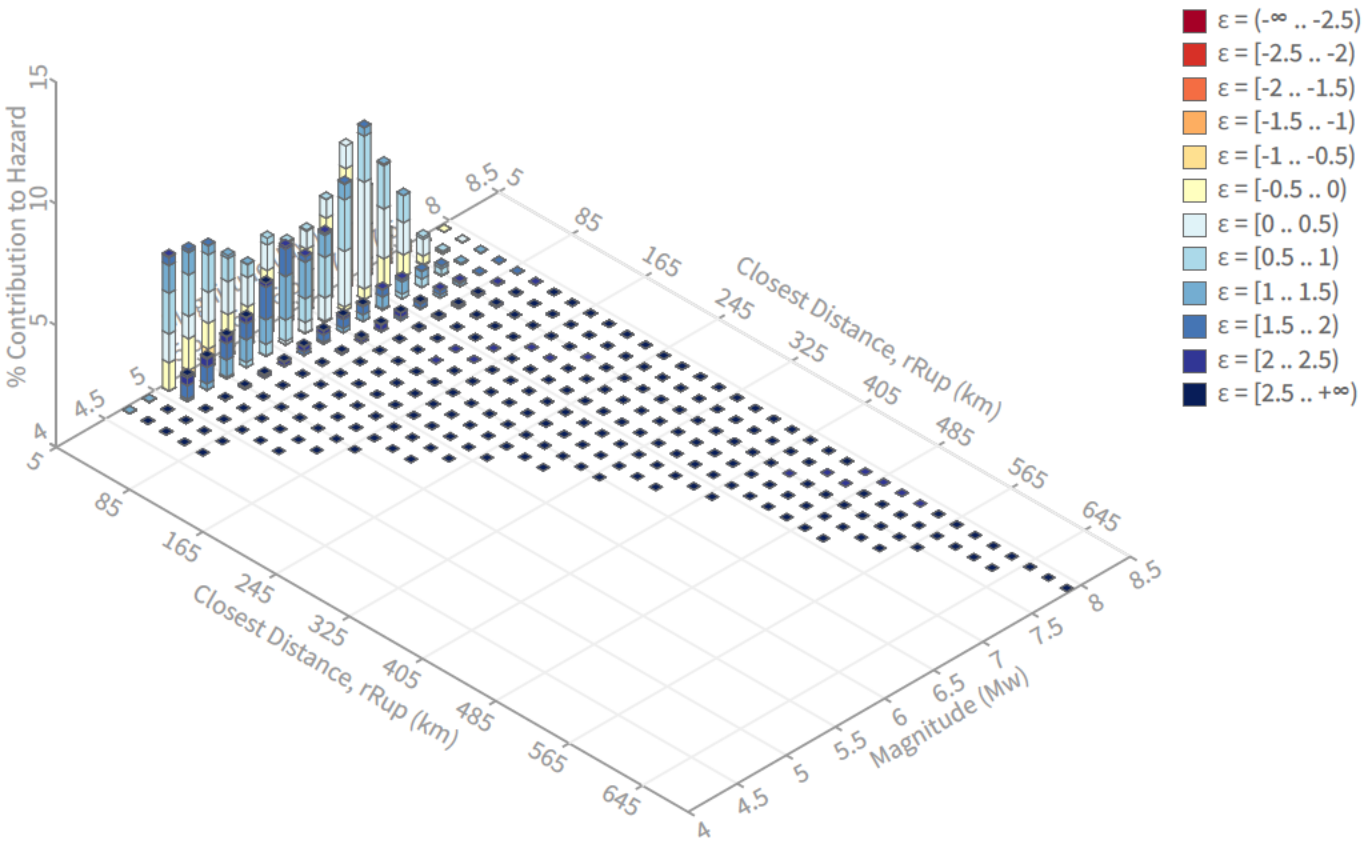


View Raw Data

Deaggregation

Component

Total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ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)
% Contribution to Hazard
0
5
10
15
Closest Distance, rRup (km)
5
85
165
245
325
405
485
565
645
Magnitude (Mw)
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.13412874 g

Recovered targets

Return period: 2532.2942 yrs
Exceedance rate: 0.00039489882 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.56 %

Mean (over all sources)

m: 6.33
r: 22.58 km
ε_0: 0.4 σ

Mode (largest m-r bin)

m: 6.9
r: 26.35 km
ε_0: 0.38 σ
Contribution: 7.07 %

Mode (largest m-r-ε_0 bin)

m: 6.9
r: 24.11 km
ε_0: 0.22 σ
Contribution: 4.39 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
EXTmap 2014 fixSm.ch.in (opt)	Grid							24.38
PointSourceFinite: -106.169, 31.707		12.59	5.85	0.12	106.169°W	31.707°N	0.00	3.38
PointSourceFinite: -106.169, 31.617		5.73	5.62	-0.70	106.169°W	31.617°N	0.00	2.61
PointSourceFinite: -106.169, 31.653		8.18	5.69	-0.34	106.169°W	31.653°N	0.00	2.00
PointSourceFinite: -106.169, 31.743		15.65	5.98	0.35	106.169°W	31.743°N	0.00	1.49
PointSourceFinite: -106.169, 31.689		11.08	5.79	-0.01	106.169°W	31.689°N	0.00	1.40
PointSourceFinite: -106.169, 31.770		17.93	6.07	0.48	106.169°W	31.770°N	0.00	1.10
PointSourceFinite: -106.169, 31.716		13.36	5.88	0.18	106.169°W	31.716°N	0.00	1.00
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PointSourceFinite: -106.169, 31.653		8.18	5.69	-0.34	106.169°W	31.653°N	0.00	1.36
PointSourceFinite: -106.169, 31.743		15.65	5.98	0.35	106.169°W	31.743°N	0.00	1.01
Geologic Model Full Rupture	Fault							15.50
East Franklin Mountains 50		23.17	6.99	0.09	106.488°W	31.605°N	272.17	4.45
Campo Grande 50		16.99	6.96	-0.13	106.034°W	31.495°N	130.87	2.62
East Franklin Mountains 35		17.38	6.98	-0.75	106.488°W	31.605°N	272.17	2.48
Amargosa 50		32.17	7.20	0.58	106.047°W	31.314°N	159.66	1.73
East Franklin Mountains 65		27.40	7.00	0.45	106.488°W	31.605°N	272.17	1.02
EXTmap 2014 fixSm.gr.in (opt)	Grid							11.86
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PointSourceFinite: -106.169, 31.617		5.73	5.62	-0.70	106.169°W	31.617°N	0.00	1.30
Geologic Model Partial Rupture	Fault							10.72
East Franklin Mountains 50		25.44	6.75	0.41	106.488°W	31.605°N	272.17	3.76
East Franklin Mountains 35		19.90	6.75	-0.25	106.488°W	31.605°N	272.17	2.13
Campo Grande 50		23.40	6.75	0.41	106.034°W	31.495°N	130.87	1.57
EXTmap 2014 adSm.gr.in (opt)	Grid							7.96
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EXTmap 2014 fixSm M8.in (opt)	Grid							4.57
Geologic Model Small Mag	Fault							4.30
Acala 50		29.82	6.10	1.54	105.938°W	31.411°N	132.98	2.54
EXTmap 2014 adSm M8.in (opt)	Grid							3.06

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error
USGS web services are now operational so this tool should work as expected.

OSHPD

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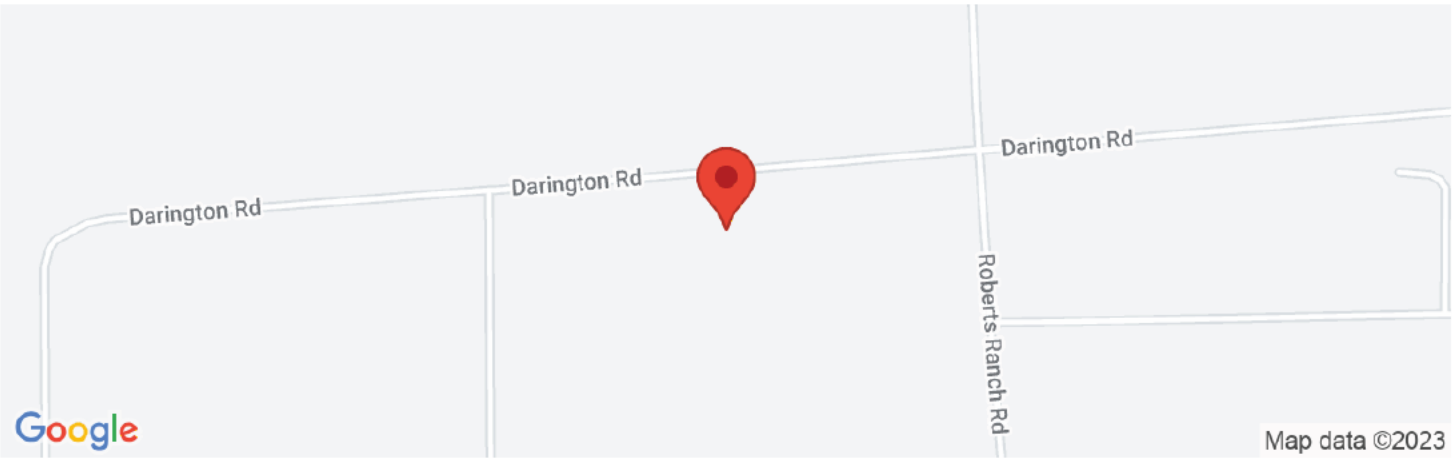

Date	10/25/2023, 6:32:29 AM
Design Code Reference Document	ASCE7 16
Risk Category	II
Site Class	D Default (See Section 11 4 3)

Type	Value	Description
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S_1	0.096	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.46	Site-modified spectral acceleration value
S_{M1}	0.231	Site-modified spectral acceleration value
S_{DS}	0.307	Numeric seismic design value at 0.2 second SA
S_{D1}	0.154	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1 565	Site amplification factor at 0 2 second
F_v	2 4	Site amplification factor at 1 0 second
PGA	0 13	MCE_G peak ground acceleration
F_{PGA}	1 539	Site amplification factor at PGA
PGA_M	0 201	Site modified peak ground acceleration
T_L	6	Long period transition period in seconds
SsRT	0 294	Probabilistic risk targeted ground motion (0 2 second)
SsUH	0.326	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1 5	Factored deterministic acceleration value (0 2 second)
S1RT	0.096	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0 105	Factored uniform hazard (2% probability of e ceedance in 50 years) spectral acceleration
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0 5	Factored deterministic acceleration value (Peak Ground Acceleration)
PGA_{UH}	0.13	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.901	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.914	Mapped value of the risk coefficient at a period of 1 s
C_V	0.888	Vertical coefficient

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Landfill Liner Interface Strengths from Torsional-Ring-Shear Tests

By Timothy D. Stark[1] and Alan R. Poeppel[2]

Abstract: A torsional-ring-shear apparatus and test procedure are described for measuring soil/geosynthetic and geosynthetic/geosynthetic interface strengths. Typical interface strengths are presented for a double-composite liner system and the relevancy of ring-shear strengths is illustrated using the slope failure at the Kettleman Hills Waste Repository, Kettleman City, Calif. The results of undrained ring-shear tests show that for a clay/geomembrane interface: (1) Interface strength depends on plasticity and compaction water content of the clay, and the applied normal stress; (2) interface strengths measured with the torsional-ring-shear apparatus are in excellent agreement with back-calculated field strengths; and (3) peak and residual interface failure envelopes are nonlinear, and the nonlinearity should be modeled in stability analyses instead of as a combination of cohesion and friction angle. Design recommendations for interface strengths and stability analyses are also presented.

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INTRODUCTION

Hazardous-waste landfills and new municipal solid-waste landfills in this country are required to have a low-hydraulic-conductivity liner and a drainage system consisting of compacted clay and geosynthetic materials. The stability of these systems is controlled by the shear strength of each component and the various component interfaces. The importance of interface strengths was illustrated by the slope-stability failure in Phase IA of Landfill B-19 at the Kettleman Hills Class I hazardous-waste treatment-and-storage facility in Kettleman City, Calif. The landfill area is an oval-shaped bowl carved into an existing valley to a depth of approximately 30 m and covering an area of 120,000 m^2. A slope-stability failure occurred during filling on 19 March 1988 that resulted in 11 m lateral displacements of the waste fill and 4.3 m vertical settlements. Byrne et al. (1992) concluded that sliding primarily occurred along the 1.1-m-thick secondary clay liner/secondary high-density polyethylene (HDPE) geomembrane interface in the double-composite liner system (Fig. 1). As a result, the majority of the ring-shear tests described here focus on the secondary clay liner/secondary HDPE geomembrane (SC/SG) interface. This paper reviews current interface test procedures, describes the torsional-ring-shear apparatus and test procedure used to measure interface strengths of various soil/geosynthetic and geosynthetic/geosynthetic interfaces, presents some typical ring-shear test results, and illustrates the relevancy of ring-shear interface-strengths using the Kettleman Hills case history.

REVIEW OF DIRECT-SHEAR INTERFACE TESTS

Direct-shear and pullout tests have been widely used to measure liner interface strengths (Martin et al. 1984; Saxena and Wong 1984; Koerner

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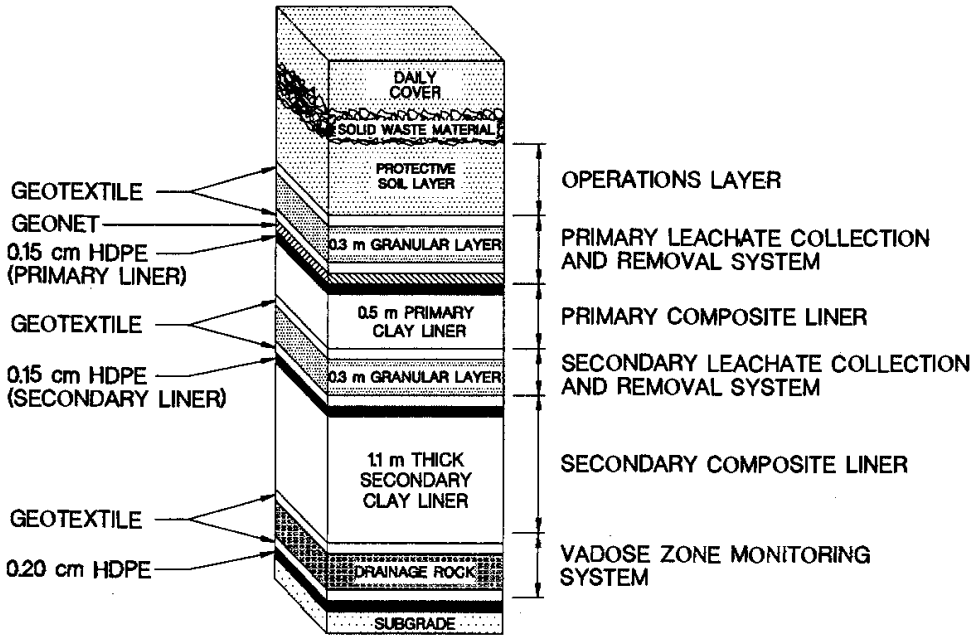

FIG. 1. Composite Double-Liner System at Base of Landfill (from Mitchell et al. 1990)

et al. 1986; Williams and Houlihan 1986; Seed et al. 1988; Giroud and Beech 1989; O'Rourke et al. 1990; Bove 1990; Seed and Boulanger 1991; Takasumi et al. 1991). Conventional direct-shear specimens range in size from 7 cm × 7 cm to 10 cm × 10 cm. Therefore, the specimen is subjected to only 0.6–0.8 cm of continuous displacement. Since the peak interface-strength is usually mobilized at a shear displacement of less than 0.5 cm, conventional direct-shear tests provide a good estimate of the peak strength. However, a shear displacement of 40–60 cm is typically required to mobilize a residual interface-strength in the ring-shear tests described here. To achieve these large displacements, the shear box must be reversed a number of times. These reversals do not apply continuous displacement in one direction, and thus do not simulate field shearing conditions that lead to a residual strength-condition.

In an effort to increase the magnitude of continuous-shear displacement, larger direct-shear boxes have been developed. These large-scale shear boxes range in size from 30 cm × 30 cm to 28 cm × 43 cm. ASTM Test Standard D5321 ("Determining" 1992) requires a shear box with a minimum dimension of 30 cm to be used to measure the coefficient of soil/geosynthetic or geosynthetic/geosynthetic friction. In this test, a geosynthetic is secured with glue to a horizontal substrate (e.g., plywood) and the shear box containing soil or a geosynthetic is moved along the substrate for a displacement of 2.5–7.5 cm. As a result, virgin geosynthetic material is sheared along the bottom substrate instead of being sheared along the same interface. Other disadvantages of 30 cm × 30 cm direct-shear boxes include the lack of vertical displacement information during consolidation or shear; the cost of the apparatus; and the need to secure large geosynthetics, compact large soil-specimens, and apply large normal forces.

Fig. 2 presents typical shear stress-displacement relationships from large-scale (30 cm × 30 cm) direct-shear tests on the SC/SG interface from landfill B-19 at Kettleman Hills (Byrne et al. 1992; "Draft" 1991). The water content of the clay specimens ranged from 30.0% to 30.6%. The tests were stopped

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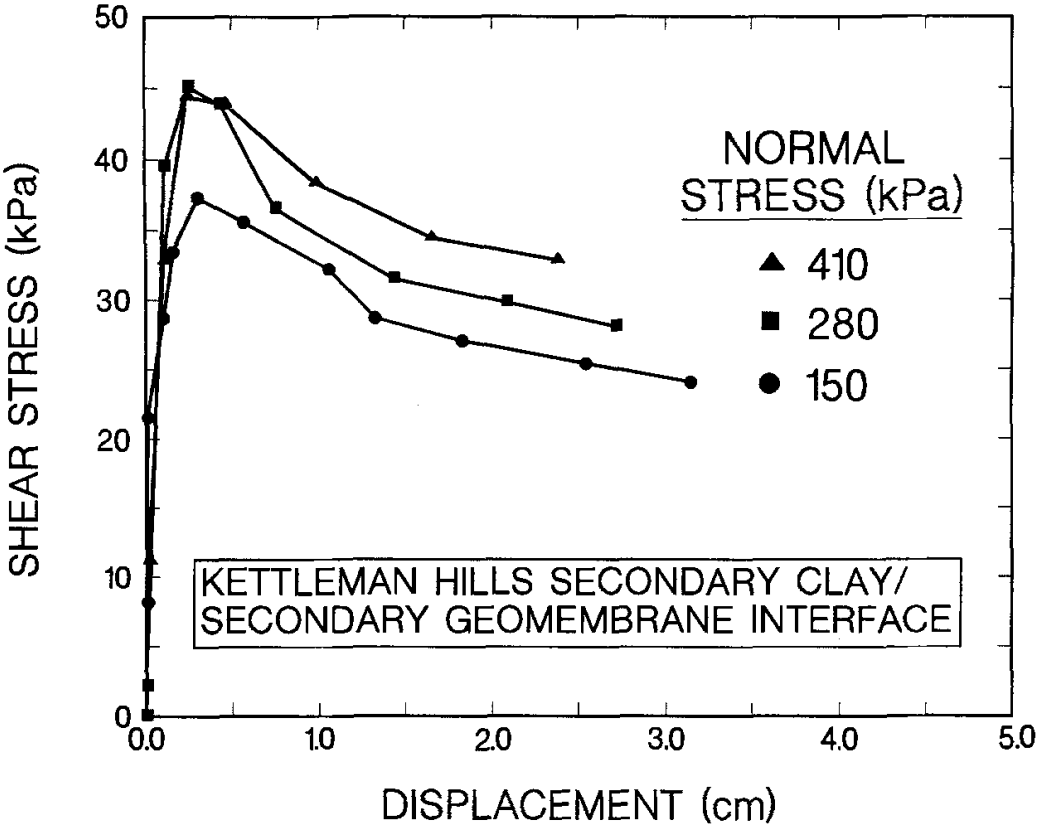

FIG. 2. Large-Scale Direct-Shear Tests Results for Secondary Clay/Secondary Geomembrane Interface (after Byrne et al. 1992)

at a shear displacement of approximately 2.5–3.0 cm, even though the shear-stress/horizontal-displacement relationships had not reached a minimum or residual strength condition. Therefore, large-scale direct-shear boxes appear applicable to the measurement of the peak interface strength, however, the limited shear displacement restricts their use in measuring the residual interface-strength.

Due to the limitations of current direct-shear testing, the suitability of a torsional-ring-shear apparatus to measure peak and residual interface-strengths was investigated. Negussey et al. (1989) also used a torsional-ring-shear apparatus to measure the strength of sand/geomembrane and nonwoven geotextile/HDPE geomembrane interfaces.

TORSIONAL-RING-SHEAR APPARATUS

The main advantage of the torsional-ring-shear apparatus is that unlimited continuous-shear displacement can be applied in one direction to achieve a residual strength condition. Other advantages of the ring-shear apparatus include continuous-shear displacement along the same interface, a constant cross-sectional area during shear, minimal laboratory supervision (because there is no reversal of the shear box), applicability of data acquisition techniques, and a smaller specimen, which allows greater control of compaction conditions and the securing of the geosynthetics. However, the small specimen size is also a disadvantage for materials that are significantly anisotropic. Larger ring-shear specimen containers are being developed to investigate scale effects of some interfaces.

The Bromhead ring-shear apparatus is based on the original design de-

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veloped by Bromhead (1979) and manufactured by Wykeham-Farrance Ltd., Slough, England. The ring-shear specimen is annular with an inside diameter of 7 cm and an outside diameter of 10 cm. In the original apparatus, drainage is provided by two knurled, bronze, porous stones screwed to the bottom of the specimen container and to the top loading platen. The specimen is confined radially by the 0.5-cm-deep specimen container.

The Bromhead ring-shear apparatus was modified to facilitate testing of soil/geosynthetic and geosynthetic/geosynthetic interfaces. A specimen container that could accommodate a 1-cm-deep specimen was fabricated, and a Lucite ring was used to facilitate securing geosynthetics to the top platen with glue. In tests on soil/geosynthetic interfaces, the bottom porous stone was replaced with a knurled stainless-steel ring to minimize drainage. In tests on geosynthetic/geosynthetic interfaces, the bottom, bronze, porous stone was replaced by another Lucite ring to aid in securing the bottom geosynthetic with glue. Digital dial gages and a microcomputer data acquisition system were used to monitor vertical displacement and shear stress during the test. Average horizontal displacements were calculated by multiplying the average circumference of the specimen by the measured angular displacement.

RING-SHEAR TEST PROCEDURE AND SPECIMEN PREPARATION

Based on water contents of the secondary clay liner, which was measured during placement and after the slope failure, and based on the determination that the dissipation of excess pore-water pressures in the vicinity of the secondary-clay/secondary-geomembrane interface would be negligible prior to failure, the unconsolidated-undrained shear strength of the secondary clay/secondary geomembrane interface was determined to be representative of the Kettleman Hills field conditions (Mitchell et al. 1990; Byrne et al. 1992). As a result, an unconsolidated-undrained test procedure was used by Mitchell et al. (1990) and in "Draft" (1991) for direct-shear tests on the SC/SG interface. For consistency, an unconsolidated-undrained test procedure was used for the ring-shear tests performed on the SC/SG interface. Since the ring-shear specimen is not enclosed in a membrane, a displacement rate of 4.4 cm/min was applied to obtain an undrained condition in the ring-shear apparatus. This displacement rate is based on the coefficient of consolidation reported by Seed et al. (1988) of 3.5×10^{-3} cm^2/min, the procedure developed by Gibson and Henkel (1954), and a degree of consolidation of 0%. It is faster than the displacement rate in previous Kettleman Hills testing (Mitchell et al. 1990; "Draft" 1991), because the ring-shear specimen is thinner than previous direct-shear specimens.

All geosynthetic/geosynthetic interfaces were sheared immediately after application of the normal stress at a displacement rate of 0.1 cm/min. This displacement rate is in agreement with direct-shear testing performed by Mitchell et al. (1990) and "Draft" (1991), in which displacement rates of 0.01 cm/min to 0.1 cm/min, and 0.1 cm/min, respectively, were applied.

The secondary clay liner at Kettleman Hills consists of on-site claystone, siltstone, and sandstone with 2–5% sodium bentonite by weight added to decrease hydraulic conductivity. The clay-liner sample used in the ring-shear tests was obtained from on-site stockpiles during construction of the liner. The secondary clay classifies as a high-plasticity clay (CH) according to the Unified Soil Classification System with a liquid limit of 65% and a plasticity index of 44. Hydrometer tests conducted during this study revealed that

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84% of the clay liner passes U.S. Standard sieve No. 200 and the clay-size fraction (percent by weight finer than 0.002 mm) is 49%. Byrne et al. (1992) reported that the as-built secondary clay liner at Kettleman Hills had a liquid limit of 60–70% and a plasticity index of 40–50; thus, the soil tested appears representative of average field conditions. Standard Proctor compaction tests revealed that the optimum water content of the secondary clay liner from Kettleman Hills is 22% and the maximum dry-unit weight is 15.6 kN/m^3. Quality-assurance records show that the secondary clay layer was placed at water contents from 27% to 33% with a median value of 29.7% (Byrne et al. 1992).

The ring-shear specimens were obtained by air drying a portion of the 18 kg sample of the secondary clay liner from landfill B-19. The air-dry soil was crushed with a ceramic pestle and processed through U.S. Standard sieve No. 40. The clay was mixed to the desired water content using distilled water. The ring-shear specimens were compacted directly into the ring-shear specimen container using a Harvard miniature compactor. The desired dry-unit weight was obtained by compacting the appropriate weight of moist soil into the specimen container using two lifts. After compaction, the top platen with a secured geosynthetic was placed on the compacted clay, and the specimen container was installed in the ring-shear apparatus. The desired normal stress was applied within 5 min and shearing commenced after the normal stress was obtained. The observations were made to ensure that specimen extrusion did not occur during application of the normal stress. The specimen was not inundated prior to or during shear. Moist cotton batting, however, was placed around the top platen to minimize changes in moisture content during testing. In accordance with field water contents and dry-unit weights, the ring-shear specimens were compacted to dry-unit weights of 14.5–15.4 kN/m^3 and initial water contents of 18–33% to investigate the effect of compaction water content on interface-shear strength.

The geosynthetics were glued to the Lucite ring using a thin coat of epoxy cement and allowed to cure for 24 h under a normal stress of 300 kPa. This aided bonding of the geosynthetics and minimized vertical displacements due to the glue during testing. The specimen container and geosynthetic were always marked to ensure that the geosynthetic did not slip during shear. The surface of the geomembrane was also wiped, if necessary, using a paper towel to minimize the effect of fingerprints and perspiration on the interface strengths (Yegian and Lahlaf 1992). The ring-shear tests were conducted at a laboratory temperature of 20°C.

The following interfaces were tested during this investigation: (1) Secondary clay/secondary HDPE geomembrane; (2) geonet/HDPE geomembrane; and (3) nonwoven geotextile/HDPE geomembrane. The other interfaces shown in Fig. 1 (i.e., geonet/nonwoven geotextile and nonwoven geotextile/secondary clay) were not tested, because Seed et al. (1988) concluded that these interfaces exhibited a large interface shear strength. The geomembrane used in the present study is a smooth 1.5-mm-thick HDPE liner (Gundle Lining Systems, Inc., Houston, Tex.). The HDPE drainage geonet is the Gundle Gundnet XL4 net with a thickness of 5 mm. The nonwoven geotextile used in the present study is Polyfelt TS 600, which is a nonwoven needle-punched geotextile made of polypropylene fibers. These geosynthetics are compatible with the geosynthetics used in the double-composite liner system at Kettleman Hills Landfill B-19.

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RING-SHEAR TEST RESULTS ON CLAY/GEOMEMBRANE INTERFACE

Fig. 3 presents a typical shear-stress/horizontal-displacement relationship for an unconsolidated-undrained ring-shear test on the SC/SG interface at a normal stress of 48 kPa. The final water content of the clay was approximately 32.5%. The interface exhibits a peak shear strength of approximately 13.5 kPa and a residual strength of about 8.5 kPa. The peak SC/SG-interface strength was usually mobilized at a shear displacement of 0.2–0.4 cm (Fig. 4). This is in good agreement with the large-scale direct-shear test results in Fig. 2 that indicate the peak interface strength is mobilized at a shear displacement of 0.2–0.3 cm. Fig. 3 also shows that the residual interface strength is reached at a horizontal displacement of approximately 60 cm. However, the majority of the strength loss occurs within a horizontal displacement of 35–40 cm. This displacement is larger than the 2.5–5 cm that is usually applied in a large-scale direct-shear apparatus. In addition, the specimen underwent a vertical displacement of less than 0.01 cm, less than 1% of the initial height, during undrained shearing. This small vertical deformation is probably due to a slight extrusion of soil during undrained shearing.

La Gatta (1970) recommended plotting the shear-stress/horizontal-displacement relationship from ring-shear tests using the logarithm of hori-

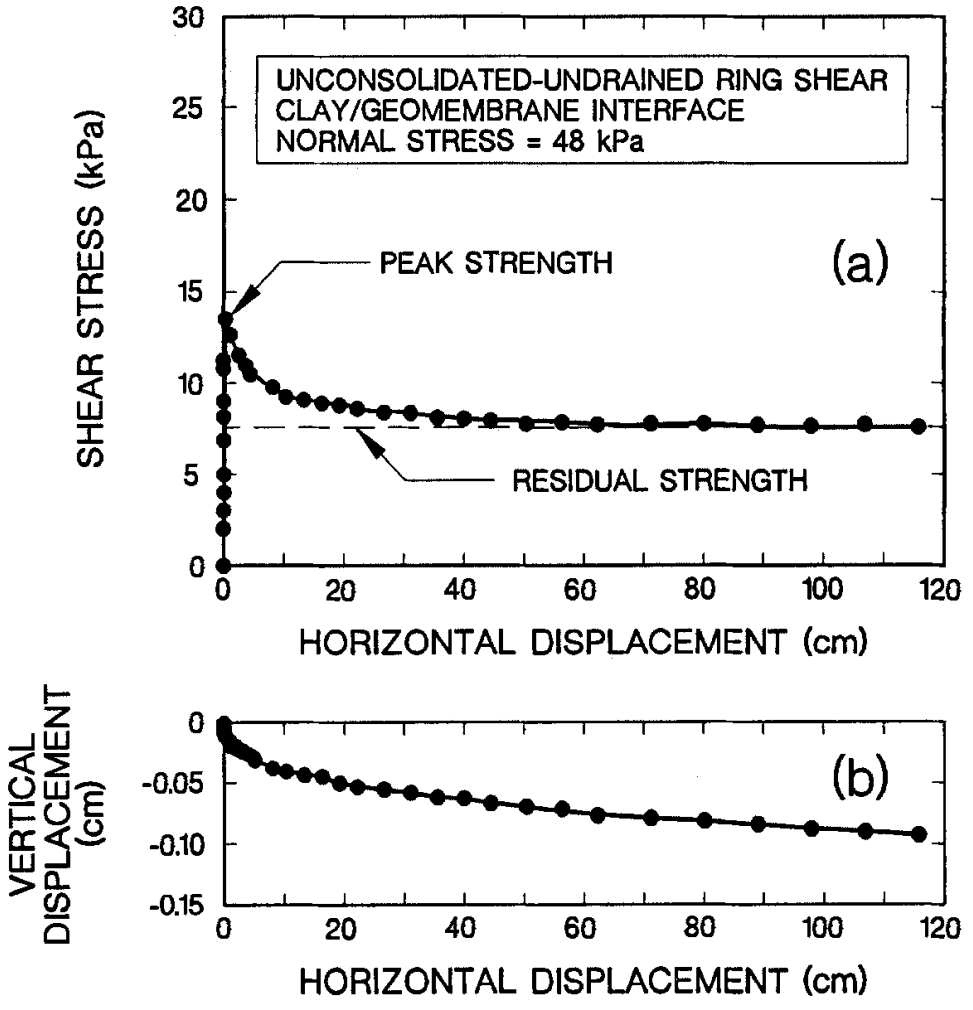

FIG. 3. Typical Undrained Ring-Shear Test Results for Secondary Clay/Secondary Geomembrane Interface: (*a*) Shear Stress; (*b*) Vertical Displacement

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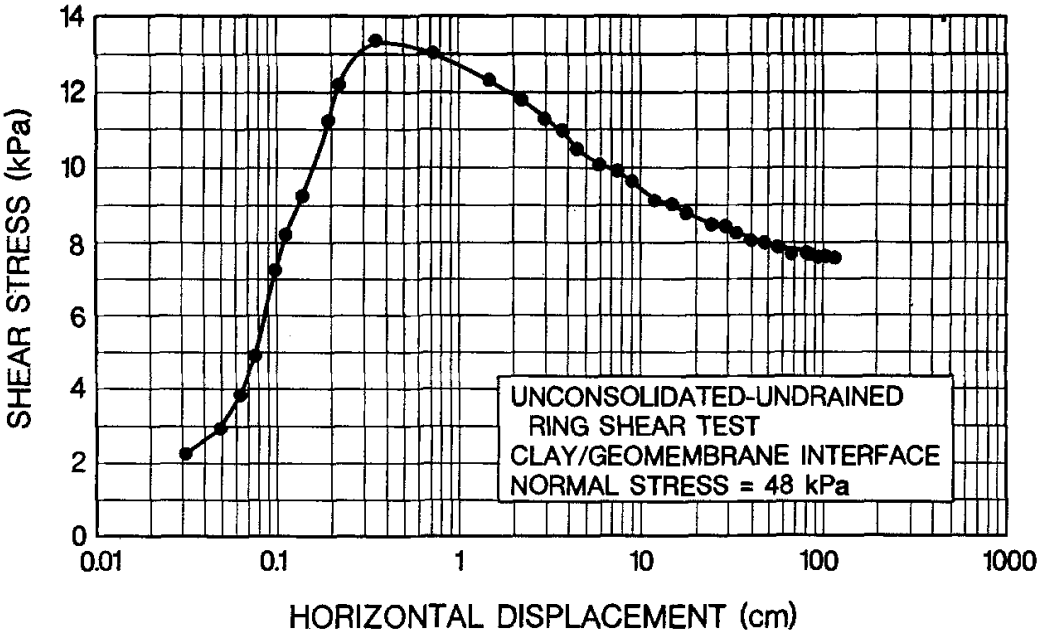

FIG. 4. Semilogarithmic Presentation of Secondary Clay/Secondary Geomembrane Ring-Shear Interface Test

zontal displacement. This plotting technique accentuates the slope of the shear stress-displacement curve at large deformations, allowing the horizontal portion of the curve to be clearly defined. Fig. 4 presents a semilogarithmic representation of the ring-shear test on the SC/SG interface presented in Fig. 3. The shear stress has reached a constant or residual value using a logarithmic scale. Therefore, to ensure that a residual strength condition is reached before a ring-shear or direct-shear test is stopped, it is recommended that the shear stress be plotted using the logarithm of horizontal displacement. Once the shear stress becomes essentially constant on a semilogarithmic plot, the test can be stopped.

Fig. 5 presents the peak SC/SG-interface strengths for the range of normal stresses and final water contents considered by Mitchell et al. (1990) and Byrne et al. (1992). At low normal stresses the peak interface strength is slightly influenced by final water content. However, as the normal stress increases, the peak interface strength becomes sensitive to compaction water content. The optimum water content of the Kettleman Hills secondary clay liner is 22%. Therefore, at placement water contents of 31–32% (9–10% above optimum), the peak interface strength converges to a range of 15–35 kPa. This is in good agreement with research on compacted cohesive soils presented by Seed et al. (1960). In summary, near the optimum water content the clay is stiffer and has more frictional resistance, which results in higher peak interface strengths. As the water content increases on the wet side of optimum, the peak interface strength decreases.

Fig. 6 presents the residual SC/SG-interface strengths for the same range of normal stresses and final water contents as Fig. 5. At low normal stresses, the residual interface strength is slightly influenced by final water content. As the normal stress increases, however, the residual interface strength becomes sensitive to compaction water content. At a water content of 31–32% the residual interface strength converges to a range of 8–24 kPa. These residual interface strengths are 30–50% lower than the peak interface strengths presented in Fig. 5.

Byrne et al. (1992) reported that the median-placed moisture content of

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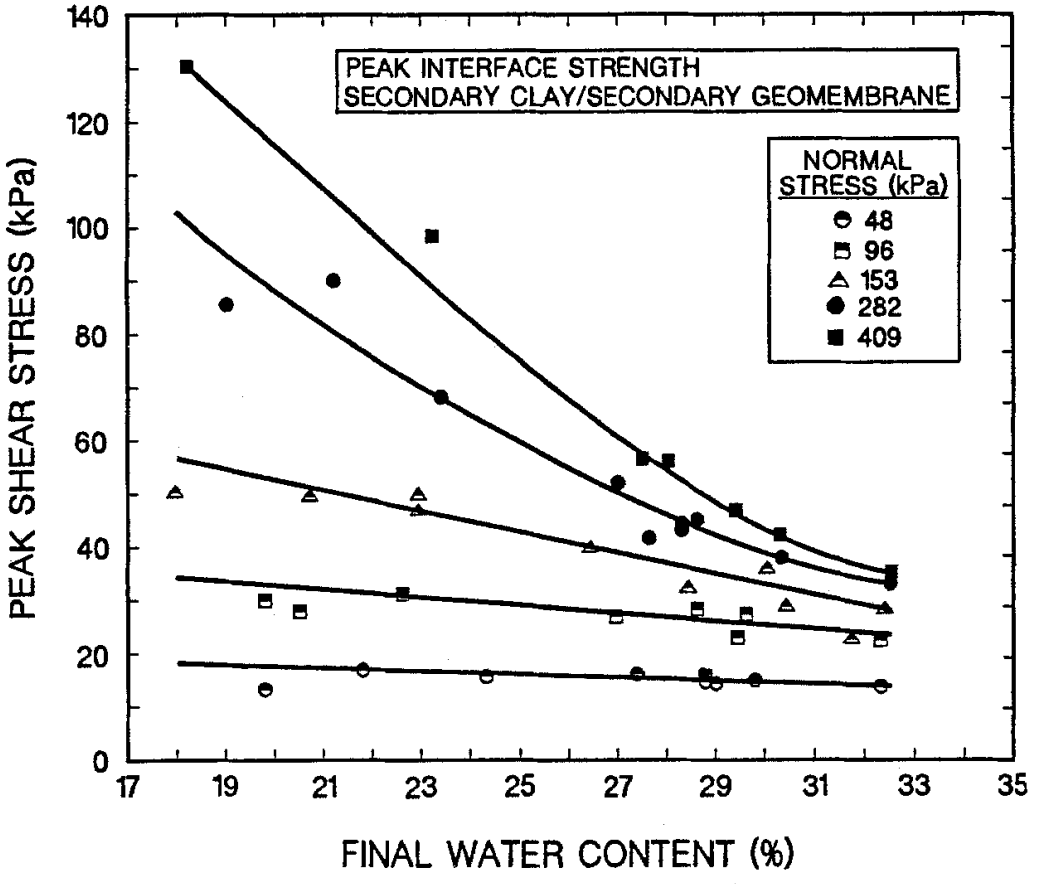

FIG. 5. Peak Secondary Clay/Secondary Geomembrane Interface Strengths

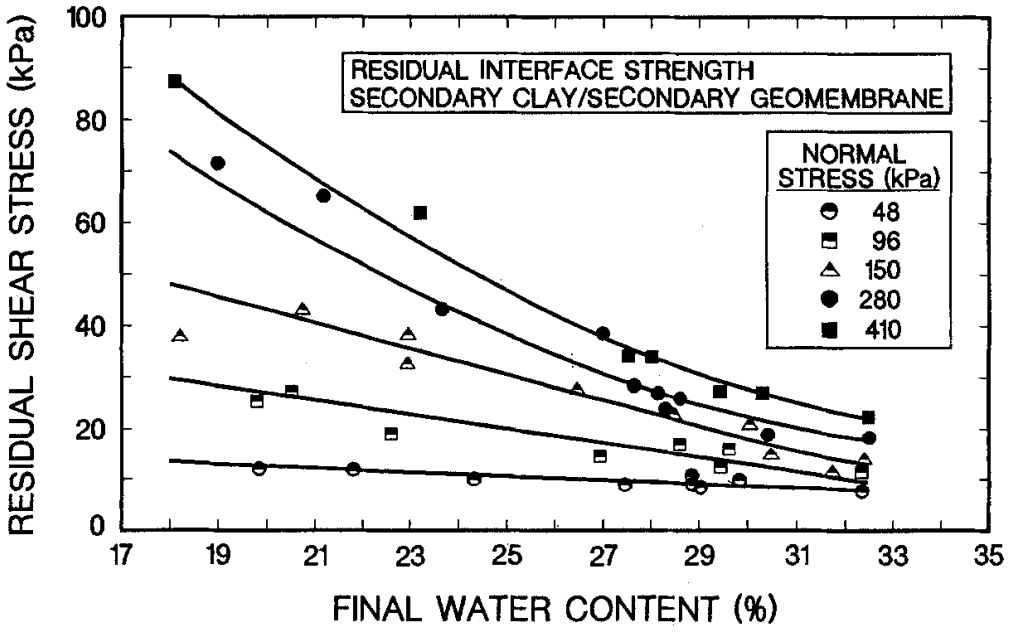

FIG. 6. Residual Secondary Clay/Secondary Geomembrane Interface Strengths

the secondary clay liner at Kettleman Hills was 29.7%. Therefore, peak and residual failure envelopes (Fig. 7) were obtained using Figs. 5 and 6 and a water content of 29.7%. Since ring-shear tests were not conducted at a water content of exactly 29.7%, data points are not shown on the ring-shear failure envelopes. Also the peak and residual ring-shear failure en-

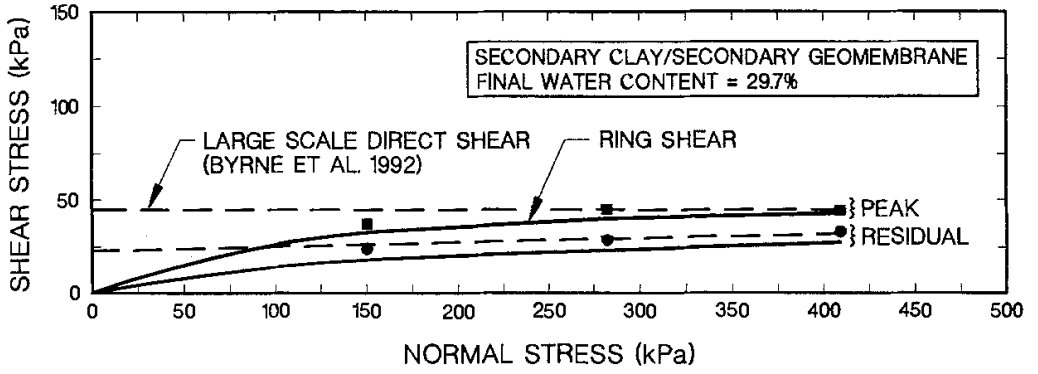

FIG. 7. Undrained Secondary Clay/Secondary Geomembrane Interface Failure Envelopes

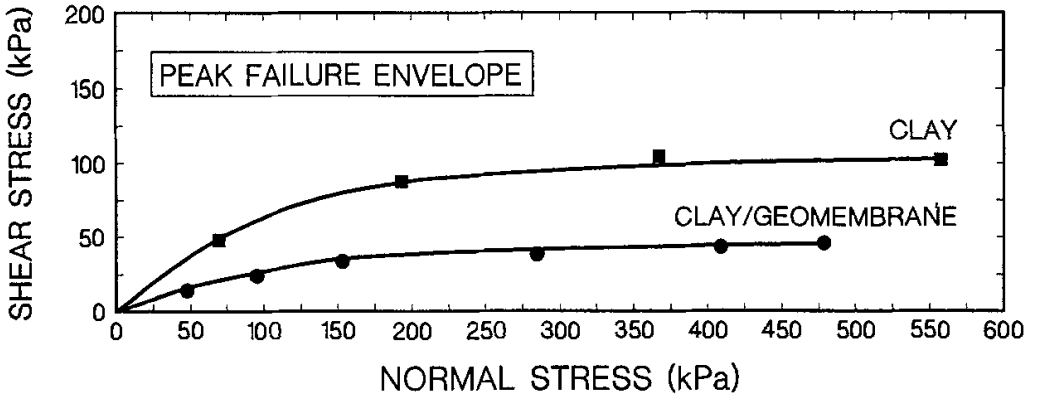

FIG. 8. Comparison of Peak Clay and Peak Clay/Geomembrane Interface Strengths

velopes are nonlinear. For comparison purposes, if a secant failure envelope is assumed to pass through the origin and the shear stress at a normal stress of 410 kPa, the peak friction angle is approximately 6°, and the residual friction angle is about 4°. Mitchell et al. (1990) reported that conventional direct-shear tests on the Kettleman Hills SC/SG interface yielded peak and residual friction angles of 13.6 ± 2.4° and 12.4 ± 1.1°, respectively, for water contents between 27–31%. However, an undrained residual strength of 43 ± 12 kPa was used by Seed et al. (1990) in post-failure stability analyses. Byrne et al. (1992) used "Draft" (1991) data from large-scale direct-shear tests to develop the following peak (τ_{peak}) and residual ($\tau_{residual}$) strength relations for the SC/SG interface at a water content of 29.7%:

$$\tau_{peak} = 45 \text{ kPa} \quad \ldots\ldots (1)$$

$$\tau_{residual} = 23.2 \text{ kPa} + 0.022\sigma_n \quad \ldots\ldots (2)$$

where σ_n = normal stress.

The failure envelopes from the large-scale direct-shear tests performed in "Draft" (1991) are superimposed on the ring-shear envelopes in Fig. 7. The three normal stresses used in "Draft" (1991) are 150, 280, and 410 kPa (Fig. 2), and the data points in Fig. 7 correspond to these tests. The ring-shear peak strength is slightly lower than the large-scale direct-shear tests at normal stresses greater than 150 kPa. This is in good agreement with previous research (Bishop et al. 1971; La Gatta 1970), suggesting that peak strengths measured in a ring-shear apparatus are slightly lower than direct-shear values for materials exhibiting a large post-peak strength loss. This is due to the nonuniformity of shear displacements radially across the speci-

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men. If the material does not exhibit a significant post-peak strength loss, the peak strengths from direct-shear and ring-shear tests will be equal. The ring-shear residual interface strengths are 15–20% lower than the large-scale direct-shear test results for normal stresses greater than 150 kPa. The difference in residual interface strengths is probably due to the larger continuous-shear displacements that can be applied to the ring-shear tests. For stability analyses, there exist a number of cohesion and friction angle combinations that can be used to model the nonlinear peak and residual failure envelopes in Fig. 7. Therefore, it is recommended that the entire envelope or an appropriate value of the friction angle be incorporated in a stability analysis.

Fig. 8 provides a comparison of the peak SC/SG-interface failure envelope and the peak failure envelope of the clay-liner material at a water content of 29.7%. The envelopes have similar shapes but the SC/SG-interface strength is significantly less than the peak strength of the clay liner. If a secant envelope is assumed to pass through the origin and the shear stress at a normal stress of 480 kPa, the peak SC/SG-interface friction angle is about 6°, and the peak clay-liner friction angle is approximately 12°. These failure envelopes can be used to estimate the efficiency of the SC/SG interface by dividing the tangent of the interface friction angle by the tangent of the clay-liner friction angle. This yields an interface efficiency of 50–55% for normal stresses greater than approximately 190 kPa. This is in good agreement with the 45–60% range that has been reported for direct-shear tests on other clay-geomembrane interfaces at a normal stress near 500 kPa (Long et al. 1993). Therefore, it may be concluded that the peak strengths measured using a ring-shear apparatus are in agreement with direct-shear test results.

Fig. 9 provides a comparison of the residual SC/SG-interface strength and the residual strength of the clay-liner material. The envelopes have similar shapes but the SC/SG-interface strength is again significantly less than the residual clay-liner strength. A comparison of Figs. 8 and 9 reveals that the clay-liner material does not exhibit a large post-peak strength loss, thus the peak and residual failure envelopes of the clay liner are similar. If a secant envelope is assumed to pass through the origin and the shear stress at a normal stress of 480 kPa, the residual SC/SG-interface friction angle is approximately 4°, and the residual clay-liner friction angle is about 11°.

The residual interface efficiency was calculated to be approximately 35% at normal stresses greater than approximately 190 kPa, which is lower than the peak interface efficiency of 55%. Therefore, the SC/SG interface exhibits a larger post-peak strength loss than the clay-liner material. This is probably caused by some clay particles being oriented parallel to the direction of shear and by significant polishing of the geomembrane that occurs at large continuous-shear displacements. It should be noted that the excavated secondary HDPE geomembrane at Kettleman Hills exhibited a highly polished surface. Typical residual interface efficiencies reported for direct-shear tests range from 45% to 55% (Long et al. 1993). The difference between the ring-shear and direct-shear residual interface efficiencies is probably due to the larger continuous-shear displacement that can be applied in the ring-shear tests.

RING-SHEAR TESTS ON GEOSYNTHETIC/GEOSYNTHETIC INTERFACES

Torsional-ring-shear tests were also conducted on geonet/geomembrane and nonwoven geotextile/geomembrane interfaces. Fig. 10 presents the peak

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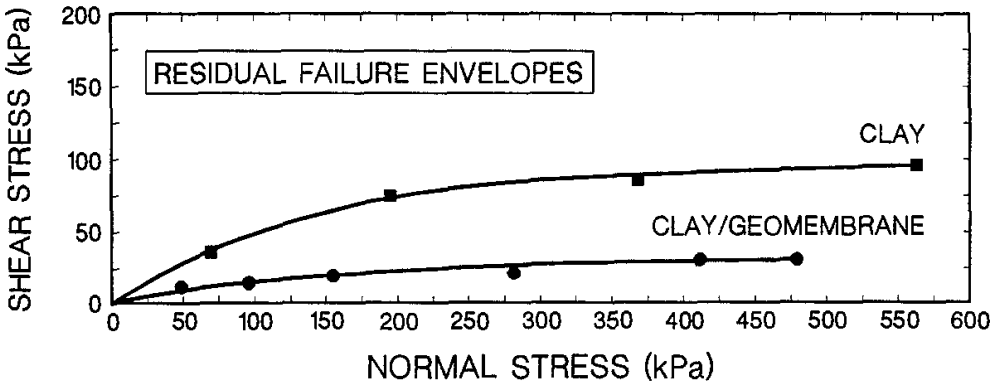

FIG. 9. Comparison of Residual Clay and Residual Clay/Geomembrane Interface Strengths

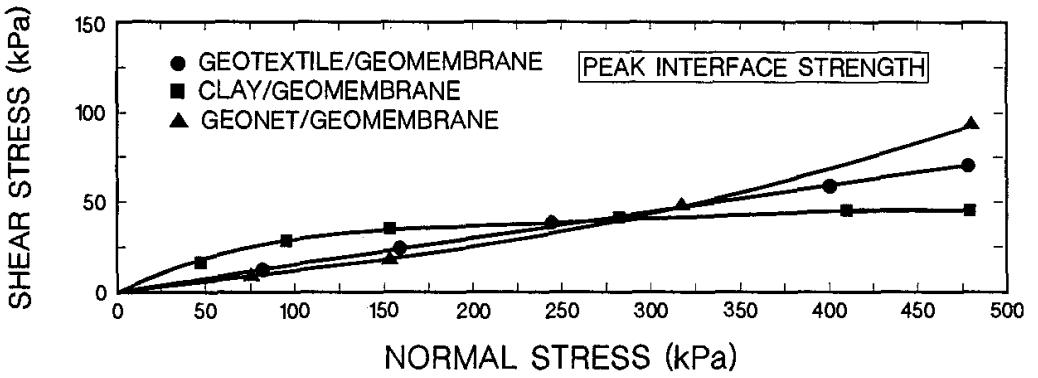

FIG. 10. Peak Failure Envelopes for Various Liner Interfaces

interface failure envelopes for these interfaces together with the SC/SG interface at a water content of 29.7%. The synthetic interfaces are critical (exhibit the lowest peak shear resistance) at normal stresses less than approximately 280 kPa. However, at normal stresses greater than approximately 280 kPa, the SC/SG interface is critical. The normal stress acting on the base of the Kettleman Hills Landfill at the time of failure ranged from 420 to 480 kPa. These stresses are based on a unit weight of 15.7–17.3 kN/m^3 and a fill depth of 27–28 m at the time of failure. Fig. 10 indicates that sliding should occur at the SC/SG interface for these normal stresses. This is in excellent agreement with field observations along the base of the landfill that showed striations only occurred along the SC/SG interface (Byrne et al. 1992).

Fig. 11 presents the residual interface failure envelopes for the geosynthetic/geosynthetic interfaces and the SC/SG interface at a water content of 29.7%. Fig. 11 suggests that in the upper 10–11 m of the sideslopes, that is, in areas with a normal stress less than or equal to 190 kPa, sliding could have occurred along any of these interfaces. However, below a depth 10–11 m along the sideslopes, that is, in areas with normal stresses greater than approximately 190 kPa, sliding should have occurred along the SC/SG interface. Again, this is in excellent agreement with field observations, which clearly showed sliding along the SC/SG interface at a depth of 10–15 m below the landfill rim. Above this depth, sliding occurred along the primary geomembrane/secondary geotextile interface.

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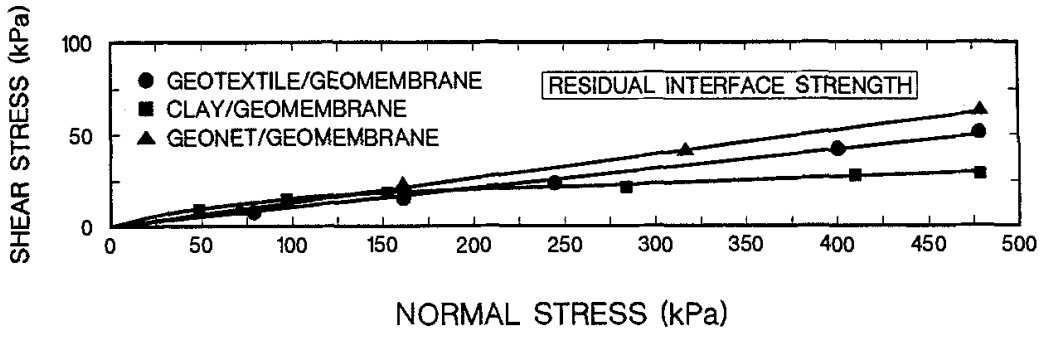

FIG. 11. Residual Failure Envelopes for Various Liner Interfaces

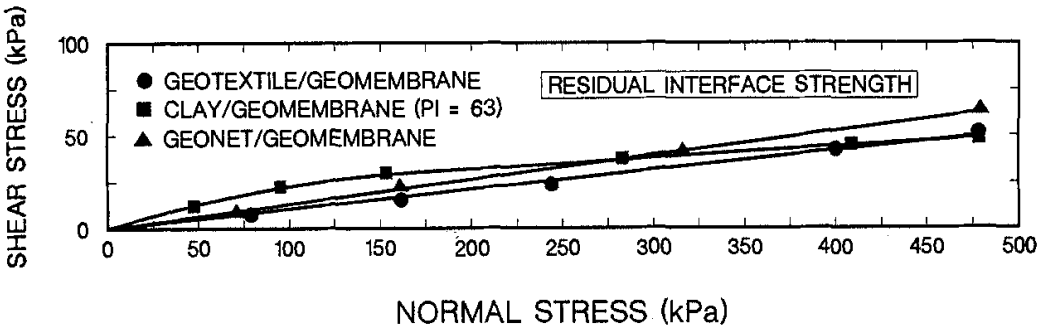

FIG. 12. Effect of Plasticity on Residual Clay/Geomembrane Interface Strength

EFFECT OF PLASTICITY ON CLAY/GEOMEMBRANE INTERFACE STRENGTH

For design considerations, the effect of increasing the percentage of sodium bentonite by weight in the secondary clay-liner mixture on the SC/SG-interface strength was also investigated. Additional sodium bentonite provides a lower hydraulic conductivity, but it may also decrease the interface strength. Fig. 12 presents the residual strength of a higher plasticity clay/geomembrane interface at a water content of 29.7%. This higher plasticity clay was obtained from the failed secondary clay liner on the base of the Kettleman Hills Landfill after waste excavation. A greater percentage of sodium bentonite was probably added to decrease hydraulic conductivity in this liner sample. This clay classifies as a CH according to the Unified Soil Classification System, having a liquid limit of 87% and a plasticity index of 63. Since both clay-liner samples classify as CH, this sample will be referred to as the higher plasticity clay liner. Hydrometer tests conducted during the present study revealed that 92% of the higher plasticity clay liner passes the U.S. Standard sieve No. 200 and the clay-size fraction (percent by weight finer than 0.002 mm) is 73%. For comparison purposes, the residual geosynthetic/geosynthetic failure envelopes from Fig. 11 are also presented in Fig. 12. The geotextile/geomembrane interface is critical for normal stresses less than approximately 450 kPa. Therefore, increasing the plasticity and clay-size fraction of the clay increases the residual interface strengths at a water content of 29.7%. The increase in interface strength with an increase in plasticity is attributed to differences in the optimum water content of the two clays. The optimum water content of the higher plasticity clay liner is 26% versus 22% for the secondary clay liner described previously. Therefore, a water content of 29.7% is slightly greater than the optimum water content of the higher plasticity clay liner. This higher op-

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timum water content causes more frictional resistance, and thus higher interface strengths for the higher plasticity clay liner. Based on these results, it appears that clay/geosynthetic interface strengths are clay/site specific. Testing should be conducted to determine the critical interface for landfill-stability analyses.

STABILITY ANALYSIS OF KETTLEMAN HILLS PHASE IA OF LANDFILL B-19

Two- and three-dimensional slope-stability analyses of the Kettleman Hills failure were conducted to investigate the effect of complex landfill geometries on the calculated factor of safety and relevancy of ring-shear interface strengths. A three-dimensional analysis was conducted using a limit equilibrium technique based on Janbu's (1973) method. This analysis neglects the vertical component of interslice-shear forces and satisfies overall vertical and horizontal force equilibrium. The three-dimensional microcomputer slope-stability program, LF, developed by Golder Associates, Seattle, Wash., and the three-dimensional geometry in Fig. 13 were used for the analysis. The computer program allows the nonlinear-interface failure envelopes to be modeled using a trilinear failure envelope.

The two-dimensional cross section shown in Fig. 13 was used by Byrne et al. (1992) and was analyzed during the present study. Janbu's (1973) stability method was also used for the two-dimensional analysis. For comparison purposes, the two-dimensional hand calculations did not utilize Janbu's correction for neglecting the vertical component of interslice-shear forces. Therefore, the identical slope-stability method and assumptions were applied in the two- and three-dimensional stability analyses to permit comparison of the factors of safety. The same trilinear failure envelope was used to model the nonlinear-interface failure envelopes in the two- and three-dimensional analyses. The two- and three-dimensional stability analyses were performed assuming an average unit weight of the waste fill of 17.3 kN/m^3, a value based on bulk unit weight determinations conducted during waste excavation (Byrne et al. 1992). The basal operations layer, the primary

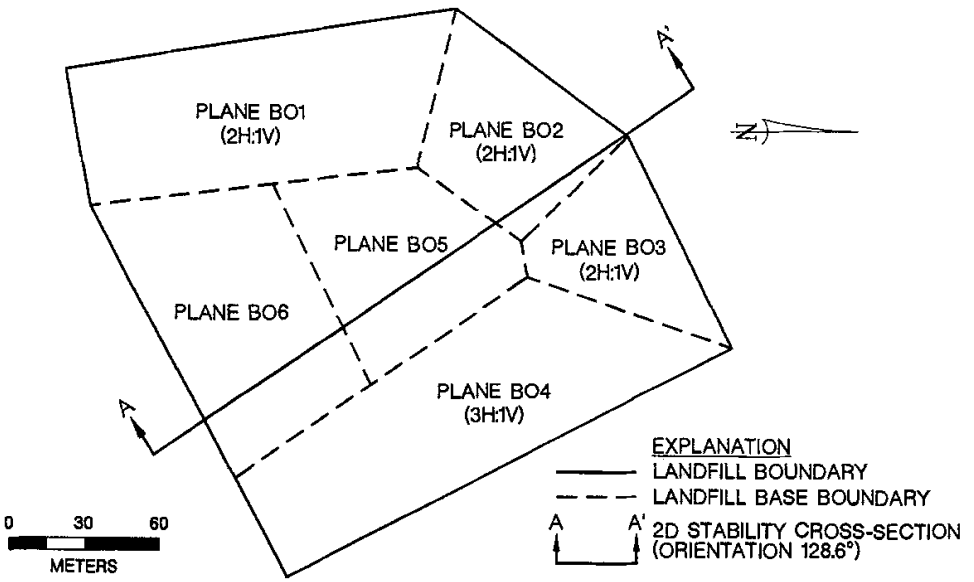

FIG. 13. Kettleman Hills Landfill B-19, Phase IA Geometry for Stability Analyses (after Byrne et al. 1992)

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and secondary gravel-drainage layers, and the primary clay overlying the secondary clay/secondary geomembrane interface (Fig. 1) were also assigned an average unit weight of 17.3 kN/m^3.

Various combinations of peak and residual SC/SG-interface failure envelopes were applied in the analysis to determine the interface strength mobilized at the time of the Kettleman Hills failure. Byrne et al. (1992) reported that inspection of the liner system during removal of the waste from Phase IA of Landfill B-19 at Kettleman Hills showed that sliding occurred along the SC/SG interface on the base of the landfill. Fig. 13 presents the geometry of Kettleman Hills Landfill B-19 and the location of the basal panels BO5 and BO6. The basal panels are inclined at a 2% grade. Sliding along the northwest and southwest sideslopes (panels BO1 through BO3) was also concentrated on the SC/SG interface, except in the upper 10–15 m of the slope, where sliding occurred along the primary geomembrane/secondary geotextile interface. Inspection of the northwest and southwest sideslope toe areas showed evidence of a more complex sliding mechanism due to the sharp change in slope angle at the toe of the slope. Sliding appeared to have occurred on synthetic interfaces as well as on the SC/SG interface in these toe areas in order to accommodate the kinematic constraints of the grade change. Sliding along the northeast sideslope (Panel BO4) was concentrated on the SC/SG interface and was approximately parallel to the strike of this sideslope.

To model field conditions, the residual failure envelope for the primary geomembrane/secondary geotextile interface was assigned to the slip surface in the upper 10–15 m of the sideslope. There is only a slight difference between the residual failure envelopes for the SC/SG and geomembrane/geotextile interfaces in Fig. 12 for normal stresses less than 190 kPa. As a result, interchanging these failure envelopes had a negligible effect on the calculated factors of safety.

Table 1 presents the three- and two-dimensional stability analyses. The three-dimensional factor of safety for the post-failure geometry and residual interface strengths assigned to all landfill panels is 0.95. This is in excellent agreement with field observations and confirms the relevancy of residual interface strengths measured using the torsional-ring-shear apparatus. The three-dimensional factors of safety for the prefailure geometry range from 0.73 to 1.26 when the residual and peak interface strengths, respectively, are assigned to all sliding surfaces. This suggests that Phase IA of landfill B-19 was marginally stable during construction. If the peak interface strength is assigned to the basal panels (BO5 and BO6 in Fig. 13), and the residual interface strength is assigned to all of the sideslopes (BO1 through BO4), then the three-dimensional factor of safety for the prefailure geometry is 0.92. This factor of safety is slightly less than unity, but still in excellent

TABLE 1. Results of Two- and Three-Dimensional Slope-Stability Analyses of Kettleman Hills Landfill B-19

Slide geometry (1)	Interface strength (2)	3D factor of safety (3)	2D factor of safety (4)
Postfailure	Residual	0.95	0.88
Prefailure	Residual	0.73	0.71
Prefailure	Peak	1.26	1.18
Prefailure	Peak and residual	0.92	1.03

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agreement with the 19 March 1988 slide. Possible reasons for this factor of safety being slightly less than unity include neglecting the complex sliding that occurred in the toe areas on the northwest and southwest sideslopes and the interface strength being slightly greater than the residual value near the toe of the sideslopes. However, a factor of safety of 0.92 is in excellent agreement with field observations, and thus it is recommended that peak and residual interface strengths be assigned to the landfill base and sideslopes, respectively, for general design purposes.

The two-dimensional factors of safety are lower than the three-dimensional values and in excellent agreement with field observations. The two-dimensional factor of safety for the postfailure geometry and a residual interface strength assigned to all sliding surfaces is 0.88. This factor of safety is lower than 0.95 because of the absence of three-dimensional effects. This suggests that the residual interface strengths should be higher for field agreement. Neglecting three-dimensional effects, however, yields back-calculated strengths that are too high. In summary, it may be concluded that the residual interface strengths measured using a torsional-ring-shear apparatus are in excellent agreement with field observations. The two-dimensional factors of safety for the prefailure geometry range from 0.71–1.18 when the residual and peak interface strengths, respectively, are assigned to all sliding surfaces. It is important to note that these two-dimensional factors of safety are less than the corresponding three-dimensional factors of safety.

When peak and residual interface strengths are applied to the base and sideslopes, respectively, the two-dimensional factor of safety for the prefailure geometry is slightly larger than the three-dimensional factor of safety. It is anticipated that this result is due to the percentage of area that is assigned peak and residual strengths in the two- and three-dimensional analyses. For example, 35% of the slide surface was assigned a peak interface strength, while 65% received a residual interface strength in the three-dimensional analysis. Conversely, in the two-dimensional analysis, 36% of the slide surface was assigned the residual interface strength, while 64% of the base received the peak value. Further evidence of the importance of area balance is that the two- and three-dimensional factors of safety yield a consistent pattern when the same interface strength is applied to the entire slip surface.

Based on this reevaluation of the Kettleman Hills failure, it appears that a two-dimensional stability analysis can be used with a suitable factor of safety for landfill design. Considerable engineering judgment should be used, however, to determine the critical two-dimensional section. A three-dimensional analysis may provide insight into the location of the critical two-dimensional section. But a more important parameter in landfill-stability analyses is the measurement and selection of the interface-shear strength parameters. The difference in the two- and three-dimensional factors of safety is 10–15% (Table 1), while the variability in interface strengths is significantly larger (Figs. 5 or 6). Therefore, the majority of the design effort should focus on site-specific testing and careful selection of interface strengths.

SELECTION OF INTERFACE STRENGTHS FOR SLOPE-STABILITY ANALYSES

The regressive analysis of the Kettleman Hills failure indicates that peak and residual interface strengths are mobilized along a landfill's base and sideslopes, respectively, during construction and waste placement. Waste is typically placed in landfills using a 2-m-thick lift with little compaction. As

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a result, the waste usually settles a considerable amount during the filling operation. Review of field settlements from several landfills indicates that municipal solid-waste landfills usually settle approximately 10% of the initial height because of placement and decomposition (Chang and Hannon 1976; York et al. 1977; Dodt et al. 1987; Coduto and Huitric 1989). It was found that hazardous-waste landfills typically settle 2–6% of the initial height (Gray and Lin 1972; Seals et al. 1972; Leonards and Bailey 1982; McLaren and DiGioia 1987). Settlement of the fill induces shear stresses in the sideslope liner system, all of which tends to displace the liner downslope. These shear stresses induce shear displacements along specific interfaces in the liner system that may lead to the mobilization of a residual interface strength. In addition, thermal expansion and contraction of the sideslope liner system during construction and filling may also contribute to the accumulation of shear displacements and the mobilization of a residual interface strength. Therefore, it is recommended that a residual interface strength be assigned to all sideslopes for design purposes.

Fill settlement, and thus liner shear displacements, decrease with depth along the sideslopes. Therefore, at the toe of the sideslopes, the residual interface strength may not be mobilized due to small displacements. For design, however, it is recommended that the entire sideslope be assigned the residual interface strength. Since shear displacements may be small along the base of the landfill, it is possible that the peak interface strength can be mobilized along the base of the landfill. In summary, it appears that peak and residual interface strengths should be assigned to the base and sideslopes, respectively, for design purposes.

A second design scenario involves assigning ring-shear residual interface-strengths to all slip surfaces and requiring a factor of safety greater than unity. This scenario should be considered, because the interface peak strength is usually mobilized at a small laboratory displacement (Fig. 3). Since field interface displacements and the effect of progressive failure are not known, it is prudent to also consider this scenario. If the residual interface strength is measured in a direct-shear apparatus, a factor of safety greater than unity may be required to compensate for the limited continuous-shear displacement applied in the apparatus.

CONCLUSIONS

The following conclusions are based on the analysis, data, and interpretation presented in this paper:

1. Clay/geomembrane interface strengths are a function of compaction water content, normal stress, and soil type. Therefore, a geosynthetic/geosynthetic interface may be more critical than the clay/geomembrane interface depending on placement water content, applied normal stress, and clay composition. Site-specific testing should be conducted to identify the critical interface as a function of normal stress.
2. Based on field observations, the torsional-ring-shear apparatus appears to provide an excellent estimate of field peak and residual interface-shear strengths. The main advantage of a ring-shear apparatus is that large continuous-shear displacement can be applied in one direction in order to achieve a residual strength condition.
3. Undrained clay/geomembrane-interface failure envelopes are nonlin-

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ear. It is recommended that the entire failure envelope or an appropriate value of the friction angle be incorporated in stability analyses.

4. Design-stability analyses should utilize peak and residual interface strengths on the landfill base and sideslopes, respectively. Since field interface displacements and the effect of progressive failure are not known, a factor of safety greater than unity with a ring-shear residual interface strength assigned to all slip surfaces should also be satisfied.

5. A two-dimensional stability analysis can be used for the design of landfills with complex geometries. However, considerable judgment should be used in determining the critical two-dimensional cross section. A three-dimensional analysis may aid the selection of the critical two-dimensional cross section.

6. The most important aspect of a landfill-stability analysis is measurement and selection of the interface-shear strengths. Significant time and effort should be expended on estimating the critical interface-shear strengths.

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Attachment III.G.6 – Utexas4 Input/Output for Phase 2 (South)

Profile: South Case: LTSS

Unit Weight Average Effective Average Total Average

Fixed Grid Coordinates

x	y
200	1110
200	1610
840	1610
840	1110

Circle Exit

x	y
840	1114

Tangent

Search Grid Subdivisions
15

Crack Depth
0

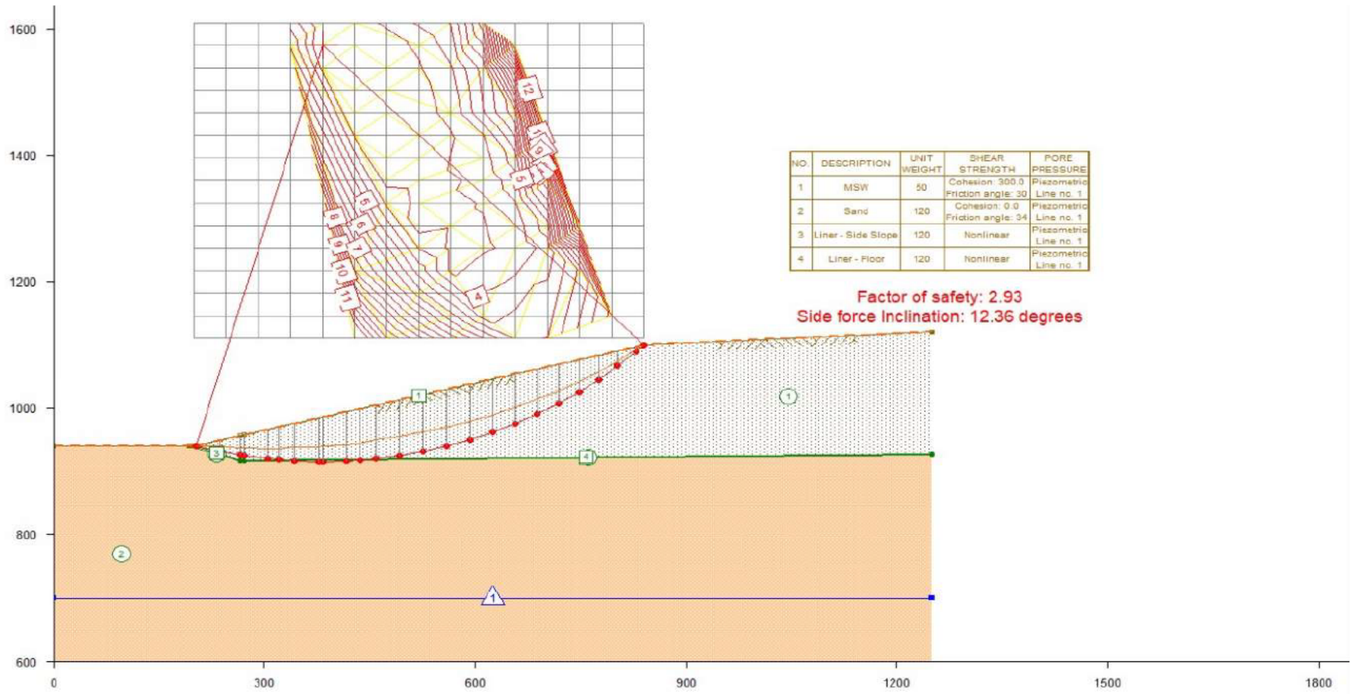
Seismic Acceleration

Minimum Weight
10000

Results

		Circle Center		Circle Exit	
Circles Attempted	Circles Completed	x	y	x	y
225	68	382.9	1574.3	219.4	936.4

Factor of Safety	Errors
2.93	



Profile: South Case: LTSS

INCLUDED

Unit Weight Average Effective Average Total Average

Fixed Grid Coordinates

x	y
200	1110
200	1710
840	1710
840	1110

Circle Exit

x	y
200	940

Tangent

Search Grid Subdivisions
15

Crack Depth
4

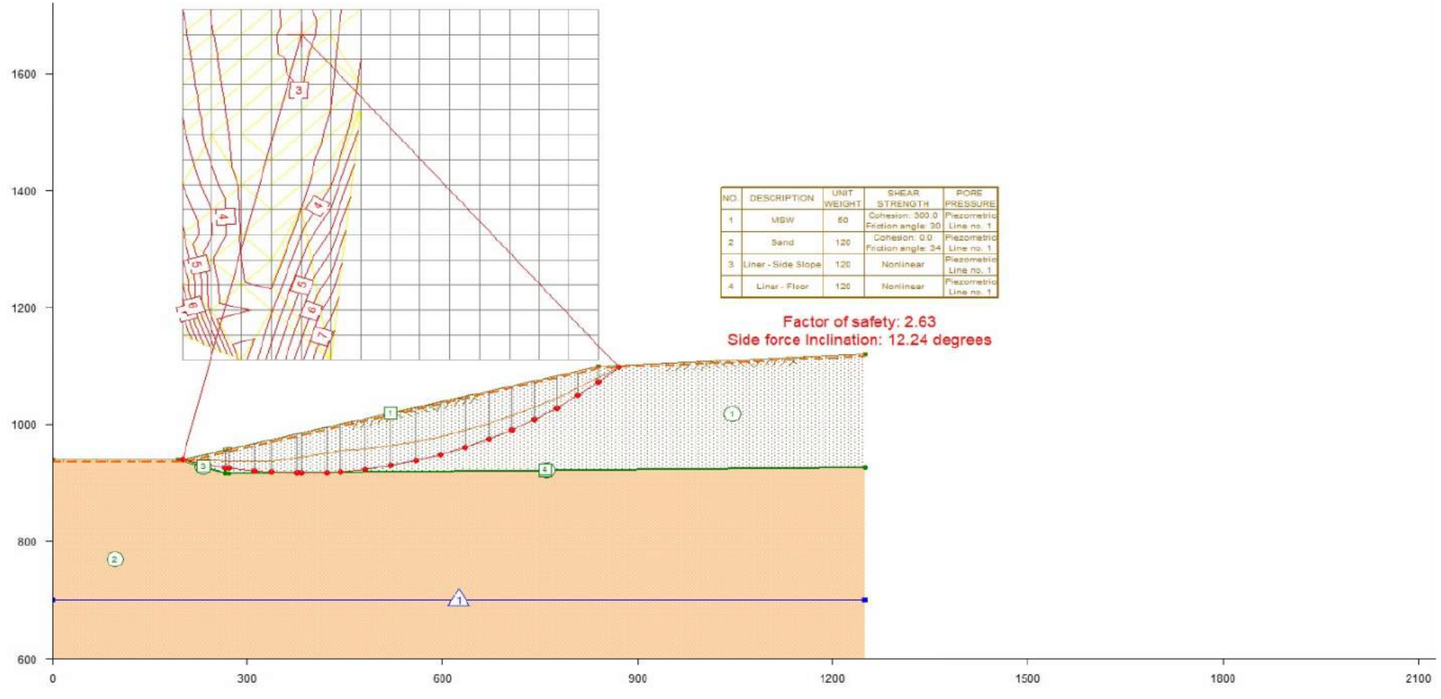
Seismic Acceleration

Minimum Weight
10000

Results

		Circle Center		Circle Exit	
Circles Attempted	Circles Completed	x	y	x	y
225	64	382.9	1667.1	200	940

Factor of Safety	Errors
2.63	



```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - South LTSS Circular
#155488

PROfile lines
   1 1 MSW
         200 940
         840 1100
         1250 1120.5

   2 2 Sand
         0 940
         194 940
         266 916
         1250 925.84

   3 3 Liner - Side Slope
           194 940
         200 940
         266 918
         271.8 916.06

   4 4 Liner - Floor
         266 918
         1250 927.84


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner - Side Slope
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 1219
         4000 1858
         10000 3628

      Piezometric Line
         1
   4 Liner - Floor
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 486
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1250 700


LABel
El Paso, TX Landfill Evaluation - South LTSS Circular
ANALYSIS/COMPUTATION
   Circular Search 2
     15 15
     200 1110 200 1710 840 1710 840 1110
     5 5
   Point
     200 940

   Minimum
     10000
   Crack
     4 D
   Short
COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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***** SHINOAK SOFTWARE CONFIDENTIAL *****


This is a special pre-release beta-test version of the UTEXAS4 software.

It is provided for confidential use only on an approved non-disclosure basis.

Posession and use of this software is only permitted with the express, written

approval of Stephen G. Wright

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*****************************************************************

* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE         *

* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *

* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *

* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *

* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE  *

* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING     *

* TO USE IT.  NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT     *

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* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS      *

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```

```
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Time and date of run: Wed Oct 25 10:33:34 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019
South LTSS.dat



El Paso, TX Landfill Evaluation - South LTSS Circular

#155488



TABLE NO. 3

************************

* NEW PROFILE LINE DATA *

************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW


Point        X           Y


   1      200.00      940.00

   2      840.00     1100.00

   3     1250.00     1120.50


------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand


Point        X           Y


   1        0.00      940.00

   2      194.00      940.00
```

3	266.00	916.00
4	1250.00	925.84

----- Profile Line No. 3 - Material Type (Number): 3 -----

Description: Liner - Side Slope

Point	X	Y
1	194.00	940.00
2	200.00	940.00
3	266.00	918.00
4	271.80	916.06

----- Profile Line No. 4 - Material Type (Number): 4 -----

Description: Liner - Floor

Point	X	Y
1	266.00	918.00
2	1250.00	927.84

```
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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

Constant unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

------------------- DATA FOR MATERIAL NUMBER 3 -------------------

---

Description: Liner - Side Slope

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	1219.0
3	4000.0	1858.0
4	10000.0	3628.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

------------------- DATA FOR MATERIAL NUMBER 4 -------------------

---

Description: Liner - Floor

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	486.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1250.00      700.00
```

```
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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************




Search will be conducted using a fixed grid.

Number of Points Across Grid: 15

Number of Points Up Grid: 15


Grid Corner

   Number           X              Y


     1           200.00        1110.00

     2           200.00        1710.00

     3           840.00        1710.00

     4           840.00        1110.00


----- Control Parameters for Finding "Critical" Radius -----

Initial number of subdivisions between maximum and minimum

radius for finding a critical radius/radii: 5


Minimum radius increment for terminating subdivision of radii: 5.000


The following criteria will be used for determining
```

```
the maximum and minimum radii:

     Point circles pass through - X: 200.00     Y: 940.00

Minimum weight required for computations to be performed: 10000


Depth of crack: 4.000

Automatic search output will be in short form.


------------------------------------------------------------------------------

The following represent default values or values that were prevously defined:

Subtended angle for slice subdivision: 3.00(degrees)

There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Search will be continued after the initial mode to find a most critical circle.

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Radii for each grid point will be sorted in the order of increasing radius.

Critical circles for grid points will be output in the order of increasing factor of safety.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

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TABLE NO. 26

****

* NEW, COMPUTED SLOPE GEOMETRY DATA *

****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	0.00	940.00
2	194.00	940.00
3	200.00	940.00
4	266.00	956.50
5	271.80	957.95
6	840.00	1100.00
7	1250.00	1120.50

```
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TABLE NO. 38

************************************************

* FINAL SUMMARY OF COMPUTATIONS WITH FIXED-GRID *

************************************************




Number of circles attempted: 225

Number of circles for which F calculated: 64

Circle with Lowest Factor of Safety:

     X coordinate for center: 382.86

     Y coordinate for center: 1667.14

     Radius of circle: 749.782

Factor of safety: 2.632

Side force inclination: 12.24

Time Required for Computations: 2.0 seconds
```

```
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TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y        Weight   No.    Cohesion    Angle    Pressure

       200.00    940.00

   1   219.15    935.71         17382    1       300.0    30.00         0.0

       238.31    931.43

   2   252.15    928.97         33320    1       300.0    30.00         0.0

       266.00    926.52

   3   268.90    926.08          9033    1       300.0    30.00         0.0

       271.80    925.63

   4   291.28    923.23         77115    1       300.0    30.00         0.0

       310.76    920.83

   5   324.26    919.78         69257    1       300.0    30.00         0.0

       337.77    918.72

   6   357.38    918.05        122605    4   NONLINEAR ENVELOPE         0.0

       377.00    917.38

   7   379.93    917.37         20533    4   NONLINEAR ENVELOPE         0.0
```

	382.86	917.36						
8	402.48	917.87	146822	4	NONLINEAR ENVELOPE			0.0
	422.10	918.39						
9	432.50	919.08	83096	4	NONLINEAR ENVELOPE			0.0
	442.91	919.77						
10	462.42	921.85	163453	1	300.0	30.00		0.0
	481.94	923.94						
11	501.32	927.04	171112	1	300.0	30.00		0.0
	520.70	930.14						
12	539.89	934.25	174105	1	300.0	30.00		0.0
	559.08	938.36						
13	578.03	943.48	172507	1	300.0	30.00		0.0
	596.98	948.59						
14	615.64	954.68	166468	1	300.0	30.00		0.0
	634.29	960.78						
15	652.61	967.84	156220	1	300.0	30.00		0.0
	670.92	974.90						
16	688.84	982.92	142069	1	300.0	30.00		0.0
	706.75	990.93						
17	724.23	999.87	124389	1	300.0	30.00		0.0
	741.70	1008.81						
18	758.68	1018.65	103624	1	300.0	30.00		0.0
	775.66	1028.49						
19	792.10	1039.21	80275	1	300.0	30.00		0.0
	808.55	1049.92						
20	824.27	1061.38	54548	1	300.0	30.00		0.0
	840.00	1072.84						
21	855.20	1085.18	23685	1	300.0	30.00		0.0
	870.41	1097.52						

No water in crack.

```
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El Paso, TX Landfill Evaluation - South LTSS Circular

#155488



TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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El Paso, TX Landfill Evaluation - South LTSS Circular

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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  21

Allowable moment imbalance for convergence: 11611



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   5.181e+004  -3.307e+007

First-order corrections to F and Theta .............   -0.3933    -3.0138

Reduced values - Deltas were too large .............   -0.3739    -2.8648



   2   2.62611    14.3239  -4.438e+003   5.947e+006

First-order corrections to F and Theta .............    0.0044    -2.1701

Second-order corrections to F and Theta ............    0.0057    -2.0807



   3   2.63180    12.2433   6.515e+000  -2.496e+003

First-order corrections to F and Theta .............   -0.0001    -0.0025
```

```
Second-order corrections to F and Theta ...........   -0.0001    -0.0025


   4   2.63174    12.2408  -5.689e-009   5.241e-006

First-order corrections to F and Theta ............    0.0000    -0.0000


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.000 (percent)

     Maximum change occurred for slice 8

     Normal stress where max. change occurred:      3765.26

     Old strength at this slice:       621.80

     New strength at this slice:       621.80

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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El Paso, TX Landfill Evaluation - South LTSS Circular

#155488


TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************


Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  21

Allowable moment imbalance for convergence: 11611


        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)


   1   3.00000    17.1887   5.181e+004  -3.307e+007

First-order corrections to F and Theta .............   -0.3933    -3.0138

Reduced values - Deltas were too large .............   -0.3739    -2.8648


   2   2.62611    14.3239  -4.438e+003   5.947e+006

First-order corrections to F and Theta .............    0.0044    -2.1701

Second-order corrections to F and Theta ............    0.0057    -2.0807


   3   2.63180    12.2433   6.515e+000  -2.496e+003

First-order corrections to F and Theta .............   -0.0001    -0.0025
```

```
Second-order corrections to F and Theta ...........   -0.0001    -0.0025


   4   2.63174    12.2408  -5.766e-009   5.283e-006

First-order corrections to F and Theta ............    0.0000    -0.0000
```

```
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South LTSS.dat



El Paso, TX Landfill Evaluation - South LTSS Circular

#155488



TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 1.06695e-010



Summation of Vertical Forces: 1.67347e-010



Summation of Moments: 1.04308e-007



Mohr Coulomb Shear Force/Shear Strength Check Summation: 5.02496e-011
```

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El Paso, TX Landfill Evaluation - South LTSS Circular

#155488

TABLE NO. 58

****

* Final Results for Stresses Along the Shear Surface *

* (Results are for the critical shear surface in the case of a search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 2.632 Side Force Inclination: 12.24

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	219.15	935.71	589.6	589.6	243.3
2	252.15	928.97	1426.2	1426.2	426.9
3	268.90	926.08	1806.9	1806.9	510.4
4	291.28	923.23	2245.6	2245.6	606.6
5	324.26	919.78	2829.6	2829.6	734.8
6	357.38	918.05	3202.3	3202.3	213.3
7	379.93	917.37	3557.5	3557.5	227.8
8	402.48	917.87	3765.3	3765.3	236.3
9	432.50	919.08	3973.0	3973.0	244.7
10	462.42	921.85	4204.5	4204.5	1036.4
11	501.32	927.04	4324.9	4324.9	1062.8

12	539.89	934.25	4337.3	4337.3	1065.5
13	578.03	943.48	4247.9	4247.9	1045.9
14	615.64	954.68	4063.0	4063.0	1005.3
15	652.61	967.84	3788.9	3788.9	945.2
16	688.84	982.92	3432.0	3432.0	866.9
17	724.23	999.87	2999.1	2999.1	771.9
18	758.68	1018.65	2497.2	2497.2	661.8
19	792.10	1039.21	1933.6	1933.6	538.2
20	824.27	1061.38	1319.3	1319.3	403.4
21	855.20	1085.18	544.3	544.3	233.4

```
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South LTSS.dat


El Paso, TX Landfill Evaluation - South LTSS Circular

#155488


TABLE NO. 59

**************************************************************************

* Final Results for Side Forces and Stresses Between Slices             *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


       --------------- VALUES AT RIGHT SIDE OF SLICE ---------------


                                Y-Coord. of   Fraction    Sigma      Sigma

Slice                   Side    Side Force       of         at         at

  No.    X-Right       Force     Location      Height      Top       Bottom


   1      238.31        14712       939.87     0.465       626.4      957.9

   2      266.00        33964       938.00     0.383       328.8     1885.7

   3      271.80        38642       937.74     0.375       289.3     2047.6

   4      310.76        73847       937.26     0.351       159.2     2921.3

   5      337.77       100282       937.74     0.341        84.5     3432.9

   6      377.00       113217       943.51     0.391       570.5     2738.9

   7      382.86       114666       944.45     0.396       619.1     2659.7

   8      422.10       120194       951.54     0.430       881.5     2164.0

   9      442.91       119792       956.17     0.450      1009.4     1882.7

  10      481.94       143257       958.33     0.397       621.4     2613.8

  11      520.70       157953       963.43     0.370       375.0     3054.0

  12      559.08       163302       970.67     0.353       210.4     3281.5

  13      596.98       159432       979.65     0.343        96.1     3341.1
```

14	634.29	147132	990.17	0.335	14.5	3260.9
15	670.92	127781	1002.10	0.328	-45.0	3060.4
16	706.75	103292	1015.35	0.322	-88.3	2753.2
17	741.70	76031	1029.84	0.316	-118.2	2348.9
18	775.66	48737	1045.53	0.307	-133.2	1851.9
19	808.55	24440	1062.50	0.298	-119.9	1251.5
20	840.00	6483	1081.88	0.333	-0.6	467.2
21	870.41	-0	1097.52	Below	0.0	-0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

Profile: South Case: LTSS NC - Peak

INCLUDED

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y	
197	940	fixed
266	917	fixed
650	920.9	0.5729387 deg
840	1100	

Shifting Points
5
1

Crack Depth
5

Seismic Acceleration

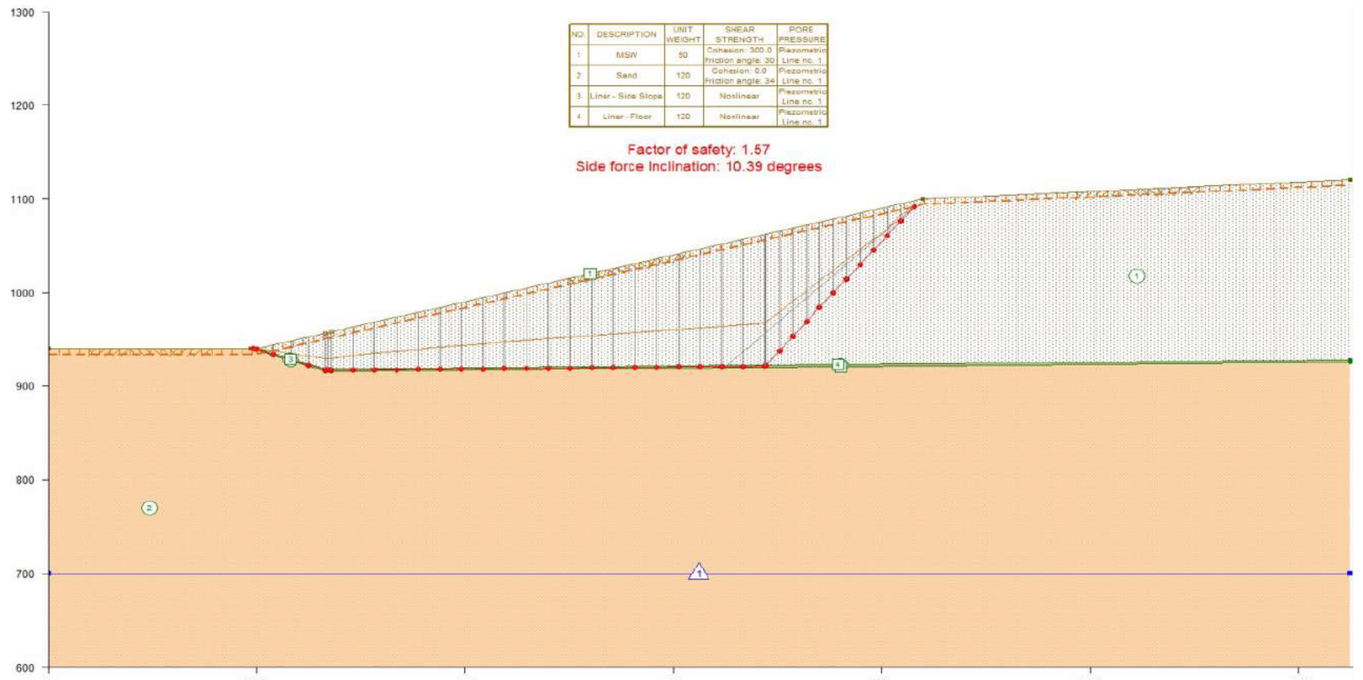
Minimum Weight

Results

Noncircular Shear Surface

197	940
266	917
688.1	921.3
831.3	1091.8

Factor of Safety
1.57



Profile: South Case: LTSS NC - Residual

INCLUDED

Unit Weight Average Effective Average Total Average

Noncircular Surface Coordinates

x	y	
197	940	fixed
266	917	fixed
650	920.9	0.5729387 deg
840	1100	

Shifting Points
5
1

Crack Depth
8

Seismic Acceleration

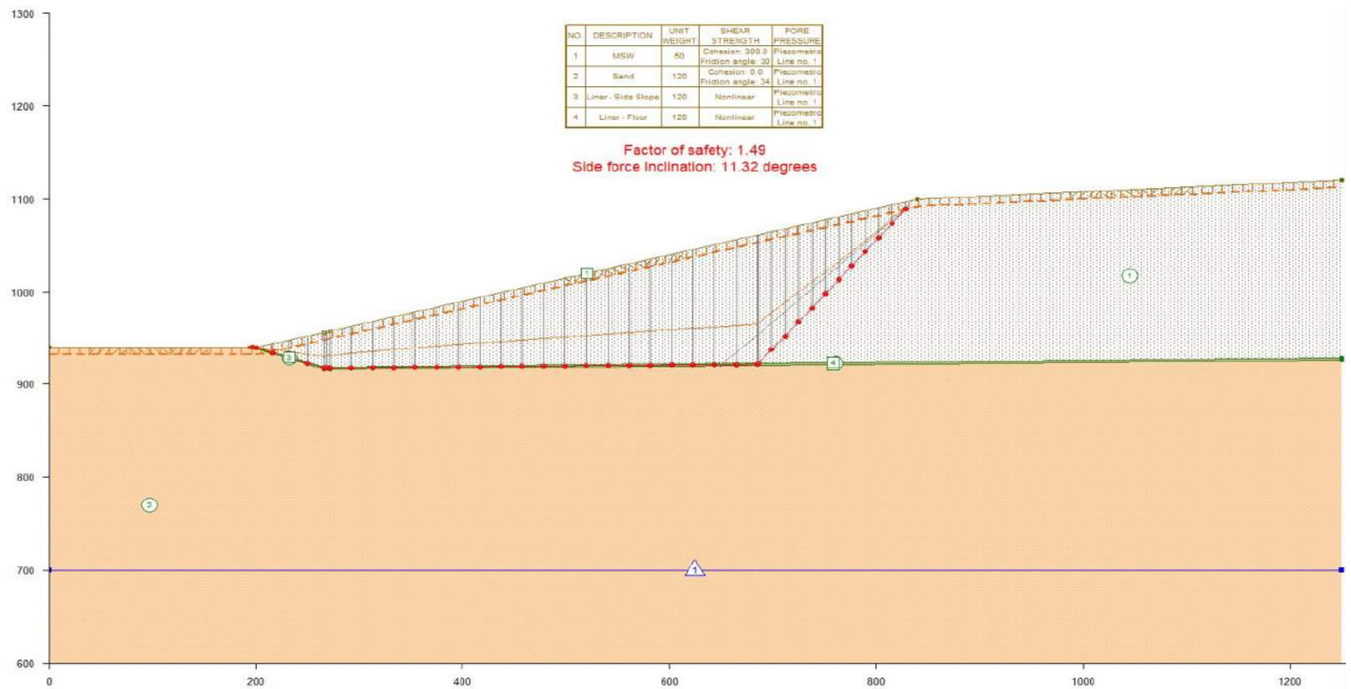
Minimum Weight

Results

Noncircular Shear Surface

197	940
266	917
685	921.3
828.5	1089.1

Factor of Safety
1.49



```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)
#155488

PROfile lines
   1 1 MSW
         200 940
         840 1100
         1250 1120.5

   2 2 Sand
         0 940
         194 940
         266 916
         271.8 916.06
         1250 925.84

   3 3 Liner - Side Slope
           194 940
         200 940
         266 918
         271.8 916.06

   4 4 Liner - Floor
         266 918
         1250 927.84


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner - Side Slope
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 1219
         4000 1858
         10000 3628

      Piezometric Line
         1
   4 Liner - Floor
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         2500 486
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1250 700


LABel
El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)
ANALYSIS/COMPUTATION
   Noncircular Search 2
     197 940 fixed
     266 917 fixed
     650 920.9 0.5729387
     840 1100 fixed

     5 1
   Crack
     6 D
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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It is provided for confidential use only on an approved non-disclosure basis.

Posession and use of this software is only permitted with the express, written

approval of Stephen G. Wright

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* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *

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* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *

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```

```
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Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019
South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 3

*************************

* NEW PROFILE LINE DATA *

*************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      940.00

   2      840.00     1100.00

   3     1250.00     1120.50



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y



   1        0.00      940.00

   2      194.00      940.00
```

3	266.00	916.00
4	271.80	916.06
5	1250.00	925.84

----- Profile Line No. 3 - Material Type (Number): 3 -----

Description: Liner - Side Slope

Point	X	Y
1	194.00	940.00
2	200.00	940.00
3	266.00	918.00
4	271.80	916.06

----- Profile Line No. 4 - Material Type (Number): 4 -----

Description: Liner - Floor

Point	X	Y
1	266.00	918.00
2	1250.00	927.84

```
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El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

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TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

Constant unit weight of soil (material): 120.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

------------------- DATA FOR MATERIAL NUMBER 3 -------------------

---

Description: Liner - Side Slope

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	1219.0
3	4000.0	1858.0
4	10000.0	3628.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

------------------- DATA FOR MATERIAL NUMBER 4 -------------------

---

Description: Liner - Floor

Constant unit weight of soil (material): 120.0

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	2500.0	486.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1250.00      700.00
```

```
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#155488



TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************



Coordinates of points on shear surface which are to be shifted



Point         X              Y      Shift Angle



   1         197.00         940.00                       - fixed

   2         266.00         917.00                       - fixed

   3         650.00         920.90      0.57             - moveable

   4         840.00        1100.00                       - fixed



Initial distance for shifting points on shear surface = 5.000

Final distance for shifting points on shear surface = 1.000

Maximum steepness permitted for toe of shear surface = 50.00





Depth of crack: 6.000

Automatic search output will be in short form.



---------------------------------------------------------------------------

The following represent default values or values that were prevously defined:

Maximum increment for slice subdivision: 30
```

```
There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Maximum number of passes for noncircular search: 50

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Minimum weight required for computations to be performed: 100

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 26

************************************

* NEW, COMPUTED SLOPE GEOMETRY DATA *

************************************



These slope geometry were generated from the Profile Lines.


     Point       X           Y


        1        0.00      940.00

        2      194.00      940.00

        3      200.00      940.00

        4      266.00      956.50

        5      271.80      957.95

        6      840.00     1100.00

        7     1250.00     1120.50


Right end point on noncircular shear surface adjusted to:

X: 831.34, Y: 1091.83

Adjustment was made to put end point at bottom of crack.


Noncircular Shear Surface Points After End Point Adjustment

Coordinates of points on shear surface which are to be shifted


Point         X             Y      Shift Angle
```

```
   1         197.00         940.00                       - fixed

   2         266.00         917.00                       - fixed

   3         650.00         920.90      0.57             - moveable

   4         831.34        1091.83                       - fixed

Computed crack depth: 6.00
```

```
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El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

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TABLE NO. 41

****************************************

*  Critical Noncircular Shear Surface  *

****************************************



***** CRITICAL NONCIRCULAR SHEAR SURFACE *****

X:     197.00     Y:     940.00

X:     266.00     Y:     917.00

X:     688.12     Y:     921.28

X:     831.34     Y:    1091.83



Minimum factor of safety: 1.571

Side force inclination: 10.39



Time required to find most critical surface:      0.0 seconds

Number of passes required to find most critical surface: 13

Total number of shear surfaces attempted: 39

Total number of shear surfaces for which the factor of safety

was successfully calculated: 39



      |   Shift    |      Max. Dist.| Minimum |   n        n    |

 Pass | Distance   | Pt.    Moved   |    F    | Tried  Computed |

      |            |                |         |                 |

    1 |     5.0000 |  3       5.000 |  1.5910 |     3        3  |

    2 |     5.0000 |  3       5.000 |  1.5856 |     6        6  |
```

3	5.0000	3	5.000	1.5810	9	9
4	5.0000	3	5.000	1.5771	12	12
5	5.0000	3	5.000	1.5741	15	15
6	5.0000	3	5.000	1.5720	18	18
7	5.0000	3	5.000	1.5708	21	21
8	5.0000	3	5.000	1.5707	24	24
9	5.0000	0	0.000	1.5707	27	27
10	2.5000	3	2.500	1.5706	30	30
11	2.5000	0	0.000	1.5706	33	33
12	1.2500	0	0.000	1.5706	36	36
13	0.6250	3	0.625	1.5706	39	39

```
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El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488


TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y       Weight   No.    Cohesion    Angle    Pressure

       197.00    940.00

   1   198.50    939.50         180    3   NONLINEAR ENVELOPE         0.0

       200.00    939.00

   2   208.25    936.25        5950    3   NONLINEAR ENVELOPE         0.0

       216.50    933.50

   3   224.75    930.75       13891    3   NONLINEAR ENVELOPE         0.0

       233.00    928.00

   4   241.25    925.25       21832    3   NONLINEAR ENVELOPE         0.0

       249.50    922.50

   5   257.75    919.75       29772    3   NONLINEAR ENVELOPE         0.0

       266.00    917.00

   6   267.45    917.01        5984    3   NONLINEAR ENVELOPE         0.0

       268.90    917.03

   7   270.35    917.04        6078    4   NONLINEAR ENVELOPE         0.0
```

	271.80	917.06				
8	282.21	917.16	46612	4	NONLINEAR ENVELOPE	0.0
	292.62	917.27				
9	303.02	917.38	51804	4	NONLINEAR ENVELOPE	0.0
	313.43	917.48				
10	323.84	917.59	56997	4	NONLINEAR ENVELOPE	0.0
	334.25	917.69				
11	344.66	917.80	62189	4	NONLINEAR ENVELOPE	0.0
	355.06	917.90				
12	365.47	918.01	67381	4	NONLINEAR ENVELOPE	0.0
	375.88	918.11				
13	386.29	918.22	72574	4	NONLINEAR ENVELOPE	0.0
	396.70	918.33				
14	407.11	918.43	77766	4	NONLINEAR ENVELOPE	0.0
	417.51	918.54				
15	427.92	918.64	82958	4	NONLINEAR ENVELOPE	0.0
	438.33	918.75				
16	448.74	918.85	88151	4	NONLINEAR ENVELOPE	0.0
	459.15	918.96				
17	469.55	919.06	93343	4	NONLINEAR ENVELOPE	0.0
	479.96	919.17				
18	490.37	919.28	98536	4	NONLINEAR ENVELOPE	0.0
	500.78	919.38				
19	511.19	919.49	103728	4	NONLINEAR ENVELOPE	0.0
	521.59	919.59				
20	532.00	919.70	108920	4	NONLINEAR ENVELOPE	0.0
	542.41	919.80				
21	552.82	919.91	114113	4	NONLINEAR ENVELOPE	0.0
	563.23	920.01				
22	573.63	920.12	119305	4	NONLINEAR ENVELOPE	0.0
	584.04	920.23				
23	594.45	920.33	124497	4	NONLINEAR ENVELOPE	0.0
	604.86	920.44				
24	615.27	920.54	129690	4	NONLINEAR ENVELOPE	0.0

	625.67	920.65						
25	636.08	920.75	134882	4	NONLINEAR ENVELOPE			0.0
	646.49	920.86						
26	656.90	920.96	140074	4	NONLINEAR ENVELOPE			0.0
	667.31	921.07						
27	677.72	921.18	145267	4	NONLINEAR ENVELOPE			0.0
	688.12	921.28						
28	688.52	921.76	5613	4	NONLINEAR ENVELOPE			0.0
	688.92	922.23						
29	695.39	929.94	86687	1	300.0	30.00		0.0
	701.87	937.65						
30	708.34	945.36	78801	1	300.0	30.00		0.0
	714.81	953.07						
31	721.29	960.78	70915	1	300.0	30.00		0.0
	727.76	968.49						
32	734.23	976.19	63029	1	300.0	30.00		0.0
	740.71	983.90						
33	747.18	991.61	55143	1	300.0	30.00		0.0
	753.65	999.32						
34	760.13	1007.03	47257	1	300.0	30.00		0.0
	766.60	1014.74						
35	773.08	1022.45	39371	1	300.0	30.00		0.0
	779.55	1030.16						
36	786.02	1037.87	31485	1	300.0	30.00		0.0
	792.50	1045.58						
37	798.97	1053.29	23599	1	300.0	30.00		0.0
	805.44	1061.00						
38	811.92	1068.71	15713	1	300.0	30.00		0.0
	818.39	1076.42						
39	824.86	1084.13	7827	1	300.0	30.00		0.0
	831.34	1091.83						

No water in crack.

```
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South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 14012



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.026e+005  -1.398e+008

First-order corrections to F and Theta .............   -2.4577    -2.0275

Reduced values - Deltas were too large .............   -0.5000    -0.4125



   2   2.50000    16.7763   1.532e+005  -1.050e+008

First-order corrections to F and Theta .............   -1.3305    -2.3223

Reduced values - Deltas were too large .............   -0.5000    -0.8727



   3   2.00000    15.9035   8.119e+004  -5.392e+007

First-order corrections to F and Theta .............   -0.4911    -2.8807
```

```
Reduced values - Deltas were too large .............   -0.4884    -2.8648


   4   1.51164    13.0387  -2.691e+004   2.477e+007

First-order corrections to F and Theta .............    0.0457    -3.6212

Reduced values - Deltas were too large .............    0.0361    -2.8648


   5   1.54776    10.1740  -6.092e+003   4.785e+006

First-order corrections to F and Theta .............    0.0229     0.2343

Second-order corrections to F and Theta ............    0.0230     0.2193


   6   1.57079    10.3933   1.244e+000  -1.267e+003

First-order corrections to F and Theta .............   -0.0000     0.0002


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.677 (percent)

     Maximum change occurred for slice 9

     Normal stress where max. change occurred:      2538.37

     Old strength at this slice:       493.46

     New strength at this slice:       490.12
```

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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Time and date of run: Wed Oct 25 10:33:34 2023

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South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 14012



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.027e+005  -1.398e+008

First-order corrections to F and Theta .............   -2.4583    -2.0267

Reduced values - Deltas were too large .............   -0.5000    -0.4122



   2   2.50000    16.7765   1.532e+005  -1.050e+008

First-order corrections to F and Theta .............   -1.3310    -2.3213

Reduced values - Deltas were too large .............   -0.5000    -0.8720



   3   2.00000    15.9045   8.123e+004  -5.396e+007

First-order corrections to F and Theta .............   -0.4914    -2.8796
```

```
Reduced values - Deltas were too large .............   -0.4889    -2.8648


   4   1.51115    13.0397  -2.700e+004   2.484e+007

First-order corrections to F and Theta .............    0.0459    -3.6270

Reduced values - Deltas were too large .............    0.0363    -2.8648


   5   1.54743    10.1749  -6.146e+003   4.830e+006

First-order corrections to F and Theta .............    0.0230     0.2341

Second-order corrections to F and Theta ............    0.0232     0.2191


   6   1.57064    10.3940   1.273e+000  -1.294e+003

First-order corrections to F and Theta .............   -0.0000     0.0002


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.000 (percent)

     Maximum change occurred for slice 11

     Normal stress where max. change occurred:      3041.92

     Old strength at this slice:       544.17

     New strength at this slice:       544.17

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 14012



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.027e+005  -1.398e+008

First-order corrections to F and Theta .............   -2.4583    -2.0267

Reduced values - Deltas were too large .............   -0.5000    -0.4122



   2   2.50000    16.7765   1.532e+005  -1.050e+008

First-order corrections to F and Theta .............   -1.3310    -2.3213

Reduced values - Deltas were too large .............   -0.5000    -0.8720



   3   2.00000    15.9045   8.123e+004  -5.396e+007

First-order corrections to F and Theta .............   -0.4914    -2.8796
```

```
Reduced values - Deltas were too large .............   -0.4889    -2.8648


   4   1.51115    13.0397  -2.700e+004   2.484e+007

First-order corrections to F and Theta .............    0.0459    -3.6270

Reduced values - Deltas were too large .............    0.0363    -2.8648


   5   1.54743    10.1749  -6.146e+003   4.830e+006

First-order corrections to F and Theta .............    0.0230     0.2341

Second-order corrections to F and Theta ............    0.0232     0.2191


   6   1.57064    10.3940   1.273e+000  -1.294e+003

First-order corrections to F and Theta .............   -0.0000     0.0002
```

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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Time and date of run: Wed Oct 25 10:33:34 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019
South LTSS - Peak.dat



El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488



TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 1.83206e-010



Summation of Vertical Forces: 3.10138e-010



Summation of Moments: 1.95135e-003



Mohr Coulomb Shear Force/Shear Strength Check Summation: 8.13998e-011
```

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Time and date of run: Wed Oct 25 10:33:34 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019 South LTSS - Peak.dat

El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488

TABLE NO. 58

****

* Final Results for Stresses Along the Shear Surface *

* (Results are for the critical shear surface in the case of a search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 1.571 Side Force Inclination: 10.39

-------- VALUES AT CENTER OF BASE OF SLICE --------

Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	198.50	939.50	77.1	77.1	23.9
2	208.25	936.25	463.3	463.3	143.8
3	224.75	930.75	1081.5	1081.5	335.8
4	241.25	925.25	1699.7	1699.7	527.7
5	257.75	919.75	2318.0	2318.0	719.6
6	267.45	917.01	2175.4	2175.4	675.3
7	270.35	917.04	2139.0	2139.0	264.8
8	282.21	917.16	2284.0	2284.0	282.7
9	303.02	917.38	2538.0	2538.0	312.0
10	323.84	917.59	2790.0	2790.0	329.2
11	344.66	917.80	3041.9	3041.9	346.5

12	365.47	918.01	3293.9	3293.9	363.7
13	386.29	918.22	3545.8	3545.8	380.9
14	407.11	918.43	3797.8	3797.8	398.1
15	427.92	918.64	4049.7	4049.7	415.3
16	448.74	918.85	4301.7	4301.7	432.6
17	469.55	919.06	4553.6	4553.6	449.8
18	490.37	919.28	4805.6	4805.6	467.0
19	511.19	919.49	5057.5	5057.5	484.2
20	532.00	919.70	5309.5	5309.5	501.4
21	552.82	919.91	5561.5	5561.5	518.6
22	573.63	920.12	5813.4	5813.4	535.9
23	594.45	920.33	6065.4	6065.4	553.1
24	615.27	920.54	6317.3	6317.3	570.3
25	636.08	920.75	6569.3	6569.3	587.5
26	656.90	920.96	6821.2	6821.2	604.7
27	677.72	921.18	7073.2	7073.2	621.9
28	688.52	921.76	5369.4	5369.4	505.5
29	695.39	929.94	4093.1	4093.1	1695.6
30	708.34	945.36	3709.7	3709.7	1554.7
31	721.29	960.78	3326.4	3326.4	1413.7
32	734.23	976.19	2943.0	2943.0	1272.8
33	747.18	991.61	2559.6	2559.6	1131.9
34	760.13	1007.03	2176.3	2176.3	991.0
35	773.08	1022.45	1792.9	1792.9	850.1
36	786.02	1037.87	1409.5	1409.5	709.1
37	798.97	1053.29	1026.1	1026.1	568.2
38	811.92	1068.71	642.8	642.8	427.3
39	824.86	1084.13	259.4	259.4	286.4

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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South LTSS - Peak.dat


El Paso, TX Landfill Evaluation - South LTSS Noncircular (Peak)

#155488


TABLE NO. 59

**************************************************************************

* Final Results for Side Forces and Stresses Between Slices             *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


       --------------- VALUES AT RIGHT SIDE OF SLICE ---------------


                                Y-Coord. of   Fraction    Sigma      Sigma

Slice                   Side    Side Force       of         at         at

  No.    X-Right       Force     Location      Height      Top       Bottom


   1      200.00          151       939.78     0.775       394.6      -96.9

   2      216.50         5155       937.91     0.415       234.3      720.0

   3      233.00        16834       934.92     0.342        41.0     1594.3

   4      249.50        35191       932.11     0.322       -80.4     2397.6

   5      266.00        60224       929.37     0.313      -181.1     3180.4

   6      268.90        62151       929.51     0.311      -207.9     3249.5

   7      271.80        62867       929.90     0.314      -175.4     3199.8

   8      292.62        68360       932.54     0.333        -4.6     2935.4

   9      313.43        74419       934.97     0.344        89.7     2787.7

  10      334.25        80788       937.27     0.350       145.2     2699.3

  11      355.06        87467       939.45     0.354       175.7     2651.3

  12      375.88        94457       941.54     0.356       189.7     2631.8

  13      396.70       101757       943.55     0.356       192.5     2632.9
```

14	417.51	109367	945.49	0.355	187.5	2649.3
15	438.33	117288	947.36	0.354	177.1	2677.2
16	459.15	125519	949.19	0.352	162.9	2714.0
17	479.96	134060	950.97	0.350	146.0	2757.8
18	500.78	142912	952.70	0.348	127.1	2807.1
19	521.59	152074	954.40	0.345	106.9	2860.7
20	542.41	161546	956.08	0.343	85.7	2918.0
21	563.23	171328	957.72	0.340	63.8	2978.2
22	584.04	181421	959.34	0.338	41.5	3040.8
23	604.86	191824	960.94	0.335	18.9	3105.4
24	625.67	202538	962.52	0.333	-3.9	3171.8
25	646.49	213561	964.08	0.331	-26.8	3239.5
26	667.31	224895	965.63	0.328	-49.7	3308.5
27	688.12	236540	967.17	0.326	-72.5	3378.5
28	688.92	231774	968.25	0.329	-45.1	3301.8
29	701.87	189930	979.33	0.326	-63.6	2986.7
30	714.81	152241	990.41	0.323	-81.1	2671.0
31	727.76	118707	1001.49	0.319	-97.1	2354.3
32	740.71	89327	1012.57	0.314	-111.3	2036.5
33	753.65	64102	1023.66	0.308	-122.6	1717.0
34	766.60	43031	1034.76	0.299	-129.8	1394.9
35	779.55	26116	1045.87	0.287	-130.2	1068.9
36	792.50	13355	1057.03	0.269	-119.0	736.4
37	805.44	4748	1068.33	0.242	-84.6	392.3
38	818.39	297	1082.94	0.359	2.4	29.7
39	831.34	0	1091.83	Below	-0.0	0.0

Read end-of-file on input while looking for another command word.

End of input data assumed - normal termination.

```
GRAphics
HEAding follows -
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)
#155488

PROfile lines
   1 1 MSW
         200 940
         840 1100
         1250 1120.5

   2 2 Sand
         0 940
         194 940
         266 916
         1250 925.84

   3 3 Liner - Side Slope
           194 940
         200 940
         266 918
         271.8 916.06

   4 4 Liner - Floor
         266 918
         1250 927.84


MATerial properties
   1 MSW
      50 = unit weight
      Conventional Shear Strength
         300 30
      Piezometric Line
         1
   2 Sand
      120 = unit weight
      Conventional Shear Strength
         0 34
      Piezometric Line
         1
   3 Liner - Side Slope
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         1500 346
         10000 1291

      Piezometric Line
         1
   4 Liner - Floor
      120 = unit weight
      Non Linear Mohr Coulomb Envelope
         0 0
         4500 713
         10000 1291

      Piezometric Line
         1

PIEzometric line
     1 Piezometric Line
         0 700
         1250 700


LABel
El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)
ANALYSIS/COMPUTATION
   Noncircular Search 2
     197 940 fixed
     266 917 fixed
     650 920.9 0.5729387
     840 1100 fixed

     5 1
   Crack
     8 D
   Short

COMpute
```

```
TABLE NO. 1

COMPUTER PROGRAM DESIGNATION: UTEXAS4

Originally Coded By Stephen G. Wright

Version No. 4.1.2.0 - Last Revision Date: 7/29/2020

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It is provided for confidential use only on an approved non-disclosure basis.

Posession and use of this software is only permitted with the express, written

approval of Stephen G. Wright

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*****************************************************************

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* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE       *

* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA      *

* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS *

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*****************************************************************
```

```
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Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019
South LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 3

*************************

* NEW PROFILE LINE DATA *

*************************



------------------------------------------------------------

----- Profile Line No. 1 - Material Type (Number): 1 -----

------------------------------------------------------------

Description: MSW



Point        X           Y



   1      200.00      940.00

   2      840.00     1100.00

   3     1250.00     1120.50



------------------------------------------------------------

----- Profile Line No. 2 - Material Type (Number): 2 -----

------------------------------------------------------------

Description: Sand



Point        X           Y



   1        0.00      940.00

   2      194.00      940.00
```

3	266.00	916.00
4	1250.00	925.84

----- Profile Line No. 3 - Material Type (Number): 3 -----

Description: Liner - Side Slope

Point	X	Y
1	194.00	940.00
2	200.00	940.00
3	266.00	918.00
4	271.80	916.06

----- Profile Line No. 4 - Material Type (Number): 4 -----

Description: Liner - Floor

Point	X	Y
1	266.00	918.00
2	1250.00	927.84

```
UTEXAS4 S/N:10001  - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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Time and date of run: Wed Oct 25 10:33:34 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019
South LTSS - Residual.dat



El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488



TABLE NO. 4

**********************************************************************

* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 1 -------------------

----------------------------------------------------------------------

Description: MSW



Constant unit weight of soil (material): 50.0



CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 300.0

Friction angle - - - - - 30.00 (degrees)



Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.



----------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 2 -------------------

----------------------------------------------------------------------

Description: Sand
```

```
Constant unit weight of soil (material): 120.0


CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS

Cohesion - - - - - - - - 0.0

Friction angle - - - - - 34.00 (degrees)


Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.


---------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 3 -------------------

---------------------------------------------------------------------

Description: Liner - Side Slope


Constant unit weight of soil (material): 120.0


---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

     Point     Normal Stress     Shear Stress


       1                0.0              0.0

       2             1500.0            346.0

       3            10000.0           1291.0


Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.


---------------------------------------------------------------------

------------------- DATA FOR MATERIAL NUMBER 4 -------------------

---------------------------------------------------------------------

Description: Liner - Floor


Constant unit weight of soil (material): 120.0
```

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	0.0	0.0
2	4500.0	713.0
3	10000.0	1291.0

Pore water pressures are defined by a piezometric line.

Piezometric line number: 1

Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6

**********************************************************************

* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

**********************************************************************



------------------------------------------------------------

--------------- Piezometric Line Number 1 ---------------

------------------------------------------------------------

Description: Piezometric Line

Unit weight of fluid (water): 62.4


Point        X           Y


  1        0.00      700.00

  2     1250.00      700.00
```

```
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TABLE NO. 16

*********************************

* NEW ANALYSIS/COMPUTATION DATA *

*********************************



Coordinates of points on shear surface which are to be shifted



Point         X              Y      Shift Angle



   1         197.00         940.00                        - fixed

   2         266.00         917.00                        - fixed

   3         650.00         920.90      0.57              - moveable

   4         840.00        1100.00                        - fixed



Initial distance for shifting points on shear surface = 5.000

Final distance for shifting points on shear surface = 1.000

Maximum steepness permitted for toe of shear surface = 50.00




Depth of crack: 8.000

Automatic search output will be in short form.



---------------------------------------------------------------------------

The following represent default values or values that were prevously defined:

Maximum increment for slice subdivision: 30
```

```
There is no water in a crack.

Conventional (single-stage) computations will be performed.

Seismic coefficient: 0.000

Unit weight of water (or other fluid) in crack: 62.4

Maximum number of passes for noncircular search: 50

No restrictions exist on the lateral extent of the search.

No shear surfaces other than the most critical will be saved for display later.

Neither slope face was explicitly designated for analysis.

Standard sign convention used for direction of shear stress on shear surface.

Procedure of Analysis: Spencer


Iteration limit: 100

Force imbalance: 1.000000e-005 (fraction of total weight)

Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)

Minimum weight required for computations to be performed: 100

Initial trial factor of safety: 3.000

Initial trial side force inclination: 17.189 (degrees)

Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00
```

```
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TABLE NO. 26

************************************

* NEW, COMPUTED SLOPE GEOMETRY DATA *

************************************



These slope geometry were generated from the Profile Lines.


     Point       X           Y


        1        0.00      940.00

        2      194.00      940.00

        3      200.00      940.00

        4      266.00      956.50

        5      271.80      957.95

        6      840.00     1100.00

        7     1250.00     1120.50


Right end point on noncircular shear surface adjusted to:

X: 828.45, Y: 1089.11

Adjustment was made to put end point at bottom of crack.


Noncircular Shear Surface Points After End Point Adjustment

Coordinates of points on shear surface which are to be shifted


Point         X             Y      Shift Angle
```

```
   1         197.00         940.00                       - fixed

   2         266.00         917.00                       - fixed

   3         650.00         920.90      0.57             - moveable

   4         828.45        1089.11                       - fixed

Computed crack depth: 8.00
```

```
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TABLE NO. 41

****************************************

*  Critical Noncircular Shear Surface  *

****************************************



***** CRITICAL NONCIRCULAR SHEAR SURFACE *****

X:     197.00     Y:     940.00

X:     266.00     Y:     917.00

X:     685.00     Y:     921.25

X:     828.45     Y:    1089.11


Minimum factor of safety: 1.486

Side force inclination: 11.32


Time required to find most critical surface:      0.0 seconds

Number of passes required to find most critical surface: 11

Total number of shear surfaces attempted: 33

Total number of shear surfaces for which the factor of safety

was successfully calculated: 33


      |   Shift    |      Max. Dist.| Minimum |   n        n    |

 Pass | Distance   | Pt.    Moved   |    F    | Tried  Computed |

      |            |                |         |                 |

    1 |     5.0000 |  3       5.000 |  1.5028 |     3        3  |

    2 |     5.0000 |  3       5.000 |  1.4980 |     6        6  |
```

3	5.0000	3	5.000	1.4939	9	9
4	5.0000	3	5.000	1.4905	12	12
5	5.0000	3	5.000	1.4880	15	15
6	5.0000	3	5.000	1.4865	18	18
7	5.0000	3	5.000	1.4859	21	21
8	5.0000	0	0.000	1.4859	24	24
9	2.5000	0	0.000	1.4859	27	27
10	1.2500	0	0.000	1.4859	30	30
11	0.6250	0	0.000	1.4859	33	33

```
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TABLE NO. 43

************************************************************

* Coordinate, Weight, Strength and Pore Water Pressure     *

* Information for Individual Slices for Conventional       *

* Computations or First Stage of Multi-Stage Computations. *

* (Information is for the critical shear surface in the    *

* case of an automatic search.)                            *

************************************************************


Slice                        Slice   Matl.             Friction     Pore

  No.      X         Y        Weight   No.    Cohesion    Angle    Pressure

       197.00    940.00

   1   198.50    939.50          180    3   NONLINEAR ENVELOPE         0.0

       200.00    939.00

   2   208.25    936.25         5950    3   NONLINEAR ENVELOPE         0.0

       216.50    933.50

   3   224.75    930.75        13891    3   NONLINEAR ENVELOPE         0.0

       233.00    928.00

   4   241.25    925.25        21832    3   NONLINEAR ENVELOPE         0.0

       249.50    922.50

   5   257.75    919.75        29772    3   NONLINEAR ENVELOPE         0.0

       266.00    917.00

   6   267.45    917.01         5984    3   NONLINEAR ENVELOPE         0.0

       268.90    917.03

   7   270.35    917.04         6078    4   NONLINEAR ENVELOPE         0.0
```

	271.80	917.06				
8	282.13	917.16	46243	4	NONLINEAR ENVELOPE	0.0
	292.46	917.27				
9	302.79	917.37	51357	4	NONLINEAR ENVELOPE	0.0
	313.12	917.48				
10	323.45	917.58	56472	4	NONLINEAR ENVELOPE	0.0
	333.78	917.69				
11	344.11	917.79	61587	4	NONLINEAR ENVELOPE	0.0
	354.44	917.90				
12	364.77	918.00	66701	4	NONLINEAR ENVELOPE	0.0
	375.10	918.11				
13	385.43	918.21	71816	4	NONLINEAR ENVELOPE	0.0
	395.76	918.32				
14	406.09	918.42	76931	4	NONLINEAR ENVELOPE	0.0
	416.42	918.53				
15	426.75	918.63	82045	4	NONLINEAR ENVELOPE	0.0
	437.08	918.74				
16	447.41	918.84	87160	4	NONLINEAR ENVELOPE	0.0
	457.74	918.94				
17	468.07	919.05	92275	4	NONLINEAR ENVELOPE	0.0
	478.40	919.15				
18	488.73	919.26	97389	4	NONLINEAR ENVELOPE	0.0
	499.06	919.36				
19	509.39	919.47	102504	4	NONLINEAR ENVELOPE	0.0
	519.72	919.57				
20	530.05	919.68	107619	4	NONLINEAR ENVELOPE	0.0
	540.38	919.78				
21	550.71	919.89	112733	4	NONLINEAR ENVELOPE	0.0
	561.04	919.99				
22	571.37	920.10	117848	4	NONLINEAR ENVELOPE	0.0
	581.70	920.20				
23	592.03	920.31	122962	4	NONLINEAR ENVELOPE	0.0
	602.36	920.41				
24	612.69	920.52	128077	4	NONLINEAR ENVELOPE	0.0

	623.02	920.62						
25	633.35	920.73	133192	4	NONLINEAR ENVELOPE			0.0
	643.68	920.83						
26	654.01	920.94	138306	4	NONLINEAR ENVELOPE			0.0
	664.34	921.04						
27	674.67	921.15	143421	4	NONLINEAR ENVELOPE			0.0
	685.00	921.25						
28	685.40	921.72	5683	4	NONLINEAR ENVELOPE			0.0
	685.81	922.20						
29	692.29	929.79	86420	1	300.0	30.00		0.0
	698.78	937.37						
30	705.26	944.96	78683	1	300.0	30.00		0.0
	711.74	952.55						
31	718.23	960.13	70947	1	300.0	30.00		0.0
	724.71	967.72						
32	731.19	975.31	63210	1	300.0	30.00		0.0
	737.68	982.89						
33	744.16	990.48	55474	1	300.0	30.00		0.0
	750.65	998.07						
34	757.13	1005.66	47738	1	300.0	30.00		0.0
	763.61	1013.24						
35	770.10	1020.83	40001	1	300.0	30.00		0.0
	776.58	1028.42						
36	783.06	1036.00	32265	1	300.0	30.00		0.0
	789.55	1043.59						
37	796.03	1051.18	24528	1	300.0	30.00		0.0
	802.52	1058.76						
38	809.00	1066.35	16792	1	300.0	30.00		0.0
	815.48	1073.94						
39	821.97	1081.53	9055	1	300.0	30.00		0.0
	828.45	1089.11						

No water in crack.

```
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TABLE NO. 44

**********************************************************

* Seismic Forces and Forces Due to Distributed Loads for *

* Individual Slices for Conventional Computations or the *

* First Stage of Multi-Stage Computations.               *

* (Information is for the critical shear surface in the  *

* case of an automatic search.)                          *

**********************************************************



There are no seismic forces or forces due to distributed loads

for the current shear surface
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 1 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 13886



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.166e+005  -1.513e+008

First-order corrections to F and Theta .............   -2.7777    -1.4587

Reduced values - Deltas were too large .............   -0.5000    -0.2626



   2   2.50000    16.9262   1.701e+005  -1.184e+008

First-order corrections to F and Theta .............   -1.5556    -1.6729

Reduced values - Deltas were too large .............   -0.5000    -0.5377



   3   2.00000    16.3885   1.022e+005  -7.009e+007

First-order corrections to F and Theta .............   -0.6319    -2.1133
```

```
Reduced values - Deltas were too large .............   -0.5000    -1.6721


   4   1.50000    14.7164  -4.992e+003   7.555e+006

First-order corrections to F and Theta .............   -0.0158    -3.5876

Reduced values - Deltas were too large .............   -0.0126    -2.8648


   5   1.48737    11.8516  -1.129e+003   1.490e+006

First-order corrections to F and Theta .............   -0.0010    -0.5390

Second-order corrections to F and Theta ............   -0.0009    -0.5321


   6   1.48649    11.3195   1.066e-001  -5.810e+001

First-order corrections to F and Theta .............   -0.0000    -0.0000


After trial 1 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -4.776 (percent)

     Maximum change occurred for slice 28

     Normal stress where max. change occurred:      5243.79

     Old strength at this slice:       830.85

     New strength at this slice:       791.17
```

```
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El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Trial No. 2 with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 13886



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.167e+005  -1.513e+008

First-order corrections to F and Theta .............   -2.7804    -1.4555

Reduced values - Deltas were too large .............   -0.5000    -0.2617



   2   2.50000    16.9270   1.702e+005  -1.184e+008

First-order corrections to F and Theta .............   -1.5577    -1.6689

Reduced values - Deltas were too large .............   -0.5000    -0.5357



   3   2.00000    16.3913   1.024e+005  -7.022e+007

First-order corrections to F and Theta .............   -0.6333    -2.1082
```

```
Reduced values - Deltas were too large .............   -0.5000    -1.6645


   4   1.50000    14.7268  -4.740e+003   7.361e+006

First-order corrections to F and Theta .............   -0.0163    -3.5869

Reduced values - Deltas were too large .............   -0.0130    -2.8648


   5   1.48702    11.8620  -1.073e+003   1.452e+006

First-order corrections to F and Theta .............   -0.0012    -0.5469

Second-order corrections to F and Theta ............   -0.0011    -0.5402


   6   1.48593    11.3218   1.048e-001  -5.751e+001

First-order corrections to F and Theta .............   -0.0000    -0.0000


After trial 2 the following changes were computed for the nonlinear

strength envelopes:

     Maximum change in shear strength:     -0.000 (percent)

     Maximum change occurred for slice 18

     Normal stress where max. change occurred:      4799.40

     Old strength at this slice:       744.46

     New strength at this slice:       744.46

Strengths from nonlinear envelope have converged.

Final computations will be performed next.
```

```
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TABLE NO. 47

************************************************************

*  Information for the Iterative Solution for the Factor of  *

*  Safety and Side Force Inclination by Spencer's Procedure  *

************************************************************



Final Trial with Nonlinear Strength Envelope

Allowable force imbalance for convergence:  25

Allowable moment imbalance for convergence: 13886



        Trial     Trial

       Factor   Side Force     Force       Moment                 Delta

Iter-    of    Inclination   Imbalance   Imbalance    Delta-F     Theta

ation  Safety   (degrees)      (lbs.)    (ft.-lbs.)             (degrees)



   1   3.00000    17.1887   2.167e+005  -1.513e+008

First-order corrections to F and Theta .............   -2.7804    -1.4555

Reduced values - Deltas were too large .............   -0.5000    -0.2617



   2   2.50000    16.9270   1.702e+005  -1.184e+008

First-order corrections to F and Theta .............   -1.5577    -1.6689

Reduced values - Deltas were too large .............   -0.5000    -0.5357



   3   2.00000    16.3913   1.024e+005  -7.022e+007

First-order corrections to F and Theta .............   -0.6333    -2.1082
```

```
Reduced values - Deltas were too large .............   -0.5000    -1.6645


   4   1.50000    14.7268  -4.740e+003   7.361e+006

First-order corrections to F and Theta .............   -0.0163    -3.5869

Reduced values - Deltas were too large .............   -0.0130    -2.8648


   5   1.48702    11.8620  -1.073e+003   1.452e+006

First-order corrections to F and Theta .............   -0.0012    -0.5469

Second-order corrections to F and Theta ............   -0.0011    -0.5402


   6   1.48593    11.3218   1.048e-001  -5.751e+001

First-order corrections to F and Theta .............   -0.0000    -0.0000
```

```
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TABLE NO. 55

**********************************************************************

* Check of Computations by Spencer's Procedure (Results are for the *

* critical shear surface in the case of an automatic search.)       *

**********************************************************************



Summation of Horizontal Forces: 1.28367e-010



Summation of Vertical Forces: 1.57343e-010



Summation of Moments: -9.68948e-005



Mohr Coulomb Shear Force/Shear Strength Check Summation: 4.65050e-011
```

```
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TABLE NO. 58

**************************************************************************

* Final Results for Stresses Along the Shear Surface                    *

* (Results are for the critical shear surface in the case of a search.) *

**************************************************************************


SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY

Factor of Safety: 1.486     Side Force Inclination:  11.32


       -------- VALUES AT CENTER OF BASE OF SLICE --------

                                Total     Effective

Slice                           Normal     Normal       Shear

  No.    X-Center   Y-Center     Stress     Stress       Stress


   1       198.50     939.50        70.6        70.6        11.0

   2       208.25     936.25       424.0       424.0        65.8

   3       224.75     930.75       989.9       989.9       153.7

   4       241.25     925.25      1553.1      1553.1       236.8

   5       257.75     919.75      2091.8      2091.8       277.1

   6       267.45     917.01      2111.0      2111.0       278.6

   7       270.35     917.04      2136.1      2136.1       227.8

   8       282.13     917.16      2279.9      2279.9       243.1

   9       302.79     917.37      2532.0      2532.0       270.0

  10       323.45     917.58      2784.2      2784.2       296.9

  11       344.11     917.79      3036.3      3036.3       323.8
```

12	364.77	918.00	3288.5	3288.5	350.7
13	385.43	918.21	3540.7	3540.7	377.5
14	406.09	918.42	3792.8	3792.8	404.4
15	426.75	918.63	4045.0	4045.0	431.3
16	447.41	918.84	4297.2	4297.2	458.2
17	468.07	919.05	4549.0	4549.0	483.3
18	488.73	919.26	4799.4	4799.4	501.0
19	509.39	919.47	5049.8	5049.8	518.7
20	530.05	919.68	5300.2	5300.2	536.4
21	550.71	919.89	5550.7	5550.7	554.1
22	571.37	920.10	5801.1	5801.1	571.9
23	592.03	920.31	6051.5	6051.5	589.6
24	612.69	920.52	6301.9	6301.9	607.3
25	633.35	920.73	6552.4	6552.4	625.0
26	654.01	920.94	6802.8	6802.8	642.7
27	674.67	921.15	7053.2	7053.2	660.4
28	685.40	921.72	5263.3	5263.3	533.8
29	692.29	929.79	4014.9	4014.9	1761.8
30	705.26	944.96	3644.6	3644.6	1618.0
31	718.23	960.13	3274.3	3274.3	1474.1
32	731.19	975.31	2904.0	2904.0	1330.2
33	744.16	990.48	2533.7	2533.7	1186.3
34	757.13	1005.66	2163.4	2163.4	1042.5
35	770.10	1020.83	1793.1	1793.1	898.6
36	783.06	1036.00	1422.8	1422.8	754.7
37	796.03	1051.18	1052.5	1052.5	610.8
38	809.00	1066.35	682.2	682.2	466.9
39	821.97	1081.53	311.9	311.9	323.1

UTEXAS4 S/N:10001 - Version: 4.1.2.0 - Latest Revision: 7/29/2020

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Time and date of run: Wed Oct 25 10:33:34 2023

Name of input data file: Z:\Clients\ENS\CityElPasoTX\155488_GEPLFExpans\Design\GeoTech\Working\Dsgn\Stability\South\20231019 South LTSS - Residual.dat

El Paso, TX Landfill Evaluation - North LTSS Noncircular (Residual)

#155488

TABLE NO. 59

****

* Final Results for Side Forces and Stresses Between Slices *

* (Results are for the critical shear surface in the case of a search.) *

****

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	200.00	105	939.80	0.800	289.7	-82.9
2	216.50	3592	938.05	0.429	189.6	473.3
3	233.00	11730	935.14	0.353	66.3	1069.7
4	249.50	24427	932.45	0.333	-1.9	1605.4
5	266.00	40824	929.99	0.329	-27.7	2054.5
6	268.90	41585	930.33	0.331	-15.6	2044.4
7	271.80	42194	930.71	0.334	3.0	2020.6
8	292.46	46829	933.30	0.350	98.3	1904.8
9	313.12	51977	935.65	0.358	147.3	1859.2
10	333.78	57637	937.81	0.361	168.0	1859.2
11	354.44	63810	939.81	0.361	170.9	1890.2
12	375.10	70495	941.68	0.359	162.4	1942.8
13	395.76	77693	943.45	0.356	146.4	2011.0

14	416.42	85404	945.14	0.352	125.4	2090.6
15	437.08	93627	946.77	0.348	101.1	2178.8
16	457.74	102363	948.35	0.344	74.6	2273.6
17	478.40	111574	949.89	0.340	47.4	2371.8
18	499.06	121105	951.46	0.336	22.9	2466.6
19	519.72	130955	953.03	0.333	0.4	2558.6
20	540.38	141124	954.62	0.331	-20.3	2648.3
21	561.04	151614	956.21	0.328	-39.8	2736.2
22	581.70	162423	957.80	0.326	-58.2	2822.6
23	602.36	173552	959.40	0.324	-75.6	2907.7
24	623.02	185000	961.00	0.323	-92.4	2991.7
25	643.68	196768	962.61	0.321	-108.5	3074.8
26	664.34	208856	964.21	0.320	-124.2	3157.1
27	685.00	221263	965.82	0.318	-139.4	3238.8
28	685.81	216615	966.93	0.321	-111.0	3161.5
29	698.78	177784	977.92	0.318	-122.1	2860.5
30	711.74	142781	988.91	0.315	-132.1	2558.7
31	724.71	111606	999.91	0.311	-140.6	2256.2
32	737.68	84258	1010.92	0.306	-147.1	1952.4
33	750.65	60738	1021.93	0.300	-150.6	1647.1
34	763.61	41046	1032.96	0.291	-149.7	1339.4
35	776.58	25181	1044.01	0.280	-142.2	1028.3
36	789.55	13144	1055.13	0.264	-123.3	711.8
37	802.52	4935	1066.46	0.242	-83.5	387.3
38	815.48	554	1080.23	0.316	-2.9	57.4
39	828.45	0	1089.11	Above	-0.0	0.0

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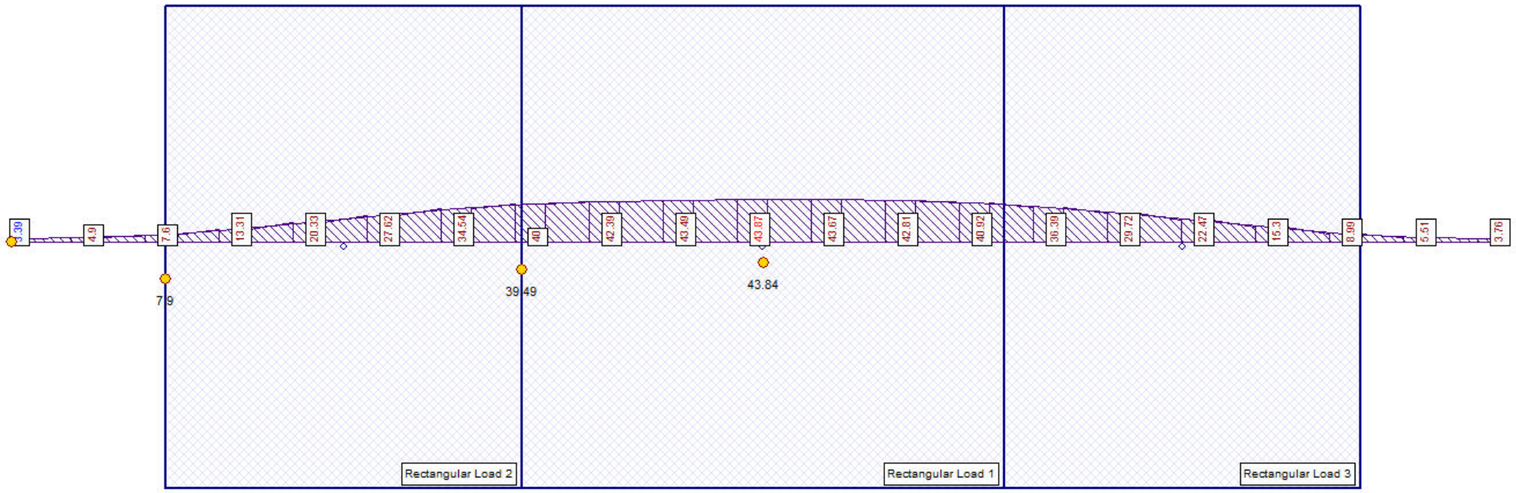
End of input data assumed - normal termination.

Attachment III.G.7 – Settlement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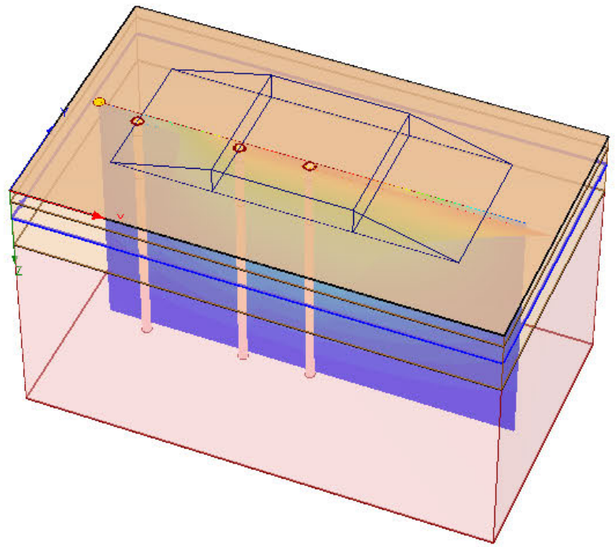
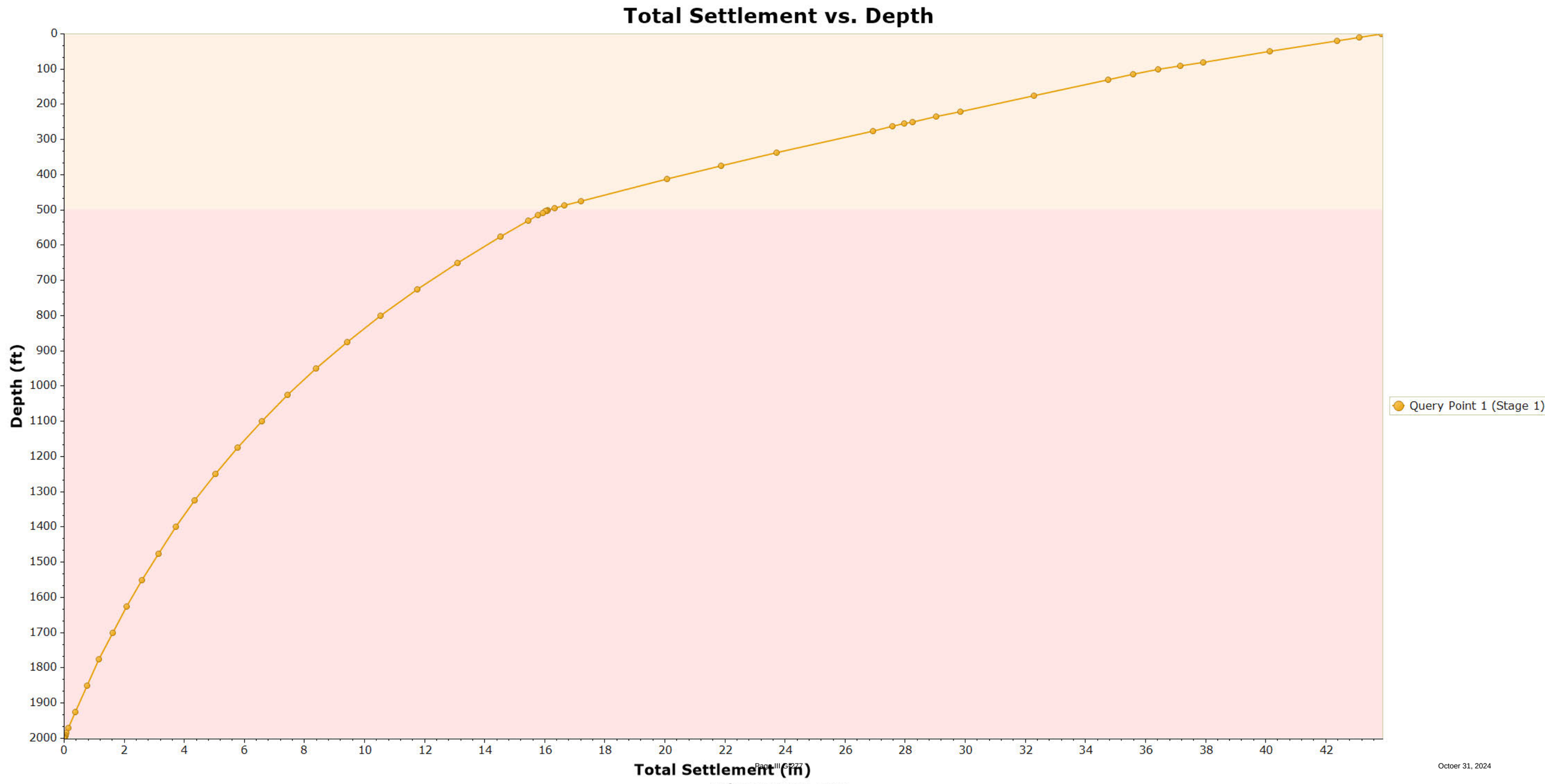
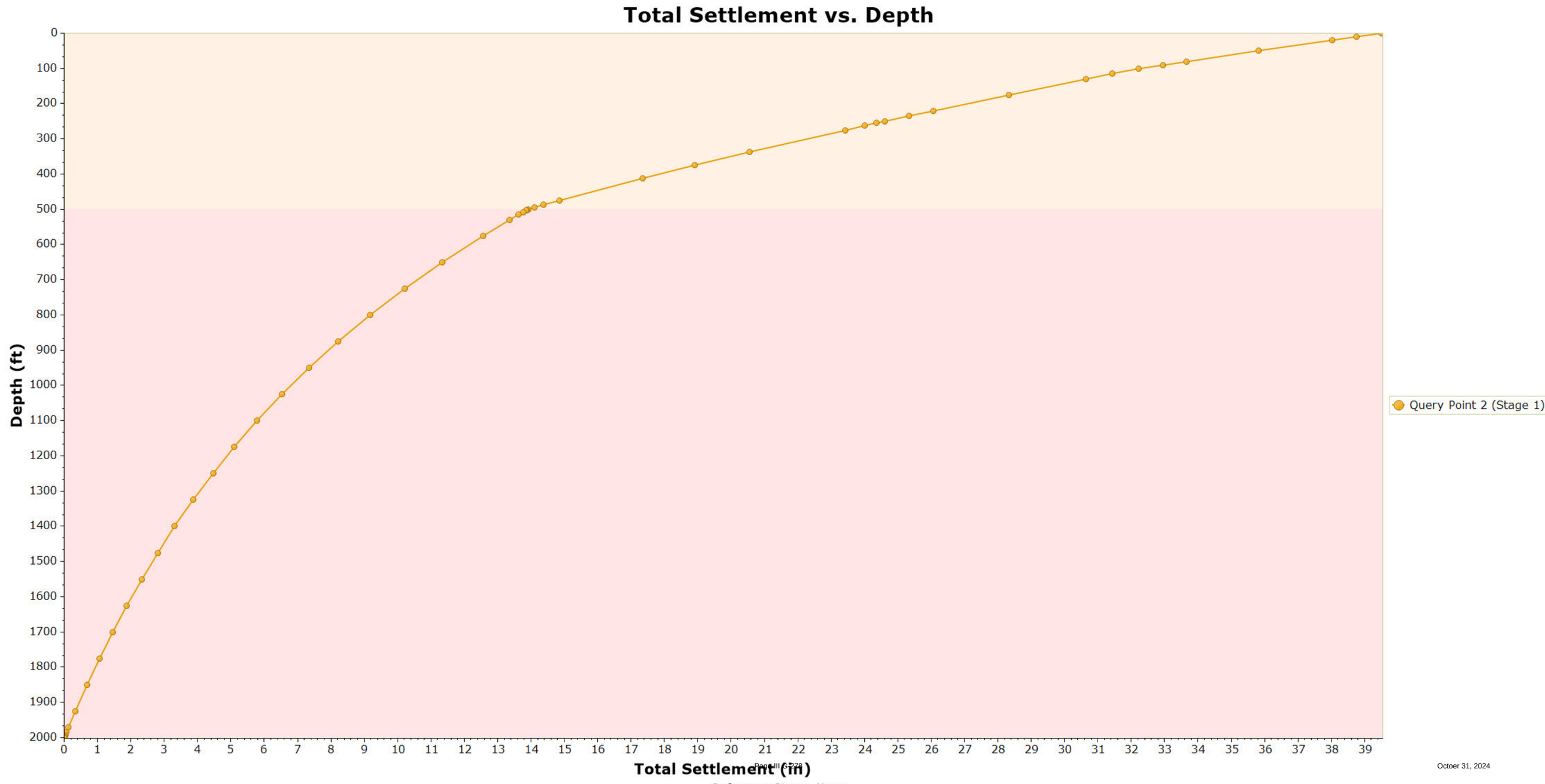
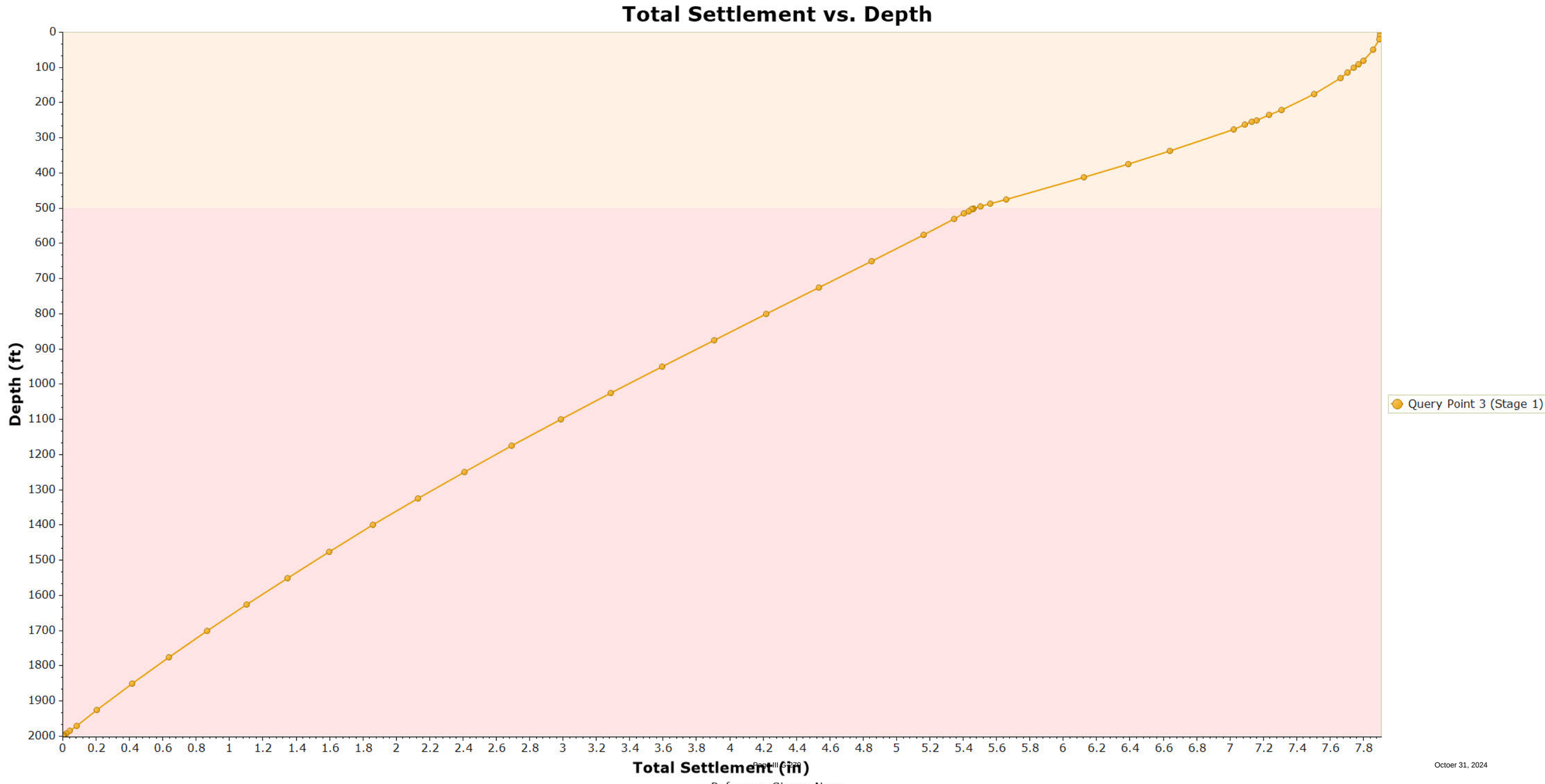
4.9
7.6
13.31
20.33
27.62
34.54
40
42.36
43.49
43.87
43.67
42.81
40.92
36.39
29.72
22.47
15.3
8.99
5.51
3.76
7.9
39.49
43.84
Rectangular Load 2
Rectangular Load 1
Rectangular Load 3




Total Settlement vs. Depth
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
Total Settlement (in)
Query Point 1 (Stage 1)


Total Settlement vs. Depth
Depth (ft)
Total Settlement (in)
Query Point 2 (Stage 1)


Total Settlement vs. Depth
Depth (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8
5
5.2
5.4
5.6
5.8
6
6.2
6.4
6.6
6.8
7
7.2
7.4
7.6
7.8
Total Settlement (in)
Query Point 3 (Stage 1)
Rocscience
Octoer 31, 2024

Settle3 Analysis Information

Greater El Paso Landfill

Project Settings

Document Name	20231031 El Paso Landfill
Project Title	Greater El Paso Landfill
Analysis	Landfill Settlement
Author	Textor
Company	Burns & McDonnell
Date Created	12/5/2023
Last saved with Settle3 version	5.021
Stress Computation Method	Boussinesq
Stress Units	Imperial, stress as ksf
Settlement Units	inches

Advanced Settings

Start of secondary consolidation (% of primary)	95
Min. stress for secondary consolidation (% of initial)	1
Reset time when load changes for secondary consolidation	No
Minimum settlement ratio for subgrade modulus	0.9
Use average poisson's ratio to calculate layered stresses	
Update Cv in each time step (improves consolidation accuracy)	
Ignore negative effective stresses in settlement calculations	
Add field points to load edges	

Soil Profile

Layer Option	Horizontal Soil Layers
Vertical Axis	Depth below ground surface

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0.201683 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	43.8844
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	43.8844
Loading Stress ZZ [ksf]	-1.89995e-11	9.30036
Loading Stress XX [ksf]	-4.53011	9.10542
Loading Stress YY [ksf]	-1.5294	7.37335
Effective Stress ZZ [ksf]	-1.89995e-11	152.369
Effective Stress XX [ksf]	-1.33007	159.741
Effective Stress YY [ksf]	0.80782	152.144
Total Stress ZZ [ksf]	-1.89995e-11	261.569
Total Stress XX [ksf]	-1.33007	268.941
Total Stress YY [ksf]	0.80782	261.344
Modulus of Subgrade Reaction (Total) [ksf/ft]	-3.57054e-11	3.04666
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	-3.57054e-11	3.04666
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	3.10384e-09	0.00620011
Pore Water Pressure [ksf]	0	109.2
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.650005	152.319
Over-consolidation Ratio	1	1
Void Ratio	0	0
Hydroconsolidation Settlement [in]	0	0
Undrained Shear Strength	0	0.321028

Loads

1. Rectangular Load: "Rectangular Load 1"

Length	1000 ft
Width	1000 ft
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	1e+06 ft2
Load	9.3 ksf
Depth	0 ft
Installation Stage	Stage 1

Coordinates

X [ft]	Y [ft]
6470.18	-9910.67
7470.18	-9910.67
7470.18	-8910.67
6470.18	-8910.67

2. Rectangular Load: "Rectangular Load 2"

Length	736 ft
Width	1000 ft
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	736000 ft2
Depth	0 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
5734.18	-9910.67	0
6470.18	-9910.67	9.3
6470.18	-8910.67	9.3
5734.18	-8910.67	0

3. Rectangular Load: "Rectangular Load 3"

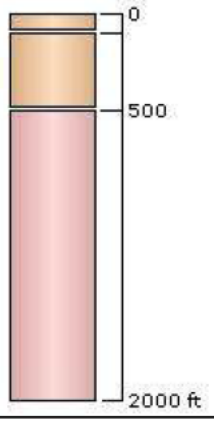
Length	736 ft
Width	1000 ft
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	736000 ft2
Depth	0 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
7470.18	-9910.68	9.3
8206.18	-9910.68	0
8206.18	-8910.68	0
7470.18	-8910.68	9.3

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	Upper Sand	100	0
2	Middle Sands	400	100
3	Deep Sand	1500	500



Soil Properties

Property	Upper Sand	Deep Sand	Middle Sands
Color			
Unit Weight [kips/ft3]	0.13	0.13	0.13
Saturated Unit Weight [kips/ft3]	0.13	0.13	0.13
K0	1	1	1
Immediate Settlement	Enabled	Enabled	Enabled
Es [ksf]	1500	4000	2000
Esur [ksf]	1500	4000	2000
Undrained Su A [kips/ft2]	0	0	0
Undrained Su S	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8
Piezo Line ID	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft3

Piezometric Line Entities

ID	Depth (ft)
1	250 ft

Query

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Query Point 1	6971.64, -9442.58	Auto: 53
2	Query Point 2	6470.18, -9457.74	Auto: 53
3	Query Point 3	5734.18, -9477.25	Auto: 53

Query Lines

Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Query Line 1	5415.24, -9400.76	8480.09, -9400.76	20	Auto: 53

parallels the Rio Grande and extends from Ysleta to beyond Tornillo, Texas. The Clint Landfill is located in the lower valley area.

The Rio Grande Alluvium consists of sand, gravel, clay, and silt deposited mainly through erosion and redeposition of the underlying bolson deposits. The individual layers and lenses of the various sediments are nonuniform in character and thickness and cannot be correlated from one location to another (TWC, 1991).

Since no known impermeable zone of regional extent separates the bolson deposits and river alluvium, the Rio Grande alluvium and the Hueco Bolson are considered to be, at least in part, hydrologically connected in the City Artesian and Lower Valley area (Agra, 1993). Groundwater in the Hueco bolson aquifer outside the valley is under water-table condition, whereas in the valley, the aquifer is in a leaky artesian condition (TWC, 1991).

The Summary of Hydrologic Information in the El Paso, Texas Area (USGS); D.E. White indicates that the Hueco Bolson includes areas in Texas, New Mexico, and Mexico. The northern part of the bolson, in Texas and New Mexico, lies between the southern Organ Mountains and the Franklin Mountains on the west and the Hueco Mountains on the east. The southeastern part of the bolson, in Texas and Mexico, lies between several mountain ridges in Mexico on the west and the Diablo Plateau and the Finley, Maline, and Quitman Mountains on the east. Along the Rio Grande, alluvium is entrenched about 200 to 250 feet (61 to 76 meters) into the Hueco bolson sediments and is locally referred to as the El Paso-Juarez Valley.

The primary water-bearing material of the Hueco bolson is the normally consolidated basin fill (Knowles and Kennedy, 1958, P. 19-20; and Alvarez and Buckner, 1974). In the northern part of the bolson, Davis and Leggat (1967) reported that the thickest section of basin fill occurs as a trough-shaped body adjacent and parallel to the Franklin Mountains. The total thickness of this section may be as much as 9,000 feet (2,743 meters). In the southeastern part of the bolson between El Paso and Clint, the basin fill is from 1,000- to 3,000-feet (305 to 914-meters) thick (Davis and Leggat, 1967).

Regional groundwater flow in the Clint landfill area is to the south-southeast and groundwater movement in the area is generally less than 1.0 foot per day (Agra, 1993). Groundwater data from the well (maintained and used by the City of El Paso) on site indicates that the static groundwater elevation in the area lies at approximately 3525 feet above mean sea level (msl), or approximately 370 feet below ground surface (AIC, 1993); however, unpublished U.S.G.S. groundwater elevation maps indicate a groundwater elevation of approximately 3630 feet (msl), based on regional groundwater data. The reason for this discrepancy is unknown but it may represent a local change from Bolson to Rio Grande Alluvium aquifer systems (Agra, 1993).

Table D-3

Typical Elastic Moduli

Soil	E_s, tsf
Clay	
Very soft clay	5 - 50
Soft clay	50 - 200
Medium clay	200 - 500
Stiff clay, silty clay	500 - 1000
Sandy clay	250 - 2000
Clay shale	1000 - 2000
Sand	
Loose sand	100 - 250
Dense sand	250 - 1000
Dense sand and gravel	1000 - 2000
Silty sand	250 - 2000

c. Laboratory Tests on Cohesive Soil. The elastic modulus is sensitive to soil disturbance which may increase pore water pressure and, therefore, decrease the effective stress in the specimen and reduce the stiffness and strength. Fissures, which may have little influence on field settlement, may reduce the measured modulus compared with the in situ modulus if confining pressures are not applied to the soil specimen.

(1) Initial hyperbolic tangent modulus. Triaxial unconsolidated undrained (Q or UU) compression tests may be performed on the best available undisturbed specimens at confining pressures equal to the total vertical overburden pressure σ_o for that specimen when in the field using the Q test procedure described in EM 1110-2-1906, Laboratory Soils Testing. An appropriate measure of E_s is the initial tangent modulus $E_{ti} = 1/a$ where a is the intercept of a plot of strain/deviator stress versus strain, Figure D-3 (item 14).

(2) Reload modulus. A triaxial consolidated undrained (R or CU) compression test may be performed on the best available undisturbed specimens. The specimen is initially fully consolidated to an isotropic confining pressure equal to the vertical overburden pressure σ_o for that specimen in the field. The R test procedure described in EM 1110-2-1906 may be used except as follows: stress is increased to the magnitude estimated for the field loading condition. The axial stress may then be reduced to zero and the cycle repeated until the reload curve shows no further increase in slope. The tangent modulus at 1/2 of the maximum applied stress is determined for each loading cycle and plotted versus the number of cycles, Figure D-4. An appropriate measure of E_s is the reload tangent modulus that approaches the asymptotic value at large cycles.

d. Field Tests. The elastic modulus may be estimated from empirical and semiempirical relationships based on results of field soil tests. Refer to

CECW-EG Engineer Manual 1110-1-1904	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	EM 1110-1-1904 30 September 1990
	Engineering and Design SETTLEMENT ANALYSIS	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

APPENDIX III.H – LANDFILL GAS MANAGEMENT PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

APPENDIX III.H – LANDFILL GAS MANAGEMENT PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 0
OCTOBER 31, 2024

Part III, Appendix H
Landfill Gas Management Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024



prepared by

Burns & McDonnell Engineering Company, Inc.
6200 Bridge Point Pkwy, Building 4, Suite 400, Austin, TX 78730
Texas Firm Registration No. F-845

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List of Abbreviations

Abbreviation	Term/Phrase/Name
bgs	Below Ground Surface
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
GCCS	Gas Collection and Control System
EPA	Environmental Protection Agency
Facility	Greater El Paso Landfill
FML	Flexible Membrane Liner
GCL	Geosynthetic Clay Liner
GEP Landfill	Greater El Paso Landfill, MSW Authorization Number 2284A
LEL	Lower Explosive Limit
LFG	Landfill Gas
LFGMP	Landfill Gas Management Plan
MSL	Mean Sea Level
MSW	Municipal Solid Wase
MSWLF	Municipal Solid Waste Landfill
NMOC	Nonmethane Organic Compound
NSPS	New Source Performance Standards
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
UEL	Upper Explosive Limit

III.H.1.0 Introduction

The purpose of this Landfill Gas Management Plan (LFGMP) is to provide a management practice for the monitoring and control of the landfill gas generated by the Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill). This LFGMP has been prepared in accordance with Chapter 30 Texas Administrative Code (TAC) §330.63(g) and pursuant to the requirements set forth in 30 TAC §§330.159 and 330.371.

III.H.1.1 Background

Landfill gas (LFG) is a product of the anaerobic decomposition of organic waste within the landfill unit and consists primarily of approximately 40-45 percent methane, 12-46 percent carbon dioxide, and 5-10 percent balance gas (mostly Nitrogen). Although both gases are colorless, odorless, and tasteless, traces of volatile organic compounds and many other substances usually present in the gas provide the characteristic pungent odor. Trace amounts (less than 1 percent) of oxygen, water, carbon monoxide, and hydrogen sulfide may also be found in LFG.

As the LFG is generated, the pressure within the landfill builds until equilibrium is reached between the quantity of LFG being generated and the quantity leaving the landfill unit. Therefore, as landfill liner and cap systems become less permeable, higher internal pressures are expected unless measures are taken to relieve the pressure. The increased pressure within the landfill unit provides the main source of energy for LFG migration through the liner, landfill cap, passive vents, or other high permeability pathways.

The primary health and safety concern with LFG is the explosive characteristics of methane. Concentrations in excess of 5 percent by volume (Lower Explosive Limit or LEL) methane in air are able to propagate a flame, thus creating an explosion hazard. The Upper Explosive Limit (UEL) for methane is 15 percent by volume in air.

LFG travels in all directions, taking a path of least resistance. LFG can travel from higher concentrations to lower concentrations (diffusion) or from higher gas pressure zones to lower gas pressure zones (convection). Subsurface geologic and hydrogeologic conditions contribute greatly to the extent of gas migration. When LFG migration is taking place, on-site and nearby structures are at risk of trapping the migrating gas in confined spaces located in and under the buildings. LFG can enter buildings through cracks in the foundation or through subsurface utility services.

The inability for the LFG to disperse or dilute may result in a fuel source that could explode if ignited.

In order to eliminate the potential hazards associated with off-site migration of landfill gas at explosive levels, 30 TAC §330.371 requires owners and operators of landfill units to ensure that the following conditions occur:

- The concentration of methane gas generated by the facility does not exceed 25 percent of the LEL or 1.25 percent by volume for methane in facility structures (excluding gas control or recovery system components).
- The concentration of methane gas does not exceed 100 percent of the LEL or 5 percent by volume at monitoring points, probes, subsurface soils, or other matrices at the facility boundary defined by the legal description in the permit.

III.H.1.2 Landfill Gas Concentrations [30 TAC §330.371(a)]

This LFGMP has been developed to provide a monitoring system that will detect if LFG concentrations exceed 5 percent by volume (LEL) in monitoring points or probes or 1.25 percent by volume (25 percent LEL) within facility structures. The LFGMP also provides procedures if exceedances are detected.

III.H.1.3 Federal Regulatory Requirements

The GEP Landfill has a design capacity equal to or greater than 2.5 million megagrams or 2.5 million cubic meters and must comply with the applicable provisions of 40 Code of Federal Regulations (CFR) Part 60, *Standards of Performance for New Stationary Sources*, Subpart XXX – *Standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014*.

III.H.2.0 Site Information [30 TAC §330.371(b)(1)]

III.H.2.1 Geology

In general, the subsurface conditions encountered in the borings drilled at the site can be grouped into a single generalized stratum, with relatively uniform physical and engineering properties. This stratum consists of tan to brown, fine- to coarse-grained sands, with varying amounts of calcareous sands, silt, gravel, and interbedded clay or silt layers varying in thickness. These soils were encountered from ground surface elevation to the total depth studied in the borings. Additional information is located in Part III, Appendix III.E – Geology Report.

III.H.2.2 Hydrogeologic and Hydraulic Conditions

Information regarding the hydrogeologic and hydraulic conditions at the site is located in Part III, Appendix III.E – Geology Report.

III.H.2.3 Facility Structures

The scale house/office and maintenance building are located on the property for the existing Clint Landfill, MSW Authorization Number 1482 (Clint Landfill) and locations are provided on Figure I/II.A.2 of Part I/II, Appendix I/II.A. There are no other existing on-site structures in the footprint of the GEP Landfill. The property boundary for the GEP Landfill is provided on Figure III.H.1 in **Attachment III.H.1**.

III.H.2.4 Easements, Right-of-Ways, and Utilities

There are three utilities or pipeline easements running through the permit limits of the GEP Landfill as indicated on Figure I/II.A.3 of Part I/II, Appendix I/II.A. Two gas lines (16” and 24”) run through the center of the footprint of the facility along with a power transmission line.

III.H.3.0 Landfill Gas Monitoring [30 TAC §330.371(b)(2), (e), (f), (g), (h), (i), (j), (k)]

Routine methane monitoring will be performed during the active life and post-closure care period to verify methane concentrations do not exceed 1.25 percent by volume in facility structures and 5 percent by volume at permitted boundary wells, probes, subsurface soils, or other matrices. At a minimum, methane monitoring will be conducted quarterly. All monitoring probes and on-site structures will be sampled for methane during the monitoring period.

III.H.3.1 LFG Structure Monitoring Procedure

A permanent landfill gas monitoring system will be installed to detect subsurface LFG migration from the GEP Landfill if any onsite structures are constructed. Structures are continuously monitored for methane concentrations at or above 1.25 percent by volume or 25 percent of the LEL. If the continuous monitors are found to not be working, a portable gas analyzer will be used to monitor structures.

Any new structures will be added to the monitoring program as they are constructed and continuous monitors will be installed prior to occupancy of the structure. The monitors will be installed as recommended by the manufacturer in areas of the structure where methane gas is most likely to accumulate. Monitoring using portable instruments may be conducted on a quarterly basis to supplement the continuous monitors. Areas within the structures to be monitored include corners, baseboards, crawl spaces, attics, and utility services. Results of the monitoring of facility structures will be recorded on field data forms (**Attachment III.H.2**) and maintained in the facility's site operating record. Any detected methane above allowable maximum limits will be verified and addressed in accordance with **Section III.H.3.5**.

The scale house/office and maintenance building are monitored in compliance with the existing site operating plan of the existing Clint Landfill.

III.H.3.2 LFG Probe Monitoring System

Permanent gas monitoring probes (GMPs) will be designed, installed, and monitored in accordance with 30 TAC §330.371. Figure III.H.1 in **Attachment III.H.1** provides the locations for the existing and future GMPs. Initial probe designs and depths were determined based on geological formations logged during the initial exploratory boring, the depth of solid waste, and the recorded groundwater surface levels. All probes will be installed at a depth equal to the lowest elevation of solid waste and above the permanent low-season groundwater table. The final design depths of the probes will be determined during construction from the probe-hole boring logs. A typical construction detail for GMPs is included in Figure lll.H.3 in **Attachment III.H.1**. Proposed construction details for future GMPs will be provided to the TCEQ prior to installation.

Six permanent gas monitoring probes (GMP-1, GMP-2, and GMP-17 through GMP-20) were installed in 2004 and installation records are provided in **Attachment III.H.3**. Two permanent gas monitoring probes PP-16 (or GMP-16) and PP-19A (or GMP-19) were installed on April 13, 2006 and installation records are provided in **Attachment III.H.4**. Four permanent gas monitoring probes (GMP-12 through GMP-15) were installed the week of May 24-27, 2011 and installation records are provided in **Attachment III.H.5**. Four permanent gas monitoring probes (GMP-3, GMP-4, GMP-10, and GMP-11) were installed the in March 2019 and available installation records are provided in **Attachment III.H.6**.

Remaining permanent probes will be installed within 90 days of the placement of refuse within 1,000 feet of the individual probe locations as shown on Figure III.H.1 in **Attachment III.H.1**. At completion, 20 GMPs will be installed and spaced approximately 600-1,000 feet on-center around the perimeter of the site.

All perimeter gas probes shall be monitored for the following parameters.

- Static gas pressure with a suitable pressure gauge. To prevent any pressure fluctuations that will give erroneous results, precautions will be taken to ensure that no venting takes place prior to measuring the pressure.
- Combustible gas (methane) with a portable gas meter. The probe shall be sufficiently evacuated with the hand pump so that methane concentrations are constant for at least thirty seconds. The large scale of 0 - 100 percent shall be used first. If readings are below 5 percent, the smaller 0 - 5 percent scale will be utilized.
- The barometric pressure shall be recorded with a barometer with adequate range.

Results of the monitoring of GMPs will be recorded on field data forms (**Attachment III.H.2**) and maintained in the facility's site operating record. Any detected methane above allowable maximum limits will be verified and addressed in accordance with **Section III.H.3.5**.

III.H.3.3 Reporting of Data and Record Keeping

All monitoring data acquired in the field will be recorded on the field data form (**Attachment III.H.2**) and maintained in the facility's site operating record. Included in the record will be all information related to subsurface gas migration and control, including records of any contingencies (**Section III.H.4.0**) that were implemented as a result of migration.

A separate calibration log for each instrument will be kept on-site and will contain the following information.

- Date and time of calibration
- Name of person calibrating
- Serial number and model number of instrument
- Type of calibration
- Results of calibration

III.H.3.4 Maintenance and Calibration

The following maintenance schedule and calibration procedures will be implemented for the LFG monitoring elements at the landfill. Training of personnel will be conducted when necessary.

III.H.3.4.1 Calibration of Continuous Monitoring Devices

Continuous monitoring devices will be maintained and calibrated according to the manufacturer's recommendation. Maintenance will be conducted quarterly and will include the following tasks.

- Verification of power to the monitor.
- Ensuring that there is no interference of air flow to the monitor.
- Exposing the sensor to a sample of calibration gas per the manufacturer's recommended procedure to verify that the monitor is calibrated correctly.

III.H.3.4.2 Maintenance of Permanent Monitoring Probes

A visual inspection of the permanent probes will be conducted in conjunction with the monitoring events. The following elements will be inspected.

- Probe label
- Condition of protective cover
- Lock
- Probe depth(s)
- Probe surroundings including standing water and vegetation

Any abnormalities with the condition of the probe will be noted on the field log and immediately addressed.

III.H.3.4.3 Portable Monitoring Instruments

Gas probes shall be monitored with a portable gas analyzer with an internal pump. Portable monitoring instruments will be maintained and calibrated according to the manufacturer's recommended procedure.

III.H.3.5 Post Closure Methane Monitoring [30 TAC §330.371(e) and (f)]

Post-Closure landfill gas monitoring will take place on a quarterly basis. Methane monitoring and control will continue for 30 years after certification of final closure consistent with 30 TAC §330.371(e). Gas monitoring will be reduced only with an approved no gas migration demonstration. Information will be submitted to the Executive Director to reduce gas monitoring and control. The information must demonstrate that there is no potential for gas migration beyond the property boundary or into on-site structures. The gas monitoring and control plan will be revised and maintained as needed in accordance with 30 TAC §330.371(f). Post-closure land use will not interfere with the gas monitoring system, and all utility trenches crossing the facility will be vented and monitored.

III.H.4.0 Contingency Plan [30 TAC §330.371(c)]

The following contingency plan will be implemented if LFG readings exceed the allowable maximum limits at the GEP Landfill property boundary or within on-site structures under 30 TAC §330.371.

- Step 1 – Immediately take all necessary steps to ensure protection of human health and notify the Executive Director of the TCEQ, local and county officials, emergency officials, and the public. Necessary steps may include, but are not limited to, evacuating personnel to a safe distance from the source of the LFG and turning off all equipment to avoid a spark hazard.
- Step 2 – Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health.
- Step 3 – Within sixty days of detection, implement a remediation plan that describes the nature and extent of the problem and proposed remedy for the methane gas releases, place the copy of the plan in the operating record, provide a copy to the Executive Director of the TCEQ, and notify the Executive Director that the plan has been implemented.

Consistent with the above requirements, notifications will be made either in person or by telephone followed by an electronic mail (Email) or letter. The City would contact the following agencies or personnel.

- MSW Permits Section – MC 124
  Waste Permits Division
  Texas Commission on Environmental Quality
  P.O. Box 13087
  Austin, Texas 78711-3083
  Telephone: (512) 239-6728
  Email: mswper@tceq.texas.gov
- Neighboring residents within approximately 1,000 feet of the location(s) with exceedances. The City of El Paso will maintain a list of property owners and residences within 1,000 feet of the permit boundary.
- The fire department, police department, and/or ambulance will be called, if necessary, by dialing 911 or the appropriate non-emergency number.

III.H.4.1 On-Site Structures Monitoring

The following actions will be implemented if the allowable limits are exceeded in on-site structures.

III.H.4.1.1 Immediate Action

1. The affected building/s would be vacated for a period of time determined by the appropriate emergency officials.
2. The Superintendent of Solid Waste Management, the occupants of the structures, and the appropriate emergency personnel will be contacted.
3. Following the evacuation, the building will be monitored by trained personnel to determine the extent and source of the methane. Remedial actions, such as sealing cracks or connections, would be taken as necessary.
4. After the remedial action has been taken, the building/structure would be monitored on a daily basis for a period of one week to determine if further mitigation measures are required.

III.H.4.1.2 Action Within 7-Days

The Superintendent of Solid Waste Management or the Landfill Manager will prepare a brief report to include at least the following items:

- Results of any additional monitoring
- Summary of actions taken included in **Section III.H.4.1.1**

III.H.4.1.3 Action Within 60-Days

A remediation plan will be prepared to include the following information:

- Nature and extent of the problem
- Proposed permanent or long-term remedial action(s)

Copies of the plan will be provided to the appropriate officials for records. Implementation of the Remediation Plan will take place following TCEQ approval in accordance with the submitted schedule.

III.H.4.2 Property Boundary Monitoring

The following actions will be implemented if the allowable limits are exceeded at the permit boundary of the facility.

III.H.4.2.1 Immediate Action

1. The Superintendent of Solid Waste Management, the appropriate emergency personnel, the neighboring residents, and the owners of the offsite underground utilities within 1,000 feet of the affected areas would be contacted.
2. The landfill operations and personnel will be directed away from the affected area.
3. The affected area/s would be monitored daily for a period of one week to confirm exceedance of the maximum allowable methane concentration.
4. If the weekly monitoring reports are positive, the areas adjacent to the affected zone, including the property line, underground utility trenches, and any off-site buildings/structures within 1,000 feet, shall be monitored/screened by designated personnel for a period of one week. Appropriate methods, such as bar-hole sampling, and instruments, such as hand-held gas detectors, shall be utilized.

III.H.4.2.2 Action Within 7-Days

The Superintendent of Solid Waste Management will prepare a brief report to include at least the following information.

- Results of any additional monitoring
- Summary of actions taken included in **Section III.H.4.2.1**

III.H.4.2.3 Action Within 60-Days

A remediation plan will be prepared to include the following information.

- Nature and extent of the problem
- Proposed permanent or long-term remedial action(s) such as installation of passive and/or active gas control system.

Copies of the plan will be provided to the appropriate emergency response officials for their records. Implementation of the remediation plan will take place following TCEQ approval, in accordance with the submitted schedule.

III.H.4.2.4 Increased Monitoring Frequency

Normally, LFG monitoring probes will only be sampled for methane gas concentration quarterly. However, in the event that methane gas concentrations in excess of 25% LEL are detected in a gas monitoring probe, the monitoring frequency for that probe and the two adjacent probes will be increased to monthly. The Executive Director may require more frequent monitoring. When more frequent monitoring is required, the Executive director shall notify the owner or operator. The increased sampling frequency will continue until three consecutive months of methane gas concentrations of less than 25% LEL are obtained. At that time, monitoring will return to quarterly measurement of methane gas concentration only.

III.H.5.0 Potential LFG Control Systems

The objective of a LFG control system installation would be to prevent the migration of landfill gas (LFG). If a LFG control system is required to control or prevent off-site LFG migration, the City will pursue one of the following two alternatives:

- Passive Gas Control System
- Active Gas Control System

III.H.5.1 Potential Passive LFG Control System

Passive vents can release some of the pressure of LFG within the waste, thus reducing the amount of localized LFG migration. The passive system is relatively economical to design, install, and operate. Typical passive LFG control systems consist of gas "vents". The vents are simple in design and require low maintenance.

The potential passive LFG control system at the GEP Landfill will consist of LFG vents installed in the refuse. The passive LFG vents will initially vent freely into the atmosphere, thereby reducing subsurface pressure and controlling local lateral migration. The design and the spacing of the LFG vents will be such that the system could be converted into an active gas collection and control system if necessary.

The locations of the passive vents will be determined using any one of the following three methods.

1. **Surface Monitoring and Observations** – Observations of the surface conditions at the site can aid in determining the best location(s) for passive LFG vents. Venting cracks, stressed vegetation, and odors are all indicative of LFG migrating through the soil cover. In addition, monitoring of the surface may be conducted to locate less visible emission sources.
2. **Subsurface Pressure** – If feasible, subsurface soil pressure measurements can be taken within the permit limits to determine areas of "high" pressure. LFG vents can then be installed to release the pressure.
3. **Location** – Passive LFG vents will be installed in close proximity to the area of concern. One or more LFG vents can be installed next to the permanent probe, bar-hole probe, or facility structure that contained methane above the designated limits. Additional probes will be installed until the area of concern is mitigated.

The actual LFG vent design will typically consist of a hole drilled into the landfill and extending to a calculated depth at least 15 feet above the base liner of the landfill. A pipe will be installed into the hole and set in place with gravel backfill. The backfill will extend to approximately ten feet from the landfill surface, where the gravel will be terminated and a clay, bentonite, or foam plug material will placed to seal the well.

Passive LFG system performance monitoring will be completed on a quarterly basis. The monitoring method will be consistent with the details provided in **Section III.H.3.0**.

III.H.5.2 Potential Active LFG Control System

Although the Landfill is currently not required to install an active landfill gas collection and control system (GCCS), a preliminary design has been developed as a precaution should the Landfill need to comply with New Source Performance Standards (NSPS) standards, or will choose to install an active GCCS voluntarily. Should exceedances in menthane concentrations at the property boundary or in site

structures occur under passive LFG control system operation, an active GCCS will be considered. An active GCCS is more complex to design, operate, and maintain than a typical passive LFG control system. The active GCCS consists of a collection system and a utilization/control system. The design of the system components depends upon the site-specific conditions. A conceptual design of an active GCCS is provided on Figure III.H.2 in **Attachment III.H.1**; however, full GCCS design would need to be completed prior to installation. If installed, applicable air permits applications will be submitted to TCEQ for the GCCS system, including anticipated emissions from the flare.

An active landfill gas system was installed within Phase 1 at the GEP Landfill in 2010; however, the system was decommissioned due to the lack of sufficient LFG production to run the system. The flare associated with the active system was retained on site. However, all existing GCCS piping has been abandoned.

III.H.5.2.1 GCCS Components

The main components of an active GCCS will be the vertical gas wells, multiple gas collection headers with appropriate fittings and supports, and the moisture/condensate removal and collection system. The locations of the vertical wells shall be determined in a manner similar to the passive gas control vent system.

As built information from the bottom liner will be used to develop maximum drilling elevations for the gas wells and a survey of the ground surface will be completed as part of the design. During design, the elevations of each component will be compared, and the wells will be designed such that the bottom of the well is a minimum of 15 feet above the bottom liner system. The wells and collections system are designed in anticipation of each well having a radius of influence of 100 feet in the landfill. A conceptual design of an active GCCS is provided on Figure III.H.2 in **Attachment III.H.1**; however, full GCCS design would need to be completed prior to installation.

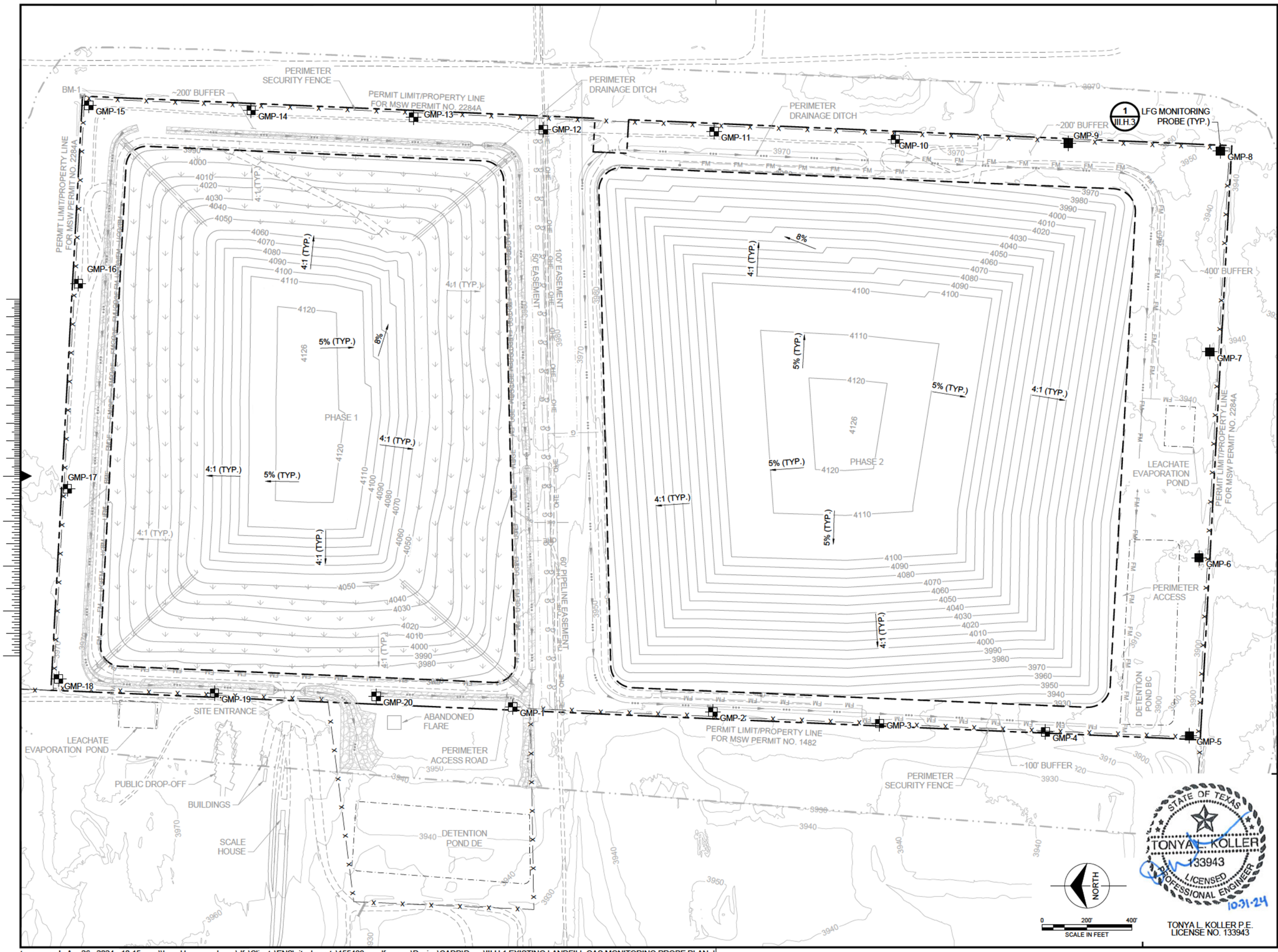
During installation of the wells, all drill spoils and other waste will be disposed at an authorized facility (likely the GEP Landfill if still active).

III.H.5.2.2 Gas Utilization/Control System

The GCCS system will consist of vertical LFG collection wells, which will pull LFG from the waste mass. Once the LFG is brought to the surface, it will enter a series of laterals and headers. After the LFG enters the header, it will flow to the flare station where it will be combusted in a candlestick flare. The flare station will monitor flow and concentration of LFG. If the flare is not operating properly, the GCCS will be programmed to be shut down. The Landfill operators will be notified and corrective procedures will be implemented to restore the flare to operation.

The GCCS will be operated in such a manner as to reduce the extent possible the generation of odors or other potential nuisance problems. If such problems develop, the system will shut down and the problems will be addressed either by repair or modification of the operating procedures.

ATTACHMENT III.H.1 – FIGURES



no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 10 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NORTH AMERICAN DATUM OF 1983 (NAD83). HORIZONTAL DATUM IS NAD 1983. VERTICAL DATUM IS NAVD 1988.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 10 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 10 FEET.
7. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

EXISTING LANDFILL GAS MONITORING PROBE PLAN

project	contract
155488	-

drawing **III.H.1** – rev. **0**

file III.H.1 EXISTING LANDFILL GAS MONITORING PROBE PLAN.dwg

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 10-31-24

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming: Millimeters / Inches

tmcammack Apr 26, 2024 - 10:15am - \\bmcd.burnsmcd.com\dfs\Clients\ENS\cityelpasotx\155488_geplfexpans\Design\CADD\Dwgs\III.H.1 EXISTING LANDFILL GAS MONITORING PROBE PLAN.dwg



NOTES (CONT.):

7. LFG HEADER, EXTRACTION WELL, AND LATERAL LOCATIONS ARE CONCEPTUAL AND SUBJECT TO CHANGE. FULL SYSTEM DESIGN TO BE COMPLETED PRIOR TO INSTALLATION.

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 10 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
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KANSAS CITY, MO 64114
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FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL GAS MANAGEMENT PLAN

project	contract
155488	-

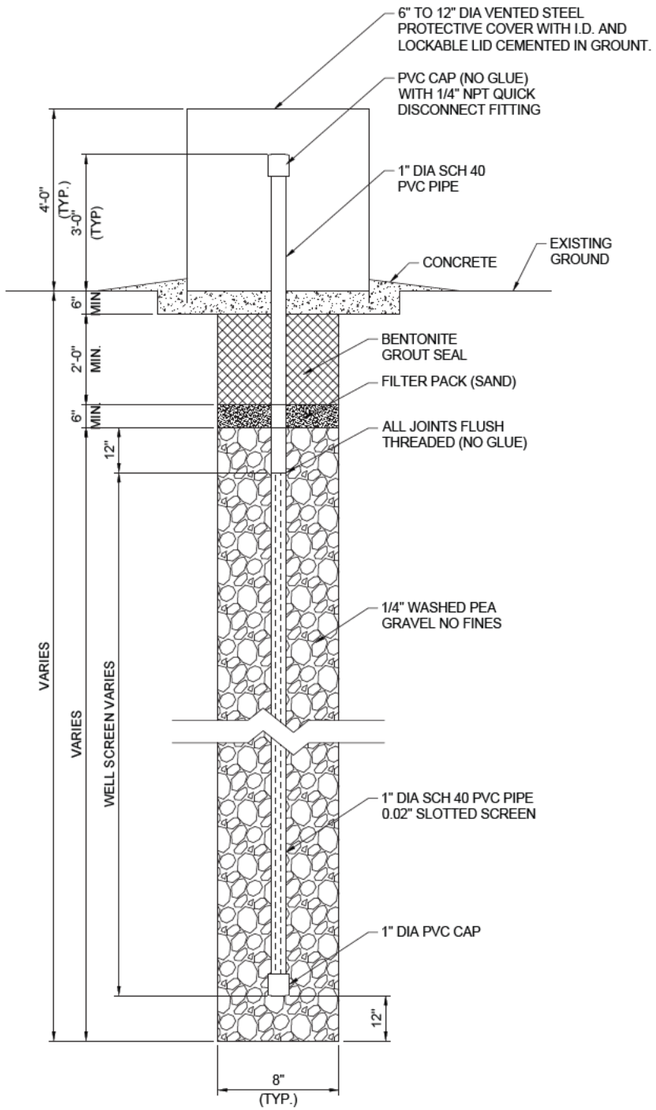
drawing **III.H.2** – rev. **0**

file III.H.2 LANDFILL GAS MANAGEMENT PLAN.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
10-31-24

TONYA L. KOLLER P.E.
LICENSE NO. 133943

Scale For Microfilming: Millimeters / Inches



LANDFILL GAS MONITORING PROBE DETAIL 1 III.H.1

HORIZONTAL SCALE 0 5' 10' SCALE IN FEET

VERTICAL SCALE 0 1' 2' SCALE IN FEET

no.	date	by	ckd	description
0	5/1/24	TMC	TLK	2284A PERMIT MOD

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9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
MAY 2024	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EPTX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

LANDFILL GAS MONITORING PROBE DETAIL

project	contract
155488	-

drawing III.H.3 — rev. 0

file III.H.3 LANDFILL GAS MONITORING PROBE DETAIL.dwg

STATE OF TEXAS TONYA L. KOLLER 133943 LICENSED PROFESSIONAL ENGINEER 10-31-24

TONYA L. KOLLER P.E.
LICENSE NO. 133943

ATTACHMENT III.H.2 – LANDFILL GAS MONITORING FIELD DATA FORMS

Monitoring Date: **Technician (s)**

Gas monitoring probe for 2284 GELP

GMP NUMBER	DATE / TIME	BAROMETRIC PRESSURE (" Hg)	GAS PROBE PRESSURE (INCHES H20)	GMP STEADY STATE METHANE READING (% VOLUME)	GMP STEADY STATE METHANE READING (% LEL)

ENVIRONMENTAL SERVICES DEPARTMENT
GREATER EP LANDFILL QUARTERLY METHANE MONITORING REPORT

REPORT COMPLETED BY:	DATE:	
WEATHER STATION DATA		
TEMPERATURE:	BAROMETRIC PRESSURE:	
ATMOSPHERIC CONDITIONS:		
CUMULATIVE RAINFALL SINCE LAST MONITORING EVENT:		
AMBIENT CONDITIONS (WEATHER):		Dew Point:
METHANE MONITOR CHARGE CHECK:	METHANE MONITOR CALIBRATION CHECK:	

PERMANENT ENCLOSED STRUCTURE MONITORING

STRUCTURE	METHANE READINGS (RANGE % LEL)	CH4 (% VOLUME)	COMMENTS
FEE COLLECTION BUILDING			
MAINTENANCE BUILDING			
OFFICE TRAILER			

ADDITIONAL COMMENTS

ATTACHMENT III.H.3 – 2004 GAS MONITORING PROBE INSTALLATION

MSW-PA/2284
/co

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

September 13, 2004

Ms. Ellen Smyth, P.E.
Solid Waste Director
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: El Paso, El Paso County
City of El Paso Clint Landfill, Permit No. 2284
Landfill Gas Monitoring System Installation Report - Phase 1, Cells 1 & 2
~~WWC No. 10701345/10729346/~~ Mail Log No. 6343/6600
RN101478766/ CN601410244

Dear Ms. Smyth:

On August 20, 2004, the Texas Commission on Environmental Quality (TCEQ) received the response to our letter, dated August 10, 2004, commenting on the above referenced report. The reponse was signed and sealed by Ms. Valerie A. Joosten, P.E. of Raba-Kistner Consultants (SW), Inc. of El Paso, Texas. The report, documenting the activities related to the installation of landfill gas monitoring probes GMP-1, GMP-2, GMP-17, GMP-18, GMP-19, and GMP-20, was signed and sealed by Ms. Valerie A. Joosten, P.E. of Raba-Kistner Consultants (SW), Inc. of El Paso, Texas. The report, along with the comment response, is accepted as the documentation submitted by Ms. Valerie A. Joosten, P.E. indicates that the landfill gas monitoring system installation for Phase I was conducted in compliance with the Site Development Plan, Attachment 14, Landfill Gas Management Plan, and the TCEQ letters dated December 23, 2003 and January 27, 2004.

Please contact me at 512/239-1132 if you have any questions concerning this matter. When addressing written correspondence, please use Mail Code 124 (MC 124).

Sincerely,

Frank Zeng, P.E.
Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

FZ/pt

RECEIVED
OCT 1 2004
TCEQ - CENTRAL FILE ROOM

cc: Mr. Jose L. Rodarte, P.E., HUITT-ZOLLARS, Inc., El Paso, TX
Ms. Valerie A. Joosten, P.E., Raba-Kistner Consultants (SW), Inc., El Paso, TX

HUITT-ZOLLARS

HUITT-ZOLLARS, INC. • 5822 Cromo Dr. • Suite 210 • El Paso, TX 79912-5502 • 915.587.4339 phone • 915.587.5247 fax • huitt-zollars.com

August 19, 2004

Mr. Frank Zeng, P.E.
Municpial Solid Waste Permits Section
Waste Permits Division
TCEQ
P.O. Box 13087
Austin, Texas 78711-3087

Re: City of El Paso Clint Landfill, Permit No. 2284
Landfill Gas Monitoring System Installation Repot – Phase I, Cells 1 & 2
WWC No. 10718449, Mail Log No. 6434
RN101478766 / CN601410244

Dear Mr. Zeng:

On August 13, 2004, we received your letter with comments concerning your review of the Landfill Gas Monitoring System Installation report for the construction of two (2) new cells in the Clint Landfill.

Attached, please find a letter from our sub-consultant addressing all the TCEQ comments.

Please let us know if you require additional information.

Sincerely,
HUITT-ZOLLARS, INC.

Jose Rodarte, P.E.

Jose Rodarte, PE
Vice President

Attachment

cc: Ms. Ellen Smyth, PE ~ City of El Paso Solid Waste Management
Mr. Ziad Al-Dasouqi, PE ~ City of El Paso Engineering Department
Mr. Said Larbi-Cherif, PE ~ City of El Paso Municipal Services
Ms. Valerie Joosten, PE ~ Raba-Kistner Consultants, Inc,
Mr. Eduardo Choquis, PE ~ Raba-Kistner Consultants, Inc.

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Raba Kistner

Raba-Kistner Consultants (SW), Inc.
7002 Commerce
El Paso, Texas 79915
(915) 778-5233 • FAX (915) 779-8301
www.rkci.com

Project No. ASF03-701-00
August 16, 2004

Mr. Frank Zeng, P.E.
MC 124
Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

RECEIVED
AUG 20 2004
WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY
LLH

Re: City of El Paso Clint Landfill, Permit No. 2284
Landfill Gas Monitoring System Installation Report
Response to Texas Commission on Environmental Quality (TCEQ) Comments

Dear Mr. Zeng:

On behalf of our client, the City of El Paso, Raba-Kistner Consultants, Inc. (R-K) is herein responding to TCEQ correspondence dated August 10, 2004 which includes comments addressing the Landfill Gas Monitoring System Installation report dated July 28, 2004 for the referenced facility. In the following paragraphs, each TCEQ comment is presented in bold font followed immediately by R-K's response.

1. **The soil strata described in the Well Report do not always match what are depicted in the boring logs. For example, the Well Report describes the formation from 0 to 11 feet as sandy clay at GMP-17, while the boring log shows five strata ranging from fill material to sand for the same depth interval. Please explain the discrepancies.**

   The Well Reports were prepared by a Texas-licensed well driller, Mr. R.C. Corona (Texas driller License No. 4709 M). Mr. Corona is not a geologist, and his descriptions of the strata are less detailed than those prepared by Mr. Patrick F. Welsh, P.G, (Texas Registration No. 5149) who prepared the boring logs presented in **Attachment 1** of the report. Nevertheless, the descriptions given by Mr. Corona and Mr. Welsh are not inconsistent with each other. As noted in the TCEQ comment, Mr. Corona described soils in GMP-17 from 0 to 11 ft as sandy clay. In turn, soils within this interval were described by Mr. Welsh as fill, clay, clayey sand, and sand. With the exception of fill, which is noted on the boring log as being approximately 6-in. thick, native materials encountered in the boring were either clay, sand or clayey sand. Mr. Corona's less detailed description (i.e., sandy clay) includes the terms used by Mr. Welsh.

   Another example of the fact that Mr. Corona described encountered soil strata in a correct, if less detailed, fashion than Mr. Welsh can be observed by comparing the well report with the corresponding boring log for GMP-18.

Depth Interval (ft)	Soil Description	
	R.C. Corona	P. Welsh
0 – 4 ft	Fill Material	Fill Material
4 – 32.5	Brown Sand	Sand, Clayey, Brown and Sand, Grayish Brown, with some Gravel

In another example, Mr. Corona described soils collected from GMP-20 as brown sand. With the exception of 6 inches of fill material encountered at the surface, Mr. Welsh logged the boring as consisting of fine-grained brown sand either clayey (0.5 – 4 ft) or loose (4 – 25 ft).

2. **On Well Report for GMP-1, the casing (solid riser) was reported to be from 0 to 9 ft, and the screen (slotted riser) was reported to be from 6 to 15.5 feet. Well Reports for all other probes except for GMP-17 have the similar issue. Well Report for BMP-17 recorded a casing depth of 0 to 18 feet, and a screen depth of 25 to 40.5 feet. Please indicate at what depth the casing and the screen joint and explain the probe structure, if necessary (Fig.2 attached in this report show a typical GMP design).**

   In preparing the Well Reports, Mr. Corona inadvertently included the above-ground portion of the casing (3 ft) in the Setting length. The Well Reports have been revised to depict casing lengths from ground surface to top of screen.

3. **As shown in the boring log and the Well Report for GMP-17, the gravel pack starts at 14 feet, about 11 feet above the top of the screen. As illustrated in the TCEQ guidelines, gravel pack normally starts about 0.5 feet above the screen top. Fig. 2 attached in this report shows a typical GMP design with gravel pack top 1 foot above the top of the screen. Please provide justification for the gravel pack design at this GMP.**

   The top of the gravel pack for GMP-17 was set approximately 24 feet below ground surface (bgs). The boring log and Well Report for GMP-17 and Table 1 – Gas Monitoring Probe Construction Data have been revised to reflect this.

   Figure 2 of the Landfill Gas Monitoring System Installation report depicting the gravel pack extending 1-ft above the screen is a reproduction of Figure 14.2 of the Site Development Plan (SDP) – Attachment 14, Landfill Gas Management Plan. This design had been previously approved by the TCEQ for this facility during the permit application process.

   Please also explain why one-bore-hole-multiple probes was not selected for this GMP, for which the Well Report recorded four different formations. Page 5 of the TCEQ Methane Monitoring Handbook (Version 2, 1993) discusses the criteria to be followed in determination of number and depth of GMP within the bore hole. Criterion No. 4 states that the specified depth of probes within the bore hole should be adjusted, based on geologic data obtained during drilling, and probes should be placed adjacent to soils which are most conductive to gas flow; Criterion No. 6 states when the depth of the bore hole does not exceed 30 feet, the permittee may reduce the number of probes to two.

   As stated in SDP-Attachment 14, Section 2.2.3 Geology, subsurface conditions at the site can

be grouped into a single generalized stratum with relatively uniform physical and engineering properties. This stratum consists of tan to brown, fine to coarse grained sands with varying amounts of calcareous sands, silt, gravel, and interbedded clay or silt layers with varying thickness.

The soils encountered at GMP-17 are consistent with said description: consisting of very fine grained sand from the base of the fill to 4 feet bgs, an intermittent clay and sandy-clay layer from 4 to 7 feet bgs, and sandy soils with intermittent gravel and clayey-sand between 7 and 41.5 feet bgs. Based on these subsurface conditions, a multiple probe completion was deemed unnecessary and screening the sandy soils from 0 to 4 feet bgs would not have been feasible due to the minimum distance necessary to provide a seal for the top of borehole completion.

As discussed above, GMP-17 was installed in accordance with SDP-Attachment 14, R-K's correspondence to TCEQ dated December 2, 2003 and January 6, 2004, and TCEQ response letters dated December 23, 2003 and January 27, 2004.

4. **Fig. 1 of this report show pipeline easements between Phase 1 and Phase 2 developments. Fig 14.1 of Attachment 14 from the permit application shows the easements and utility vents at the permit limits. Attachment 14 appears to include no monitoring measure for the utility vents. Please clarify whether there are monitoring procedures for the utility vents.**

   R-K did not observe utility vents at the locations illustrated on Figure 14.1 of SDP-Attachment 14. R-K contacted Mr. Cal Gray of El Paso Natural Gas who stated that El Paso Natural Gas does not have utility vents at these locations. Based on this information, it appears that the utility vents shown on Figure 14.1 do not currently exist.

If you have any questions or need additional information on this matter, please do not hesitate to contact either of the undersigned.

Respectfully submitted,

RABA-KISTNER CONSULTANTS (SW), INC.

Valerie A. Joosten, P.E.
Environmental Engineer

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
8/18/04
LICENSED
PROFESSIONAL ENGINEER

Patrick F. Welsh, P.G.
Senior Geologist

Copies Submitted: Above (3)
Ms. Ellen Smyth, P.E., City of El Paso, Solid Waste Management (1)
Mr. Ziad Al-Dasouqi, P.E., City of El Paso, Engineering Dept. (1)
Mr. Jose Rodarte, P.E., R.P.L.S., Huitt-Zollars, Inc. (1)

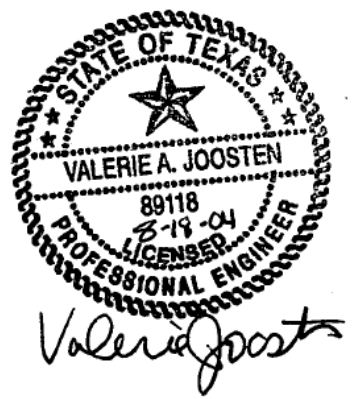
Attachments
P:\Environmental Transfer File\Active Projects\701.Clint.Landfill\Task 4000\GMP Response LTR.doc

ILLUSTRATIONS

TABLE 1
GAS MONITORING PROBE CONSTRUCTION DATA
City of El Paso - Clint Landfill, Phase 1 Cells 1 and 2
R-K Project No. ASF03-701-00

CODE	COMPONENT	ELEVATION (FT MSL)/DEPTH (FT BGS)											
		GMP-2		GMP-1		GMP-20		GMP-19		GMP-18		GMP-17	
A	Site Grid Coordinates (Northing and Easting)	21+90.82, A+23.51		30+65.74, A+17.20		63+75.38, A+01.02		44+01.09, A+01.30		50+94.03, A+01.27		50+99.12, I+49.99	
B	Top of Protective Steel Collar	3939.53	-3.6	3943.31	-3.11	3957.95	-3.22	3964.64	-3.42	3963	-3.67	3972.02	-3.26
C	Top of PVC Riser	3939.25	-3.32	3943.44	-3.24	3957.66	-2.93	3964.12	-2.9	3962.5	-3.17	3971.74	-2.98
D	Top of Concrete Pad	3936.75	-0.82	3940.96	-0.76	3954.58	0.15	3961.95	-0.73	3959.43	-0.1	3968.53	0.23
E	**Ground Surface Elevation**	**3935.93**	---	**3940.2**	---	**3954.73**	---	**3961.22**	---	**3959.33**	---	**3968.76**	---
F	Bottom of Protective Steel Collar	3934.43	1.5	3938.7	1.5	3953.23	1.5	3959.72	1.5	3957.83	1.5	3967.26	1.5
G	Bottom of Concrete Seal/Top of Annular Bentonite Seal	3933.93	2	3938.2	2	3952.73	2	3959.22	2	3957.33	2	3966.76	2
H	Bottom of Annular Bent. Seal/Top of Filter Pack	3931.93	4	3936.2	4	3949.73	5	3948.22	13	3946.33	13	3945.76	23
I	Bottom of Filter Pack/Top of Pea Gravel	3930.93	5	3935.2	5	3948.73	6	3947.22	14	3945.33	14	3944.76	24
J	**Top of Screen**	**3929.93**	**6**	**3934.2**	**6**	**3947.73**	**7**	**3946.22**	**15**	**3944.33**	**15**	**3943.76**	**25**
K	**Bottom of Screen/Bottom Cap**	**3909.43**	**26.5**	**3924.7**	**15.5**	**3930.23**	**24.5**	**3928.72**	**32.5**	**3928.83**	**30.5**	**3928.26**	**40.5**
L	Bottom of Pea Gravel/Bottom of Boring	3908.43	27.5	3923.7	16.5	3929.23	25.5	3927.72	33.5	3927.83	31.5	3927.26	41.5
(C-J)	Solid Pipe Length, ft.	9.32		9.24		9.93		17.9		18.17		27.98	
(J-K)	Slotted Screen Length, ft.	20.5		9.5		17.5		17.5		15.5		15.5	

Notes:
- See Figure 2, Typical Gas Monitoring Probe Construction Detail for letter code (A-L) visualization.
- Ground Surface Elevations were based on City of El Paso Datum.
- Site Grid Coordinates based on site grid coordinate system.
- FT MSL = Feet above Mean Sea Level, FT BGS = Feet Below Ground Surface



ATTACHMENT 1

BORING LOGS

OF BORING NO. GMP-17

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 50+99.12, 1+49.99

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.76'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3970 / 0				FILL MATERIAL - approximately 6 inches thick						
				SAND, Very Fine Grained, Clayey, Light Brown, Loose, Dry USCS: SC						
3965 / 5				CLAY, Brown, Stiff, Slightly Moist USCS: CL						
				CLAY, Sandy, Brown, Moderately Stiff USCS: CL						
3960 / 10				SAND, Very Fine Grained, Brown, Loose, Slightly Moist USCS: SW						
3955 / 15				- with some small gravel from 13 to 25 feet						
3950 / 20				- slightly clayey from 20 to 25 feet						
3945 / 25				SAND, Medium Grained, Grayish-brown, Loose, Slightly Moist USCS: SW						
3940 / 30										
3935 / 35				- with some small gravel from 35 to 40 feet USCS: SP						

DEPTH DRILLED:	41.5ft	**DEPTH TO WATER:**	N/A	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/25/04	**DATE MEASURED:**	N/A	**FIGURE**	3

OF BORING NO. GMP-17

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 50+99.12, 1+49.99

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.76'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3930 / 40										
				Boring was terminated at an approximate depth of 41.5 feet below ground surface.						
3925 / 45										
3920 / 50										
3915 / 55										
3910 / 60										
3905 / 65										
3900 / 70										
3895 / 75										

DEPTH DRILLED:	41.5ft	**DEPTH TO WATER:**	N/A	**PROJ. No.**	ASF03-701-00
DATE DRILLED:	6/25/04	**DATE MEASURED:**	N/A	**FIGURE**	3

ATTACHMENT 2

TDLR WELL REPORT

original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

TTENTION OWNER: Confidentiality rivilege Notice on on reverse side Well Owner's copy (pink)

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

) OWNER City of El Paso (Name) ADDRESS 7969 San Paulo Dr. (Street or RFD) El P (City) Tx (State) 79915 (Zip)

) ADDRESS OF WELL
County El Paso Clint Landfill (Street, RFD or other) El P (City) Tx (State) 79915 (Zip) GRID #

) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMP-1
N-30+75
E-N+50

) WELL LOG
Date Drilling:
Started 7/01/04 18
Completed 7/01/04 18

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	16.5

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	16.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval from 5 ft. to 16.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg. if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	PVC Sch 40	0	6	
1	N	Screen	6	15.5	.020

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method used
Cemented by R C Corona
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc. ft.

10) SURFACE COMPLETION:
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit REPORT OF UNDESIRABLE WATER
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Lepasa Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO. 4709 M

ADDRESS 245 Harvard Ave (Street or RFD) El Paso (City) Tx (State) 79907 (Zip)

(Signed) R C Corona (Licensed Well Driller) (Signed) (Registered Driller Trainee)

original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

TTENTION OWNER: Confidentiality
nvilege Notice on on reverse side
Well Owner's copy (pink)

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER: City of El Paso (Name) ADDRESS: 7969 San Paulo Dr. (Street or RFD) ELP (City) Tx (State) 79915 (Zip)

ADDRESS OF WELL:
County: El Paso Clint Landfill (Street, RFD or other) ELP (City) Tx (State) 79915 (Zip) GRID #

TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [X] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5) GMP-1
N-22+00
E-4+00

WELL LOG:
Date Drilling:
Started 7/01/04
Completed 7/01/04

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	27.5

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [X] Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	27.5	Sand

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval from 5 ft. to 27.3 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch 40 PVC	0	6	.015
1	N	Sch 40 Screen	6	26.5	.020

9) CEMENTING DATA: [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used
ft. to ft. No. of sacks used
Method used
Cemented by R C Corona
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION:
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm Date

12) PACKERS: Type Depth

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc. ft.

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME: Lubbock Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO.: 4709 M

ADDRESS: 245 Harvard Ave (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) R C Corona (Licensed Well Driller) (Signed) (Registered Driller Trainee)

original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality/Privilege Notice on reverse side. Well Owners copy (pink).*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER: City of El Paso (Name) ADDRESS: 7925 San Paulo Rd. El Paso (City) Tx. (State) 79915 (Zip)

ADDRESS OF WELL: County: El Paso CLINT LANDFILL El Paso Tx. 79915 GRID #:
(Street, RFD or other) (City) (State) (Zip)

2) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [X] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Test well
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5) [6 MILE]
N-5,174.00
E-1,174.50
N

WELL LOG

Date Drilling: Started 6/25/04 Completed 6/25/04

DIAMETER OF HOLE

Dia (in)	From (ft)	To (ft)
8"	Surface	41.5'

7) DRILLING METHOD (Check): [ ] Driven [X] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [X] Other Hollow Stem Auger

From (ft)	To (ft)	Description and color of formation material
0	11	Caliche, Clay
11	35	Brown Sand
35	41.5	Caliche
41.5		Brown Sand

8) Bore Hole Completion (Check): [ ] Open Hole [X] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
[X] Gravel Packed Give Interval from 2' ft. to 41.5' ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA

Dia (in)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg. (commercial)	Setting (ft) From	Setting (ft) To	Gage Casing & Screen
5"	N	Sch 40 PVC	0	25'	.020
5"	N	Screen	25'	40.5'	.020

(Use reverse side of Well Owners copy, if necessary)

9) TYPE PUMP: [ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder [ ] Other
Depth to pump bowl, cylinder, jet, etc. ft.

10) SURFACE COMPLETION:
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(B)]
[ ] Approved Alternative Procedure Used [Rule 338.7(1)]

9) CEMENTING DATA: [Rule 338.44(3)(C)]
Cemented from 0 ft. to 2' ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method used
Cemented by K & C Services
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

11) WATER LEVEL:
Static level ft. Below land surface Date
Artesian flow gpm Date

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield gpm with ft. drawdown after hrs.

12) PACKERS: Type Depth

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit REPORT OF UNDESIRABLE WATER
Type of water: Depth of strata:
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME: El Paso Drilling Co. (Type or print)
WELL DRILLER'S LICENSE NO.: 4709

ADDRESS: 245 Harvard Ave. El Paso Tx. 79907
(Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: Confidentiality Privilege Notice on on reverse side. Well Owner's copy (pink)

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER: City of El Paso (Name) ADDRESS: 7969 San Paulo Dr. (Street or RFD) ELP (City) Tx (State) 79915 (Zip)

ADDRESS OF WELL: County: El Paso Clint Landfill (Street, RFD or other) ELP (City) Tx (State) 79915 (Zip) GRID #

TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [X] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5) GMP-18
N-51+00
E-A+00

WELL LOG:
Date Drilling:
Started 6/25/04
Completed 6/29/04

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
9	Surface	32.5

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [X] Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	4	Fill Material
4	32.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval from 14 ft. to 32.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg. if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	15	BLK
1	N	Sch. 40 PVC	15	30.5	.020

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method Used
Cemented by R.C. Corona
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION:
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm Date

12) PACKERS: Type Depth

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc. ft.

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME: L Peasa Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO. 4709 M

ADDRESS: 245 Harvard Ave. (Street or RFD) El Paso (City) Tx (State) 79907 (Zip)

(Signed) R.C. Corona (Licensed Well Driller) (Signed) (Registered Driller Trainee)

d original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER: City of El Paso (Name) ADDRESS: 7969 San Paulo Dr. (Street or RFD) El Paso (City) Tx (State) 79915 (Zip)

2) ADDRESS OF WELL: County: El Paso (Street, RFD or other) Clint Landfill (City) Tx (State) 79915 (Zip) GRID #

3) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [X] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5) GMP-19
N-44+00
E-A+00
N

6) WELL LOG:
Date Drilling:
Started 6/25/04 19
Completed 6/25/04 19

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	33.5

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [X] Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	33.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval from 14 ft. to 33.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg. if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	15	Lock
1	N	Sch. 40 PVC Screen	15	32.5	.020

9) CEMENTING DATA: [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method used
Cemented by R C Corona
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION:
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm Date

12) PACKERS: Type Depth

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc. ft.

14) WELL TESTS:
Type test [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit REPORT OF UNDESIRABLE WATER
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME: Lizasa Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO.: 4709 M

ADDRESS: 245 Hartwell Ave. (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) R C Corona (Licensed Well Driller) (Signed) (Registered Driller Trainee)

original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

TENTION OWNER: *Confidentiality Privilege Notice on on reverse side Well Owner's copy (pink)*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

OWNER: EL PASO (Name) ADDRESS: 7969 San Pablo Dr. (Street or RFD) EL Paso (City) Tx (State) 79915 (Zip)

ADDRESS OF WELL:
County: EL PASO CLINT LANDFILL (Street, RFD or other) ELP (City) Tx (State) 79915 (Zip) GRID #

TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [X] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5) GMP-20
N-36+85
E-A+00

WELL LOG:
Date Drilling:
Started 6/26/04
Completed 6/26/04

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
	Surface	

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [ ] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [X] Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	25.5	Brown Sand

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval from 6 ft. to 25.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	7	BLK
1	N	Sch. 40 PVC Screen	7	24.5	.020

(Use reverse side of Well Owner's copy, if necessary)

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 2
ft. to ft. No. of sacks used
Method used
Cemented by [signature]
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) TYPE PUMP:
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc. ft.

10) SURFACE COMPLETION:
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: [ ] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: gpm with ft. drawdown after hrs.

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

12) PACKERS: Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME: Lirasa Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO.: 4709 M

ADDRESS: 245 Harvard Ave. (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) [signature] (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Margaret Hoffman, *Executive Director*

MSW/2284/CO

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 10, 2004

Mr. Jose L. Rodarte, P.E.
HUITT-ZOLLARS, Inc.
5822 Cromo Dr., Suite 210
El Paso, TX 79912

Re: El Paso, El Paso County
City of El Paso Clint Landfill, Permit No. 2284
Landfill Gas Monitoring System Installation
WWC No. 10701345, Mail Log No. 6343
RN101478766 / CN601410244

Dear Mr. Rodarte:

The Landfill Gas Monitoring System Installation report from the referenced facility was received by the Municipal Solid Waste Permits Section of the Texas Commission on Environmental Quality (TCEQ) on July 29, 2004. The report, with attached cover letter dated July 28, 2004, documented the activities related to installation of landfill gas monitoring probes GMP-1, GMP-2, GMP-17, GMP-18, GMP-19, and GMP-20. The Landfill Gas Monitoring System Installation report was signed and sealed by Ms. Valerie A. Joosten, P.E. of Raba-Kistner Consultants (SW), Inc. of El Paso, Texas.

The review of the report has been completed and it cannot be accepted at this time. Please submit an Addendum to the Landfill Gas Monitoring System Installation report within 30 days of the date of this letter in response to the following comments:

1. The soil strata described in the Well Report do not always match what are depicted in the boring logs. For example, the Well Report describes the formation from 0 to 11 feet as sandy clay at GMP-17, while the boring log shows five strata ranging from fill material to sand for the same depth interval. Please explain the discrepancies.

2. On Well Report for GMP-1, the casing (solid riser) was reported to be from 0 to 9 feet, and the screen (slotted riser) was reported to be from 6 to 15.5 feet. Well Reports for all other probes except for GMP-17 have the similar issue. Well Report for GMP-17 recorded a casing depth of 0 to 18 feet, and a screen depth of 25 to 40.5 feet. Please indicate at what depth the casing and the screen joint and explain the probe structure, if necessary (Fig. 2 attached in this report shows a typical GMP design).

3. As shown in the boring log and the Well Report for GMP-17, the gravel pack starts at 14 feet, about 11 feet above the top of the screen. As illustrated in the TCEQ guidelines, gravel pack normally starts about 0.5 feet above the screen top. Fig. 2 attached in this report shows a typical GMP design

with gravel pack top 1 foot above the top of the screen. Please provide justification for the gravel pack design at this GMP. Please also explain why one-bore-hole-multiple probes was not selected for this GMP, for which the Well Report recorded four different formations. Page 5 of the TCEQ Methane Monitoring Handbook (Version 2, 1993) discusses the criteria to be followed in determination of number and depth of GMP within the bore hole. Criterium No. 4 states that the specified depths of probes within the bore hole should be adjusted, based on geologic data obtained during drilling, and probes should be placed adjacent to soils which are most conductive to gas flow; Criterium No. 6 states when the depth of the bore hole does not exceed 30 feet, the permitee may reduce the number of probes to two.

4. Fig. 1 of this report shows pipeline easements between Phase 1 and Phase 2 developments. Fig. 14.1 of Attachment 14 from the permit application shows the easements and utility vents at the permit limits. Attachment 14 appears to include no monitoring measures for the utility vents. Please clarify whether there are monitoring procedures for the utility vents.

If you have any questions concerning this letter, please contact me at 512/239-1132, or at the address on our letterhead (please include Mail Code No. 124).

Sincerely,

Frank Zeng, P.E.
Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

FZ/fef

cc: Ms. Ellen Smyth, P.E., City of El Paso Solid Waste Management, El Paso, TX
Ms. Valerie A. Joosten, P.E., Raba-Kistner Consultants (SW), Inc., El Paso, TX

HUITT-ZOLLARS

HUITT-ZOLLARS, INC. • 5822 Cromo Dr. • Suite 210 • El Paso, TX 79912-5502 • 915.587.4339 phone • 915.587.5247 fax • huitt-zollars.com

July 28, 2004

Mr. Richard Carmichael, PE
Municipal Solid Waste Permits Section – MC-124
TCEQ
P.O. Box 13087
Austin, TX 78711-3087

Re: Landfill Gas Monitoring System Installation
Phase 1, Cells 1 and 2
City of El Paso Clint Landfill – Permit No. MSW-2284
El Paso County. Texas

Dear Mr. Carmichael:

We are respectfully submitting for your review and approval, this letter report documenting the field activities conducted in support of the installation of the Clint Landfill Gas Monitoring System, required for Cells 1 and 2.

Please let us know if you need additional information. Our design team is ready to respond quickly to any of your requests. The opening of these two new cells is a high priority project for the community of El Paso.

We thank you in advance for your consideration.

Sincerely,
HUITT-ZOLLARS, INC.

Jose Rodarte, P.E.

Jose L. Rodarte, P.E., RPLS
Vice President

Attachments

cc: Ms. Ellen Smyth, PE ~ City of El Paso Solid Waste Management
Mr. Ziad Al-Dasouqui, PE ~ City of El Paso Engineering Department
Mr. Said Larbi-Cherif, PE ~ City of El Paso Municipal Services
Ms. Valerie Joosten, PE ~ Raba-Kistner Consultants (SW), Inc,

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Raba Kistner

Raba-Kistner Consultants (SW), Inc.
7002 Commerce
El Paso, Texas 79915
(915) 778-5233 • FAX (915) 779-8301
www.rkci.com

Project No. ASF03-701-00
July 28, 2004

Mr. Richard Carmichael, P.E.
Municipal Solid Waste Permits Section – MC-124
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Re: Landfill Gas Monitoring System Installation
Phase 1 Cells 1 and 2
City of El Paso Clint Landfill - Permit No. MSW-2284
El Paso County, Texas

Dear Mr: Carmichael:

On behalf of the City of El Paso, Raba-Kistner Consultants, Inc. (Raba-Kistner) is pleased to submit this letter report documenting the field activities conducted in support of the installation of the landfill gas monitoring system required for Phase 1 Cells 1 and 2 at the above referenced facility. The field activities described in this report were conducted in accordance with the Site Development Plan (SDP) – Attachment 14, Landfill Gas Management Plan, Raba-Kistner's letters to the Texas Commission on Environmental Quality (TCEQ) dated December 2, 2003 and January 6, 2004, and TCEQ response letters dated December 23, 2003 and January 27, 2004.

Landfill Gas Monitoring Probe Installation

Six permanent landfill gas monitoring probes (GMP-1, GMP-2, GMP-17, GMP-18, GMP-19 and GMP-20) were installed on June 25, June 26, and July 1, 2004 at the locations depicted on **Figure 1 – Landfill Gas Monitoring Probe Location Map**. The purpose of the probes is to monitor potential landfill gas migration from Phase 1 Cells 1 and 2, which are the first cells to be developed under Permit No. MSW-2284.

The probes were installed by a Texas-licensed driller, Mr. R.C. Corona (Texas Driller License No. 4709 M). Borings for the probes were drilled using a truck-mounted drilling rig equipped with 8-inch outside diameter hollow-stem augers. During drilling, soils were continuously examined, visually classified, and logged by an experienced Raba-Kistner geologist, Patrick F. Welsh, P.G., (Texas Registration No. 5149) using standard geotechnical logging methods. Boring logs depicting the soils encountered during drilling are presented in **Attachment 1**. The required Texas Department of Licensing and Regulation Well Reports are presented in **Attachment 2**.

The ambient levels of methane, oxygen, and combustible gas (lower explosive level) were continuously monitored during field activities using an Innova Land Surveyor, which had been calibrated with methane on April 20, 2004 and was calibrated with ambient air at the start of each day prior to drilling. Methane and combustible gases were not detected during field drilling and sampling activities.

Subsequent to completion of drilling activities, the landfill gas monitoring probes were constructed in accordance with SDP – Attachment 14 requirements. Probe construction details are presented on **Table 1 – Gas Monitoring Probe As-Built Construction Data** and depicted on **Figure 2 – Typical Gas Monitoring Probe Detail**.

As illustrated on **Figure 2**, the probes were constructed using 1-inch diameter, schedule 40 PVC pipe and fitted with schedule 40 PVC, 0.020-in. slotted screen. The following components were installed around the well screen and casing (from bottom to top):

- ¼-in. washed pea gravel – extending from bottom of each borehole to depths corresponding to approximately one (1) foot above the top of the screen,
- 10/20 silica sand – extending 1 ft from the top of the gravel pack,
- annular seal (3/8-inch hydrated bentonite pellets) – extending from top of silica sand to two (2) feet below ground surface (bgs), and
- concrete seal (concrete grout) – extending from two (2) feet bgs to ground surface.

Surface completion for the gas monitoring probes consisted of 4-inch diameter steel protective casing extending approximately 3.5 feet above ground surface and set 1.5 feet bgs. A 4-feet long by 4-feet wide by 6-inch thick reinforced concrete pad was constructed around the protective casing. Steel bollards set approximately 2 feet bgs were placed within concrete footings offset approximately 1 foot from the corners of the surface pad.

The locations and elevations of the landfill gas monitoring probes were surveyed by a Texas-licensed professional land surveyor subsequent to the installation of the probes. The surveyor's certification of the location and elevation of the landfill gas monitoring probes is presented as **Attachment 3**.

If you have any questions or need additional information on this matter, please do not hesitate to contact either of the undersigned.

Respectfully submitted,

RABA-KISTNER CONSULTANTS (SW), INC.

Valerie A. Joosten, P.E.
Environmental Engineer

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
7-28-04
LICENSED
PROFESSIONAL ENGINEER

Patrick F. Welsh, P.G.
Senior Geologist

Copies Submitted: Above (3)
Ms. Ellen Smyth, P.E., City of El Paso, Solid Waste Management (1)
Mr. Ziad Al-Dasouqi, P.E., City of El Paso, Engineering Dept. (1)
Mr. Jose Rodarte, P.E., R.P.L.S., Huitt-Zollars, Inc. (1)

Attachments
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ILLUSTRATIONS

TABLE 1
GAS MONITORING PROBE CONSTRUCTION DATA
City of El Paso - Clint Landfill, Phase 1 Cells 1 and 2
R-K Project No. ASF03-701-00

CODE	COMPONENT	ELEVATION (FT MSL)/DEPTH (FT BGS)											
		GMP-2		GMP-1		GMP-20		GMP-19		GMP-18		GMP-17	
A	Site Grid Coordinates (Northing and Easting)	21+90.82, A+23.51		30+65.74, A+17.20		63+75.38, A+01.02		44+01.09, A+01.30		50+94.03, A+01.27		50+99.12, I+49.99	
B	Top of Protective Steel Collar	3939.53	-3.6	3943.31	-3.11	3957.95	-3.22	3964.64	-3.42	3963	-3.67	3972.02	-3.26
C	Top of PVC Riser	3939.25	-3.32	3943.44	-3.24	3957.66	-2.93	3964.12	-2.9	3962.5	-3.17	3971.74	-2.98
D	Top of Concrete Pad	3936.75	-0.82	3940.96	-0.76	3954.58	0.15	3961.95	-0.73	3959.43	-0.1	3968.53	0.23
E	**Ground Surface Elevation**	**3935.93**	---	**3940.2**	---	**3954.73**	---	**3961.22**	---	**3959.33**	---	**3968.76**	---
F	Bottom of Protective Steel Collar	3934.43	1.5	3938.7	1.5	3953.23	1.5	3959.72	1.5	3957.83	1.5	3967.26	1.5
G	Bottom of Concrete Seal/Top of Annular Bentonite Seal	3933.93	2	3938.2	2	3952.73	2	3959.22	2	3957.33	2	3966.76	2
H	Bottom of Annular Bent. Seal/Top of Filter Pack	3931.93	4	3936.2	4	3949.73	5	3948.22	13	3946.33	13	3955.76	13
I	Bottom of Filter Pack/Top of Pea Gravel	3930.93	5	3935.2	5	3948.73	6	3947.22	14	3945.33	14	3954.76	14
J	**Top of Screen**	**3929.93**	**6**	**3934.2**	**6**	**3947.73**	**7**	**3946.22**	**15**	**3944.33**	**15**	**3943.76**	**25**
K	**Bottom of Screen/Bottom Cap**	**3909.43**	**26.5**	**3924.7**	**15.5**	**3930.23**	**24.5**	**3928.72**	**32.5**	**3928.83**	**30.5**	**3928.26**	**40.5**
L	Bottom of Pea Gravel/Bottom of Boring	3908.43	27.5	3923.7	16.5	3929.23	25.5	3927.72	33.5	3927.83	31.5	3927.26	41.5
(C-J)	Solid Pipe Length, ft.	9.32		9.24		9.93		17.9		18.17		27.98	
(J-K)	Slotted Screen Length, ft.	20.5		9.5		17.5		17.5		15.5		15.5	

Notes:
- See Figure 2, Typical Gas Monitoring Probe Construction Detail for letter code (A-L) visualization.
- Ground Surface Elevations were based on City of El Paso Datum.
- Site Grid Coordinates based on site grid coordinate system.
- FT MSL = Feet above Mean Sea Level, FT BGS = Feet Below Ground Surface



PERMANENT BENCHMARK
SEE NOTE 'A'

PERMIT LIMIT/PROPERTY LINE

GMP15 GMP14 GMP13 GMP12 GMP11 GMP10 GMP9 GMP8

200' BUFFER

50' EASEMENT

100' EASEMENT

N

0 200 400
SCALE IN FEET

AA+00 Z+00 Y+00 X+00 W+00 V+00 U+00 T+00 S+00 R+00 Q+00 P+00 O+00 N+00 M+00 L+00 K+00 J+00 I+00 H+00 G+00 F+00 E+00 D+00 C+00 B+00 A+00

GMP16

GMP17

GMP18

GMP19

GMP20

GMP1

GMP2

GMP3

GMP4

GMP5

GMP6

GMP7

200' BUFFER

100' BUFFER

PHASE 1

PHASE 2

9 10 8 7 5 6 4 2 3 1

19 18 15 14 13 20 17 16 12 11

110'

85'

69' PIPELINE EASEMENT

DETENTION POND BC

PERMIT LIMIT/PROPERTY LINE

LFG PROBE

50+00 49+00 48+00 47+00 46+00 45+00 44+00 43+00 42+00 41+00 40+00 39+00 38+00 37+00 36+00 35+00 34+00 33+00 32+00 31+00 30+00 29+00 28+00 27+00 26+00 25+00 24+00 23+00 22+00 21+00 20+00 19+00 18+00 17+00 16+00 15+00 14+00 13+00 12+00 11+00 10+00 9+00 8+00 7+00 6+00 5+00 4+00 3+00 2+00 1+00 0+00

LEGEND

- CELLS UNDER CONSTRUCTION
- PERMIT LIMIT/PROPERTY LINE
- PHASE BOUNDARY
- CELL BOUNDARY
- 12 — CELL NUMBER AND FILL DIRECTION
- GMP20 — CONSTRUCTED GAS MONITORING PROBE (MSW-2284)
- GMP16 — FUTURE GAS MONITORING PROBE
- LFG PROBE — EXISTING GAS MONITORING PROBE, FORMER CLINT LANDFILL (MSW-1482)

NOTES:

A. PERMANENT BENCHMARK: 3-INCH DIAMETER BRASS CAP SET IN CONCRETE, ELEV. 3976.55 CITY DATUM.

BASE DRAWINGS:

1. LANDFILL GAS MANAGEMENT PLAN, FIGURE III ATT.1.4 BY HDR ENGINEERING, 8/31/2000.
2. LINER GRADES, FIGURE III ATT.1.4 BY HDR ENGINEERING, 9/1/2000.

STATE OF TEXAS
VALERIE A. JOOSTEN
89118
7-28-04
LICENSED
PROFESSIONAL ENGINEER

Valerie Joosten

NO.	DATE	REVISION REMARKS	BY

Raba Kistner

PROJECT: ASF03-701-00

SCALE: Horiz. 1" = 400' Vert. 1" = 400'
Date: 11-25-03
Drawn by: A.A.
Chkd. by: E.B.C./V.A.J.
Appd. by: V.A.J.
FILE: k:\work\clint\arcmxd\mxd\ASF03701800_Fig1.4.mxd

PROJECT NAME
CLINT LANDFILL
MSW PERMIT No. 2284
EL PASO, TEXAS

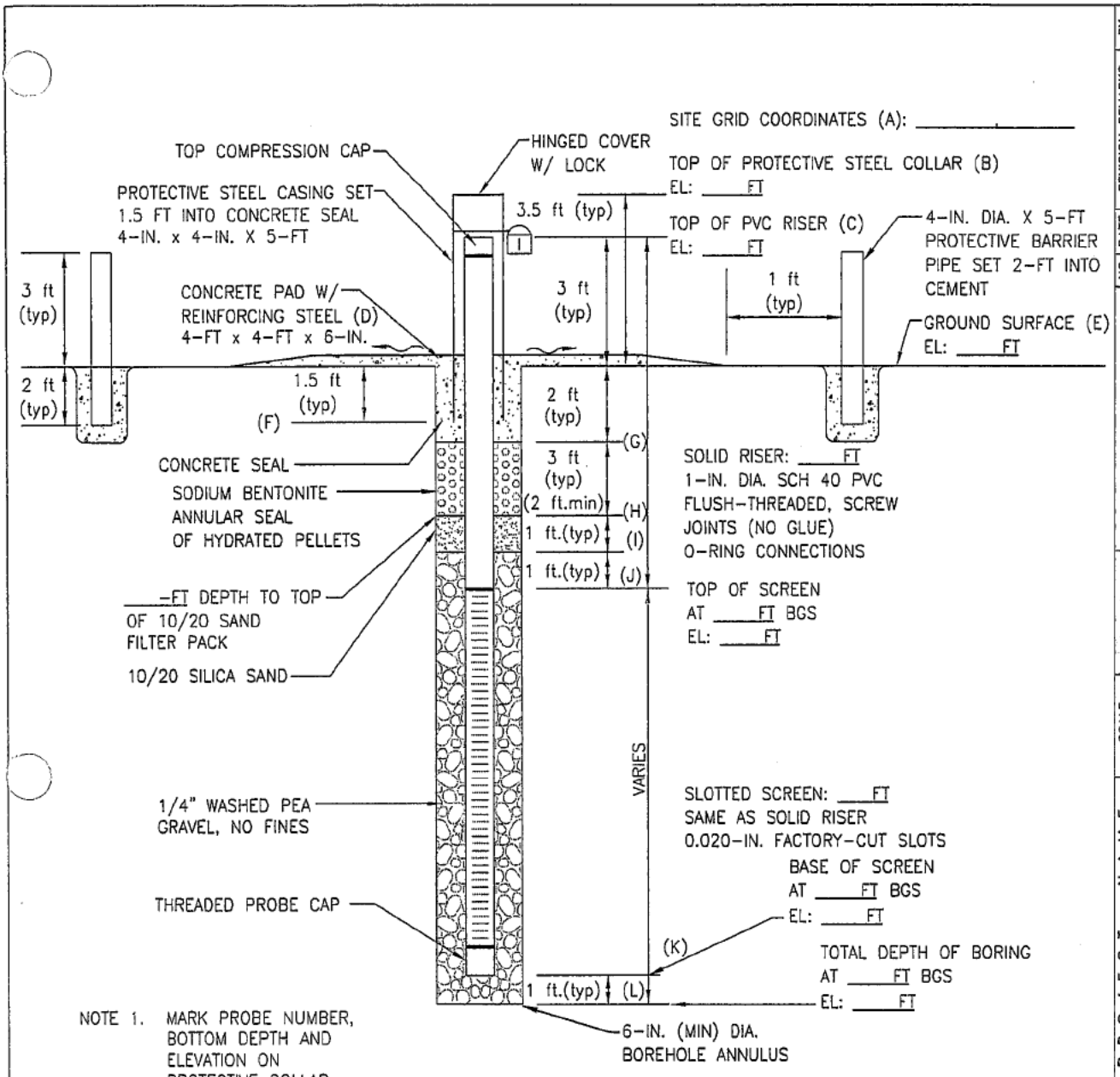
CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4098

SHEET TITLE
LANDFILL GAS MONITORING PROBE LOCATION MAP

SHEET 1 OF 1

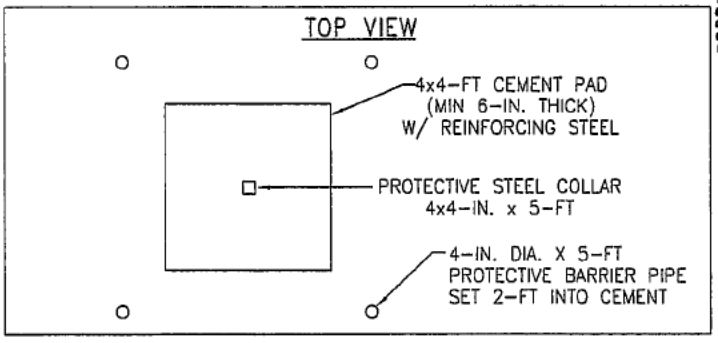
FIGURE 1

P:\DATA\ENV\ASF03\701 Clint Landfill\Task 4000\DRAWINGS\FIG1_715X403.dgn 07/28/2004 11:53:41



NOTE 1. MARK PROBE NUMBER, BOTTOM DEPTH AND ELEVATION ON PROTECTIVE COLLAR

NOTE 2. SEE TABLE 1 FOR LETTER CODE (A-L) VALUES



STATE OF TEXAS
VALERIE A. JOOSTEN
89118
7-28-04
LICENSED PROFESSIONAL ENGINEER

NO. | DATE | REVISION REMARKS | BY

Raba Kistner

PROJECT: ASF03-701-00

SCALE Horiz. N.T.S. Vert. N.T.S.
Date 11-25-03
Drawn by A.A.
Chkd. by E.B.C./V.A.J.
Appd. by V.A.J.
FILE: H:\Data\Env\Asf03\701\ASF0370100_Fig3.dwg

PROJECT NAME
CLINT LANDFILL
MSW PERMIT No. 2284
EL PASO, TEXAS

CITY OF El Paso
#2 CIVIC CENTER PLAZA PH. (915) 541-4200

SHEET TITLE
TYPICAL GAS MONITORING PROBE DETAIL

SHEET 1 OF 1

FIGURE 2

ATTACHMENT 1

BORING LOGS

LOG OF BORING NO. GMP-1

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 30+65.74, A-17.20

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3940.20'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3940 – 0				SAND, Fine Grained, Brown, Loose, Slightly Moist, with some gravel USCS: SP						
3935 – 5				SAND, Fine Grained, Whittish, Loose, Dry, with gravel and calcareous material USCS: SW						
3930 – 10				SAND, Medium Grained, Grayish-brown, Loose, Dry, with some sand - course grained USCS: SP						
3925 – 15										
				Boring was terminated at an approximate depth of 16.5 feet below ground surface.						
3920 – 20										
3915 – 25										
3910 – 30										
3905 – 35										

DEPTH DRILLED: 16.5ft

DATE DRILLED: 7/01/04

DEPTH TO WATER: N/A

DATE MEASURED: N/A

PROJ. No. ASF03-701-00

FIGURE 1

LOG OF BORING NO. GMP-2

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 21+90.82, A-23.51

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3935.93'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3935 / 0				SAND, Very Fine Grained, Brown, Loose, Dry USCS: SW						
3930 / 5				SAND, Fine Grained, Light Brown, Loose. with some course grained sand USCS: SW						
				SAND, Medium to Course Grained, Grayish-brown, Loose, Dry USCS: SP						
3925 / 10										
				SAND, Medium Grained, Whittish, Loose, Dry. with some calcareous material USCS: SW						
3920 / 15				SAND, Medium Grained, Light Brown to Grayish-brown, Loose, Dry, with some small gravel USCS: SP						
3915 / 20										
3910 / 25										
				Boring was terminated at an approximate depth of 27.5 feet below ground surface.						
3905 / 30										
3900 / 35										

DEPTH DRILLED: 27.5ft | DEPTH TO WATER: N/A | PROJ. No. ASF03-701-00

DATE DRILLED: 7/01/04 | DATE MEASURED: N/A | FIGURE 2

LOG OF BORING NO. GMP-17

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 50+99.12, 1+49.99

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.76'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3970 – 0				FILL MATERIAL - approximately 6 inches thick						
				SAND, Very Fine Grained, Clayey, Light Brown, Loose, Dry USCS: SC						
3965 – 5				CLAY, Brown, Stiff, Slightly Moist USCS: CL						
				CLAY, Sandy, Brown, Moderately Stiff USCS: CL						
3960 – 10				SAND, Very Fine Grained, Brown, Loose, Slightly Moist USCS: SW						
3955 – 15				- with some small gravel from 13 to 25 feet						
3950 – 20				- slightly clayey from 20 to 25 feet						
3945 – 25				SAND, Medium Grained, Grayish-brown, Loose, Slightly Moist USCS: SW						
3940 – 30										
3935 – 35				- with some small gravel from 35 to 40 feet USCS: SP						

DEPTH DRILLED:	41.5ft	DEPTH TO WATER:	N/A	PROJ. No. ASF03-701-00
DATE DRILLED:	6/25/04	DATE MEASURED:	N/A	FIGURE 3

LOG OF BORING NO. GMP-17

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 50+99.12, 1+49.99

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3968.76'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3930 / 40										
3925 / 45				Boring was terminated at an approximate depth of 41.5 feet below ground surface.						
3920 / 50										
3915 / 55										
3910 / 60										
3905 / 65										
3900 / 70										
3895 / 75										

DEPTH DRILLED: 41.5ft

DATE DRILLED: 6/25/04

DEPTH TO WATER: N/A

DATE MEASURED: N/A

PROJ. No. ASF03-701-00

FIGURE 3

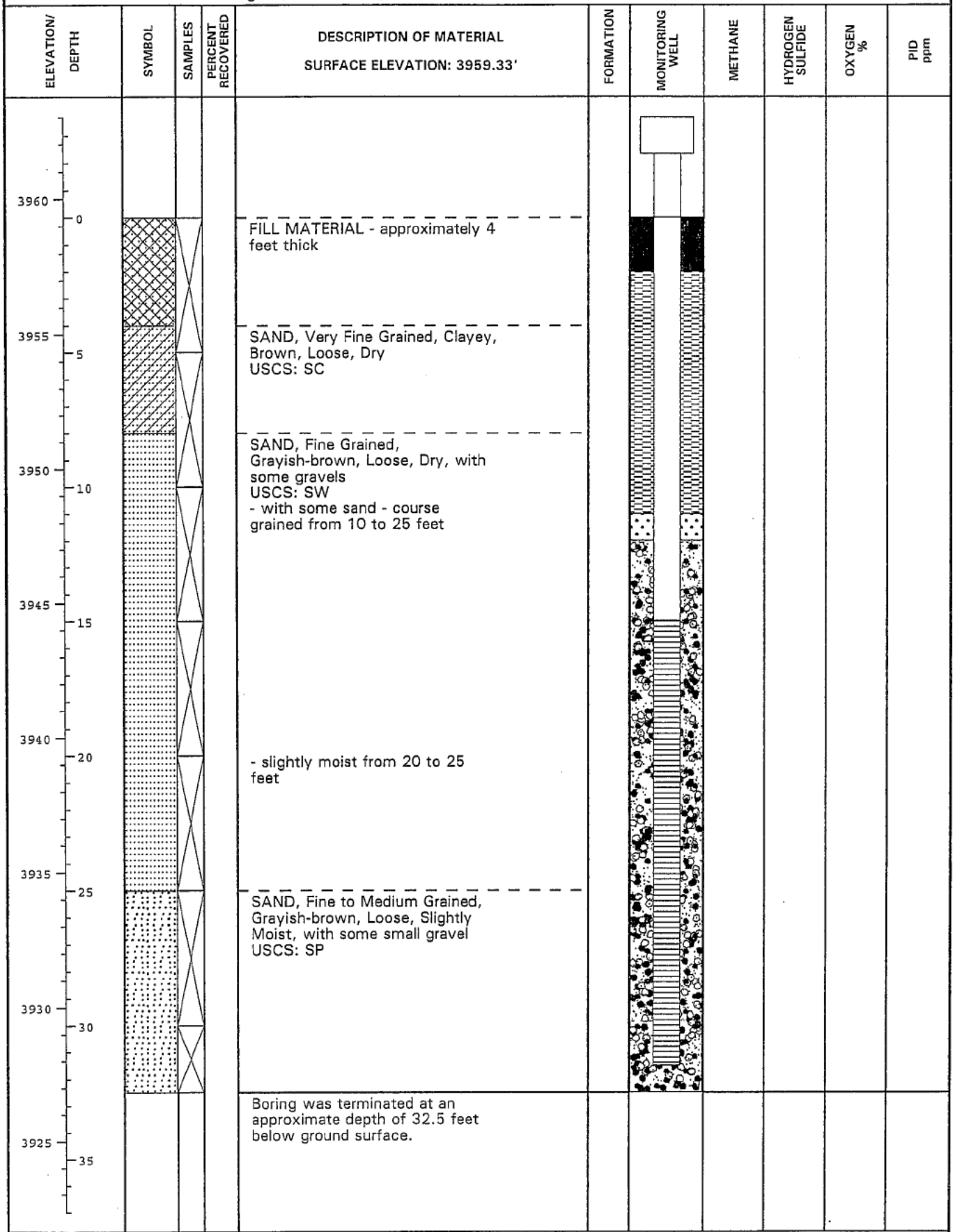
LOG OF BORING NO. GMP-18

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 50+84.03, A+01.27



DEPTH DRILLED:	32.5ft	DEPTH TO WATER:	N/A	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/25/04	DATE MEASURED:	N/A	FIGURE	4

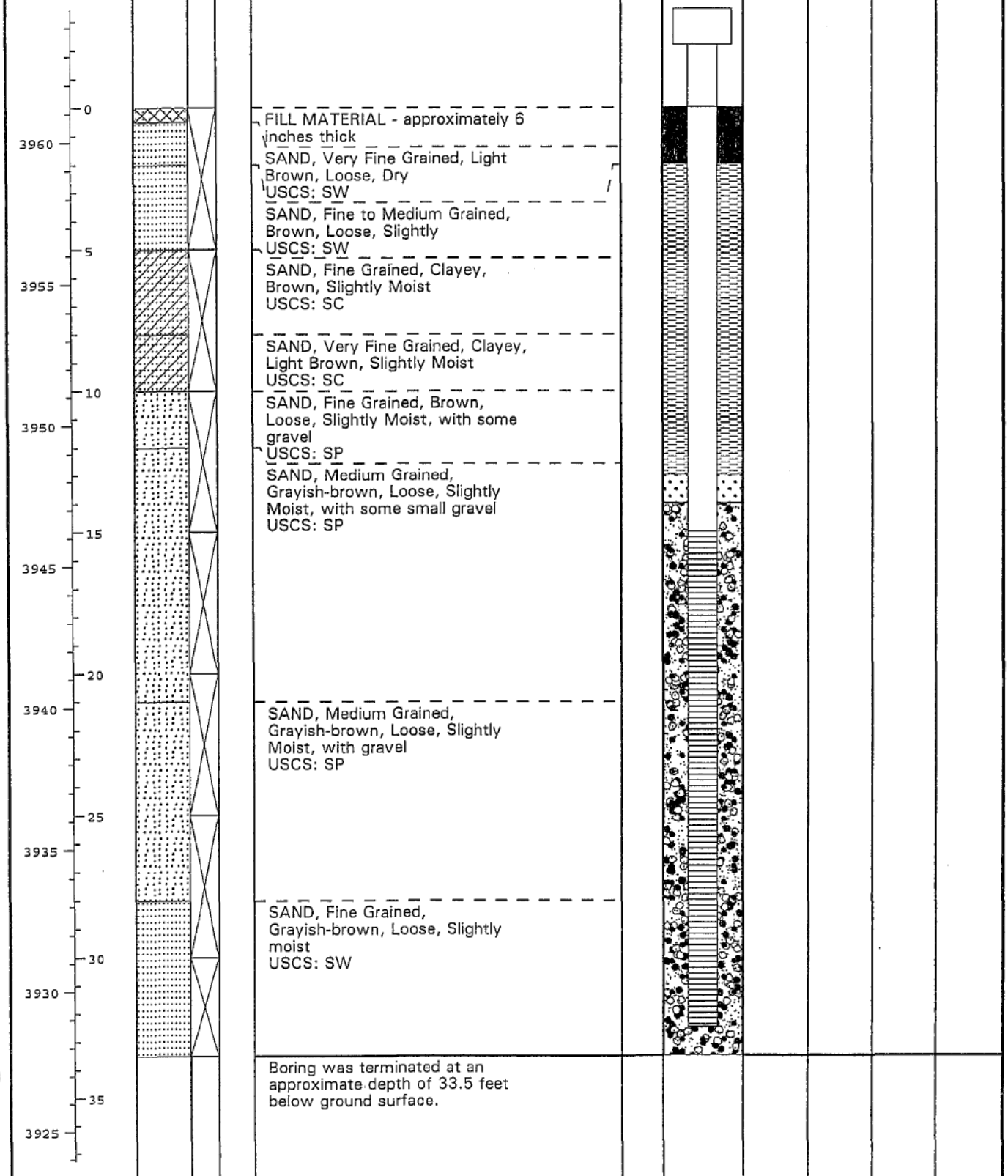
LOG OF BORING NO. GMP-19

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 44+01.09, A+01.30



DEPTH DRILLED:	33.5ft	DEPTH TO WATER:	N/A	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/25/04	DATE MEASURED:	N/A	FIGURE	5

LOG OF BORING NO. GMP-20

Clint Landfill - MSW-2284

Raba-Kistner Consultants, Inc.

DRILLING METHOD: Hollow Stem Auger (8"Dia.Hole)

LOCATION: 36+75.38, A-01.02

ELEVATION/ DEPTH	SYMBOL	SAMPLES	PERCENT RECOVERED	DESCRIPTION OF MATERIAL SURFACE ELEVATION: 3954.73'	FORMATION	MONITORING WELL	METHANE	HYDROGEN SULFIDE	OXYGEN %	PID ppm
3955 – 0				FILL MATERIAL - approximately 6 inches thick						
				SAND, Very Fine Grained, Light Brown, Clayey, Dry USCS: SC						
3950 – 5				SAND, Fine Grained, Brown, Loose, Slightly Moist USCS: SW						
3945 – 10				SAND, Fine Grained, Brown, Loose, Slightly Moist USCS: SW						
3940 – 15										
3935 – 20										
3930 – 25				Boring was terminated at an approximate depth of 25.5 feet below ground surface.						
3925 – 30										
3920 – 35										

DEPTH DRILLED:	25.5ft	DEPTH TO WATER:	N/A	PROJ. No.	ASF03-701-00
DATE DRILLED:	6/26/04	DATE MEASURED:	N/A	FIGURE	6

KEY TO SYMBOLS

Symbol Description

Strata symbols

 Poorly graded sand

 Well graded sand

 Sandy Fill

 Clayey sand

 Low plasticity clay

Misc. Symbols

 Boring continues

Soil Samplers

 Sample Interval

Monitor Well Details

 covered riser

 concrete, blank PVC

 hydrated bentonite pellets, blank PVC

 silica sand, blank PVC

 gravel, blank PVC

 gravel, slotted PVC (screen)

 gravel fill, end of pipe

Figure: 7

KEY TO SYMBOLS

Notes:

DEFINITION OF DESCRIPTIVE TERMS

DENSITY OF GRANULAR SOILS		CONSISTENCY OF COHESIVE SOILS	
SPT N Value	Relative Density	SPT N Value	Consistency
< 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
11 - 30	Med. Dense	5 - 8	Medium Stiff
31 - 50	Dense	9 - 15	Stiff
50 - 80	Very Dense	16 - 50	Very Stiff
> 80	Hard	50 - 80	Hard
		> 80	Very Hard

DEGREE OF PLASTICITY

Non Plastic - Has no cohesion; will not roll into a thread.
Trace of Plasticity - Barely hold its shape when rolled into a thread.
Low Plasticity - Has sufficient cohesion to form a thread but will quickly rupture when deformed.
Med. Plasticity - Has considerable cohesion. Can be molded into a thread and will withstand considerable deformation without rupture.
High Plasticity - Can be kneaded like dough without trace of rupture.

MOISTURE DESCRIPTIONS

	Granular Soils	Cohesive Soils
Dry	No Apparent Moisture	No Apparent Moisture
Slightly Moist	< Than 3% by Weight	<Less Than Plastic Limit
Moist	3% to 9% by Weight	Approximatley Plastic Limit
Very Moist	>9% by Weight	> than PL but < than LL
Wet	Submerged or Saturated	Submerged or Saturated

ABBBREVATIONS

V. - Very Fl.- Fairly Sl. - Slightly Med. - Medium
Tr. - Trace < - Less than > - Greater Than PL - Plastic Limit
Mod. - Moderately

Figure: 7

ATTACHMENT 2

TDLR WELL REPORTS

Send original copy by certified return receipt requested mail to: **TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087**

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** CITY OF EL PASO (Name) **ADDRESS** 7969 San Paulo Dr. (Street or RFD) EL P (City) TX (State) 79915 (Zip)

2) **ADDRESS OF WELL:** County EL PASO CLINT LANDFILL (Street, RFD or other) ELP (City) TX (State) 79915 (Zip) **GRID #**

3) **TYPE OF WORK (Check):** ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMP-1
N-30+75
E-A+50
N

6) **WELL LOG:**
Date Drilling:
Started 7/30/04 19
Completed 7/30/04 19

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	16.5

7) **DRILLING METHOD (Check):** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	16.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) **Borehole Completion (Check):** ☒ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 16.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	PVC Sch. 40	0	9	
1	N	Screen	6	15.5	.020

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method used
Cemented by TEC Corona
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) **WATER LEVEL:**
Static level ft. below land surface Date
Artesian flow gpm. Date

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) **WELL TESTS:**
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Layne Drilling Co. (Type or print) **WELL DRILLER'S LICENSE NO.** 4709

ADDRESS 245 Harvard Ave (Street or RFD) El Paso (City) TX (State) 79907 (Zip)

(Signed) R C Corona (Licensed Well Driller) **(Signed)** (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Send original copy by certified return receipt requested mail to: **TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087**

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** CITY OF EL PASO (Name) **ADDRESS** 7960 San Paulo Dr. (Street or RFD) EL P (City) Tx (State) 79915 (Zip)

2) **ADDRESS OF WELL:** County EL PASO CLINT LANDFILL (Street, RFD or other) EL P (City) Tx (State) 79915 (Zip) **GRID #**

3) **TYPE OF WORK (Check):** ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMA 2
N- 22+00
E- A+00
N

6) **WELL LOG:**
Date Drilling:
Started 7/01/04 19___
Completed 7/06/04 19___

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	27.5

7) **DRILLING METHOD (Check):** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	27.5	Sand

(Use reverse side of Well Owner's copy, if necessary)

8) **Borehole Completion (Check):** ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 27.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch 40 PVC	0	9	BLK
1	N	Sch 40 Screen	6	26.5	.020

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 8 ft. to 2 ft. No. of sacks used 1
___ ft. to ___ ft. No. of sacks used ___
Method used ___
Cemented by T C Cramer
Distance to septic system field lines or other concentrated contamination ___ ft.
Method of verification of above distance ___

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) **WATER LEVEL:**
Static level ___ ft. below land surface Date ___
Artesian flow ___ gpm. Date ___

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ___
Depth to pump bowls, cylinder, jet, etc. ___ ft.

14) **WELL TESTS:**
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ___ gpm with ___ ft. drawdown after ___ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ___ Depth of strata ___
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Liras Drilling Co. (Type or print) **WELL DRILLER'S LICENSE NO.** 4709 M

ADDRESS 245 Harvard Ave (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) T C Cramer (Licensed Well Driller) **(Signed)** ___ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER: City of El Paso (Name) ADDRESS 7969 San Paulo Dr. El P (Street or RFD) (City) Tx (State) 79915 (Zip)

2) ADDRESS OF WELL: County El Paso Clint Landfill (Street, RFD or other) El Paso (City) Tx (State) 79915 (Zip) GRID # _____

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMA-17
N-51+00
E-1+50
N

6) WELL LOG:
Date Drilling:
Started 6/25/04 19__
Completed 6/25/04 19__

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
9"	Surface	41.5

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	11	Sand, Clay
11	20	Brown Sand
20	25	Clayey
25	41.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval from 14 ft. to 41.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	18	BLK
1	N	Screen	18	40.5	0.020

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
_____ ft. to _____ ft. No. of sacks used _____
Method used _____
Cemented by TCC employee
Distance to septic system field lines or other concentrated contamination _____ ft.
Method of verification of above distance _____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level _____ ft. below land surface Date _____
Artesian flow _____ gpm. Date _____

12) PACKERS: Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____
Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Lipsa Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO. 4709 M

ADDRESS 245 Harvard Ave (Street or RFD) El Paso (City) Tx (State) 79907 (Zip)

(Signed) TCC employee (Licensed Well Driller) (Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Send original copy by certified return receipt requested mail to: **TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087**

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** CITY OF EL PASO (Name) **ADDRESS** 7969 San Paulo Dr. (Street or RFD) EL P (City) Tx (State) 79915 (Zip)

2) **ADDRESS OF WELL:** County EL PASO CLINT LANDFILL (Street, RFD or other) EL P (City) Tx (State) 79915 (Zip) **GRID #**

3) **TYPE OF WORK (Check):**
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMP-18
N-51400
E-A400

6) **WELL LOG:**
Date Drilling:
Started 6/23/04 19
Completed 6/23/04 19

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	32.5

7) **DRILLING METHOD (Check):** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	4	FILL MATERIAL
4	32.5	BROWN SAND

8) **Borehole Completion (Check):** ☐ Open Hole ☒ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 14 ft. to 32.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	18	BLK
1	N	Sch. 40 PVC	18	30.5	.020

(Use reverse side of Well Owner's copy, if necessary)

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
ft. to ft. No. of sacks used
Method used
Cemented by RC Aranda
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) **WELL TESTS:**
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) **WATER LEVEL:**
Static level ft. below land surface Date
Artesian flow gpm. Date

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

12) **PACKERS:** Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME L PEASA Drilling Co. (Type or print) **WELL DRILLER'S LICENSE NO.** 4709

ADDRESS 245 Maryland Ave. (Street or RFD) EL Paso (City) Tx (State) 79907 (Zip)

(Signed) RC Aranda (Licensed Well Driller) **(Signed)** (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Send original copy by certified return receipt requested mail to: **TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087**

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** City of El Paso (Name) **ADDRESS** 7969 San Paisho Dr. (Street or RFD) El Paso (City) Tx (State) 79915 (Zip)

2) **ADDRESS OF WELL:** County El Paso Clint Landfill (Street, RFD or other) El Paso (City) Tx (State) 79915 (Zip) **GRID #**

3) **TYPE OF WORK (Check):** ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMP-19
N- 44+00
E- 4+00
N

6) **WELL LOG:**
Date Drilling:
Started 6/25/04 19__
Completed 6/25/04 19__

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8	Surface	33.5

7) **DRILLING METHOD (Check):** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	33.5	Brown Sand

(Use reverse side of Well Owner's copy, if necessary)

8) **Borehole Completion (Check):** ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval... from 1 ft. to 33.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	Sch. 40 PVC	0	18	BLK
2	N	Sch 40 PVC Screen	18	33.5	.020

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 1
__ ft. to __ ft. No. of sacks used __
Method used __
Cemented by R C Cerna
Distance to septic system field lines or other concentrated contamination __ ft.
Method of verification of above distance __

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) **WATER LEVEL:**
Static level __ ft. below land surface Date __
Artesian flow __ gpm. Date __

12) **PACKERS:** Type Depth

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other __
Depth to pump bowls, cylinder, jet, etc., __ ft.

14) **WELL TESTS:**
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: __ gpm with __ ft. drawdown after __ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? __ Depth of strata __
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Lobasa Drilling Co. (Type or print) **WELL DRILLER'S LICENSE NO.** 4709

ADDRESS 245 Harvard Ave. (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) R C Cerna (Licensed Well Driller) **(Signed)** __ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Send original copy by certified return receipt requested mail to: **TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087**

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** EL PASO (Name) **ADDRESS** 7969 San Paulo Dr. (Street or RFD) El Paso (City) TX (State) 79915 (Zip)

2) **ADDRESS OF WELL:** County EL PASO CLINT LANDFILL ELP (Street, RFD or other) (City) TX (State) 79915 (Zip) **GRID #**

3) **TYPE OF WORK (Check):**
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GMP-20
N-36+85
E-A+00

6) **WELL LOG:**
Date Drilling:
Started 6/26/04 19
Completed 6/26/04 19

DIAMETER OF HOLE		
Dia. (in.)	From (ft.)	To (ft.)
	Surface	

7) **DRILLING METHOD (Check):** ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☒ Other Hollow Stem Auger

From (ft.)	To (ft.)	Description and color of formation material
0	25.5	Poorly Sand

(Use reverse side of Well Owner's copy, if necessary)

8) **Borehole Completion (Check):** ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval... from 6 ft. to 25.5 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia: (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
1	N	Sch. 40 PVC	0	10	BLK
1	N	Sch 40 PVC Screen	7	24.5	.020

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 0 ft. to 2 ft. No. of sacks used 2
ft. to ft. No. of sacks used
Method used
Cemented by T C Construction
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) **TYPE PUMP:**
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) **WELL TESTS:**
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) **WATER LEVEL:**
Static level ft. below land surface Date
Artesian flow gpm. Date

12) **PACKERS:** Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Layne Drilling Co. (Type or print) WELL DRILLER'S LICENSE NO. 4709 M

ADDRESS 245 Harvard Ave. (Street or RFD) El Paso (City) Texas (State) 79907 (Zip)

(Signed) T C Construction (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

ATTACHMENT 3

SURVEYOR'S CERTIFICATION

GAS MONITORING PROBE ELEVATIONS AND LOCATIONS
CLINT LANDFILL TCEQ PERMIT NUMBER 2284

GMP	LATITUDE NAD83	LONGITUDE NAD83	TOP OF CASING ELEV.	TOP OF PROTECTIVE COLLAR ELEV. (TUBE)	TOP OF PROTECTIVE COLLAR LID ELEV. (CALC.)	CHIS. X ELEV.	TOP OF GROUND ELEV	GRID STATIONING
1	N 31°35'45.68765"	W 106°10'18.90246"	3943.44'	3943.31'	3943.65'	3940.96'	3940.20'	30+65.74 A-17.20
2	N 31°35'37.03093"	W 106°10'18.97541"	3939.25'	3939.19'	3939.53'	3936.75'	3935.93'	21+90.82 A-23.51
17	N 31°36'05.80640"	W 106°10'08.87736"	3971.74'	3971.68'	3972.02'	3968.53'	3968.76'	50+99.12 I+49.99
18	N 31°36'05.75621"	W 106°10'18.68896"	3962.50'	3962.66'	3963.00'	3959.43'	3959.33'	50+94.03 A+01.27
19	N 31°35'58.89999"	W 106°10'18.68858"	3964.12'	3964.30'	3964.64'	3961.95'	3961.22'	44+01.09 A+01.30
20	N 31°35'51.71960	W 106°10'18.71544"	3957.66'	3957.61'	3957.95'	3954.58'	3954.73'	36+75.38 A-01.02

SURVEY MARKER IS A SET CHISELED "X" ON CONCRETE SLAB AT BASE OF PROTECTIVE COLLAR
CASING SHOTS ARE TAKEN ON A SET BLACK ARROW ON NORTH END EDGE OF TOP OF PVC PIPE



7/28/2004
STEPHEN EARL COBB TX4297 NM10472 AZ25068

GAS MONITORING PROBE ELEVATIONS AND LOCATIONS
CLINT LANDFILL TCEQ PERMIT NUMBER 2284

GMP	LATITUDE NAD83	LONGITUDE NAD83	TOP OF CASING ELEV. "CITY DATUM"	TOP OF PROTECTIVE COLLAR ELEV. (TUBE) "CITY DATUM"	TOP OF PROTECTIVE COLLAR LID ELEV. (CALC.) "CITY DATUM"	CHIS. X ELEV. "CITY DATUM"	TOP OF GROUND ELEV. "CITY DATUM"	GRID STATIONING
1	N 31°35'45.68765"	W 106°10'18.90246"	3943.44'	3943.31'	3943.65'	3940.96'	3940.20'	30+65.74 A-17.20
2	N 31°35'37.03093"	W 106°10'18.97541"	3939.25'	3939.19'	3939.53'	3936.75'	3935.93'	21+90.82 A-23.51
17	N 31°36'05.80640"	W 106°10'08.87736"	3971.74'	3971.68'	3972.02'	3968.53'	3968.76'	50+99.12 I+49.99
18	N 31°36'05.75621"	W 106°10'18.68896"	3962.50'	3962.66'	3963.00'	3959.43'	3959.33'	50+94.03 A+01.27
19	N 31°35'58.89999"	W 106°10'18.68858"	3964.12'	3964.30'	3964.64'	3961.95'	3961.22'	44+01.09 A+01.30
20	N 31°35'51.71960	W 106°10'18.71544"	3957.66'	3957.61'	3957.95'	3954.58'	3954.73'	36+75.38 A-01.02

SURVEY MARKER IS A SET CHISELED "X" ON CONCRETE SLAB AT BASE OF PROTECTIVE COLLAR
CASING SHOTS ARE TAKEN ON A SET BLACK ARROW ON NORTH END EDGE OF TOP OF PVC PIPE

ELEVATIONS REPORTED HEREON ARE "CITY DATUM" AND ARE APPROXIMATELY 10.45 FEET LOWER IN ELEVATION THAN VALUES EXPRESSED IN NAVD88 DATUM

7/30/2004

STEPHEN EARL COBB TX4297 NM10472 AZ25068
Huitt-Zollars



ATTACHMENT III.H.4 – 2006 GAS MONITORING PROBE INSTALLATION

MSW/2284/RP

Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Martin A. Hubert, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 3, 2006

Ms. Ellen Smyth, P.E., Director
Department of Environmental Services
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: Municipal Solid Waste (MSW) - El Paso County
City of El Paso Clint Landfill - MSW Permit No. 2284
Landfill Gas Monitoring Well Installation
WWC11458567; RN101478766 / CN601410244

Dear Ms. Smyth:

On September 1, 2006 the MSW Permits Section of the Texas Commission on Environmental Quality received the revised State of Texas Well Report forms for Tracking #80993 (Gas Probe 16) and #80994 (Gas Probe 19A). Submittal of these two revised forms was requested in our August 17, 2006 letter conditionally approving the Installation of Gas Monitoring Wells report. The two revised forms were submitted under a cover letter dated August 31, 2006 and signed by Mr. Gary Dawson, P.E. of Parkhill, Smith & Cooper, Inc. of Lubbock, Texas.

RECEIVED
NOV 06 2006
TCEQ
CENTRAL FILE ROOM

Thank you for this submittal. If you have any questions concerning this letter, please contact me at 512/239-1132, or at the address on our letterhead (please include Mail Code No. 124).

Sincerely,

Frank Zeng, P.E.
Municipal Solid Waste Permits Section
Waste Permits Division

FZ/fp

cc: Mr. Gary Dawson, P.E., PSC Inc., Lubbock

TNRCC CENTRAL RECORDS
337186

MSW/2284/RP

August 31, 2006

RECEIVED

SEP 01 2006

WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY
DA

Mr. Frank Zeng, P.E. MC-124
TCEQ - Municipal Solid Waste Permits
12100 Park 35 Circle, Bldg. F
Austin, TX 78753

Re: Municipal Solid Waste - El Paso County
City of El Paso Clint Landfill – MSW No. 2284
Landfill Gas Monitoring Well Installation
WWC11418660; RN101478766 / CN601410244

Dear Mr. Zeng:

The City of El Paso submitted an Installation of Gas Monitoring Wells report on July 25, 2006. Comments were received from you under cover letter dated July 25, 2006. The report was revised to address your comments on August 10, 2006. The response to your comment number 7 stated that the driller has been advised about the error on the State of Texas Well Reports that he had filed and has been directed to correct the reports. The corrected reports have now been published. I am sending you copies of the corrected reports for your records.

Please call me at (806) 473-3530 if you have any questions.

Sincerely,

PARKHILL, SMITH & COOPER, INC.

By _____
Gary A. Dawson, P.E.
Project Engineer

GAD/jbh

Enclosures

cc: Terry McMillan, TCEQ Region 6
Ellen Smyth, P.E., City of El Paso
Robert H. (Holly) Holder, P.E., Parkhill, Smith & Cooper, Inc.

DUE DATE 10/31/2006
WWC# 11458567
PM F Zeng
TEAM ☐ I ☐ II

X:\20045105.04\CORRESPLTR\Ltr083106.DOC

Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners
4222 85th Street, Lubbock, Texas 79423
(806) 473-2200 FAX (806) 473-3500
Lubbock El Paso Midland Amarillo Odessa

MSW/2284/RP

Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 17, 2006

Ms. Ellen Smyth, P.E., Director
Department of Environmental Services
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: Municipal Solid Waste (MSW) - El Paso County
City of El Paso Clint Landfill - MSW Permit No. 2284
Landfill Gas Monitoring Well Installation
WWC11441734; RN101478766 / CN601410244

Dear Ms. Smyth:

On August 11, 2006 the MSW Permits Section of the Texas Commission on Environmental Quality received the revised Installation of Gas Monitoring Wells report submitted under a cover letter dated August 10, 2006 and signed by Mr. Gary Dawson, P.E. of Parkhill, Smith & Cooper, Inc. of Lubbock, Texas. The report was revised in response to our July 25, 2006 letter commenting the original report received on July 19, 2006.

In response to a comment regarding the coordinates provided for PP-16 and PP-19A in the State of Texas Well Reports, the cover letter stated, "The driller was directed to file corrected reports with accurate Universal Transverse Mercator (UTM) coordinates." Please submit a copy of the corrected reports when they are available (please reference this letter when submitting the corrected reports). The reviewer does not have other comments on the revised Installation of Gas Monitoring Wells report.

If you have any questions concerning this letter, please contact me at 512/239-1132, or at the address on our letterhead (please include Mail Code No. 124).

Sincerely,

Frank Zeng, P.E.
Municipal Solid Waste Permits Section
Waste Permits Division

TNRCC CENTRAL RECORDS
315957

FZ/ff

cc: Mr. Gary Dawson, P.E., PSC Inc., Lubbock

RECEIVED
AUG 21 2006
TCEQ
CENTRAL FILE ROOM

MSW/2284/RP

August 10, 2006

RECEIVED

AUG 11 2006

WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY
DA

Mr. Frank Zeng, P.E. MC-124
TCEQ - Municipal Solid Waste Permits
12100 Park 35 Circle
Bldg. F
Austin, TX 78753

Re: Municipal Solid Waste - El Paso County
City of El Paso Clint Landfill – MSW No. 2284
Landfill Gas Monitoring Well Installation
WWC11418660; RN101478766 / CN601410244

Dear Mr. Zeng:

The City of El Paso submitted an Installation of Gas Monitoring Wells report on July 25, 2006. Comments were received from you under cover letter dated July 25, 2006. The report has been revised to address your comments. Your comments have been addressed as described below.

1. Comment: Page 1 of this report stated, "The bottom of deposited waste near PP-19A is at a lowest elevation of 3235.9, with leachate sumps as low as 3232.4. The bottom of the screen for monitor well PP-19A was set at 3225.98, so the base of PP-19A is approximately six feet below waste product." Figure 2 included in this report depicted the bottom of deposited waste at 3935.9, leachate sumps at 3932.4, and the bottom of probe screen at.3925.98. Please explain the discrepancies in the reported elevations and revise the report as appropriate. Please also double check or explain the number and the term used in "so the base of PP-19A is approximately six feet below water product."

   Response: Elevations for PP-19A and nearby waste elevations in paragraph 5 of page 1 have been corrected from 3235.9, 3232.4 and 3225.98 to 3935.9, 3932.4 and 3925.98 respectively. These corrected elevations match elevations shown on Figure 2. The statement "...the base of PP-19A is approximately six feet below the base on waste product" is based on the bottom of screen elevation for PP-19A (3925.98) and the lowest elevation of the leachate sump (3932.4). "Waste product" refers to the leachate fluid produced by deposited waste. The difference in these elevations is 3932.4 – 3925.98 = 6.42 feet.

2. Comment: Figure 1 showed locations of two gas wells PP16A and PP19, while this report as indicated in the text was submitted for gas wells PP-16 and PP-19A. Please explain the discrepancies in the well numbering and revise the report as appropriate.

   Response: The correct nomenclature for the gas monitoring wells described in this report is PP-16 and PP-19A. The labels have been corrected on Figure 1.

3. Comment: Figure 2 showed two sections: A Section near GMP-16 (PP-16A) and B Section near GMP-19 (PP-19). Please explain the discrepancies in the well (probe) naming and numbering and revise this figure and the entire report for consistency. Please note that in making Comment No. 1 of this NOD it was assumed that B Section was depicting the relative location of PP19A.

Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners
4222 85th Street, Lubbock, Texas 79423
(806) 473-2200 FAX (806) 473-3500
Lubbock El Paso

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CENTRAL FILE ROOM

DUE DATE 10/10/2006
WWC# 11441734
PM F Zeng
TEAM ☒ I ☐ II ☐ III

TNRCC CENTRAL RECORDS
315956

Response: See response to Comment 2. Also, the nomenclature for both wells have been revised to consistently have the prefix of PP-xx rather than GMW-xx as further described in the response to Comment 5.

4. Comment: The location of gas well PP16A shown in Figure 1 appeared to be the same location for PP-19A as indicated in the permit modification (MOD) approved on April 7, 2006, while the location of gas well PP19 shown in Figure 1 appeared to be the same location for PP-16 as shown in the April 7, 2006 MOD. Please explain the discrepancies in the well locations and revise the report as appropriate.

   Response: See response to Comment 2

5. Comment: The April 7, 2006 MOD documents described the gas monitoring installation as gas monitoring probe and numbered them as PPx or PPxx. Please revise naming and numbering of the gas monitoring installations in this report to be consistent with the permit.

   Response: See response to Comment 3. Please note that some other permit documents and correspondences refer use a GMW-xx nomenclature for the gas monitoring wells. The wells described in this report pertain to facility gas monitoring wells that are previously described as either PP-16 or GMW-16 and PP-19A or GMW-19A.

6. Comment: Page 1 stated that PP-19A was installed to replace the original PP-19, which location conflicted with the extension of drainage facilities (this relocation was approved in an April 7, 2006 MOD). Please revise this report to describe whether PP-19 was plugged and abandoned in accordance with all applicable requirements.

   Response: The original gas monitoring well PP-19 was plugged in accordance with applicable requirements. A statement to this effect has been added to the report.

7. Comment: The State of Texas Well Report for Tracking #80993 and #80994 listed the coordinates as Latitude 31° 39' 54" N and Longitude 106° 11' 03" W for both PP16 and PP19A. Page 2 of this report stated, "The coordinates and elevations shown on the drawings correspond to the horizontal and vertical data defined by the MSW facility benchmark. A State of Texas Well Report was completed and submitted to the TCEQ for each of the wells." Per Figure 1 the two wells are roughly 600 feet apart in north-south direction and roughly 1,700 feet apart in east-west direction. The coordinates of the site benchmark listed in Figure III, Att. 1.1 of the permit application document are Latitude 31° 36' 06.04583" N and Longitude 108° 09' 48.64117" W. The coordinates stated in this report for the two wells appear to be off relative to each other and to the benchmark. Please explain in detail how the wells' coordinates were determined and revise the coordinates, as necessary.

   Response: The error in the coordinates on the State of Texas Well Reports was reported to the driller who is required to file the report. The driller was directed to file corrected reports with accurate Universal transverse Mercator (UTM) coordinates. In addition, both the UTM and City of El Paso Coordinates of the permanent facility benchmark have been added to Figure 1 corresponding to the coordinate locations shown on the construction drawings. The well locations shown on the construction drawings were determined by a registered land surveyor and provided using the datum of the City of El Paso Coordinate system, which is the primary surveying datum that has been established for use at the landfill facility.

Two copies of the revised report are enclosed. An additional copy of the document is transmitted to the TCEQ Region 6 Office by copy of this letter.

Please call me at (806) 473-3530 if you have any questions.

Sincerely,

PARKHILL, SMITH & COOPER, INC.

By _____
Gary A. Dawson, P.E.
Project Engineer

GAD/jbh

Enclosures

cc: Terry McMillan, TCEQ Region 6
Ellen Smyth, P.E., City of El Paso
Robert H. (Holly) Holder, P.E., Parkhill, Smith & Cooper, Inc.

X:\2004\5105.04\CORRESPL\TR\Lr.081006.DOC

MSW/2284/RP

Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

July 25, 2006

Ms. Ellen Smyth, P.E., Director
Department of Environmental Services
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: Municipal Solid Waste (MSW) - El Paso County
City of El Paso Clint Landfill - MSW Permit No. 2284
Landfill Gas Monitoring Well Installation – Notice of Deficiency
WWC11418660; RN101478766 / CN601410244

Dear Ms. Smyth:

The Installation of Gas Monitoring Wells report from the referenced facility was received by the MSW Permits Section of the Texas Commission on Environmental Quality (TCEQ) on July 19, 2006. The report, with attached cover letter dated July 18, 2006, documented the activities related to installation of landfill gas monitoring wells PP-16 and PP-19A. The Installation of Gas Monitoring Wells report was signed and sealed by Mr. Gary Dawson, P.E. of Parkhill, Smith & Cooper, Inc. of El Paso, Texas.

Review of the report has been completed and it cannot be accepted at this time. Please submit an Addendum to the Installation of Gas Monitoring Wells report within 30 days of the date of this letter in response to the following comments:

1. Page 1 of this report stated, "The bottom of deposited waste near PP-19A is at a lowest elevation of 3235.9, with leachate sumps as low as 3232.4. The bottom of the screen for monitor well PP-19A was set at 3225.98, so the base of PP-19A is approximately six feet below waste product." Figure 2 included in this report depicted the bottom of deposited waste at 3935.9, leachate sumps at 3932.4, and the bottom of probe screen at 3925.98. Please explain the discrepancies in the reported elevations and revise the report as appropriate. Please also double check or explain the number and the term used in "so the base of PP-19A is approximately six feet below waste product."

2. Figure 1 showed locations of two gas wells PP16A and PP19, while this report as indicated in the text was submitted for gas wells PP-16 and PP-19A. Please explain the discrepancies in the well numberings and revise the report as appropriate.

3. Figure 2 showed two sections: A Section near GMP-16 (PP-16A) and B Section near GMP-19 (PP-19). Please explain the discrepancies in the well (probe) naming and numbering and revise this figure and the entire report for consistency. Please note that in making Comment No. 1 of this NOD it was assumed that B Section was depicting the relative location of PP19A.

TNRCC CENTRAL RECORDS
315954

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AUG 21 2006
TCEQ
CENTRAL FILE ROOM

4. The location of gas well PP16A shown in Figure 1 appeared to be the same location for PP-19A as indicated in the permit modification (MOD) approved on April 7, 2006, while the location of gas well PP19 shown in Figure 1 appeared to be the same location for PP-16 as shown in the April 7, 2006 MOD. Please explain the discrepancies in the well locations and revise the report as appropriate.

5. The April 7, 2006 MOD documents described the gas monitoring installation as gas monitoring probe and numbered them as PPx or PPxx. Please revise naming and numbering of the gas monitoring installations in this report to be consistent with the permit.

6. Page 1 stated that PP-19A was installed to replace the original PP-19, which location conflicted with the extension of drainage facilities (this relocation was approved in an April 7, 2006 MOD). Please revise this report to describe whether PP-19 was plugged and abandoned in accordance with all applicable requirements.

7. The State of Texas Well Report for Tracking #80993 and #80994 listed the coordinates as Latitude 31° 39' 54" N and Longitude 106° 11' 03" W for both PP16 and PP19A. Page 2 of this report stated, "The coordinates and elevations shown on the drawings correspond to the horizontal and vertical data defined by the MSW facility benchmark. A State of Texas Well Report was completed and submitted to the TCEQ for each of the wells." Per Figure 1 the two wells are roughly 600 feet apart in north-south direction and roughly 1,700 feet apart in east-west direction. The coordinates of the site benchmark listed in Figure III. Att. 1.1 of the permit application document are Latitude 31° 36' 06.04583" N and Longitude 108° 09' 48.64117" W. The coordinates stated in this report for the two wells appear to be off relative to each other and to the benchmark. Please explain in detail how the wells' coordinates were determined and revise the coordinates, as necessary.

If you have any questions concerning this letter, please contact me at 512/239-1132, or at the address on our letterhead (please include Mail Code No. 124).

Sincerely,

Frank Zeng, P.E.
Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

FZ/ff

cc: Mr. Gary Dawson, P.E., PSC Inc., El Paso

MSW/2284/RP

July 18, 2006

Mr. Jeff Davis, P.E. (MC-124)
TCEQ - Municipal Solid Waste Permits
12100 Park 35 Circle, Bldg. F
Austin, TX 78753

RECEIVED
JUL 19 2006
WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY
DA

Re: Municipal Solid Waste - El Paso County
Municipal Solid Waste Permit No. 2284
Gas Monitoring Well Installation
RN101478766 / CN601410244

Dear Mr. Davis:

The City of El Paso has installed two gas monitoring wells at its Clint Landfill municipal solid waste facility (TCEQ Permit No. MSW-2284). The enclosed report documents that the gas wells were installed in accordance with the facility's Landfill Gas Management Plan.

Two copies of the referenced report are enclosed. An additional copy of the document is transmitted to the TCEQ Region 6 Office by copy of this letter.

Please call me at (806) 473-3530 if you have any questions.

Sincerely,

PARKHILL, SMITH & COOPER, INC.

By Gary A. Dawson
Gary A. Dawson, P.E.
Project Engineer

GAD/jbh

Enclosures

cc: Terry McMillan, TCEQ Region 6
Ellen Smyth, P.E., City of El Paso
Robert H. (Holly) Holder, P.E., PSC Lubbock
Jose Reyes, P.E., PSC El Paso

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AUG 21 2006
TCEQ
CENTRAL FILE ROOM

DUE DATE 9/7/06 30 days
WWC# 11418660
PM F Zeng
TEAM ☒ I ☐ II ☐ III

X:\2004\5105.04\CORRESP\LTR\jd 071806.DOC

TNRCC CENTRAL RECORDS
315953

Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners
810 E. Yandell, El Paso, Texas 79902
(915) 533-6811 FAX (915) 544-2059
Lubbock El Paso Midland Amarillo Odessa

MSW/2284/RP

Engineering Report

City of El Paso, Texas
Clint Municipal Solid Waste Landfill
Permit No. MSW-2284
Landfill Gas Management

RECEIVED
AUG 11 2006
WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY
DA

Installation of Gas Monitoring Wells

July 2006
Modified August 2006

PSC Project # 01510504

PSC **Parkhill, Smith & Cooper, Inc.**
Engineers ▪ Architects ▪ Planners

RECEIVED
AUG 21 2006
TCEQ
CENTRAL FILE ROOM

TNRCC CENTRAL RECORDS
315955

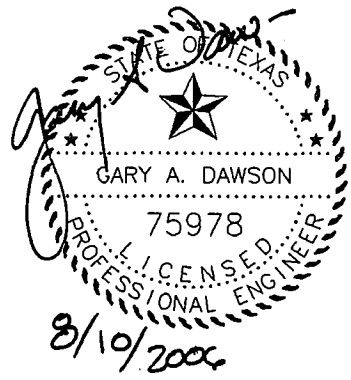
Engineering Report

City of El Paso, Texas
Clint Municipal Solid Waste Landfill
Permit No. MSW-2284
Landfill Gas Management

Installation of Gas Monitoring Wells

July 2006
Modified August 2006

PSC Project # 01510504



Parkhill, Smith & Cooper, Inc.
Engineers ▪ Architects ▪ Planners

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WELL LOGS

CONSTRUCTION DETAILS

STATE OF TEXAS WELL REPORTS

PURPOSE

Two permanent gas monitoring wells (PP-16 and PP-19A) were installed on April 13, 2006 at the El Paso Clint Landfill (TCEQ Permit No. MSW-2284). The purpose of this report is to document that installation of two gas monitoring wells was in accordance with the Landfill Gas Management Plan.

COMPLIANCE WITH GAS MANAGEMENT PLAN

Section 4.4 of the facility Landfill Gas Management Plan (Part III Site Development Plan Attachment 14) requires that permanent gas wells that were not installed initially be installed with 90 days of placement of refuse within 1000 feet of each individual well. The City of El Paso is in the process of preparing landfill cells to accept waste within 1000 feet of the location for permanent gas monitoring well PP-16. Gas monitoring well PP-16 was installed in April 2006 so that it will be in place when first waste is placed within 1000 feet of the well.

The original location of permanent gas monitoring well PP-19 conflicted with the extension of drainage facilities. A permit modification was approved April 7, 2006 to relocate the well a short distance away from the needed drainage facilities. The new location for PP-19 was named PP-19A. Gas monitoring well PP-19A was installed in April 2006 at the location described by the permit modification.

WELL CONSTRUCTION

Section 4.2.2 of the Landfill Gas Management Plan requires that all wells be installed at a single depth at the elevation of the bottom of trash and above the permanent low-season water table.

Facility piezometers indicate that groundwater depths are well over 200 feet from the ground surface. Neither of the new gas wells is over 40 feet deep, so the wells are installed above the permanent low-season water table. Bottom of deposited waste near PP-16 will have a lowest elevation of 3937.5, however, leachate collection sumps will have a lowest elevation of 3934.0. The bottom of the screen for monitor well PP-16 is set at 3931.38, so the base of PP-16 is approximately two feet below future waste product. The bottom of deposited waste near PP-19A is at a lowest elevation of ~~3235~~3935.9, with leachate sumps as low as ~~3232~~3932.4. The bottom of the screen for monitor well PP-19A was set at ~~3225~~3925.98, so the base of PP-19A is approximately six feet below waste product.

Figure 2, located in the appendix, shows cross sections indicating the profile of the monitor wells and base of exiting or proposed waste. Figure 1, located in the appendix, is a plan view of the landfill showing the locations of the cross sections.

Gas Monitor Well PP-19 has been abandoned. The well was plugged in accordance with applicable requirements.

CONSTRUCTION DETAILS

The wells were installed by a qualified driller under the direction of Raba-Kristner Consultants, Inc. Soils encountered during drilling were logged using USCS conventions. Boring logs are located in the appendix. Wells were constructed as described in the facility Landfill Gas Management Plan. Well construction details are also included in the appendix. The coordinates and elevations shown on the drawings correspond to the horizontal and vertical data defined by the MSW facility benchmark. A State of Texas Well Report was completed and submitted to the TCEQ for each of the wells. Copies of the completed well reports are included in the appendix.

CONCLUSION

The two new gas monitoring wells PP-16 and PP-19A were installed in accordance with the facility Landfill Gas Management Plan.

APPENDIX

- FIGURE 1 – NEW WELL LOCATIONS
- FIGURE 2 – CROSS SECTIONS
- WELL LOGS
- CONSTRUCTION DETAILS
- STATE OF TEXAS WELL REPORTS

FACILITY BENCHMARK
LAT: 31°36'06.04583 N
LONG: 108°89'48.64117" W
NORTHING: 9292.389
EASTING: 1332.2380

N

0 200 400

S 00°33'54" E 2285.30' T1 T2 T3 S 00°34'28" E 2689.87'

2650.55'

PP16

A/FIG2

B/FIG2

N 90°00'00" E

S 90°00'00" W

PP19A N 00°33'54" W 2435.30' N 00°34'28" W 2689.87'

9	10	19	18	15	14	13
8	7					
5	6					
4	2	20	17	16	12	11
3	1					

LEGEND

PP16A NEW GAS MONITORING WELL

3 LANDFILL CELL

PERMIT BOUNDARY

REFERENCES -- BENCH MARKS

DATE	REVISIONS	BY

ENGINEER'S SEAL
GARY A. DAMSON
75978
LICENSED PROFESSIONAL ENGINEER
STATE OF TEXAS
8/10/2006

SCALE
Hor. AS SHOWN
Ver. AS SHOWN

DATE 7-07-06
DESIGN BY GAD
DRAWN BY GM
CHKD. BY RHH
APPD. BY

PROJECT NAME
EL PASO CLINT MSW
FACILITY GAS MONITORING
WELLS
TCEQ MSW PERMIT NO. 2284

CITY OF EL PASO

SHEET TITLE
NEW WELL LOCATIONS

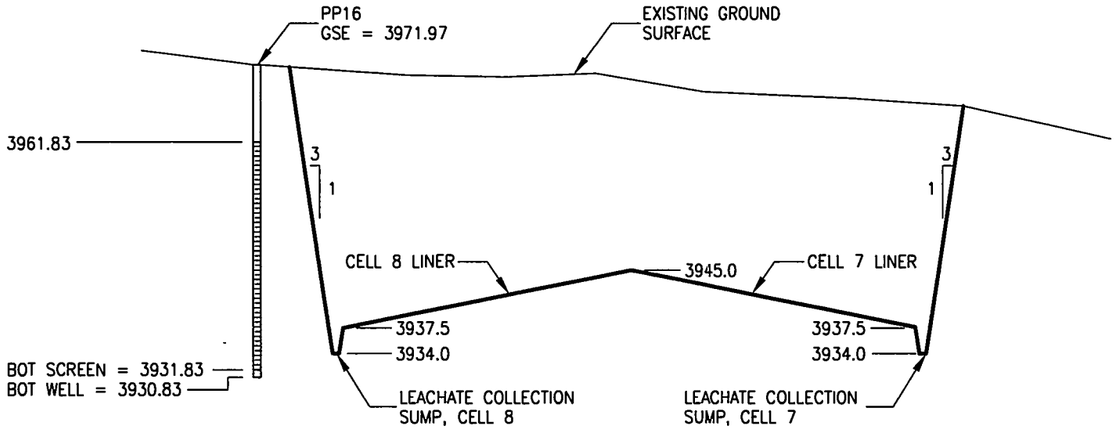
FIGURE 1

8/4/2006 8:7:54

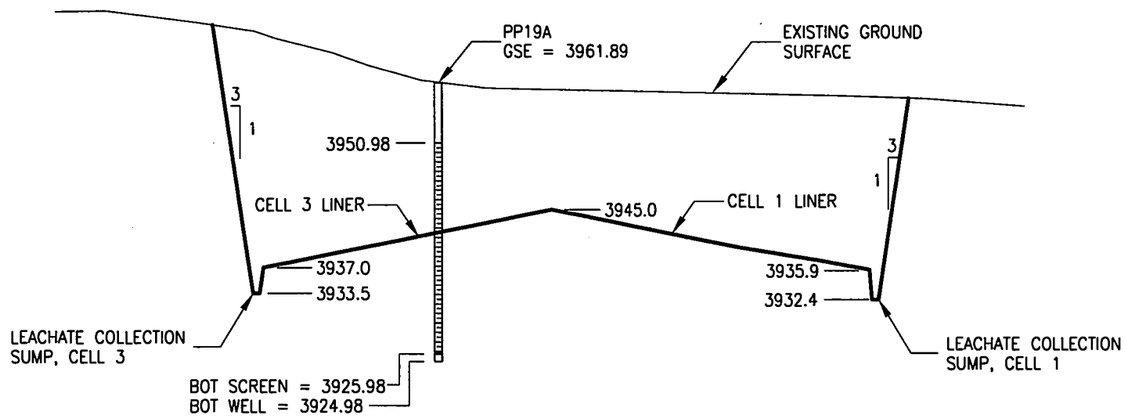
Drawing File: X:\2004\5105.04\CADD\CIVIL\SDP-MODS\5105-F1.dwg (DCox)

October 31, 2024

Page IIH-62



A SECTION
NEAR PP16



B SECTION
NEAR PP19A

SCALES:

HORIZONTAL:

0 200 400

VERTICAL:

0 10 20

REFERENCES -- BENCH MARKS

DATE	REVISIONS	BY

ENGINEER'S SEAL
GARY A. DAWSON
75978
LICENSED PROFESSIONAL ENGINEER
8/10/2006

SCALE
Hor. AS SHOWN
Ver. AS SHOWN

DATE 7-07-06
DESIGN BY CAD
DRAWN BY GM
CHKD. BY
APPD. BY RHH

PROJECT NAME
EL PASO CLINT MSW
FACILITY GAS MONITORING
WELLS
TCEQ MSW PERMIT NO. 2284

CITY OF EL PASO

SHEET TITLE
CROSS SECTIONS

FIGURE
2

8/3/2006 9:56:1

Drawing File: X:\2004\5105.04\CADD\CIVIL\SDP-MODS\5105-F2.dwg (DCox)

WELL LOGS

LOG OF BORING NO. B-16

Clint Landfill
El Paso County, Texas

Raba Kistner

DRILLING METHOD: CME 75 w/ 4.25 I.D. HSA

LOCATION: See Figure 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WIEGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
0			SAND, fine grained, silty, brown, poorly graded, moist					
5			SAND, fine grained, silty, calcareous, brown, slightly moist					
10			SAND, fine grained, silty, brown, dry					
15			SAND, medium grained, brown, poorly graded, dry, with some fine gravel					
20								
25								
30								
35			The boring was terminated at 40 feet					

DEPTH DRILLED:	40 ft	**DEPTH TO WATER:**	NA	**PROJ. No.:**	AEH06-011-00
DATE DRILLED:	4/13/2006	**DATE MEASURED:**	4/13/2006	**FIGURE:**	2

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-19A

Clint Landfill
El Paso County, Texas

Raba Kistner

DRILLING METHOD: CME 75 w/ 4.25 I.D. HSA

LOCATION: See Figure 1

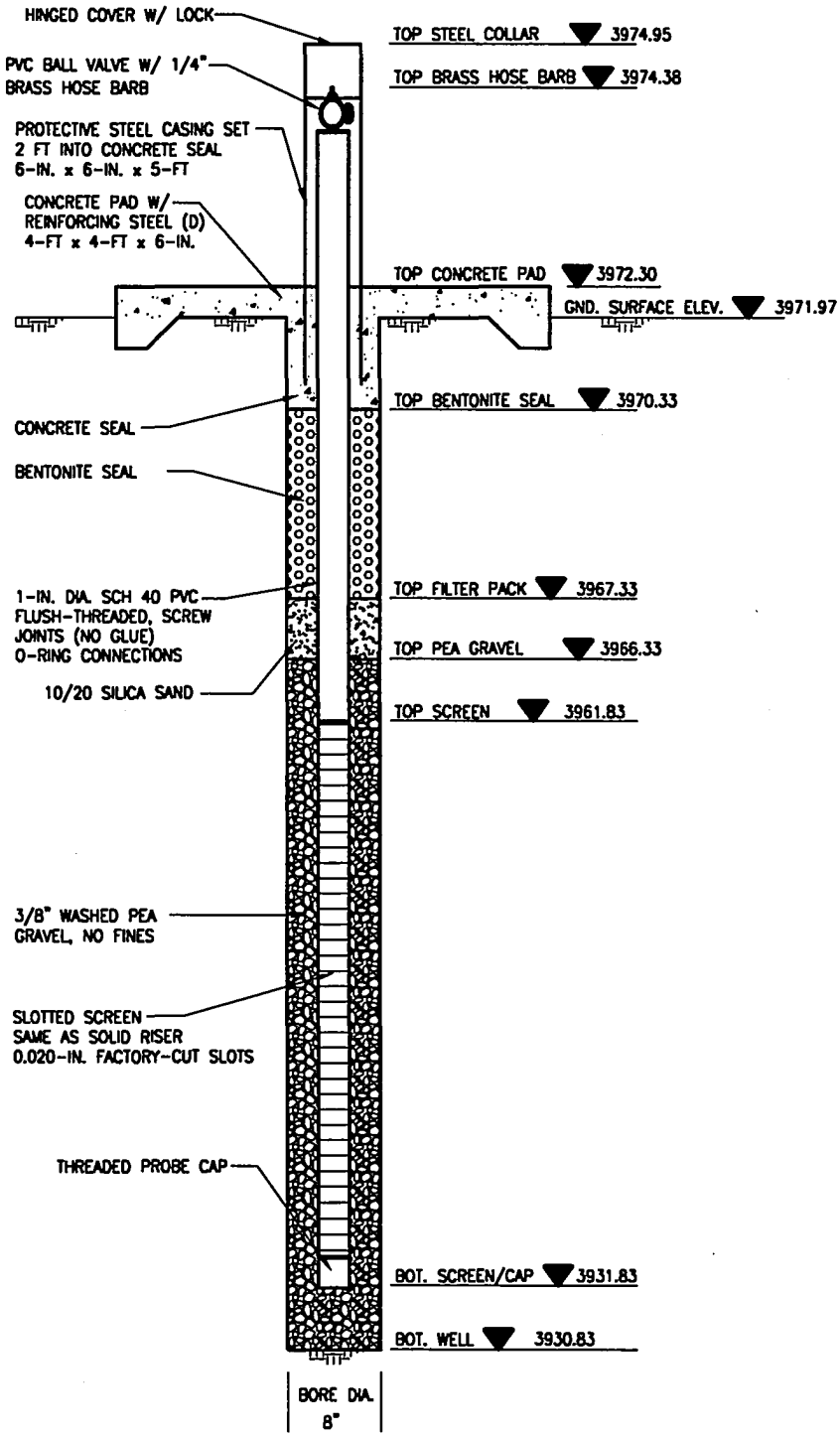
DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
0			SAND, fine grained, silty, brown, poorly graded, slightly moist, wth calcareous nodules					
			- light brown below 2 feet					
5								
			- slightly moist below 8½ feet					
10								
			SAND, medium grained, light brown, poorly graded, slightly moist, with some fine gravel					
15								
20								
25								
30								
35			The boring was terminated at 35 feet					

DEPTH DRILLED:	35 ft	**DEPTH TO WATER:**	NA	**PROJ. No.:**	AEH06-011-00
DATE DRILLED:	4/13/2006	**DATE MEASURED:**	4/13/2006	**FIGURE:**	3

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

CONSTRUCTION DETAILS

PP 16 (N-9318.14, E 496.88)



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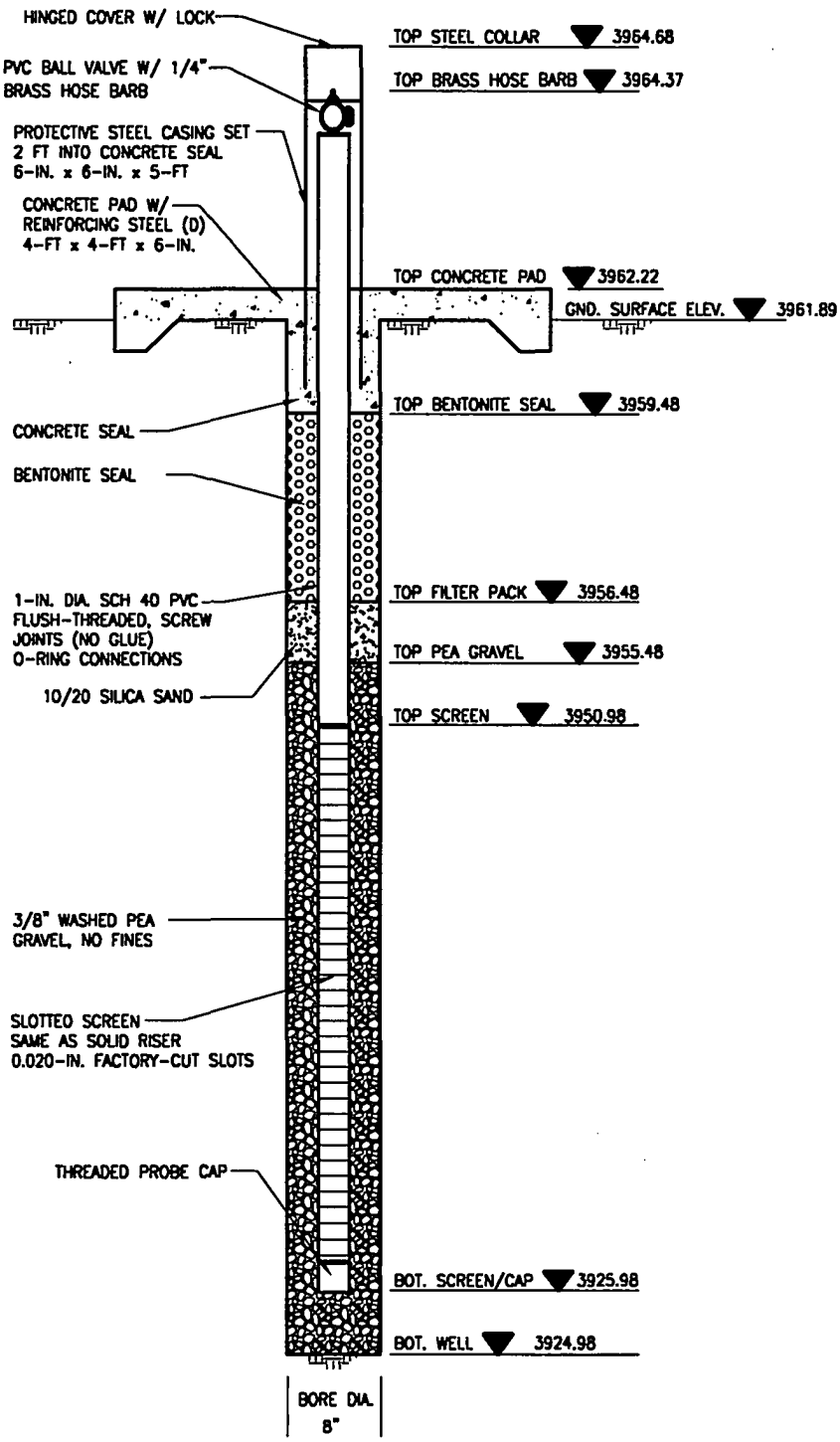
PP 19A (N-10,016.23, E-1298.73)



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STATE OF TEXAS WELL REPORTS

STATE OF TEXAS WELL REPORT for Tracking #80993

Owner:	**City of El Paso**	Owner Well #:	**16**
Address:	**2 Civic Center Plaza El Paso , TX 79901**	Grid #:	**49-31-2**
Well Location:	**2300 Darrington Road El Paso , TX 79907**	Latitude:	**31° 35' 60" N**
Well County:	**El Paso**	Longitude:	**106° 10' 14" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **4/13/2006**
Completed: **4/13/2006**

Diameter of Hole: Diameter: **8 in From Surface To 40 ft**

Drilling Method: **Bored**

Borehole Completion: Gravel Packed From: **6 ft to 40 ft**
Gravel Pack Size: **3/8 pea gr**

Annular Seal Data: 1st Interval: **From 2 ft to 5 ft with 2 ben/chip (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **No Data**
Cemented By: **No Data**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Raba-Kistner Consultants, Inc**
7002 Commerce

	El Paso , TX 79915
Driller License Number:	**2914**
Licensed Well Driller Signature:	**Manuel I. Duenez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Amended Ref# 3871 8/30/06**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#80993**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 - 3 1/2 ft silty sand,brn, moist
3 1/2 - 7 1/2 silty sand calcareous, lt. brn, slightly moist

7 1/2 to 12 silty sand, brn, dry
12 to 40 sand, med.grained, brn, dry, w/fine gravel

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
1	**new**	**plastic**	**0-10 blank**
1"	**new**	**plastic**	**10-40 screen**

STATE OF TEXAS WELL REPORT for Tracking #80994

Owner:	**City of El Paso**	Owner Well #:	**19A**
Address:	**2 Civic Center Plaza El Paso , TX 79901**	Grid #:	**49-31-2**
Well Location:	**2300 Darrington Road El Paso , TX 79907**	Latitude:	**31° 36' 02" N**
Well County:	**El Paso**	Longitude:	**106° 10' 32" W**
Elevation:	**No Data**	GPS Brand Used:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **4/13/2006**
Completed: **4/13/2006**

Diameter of Hole: Diameter: **8 in From Surface To 35 ft**

Drilling Method: **Bored Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **6 ft to 35 ft**
Gravel Pack Size: **3/8 pea gr**

Annular Seal Data: 1st Interval: **From 2 ft to 5 ft with 2 ben/chip (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **No Data**
Cemented By: **No Data**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Slab Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Raba-Kistner Consultants, Inc**
7002 Commerce

	El Paso , TX 79915
Driller License Number:	**2914**
Licensed Well Driller Signature:	**Manuel I. Duenez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Amended Ref# 3870 8/30/06**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#80994**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 2 silty sand, brn slightly moist w/calcareous nodules
2-8 1/2 silty sand, calcareous, lt brn, dry
8 1/2 to 13 1/2 silty sand, lt brn, slightly moist
13 1/2 to 35 sand, med grained, lt brn, slightly moist w/some fine gravel

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
1"	**new**	**plastic**	**0-10 blank**
1"	**new**	**plastic**	**10-35 screen**

ATTACHMENT III.H.5 – 2011 GAS MONITORING PROBE INSTALLATION

LEGEND

PROJECT BOUNDARY

GAS LINE — G —

OVERHEAD ELECTRIC LINE — OE —

MONUMENT TIE LINE

MARKER POST ⓜ

MONITOR/TEST WELL Ⓐ

POWER/UTILITY POLE

GUY ANCHOR FOR WOOD POLE FENCE

NATURAL GAS PIPELINE SIGN

MONITOR WELL NUMBER MW-9

GAS MONITOR PROBE GMP-12



GRAPHIC SCALE

0 300'

(IN FEET)

1 inch = 300 FT.

COORDINATE TABLE				
WELL NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
MW-9	10,591,290.64	482,094.15	3976.95	BRASS DISK AT MW NO. 9
MW-9	10,591,290.86	482,095.39	3979.96	TOP OF ALUMINUM CASING
MW-9	10,591,290.86	482,095.39	3979.58	TOP OF 4" PVC PIPE
GMP-12	10,591,833.11	482,195.70	3982.90	TOP OF VALVE
GMP-13	10,592,555.59	482,226.96	3989.08	TOP OF VALVE
GMP-14	10,593,278.95	482,258.58	3988.63	TOP OF VALVE
GMP-15	10,594,003.08	482,279.47	3990.15	TOP OF VALVE

SUPPLEMENTAL NOTES

1. BASIS OF BEARING IS THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE NO. 4203 DETERMINED THROUGH G.P.S. OBSERVATION AT NATIONAL GEODETIC SURVEY (N.G.S.) TRIANGULATION STATION "CLINT" (P.I.D. CE0479), A BRASS CAP MONUMENT LOCATED 3 MILES NORTHEAST ALONG DARRINGTON ROAD FROM THE INTERSECTION OF IH-10 AND F.M. 1110 , 0.5 MILES WEST ON ROARING SPRINGS DRIVE AND 0.3 MILES NORTH ON CASCADE DRIVE TO A DIRT ROAD ON THE LEFT FOR 0.25 MILES TO THE STATION. COORDINATES SHOWN ARE NAD 83 TEXAS CENTRAL ZONE STATE PLANE SURFACE COORDINATES, IN U.S. SURVEY FEET.

2. ELEVATIONS AND CONTOURS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (N.A.V.D. 88) DETERMINED THROUGH G.P.S. OBSERVATION AT A NATIONAL GEODETIC SURVEY (N.G.S.) MONUMENT "Z 1392" (P.I.D. CE0373), A STAINLESS STEEL ROD LOCATED 1.75 MILES NORTHWEST FROM THE INTERSECTION OF F.M. 1110 AND THE SOUTHERN PACIFIC RAILROAD IN CLINT, TEXAS, APPROXIMATELY 100 FEET EAST-SOUTHEAST OF MILEPOST 809, ELEVATION = 3638.32' (N.A.V.D.88.).

3. CONVERGENCE ANGLE FROM TEXAS CENTRAL ZONE NO. 4203 TO TRUE NORTH AT TRIANGULATION STATION "CLINT" IS -03°00'50".

4. TO ARRIVE AT GRID COORDINATES APPLY A SCALE FACTOR OF 0.9997474032 AT THE G.P.S. BASE CONTROL POINT SHOWN.

5. SURFACE COORDINATES FOR TRIANGULATION STATION "CLINT" ARE N: 10,605122.549 sft, E: 476,297.451 sft. WITH AN ELEVATION OF 4014.87. GRID COORDINATES FOR TRIANGULATION STATION "CLINT" ARE N: 10,605119.411 sft, E: 476,298.450 sft.

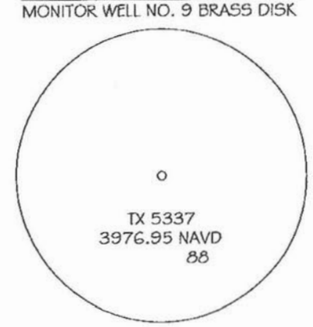
REFERENCE DOCUMENTS

1. BOUNDARY & TOPOGRAPHIC SURVEY FOR TCEQ MSW PERMIT NO. 2284, PHASE I-CELLS 3-6 AND SCALE HOUSE, PAGE NO. C-001, SHEET 4 OF 67, DATED 8-17-05.

2. NGS DATASHEETS FOR "CLINT" (PID NO. CE0479) & "Z 1392" (PID NO. 0373) DOWNLOADED FROM THE NATIONAL GEODETIC SURVEY WEBSITE.

DETAIL:

MONITOR WELL NO. 9 BRASS DISK



CERTIFICATION;

I HEREBY CERTIFY THAT THIS SURVEY PLAT AND THE ACTUAL SURVEY ON THE GROUND UPON WHICH IT IS BASED WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION; THAT I AM RESPONSIBLE FOR THIS SURVEY; THAT THIS SURVEY MEETS THE MINIMUM STANDARDS FOR SURVEYING IN THE STATE OF TEXAS; AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Isaac Camacho 07/01/11

ISAAC CAMACHO, TX. R.P.L.S. NO. 5337

DRAWN BY: J.M.	CLINT LANDFILL-CELLS 7, 8, 9, & 10
APPROVED BY: I.C.	NEW MONITOR WELL NO. 9 AND GMP NO.'s 12, 13, 14 & 15
DATE: 06/30/2011	CITY OF EL PASO PROPERTY IN SECTION 16, BLOCK 78, TOWNSHIP 4, TEXAS & PACIFIC RAILWAY COMPANY SURVEYS, EL PASO COUNTY, TEXAS.
SCALE: 1"=300'	
JOB NO. 06315-010	

⚠	.	DATE:	.

BROCK & BUSTILLOS INC.
CONSULTING CIVIL ENGINEERS
LAND SURVEYORS
TBPE REG. NO. F-737

417 EXECUTIVE CENTER
EL PASO, TX 79902
PH (915) 542-4900
FAX (915) 542-2867
www.brockbustillos.com

STATE OF TEXAS REGISTERED ISAAC CAMACHO 5337 PROFESSIONAL LAND SURVEYOR

CADD5
Jun 30, 2011 - 4:37pm
U:\06315-010-CLINT LANDFILL\06315-010-LDD\dwg\06315-010-CLINT LANDFILL-NEW MONITOR WELL EXHIBIT.dwg

MSW|2284|RP

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

September 23, 2011

Ms. Ellen A. Smyth, P.E.
Director of Environmental Services
City of El Paso
7969 San Paulo
El Paso, TX 79907

Re: Clint Municipal Solid Waste Landfill – El Paso County
Municipal Solid Waste (MSW) - Permit No. 2284
Landfill Gas Monitor Probe Installation Report
Tracking No. 14882317; CN601410244/RN104362218

Dear Ms. Smyth:

This letter acknowledges that we received a report documenting the installation of four new landfill gas probes at the referenced facility. The report documented the activities related to the installation of four gas monitoring probes designated as GMP 12, 13, 14, and 15. The report was prepared by Parkhill, Smith & Cooper, Inc. (PSC) of El Paso, Texas and submitted on behalf of the facility by the supervising engineer Matt Dyer, P.E. of PSC, under a cover letter dated August 12, 2011.

Thank you for the submittal. The installation appears to be in accordance with the Clint Landfill's Gas Management Plan approved on January 21, 2011.

If you have any questions in regard to this letter, please contact me at (512) 239-2347. When addressing written correspondence, please use mail code MC 124.

Sincerely,

Eleanore Whitworth, Permit Reviewer
Municipal Solid Waste Permits Section
Waste Permits Division

EDW/sm

cc: Matt Dyer, P.E., Parkhill, Smith, & Cooper, Inc., El Paso

WST MSW/ REPORTS
1st: 02284 2nd: Vol: 001 9/23/2011
BBC: 100369763
IBC: 100434907

RECEIVED
NOV 22 2011
TCEQ
CENTRAL FILE ROOM

Monitor Probe Installation Report

City of El Paso, Texas

Clint Municipal Solid Waste Landfill

MSW Permit No. 2284

Landfill Gas Management

RECEIVED
DEC 15 2011
TCEQ
CENTRAL FILE ROOM

RECEIVED
AUG 15 2011
WASTE PERMITS DIVISION
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY

Installation of Gas Monitoring Probes



08/12/11

August 2011

PSC Project # 01513010

PARKHILLSMITH&COOPER

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2.0 COMPLIANCE WITH GAS MANAGEMENT PLAN 1
3.0 PROBE CONSTRUCTION 1
4.0 CONSTRUCTION DETAILS 2
5.0 CONCLUSION 2

APPENDIX

FIGURE 1 – NEW GAS PROBES LAYOUT PLAN

FIGURE 2 – CROSS SECTION

CONSTRUCTION DETAILS

STATE OF TEXAS WELL REPORTS

1.0 PURPOSE

Four permanent gas monitoring probes (GMP 12, GMP 13, GMP 14 and GMP 15) were installed the week of May 24-27, 2011 at the El Paso Clint Landfill (TCEQ MSW Permit No. 2284). The purpose of this report is to document that installation of the four gas monitoring probes was in accordance with the Landfill Gas Management Plan.

2.0 COMPLIANCE WITH GAS MANAGEMENT PLAN

Section 4.4 of the facility Landfill Gas Management Plan (Part III Site Development Plan Attachment 14) requires that permanent gas probes that were not installed initially be installed within 90 days of placement of refuse within 1,000 feet of each individual probe. The City of El Paso is in the process of preparing landfill cells to accept waste within 1,000 feet from the location for permanent gas monitoring probes GMP 12, GMP 13, GMP 14 and GMP 15. Gas monitoring probes GMP 12 - GMP 15 were installed in May 2011 to be in place before the completion of new cells 7, 8, 9 and 10.

3.0 PROBE CONSTRUCTION

Section 4.2.2 of the Landfill Gas Management Plan requires that all probes are to be installed at or below the bottom of waste elevation and above the permanent low-season water table. Facility piezometers indicate that groundwater depths are over 200-feet from the ground surface. None of the new gas probes are over 70-feet deep, therefore the probes are installed above the permanent low-season water table.

A cross section of the new cells was created to identify the lowest point of waste deposit and leachate sump elevation. The lowest elevation of proposed cells which will contain deposited waste is 3,947.92-feet NAVD88; however, leachate collection sumps will have a lowest elevation of 3,944.42-feet NAVD88. The four new gas probes are all set at an elevation below the leachate collection sump.

The elevations of the gas monitoring probes are provided in the table below.

PROBE NO.	DEPOSITED WASTE LOW ELEVATION	LEACHATE SUMP LOW ELEVATION	BOTTOM OF PROBE SCREEN ELEVATION
	(FT-NAVD88)	(FT- NAVD88)	(FT- NAVD88)
GMP 12	3947.92	3944.42	3909.37
GMP 13	3947.92	3944.42	3924.45
GMP 14	3947.92	3944.42	3939.20
GMP 15	3947.92	3944.42	3939.02

Figure 1, located in the Appendix, is a plan view of the landfill showing the locations of the new gas probes and a section cut of the new landfill cells. Figure 2, located in the Appendix, shows the profile of the monitor probes and base of proposed waste.

4.0 CONSTRUCTION DETAILS

The probes were installed by WDC Exploration and Wells under the direction of Parkhill, Smith and Cooper, Inc. Soils encountered during drilling were logged using USCS conventions. Probes were constructed as described in the facility Landfill Gas Management Plan. Probe construction details are also provided in the Appendix. The coordinates and elevations shown on the drawings correspond to the horizontal and vertical data defined by the MSW facility benchmark. A State of Texas Well Report was completed and submitted to TCEQ for each of the probes. Copies of the completed reports are included in the Appendix.

5.0 CONCLUSION

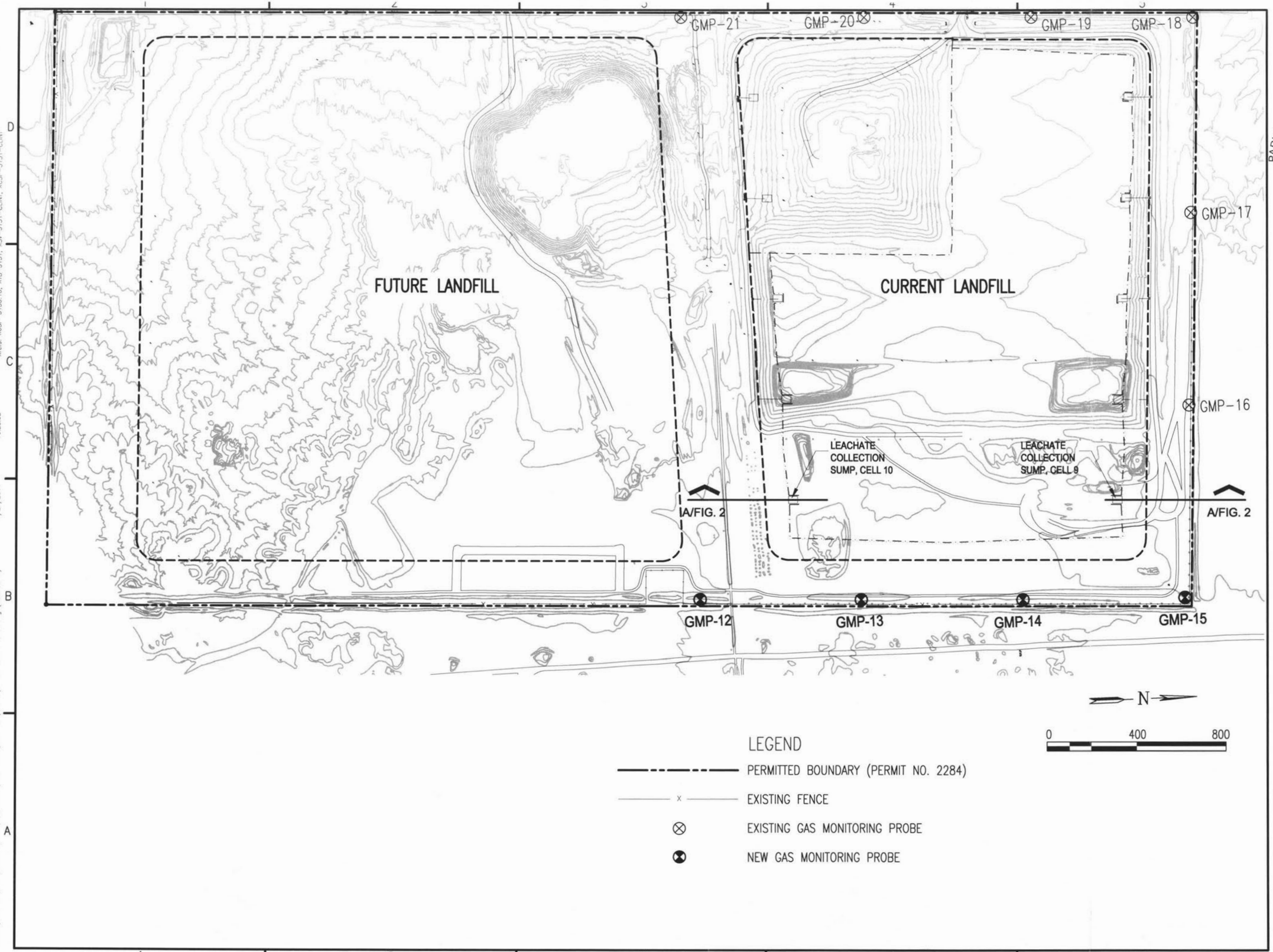
The four new gas monitoring probes GMP 12, GMP 13, GMP 14 and GMP 15 were installed in accordance with the facility Landfill Gas Management Plan.

APPENDIX

- FIGURE 1 – NEW GAS PROBES LAYOUT PLAN
- FIGURE 2 – CROSS SECTION
- CONSTRUCTION DETAILS
- STATE OF TEXAS WELL REPORTS

FIGURE 1

NEW GAS PROBES LAYOUT PLAN



PSC

PARKHILL SMITH & COOPER

PARKHILL SMITH & COOPER, INC. F-560
STATE OF TEXAS
R. MATT DYER
92189
LICENSED PROFESSIONAL ENGINEER
07/27/11

THE CITY OF EL PASO, TEXAS

CITY OF EL PASO, TEXAS
GAS MONITORING PROBES REPORT

CLINT LANDFILL
TCEQ MSW PERMIT NO. 2284

7968 SAN PAULO DRIVE
EL PASO, TEXAS 79907

KEY PLAN

NO	DATE	DESCRIPTION

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

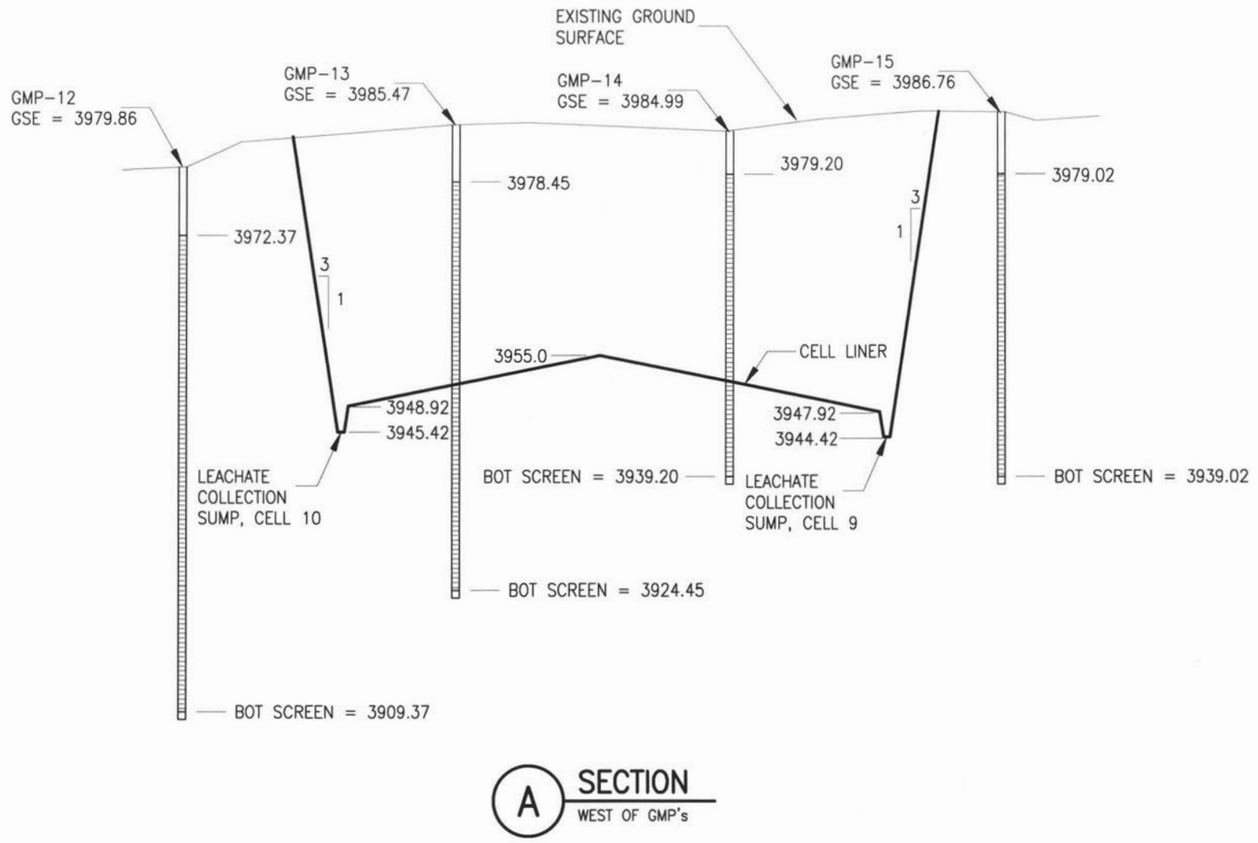
NEW GAS PROBES LAYOUT PLAN

FIGURE 1

Xrefs: XCSP-5130.10, XTB-5151, XSV-5151-CLINT, XCSP-5151-CLINT
7/27/2011 16:28:52
Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL-RPTS\CLINT-LF\GRGAS\C-101-GMRPT-5151.dwg (GEORGE-M)

FIGURE 2

CROSS SECTION



A SECTION
WEST OF GMP's

SCALES:

HORIZONTAL:
0 200 400

VERTICAL:
0 10 20

PSC

PARKHILL SMITH & COOPER, INC. F-2
STATE OF TEXAS
R. MATT DYER
92189
LICENSED PROFESSIONAL ENGINEER
07/27/11

THE CITY OF EL PASO TEXAS

CITY OF EL PASO, TEXAS
GAS MONITORING PROBES REPORT

CLINT LANDFILL
TCEQ MSW PERMIT NO. 228

7968 SAN PAULO DRIVE
EL PASO, TEXAS 79907

KEY PLAN

NO	DATE	DESCRIPTION

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

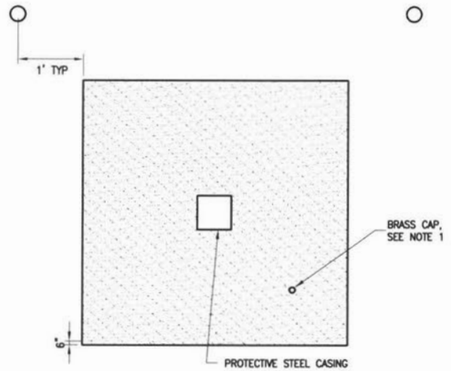
CROSS SECTION

FIGURE 2

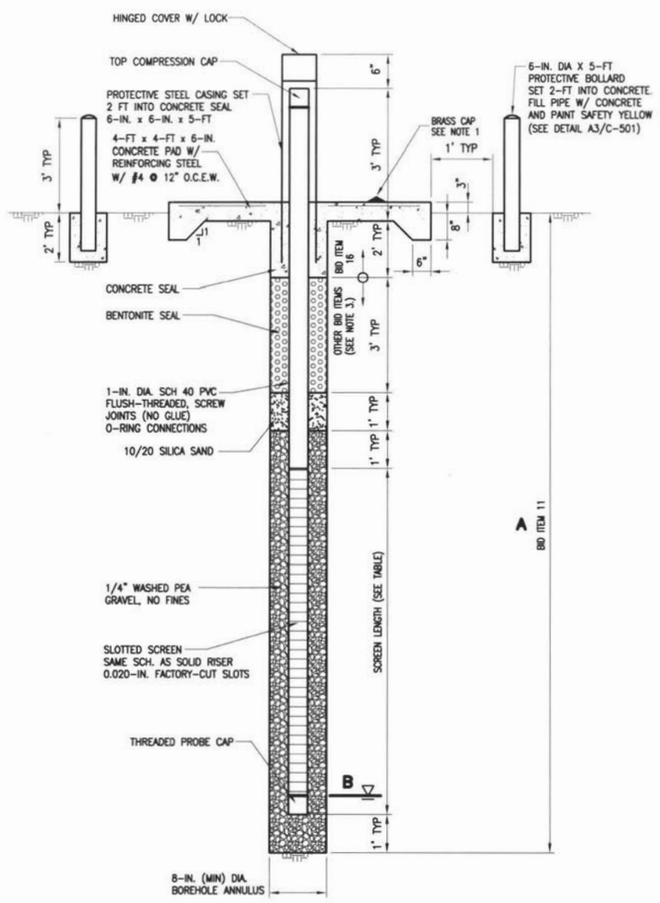
Xrefs: XTB-GMRPT-CLNT-5151

Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL-RPTS\CLINT-LF\GRGAS\C-201-GMRPT-5151.dwg (GEORGE-W) 7/27/2011 16:28:42

CONSTRUCTION DETAILS



TOP VIEW



B3 GAS MONITORING PROBE SECTION
NO SCALE

PSC
PARKHILL SMITH & COOPER

THE CITY OF EL PASO TEXAS

CITY OF EL PASO, TEXAS
GAS MONITORING PROBES REPORT

CLINT LANDFILL
TCEQ MSW PERMIT NO. 2284

7968 SAN PAULO DRIVE
EL PASO, TEXAS 79907

KEY PLAN

NO	DATE	DESCRIPTION

ISSUING OFFICE: LUBBOCK, TX PROJECT NO: 01.5151.10

GAS MONITORING PROBE DETAILS

C-501

Xrefs: XTB-8.5x11-5127, XTB-5151
Drawing File: X:\2010\5151.10\CADD\00_SHEETS\WELL-RPTS\CLINT-LFL\DRDAS\C-501-DMRPT-5151.dwg (GEORGE-M) 7/13/2011 1:40:47

STATE OF TEXAS WELL REPORTS

STATE OF TEXAS WELL REPORT for Tracking #256297

Owner:	**City of El Paso Environmental Services D**	Owner Well #:	**GMP-12**
Address:	**7968 San Paulo El Paso , TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint , TX 79928**	Latitude:	**31° 35' 47" N**
Well County:	**El Paso**	Longitude:	**106° 09' 49" W**
Elevation:	**3986 ft.**	GPS Brand Used:	**Google Earth**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **5/25/2011**
Completed: **5/25/2011**

Diameter of Hole: Diameter: **8 in From Surface To 72 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **7 ft to 72 ft**
Gravel Pack Size: **pea gravel**

Annular Seal Data: 1st Interval: **From 2 ft to 6 ft with 2/ Bent. Chips (#sacks and material)**
2nd Interval: **From 6 ft to 7 ft with transition sand (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie**
Cemented By: **WDC**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **WDC Exploration & Wells**
3621 Hwy 47

	Peralta , NM 87042
Driller License Number:	**4885**
Licensed Well Driller Signature:	**William B. Bludworth**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Vapor Well**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#256297**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-5 Sand, brown, fine grain.
5-10 Sand, light brown, some gravel.
10-15 Clayey Sand, brown, some gravel.
15-30 Sand and Gravel, brown.
30-50 Gravelly Sand.
50-72 Sand, fine.

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
1 N PVC Riser +3-8 Sch#40
1 N PVC Slotted Screen 8-71 .020"slot

STATE OF TEXAS WELL REPORT for Tracking #256299

Owner:	**City of El Paso Environmental Services D**	Owner Well #:	**GMP-13**
Address:	**7968 San Paulo El Paso , TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint , TX 79928**	Latitude:	**31° 35' 55" N**
Well County:	**El Paso**	Longitude:	**106° 09' 48" W**
Elevation:	**3985 ft.**	GPS Brand Used:	**Google Earth**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **5/26/2011**
Completed: **5/26/2011**

Diameter of Hole: Diameter: **8 in From Surface To 63 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **7 ft to 62 ft**
Gravel Pack Size: **pea gravel**

Annular Seal Data: 1st Interval: **From 2 ft to 6 ft with 2/ Bent. Chips (#sacks and material)**
2nd Interval: **From 6 ft to 7 ft with transition sand (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie**
Cemented By: **WDC**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **WDC Exploration & Wells**
3621 Hwy 47

	Peralta , NM 87042
Driller License Number:	**4885**
Licensed Well Driller Signature:	**William B. Bludworth**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Vapor Well**

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-10 Sand, brown, fine.
10-15 Gravelly Sand, light brown.
15-63 Gravelly Sand, brown, 1/4" or smaller gravel.

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
1 N PVC Riser +3-8 Sch#40
1 N PVC Slotted Screen 8-62 .020"slot

STATE OF TEXAS WELL REPORT for Tracking #256296

Owner:	**City of El Paso Environmental Services D**	Owner Well #:	**GMP-14**
Address:	**7968 San Paulo El Paso , TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint , TX 79928**	Latitude:	**31° 35' 59" N**
Well County:	**El Paso**	Longitude:	**106° 09' 49" W**
Elevation:	**3985 ft.**	GPS Brand Used:	**Google Earth**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **5/24/2011** Completed: **5/24/2011**
Diameter of Hole:	Diameter: **8 in From Surface To 47 ft**
Drilling Method:	**Hollow Stem Auger**
Borehole Completion:	Gravel Packed From: **5 ft to 47 ft** Gravel Pack Size: **pea gravel**
Annular Seal Data:	1st Interval: **From 2 ft to 4 ft with 1/ Bent. Chips (#sacks and material)** 2nd Interval: **From 4 ft to 5 ft with transition sand (#sacks and material)** 3rd Interval: **No Data** Method Used: **Tremie** Cemented By: **WDC** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**WDC Exploration & Wells** **3621 Hwy 47**

	Peralta , NM 87042
Driller License Number:	**4885**
Licensed Well Driller Signature:	**William B. Bludworth**
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Apprentice Registration Number:	**No Data**
Comments:	**Vapor Well**

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-5 Sand, brown, fine grain.
5-10 Sand, light brown, some gravel.
10-15 Silty Sand, tan, some caliche.
15-47 Sand and Gravel, brown.

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
1 N PVC Riser +3- 6 Sch#40
1 N PVC Slotted Screen 6-46 .020"slot

STATE OF TEXAS WELL REPORT for Tracking #256298

Owner:	**City of El Paso Environmental Services D**	Owner Well #:	**GMP-15**
Address:	**7968 San Paulo El Paso , TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint , TX 79928**	Latitude:	**31° 36' 07" N**
Well County:	**El Paso**	Longitude:	**106° 09' 50" W**
Elevation:	**3987 ft.**	GPS Brand Used:	**Google Earth**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **5/25/2011**
Completed: **5/25/2011**

Diameter of Hole: Diameter: **8 in From Surface To 49 ft**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: Gravel Packed From: **7 ft to 49 ft**
Gravel Pack Size: **pea gravel**

Annular Seal Data: 1st Interval: **From 2 ft to 6 ft with 2/ Bent. Chips (#sacks and material)**
2nd Interval: **From 6 ft to 7 ft with transition sand (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Tremie**
Cemented By: **WDC**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **WDC Exploration & Wells**
3621 Hwy 47

	Peralta , NM 87042
Driller License Number:	**4885**
Licensed Well Driller Signature:	**William B. Bludworth**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Vapor Well**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking number (Tracking **#256298**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-15 Silty Sand, brown, coarse sandstone gravel.
15-22 Silty Sand, tan, some caliche.
22-35 Silty Sand, brown to dusky brown, some gravel, moist.
35-49 Sand, fine, moist.

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
1 N PVC Riser +3-8 Sch#40
1 N PVC Slotted Screen 8-48 .020"slot

ATTACHMENT III.H.6 – 2019 GAS MONITORING PROBE INSTALLATION

STATE OF TEXAS WELL REPORT for Tracking #508768

Owner:	**City of El Paso Environmental Services**	Owner Well #:	**GMP-3**
Address:	**7968 San Paulo El Paso, TX 79907**	Grid #:	**49-31-2**
Well Location:	**2300 Darrington Rd. Clint, TX 79928**	Latitude:	**31° 35' 31.5" N**
Well County:	**El Paso**	Longitude:	**106° 10' 18.9" W**
		Elevation:	**3944 ft. above sea level**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **3/7/2019** Drilling End Date: **3/21/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.5**	**0**	**58.7**

Drilling Method: **Air Rotary Casing Hammer**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
Filter Pack Intervals:	**14**	**55.7**	**Gravel**	**Pea**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**2**	**13**	**Bentonite 1.5 Bags/Sacks**
	13	**14**	**Sand 0.5 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Cascade Drilling**

3621 Hwy 47
Peralta, NM 87042

Driller Name: **William B. Bludworth** License Number: **4885**

Comments: **This is a soil gas monitoring probe.**

Surface Slab is 5' X 5' X 6" steel reinforced concrete w/ 4" X 5' steel pipe and aluminum locking cover as well protector. Slab is surrounded by 4- 6" X 5' steel bollards. Top of well is 2'9" above grade, and protector and bollards are 3' above grade. Steel protector and bollards are painted safety yellow.

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**13**	**Sand, slightly silty, 90% sand, 10% fines, nonplastic, brown.**
13	**15**	**Sand, gravelly, silty, 10% coarse gravel, 85% sand, 5% fines, nonplastic, brownish grey.**
15	**22**	**Sand, gravelly, slightly silty, 20% fine gravel, 70% sand, 10% fines, nonplastic, greyish yellow brown.**
22	**32**	**Sand, coarse, slightly silty, 90% sand, 10% fines, nonplastic, greyish yellow brown.**
32	**38**	**Sand, silty laminae, 95% sand, 5% silt, Brown.**
38	**42**	**Sand, fine grained, minor silt, 95% sand, 5% fines, nonplastic, dull orange**
42	**49**	**Sand, fine, silty, gravelly, 5% fine gravel, 85% sand, 10% fines, nonplastic, dull orange.**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
1	**Riser**	**New Plastic (PVC)**	**40**	**0**	**15.1**
1	**Screen**	**New Plastic (PVC)**	**40 0.020**	**15.1**	**55.1**

49	**52**	**Sand, fine, silty, 95% sand, 5% silt, nonplastic, Light brown.**
52	**58.7**	**Sand, fine, silt-clay laminae, 05% sand, 10% silt, nonplastic, Light brown.**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508769

Owner:	**City of El Paso Environmental Services**	Owner Well #:	**GMP-4**
Address:	**7968 San Paulo El Paso, TX 79907**	Grid #:	**49-31-2**
Well Location:	**2300 Darrington Rd. Clint, TX 79928**	Latitude:	**31° 35' 24.18" N**
Well County:	**El Paso**	Longitude:	**106° 10' 18.81" W**
		Elevation:	**3915 ft. above sea level**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **3/8/2019** Drilling End Date: **3/21/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.5	**0**	**62.3**

Drilling Method: **Air Rotary Casing Hammer**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
10.1	**62.1**	**Gravel**	**Pea**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
2	**9**	**Bentonite 1 Bags/Sacks**
9	**10.1**	**Sand 0.5 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Cascade Drilling**

3621 Hwy 47
Peralta, NM 87042

Driller Name: **William B. Bludworth** License Number: **4885**

Comments: **This is a soil vapor monitoring probe.**

Surface Slab is 5' X 5' X 6" steel reinforced concrete w/ 4" X 5' steel pipe and aluminum locking cover as well protector. Slab is surrounded by 4- 6" X 5' steel bollards. Top of well is 2'9" above grade, and protector and bollards are 3' above grade. Steel protector and bollards are painted safety yellow.

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**13**	**Sand, gravelly, slightly silty, 5% gravel, 80% sand, 10% fines, nonplastic, brown.**
13	**19**	**Clay, silty, dull reddish brown, plastic.**
19	**25**	**Sand, fine, slightly silty, 95% sand, 5% fines, nonplastic dull orange.**
25	**39**	**Sand, fine, gravelly, lightly silty, 5% gravel, 90% sand, 5% fines, nonplastic.**
39	**52**	**Sand, fine, slightly silty, 95% sand, 5% fines, nonplastic, dull orange.**
52	**59**	**Sand, fine, gravelly, silty laminae, 10% gravel, 80% sand, 10% fines, nonplastic, brown.**
59	**62.3**	**Sand, fine, silty, 95% sand, 5% fines, light brownish grey.**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
8.5	**Riser**	**New Plastic (PVC)**	**40**	**0**	**11.1**
8.5	**Screen**	**New Plastic (PVC)**	**40 0.020**	**11.1**	**61.1**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508761

Owner:	**City of El Paso Environmental Services**	Owner Well #:	**GMP-10**
Address:	**7968 San Paulo El Paso, TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint, TX 79928**	Latitude:	**31° 35' 32.16" N**
Well County:	**El Paso**	Longitude:	**106° 09' 48.66" W**
		Elevation:	**3976 ft. above sea level**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **3/2/2019** Drilling End Date: **3/21/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.5**	**0**	**85.6**

Drilling Method: **Air Rotary Casing Hammer**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
Filter Pack Intervals:	**13.6**	**85.6**	**Gravel**	**Pea**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**12.6**	**Bentonite 2 Bags/Sacks**
	12.6	**13.6**	**Sand 0.25 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Cascade Drilling**

3621 Hwy 47
Peralta, NM 87042

Driller Name: **Wiliam B. Bludworth** License Number: **4885**

Comments: **This is a soil gas probe.**

Surface Slab is 5' X 5' X 6" steel reinforced concrete w/ 4" X 5' steel pipe and aluminum locking cover as well protector. Slab is surrounded by 4- 6" X 5' steel bollards. Top of well is 2'9" above grade, and protector and bollards are 3' above grade. Steel protector and bollards are painted safety yellow.

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**13**	**Sand, silty, gravelly,5% fine gravel, 90% sand, 10% silt, nonplastic, light brownish grey.**
13	**25**	**Sand, medium, silty, 95% sand, 5% silt, nonplastic, greyish brown.**
25	**32**	**Sand, fine, silty, 95% sand, 5% silt, nonplastic, light brownish grey.**
32	**38**	**Sand, fine, silty, 95% sand, 5% silt, nonplastic, light brownish grey.**
38	**48**	**Sand, fine, gravelly, silty, 10% gravel, 85% sand, 5% silt, nonplastic, greyish brown.**
48	**57**	**Sand, fine-medium, gravelly, silty, 10% gravel, 85% sand, 5% silt, nonplastic, brown.**
57	**65**	**Sand, fine, silty, 95% sand, 5% silt, nonplastic, dull orange.**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
1	**Riser**	**New Plastic (PVC)**	**40**	**0**	**14.6**
1	**Screen**	**New Plastic (PVC)**	**40 0.020**	**14.6**	**84.6**

65	**74**	**Sand, fine, silty, 95% sand, 5% silt, nonplastic, light brownish grey.**
74	**79**	**Sand, gravelly, silty, 5% gravel, 90% sand, 5% silt, nonplastic, greyish brown.**
79	**83**	**Sand, gravelly, silty, 5% gravel, 90% sand, 5% silt, nonplastic, light brownish grey.**
83	**85.6**	**Sand, fine, gravelly, silty, 10% gravel, 85% sand, 5% silt, nonplastic SW Slightly moist ----90 dull orance.**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508767

Owner:	**City of El Paso Environmental Services**	Owner Well #:	**GMP-11**
Address:	**7968 San Paulo El Paso, TX 79907**	Grid #:	**49-31-3**
Well Location:	**2300 Darrington Rd. Clint, TX 79928**	Latitude:	**31° 35' 40.16" N**
Well County:	**El Paso**	Longitude:	**106° 09' 48.75" W**
		Elevation:	**3976 ft. above sea level**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **3/7/2019** Drilling End Date: **3/21/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.5	**0**	**88**

Drilling Method: **Air Rotary Casing Hammer**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
15.3	**88**	**Gravel**	**Pea**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
2	**13.3**	**Bentonite 2 Bags/Sacks**
13.3	**15.3**	**Sand 0.1 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Cascade Drilling**

3621 Hwy 47
Peralta, NM 87042

Driller Name: **William B. Bludworthg** License Number: **4885**

Comments: **This is a soil gas monitoring probe.**

Surface Slab is 5' X 5 X 6" steel reinforced concrete w/ 4" X 5' steel pipe and aluminum locking cover as well protector. Slab is surrounded by 4- 6" X 5' steel bollards. Top of well is 2'9" above grade, and protector and bollards are 3' above grade. Steel protector and bollards are painted safety yellow.

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**6**	**Sand, fine, silty, 90% sand, 10% fines, nonplastic, dull reddish brown.**
6	**12**	**Sand, fine, silty, 90% sand, 10% fines, nonplastic, dull orange**
12	**19**	**Sand, as above, coarse gravel.**
19	**25**	**Sand, fine-med, gravelly, 10% gravel. 80% sand, 10% fines, nonplastic SP --- dull orange.**
25	**35**	**Sand, med-coarse, gravelly, 5% gravel. 85% sand, 10% fines, nonplastic SP ----30 greyish brown.**
35	**45**	**Sand, fine-med, silty, 90% sand, 10% fines, nonplastic, brown.**
45	**55**	**Sand, fine-med, silty, 90% sand, 10% fines, nonplastic SP Moist, brown.**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
1	**Riser**	**New Plastic (PVC)**	**40**	**0**	**16.7**
1	**Screen**	**New Plastic (PVC)**	**40 0.020**	**16.7**	**86.7**

55	**61**	**Sand, fine-med, silty, 90% sand, 10% fines, nonplastic, greyish brown.**
61	**65**	**Sand, fine-med, silty, gravelly, 10% gravel, 80% sand, 10% fines, nonplastic SP Moist --- greyish brown**
65	**75**	**Sand, fine-med, silt, gravelly (coarse), 10% gravel, 80% sand, 10% fines, nonplastic SP Moist ----70 greyish brown**
75	**82**	**Sand, fine-med, silty, 90% sand, 10% fines, nonplastic SP Dry, greyish brown.**
82	**85**	**Sand, fine, silty laminae, 80% sand, 20% fines, plastic, orange.**
85	**88**	**Sand, fine, silty, 90% sand, 10% fines, plastic, light grey.**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

Monitor Well Installation Report

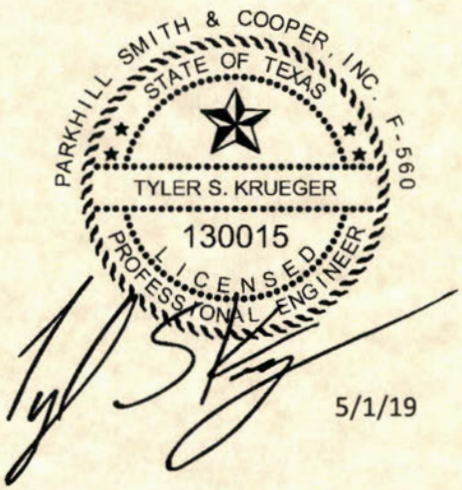
30 TAC §330.421(e)

Greater El Paso Municipal Landfill

MSW Permit No. 2284

El Paso, Texas

Monitor Wells #10 and 11



May 2019

PSC Project #01515318

PARKHILLSMITH&COOPER

	CLINT LANDFILL GROUND WATER MONITOR WELLS & GAS PROBES				26-Mar-2019	JOB NO.
	TEXAS CENTRAL ZONE, NO. 4203, NAD 1983				NAVD 88	06315-034
	GEODETIC COORDINATES		STATE PLANE COORDINATES			
			SURFACE	SURFACE	ELEV.	POINT
BRASS CAP	LATITUDE	LONGITUDE	NORTHING, FT.	EASTING, FT.	FT.	NO.
BRASS CAP GMP NO. 3	31d35'31.50004"	-106d10'18.90043"	10,590,479.60	479,512.45	3,944.89	20001
SURFACE ELEVATION					3,944.70	
TOP OF STEM					3,947.83	
TOP OF PROTECTIVE COLLAR					3,947.84	
BRASS CAP GMP NO. 4	31d35'24.18041"	-106d10'18.80594"	10,589,740.41	479,481.80	3,915.10	20002
SURFACE ELEVATION					3,914.98	
TOP OF STEM					3,917.99	
TOP OF PROTECTIVE COLLAR					3,918.05	
BRASS CAP GMP NO. 10	31d35'32.15931"	-106d09'48.66502"	10,590,409.01	482,128.03	3,975.89	20003
SURFACE ELEVATION					3,975.64	
TOP OF CASING					3,978.65	
TOP OF PROTECTIVE COLLAR					3,978.76	
BRASS CAP GMP NO. 11	31d35'40.15944"	-106d09'48.75309"	10,591,216.86	482,162.78	3,975.64	20004
SURFACE ELEVATION					3,975.46	
TOP OF CASING					3,978.50	
TOP OF PROTECTIVE COLLAR					3,978.61	
BRASS CAP MW NO. 10	31d35'35.23514"	-106d09'48.73597"	10,590,719.78	482,138.19	3,976.59	20005
SURFACE ELEVATION					3,976.33	
TOP OF CASING					3,979.38	
TOP OF PROTECTIVE COLLAR					3,979.63	
BRASS CAP MW NO. 11	31d35'29.37438"	-106d09'48.63206"	10,590,127.78	482,116.13	3,975.01	20006
SURFACE ELEVATION					3,974.67	
TOP OF CASING					3,977.44	
TOP OF PROTECTIVE COLLAR					3,977.85	
BRASS CAP MW NO. 8 (BM)	31d35'52.04262"	-106d09'49.71766"	10,592,420.59	482,142.37	3,983.76	30008

APPENDIX III.I – FINAL CLOSURE PLAN

MSW AUTH NO. 2284A

APPENDIX III.I – CLOSURE PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 2
SEPTEMBER 12, 2025

Part III, Appendix I
Closure Plan
MSW Auth No. 2284A

prepared for

City of El Paso, Texas
Greater El Paso Landfill Major Amendment
El Paso County, Texas

Project No. 155488

Revision 0, October 31, 2024
Revision 1, May 16, 2025
Revision 2, September 12, 2025



prepared by

Burns & McDonnell Engineering Company, Inc.
6200 Bridge Point Pkwy, Building 4, Suite 400, Austin, TX 78730
Texas Firm Registration No. F-845

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Texas Commission on Environmental Quality

Closure Plan for Municipal Solid Waste Type I Landfill Units and Final Facility Closure

This form is for use by applicants or site operators of Municipal Solid Waste (MSW) Type I landfills to detail the plan for closure of a landfill unit, closure of associated storage or processing units, and final closure of the facility to meet the requirements in 30 TAC Chapter 330, §330.63(h) and 30 TAC Chapter 330 Subchapter K for a MSW Type I facility.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: Greater El Paso Landfill

MSW Permit No.:2284A

Site Operator/Permittee Name: City of El Paso/CN601410244

II. Landfill and Other Waste Management Units and Operations Requiring Closure at the Facility

A. Facility Units

Table 1. Description of Landfill Units.

Name or Descriptor of Unit	Operating Status of Unit	Type of Liner System Under Unit	Above Grade Class 1 Disposal Cells in this Unit	Below Grade Class 1 Disposal Cells in this Unit	Other Class 1 Disposal Cells in this Unit (describe)	Size of Unit's Waste Footprint (acres)	Maximum Inventory of Waste Ever in Unit (indicate cubic yards or tons)	Other Necessary Information that Pertains to the Unit
Phase 1	Closed	Alternative Liner (GCL with HDPE liner)	☐	☐	☐	93.9	12,582,982 CY	Area closed, increasing capacity with vertical expansion.
Phase 2	Active	Alternative Liner (GCL with HDPE liner)	☐	☐	☐	122.5	22,281,524 CY	Increased capacity with vertical expansion.
Totals		*(inclusive of daily/intermediate cover)*				216.4	34,864,506 CY	

Table 2. Description of Waste Storage or Processing Units or Operations Associated with this Permit.

Type of Storage or Processing Unit or Operation (individual units may be closed at any time prior to or during the final facility closure as described in this plan)	Operational Status of Unit	Size of the Area Used for the Storage or Processing Unit or Operation (Acres)	Maximum Inventory of Waste Ever in Storage or Processing Unit or Operation (indicate cubic yards or tons)	Other Information (enter other necessary information that pertains to the unit)
Lined Evaporation Pond	Active	0.46	0 ☒cubic yards ☐tons	Leachate pond
Lined Evaporation Pond	Active	0.44	0 ☒cubic yards ☐tons	Leachate pond
Totals		1.0 acres	0	

B. Waste Inventory Summary

Table 3. Maximum Inventory of Wastes Ever On Site.

Item	Quantity (indicate cubic yards or tons)
Maximum inventory of waste in landfill units (total from Table 1)	34,864,506 ☒cubic yards or ☐tons
Maximum inventory of waste in storage or processing units or operations (total from Table 2)	0 ☒cubic yards or ☐tons
Total Maximum Inventory of Wastes ever on site over the active life of the MSW facility (sum of totals from Tables 1 and 2)	34,864,506 ☒cubic yards or ☐tons

C. Drawings Showing Details of the Waste Management Units at Closure

Table 4. Location of the Drawings showing Details of the Waste Management Units at Closure (outlines, dimensions, maximum elevations of waste and final cover of

landfill units, and waste storage or processing units or operations at closure of the facility).

Drawing Location in the SDP	Drawing Figure Number	Drawing Title	Waste Management Units Details Shown
Part I/II, App. I/II.B	Drawing I/II.B.3	Landfill Cell Expansion Plan	Cell dimensions and outlines.
Part III, App. III.A	Drawing III.A.10	Final Grading Plan	Existing Area and Expansion Area: Top of final cover elevations and maximum waste elevations.
Part III, App. III.C	Drawing III.C.5 and III.C.7	Phase 1 Leachate Evaporation Pond Layout and Phase 2 Leachate Evaporation Pond Layout	Waste storage (leachate) ponds.
Part III, App III.I	Drawing III.I.1	Post-Development Drainage Map	Final contours and surface drainage features (e.g. berms, downchutes, channels, ponds, etc.).

III. Description of the Final Cover System Design

A. Types and Descriptions of the Final Cover Systems

Table 5. Types and Descriptions of the Final Cover Systems Permitted or Proposed for Closure of the Landfill Units.

Landfill Unit Name or Descriptor	Type of Final Cover System	Final Cover System Components Description	Other Information (Enter other information as applicable)
Phase 1 and 2	Alternative Final Cover	6" base layer, 18" infiltration layer, non-woven geotextile, and 4" rock armoring	Attachment III.I.1

B. Design Details

Table 6. Design Details of the Final Cover Top and Side Slopes for the Landfill Units.

Landfill Unit Name or Descriptor	Maximum Final Elevation of Waste (feet above mean sea level [ft-msl])	Maximum Elevation of Top of Final Cover (ft-msl)	Minimum Grade of the Final Cover Top Slope (%)	Maximum Grade of the Final Cover Side Slope (%)	Other Information (enter other information as applicable, e.g. above-grade Class 1 Cell Dikes)
Vertical Expansion of Phase 1	4,126.3 (NAVD 88)	4,127.4 (NAVD 88)	5	25	
Phase 2	4,126.9 (NAVD 88)	4,128.1 (NAVD 88)	5	25	

C. Final Cover Drainage Features

Stormwater drainage and erosion and sediment control features incorporated on the final cover of the landfill units to protect the integrity and effectiveness of the final cover system include *(please list and describe the drainage features to be installed on the final cover at or prior to closure for each landfill unit, or list the drainage features and provide cross references on the location(s) of the descriptive and details (drawing) information in other parts of the SDP)*:

Drawing III.I.1 depicts final contours and surface drainage features (e.g. berms, downchutes, channels, ponds, etc.).

Appendix III.B contains the Surface Water Drainage Report. The report describes the drainage controls incorporated into the site, including perimeter ditches, down chutes, benches, and roadway culverts.

Additional drainage features are detailed in Attachment III.B.3. The drainage profiles for ditches are shown in Drawings III.B.8-III.B.10. For post-development drainage, Drawings III.B.3 and III.B.4 display the map and conditions.

Attachment III.B.2 contains the Erosion and Sedimentation Control Plan. To provide long term erosional stability, rock armoring and diversional berms will be added.

Alternative final cover rock armoring is detailed in Attachment III.B.3 (Drawing III.B.5).

D. Final Cover Vegetation or Other Ground Cover Material

Upon completion of the water balance alternate final cover system, no vegetation will be planted. Instead, a rock armoring layer will be placed on top of the cap to provide erosion protection. The estimated percent ground cover to minimize soil loss and maintain long-term erosional stability of the final cover top and side slopes is: **100**%. The minimum material specifications for ground cover materials are summarized in the table below.

For a landfill with water balance final cover design, the percentage vegetation cover (excluding other ground cover types) will not be less than that assumed in the water balance final cover model.

Table 7. Minimum Specification for Ground Cover Materials Other Than Vegetation, if Applicable.

Other Ground Cover Material	Maximum Particle Size (inches)	Minimum Particle Size (inches)	Material Placement Method	Thickness of Layer (inches)	Percentage Coverage (%)	Other (specify)
Rock Armoring	100% Passing 4-inch	0-5% Passing 2-inch	Place in single uncompacted lift	4-inch thick	100	Crushed rock or river-run rock

E. Final Contour Map

Drawing III.A.10, a facility final contour map is included in Appendix III.A. The map shows the final contours of the landfill units and the entire facility at closure.

Drawings III.A.13 through **III.A.21** showing the cross–sections of the landfill units at closure are also provided in Appendix III.A.

The facility final contour and cross-section maps/drawings depict the following information:

(1) Final constructed contours of the landfill at closure. **Drawing III.A.10 in Appendix III.A**

(2) Top slopes and side slopes of the landfill units. **Drawing III.A.10 in Appendix III.A**

(3) Surface drainage features. **Drawing III.B.3 – III.B.10 in Appendix III.B, and Drawing III.I.1 in Appendix III.I.**

(4) 100-year floodplain, as applicable. **Figure I/II.A.11 in Part I/II, Appendix I/II.A**

(5) Constructed features providing protection of/from the 100-year floodplain. **N/A**

(6) Other (specify):
N/A

IV. Description of the Final Cover System Installation Procedure

A. Mode of Installation

Table 8. Mode of Final Cover Installation on the Landfill Units.

Landfill Unit Name or Descriptor	Largest Area of Unit Ever Requiring Final Cover (Acres)	Check this Column if Final Cover will be Placed in Installments as Permitted Elevation is Reached	Check this Column if Final Cover will be Placed when Entire Unit Area Reaches Permitted Elevation	Final Cover Installation Status
Vertical Expansion of Phase 1	34.6 Acres (Drawing III.A.10)	☐	☒	A portion of Phase 1 Final Cover will be removed with the vertical expansion.
Phase 2	55.2 Acres (Drawing III.A.11)	☒	☐	Final Cover will be installed once Phase 2 reaches final grade.

B. Installation Drawings for Final Cover and Drainage Features

The following attached plan and cross-section drawings show the final cover design details, the largest area requiring final cover, details of the sequence of installation of the final cover system, and all drainage features.

Table 9. List of Attached Installation Drawings for Final Cover and Drainage Features.

Drawings below provided in Appendix III.A, Appendix III.B, and Appendix III.I.

Drawing No.	Drawing Title	Description of Information Contained in Drawing
III.A.6	Sequence of Development Phase 2 (Cells 11-14)	Details of the sequence of landfill development.
III.A.7	Sequence of Development Phase 2 (Cells 15-16)	Details of the sequence of landfill development.

Drawing No.	Drawing Title	Description of Information Contained in Drawing
III.A.8	Sequence of Development Phase 2 (Cells 17-18)	Details of the sequence of landfill development.
III.A.9	Sequence of Development Phase 2 (Cells 19-20)	Details of the sequence of landfill development.
III.A.10	Final Grading Plan	Final cover design details.
III.A.11	Largest Open Area	Largest open area.
III.A.13-III.A.21	Landfill Section A-A' through G-G'	Cross sectional drawings.
III.B.3	Post-Development Drainage Conditions	Drainage features and developed conditions summary.
III.B.4 and III.I.1	Post-Development Drainage Map	Drainage features after closure.
III.B.5	Drainage Details, 1 of 2	Details of drainage features.
III.B.6	Drainage Details, 2 of 2	Details of drainage features.
III.B.8 - III.B.10	Drainage Profiles Ditches	Drainage features for ditches.

C. Final Cover Quality Control Plan

A final cover quality control plan (FCQCP) is located in **Attachment III.I.2**. The FCQCP describes the final cover system design, construction, and evaluation protocol and processes, including the personnel, materials, methods, sampling and testing standards, procedures, and practices to be used in procuring, handling, installing, and evaluating all elements of the final cover system. It establishes the material requirements; personnel qualifications and roles; installation requirements; quality control and quality assurance monitoring, testing, documentation, and reporting programs to be used during construction of each component of the final cover system to assure and to verify that the final cover system is constructed as designed and in accordance with applicable rules and technical standards.

D. Documentation and Reporting of Final Cover System Construction and Testing

The professional of record will document all aspects and stages of the final cover installation, including materials used, equipment and construction methods, and the type and rate of sampling and quality control testing performed. Following completion of construction of the final cover, the site operator/permittee will submit to the TCEQ executive director, a Final Cover System Evaluation Report (FCSER) for each landfill unit.

V. Closure Activities and Completion Schedules for Each Landfill Unit and for the Final Facility Closure

A. Closure of a Landfill Unit

The following activities will be conducted to satisfy the closure criteria for a landfill unit:

(1) Closure Notification to the TCEQ Executive Director:

The site operator will inform the executive director of the TCEQ, in writing, of the intent to close the unit no later than 45 days prior to the initiation of closure activities and place this notice of intent in the operating record.

(2) Stoppage of Waste Acceptance and Commencement of Other Closure Activities for the Unit:

The site operator will stop accepting waste upon receiving the known final receipt of waste. The site operator will ensure that the permitted top elevations of the in-place waste, as depicted in/derived from the unit's final contour map approved by the TCEQ executive director, are not exceeded at any section or part of the landfill unit. The site operator will begin closure activities for the unit no later than:

- Thirty days after the date on which the unit receives the known final receipt of wastes; or
- One year after the most recent receipt of wastes if the unit has remaining capacity and there is a reasonable likelihood that the unit will receive additional wastes.

(3) Request for Extension Beyond the 1-Year Deadline for Commencing Closure Activities for a Unit:

The site operator may submit a written request to the executive director of the TCEQ for review and approval for an extension beyond the one-year deadline for the initiation of closure. The request will include the following:

(a) All applicable documentation necessary to demonstrate that the unit has the capacity to receive additional waste; and

(b) All documentation necessary to demonstrate that the site operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the MSW landfill unit.

(4) Construction of Final Cover:

The site operator will construct the permitted final cover over the waste mass utilizing methods, procedures, and specifications described in the FCQCP. The final constructed contours, elevations, and slopes of the installed final cover will match the permitted final cover contours, elevations, and slopes shown in closure drawings contained in this closure plan.

(5) Construction of Drainage Features:

The site operator will construct the drainage structures shown in drawings referenced or contained in this closure plan or in the facility surface water drainage report.

(6) Completion of Outstanding or Replacement of Damaged Groundwater or Landfill Gas Monitoring Components:

The site operator will complete installation of any outstanding or replacement of any damaged groundwater or landfill gas monitoring system components and landfill gas control systems as needed to maintain current and effective groundwater or landfill gas monitoring and control systems.

(7) Submittal of Final Cover System Evaluation Report (FCSER) to the TCEQ Executive Director:

Following completion of construction of the final cover for the subject landfill unit, the site operator will submit to the TCEQ executive director for review and acceptance, a FCSER for the unit.

(8) Completion of Closure Activities for the Landfill Unit:

The site operator will complete closure activities for the unit within 180 days following the start of closure activities, unless the executive director of the TCEQ grants an extension as described in Item V.A.8(a) below.

(a) Request for Extension of the Completion of Closure Activities for the Landfill Unit:

The site operator may submit a written request for an extension for the completion of closure activities to the TCEQ for review and approval. The extension request will include:

- All applicable documentation necessary to demonstrate that closure will, of necessity, take longer than 180 days; and
- All applicable documentation necessary to document that all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed MSW landfill unit.

(9) Submittal of Engineer's Certification of Closure to the TCEQ Executive Director and Request of Closure Inspection to TCEQ Regional Office:

Following completion of all closure activities for the landfill unit, the site operator will submit:

(a) Closure Inspection

A written request to the local TCEQ regional office for a closure inspection of the unit.

(b) Closure Certification

A certification, signed by an independent licensed professional engineer, to the executive director of the TCEQ for review and approval verifying that closure has been completed in accordance with this closure plan. The site operator will submit the certification via registered mail, and the submittal will contain all applicable documentation necessary for certification of closure of the unit, including:

- A final cover system evaluation report (FCSER) documenting the installation of the final cover. The FCSER may be submitted as a separate document for review and approval following the completion of the final cover installation. In that case, the certification of closure will be submitted subsequently;
- A final contour map as described under Section III.E that includes the relevant unit; and
- Copy of the letter to the TCEQ regional office requesting a closure inspection of the relevant unit.

(10) TCEQ's Acknowledgement of Termination of Operation and Closure of a Unit:

Upon receipt, the TCEQ executive director will review the closure documents for completeness and accuracy; and following receipt of the closure inspection report from the agency's regional office verifying proper closure of the MSW landfill unit according to this closure plan, the executive director will, in writing, acknowledge the termination of operation and closure of the unit and deem it properly closed. Thereafter, the site operator will comply with the post-closure care requirements described in the post-closure care plan for the unit.

(11) Deed Recordation for Disposed Regulated Asbestos Containing Materials (RACM):

Upon closure of the unit that accepted RACM, the site operator will place a specific notation that the unit accepted RACM in the deed records for the facility with a diagram identifying the RACM disposal areas. Concurrently, the site operator will submit to the TCEQ executive director, a notice of the deed recordation and a copy of the diagram identifying the asbestos disposal areas.

(12) Placement of all Closure Documentation in the Site Operating Record:

Once approved, the closure certification and all other documentation of closure will be placed in the site operating record.

(13) Closure Schedule for the Landfill Unit:

A closure schedule, **Attachment III.I.3**, is attached. The schedule shows all the closure activities listed within Section V.A and the timelines for commencing and completing each activity. Also, the schedule shows that closure activities for the landfill unit will be completed within 180 days following the initiation of closure activities as required, unless an extension is granted by the TCEQ executive director.

(14) Other: (enter as applicable).

B. Closure of the Waste Storage or Processing Units or Operations

Closure of the waste storage or processing units or operations authorized under this permit will include removal of all waste, waste residues, and any recovered materials. The facility units and operations will either be dismantled and removed off-site or decontaminated. The site operator will dispose at the landfill or evacuate all materials (including feedstock, in process, and processed) to an authorized facility and disinfect all leachate handling units, tipping areas, processing areas, and post-processing areas. If there is evidence of a release from a unit or operation, the site operator will conduct an investigation, as approved by the TCEQ executive director, into the nature and extent of the release and an assessment of measures necessary to correct an impact to groundwater.

C. Final Closure of the Facility

In addition to the closure activities listed in Section V.A above for closing a landfill unit, the site operator will conduct the following activities for the closure of the entire facility:

(1) Publish Final Closure Notice and Place the closure Plan in a Public Place:

No later than 90 days prior to the initiation of the final facility closure, the site operator will:

(a) Publication of Notice:

The site operator will publish notice in the newspaper(s) of largest circulation in the vicinity of the facility to inform the public of the final closure of the facility. This notice will include:

- The name of the facility;
- The address, and physical location of the facility;
- The facility's permit number; and
- The last date of intended receipt of waste.

(b) Place Copies of the Closure Plan in a Public Place:

The site operator will also make available an adequate number of copies of the approved final closure and post-closure plans for public access and review at the

Greater El Paso Landfill

7968 San Paulo Drive

El Paso, Texas 79915

(state public place within the area, including address, where the plan will be available for public access and review).

(2) Submit Written Notice of "Intent to Close the Facility" to the TCEQ Executive Director:

The site operator will provide written notification to the TCEQ executive director of the intent to close the facility. This notice will be provided to the executive director no later than 90 days prior to the initiation of the final facility closure, and thereafter be placed in the site operating record.

(3) Post Signs and Install Barriers:

Upon notifying the executive director of the intent to close the facility and no later than 90 days prior to the initiation of final facility closure, the site operator will:

(a) Post Final Closure Signs:

The site operator will post a minimum of one sign at the main entrance and all other frequently used points of access for the facility notifying all persons who may utilize the facility of the date of closing for the entire facility and the prohibition against further receipt of waste materials after the stated date.

(b) Install Barriers:

Also, the site/operator will install suitable barriers at all gates or access points to adequately prevent the unauthorized dumping of solid waste at the closed facility.

(4) Filling of "Affidavit to the Public" and Performance of the Final Deed Recording:

Upon closure of all the landfill units or upon final closure of the facility, the site operator will:

(a) File Affidavit

File with the county deed records an "Affidavit to the Public" in a form provided by the TCEQ executive director that includes an updated metes and bounds description of the extent of the disposal areas at the facility and the restrictions to future use of the land in accordance with applicable provisions under 30 TAC Chapter 330, Subchapter T.

(b) Record a Notation on the Deed

Record a certified notation on the deed to the facility property, or on some other instrument that is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and use of the land is restricted according to the provisions under 30 TAC Chapter 330, Subchapter T.

(c) Place Documents in the Operating Record

Place a copy of the "Affidavit to the Public" and a copy of the modified deed in the site operating record.

(5) Submittal of a Copy of the "Affidavit to the Public" and the "Modified Deed" to the TCEQ Executive Director:

Within ten days after completion of final closure activities of the facility, the site operator will submit the following to the TCEQ executive director by registered mail:

(a) A certified copy of the "Affidavit to the Public";

(b) A certified copy of the modified deed to the facility property; and

(c) A certification, signed by an independent licensed professional engineer, verifying that final facility closure has been completed in accordance with the approved closure plan. The submittal will contain all applicable documentation necessary for certification of final facility closure, including:

- Final Cover System Evaluation Report (FCSER) documenting the installation of the final cover. The FCSER may be submitted earlier as a separate document for review and approval following the completion of the final cover installation. In that case, the certification of closure will be submitted subsequently;
- A final contour map as described under Item III.G above;
- Copy of a letter to the TCEQ regional office requesting a final closure inspection of the facility; and
- Copies of documents verifying newspaper publication of the notice of the final facility closure.

(6) Other

Additional items relating to the schedule for final facility closure, and additional closure activities specific to the final closure of this facility include:

(7) TCEQ's Acceptance of Termination of Operation and Closure of a Landfill Facility:

Following the TCEQ executive director's receipt and completion of the review of the professional engineer's certification of the completion of facility closure and the final closure documents, and receipt of the inspection report from the agency's regional office verifying proper closure of the facility according to this closure plan, the executive director will, in writing, accept the termination of operation and closure of the facility and deem it properly closed. Thereafter, the site operator will comply with the post closure care requirements described in the post closure plan for the facility.

(8) Final Closure Schedule for the Facility:

Attachment III.I.3, Final Closure Schedule, provides the closure schedule for the final facility closure. It incorporates the schedule for closure of a unit as discussed in Section V.A and also shows the commencement and completion timelines for the final closure activities listed within this Section.

VI. Summary of Attachments

A. Drawings and Maps

The following Drawings and Maps are provided in **Appendix III.A**, **Appendix III.B**, **Appendix III.C,** and **Appendix III.I** to supplement this plan.

- **Drawing III.A.10**, Final Contour Map.
- **Drawings III.A.13** through **III.A.21** , Cross-Section Drawings of the Landfill Units at Closure.
- **Drawings III.B.1** through **III.B.14 and III.I.1**, Final Cover and Drainage Features Installation Drawings.

Other Drawings/Maps: **Drawings III.C.5** through **III.C.8**, Leachate Evaporation Pond Layout

B. Documents

- **Attachment III.I.1**, Alternative Final Cover Demonstration Water Balance Cap.
- **Attachment III.I.2**, Final Cover Quality Control Plan (FCQCP).
- **Attachment III.I.3**, Final Closure Schedule Chart.

C. Additional Items Attached (enter as applicable)

N/A

VII. Professional Engineer's Statement, Seal, and Signature

Name: Tonya Koller

Title: Project Engineer

Date: 9/12/2025

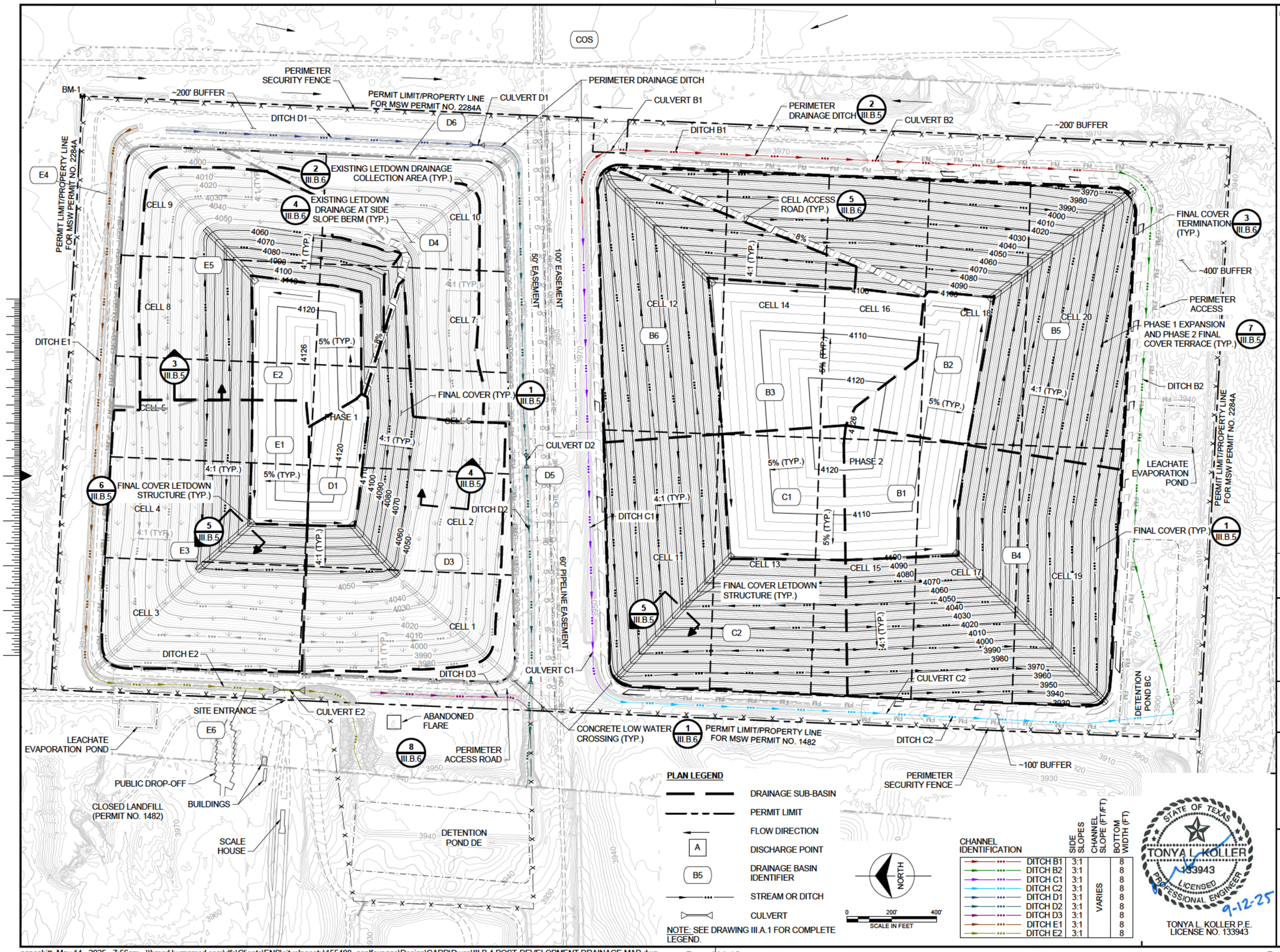
Company Name: Burns & McDonnell

Firm Registration Number: F-845

Professional Engineer's Seal



Signature



no.	date	by	ckd	description
0	9/12/25	TMC	TLK	2284A PERMIT MOD

NOTES:

1. INDEX CONTOUR INTERVAL, 2 FEET.
2. GREATER EL PASO LANDFILL EXISTING SITE TOPOGRAPHY (2284A PERMIT AREA) DERIVED FROM ORTHO-PHOTOGRAPHY FROM AN UNMANNED AERIAL SURVEY TIED TO GROUND CONTROL PANELS PROVIDED BY PARKHILL, SMITH & COOPER, AUGUST 28, 2019. TOPOGRAPHY WITHIN CELLS 11 THROUGH 14 COMPLETED WITH GROUND CONTROL POINTS PROVIDED BY THE CITY OF EL PASO, AUGUST 2022. TOPOGRAPHY OUTSIDE OF THE SURVEY EXTENTS WAS OBTAINED FROM THE TEXAS NATURAL RESOURCES INFORMATION SYSTEM, DATED APRIL 2008.
3. THE SURVEY COORDINATES ARE ON THE TEXAS COORDINATE SYSTEM, CENTRAL ZONE 4203, NAD83. HORIZONTAL DATUM IS NAD83. VERTICAL DATUM IS NAVD88.
4. EXISTING TOP OF FINAL COVER SURFACE FOR PHASE 1 PREPARED BY PARKHILL, SMITH & COOPER, INC. AND REPRESENTS DESIGN FINAL COVER ELEVATIONS. CONTOUR INTERVAL IS 2 FEET. PHASE 1 RECEIVED FINAL COVER IN 2021.
5. DESIGN CONTOURS REPRESENT TOP OF FINAL COVER SURFACE FOR PHASE 1 AND PHASE 2. CONTOUR INTERVAL IS 2 FEET. 2284 PERMITTED DESIGN CONTOURS WERE BASED ON CITY DATUM ELEVATIONS AND WERE ADJUSTED TO NAVD88 BY ADDING 10.39 FEET AS CERTIFIED BY BROCK & BUSTILLOS INC. ON DECEMBER 7, 2023. DATUM CERTIFICATION LETTER INCLUDED IN APPENDIX I/II.B.

FOR PERMITTING PURPOSES ONLY

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.
FIRM REG. NO. F-845

date	detailed
SEPTEMBER 2025	D. KAMBLE
designed	checked
T. CAMMACK	T. KOLLER

EP TX CITY OF EL PASO

City of El Paso, Texas

2284A PERMIT AMENDMENT

POST-DEVELOPMENT DRAINAGE MAP

project	contract
155488	-

drawing **III.I.1** – rev. **0**

file III.B.4 POST-DEVELOPMENT DRAINAGE MAP.dwg

STATE OF TEXAS
TONYA L. KOLLER
133943
LICENSED PROFESSIONAL ENGINEER
9-12-25

TONYA L. KOLLER P.E.
LICENSE NO. 133943

ATTACHMENT III.I.1 – ALTERNATIVE FINAL COVER DEMONSTRATION

MSW AUTH NO. 2284A

ATTACHMENT III.I.1 – ALTERNATIVE FINAL COVER DEMONSTRATION

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 0
SEPTEMBER 12, 2025

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List of Abbreviations

Abbreviation	Term/Phrase/Name
AFC	Alternative Final Cover
DBS	Daniel B Stephen, Inc.
FCQCP	Final Cover Quality Control Plan
GEP Landfill or Facility	Greater El Paso Landfill, MSW Authorization Number 2284A
HELP	Hydrologic Evaluation of Landfill Performance
MSW	Municipal Solid Waste
NCDC	National Climatic Data Center
NSW	National Weather Service
NOAA	National Oceanic and Atmospheric Administration
P	Precipitation
PET	Potential Evapotranspiration
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TRI	Texas Research International
WB	Water Balance

III.I.1.1.0 Introduction

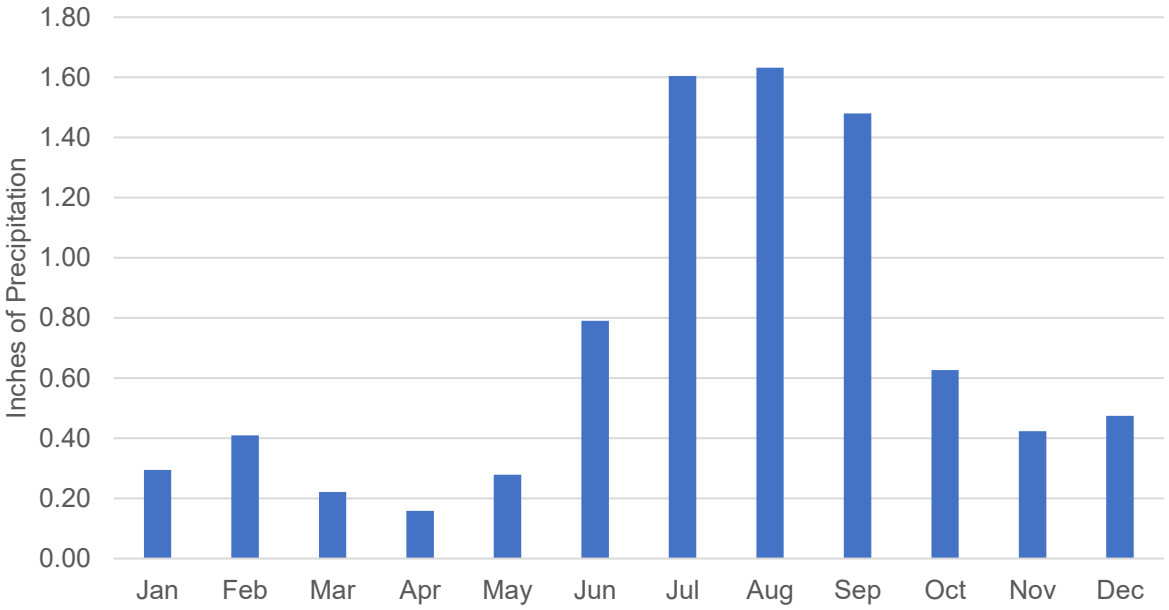
The purpose of this attachment is to present a Water Balance (WB) Alternative Final Cover (AFC) system for the Greater El Paso Landfill, Municipal Solid Waste (MSW) Authorization Number 2284A (GEP Landfill or Facility). This final cover system has been prepared in accordance with Chapter 30 of Texas Administrative Code (TAC) §330.457(d) and Texas Commission on Environmental Quality's (TCEQ's) "Guidance for Requesting a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill" (Revised March 2017).

This report was originally prepared by Parkhill, Smith & Cooper, Inc. in March 2012 for Permit Authorization 2284. This report includes updates to incorporate current meteorological data into the UNSAT-H modeling in support of the vertical expansion permit amendment.

III.I.1.2.0 Water Balance Cover System Potential

The GEP Landfill is located southeast of the city of El Paso in El Paso County. This area is ideal for water balance cover systems due to climate and local soils. The area has a warm, desert climate with very hot summers, usually with little or no humidity, and mild, dry winters. Rainfall averages 8.4-inches per year, most of which occur during the monsoon season from July to September (see **Figure III.I.1.2-1**). According to the National Weather Service (NWS), El Paso Weather Bureau, the sun shines during 83.8 percent of daylight hours.

Figure III.I.1.2-1: Average Monthly Precipitation for El Paso, Texas (NOAA)



Existing vegetation at the landfill site consists of sparse shrubs and grasses. Due to the mild climate, the El Paso area has a long growing season (March 23 - November 9). However, high temperatures and low rainfall make sustaining vegetative growth without irrigation extremely difficult. Therefore, the GEP Landfill's WB cap has been designed with no vegetative cover.

The soils available for construction of the WB cap will be obtained from future cell development areas (e.g., Phase 2). These soils are stockpiled on adjacent City owned property during cell excavation. These soils are sandy in nature with high hydraulic conductivity. They exhibit favorable compaction characteristics as they can be placed in a controlled manner from 75 percent to 95 percent standard proctor. These soils also have beneficial soil water retention characteristics as they are able to achieve 37 percent - 46 percent volumetric water storage based upon compaction. The ability of these soils to sustain native or non-native plants is inconsequential as plant growth will not be required for the WB cap to perform as designed.

III.I.1.3.0 Soil Property Description

Soil samples were previously collected from the GEP Landfill Phase 2 area in 2011 for analysis and results are provided in **Appendix III.I.1.E**. Soil samples obtained from the site were analyzed by Daniel B. Stephen, Inc. (DBS) in Albuquerque, New Mexico and Texas Research International (TRI) in Austin, Texas. DBS completed the soil-water retention curve, saturated hydraulic conductivity, and bulk density testing. TRI completed the USCS classification, standard proctor, optimum moisture, and shear strength testing. For soil characteristics which vary by compaction, tests were run at 75 percent, 80 percent, 85 percent, 90 percent, and 95 percent of standard proctor. **Table III.I.1.3-1** summarizes the results of soil testing.

Table III.I.1.3-1: Soil Testing Results

Parameter	Value	
USCS Classification	Silty sand with gravel (SM)	
Bulk Density	163.9 lb/cf	
Maximum Dry Density (Standard Proctor)	120.0 lb/cf	
Percent Optimum Moisture	10.4%	
Soil Water Retention Curve - 80%	Pressure Head (cm)	Moisture Content (%)
	0.00	0.4523
	12.00	0.4154
	38.00	0.3966
	79.00	0.1882
	509.90	0.1043
	11,727.7	0.0558
	851,293	0.0123
Soil Water Retention Curve - 90%	Pressure Head (cm)	Moisture Content
	0.00	0.3766
	10.50	0.3609
	39.50	0.3483
	83.00	0.3355
	509.90	0.1154
	11,727.7	0.0628
	851,293	0.0138
Saturated Hydraulic Conductivity - 80%	6.6E-03 cm/sec (23.7 cm/hr)	
Saturated Hydraulic Conductivity - 90%	1.3E-03 cm/sec (4.6 cm/hr)	

Notes: pounds per cubic foot = lb/cf; centimeters = cm; centimeters/second = cm/sec; centimeters per hour = cm/hr

The following soil parameters are required to simulate final cover performance: saturated water content, residual water content, saturated hydraulic conductivity, and van Genuchten parameters. Saturated water content was directly determined by DBS during lab testing. The water content and van Genuchten parameters were determined by fitting the soil's moisture retention data to the van Genuchten equation.

Curves of best fit for 80 percent and 90 percent compaction of soils and curves showing the relationship between hydraulic conductivity and water content are provided in **Appendix III.I.1.E**.

III.I.1.4.0 Climate Data

In order to accurately simulate the performance of a water balance cap at the GEP Landfill, historical recent weather data from the region was used. In accordance with TCEQ guidelines the selected weather station needed to be representative of conditions at the site and have sufficient records for 30 years of climate data. Daily meteorological data from the El Paso International Airport weather station was provided for the model for current modeling years, between 1995 and 2024, where available. Data sources are summarized in **Table III.I.1.4-1**.

Table III.I.1.4-1: Meteorological Data Sources

Data Type	Date Range	Source
Daily Precipitation	1995-2024	National Oceanic and Atmospheric Administration (NOAA)
Maximum Dew Point Temperature	1995-2011	NOAA
	2012-2024	Weather Underground
Air Temperature	1995-2024	NOAA
Solar Radiation	1995-2024	Synthetic generation using the Hydrologic Evaluation of Landfill Performance (HELP) model
Wind Speed	1995-2024	NOAA
Cloud Cover	1995-2024	Synthetic generation using the HELP model

Note in 2006, precipitation reached 208 percent of the annual average precipitation, and the severe August 2006 storm events led to widespread flooding and substantial damage throughout the area. Given the extreme and atypical nature of these conditions, 2006 is considered a force majeure event and is not representative of the region's typical meteorological patterns. As such, including this outlier in long-term performance modeling would not produce results reflective of expected final cover performance. To account for this anomaly, daily precipitation values for 2006 were replaced with the daily average precipitation calculated over the 30-year modeling period, inclusive of the 2006 data points.

Climatological data input files are provided for reference in **Appendix III.I.1.A**.

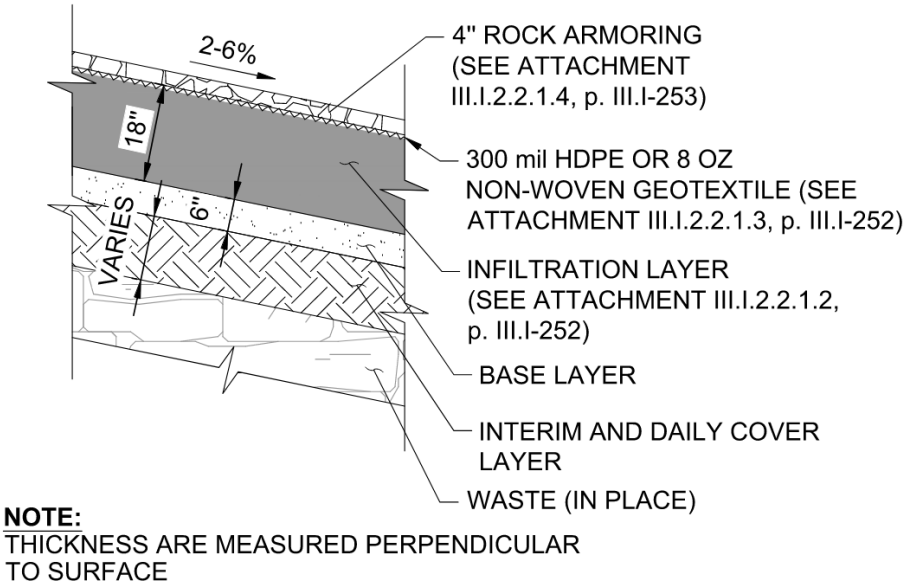
III.I.1.5.0 Water Balance Final Cover Design

The water balance final cover design for the GEP Landfill will be a multilayer soil cap. This final cover system has been designed to maximize precipitation infiltration and to minimize percolation to less than 4 millimeters annually in accordance with TCEQ 2017 guidance document requirements. The final cover system will consist of the following layers, from top to bottom:

- **Erosion Control Layer.** This 4-inch thick layer of rock armoring will be placed as the top layer of the cap and will consist of either crushed stone or river rock. It will be constructed to prevent erosion while allowing infiltration into the lower portion of the cap. A geonet or geotextile will be placed below this layer to provide separation between the rock armoring and the soil.
- **Infiltration Layer.** This 18-inch thick soil layer will be constructed from on-site borrow soil. It will provide the water storage required by the 30-year weather period simulation.
- **Base Layer.** This 6-inch thick soil layer will be constructed from on-site borrow soil. It will serve as a base layer for placement of the infiltration layer.

As previously discussed, the final cover system is designed with no vegetation. The erosion control layer will provide more consistent, year-round erosion control than vegetation. A detail of the water balance final cover system is provided as **Figure III.I.1.5-1**. Details for the termination of the liner and tie-ins are provided in Part III, Appendix III.B, Attachment III.B.3, Drawings III.B.5 and III.B.6.

Figure III.I.1.5-1: Typical Water Balance Cover



III.I.1.5.1 Slope Stability Calculations

The slope stability of the WB AFC has been calculated using infinite slope analysis using the following equation:

$FS = \frac{\tan \emptyset}{\tan B}$ Where:

FS = Factor of Safety

$\emptyset$ = WB Cap Soil Friction

B = Slope Angle

The maximum slope the WB AFC will be installed at B 4:1 (H:V) or 14.1º. The soil friction has been determined by ASTM D3080. Results of this test are available in **Appendix III.I.1.E**. Using this data the factor of safety was calculated as:

$$FS = \frac{\tan(25.1°)}{\tan(14.1°)}$$

$$FS = \frac{0.4684}{0.2511}$$

FS = 1.86

The calculated factor of safety is greater than the typical landfill slope factor of safety of 1.5.

III.I.1.5.2 Equivalent Erosion Protection

As required by 30 TAC §330.457(d)(2) the WB AFC must provide equivalent protection from wind and water as the prescriptive cover. The WB AFC will provide the same erosion protection from wind and water as the prescriptive cover as they both have identical erosion protection. The same erosion controls, both structural and non-structural, will also be used on the WB AFC system. The noted erosion controls are located in the Erosion and Sedimentation Control Plan (Part III, Appendix III.B, Attachment III.B.2).

Soil loss calculations provided in Part III, Appendix III.B, Attachment III.B.2 show that both cover systems keep erosion below 2-3 tons of soil per year, meeting the requirements of 30 TAC §330 Subchapter G. No additional restraints will be used to hold the rock armor in place. An identical placement of rock armoring was utilized on Phase 1 of the GEP Landfill, as well as on the Clint Landfill (MSW No. 1482) adjacent to this Facility, and both have performed as designed. Based on this information, the WB AFC provides equivalent protection from wind and water erosion as the prescriptive cover.

III.I.1.5.3 Final Cover Storage Capacity

The theoretical water storage capacity of a unit of soil is the volumetric difference between the soil's saturated water content and residual water content. The storage capacity for the final cover system is the total of the capacity of all the layers in the system.

Erosion Protection Layer

No storage capacity

Infiltration Layer (18”)

$\Theta_S = 0.37$ (Saturated Water Content, measured)

$\Theta_{FC} = 0.85 * \Theta_S$ (Field Capacity Water Content)

$\Theta_{FC} = 0.32$

$\Theta_{WP} = 0.03$ (Wilting Point Water Content)

$\Theta_V = \Theta_{FC} - \Theta_{WP}$

$\Theta_V = 0.32 - 0.03 = \mathbf{0.29}$ (Volumetric Storage Capacity)

$S = T * \Theta_V$ (Layer Storage = Thickness * Θ_V)

$S = 18\ in. * 0.29 = \mathbf{5.22\ in.}$

Base Layer (6")

$\Theta_S = 0.44$ (Saturated Water Content, measured)

$\Theta_{FC} = 0.85 * \Theta_S$ (Field Capacity Water Content)

$\Theta_{FC} = 0.37$

$\Theta_{WP} = 0.05$ (Wilting Point Water Content)

$\Theta_V = \Theta_{FC} - \Theta_{WP}$

$\Theta_V = 0.37 - 0.05 = \mathbf{0.32}$ (Volumetric Storage Capacity)

$S = T * \Theta_V$ (Layer Storage = Thickness * Θ_V)

$S = 6\ in. * 0.32 = \mathbf{1.92\ in.}$

Total Final Cover System Storage

$S_T = 5.22 + 1.92 = \mathbf{7.14\ in.} = \mathbf{18.14\ cm}$

III.I.1.6.0 UNSAT-H Final Cover Model

UNSAT-H is a one-dimensional, physically based model and is commonly used to model alternative final covers. UNSAT-H is able to address soil water infiltration, redistribution, evaporation, plant transpiration, deep drainage, and soil heat flow in one-dimension. UNSAT-H simulates liquid water flow using Richards' equation, water vapor diffusion using Flick's law, and sensible heat flow using the Fourier equation. These calculations are run by calculating the finite differences between nodes in a soil network. Starting with the input file, hundreds of these calculations are run for each day in the simulation, the results of the previous day serving as the initial conditions for the following day. Totals for each movement (infiltration, evaporation, etc.) are summed at the end of each year.

For analysis of the Alternative Final Cover at the GEP Landfill, three simulation runs were completed to demonstrate the effectiveness of the alternative final cover, which include “Greater El Paso Landfill 2284A - 2025 ET Cap Design” (Normal), “Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity Increase” (+20% hydraulic conductivity data for the infiltration layer and base layer material, to reflect the soil types allowed for use in the Final Cover Quality Control Plan [+20% HC]), and “Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants” (No Plants). The following paragraphs outline the input values used, the source of those values, and any assumptions made. Results for these simulations are discussed in **Section III.I.1.7.0** and model files are included in **Appendix III.I.1.B** (Normal), **Appendix III.I.1.C** (+20% HC), and **Appendix III.I.1.D** (No Plants).

III.I.1.6.1 Model Input Setup

UNSAT-H input parameters are classified into one of the five following categories:

- Options, Contracts, and Limits
- Soil Property Description
- Initial Conditions
- Plant Information
- Boundary Conditions

III.I.1.6.2 Options, Constants, and Limits

These input parameters define the components of groundwater flow to be modeled, the equations to be used, the soil profile, and model preferences. **Table III.I.1.6-1** provides a tabular view of model input options used for alternative final cover design.

Under the “Normal” and “+20% HC” simulations, the plant option selected was to include plants to simulate the rock armoring, not actual plant grades. The lower boundary condition specified was a unit gradient. The goal of the WB AFC design is to limit infiltration into the bottom of the cap. The unit gradient condition assumes a constant hydraulic conductivity of the bottom layer. The profile orientation is vertical. UNSAT-H is a one-dimensional model and can only simulate horizontal flow or vertical flow independently. The time step control was based on the total mass balance, rather than on the change in theta. Theta, representing water content, is assumed to be the source of the largest error. Heat flow was not simulated, as not enough soil information is available to accurately simulate it.

The level of output specified was for end of day and end of simulation. The ending day of the simulation and the number of days data are provided was set at 366, which is the maximum UNSAT-H allows. The

simulation was performed for a period of 30 years, which allows the cover to be tested using real data and under various climate situations. The water application information was set to use the meteorological data since actual data was available. Convective heat flow was not included. The DELSUB period was set to zero. The DELSUB period determines the level of output generated, and daily summaries were specified previously.

Next, the option was selected to allow evaporation to occur independent of plant growth. Daily potential evapotranspiration was set to be distributed throughout the day using a sinewave function. This option was selected to calculate the surface boundary condition when heat flow is not modeled. The flux option was selected as the surface boundary condition, as head on the top of the soil profile will vary. The option to input meteorological data was selected, but the option to use the cloud cover from the meteorological data was not selected due to lack of measured data. Instead, the solar radiation provided as part of the data will be used to determine a similar effect.

The van Genuchten method was selected to represent the soil hydraulic properties. Samples tested by DBS provided van Genuchten parameters required by UNSAT-H. It was decided to simulate the soil hydraulic properties without hysteresis as site specific soil data on the hysteric behavior of the soils is not available and it was determined to be more accurate to simulate without it.

The Van Genuchten parameters describe the relationship between suction pressure, water content, and hydraulic conductivity in a soil layer. This allows UNSAT-H to automatically adjust the hydraulic conductivity of each layer of the WB AFC infinitely between the "saturated" and "unsaturated" times of the year. This also allows UNSAT-H to simulate capillary breaks between layers of soil as capillary breaks are caused by a difference in metric potential or suction between two adjacent layers.

The geometric mean was selected as the option for estimating liquid conductivity at the midpoint between the nodes and is the most commonly used method by UNSAT-H. Vapor flow was included in the analysis. The option for determining an upper limit for surface head was calculated daily based on atmospheric humidity, as opposed to a constant head. The number of iterations used to solve both the heat and water flow equations was set at the default value of two each. A summary of these parameters is included in **Table III.I.1.6-1**.

Table III.I.1.6-1: Summary of UNSAT-H Input Parameters

Parameter Name	Parameter Description	Value	Source/Notes
TITLE	Input file description	Greater El Paso Landfill 2284A - 2025 ET Cap Design	Normal simulation
		Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity Increase	+20% HC simulation
		Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants	No Plants simulation
IPLANT	Option of plants	1 (Plants)	Normal and +20% HC Simulations

Parameter Name	Parameter Description	Value	Source/Notes
		0 (No Plants)	No Plants simulation
NGRAV	Domain orientation	1 (Vertical)	Simulation of vertical network
IFDEND	Last day of the last year of the simulation	365	365 days each year
IDTBEG	First day for which data have been provided	1	Data provided for Day 1, Year 1
IDTEND	Last day for which data have been provided	365	Data provided for Day 365, Year 30
IYS	Year of the simulation	1995	Simulation to begin in Year 1995
NYEARS	Number of years to simulate	30	Simulation to run to Year 30
ISTEAD	Steady state option	0 (Transient Solution)	Each year only simulated once
IFLIST	Options for entering weather data	2 (Data provided in separate files)	Matches weather data files provided
NFLIST	Number of file names	30	30 weather data files
NPRINT	Option for level of output	0 (Daily summaries and end-of-simulation summary)	Larger files not needed
STOPHR	Time to stop daily simulation	24.0	Simulation to stop at end of day
ISMETH	Option for method of solution	0 (Crank-Nicholson)	Standard method of UNSAT-H solution
INMAX	Number of iterations allowed for solving water flow	4	2 is minimum, selected for stability and mass balance error
ISWDIF	Option for time-step control	1 (Reduce time step if mass balance exceeds DMAXBA)	Standard method of UNSAT-H solution
DMAXBA	Time-step control parameter	1.0E-06	Suggested value is 0.01, selected to reduce mass balance error
DELMAX	Maximum time-step	1.0	Normally 1 hour
DELMIN	Minimum time-step	1.0E-8	Selected to reduce mass balance error
OUTIIM	Time-step parameter	1.00	Selected to reduce mass balance error
RFACT	Maximum time-step factor	1.2	Selected to increase stability
RAINIF	Rainfall time-step reduction factor	1.0E-04	Selected to increase stability

Parameter Name	Parameter Description	Value	Source/Notes
DHTOL	Iteration control parameter	0.0	Selected to increase stability
DHMAX	Iteration control parameter	0.0	Selected to increase stability
DHFACT	Time-step reduction factor	n/a	DHMAX = 0
KOPT	Options for describing soil hydraulic properties	4 (van Genuchten)	Site soils were tested for van Genuchten parameters
KEST	Option for estimating liquid conductivity between nodes	3 (Geometric mean)	Selected to increase stability
WTF	Weighting factor	n/a	KEST ≠ 1
OPBC	Option for the surface-boundary condition	0 (Flux)	Flux to simulate changes soil-atmosphere interaction
IEVOPT	Option to allow evaporation	1 (Evaporation)	Simulation must include evaporation
NFHOUR	Option to distribute daily potential evapotranspiration (PET)	2 (Distributed with sine function)	Data on site specific distribution not available
LOWER	Lower boundary condition option	1 (Unit gradient)	Selected to allow for free drainage at the lower boundary
HIRRI	Minimum head to which the soil can wet	1.0	Typical soil value, confirmed by laboratory results
HDRY	Maximum head to which the soil can dry	1.0E06	Typical soil value, confirmed by laboratory results
HTOP	Constant head of surface node	n/a	ITOPBC ≠ 1
RHA	Relative humidity of the air	n/a	HDRY ≠ 1
IETOPT	Option to input daily meteorological data	1 (Daily data are entered)	30 years of daily data must be used in simulation
ICLOUD	Options to include cloud cover	0 (No)	Cloud cover is already included in the daily solar radiation values in the weather data files
ISHOPT	Options for the upper surface head limit	1 (HDRY based on calculated humidity)	Selected to utilize weather data
IRAIN	Option for water application	1 (Apply precipitation at HPR rate)	Selected as hourly precipitation data is not available
HPR	Hourly precipitation rate	1.0	Default value is 1.0, this value is conservative and allows greater infiltration
IHYS	Option for hysteresis	0 (No hysteresis)	Hysteresis data for this soil not available

Parameter Name	Parameter Description	Value	Source/Notes
AIRTOL	Tolerance limit for entrapped air	n/a	IHYS = 0
HYSTOL	Tolerance limit on head changes	n/a	IHYS = 0
HYSMXH	Maximum head value	n/a	IHYS = 0
HYFILE	Name of restart file	n/a	IHYS = 0
IHEAT	Option for simulating heat flow	0 (No heat flow)	Heat flow parameters not available for this soil
ICONVH	Option to allow convective heat flow	0 (No convective heat flow)	Heat flow parameters not available for this soil
DMAXHE	Time-step control parameter	n/a	IHEAT ≠ 1
UPPERH	Option for the upper boundary condition for heat flow	n/a	IHEAT ≠ 1
TSMEAN	Daily mean temperature	n/a	IHEAT ≠ 1
TSAMP	Daily surface temperature amplitude	n/a	IHEAT ≠ 1
QHCTOP	User-specified surface heat flux	n/a	IHEAT ≠ 1
LOWERH	Option for the lower boundary condition for heat flow	n/a	IHEAT ≠ 1
QHLEAK	Heat flux at bottom boundary	n/a	IHEAT ≠ 1
TGRAD	Temperature gradient	n/a	IHEAT ≠ 1
IVAPOR	Option to allow vapor flow	1 (Yes)	Typical soil values for vapor flow are available
TORT	Tortuosity	0.66	Average soil values are between 0-2, 0.66 is conservative estimate for sandy soils
TSOIL	Average temperature of soil	292.65	Average air temperature for site is 292.65 K (67.1 F)
VAPDIF	Diffusion coefficient of vapor in air	0.24	Coefficient of vapor at 292.65 K, per Bolz and Tuve (1976)
MATN	Number of different soil materials	2	Base and infiltration layer soils
NPT	Number of nodes	43	43 nodes at irregular spacing
MAT,Z	Soil material, depth below surface	(see input file)	

III.I.1.6.3 Soil Property Description

Soil samples were collected from the landfill site for analysis in order to determine their suitability for use in the AFC system. Soil samples obtained from the site were analyzed by DBS for their hydraulic properties and results are provided in **Appendix III.I.1.E**.

UNSAT-H uses the following input parameters to classify soil layers: saturated water content, residual water content, saturated hydraulic conductivity, van Genuchten parameters, and initial suction head. **Table III.I.1.6-2** summarizes the input parameters used by UNSAT-H for the analyses. As specified in the Final Cover Quality Control Plan (Part III, Appendix III.I, Attachment III.I.2) the constructed WB AFC will be tested to verify that each layer is representative of the parameters listed in **Table III.I.1.6-2**. All of these parameters were determined using site-specific laboratory data.

The collected soil sample was classified as Silty Sand (SM). The facility's soil boring plan shows that the proposed borrow area contains several classifications of sand (SM, SC, SW, and SP). To allow for use of these classifications for cap construction the soils will be tested for hydraulic conductivity as noted in Final Cover Quality Control Plan (FCQCP).

Table III.I.1.7-3 summarizes the results of the "+20% HC" simulation run utilizing soils with hydraulic conductivity at the maximum allowed by the FCQCP. These results show that these soils still perform within the required criteria.

Table III.I.1.6-2: Summary of UNSAT-H Input Parameters – Soil

Parameter Name	Parameter Description	Value	Source/Notes
DUMMY	Soil Type Name	90% Compaction Soil	n/a
THET	Saturated water content	0.38	Calculated using lab data
THTR	Residual water content	0.03	Calculated using lab data
VGA	Van Genuchten -	0.006	Calculated using lab data
VGN	Van Genuchten - n	2.2	Calculated using lab data
RKMOD	Conductivity model options	2 (Mualem)	Typical option utilized
SK	Saturated hydraulic conductivity	4.6	Lab measurement, Normal and No Plants simulations
		5.5	Lab measurement, +20% HC simulation
EPIT	Exponent of the pore interaction term	0.5	Value for use with Mualem option
DUMMY	Soil Type Name	80% Compaction Soil	n/a
THET	Saturated water content	0.44	Calculated using lab data
THTR	Residual water content	0.05	Calculated using lab data
VGA	Van Genuchten -	0.017	Calculated using lab data
VGN	Van Genuchten - n	3.5	Calculated using lab data
RKMOD	Conductivity model options	2 (Mualem)	Typical option utilized

Parameter Name	Parameter Description	Value	Source/Notes
SK	Saturated hydraulic conductivity	23.7	Lab measurement, Normal and No Plants simulations
		28.4	Lab measurement, +20% HC simulation
EPIT	Exponent of the pore interaction term	0.5	Value for use with Mualem option

Table III.I.1.6-2 provides names of the various layers of the modeled cover system. The AFC system was represented by a network of nodes in a vertical profile, with two layers. For design, the thickness of each layer was varied until the WB AFC design met performance criteria.

III.I.1.6.4 Initial Conditions

UNSAT-H utilizes initial suction head of the soil for initial hydraulic conditions. In accordance with the FCQCP, soils will be placed within 2 percent of the optimum moisture of the soil. The initial suction head was determined for each soil layer at 10.4 percent moisture content. The infiltration layer will have an initial suction head of 575 centimeters. The base layer will have an initial suction head of 125 centimeters. **Table III.I.1.6-3** summarizes the UNSAT-H initial condition input parameters.

Table III.I.1.6-3: Summary of UNSAT-H Input Parameters – Initial Conditions

Parameter Name	Parameter Description	Value (cm)	Source
NDAY	Day before suction head values are set	0	Sets initial suction head values for Day 1
H	Suction Head - 90% Soil	575 (Nodes 1 - 19)	Calculated value soil suction at optimum moisture
H	Suction Head - 80% Soil	125 (Nodes 20 - 25)	Calculated value soil suction at optimum moisture

III.I.1.6.5 Plant Information

Upon completion of the WB AFC system no vegetation will be planted. Instead, a rock armoring layer will be placed on top of the cap to provide erosion protection. The rock armoring will be well graded and placed to allow precipitation free access to the infiltration surface.

The “Normal” and “+20% HC” simulations were modeled in UNSAT-H by simulating the rock layer as a year-round plant canopy covering 80 percent of the ground surface. This is accomplished by having the plant canopy germinate on Day 1 and go dormant on Day 365 of every year. To verify that this method did not result in inappropriate transpiration, the root system does not start growth until Day 365 of every year. This method was utilized to simulate the rock layer because the layer will provide some cover to the soil but will not behave as a soil in any way. This is similar to the function of a plant canopy on a cover.

This is confirmed by no modeled transpiration occurring during the 30-year simulation. **Table III.I.1.6-4** summarizes the plant input parameters for the “Normal” and the “+20% HC” simulations. For the “No

Plant" simulation, these parameters were removed. **Table III.I.1.7-2** summarizes the results of a 30-year simulation with "No Plant" simulation (IPLANTS = 0). These results show that the addition of the rock layer does not affect the performance of the WB cap.

Table III.I.1.6-4: Summary of UNSAT-H Input Parameters – Plant Information[1]

Parameter Name	Parameter Description	Value	Source
LEAF	Option for leaf area index	0 (LAI values not needed)	NFPET = 1
NFROOT	Option for root growth	1 (Exponential relationship)	Only option available
NUPTAK	Option for plant water intake	1 (Sink term approximation proposed by Feddes)	Only option available
NFPET	Option for portioning PET	1 (Partitioning using LAI of Ritchie and Burnett (1971))	Typical option used for partitioning
NSOW	Day of the year when seeds germinate	1	Rocks will be present on Dav l of each year
NHRVST	Day of the year which the plants cease transpiration	365	Rocks wil1 be present on Dav 365 of each year
BARE	Fraction of soil surface bare of plants	0.2	Average percentage of exposed soil under rock cover
Parameter Name	Parameter Description	Value	Source
AA, Bl, B2	Root growth coefficients	n/a	Roots not allowed to grow
NTROOT	Growth day on which roots reach the corresponding node	365 (All nodes)	Roots not allowed to grow
HW,HD,HN	Head values for wilting, transpiration decrease, and anaerobic conditions	n/a	Roots not allowed to grow, so there will be no transpiration
PETPC (1:5)	Coefficients for the partitioning of PET using LAI	0.0, 0.52, 0.5, 0.1, 2.7	All default values for Ritchie and Burnett (1971)

[1] Parameters apply for only the "Normal" and the "+20% HC" simulations. Plant information parameters were removed for the "No Plant" simulation.

III.I.1.6.6 Boundary Conditions

The boundary conditions include the meteorological input data and identification of the site where it is measured. Meteorological input required by UNSAT-H includes daily maximum and minimum temperatures, dew point, solar radiation, wind speed, and precipitation. The climate of the area was researched for use in the model.

The climate of the area is desert. Actual daily climate data obtained from the NWS weather station at El Paso International Airport from 1994-2024 were used in the simulations. The data set provided the most comprehensive actual measured data nearest the facility. The average annual rainfall in El Paso is 8.4-inches. The data from NOAA as entered in UNSAT-H model is included in **Appendix III.I.1.A**. **Table III.I.1.6-5** summarizes the boundary condition input parameters.

Table III.I.1.6-5: Summary of UNSAT-H Input Parameters – Boundary Conditions

Parameter Name	Parameter Description	Value	Source
ALBEDO	Potential evapotranspiration	0.20 (unitless)	Average daily pan evaporation for El Paso
ALT	Altitude of site	1234 meters	Average elevation of final cap
ZU	Height of wind speed measurement	0.5 meters	Height of wind speed meter at weather station
PMB	Average annual atmospheric pressure	875 millibars	Average pressure measure at weather station

III.I.1.7.0 UNSAT-H Final Cover Model Results

To meet the requirements of 30 TAC §330.457(d)(I) the modeled performance of the WB AFC must show that percolation at the base of the final cover system is less than 4.0 millimeters annually for the entire simulation. The results of the simulation are summarized in **Table III.I.1.7-1** (Normal), **Table III.I.1.7-2** (No Plants), and **Table III.I.1.7-3** (+20% HC). These tables include annual data on precipitation (P), potential evapotranspiration (PET), P/PET ratio, evaporation, runoff percentage, storage, percolation, and total mass balance.

Model-estimated storage requirements plotted by year and the calculated available storage capacity for the WB cover are provided in **Figure III.I.1.7-1** (Normal), **Figure III.I.1.7-2** (No Plants), and **Figure III.I.1.7-3** (+20% HC). Based on the results, the annual storage requirement never exceeds the overall storage capacity.

III.I.1.7.1 Design Demonstration Summary

The water balance alternative final cover design satisfies the requirements of 30 TAC §330.457(d). It has been demonstrated that the alternative final cover design achieves an equivalent reduction in infiltration compared to the clay-rich soil cover layers specified in 30 TAC §330.457(a)(1) or (2), in accordance with the methodology outlined in the TCEQ's Guidance for Requesting a Water Balance Alternative Final Cover for a Municipal Solid Waste Landfill (Revised March 2017). Furthermore, the design has been shown to provide comparable protection against wind and water erosion as the erosion layer described in 30 TAC §330.457(a).

Table III.I.1.7-1: Summary of UNSAT-H WB AFC Performance: Normal

	Climate Data Year	Precipitation P (cm)	Potential Evaporation PE (cm)	P/PE Ratio	Actual Evaporation (cm)	Runoff (% of P)	End of Year Storage (cm)	Percolation (mm)	Mass Balance Error (cm)	Percolation + Mass Balance Error (mm)
Year 1	1995	15.39	317	0.0486	18.8	0.00%	2.84	2.19	6.00E-03	2.25
Year 2	1996	21.31	335	0.0635	21.5	0.00%	2.69	0.01	6.39E-03	0.07
Year 3	1997	24.46	283	0.0865	23.2	0.00%	3.97	0.00	1.18E-02	0.12
Year 4	1998	17.20	300	0.0574	18.0	0.00%	3.20	0.00	7.62E-03	0.08
Year 5	1999	20.73	301	0.0689	20.3	0.00%	3.61	0.00	6.51E-03	0.07
Year 6	2000	18.82	302	0.0623	19.3	0.00%	3.16	0.00	7.99E-03	0.08
Year 7	2001	10.90	304	0.0358	11.1	0.00%	2.95	0.00	7.59E-03	0.08
Year 8	2002	17.50	305	0.0574	16.5	0.00%	3.92	0.00	8.03E-03	0.08
Year 9	2003	10.69	321	0.0333	11.8	0.00%	2.80	0.00	6.90E-03	0.07
Year 10	2004	30.99	299	0.1037	30.5	0.00%	3.32	0.00	8.52E-03	0.09
Year 11	2005	32.69	300	0.1090	33.2	0.00%	2.81	0.01	7.34E-03	0.08
Year 12	2006	21.18	335	0.0631	21.1	0.00%	2.86	0.01	1.42E-02	0.15
Year 13	2007	25.71	305	0.0843	25.2	0.00%	3.36	0.00	9.46E-03	0.10
Year 14	2008	25.02	328	0.0762	25.5	0.00%	2.89	0.00	6.63E-03	0.07
Year 15	2009	22.05	309	0.0714	21.1	0.00%	3.82	0.00	7.79E-03	0.08
Year 16	2010	16.94	303	0.0560	17.9	0.00%	2.86	0.00	6.88E-03	0.07
Year 17	2011	13.92	342	0.0407	12.6	0.00%	4.18	0.00	8.31E-03	0.08
Year 18	2012	13.39	318	0.0421	14.4	0.00%	3.18	0.00	4.93E-03	0.05
Year 19	2013	24.16	312	0.0775	24.4	0.00%	2.91	0.01	6.59E-03	0.07
Year 20	2014	21.77	321	0.0678	21.7	0.00%	3.01	0.04	7.18E-03	0.11
Year 21	2015	30.68	284	0.1079	29.2	0.00%	4.51	0.02	1.07E-02	0.12
Year 22	2016	23.83	317	0.0752	24.7	0.00%	3.63	0.00	6.96E-03	0.07
Year 23	2017	25.63	322	0.0797	25.9	0.00%	3.40	0.00	6.99E-03	0.07
Year 24	2018	21.26	324	0.0657	21.4	0.00%	3.23	0.00	8.04E-03	0.08

	Climate Data Year	Precipitation P (cm)	Potential Evaporation PE (cm)	P/PE Ratio	Actual Evaporation (cm)	Runoff (% of P)	End of Year Storage (cm)	Percolation (mm)	Mass Balance Error (cm)	Percolation + Mass Balance Error (mm)
Year 25	2019	20.52	316	0.0650	20.2	0.00%	3.56	0.00	8.99E-03	0.09
Year 26	2020	14.83	326	0.0455	15.8	0.00%	2.63	0.00	5.99E-03	0.06
Year 27	2021	30.56	318	0.0961	29.0	0.00%	4.16	0.00	7.88E-03	0.08
Year 28	2022	22.66	320	0.0709	23.7	0.00%	3.14	0.00	7.61E-03	0.08
Year 29	2023	11.02	337	0.0327	11.2	0.00%	2.95	0.00	7.14E-03	0.07
Year 30	2024	11.63	344	0.0338	11.7	0.00%	2.86	0.00	6.68E-03	0.07



Table III.I.1.7-2: Summary of UNSAT-H WB AFC Performance: No Plants

	Climate Data Year	Precipitation P (cm)	Potential Evaporation PE (cm)	P/PE Ratio	Actual Evaporation (cm)	Runoff (% of P)	End of Year Storage (cm)	Percolation (mm)	Mass Balance Error (cm)	Percolation + Mass Balance Error (mm)
Year 1	1995	15.39	317	0.0486	18.8	0.00%	2.84	2.19	6.00E-03	2.25
Year 2	1996	21.31	335	0.0635	21.5	0.00%	2.69	0.01	6.39E-03	0.07
Year 3	1997	24.46	283	0.0865	23.2	0.00%	3.97	0.00	1.18E-02	0.12
Year 4	1998	17.20	300	0.0574	18.0	0.00%	3.20	0.00	7.62E-03	0.08
Year 5	1999	20.73	301	0.0689	20.3	0.00%	3.61	0.00	6.51E-03	0.07
Year 6	2000	18.82	302	0.0623	19.3	0.00%	3.16	0.00	7.99E-03	0.08
Year 7	2001	10.90	304	0.0358	11.1	0.00%	2.95	0.00	7.59E-03	0.08
Year 8	2002	17.50	305	0.0574	16.5	0.00%	3.92	0.00	8.03E-03	0.08
Year 9	2003	10.69	321	0.0333	11.8	0.00%	2.80	0.00	6.90E-03	0.07
Year 10	2004	30.99	299	0.1040	30.5	0.00%	3.32	0.00	8.52E-03	0.09
Year 11	2005	32.69	300	0.1090	33.2	0.00%	2.81	0.01	7.34E-03	0.08
Year 12	2006	21.18	335	0.0631	21.1	0.00%	2.86	0.01	1.42E-02	0.15
Year 13	2007	25.71	305	0.0843	25.2	0.00%	3.36	0.00	9.46E-03	0.10
Year 14	2008	25.02	328	0.0762	25.5	0.00%	2.89	0.00	6.63E-03	0.07
Year 15	2009	22.05	309	0.0714	21.1	0.00%	3.82	0.00	7.79E-03	0.08
Year 16	2010	16.94	303	0.0560	17.9	0.00%	2.86	0.00	6.88E-03	0.07
Year 17	2011	13.92	342	0.0407	12.6	0.00%	4.18	0.00	8.31E-03	0.08
Year 18	2012	13.39	318	0.0421	14.4	0.00%	3.18	0.00	4.93E-03	0.05
Year 19	2013	24.16	312	0.0775	24.4	0.00%	2.91	0.01	6.59E-03	0.07
Year 20	2014	21.77	321	0.0678	21.7	0.00%	3.01	0.04	7.18E-03	0.11
Year 21	2015	30.68	284	0.1080	29.2	0.00%	4.51	0.02	1.07E-02	0.12
Year 22	2016	23.83	317	0.0752	24.7	0.00%	3.63	0.00	6.96E-03	0.07
Year 23	2017	25.63	322	0.0797	25.9	0.00%	3.40	0.00	6.99E-03	0.07
Year 24	2018	21.26	324	0.0657	21.4	0.00%	3.23	0.00	8.04E-03	0.08

	Climate Data Year	Precipitation P (cm)	Potential Evaporation PE (cm)	P/PE Ratio	Actual Evaporation (cm)	Runoff (% of P)	End of Year Storage (cm)	Percolation (mm)	Mass Balance Error (cm)	Percolation + Mass Balance Error (mm)
Year 25	2019	20.52	316	0.0650	20.2	0.00%	3.56	0.00	8.99E-03	0.09
Year 26	2020	14.83	326	0.0455	15.8	0.00%	2.63	0.00	5.99E-03	0.06
Year 27	2021	30.56	318	0.0961	29.0	0.00%	4.16	0.00	7.88E-03	0.08
Year 28	2022	22.66	320	0.0709	23.7	0.00%	3.14	0.00	7.61E-03	0.08
Year 29	2023	11.02	337	0.0327	11.2	0.00%	2.95	0.00	7.14E-03	0.07
Year 30	2024	11.63	344	0.0338	11.7	0.00%	2.86	0.00	6.68E-03	0.07



Table III.I.1.7-3: Summary of UNSAT-H WB AFC Performance: +20% HC

	Climate Data Year	Precipitation P (cm)	Potential Evaporation PE (cm)	P/PE Ratio	Actual Evaporation (cm)	Runoff (% of P)	End of Year Storage (cm)	Percolation (mm)	Mass Balance Error (cm)	Percolation + Mass Balance Error (mm)
Year 1	1995	15.39	317	0.0486	18.9	0.00%	2.79	2.18	5.98E-03	2.24
Year 2	1996	21.31	335	0.0635	21.5	0.00%	2.64	0.01	6.39E-03	0.07
Year 3	1997	24.46	283	0.0865	23.2	0.00%	3.89	0.00	1.18E-02	0.12
Year 4	1998	17.20	300	0.0574	18.0	0.00%	3.13	0.00	7.60E-03	0.08
Year 5	1999	20.73	301	0.0689	20.3	0.00%	3.56	0.00	6.62E-03	0.07
Year 6	2000	18.82	302	0.0623	19.3	0.00%	3.10	0.00	8.06E-03	0.08
Year 7	2001	10.90	304	0.0358	11.1	0.00%	2.90	0.00	7.60E-03	0.08
Year 8	2002	17.50	305	0.0574	16.6	0.00%	3.84	0.00	8.02E-03	0.08
Year 9	2003	10.69	321	0.0333	11.8	0.00%	2.76	0.00	6.90E-03	0.07
Year 10	2004	30.99	299	0.0104	30.5	0.00%	3.23	0.00	8.47E-03	0.08
Year 11	2005	32.69	300	0.0109	33.2	0.00%	2.75	0.01	7.31E-03	0.08
Year 12	2006	21.18	335	0.0631	21.1	0.00%	2.82	0.01	1.42E-02	0.15
Year 13	2007	25.71	305	0.0843	25.2	0.00%	3.28	0.00	9.46E-03	0.10
Year 14	2008	25.02	328	0.0762	25.5	0.00%	2.84	0.00	6.62E-03	0.07
Year 15	2009	22.05	309	0.0714	21.1	0.00%	3.74	0.00	7.84E-03	0.08
Year 16	2010	16.94	303	0.0560	17.9	0.00%	2.81	0.00	6.88E-03	0.07
Year 17	2011	13.92	342	0.0407	12.6	0.00%	4.13	0.00	8.37E-03	0.08
Year 18	2012	13.39	318	0.0421	14.4	0.00%	3.13	0.00	4.93E-03	0.05
Year 19	2013	24.16	312	0.0775	24.4	0.00%	2.86	0.01	6.60E-03	0.08
Year 20	2014	21.77	321	0.0678	21.7	0.00%	2.95	0.05	7.23E-03	0.12
Year 21	2015	30.68	284	0.0108	29.2	0.00%	4.43	0.02	1.08E-02	0.13
Year 22	2016	23.83	317	0.0752	24.7	0.00%	3.57	0.00	7.08E-03	0.07
Year 23	2017	25.63	322	0.0797	25.9	0.00%	3.34	0.00	7.05E-03	0.07
Year 24	2018	21.26	324	0.0657	21.4	0.00%	3.17	0.00	8.01E-03	0.08

Year 25	2019	20.52	316	0.0650	20.2	0.00%	3.46	0.00	9.04E-03	0.09
Year 26	2020	14.83	326	0.0455	15.7	0.00%	2.59	0.00	6.03E-03	0.06
Year 27	2021	30.56	318	0.0961	29.0	0.00%	4.11	0.00	7.93E-03	0.08
Year 28	2022	22.66	320	0.0709	23.7	0.00%	3.08	0.00	7.67E-03	0.08
Year 29	2023	11.02	337	0.0327	11.2	0.00%	2.91	0.00	7.16E-03	0.07
Year 30	2024	11.63	344	0.0338	11.7	0.00%	2.82	0.00	6.72E-03	0.07



Figure III.I.1.7-1: Storage Requirement and Storage Capacity: Normal

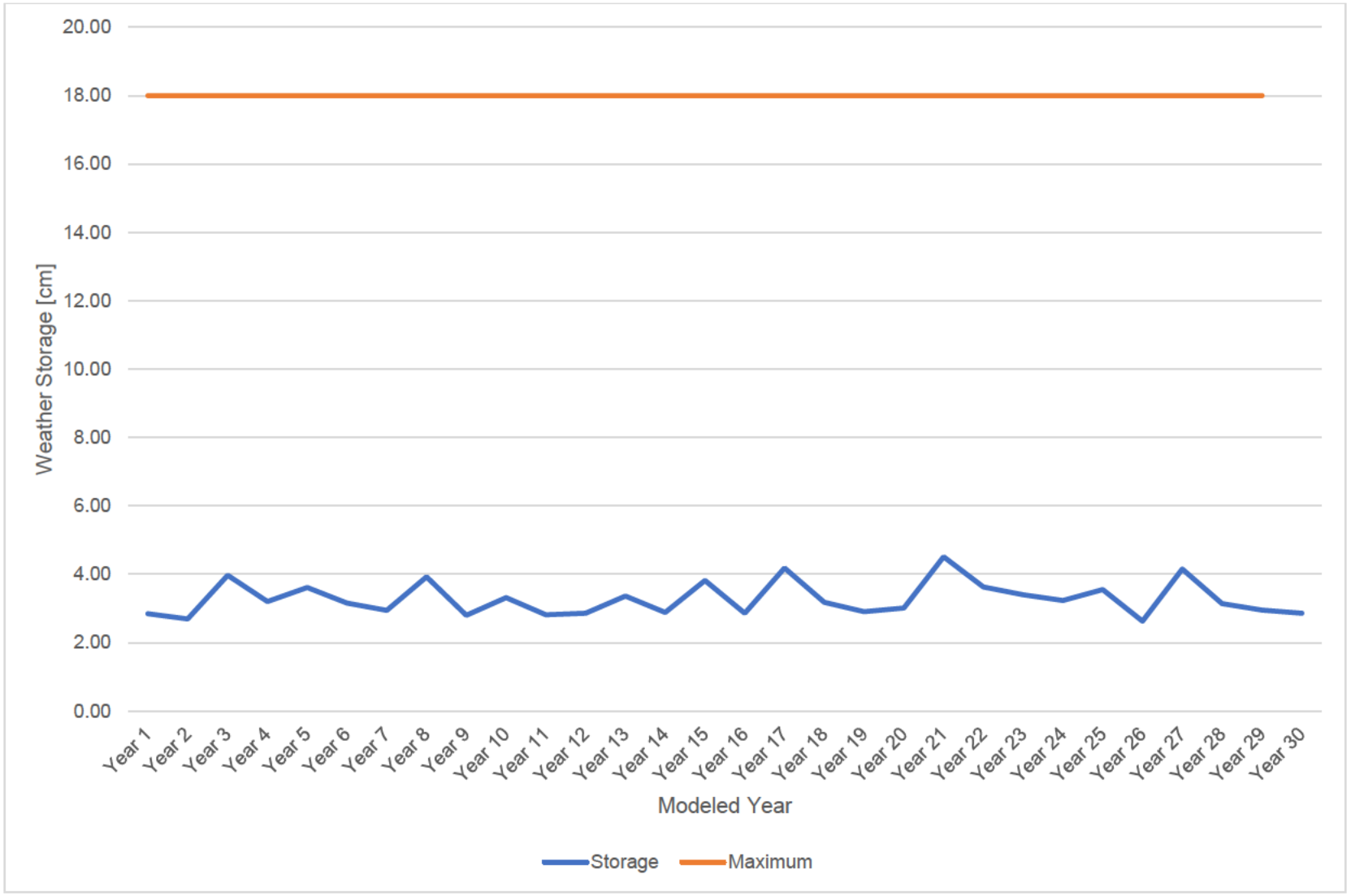


Figure III.I.1.7-2: Storage Requirement and Storage Capacity: No Plants

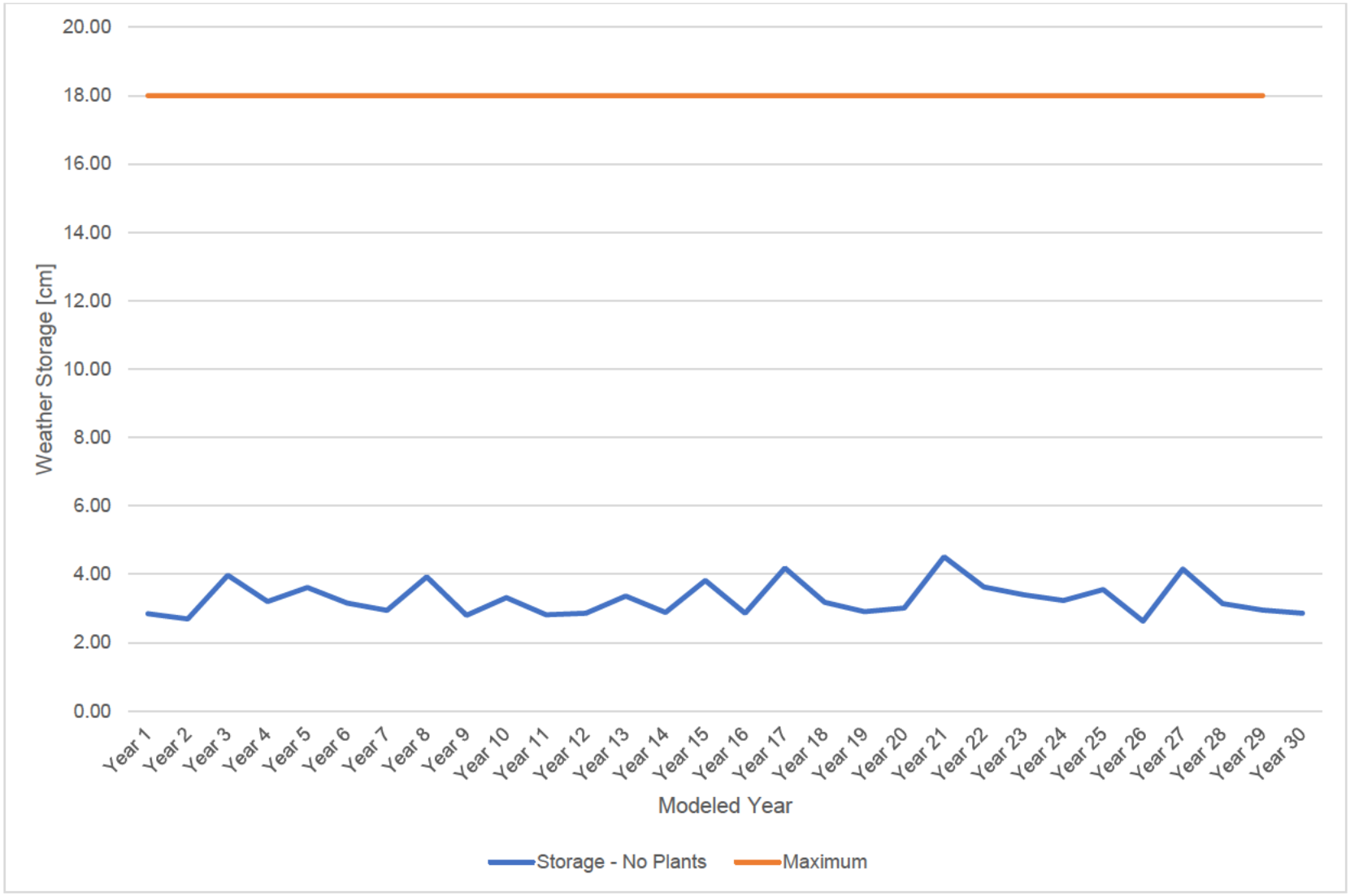
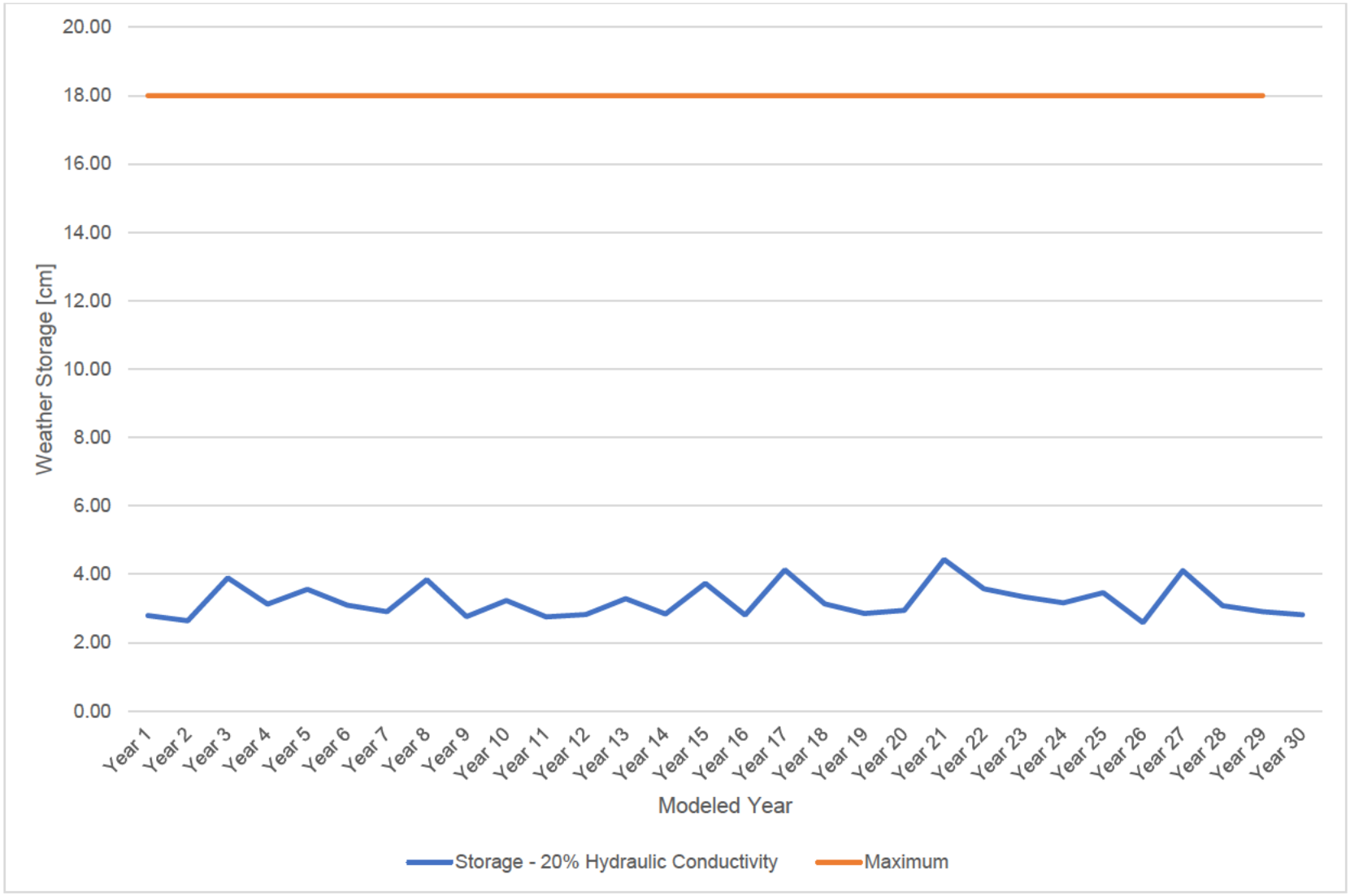


Figure III.I.1.7-3: Storage Requirement and Storage Capacity: +20% HC



APPENDIX III.I.1.A – DAILY CLIMATOLOGICAL DATA



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337,64,45,46,203.2,6.04,0.3,0
338,69,45,46,360.8,6.04,0.3,0
339,63,49,40,359.6,11.63,0.4,0
340,53,47,45,253.1,8.5,0.2,0
341,60,44,40,235.2,6.04,0.3,0
342,67,44,39,356.4,11.63,0.4,0
343,67,50,25,355.5,11.86,0.4,0
344,55,30,17,354.7,10.51,0.4,0
345,55,23,7,354,3.58,0.4,0
346,52,33,10,353.3,4.92,0.4,0
347,67,32,28,326.9,5.82,0.4,0
348,66,34,17,263.9,3.13,0.4,0
349,69,35,18,252.8,5.82,0.3,0
350,69,38,16,351.5,5.82,0.4,0
```

```
351,68,31,17,280.4,5.14,0.4,0
352,64,41,22,277.9,9.17,0.5,0
353,67,37,23,350.9,5.82,0.4,0
354,67,37,21,350.9,4.7,0.4,0
355,67,38,25,351,3.58,0.4,0
356,69,31,26,320.2,4.92,0.4,0
357,72,36,18,243.5,4.7,0.4,0
358,68,39,23,351.7,4.7,0.4,0
359,70,38,26,352.1,10.96,0.5,0
360,61,38,25,352.6,9.4,0.6,0
361,66,39,24,353.1,12.75,0.5,0
362,67,45,23,353.8,9.4,0.5,0
363,70,35,23,354.5,6.49,0.5,0
364,76,54,21,355.3,9.4,0.4,0
365,71,40,14,316.1,11.08,0.4,0
```

APPENDIX III.I.1.B – UNSAT-H MODEL INPUT AND OUTPUT: NORMAL



```
Greater El Paso Landfill 2284A - 2025 ET Cap Design
1,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1995,30,0,2,30,                         IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24,                                   NPRINT,STOPHR
0,4,1,1.0E-6,                           ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-8,1.0,                         DELMAX,DELMIN,OUTTIM
1.2,1.0E-4,0.0,0.0,0.0,                 RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.0,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
1.0,1.0E6,0.0,0.0,                      HIRRI,HDRY,HTOP,RHA
1,0,1,                                  IETOPT,ICLOUD,ISHOPT
1,1.0,                                  IRAIN,HPR
0,0.0,0.0,0.0,0,                        IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0.0,                                IHEAT,ICONVH,DMAXHE
0,0.0,0.0,0.0,                          UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,292.65,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
2,43,                                   MATN,NPT
1, 0.00,1, 0.10,1, 0.20,1, 0.30,
1, 0.40,1, 0.50,1, 0.60,1, 0.70,
1, 0.80,1, 0.90,1, 1.00,1, 1.25,
1, 1.50,1, 1.75,1, 2.00,1, 2.50,
1, 3.00,1, 3.50,1, 4.00,1, 4.50,
1, 5.08,1, 7.62,1,10.16,1,12.70,
1,15.24,1,17.78,1,20.32,1,22.86,
1,25.40,1,27.94,1,30.48,1,33.02,
1,35.56,1,38.10,1,40.64,1,43.18,
1,45.72,2,48.26,2,50.80,2,53.34,
2,55.88,2,58.42,2,60.96,
90% Compaction Layer            DUMMY
0.38,0.03,0.006,2.2,            THET,THTR,VGA,VGN
conductivity                    DUMMY
2.0,4.6,0.006,2.2,0.5,          RKMOD,SK,VGA,VGN,EPIT
80% Compaction Layer            DUMMY
0.44,0.05,0.017,3.5,            THET,THTR,vGA,vGN
conductivity                    DUMMY
2.0,23.7,0.017,3.5,0.5,         RKMOD,SK,VGA,VGN,EPIT
0,                              NDAY
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,125.0,125.0,125.0,
125.0,125.0,125.0,
```

```
0,1,1,1,1,365,                                  LEAF,NFROOT,NUPTAK,NFPET,NSOW,NHRVST
0.2,                                            BARE
0.0,0.0,0.0,                                    AA,B1,B2
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,
0.1,0.05,0.0,                                   HW,HD,HN
0.1,0.05,0.0,                                   HW,HD,HN
0.0,0.52,0.5,0.1,2.7,                           PETPC1,PETPC2,PETPC3,PETPC4,PETPC5
0.20,1234,0.5,875.0,                            ALBEDO,ALT,ZU,PMB
1995.txt
1996.txt
1997.txt
1998.txt
1999.txt
2000.txt
2001.txt
2002.txt
2003.txt
2004.txt
2005.txt
2006.txt
2007.txt
2008.txt
2009.txt
2010.txt
2011.txt
2012.txt
2013.txt
2014.txt
2015.txt
2016.txt
2017.txt
2018.txt
2019.txt
2020.txt
2021.txt
2022.txt
2023.txt
2024.txt
```

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm1995.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.750E+02	0.1065	292.65	2	1.000E-01	5.750E+02	0.1065	292.65
3	2.000E-01	5.750E+02	0.1065	292.65	4	3.000E-01	5.750E+02	0.1065	292.65
5	4.000E-01	5.750E+02	0.1065	292.65	6	5.000E-01	5.750E+02	0.1065	292.65
7	6.000E-01	5.750E+02	0.1065	292.65	8	7.000E-01	5.750E+02	0.1065	292.65
9	8.000E-01	5.750E+02	0.1065	292.65	10	9.000E-01	5.750E+02	0.1065	292.65
11	1.000E+00	5.750E+02	0.1065	292.65	12	1.250E+00	5.750E+02	0.1065	292.65
13	1.500E+00	5.750E+02	0.1065	292.65	14	1.750E+00	5.750E+02	0.1065	292.65
15	2.000E+00	5.750E+02	0.1065	292.65	16	2.500E+00	5.750E+02	0.1065	292.65
17	3.000E+00	5.750E+02	0.1065	292.65	18	3.500E+00	5.750E+02	0.1065	292.65
19	4.000E+00	5.750E+02	0.1065	292.65	20	4.500E+00	5.750E+02	0.1065	292.65
21	5.080E+00	5.750E+02	0.1065	292.65	22	7.620E+00	5.750E+02	0.1065	292.65
23	1.016E+01	5.750E+02	0.1065	292.65	24	1.270E+01	5.750E+02	0.1065	292.65
25	1.524E+01	5.750E+02	0.1065	292.65	26	1.778E+01	5.750E+02	0.1065	292.65
27	2.032E+01	5.750E+02	0.1065	292.65	28	2.286E+01	5.750E+02	0.1065	292.65
29	2.540E+01	5.750E+02	0.1065	292.65	30	2.794E+01	5.750E+02	0.1065	292.65
31	3.048E+01	5.750E+02	0.1065	292.65	32	3.302E+01	5.750E+02	0.1065	292.65
33	3.556E+01	5.750E+02	0.1065	292.65	34	3.810E+01	5.750E+02	0.1065	292.65
35	4.064E+01	5.750E+02	0.1065	292.65	36	4.318E+01	5.750E+02	0.1065	292.65
37	4.572E+01	5.750E+02	0.1065	292.65	38	4.826E+01	1.250E+02	0.1064	292.65
39	5.080E+01	1.250E+02	0.1064	292.65	40	5.334E+01	1.250E+02	0.1064	292.65
41	5.588E+01	1.250E+02	0.1064	292.65	42	5.842E+01	1.250E+02	0.1064	292.65
43	6.096E+01	1.250E+02	0.1064	292.65					

Initial Water Storage = 6.4909 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.09064     0.09148     0.11152     0.07609
 Head (cm)         = 7.04973E+02 6.96597E+02 5.43311E+02 1.72394E+02
 LiqWater Flow (cm)=-3.30934E-01-2.96830E-01-1.85300E-01 1.40052E-01
 IsoVapor Flow (cm)=-2.35437E-06-9.10224E-07-1.40543E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   6.4909+ 0.0000+ 0.0000 - 0.3317- 0.0000-  0.1401 =    6.0191 vs.    6.0191

 Mass Balance = -4.9484E-05 cm;  Time step attempts =  219 and successes =  197
   Evaporation:  Potential =  0.3317 cm, Actual =  0.3317 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 60.0 %;  TMEAN = 278.4 K;  HDRY =  7.0365E+05 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04795     0.05164
 Head (cm)         = 1.32310E+06 1.95513E+05 1.97735E+03 5.25300E+02
 LiqWater Flow (cm)= 5.23751E-02 1.17400E-02-1.02339E-03 4.16114E-06
 IsoVapor Flow (cm)=-4.34634E-02-2.98159E-03-4.48495E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8359+ 0.0762+ 0.0000 - 0.0673- 0.0000-  0.0000 =    2.8448 vs.    2.8446

 Mass Balance =  1.3370E-04 cm;  Time step attempts = 1382 and successes = 1068
   Evaporation:  Potential =  1.0289 cm, Actual =  0.0673 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 38.3 %;  TMEAN = 284.8 K;  HDRY =  1.3231E+06 cm;  DAYUBC =   449
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1660E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1660E+02	[cm]
Actual Evaporation	=	1.8814E+01	[cm]
Evaporation during Growth	=	1.8814E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.5392E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.1868E-01	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.5392E+01	[cm]
Actual Rainfall	=	1.5392E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8446E+00	[cm]
Mass Balance Error	=	6.0031E-03	[cm]
Total Successful Time Steps	=	57521	
Total Attempted Time Steps	=	70351	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30386	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-3.4216E+00	0.050	8.5530E+00	0.150	5.3339E+00
0.250	3.9850E+00	0.350	3.2012E+00	0.450	2.6445E+00
0.550	2.0839E+00	0.650	1.7436E+00	0.750	1.3917E+00
0.850	1.0897E+00	0.950	7.2371E-01	1.125	4.4810E-01
1.375	-1.6629E-01	1.625	-6.1738E-01	1.875	-9.0390E-01
2.250	-1.0926E+00	2.750	-1.4609E+00	3.250	-1.7134E+00
3.750	-1.9646E+00	4.250	-2.1095E+00	4.790	-2.2048E+00
6.350	-2.2550E+00	8.890	-2.4396E+00	11.430	-2.4155E+00
13.970	-2.3801E+00	16.510	-2.3243E+00	19.050	-2.1800E+00
21.590	-2.0289E+00	24.130	-1.8788E+00	26.670	-1.7295E+00
29.210	-1.5809E+00	31.750	-1.4328E+00	34.290	-1.2852E+00
36.830	-1.1381E+00	39.370	-9.9119E-01	41.910	-8.4460E-01
44.450	-6.9822E-01	46.990	-5.4946E-01	49.530	-4.0137E-01
52.070	-2.6876E-01	54.610	-1.2923E-01	57.150	1.0036E-02
59.690	1.4915E-01	60.960	2.1868E-01		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm1996.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.323E+06	0.0300	292.65	2	1.000E-01	1.238E+06	0.0300	292.65
3	2.000E-01	1.159E+06	0.0300	292.65	4	3.000E-01	1.083E+06	0.0300	292.65
5	4.000E-01	1.012E+06	0.0300	292.65	6	5.000E-01	9.440E+05	0.0300	292.65
7	6.000E-01	8.793E+05	0.0300	292.65	8	7.000E-01	8.175E+05	0.0300	292.65
9	8.000E-01	7.583E+05	0.0300	292.65	10	9.000E-01	7.015E+05	0.0300	292.65
11	1.000E+00	6.470E+05	0.0300	292.65	12	1.250E+00	5.195E+05	0.0300	292.65
13	1.500E+00	4.028E+05	0.0300	292.65	14	1.750E+00	2.952E+05	0.0300	292.65
15	2.000E+00	1.955E+05	0.0301	292.65	16	2.500E+00	1.530E+04	0.0315	292.65
17	3.000E+00	4.914E+03	0.0360	292.65	18	3.500E+00	4.731E+03	0.0363	292.65
19	4.000E+00	4.769E+03	0.0363	292.65	20	4.500E+00	4.436E+03	0.0368	292.65
21	5.080E+00	3.894E+03	0.0380	292.65	22	7.620E+00	2.795E+03	0.0419	292.65
23	1.016E+01	2.481E+03	0.0437	292.65	24	1.270E+01	2.313E+03	0.0449	292.65
25	1.524E+01	2.207E+03	0.0457	292.65	26	1.778E+01	2.132E+03	0.0464	292.65
27	2.032E+01	2.078E+03	0.0469	292.65	28	2.286E+01	2.036E+03	0.0473	292.65
29	2.540E+01	2.003E+03	0.0477	292.65	30	2.794E+01	1.977E+03	0.0479	292.65
31	3.048E+01	1.956E+03	0.0482	292.65	32	3.302E+01	1.939E+03	0.0484	292.65
33	3.556E+01	1.925E+03	0.0485	292.65	34	3.810E+01	1.913E+03	0.0487	292.65
35	4.064E+01	1.904E+03	0.0488	292.65	36	4.318E+01	1.897E+03	0.0489	292.65
37	4.572E+01	1.892E+03	0.0489	292.65	38	4.826E+01	1.602E+03	0.0501	292.65
39	5.080E+01	5.861E+02	0.0512	292.65	40	5.334E+01	5.530E+02	0.0514	292.65
41	5.588E+01	5.364E+02	0.0516	292.65	42	5.842E+01	5.279E+02	0.0516	292.65
43	6.096E+01	5.253E+02	0.0516	292.65					

Initial Water Storage = 2.8446 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03005     0.04786     0.05163
 Head (cm)         = 6.46939E+05 2.64598E+05 1.98486E+03 5.25739E+02
 LiqWater Flow (cm)=-1.04353E-11-1.40322E-07-1.06432E-03 4.13257E-06
 IsoVapor Flow (cm)=-9.19674E-03-9.20291E-03-4.71421E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8446+ 0.0000+ 0.0000 - 0.0092- 0.0000-  0.0000 =    2.8354 vs.    2.8355

 Mass Balance = -2.7207E-05 cm;  Time step attempts =  103 and successes =   81
   Evaporation:  Potential =  0.3638 cm, Actual =  0.0092 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 62.5 %;  TMEAN = 279.0 K;  HDRY =  6.4694E+05 cm;  DAYUBC =    78

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04628     0.05093
 Head (cm)         = 1.37244E+06 9.76165E+05 2.14499E+03 6.58202E+02
 LiqWater Flow (cm)=-2.06547E-13-9.99673E-13-1.46826E-03 6.46714E-07
 IsoVapor Flow (cm)=-4.94573E-03-4.94516E-03-8.85352E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6965+ 0.0000+ 0.0000 - 0.0049- 0.0000-  0.0000 =    2.6915 vs.    2.6915

 Mass Balance =  2.1425E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3649 cm, Actual =  0.0049 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.9 %;  TMEAN = 282.9 K;  HDRY =  1.3724E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3540E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

```
Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.3540E+02     [cm]
Actual Evaporation                 =  2.1457E+01     [cm]
Evaporation during Growth          =  2.1452E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  2.1311E+01     [cm]
Total Basal Liquid Flux (drainage) =  6.0918E-04     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1311E+01     [cm]
Actual Rainfall                    =  2.1311E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.6915E+00     [cm]
Mass Balance Error                 =  6.3878E-03     [cm]
Total Successful Time Steps        =     50967
Total Attempted Time Steps         =     61488
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     26469
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.4610E-01	0.050	1.5303E+01	0.150	8.2999E+00
0.250	6.4493E+00	0.350	5.2358E+00	0.450	4.4320E+00
0.550	3.9595E+00	0.650	3.6295E+00	0.750	3.4465E+00
0.850	3.1397E+00	0.950	2.9979E+00	1.125	2.7912E+00
1.375	2.4272E+00	1.625	2.2129E+00	1.875	2.0704E+00
2.250	1.9183E+00	2.750	1.6150E+00	3.250	1.4752E+00
3.750	1.3252E+00	4.250	1.1923E+00	4.790	1.0949E+00
6.350	9.3450E-01	8.890	4.5841E-01	11.430	2.3411E-01
13.970	1.1022E-01	16.510	-2.1620E-02	19.050	-4.9194E-02
21.590	-4.3707E-02	24.130	-3.8701E-02	26.670	-3.4193E-02
29.210	-3.0100E-02	31.750	-2.6353E-02	34.290	-2.2883E-02
36.830	-1.9624E-02	39.370	-1.6531E-02	41.910	-1.3559E-02
44.450	-1.0664E-02	46.990	-5.9001E-03	49.530	-1.0519E-03
52.070	-5.0177E-03	54.610	-3.5985E-03	57.150	-1.9528E-03
59.690	-2.5020E-04	60.960	6.0918E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm1997.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.372E+06	0.0300	292.65	2	1.000E-01	1.349E+06	0.0300	292.65
3	2.000E-01	1.327E+06	0.0300	292.65	4	3.000E-01	1.305E+06	0.0300	292.65
5	4.000E-01	1.284E+06	0.0300	292.65	6	5.000E-01	1.262E+06	0.0300	292.65
7	6.000E-01	1.241E+06	0.0300	292.65	8	7.000E-01	1.221E+06	0.0300	292.65
9	8.000E-01	1.200E+06	0.0300	292.65	10	9.000E-01	1.180E+06	0.0300	292.65
11	1.000E+00	1.160E+06	0.0300	292.65	12	1.250E+00	1.112E+06	0.0300	292.65
13	1.500E+00	1.065E+06	0.0300	292.65	14	1.750E+00	1.020E+06	0.0300	292.65
15	2.000E+00	9.762E+05	0.0300	292.65	16	2.500E+00	8.926E+05	0.0300	292.65
17	3.000E+00	8.137E+05	0.0300	292.65	18	3.500E+00	7.392E+05	0.0300	292.65
19	4.000E+00	6.685E+05	0.0300	292.65	20	4.500E+00	6.013E+05	0.0300	292.65
21	5.080E+00	5.272E+05	0.0300	292.65	22	7.620E+00	2.423E+05	0.0301	292.65
23	1.016E+01	4.947E+03	0.0360	292.65	24	1.270E+01	3.058E+03	0.0406	292.65
25	1.524E+01	2.685E+03	0.0424	292.65	26	1.778E+01	2.486E+03	0.0436	292.65
27	2.032E+01	2.357E+03	0.0445	292.65	28	2.286E+01	2.265E+03	0.0453	292.65
29	2.540E+01	2.197E+03	0.0458	292.65	30	2.794E+01	2.145E+03	0.0463	292.65
31	3.048E+01	2.104E+03	0.0467	292.65	32	3.302E+01	2.072E+03	0.0470	292.65
33	3.556E+01	2.046E+03	0.0472	292.65	34	3.810E+01	2.026E+03	0.0474	292.65
35	4.064E+01	2.011E+03	0.0476	292.65	36	4.318E+01	2.000E+03	0.0477	292.65
37	4.572E+01	1.993E+03	0.0478	292.65	38	4.826E+01	1.736E+03	0.0501	292.65
39	5.080E+01	9.141E+02	0.0504	292.65	40	5.334E+01	7.279E+02	0.0507	292.65
41	5.588E+01	6.817E+02	0.0509	292.65	42	5.842E+01	6.634E+02	0.0509	292.65
43	6.096E+01	6.582E+02	0.0509	292.65					

Initial Water Storage = 2.6915 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04619     0.05093
 Head (cm)         = 1.39883E+06 9.92133E+05 2.15531E+03 6.58520E+02
 LiqWater Flow (cm)=-1.93373E-13-9.42340E-13-1.46981E-03 6.44141E-07
 IsoVapor Flow (cm)=-4.99903E-03-4.99863E-03-9.05855E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6915+ 0.0000+ 0.0000 - 0.0050- 0.0000-  0.0000 =    2.6865 vs.    2.6865

 Mass Balance =  1.2593E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6119 cm, Actual =  0.0050 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.2 %;  TMEAN = 287.6 K;  HDRY =  1.3988E+06 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.05124     0.07399     0.05058
 Head (cm)         = 5.55168E+05 1.71695E+03 9.28870E+02 7.97508E+02
 LiqWater Flow (cm)=-1.25591E-09-6.47971E-02-2.72442E-02 1.32651E-07
 IsoVapor Flow (cm)=-7.01576E-02-9.62803E-06-2.63151E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.0401+ 0.0000+ 0.0000 - 0.0702- 0.0000-  0.0000 =    3.9700 vs.    3.9700

 Mass Balance = -1.3438E-05 cm;  Time step attempts =  106 and successes =   84
   Evaporation:  Potential =  0.2501 cm, Actual =  0.0702 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.2 %;  TMEAN = 278.7 K;  HDRY =  5.6862E+05 cm;  DAYUBC =    65
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.8279E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.8279E+02	[cm]
Actual Evaporation	=	2.3170E+01	[cm]
Evaporation during Growth	=	2.3170E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.4460E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.1399E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.4460E+01	[cm]
Actual Rainfall	=	2.4460E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.9700E+00	[cm]
Mass Balance Error	=	1.1831E-02	[cm]
Total Successful Time Steps	=	81675	
Total Attempted Time Steps	=	102016	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	38109	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.2904E+00	0.050	1.7795E+01	0.150	1.3673E+01
0.250	1.1751E+01	0.350	1.0355E+01	0.450	9.3016E+00
0.550	8.4322E+00	0.650	7.6790E+00	0.750	7.0336E+00
0.850	6.5895E+00	0.950	6.1165E+00	1.125	5.7004E+00
1.375	4.6234E+00	1.625	3.9974E+00	1.875	3.4912E+00
2.250	3.1282E+00	2.750	2.4964E+00	3.250	2.1583E+00
3.750	1.9172E+00	4.250	1.6718E+00	4.790	1.5194E+00
6.350	1.3664E+00	8.890	1.1405E+00	11.430	9.8696E-01
13.970	9.2072E-01	16.510	8.5501E-01	19.050	7.8865E-01
21.590	7.2133E-01	24.130	6.5296E-01	26.670	5.8352E-01
29.210	5.1306E-01	31.750	4.4167E-01	34.290	3.6941E-01
36.830	2.9636E-01	39.370	2.2263E-01	41.910	1.4829E-01
44.450	7.3438E-02	46.990	-1.2404E-03	49.530	1.5304E-06
52.070	-9.7184E-04	54.610	-1.3882E-03	57.150	-9.3634E-04
59.690	-2.5235E-04	60.960	1.1399E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm1998.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.552E+05	0.0300	292.65	2	1.000E-01	3.917E+05	0.0300	292.65
3	2.000E-01	2.464E+05	0.0301	292.65	4	3.000E-01	1.160E+05	0.0301	292.65
5	4.000E-01	2.582E+03	0.0430	292.65	6	5.000E-01	2.438E+03	0.0440	292.65
7	6.000E-01	2.328E+03	0.0448	292.65	8	7.000E-01	2.240E+03	0.0455	292.65
9	8.000E-01	2.166E+03	0.0461	292.65	10	9.000E-01	2.102E+03	0.0467	292.65
11	1.000E+00	2.047E+03	0.0472	292.65	12	1.250E+00	1.934E+03	0.0484	292.65
13	1.500E+00	1.847E+03	0.0495	292.65	14	1.750E+00	1.776E+03	0.0504	292.65
15	2.000E+00	1.717E+03	0.0512	292.65	16	2.500E+00	1.623E+03	0.0527	292.65
17	3.000E+00	1.550E+03	0.0540	292.65	18	3.500E+00	1.491E+03	0.0551	292.65
19	4.000E+00	1.442E+03	0.0562	292.65	20	4.500E+00	1.400E+03	0.0571	292.65
21	5.080E+00	1.359E+03	0.0581	292.65	22	7.620E+00	1.230E+03	0.0616	292.65
23	1.016E+01	1.149E+03	0.0642	292.65	24	1.270E+01	1.092E+03	0.0664	292.65
25	1.524E+01	1.048E+03	0.0682	292.65	26	1.778E+01	1.014E+03	0.0697	292.65
27	2.032E+01	9.865E+02	0.0710	292.65	28	2.286E+01	9.638E+02	0.0721	292.65
29	2.540E+01	9.448E+02	0.0731	292.65	30	2.794E+01	9.289E+02	0.0740	292.65
31	3.048E+01	9.154E+02	0.0748	292.65	32	3.302E+01	9.041E+02	0.0754	292.65
33	3.556E+01	8.946E+02	0.0760	292.65	34	3.810E+01	8.867E+02	0.0765	292.65
35	4.064E+01	8.803E+02	0.0768	292.65	36	4.318E+01	8.753E+02	0.0772	292.65
37	4.572E+01	8.715E+02	0.0774	292.65	38	4.826E+01	8.608E+02	0.0505	292.65
39	5.080E+01	9.434E+02	0.0504	292.65	40	5.334E+01	8.844E+02	0.0504	292.65
41	5.588E+01	8.329E+02	0.0505	292.65	42	5.842E+01	8.059E+02	0.0506	292.65
43	6.096E+01	7.975E+02	0.0506	292.65					

Initial Water Storage = 3.9700 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.05000     0.07264     0.05058
 Head (cm)         = 3.72655E+05 1.80564E+03 9.53849E+02 7.97785E+02
 LiqWater Flow (cm)=-5.38177E-10-5.82323E-02-2.50070E-02 1.32272E-07
 IsoVapor Flow (cm)=-6.14426E-02-1.09375E-05-2.74933E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9700+ 0.0000+ 0.0000 - 0.0614- 0.0000-  0.0000 =    3.9085 vs.    3.9085

 Mass Balance = -2.8098E-06 cm;  Time step attempts =   37 and successes =   31
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0614 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.3 %;  TMEAN = 279.3 K;  HDRY =  5.6596E+05 cm;  DAYUBC =    12

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03006     0.05686     0.05035
 Head (cm)         = 9.19880E+05 2.45277E+05 1.41005E+03 9.73624E+02
 LiqWater Flow (cm)=-3.18818E-12-6.80523E-07-5.73186E-03 2.55715E-08
 IsoVapor Flow (cm)=-1.33579E-02-1.33419E-02-4.41930E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2124+ 0.0000+ 0.0000 - 0.0134- 0.0000-  0.0000 =    3.1990 vs.    3.1990

 Mass Balance = -6.0264E-06 cm;  Time step attempts =   94 and successes =   90
   Evaporation:  Potential =  0.3702 cm, Actual =  0.0134 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.3 %;  TMEAN = 282.0 K;  HDRY =  9.1988E+05 cm;  DAYUBC =    85
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9981E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9981E+02	[cm]
Actual Evaporation	=	1.7959E+01	[cm]
Evaporation during Growth	=	1.7959E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.7196E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.6652E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.7196E+01	[cm]
Actual Rainfall	=	1.7196E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.1990E+00	[cm]
Mass Balance Error	=	7.6198E-03	[cm]
Total Successful Time Steps	=	63438	
Total Attempted Time Steps	=	77938	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	31495	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-7.6328E-01	0.050	1.1429E+01	0.150	8.2647E+00
0.250	7.1350E+00	0.350	6.1800E+00	0.450	5.4287E+00
0.550	4.9157E+00	0.650	4.4186E+00	0.750	3.9611E+00
0.850	3.6072E+00	0.950	3.2607E+00	1.125	2.9651E+00
1.375	2.2105E+00	1.625	1.7303E+00	1.875	1.3007E+00
2.250	1.0574E+00	2.750	5.7972E-01	3.250	2.9236E-01
3.750	5.5740E-02	4.250	-4.2571E-02	4.790	-1.0034E-01
6.350	-1.7476E-01	8.890	-3.5247E-01	11.430	-4.2850E-01
13.970	-4.6691E-01	16.510	-4.8928E-01	19.050	-4.9079E-01
21.590	-4.5036E-01	24.130	-4.0864E-01	26.670	-3.6600E-01
29.210	-3.2255E-01	31.750	-2.7840E-01	34.290	-2.3360E-01
36.830	-1.8825E-01	39.370	-1.4240E-01	41.910	-9.6115E-02
44.450	-4.9466E-02	46.990	-1.7710E-03	49.530	4.4838E-04
52.070	-1.3983E-04	54.610	-3.2787E-04	57.150	-3.1580E-04
59.690	-1.0951E-04	60.960	2.6652E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm1999.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.199E+05	0.0300	292.65	2	1.000E-01	8.770E+05	0.0300	292.65
3	2.000E-01	8.355E+05	0.0300	292.65	4	3.000E-01	7.952E+05	0.0300	292.65
5	4.000E-01	7.560E+05	0.0300	292.65	6	5.000E-01	7.179E+05	0.0300	292.65
7	6.000E-01	6.808E+05	0.0300	292.65	8	7.000E-01	6.447E+05	0.0300	292.65
9	8.000E-01	6.095E+05	0.0300	292.65	10	9.000E-01	5.752E+05	0.0300	292.65
11	1.000E+00	5.417E+05	0.0300	292.65	12	1.250E+00	4.614E+05	0.0300	292.65
13	1.500E+00	3.856E+05	0.0300	292.65	14	1.750E+00	3.136E+05	0.0300	292.65
15	2.000E+00	2.453E+05	0.0301	292.65	16	2.500E+00	1.179E+05	0.0301	292.65
17	3.000E+00	3.052E+03	0.0407	292.65	18	3.500E+00	2.743E+03	0.0421	292.65
19	4.000E+00	2.548E+03	0.0432	292.65	20	4.500E+00	2.408E+03	0.0442	292.65
21	5.080E+00	2.286E+03	0.0451	292.65	22	7.620E+00	1.968E+03	0.0480	292.65
23	1.016E+01	1.800E+03	0.0501	292.65	24	1.270E+01	1.690E+03	0.0517	292.65
25	1.524E+01	1.611E+03	0.0529	292.65	26	1.778E+01	1.551E+03	0.0540	292.65
27	2.032E+01	1.504E+03	0.0549	292.65	28	2.286E+01	1.466E+03	0.0556	292.65
29	2.540E+01	1.436E+03	0.0563	292.65	30	2.794E+01	1.410E+03	0.0569	292.65
31	3.048E+01	1.389E+03	0.0573	292.65	32	3.302E+01	1.372E+03	0.0578	292.65
33	3.556E+01	1.357E+03	0.0581	292.65	34	3.810E+01	1.346E+03	0.0584	292.65
35	4.064E+01	1.337E+03	0.0586	292.65	36	4.318E+01	1.330E+03	0.0588	292.65
37	4.572E+01	1.325E+03	0.0589	292.65	38	4.826E+01	1.296E+03	0.0502	292.65
39	5.080E+01	1.019E+03	0.0503	292.65	40	5.334E+01	9.986E+02	0.0503	292.65
41	5.588E+01	9.984E+02	0.0503	292.65	42	5.842E+01	9.829E+02	0.0503	292.65
43	6.096E+01	9.736E+02	0.0503	292.65					

Initial Water Storage = 3.1990 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03004     0.05655     0.05035
 Head (cm)         = 1.35965E+06 3.27437E+05 1.42364E+03 9.73909E+02
 LiqWater Flow (cm)=-8.32675E-13-2.60138E-09-5.56906E-03 2.55092E-08
 IsoVapor Flow (cm)=-1.66486E-02-1.66281E-02-4.49810E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1990+ 0.0000+ 0.0000 - 0.0166- 0.0000-  0.0000 =    3.1824 vs.    3.1824

 Mass Balance = -4.9288E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8887 cm, Actual =  0.0166 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.3 %;  TMEAN = 284.0 K;  HDRY =  1.3596E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04558     0.06596     0.05024
 Head (cm)         = 8.66730E+05 2.22598E+03 1.10238E+03 1.13576E+03
 LiqWater Flow (cm)=-1.67325E-11-3.86446E-02-1.10895E-02 7.16000E-09
 IsoVapor Flow (cm)=-4.20348E-02-1.95531E-05-2.65098E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6559+ 0.0000+ 0.0000 - 0.0420- 0.0000-  0.0000 =    3.6139 vs.    3.6139

 Mass Balance = -1.8123E-05 cm;  Time step attempts =  102 and successes =   79
   Evaporation:  Potential =  0.3425 cm, Actual =  0.0420 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.3 %;  TMEAN = 285.7 K;  HDRY =  8.6673E+05 cm;  DAYUBC =    79
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0082E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
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Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.0082E+02     [cm]
Actual Evaporation                 =  2.0305E+01     [cm]
Evaporation during Growth          =  2.0305E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  2.0726E+01     [cm]
Total Basal Liquid Flux (drainage) =  4.9662E-06     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.0726E+01     [cm]
Actual Rainfall                    =  2.0726E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.6139E+00     [cm]
Mass Balance Error                 =  6.5105E-03     [cm]
Total Successful Time Steps        =     49260
Total Attempted Time Steps         =     59592
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     25281
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	4.2139E-01	0.050	1.4096E+01	0.150	9.2845E+00
0.250	7.7256E+00	0.350	6.6492E+00	0.450	5.8424E+00
0.550	5.2020E+00	0.650	4.7766E+00	0.750	4.2826E+00
0.850	3.8464E+00	0.950	3.5936E+00	1.125	3.2904E+00
1.375	2.7010E+00	1.625	2.3325E+00	1.875	2.0691E+00
2.250	1.9375E+00	2.750	1.6728E+00	3.250	1.5410E+00
3.750	1.4371E+00	4.250	1.2958E+00	4.790	1.1884E+00
6.350	1.0046E+00	8.890	7.4586E-01	11.430	6.1642E-01
13.970	5.0334E-01	16.510	4.1794E-01	19.050	3.3936E-01
21.590	2.5820E-01	24.130	2.1142E-01	26.670	1.8800E-01
29.210	1.6466E-01	31.750	1.4126E-01	34.290	1.1779E-01
36.830	9.4233E-02	39.370	7.0603E-02	41.910	4.6898E-02
44.450	2.3103E-02	46.990	-5.0028E-06	49.530	5.3829E-04
52.070	3.0724E-05	54.610	-2.9751E-05	57.150	-4.4802E-05
59.690	-1.9052E-05	60.960	4.9662E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2000.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.667E+05	0.0300	292.65	2	1.000E-01	7.511E+05	0.0300	292.65
3	2.000E-01	6.441E+05	0.0300	292.65	4	3.000E-01	5.450E+05	0.0300	292.65
5	4.000E-01	4.526E+05	0.0300	292.65	6	5.000E-01	3.659E+05	0.0300	292.65
7	6.000E-01	2.844E+05	0.0300	292.65	8	7.000E-01	2.074E+05	0.0301	292.65
9	8.000E-01	1.345E+05	0.0301	292.65	10	9.000E-01	6.528E+04	0.0303	292.65
11	1.000E+00	3.663E+03	0.0386	292.65	12	1.250E+00	2.876E+03	0.0415	292.65
13	1.500E+00	2.557E+03	0.0432	292.65	14	1.750E+00	2.363E+03	0.0445	292.65
15	2.000E+00	2.226E+03	0.0456	292.65	16	2.500E+00	2.038E+03	0.0473	292.65
17	3.000E+00	1.911E+03	0.0487	292.65	18	3.500E+00	1.816E+03	0.0499	292.65
19	4.000E+00	1.742E+03	0.0509	292.65	20	4.500E+00	1.681E+03	0.0518	292.65
21	5.080E+00	1.623E+03	0.0527	292.65	22	7.620E+00	1.453E+03	0.0559	292.65
23	1.016E+01	1.352E+03	0.0582	292.65	24	1.270E+01	1.283E+03	0.0600	292.65
25	1.524E+01	1.233E+03	0.0615	292.65	26	1.778E+01	1.194E+03	0.0627	292.65
27	2.032E+01	1.164E+03	0.0637	292.65	28	2.286E+01	1.139E+03	0.0646	292.65
29	2.540E+01	1.119E+03	0.0653	292.65	30	2.794E+01	1.102E+03	0.0660	292.65
31	3.048E+01	1.089E+03	0.0665	292.65	32	3.302E+01	1.077E+03	0.0670	292.65
33	3.556E+01	1.068E+03	0.0673	292.65	34	3.810E+01	1.060E+03	0.0677	292.65
35	4.064E+01	1.054E+03	0.0679	292.65	36	4.318E+01	1.049E+03	0.0681	292.65
37	4.572E+01	1.045E+03	0.0683	292.65	38	4.826E+01	1.037E+03	0.0503	292.65
39	5.080E+01	1.235E+03	0.0502	292.65	40	5.334E+01	1.141E+03	0.0502	292.65
41	5.588E+01	1.118E+03	0.0502	292.65	42	5.842E+01	1.129E+03	0.0502	292.65
43	6.096E+01	1.136E+03	0.0502	292.65					

Initial Water Storage = 3.6139 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04491     0.06522     0.05024
 Head (cm)         = 1.04627E+06 2.30896E+03 1.12200E+03 1.13548E+03
 LiqWater Flow (cm)=-6.00077E-12-3.37137E-02-1.16958E-02 7.17472E-09
 IsoVapor Flow (cm)=-3.60676E-02-2.12870E-05-2.97586E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6139+ 0.0000+ 0.0000 - 0.0361- 0.0000-  0.0000 =    3.5778 vs.    3.5779

 Mass Balance = -1.1454E-05 cm;  Time step attempts =   74 and successes =   59
   Evaporation:  Potential =  0.7655 cm, Actual =  0.0361 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 46.8 %;  TMEAN = 285.9 K;  HDRY =  1.0463E+06 cm;  DAYUBC =    59

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.05566     0.05020
 Head (cm)         = 8.48906E+05 1.36533E+05 1.46520E+03 1.22725E+03
 LiqWater Flow (cm)=-5.05373E-12-2.08012E-04-4.32763E-03 3.78323E-09
 IsoVapor Flow (cm)=-1.46930E-02-1.44844E-02-4.12622E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1727+ 0.0000+ 0.0000 - 0.0147- 0.0000-  0.0000 =    3.1581 vs.    3.1581

 Mass Balance = -2.7162E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2151 cm, Actual =  0.0147 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.0 %;  TMEAN = 277.0 K;  HDRY =  8.4891E+05 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0228E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

```
Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.0228E+02     [cm]
Actual Evaporation                 =  1.9269E+01     [cm]
Evaporation during Growth          =  1.9255E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  1.8821E+01     [cm]
Total Basal Liquid Flux (drainage) =  1.7750E-06     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.8821E+01     [cm]
Actual Rainfall                    =  1.8821E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1581E+00     [cm]
Mass Balance Error                 =  7.9892E-03     [cm]
Total Successful Time Steps        =     60369
Total Attempted Time Steps         =     73990
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30877
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.4787E-01	0.050	1.3790E+01	0.150	9.2170E+00
0.250	7.9422E+00	0.350	7.0846E+00	0.450	6.2951E+00
0.550	5.7758E+00	0.650	5.3168E+00	0.750	4.7933E+00
0.850	4.3870E+00	0.950	4.1347E+00	1.125	3.8738E+00
1.375	3.0384E+00	1.625	2.5022E+00	1.875	1.9957E+00
2.250	1.7168E+00	2.750	1.1506E+00	3.250	7.2996E-01
3.750	5.8479E-01	4.250	4.2780E-01	4.790	2.9940E-01
6.350	1.8255E-01	8.890	-1.0399E-01	11.430	-2.4825E-01
13.970	-2.9196E-01	16.510	-3.1574E-01	19.050	-2.9196E-01
21.590	-2.6731E-01	24.130	-2.4208E-01	26.670	-2.1639E-01
29.210	-1.9030E-01	31.750	-1.6389E-01	34.290	-1.3720E-01
36.830	-1.1027E-01	39.370	-8.3143E-02	41.910	-5.5835E-02
44.450	-2.8371E-02	46.990	-4.1043E-04	49.530	6.4138E-04
52.070	3.9823E-05	54.610	-5.4667E-06	57.150	-7.2319E-06
59.690	-1.8881E-06	60.960	1.7750E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2001.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.489E+05	0.0300	292.65	2	1.000E-01	8.031E+05	0.0300	292.65
3	2.000E-01	7.587E+05	0.0300	292.65	4	3.000E-01	7.157E+05	0.0300	292.65
5	4.000E-01	6.740E+05	0.0300	292.65	6	5.000E-01	6.335E+05	0.0300	292.65
7	6.000E-01	5.942E+05	0.0300	292.65	8	7.000E-01	5.559E+05	0.0300	292.65
9	8.000E-01	5.187E+05	0.0300	292.65	10	9.000E-01	4.825E+05	0.0300	292.65
11	1.000E+00	4.472E+05	0.0300	292.65	12	1.250E+00	3.628E+05	0.0300	292.65
13	1.500E+00	2.832E+05	0.0300	292.65	14	1.750E+00	2.079E+05	0.0301	292.65
15	2.000E+00	1.365E+05	0.0301	292.65	16	2.500E+00	3.984E+03	0.0378	292.65
17	3.000E+00	3.113E+03	0.0404	292.65	18	3.500E+00	2.772E+03	0.0420	292.65
19	4.000E+00	2.568E+03	0.0431	292.65	20	4.500E+00	2.424E+03	0.0441	292.65
21	5.080E+00	2.301E+03	0.0450	292.65	22	7.620E+00	1.992E+03	0.0478	292.65
23	1.016E+01	1.831E+03	0.0497	292.65	24	1.270E+01	1.727E+03	0.0511	292.65
25	1.524E+01	1.653E+03	0.0522	292.65	26	1.778E+01	1.597E+03	0.0532	292.65
27	2.032E+01	1.553E+03	0.0539	292.65	28	2.286E+01	1.518E+03	0.0546	292.65
29	2.540E+01	1.489E+03	0.0552	292.65	30	2.794E+01	1.465E+03	0.0557	292.65
31	3.048E+01	1.445E+03	0.0561	292.65	32	3.302E+01	1.429E+03	0.0564	292.65
33	3.556E+01	1.416E+03	0.0567	292.65	34	3.810E+01	1.405E+03	0.0570	292.65
35	4.064E+01	1.396E+03	0.0572	292.65	36	4.318E+01	1.390E+03	0.0573	292.65
37	4.572E+01	1.385E+03	0.0574	292.65	38	4.826E+01	1.362E+03	0.0502	292.65
39	5.080E+01	1.249E+03	0.0502	292.65	40	5.334E+01	1.231E+03	0.0502	292.65
41	5.588E+01	1.230E+03	0.0502	292.65	42	5.842E+01	1.228E+03	0.0502	292.65
43	6.096E+01	1.227E+03	0.0502	292.65					

Initial Water Storage = 3.1581 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.05541     0.05020
 Head (cm)         = 8.74418E+05 1.41905E+05 1.47744E+03 1.22731E+03
 LiqWater Flow (cm)=-4.53698E-12-1.03361E-04-4.30247E-03 3.78171E-09
 IsoVapor Flow (cm)=-1.49669E-02-1.48596E-02-4.25620E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1581+ 0.0000+ 0.0000 - 0.0150- 0.0000-  0.0000 =    3.1431 vs.    3.1431

 Mass Balance = -6.6952E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2193 cm, Actual =  0.0150 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.0 %;  TMEAN = 277.3 K;  HDRY =  8.7442E+05 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04464     0.04900     0.05011
 Head (cm)         = 8.82736E+05 2.34469E+03 1.88501E+03 1.54402E+03
 LiqWater Flow (cm)= 1.69846E-01 9.42150E-02-1.98821E-03 5.69678E-10
 IsoVapor Flow (cm)=-5.79369E-02 1.82264E-04-6.44867E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8341+ 0.2032+ 0.0000 - 0.0913- 0.0000-  0.0000 =    2.9460 vs.    2.9456

 Mass Balance =  4.5777E-04 cm;  Time step attempts = 1811 and successes = 1382
   Evaporation:  Potential =  0.2283 cm, Actual =  0.0913 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 52.7 %;  TMEAN = 276.2 K;  HDRY =  8.8274E+05 cm;  DAYUBC =   325
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0416E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0416E+02	[cm]
Actual Evaporation	=	1.1101E+01	[cm]
Evaporation during Growth	=	1.1101E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.0897E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.7343E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.0897E+01	[cm]
Actual Rainfall	=	1.0897E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.9456E+00	[cm]
Mass Balance Error	=	7.5948E-03	[cm]
Total Successful Time Steps	=	61541	
Total Attempted Time Steps	=	76196	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	31424	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.0488E-01	0.050	8.2830E+00	0.150	6.5620E+00
0.250	5.9107E+00	0.350	5.4484E+00	0.450	5.0285E+00
0.550	4.6886E+00	0.650	4.3356E+00	0.750	4.1038E+00
0.850	3.8920E+00	0.950	3.7253E+00	1.125	3.5500E+00
1.375	3.0756E+00	1.625	2.8258E+00	1.875	2.5772E+00
2.250	2.3776E+00	2.750	1.9976E+00	3.250	1.6936E+00
3.750	1.4480E+00	4.250	1.1336E+00	4.790	8.9895E-01
6.350	6.1827E-01	8.890	3.5760E-02	11.430	-1.3507E-01
13.970	-2.2022E-01	16.510	-2.0491E-01	19.050	-1.8883E-01
21.590	-1.7250E-01	24.130	-1.5597E-01	26.670	-1.3926E-01
29.210	-1.2241E-01	31.750	-1.0543E-01	34.290	-8.8307E-02
36.830	-7.1069E-02	39.370	-5.3727E-02	41.910	-3.6289E-02
44.450	-1.8763E-02	46.990	-6.6172E-04	49.530	1.3729E-05
52.070	-7.0077E-06	54.610	-8.2532E-06	57.150	-6.5131E-06
59.690	-2.1460E-06	60.960	6.7343E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2002.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.827E+05	0.0300	292.65	2	1.000E-01	7.491E+05	0.0300	292.65
3	2.000E-01	6.318E+05	0.0300	292.65	4	3.000E-01	5.236E+05	0.0300	292.65
5	4.000E-01	4.220E+05	0.0300	292.65	6	5.000E-01	3.269E+05	0.0300	292.65
7	6.000E-01	2.383E+05	0.0301	292.65	8	7.000E-01	1.551E+05	0.0301	292.65
9	8.000E-01	7.667E+04	0.0302	292.65	10	9.000E-01	4.341E+03	0.0370	292.65
11	1.000E+00	3.540E+03	0.0389	292.65	12	1.250E+00	2.899E+03	0.0414	292.65
13	1.500E+00	2.626E+03	0.0428	292.65	14	1.750E+00	2.460E+03	0.0438	292.65
15	2.000E+00	2.345E+03	0.0446	292.65	16	2.500E+00	2.192E+03	0.0459	292.65
17	3.000E+00	2.097E+03	0.0467	292.65	18	3.500E+00	2.034E+03	0.0473	292.65
19	4.000E+00	1.993E+03	0.0478	292.65	20	4.500E+00	1.966E+03	0.0481	292.65
21	5.080E+00	1.951E+03	0.0482	292.65	22	7.620E+00	2.040E+03	0.0473	292.65
23	1.016E+01	2.243E+03	0.0454	292.65	24	1.270E+01	2.280E+03	0.0451	292.65
25	1.524E+01	2.193E+03	0.0459	292.65	26	1.778E+01	2.100E+03	0.0467	292.65
27	2.032E+01	2.026E+03	0.0474	292.65	28	2.286E+01	1.968E+03	0.0480	292.65
29	2.540E+01	1.922E+03	0.0486	292.65	30	2.794E+01	1.885E+03	0.0490	292.65
31	3.048E+01	1.855E+03	0.0494	292.65	32	3.302E+01	1.831E+03	0.0497	292.65
33	3.556E+01	1.811E+03	0.0499	292.65	34	3.810E+01	1.795E+03	0.0501	292.65
35	4.064E+01	1.783E+03	0.0503	292.65	36	4.318E+01	1.775E+03	0.0504	292.65
37	4.572E+01	1.769E+03	0.0505	292.65	38	4.826E+01	1.727E+03	0.0501	292.65
39	5.080E+01	1.629E+03	0.0501	292.65	40	5.334E+01	1.583E+03	0.0501	292.65
41	5.588E+01	1.560E+03	0.0501	292.65	42	5.842E+01	1.548E+03	0.0501	292.65
43	6.096E+01	1.544E+03	0.0501	292.65					

Initial Water Storage = 2.9456 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04044     0.04889     0.05011
 Head (cm)         = 4.99787E+05 3.10879E+03 1.89439E+03 1.54447E+03
 LiqWater Flow (cm)=-1.02167E-10-1.49731E-02-1.97279E-03 5.68307E-10
 IsoVapor Flow (cm)=-2.30510E-02-2.46817E-05-6.55152E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9456+ 0.0000+ 0.0000 - 0.0231- 0.0000-  0.0000 =    2.9225 vs.    2.9225

 Mass Balance = -2.0511E-05 cm;  Time step attempts =  130 and successes =  108
   Evaporation:  Potential =  0.2228 cm, Actual =  0.0231 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 69.6 %;  TMEAN = 276.2 K;  HDRY =  4.9979E+05 cm;  DAYUBC =   106

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.05015     0.07316     0.05012
 Head (cm)         = 8.15596E+05 1.79425E+03 9.44111E+02 1.48670E+03
 LiqWater Flow (cm)=-3.72389E-11-5.97659E-02-2.62037E-02 7.75130E-10
 IsoVapor Flow (cm)=-5.99088E-02-1.16725E-05-2.72928E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9826+ 0.0000+ 0.0000 - 0.0599- 0.0000-  0.0000 =    3.9227 vs.    3.9227

 Mass Balance = -1.0969E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3809 cm, Actual =  0.0599 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 55.3 %;  TMEAN = 277.9 K;  HDRY =  8.1560E+05 cm;  DAYUBC =    77
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0470E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0470E+02	[cm]
Actual Evaporation	=	1.6515E+01	[cm]
Evaporation during Growth	=	1.6515E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.7501E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.8946E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.7501E+01	[cm]
Actual Rainfall	=	1.7501E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.9227E+00	[cm]
Mass Balance Error	=	8.0348E-03	[cm]
Total Successful Time Steps	=	60109	
Total Attempted Time Steps	=	73676	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30270	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.8518E-01	0.050	1.2313E+01	0.150	9.4304E+00
0.250	8.5348E+00	0.350	7.8240E+00	0.450	7.3196E+00
0.550	6.8618E+00	0.650	6.3546E+00	0.750	5.8116E+00
0.850	5.3160E+00	0.950	5.0528E+00	1.125	4.7842E+00
1.375	4.2036E+00	1.625	3.8071E+00	1.875	3.4933E+00
2.250	3.2140E+00	2.750	2.6954E+00	3.250	2.3251E+00
3.750	2.0780E+00	4.250	1.8400E+00	4.790	1.7359E+00
6.350	1.5867E+00	8.890	1.2521E+00	11.430	1.0246E+00
13.970	8.7760E-01	16.510	7.5010E-01	19.050	6.9241E-01
21.590	6.3439E-01	24.130	5.7517E-01	26.670	5.1479E-01
29.210	4.5333E-01	31.750	3.9090E-01	34.290	3.2760E-01
36.830	2.6353E-01	39.370	1.9880E-01	41.910	1.3349E-01
44.450	6.7693E-02	46.990	1.7328E-03	49.530	1.0438E-04
52.070	9.3589E-06	54.610	2.8122E-06	57.150	9.9961E-07
59.690	3.5831E-07	60.960	1.8946E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2003.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.156E+05	0.0300	292.65	2	1.000E-01	6.414E+05	0.0300	292.65
3	2.000E-01	4.868E+05	0.0300	292.65	4	3.000E-01	3.478E+05	0.0300	292.65
5	4.000E-01	2.215E+05	0.0301	292.65	6	5.000E-01	1.058E+05	0.0302	292.65
7	6.000E-01	2.719E+03	0.0423	292.65	8	7.000E-01	2.542E+03	0.0433	292.65
9	8.000E-01	2.411E+03	0.0442	292.65	10	9.000E-01	2.308E+03	0.0449	292.65
11	1.000E+00	2.224E+03	0.0456	292.65	12	1.250E+00	2.066E+03	0.0470	292.65
13	1.500E+00	1.952E+03	0.0482	292.65	14	1.750E+00	1.865E+03	0.0492	292.65
15	2.000E+00	1.794E+03	0.0502	292.65	16	2.500E+00	1.685E+03	0.0517	292.65
17	3.000E+00	1.603E+03	0.0530	292.65	18	3.500E+00	1.539E+03	0.0542	292.65
19	4.000E+00	1.485E+03	0.0552	292.65	20	4.500E+00	1.440E+03	0.0562	292.65
21	5.080E+00	1.396E+03	0.0572	292.65	22	7.620E+00	1.260E+03	0.0607	292.65
23	1.016E+01	1.174E+03	0.0634	292.65	24	1.270E+01	1.114E+03	0.0655	292.65
25	1.524E+01	1.069E+03	0.0673	292.65	26	1.778E+01	1.033E+03	0.0688	292.65
27	2.032E+01	1.004E+03	0.0701	292.65	28	2.286E+01	9.804E+02	0.0713	292.65
29	2.540E+01	9.606E+02	0.0723	292.65	30	2.794E+01	9.441E+02	0.0732	292.65
31	3.048E+01	9.302E+02	0.0739	292.65	32	3.302E+01	9.185E+02	0.0746	292.65
33	3.556E+01	9.087E+02	0.0751	292.65	34	3.810E+01	9.007E+02	0.0756	292.65
35	4.064E+01	8.941E+02	0.0760	292.65	36	4.318E+01	8.889E+02	0.0763	292.65
37	4.572E+01	8.851E+02	0.0766	292.65	38	4.826E+01	8.748E+02	0.0505	292.65
39	5.080E+01	1.185E+03	0.0502	292.65	40	5.334E+01	1.360E+03	0.0502	292.65
41	5.588E+01	1.440E+03	0.0501	292.65	42	5.842E+01	1.476E+03	0.0501	292.65
43	6.096E+01	1.487E+03	0.0501	292.65					

Initial Water Storage = 3.9227 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04804     0.07187     0.05012
 Head (cm)         = 1.31147E+06 1.96913E+03 9.68844E+02 1.48562E+03
 LiqWater Flow (cm)=-5.45174E-12-5.75570E-02-2.40460E-02 7.79741E-10
 IsoVapor Flow (cm)=-6.56139E-02-1.54583E-05-2.84470E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9227+ 0.0000+ 0.0000 - 0.0656- 0.0000-  0.0000 =    3.8571 vs.    3.8571

 Mass Balance = -3.5469E-05 cm;  Time step attempts =  189 and successes =  145
   Evaporation:  Potential =  0.6492 cm, Actual =  0.0656 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 38.6 %;  TMEAN = 280.9 K;  HDRY =  1.3115E+06 cm;  DAYUBC =   145

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04876     0.05010
 Head (cm)         = 2.20848E+06 1.23333E+06 1.90527E+03 1.57860E+03
 LiqWater Flow (cm)=-6.03901E-14-7.02484E-13-2.21993E-03 4.74343E-10
 IsoVapor Flow (cm)=-8.33690E-03-8.33663E-03-7.45309E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8070+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.7987 vs.    2.7987

 Mass Balance = -4.3809E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5595 cm, Actual =  0.0083 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 20.1 %;  TMEAN = 279.3 K;  HDRY =  2.2085E+06 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2069E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2069E+02	[cm]
Actual Evaporation	=	1.1811E+01	[cm]
Evaporation during Growth	=	1.1811E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.0693E+01	[cm]
Total Basal Liquid Flux (drainage)	=	4.0777E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.0693E+01	[cm]
Actual Rainfall	=	1.0693E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.7987E+00	[cm]
Mass Balance Error	=	6.9012E-03	[cm]
Total Successful Time Steps	=	58851	
Total Attempted Time Steps	=	72478	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	31350	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.1171E+00	0.050	8.1387E+00	0.150	6.8730E+00
0.250	5.8920E+00	0.350	5.4591E+00	0.450	5.0176E+00
0.550	4.6325E+00	0.650	4.4048E+00	0.750	4.1812E+00
0.850	3.8716E+00	0.950	3.4818E+00	1.125	3.2178E+00
1.375	2.7133E+00	1.625	2.2174E+00	1.875	1.8604E+00
2.250	1.5131E+00	2.750	9.4054E-01	3.250	5.7947E-01
3.750	3.3322E-01	4.250	1.6185E-01	4.790	-3.5484E-02
6.350	-2.3036E-01	8.890	-6.5524E-01	11.430	-7.7073E-01
13.970	-8.0941E-01	16.510	-7.5379E-01	19.050	-6.9637E-01
21.590	-6.3767E-01	24.130	-5.7781E-01	26.670	-5.1687E-01
29.210	-4.5495E-01	31.750	-3.9215E-01	34.290	-3.2855E-01
36.830	-2.6423E-01	39.370	-1.9929E-01	41.910	-1.3380E-01
44.450	-6.7844E-02	46.990	-1.2262E-03	49.530	8.6885E-05
52.070	8.8971E-06	54.610	2.5161E-06	57.150	5.7301E-07
59.690	2.8313E-07	60.960	4.0777E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2004.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	2.208E+06	0.0300	292.65	2	1.000E-01	2.140E+06	0.0300	292.65
3	2.000E-01	2.075E+06	0.0300	292.65	4	3.000E-01	2.012E+06	0.0300	292.65
5	4.000E-01	1.953E+06	0.0300	292.65	6	5.000E-01	1.895E+06	0.0300	292.65
7	6.000E-01	1.840E+06	0.0300	292.65	8	7.000E-01	1.787E+06	0.0300	292.65
9	8.000E-01	1.736E+06	0.0300	292.65	10	9.000E-01	1.686E+06	0.0300	292.65
11	1.000E+00	1.638E+06	0.0300	292.65	12	1.250E+00	1.525E+06	0.0300	292.65
13	1.500E+00	1.421E+06	0.0300	292.65	14	1.750E+00	1.324E+06	0.0300	292.65
15	2.000E+00	1.233E+06	0.0300	292.65	16	2.500E+00	1.068E+06	0.0300	292.65
17	3.000E+00	9.208E+05	0.0300	292.65	18	3.500E+00	7.879E+05	0.0300	292.65
19	4.000E+00	6.668E+05	0.0300	292.65	20	4.500E+00	5.555E+05	0.0300	292.65
21	5.080E+00	4.368E+05	0.0300	292.65	22	7.620E+00	8.161E+03	0.0333	292.65
23	1.016E+01	2.805E+03	0.0418	292.65	24	1.270E+01	2.482E+03	0.0437	292.65
25	1.524E+01	2.291E+03	0.0450	292.65	26	1.778E+01	2.164E+03	0.0461	292.65
27	2.032E+01	2.072E+03	0.0470	292.65	28	2.286E+01	2.003E+03	0.0477	292.65
29	2.540E+01	1.948E+03	0.0483	292.65	30	2.794E+01	1.905E+03	0.0488	292.65
31	3.048E+01	1.871E+03	0.0492	292.65	32	3.302E+01	1.843E+03	0.0495	292.65
33	3.556E+01	1.821E+03	0.0498	292.65	34	3.810E+01	1.803E+03	0.0500	292.65
35	4.064E+01	1.790E+03	0.0502	292.65	36	4.318E+01	1.780E+03	0.0503	292.65
37	4.572E+01	1.774E+03	0.0504	292.65	38	4.826E+01	1.730E+03	0.0501	292.65
39	5.080E+01	1.634E+03	0.0501	292.65	40	5.334E+01	1.599E+03	0.0501	292.65
41	5.588E+01	1.587E+03	0.0501	292.65	42	5.842E+01	1.581E+03	0.0501	292.65
43	6.096E+01	1.579E+03	0.0501	292.65					

Initial Water Storage = 2.7987 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04864     0.05010
 Head (cm)         = 8.54706E+05 5.78860E+05 1.91576E+03 1.57890E+03
 LiqWater Flow (cm)=-1.47709E-12-1.03590E-11-2.18952E-03 4.73594E-10
 IsoVapor Flow (cm)=-4.74133E-03-4.76431E-03-7.54881E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7987+ 0.0000+ 0.0000 - 0.0047- 0.0000-  0.0000 =    2.7939 vs.    2.7939

 Mass Balance = -6.6750E-06 cm;  Time step attempts =   49 and successes =   47
   Evaporation:  Potential =  0.4078 cm, Actual =  0.0047 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.8 %;  TMEAN = 283.7 K;  HDRY =  8.5471E+05 cm;  DAYUBC =    42

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04154     0.05920     0.05026
 Head (cm)         = 5.47835E+05 2.85906E+03 1.31418E+03 1.09478E+03
 LiqWater Flow (cm)=-3.92395E-11-1.54343E-02-7.49488E-03 9.64090E-09
 IsoVapor Flow (cm)=-1.51909E-02-3.17686E-05-4.07197E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3330+ 0.0000+ 0.0000 - 0.0152- 0.0000-  0.0000 =    3.3178 vs.    3.3178

 Mass Balance = -3.4530E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.2091 cm, Actual =  0.0152 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 67.2 %;  TMEAN = 283.2 K;  HDRY =  5.4784E+05 cm;  DAYUBC =    76
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9889E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9889E+02	[cm]
Actual Evaporation	=	3.0460E+01	[cm]
Evaporation during Growth	=	3.0445E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0988E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.6258E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0988E+01	[cm]
Actual Rainfall	=	3.0988E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.3178E+00	[cm]
Mass Balance Error	=	8.5157E-03	[cm]
Total Successful Time Steps	=	55326	
Total Attempted Time Steps	=	67735	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26759	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	5.2762E-01	0.050	1.8751E+01	0.150	1.2580E+01
0.250	1.0738E+01	0.350	8.9341E+00	0.450	7.9781E+00
0.550	7.1826E+00	0.650	6.2100E+00	0.750	5.7581E+00
0.850	5.4258E+00	0.950	5.0525E+00	1.125	4.6271E+00
1.375	4.0184E+00	1.625	3.3488E+00	1.875	2.7157E+00
2.250	2.3008E+00	2.750	1.7181E+00	3.250	1.4196E+00
3.750	1.1969E+00	4.250	1.0548E+00	4.790	8.7744E-01
6.350	7.4422E-01	8.890	5.4986E-01	11.430	3.8105E-01
13.970	3.5384E-01	16.510	3.2805E-01	19.050	3.0229E-01
21.590	2.7640E-01	24.130	2.5028E-01	26.670	2.2390E-01
29.210	1.9725E-01	31.750	1.7036E-01	34.290	1.4323E-01
36.830	1.1587E-01	39.370	8.8301E-02	41.910	6.0553E-02
44.450	3.2642E-02	46.990	4.6758E-03	49.530	4.5062E-03
52.070	1.8701E-03	54.610	4.4094E-04	57.150	7.4566E-05
59.690	1.2860E-05	60.960	6.6258E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2005.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.478E+05	0.0300	292.65	2	1.000E-01	5.095E+05	0.0300	292.65
3	2.000E-01	4.723E+05	0.0300	292.65	4	3.000E-01	4.360E+05	0.0300	292.65
5	4.000E-01	4.007E+05	0.0300	292.65	6	5.000E-01	3.662E+05	0.0300	292.65
7	6.000E-01	3.326E+05	0.0300	292.65	8	7.000E-01	2.998E+05	0.0300	292.65
9	8.000E-01	2.677E+05	0.0300	292.65	10	9.000E-01	2.364E+05	0.0301	292.65
11	1.000E+00	2.058E+05	0.0301	292.65	12	1.250E+00	1.320E+05	0.0301	292.65
13	1.500E+00	6.199E+04	0.0303	292.65	14	1.750E+00	3.064E+03	0.0406	292.65
15	2.000E+00	2.859E+03	0.0415	292.65	16	2.500E+00	2.589E+03	0.0430	292.65
17	3.000E+00	2.412E+03	0.0441	292.65	18	3.500E+00	2.283E+03	0.0451	292.65
19	4.000E+00	2.182E+03	0.0460	292.65	20	4.500E+00	2.100E+03	0.0467	292.65
21	5.080E+00	2.022E+03	0.0475	292.65	22	7.620E+00	1.793E+03	0.0502	292.65
23	1.016E+01	1.657E+03	0.0522	292.65	24	1.270E+01	1.564E+03	0.0537	292.65
25	1.524E+01	1.496E+03	0.0550	292.65	26	1.778E+01	1.443E+03	0.0561	292.65
27	2.032E+01	1.400E+03	0.0571	292.65	28	2.286E+01	1.366E+03	0.0579	292.65
29	2.540E+01	1.338E+03	0.0586	292.65	30	2.794E+01	1.314E+03	0.0592	292.65
31	3.048E+01	1.295E+03	0.0597	292.65	32	3.302E+01	1.278E+03	0.0602	292.65
33	3.556E+01	1.265E+03	0.0606	292.65	34	3.810E+01	1.254E+03	0.0609	292.65
35	4.064E+01	1.246E+03	0.0611	292.65	36	4.318E+01	1.239E+03	0.0613	292.65
37	4.572E+01	1.235E+03	0.0614	292.65	38	4.826E+01	1.202E+03	0.0502	292.65
39	5.080E+01	7.460E+02	0.0507	292.65	40	5.334E+01	7.758E+02	0.0506	292.65
41	5.588E+01	9.195E+02	0.0504	292.65	42	5.842E+01	1.050E+03	0.0503	292.65
43	6.096E+01	1.095E+03	0.0503	292.65					

Initial Water Storage = 3.3178 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04035     0.05882     0.05026
 Head (cm)         = 6.47479E+05 3.13075E+03 1.32889E+03 1.09300E+03
 LiqWater Flow (cm)=-2.12061E-11-1.62724E-02-7.19156E-03 9.77095E-09
 IsoVapor Flow (cm)=-1.72057E-02-3.90605E-05-4.12967E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3178+ 0.0000+ 0.0000 - 0.0172- 0.0000-  0.0000 =    3.3006 vs.    3.3006

 Mass Balance = -2.7958E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3008 cm, Actual =  0.0172 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 62.5 %;  TMEAN = 283.7 K;  HDRY =  6.4748E+05 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04879     0.05167
 Head (cm)         = 1.93021E+06 1.28460E+06 1.90298E+03 5.21252E+02
 LiqWater Flow (cm)=-7.69435E-14-5.89533E-13-2.30467E-03 4.43588E-06
 IsoVapor Flow (cm)=-6.63769E-03-6.63467E-03-7.66530E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8171+ 0.0000+ 0.0000 - 0.0066- 0.0000-  0.0000 =    2.8105 vs.    2.8105

 Mass Balance = -7.2760E-06 cm;  Time step attempts =   50 and successes =   39
   Evaporation:  Potential =  0.2782 cm, Actual =  0.0066 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.7 %;  TMEAN = 286.8 K;  HDRY =  1.9302E+06 cm;  DAYUBC =    39
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9999E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9999E+02	[cm]
Actual Evaporation	=	3.3189E+01	[cm]
Evaporation during Growth	=	3.3189E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.2690E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.7260E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.2690E+01	[cm]
Actual Rainfall	=	3.2690E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8105E+00	[cm]
Mass Balance Error	=	7.3410E-03	[cm]
Total Successful Time Steps	=	59159	
Total Attempted Time Steps	=	72323	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28803	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.9929E-01	0.050	1.6211E+01	0.150	1.0283E+01
0.250	8.3461E+00	0.350	7.1739E+00	0.450	6.1775E+00
0.550	5.3781E+00	0.650	4.7355E+00	0.750	4.3997E+00
0.850	4.0475E+00	0.950	3.6663E+00	1.125	3.3779E+00
1.375	2.7271E+00	1.625	2.4224E+00	1.875	2.1279E+00
2.250	1.7830E+00	2.750	1.2704E+00	3.250	8.9599E-01
3.750	6.8205E-01	4.250	4.4568E-01	4.790	2.6262E-01
6.350	2.5745E-02	8.890	-3.7580E-01	11.430	-3.5593E-01
13.970	-3.3167E-01	16.510	-3.0695E-01	19.050	-2.8183E-01
21.590	-2.5635E-01	24.130	-2.3057E-01	26.670	-2.0450E-01
29.210	-1.7814E-01	31.750	-1.5152E-01	34.290	-1.2466E-01
36.830	-9.7583E-02	39.370	-7.0311E-02	41.910	-4.2869E-02
44.450	-1.5287E-02	46.990	1.2761E-02	49.530	1.6059E-02
52.070	1.1583E-02	54.610	8.7807E-03	57.150	5.5357E-03
59.690	2.2357E-03	60.960	6.7260E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2006.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.930E+06	0.0300	292.65	2	1.000E-01	1.889E+06	0.0300	292.65
3	2.000E-01	1.849E+06	0.0300	292.65	4	3.000E-01	1.812E+06	0.0300	292.65
5	4.000E-01	1.774E+06	0.0300	292.65	6	5.000E-01	1.738E+06	0.0300	292.65
7	6.000E-01	1.703E+06	0.0300	292.65	8	7.000E-01	1.668E+06	0.0300	292.65
9	8.000E-01	1.634E+06	0.0300	292.65	10	9.000E-01	1.602E+06	0.0300	292.65
11	1.000E+00	1.570E+06	0.0300	292.65	12	1.250E+00	1.493E+06	0.0300	292.65
13	1.500E+00	1.420E+06	0.0300	292.65	14	1.750E+00	1.351E+06	0.0300	292.65
15	2.000E+00	1.285E+06	0.0300	292.65	16	2.500E+00	1.161E+06	0.0300	292.65
17	3.000E+00	1.048E+06	0.0300	292.65	18	3.500E+00	9.438E+05	0.0300	292.65
19	4.000E+00	8.466E+05	0.0300	292.65	20	4.500E+00	7.559E+05	0.0300	292.65
21	5.080E+00	6.576E+05	0.0300	292.65	22	7.620E+00	2.936E+05	0.0300	292.65
23	1.016E+01	2.712E+03	0.0423	292.65	24	1.270E+01	2.435E+03	0.0440	292.65
25	1.524E+01	2.275E+03	0.0452	292.65	26	1.778E+01	2.159E+03	0.0462	292.65
27	2.032E+01	2.071E+03	0.0470	292.65	28	2.286E+01	2.002E+03	0.0477	292.65
29	2.540E+01	1.947E+03	0.0483	292.65	30	2.794E+01	1.903E+03	0.0488	292.65
31	3.048E+01	1.867E+03	0.0492	292.65	32	3.302E+01	1.839E+03	0.0496	292.65
33	3.556E+01	1.816E+03	0.0499	292.65	34	3.810E+01	1.798E+03	0.0501	292.65
35	4.064E+01	1.784E+03	0.0503	292.65	36	4.318E+01	1.774E+03	0.0504	292.65
37	4.572E+01	1.768E+03	0.0505	292.65	38	4.826E+01	1.539E+03	0.0501	292.65
39	5.080E+01	5.803E+02	0.0513	292.65	40	5.334E+01	5.486E+02	0.0515	292.65
41	5.588E+01	5.322E+02	0.0516	292.65	42	5.842E+01	5.239E+02	0.0516	292.65
43	6.096E+01	5.213E+02	0.0517	292.65					

Initial Water Storage = 2.8105 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04867     0.05166
 Head (cm)         = 2.25090E+06 1.43704E+06 1.91291E+03 5.21705E+02
 LiqWater Flow (cm)= 1.93955E-02 6.18236E-08-2.25475E-03 4.40417E-06
 IsoVapor Flow (cm)=-2.42458E-02-4.85178E-03-7.70157E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8105+ 0.0254+ 0.0000 - 0.0302- 0.0000-  0.0000 =    2.8056 vs.    2.8056

 Mass Balance = -1.5219E-05 cm;  Time step attempts =  901 and successes =  704
   Evaporation:  Potential =  1.4538 cm, Actual =  0.0302 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 19.5 %;  TMEAN = 287.9 K;  HDRY =  2.2509E+06 cm;  DAYUBC =   379

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03980     0.04722     0.05085
 Head (cm)         = 6.05038E+05 3.27684E+03 2.04689E+03 6.82283E+02
 LiqWater Flow (cm)= 3.69131E-02 3.43640E-03-8.99606E-04 4.81035E-07
 IsoVapor Flow (cm)=-2.80920E-02-1.09397E-05-4.70002E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8503+ 0.0508+ 0.0000 - 0.0420- 0.0000-  0.0000 =    2.8591 vs.    2.8590

 Mass Balance =  1.0953E-04 cm;  Time step attempts =  942 and successes =  725
   Evaporation:  Potential =  0.2209 cm, Actual =  0.0420 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 64.5 %;  TMEAN = 276.8 K;  HDRY =  6.0504E+05 cm;  DAYUBC =   275
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3548E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.3548E+02	[cm]
Actual Evaporation	=	2.1120E+01	[cm]
Evaporation during Growth	=	2.1120E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1184E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.1766E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1184E+01	[cm]
Actual Rainfall	=	2.1184E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8590E+00	[cm]
Mass Balance Error	=	1.4171E-02	[cm]
Total Successful Time Steps	=	213861	
Total Attempted Time Steps	=	270799	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	95875	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	6.3285E-02	0.050	1.4300E+01	0.150	1.2390E+01
0.250	1.0336E+01	0.350	8.6629E+00	0.450	7.3714E+00
0.550	6.3320E+00	0.650	5.4749E+00	0.750	4.7834E+00
0.850	4.1890E+00	0.950	3.6614E+00	1.125	3.1270E+00
1.375	2.2598E+00	1.625	1.7576E+00	1.875	1.4602E+00
2.250	1.2039E+00	2.750	9.4591E-01	3.250	7.8806E-01
3.750	6.8879E-01	4.250	6.1434E-01	4.790	5.5346E-01
6.350	4.7368E-01	8.890	3.8271E-01	11.430	2.1977E-01
13.970	1.6295E-01	16.510	1.1483E-01	19.050	7.0051E-02
21.590	2.6902E-02	24.130	-2.6562E-02	26.670	-4.9678E-02
29.210	-4.6270E-02	31.750	-4.1948E-02	34.290	-3.7127E-02
36.830	-3.1962E-02	39.370	-2.6548E-02	41.910	-2.0954E-02
44.450	-1.5234E-02	46.990	-5.7524E-03	49.530	-1.0552E-03
52.070	-5.3722E-03	54.610	-4.2211E-03	57.150	-2.3370E-03
59.690	-3.7211E-04	60.960	6.1766E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2007.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	6.050E+05	0.0300	292.65	2	1.000E-01	5.546E+05	0.0300	292.65
3	2.000E-01	5.060E+05	0.0300	292.65	4	3.000E-01	4.590E+05	0.0300	292.65
5	4.000E-01	4.136E+05	0.0300	292.65	6	5.000E-01	3.696E+05	0.0300	292.65
7	6.000E-01	3.271E+05	0.0300	292.65	8	7.000E-01	2.858E+05	0.0300	292.65
9	8.000E-01	2.458E+05	0.0301	292.65	10	9.000E-01	2.070E+05	0.0301	292.65
11	1.000E+00	1.694E+05	0.0301	292.65	12	1.250E+00	8.031E+04	0.0302	292.65
13	1.500E+00	4.003E+03	0.0377	292.65	14	1.750E+00	3.529E+03	0.0390	292.65
15	2.000E+00	3.277E+03	0.0398	292.65	16	2.500E+00	2.981E+03	0.0410	292.65
17	3.000E+00	2.814E+03	0.0418	292.65	18	3.500E+00	2.708E+03	0.0423	292.65
19	4.000E+00	2.635E+03	0.0427	292.65	20	4.500E+00	2.582E+03	0.0430	292.65
21	5.080E+00	2.536E+03	0.0433	292.65	22	7.620E+00	2.426E+03	0.0441	292.65
23	1.016E+01	2.328E+03	0.0448	292.65	24	1.270E+01	2.251E+03	0.0454	292.65
25	1.524E+01	2.195E+03	0.0458	292.65	26	1.778E+01	2.154E+03	0.0462	292.65
27	2.032E+01	2.122E+03	0.0465	292.65	28	2.286E+01	2.095E+03	0.0468	292.65
29	2.540E+01	2.070E+03	0.0470	292.65	30	2.794E+01	2.047E+03	0.0472	292.65
31	3.048E+01	2.026E+03	0.0474	292.65	32	3.302E+01	2.007E+03	0.0476	292.65
33	3.556E+01	1.990E+03	0.0478	292.65	34	3.810E+01	1.976E+03	0.0480	292.65
35	4.064E+01	1.965E+03	0.0481	292.65	36	4.318E+01	1.957E+03	0.0482	292.65
37	4.572E+01	1.951E+03	0.0482	292.65	38	4.826E+01	1.749E+03	0.0501	292.65
39	5.080E+01	1.083E+03	0.0503	292.65	40	5.334E+01	7.887E+02	0.0506	292.65
41	5.588E+01	7.170E+02	0.0508	292.65	42	5.842E+01	6.899E+02	0.0508	292.65
43	6.096E+01	6.823E+02	0.0509	292.65					

Initial Water Storage = 2.8590 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.04720     0.05085
 Head (cm)         = 8.36981E+05 1.36252E+05 2.04888E+03 6.82685E+02
 LiqWater Flow (cm)=-7.16283E-12-6.19291E-03-8.54894E-04 4.78706E-07
 IsoVapor Flow (cm)=-1.85916E-02-4.51350E-03-4.51250E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8590+ 0.0000+ 0.0000 - 0.0186- 0.0000-  0.0000 =    2.8404 vs.    2.8404

 Mass Balance = -3.6319E-05 cm;  Time step attempts =  144 and successes =  111
   Evaporation:  Potential =  0.4122 cm, Actual =  0.0186 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.5 %;  TMEAN = 278.7 K;  HDRY =  8.3698E+05 cm;  DAYUBC =   111

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.06059     0.05056
 Head (cm)         = 1.64351E+06 2.11002E+05 1.26377E+03 8.07957E+02
 LiqWater Flow (cm)=-5.34070E-13-2.22420E-04-8.97308E-03 1.19115E-07
 IsoVapor Flow (cm)=-2.22025E-02-2.19628E-02-3.99009E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3848+ 0.0000+ 0.0000 - 0.0222- 0.0000-  0.0000 =    3.3626 vs.    3.3626

 Mass Balance =  3.2649E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6772 cm, Actual =  0.0222 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 30.4 %;  TMEAN = 283.4 K;  HDRY =  1.6435E+06 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0482E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0482E+02	[cm]
Actual Evaporation	=	2.5192E+01	[cm]
Evaporation during Growth	=	2.5192E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5705E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.7779E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5705E+01	[cm]
Actual Rainfall	=	2.5705E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.3626E+00	[cm]
Mass Balance Error	=	9.4584E-03	[cm]
Total Successful Time Steps	=	70064	
Total Attempted Time Steps	=	86834	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	33200	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	5.1315E-01	0.050	1.8188E+01	0.150	1.3512E+01
0.250	1.1284E+01	0.350	9.7944E+00	0.450	8.7670E+00
0.550	7.8405E+00	0.650	7.0364E+00	0.750	6.4523E+00
0.850	5.9187E+00	0.950	5.4691E+00	1.125	5.0811E+00
1.375	4.1835E+00	1.625	3.4597E+00	1.875	3.0074E+00
2.250	2.5544E+00	2.750	1.9239E+00	3.250	1.5652E+00
3.750	1.3407E+00	4.250	1.1565E+00	4.790	1.0161E+00
6.350	8.7322E-01	8.890	5.4227E-01	11.430	4.6263E-01
13.970	4.3811E-01	16.510	4.1152E-01	19.050	3.8299E-01
21.590	3.5274E-01	24.130	3.2099E-01	26.670	2.8798E-01
29.210	2.5392E-01	31.750	2.1900E-01	34.290	1.8339E-01
36.830	1.4719E-01	39.370	1.1054E-01	41.910	7.3510E-02
44.450	3.6196E-02	46.990	-1.0662E-03	49.530	3.0182E-04
52.070	-7.2875E-04	54.610	-1.0247E-03	57.150	-7.2724E-04
59.690	-2.0337E-04	60.960	8.7779E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2008.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.644E+06	0.0300	292.65	2	1.000E-01	1.523E+06	0.0300	292.65
3	2.000E-01	1.413E+06	0.0300	292.65	4	3.000E-01	1.311E+06	0.0300	292.65
5	4.000E-01	1.215E+06	0.0300	292.65	6	5.000E-01	1.126E+06	0.0300	292.65
7	6.000E-01	1.042E+06	0.0300	292.65	8	7.000E-01	9.634E+05	0.0300	292.65
9	8.000E-01	8.887E+05	0.0300	292.65	10	9.000E-01	8.177E+05	0.0300	292.65
11	1.000E+00	7.502E+05	0.0300	292.65	12	1.250E+00	5.945E+05	0.0300	292.65
13	1.500E+00	4.545E+05	0.0300	292.65	14	1.750E+00	3.273E+05	0.0300	292.65
15	2.000E+00	2.110E+05	0.0301	292.65	16	2.500E+00	2.932E+03	0.0412	292.65
17	3.000E+00	2.546E+03	0.0433	292.65	18	3.500E+00	2.334E+03	0.0447	292.65
19	4.000E+00	2.191E+03	0.0459	292.65	20	4.500E+00	2.085E+03	0.0468	292.65
21	5.080E+00	1.991E+03	0.0478	292.65	22	7.620E+00	1.739E+03	0.0509	292.65
23	1.016E+01	1.601E+03	0.0531	292.65	24	1.270E+01	1.509E+03	0.0548	292.65
25	1.524E+01	1.442E+03	0.0562	292.65	26	1.778E+01	1.390E+03	0.0573	292.65
27	2.032E+01	1.348E+03	0.0583	292.65	28	2.286E+01	1.315E+03	0.0592	292.65
29	2.540E+01	1.287E+03	0.0599	292.65	30	2.794E+01	1.264E+03	0.0606	292.65
31	3.048E+01	1.245E+03	0.0611	292.65	32	3.302E+01	1.229E+03	0.0616	292.65
33	3.556E+01	1.215E+03	0.0620	292.65	34	3.810E+01	1.205E+03	0.0624	292.65
35	4.064E+01	1.196E+03	0.0626	292.65	36	4.318E+01	1.190E+03	0.0628	292.65
37	4.572E+01	1.186E+03	0.0630	292.65	38	4.826E+01	1.164E+03	0.0502	292.65
39	5.080E+01	9.495E+02	0.0504	292.65	40	5.334E+01	8.838E+02	0.0504	292.65
41	5.588E+01	8.386E+02	0.0505	292.65	42	5.842E+01	8.151E+02	0.0505	292.65
43	6.096E+01	8.080E+02	0.0506	292.65					

Initial Water Storage = 3.3626 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03006     0.06014     0.05056
 Head (cm)         = 1.92914E+06 2.30598E+05 1.27963E+03 8.08190E+02
 LiqWater Flow (cm)=-3.13727E-13-1.14092E-04-8.52089E-03 1.18833E-07
 IsoVapor Flow (cm)=-2.40347E-02-2.39143E-02-4.03528E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3626+ 0.0000+ 0.0000 - 0.0240- 0.0000-  0.0000 =    3.3385 vs.    3.3385

 Mass Balance = -2.9499E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5619 cm, Actual =  0.0240 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.7 %;  TMEAN = 276.2 K;  HDRY =  1.9291E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.05017     0.05045
 Head (cm)         = 1.38020E+06 8.69982E+05 1.79324E+03 8.82110E+02
 LiqWater Flow (cm)=-2.72083E-13-2.37867E-12-2.23536E-03 5.75497E-08
 IsoVapor Flow (cm)=-6.60513E-03-6.60704E-03-5.70817E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8920+ 0.0000+ 0.0000 - 0.0066- 0.0000-  0.0000 =    2.8854 vs.    2.8854

 Mass Balance = -8.6051E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3319 cm, Actual =  0.0066 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.7 %;  TMEAN = 279.8 K;  HDRY =  1.3802E+06 cm;  DAYUBC =    72
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2814E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2814E+02	[cm]
Actual Evaporation	=	2.5490E+01	[cm]
Evaporation during Growth	=	2.5483E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5019E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.5488E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5019E+01	[cm]
Actual Rainfall	=	2.5019E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8854E+00	[cm]
Mass Balance Error	=	6.6330E-03	[cm]
Total Successful Time Steps	=	55076	
Total Attempted Time Steps	=	67117	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27369	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.7054E-01	0.050	1.6178E+01	0.150	7.4897E+00
0.250	5.7656E+00	0.350	4.6058E+00	0.450	3.8431E+00
0.550	3.3108E+00	0.650	2.9942E+00	0.750	2.8271E+00
0.850	2.6661E+00	0.950	2.5075E+00	1.125	2.4116E+00
1.375	2.1264E+00	1.625	1.9193E+00	1.875	1.7370E+00
2.250	1.5482E+00	2.750	1.2958E+00	3.250	1.0281E+00
3.750	8.7567E-01	4.250	7.1550E-01	4.790	4.9960E-01
6.350	3.3813E-01	8.890	2.8987E-02	11.430	-2.3982E-02
13.970	-7.4610E-02	16.510	-1.1730E-01	19.050	-1.5619E-01
21.590	-1.9422E-01	24.130	-2.1211E-01	26.670	-2.2184E-01
29.210	-1.9620E-01	31.750	-1.6942E-01	34.290	-1.4214E-01
36.830	-1.1444E-01	39.370	-8.6382E-02	41.910	-5.8052E-02
44.450	-2.9497E-02	46.990	4.3460E-04	49.530	3.1020E-03
52.070	1.0744E-03	54.610	1.7985E-04	57.150	-9.6364E-05
59.690	-4.7676E-05	60.960	2.5488E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2009.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.380E+06	0.0300	292.65	2	1.000E-01	1.350E+06	0.0300	292.65
3	2.000E-01	1.320E+06	0.0300	292.65	4	3.000E-01	1.291E+06	0.0300	292.65
5	4.000E-01	1.262E+06	0.0300	292.65	6	5.000E-01	1.234E+06	0.0300	292.65
7	6.000E-01	1.206E+06	0.0300	292.65	8	7.000E-01	1.179E+06	0.0300	292.65
9	8.000E-01	1.153E+06	0.0300	292.65	10	9.000E-01	1.127E+06	0.0300	292.65
11	1.000E+00	1.102E+06	0.0300	292.65	12	1.250E+00	1.040E+06	0.0300	292.65
13	1.500E+00	9.809E+05	0.0300	292.65	14	1.750E+00	9.243E+05	0.0300	292.65
15	2.000E+00	8.700E+05	0.0300	292.65	16	2.500E+00	7.673E+05	0.0300	292.65
17	3.000E+00	6.717E+05	0.0300	292.65	18	3.500E+00	5.823E+05	0.0300	292.65
19	4.000E+00	4.984E+05	0.0300	292.65	20	4.500E+00	4.193E+05	0.0300	292.65
21	5.080E+00	3.328E+05	0.0300	292.65	22	7.620E+00	2.721E+03	0.0422	292.65
23	1.016E+01	2.367E+03	0.0445	292.65	24	1.270E+01	2.185E+03	0.0459	292.65
25	1.524E+01	2.067E+03	0.0470	292.65	26	1.778E+01	1.982E+03	0.0479	292.65
27	2.032E+01	1.918E+03	0.0486	292.65	28	2.286E+01	1.867E+03	0.0492	292.65
29	2.540E+01	1.826E+03	0.0497	292.65	30	2.794E+01	1.793E+03	0.0502	292.65
31	3.048E+01	1.766E+03	0.0505	292.65	32	3.302E+01	1.745E+03	0.0508	292.65
33	3.556E+01	1.727E+03	0.0511	292.65	34	3.810E+01	1.713E+03	0.0513	292.65
35	4.064E+01	1.703E+03	0.0515	292.65	36	4.318E+01	1.695E+03	0.0516	292.65
37	4.572E+01	1.689E+03	0.0517	292.65	38	4.826E+01	1.590E+03	0.0501	292.65
39	5.080E+01	1.053E+03	0.0503	292.65	40	5.334E+01	8.655E+02	0.0505	292.65
41	5.588E+01	8.476E+02	0.0505	292.65	42	5.842E+01	8.690E+02	0.0505	292.65
43	6.096E+01	8.821E+02	0.0504	292.65					

Initial Water Storage = 2.8854 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.05003     0.05045
 Head (cm)         = 1.61006E+06 9.83207E+05 1.80325E+03 8.81709E+02
 LiqWater Flow (cm)=-1.65072E-13-1.56529E-12-2.22452E-03 5.77680E-08
 IsoVapor Flow (cm)=-7.19504E-03-7.19188E-03-5.82876E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8854+ 0.0000+ 0.0000 - 0.0072- 0.0000-  0.0000 =    2.8782 vs.    2.8782

 Mass Balance =  1.0888E-06 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.4194 cm, Actual =  0.0072 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 31.1 %;  TMEAN = 281.8 K;  HDRY =  1.6101E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.05140     0.06992     0.05029
 Head (cm)         = 1.02625E+06 1.70623E+03 1.00895E+03 1.04442E+03
 LiqWater Flow (cm)=-1.18078E-09-8.72441E-02 1.11995E-02 1.43161E-08
 IsoVapor Flow (cm)=-1.10828E-01-8.84836E-06 8.55545E-08 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9301+ 0.0000+ 0.0000 - 0.1108- 0.0000-  0.0000 =    3.8193 vs.    3.8193

 Mass Balance = -4.2886E-05 cm;  Time step attempts =  262 and successes =  209
   Evaporation:  Potential =  0.4897 cm, Actual =  0.1108 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.5 %;  TMEAN = 279.0 K;  HDRY =  1.0263E+06 cm;  DAYUBC =   181
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0884E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0884E+02	[cm]
Actual Evaporation	=	2.1105E+01	[cm]
Evaporation during Growth	=	2.1105E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.2047E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.3736E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.2047E+01	[cm]
Actual Rainfall	=	2.2047E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.8193E+00	[cm]
Mass Balance Error	=	7.7945E-03	[cm]
Total Successful Time Steps	=	60065	
Total Attempted Time Steps	=	73986	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29914	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.4177E-01	0.050	1.4571E+01	0.150	1.0366E+01
0.250	8.6301E+00	0.350	7.8599E+00	0.450	7.1707E+00
0.550	6.5331E+00	0.650	5.8628E+00	0.750	5.3560E+00
0.850	5.0144E+00	0.950	4.6261E+00	1.125	4.2428E+00
1.375	3.5465E+00	1.625	3.1706E+00	1.875	2.7008E+00
2.250	2.4901E+00	2.750	2.2167E+00	3.250	2.0035E+00
3.750	1.8544E+00	4.250	1.7575E+00	4.790	1.6510E+00
6.350	1.5309E+00	8.890	1.2039E+00	11.430	1.0484E+00
13.970	9.1629E-01	16.510	7.9111E-01	19.050	6.7398E-01
21.590	5.6876E-01	24.130	4.7515E-01	26.670	3.8369E-01
29.210	3.3177E-01	31.750	2.8218E-01	34.290	2.3347E-01
36.830	1.8558E-01	39.370	1.3838E-01	41.910	9.1719E-02
44.450	4.5386E-02	46.990	2.6152E-04	49.530	8.6803E-04
52.070	-6.6697E-05	54.610	-1.7645E-04	57.150	-1.4104E-04
59.690	-4.4626E-05	60.960	1.3736E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2010.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.026E+06	0.0300	292.65	2	1.000E-01	7.520E+05	0.0300	292.65
3	2.000E-01	5.235E+05	0.0300	292.65	4	3.000E-01	3.276E+05	0.0300	292.65
5	4.000E-01	1.562E+05	0.0301	292.65	6	5.000E-01	3.437E+03	0.0393	292.65
7	6.000E-01	2.859E+03	0.0415	292.65	8	7.000E-01	2.576E+03	0.0431	292.65
9	8.000E-01	2.396E+03	0.0443	292.65	10	9.000E-01	2.266E+03	0.0452	292.65
11	1.000E+00	2.166E+03	0.0461	292.65	12	1.250E+00	1.988E+03	0.0478	292.65
13	1.500E+00	1.867E+03	0.0492	292.65	14	1.750E+00	1.777E+03	0.0504	292.65
15	2.000E+00	1.706E+03	0.0514	292.65	16	2.500E+00	1.599E+03	0.0531	292.65
17	3.000E+00	1.521E+03	0.0545	292.65	18	3.500E+00	1.460E+03	0.0558	292.65
19	4.000E+00	1.410E+03	0.0569	292.65	20	4.500E+00	1.369E+03	0.0578	292.65
21	5.080E+00	1.329E+03	0.0588	292.65	22	7.620E+00	1.211E+03	0.0622	292.65
23	1.016E+01	1.141E+03	0.0645	292.65	24	1.270E+01	1.096E+03	0.0662	292.65
25	1.524E+01	1.065E+03	0.0675	292.65	26	1.778E+01	1.043E+03	0.0684	292.65
27	2.032E+01	1.028E+03	0.0690	292.65	28	2.286E+01	1.018E+03	0.0695	292.65
29	2.540E+01	1.012E+03	0.0698	292.65	30	2.794E+01	1.009E+03	0.0699	292.65
31	3.048E+01	1.008E+03	0.0700	292.65	32	3.302E+01	1.008E+03	0.0700	292.65
33	3.556E+01	1.009E+03	0.0699	292.65	34	3.810E+01	1.011E+03	0.0698	292.65
35	4.064E+01	1.012E+03	0.0698	292.65	36	4.318E+01	1.012E+03	0.0698	292.65
37	4.572E+01	1.011E+03	0.0698	292.65	38	4.826E+01	1.028E+03	0.0503	292.65
39	5.080E+01	9.853E+02	0.0503	292.65	40	5.334E+01	1.032E+03	0.0503	292.65
41	5.588E+01	1.046E+03	0.0503	292.65	42	5.842E+01	1.046E+03	0.0503	292.65
43	6.096E+01	1.044E+03	0.0503	292.65					

Initial Water Storage = 3.8193 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03004     0.05005     0.06874     0.05029
 Head (cm)         = 3.26692E+05 1.80221E+03 1.03484E+03 1.04447E+03
 LiqWater Flow (cm)=-7.55792E-09-5.94702E-02-3.12013E-03 1.43107E-08
 IsoVapor Flow (cm)=-5.89595E-02-1.13378E-05-9.64523E-08 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.8193+ 0.0000+ 0.0000 - 0.0590- 0.0000-  0.0000 =    3.7604 vs.    3.7604

 Mass Balance = -1.3270E-05 cm;  Time step attempts =  402 and successes =  321
   Evaporation:  Potential =  0.1600 cm, Actual =  0.0590 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 55.0 %;  TMEAN = 276.8 K;  HDRY =  8.2333E+05 cm;  DAYUBC =   123

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04106     0.04680     0.05024
 Head (cm)         = 9.30306E+05 2.96420E+03 2.08955E+03 1.12827E+03
 LiqWater Flow (cm)=-1.13124E-11-2.26587E-02-1.75084E-03 7.57639E-09
 IsoVapor Flow (cm)=-3.91078E-02-2.23882E-05-9.19655E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8979+ 0.0000+ 0.0000 - 0.0391- 0.0000-  0.0000 =    2.8587 vs.    2.8588

 Mass Balance = -5.5538E-05 cm;  Time step attempts =  311 and successes =  256
   Evaporation:  Potential =  0.4364 cm, Actual =  0.0391 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 50.9 %;  TMEAN = 273.7 K;  HDRY =  9.3031E+05 cm;  DAYUBC =   255
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0272E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0272E+02	[cm]
Actual Evaporation	=	1.7895E+01	[cm]
Evaporation during Growth	=	1.7895E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.6942E+01	[cm]
Total Basal Liquid Flux (drainage)	=	4.4306E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.6942E+01	[cm]
Actual Rainfall	=	1.6942E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8588E+00	[cm]
Mass Balance Error	=	6.8764E-03	[cm]
Total Successful Time Steps	=	64119	
Total Attempted Time Steps	=	78822	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	33409	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.5366E-01	0.050	1.2404E+01	0.150	9.5410E+00
0.250	8.0181E+00	0.350	7.0281E+00	0.450	6.1468E+00
0.550	5.2994E+00	0.650	4.8119E+00	0.750	4.3700E+00
0.850	3.8769E+00	0.950	3.3845E+00	1.125	3.0843E+00
1.375	2.4696E+00	1.625	1.9236E+00	1.875	1.6096E+00
2.250	1.2946E+00	2.750	7.0608E-01	3.250	3.8045E-01
3.750	1.8416E-01	4.250	5.5345E-02	4.790	-4.4717E-02
6.350	-1.6918E-01	8.890	-5.1454E-01	11.430	-6.4497E-01
13.970	-6.7576E-01	16.510	-6.8852E-01	19.050	-6.2981E-01
21.590	-5.6914E-01	24.130	-5.0894E-01	26.670	-4.4947E-01
29.210	-3.9086E-01	31.750	-3.3315E-01	34.290	-2.7634E-01
36.830	-2.2037E-01	39.370	-1.6513E-01	41.910	-1.1044E-01
44.450	-5.6064E-02	46.990	-1.3371E-03	49.530	2.4991E-04
52.070	-1.3946E-05	54.610	-2.5069E-05	57.150	-1.9098E-05
59.690	-4.4275E-06	60.960	4.4306E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2011.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.303E+05	0.0300	292.65	2	1.000E-01	8.450E+05	0.0300	292.65
3	2.000E-01	7.646E+05	0.0300	292.65	4	3.000E-01	6.886E+05	0.0300	292.65
5	4.000E-01	6.167E+05	0.0300	292.65	6	5.000E-01	5.483E+05	0.0300	292.65
7	6.000E-01	4.831E+05	0.0300	292.65	8	7.000E-01	4.209E+05	0.0300	292.65
9	8.000E-01	3.613E+05	0.0300	292.65	10	9.000E-01	3.043E+05	0.0300	292.65
11	1.000E+00	2.495E+05	0.0301	292.65	12	1.250E+00	1.213E+05	0.0301	292.65
13	1.500E+00	4.258E+03	0.0372	292.65	14	1.750E+00	3.311E+03	0.0397	292.65
15	2.000E+00	2.964E+03	0.0411	292.65	16	2.500E+00	2.625E+03	0.0428	292.65
17	3.000E+00	2.445E+03	0.0439	292.65	18	3.500E+00	2.329E+03	0.0448	292.65
19	4.000E+00	2.248E+03	0.0454	292.65	20	4.500E+00	2.190E+03	0.0459	292.65
21	5.080E+00	2.141E+03	0.0463	292.65	22	7.620E+00	2.073E+03	0.0470	292.65
23	1.016E+01	2.144E+03	0.0463	292.65	24	1.270E+01	2.299E+03	0.0450	292.65
25	1.524E+01	2.404E+03	0.0442	292.65	26	1.778E+01	2.375E+03	0.0444	292.65
27	2.032E+01	2.291E+03	0.0450	292.65	28	2.286E+01	2.210E+03	0.0457	292.65
29	2.540E+01	2.143E+03	0.0463	292.65	30	2.794E+01	2.090E+03	0.0468	292.65
31	3.048E+01	2.047E+03	0.0472	292.65	32	3.302E+01	2.013E+03	0.0476	292.65
33	3.556E+01	1.987E+03	0.0478	292.65	34	3.810E+01	1.966E+03	0.0481	292.65
35	4.064E+01	1.950E+03	0.0482	292.65	36	4.318E+01	1.939E+03	0.0484	292.65
37	4.572E+01	1.932E+03	0.0484	292.65	38	4.826E+01	1.805E+03	0.0501	292.65
39	5.080E+01	1.457E+03	0.0501	292.65	40	5.334E+01	1.244E+03	0.0502	292.65
41	5.588E+01	1.161E+03	0.0502	292.65	42	5.842E+01	1.134E+03	0.0502	292.65
43	6.096E+01	1.128E+03	0.0502	292.65					

Initial Water Storage = 2.8588 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04672     0.05024
 Head (cm)         = 1.63309E+06 2.13165E+05 2.09791E+03 1.12853E+03
 LiqWater Flow (cm)=-6.93514E-13-8.92615E-03-1.71002E-03 7.56218E-09
 IsoVapor Flow (cm)=-2.69927E-02-9.66092E-03-9.19205E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8588+ 0.0000+ 0.0000 - 0.0270- 0.0000-  0.0000 =    2.8318 vs.    2.8319

 Mass Balance = -4.3839E-05 cm;  Time step attempts =  180 and successes =  138
   Evaporation:  Potential =  0.5153 cm, Actual =  0.0270 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 30.6 %;  TMEAN = 280.1 K;  HDRY =  1.6331E+06 cm;  DAYUBC =   138

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03007     0.05757     0.07834     0.05009
 Head (cm)         = 1.93406E+05 1.37937E+03 8.57116E+02 1.68511E+03
 LiqWater Flow (cm)=-1.48295E-08-7.41189E-02-3.64072E-02 2.77874E-10
 IsoVapor Flow (cm)=-6.01614E-02-5.17880E-06-2.35506E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.2409+ 0.0000+ 0.0000 - 0.0602- 0.0000-  0.0000 =    4.1807 vs.    4.1807

 Mass Balance =  1.9180E-05 cm;  Time step attempts =  171 and successes =  151
   Evaporation:  Potential =  0.2528 cm, Actual =  0.0602 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 78.7 %;  TMEAN = 279.5 K;  HDRY =  3.3014E+05 cm;  DAYUBC =    90
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4173E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.4173E+02	[cm]
Actual Evaporation	=	1.2589E+01	[cm]
Evaporation during Growth	=	1.2589E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.3919E+01	[cm]
Total Basal Liquid Flux (drainage)	=	9.2968E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.3919E+01	[cm]
Actual Rainfall	=	1.3919E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.1807E+00	[cm]
Mass Balance Error	=	8.3141E-03	[cm]
Total Successful Time Steps	=	64938	
Total Attempted Time Steps	=	80077	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	33261	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.3302E+00	0.050	1.0626E+01	0.150	8.5538E+00
0.250	7.5587E+00	0.350	6.9268E+00	0.450	6.5789E+00
0.550	6.3023E+00	0.650	6.0189E+00	0.750	5.7703E+00
0.850	5.5641E+00	0.950	5.4138E+00	1.125	5.2522E+00
1.375	4.8883E+00	1.625	4.5547E+00	1.875	4.2961E+00
2.250	4.0180E+00	2.750	3.4990E+00	3.250	3.1340E+00
3.750	2.8882E+00	4.250	2.6059E+00	4.790	2.3704E+00
6.350	2.0845E+00	8.890	1.5819E+00	11.430	1.2372E+00
13.970	1.0454E+00	16.510	9.7340E-01	19.050	8.9864E-01
21.590	8.2211E-01	24.130	7.4424E-01	26.670	6.6517E-01
29.210	5.8500E-01	31.750	5.0381E-01	34.290	4.2168E-01
36.830	3.3870E-01	39.370	2.5496E-01	41.910	1.7056E-01
44.450	8.5566E-02	46.990	7.3096E-04	49.530	2.2898E-05
52.070	-7.1335E-06	54.610	-1.4925E-05	57.150	-1.5449E-05
59.690	-6.1756E-06	60.960	9.2968E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2012.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.934E+05	0.0301	292.65	2	1.000E-01	7.846E+04	0.0302	292.65
3	2.000E-01	1.584E+03	0.0534	292.65	4	3.000E-01	1.570E+03	0.0536	292.65
5	4.000E-01	1.556E+03	0.0539	292.65	6	5.000E-01	1.542E+03	0.0541	292.65
7	6.000E-01	1.529E+03	0.0544	292.65	8	7.000E-01	1.516E+03	0.0546	292.65
9	8.000E-01	1.504E+03	0.0549	292.65	10	9.000E-01	1.491E+03	0.0551	292.65
11	1.000E+00	1.480E+03	0.0554	292.65	12	1.250E+00	1.452E+03	0.0559	292.65
13	1.500E+00	1.426E+03	0.0565	292.65	14	1.750E+00	1.402E+03	0.0570	292.65
15	2.000E+00	1.379E+03	0.0576	292.65	16	2.500E+00	1.339E+03	0.0586	292.65
17	3.000E+00	1.304E+03	0.0595	292.65	18	3.500E+00	1.273E+03	0.0603	292.65
19	4.000E+00	1.245E+03	0.0611	292.65	20	4.500E+00	1.221E+03	0.0619	292.65
21	5.080E+00	1.195E+03	0.0627	292.65	22	7.620E+00	1.109E+03	0.0657	292.65
23	1.016E+01	1.048E+03	0.0682	292.65	24	1.270E+01	1.001E+03	0.0703	292.65
25	1.524E+01	9.639E+02	0.0721	292.65	26	1.778E+01	9.341E+02	0.0737	292.65
27	2.032E+01	9.095E+02	0.0751	292.65	28	2.286E+01	8.890E+02	0.0763	292.65
29	2.540E+01	8.717E+02	0.0774	292.65	30	2.794E+01	8.571E+02	0.0783	292.65
31	3.048E+01	8.448E+02	0.0792	292.65	32	3.302E+01	8.343E+02	0.0799	292.65
33	3.556E+01	8.255E+02	0.0805	292.65	34	3.810E+01	8.182E+02	0.0810	292.65
35	4.064E+01	8.121E+02	0.0815	292.65	36	4.318E+01	8.073E+02	0.0818	292.65
37	4.572E+01	8.037E+02	0.0821	292.65	38	4.826E+01	7.949E+02	0.0506	292.65
39	5.080E+01	1.509E+03	0.0501	292.65	40	5.334E+01	1.708E+03	0.0501	292.65
41	5.588E+01	1.721E+03	0.0501	292.65	42	5.842E+01	1.697E+03	0.0501	292.65
43	6.096E+01	1.685E+03	0.0501	292.65					

Initial Water Storage = 4.1807 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06537     0.06560     0.07668     0.05009
 Head (cm)         = 1.11780E+03 1.11184E+03 8.83015E+02 1.68690E+03
 LiqWater Flow (cm)=-1.71788E-03-2.57592E-02-3.23945E-02 2.75352E-10
 IsoVapor Flow (cm)=-5.54926E-05-1.16636E-06-2.45205E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1807+ 0.0000+ 0.0000 - 0.0000- 0.0000-  0.0000 =    4.1807 vs.    4.1807

 Mass Balance =  2.2094E-05 cm;  Time step attempts =  107 and successes =   95
   Evaporation:  Potential =  0.0878 cm, Actual =  0.0000 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = **** %;  TMEAN = 272.6 K;  HDRY =  1.5303E-10 cm;  DAYUBC =     0

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03009     0.05609     0.05011
 Head (cm)         = 1.03684E+06 1.57500E+05 1.44500E+03 1.53378E+03
 LiqWater Flow (cm)=-2.46492E-12-2.23950E-04-2.66652E-03 6.01803E-10
 IsoVapor Flow (cm)=-1.69046E-02-1.66803E-02-2.61679E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1966+ 0.0000+ 0.0000 - 0.0169- 0.0000-  0.0000 =    3.1797 vs.    3.1797

 Mass Balance = -3.0048E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8232 cm, Actual =  0.0169 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.1 %;  TMEAN = 284.0 K;  HDRY =  1.0368E+06 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1811E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1811E+02	[cm]
Actual Evaporation	=	1.4382E+01	[cm]
Evaporation during Growth	=	1.4365E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.3386E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.3865E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.3386E+01	[cm]
Actual Rainfall	=	1.3386E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.1797E+00	[cm]
Mass Balance Error	=	4.9321E-03	[cm]
Total Successful Time Steps	=	52650	
Total Attempted Time Steps	=	63414	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28860	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.9601E-01	0.050	9.6302E+00	0.150	6.8230E+00
0.250	5.7318E+00	0.350	4.8757E+00	0.450	4.3365E+00
0.550	3.8037E+00	0.650	3.3583E+00	0.750	3.0732E+00
0.850	2.7259E+00	0.950	2.3739E+00	1.125	2.1501E+00
1.375	1.7397E+00	1.625	1.4334E+00	1.875	1.0189E+00
2.250	7.7207E-01	2.750	4.0090E-01	3.250	2.1718E-01
3.750	8.5544E-02	4.250	4.4295E-02	4.790	-1.9564E-02
6.350	-1.1548E-01	8.890	-3.9065E-01	11.430	-4.6616E-01
13.970	-5.1804E-01	16.510	-5.5938E-01	19.050	-5.6868E-01
21.590	-5.6579E-01	24.130	-5.3752E-01	26.670	-4.8282E-01
29.210	-4.2647E-01	31.750	-3.6872E-01	34.290	-3.0970E-01
36.830	-2.4957E-01	39.370	-1.8848E-01	41.910	-1.2655E-01
44.450	-6.3968E-02	46.990	-4.7922E-04	49.530	1.7982E-04
52.070	1.1294E-05	54.610	3.1300E-06	57.150	1.1260E-06
59.690	3.6838E-07	60.960	1.3865E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2013.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.037E+06	0.0300	292.65	2	1.000E-01	9.767E+05	0.0300	292.65
3	2.000E-01	9.190E+05	0.0300	292.65	4	3.000E-01	8.637E+05	0.0300	292.65
5	4.000E-01	8.104E+05	0.0300	292.65	6	5.000E-01	7.592E+05	0.0300	292.65
7	6.000E-01	7.098E+05	0.0300	292.65	8	7.000E-01	6.621E+05	0.0300	292.65
9	8.000E-01	6.161E+05	0.0300	292.65	10	9.000E-01	5.715E+05	0.0300	292.65
11	1.000E+00	5.283E+05	0.0300	292.65	12	1.250E+00	4.258E+05	0.0300	292.65
13	1.500E+00	3.304E+05	0.0300	292.65	14	1.750E+00	2.413E+05	0.0301	292.65
15	2.000E+00	1.575E+05	0.0301	292.65	16	2.500E+00	3.484E+03	0.0391	292.65
17	3.000E+00	2.882E+03	0.0414	292.65	18	3.500E+00	2.602E+03	0.0429	292.65
19	4.000E+00	2.425E+03	0.0441	292.65	20	4.500E+00	2.298E+03	0.0450	292.65
21	5.080E+00	2.187E+03	0.0459	292.65	22	7.620E+00	1.904E+03	0.0488	292.65
23	1.016E+01	1.757E+03	0.0507	292.65	24	1.270E+01	1.663E+03	0.0521	292.65
25	1.524E+01	1.597E+03	0.0532	292.65	26	1.778E+01	1.549E+03	0.0540	292.65
27	2.032E+01	1.512E+03	0.0547	292.65	28	2.286E+01	1.484E+03	0.0553	292.65
29	2.540E+01	1.462E+03	0.0557	292.65	30	2.794E+01	1.445E+03	0.0561	292.65
31	3.048E+01	1.431E+03	0.0564	292.65	32	3.302E+01	1.421E+03	0.0566	292.65
33	3.556E+01	1.412E+03	0.0568	292.65	34	3.810E+01	1.406E+03	0.0570	292.65
35	4.064E+01	1.400E+03	0.0571	292.65	36	4.318E+01	1.396E+03	0.0572	292.65
37	4.572E+01	1.393E+03	0.0573	292.65	38	4.826E+01	1.399E+03	0.0501	292.65
39	5.080E+01	1.514E+03	0.0501	292.65	40	5.334E+01	1.548E+03	0.0501	292.65
41	5.588E+01	1.546E+03	0.0501	292.65	42	5.842E+01	1.538E+03	0.0501	292.65
43	6.096E+01	1.534E+03	0.0501	292.65					

Initial Water Storage = 3.1797 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.05579     0.05011
 Head (cm)         = 6.62341E+05 1.10405E+05 1.45890E+03 1.53421E+03
 LiqWater Flow (cm)=-1.27037E-11-3.84751E-04-3.13025E-03 6.00400E-10
 IsoVapor Flow (cm)=-1.22067E-02-1.18689E-02-3.09256E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1797+ 0.0000+ 0.0000 - 0.0122- 0.0000-  0.0000 =    3.1675 vs.    3.1675

 Mass Balance = -5.3866E-07 cm;  Time step attempts =   51 and successes =   49
   Evaporation:  Potential =  0.2331 cm, Actual =  0.0122 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 61.8 %;  TMEAN = 276.2 K;  HDRY =  6.6234E+05 cm;  DAYUBC =    48

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05004     0.05185
 Head (cm)         = 1.00583E+06 5.20808E+05 1.80296E+03 4.99792E+02
 LiqWater Flow (cm)=-1.38143E-12-5.88668E-11-2.18112E-03 6.27447E-06
 IsoVapor Flow (cm)=-8.77296E-03-8.76710E-03-5.72794E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9175+ 0.0000+ 0.0000 - 0.0088- 0.0000-  0.0000 =    2.9088 vs.    2.9088

 Mass Balance = -1.0826E-05 cm;  Time step attempts =   43 and successes =   35
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0088 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 48.2 %;  TMEAN = 278.2 K;  HDRY =  1.0058E+06 cm;  DAYUBC =    35
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1167E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1167E+02	[cm]
Actual Evaporation	=	2.4419E+01	[cm]
Evaporation during Growth	=	2.4419E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.4155E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.8706E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.4155E+01	[cm]
Actual Rainfall	=	2.4155E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.9088E+00	[cm]
Mass Balance Error	=	6.5881E-03	[cm]
Total Successful Time Steps	=	52807	
Total Attempted Time Steps	=	64683	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26908	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.6369E-01	0.050	1.2368E+01	0.150	8.1024E+00
0.250	6.9024E+00	0.350	6.0521E+00	0.450	5.4175E+00
0.550	4.8381E+00	0.650	4.3850E+00	0.750	3.9380E+00
0.850	3.5882E+00	0.950	3.3276E+00	1.125	3.0813E+00
1.375	2.3765E+00	1.625	2.1797E+00	1.875	2.0014E+00
2.250	1.8430E+00	2.750	1.4390E+00	3.250	1.2312E+00
3.750	8.8164E-01	4.250	6.3063E-01	4.790	5.1191E-01
6.350	3.9154E-01	8.890	1.2712E-01	11.430	-1.7845E-02
13.970	-1.4013E-01	16.510	-1.6082E-01	19.050	-1.4555E-01
21.590	-1.3010E-01	24.130	-1.1465E-01	26.670	-9.9275E-02
29.210	-8.4029E-02	31.750	-6.8931E-02	34.290	-5.3988E-02
36.830	-3.9195E-02	39.370	-2.4533E-02	41.910	-9.9723E-03
44.450	4.5259E-03	46.990	1.9588E-02	49.530	2.0807E-02
52.070	1.5434E-02	54.610	1.1477E-02	57.150	7.1425E-03
59.690	2.7150E-03	60.960	6.8706E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2014.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.006E+06	0.0300	292.65	2	1.000E-01	9.771E+05	0.0300	292.65
3	2.000E-01	9.485E+05	0.0300	292.65	4	3.000E-01	9.207E+05	0.0300	292.65
5	4.000E-01	8.936E+05	0.0300	292.65	6	5.000E-01	8.672E+05	0.0300	292.65
7	6.000E-01	8.412E+05	0.0300	292.65	8	7.000E-01	8.158E+05	0.0300	292.65
9	8.000E-01	7.907E+05	0.0300	292.65	10	9.000E-01	7.661E+05	0.0300	292.65
11	1.000E+00	7.420E+05	0.0300	292.65	12	1.250E+00	6.834E+05	0.0300	292.65
13	1.500E+00	6.271E+05	0.0300	292.65	14	1.750E+00	5.729E+05	0.0300	292.65
15	2.000E+00	5.208E+05	0.0300	292.65	16	2.500E+00	4.221E+05	0.0300	292.65
17	3.000E+00	3.301E+05	0.0300	292.65	18	3.500E+00	2.438E+05	0.0301	292.65
19	4.000E+00	1.626E+05	0.0301	292.65	20	4.500E+00	8.594E+04	0.0302	292.65
21	5.080E+00	3.952E+03	0.0378	292.65	22	7.620E+00	2.688E+03	0.0424	292.65
23	1.016E+01	2.368E+03	0.0445	292.65	24	1.270E+01	2.191E+03	0.0459	292.65
25	1.524E+01	2.075E+03	0.0469	292.65	26	1.778E+01	1.990E+03	0.0478	292.65
27	2.032E+01	1.926E+03	0.0485	292.65	28	2.286E+01	1.876E+03	0.0491	292.65
29	2.540E+01	1.836E+03	0.0496	292.65	30	2.794E+01	1.803E+03	0.0500	292.65
31	3.048E+01	1.776E+03	0.0504	292.65	32	3.302E+01	1.754E+03	0.0507	292.65
33	3.556E+01	1.736E+03	0.0510	292.65	34	3.810E+01	1.722E+03	0.0512	292.65
35	4.064E+01	1.711E+03	0.0513	292.65	36	4.318E+01	1.703E+03	0.0514	292.65
37	4.572E+01	1.697E+03	0.0515	292.65	38	4.826E+01	1.487E+03	0.0501	292.65
39	5.080E+01	5.446E+02	0.0515	292.65	40	5.334E+01	5.213E+02	0.0517	292.65
41	5.588E+01	5.085E+02	0.0518	292.65	42	5.842E+01	5.019E+02	0.0518	292.65
43	6.096E+01	4.998E+02	0.0519	292.65					

Initial Water Storage = 2.9088 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04991     0.05185
 Head (cm)         = 1.15661E+06 5.84796E+05 1.81255E+03 5.00235E+02
 LiqWater Flow (cm)=-7.83563E-13-2.42562E-11-2.17015E-03 6.22876E-06
 IsoVapor Flow (cm)=-8.93144E-03-8.92652E-03-5.83959E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9088+ 0.0000+ 0.0000 - 0.0089- 0.0000-  0.0000 =    2.8998 vs.    2.8998

 Mass Balance =  3.3405E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2497 cm, Actual =  0.0089 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 43.2 %;  TMEAN = 279.8 K;  HDRY =  1.1566E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03005     0.03714     0.05082     0.05240
 Head (cm)         = 2.73526E+05 4.27114E+03 1.74601E+03 4.50940E+02
 LiqWater Flow (cm)=-5.09371E-10-9.48934E-03-1.15948E-03 1.46696E-05
 IsoVapor Flow (cm)=-7.63440E-03-1.03328E-04-2.95223E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0179+ 0.0000+ 0.0000 - 0.0076- 0.0000-  0.0000 =    3.0102 vs.    3.0102

 Mass Balance =  3.8508E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.1854 cm, Actual =  0.0076 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 82.0 %;  TMEAN = 270.4 K;  HDRY =  2.7353E+05 cm;  DAYUBC =    51
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2121E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2121E+02	[cm]
Actual Evaporation	=	2.1655E+01	[cm]
Evaporation during Growth	=	2.1655E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1768E+01	[cm]
Total Basal Liquid Flux (drainage)	=	4.0816E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1768E+01	[cm]
Actual Rainfall	=	2.1768E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.0102E+00	[cm]
Mass Balance Error	=	7.1795E-03	[cm]
Total Successful Time Steps	=	58450	
Total Attempted Time Steps	=	71740	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29263	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1271E-01	0.050	1.2009E+01	0.150	7.7434E+00
0.250	6.3572E+00	0.350	5.5262E+00	0.450	4.9294E+00
0.550	4.2400E+00	0.650	3.7168E+00	0.750	3.3362E+00
0.850	3.0930E+00	0.950	2.9043E+00	1.125	2.7246E+00
1.375	2.2775E+00	1.625	1.9882E+00	1.875	1.8554E+00
2.250	1.6989E+00	2.750	1.5064E+00	3.250	1.3804E+00
3.750	1.1927E+00	4.250	1.0010E+00	4.790	9.3725E-01
6.350	8.2966E-01	8.890	6.1956E-01	11.430	3.9918E-01
13.970	2.2939E-01	16.510	1.0103E-01	19.050	3.0562E-02
21.590	2.5930E-02	24.130	2.2522E-02	26.670	1.9843E-02
29.210	1.7727E-02	31.750	1.6056E-02	34.290	1.4722E-02
36.830	1.3626E-02	39.370	1.2698E-02	41.910	1.1882E-02
44.450	1.1129E-02	46.990	1.3107E-02	49.530	1.8264E-02
52.070	9.3692E-03	54.610	7.6958E-03	57.150	6.2179E-03
59.690	4.7844E-03	60.960	4.0816E-03		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2015.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	2.735E+05	0.0300	292.65	2	1.000E-01	2.564E+05	0.0301	292.65
3	2.000E-01	2.398E+05	0.0301	292.65	4	3.000E-01	2.233E+05	0.0301	292.65
5	4.000E-01	2.069E+05	0.0301	292.65	6	5.000E-01	1.907E+05	0.0301	292.65
7	6.000E-01	1.748E+05	0.0301	292.65	8	7.000E-01	1.590E+05	0.0301	292.65
9	8.000E-01	1.434E+05	0.0301	292.65	10	9.000E-01	1.279E+05	0.0301	292.65
11	1.000E+00	1.126E+05	0.0301	292.65	12	1.250E+00	7.518E+04	0.0302	292.65
13	1.500E+00	3.866E+04	0.0305	292.65	14	1.750E+00	5.848E+03	0.0349	292.65
15	2.000E+00	4.271E+03	0.0371	292.65	16	2.500E+00	3.409E+03	0.0393	292.65
17	3.000E+00	3.043E+03	0.0407	292.65	18	3.500E+00	2.820E+03	0.0417	292.65
19	4.000E+00	2.665E+03	0.0426	292.65	20	4.500E+00	2.547E+03	0.0433	292.65
21	5.080E+00	2.441E+03	0.0439	292.65	22	7.620E+00	2.162E+03	0.0461	292.65
23	1.016E+01	2.019E+03	0.0475	292.65	24	1.270E+01	1.931E+03	0.0485	292.65
25	1.524E+01	1.873E+03	0.0491	292.65	26	1.778E+01	1.833E+03	0.0496	292.65
27	2.032E+01	1.803E+03	0.0500	292.65	28	2.286E+01	1.780E+03	0.0503	292.65
29	2.540E+01	1.762E+03	0.0506	292.65	30	2.794E+01	1.746E+03	0.0508	292.65
31	3.048E+01	1.732E+03	0.0510	292.65	32	3.302E+01	1.720E+03	0.0512	292.65
33	3.556E+01	1.709E+03	0.0514	292.65	34	3.810E+01	1.699E+03	0.0515	292.65
35	4.064E+01	1.691E+03	0.0516	292.65	36	4.318E+01	1.684E+03	0.0517	292.65
37	4.572E+01	1.680E+03	0.0518	292.65	38	4.826E+01	1.429E+03	0.0501	292.65
39	5.080E+01	4.800E+02	0.0520	292.65	40	5.334E+01	4.659E+02	0.0522	292.65
41	5.588E+01	4.573E+02	0.0523	292.65	42	5.842E+01	4.525E+02	0.0524	292.65
43	6.096E+01	4.509E+02	0.0524	292.65					

Initial Water Storage = 3.0102 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.03417     0.05075     0.05239
 Head (cm)         = 4.46116E+05 6.68903E+03 1.75097E+03 4.51470E+02
 LiqWater Flow (cm)=-7.72381E-11-8.94834E-03-1.21834E-03 1.45276E-05
 IsoVapor Flow (cm)=-1.15374E-02-1.60151E-04-3.09998E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0102+ 0.0000+ 0.0000 - 0.0115- 0.0000-  0.0000 =    2.9987 vs.    2.9987

 Mass Balance = -9.1430E-06 cm;  Time step attempts =   55 and successes =   44
   Evaporation:  Potential =  0.2333 cm, Actual =  0.0115 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 72.3 %;  TMEAN = 276.2 K;  HDRY =  4.4612E+05 cm;  DAYUBC =    44

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03013     0.06276     0.08544     0.05117
 Head (cm)         = 1.20186E+05 1.19275E+03 7.61901E+02 6.00783E+02
 LiqWater Flow (cm)=-6.34932E-02-1.43312E-01-4.41809E-02 1.37268E-06
 IsoVapor Flow (cm)=-9.87435E-02-3.68917E-06-1.71695E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.6754+ 0.0000+ 0.0000 - 0.1642- 0.0000-  0.0000 =    4.5112 vs.    4.5112

 Mass Balance = -2.3310E-05 cm;  Time step attempts =  194 and successes =  147
   Evaporation:  Potential =  0.3290 cm, Actual =  0.1642 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 70.1 %;  TMEAN = 278.4 K;  HDRY =  4.9048E+05 cm;  DAYUBC =    30
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.8444E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.8444E+02	[cm]
Actual Evaporation	=	2.9170E+01	[cm]
Evaporation during Growth	=	2.9170E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0683E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.7248E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0683E+01	[cm]
Actual Rainfall	=	3.0683E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.5112E+00	[cm]
Mass Balance Error	=	1.0704E-02	[cm]
Total Successful Time Steps	=	73933	
Total Attempted Time Steps	=	91409	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32787	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.5134E+00	0.050	2.0348E+01	0.150	1.4075E+01
0.250	1.1809E+01	0.350	1.0265E+01	0.450	9.0517E+00
0.550	8.1675E+00	0.650	7.6598E+00	0.750	7.1403E+00
0.850	6.4682E+00	0.950	5.8626E+00	1.125	5.4985E+00
1.375	4.5449E+00	1.625	3.8734E+00	1.875	3.4718E+00
2.250	3.0838E+00	2.750	2.3917E+00	3.250	2.0620E+00
3.750	1.7576E+00	4.250	1.5568E+00	4.790	1.4789E+00
6.350	1.3450E+00	8.890	1.2779E+00	11.430	1.2082E+00
13.970	1.1352E+00	16.510	1.0589E+00	19.050	9.7973E-01
21.590	8.9793E-01	24.130	8.1380E-01	26.670	7.2761E-01
29.210	6.3960E-01	31.750	5.5001E-01	34.290	4.5905E-01
36.830	3.6691E-01	39.370	2.7376E-01	41.910	1.7975E-01
44.450	8.4990E-02	46.990	-9.8953E-03	49.530	-7.1173E-03
52.070	-8.7067E-03	54.610	-5.8320E-03	57.150	-2.8514E-03
59.690	1.9202E-04	60.960	1.7248E-03		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2016.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.202E+05	0.0301	292.65	2	1.000E-01	1.324E+03	0.0590	292.65
3	2.000E-01	1.316E+03	0.0592	292.65	4	3.000E-01	1.308E+03	0.0594	292.65
5	4.000E-01	1.300E+03	0.0596	292.65	6	5.000E-01	1.293E+03	0.0598	292.65
7	6.000E-01	1.285E+03	0.0600	292.65	8	7.000E-01	1.278E+03	0.0602	292.65
9	8.000E-01	1.271E+03	0.0604	292.65	10	9.000E-01	1.264E+03	0.0606	292.65
11	1.000E+00	1.257E+03	0.0608	292.65	12	1.250E+00	1.240E+03	0.0613	292.65
13	1.500E+00	1.224E+03	0.0618	292.65	14	1.750E+00	1.208E+03	0.0623	292.65
15	2.000E+00	1.193E+03	0.0628	292.65	16	2.500E+00	1.164E+03	0.0637	292.65
17	3.000E+00	1.138E+03	0.0646	292.65	18	3.500E+00	1.114E+03	0.0655	292.65
19	4.000E+00	1.092E+03	0.0664	292.65	20	4.500E+00	1.071E+03	0.0672	292.65
21	5.080E+00	1.049E+03	0.0681	292.65	22	7.620E+00	9.721E+02	0.0717	292.65
23	1.016E+01	9.177E+02	0.0746	292.65	24	1.270E+01	8.776E+02	0.0770	292.65
25	1.524E+01	8.469E+02	0.0790	292.65	26	1.778E+01	8.226E+02	0.0807	292.65
27	2.032E+01	8.030E+02	0.0822	292.65	28	2.286E+01	7.868E+02	0.0834	292.65
29	2.540E+01	7.733E+02	0.0845	292.65	30	2.794E+01	7.619E+02	0.0854	292.65
31	3.048E+01	7.522E+02	0.0863	292.65	32	3.302E+01	7.439E+02	0.0870	292.65
33	3.556E+01	7.368E+02	0.0876	292.65	34	3.810E+01	7.308E+02	0.0882	292.65
35	4.064E+01	7.258E+02	0.0886	292.65	36	4.318E+01	7.216E+02	0.0890	292.65
37	4.572E+01	7.183E+02	0.0893	292.65	38	4.826E+01	7.105E+02	0.0508	292.65
39	5.080E+01	6.799E+02	0.0509	292.65	40	5.334E+01	6.343E+02	0.0510	292.65
41	5.588E+01	6.131E+02	0.0511	292.65	42	5.842E+01	6.036E+02	0.0512	292.65
43	6.096E+01	6.008E+02	0.0512	292.65					

Initial Water Storage = 4.5112 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05546     0.05967     0.08286     0.05117
 Head (cm)         = 1.47496E+03 1.29651E+03 7.93712E+02 6.01038E+02
 LiqWater Flow (cm)=-5.24966E-02-1.17013E-01-4.46999E-02 1.36790E-06
 IsoVapor Flow (cm)=-7.15645E-02-4.73932E-06-2.01760E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.5112+ 0.0000+ 0.0000 - 0.1228- 0.0000-  0.0000 =    4.3884 vs.    4.3884

 Mass Balance = -1.9060E-06 cm;  Time step attempts =  352 and successes =  274
   Evaporation:  Potential =  0.2426 cm, Actual =  0.1228 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 76.7 %;  TMEAN = 276.5 K;  HDRY =  3.6523E+05 cm;  DAYUBC =    62

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05004     0.05450     0.06356     0.05079
 Head (cm)         = 1.80298E+03 1.52344E+03 1.16876E+03 7.02518E+02
 LiqWater Flow (cm)= 4.66811E-02 9.74416E-03-3.79147E-03 3.77331E-07
 IsoVapor Flow (cm)=-3.25437E-02-2.30104E-06-1.55793E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6161+ 0.1016+ 0.0000 - 0.0865- 0.0000-  0.0000 =    3.6313 vs.    3.6312

 Mass Balance =  4.2927E-05 cm;  Time step attempts =  318 and successes =  273
   Evaporation:  Potential =  0.2069 cm, Actual =  0.0865 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 88.3 %;  TMEAN = 282.9 K;  HDRY =  1.7170E+05 cm;  DAYUBC =    59
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1664E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1664E+02	[cm]
Actual Evaporation	=	2.4698E+01	[cm]
Evaporation during Growth	=	2.4612E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.3825E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.5834E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.3825E+01	[cm]
Actual Rainfall	=	2.3825E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.6312E+00	[cm]
Mass Balance Error	=	6.9570E-03	[cm]
Total Successful Time Steps	=	59852	
Total Attempted Time Steps	=	73546	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29255	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.7278E-01	0.050	1.3549E+01	0.150	7.8886E+00
0.250	6.3369E+00	0.350	5.1669E+00	0.450	4.3629E+00
0.550	3.9008E+00	0.650	3.4830E+00	0.750	3.2630E+00
0.850	2.9031E+00	0.950	2.6077E+00	1.125	2.3241E+00
1.375	1.6848E+00	1.625	1.4288E+00	1.875	1.1923E+00
2.250	9.1418E-01	2.750	5.4712E-01	3.250	2.1084E-01
3.750	8.0325E-02	4.250	3.5609E-03	4.790	-8.5649E-02
6.350	-2.0461E-01	8.890	-4.0931E-01	11.430	-5.4619E-01
13.970	-6.0036E-01	16.510	-6.7511E-01	19.050	-6.3408E-01
21.590	-5.8562E-01	24.130	-5.3433E-01	26.670	-4.8076E-01
29.210	-4.2532E-01	31.750	-3.6834E-01	34.290	-3.1004E-01
36.830	-2.5063E-01	39.370	-1.9029E-01	41.910	-1.2916E-01
44.450	-6.7396E-02	46.990	-3.5432E-03	49.530	1.2433E-03
52.070	-1.6633E-03	54.610	-1.7559E-03	57.150	-1.0308E-03
59.690	-1.8134E-04	60.960	2.5834E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2017.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.803E+03	0.0500	292.65	2	1.000E-01	1.781E+03	0.0503	292.65
3	2.000E-01	1.760E+03	0.0506	292.65	4	3.000E-01	1.741E+03	0.0509	292.65
5	4.000E-01	1.723E+03	0.0512	292.65	6	5.000E-01	1.705E+03	0.0514	292.65
7	6.000E-01	1.689E+03	0.0517	292.65	8	7.000E-01	1.674E+03	0.0519	292.65
9	8.000E-01	1.659E+03	0.0521	292.65	10	9.000E-01	1.645E+03	0.0524	292.65
11	1.000E+00	1.631E+03	0.0526	292.65	12	1.250E+00	1.600E+03	0.0531	292.65
13	1.500E+00	1.572E+03	0.0536	292.65	14	1.750E+00	1.547E+03	0.0541	292.65
15	2.000E+00	1.523E+03	0.0545	292.65	16	2.500E+00	1.483E+03	0.0553	292.65
17	3.000E+00	1.448E+03	0.0560	292.65	18	3.500E+00	1.418E+03	0.0567	292.65
19	4.000E+00	1.392E+03	0.0573	292.65	20	4.500E+00	1.369E+03	0.0578	292.65
21	5.080E+00	1.346E+03	0.0584	292.65	22	7.620E+00	1.277E+03	0.0602	292.65
23	1.016E+01	1.238E+03	0.0613	292.65	24	1.270E+01	1.216E+03	0.0620	292.65
25	1.524E+01	1.204E+03	0.0624	292.65	26	1.778E+01	1.196E+03	0.0627	292.65
27	2.032E+01	1.189E+03	0.0629	292.65	28	2.286E+01	1.182E+03	0.0631	292.65
29	2.540E+01	1.176E+03	0.0633	292.65	30	2.794E+01	1.169E+03	0.0636	292.65
31	3.048E+01	1.162E+03	0.0638	292.65	32	3.302E+01	1.156E+03	0.0640	292.65
33	3.556E+01	1.150E+03	0.0642	292.65	34	3.810E+01	1.145E+03	0.0644	292.65
35	4.064E+01	1.140E+03	0.0646	292.65	36	4.318E+01	1.136E+03	0.0647	292.65
37	4.572E+01	1.133E+03	0.0648	292.65	38	4.826E+01	1.120E+03	0.0502	292.65
39	5.080E+01	8.442E+02	0.0505	292.65	40	5.334E+01	7.456E+02	0.0507	292.65
41	5.588E+01	7.152E+02	0.0508	292.65	42	5.842E+01	7.049E+02	0.0508	292.65
43	6.096E+01	7.025E+02	0.0508	292.65					

Initial Water Storage = 3.6312 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06430     0.06661     0.06693     0.05079
 Head (cm)         = 1.14743E+03 1.08568E+03 1.07774E+03 7.02637E+02
 LiqWater Flow (cm)= 3.14902E-01 2.35926E-01 1.03990E-02 3.76809E-07
 IsoVapor Flow (cm)=-5.05616E-02-1.06421E-06 1.71256E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6312+ 0.4572+ 0.0000 - 0.1922- 0.0000-  0.0000 =    3.8963 vs.    3.8961

 Mass Balance =  1.3058E-04 cm;  Time step attempts =  529 and successes =  442
   Evaporation:  Potential =  0.3119 cm, Actual =  0.1922 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 75.1 %;  TMEAN = 283.7 K;  HDRY =  3.9383E+05 cm;  DAYUBC =    64

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03040     0.06153     0.05061
 Head (cm)         = 1.50332E+06 4.69196E+04 1.23187E+03 7.77678E+02
 LiqWater Flow (cm)=-9.03240E-13-2.26255E-02-9.71717E-03 1.63082E-07
 IsoVapor Flow (cm)=-2.64699E-02-2.88345E-04-3.81421E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.4285+ 0.0000+ 0.0000 - 0.0265- 0.0000-  0.0000 =    3.4020 vs.    3.4020

 Mass Balance = -1.1567E-05 cm;  Time step attempts =   55 and successes =   42
   Evaporation:  Potential =  0.6403 cm, Actual =  0.0265 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 33.6 %;  TMEAN = 285.7 K;  HDRY =  1.5033E+06 cm;  DAYUBC =    42
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2162E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2162E+02	[cm]
Actual Evaporation	=	2.5851E+01	[cm]
Evaporation during Growth	=	2.5851E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5629E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.7196E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5629E+01	[cm]
Actual Rainfall	=	2.5629E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.4020E+00	[cm]
Mass Balance Error	=	6.9867E-03	[cm]
Total Successful Time Steps	=	53456	
Total Attempted Time Steps	=	65118	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26714	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.2213E-01	0.050	1.6857E+01	0.150	9.2527E+00
0.250	7.8425E+00	0.350	6.5009E+00	0.450	6.0172E+00
0.550	5.5713E+00	0.650	5.3263E+00	0.750	4.9606E+00
0.850	4.5875E+00	0.950	4.1565E+00	1.125	3.9106E+00
1.375	2.9709E+00	1.625	2.4363E+00	1.875	1.9723E+00
2.250	1.6844E+00	2.750	9.6905E-01	3.250	8.4539E-01
3.750	7.0963E-01	4.250	5.8468E-01	4.790	4.7032E-01
6.350	4.0616E-01	8.890	1.6757E-01	11.430	1.2537E-02
13.970	-6.4498E-02	16.510	-5.9786E-02	19.050	-4.8834E-02
21.590	-3.9805E-02	24.130	-3.2405E-02	26.670	-2.6336E-02
29.210	-2.1333E-02	31.750	-1.7160E-02	34.290	-1.3654E-02
36.830	-1.0664E-02	39.370	-8.0665E-03	41.910	-5.7571E-03
44.450	-3.6415E-03	46.990	-1.0137E-03	49.530	1.4848E-03
52.070	-2.8803E-04	54.610	-6.2782E-04	57.150	-4.2068E-04
59.690	-9.0434E-05	60.960	8.7196E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2018.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.503E+06	0.0300	292.65	2	1.000E-01	1.379E+06	0.0300	292.65
3	2.000E-01	1.265E+06	0.0300	292.65	4	3.000E-01	1.160E+06	0.0300	292.65
5	4.000E-01	1.062E+06	0.0300	292.65	6	5.000E-01	9.704E+05	0.0300	292.65
7	6.000E-01	8.847E+05	0.0300	292.65	8	7.000E-01	8.040E+05	0.0300	292.65
9	8.000E-01	7.278E+05	0.0300	292.65	10	9.000E-01	6.557E+05	0.0300	292.65
11	1.000E+00	5.871E+05	0.0300	292.65	12	1.250E+00	4.293E+05	0.0300	292.65
13	1.500E+00	2.881E+05	0.0300	292.65	14	1.750E+00	1.608E+05	0.0301	292.65
15	2.000E+00	4.692E+04	0.0304	292.65	16	2.500E+00	2.639E+03	0.0427	292.65
17	3.000E+00	2.444E+03	0.0439	292.65	18	3.500E+00	2.277E+03	0.0452	292.65
19	4.000E+00	2.148E+03	0.0463	292.65	20	4.500E+00	2.046E+03	0.0472	292.65
21	5.080E+00	1.953E+03	0.0482	292.65	22	7.620E+00	1.700E+03	0.0515	292.65
23	1.016E+01	1.562E+03	0.0538	292.65	24	1.270E+01	1.470E+03	0.0555	292.65
25	1.524E+01	1.404E+03	0.0570	292.65	26	1.778E+01	1.354E+03	0.0582	292.65
27	2.032E+01	1.313E+03	0.0592	292.65	28	2.286E+01	1.281E+03	0.0601	292.65
29	2.540E+01	1.254E+03	0.0609	292.65	30	2.794E+01	1.232E+03	0.0615	292.65
31	3.048E+01	1.213E+03	0.0621	292.65	32	3.302E+01	1.198E+03	0.0626	292.65
33	3.556E+01	1.185E+03	0.0630	292.65	34	3.810E+01	1.175E+03	0.0633	292.65
35	4.064E+01	1.167E+03	0.0636	292.65	36	4.318E+01	1.161E+03	0.0638	292.65
37	4.572E+01	1.156E+03	0.0640	292.65	38	4.826E+01	1.136E+03	0.0502	292.65
39	5.080E+01	9.257E+02	0.0504	292.65	40	5.334E+01	8.211E+02	0.0505	292.65
41	5.588E+01	7.877E+02	0.0506	292.65	42	5.842E+01	7.791E+02	0.0506	292.65
43	6.096E+01	7.777E+02	0.0506	292.65					

Initial Water Storage = 3.4020 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.06103     0.05061
 Head (cm)         = 7.20447E+05 1.14410E+05 1.24858E+03 7.77730E+02
 LiqWater Flow (cm)=-9.41296E-12-7.83704E-04-9.27695E-03 1.62996E-07
 IsoVapor Flow (cm)=-1.31360E-02-1.22687E-02-3.89091E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.4020+ 0.0000+ 0.0000 - 0.0131- 0.0000-  0.0000 =    3.3889 vs.    3.3889

 Mass Balance = -1.0060E-06 cm;  Time step attempts =   58 and successes =   56
   Evaporation:  Potential =  0.2468 cm, Actual =  0.0131 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.3 %;  TMEAN = 275.7 K;  HDRY =  7.2045E+05 cm;  DAYUBC =    53

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04447     0.05551     0.05045
 Head (cm)         = 8.58098E+05 2.36711E+03 1.47251E+03 8.82114E+02
 LiqWater Flow (cm)=-2.23125E-11-3.41122E-02 4.41607E-03 5.76756E-08
 IsoVapor Flow (cm)=-4.83108E-02-1.76663E-05 3.63275E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2799+ 0.0000+ 0.0000 - 0.0483- 0.0000-  0.0000 =    3.2316 vs.    3.2316

 Mass Balance = -5.7639E-05 cm;  Time step attempts =  293 and successes =  228
   Evaporation:  Potential =  0.4952 cm, Actual =  0.0483 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.7 %;  TMEAN = 279.5 K;  HDRY =  8.5810E+05 cm;  DAYUBC =   227
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2377E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2377E+02	[cm]
Actual Evaporation	=	2.1422E+01	[cm]
Evaporation during Growth	=	2.1422E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1260E+01	[cm]
Total Basal Liquid Flux (drainage)	=	3.9114E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1260E+01	[cm]
Actual Rainfall	=	2.1260E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.2316E+00	[cm]
Mass Balance Error	=	8.0353E-03	[cm]
Total Successful Time Steps	=	58101	
Total Attempted Time Steps	=	71538	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28966	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.6230E-01	0.050	1.4549E+01	0.150	1.0475E+01
0.250	9.0283E+00	0.350	8.0494E+00	0.450	7.3823E+00
0.550	6.6063E+00	0.650	5.8517E+00	0.750	5.3948E+00
0.850	4.8779E+00	0.950	4.5168E+00	1.125	4.2655E+00
1.375	3.3820E+00	1.625	2.9954E+00	1.875	2.2928E+00
2.250	1.9388E+00	2.750	1.2631E+00	3.250	9.3559E-01
3.750	7.1133E-01	4.250	5.8516E-01	4.790	4.5431E-01
6.350	2.5657E-01	8.890	-8.7253E-02	11.430	-1.9146E-01
13.970	-2.0297E-01	16.510	-2.0105E-01	19.050	-1.9642E-01
21.590	-1.8906E-01	24.130	-1.7897E-01	26.670	-1.6625E-01
29.210	-1.5106E-01	31.750	-1.3367E-01	34.290	-1.1441E-01
36.830	-9.3621E-02	39.370	-7.1629E-02	41.910	-4.8772E-02
44.450	-2.5337E-02	46.990	-1.3010E-03	49.530	7.1558E-04
52.070	-2.0713E-04	54.610	-4.1797E-04	57.150	-3.1207E-04
59.690	-8.6013E-05	60.960	3.9114E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2019.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.581E+05	0.0300	292.65	2	1.000E-01	7.469E+05	0.0300	292.65
3	2.000E-01	6.392E+05	0.0300	292.65	4	3.000E-01	5.432E+05	0.0300	292.65
5	4.000E-01	4.522E+05	0.0300	292.65	6	5.000E-01	3.670E+05	0.0300	292.65
7	6.000E-01	2.868E+05	0.0300	292.65	8	7.000E-01	2.110E+05	0.0301	292.65
9	8.000E-01	1.392E+05	0.0301	292.65	10	9.000E-01	7.089E+04	0.0302	292.65
11	1.000E+00	6.475E+03	0.0343	292.65	12	1.250E+00	3.156E+03	0.0403	292.65
13	1.500E+00	2.751E+03	0.0421	292.65	14	1.750E+00	2.522E+03	0.0434	292.65
15	2.000E+00	2.367E+03	0.0445	292.65	16	2.500E+00	2.162E+03	0.0461	292.65
17	3.000E+00	2.029E+03	0.0474	292.65	18	3.500E+00	1.932E+03	0.0484	292.65
19	4.000E+00	1.858E+03	0.0493	292.65	20	4.500E+00	1.799E+03	0.0501	292.65
21	5.080E+00	1.743E+03	0.0509	292.65	22	7.620E+00	1.590E+03	0.0533	292.65
23	1.016E+01	1.511E+03	0.0547	292.65	24	1.270E+01	1.468E+03	0.0556	292.65
25	1.524E+01	1.445E+03	0.0561	292.65	26	1.778E+01	1.437E+03	0.0563	292.65
27	2.032E+01	1.438E+03	0.0562	292.65	28	2.286E+01	1.446E+03	0.0561	292.65
29	2.540E+01	1.458E+03	0.0558	292.65	30	2.794E+01	1.473E+03	0.0555	292.65
31	3.048E+01	1.487E+03	0.0552	292.65	32	3.302E+01	1.499E+03	0.0550	292.65
33	3.556E+01	1.508E+03	0.0548	292.65	34	3.810E+01	1.514E+03	0.0547	292.65
35	4.064E+01	1.518E+03	0.0546	292.65	36	4.318E+01	1.518E+03	0.0546	292.65
37	4.572E+01	1.517E+03	0.0546	292.65	38	4.826E+01	1.465E+03	0.0501	292.65
39	5.080E+01	9.716E+02	0.0504	292.65	40	5.334E+01	8.870E+02	0.0504	292.65
41	5.588E+01	8.854E+02	0.0504	292.65	42	5.842E+01	8.844E+02	0.0504	292.65
43	6.096E+01	8.821E+02	0.0504	292.65					

Initial Water Storage = 3.2316 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04334     0.05545     0.05045
 Head (cm)         = 6.36590E+05 2.53410E+03 1.47512E+03 8.82181E+02
 LiqWater Flow (cm)=-3.71215E-11-2.40150E-02 3.06965E-03 5.76387E-08
 IsoVapor Flow (cm)=-2.58388E-02-2.26761E-05 2.27088E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2316+ 0.0000+ 0.0000 - 0.0258- 0.0000-  0.0000 =    3.2058 vs.    3.2058

 Mass Balance = -8.9513E-06 cm;  Time step attempts =   95 and successes =   83
   Evaporation:  Potential =  0.2932 cm, Actual =  0.0258 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 63.0 %;  TMEAN = 275.9 K;  HDRY =  6.3659E+05 cm;  DAYUBC =    82

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04393     0.06482     0.05028
 Head (cm)         = 1.19840E+06 2.44439E+03 1.13268E+03 1.06308E+03
 LiqWater Flow (cm)=-3.46012E-12-3.24701E-02-1.24756E-02 1.23723E-08
 IsoVapor Flow (cm)=-3.67543E-02-2.62342E-05-3.26469E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5921+ 0.0000+ 0.0000 - 0.0368- 0.0000-  0.0000 =    3.5553 vs.    3.5554

 Mass Balance = -1.4396E-05 cm;  Time step attempts =   70 and successes =   53
   Evaporation:  Potential =  0.4041 cm, Actual =  0.0368 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 41.9 %;  TMEAN = 278.4 K;  HDRY =  1.1984E+06 cm;  DAYUBC =    53
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1575E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1575E+02	[cm]
Actual Evaporation	=	2.0190E+01	[cm]
Evaporation during Growth	=	2.0190E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.0523E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.2828E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.0523E+01	[cm]
Actual Rainfall	=	2.0523E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.5554E+00	[cm]
Mass Balance Error	=	8.9914E-03	[cm]
Total Successful Time Steps	=	67254	
Total Attempted Time Steps	=	83746	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32257	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	3.3273E-01	0.050	1.3774E+01	0.150	1.0483E+01
0.250	8.7808E+00	0.350	7.3702E+00	0.450	6.5017E+00
0.550	5.8800E+00	0.650	5.2931E+00	0.750	4.8904E+00
0.850	4.5162E+00	0.950	4.1625E+00	1.125	3.9198E+00
1.375	3.3622E+00	1.625	2.8637E+00	1.875	2.5182E+00
2.250	2.2861E+00	2.750	1.8524E+00	3.250	1.5531E+00
3.750	1.3095E+00	4.250	1.1034E+00	4.790	9.3901E-01
6.350	7.9309E-01	8.890	5.6177E-01	11.430	4.1563E-01
13.970	3.2088E-01	16.510	3.0247E-01	19.050	2.8921E-01
21.590	2.7329E-01	24.130	2.5466E-01	26.670	2.3337E-01
29.210	2.0960E-01	31.750	1.8361E-01	34.290	1.5570E-01
36.830	1.2624E-01	39.370	9.5556E-02	41.910	6.3976E-02
44.450	3.1779E-02	46.990	-1.6477E-04	49.530	4.5167E-04
52.070	-6.8048E-05	54.610	-1.5511E-04	57.150	-1.4147E-04
59.690	-4.9737E-05	60.960	1.2828E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

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                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
 Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2020.res
 Date of Run:      15 Sep 2025
 Time of Run:      16:35:05.87
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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```

NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.198E+06	0.0300	292.65	2	1.000E-01	1.077E+06	0.0300	292.65
3	2.000E-01	9.652E+05	0.0300	292.65	4	3.000E-01	8.620E+05	0.0300	292.65
5	4.000E-01	7.660E+05	0.0300	292.65	6	5.000E-01	6.762E+05	0.0300	292.65
7	6.000E-01	5.919E+05	0.0300	292.65	8	7.000E-01	5.125E+05	0.0300	292.65
9	8.000E-01	4.374E+05	0.0300	292.65	10	9.000E-01	3.662E+05	0.0300	292.65
11	1.000E+00	2.984E+05	0.0300	292.65	12	1.250E+00	1.424E+05	0.0301	292.65
13	1.500E+00	2.906E+03	0.0413	292.65	14	1.750E+00	2.624E+03	0.0428	292.65
15	2.000E+00	2.444E+03	0.0439	292.65	16	2.500E+00	2.211E+03	0.0457	292.65
17	3.000E+00	2.056E+03	0.0471	292.65	18	3.500E+00	1.942E+03	0.0483	292.65
19	4.000E+00	1.854E+03	0.0494	292.65	20	4.500E+00	1.783E+03	0.0503	292.65
21	5.080E+00	1.716E+03	0.0513	292.65	22	7.620E+00	1.524E+03	0.0545	292.65
23	1.016E+01	1.413E+03	0.0568	292.65	24	1.270E+01	1.337E+03	0.0586	292.65
25	1.524E+01	1.281E+03	0.0601	292.65	26	1.778E+01	1.238E+03	0.0613	292.65
27	2.032E+01	1.203E+03	0.0624	292.65	28	2.286E+01	1.175E+03	0.0633	292.65
29	2.540E+01	1.152E+03	0.0641	292.65	30	2.794E+01	1.133E+03	0.0648	292.65
31	3.048E+01	1.117E+03	0.0654	292.65	32	3.302E+01	1.103E+03	0.0659	292.65
33	3.556E+01	1.092E+03	0.0664	292.65	34	3.810E+01	1.083E+03	0.0667	292.65
35	4.064E+01	1.075E+03	0.0670	292.65	36	4.318E+01	1.070E+03	0.0673	292.65
37	4.572E+01	1.066E+03	0.0674	292.65	38	4.826E+01	1.051E+03	0.0503	292.65
39	5.080E+01	9.238E+02	0.0504	292.65	40	5.334E+01	1.015E+03	0.0503	292.65
41	5.588E+01	1.060E+03	0.0503	292.65	42	5.842E+01	1.065E+03	0.0503	292.65
43	6.096E+01	1.063E+03	0.0503	292.65					

```
 Initial Water Storage =   3.5554 cm

 NOTE:  There are no temperature data when plants are modelled.

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
```

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04584     0.06416     0.05028
 Head (cm)         = 7.50500E+05 2.19449E+03 1.15133E+03 1.06316E+03
 LiqWater Flow (cm)=-1.45651E-11-2.47285E-02-1.19994E-02 1.23642E-08
 IsoVapor Flow (cm)=-2.25943E-02-1.72107E-05-3.39095E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5554+ 0.0000+ 0.0000 - 0.0226- 0.0000-  0.0000 =    3.5328 vs.    3.5328

 Mass Balance = -7.2661E-07 cm;  Time step attempts =   62 and successes =   60
   Evaporation:  Potential =  0.4127 cm, Actual =  0.0226 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 58.0 %;  TMEAN = 279.5 K;  HDRY =  7.5050E+05 cm;  DAYUBC =    59

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04512     0.05025
 Head (cm)         = 8.61063E+05 6.85429E+05 2.28256E+03 1.11631E+03
 LiqWater Flow (cm)=-8.55997E-13-2.64299E-12-1.31436E-03 8.28772E-09
 IsoVapor Flow (cm)=-2.92266E-03-2.92266E-03-1.06713E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6300+ 0.0000+ 0.0000 - 0.0029- 0.0000-  0.0000 =    2.6271 vs.    2.6271

 Mass Balance = -4.5638E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2451 cm, Actual =  0.0029 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.5 %;  TMEAN = 275.4 K;  HDRY =  8.6106E+05 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2628E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

```
Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.2628E+02     [cm]
Actual Evaporation                 =  1.5756E+01     [cm]
Evaporation during Growth          =  1.5753E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  1.4834E+01     [cm]
Total Basal Liquid Flux (drainage) =  4.5471E-06     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.4834E+01     [cm]
Actual Rainfall                    =  1.4834E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.6271E+00     [cm]
Mass Balance Error                 =  5.9940E-03     [cm]
Total Successful Time Steps        =     50879
Total Attempted Time Steps         =     61797
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     27333
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.2231E-01	0.050	1.0309E+01	0.150	7.2574E+00
0.250	6.4006E+00	0.350	5.8049E+00	0.450	5.3515E+00
0.550	4.9830E+00	0.650	4.5178E+00	0.750	4.1966E+00
0.850	3.8978E+00	0.950	3.5870E+00	1.125	3.2950E+00
1.375	2.6672E+00	1.625	2.3083E+00	1.875	2.0397E+00
2.250	1.6984E+00	2.750	1.1390E+00	3.250	7.7352E-01
3.750	5.1126E-01	4.250	2.2814E-01	4.790	8.3418E-02
6.350	-1.0243E-01	8.890	-5.9324E-01	11.430	-6.8378E-01
13.970	-6.5666E-01	16.510	-6.0870E-01	19.050	-5.6069E-01
21.590	-5.1231E-01	24.130	-4.6343E-01	26.670	-4.1400E-01
29.210	-3.6402E-01	31.750	-3.1352E-01	34.290	-2.6255E-01
36.830	-2.1114E-01	39.370	-1.5934E-01	41.910	-1.0720E-01
44.450	-5.4744E-02	46.990	-1.6860E-03	49.530	2.2692E-04
52.070	-7.1239E-06	54.610	-1.4950E-05	57.150	-1.0146E-05
59.690	-7.2527E-07	60.960	4.5471E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

```
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                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
 Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2021.res
 Date of Run:      15 Sep 2025
 Time of Run:      16:35:05.87
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
--------------------------------------------------------------------------------
```

NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.611E+05	0.0300	292.65	2	1.000E-01	8.517E+05	0.0300	292.65
3	2.000E-01	8.425E+05	0.0300	292.65	4	3.000E-01	8.333E+05	0.0300	292.65
5	4.000E-01	8.241E+05	0.0300	292.65	6	5.000E-01	8.150E+05	0.0300	292.65
7	6.000E-01	8.060E+05	0.0300	292.65	8	7.000E-01	7.970E+05	0.0300	292.65
9	8.000E-01	7.881E+05	0.0300	292.65	10	9.000E-01	7.792E+05	0.0300	292.65
11	1.000E+00	7.705E+05	0.0300	292.65	12	1.250E+00	7.487E+05	0.0300	292.65
13	1.500E+00	7.273E+05	0.0300	292.65	14	1.750E+00	7.062E+05	0.0300	292.65
15	2.000E+00	6.854E+05	0.0300	292.65	16	2.500E+00	6.448E+05	0.0300	292.65
17	3.000E+00	6.053E+05	0.0300	292.65	18	3.500E+00	5.670E+05	0.0300	292.65
19	4.000E+00	5.297E+05	0.0300	292.65	20	4.500E+00	4.933E+05	0.0300	292.65
21	5.080E+00	4.523E+05	0.0300	292.65	22	7.620E+00	2.858E+05	0.0300	292.65
23	1.016E+01	1.373E+05	0.0301	292.65	24	1.270E+01	3.518E+03	0.0390	292.65
25	1.524E+01	2.963E+03	0.0411	292.65	26	1.778E+01	2.701E+03	0.0424	292.65
27	2.032E+01	2.539E+03	0.0433	292.65	28	2.286E+01	2.428E+03	0.0440	292.65
29	2.540E+01	2.345E+03	0.0446	292.65	30	2.794E+01	2.283E+03	0.0451	292.65
31	3.048E+01	2.234E+03	0.0455	292.65	32	3.302E+01	2.195E+03	0.0458	292.65
33	3.556E+01	2.164E+03	0.0461	292.65	34	3.810E+01	2.141E+03	0.0463	292.65
35	4.064E+01	2.123E+03	0.0465	292.65	36	4.318E+01	2.111E+03	0.0466	292.65
37	4.572E+01	2.103E+03	0.0467	292.65	38	4.826E+01	1.941E+03	0.0501	292.65
39	5.080E+01	1.605E+03	0.0501	292.65	40	5.334E+01	1.350E+03	0.0502	292.65
41	5.588E+01	1.201E+03	0.0502	292.65	42	5.842E+01	1.135E+03	0.0502	292.65
43	6.096E+01	1.116E+03	0.0502	292.65					

```
 Initial Water Storage =   2.6271 cm

 NOTE:  There are no temperature data when plants are modelled.

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 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
```

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04504     0.05025
 Head (cm)         = 1.42694E+06 1.08397E+06 2.29221E+03 1.11705E+03
 LiqWater Flow (cm)=-1.47721E-13-5.34144E-13-1.30647E-03 8.24271E-09
 IsoVapor Flow (cm)=-4.12682E-03-4.11260E-03-1.08211E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6271+ 0.0000+ 0.0000 - 0.0041- 0.0000-  0.0000 =    2.6229 vs.    2.6229

 Mass Balance =  6.0153E-06 cm;  Time step attempts =   48 and successes =   41
   Evaporation:  Potential =  0.2990 cm, Actual =  0.0041 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 35.5 %;  TMEAN = 275.9 K;  HDRY =  1.4269E+06 cm;  DAYUBC =    41

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.08653     0.08752     0.07301     0.05058
 Head (cm)         = 7.49185E+02 7.38039E+02 9.46956E+02 7.96306E+02
 LiqWater Flow (cm)= 1.28766E+00 1.16127E+00 9.67814E-02 1.33728E-07
 IsoVapor Flow (cm)= 1.45604E-05 3.41266E-05 2.76437E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8664+ 1.4732+ 0.0000 - 0.1827- 0.0000-  0.0000 =    4.1569 vs.    4.1559

 Mass Balance =  1.0595E-03 cm;  Time step attempts = 2307 and successes = 1729
   Evaporation:  Potential =  0.1864 cm, Actual =  0.1827 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 91.4 %;  TMEAN = 281.8 K;  HDRY =  1.2349E+05 cm;  DAYUBC =     0
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1796E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1796E+02	[cm]
Actual Evaporation	=	2.9019E+01	[cm]
Evaporation during Growth	=	2.9019E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0556E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.2857E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0556E+01	[cm]
Actual Rainfall	=	3.0556E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.1559E+00	[cm]
Mass Balance Error	=	7.8821E-03	[cm]
Total Successful Time Steps	=	57974	
Total Attempted Time Steps	=	70806	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27145	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.5367E+00	0.050	1.5375E+01	0.150	8.7842E+00
0.250	7.2983E+00	0.350	6.0681E+00	0.450	5.5426E+00
0.550	5.1104E+00	0.650	4.7733E+00	0.750	4.6095E+00
0.850	4.4096E+00	0.950	4.2644E+00	1.125	4.1658E+00
1.375	3.9068E+00	1.625	3.7132E+00	1.875	3.5227E+00
2.250	3.3130E+00	2.750	2.9895E+00	3.250	2.7765E+00
3.750	2.6101E+00	4.250	2.4357E+00	4.790	2.2728E+00
6.350	2.0253E+00	8.890	1.4800E+00	11.430	1.1812E+00
13.970	8.7885E-01	16.510	6.4813E-01	19.050	5.2711E-01
21.590	4.2666E-01	24.130	3.3465E-01	26.670	2.5230E-01
29.210	1.8129E-01	31.750	1.2366E-01	34.290	8.1509E-02
36.830	5.5178E-02	39.370	3.9243E-02	41.910	2.7028E-02
44.450	1.5685E-02	46.990	5.3446E-03	49.530	7.4396E-03
52.070	4.4976E-03	54.610	2.7253E-03	57.150	1.0627E-03
59.690	2.2001E-04	60.960	8.2857E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2022.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	7.492E+02	0.0865	292.65	2	1.000E-01	7.416E+02	0.0872	292.65
3	2.000E-01	7.434E+02	0.0870	292.65	4	3.000E-01	7.430E+02	0.0871	292.65
5	4.000E-01	7.424E+02	0.0871	292.65	6	5.000E-01	7.421E+02	0.0871	292.65
7	6.000E-01	7.419E+02	0.0872	292.65	8	7.000E-01	7.417E+02	0.0872	292.65
9	8.000E-01	7.414E+02	0.0872	292.65	10	9.000E-01	7.411E+02	0.0872	292.65
11	1.000E+00	7.408E+02	0.0873	292.65	12	1.250E+00	7.401E+02	0.0873	292.65
13	1.500E+00	7.393E+02	0.0874	292.65	14	1.750E+00	7.387E+02	0.0875	292.65
15	2.000E+00	7.380E+02	0.0875	292.65	16	2.500E+00	7.369E+02	0.0876	292.65
17	3.000E+00	7.359E+02	0.0877	292.65	18	3.500E+00	7.350E+02	0.0878	292.65
19	4.000E+00	7.342E+02	0.0879	292.65	20	4.500E+00	7.336E+02	0.0879	292.65
21	5.080E+00	7.330E+02	0.0880	292.65	22	7.620E+00	7.326E+02	0.0880	292.65
23	1.016E+01	7.356E+02	0.0877	292.65	24	1.270E+01	7.426E+02	0.0871	292.65
25	1.524E+01	7.543E+02	0.0861	292.65	26	1.778E+01	7.716E+02	0.0846	292.65
27	2.032E+01	7.961E+02	0.0827	292.65	28	2.286E+01	8.304E+02	0.0802	292.65
29	2.540E+01	8.784E+02	0.0770	292.65	30	2.794E+01	9.470E+02	0.0730	292.65
31	3.048E+01	1.048E+03	0.0682	292.65	32	3.302E+01	1.204E+03	0.0624	292.65
33	3.556E+01	1.429E+03	0.0564	292.65	34	3.810E+01	1.632E+03	0.0526	292.65
35	4.064E+01	1.716E+03	0.0513	292.65	36	4.318E+01	1.731E+03	0.0510	292.65
37	4.572E+01	1.730E+03	0.0511	292.65	38	4.826E+01	1.600E+03	0.0501	292.65
39	5.080E+01	9.382E+02	0.0504	292.65	40	5.334E+01	7.835E+02	0.0506	292.65
41	5.588E+01	7.635E+02	0.0506	292.65	42	5.842E+01	7.809E+02	0.0506	292.65
43	6.096E+01	7.963E+02	0.0506	292.65					

Initial Water Storage = 4.1559 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03007     0.07064     0.07314     0.05058
 Head (cm)         = 1.98374E+05 9.93641E+02 9.44585E+02 7.95756E+02
 LiqWater Flow (cm)=-6.07483E-02-9.88876E-02 1.20797E-01 1.34505E-07
 IsoVapor Flow (cm)=-7.72573E-02-1.03629E-06 1.24158E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1559+ 0.0508+ 0.0000 - 0.1916- 0.0000-  0.0000 =    4.0150 vs.    4.0151

 Mass Balance = -2.6415E-05 cm;  Time step attempts =  248 and successes =  210
   Evaporation:  Potential =  0.4749 cm, Actual =  0.1916 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 80.3 %;  TMEAN = 280.4 K;  HDRY =  3.0227E+05 cm;  DAYUBC =    64

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04633     0.05131     0.05046
 Head (cm)         = 7.13118E+05 2.13938E+03 1.71252E+03 8.74989E+02
 LiqWater Flow (cm)=-1.83405E-04-4.47956E-02-1.42134E-03 6.16353E-08
 IsoVapor Flow (cm)=-7.69419E-02-1.12819E-05-3.39111E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2154+ 0.0000+ 0.0000 - 0.0771- 0.0000-  0.0000 =    3.1383 vs.    3.1383

 Mass Balance = -7.0153E-05 cm;  Time step attempts =  383 and successes =  304
   Evaporation:  Potential =  0.5522 cm, Actual =  0.0771 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.6 %;  TMEAN = 285.7 K;  HDRY =  7.1312E+05 cm;  DAYUBC =   201
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1971E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

```
Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.1971E+02     [cm]
Actual Evaporation                 =  2.3667E+01     [cm]
Evaporation during Growth          =  2.3667E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  2.2657E+01     [cm]
Total Basal Liquid Flux (drainage) =  3.9583E-05     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.2657E+01     [cm]
Actual Rainfall                    =  2.2657E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1383E+00     [cm]
Mass Balance Error                 =  7.6074E-03     [cm]
Total Successful Time Steps        =     62633
Total Attempted Time Steps         =     76742
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30594
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.0099E+00	0.050	1.3406E+01	0.150	8.0691E+00
0.250	6.4709E+00	0.350	5.6810E+00	0.450	5.1205E+00
0.550	4.5368E+00	0.650	4.0134E+00	0.750	3.6789E+00
0.850	3.4251E+00	0.950	3.1542E+00	1.125	2.7857E+00
1.375	2.2144E+00	1.625	1.7686E+00	1.875	1.4624E+00
2.250	1.2264E+00	2.750	7.0410E-01	3.250	2.8531E-01
3.750	6.1545E-02	4.250	-1.1171E-01	4.790	-2.4058E-01
6.350	-2.9611E-01	8.890	-3.6925E-01	11.430	-3.8787E-01
13.970	-3.9072E-01	16.510	-4.0599E-01	19.050	-3.4356E-01
21.590	-2.6768E-01	24.130	-1.9619E-01	26.670	-1.3155E-01
29.210	-7.6539E-02	31.750	-3.3993E-02	34.290	-6.4978E-03
36.830	5.3791E-03	39.370	6.9308E-03	41.910	4.7725E-03
44.450	1.7352E-03	46.990	-9.0028E-04	49.530	1.3492E-03
52.070	-8.7299E-05	54.610	-3.7467E-04	57.150	-2.4570E-04
59.690	-4.8142E-05	60.960	3.9583E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2023.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	7.131E+05	0.0300	292.65	2	1.000E-01	5.871E+05	0.0300	292.65
3	2.000E-01	4.716E+05	0.0300	292.65	4	3.000E-01	3.650E+05	0.0300	292.65
5	4.000E-01	2.661E+05	0.0301	292.65	6	5.000E-01	1.738E+05	0.0301	292.65
7	6.000E-01	8.734E+04	0.0302	292.65	8	7.000E-01	6.317E+03	0.0345	292.65
9	8.000E-01	3.755E+03	0.0383	292.65	10	9.000E-01	3.257E+03	0.0399	292.65
11	1.000E+00	2.981E+03	0.0410	292.65	12	1.250E+00	2.599E+03	0.0429	292.65
13	1.500E+00	2.387E+03	0.0443	292.65	14	1.750E+00	2.244E+03	0.0454	292.65
15	2.000E+00	2.139E+03	0.0463	292.65	16	2.500E+00	1.991E+03	0.0478	292.65
17	3.000E+00	1.889E+03	0.0489	292.65	18	3.500E+00	1.814E+03	0.0499	292.65
19	4.000E+00	1.755E+03	0.0507	292.65	20	4.500E+00	1.709E+03	0.0514	292.65
21	5.080E+00	1.665E+03	0.0520	292.65	22	7.620E+00	1.555E+03	0.0539	292.65
23	1.016E+01	1.513E+03	0.0547	292.65	24	1.270E+01	1.510E+03	0.0548	292.65
25	1.524E+01	1.533E+03	0.0543	292.65	26	1.778E+01	1.574E+03	0.0536	292.65
27	2.032E+01	1.624E+03	0.0527	292.65	28	2.286E+01	1.671E+03	0.0519	292.65
29	2.540E+01	1.702E+03	0.0515	292.65	30	2.794E+01	1.713E+03	0.0513	292.65
31	3.048E+01	1.708E+03	0.0514	292.65	32	3.302E+01	1.697E+03	0.0515	292.65
33	3.556E+01	1.684E+03	0.0517	292.65	34	3.810E+01	1.672E+03	0.0519	292.65
35	4.064E+01	1.661E+03	0.0521	292.65	36	4.318E+01	1.653E+03	0.0522	292.65
37	4.572E+01	1.648E+03	0.0523	292.65	38	4.826E+01	1.556E+03	0.0501	292.65
39	5.080E+01	1.018E+03	0.0503	292.65	40	5.334E+01	8.834E+02	0.0504	292.65
41	5.588E+01	8.701E+02	0.0505	292.65	42	5.842E+01	8.737E+02	0.0505	292.65
43	6.096E+01	8.750E+02	0.0505	292.65					

Initial Water Storage = 3.1383 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04342     0.05187     0.05046
 Head (cm)         = 7.09845E+05 2.52160E+03 1.67568E+03 8.74950E+02
 LiqWater Flow (cm)=-3.25950E-11-2.68190E-02 7.28023E-04 6.16577E-08
 IsoVapor Flow (cm)=-3.45174E-02-2.06315E-05 7.62073E-08 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1383+ 0.0000+ 0.0000 - 0.0345- 0.0000-  0.0000 =    3.1038 vs.    3.1039

 Mass Balance = -3.2708E-05 cm;  Time step attempts =  197 and successes =  157
   Evaporation:  Potential =  0.4151 cm, Actual =  0.0345 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.8 %;  TMEAN = 286.2 K;  HDRY =  7.0984E+05 cm;  DAYUBC =   156

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05125     0.05023
 Head (cm)         = 1.53614E+06 5.72974E+05 1.71650E+03 1.14847E+03
 LiqWater Flow (cm)=-3.94946E-13-5.63822E-11-1.45656E-03 6.55251E-09
 IsoVapor Flow (cm)=-1.33724E-02-1.33619E-02-3.27938E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9673+ 0.0000+ 0.0000 - 0.0134- 0.0000-  0.0000 =    2.9539 vs.    2.9539

 Mass Balance = -4.1195E-06 cm;  Time step attempts =   28 and successes =   26
   Evaporation:  Potential =  0.4463 cm, Actual =  0.0134 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 32.8 %;  TMEAN = 280.9 K;  HDRY =  1.5361E+06 cm;  DAYUBC =    26
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3745E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

```
Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.3745E+02     [cm]
Actual Evaporation                 =  1.1201E+01     [cm]
Evaporation during Growth          =  1.1201E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  1.1024E+01     [cm]
Total Basal Liquid Flux (drainage) =  1.3305E-05     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.1024E+01     [cm]
Actual Rainfall                    =  1.1024E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.9539E+00     [cm]
Mass Balance Error                 =  7.1438E-03     [cm]
Total Successful Time Steps        =     58525
Total Attempted Time Steps         =     72070
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31150
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.7731E-01	0.050	8.5643E+00	0.150	6.6354E+00
0.250	5.9816E+00	0.350	5.5777E+00	0.450	5.2074E+00
0.550	4.8888E+00	0.650	4.6139E+00	0.750	4.3545E+00
0.850	4.0922E+00	0.950	3.8994E+00	1.125	3.7057E+00
1.375	3.1063E+00	1.625	2.7385E+00	1.875	2.4496E+00
2.250	2.2020E+00	2.750	1.6182E+00	3.250	1.2590E+00
3.750	1.0109E+00	4.250	8.9616E-01	4.790	7.4015E-01
6.350	5.9081E-01	8.890	3.8483E-01	11.430	2.7566E-01
13.970	1.6716E-01	16.510	8.2211E-02	19.050	2.8136E-02
21.590	-5.7786E-03	24.130	-3.0442E-03	26.670	-1.9587E-03
29.210	-1.9442E-03	31.750	-2.3480E-03	34.290	-2.7813E-03
36.830	-3.0714E-03	39.370	-3.1728E-03	41.910	-3.0998E-03
44.450	-2.8948E-03	46.990	-1.5080E-03	49.530	-1.7529E-05
52.070	-1.3331E-04	54.610	-1.8787E-04	57.150	-1.6291E-04
59.690	-5.9882E-05	60.960	1.3305E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpasonorm2024.res
Date of Run: 15 Sep 2025
Time of Run: 16:35:05.87
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.536E+06	0.0300	292.65	2	1.000E-01	1.469E+06	0.0300	292.65
3	2.000E-01	1.404E+06	0.0300	292.65	4	3.000E-01	1.342E+06	0.0300	292.65
5	4.000E-01	1.283E+06	0.0300	292.65	6	5.000E-01	1.227E+06	0.0300	292.65
7	6.000E-01	1.172E+06	0.0300	292.65	8	7.000E-01	1.120E+06	0.0300	292.65
9	8.000E-01	1.069E+06	0.0300	292.65	10	9.000E-01	1.020E+06	0.0300	292.65
11	1.000E+00	9.732E+05	0.0300	292.65	12	1.250E+00	8.618E+05	0.0300	292.65
13	1.500E+00	7.587E+05	0.0300	292.65	14	1.750E+00	6.627E+05	0.0300	292.65
15	2.000E+00	5.730E+05	0.0300	292.65	16	2.500E+00	4.093E+05	0.0300	292.65
17	3.000E+00	2.633E+05	0.0301	292.65	18	3.500E+00	1.314E+05	0.0301	292.65
19	4.000E+00	1.098E+04	0.0323	292.65	20	4.500E+00	3.539E+03	0.0389	292.65
21	5.080E+00	3.083E+03	0.0405	292.65	22	7.620E+00	2.376E+03	0.0444	292.65
23	1.016E+01	2.133E+03	0.0464	292.65	24	1.270E+01	1.997E+03	0.0477	292.65
25	1.524E+01	1.908E+03	0.0487	292.65	26	1.778E+01	1.845E+03	0.0495	292.65
27	2.032E+01	1.799E+03	0.0501	292.65	28	2.286E+01	1.764E+03	0.0506	292.65
29	2.540E+01	1.737E+03	0.0509	292.65	30	2.794E+01	1.716E+03	0.0512	292.65
31	3.048E+01	1.700E+03	0.0515	292.65	32	3.302E+01	1.688E+03	0.0517	292.65
33	3.556E+01	1.678E+03	0.0518	292.65	34	3.810E+01	1.670E+03	0.0520	292.65
35	4.064E+01	1.664E+03	0.0521	292.65	36	4.318E+01	1.659E+03	0.0521	292.65
37	4.572E+01	1.655E+03	0.0522	292.65	38	4.826E+01	1.614E+03	0.0501	292.65
39	5.080E+01	1.392E+03	0.0501	292.65	40	5.334E+01	1.261E+03	0.0502	292.65
41	5.588E+01	1.198E+03	0.0502	292.65	42	5.842E+01	1.162E+03	0.0502	292.65
43	6.096E+01	1.148E+03	0.0502	292.65					

Initial Water Storage = 2.9539 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05109     0.05023
 Head (cm)         = 1.41657E+06 6.10843E+05 1.72739E+03 1.14906E+03
 LiqWater Flow (cm)=-4.53606E-13-3.34251E-11-1.61955E-03 6.52490E-09
 IsoVapor Flow (cm)=-1.16201E-02-1.16201E-02-3.67610E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9539+ 0.0000+ 0.0000 - 0.0116- 0.0000-  0.0000 =    2.9423 vs.    2.9423

 Mass Balance = -6.2022E-06 cm;  Time step attempts =   64 and successes =   58
   Evaporation:  Potential =  0.3896 cm, Actual =  0.0116 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 35.8 %;  TMEAN = 281.5 K;  HDRY =  1.4166E+06 cm;  DAYUBC =    57

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.05000     0.05013
 Head (cm)         = 2.16723E+06 1.21638E+06 1.80603E+03 1.46495E+03
 LiqWater Flow (cm)=-6.38283E-14-7.33809E-13-2.53177E-03 8.78066E-10
 IsoVapor Flow (cm)=-8.27982E-03-8.28004E-03-6.56984E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8696+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.8613 vs.    2.8613

 Mass Balance = -2.8309E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.8891 cm, Actual =  0.0083 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 20.8 %;  TMEAN = 286.2 K;  HDRY =  2.1672E+06 cm;  DAYUBC =    77
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4447E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.4447E+02	[cm]
Actual Evaporation	=	1.1719E+01	[cm]
Evaporation during Growth	=	1.1719E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.1633E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.1990E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.1633E+01	[cm]
Actual Rainfall	=	1.1633E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8613E+00	[cm]
Mass Balance Error	=	6.6786E-03	[cm]
Total Successful Time Steps	=	55052	
Total Attempted Time Steps	=	67567	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29649	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.5925E-02	0.050	9.0392E+00	0.150	6.9847E+00
0.250	6.2650E+00	0.350	5.6683E+00	0.450	5.2342E+00
0.550	4.8918E+00	0.650	4.5887E+00	0.750	4.2915E+00
0.850	4.0521E+00	0.950	3.7820E+00	1.125	3.5889E+00
1.375	3.1565E+00	1.625	2.8897E+00	1.875	2.5731E+00
2.250	2.3133E+00	2.750	1.8990E+00	3.250	1.4995E+00
3.750	1.2919E+00	4.250	1.1012E+00	4.790	8.7650E-01
6.350	6.6167E-01	8.890	2.7643E-01	11.430	2.1497E-01
13.970	1.5462E-01	16.510	1.0014E-01	19.050	5.0029E-02
21.590	-3.4339E-03	24.130	-1.9952E-02	26.670	-1.6570E-02
29.210	-1.3535E-02	31.750	-1.0882E-02	34.290	-8.5937E-03
36.830	-6.6310E-03	39.370	-4.9339E-03	41.910	-3.4387E-03
44.450	-2.0893E-03	46.990	-1.9108E-04	49.530	3.9153E-05
52.070	-3.3472E-06	54.610	-1.0431E-05	57.150	-1.1550E-05
59.690	-4.7625E-06	60.960	8.1990E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

APPENDIX III.I.1.C – UNSAT-H MODEL INPUT AND OUTPUT: +20% HC



```
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
Increase
1,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1995,30,0,2,30,                            IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24,                                   NPRINT,STOPHR
0,4,1,1.0E-6,                           ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-8,1.0,                         DELMAX,DELMIN,OUTTIM
1.2,1.0E-4,0.0,0.0,0.0,                 RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.0,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
1.0,1.0E6,0.0,0.0,                      HIRRI,HDRY,HTOP,RHA
1,0,1,                                  IETOPT,ICLOUD,ISHOPT
1,1.0,                                  IRAIN,HPR
0,0.0,0.0,0.0,0,                        IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0.0,                                IHEAT,ICONVH,DMAXHE
0,0.0,0.0,0.0,0.0,                      UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,292.65,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
2,43,                                   MATN,NPT
1, 0.00,1, 0.10,1, 0.20,1, 0.30,
1, 0.40,1, 0.50,1, 0.60,1, 0.70,
1, 0.80,1, 0.90,1, 1.00,1, 1.25,
1, 1.50,1, 1.75,1, 2.00,1, 2.50,
1, 3.00,1, 3.50,1, 4.00,1, 4.50,
1, 5.08,1, 7.62,1,10.16,1,12.70,
1,15.24,1,17.78,1,20.32,1,22.86,
1,25.40,1,27.94,1,30.48,1,33.02,
1,35.56,1,38.10,1,40.64,1,43.18,
1,45.72,2,48.26,2,50.80,2,53.34,
2,55.88,2,58.42,2,60.96,
90% Compaction Layer            DUMMY
0.38,0.03,0.006,2.2,            THET,THTR,VGA,VGN
conductivity                    DUMMY
2.0,5.5,0.006,2.2,0.5,          RKMOD,SK,VGA,VGN,EPIT
80% Compaction Layer            DUMMY
0.44,0.05,0.017,3.5,            THET,THTR,vGA,vGN
conductivity                    DUMMY
2.0,28.4,0.017,3.5,0.5,         RKMOD,SK,VGA,VGN,EPIT
0,                              NDAY
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,125.0,125.0,125.0,
```

```
125.0,125.0,125.0,
0,1,1,1,1,365,                                  LEAF,NFROOT,NUPTAK,NFPET,NSOW,NHRVST
0.2,                                            BARE
0.0,0.0,0.0,                                    AA,B1,B2
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,365,365,365,365,365,365,365,
365,365,365,
0.1,0.05,0.0,                                   HW,HD,HN
0.1,0.05,0.0,                                   HW,HD,HN
0.0,0.52,0.5,0.1,2.7,                           PETPC1,PETPC2,PETPC3,PETPC4,PETPC5
0.20,1234,0.5,875.0,                            ALBEDO,ALT,ZU,PMB
1995.txt
1996.txt
1997.txt
1998.txt
1999.txt
2000.txt
2001.txt
2002.txt
2003.txt
2004.txt
2005.txt
2006.txt
2007.txt
2008.txt
2009.txt
2010.txt
2011.txt
2012.txt
2013.txt
2014.txt
2015.txt
2016.txt
2017.txt
2018.txt
2019.txt
2020.txt
2021.txt
2022.txt
2023.txt
2024.txt
```

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso1995.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.750E+02	0.1065	292.65	2	1.000E-01	5.750E+02	0.1065	292.65
3	2.000E-01	5.750E+02	0.1065	292.65	4	3.000E-01	5.750E+02	0.1065	292.65
5	4.000E-01	5.750E+02	0.1065	292.65	6	5.000E-01	5.750E+02	0.1065	292.65
7	6.000E-01	5.750E+02	0.1065	292.65	8	7.000E-01	5.750E+02	0.1065	292.65
9	8.000E-01	5.750E+02	0.1065	292.65	10	9.000E-01	5.750E+02	0.1065	292.65
11	1.000E+00	5.750E+02	0.1065	292.65	12	1.250E+00	5.750E+02	0.1065	292.65
13	1.500E+00	5.750E+02	0.1065	292.65	14	1.750E+00	5.750E+02	0.1065	292.65
15	2.000E+00	5.750E+02	0.1065	292.65	16	2.500E+00	5.750E+02	0.1065	292.65
17	3.000E+00	5.750E+02	0.1065	292.65	18	3.500E+00	5.750E+02	0.1065	292.65
19	4.000E+00	5.750E+02	0.1065	292.65	20	4.500E+00	5.750E+02	0.1065	292.65
21	5.080E+00	5.750E+02	0.1065	292.65	22	7.620E+00	5.750E+02	0.1065	292.65
23	1.016E+01	5.750E+02	0.1065	292.65	24	1.270E+01	5.750E+02	0.1065	292.65
25	1.524E+01	5.750E+02	0.1065	292.65	26	1.778E+01	5.750E+02	0.1065	292.65
27	2.032E+01	5.750E+02	0.1065	292.65	28	2.286E+01	5.750E+02	0.1065	292.65
29	2.540E+01	5.750E+02	0.1065	292.65	30	2.794E+01	5.750E+02	0.1065	292.65
31	3.048E+01	5.750E+02	0.1065	292.65	32	3.302E+01	5.750E+02	0.1065	292.65
33	3.556E+01	5.750E+02	0.1065	292.65	34	3.810E+01	5.750E+02	0.1065	292.65
35	4.064E+01	5.750E+02	0.1065	292.65	36	4.318E+01	5.750E+02	0.1065	292.65
37	4.572E+01	5.750E+02	0.1065	292.65	38	4.826E+01	1.250E+02	0.1064	292.65
39	5.080E+01	1.250E+02	0.1064	292.65	40	5.334E+01	1.250E+02	0.1064	292.65
41	5.588E+01	1.250E+02	0.1064	292.65	42	5.842E+01	1.250E+02	0.1064	292.65
43	6.096E+01	1.250E+02	0.1064	292.65					

Initial Water Storage = 6.4909 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.09338     0.09426     0.11108     0.07426
 Head (cm)         = 6.78406E+02 6.70269E+02 5.45963E+02 1.77612E+02
 LiqWater Flow (cm)=-3.31071E-01-3.03324E-01-2.12618E-01 1.46859E-01
 IsoVapor Flow (cm)=-1.19400E-06-6.56663E-07-1.36545E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   6.4909+ 0.0000+ 0.0000 - 0.3317- 0.0000-  0.1469 =    6.0123 vs.    6.0123

 Mass Balance = -5.0021E-05 cm;  Time step attempts =  221 and successes =  192
   Evaporation:  Potential =  0.3317 cm, Actual =  0.3317 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 60.0 %;  TMEAN = 278.4 K;  HDRY =  7.0365E+05 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04661     0.05149
 Head (cm)         = 1.32310E+06 1.99550E+05 2.10926E+03 5.45638E+02
 LiqWater Flow (cm)= 5.26906E-02 1.27109E-02-9.00046E-04 3.64589E-06
 IsoVapor Flow (cm)=-4.30946E-02-3.25996E-03-4.56605E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7795+ 0.0762+ 0.0000 - 0.0666- 0.0000-  0.0000 =    2.7891 vs.    2.7889

 Mass Balance =  1.2832E-04 cm;  Time step attempts = 1353 and successes = 1057
   Evaporation:  Potential =  1.0289 cm, Actual =  0.0666 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 38.3 %;  TMEAN = 284.8 K;  HDRY =  1.3231E+06 cm;  DAYUBC =   440
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1660E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1660E+02	[cm]
Actual Evaporation	=	1.8870E+01	[cm]
Evaporation during Growth	=	1.8870E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.5392E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.1827E-01	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.5392E+01	[cm]
Actual Rainfall	=	1.5392E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.7889E+00	[cm]
Mass Balance Error	=	5.9873E-03	[cm]
Total Successful Time Steps	=	57294	
Total Attempted Time Steps	=	69867	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30162	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-3.4777E+00	0.050	8.2195E+00	0.150	5.2568E+00
0.250	3.7214E+00	0.350	3.0356E+00	0.450	2.3615E+00
0.550	1.9261E+00	0.650	1.6201E+00	0.750	1.2479E+00
0.850	9.4067E-01	0.950	5.8103E-01	1.125	3.1675E-01
1.375	-2.2797E-01	1.625	-7.2723E-01	1.875	-9.9550E-01
2.250	-1.1840E+00	2.750	-1.5224E+00	3.250	-1.7658E+00
3.750	-1.9760E+00	4.250	-2.1698E+00	4.790	-2.2439E+00
6.350	-2.3030E+00	8.890	-2.4868E+00	11.430	-2.4560E+00
13.970	-2.4059E+00	16.510	-2.3484E+00	19.050	-2.2200E+00
21.590	-2.0660E+00	24.130	-1.9127E+00	26.670	-1.7601E+00
29.210	-1.6081E+00	31.750	-1.4566E+00	34.290	-1.3055E+00
36.830	-1.1547E+00	39.370	-1.0043E+00	41.910	-8.5404E-01
44.450	-7.0398E-01	46.990	-5.5126E-01	49.530	-4.0297E-01
52.070	-2.7045E-01	54.610	-1.3057E-01	57.150	9.0643E-03
59.690	1.4855E-01	60.960	2.1827E-01		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
 Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso1996.res
 Date of Run:      15 Sep 2025
 Time of Run:      17:02:21.02
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
--------------------------------------------------------------------------------
```

NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	Initial Conditions HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.323E+06	0.0300	292.65	2	1.000E-01	1.239E+06	0.0300	292.65
3	2.000E-01	1.160E+06	0.0300	292.65	4	3.000E-01	1.085E+06	0.0300	292.65
5	4.000E-01	1.013E+06	0.0300	292.65	6	5.000E-01	9.457E+05	0.0300	292.65
7	6.000E-01	8.812E+05	0.0300	292.65	8	7.000E-01	8.196E+05	0.0300	292.65
9	8.000E-01	7.606E+05	0.0300	292.65	10	9.000E-01	7.041E+05	0.0300	292.65
11	1.000E+00	6.498E+05	0.0300	292.65	12	1.250E+00	5.226E+05	0.0300	292.65
13	1.500E+00	4.062E+05	0.0300	292.65	14	1.750E+00	2.990E+05	0.0300	292.65
15	2.000E+00	1.995E+05	0.0301	292.65	16	2.500E+00	2.015E+04	0.0311	292.65
17	3.000E+00	5.029E+03	0.0359	292.65	18	3.500E+00	4.771E+03	0.0362	292.65
19	4.000E+00	4.819E+03	0.0362	292.65	20	4.500E+00	4.747E+03	0.0363	292.65
21	5.080E+00	4.334E+03	0.0370	292.65	22	7.620E+00	2.996E+03	0.0409	292.65
23	1.016E+01	2.648E+03	0.0427	292.65	24	1.270E+01	2.465E+03	0.0438	292.65
25	1.524E+01	2.350E+03	0.0446	292.65	26	1.778E+01	2.271E+03	0.0452	292.65
27	2.032E+01	2.213E+03	0.0457	292.65	28	2.286E+01	2.170E+03	0.0461	292.65
29	2.540E+01	2.136E+03	0.0464	292.65	30	2.794E+01	2.109E+03	0.0466	292.65
31	3.048E+01	2.088E+03	0.0468	292.65	32	3.302E+01	2.070E+03	0.0470	292.65
33	3.556E+01	2.056E+03	0.0471	292.65	34	3.810E+01	2.044E+03	0.0472	292.65
35	4.064E+01	2.035E+03	0.0473	292.65	36	4.318E+01	2.028E+03	0.0474	292.65
37	4.572E+01	2.023E+03	0.0475	292.65	38	4.826E+01	1.687E+03	0.0501	292.65
39	5.080E+01	6.144E+02	0.0511	292.65	40	5.334E+01	5.762E+02	0.0513	292.65
41	5.588E+01	5.577E+02	0.0514	292.65	42	5.842E+01	5.485E+02	0.0515	292.65
43	6.096E+01	5.456E+02	0.0515	292.65					

```
 Initial Water Storage =   2.7889 cm

 NOTE:  There are no temperature data when plants are modelled.

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 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
```

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03005     0.04654     0.05148
 Head (cm)         = 6.46939E+05 2.86100E+05 2.11739E+03 5.46114E+02
 LiqWater Flow (cm)=-1.23602E-11-6.16019E-08-9.45132E-04 3.61974E-06
 IsoVapor Flow (cm)=-9.05363E-03-9.05769E-03-4.84152E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7889+ 0.0000+ 0.0000 - 0.0091- 0.0000-  0.0000 =    2.7799 vs.    2.7799

 Mass Balance = -2.5151E-05 cm;  Time step attempts =  101 and successes =   79
   Evaporation:  Potential =  0.3638 cm, Actual =  0.0091 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 62.5 %;  TMEAN = 279.0 K;  HDRY =  6.4694E+05 cm;  DAYUBC =    76

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04499     0.05082
 Head (cm)         = 1.37244E+06 9.77636E+05 2.29837E+03 6.91463E+02
 LiqWater Flow (cm)=-2.46112E-13-1.18443E-12-1.38935E-03 5.16082E-07
 IsoVapor Flow (cm)=-4.92934E-03-4.92876E-03-9.84279E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6427+ 0.0000+ 0.0000 - 0.0049- 0.0000-  0.0000 =    2.6378 vs.    2.6378

 Mass Balance =  1.3646E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3649 cm, Actual =  0.0049 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.9 %;  TMEAN = 282.9 K;  HDRY =  1.3724E+06 cm;  DAYUBC =    24
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3540E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.3540E+02	[cm]
Actual Evaporation	=	2.1455E+01	[cm]
Evaporation during Growth	=	2.1450E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1311E+01	[cm]
Total Basal Liquid Flux (drainage)	=	5.1100E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1311E+01	[cm]
Actual Rainfall	=	2.1311E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.6378E+00	[cm]
Mass Balance Error	=	6.3947E-03	[cm]
Total Successful Time Steps	=	50957	
Total Attempted Time Steps	=	61519	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26445	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.4421E-01	0.050	1.5264E+01	0.150	8.1942E+00
0.250	6.2850E+00	0.350	5.0765E+00	0.450	4.2862E+00
0.550	3.8427E+00	0.650	3.5426E+00	0.750	3.3648E+00
0.850	3.1387E+00	0.950	2.9205E+00	1.125	2.7594E+00
1.375	2.3796E+00	1.625	2.1886E+00	1.875	2.0293E+00
2.250	1.9003E+00	2.750	1.5852E+00	3.250	1.4578E+00
3.750	1.3191E+00	4.250	1.2006E+00	4.790	1.0906E+00
6.350	9.4296E-01	8.890	4.9152E-01	11.430	2.4136E-01
13.970	1.1937E-01	16.510	-7.0139E-03	19.050	-4.6879E-02
21.590	-4.1808E-02	24.130	-3.6894E-02	26.670	-3.2485E-02
29.210	-2.8516E-02	31.750	-2.4900E-02	34.290	-2.1585E-02
36.830	-1.8502E-02	39.370	-1.5595E-02	41.910	-1.2815E-02
44.450	-1.0120E-02	46.990	-5.3882E-03	49.530	-5.6922E-04
52.070	-4.5935E-03	54.610	-3.4040E-03	57.150	-1.8824E-03
59.690	-2.9286E-04	60.960	5.1100E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso1997.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.372E+06	0.0300	292.65	2	1.000E-01	1.349E+06	0.0300	292.65
3	2.000E-01	1.327E+06	0.0300	292.65	4	3.000E-01	1.306E+06	0.0300	292.65
5	4.000E-01	1.284E+06	0.0300	292.65	6	5.000E-01	1.263E+06	0.0300	292.65
7	6.000E-01	1.242E+06	0.0300	292.65	8	7.000E-01	1.221E+06	0.0300	292.65
9	8.000E-01	1.201E+06	0.0300	292.65	10	9.000E-01	1.181E+06	0.0300	292.65
11	1.000E+00	1.161E+06	0.0300	292.65	12	1.250E+00	1.113E+06	0.0300	292.65
13	1.500E+00	1.066E+06	0.0300	292.65	14	1.750E+00	1.021E+06	0.0300	292.65
15	2.000E+00	9.776E+05	0.0300	292.65	16	2.500E+00	8.943E+05	0.0300	292.65
17	3.000E+00	8.157E+05	0.0300	292.65	18	3.500E+00	7.414E+05	0.0300	292.65
19	4.000E+00	6.709E+05	0.0300	292.65	20	4.500E+00	6.038E+05	0.0300	292.65
21	5.080E+00	5.299E+05	0.0300	292.65	22	7.620E+00	2.456E+05	0.0301	292.65
23	1.016E+01	9.489E+03	0.0327	292.65	24	1.270E+01	3.260E+03	0.0399	292.65
25	1.524E+01	2.891E+03	0.0414	292.65	26	1.778E+01	2.676E+03	0.0425	292.65
27	2.032E+01	2.534E+03	0.0433	292.65	28	2.286E+01	2.432E+03	0.0440	292.65
29	2.540E+01	2.356E+03	0.0446	292.65	30	2.794E+01	2.298E+03	0.0450	292.65
31	3.048E+01	2.253E+03	0.0454	292.65	32	3.302E+01	2.217E+03	0.0457	292.65
33	3.556E+01	2.189E+03	0.0459	292.65	34	3.810E+01	2.167E+03	0.0461	292.65
35	4.064E+01	2.151E+03	0.0462	292.65	36	4.318E+01	2.139E+03	0.0463	292.65
37	4.572E+01	2.132E+03	0.0464	292.65	38	4.826E+01	1.839E+03	0.0501	292.65
39	5.080E+01	1.025E+03	0.0503	292.65	40	5.334E+01	7.745E+02	0.0506	292.65
41	5.588E+01	7.185E+02	0.0507	292.65	42	5.842E+01	6.973E+02	0.0508	292.65
43	6.096E+01	6.915E+02	0.0508	292.65					

Initial Water Storage = 2.6378 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04491     0.05082
 Head (cm)         = 1.39883E+06 9.95354E+05 2.30945E+03 6.91812E+02
 LiqWater Flow (cm)=-2.29740E-13-1.10782E-12-1.38624E-03 5.13941E-07
 IsoVapor Flow (cm)=-4.96832E-03-4.96789E-03-1.00443E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6378+ 0.0000+ 0.0000 - 0.0050- 0.0000-  0.0000 =    2.6328 vs.    2.6328

 Mass Balance = -3.3678E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6119 cm, Actual =  0.0050 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.2 %;  TMEAN = 287.6 K;  HDRY =  1.3988E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.05061     0.07209     0.05048
 Head (cm)         = 5.32865E+05 1.76103E+03 9.64625E+02 8.54698E+02
 LiqWater Flow (cm)=-1.61353E-09-6.69134E-02-2.81553E-02 8.97827E-08
 IsoVapor Flow (cm)=-7.34902E-02-9.19038E-06-2.72478E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9643+ 0.0000+ 0.0000 - 0.0735- 0.0000-  0.0000 =    3.8908 vs.    3.8909

 Mass Balance = -1.5821E-05 cm;  Time step attempts =  107 and successes =   83
   Evaporation:  Potential =  0.2501 cm, Actual =  0.0735 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.2 %;  TMEAN = 278.7 K;  HDRY =  5.6862E+05 cm;  DAYUBC =    63
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.8279E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.8279E+02	[cm]
Actual Evaporation	=	2.3195E+01	[cm]
Evaporation during Growth	=	2.3195E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.4460E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.5440E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.4460E+01	[cm]
Actual Rainfall	=	2.4460E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.8909E+00	[cm]
Mass Balance Error	=	1.1840E-02	[cm]
Total Successful Time Steps	=	81008	
Total Attempted Time Steps	=	101132	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	37722	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.2650E+00	0.050	1.7749E+01	0.150	1.3603E+01
0.250	1.1659E+01	0.350	1.0230E+01	0.450	9.1983E+00
0.550	8.3404E+00	0.650	7.5854E+00	0.750	6.9603E+00
0.850	6.5079E+00	0.950	6.0579E+00	1.125	5.6113E+00
1.375	4.5642E+00	1.625	3.9675E+00	1.875	3.4605E+00
2.250	3.0963E+00	2.750	2.4890E+00	3.250	2.1376E+00
3.750	1.8999E+00	4.250	1.6745E+00	4.790	1.5068E+00
6.350	1.3483E+00	8.890	1.1377E+00	11.430	9.6846E-01
13.970	9.0023E-01	16.510	8.3588E-01	19.050	7.7084E-01
21.590	7.0488E-01	24.130	6.3795E-01	26.670	5.7001E-01
29.210	5.0111E-01	31.750	4.3133E-01	34.290	3.6074E-01
36.830	2.8941E-01	39.370	2.1742E-01	41.910	1.4487E-01
44.450	7.1825E-02	46.990	-9.5790E-04	49.530	6.9669E-05
52.070	-6.2522E-04	54.610	-1.1422E-03	57.150	-8.3611E-04
59.690	-2.4225E-04	60.960	8.5440E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso1998.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.329E+05	0.0300	292.65	2	1.000E-01	3.694E+05	0.0300	292.65
3	2.000E-01	2.316E+05	0.0301	292.65	4	3.000E-01	1.056E+05	0.0302	292.65
5	4.000E-01	2.501E+03	0.0435	292.65	6	5.000E-01	2.397E+03	0.0443	292.65
7	6.000E-01	2.311E+03	0.0449	292.65	8	7.000E-01	2.237E+03	0.0455	292.65
9	8.000E-01	2.174E+03	0.0460	292.65	10	9.000E-01	2.118E+03	0.0465	292.65
11	1.000E+00	2.069E+03	0.0470	292.65	12	1.250E+00	1.967E+03	0.0481	292.65
13	1.500E+00	1.885E+03	0.0490	292.65	14	1.750E+00	1.818E+03	0.0498	292.65
15	2.000E+00	1.761E+03	0.0506	292.65	16	2.500E+00	1.669E+03	0.0520	292.65
17	3.000E+00	1.597E+03	0.0532	292.65	18	3.500E+00	1.538E+03	0.0542	292.65
19	4.000E+00	1.488E+03	0.0552	292.65	20	4.500E+00	1.446E+03	0.0561	292.65
21	5.080E+00	1.404E+03	0.0570	292.65	22	7.620E+00	1.273E+03	0.0603	292.65
23	1.016E+01	1.190E+03	0.0628	292.65	24	1.270E+01	1.131E+03	0.0649	292.65
25	1.524E+01	1.087E+03	0.0666	292.65	26	1.778E+01	1.052E+03	0.0680	292.65
27	2.032E+01	1.024E+03	0.0692	292.65	28	2.286E+01	1.000E+03	0.0703	292.65
29	2.540E+01	9.810E+02	0.0713	292.65	30	2.794E+01	9.646E+02	0.0721	292.65
31	3.048E+01	9.508E+02	0.0728	292.65	32	3.302E+01	9.392E+02	0.0734	292.65
33	3.556E+01	9.294E+02	0.0740	292.65	34	3.810E+01	9.214E+02	0.0744	292.65
35	4.064E+01	9.148E+02	0.0748	292.65	36	4.318E+01	9.097E+02	0.0751	292.65
37	4.572E+01	9.058E+02	0.0753	292.65	38	4.826E+01	8.947E+02	0.0504	292.65
39	5.080E+01	9.961E+02	0.0503	292.65	40	5.334E+01	9.484E+02	0.0504	292.65
41	5.588E+01	8.942E+02	0.0504	292.65	42	5.842E+01	8.641E+02	0.0505	292.65
43	6.096E+01	8.547E+02	0.0505	292.65					

Initial Water Storage = 3.8909 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.04955     0.07071     0.05048
 Head (cm)         = 3.69077E+05 1.84050E+03 9.92319E+02 8.55011E+02
 LiqWater Flow (cm)=-6.82947E-10-5.92143E-02-2.55635E-02 8.95120E-08
 IsoVapor Flow (cm)=-6.16045E-02-1.04872E-05-2.84400E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.8909+ 0.0000+ 0.0000 - 0.0616- 0.0000-  0.0000 =    3.8293 vs.    3.8293

 Mass Balance = -1.1443E-06 cm;  Time step attempts =   29 and successes =   27
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0616 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 66.3 %;  TMEAN = 279.3 K;  HDRY =  5.6596E+05 cm;  DAYUBC =    12

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03006     0.05514     0.05027
 Head (cm)         = 9.19880E+05 2.45672E+05 1.49065E+03 1.08584E+03
 LiqWater Flow (cm)=-3.69658E-12-8.92585E-09-5.54018E-03 1.24485E-08
 IsoVapor Flow (cm)=-1.29965E-02-1.30052E-02-4.69480E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1403+ 0.0000+ 0.0000 - 0.0130- 0.0000-  0.0000 =    3.1273 vs.    3.1273

 Mass Balance = -6.8647E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3702 cm, Actual =  0.0130 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 51.3 %;  TMEAN = 282.0 K;  HDRY =  9.1988E+05 cm;  DAYUBC =    72
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9981E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9981E+02	[cm]
Actual Evaporation	=	1.7952E+01	[cm]
Evaporation during Growth	=	1.7952E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.7196E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.6456E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.7196E+01	[cm]
Actual Rainfall	=	1.7196E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.1273E+00	[cm]
Mass Balance Error	=	7.6029E-03	[cm]
Total Successful Time Steps	=	62903	
Total Attempted Time Steps	=	77286	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	31140	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-7.5598E-01	0.050	1.1269E+01	0.150	8.1684E+00
0.250	7.0415E+00	0.350	6.0920E+00	0.450	5.3553E+00
0.550	4.8330E+00	0.650	4.3854E+00	0.750	3.8799E+00
0.850	3.5593E+00	0.950	3.2229E+00	1.125	2.9310E+00
1.375	2.1884E+00	1.625	1.7152E+00	1.875	1.3386E+00
2.250	1.0496E+00	2.750	5.9347E-01	3.250	2.9968E-01
3.750	1.0624E-01	4.250	-3.8516E-02	4.790	-9.7074E-02
6.350	-1.6771E-01	8.890	-3.4639E-01	11.430	-4.1239E-01
13.970	-4.5189E-01	16.510	-4.7025E-01	19.050	-4.8253E-01
21.590	-4.4481E-01	24.130	-4.0354E-01	26.670	-3.6138E-01
29.210	-3.1842E-01	31.750	-2.7477E-01	34.290	-2.3051E-01
36.830	-1.8570E-01	39.370	-1.4042E-01	41.910	-9.4712E-02
44.450	-4.8656E-02	46.990	-1.5016E-03	49.530	4.7236E-04
52.070	-6.6888E-05	54.610	-2.0143E-04	57.150	-2.1485E-04
59.690	-8.1422E-05	60.960	1.6456E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso1999.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.199E+05	0.0300	292.65	2	1.000E-01	8.771E+05	0.0300	292.65
3	2.000E-01	8.355E+05	0.0300	292.65	4	3.000E-01	7.953E+05	0.0300	292.65
5	4.000E-01	7.561E+05	0.0300	292.65	6	5.000E-01	7.180E+05	0.0300	292.65
7	6.000E-01	6.810E+05	0.0300	292.65	8	7.000E-01	6.449E+05	0.0300	292.65
9	8.000E-01	6.097E+05	0.0300	292.65	10	9.000E-01	5.754E+05	0.0300	292.65
11	1.000E+00	5.420E+05	0.0300	292.65	12	1.250E+00	4.617E+05	0.0300	292.65
13	1.500E+00	3.859E+05	0.0300	292.65	14	1.750E+00	3.140E+05	0.0300	292.65
15	2.000E+00	2.457E+05	0.0301	292.65	16	2.500E+00	1.184E+05	0.0301	292.65
17	3.000E+00	3.414E+03	0.0393	292.65	18	3.500E+00	2.992E+03	0.0409	292.65
19	4.000E+00	2.750E+03	0.0421	292.65	20	4.500E+00	2.583E+03	0.0430	292.65
21	5.080E+00	2.441E+03	0.0439	292.65	22	7.620E+00	2.087E+03	0.0468	292.65
23	1.016E+01	1.905E+03	0.0488	292.65	24	1.270E+01	1.787E+03	0.0502	292.65
25	1.524E+01	1.704E+03	0.0514	292.65	26	1.778E+01	1.640E+03	0.0524	292.65
27	2.032E+01	1.590E+03	0.0533	292.65	28	2.286E+01	1.550E+03	0.0540	292.65
29	2.540E+01	1.518E+03	0.0546	292.65	30	2.794E+01	1.491E+03	0.0551	292.65
31	3.048E+01	1.468E+03	0.0556	292.65	32	3.302E+01	1.450E+03	0.0560	292.65
33	3.556E+01	1.435E+03	0.0563	292.65	34	3.810E+01	1.423E+03	0.0566	292.65
35	4.064E+01	1.413E+03	0.0568	292.65	36	4.318E+01	1.406E+03	0.0569	292.65
37	4.572E+01	1.401E+03	0.0571	292.65	38	4.826E+01	1.369E+03	0.0501	292.65
39	5.080E+01	1.085E+03	0.0503	292.65	40	5.334E+01	1.068E+03	0.0503	292.65
41	5.588E+01	1.086E+03	0.0503	292.65	42	5.842E+01	1.088E+03	0.0503	292.65
43	6.096E+01	1.086E+03	0.0503	292.65					

Initial Water Storage = 3.1273 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03004     0.05484     0.05027
 Head (cm)         = 1.35965E+06 3.28555E+05 1.50542E+03 1.08594E+03
 LiqWater Flow (cm)=-9.94575E-13-3.06389E-09-5.37399E-03 1.24393E-08
 IsoVapor Flow (cm)=-1.66353E-02-1.66147E-02-4.77817E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1273+ 0.0000+ 0.0000 - 0.0166- 0.0000-  0.0000 =    3.1106 vs.    3.1106

 Mass Balance = -8.4971E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8887 cm, Actual =  0.0166 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 37.3 %;  TMEAN = 284.0 K;  HDRY =  1.3596E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04487     0.06473     0.05019
 Head (cm)         = 8.66730E+05 2.31392E+03 1.13522E+03 1.24299E+03
 LiqWater Flow (cm)=-2.05159E-11-3.96021E-02-1.31023E-02 4.07471E-09
 IsoVapor Flow (cm)=-4.28185E-02-2.01395E-05-2.94870E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6032+ 0.0000+ 0.0000 - 0.0428- 0.0000-  0.0000 =    3.5603 vs.    3.5603

 Mass Balance = -1.2817E-05 cm;  Time step attempts =   72 and successes =   58
   Evaporation:  Potential =  0.3425 cm, Actual =  0.0428 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.3 %;  TMEAN = 285.7 K;  HDRY =  8.6673E+05 cm;  DAYUBC =    58
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0082E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0082E+02	[cm]
Actual Evaporation	=	2.0287E+01	[cm]
Evaporation during Growth	=	2.0287E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.0726E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.3154E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.0726E+01	[cm]
Actual Rainfall	=	2.0726E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.5603E+00	[cm]
Mass Balance Error	=	6.6179E-03	[cm]
Total Successful Time Steps	=	49290	
Total Attempted Time Steps	=	59355	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	25184	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	4.3970E-01	0.050	1.3957E+01	0.150	9.1828E+00
0.250	7.5786E+00	0.350	6.5600E+00	0.450	5.7561E+00
0.550	5.1383E+00	0.650	4.7246E+00	0.750	4.3356E+00
0.850	3.7939E+00	0.950	3.5424E+00	1.125	3.2789E+00
1.375	2.6571E+00	1.625	2.3214E+00	1.875	2.0706E+00
2.250	1.9256E+00	2.750	1.6825E+00	3.250	1.5303E+00
3.750	1.4291E+00	4.250	1.3195E+00	4.790	1.1998E+00
6.350	1.0355E+00	8.890	7.5929E-01	11.430	6.4238E-01
13.970	5.2362E-01	16.510	4.4392E-01	19.050	3.6812E-01
21.590	2.9411E-01	24.130	2.2695E-01	26.670	2.0072E-01
29.210	1.7608E-01	31.750	1.5129E-01	34.290	1.2634E-01
36.830	1.0122E-01	39.370	7.5960E-02	41.910	5.0561E-02
44.450	2.5039E-02	46.990	2.3625E-04	49.530	5.2723E-04
52.070	4.1606E-05	54.610	-3.8971E-06	57.150	-1.4258E-05
59.690	-6.5474E-06	60.960	2.3154E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2000.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.667E+05	0.0300	292.65	2	1.000E-01	7.399E+05	0.0300	292.65
3	2.000E-01	6.242E+05	0.0300	292.65	4	3.000E-01	5.173E+05	0.0300	292.65
5	4.000E-01	4.180E+05	0.0300	292.65	6	5.000E-01	3.254E+05	0.0300	292.65
7	6.000E-01	2.387E+05	0.0301	292.65	8	7.000E-01	1.571E+05	0.0301	292.65
9	8.000E-01	8.000E+04	0.0302	292.65	10	9.000E-01	7.447E+03	0.0337	292.65
11	1.000E+00	3.995E+03	0.0377	292.65	12	1.250E+00	3.021E+03	0.0408	292.65
13	1.500E+00	2.669E+03	0.0425	292.65	14	1.750E+00	2.460E+03	0.0438	292.65
15	2.000E+00	2.314E+03	0.0449	292.65	16	2.500E+00	2.116E+03	0.0466	292.65
17	3.000E+00	1.982E+03	0.0479	292.65	18	3.500E+00	1.884E+03	0.0490	292.65
19	4.000E+00	1.807E+03	0.0500	292.65	20	4.500E+00	1.744E+03	0.0509	292.65
21	5.080E+00	1.683E+03	0.0518	292.65	22	7.620E+00	1.506E+03	0.0548	292.65
23	1.016E+01	1.401E+03	0.0571	292.65	24	1.270E+01	1.328E+03	0.0588	292.65
25	1.524E+01	1.275E+03	0.0603	292.65	26	1.778E+01	1.234E+03	0.0615	292.65
27	2.032E+01	1.201E+03	0.0625	292.65	28	2.286E+01	1.175E+03	0.0633	292.65
29	2.540E+01	1.153E+03	0.0641	292.65	30	2.794E+01	1.135E+03	0.0647	292.65
31	3.048E+01	1.120E+03	0.0653	292.65	32	3.302E+01	1.108E+03	0.0658	292.65
33	3.556E+01	1.097E+03	0.0662	292.65	34	3.810E+01	1.089E+03	0.0665	292.65
35	4.064E+01	1.082E+03	0.0668	292.65	36	4.318E+01	1.077E+03	0.0670	292.65
37	4.572E+01	1.073E+03	0.0671	292.65	38	4.826E+01	1.064E+03	0.0503	292.65
39	5.080E+01	1.326E+03	0.0502	292.65	40	5.334E+01	1.257E+03	0.0502	292.65
41	5.588E+01	1.227E+03	0.0502	292.65	42	5.842E+01	1.236E+03	0.0502	292.65
43	6.096E+01	1.243E+03	0.0502	292.65					

Initial Water Storage = 3.5603 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04447     0.06395     0.05019
 Head (cm)         = 1.04627E+06 2.36728E+03 1.15731E+03 1.24260E+03
 LiqWater Flow (cm)=-7.23520E-12-3.45618E-02-1.31900E-02 4.08552E-09
 IsoVapor Flow (cm)=-3.66306E-02-2.16804E-05-3.21674E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5603+ 0.0000+ 0.0000 - 0.0366- 0.0000-  0.0000 =    3.5237 vs.    3.5237

 Mass Balance = -1.9649E-05 cm;  Time step attempts =  111 and successes =   86
   Evaporation:  Potential =  0.7655 cm, Actual =  0.0366 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 46.8 %;  TMEAN = 285.9 K;  HDRY =  1.0463E+06 cm;  DAYUBC =    86

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.05419     0.05015
 Head (cm)         = 8.48906E+05 1.36951E+05 1.53953E+03 1.34855E+03
 LiqWater Flow (cm)=-6.03941E-12-1.96308E-04-4.26231E-03 2.08200E-09
 IsoVapor Flow (cm)=-1.46862E-02-1.44892E-02-4.33362E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1114+ 0.0000+ 0.0000 - 0.0147- 0.0000-  0.0000 =    3.0967 vs.    3.0967

 Mass Balance = -2.9159E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2151 cm, Actual =  0.0147 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.0 %;  TMEAN = 277.0 K;  HDRY =  8.4891E+05 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0228E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
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Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0228E+02	[cm]
Actual Evaporation	=	1.9277E+01	[cm]
Evaporation during Growth	=	1.9262E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.8821E+01	[cm]
Total Basal Liquid Flux (drainage)	=	9.2805E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.8821E+01	[cm]
Actual Rainfall	=	1.8821E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.0967E+00	[cm]
Mass Balance Error	=	8.0597E-03	[cm]
Total Successful Time Steps	=	60316	
Total Attempted Time Steps	=	74063	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30716	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.5562E-01	0.050	1.3225E+01	0.150	9.0959E+00
0.250	7.7580E+00	0.350	6.9368E+00	0.450	6.2889E+00
0.550	5.6101E+00	0.650	5.1706E+00	0.750	4.6814E+00
0.850	4.3323E+00	0.950	4.0873E+00	1.125	3.7999E+00
1.375	3.0145E+00	1.625	2.5078E+00	1.875	2.0199E+00
2.250	1.7129E+00	2.750	1.1580E+00	3.250	7.3905E-01
3.750	5.6545E-01	4.250	4.1869E-01	4.790	2.9698E-01
6.350	1.7771E-01	8.890	-9.4694E-02	11.430	-2.4386E-01
13.970	-2.8414E-01	16.510	-3.2215E-01	19.050	-2.9998E-01
21.590	-2.7504E-01	24.130	-2.4942E-01	26.670	-2.2323E-01
29.210	-1.9654E-01	31.750	-1.6943E-01	34.290	-1.4195E-01
36.830	-1.1415E-01	39.370	-8.6084E-02	41.910	-5.7787E-02
44.450	-2.9299E-02	46.990	-2.7168E-04	49.530	4.9686E-04
52.070	2.8838E-05	54.610	-2.7728E-07	57.150	-2.9268E-06
59.690	-8.0721E-07	60.960	9.2805E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2001.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.489E+05	0.0300	292.65	2	1.000E-01	8.034E+05	0.0300	292.65
3	2.000E-01	7.590E+05	0.0300	292.65	4	3.000E-01	7.159E+05	0.0300	292.65
5	4.000E-01	6.741E+05	0.0300	292.65	6	5.000E-01	6.336E+05	0.0300	292.65
7	6.000E-01	5.943E+05	0.0300	292.65	8	7.000E-01	5.561E+05	0.0300	292.65
9	8.000E-01	5.190E+05	0.0300	292.65	10	9.000E-01	4.828E+05	0.0300	292.65
11	1.000E+00	4.475E+05	0.0300	292.65	12	1.250E+00	3.631E+05	0.0300	292.65
13	1.500E+00	2.835E+05	0.0300	292.65	14	1.750E+00	2.083E+05	0.0301	292.65
15	2.000E+00	1.370E+05	0.0301	292.65	16	2.500E+00	4.485E+03	0.0367	292.65
17	3.000E+00	3.337E+03	0.0396	292.65	18	3.500E+00	2.947E+03	0.0411	292.65
19	4.000E+00	2.719E+03	0.0423	292.65	20	4.500E+00	2.563E+03	0.0432	292.65
21	5.080E+00	2.429E+03	0.0440	292.65	22	7.620E+00	2.096E+03	0.0467	292.65
23	1.016E+01	1.926E+03	0.0485	292.65	24	1.270E+01	1.816E+03	0.0499	292.65
25	1.524E+01	1.737E+03	0.0509	292.65	26	1.778E+01	1.678E+03	0.0518	292.65
27	2.032E+01	1.632E+03	0.0526	292.65	28	2.286E+01	1.595E+03	0.0532	292.65
29	2.540E+01	1.565E+03	0.0537	292.65	30	2.794E+01	1.540E+03	0.0542	292.65
31	3.048E+01	1.519E+03	0.0546	292.65	32	3.302E+01	1.502E+03	0.0549	292.65
33	3.556E+01	1.488E+03	0.0552	292.65	34	3.810E+01	1.476E+03	0.0554	292.65
35	4.064E+01	1.468E+03	0.0556	292.65	36	4.318E+01	1.461E+03	0.0557	292.65
37	4.572E+01	1.456E+03	0.0558	292.65	38	4.826E+01	1.433E+03	0.0501	292.65
39	5.080E+01	1.335E+03	0.0502	292.65	40	5.334E+01	1.329E+03	0.0502	292.65
41	5.588E+01	1.340E+03	0.0502	292.65	42	5.842E+01	1.347E+03	0.0502	292.65
43	6.096E+01	1.349E+03	0.0502	292.65					

Initial Water Storage = 3.0967 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03010     0.05394     0.05016
 Head (cm)         = 8.74418E+05 1.47202E+05 1.55301E+03 1.34841E+03
 LiqWater Flow (cm)=-5.41134E-12-7.53043E-05-4.23865E-03 2.08368E-09
 IsoVapor Flow (cm)=-1.49343E-02-1.48527E-02-4.47988E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0967+ 0.0000+ 0.0000 - 0.0149- 0.0000-  0.0000 =    3.0817 vs.    3.0817

 Mass Balance = -4.4192E-06 cm;  Time step attempts =   30 and successes =   27
   Evaporation:  Potential =  0.2193 cm, Actual =  0.0149 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.0 %;  TMEAN = 277.3 K;  HDRY =  8.7442E+05 cm;  DAYUBC =    27

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04396     0.04794     0.05009
 Head (cm)         = 8.82736E+05 2.44015E+03 1.97796E+03 1.66560E+03
 LiqWater Flow (cm)= 1.70569E-01 9.54765E-02-1.99053E-03 3.65116E-10
 IsoVapor Flow (cm)=-5.82399E-02 1.75161E-04-6.84222E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7925+ 0.2032+ 0.0000 - 0.0909- 0.0000-  0.0000 =    2.9048 vs.    2.9044

 Mass Balance =  4.5404E-04 cm;  Time step attempts = 1800 and successes = 1386
   Evaporation:  Potential =  0.2283 cm, Actual =  0.0909 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 52.7 %;  TMEAN = 276.2 K;  HDRY =  8.8274E+05 cm;  DAYUBC =   331
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0416E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0416E+02	[cm]
Actual Evaporation	=	1.1081E+01	[cm]
Evaporation during Growth	=	1.1081E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.0897E+01	[cm]
Total Basal Liquid Flux (drainage)	=	3.5516E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.0897E+01	[cm]
Actual Rainfall	=	1.0897E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.9044E+00	[cm]
Mass Balance Error	=	7.5984E-03	[cm]
Total Successful Time Steps	=	61298	
Total Attempted Time Steps	=	75920	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	31299	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.8469E-01	0.050	8.2669E+00	0.150	6.5637E+00
0.250	5.9158E+00	0.350	5.4556E+00	0.450	5.0183E+00
0.550	4.6710E+00	0.650	4.3117E+00	0.750	4.0571E+00
0.850	3.8601E+00	0.950	3.6771E+00	1.125	3.5010E+00
1.375	3.0603E+00	1.625	2.8136E+00	1.875	2.5690E+00
2.250	2.3788E+00	2.750	2.0219E+00	3.250	1.7043E+00
3.750	1.4661E+00	4.250	1.1877E+00	4.790	9.2403E-01
6.350	6.5888E-01	8.890	5.6202E-02	11.430	-1.1299E-01
13.970	-2.0600E-01	16.510	-1.9198E-01	19.050	-1.7689E-01
21.590	-1.6153E-01	24.130	-1.4600E-01	26.670	-1.3031E-01
29.210	-1.1449E-01	31.750	-9.8564E-02	34.290	-8.2518E-02
36.830	-6.6367E-02	39.370	-5.0123E-02	41.910	-3.3796E-02
44.450	-1.7392E-02	46.990	-4.3076E-04	49.530	1.7453E-05
52.070	-2.8110E-06	54.610	-3.6740E-06	57.150	-2.8172E-06
59.690	-8.6654E-07	60.960	3.5516E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2002.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.827E+05	0.0300	292.65	2	1.000E-01	7.491E+05	0.0300	292.65
3	2.000E-01	6.318E+05	0.0300	292.65	4	3.000E-01	5.236E+05	0.0300	292.65
5	4.000E-01	4.220E+05	0.0300	292.65	6	5.000E-01	3.269E+05	0.0300	292.65
7	6.000E-01	2.383E+05	0.0301	292.65	8	7.000E-01	1.551E+05	0.0301	292.65
9	8.000E-01	7.664E+04	0.0302	292.65	10	9.000E-01	4.539E+03	0.0366	292.65
11	1.000E+00	3.698E+03	0.0385	292.65	12	1.250E+00	3.024E+03	0.0408	292.65
13	1.500E+00	2.737E+03	0.0422	292.65	14	1.750E+00	2.562E+03	0.0432	292.65
15	2.000E+00	2.440E+03	0.0440	292.65	16	2.500E+00	2.279E+03	0.0451	292.65
17	3.000E+00	2.177E+03	0.0460	292.65	18	3.500E+00	2.108E+03	0.0466	292.65
19	4.000E+00	2.062E+03	0.0471	292.65	20	4.500E+00	2.031E+03	0.0474	292.65
21	5.080E+00	2.009E+03	0.0476	292.65	22	7.620E+00	2.066E+03	0.0470	292.65
23	1.016E+01	2.262E+03	0.0453	292.65	24	1.270E+01	2.357E+03	0.0445	292.65
25	1.524E+01	2.296E+03	0.0450	292.65	26	1.778E+01	2.205E+03	0.0458	292.65
27	2.032E+01	2.127E+03	0.0464	292.65	28	2.286E+01	2.066E+03	0.0470	292.65
29	2.540E+01	2.017E+03	0.0475	292.65	30	2.794E+01	1.978E+03	0.0479	292.65
31	3.048E+01	1.946E+03	0.0483	292.65	32	3.302E+01	1.920E+03	0.0486	292.65
33	3.556E+01	1.900E+03	0.0488	292.65	34	3.810E+01	1.883E+03	0.0490	292.65
35	4.064E+01	1.871E+03	0.0492	292.65	36	4.318E+01	1.862E+03	0.0493	292.65
37	4.572E+01	1.856E+03	0.0494	292.65	38	4.826E+01	1.813E+03	0.0501	292.65
39	5.080E+01	1.726E+03	0.0501	292.65	40	5.334E+01	1.689E+03	0.0501	292.65
41	5.588E+01	1.674E+03	0.0501	292.65	42	5.842E+01	1.668E+03	0.0501	292.65
43	6.096E+01	1.666E+03	0.0501	292.65					

Initial Water Storage = 2.9044 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03996     0.04783     0.05009
 Head (cm)         = 4.99787E+05 3.23349E+03 1.98816E+03 1.66589E+03
 LiqWater Flow (cm)=-1.22574E-10-1.54783E-02-1.97089E-03 3.64583E-10
 IsoVapor Flow (cm)=-2.31113E-02-2.58880E-05-6.94710E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9044+ 0.0000+ 0.0000 - 0.0231- 0.0000-  0.0000 =    2.8813 vs.    2.8813

 Mass Balance = -1.9803E-05 cm;  Time step attempts =  131 and successes =  107
   Evaporation:  Potential =  0.2228 cm, Actual =  0.0231 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 69.6 %;  TMEAN = 276.2 K;  HDRY =  4.9979E+05 cm;  DAYUBC =   105

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04917     0.07118     0.05011
 Head (cm)         = 8.15596E+05 1.87132E+03 9.82577E+02 1.53839E+03
 LiqWater Flow (cm)=-4.76829E-11-6.22475E-02-2.69491E-02 7.00207E-10
 IsoVapor Flow (cm)=-6.23548E-02-1.28616E-05-2.83985E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9011+ 0.0000+ 0.0000 - 0.0624- 0.0000-  0.0000 =    3.8387 vs.    3.8388

 Mass Balance = -9.9587E-06 cm;  Time step attempts =  128 and successes =  116
   Evaporation:  Potential =  0.3809 cm, Actual =  0.0624 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 55.3 %;  TMEAN = 277.9 K;  HDRY =  8.1560E+05 cm;  DAYUBC =   115
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0470E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0470E+02	[cm]
Actual Evaporation	=	1.6558E+01	[cm]
Evaporation during Growth	=	1.6558E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.7501E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.4365E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.7501E+01	[cm]
Actual Rainfall	=	1.7501E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.8388E+00	[cm]
Mass Balance Error	=	8.0244E-03	[cm]
Total Successful Time Steps	=	59959	
Total Attempted Time Steps	=	73384	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30248	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.4240E-01	0.050	1.2253E+01	0.150	9.3836E+00
0.250	8.4954E+00	0.350	7.7844E+00	0.450	7.2653E+00
0.550	6.7546E+00	0.650	6.2025E+00	0.750	5.6756E+00
0.850	5.2110E+00	0.950	4.9462E+00	1.125	4.6307E+00
1.375	4.0985E+00	1.625	3.7076E+00	1.875	3.4054E+00
2.250	3.1282E+00	2.750	2.6158E+00	3.250	2.2860E+00
3.750	2.0261E+00	4.250	1.8064E+00	4.790	1.6884E+00
6.350	1.5608E+00	8.890	1.2205E+00	11.430	9.9925E-01
13.970	8.6230E-01	16.510	7.3818E-01	19.050	6.6608E-01
21.590	6.1017E-01	24.130	5.5314E-01	26.670	4.9502E-01
29.210	4.3588E-01	31.750	3.7583E-01	34.290	3.1495E-01
36.830	2.5334E-01	39.370	1.9110E-01	41.910	1.2832E-01
44.450	6.5082E-02	46.990	1.7351E-03	49.530	1.0457E-04
52.070	9.2635E-06	54.610	2.8941E-06	57.150	1.0957E-06
59.690	3.7153E-07	60.960	1.4365E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2003.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.156E+05	0.0300	292.65	2	1.000E-01	6.413E+05	0.0300	292.65
3	2.000E-01	4.866E+05	0.0300	292.65	4	3.000E-01	3.475E+05	0.0300	292.65
5	4.000E-01	2.212E+05	0.0301	292.65	6	5.000E-01	1.054E+05	0.0302	292.65
7	6.000E-01	2.827E+03	0.0417	292.65	8	7.000E-01	2.646E+03	0.0427	292.65
9	8.000E-01	2.511E+03	0.0435	292.65	10	9.000E-01	2.405E+03	0.0442	292.65
11	1.000E+00	2.319E+03	0.0448	292.65	12	1.250E+00	2.155E+03	0.0462	292.65
13	1.500E+00	2.036E+03	0.0473	292.65	14	1.750E+00	1.945E+03	0.0483	292.65
15	2.000E+00	1.871E+03	0.0492	292.65	16	2.500E+00	1.757E+03	0.0507	292.65
17	3.000E+00	1.672E+03	0.0519	292.65	18	3.500E+00	1.604E+03	0.0530	292.65
19	4.000E+00	1.548E+03	0.0540	292.65	20	4.500E+00	1.501E+03	0.0549	292.65
21	5.080E+00	1.455E+03	0.0559	292.65	22	7.620E+00	1.312E+03	0.0593	292.65
23	1.016E+01	1.223E+03	0.0618	292.65	24	1.270E+01	1.160E+03	0.0639	292.65
25	1.524E+01	1.112E+03	0.0656	292.65	26	1.778E+01	1.075E+03	0.0671	292.65
27	2.032E+01	1.045E+03	0.0683	292.65	28	2.286E+01	1.020E+03	0.0694	292.65
29	2.540E+01	9.997E+02	0.0704	292.65	30	2.794E+01	9.826E+02	0.0712	292.65
31	3.048E+01	9.682E+02	0.0719	292.65	32	3.302E+01	9.561E+02	0.0725	292.65
33	3.556E+01	9.460E+02	0.0731	292.65	34	3.810E+01	9.377E+02	0.0735	292.65
35	4.064E+01	9.309E+02	0.0739	292.65	36	4.318E+01	9.257E+02	0.0742	292.65
37	4.572E+01	9.218E+02	0.0744	292.65	38	4.826E+01	9.110E+02	0.0504	292.65
39	5.080E+01	1.214E+03	0.0502	292.65	40	5.334E+01	1.400E+03	0.0501	292.65
41	5.588E+01	1.486E+03	0.0501	292.65	42	5.842E+01	1.527E+03	0.0501	292.65
43	6.096E+01	1.538E+03	0.0501	292.65					

Initial Water Storage = 3.8388 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04712     0.06986     0.05011
 Head (cm)         = 1.31147E+06 2.05714E+03 1.01018E+03 1.53705E+03
 LiqWater Flow (cm)=-6.56785E-12-5.83076E-02-2.45755E-02 7.05203E-10
 IsoVapor Flow (cm)=-6.59976E-02-1.61403E-05-2.96961E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.8388+ 0.0000+ 0.0000 - 0.0660- 0.0000-  0.0000 =    3.7728 vs.    3.7728

 Mass Balance = -3.4478E-05 cm;  Time step attempts =  182 and successes =  139
   Evaporation:  Potential =  0.6492 cm, Actual =  0.0660 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 38.6 %;  TMEAN = 280.9 K;  HDRY =  1.3115E+06 cm;  DAYUBC =   139

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04778     0.05009
 Head (cm)         = 2.20848E+06 1.23395E+06 1.99270E+03 1.67002E+03
 LiqWater Flow (cm)=-7.21700E-14-8.38472E-13-2.23506E-03 3.56894E-10
 IsoVapor Flow (cm)=-8.33300E-03-8.33272E-03-7.83506E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7701+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.7618 vs.    2.7618

 Mass Balance = -6.7070E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5595 cm, Actual =  0.0083 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 20.1 %;  TMEAN = 279.3 K;  HDRY =  2.2085E+06 cm;  DAYUBC =    24
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2069E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

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Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.2069E+02     [cm]
Actual Evaporation                 =  1.1763E+01     [cm]
Evaporation during Growth          =  1.1763E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  1.0693E+01     [cm]
Total Basal Liquid Flux (drainage) =  3.5082E-07     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.0693E+01     [cm]
Actual Rainfall                    =  1.0693E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.7618E+00     [cm]
Mass Balance Error                 =  6.9004E-03     [cm]
Total Successful Time Steps        =     58979
Total Attempted Time Steps         =     72723
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31376
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.0700E+00	0.050	8.1240E+00	0.150	6.6769E+00
0.250	5.8371E+00	0.350	5.4184E+00	0.450	4.9780E+00
0.550	4.5939E+00	0.650	4.3707E+00	0.750	4.1525E+00
0.850	3.8501E+00	0.950	3.4621E+00	1.125	3.2066E+00
1.375	2.7180E+00	1.625	2.2409E+00	1.875	1.8811E+00
2.250	1.5472E+00	2.750	9.9162E-01	3.250	6.1030E-01
3.750	3.7728E-01	4.250	1.9985E-01	4.790	3.2327E-02
6.350	-1.7409E-01	8.890	-6.1206E-01	11.430	-7.1490E-01
13.970	-7.6854E-01	16.510	-7.2256E-01	19.050	-6.6753E-01
21.590	-6.1125E-01	24.130	-5.5385E-01	26.670	-4.9542E-01
29.210	-4.3604E-01	31.750	-3.7583E-01	34.290	-3.1485E-01
36.830	-2.5319E-01	39.370	-1.9095E-01	41.910	-1.2818E-01
44.450	-6.4984E-02	46.990	-1.1180E-03	49.530	8.2000E-05
52.070	7.7733E-06	54.610	2.2080E-06	57.150	4.7055E-07
59.690	2.1840E-07	60.960	3.5082E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2004.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	2.208E+06	0.0300	292.65	2	1.000E-01	2.140E+06	0.0300	292.65
3	2.000E-01	2.075E+06	0.0300	292.65	4	3.000E-01	2.013E+06	0.0300	292.65
5	4.000E-01	1.953E+06	0.0300	292.65	6	5.000E-01	1.895E+06	0.0300	292.65
7	6.000E-01	1.840E+06	0.0300	292.65	8	7.000E-01	1.787E+06	0.0300	292.65
9	8.000E-01	1.736E+06	0.0300	292.65	10	9.000E-01	1.686E+06	0.0300	292.65
11	1.000E+00	1.639E+06	0.0300	292.65	12	1.250E+00	1.526E+06	0.0300	292.65
13	1.500E+00	1.422E+06	0.0300	292.65	14	1.750E+00	1.325E+06	0.0300	292.65
15	2.000E+00	1.234E+06	0.0300	292.65	16	2.500E+00	1.069E+06	0.0300	292.65
17	3.000E+00	9.216E+05	0.0300	292.65	18	3.500E+00	7.887E+05	0.0300	292.65
19	4.000E+00	6.676E+05	0.0300	292.65	20	4.500E+00	5.564E+05	0.0300	292.65
21	5.080E+00	4.377E+05	0.0300	292.65	22	7.620E+00	9.426E+03	0.0328	292.65
23	1.016E+01	2.922E+03	0.0412	292.65	24	1.270E+01	2.595E+03	0.0430	292.65
25	1.524E+01	2.397E+03	0.0443	292.65	26	1.778E+01	2.264E+03	0.0453	292.65
27	2.032E+01	2.168E+03	0.0461	292.65	28	2.286E+01	2.095E+03	0.0468	292.65
29	2.540E+01	2.038E+03	0.0473	292.65	30	2.794E+01	1.993E+03	0.0478	292.65
31	3.048E+01	1.956E+03	0.0482	292.65	32	3.302E+01	1.927E+03	0.0485	292.65
33	3.556E+01	1.904E+03	0.0488	292.65	34	3.810E+01	1.886E+03	0.0490	292.65
35	4.064E+01	1.872E+03	0.0492	292.65	36	4.318E+01	1.862E+03	0.0493	292.65
37	4.572E+01	1.856E+03	0.0494	292.65	38	4.826E+01	1.808E+03	0.0501	292.65
39	5.080E+01	1.710E+03	0.0501	292.65	40	5.334E+01	1.676E+03	0.0501	292.65
41	5.588E+01	1.669E+03	0.0501	292.65	42	5.842E+01	1.670E+03	0.0501	292.65
43	6.096E+01	1.670E+03	0.0501	292.65					

Initial Water Storage = 2.7618 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04766     0.05009
 Head (cm)         = 8.54706E+05 5.79730E+05 2.00426E+03 1.66998E+03
 LiqWater Flow (cm)=-1.76156E-12-1.22847E-11-2.20103E-03 3.56986E-10
 IsoVapor Flow (cm)=-4.72967E-03-4.75261E-03-7.93604E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7618+ 0.0000+ 0.0000 - 0.0047- 0.0000-  0.0000 =    2.7571 vs.    2.7571

 Mass Balance = -6.7109E-06 cm;  Time step attempts =   49 and successes =   47
   Evaporation:  Potential =  0.4078 cm, Actual =  0.0047 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.8 %;  TMEAN = 283.7 K;  HDRY =  8.5471E+05 cm;  DAYUBC =    42

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03959     0.05724     0.05026
 Head (cm)         = 5.47835E+05 3.33729E+03 1.39350E+03 1.09031E+03
 LiqWater Flow (cm)=-4.65254E-11-1.52649E-02-7.15396E-03 1.19433E-08
 IsoVapor Flow (cm)=-1.50826E-02-5.09570E-05-4.33516E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2484+ 0.0000+ 0.0000 - 0.0151- 0.0000-  0.0000 =    3.2333 vs.    3.2333

 Mass Balance = -3.4143E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.2091 cm, Actual =  0.0151 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 67.2 %;  TMEAN = 283.2 K;  HDRY =  5.4784E+05 cm;  DAYUBC =    76
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9889E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9889E+02	[cm]
Actual Evaporation	=	3.0508E+01	[cm]
Evaporation during Growth	=	3.0493E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0988E+01	[cm]
Total Basal Liquid Flux (drainage)	=	7.5232E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0988E+01	[cm]
Actual Rainfall	=	3.0988E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.2333E+00	[cm]
Mass Balance Error	=	8.4663E-03	[cm]
Total Successful Time Steps	=	55159	
Total Attempted Time Steps	=	67598	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26687	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	4.8000E-01	0.050	1.8657E+01	0.150	1.2468E+01
0.250	1.0588E+01	0.350	8.8184E+00	0.450	7.8821E+00
0.550	7.1101E+00	0.650	6.1992E+00	0.750	5.6878E+00
0.850	5.3399E+00	0.950	4.9155E+00	1.125	4.5717E+00
1.375	3.9403E+00	1.625	3.2543E+00	1.875	2.6469E+00
2.250	2.2787E+00	2.750	1.6986E+00	3.250	1.3586E+00
3.750	1.1558E+00	4.250	1.0376E+00	4.790	8.4474E-01
6.350	7.1214E-01	8.890	5.1565E-01	11.430	3.4770E-01
13.970	3.2112E-01	16.510	2.9764E-01	19.050	2.7423E-01
21.590	2.5071E-01	24.130	2.2700E-01	26.670	2.0308E-01
29.210	1.7893E-01	31.750	1.5457E-01	34.290	1.3000E-01
36.830	1.0525E-01	39.370	8.0309E-02	41.910	5.5215E-02
44.450	2.9978E-02	46.990	4.7103E-03	49.530	4.6636E-03
52.070	2.0224E-03	54.610	5.3053E-04	57.150	9.3650E-05
59.690	1.5967E-05	60.960	7.5232E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2005.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.478E+05	0.0300	292.65	2	1.000E-01	5.098E+05	0.0300	292.65
3	2.000E-01	4.728E+05	0.0300	292.65	4	3.000E-01	4.368E+05	0.0300	292.65
5	4.000E-01	4.017E+05	0.0300	292.65	6	5.000E-01	3.675E+05	0.0300	292.65
7	6.000E-01	3.341E+05	0.0300	292.65	8	7.000E-01	3.015E+05	0.0300	292.65
9	8.000E-01	2.696E+05	0.0300	292.65	10	9.000E-01	2.384E+05	0.0301	292.65
11	1.000E+00	2.080E+05	0.0301	292.65	12	1.250E+00	1.347E+05	0.0301	292.65
13	1.500E+00	6.502E+04	0.0303	292.65	14	1.750E+00	3.749E+03	0.0383	292.65
15	2.000E+00	3.337E+03	0.0396	292.65	16	2.500E+00	2.902E+03	0.0413	292.65
17	3.000E+00	2.656E+03	0.0426	292.65	18	3.500E+00	2.488E+03	0.0436	292.65
19	4.000E+00	2.363E+03	0.0445	292.65	20	4.500E+00	2.265E+03	0.0453	292.65
21	5.080E+00	2.173E+03	0.0460	292.65	22	7.620E+00	1.912E+03	0.0487	292.65
23	1.016E+01	1.762E+03	0.0506	292.65	24	1.270E+01	1.661E+03	0.0521	292.65
25	1.524E+01	1.587E+03	0.0533	292.65	26	1.778E+01	1.530E+03	0.0544	292.65
27	2.032E+01	1.485E+03	0.0553	292.65	28	2.286E+01	1.448E+03	0.0560	292.65
29	2.540E+01	1.418E+03	0.0567	292.65	30	2.794E+01	1.393E+03	0.0572	292.65
31	3.048E+01	1.373E+03	0.0577	292.65	32	3.302E+01	1.356E+03	0.0581	292.65
33	3.556E+01	1.342E+03	0.0585	292.65	34	3.810E+01	1.330E+03	0.0588	292.65
35	4.064E+01	1.321E+03	0.0590	292.65	36	4.318E+01	1.314E+03	0.0592	292.65
37	4.572E+01	1.310E+03	0.0593	292.65	38	4.826E+01	1.271E+03	0.0502	292.65
39	5.080E+01	7.627E+02	0.0506	292.65	40	5.334E+01	7.797E+02	0.0506	292.65
41	5.588E+01	9.116E+02	0.0504	292.65	42	5.842E+01	1.044E+03	0.0503	292.65
43	6.096E+01	1.090E+03	0.0503	292.65					

Initial Water Storage = 3.2333 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03820     0.05687     0.05026
 Head (cm)         = 6.47479E+05 3.80477E+03 1.40952E+03 1.08842E+03
 LiqWater Flow (cm)=-2.51728E-11-1.58187E-02-6.86561E-03 1.21158E-08
 IsoVapor Flow (cm)=-1.71006E-02-6.64782E-05-4.40308E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2333+ 0.0000+ 0.0000 - 0.0171- 0.0000-  0.0000 =    3.2162 vs.    3.2162

 Mass Balance = -3.2349E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3008 cm, Actual =  0.0171 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 62.5 %;  TMEAN = 283.7 K;  HDRY =  6.4748E+05 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04737     0.05166
 Head (cm)         = 1.93021E+06 1.28523E+06 2.03183E+03 5.21714E+02
 LiqWater Flow (cm)=-8.14226E-14-4.62430E-13-2.12919E-03 5.27905E-06
 IsoVapor Flow (cm)=-5.91546E-03-5.91385E-03-8.20707E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7594+ 0.0000+ 0.0000 - 0.0059- 0.0000-  0.0000 =    2.7535 vs.    2.7535

 Mass Balance =  1.0265E-06 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2782 cm, Actual =  0.0059 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.7 %;  TMEAN = 286.8 K;  HDRY =  1.9302E+06 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.9999E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.9999E+02	[cm]
Actual Evaporation	=	3.3161E+01	[cm]
Evaporation during Growth	=	3.3161E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.2690E+01	[cm]
Total Basal Liquid Flux (drainage)	=	9.9620E-04	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.2690E+01	[cm]
Actual Rainfall	=	3.2690E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.7535E+00	[cm]
Mass Balance Error	=	7.3075E-03	[cm]
Total Successful Time Steps	=	59728	
Total Attempted Time Steps	=	73185	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29122	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.7154E-01	0.050	1.5633E+01	0.150	1.0071E+01
0.250	8.2944E+00	0.350	7.0406E+00	0.450	6.1513E+00
0.550	5.3281E+00	0.650	4.7069E+00	0.750	4.3771E+00
0.850	4.0346E+00	0.950	3.6980E+00	1.125	3.4047E+00
1.375	2.7457E+00	1.625	2.3927E+00	1.875	2.1046E+00
2.250	1.7778E+00	2.750	1.2863E+00	3.250	9.1916E-01
3.750	7.1020E-01	4.250	4.8083E-01	4.790	3.0315E-01
6.350	8.9938E-02	8.890	-3.4045E-01	11.430	-3.3737E-01
13.970	-3.1328E-01	16.510	-2.8949E-01	19.050	-2.6561E-01
21.590	-2.4150E-01	24.130	-2.1711E-01	26.670	-1.9243E-01
29.210	-1.6747E-01	31.750	-1.4226E-01	34.290	-1.1681E-01
36.830	-9.1168E-02	39.370	-6.5341E-02	41.910	-3.9358E-02
44.450	-1.3250E-02	46.990	1.3394E-02	49.530	1.6881E-02
52.070	1.2028E-02	54.610	9.1666E-03	57.150	5.9178E-03
59.690	2.5888E-03	60.960	9.9620E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2006.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.930E+06	0.0300	292.65	2	1.000E-01	1.890E+06	0.0300	292.65
3	2.000E-01	1.851E+06	0.0300	292.65	4	3.000E-01	1.813E+06	0.0300	292.65
5	4.000E-01	1.775E+06	0.0300	292.65	6	5.000E-01	1.739E+06	0.0300	292.65
7	6.000E-01	1.704E+06	0.0300	292.65	8	7.000E-01	1.670E+06	0.0300	292.65
9	8.000E-01	1.636E+06	0.0300	292.65	10	9.000E-01	1.603E+06	0.0300	292.65
11	1.000E+00	1.571E+06	0.0300	292.65	12	1.250E+00	1.494E+06	0.0300	292.65
13	1.500E+00	1.421E+06	0.0300	292.65	14	1.750E+00	1.351E+06	0.0300	292.65
15	2.000E+00	1.285E+06	0.0300	292.65	16	2.500E+00	1.162E+06	0.0300	292.65
17	3.000E+00	1.048E+06	0.0300	292.65	18	3.500E+00	9.437E+05	0.0300	292.65
19	4.000E+00	8.465E+05	0.0300	292.65	20	4.500E+00	7.557E+05	0.0300	292.65
21	5.080E+00	6.574E+05	0.0300	292.65	22	7.620E+00	2.935E+05	0.0300	292.65
23	1.016E+01	3.221E+03	0.0400	292.65	24	1.270E+01	2.692E+03	0.0424	292.65
25	1.524E+01	2.458E+03	0.0438	292.65	26	1.778E+01	2.314E+03	0.0449	292.65
27	2.032E+01	2.213E+03	0.0457	292.65	28	2.286E+01	2.138E+03	0.0463	292.65
29	2.540E+01	2.079E+03	0.0469	292.65	30	2.794E+01	2.032E+03	0.0474	292.65
31	3.048E+01	1.994E+03	0.0478	292.65	32	3.302E+01	1.963E+03	0.0481	292.65
33	3.556E+01	1.939E+03	0.0484	292.65	34	3.810E+01	1.919E+03	0.0486	292.65
35	4.064E+01	1.905E+03	0.0488	292.65	36	4.318E+01	1.894E+03	0.0489	292.65
37	4.572E+01	1.887E+03	0.0490	292.65	38	4.826E+01	1.605E+03	0.0501	292.65
39	5.080E+01	5.749E+02	0.0513	292.65	40	5.334E+01	5.469E+02	0.0515	292.65
41	5.588E+01	5.319E+02	0.0516	292.65	42	5.842E+01	5.242E+02	0.0516	292.65
43	6.096E+01	5.217E+02	0.0517	292.65					

Initial Water Storage = 2.7535 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04726     0.05166
 Head (cm)         = 2.25090E+06 1.43689E+06 2.04280E+03 5.22218E+02
 LiqWater Flow (cm)= 1.93735E-02 1.08714E-07-2.09294E-03 5.23710E-06
 IsoVapor Flow (cm)=-2.41874E-02-4.81159E-03-8.28131E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7535+ 0.0254+ 0.0000 - 0.0302- 0.0000-  0.0000 =    2.7487 vs.    2.7487

 Mass Balance = -2.2199E-05 cm;  Time step attempts =  895 and successes =  699
   Evaporation:  Potential =  1.4538 cm, Actual =  0.0302 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 19.5 %;  TMEAN = 287.9 K;  HDRY =  2.2509E+06 cm;  DAYUBC =   376

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03938     0.04627     0.05080
 Head (cm)         = 6.05038E+05 3.40050E+03 2.14621E+03 7.01004E+02
 LiqWater Flow (cm)= 3.67527E-02 3.79832E-03-7.75998E-04 4.61167E-07
 IsoVapor Flow (cm)=-2.78983E-02-1.16404E-05-4.36837E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8109+ 0.0508+ 0.0000 - 0.0419- 0.0000-  0.0000 =    2.8197 vs.    2.8196

 Mass Balance =  1.1324E-04 cm;  Time step attempts =  919 and successes =  710
   Evaporation:  Potential =  0.2209 cm, Actual =  0.0419 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 64.5 %;  TMEAN = 276.8 K;  HDRY =  6.0504E+05 cm;  DAYUBC =   267
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3548E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

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Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.3548E+02     [cm]
Actual Evaporation                 =  2.1103E+01     [cm]
Evaporation during Growth          =  2.1103E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  2.1184E+01     [cm]
Total Basal Liquid Flux (drainage) =  6.7956E-04     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1184E+01     [cm]
Actual Rainfall                    =  2.1184E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8196E+00     [cm]
Mass Balance Error                 =  1.4157E-02     [cm]
Total Successful Time Steps        =    212567
Total Attempted Time Steps         =    268965
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     95332
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	8.0985E-02	0.050	1.4275E+01	0.150	1.2383E+01
0.250	1.0326E+01	0.350	8.6690E+00	0.450	7.3891E+00
0.550	6.3528E+00	0.650	5.4987E+00	0.750	4.8084E+00
0.850	4.2136E+00	0.950	3.6896E+00	1.125	3.1636E+00
1.375	2.3038E+00	1.625	1.7946E+00	1.875	1.4896E+00
2.250	1.2321E+00	2.750	9.6208E-01	3.250	7.9698E-01
3.750	6.9265E-01	4.250	6.1595E-01	4.790	5.5271E-01
6.350	4.7428E-01	8.890	3.9031E-01	11.430	2.2985E-01
13.970	1.7578E-01	16.510	1.3342E-01	19.050	9.0216E-02
21.590	4.9136E-02	24.130	5.2096E-03	26.670	-3.7715E-02
29.210	-3.8496E-02	31.750	-3.5476E-02	34.290	-3.1870E-02
36.830	-2.7890E-02	39.370	-2.3646E-02	41.910	-1.9215E-02
44.450	-1.4652E-02	46.990	-5.7518E-03	49.530	-1.1371E-03
52.070	-5.7348E-03	54.610	-4.4880E-03	57.150	-2.4719E-03
59.690	-3.7568E-04	60.960	6.7956E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2007.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	6.050E+05	0.0300	292.65	2	1.000E-01	5.550E+05	0.0300	292.65
3	2.000E-01	5.068E+05	0.0300	292.65	4	3.000E-01	4.602E+05	0.0300	292.65
5	4.000E-01	4.151E+05	0.0300	292.65	6	5.000E-01	3.715E+05	0.0300	292.65
7	6.000E-01	3.292E+05	0.0300	292.65	8	7.000E-01	2.882E+05	0.0300	292.65
9	8.000E-01	2.484E+05	0.0301	292.65	10	9.000E-01	2.097E+05	0.0301	292.65
11	1.000E+00	1.722E+05	0.0301	292.65	12	1.250E+00	8.301E+04	0.0302	292.65
13	1.500E+00	4.183E+03	0.0373	292.65	14	1.750E+00	3.667E+03	0.0386	292.65
15	2.000E+00	3.401E+03	0.0394	292.65	16	2.500E+00	3.089E+03	0.0405	292.65
17	3.000E+00	2.912E+03	0.0413	292.65	18	3.500E+00	2.798E+03	0.0418	292.65
19	4.000E+00	2.719E+03	0.0423	292.65	20	4.500E+00	2.662E+03	0.0426	292.65
21	5.080E+00	2.613E+03	0.0429	292.65	22	7.620E+00	2.509E+03	0.0435	292.65
23	1.016E+01	2.418E+03	0.0441	292.65	24	1.270E+01	2.343E+03	0.0447	292.65
25	1.524E+01	2.287E+03	0.0451	292.65	26	1.778E+01	2.246E+03	0.0454	292.65
27	2.032E+01	2.215E+03	0.0457	292.65	28	2.286E+01	2.190E+03	0.0459	292.65
29	2.540E+01	2.167E+03	0.0461	292.65	30	2.794E+01	2.146E+03	0.0463	292.65
31	3.048E+01	2.127E+03	0.0465	292.65	32	3.302E+01	2.109E+03	0.0466	292.65
33	3.556E+01	2.093E+03	0.0468	292.65	34	3.810E+01	2.079E+03	0.0469	292.65
35	4.064E+01	2.068E+03	0.0470	292.65	36	4.318E+01	2.060E+03	0.0471	292.65
37	4.572E+01	2.054E+03	0.0471	292.65	38	4.826E+01	1.828E+03	0.0501	292.65
39	5.080E+01	1.143E+03	0.0502	292.65	40	5.334E+01	8.151E+02	0.0505	292.65
41	5.588E+01	7.376E+02	0.0507	292.65	42	5.842E+01	7.090E+02	0.0508	292.65
43	6.096E+01	7.010E+02	0.0508	292.65					

Initial Water Storage = 2.8196 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.04625     0.05079
 Head (cm)         = 8.36981E+05 1.36432E+05 2.14812E+03 7.01449E+02
 LiqWater Flow (cm)=-8.52495E-12-6.31840E-03-7.42674E-04 4.58759E-07
 IsoVapor Flow (cm)=-1.85182E-02-4.67860E-03-4.21758E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8196+ 0.0000+ 0.0000 - 0.0185- 0.0000-  0.0000 =    2.8011 vs.    2.8012

 Mass Balance = -3.4644E-05 cm;  Time step attempts =  146 and successes =  112
   Evaporation:  Potential =  0.4122 cm, Actual =  0.0185 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 54.5 %;  TMEAN = 278.7 K;  HDRY =  8.3698E+05 cm;  DAYUBC =   112

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.05870     0.05050
 Head (cm)         = 1.64351E+06 2.11127E+05 1.33352E+03 8.42765E+02
 LiqWater Flow (cm)=-6.38544E-13-2.08314E-04-8.69518E-03 1.00805E-07
 IsoVapor Flow (cm)=-2.22019E-02-2.19763E-02-4.21115E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3052+ 0.0000+ 0.0000 - 0.0222- 0.0000-  0.0000 =    3.2830 vs.    3.2830

 Mass Balance =  9.4992E-09 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6772 cm, Actual =  0.0222 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 30.4 %;  TMEAN = 283.4 K;  HDRY =  1.6435E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0482E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0482E+02	[cm]
Actual Evaporation	=	2.5232E+01	[cm]
Evaporation during Growth	=	2.5232E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5705E+01	[cm]
Total Basal Liquid Flux (drainage)	=	7.9792E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5705E+01	[cm]
Actual Rainfall	=	2.5705E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.2830E+00	[cm]
Mass Balance Error	=	9.4609E-03	[cm]
Total Successful Time Steps	=	69733	
Total Attempted Time Steps	=	86309	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32880	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	4.7294E-01	0.050	1.8104E+01	0.150	1.3388E+01
0.250	1.1117E+01	0.350	9.6540E+00	0.450	8.6193E+00
0.550	7.6959E+00	0.650	6.8990E+00	0.750	6.3194E+00
0.850	5.7974E+00	0.950	5.3637E+00	1.125	4.9872E+00
1.375	3.9594E+00	1.625	3.4052E+00	1.875	2.9670E+00
2.250	2.5967E+00	2.750	1.8514E+00	3.250	1.5265E+00
3.750	1.3104E+00	4.250	1.1337E+00	4.790	9.8108E-01
6.350	8.6009E-01	8.890	5.2380E-01	11.430	4.2982E-01
13.970	4.0721E-01	16.510	3.8278E-01	19.050	3.5651E-01
21.590	3.2859E-01	24.130	2.9920E-01	26.670	2.6857E-01
29.210	2.3689E-01	31.750	2.0436E-01	34.290	1.7113E-01
36.830	1.3734E-01	39.370	1.0310E-01	41.910	6.8507E-02
44.450	3.3641E-02	46.990	-1.1090E-03	49.530	3.3784E-04
52.070	-6.5065E-04	54.610	-9.8367E-04	57.150	-7.1306E-04
59.690	-2.0474E-04	60.960	7.9792E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2008.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.644E+06	0.0300	292.65	2	1.000E-01	1.523E+06	0.0300	292.65
3	2.000E-01	1.413E+06	0.0300	292.65	4	3.000E-01	1.311E+06	0.0300	292.65
5	4.000E-01	1.215E+06	0.0300	292.65	6	5.000E-01	1.126E+06	0.0300	292.65
7	6.000E-01	1.043E+06	0.0300	292.65	8	7.000E-01	9.635E+05	0.0300	292.65
9	8.000E-01	8.887E+05	0.0300	292.65	10	9.000E-01	8.178E+05	0.0300	292.65
11	1.000E+00	7.503E+05	0.0300	292.65	12	1.250E+00	5.946E+05	0.0300	292.65
13	1.500E+00	4.546E+05	0.0300	292.65	14	1.750E+00	3.275E+05	0.0300	292.65
15	2.000E+00	2.111E+05	0.0301	292.65	16	2.500E+00	3.306E+03	0.0397	292.65
17	3.000E+00	2.773E+03	0.0420	292.65	18	3.500E+00	2.512E+03	0.0435	292.65
19	4.000E+00	2.345E+03	0.0446	292.65	20	4.500E+00	2.224E+03	0.0456	292.65
21	5.080E+00	2.117E+03	0.0465	292.65	22	7.620E+00	1.840E+03	0.0496	292.65
23	1.016E+01	1.692E+03	0.0516	292.65	24	1.270E+01	1.593E+03	0.0532	292.65
25	1.524E+01	1.521E+03	0.0545	292.65	26	1.778E+01	1.466E+03	0.0556	292.65
27	2.032E+01	1.422E+03	0.0566	292.65	28	2.286E+01	1.387E+03	0.0574	292.65
29	2.540E+01	1.358E+03	0.0581	292.65	30	2.794E+01	1.334E+03	0.0587	292.65
31	3.048E+01	1.313E+03	0.0592	292.65	32	3.302E+01	1.297E+03	0.0597	292.65
33	3.556E+01	1.283E+03	0.0600	292.65	34	3.810E+01	1.272E+03	0.0604	292.65
35	4.064E+01	1.263E+03	0.0606	292.65	36	4.318E+01	1.256E+03	0.0608	292.65
37	4.572E+01	1.252E+03	0.0609	292.65	38	4.826E+01	1.228E+03	0.0502	292.65
39	5.080E+01	9.949E+02	0.0503	292.65	40	5.334E+01	9.264E+02	0.0504	292.65
41	5.588E+01	8.768E+02	0.0505	292.65	42	5.842E+01	8.507E+02	0.0505	292.65
43	6.096E+01	8.428E+02	0.0505	292.65					

Initial Water Storage = 3.2830 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03006     0.05826     0.05050
 Head (cm)         = 1.92914E+06 2.32087E+05 1.35086E+03 8.43033E+02
 LiqWater Flow (cm)=-3.74910E-13-8.54555E-05-8.25339E-03 1.00541E-07
 IsoVapor Flow (cm)=-2.40236E-02-2.39316E-02-4.26568E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2830+ 0.0000+ 0.0000 - 0.0240- 0.0000-  0.0000 =    3.2590 vs.    3.2590

 Mass Balance = -2.0923E-06 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5619 cm, Actual =  0.0240 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 24.7 %;  TMEAN = 276.2 K;  HDRY =  1.9291E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04892     0.05039
 Head (cm)         = 1.38020E+06 8.69865E+05 1.89147E+03 9.31475E+02
 LiqWater Flow (cm)=-3.25414E-13-2.84693E-12-2.19369E-03 4.39969E-08
 IsoVapor Flow (cm)=-6.60703E-03-6.60893E-03-6.09045E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8422+ 0.0000+ 0.0000 - 0.0066- 0.0000-  0.0000 =    2.8356 vs.    2.8356

 Mass Balance = -8.5965E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3319 cm, Actual =  0.0066 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 36.7 %;  TMEAN = 279.8 K;  HDRY =  1.3802E+06 cm;  DAYUBC =    72
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2814E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2814E+02	[cm]
Actual Evaporation	=	2.5460E+01	[cm]
Evaporation during Growth	=	2.5453E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5019E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.9656E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5019E+01	[cm]
Actual Rainfall	=	2.5019E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8356E+00	[cm]
Mass Balance Error	=	6.6188E-03	[cm]
Total Successful Time Steps	=	55284	
Total Attempted Time Steps	=	67285	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27483	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.4083E-01	0.050	1.5839E+01	0.150	7.4894E+00
0.250	5.5674E+00	0.350	4.5760E+00	0.450	3.7463E+00
0.550	3.2460E+00	0.650	2.9357E+00	0.750	2.7672E+00
0.850	2.6394E+00	0.950	2.4729E+00	1.125	2.3701E+00
1.375	2.1146E+00	1.625	1.9103E+00	1.875	1.7440E+00
2.250	1.5569E+00	2.750	1.2960E+00	3.250	1.0379E+00
3.750	8.9391E-01	4.250	7.5265E-01	4.790	5.5691E-01
6.350	3.7874E-01	8.890	4.3173E-02	11.430	-1.7008E-03
13.970	-5.0008E-02	16.510	-9.0550E-02	19.050	-1.2392E-01
21.590	-1.6312E-01	24.130	-1.8036E-01	26.670	-1.9461E-01
29.210	-1.8370E-01	31.750	-1.5869E-01	34.290	-1.3315E-01
36.830	-1.0722E-01	39.370	-8.0963E-02	41.910	-5.4448E-02
44.450	-2.7739E-02	46.990	4.8555E-04	49.530	3.0656E-03
52.070	1.1099E-03	54.610	2.1970E-04	57.150	-6.9975E-05
59.690	-4.4964E-05	60.960	1.9656E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2009.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.380E+06	0.0300	292.65	2	1.000E-01	1.350E+06	0.0300	292.65
3	2.000E-01	1.320E+06	0.0300	292.65	4	3.000E-01	1.290E+06	0.0300	292.65
5	4.000E-01	1.262E+06	0.0300	292.65	6	5.000E-01	1.234E+06	0.0300	292.65
7	6.000E-01	1.206E+06	0.0300	292.65	8	7.000E-01	1.179E+06	0.0300	292.65
9	8.000E-01	1.153E+06	0.0300	292.65	10	9.000E-01	1.127E+06	0.0300	292.65
11	1.000E+00	1.102E+06	0.0300	292.65	12	1.250E+00	1.040E+06	0.0300	292.65
13	1.500E+00	9.808E+05	0.0300	292.65	14	1.750E+00	9.242E+05	0.0300	292.65
15	2.000E+00	8.699E+05	0.0300	292.65	16	2.500E+00	7.671E+05	0.0300	292.65
17	3.000E+00	6.715E+05	0.0300	292.65	18	3.500E+00	5.822E+05	0.0300	292.65
19	4.000E+00	4.982E+05	0.0300	292.65	20	4.500E+00	4.191E+05	0.0300	292.65
21	5.080E+00	3.326E+05	0.0300	292.65	22	7.620E+00	2.939E+03	0.0412	292.65
23	1.016E+01	2.519E+03	0.0434	292.65	24	1.270E+01	2.314E+03	0.0449	292.65
25	1.524E+01	2.185E+03	0.0459	292.65	26	1.778E+01	2.093E+03	0.0468	292.65
27	2.032E+01	2.024E+03	0.0475	292.65	28	2.286E+01	1.970E+03	0.0480	292.65
29	2.540E+01	1.926E+03	0.0485	292.65	30	2.794E+01	1.891E+03	0.0489	292.65
31	3.048E+01	1.863E+03	0.0493	292.65	32	3.302E+01	1.840E+03	0.0496	292.65
33	3.556E+01	1.821E+03	0.0498	292.65	34	3.810E+01	1.807E+03	0.0500	292.65
35	4.064E+01	1.795E+03	0.0501	292.65	36	4.318E+01	1.787E+03	0.0503	292.65
37	4.572E+01	1.781E+03	0.0503	292.65	38	4.826E+01	1.673E+03	0.0501	292.65
39	5.080E+01	1.155E+03	0.0502	292.65	40	5.334E+01	9.238E+02	0.0504	292.65
41	5.588E+01	8.950E+02	0.0504	292.65	42	5.842E+01	9.170E+02	0.0504	292.65
43	6.096E+01	9.315E+02	0.0504	292.65					

Initial Water Storage = 2.8356 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

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 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04879     0.05039
 Head (cm)         = 1.61006E+06 9.83072E+05 1.90242E+03 9.31000E+02
 LiqWater Flow (cm)=-1.97427E-13-1.87342E-12-2.18015E-03 4.41843E-08
 IsoVapor Flow (cm)=-7.19707E-03-7.19391E-03-6.21740E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8356+ 0.0000+ 0.0000 - 0.0072- 0.0000-  0.0000 =    2.8284 vs.    2.8284

 Mass Balance =  1.0885E-06 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.4194 cm, Actual =  0.0072 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 31.1 %;  TMEAN = 281.8 K;  HDRY =  1.6101E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
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 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.05015     0.06805     0.05023
 Head (cm)         = 1.02625E+06 1.79438E+03 1.05087E+03 1.14663E+03
 LiqWater Flow (cm)=-1.41952E-09-8.67525E-02 9.87992E-03 7.93636E-09
 IsoVapor Flow (cm)=-1.09471E-01-9.40207E-06 7.07613E-08 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.8458+ 0.0000+ 0.0000 - 0.1095- 0.0000-  0.0000 =    3.7363 vs.    3.7364

 Mass Balance = -4.4255E-05 cm;  Time step attempts =  237 and successes =  185
   Evaporation:  Potential =  0.4897 cm, Actual =  0.1095 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.5 %;  TMEAN = 279.0 K;  HDRY =  1.0263E+06 cm;  DAYUBC =   169
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0884E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.0884E+02	[cm]
Actual Evaporation	=	2.1139E+01	[cm]
Evaporation during Growth	=	2.1139E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.2047E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.9568E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.2047E+01	[cm]
Actual Rainfall	=	2.2047E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.7364E+00	[cm]
Mass Balance Error	=	7.8360E-03	[cm]
Total Successful Time Steps	=	59806	
Total Attempted Time Steps	=	73528	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29805	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.0866E-01	0.050	1.4431E+01	0.150	1.0186E+01
0.250	8.4585E+00	0.350	7.6842E+00	0.450	7.0186E+00
0.550	6.3728E+00	0.650	5.7447E+00	0.750	5.2471E+00
0.850	4.9204E+00	0.950	4.5623E+00	1.125	4.2227E+00
1.375	3.5033E+00	1.625	3.1323E+00	1.875	2.6603E+00
2.250	2.4783E+00	2.750	2.1781E+00	3.250	1.9571E+00
3.750	1.8077E+00	4.250	1.7231E+00	4.790	1.6153E+00
6.350	1.4978E+00	8.890	1.1754E+00	11.430	1.0245E+00
13.970	9.0062E-01	16.510	7.8382E-01	19.050	6.6642E-01
21.590	5.6929E-01	24.130	4.7843E-01	26.670	3.9189E-01
29.210	3.2454E-01	31.750	2.7622E-01	34.290	2.2876E-01
36.830	1.8201E-01	39.370	1.3583E-01	41.910	9.0094E-02
44.450	4.4625E-02	46.990	4.0872E-04	49.530	8.7144E-04
52.070	-2.2819E-05	54.610	-1.1855E-04	57.150	-1.0041E-04
59.690	-3.5336E-05	60.960	8.9568E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2010.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.026E+06	0.0300	292.65	2	1.000E-01	7.521E+05	0.0300	292.65
3	2.000E-01	5.237E+05	0.0300	292.65	4	3.000E-01	3.279E+05	0.0300	292.65
5	4.000E-01	1.565E+05	0.0301	292.65	6	5.000E-01	3.886E+03	0.0380	292.65
7	6.000E-01	3.087E+03	0.0405	292.65	8	7.000E-01	2.751E+03	0.0421	292.65
9	8.000E-01	2.546E+03	0.0433	292.65	10	9.000E-01	2.402E+03	0.0442	292.65
11	1.000E+00	2.291E+03	0.0450	292.65	12	1.250E+00	2.097E+03	0.0467	292.65
13	1.500E+00	1.967E+03	0.0481	292.65	14	1.750E+00	1.870E+03	0.0492	292.65
15	2.000E+00	1.794E+03	0.0502	292.65	16	2.500E+00	1.680E+03	0.0518	292.65
17	3.000E+00	1.597E+03	0.0532	292.65	18	3.500E+00	1.533E+03	0.0543	292.65
19	4.000E+00	1.480E+03	0.0553	292.65	20	4.500E+00	1.437E+03	0.0563	292.65
21	5.080E+00	1.395E+03	0.0572	292.65	22	7.620E+00	1.269E+03	0.0604	292.65
23	1.016E+01	1.196E+03	0.0627	292.65	24	1.270E+01	1.147E+03	0.0643	292.65
25	1.524E+01	1.114E+03	0.0655	292.65	26	1.778E+01	1.090E+03	0.0664	292.65
27	2.032E+01	1.074E+03	0.0671	292.65	28	2.286E+01	1.063E+03	0.0676	292.65
29	2.540E+01	1.055E+03	0.0679	292.65	30	2.794E+01	1.051E+03	0.0680	292.65
31	3.048E+01	1.049E+03	0.0681	292.65	32	3.302E+01	1.048E+03	0.0682	292.65
33	3.556E+01	1.048E+03	0.0682	292.65	34	3.810E+01	1.049E+03	0.0681	292.65
35	4.064E+01	1.049E+03	0.0681	292.65	36	4.318E+01	1.049E+03	0.0681	292.65
37	4.572E+01	1.048E+03	0.0682	292.65	38	4.826E+01	1.065E+03	0.0503	292.65
39	5.080E+01	1.043E+03	0.0503	292.65	40	5.334E+01	1.103E+03	0.0503	292.65
41	5.588E+01	1.134E+03	0.0502	292.65	42	5.842E+01	1.144E+03	0.0502	292.65
43	6.096E+01	1.147E+03	0.0502	292.65					

Initial Water Storage = 3.7364 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.04886     0.06687     0.05023
 Head (cm)         = 3.59124E+05 1.89670E+03 1.07926E+03 1.14650E+03
 LiqWater Flow (cm)=-1.43390E-08-5.87083E-02-4.62940E-03 7.94335E-09
 IsoVapor Flow (cm)=-5.83115E-02-1.19578E-05-1.19832E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.7364+ 0.0000+ 0.0000 - 0.0583- 0.0000-  0.0000 =    3.6781 vs.    3.6781

 Mass Balance = -1.6949E-05 cm;  Time step attempts =  465 and successes =  375
   Evaporation:  Potential =  0.1600 cm, Actual =  0.0583 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 55.0 %;  TMEAN = 276.8 K;  HDRY =  8.2333E+05 cm;  DAYUBC =   148

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04053     0.04545     0.05019
 Head (cm)         = 9.30306E+05 3.08742E+03 2.24167E+03 1.23684E+03
 LiqWater Flow (cm)=-1.34775E-11-2.34778E-02-1.67742E-03 4.25575E-09
 IsoVapor Flow (cm)=-3.90227E-02-2.36185E-05-1.03994E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8480+ 0.0000+ 0.0000 - 0.0390- 0.0000-  0.0000 =    2.8090 vs.    2.8090

 Mass Balance = -5.3336E-05 cm;  Time step attempts =  307 and successes =  252
   Evaporation:  Potential =  0.4364 cm, Actual =  0.0390 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 50.9 %;  TMEAN = 273.7 K;  HDRY =  9.3031E+05 cm;  DAYUBC =   251
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.0272E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
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Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.0272E+02     [cm]
Actual Evaporation                 =  1.7862E+01     [cm]
Evaporation during Growth          =  1.7862E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  1.6942E+01     [cm]
Total Basal Liquid Flux (drainage) =  2.5495E-06     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.6942E+01     [cm]
Actual Rainfall                    =  1.6942E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8090E+00     [cm]
Mass Balance Error                 =  6.8817E-03     [cm]
Total Successful Time Steps        =     64503
Total Attempted Time Steps         =     79197
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     33624
Total Time Actually Simulated      =  3.6500E+02     [days]
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Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.2045E-01	0.050	1.2376E+01	0.150	9.3568E+00
0.250	7.9180E+00	0.350	6.8581E+00	0.450	6.0130E+00
0.550	5.2010E+00	0.650	4.7167E+00	0.750	4.2658E+00
0.850	3.8104E+00	0.950	3.2950E+00	1.125	3.0274E+00
1.375	2.4582E+00	1.625	1.8959E+00	1.875	1.5915E+00
2.250	1.3133E+00	2.750	7.5115E-01	3.250	4.0467E-01
3.750	2.2738E-01	4.250	7.2902E-02	4.790	-1.9209E-02
6.350	-1.2923E-01	8.890	-4.6869E-01	11.430	-6.1275E-01
13.970	-6.4447E-01	16.510	-6.5430E-01	19.050	-6.1756E-01
21.590	-5.5872E-01	24.130	-5.0012E-01	26.670	-4.4211E-01
29.210	-3.8483E-01	31.750	-3.2830E-01	34.290	-2.7253E-01
36.830	-2.1747E-01	39.370	-1.6302E-01	41.910	-1.0903E-01
44.450	-5.5291E-02	46.990	-1.1295E-03	49.530	2.5605E-04
52.070	2.5079E-06	54.610	-8.1683E-06	57.150	-7.3848E-06
59.690	-1.4050E-06	60.960	2.5495E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2011.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.303E+05	0.0300	292.65	2	1.000E-01	8.450E+05	0.0300	292.65
3	2.000E-01	7.646E+05	0.0300	292.65	4	3.000E-01	6.886E+05	0.0300	292.65
5	4.000E-01	6.167E+05	0.0300	292.65	6	5.000E-01	5.483E+05	0.0300	292.65
7	6.000E-01	4.831E+05	0.0300	292.65	8	7.000E-01	4.209E+05	0.0300	292.65
9	8.000E-01	3.613E+05	0.0300	292.65	10	9.000E-01	3.043E+05	0.0300	292.65
11	1.000E+00	2.495E+05	0.0301	292.65	12	1.250E+00	1.213E+05	0.0301	292.65
13	1.500E+00	4.424E+03	0.0368	292.65	14	1.750E+00	3.449E+03	0.0392	292.65
15	2.000E+00	3.087E+03	0.0405	292.65	16	2.500E+00	2.732E+03	0.0422	292.65
17	3.000E+00	2.542E+03	0.0433	292.65	18	3.500E+00	2.420E+03	0.0441	292.65
19	4.000E+00	2.333E+03	0.0447	292.65	20	4.500E+00	2.270E+03	0.0452	292.65
21	5.080E+00	2.217E+03	0.0457	292.65	22	7.620E+00	2.132E+03	0.0464	292.65
23	1.016E+01	2.189E+03	0.0459	292.65	24	1.270E+01	2.347E+03	0.0446	292.65
25	1.524E+01	2.511E+03	0.0435	292.65	26	1.778E+01	2.536E+03	0.0433	292.65
27	2.032E+01	2.463E+03	0.0438	292.65	28	2.286E+01	2.376E+03	0.0444	292.65
29	2.540E+01	2.302E+03	0.0450	292.65	30	2.794E+01	2.242E+03	0.0454	292.65
31	3.048E+01	2.194E+03	0.0458	292.65	32	3.302E+01	2.156E+03	0.0462	292.65
33	3.556E+01	2.126E+03	0.0465	292.65	34	3.810E+01	2.103E+03	0.0467	292.65
35	4.064E+01	2.086E+03	0.0468	292.65	36	4.318E+01	2.074E+03	0.0470	292.65
37	4.572E+01	2.067E+03	0.0470	292.65	38	4.826E+01	1.925E+03	0.0501	292.65
39	5.080E+01	1.593E+03	0.0501	292.65	40	5.334E+01	1.373E+03	0.0501	292.65
41	5.588E+01	1.275E+03	0.0502	292.65	42	5.842E+01	1.243E+03	0.0502	292.65
43	6.096E+01	1.237E+03	0.0502	292.65					

Initial Water Storage = 2.8090 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04538     0.05019
 Head (cm)         = 1.63309E+06 2.13733E+05 2.24981E+03 1.23720E+03
 LiqWater Flow (cm)=-8.25380E-13-8.93958E-03-1.62437E-03 4.24577E-09
 IsoVapor Flow (cm)=-2.68820E-02-9.93137E-03-1.03098E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8090+ 0.0000+ 0.0000 - 0.0269- 0.0000-  0.0000 =    2.7822 vs.    2.7822

 Mass Balance = -4.3163E-05 cm;  Time step attempts =  183 and successes =  140
   Evaporation:  Potential =  0.5153 cm, Actual =  0.0269 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 30.6 %;  TMEAN = 280.1 K;  HDRY =  1.6331E+06 cm;  DAYUBC =   140

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05348     0.05733     0.07692     0.05007
 Head (cm)         = 1.57853E+03 1.38956E+03 8.79260E+02 1.90876E+03
 LiqWater Flow (cm)=-1.18466E-02-7.98171E-02-4.01747E-02 1.18475E-10
 IsoVapor Flow (cm)=-5.21162E-02-4.74719E-06-2.43407E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1904+ 0.0000+ 0.0000 - 0.0628- 0.0000-  0.0000 =    4.1276 vs.    4.1276

 Mass Balance =  3.2495E-05 cm;  Time step attempts =  239 and successes =  204
   Evaporation:  Potential =  0.2528 cm, Actual =  0.0628 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 78.7 %;  TMEAN = 279.5 K;  HDRY =  3.3014E+05 cm;  DAYUBC =    60
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4173E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.4173E+02	[cm]
Actual Evaporation	=	1.2592E+01	[cm]
Evaporation during Growth	=	1.2592E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.3919E+01	[cm]
Total Basal Liquid Flux (drainage)	=	4.2791E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.3919E+01	[cm]
Actual Rainfall	=	1.3919E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.1276E+00	[cm]
Mass Balance Error	=	8.3741E-03	[cm]
Total Successful Time Steps	=	64974	
Total Attempted Time Steps	=	80029	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	33269	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.3269E+00	0.050	1.0574E+01	0.150	8.4879E+00
0.250	7.6133E+00	0.350	6.8859E+00	0.450	6.5596E+00
0.550	6.2836E+00	0.650	5.9957E+00	0.750	5.7439E+00
0.850	5.5419E+00	0.950	5.3863E+00	1.125	5.2225E+00
1.375	4.8584E+00	1.625	4.5211E+00	1.875	4.2500E+00
2.250	3.9879E+00	2.750	3.4655E+00	3.250	3.1147E+00
3.750	2.8662E+00	4.250	2.5965E+00	4.790	2.3595E+00
6.350	2.0609E+00	8.890	1.5865E+00	11.430	1.2668E+00
13.970	1.0451E+00	16.510	9.7100E-01	19.050	8.9654E-01
21.590	8.2008E-01	24.130	7.4228E-01	26.670	6.6334E-01
29.210	5.8333E-01	31.750	5.0233E-01	34.290	4.2043E-01
36.830	3.3770E-01	39.370	2.5425E-01	41.910	1.7014E-01
44.450	8.5464E-02	46.990	9.4273E-04	49.530	2.7682E-05
52.070	-2.1451E-06	54.610	-6.5187E-06	57.150	-7.0486E-06
59.690	-2.8355E-06	60.960	4.2791E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2012.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.579E+03	0.0535	292.65	2	1.000E-01	1.567E+03	0.0537	292.65
3	2.000E-01	1.555E+03	0.0539	292.65	4	3.000E-01	1.544E+03	0.0541	292.65
5	4.000E-01	1.533E+03	0.0543	292.65	6	5.000E-01	1.522E+03	0.0545	292.65
7	6.000E-01	1.512E+03	0.0547	292.65	8	7.000E-01	1.502E+03	0.0549	292.65
9	8.000E-01	1.492E+03	0.0551	292.65	10	9.000E-01	1.482E+03	0.0553	292.65
11	1.000E+00	1.473E+03	0.0555	292.65	12	1.250E+00	1.450E+03	0.0560	292.65
13	1.500E+00	1.429E+03	0.0564	292.65	14	1.750E+00	1.409E+03	0.0569	292.65
15	2.000E+00	1.390E+03	0.0573	292.65	16	2.500E+00	1.354E+03	0.0582	292.65
17	3.000E+00	1.323E+03	0.0590	292.65	18	3.500E+00	1.294E+03	0.0597	292.65
19	4.000E+00	1.268E+03	0.0605	292.65	20	4.500E+00	1.244E+03	0.0612	292.65
21	5.080E+00	1.219E+03	0.0619	292.65	22	7.620E+00	1.132E+03	0.0649	292.65
23	1.016E+01	1.070E+03	0.0672	292.65	24	1.270E+01	1.024E+03	0.0692	292.65
25	1.524E+01	9.868E+02	0.0710	292.65	26	1.778E+01	9.569E+02	0.0725	292.65
27	2.032E+01	9.322E+02	0.0738	292.65	28	2.286E+01	9.115E+02	0.0750	292.65
29	2.540E+01	8.941E+02	0.0760	292.65	30	2.794E+01	8.793E+02	0.0769	292.65
31	3.048E+01	8.667E+02	0.0777	292.65	32	3.302E+01	8.560E+02	0.0784	292.65
33	3.556E+01	8.470E+02	0.0790	292.65	34	3.810E+01	8.395E+02	0.0795	292.65
35	4.064E+01	8.334E+02	0.0799	292.65	36	4.318E+01	8.285E+02	0.0803	292.65
37	4.572E+01	8.248E+02	0.0805	292.65	38	4.826E+01	8.157E+02	0.0505	292.65
39	5.080E+01	1.549E+03	0.0501	292.65	40	5.334E+01	1.820E+03	0.0501	292.65
41	5.588E+01	1.893E+03	0.0501	292.65	42	5.842E+01	1.907E+03	0.0501	292.65
43	6.096E+01	1.909E+03	0.0501	292.65					

Initial Water Storage = 4.1276 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06538     0.06560     0.07521     0.05007
 Head (cm)         = 1.11766E+03 1.11165E+03 9.07483E+02 1.90827E+03
 LiqWater Flow (cm)=-5.95058E-04-2.21155E-02-3.43254E-02 1.18651E-10
 IsoVapor Flow (cm)=-9.60982E-08-8.08598E-07-2.48344E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1276+ 0.0000+ 0.0000 - 0.0000- 0.0000-  0.0000 =    4.1276 vs.    4.1276

 Mass Balance =  3.2337E-06 cm;  Time step attempts =   30 and successes =   28
   Evaporation:  Potential =  0.0878 cm, Actual =  0.0000 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = **** %;  TMEAN = 272.6 K;  HDRY =  1.5303E-10 cm;  DAYUBC =     0

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03009     0.05502     0.05010
 Head (cm)         = 1.03684E+06 1.57449E+05 1.49665E+03 1.60471E+03
 LiqWater Flow (cm)=-2.94767E-12-2.40180E-04-3.24175E-03 4.96850E-10
 IsoVapor Flow (cm)=-1.69070E-02-1.66666E-02-3.05333E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1516+ 0.0000+ 0.0000 - 0.0169- 0.0000-  0.0000 =    3.1346 vs.    3.1346

 Mass Balance = -2.9870E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8232 cm, Actual =  0.0169 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 47.1 %;  TMEAN = 284.0 K;  HDRY =  1.0368E+06 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1811E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1811E+02	[cm]
Actual Evaporation	=	1.4374E+01	[cm]
Evaporation during Growth	=	1.4357E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.3386E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.0489E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.3386E+01	[cm]
Actual Rainfall	=	1.3386E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.1346E+00	[cm]
Mass Balance Error	=	4.9309E-03	[cm]
Total Successful Time Steps	=	52751	
Total Attempted Time Steps	=	63527	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28824	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.8804E-01	0.050	9.5712E+00	0.150	6.7431E+00
0.250	5.6309E+00	0.350	4.7515E+00	0.450	4.2635E+00
0.550	3.6591E+00	0.650	3.3068E+00	0.750	3.0138E+00
0.850	2.6808E+00	0.950	2.3340E+00	1.125	2.1142E+00
1.375	1.7008E+00	1.625	1.4169E+00	1.875	1.0462E+00
2.250	7.6613E-01	2.750	3.8758E-01	3.250	2.0711E-01
3.750	1.2412E-01	4.250	3.6186E-02	4.790	-2.1925E-02
6.350	-1.0794E-01	8.890	-3.8471E-01	11.430	-4.4997E-01
13.970	-4.9814E-01	16.510	-5.2776E-01	19.050	-5.4031E-01
21.590	-5.3483E-01	24.130	-5.2572E-01	26.670	-4.7272E-01
29.210	-4.1733E-01	31.750	-3.6061E-01	34.290	-3.0273E-01
36.830	-2.4383E-01	39.370	-1.8406E-01	41.910	-1.2353E-01
44.450	-6.2379E-02	46.990	-3.2530E-04	49.530	1.7933E-04
52.070	1.0381E-05	54.610	2.7930E-06	57.150	1.0075E-06
59.690	3.2502E-07	60.960	1.0489E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2013.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.037E+06	0.0300	292.65	2	1.000E-01	9.767E+05	0.0300	292.65
3	2.000E-01	9.190E+05	0.0300	292.65	4	3.000E-01	8.636E+05	0.0300	292.65
5	4.000E-01	8.104E+05	0.0300	292.65	6	5.000E-01	7.592E+05	0.0300	292.65
7	6.000E-01	7.098E+05	0.0300	292.65	8	7.000E-01	6.621E+05	0.0300	292.65
9	8.000E-01	6.160E+05	0.0300	292.65	10	9.000E-01	5.714E+05	0.0300	292.65
11	1.000E+00	5.282E+05	0.0300	292.65	12	1.250E+00	4.258E+05	0.0300	292.65
13	1.500E+00	3.304E+05	0.0300	292.65	14	1.750E+00	2.412E+05	0.0301	292.65
15	2.000E+00	1.574E+05	0.0301	292.65	16	2.500E+00	3.640E+03	0.0386	292.65
17	3.000E+00	3.012E+03	0.0408	292.65	18	3.500E+00	2.719E+03	0.0423	292.65
19	4.000E+00	2.533E+03	0.0433	292.65	20	4.500E+00	2.400E+03	0.0442	292.65
21	5.080E+00	2.284E+03	0.0451	292.65	22	7.620E+00	1.988E+03	0.0478	292.65
23	1.016E+01	1.832E+03	0.0497	292.65	24	1.270E+01	1.733E+03	0.0510	292.65
25	1.524E+01	1.663E+03	0.0521	292.65	26	1.778E+01	1.611E+03	0.0529	292.65
27	2.032E+01	1.571E+03	0.0536	292.65	28	2.286E+01	1.540E+03	0.0542	292.65
29	2.540E+01	1.516E+03	0.0546	292.65	30	2.794E+01	1.497E+03	0.0550	292.65
31	3.048E+01	1.481E+03	0.0553	292.65	32	3.302E+01	1.469E+03	0.0556	292.65
33	3.556E+01	1.459E+03	0.0558	292.65	34	3.810E+01	1.451E+03	0.0560	292.65
35	4.064E+01	1.445E+03	0.0561	292.65	36	4.318E+01	1.440E+03	0.0562	292.65
37	4.572E+01	1.436E+03	0.0563	292.65	38	4.826E+01	1.439E+03	0.0501	292.65
39	5.080E+01	1.568E+03	0.0501	292.65	40	5.334E+01	1.613E+03	0.0501	292.65
41	5.588E+01	1.618E+03	0.0501	292.65	42	5.842E+01	1.609E+03	0.0501	292.65
43	6.096E+01	1.605E+03	0.0501	292.65					

Initial Water Storage = 3.1346 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.05472     0.05010
 Head (cm)         = 6.62341E+05 1.10166E+05 1.51194E+03 1.60528E+03
 LiqWater Flow (cm)=-1.51965E-11-4.17488E-04-3.63559E-03 4.95335E-10
 IsoVapor Flow (cm)=-1.22119E-02-1.18416E-02-3.50101E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1346+ 0.0000+ 0.0000 - 0.0122- 0.0000-  0.0000 =    3.1224 vs.    3.1224

 Mass Balance = -5.3837E-07 cm;  Time step attempts =   51 and successes =   49
   Evaporation:  Potential =  0.2331 cm, Actual =  0.0122 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 61.8 %;  TMEAN = 276.2 K;  HDRY =  6.6234E+05 cm;  DAYUBC =    48

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04872     0.05187
 Head (cm)         = 1.00583E+06 5.21626E+05 1.90861E+03 4.98193E+02
 LiqWater Flow (cm)=-1.52522E-12-4.47614E-11-2.10306E-03 7.72381E-06
 IsoVapor Flow (cm)=-8.18404E-03-8.17958E-03-6.11604E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8638+ 0.0000+ 0.0000 - 0.0082- 0.0000-  0.0000 =    2.8556 vs.    2.8556

 Mass Balance = -3.9240E-07 cm;  Time step attempts =   28 and successes =   27
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0082 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 48.2 %;  TMEAN = 278.2 K;  HDRY =  1.0058E+06 cm;  DAYUBC =    27
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1167E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1167E+02	[cm]
Actual Evaporation	=	2.4427E+01	[cm]
Evaporation during Growth	=	2.4427E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.4155E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.0346E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.4155E+01	[cm]
Actual Rainfall	=	2.4155E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8556E+00	[cm]
Mass Balance Error	=	6.5954E-03	[cm]
Total Successful Time Steps	=	52541	
Total Attempted Time Steps	=	64596	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26613	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.7144E-01	0.050	1.1839E+01	0.150	7.8537E+00
0.250	6.7493E+00	0.350	5.9326E+00	0.450	5.2757E+00
0.550	4.7316E+00	0.650	4.3230E+00	0.750	3.9551E+00
0.850	3.5163E+00	0.950	3.2574E+00	1.125	3.0267E+00
1.375	2.4977E+00	1.625	2.1262E+00	1.875	1.9560E+00
2.250	1.8245E+00	2.750	1.4610E+00	3.250	1.2297E+00
3.750	9.4423E-01	4.250	6.3535E-01	4.790	5.0990E-01
6.350	3.9218E-01	8.890	1.1976E-01	11.430	-1.7740E-02
13.970	-1.4019E-01	16.510	-1.6868E-01	19.050	-1.5331E-01
21.590	-1.3756E-01	24.130	-1.2170E-01	26.670	-1.0581E-01
29.210	-8.9940E-02	31.750	-7.4116E-02	34.290	-5.8347E-02
36.830	-4.2643E-02	39.370	-2.6996E-02	41.910	-1.1391E-02
44.450	4.1920E-03	46.990	2.0460E-02	49.530	2.1755E-02
52.070	1.6058E-02	54.610	1.2010E-02	57.150	7.6231E-03
59.690	3.1283E-03	60.960	1.0346E-03		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2014.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.006E+06	0.0300	292.65	2	1.000E-01	9.769E+05	0.0300	292.65
3	2.000E-01	9.482E+05	0.0300	292.65	4	3.000E-01	9.203E+05	0.0300	292.65
5	4.000E-01	8.932E+05	0.0300	292.65	6	5.000E-01	8.668E+05	0.0300	292.65
7	6.000E-01	8.408E+05	0.0300	292.65	8	7.000E-01	8.154E+05	0.0300	292.65
9	8.000E-01	7.904E+05	0.0300	292.65	10	9.000E-01	7.659E+05	0.0300	292.65
11	1.000E+00	7.419E+05	0.0300	292.65	12	1.250E+00	6.835E+05	0.0300	292.65
13	1.500E+00	6.275E+05	0.0300	292.65	14	1.750E+00	5.736E+05	0.0300	292.65
15	2.000E+00	5.216E+05	0.0300	292.65	16	2.500E+00	4.232E+05	0.0300	292.65
17	3.000E+00	3.312E+05	0.0300	292.65	18	3.500E+00	2.450E+05	0.0301	292.65
19	4.000E+00	1.639E+05	0.0301	292.65	20	4.500E+00	8.727E+04	0.0302	292.65
21	5.080E+00	4.778E+03	0.0362	292.65	22	7.620E+00	2.864E+03	0.0415	292.65
23	1.016E+01	2.514E+03	0.0435	292.65	24	1.270E+01	2.323E+03	0.0448	292.65
25	1.524E+01	2.198E+03	0.0458	292.65	26	1.778E+01	2.108E+03	0.0466	292.65
27	2.032E+01	2.040E+03	0.0473	292.65	28	2.286E+01	1.986E+03	0.0478	292.65
29	2.540E+01	1.943E+03	0.0483	292.65	30	2.794E+01	1.909E+03	0.0487	292.65
31	3.048E+01	1.880E+03	0.0491	292.65	32	3.302E+01	1.857E+03	0.0493	292.65
33	3.556E+01	1.838E+03	0.0496	292.65	34	3.810E+01	1.823E+03	0.0498	292.65
35	4.064E+01	1.811E+03	0.0499	292.65	36	4.318E+01	1.803E+03	0.0500	292.65
37	4.572E+01	1.797E+03	0.0501	292.65	38	4.826E+01	1.542E+03	0.0501	292.65
39	5.080E+01	5.382E+02	0.0515	292.65	40	5.334E+01	5.178E+02	0.0517	292.65
41	5.588E+01	5.062E+02	0.0518	292.65	42	5.842E+01	5.001E+02	0.0518	292.65
43	6.096E+01	4.982E+02	0.0519	292.65					

Initial Water Storage = 2.8556 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04860     0.05186
 Head (cm)         = 1.15661E+06 5.86317E+05 1.91900E+03 4.98692E+02
 LiqWater Flow (cm)=-9.34819E-13-2.86557E-11-2.09079E-03 7.66019E-06
 IsoVapor Flow (cm)=-8.91193E-03-8.90699E-03-6.23505E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8556+ 0.0000+ 0.0000 - 0.0089- 0.0000-  0.0000 =    2.8467 vs.    2.8467

 Mass Balance = -1.2592E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2497 cm, Actual =  0.0089 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 43.2 %;  TMEAN = 279.8 K;  HDRY =  1.1566E+06 cm;  DAYUBC =    24

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03005     0.03693     0.04933     0.05232
 Head (cm)         = 2.73526E+05 4.37804E+03 1.85790E+03 4.56828E+02
 LiqWater Flow (cm)=-5.81209E-10-8.92382E-03-9.50676E-04 1.58004E-05
 IsoVapor Flow (cm)=-7.33027E-03-1.63153E-04-2.81225E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9541+ 0.0000+ 0.0000 - 0.0073- 0.0000-  0.0000 =    2.9467 vs.    2.9467

 Mass Balance = -2.3029E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.1854 cm, Actual =  0.0073 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 82.0 %;  TMEAN = 270.4 K;  HDRY =  2.7353E+05 cm;  DAYUBC =    51
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2121E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2121E+02	[cm]
Actual Evaporation	=	2.1664E+01	[cm]
Evaporation during Growth	=	2.1664E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1768E+01	[cm]
Total Basal Liquid Flux (drainage)	=	5.0824E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1768E+01	[cm]
Actual Rainfall	=	2.1768E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.9467E+00	[cm]
Mass Balance Error	=	7.2329E-03	[cm]
Total Successful Time Steps	=	58244	
Total Attempted Time Steps	=	71322	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29144	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.0345E-01	0.050	1.1619E+01	0.150	7.6872E+00
0.250	6.3240E+00	0.350	5.3969E+00	0.450	4.9086E+00
0.550	4.3092E+00	0.650	3.6911E+00	0.750	3.3927E+00
0.850	3.0275E+00	0.950	2.8472E+00	1.125	2.7050E+00
1.375	2.2861E+00	1.625	1.9403E+00	1.875	1.8131E+00
2.250	1.6540E+00	2.750	1.4733E+00	3.250	1.3637E+00
3.750	1.2030E+00	4.250	1.0106E+00	4.790	9.1976E-01
6.350	8.1462E-01	8.890	6.1335E-01	11.430	4.0594E-01
13.970	2.4355E-01	16.510	1.1138E-01	19.050	2.6380E-02
21.590	2.1130E-02	24.130	1.8061E-02	26.670	1.5774E-02
29.210	1.4079E-02	31.750	1.2857E-02	34.290	1.2001E-02
36.830	1.1413E-02	39.370	1.1012E-02	41.910	1.0739E-02
44.450	1.0541E-02	46.990	1.3456E-02	49.530	1.8727E-02
52.070	9.5455E-03	54.610	8.1187E-03	57.150	6.8727E-03
59.690	5.6703E-03	60.960	5.0824E-03		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2015.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	2.735E+05	0.0300	292.65	2	1.000E-01	2.573E+05	0.0301	292.65
3	2.000E-01	2.415E+05	0.0301	292.65	4	3.000E-01	2.258E+05	0.0301	292.65
5	4.000E-01	2.102E+05	0.0301	292.65	6	5.000E-01	1.948E+05	0.0301	292.65
7	6.000E-01	1.796E+05	0.0301	292.65	8	7.000E-01	1.645E+05	0.0301	292.65
9	8.000E-01	1.496E+05	0.0301	292.65	10	9.000E-01	1.349E+05	0.0301	292.65
11	1.000E+00	1.203E+05	0.0301	292.65	12	1.250E+00	8.449E+04	0.0302	292.65
13	1.500E+00	4.951E+04	0.0304	292.65	14	1.750E+00	1.533E+04	0.0315	292.65
15	2.000E+00	4.378E+03	0.0369	292.65	16	2.500E+00	3.589E+03	0.0388	292.65
17	3.000E+00	3.224E+03	0.0400	292.65	18	3.500E+00	2.995E+03	0.0409	292.65
19	4.000E+00	2.831E+03	0.0417	292.65	20	4.500E+00	2.706E+03	0.0423	292.65
21	5.080E+00	2.593E+03	0.0430	292.65	22	7.620E+00	2.292E+03	0.0450	292.65
23	1.016E+01	2.139E+03	0.0463	292.65	24	1.270E+01	2.046E+03	0.0472	292.65
25	1.524E+01	1.986E+03	0.0479	292.65	26	1.778E+01	1.944E+03	0.0483	292.65
27	2.032E+01	1.914E+03	0.0487	292.65	28	2.286E+01	1.891E+03	0.0489	292.65
29	2.540E+01	1.873E+03	0.0491	292.65	30	2.794E+01	1.858E+03	0.0493	292.65
31	3.048E+01	1.845E+03	0.0495	292.65	32	3.302E+01	1.833E+03	0.0497	292.65
33	3.556E+01	1.822E+03	0.0498	292.65	34	3.810E+01	1.812E+03	0.0499	292.65
35	4.064E+01	1.804E+03	0.0500	292.65	36	4.318E+01	1.798E+03	0.0501	292.65
37	4.572E+01	1.793E+03	0.0502	292.65	38	4.826E+01	1.494E+03	0.0501	292.65
39	5.080E+01	4.844E+02	0.0520	292.65	40	5.334E+01	4.711E+02	0.0521	292.65
41	5.588E+01	4.628E+02	0.0522	292.65	42	5.842E+01	4.583E+02	0.0523	292.65
43	6.096E+01	4.568E+02	0.0523	292.65					

Initial Water Storage = 2.9467 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.03116     0.04927     0.05231
 Head (cm)         = 4.46116E+05 1.93620E+04 1.86314E+03 4.57399E+02
 LiqWater Flow (cm)=-8.82723E-11-8.11800E-03-1.02897E-03 1.56381E-05
 IsoVapor Flow (cm)=-1.10951E-02-3.57394E-04-3.02163E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9467+ 0.0000+ 0.0000 - 0.0111- 0.0000-  0.0000 =    2.9356 vs.    2.9356

 Mass Balance = -1.0289E-05 cm;  Time step attempts =   50 and successes =   40
   Evaporation:  Potential =  0.2333 cm, Actual =  0.0111 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 72.3 %;  TMEAN = 276.2 K;  HDRY =  4.4612E+05 cm;  DAYUBC =    40

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03015     0.06263     0.08349     0.05108
 Head (cm)         = 1.05228E+05 1.19662E+03 7.85751E+02 6.19851E+02
 LiqWater Flow (cm)=-6.72726E-02-1.46589E-01-4.79671E-02 1.27134E-06
 IsoVapor Flow (cm)=-9.64575E-02-3.40185E-06-1.78344E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.5979+ 0.0000+ 0.0000 - 0.1656- 0.0000-  0.0000 =    4.4323 vs.    4.4323

 Mass Balance = -2.2000E-05 cm;  Time step attempts =  227 and successes =  185
   Evaporation:  Potential =  0.3290 cm, Actual =  0.1656 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 70.1 %;  TMEAN = 278.4 K;  HDRY =  4.9048E+05 cm;  DAYUBC =    68
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  2.8444E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	2.8444E+02	[cm]
Actual Evaporation	=	2.9185E+01	[cm]
Evaporation during Growth	=	2.9185E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0683E+01	[cm]
Total Basal Liquid Flux (drainage)	=	1.7430E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0683E+01	[cm]
Actual Rainfall	=	3.0683E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.4323E+00	[cm]
Mass Balance Error	=	1.0816E-02	[cm]
Total Successful Time Steps	=	74378	
Total Attempted Time Steps	=	91923	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	33173	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.4982E+00	0.050	2.0253E+01	0.150	1.3993E+01
0.250	1.1713E+01	0.350	1.0174E+01	0.450	8.9778E+00
0.550	8.1743E+00	0.650	7.5728E+00	0.750	7.0640E+00
0.850	6.4015E+00	0.950	5.8512E+00	1.125	5.4653E+00
1.375	4.5207E+00	1.625	3.8770E+00	1.875	3.4751E+00
2.250	3.0819E+00	2.750	2.3848E+00	3.250	2.0460E+00
3.750	1.7783E+00	4.250	1.5436E+00	4.790	1.4696E+00
6.350	1.3314E+00	8.890	1.2610E+00	11.430	1.1921E+00
13.970	1.1200E+00	16.510	1.0448E+00	19.050	9.6674E-01
21.590	8.8611E-01	24.130	8.0314E-01	26.670	7.1811E-01
29.210	6.3126E-01	31.750	5.4282E-01	34.290	4.5301E-01
36.830	3.6200E-01	39.370	2.6999E-01	41.910	1.7711E-01
44.450	8.3519E-02	46.990	-1.0115E-02	49.530	-7.0075E-03
52.070	-8.8170E-03	54.610	-5.8959E-03	57.150	-2.8778E-03
59.690	1.9616E-04	60.960	1.7430E-03		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2016.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.052E+05	0.0302	292.65	2	1.000E-01	1.302E+03	0.0595	292.65
3	2.000E-01	1.296E+03	0.0597	292.65	4	3.000E-01	1.290E+03	0.0599	292.65
5	4.000E-01	1.284E+03	0.0600	292.65	6	5.000E-01	1.278E+03	0.0602	292.65
7	6.000E-01	1.272E+03	0.0603	292.65	8	7.000E-01	1.266E+03	0.0605	292.65
9	8.000E-01	1.261E+03	0.0607	292.65	10	9.000E-01	1.255E+03	0.0608	292.65
11	1.000E+00	1.249E+03	0.0610	292.65	12	1.250E+00	1.236E+03	0.0614	292.65
13	1.500E+00	1.222E+03	0.0618	292.65	14	1.750E+00	1.209E+03	0.0622	292.65
15	2.000E+00	1.197E+03	0.0626	292.65	16	2.500E+00	1.173E+03	0.0634	292.65
17	3.000E+00	1.150E+03	0.0642	292.65	18	3.500E+00	1.129E+03	0.0650	292.65
19	4.000E+00	1.109E+03	0.0657	292.65	20	4.500E+00	1.090E+03	0.0664	292.65
21	5.080E+00	1.070E+03	0.0672	292.65	22	7.620E+00	9.975E+02	0.0705	292.65
23	1.016E+01	9.443E+02	0.0732	292.65	24	1.270E+01	9.042E+02	0.0754	292.65
25	1.524E+01	8.731E+02	0.0773	292.65	26	1.778E+01	8.483E+02	0.0789	292.65
27	2.032E+01	8.281E+02	0.0803	292.65	28	2.286E+01	8.115E+02	0.0815	292.65
29	2.540E+01	7.975E+02	0.0826	292.65	30	2.794E+01	7.858E+02	0.0835	292.65
31	3.048E+01	7.757E+02	0.0843	292.65	32	3.302E+01	7.672E+02	0.0850	292.65
33	3.556E+01	7.600E+02	0.0856	292.65	34	3.810E+01	7.538E+02	0.0861	292.65
35	4.064E+01	7.487E+02	0.0866	292.65	36	4.318E+01	7.444E+02	0.0869	292.65
37	4.572E+01	7.410E+02	0.0872	292.65	38	4.826E+01	7.330E+02	0.0507	292.65
39	5.080E+01	7.035E+02	0.0508	292.65	40	5.334E+01	6.555E+02	0.0509	292.65
41	5.588E+01	6.329E+02	0.0510	292.65	42	5.842E+01	6.228E+02	0.0511	292.65
43	6.096E+01	6.199E+02	0.0511	292.65					

Initial Water Storage = 4.4323 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05637     0.05966     0.08083     0.05108
 Head (cm)         = 1.43213E+03 1.29699E+03 8.20950E+02 6.20130E+02
 LiqWater Flow (cm)=-6.16171E-02-1.19964E-01-4.70017E-02 1.26665E-06
 IsoVapor Flow (cm)=-6.49603E-02-4.35047E-06-2.07659E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.4323+ 0.0000+ 0.0000 - 0.1253- 0.0000-  0.0000 =    4.3070 vs.    4.3070

 Mass Balance =  2.6513E-06 cm;  Time step attempts =  344 and successes =  277
   Evaporation:  Potential =  0.2426 cm, Actual =  0.1253 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 76.7 %;  TMEAN = 276.5 K;  HDRY =  3.6523E+05 cm;  DAYUBC =    64

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.04938     0.05347     0.06228     0.05070
 Head (cm)         = 1.85425E+03 1.57884E+03 1.20767E+03 7.37892E+02
 LiqWater Flow (cm)= 4.62667E-02 9.59103E-03-4.04452E-03 3.01529E-07
 IsoVapor Flow (cm)=-3.24227E-02-2.40985E-06-1.61645E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5563+ 0.1016+ 0.0000 - 0.0868- 0.0000-  0.0000 =    3.5711 vs.    3.5711

 Mass Balance =  4.2492E-05 cm;  Time step attempts =  313 and successes =  269
   Evaporation:  Potential =  0.2069 cm, Actual =  0.0868 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 88.3 %;  TMEAN = 282.9 K;  HDRY =  1.7170E+05 cm;  DAYUBC =    57
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1664E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
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Actual Transpiration               =  0.0000E+00     [cm]
Potential Evaporation              =  3.1664E+02     [cm]
Actual Evaporation                 =  2.4679E+01     [cm]
Evaporation during Growth          =  2.4592E+01     [cm]
Total Runoff                       =  0.0000E+00     [cm]
Total Infiltration                 =  2.3825E+01     [cm]
Total Basal Liquid Flux (drainage) =  2.2832E-04     [cm]
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.3825E+01     [cm]
Actual Rainfall                    =  2.3825E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.5711E+00     [cm]
Mass Balance Error                 =  7.0804E-03     [cm]
Total Successful Time Steps        =     59510
Total Attempted Time Steps         =     73078
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     29010
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.5392E-01	0.050	1.3332E+01	0.150	7.7536E+00
0.250	6.1900E+00	0.350	5.0546E+00	0.450	4.2747E+00
0.550	3.8328E+00	0.650	3.4192E+00	0.750	3.2065E+00
0.850	2.9389E+00	0.950	2.5799E+00	1.125	2.3164E+00
1.375	1.6623E+00	1.625	1.4262E+00	1.875	1.1959E+00
2.250	9.3337E-01	2.750	5.7890E-01	3.250	2.3541E-01
3.750	9.0617E-02	4.250	2.0945E-02	4.790	-6.2023E-02
6.350	-1.9149E-01	8.890	-3.7856E-01	11.430	-5.1368E-01
13.970	-5.6125E-01	16.510	-6.2801E-01	19.050	-6.1439E-01
21.590	-5.6766E-01	24.130	-5.1804E-01	26.670	-4.6618E-01
29.210	-4.1246E-01	31.750	-3.5722E-01	34.290	-3.0070E-01
36.830	-2.4310E-01	39.370	-1.8460E-01	41.910	-1.2534E-01
44.450	-6.5474E-02	46.990	-3.3417E-03	49.530	1.2575E-03
52.070	-1.4566E-03	54.610	-1.7431E-03	57.150	-1.0520E-03
59.690	-2.0918E-04	60.960	2.2832E-04		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2017.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.854E+03	0.0494	292.65	2	1.000E-01	1.833E+03	0.0496	292.65
3	2.000E-01	1.813E+03	0.0499	292.65	4	3.000E-01	1.794E+03	0.0502	292.65
5	4.000E-01	1.777E+03	0.0504	292.65	6	5.000E-01	1.760E+03	0.0506	292.65
7	6.000E-01	1.744E+03	0.0509	292.65	8	7.000E-01	1.728E+03	0.0511	292.65
9	8.000E-01	1.714E+03	0.0513	292.65	10	9.000E-01	1.700E+03	0.0515	292.65
11	1.000E+00	1.687E+03	0.0517	292.65	12	1.250E+00	1.656E+03	0.0522	292.65
13	1.500E+00	1.628E+03	0.0526	292.65	14	1.750E+00	1.602E+03	0.0531	292.65
15	2.000E+00	1.579E+03	0.0535	292.65	16	2.500E+00	1.538E+03	0.0542	292.65
17	3.000E+00	1.502E+03	0.0549	292.65	18	3.500E+00	1.472E+03	0.0555	292.65
19	4.000E+00	1.445E+03	0.0561	292.65	20	4.500E+00	1.422E+03	0.0566	292.65
21	5.080E+00	1.398E+03	0.0571	292.65	22	7.620E+00	1.324E+03	0.0589	292.65
23	1.016E+01	1.283E+03	0.0601	292.65	24	1.270E+01	1.258E+03	0.0607	292.65
25	1.524E+01	1.244E+03	0.0612	292.65	26	1.778E+01	1.235E+03	0.0614	292.65
27	2.032E+01	1.228E+03	0.0617	292.65	28	2.286E+01	1.221E+03	0.0619	292.65
29	2.540E+01	1.214E+03	0.0621	292.65	30	2.794E+01	1.208E+03	0.0623	292.65
31	3.048E+01	1.201E+03	0.0625	292.65	32	3.302E+01	1.195E+03	0.0627	292.65
33	3.556E+01	1.189E+03	0.0629	292.65	34	3.810E+01	1.183E+03	0.0631	292.65
35	4.064E+01	1.179E+03	0.0632	292.65	36	4.318E+01	1.175E+03	0.0634	292.65
37	4.572E+01	1.172E+03	0.0635	292.65	38	4.826E+01	1.159E+03	0.0502	292.65
39	5.080E+01	9.048E+02	0.0504	292.65	40	5.334E+01	7.884E+02	0.0506	292.65
41	5.588E+01	7.527E+02	0.0507	292.65	42	5.842E+01	7.407E+02	0.0507	292.65
43	6.096E+01	7.379E+02	0.0507	292.65					

Initial Water Storage = 3.5711 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06299     0.06513     0.06610     0.05070
 Head (cm)         = 1.18572E+03 1.12444E+03 1.09870E+03 7.38030E+02
 LiqWater Flow (cm)= 3.14463E-01 2.36693E-01 1.42544E-02 3.01070E-07
 IsoVapor Flow (cm)=-5.05120E-02-1.10710E-06 2.37364E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5711+ 0.4572+ 0.0000 - 0.1926- 0.0000-  0.0000 =    3.8357 vs.    3.8356

 Mass Balance =  1.3085E-04 cm;  Time step attempts =  525 and successes =  444
   Evaporation:  Potential =  0.3119 cm, Actual =  0.1926 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 75.1 %;  TMEAN = 283.7 K;  HDRY =  3.9383E+05 cm;  DAYUBC =    63

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03134     0.06003     0.05053
 Head (cm)         = 1.50332E+06 1.72434E+04 1.28337E+03 8.26050E+02
 LiqWater Flow (cm)=-1.08059E-12-2.32193E-02-9.97334E-03 1.18790E-07
 IsoVapor Flow (cm)=-2.64827E-02-2.40812E-04-3.99316E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                            LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3662+ 0.0000+ 0.0000 - 0.0265- 0.0000-  0.0000 =    3.3397 vs.    3.3397

 Mass Balance = -7.8625E-06 cm;  Time step attempts =   43 and successes =   34
   Evaporation:  Potential =  0.6403 cm, Actual =  0.0265 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 33.6 %;  TMEAN = 285.7 K;  HDRY =  1.5033E+06 cm;  DAYUBC =    34
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2162E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
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Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2162E+02	[cm]
Actual Evaporation	=	2.5853E+01	[cm]
Evaporation during Growth	=	2.5853E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.5629E+01	[cm]
Total Basal Liquid Flux (drainage)	=	6.6750E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.5629E+01	[cm]
Actual Rainfall	=	2.5629E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.3397E+00	[cm]
Mass Balance Error	=	7.0487E-03	[cm]
Total Successful Time Steps	=	53695	
Total Attempted Time Steps	=	65432	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	26782	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.2422E-01	0.050	1.6696E+01	0.150	9.1637E+00
0.250	7.7607E+00	0.350	6.4348E+00	0.450	5.9322E+00
0.550	5.5022E+00	0.650	5.2675E+00	0.750	4.9137E+00
0.850	4.5211E+00	0.950	4.1054E+00	1.125	3.8648E+00
1.375	2.9304E+00	1.625	2.3096E+00	1.875	1.9393E+00
2.250	1.6577E+00	2.750	1.0327E+00	3.250	8.2208E-01
3.750	7.1104E-01	4.250	5.8501E-01	4.790	4.6819E-01
6.350	3.9835E-01	8.890	1.6979E-01	11.430	2.4713E-02
13.970	-5.2915E-02	16.510	-6.6318E-02	19.050	-5.5122E-02
21.590	-4.5698E-02	24.130	-3.7830E-02	26.670	-3.1241E-02
29.210	-2.5689E-02	31.750	-2.0965E-02	34.290	-1.6861E-02
36.830	-1.3250E-02	39.370	-1.0009E-02	41.910	-7.0313E-03
44.450	-4.2330E-03	46.990	-8.6002E-04	49.530	1.5217E-03
52.070	-1.2201E-04	54.610	-5.2269E-04	57.150	-3.8561E-04
59.690	-9.4503E-05	60.960	6.6750E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2018.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.503E+06	0.0300	292.65	2	1.000E-01	1.376E+06	0.0300	292.65
3	2.000E-01	1.259E+06	0.0300	292.65	4	3.000E-01	1.151E+06	0.0300	292.65
5	4.000E-01	1.051E+06	0.0300	292.65	6	5.000E-01	9.583E+05	0.0300	292.65
7	6.000E-01	8.711E+05	0.0300	292.65	8	7.000E-01	7.891E+05	0.0300	292.65
9	8.000E-01	7.116E+05	0.0300	292.65	10	9.000E-01	6.383E+05	0.0300	292.65
11	1.000E+00	5.687E+05	0.0300	292.65	12	1.250E+00	4.086E+05	0.0300	292.65
13	1.500E+00	2.653E+05	0.0301	292.65	14	1.750E+00	1.356E+05	0.0301	292.65
15	2.000E+00	1.724E+04	0.0313	292.65	16	2.500E+00	2.821E+03	0.0417	292.65
17	3.000E+00	2.570E+03	0.0431	292.65	18	3.500E+00	2.382E+03	0.0444	292.65
19	4.000E+00	2.243E+03	0.0454	292.65	20	4.500E+00	2.135E+03	0.0464	292.65
21	5.080E+00	2.037E+03	0.0473	292.65	22	7.620E+00	1.772E+03	0.0505	292.65
23	1.016E+01	1.628E+03	0.0526	292.65	24	1.270E+01	1.533E+03	0.0543	292.65
25	1.524E+01	1.463E+03	0.0557	292.65	26	1.778E+01	1.410E+03	0.0568	292.65
27	2.032E+01	1.368E+03	0.0578	292.65	28	2.286E+01	1.334E+03	0.0587	292.65
29	2.540E+01	1.307E+03	0.0594	292.65	30	2.794E+01	1.283E+03	0.0600	292.65
31	3.048E+01	1.264E+03	0.0606	292.65	32	3.302E+01	1.248E+03	0.0610	292.65
33	3.556E+01	1.235E+03	0.0614	292.65	34	3.810E+01	1.224E+03	0.0618	292.65
35	4.064E+01	1.216E+03	0.0620	292.65	36	4.318E+01	1.209E+03	0.0622	292.65
37	4.572E+01	1.205E+03	0.0624	292.65	38	4.826E+01	1.184E+03	0.0502	292.65
39	5.080E+01	9.904E+02	0.0503	292.65	40	5.334E+01	8.759E+02	0.0505	292.65
41	5.588E+01	8.370E+02	0.0505	292.65	42	5.842E+01	8.274E+02	0.0505	292.65
43	6.096E+01	8.261E+02	0.0505	292.65					

Initial Water Storage = 3.3397 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.05953     0.05053
 Head (cm)         = 7.20447E+05 1.13655E+05 1.30198E+03 8.26099E+02
 LiqWater Flow (cm)=-1.14423E-11-1.09915E-03-9.47492E-03 1.18734E-07
 IsoVapor Flow (cm)=-1.32743E-02-1.17298E-02-4.07395E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3397+ 0.0000+ 0.0000 - 0.0133- 0.0000-  0.0000 =    3.3265 vs.    3.3265

 Mass Balance = -5.2655E-06 cm;  Time step attempts =   57 and successes =   55
   Evaporation:  Potential =  0.2468 cm, Actual =  0.0133 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.3 %;  TMEAN = 275.7 K;  HDRY =  7.2045E+05 cm;  DAYUBC =    52

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
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 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04366     0.05413     0.05037
 Head (cm)         = 8.58098E+05 2.48410E+03 1.54251E+03 9.50907E+02
 LiqWater Flow (cm)=-2.60220E-11-3.36768E-02 5.10224E-03 3.71852E-08
 IsoVapor Flow (cm)=-4.74317E-02-1.88985E-05 4.56943E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2141+ 0.0000+ 0.0000 - 0.0474- 0.0000-  0.0000 =    3.1667 vs.    3.1668

 Mass Balance = -6.6357E-05 cm;  Time step attempts =  309 and successes =  240
   Evaporation:  Potential =  0.4952 cm, Actual =  0.0474 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.7 %;  TMEAN = 279.5 K;  HDRY =  8.5810E+05 cm;  DAYUBC =   240
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2377E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2377E+02	[cm]
Actual Evaporation	=	2.1425E+01	[cm]
Evaporation during Growth	=	2.1425E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.1260E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.7100E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.1260E+01	[cm]
Actual Rainfall	=	2.1260E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.1668E+00	[cm]
Mass Balance Error	=	8.0100E-03	[cm]
Total Successful Time Steps	=	58105	
Total Attempted Time Steps	=	71747	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28855	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.6492E-01	0.050	1.4460E+01	0.150	1.0405E+01
0.250	8.9428E+00	0.350	7.9462E+00	0.450	7.2957E+00
0.550	6.4660E+00	0.650	5.7963E+00	0.750	5.3499E+00
0.850	4.8582E+00	0.950	4.4620E+00	1.125	4.1182E+00
1.375	3.4096E+00	1.625	2.9781E+00	1.875	2.3414E+00
2.250	1.9378E+00	2.750	1.2915E+00	3.250	9.4429E-01
3.750	6.9836E-01	4.250	5.7933E-01	4.790	4.5184E-01
6.350	2.6577E-01	8.890	-7.7695E-02	11.430	-1.7625E-01
13.970	-2.0121E-01	16.510	-1.9909E-01	19.050	-1.9440E-01
21.590	-1.8712E-01	24.130	-1.7724E-01	26.670	-1.6479E-01
29.210	-1.4992E-01	31.750	-1.3285E-01	34.290	-1.1385E-01
36.830	-9.3269E-02	39.370	-7.1421E-02	41.910	-4.8627E-02
44.450	-2.5212E-02	46.990	-1.1508E-03	49.530	7.3374E-04
52.070	-1.0299E-04	54.610	-2.9943E-04	57.150	-2.4445E-04
59.690	-7.2813E-05	60.960	2.7100E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2019.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.581E+05	0.0300	292.65	2	1.000E-01	7.662E+05	0.0300	292.65
3	2.000E-01	6.766E+05	0.0300	292.65	4	3.000E-01	5.953E+05	0.0300	292.65
5	4.000E-01	5.177E+05	0.0300	292.65	6	5.000E-01	4.444E+05	0.0300	292.65
7	6.000E-01	3.748E+05	0.0300	292.65	8	7.000E-01	3.088E+05	0.0300	292.65
9	8.000E-01	2.459E+05	0.0301	292.65	10	9.000E-01	1.861E+05	0.0301	292.65
11	1.000E+00	1.294E+05	0.0301	292.65	12	1.250E+00	3.070E+03	0.0406	292.65
13	1.500E+00	2.817E+03	0.0418	292.65	14	1.750E+00	2.629E+03	0.0428	292.65
15	2.000E+00	2.484E+03	0.0437	292.65	16	2.500E+00	2.275E+03	0.0452	292.65
17	3.000E+00	2.135E+03	0.0464	292.65	18	3.500E+00	2.033E+03	0.0474	292.65
19	4.000E+00	1.954E+03	0.0482	292.65	20	4.500E+00	1.891E+03	0.0489	292.65
21	5.080E+00	1.832E+03	0.0497	292.65	22	7.620E+00	1.669E+03	0.0520	292.65
23	1.016E+01	1.585E+03	0.0534	292.65	24	1.270E+01	1.538E+03	0.0542	292.65
25	1.524E+01	1.513E+03	0.0547	292.65	26	1.778E+01	1.503E+03	0.0549	292.65
27	2.032E+01	1.504E+03	0.0549	292.65	28	2.286E+01	1.512E+03	0.0547	292.65
29	2.540E+01	1.526E+03	0.0544	292.65	30	2.794E+01	1.543E+03	0.0541	292.65
31	3.048E+01	1.560E+03	0.0538	292.65	32	3.302E+01	1.576E+03	0.0535	292.65
33	3.556E+01	1.589E+03	0.0533	292.65	34	3.810E+01	1.598E+03	0.0531	292.65
35	4.064E+01	1.604E+03	0.0530	292.65	36	4.318E+01	1.607E+03	0.0530	292.65
37	4.572E+01	1.607E+03	0.0530	292.65	38	4.826E+01	1.549E+03	0.0501	292.65
39	5.080E+01	1.050E+03	0.0503	292.65	40	5.334E+01	9.448E+02	0.0504	292.65
41	5.588E+01	9.455E+02	0.0504	292.65	42	5.842E+01	9.507E+02	0.0504	292.65
43	6.096E+01	9.509E+02	0.0504	292.65					

Initial Water Storage = 3.1668 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04278     0.05404     0.05037
 Head (cm)         = 6.36590E+05 2.62573E+03 1.54780E+03 9.50901E+02
 LiqWater Flow (cm)=-3.98934E-11-2.27173E-02 3.39434E-03 3.71869E-08
 IsoVapor Flow (cm)=-2.37598E-02-2.10146E-05 2.76832E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1668+ 0.0000+ 0.0000 - 0.0238- 0.0000-  0.0000 =    3.1430 vs.    3.1430

 Mass Balance =  1.7731E-08 cm;  Time step attempts =   56 and successes =   55
   Evaporation:  Potential =  0.2932 cm, Actual =  0.0238 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 63.0 %;  TMEAN = 275.9 K;  HDRY =  6.3659E+05 cm;  DAYUBC =    54

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04289     0.06265     0.05022
 Head (cm)         = 1.19840E+06 2.60670E+03 1.19600E+03 1.17959E+03
 LiqWater Flow (cm)=-3.96833E-12-3.13221E-02-1.21172E-02 6.27788E-09
 IsoVapor Flow (cm)=-3.54914E-02-2.81653E-05-3.45771E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.4997+ 0.0000+ 0.0000 - 0.0355- 0.0000-  0.0000 =    3.4642 vs.    3.4642

 Mass Balance = -1.4163E-05 cm;  Time step attempts =   75 and successes =   61
   Evaporation:  Potential =  0.4041 cm, Actual =  0.0355 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 41.9 %;  TMEAN = 278.4 K;  HDRY =  1.1984E+06 cm;  DAYUBC =    61
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1575E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1575E+02	[cm]
Actual Evaporation	=	2.0217E+01	[cm]
Evaporation during Growth	=	2.0217E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.0523E+01	[cm]
Total Basal Liquid Flux (drainage)	=	7.4887E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.0523E+01	[cm]
Actual Rainfall	=	2.0523E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.4642E+00	[cm]
Mass Balance Error	=	9.0421E-03	[cm]
Total Successful Time Steps	=	67053	
Total Attempted Time Steps	=	83352	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32232	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	3.0649E-01	0.050	1.3719E+01	0.150	1.0414E+01
0.250	8.6543E+00	0.350	7.2737E+00	0.450	6.3615E+00
0.550	5.8475E+00	0.650	5.2074E+00	0.750	4.8324E+00
0.850	4.4678E+00	0.950	4.1568E+00	1.125	3.8959E+00
1.375	3.3349E+00	1.625	2.8694E+00	1.875	2.5304E+00
2.250	2.2534E+00	2.750	1.8093E+00	3.250	1.5050E+00
3.750	1.2511E+00	4.250	1.0522E+00	4.790	9.0495E-01
6.350	7.6929E-01	8.890	5.4395E-01	11.430	4.0349E-01
13.970	3.0624E-01	16.510	2.8012E-01	19.050	2.6829E-01
21.590	2.5402E-01	24.130	2.3720E-01	26.670	2.1787E-01
29.210	1.9611E-01	31.750	1.7217E-01	34.290	1.4630E-01
36.830	1.1882E-01	39.370	9.0078E-02	41.910	6.0391E-02
44.450	3.0054E-02	46.990	5.7226E-06	49.530	4.4786E-04
52.070	-2.4923E-05	54.610	-9.0519E-05	57.150	-8.5365E-05
59.690	-3.1632E-05	60.960	7.4887E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2020.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.198E+06	0.0300	292.65	2	1.000E-01	1.077E+06	0.0300	292.65
3	2.000E-01	9.654E+05	0.0300	292.65	4	3.000E-01	8.621E+05	0.0300	292.65
5	4.000E-01	7.661E+05	0.0300	292.65	6	5.000E-01	6.764E+05	0.0300	292.65
7	6.000E-01	5.921E+05	0.0300	292.65	8	7.000E-01	5.127E+05	0.0300	292.65
9	8.000E-01	4.376E+05	0.0300	292.65	10	9.000E-01	3.664E+05	0.0300	292.65
11	1.000E+00	2.987E+05	0.0300	292.65	12	1.250E+00	1.426E+05	0.0301	292.65
13	1.500E+00	3.199E+03	0.0401	292.65	14	1.750E+00	2.827E+03	0.0417	292.65
15	2.000E+00	2.607E+03	0.0429	292.65	16	2.500E+00	2.336E+03	0.0447	292.65
17	3.000E+00	2.168E+03	0.0461	292.65	18	3.500E+00	2.048E+03	0.0472	292.65
19	4.000E+00	1.956E+03	0.0482	292.65	20	4.500E+00	1.882E+03	0.0490	292.65
21	5.080E+00	1.812E+03	0.0499	292.65	22	7.620E+00	1.610E+03	0.0529	292.65
23	1.016E+01	1.492E+03	0.0551	292.65	24	1.270E+01	1.412E+03	0.0568	292.65
25	1.524E+01	1.353E+03	0.0582	292.65	26	1.778E+01	1.307E+03	0.0594	292.65
27	2.032E+01	1.270E+03	0.0604	292.65	28	2.286E+01	1.241E+03	0.0613	292.65
29	2.540E+01	1.216E+03	0.0620	292.65	30	2.794E+01	1.196E+03	0.0627	292.65
31	3.048E+01	1.179E+03	0.0632	292.65	32	3.302E+01	1.165E+03	0.0637	292.65
33	3.556E+01	1.153E+03	0.0641	292.65	34	3.810E+01	1.144E+03	0.0644	292.65
35	4.064E+01	1.136E+03	0.0647	292.65	36	4.318E+01	1.130E+03	0.0649	292.65
37	4.572E+01	1.126E+03	0.0651	292.65	38	4.826E+01	1.109E+03	0.0503	292.65
39	5.080E+01	9.703E+02	0.0504	292.65	40	5.334E+01	1.076E+03	0.0503	292.65
41	5.588E+01	1.147E+03	0.0502	292.65	42	5.842E+01	1.173E+03	0.0502	292.65
43	6.096E+01	1.180E+03	0.0502	292.65					

Initial Water Storage = 3.4642 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04453     0.06201     0.05022
 Head (cm)         = 7.50500E+05 2.35860E+03 1.21627E+03 1.17929E+03
 LiqWater Flow (cm)=-1.74067E-11-2.45257E-02-1.16212E-02 6.29080E-09
 IsoVapor Flow (cm)=-2.25859E-02-1.98176E-05-3.59152E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.4642+ 0.0000+ 0.0000 - 0.0226- 0.0000-  0.0000 =    3.4416 vs.    3.4416

 Mass Balance = -7.3041E-07 cm;  Time step attempts =   62 and successes =   60
   Evaporation:  Potential =  0.4127 cm, Actual =  0.0226 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 58.0 %;  TMEAN = 279.5 K;  HDRY =  7.5050E+05 cm;  DAYUBC =    59

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 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04403     0.05019
 Head (cm)         = 8.61063E+05 6.85621E+05 2.42988E+03 1.23412E+03
 LiqWater Flow (cm)=-1.02226E-12-3.15191E-12-1.28886E-03 4.34594E-09
 IsoVapor Flow (cm)=-2.91928E-03-2.91928E-03-1.18872E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.5884+ 0.0000+ 0.0000 - 0.0029- 0.0000-  0.0000 =    2.5855 vs.    2.5855

 Mass Balance = -4.4985E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2451 cm, Actual =  0.0029 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 53.5 %;  TMEAN = 275.4 K;  HDRY =  8.6106E+05 cm;  DAYUBC =    24
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.2628E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.2628E+02	[cm]
Actual Evaporation	=	1.5706E+01	[cm]
Evaporation during Growth	=	1.5703E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.4834E+01	[cm]
Total Basal Liquid Flux (drainage)	=	2.6809E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.4834E+01	[cm]
Actual Rainfall	=	1.4834E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.5855E+00	[cm]
Mass Balance Error	=	6.0347E-03	[cm]
Total Successful Time Steps	=	50980	
Total Attempted Time Steps	=	61958	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27305	
Total Time Actually Simulated	=	3.6600E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.7273E-01	0.050	1.0187E+01	0.150	7.1637E+00
0.250	6.2545E+00	0.350	5.7350E+00	0.450	5.2421E+00
0.550	4.9028E+00	0.650	4.4347E+00	0.750	4.1170E+00
0.850	3.8324E+00	0.950	3.5395E+00	1.125	3.2451E+00
1.375	2.6430E+00	1.625	2.2985E+00	1.875	2.0497E+00
2.250	1.7717E+00	2.750	1.1657E+00	3.250	8.2153E-01
3.750	5.6216E-01	4.250	3.2245E-01	4.790	1.3933E-01
6.350	-2.5065E-02	8.890	-5.3045E-01	11.430	-6.4026E-01
13.970	-6.2150E-01	16.510	-5.7534E-01	19.050	-5.2951E-01
21.590	-4.8352E-01	24.130	-4.3719E-01	26.670	-3.9043E-01
29.210	-3.4320E-01	31.750	-2.9553E-01	34.290	-2.4743E-01
36.830	-1.9894E-01	39.370	-1.5009E-01	41.910	-1.0094E-01
44.450	-5.1504E-02	46.990	-1.4521E-03	49.530	2.3424E-04
52.070	8.4719E-06	54.610	-1.2283E-06	57.150	-2.0665E-06
59.690	7.8899E-07	60.960	2.6809E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2021.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.611E+05	0.0300	292.65	2	1.000E-01	8.517E+05	0.0300	292.65
3	2.000E-01	8.425E+05	0.0300	292.65	4	3.000E-01	8.333E+05	0.0300	292.65
5	4.000E-01	8.241E+05	0.0300	292.65	6	5.000E-01	8.151E+05	0.0300	292.65
7	6.000E-01	8.060E+05	0.0300	292.65	8	7.000E-01	7.971E+05	0.0300	292.65
9	8.000E-01	7.882E+05	0.0300	292.65	10	9.000E-01	7.793E+05	0.0300	292.65
11	1.000E+00	7.706E+05	0.0300	292.65	12	1.250E+00	7.488E+05	0.0300	292.65
13	1.500E+00	7.274E+05	0.0300	292.65	14	1.750E+00	7.064E+05	0.0300	292.65
15	2.000E+00	6.856E+05	0.0300	292.65	16	2.500E+00	6.450E+05	0.0300	292.65
17	3.000E+00	6.056E+05	0.0300	292.65	18	3.500E+00	5.673E+05	0.0300	292.65
19	4.000E+00	5.300E+05	0.0300	292.65	20	4.500E+00	4.937E+05	0.0300	292.65
21	5.080E+00	4.527E+05	0.0300	292.65	22	7.620E+00	2.864E+05	0.0300	292.65
23	1.016E+01	1.380E+05	0.0301	292.65	24	1.270E+01	4.149E+03	0.0374	292.65
25	1.524E+01	3.261E+03	0.0399	292.65	26	1.778E+01	2.922E+03	0.0412	292.65
27	2.032E+01	2.726E+03	0.0422	292.65	28	2.286E+01	2.595E+03	0.0430	292.65
29	2.540E+01	2.501E+03	0.0436	292.65	30	2.794E+01	2.430E+03	0.0440	292.65
31	3.048E+01	2.375E+03	0.0444	292.65	32	3.302E+01	2.333E+03	0.0447	292.65
33	3.556E+01	2.300E+03	0.0450	292.65	34	3.810E+01	2.274E+03	0.0452	292.65
35	4.064E+01	2.255E+03	0.0453	292.65	36	4.318E+01	2.242E+03	0.0454	292.65
37	4.572E+01	2.234E+03	0.0455	292.65	38	4.826E+01	2.060E+03	0.0501	292.65
39	5.080E+01	1.742E+03	0.0501	292.65	40	5.334E+01	1.493E+03	0.0501	292.65
41	5.588E+01	1.334E+03	0.0502	292.65	42	5.842E+01	1.256E+03	0.0502	292.65
43	6.096E+01	1.234E+03	0.0502	292.65					

Initial Water Storage = 2.5855 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04395     0.05019
 Head (cm)         = 1.42694E+06 1.08415E+06 2.44120E+03 1.23534E+03
 LiqWater Flow (cm)=-1.76504E-13-6.37633E-13-1.28355E-03 4.31102E-09
 IsoVapor Flow (cm)=-4.12415E-03-4.10993E-03-1.20998E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.5855+ 0.0000+ 0.0000 - 0.0041- 0.0000-  0.0000 =    2.5813 vs.    2.5813

 Mass Balance =  6.0114E-06 cm;  Time step attempts =   48 and successes =   41
   Evaporation:  Potential =  0.2990 cm, Actual =  0.0041 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 35.5 %;  TMEAN = 275.9 K;  HDRY =  1.4269E+06 cm;  DAYUBC =    41

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.08484     0.08517     0.07297     0.05055
 Head (cm)         = 7.69023E+02 7.65006E+02 9.47748E+02 8.12147E+02
 LiqWater Flow (cm)= 1.28774E+00 1.16652E+00 1.22701E-01 1.36310E-07
 IsoVapor Flow (cm)= 1.40113E-05 3.24591E-05 2.88303E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8200+ 1.4732+ 0.0000 - 0.1827- 0.0000-  0.0000 =    4.1106 vs.    4.1095

 Mass Balance =  1.0462E-03 cm;  Time step attempts = 2329 and successes = 1727
   Evaporation:  Potential =  0.1864 cm, Actual =  0.1827 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 91.4 %;  TMEAN = 281.8 K;  HDRY =  1.2349E+05 cm;  DAYUBC =     0
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
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 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1796E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1796E+02	[cm]
Actual Evaporation	=	2.9024E+01	[cm]
Evaporation during Growth	=	2.9024E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	3.0556E+01	[cm]
Total Basal Liquid Flux (drainage)	=	8.4393E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0556E+01	[cm]
Actual Rainfall	=	3.0556E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.1095E+00	[cm]
Mass Balance Error	=	7.9263E-03	[cm]
Total Successful Time Steps	=	57979	
Total Attempted Time Steps	=	70902	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27104	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.5320E+00	0.050	1.5004E+01	0.150	8.7432E+00
0.250	7.2619E+00	0.350	6.0749E+00	0.450	5.5084E+00
0.550	5.1021E+00	0.650	4.7567E+00	0.750	4.5643E+00
0.850	4.3973E+00	0.950	4.2281E+00	1.125	4.1245E+00
1.375	3.8772E+00	1.625	3.6906E+00	1.875	3.5098E+00
2.250	3.3464E+00	2.750	3.0007E+00	3.250	2.7808E+00
3.750	2.6146E+00	4.250	2.4423E+00	4.790	2.2893E+00
6.350	2.0444E+00	8.890	1.4950E+00	11.430	1.1996E+00
13.970	9.1975E-01	16.510	6.7348E-01	19.050	5.5414E-01
21.590	4.5470E-01	24.130	3.6280E-01	26.670	2.7934E-01
29.210	2.0566E-01	31.750	1.4345E-01	34.290	9.4664E-02
36.830	6.0886E-02	39.370	4.0452E-02	41.910	2.6905E-02
44.450	1.5415E-02	46.990	5.1836E-03	49.530	7.2457E-03
52.070	4.3555E-03	54.610	2.6269E-03	57.150	1.0164E-03
59.690	2.1531E-04	60.960	8.4393E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2022.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	7.690E+02	0.0848	292.65	2	1.000E-01	7.729E+02	0.0845	292.65
3	2.000E-01	7.702E+02	0.0847	292.65	4	3.000E-01	7.693E+02	0.0848	292.65
5	4.000E-01	7.693E+02	0.0848	292.65	6	5.000E-01	7.692E+02	0.0848	292.65
7	6.000E-01	7.690E+02	0.0848	292.65	8	7.000E-01	7.687E+02	0.0849	292.65
9	8.000E-01	7.684E+02	0.0849	292.65	10	9.000E-01	7.681E+02	0.0849	292.65
11	1.000E+00	7.678E+02	0.0849	292.65	12	1.250E+00	7.671E+02	0.0850	292.65
13	1.500E+00	7.663E+02	0.0851	292.65	14	1.750E+00	7.656E+02	0.0851	292.65
15	2.000E+00	7.650E+02	0.0852	292.65	16	2.500E+00	7.638E+02	0.0853	292.65
17	3.000E+00	7.628E+02	0.0854	292.65	18	3.500E+00	7.619E+02	0.0854	292.65
19	4.000E+00	7.611E+02	0.0855	292.65	20	4.500E+00	7.604E+02	0.0856	292.65
21	5.080E+00	7.598E+02	0.0856	292.65	22	7.620E+00	7.590E+02	0.0857	292.65
23	1.016E+01	7.615E+02	0.0855	292.65	24	1.270E+01	7.678E+02	0.0849	292.65
25	1.524E+01	7.783E+02	0.0841	292.65	26	1.778E+01	7.939E+02	0.0828	292.65
27	2.032E+01	8.161E+02	0.0812	292.65	28	2.286E+01	8.466E+02	0.0790	292.65
29	2.540E+01	8.888E+02	0.0763	292.65	30	2.794E+01	9.477E+02	0.0730	292.65
31	3.048E+01	1.032E+03	0.0689	292.65	32	3.302E+01	1.159E+03	0.0639	292.65
33	3.556E+01	1.352E+03	0.0582	292.65	34	3.810E+01	1.595E+03	0.0532	292.65
35	4.064E+01	1.759E+03	0.0506	292.65	36	4.318E+01	1.810E+03	0.0499	292.65
37	4.572E+01	1.818E+03	0.0498	292.65	38	4.826E+01	1.677E+03	0.0501	292.65
39	5.080E+01	1.013E+03	0.0503	292.65	40	5.334E+01	8.207E+02	0.0505	292.65
41	5.588E+01	7.908E+02	0.0506	292.65	42	5.842E+01	8.010E+02	0.0506	292.65
43	6.096E+01	8.121E+02	0.0506	292.65					

Initial Water Storage = 4.1095 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03007     0.06885     0.07205     0.05055
 Head (cm)         = 1.94159E+05 1.03254E+03 9.65377E+02 8.11724E+02
 LiqWater Flow (cm)=-6.13787E-02-1.00590E-01 1.22132E-01 1.36909E-07
 IsoVapor Flow (cm)=-7.69706E-02-1.07066E-06 1.08323E-06 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1095+ 0.0508+ 0.0000 - 0.1919- 0.0000-  0.0000 =    3.9684 vs.    3.9684

 Mass Balance = -2.5828E-05 cm;  Time step attempts =  249 and successes =  212
   Evaporation:  Potential =  0.4749 cm, Actual =  0.1919 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 80.3 %;  TMEAN = 280.4 K;  HDRY =  3.0227E+05 cm;  DAYUBC =    64

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04538     0.05002     0.05040
 Head (cm)         = 7.13118E+05 2.24955E+03 1.80431E+03 9.19052E+02
 LiqWater Flow (cm)=-1.90941E-04-4.49894E-02-9.43795E-04 4.92348E-08
 IsoVapor Flow (cm)=-7.59010E-02-1.20362E-05-2.68710E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                             LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1553+ 0.0000+ 0.0000 - 0.0761- 0.0000-  0.0000 =    3.0791 vs.    3.0792

 Mass Balance = -6.8439E-05 cm;  Time step attempts =  384 and successes =  298
   Evaporation:  Potential =  0.5522 cm, Actual =  0.0761 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.6 %;  TMEAN = 285.7 K;  HDRY =  7.1312E+05 cm;  DAYUBC =   196
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.1971E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.1971E+02	[cm]
Actual Evaporation	=	2.3679E+01	[cm]
Evaporation during Growth	=	2.3679E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	2.2657E+01	[cm]
Total Basal Liquid Flux (drainage)	=	3.5058E-05	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.2657E+01	[cm]
Actual Rainfall	=	2.2657E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.0792E+00	[cm]
Mass Balance Error	=	7.6719E-03	[cm]
Total Successful Time Steps	=	62600	
Total Attempted Time Steps	=	76696	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30520	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.0226E+00	0.050	1.3262E+01	0.150	7.9358E+00
0.250	6.3469E+00	0.350	5.6242E+00	0.450	5.0484E+00
0.550	4.4957E+00	0.650	3.9954E+00	0.750	3.6262E+00
0.850	3.3856E+00	0.950	3.1337E+00	1.125	2.7920E+00
1.375	2.1757E+00	1.625	1.7327E+00	1.875	1.4342E+00
2.250	1.1971E+00	2.750	7.0736E-01	3.250	2.6499E-01
3.750	3.1814E-02	4.250	-1.3891E-01	4.790	-2.5948E-01
6.350	-3.2064E-01	8.890	-3.9560E-01	11.430	-4.1086E-01
13.970	-4.1255E-01	16.510	-4.1613E-01	19.050	-3.7729E-01
21.590	-3.0277E-01	24.130	-2.3149E-01	26.670	-1.6554E-01
29.210	-1.0737E-01	31.750	-5.9548E-02	34.290	-2.4580E-02
36.830	-4.3548E-03	39.370	2.6465E-03	41.910	2.7888E-03
44.450	8.7978E-04	46.990	-8.2617E-04	49.530	1.3764E-03
52.070	-2.0519E-05	54.610	-3.4592E-04	57.150	-2.6572E-04
59.690	-6.6489E-05	60.960	3.5058E-05		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2023.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	7.131E+05	0.0300	292.65	2	1.000E-01	5.880E+05	0.0300	292.65
3	2.000E-01	4.734E+05	0.0300	292.65	4	3.000E-01	3.675E+05	0.0300	292.65
5	4.000E-01	2.692E+05	0.0300	292.65	6	5.000E-01	1.775E+05	0.0301	292.65
7	6.000E-01	9.146E+04	0.0302	292.65	8	7.000E-01	1.063E+04	0.0324	292.65
9	8.000E-01	3.899E+03	0.0380	292.65	10	9.000E-01	3.425E+03	0.0393	292.65
11	1.000E+00	3.144E+03	0.0403	292.65	12	1.250E+00	2.740E+03	0.0422	292.65
13	1.500E+00	2.513E+03	0.0435	292.65	14	1.750E+00	2.361E+03	0.0445	292.65
15	2.000E+00	2.250E+03	0.0454	292.65	16	2.500E+00	2.092E+03	0.0468	292.65
17	3.000E+00	1.983E+03	0.0479	292.65	18	3.500E+00	1.903E+03	0.0488	292.65
19	4.000E+00	1.841E+03	0.0495	292.65	20	4.500E+00	1.791E+03	0.0502	292.65
21	5.080E+00	1.745E+03	0.0508	292.65	22	7.620E+00	1.625E+03	0.0527	292.65
23	1.016E+01	1.578E+03	0.0535	292.65	24	1.270E+01	1.571E+03	0.0536	292.65
25	1.524E+01	1.592E+03	0.0532	292.65	26	1.778E+01	1.633E+03	0.0525	292.65
27	2.032E+01	1.687E+03	0.0517	292.65	28	2.286E+01	1.741E+03	0.0509	292.65
29	2.540E+01	1.783E+03	0.0503	292.65	30	2.794E+01	1.804E+03	0.0500	292.65
31	3.048E+01	1.807E+03	0.0500	292.65	32	3.302E+01	1.799E+03	0.0501	292.65
33	3.556E+01	1.787E+03	0.0503	292.65	34	3.810E+01	1.775E+03	0.0504	292.65
35	4.064E+01	1.764E+03	0.0506	292.65	36	4.318E+01	1.756E+03	0.0507	292.65
37	4.572E+01	1.751E+03	0.0508	292.65	38	4.826E+01	1.644E+03	0.0501	292.65
39	5.080E+01	1.095E+03	0.0503	292.65	40	5.334E+01	9.291E+02	0.0504	292.65
41	5.588E+01	9.105E+02	0.0504	292.65	42	5.842E+01	9.162E+02	0.0504	292.65
43	6.096E+01	9.191E+02	0.0504	292.65					

Initial Water Storage = 3.0792 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04259     0.05062     0.05040
 Head (cm)         = 7.09845E+05 2.65856E+03 1.75996E+03 9.18960E+02
 LiqWater Flow (cm)=-3.77650E-11-2.65466E-02 1.41622E-03 4.92759E-08
 IsoVapor Flow (cm)=-3.37138E-02-2.19733E-05 2.23954E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0792+ 0.0000+ 0.0000 - 0.0337- 0.0000-  0.0000 =    3.0455 vs.    3.0455

 Mass Balance = -3.0199E-05 cm;  Time step attempts =  188 and successes =  152
   Evaporation:  Potential =  0.4151 cm, Actual =  0.0337 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 59.8 %;  TMEAN = 286.2 K;  HDRY =  7.0984E+05 cm;  DAYUBC =   151

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05008     0.05017
 Head (cm)         = 1.53614E+06 6.45743E+05 1.79963E+03 1.28813E+03
 LiqWater Flow (cm)=-4.67446E-13-6.35194E-11-1.47252E-03 3.04359E-09
 IsoVapor Flow (cm)=-1.32429E-02-1.32300E-02-3.47915E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9187+ 0.0000+ 0.0000 - 0.0132- 0.0000-  0.0000 =    2.9055 vs.    2.9055

 Mass Balance = -1.2203E-05 cm;  Time step attempts =   53 and successes =   43
   Evaporation:  Potential =  0.4463 cm, Actual =  0.0132 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 32.8 %;  TMEAN = 280.9 K;  HDRY =  1.5361E+06 cm;  DAYUBC =    43
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.3745E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.3745E+02	[cm]
Actual Evaporation	=	1.1190E+01	[cm]
Evaporation during Growth	=	1.1190E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.1024E+01	[cm]
Total Basal Liquid Flux (drainage)	=	9.5042E-06	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.1024E+01	[cm]
Actual Rainfall	=	1.1024E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.9055E+00	[cm]
Mass Balance Error	=	7.1604E-03	[cm]
Total Successful Time Steps	=	58166	
Total Attempted Time Steps	=	71682	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30988	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.6654E-01	0.050	8.5541E+00	0.150	6.6400E+00
0.250	5.9689E+00	0.350	5.5754E+00	0.450	5.2071E+00
0.550	4.8866E+00	0.650	4.6127E+00	0.750	4.3524E+00
0.850	4.0912E+00	0.950	3.8981E+00	1.125	3.7007E+00
1.375	3.0843E+00	1.625	2.7186E+00	1.875	2.4351E+00
2.250	2.1806E+00	2.750	1.6134E+00	3.250	1.2663E+00
3.750	1.0188E+00	4.250	9.0474E-01	4.790	7.5423E-01
6.350	5.9553E-01	8.890	3.8750E-01	11.430	2.8098E-01
13.970	1.8077E-01	16.510	9.3399E-02	19.050	4.4657E-02
21.590	2.5445E-03	24.130	2.7413E-03	26.670	3.7609E-03
29.210	3.4500E-03	31.750	2.5123E-03	34.290	1.4076E-03
36.830	3.6622E-04	39.370	-5.3137E-04	41.910	-1.2815E-03
44.450	-1.9150E-03	46.990	-1.3030E-03	49.530	-6.9550E-06
52.070	-9.5667E-05	54.610	-1.4331E-04	57.150	-1.2430E-04
59.690	-4.7044E-05	60.960	9.5042E-06		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\gkmathiason\OneDrive - Burns & McDonnell\El Paso TX UNSA
Results File: C:\Users\gkmathiason\Documents\EL PASO\elpaso2024.res
Date of Run: 15 Sep 2025
Time of Run: 17:02:21.02
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity

---

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.536E+06	0.0300	292.65	2	1.000E-01	1.475E+06	0.0300	292.65
3	2.000E-01	1.416E+06	0.0300	292.65	4	3.000E-01	1.360E+06	0.0300	292.65
5	4.000E-01	1.306E+06	0.0300	292.65	6	5.000E-01	1.254E+06	0.0300	292.65
7	6.000E-01	1.204E+06	0.0300	292.65	8	7.000E-01	1.155E+06	0.0300	292.65
9	8.000E-01	1.109E+06	0.0300	292.65	10	9.000E-01	1.064E+06	0.0300	292.65
11	1.000E+00	1.020E+06	0.0300	292.65	12	1.250E+00	9.166E+05	0.0300	292.65
13	1.500E+00	8.203E+05	0.0300	292.65	14	1.750E+00	7.303E+05	0.0300	292.65
15	2.000E+00	6.457E+05	0.0300	292.65	16	2.500E+00	4.907E+05	0.0300	292.65
17	3.000E+00	3.514E+05	0.0300	292.65	18	3.500E+00	2.249E+05	0.0301	292.65
19	4.000E+00	1.090E+05	0.0301	292.65	20	4.500E+00	3.731E+03	0.0384	292.65
21	5.080E+00	3.224E+03	0.0400	292.65	22	7.620E+00	2.502E+03	0.0435	292.65
23	1.016E+01	2.243E+03	0.0454	292.65	24	1.270E+01	2.098E+03	0.0467	292.65
25	1.524E+01	2.003E+03	0.0477	292.65	26	1.778E+01	1.936E+03	0.0484	292.65
27	2.032E+01	1.887E+03	0.0490	292.65	28	2.286E+01	1.850E+03	0.0494	292.65
29	2.540E+01	1.822E+03	0.0498	292.65	30	2.794E+01	1.800E+03	0.0501	292.65
31	3.048E+01	1.782E+03	0.0503	292.65	32	3.302E+01	1.769E+03	0.0505	292.65
33	3.556E+01	1.759E+03	0.0506	292.65	34	3.810E+01	1.750E+03	0.0508	292.65
35	4.064E+01	1.744E+03	0.0508	292.65	36	4.318E+01	1.739E+03	0.0509	292.65
37	4.572E+01	1.735E+03	0.0510	292.65	38	4.826E+01	1.694E+03	0.0501	292.65
39	5.080E+01	1.492E+03	0.0501	292.65	40	5.334E+01	1.367E+03	0.0501	292.65
41	5.588E+01	1.314E+03	0.0502	292.65	42	5.842E+01	1.294E+03	0.0502	292.65
43	6.096E+01	1.288E+03	0.0502	292.65					

Initial Water Storage = 2.9055 cm

NOTE: There are no temperature data when plants are modelled.

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 1 15 30 43

```
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04992     0.05017
 Head (cm)         = 1.41657E+06 6.11101E+05 1.81176E+03 1.28849E+03
 LiqWater Flow (cm)=-5.31571E-13-3.38265E-11-1.63953E-03 3.03662E-09
 IsoVapor Flow (cm)=-1.14111E-02-1.14135E-02-3.91562E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9055+ 0.0000+ 0.0000 - 0.0114- 0.0000-  0.0000 =    2.8941 vs.    2.8941

 Mass Balance = -3.2587E-07 cm;  Time step attempts =   50 and successes =   48
   Evaporation:  Potential =  0.3896 cm, Actual =  0.0114 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 35.8 %;  TMEAN = 281.5 K;  HDRY =  1.4166E+06 cm;  DAYUBC =    47

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04883     0.05011
 Head (cm)         = 2.16723E+06 1.21629E+06 1.89917E+03 1.57469E+03
 LiqWater Flow (cm)=-7.63296E-14-8.77908E-13-2.50597E-03 5.79501E-10
 IsoVapor Flow (cm)=-8.28116E-03-8.28138E-03-6.96934E-07 0.00000E+00
 Plant Sink (cm)   = 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00

                                          LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8239+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.8156 vs.    2.8156

 Mass Balance = -2.8503E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.8891 cm, Actual =  0.0083 cm
 Transpiration:  Potential =  0.0000 cm, Actual =  0.0000 cm
 RHMEAN = 20.8 %;  TMEAN = 286.2 K;  HDRY =  2.1672E+06 cm;  DAYUBC =    77
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, 20% Hydraulic Conductivity
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    1
 Potential Evapotranspiration       =  3.4447E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
```

Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	3.4447E+02	[cm]
Actual Evaporation	=	1.1716E+01	[cm]
Evaporation during Growth	=	1.1716E+01	[cm]
Total Runoff	=	0.0000E+00	[cm]
Total Infiltration	=	1.1633E+01	[cm]
Total Basal Liquid Flux (drainage)	=	3.6862E-07	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	1.1633E+01	[cm]
Actual Rainfall	=	1.1633E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8156E+00	[cm]
Mass Balance Error	=	6.7202E-03	[cm]
Total Successful Time Steps	=	54981	
Total Attempted Time Steps	=	67333	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29564	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.3142E-02	0.050	9.0335E+00	0.150	6.9946E+00
0.250	6.2631E+00	0.350	5.6213E+00	0.450	5.1782E+00
0.550	4.8359E+00	0.650	4.5296E+00	0.750	4.2362E+00
0.850	4.0020E+00	0.950	3.7215E+00	1.125	3.5439E+00
1.375	3.1244E+00	1.625	2.8629E+00	1.875	2.5104E+00
2.250	2.3036E+00	2.750	1.8906E+00	3.250	1.4986E+00
3.750	1.2892E+00	4.250	1.1080E+00	4.790	8.9021E-01
6.350	6.7382E-01	8.890	2.7221E-01	11.430	2.1388E-01
13.970	1.5743E-01	16.510	1.0701E-01	19.050	5.7268E-02
21.590	1.0768E-02	24.130	-1.9890E-02	26.670	-1.6783E-02
29.210	-1.3794E-02	31.750	-1.1137E-02	34.290	-8.8085E-03
36.830	-6.7786E-03	39.370	-5.0041E-03	41.910	-3.4136E-03
44.450	-1.9539E-03	46.990	4.1988E-05	49.530	4.0472E-05
52.070	1.6781E-07	54.610	-3.9210E-06	57.150	-4.1602E-06
59.690	-1.5565E-06	60.960	3.6862E-07		

Total plant water uptake (cm) at different depths:

DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE	DEPTH	WATER UPTAKE
0.000	0.0000E+00	0.100	0.0000E+00	0.200	0.0000E+00
0.300	0.0000E+00	0.400	0.0000E+00	0.500	0.0000E+00
0.600	0.0000E+00	0.700	0.0000E+00	0.800	0.0000E+00

0.900	0.0000E+00	1.000	0.0000E+00	1.250	0.0000E+00
1.500	0.0000E+00	1.750	0.0000E+00	2.000	0.0000E+00
2.500	0.0000E+00	3.000	0.0000E+00	3.500	0.0000E+00
4.000	0.0000E+00	4.500	0.0000E+00	5.080	0.0000E+00
7.620	0.0000E+00	10.160	0.0000E+00	12.700	0.0000E+00
15.240	0.0000E+00	17.780	0.0000E+00	20.320	0.0000E+00
22.860	0.0000E+00	25.400	0.0000E+00	27.940	0.0000E+00
30.480	0.0000E+00	33.020	0.0000E+00	35.560	0.0000E+00
38.100	0.0000E+00	40.640	0.0000E+00	43.180	0.0000E+00
45.720	0.0000E+00	48.260	0.0000E+00	50.800	0.0000E+00
53.340	0.0000E+00	55.880	0.0000E+00	58.420	0.0000E+00
60.960	0.0000E+00				

APPENDIX III.I.1.D – UNSAT-H MODEL INPUT AND OUTPUT: NO PLANTS



```
Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1995,30,0,2,30,                         IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24,                                   NPRINT,STOPHR
0,4,1,1.0E-6,                           ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-8,1.0,                         DELMAX,DELMIN,OUTTIM
1.2,1.0E-4,0.0,0.0,0.0,                 RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.0,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
1.0,1.0E6,0.0,0.0,                      HIRRI,HDRY,HTOP,RHA
1,0,1,                                  IETOPT,ICLOUD,ISHOPT
1,1.0,                                  IRAIN,HPR
0,0.0,0.0,0.0,0,                        IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0.0,                                IHEAT,ICONVH,DMAXHE
0,0.0,0.0,0.0,                          UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,292.65,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
2,43,                                   MATN,NPT
1, 0.00,1, 0.10,1, 0.20,1, 0.30,
1, 0.40,1, 0.50,1, 0.60,1, 0.70,
1, 0.80,1, 0.90,1, 1.00,1, 1.25,
1, 1.50,1, 1.75,1, 2.00,1, 2.50,
1, 3.00,1, 3.50,1, 4.00,1, 4.50,
1, 5.08,1, 7.62,1,10.16,1,12.70,
1,15.24,1,17.78,1,20.32,1,22.86,
1,25.40,1,27.94,1,30.48,1,33.02,
1,35.56,1,38.10,1,40.64,1,43.18,
1,45.72,2,48.26,2,50.80,2,53.34,
2,55.88,2,58.42,2,60.96,
90% Compaction Layer            DUMMY
0.38,0.03,0.006,2.2,            THET,THTR,VGA,VGN
conductivity                    DUMMY
2.0,4.6,0.006,2.2,0.5,          RKMOD,SK,VGA,VGN,EPIT
80% Compaction Layer            DUMMY
0.44,0.05,0.017,3.5,            THET,THTR,vGA,vGN
conductivity                    DUMMY
2.0,23.7,0.017,3.5,0.5,         RKMOD,SK,VGA,VGN,EPIT
0,                              NDAY
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,575.0,575.0,575.0,
575.0,125.0,125.0,125.0,
125.0,125.0,125.0,
```

```
0.20,1234,0.5,875.0,                    ALBEDO,ALT,ZU,PMB
1995.txt
1996.txt
1997.txt
1998.txt
1999.txt
2000.txt
2001.txt
2002.txt
2003.txt
2004.txt
2005.txt
2006.txt
2007.txt
2008.txt
2009.txt
2010.txt
2011.txt
2012.txt
2013.txt
2014.txt
2015.txt
2016.txt
2017.txt
2018.txt
2019.txt
2020.txt
2021.txt
2022.txt
2023.txt
2024.txt
```

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
```

NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	5.750E+02	0.1065	292.65	2	1.000E-01	5.750E+02	0.1065	292.65
3	2.000E-01	5.750E+02	0.1065	292.65	4	3.000E-01	5.750E+02	0.1065	292.65
5	4.000E-01	5.750E+02	0.1065	292.65	6	5.000E-01	5.750E+02	0.1065	292.65
7	6.000E-01	5.750E+02	0.1065	292.65	8	7.000E-01	5.750E+02	0.1065	292.65
9	8.000E-01	5.750E+02	0.1065	292.65	10	9.000E-01	5.750E+02	0.1065	292.65
11	1.000E+00	5.750E+02	0.1065	292.65	12	1.250E+00	5.750E+02	0.1065	292.65
13	1.500E+00	5.750E+02	0.1065	292.65	14	1.750E+00	5.750E+02	0.1065	292.65
15	2.000E+00	5.750E+02	0.1065	292.65	16	2.500E+00	5.750E+02	0.1065	292.65
17	3.000E+00	5.750E+02	0.1065	292.65	18	3.500E+00	5.750E+02	0.1065	292.65
19	4.000E+00	5.750E+02	0.1065	292.65	20	4.500E+00	5.750E+02	0.1065	292.65
21	5.080E+00	5.750E+02	0.1065	292.65	22	7.620E+00	5.750E+02	0.1065	292.65
23	1.016E+01	5.750E+02	0.1065	292.65	24	1.270E+01	5.750E+02	0.1065	292.65
25	1.524E+01	5.750E+02	0.1065	292.65	26	1.778E+01	5.750E+02	0.1065	292.65
27	2.032E+01	5.750E+02	0.1065	292.65	28	2.286E+01	5.750E+02	0.1065	292.65
29	2.540E+01	5.750E+02	0.1065	292.65	30	2.794E+01	5.750E+02	0.1065	292.65
31	3.048E+01	5.750E+02	0.1065	292.65	32	3.302E+01	5.750E+02	0.1065	292.65
33	3.556E+01	5.750E+02	0.1065	292.65	34	3.810E+01	5.750E+02	0.1065	292.65
35	4.064E+01	5.750E+02	0.1065	292.65	36	4.318E+01	5.750E+02	0.1065	292.65
37	4.572E+01	5.750E+02	0.1065	292.65	38	4.826E+01	1.250E+02	0.1064	292.65
39	5.080E+01	1.250E+02	0.1064	292.65	40	5.334E+01	1.250E+02	0.1064	292.65
41	5.588E+01	1.250E+02	0.1064	292.65	42	5.842E+01	1.250E+02	0.1064	292.65
43	6.096E+01	1.250E+02	0.1064	292.65					

```
 Initial Water Storage =   6.4909 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.09064     0.09148     0.11152     0.07609
 Head (cm)         = 7.04973E+02 6.96597E+02 5.43311E+02 1.72394E+02
```

```
 LiqWater Flow (cm)=-3.30934E-01-2.96830E-01-1.85300E-01 1.40052E-01
 IsoVapor Flow (cm)=-2.35437E-06-9.10224E-07-1.40543E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   6.4909+ 0.0000+ 0.0000 - 0.3317- 0.0000-  0.1401 =    6.0191 vs.    6.0191

 Mass Balance = -4.9484E-05 cm;  Time step attempts =  219 and successes =  197
   Evaporation:  Potential =  0.3317 cm, Actual =  0.3317 cm
 RHMEAN = 60.0 %;  TMEAN = 278.4 K;  HDRY =  7.0365E+05 cm;  DAYUBC =     0

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04795     0.05164
 Head (cm)         = 1.32310E+06 1.95513E+05 1.97735E+03 5.25300E+02
 LiqWater Flow (cm)= 5.23751E-02 1.17400E-02-1.02339E-03 4.16114E-06
 IsoVapor Flow (cm)=-4.34634E-02-2.98159E-03-4.48495E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8359+ 0.0762+ 0.0000 - 0.0673- 0.0000-  0.0000 =    2.8448 vs.    2.8446

 Mass Balance =  1.3370E-04 cm;  Time step attempts = 1382 and successes = 1068
   Evaporation:  Potential =  1.0289 cm, Actual =  0.0673 cm
 RHMEAN = 38.3 %;  TMEAN = 284.8 K;  HDRY =  1.3231E+06 cm;  DAYUBC =   449
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1660E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1660E+02     [cm]
 Actual Evaporation                 =  1.8814E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.5392E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.1868E-01     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.5392E+01     [cm]
Actual Rainfall                    =  1.5392E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8446E+00     [cm]
Mass Balance Error                 =  6.0031E-03     [cm]
Total Successful Time Steps        =     57521
Total Attempted Time Steps         =     70351
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30386
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-3.4216E+00	0.050	8.5530E+00	0.150	5.3339E+00
0.250	3.9850E+00	0.350	3.2012E+00	0.450	2.6445E+00
0.550	2.0839E+00	0.650	1.7436E+00	0.750	1.3917E+00
0.850	1.0897E+00	0.950	7.2371E-01	1.125	4.4810E-01
1.375	-1.6629E-01	1.625	-6.1738E-01	1.875	-9.0390E-01
2.250	-1.0926E+00	2.750	-1.4609E+00	3.250	-1.7134E+00
3.750	-1.9646E+00	4.250	-2.1095E+00	4.790	-2.2048E+00
6.350	-2.2550E+00	8.890	-2.4396E+00	11.430	-2.4155E+00
13.970	-2.3801E+00	16.510	-2.3243E+00	19.050	-2.1800E+00
21.590	-2.0289E+00	24.130	-1.8788E+00	26.670	-1.7295E+00
29.210	-1.5809E+00	31.750	-1.4328E+00	34.290	-1.2852E+00
36.830	-1.1381E+00	39.370	-9.9119E-01	41.910	-8.4460E-01
44.450	-6.9822E-01	46.990	-5.4946E-01	49.530	-4.0137E-01
52.070	-2.6876E-01	54.610	-1.2923E-01	57.150	1.0036E-02
59.690	1.4915E-01	60.960	2.1868E-01		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                 -----------------------                 -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.323E+06 0.0300 292.65     2 1.000E-01 1.238E+06 0.0300 292.65
     3 2.000E-01 1.159E+06 0.0300 292.65     4 3.000E-01 1.083E+06 0.0300 292.65
     5 4.000E-01 1.012E+06 0.0300 292.65     6 5.000E-01 9.440E+05 0.0300 292.65
     7 6.000E-01 8.793E+05 0.0300 292.65     8 7.000E-01 8.175E+05 0.0300 292.65
     9 8.000E-01 7.583E+05 0.0300 292.65    10 9.000E-01 7.015E+05 0.0300 292.65
    11 1.000E+00 6.470E+05 0.0300 292.65    12 1.250E+00 5.195E+05 0.0300 292.65
    13 1.500E+00 4.028E+05 0.0300 292.65    14 1.750E+00 2.952E+05 0.0300 292.65
    15 2.000E+00 1.955E+05 0.0301 292.65    16 2.500E+00 1.530E+04 0.0315 292.65
    17 3.000E+00 4.914E+03 0.0360 292.65    18 3.500E+00 4.731E+03 0.0363 292.65
    19 4.000E+00 4.769E+03 0.0363 292.65    20 4.500E+00 4.436E+03 0.0368 292.65
    21 5.080E+00 3.894E+03 0.0380 292.65    22 7.620E+00 2.795E+03 0.0419 292.65
    23 1.016E+01 2.481E+03 0.0437 292.65    24 1.270E+01 2.313E+03 0.0449 292.65
    25 1.524E+01 2.207E+03 0.0457 292.65    26 1.778E+01 2.132E+03 0.0464 292.65
    27 2.032E+01 2.078E+03 0.0469 292.65    28 2.286E+01 2.036E+03 0.0473 292.65
    29 2.540E+01 2.003E+03 0.0477 292.65    30 2.794E+01 1.977E+03 0.0479 292.65
    31 3.048E+01 1.956E+03 0.0482 292.65    32 3.302E+01 1.939E+03 0.0484 292.65
    33 3.556E+01 1.925E+03 0.0485 292.65    34 3.810E+01 1.913E+03 0.0487 292.65
    35 4.064E+01 1.904E+03 0.0488 292.65    36 4.318E+01 1.897E+03 0.0489 292.65
    37 4.572E+01 1.892E+03 0.0489 292.65    38 4.826E+01 1.602E+03 0.0501 292.65
    39 5.080E+01 5.861E+02 0.0512 292.65    40 5.334E+01 5.530E+02 0.0514 292.65
    41 5.588E+01 5.364E+02 0.0516 292.65    42 5.842E+01 5.279E+02 0.0516 292.65
    43 6.096E+01 5.253E+02 0.0516 292.65

 Initial Water Storage =   2.8446 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03005     0.04786     0.05163
 Head (cm)         = 6.46939E+05 2.64598E+05 1.98486E+03 5.25739E+02
```

```
 LiqWater Flow (cm)=-1.04353E-11-1.40322E-07-1.06432E-03 4.13257E-06
 IsoVapor Flow (cm)=-9.19674E-03-9.20291E-03-4.71421E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.8446+ 0.0000+ 0.0000 - 0.0092- 0.0000-  0.0000 =     2.8354 vs.     2.8355

 Mass Balance = -2.7207E-05 cm;  Time step attempts =  103 and successes =   81
   Evaporation:  Potential =  0.3638 cm, Actual =  0.0092 cm
 RHMEAN = 62.5 %;  TMEAN = 279.0 K;  HDRY =  6.4694E+05 cm;  DAYUBC =    78

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04628     0.05093
 Head (cm)         = 1.37244E+06 9.76165E+05 2.14499E+03 6.58202E+02
 LiqWater Flow (cm)=-2.06547E-13-9.99673E-13-1.46826E-03 6.46714E-07
 IsoVapor Flow (cm)=-4.94573E-03-4.94516E-03-8.85352E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.6965+ 0.0000+ 0.0000 - 0.0049- 0.0000-  0.0000 =     2.6915 vs.     2.6915

 Mass Balance =  2.1425E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3649 cm, Actual =  0.0049 cm
 RHMEAN = 36.9 %;  TMEAN = 282.9 K;  HDRY =  1.3724E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.3540E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3540E+02     [cm]
 Actual Evaporation                 =  2.1457E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.1311E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.0918E-04     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1311E+01     [cm]
Actual Rainfall                    =  2.1311E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.6915E+00     [cm]
Mass Balance Error                 =  6.3878E-03     [cm]
Total Successful Time Steps        =     50967
Total Attempted Time Steps         =     61488
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     26469
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.4610E-01	0.050	1.5303E+01	0.150	8.2999E+00
0.250	6.4493E+00	0.350	5.2358E+00	0.450	4.4320E+00
0.550	3.9595E+00	0.650	3.6295E+00	0.750	3.4465E+00
0.850	3.1397E+00	0.950	2.9979E+00	1.125	2.7912E+00
1.375	2.4272E+00	1.625	2.2129E+00	1.875	2.0704E+00
2.250	1.9183E+00	2.750	1.6150E+00	3.250	1.4752E+00
3.750	1.3252E+00	4.250	1.1923E+00	4.790	1.0949E+00
6.350	9.3450E-01	8.890	4.5841E-01	11.430	2.3411E-01
13.970	1.1022E-01	16.510	-2.1620E-02	19.050	-4.9194E-02
21.590	-4.3707E-02	24.130	-3.8701E-02	26.670	-3.4193E-02
29.210	-3.0100E-02	31.750	-2.6353E-02	34.290	-2.2883E-02
36.830	-1.9624E-02	39.370	-1.6531E-02	41.910	-1.3559E-02
44.450	-1.0664E-02	46.990	-5.9001E-03	49.530	-1.0519E-03
52.070	-5.0177E-03	54.610	-3.5985E-03	57.150	-1.9528E-03
59.690	-2.5020E-04	60.960	6.0918E-04		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                ----------------------                ----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.372E+06 0.0300 292.65     2 1.000E-01 1.349E+06 0.0300 292.65
     3 2.000E-01 1.327E+06 0.0300 292.65     4 3.000E-01 1.305E+06 0.0300 292.65
     5 4.000E-01 1.284E+06 0.0300 292.65     6 5.000E-01 1.262E+06 0.0300 292.65
     7 6.000E-01 1.241E+06 0.0300 292.65     8 7.000E-01 1.221E+06 0.0300 292.65
     9 8.000E-01 1.200E+06 0.0300 292.65    10 9.000E-01 1.180E+06 0.0300 292.65
    11 1.000E+00 1.160E+06 0.0300 292.65    12 1.250E+00 1.112E+06 0.0300 292.65
    13 1.500E+00 1.065E+06 0.0300 292.65    14 1.750E+00 1.020E+06 0.0300 292.65
    15 2.000E+00 9.762E+05 0.0300 292.65    16 2.500E+00 8.926E+05 0.0300 292.65
    17 3.000E+00 8.137E+05 0.0300 292.65    18 3.500E+00 7.392E+05 0.0300 292.65
    19 4.000E+00 6.685E+05 0.0300 292.65    20 4.500E+00 6.013E+05 0.0300 292.65
    21 5.080E+00 5.272E+05 0.0300 292.65    22 7.620E+00 2.423E+05 0.0301 292.65
    23 1.016E+01 4.947E+03 0.0360 292.65    24 1.270E+01 3.058E+03 0.0406 292.65
    25 1.524E+01 2.685E+03 0.0424 292.65    26 1.778E+01 2.486E+03 0.0436 292.65
    27 2.032E+01 2.357E+03 0.0445 292.65    28 2.286E+01 2.265E+03 0.0453 292.65
    29 2.540E+01 2.197E+03 0.0458 292.65    30 2.794E+01 2.145E+03 0.0463 292.65
    31 3.048E+01 2.104E+03 0.0467 292.65    32 3.302E+01 2.072E+03 0.0470 292.65
    33 3.556E+01 2.046E+03 0.0472 292.65    34 3.810E+01 2.026E+03 0.0474 292.65
    35 4.064E+01 2.011E+03 0.0476 292.65    36 4.318E+01 2.000E+03 0.0477 292.65
    37 4.572E+01 1.993E+03 0.0478 292.65    38 4.826E+01 1.736E+03 0.0501 292.65
    39 5.080E+01 9.141E+02 0.0504 292.65    40 5.334E+01 7.279E+02 0.0507 292.65
    41 5.588E+01 6.817E+02 0.0509 292.65    42 5.842E+01 6.634E+02 0.0509 292.65
    43 6.096E+01 6.582E+02 0.0509 292.65

 Initial Water Storage =   2.6915 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04619     0.05093
 Head (cm)         = 1.39883E+06 9.92133E+05 2.15531E+03 6.58520E+02
```

```
 LiqWater Flow (cm)=-1.93373E-13-9.42340E-13-1.46981E-03 6.44141E-07
 IsoVapor Flow (cm)=-4.99903E-03-4.99863E-03-9.05855E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6915+ 0.0000+ 0.0000 - 0.0050- 0.0000-  0.0000 =    2.6865 vs.    2.6865

 Mass Balance =  1.2593E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6119 cm, Actual =  0.0050 cm
 RHMEAN = 36.2 %;  TMEAN = 287.6 K;  HDRY =  1.3988E+06 cm;  DAYUBC =    24

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.05124     0.07399     0.05058
 Head (cm)         = 5.55168E+05 1.71695E+03 9.28870E+02 7.97508E+02
 LiqWater Flow (cm)=-1.25591E-09-6.47971E-02-2.72442E-02 1.32651E-07
 IsoVapor Flow (cm)=-7.01576E-02-9.62803E-06-2.63151E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.0401+ 0.0000+ 0.0000 - 0.0702- 0.0000-  0.0000 =    3.9700 vs.    3.9700

 Mass Balance = -1.3438E-05 cm;  Time step attempts =  106 and successes =   84
   Evaporation:  Potential =  0.2501 cm, Actual =  0.0702 cm
 RHMEAN = 66.2 %;  TMEAN = 278.7 K;  HDRY =  5.6862E+05 cm;  DAYUBC =    65
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  2.8279E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.8279E+02     [cm]
 Actual Evaporation                 =  2.3170E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.4460E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.1399E-04     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.4460E+01     [cm]
Actual Rainfall                    =  2.4460E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.9700E+00     [cm]
Mass Balance Error                 =  1.1831E-02     [cm]
Total Successful Time Steps        =     81675
Total Attempted Time Steps         =    102016
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     38109
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.2904E+00	0.050	1.7795E+01	0.150	1.3673E+01
0.250	1.1751E+01	0.350	1.0355E+01	0.450	9.3016E+00
0.550	8.4322E+00	0.650	7.6790E+00	0.750	7.0336E+00
0.850	6.5895E+00	0.950	6.1165E+00	1.125	5.7004E+00
1.375	4.6234E+00	1.625	3.9974E+00	1.875	3.4912E+00
2.250	3.1282E+00	2.750	2.4964E+00	3.250	2.1583E+00
3.750	1.9172E+00	4.250	1.6718E+00	4.790	1.5194E+00
6.350	1.3664E+00	8.890	1.1405E+00	11.430	9.8696E-01
13.970	9.2072E-01	16.510	8.5501E-01	19.050	7.8865E-01
21.590	7.2133E-01	24.130	6.5296E-01	26.670	5.8352E-01
29.210	5.1306E-01	31.750	4.4167E-01	34.290	3.6941E-01
36.830	2.9636E-01	39.370	2.2263E-01	41.910	1.4829E-01
44.450	7.3438E-02	46.990	-1.2404E-03	49.530	1.5304E-06
52.070	-9.7184E-04	54.610	-1.3882E-03	57.150	-9.3634E-04
59.690	-2.5235E-04	60.960	1.1399E-04		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                 -----------------------                 -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 5.552E+05 0.0300 292.65     2 1.000E-01 3.917E+05 0.0300 292.65
     3 2.000E-01 2.464E+05 0.0301 292.65     4 3.000E-01 1.160E+05 0.0301 292.65
     5 4.000E-01 2.582E+03 0.0430 292.65     6 5.000E-01 2.438E+03 0.0440 292.65
     7 6.000E-01 2.328E+03 0.0448 292.65     8 7.000E-01 2.240E+03 0.0455 292.65
     9 8.000E-01 2.166E+03 0.0461 292.65    10 9.000E-01 2.102E+03 0.0467 292.65
    11 1.000E+00 2.047E+03 0.0472 292.65    12 1.250E+00 1.934E+03 0.0484 292.65
    13 1.500E+00 1.847E+03 0.0495 292.65    14 1.750E+00 1.776E+03 0.0504 292.65
    15 2.000E+00 1.717E+03 0.0512 292.65    16 2.500E+00 1.623E+03 0.0527 292.65
    17 3.000E+00 1.550E+03 0.0540 292.65    18 3.500E+00 1.491E+03 0.0551 292.65
    19 4.000E+00 1.442E+03 0.0562 292.65    20 4.500E+00 1.400E+03 0.0571 292.65
    21 5.080E+00 1.359E+03 0.0581 292.65    22 7.620E+00 1.230E+03 0.0616 292.65
    23 1.016E+01 1.149E+03 0.0642 292.65    24 1.270E+01 1.092E+03 0.0664 292.65
    25 1.524E+01 1.048E+03 0.0682 292.65    26 1.778E+01 1.014E+03 0.0697 292.65
    27 2.032E+01 9.865E+02 0.0710 292.65    28 2.286E+01 9.638E+02 0.0721 292.65
    29 2.540E+01 9.448E+02 0.0731 292.65    30 2.794E+01 9.289E+02 0.0740 292.65
    31 3.048E+01 9.154E+02 0.0748 292.65    32 3.302E+01 9.041E+02 0.0754 292.65
    33 3.556E+01 8.946E+02 0.0760 292.65    34 3.810E+01 8.867E+02 0.0765 292.65
    35 4.064E+01 8.803E+02 0.0768 292.65    36 4.318E+01 8.753E+02 0.0772 292.65
    37 4.572E+01 8.715E+02 0.0774 292.65    38 4.826E+01 8.608E+02 0.0505 292.65
    39 5.080E+01 9.434E+02 0.0504 292.65    40 5.334E+01 8.844E+02 0.0504 292.65
    41 5.588E+01 8.329E+02 0.0505 292.65    42 5.842E+01 8.059E+02 0.0506 292.65
    43 6.096E+01 7.975E+02 0.0506 292.65

 Initial Water Storage =   3.9700 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.05000     0.07264     0.05058
 Head (cm)         = 3.72655E+05 1.80564E+03 9.53849E+02 7.97785E+02
```

```
 LiqWater Flow (cm)=-5.38177E-10-5.82323E-02-2.50070E-02 1.32272E-07
 IsoVapor Flow (cm)=-6.14426E-02-1.09375E-05-2.74933E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9700+ 0.0000+ 0.0000 - 0.0614- 0.0000-  0.0000 =    3.9085 vs.    3.9085

 Mass Balance = -2.8098E-06 cm;  Time step attempts =   37 and successes =   31
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0614 cm
 RHMEAN = 66.3 %;  TMEAN = 279.3 K;  HDRY =  5.6596E+05 cm;  DAYUBC =    12

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03006     0.05686     0.05035
 Head (cm)         = 9.19880E+05 2.45277E+05 1.41005E+03 9.73624E+02
 LiqWater Flow (cm)=-3.18818E-12-6.80523E-07-5.73186E-03 2.55715E-08
 IsoVapor Flow (cm)=-1.33579E-02-1.33419E-02-4.41930E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2124+ 0.0000+ 0.0000 - 0.0134- 0.0000-  0.0000 =    3.1990 vs.    3.1990

 Mass Balance = -6.0264E-06 cm;  Time step attempts =   94 and successes =   90
   Evaporation:  Potential =  0.3702 cm, Actual =  0.0134 cm
 RHMEAN = 51.3 %;  TMEAN = 282.0 K;  HDRY =  9.1988E+05 cm;  DAYUBC =    85
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  2.9981E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.9981E+02     [cm]
 Actual Evaporation                 =  1.7959E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.7196E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.6652E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.7196E+01     [cm]
Actual Rainfall                    =  1.7196E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1990E+00     [cm]
Mass Balance Error                 =  7.6198E-03     [cm]
Total Successful Time Steps        =     63438
Total Attempted Time Steps         =     77938
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31495
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-7.6328E-01	0.050	1.1429E+01	0.150	8.2647E+00
0.250	7.1350E+00	0.350	6.1800E+00	0.450	5.4287E+00
0.550	4.9157E+00	0.650	4.4186E+00	0.750	3.9611E+00
0.850	3.6072E+00	0.950	3.2607E+00	1.125	2.9651E+00
1.375	2.2105E+00	1.625	1.7303E+00	1.875	1.3007E+00
2.250	1.0574E+00	2.750	5.7972E-01	3.250	2.9236E-01
3.750	5.5740E-02	4.250	-4.2571E-02	4.790	-1.0034E-01
6.350	-1.7476E-01	8.890	-3.5247E-01	11.430	-4.2850E-01
13.970	-4.6691E-01	16.510	-4.8928E-01	19.050	-4.9079E-01
21.590	-4.5036E-01	24.130	-4.0864E-01	26.670	-3.6600E-01
29.210	-3.2255E-01	31.750	-2.7840E-01	34.290	-2.3360E-01
36.830	-1.8825E-01	39.370	-1.4240E-01	41.910	-9.6115E-02
44.450	-4.9466E-02	46.990	-1.7710E-03	49.530	4.4838E-04
52.070	-1.3983E-04	54.610	-3.2787E-04	57.150	-3.1580E-04
59.690	-1.0951E-04	60.960	2.6652E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                 -----------------------                 -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 9.199E+05 0.0300 292.65     2 1.000E-01 8.770E+05 0.0300 292.65
     3 2.000E-01 8.355E+05 0.0300 292.65     4 3.000E-01 7.952E+05 0.0300 292.65
     5 4.000E-01 7.560E+05 0.0300 292.65     6 5.000E-01 7.179E+05 0.0300 292.65
     7 6.000E-01 6.808E+05 0.0300 292.65     8 7.000E-01 6.447E+05 0.0300 292.65
     9 8.000E-01 6.095E+05 0.0300 292.65    10 9.000E-01 5.752E+05 0.0300 292.65
    11 1.000E+00 5.417E+05 0.0300 292.65    12 1.250E+00 4.614E+05 0.0300 292.65
    13 1.500E+00 3.856E+05 0.0300 292.65    14 1.750E+00 3.136E+05 0.0300 292.65
    15 2.000E+00 2.453E+05 0.0301 292.65    16 2.500E+00 1.179E+05 0.0301 292.65
    17 3.000E+00 3.052E+03 0.0407 292.65    18 3.500E+00 2.743E+03 0.0421 292.65
    19 4.000E+00 2.548E+03 0.0432 292.65    20 4.500E+00 2.408E+03 0.0442 292.65
    21 5.080E+00 2.286E+03 0.0451 292.65    22 7.620E+00 1.968E+03 0.0480 292.65
    23 1.016E+01 1.800E+03 0.0501 292.65    24 1.270E+01 1.690E+03 0.0517 292.65
    25 1.524E+01 1.611E+03 0.0529 292.65    26 1.778E+01 1.551E+03 0.0540 292.65
    27 2.032E+01 1.504E+03 0.0549 292.65    28 2.286E+01 1.466E+03 0.0556 292.65
    29 2.540E+01 1.436E+03 0.0563 292.65    30 2.794E+01 1.410E+03 0.0569 292.65
    31 3.048E+01 1.389E+03 0.0573 292.65    32 3.302E+01 1.372E+03 0.0578 292.65
    33 3.556E+01 1.357E+03 0.0581 292.65    34 3.810E+01 1.346E+03 0.0584 292.65
    35 4.064E+01 1.337E+03 0.0586 292.65    36 4.318E+01 1.330E+03 0.0588 292.65
    37 4.572E+01 1.325E+03 0.0589 292.65    38 4.826E+01 1.296E+03 0.0502 292.65
    39 5.080E+01 1.019E+03 0.0503 292.65    40 5.334E+01 9.986E+02 0.0503 292.65
    41 5.588E+01 9.984E+02 0.0503 292.65    42 5.842E+01 9.829E+02 0.0503 292.65
    43 6.096E+01 9.736E+02 0.0503 292.65

 Initial Water Storage =   3.1990 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03004     0.05655     0.05035
 Head (cm)         = 1.35965E+06 3.27437E+05 1.42364E+03 9.73909E+02
```

```
 LiqWater Flow (cm)=-8.32675E-13-2.60138E-09-5.56906E-03 2.55092E-08
 IsoVapor Flow (cm)=-1.66486E-02-1.66281E-02-4.49810E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1990+ 0.0000+ 0.0000 - 0.0166- 0.0000-  0.0000 =    3.1824 vs.    3.1824

 Mass Balance = -4.9288E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8887 cm, Actual =  0.0166 cm
 RHMEAN = 37.3 %;  TMEAN = 284.0 K;  HDRY =  1.3596E+06 cm;  DAYUBC =    24

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04558     0.06596     0.05024
 Head (cm)         = 8.66730E+05 2.22598E+03 1.10238E+03 1.13576E+03
 LiqWater Flow (cm)=-1.67325E-11-3.86446E-02-1.10895E-02 7.16000E-09
 IsoVapor Flow (cm)=-4.20348E-02-1.95531E-05-2.65098E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6559+ 0.0000+ 0.0000 - 0.0420- 0.0000-  0.0000 =    3.6139 vs.    3.6139

 Mass Balance = -1.8123E-05 cm;  Time step attempts =  102 and successes =   79
   Evaporation:  Potential =  0.3425 cm, Actual =  0.0420 cm
 RHMEAN = 53.3 %;  TMEAN = 285.7 K;  HDRY =  8.6673E+05 cm;  DAYUBC =    79
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0082E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0082E+02     [cm]
 Actual Evaporation                 =  2.0305E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0726E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.9662E-06     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.0726E+01     [cm]
Actual Rainfall                    =  2.0726E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.6139E+00     [cm]
Mass Balance Error                 =  6.5105E-03     [cm]
Total Successful Time Steps        =     49260
Total Attempted Time Steps         =     59592
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     25281
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	4.2139E-01	0.050	1.4096E+01	0.150	9.2845E+00
0.250	7.7256E+00	0.350	6.6492E+00	0.450	5.8424E+00
0.550	5.2020E+00	0.650	4.7766E+00	0.750	4.2826E+00
0.850	3.8464E+00	0.950	3.5936E+00	1.125	3.2904E+00
1.375	2.7010E+00	1.625	2.3325E+00	1.875	2.0691E+00
2.250	1.9375E+00	2.750	1.6728E+00	3.250	1.5410E+00
3.750	1.4371E+00	4.250	1.2958E+00	4.790	1.1884E+00
6.350	1.0046E+00	8.890	7.4586E-01	11.430	6.1642E-01
13.970	5.0334E-01	16.510	4.1794E-01	19.050	3.3936E-01
21.590	2.5820E-01	24.130	2.1142E-01	26.670	1.8800E-01
29.210	1.6466E-01	31.750	1.4126E-01	34.290	1.1779E-01
36.830	9.4233E-02	39.370	7.0603E-02	41.910	4.6898E-02
44.450	2.3103E-02	46.990	-5.0028E-06	49.530	5.3829E-04
52.070	3.0724E-05	54.610	-2.9751E-05	57.150	-4.4802E-05
59.690	-1.9052E-05	60.960	4.9662E-06		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 8.667E+05 0.0300 292.65     2 1.000E-01 7.511E+05 0.0300 292.65
     3 2.000E-01 6.441E+05 0.0300 292.65     4 3.000E-01 5.450E+05 0.0300 292.65
     5 4.000E-01 4.526E+05 0.0300 292.65     6 5.000E-01 3.659E+05 0.0300 292.65
     7 6.000E-01 2.844E+05 0.0300 292.65     8 7.000E-01 2.074E+05 0.0301 292.65
     9 8.000E-01 1.345E+05 0.0301 292.65    10 9.000E-01 6.528E+04 0.0303 292.65
    11 1.000E+00 3.663E+03 0.0386 292.65    12 1.250E+00 2.876E+03 0.0415 292.65
    13 1.500E+00 2.557E+03 0.0432 292.65    14 1.750E+00 2.363E+03 0.0445 292.65
    15 2.000E+00 2.226E+03 0.0456 292.65    16 2.500E+00 2.038E+03 0.0473 292.65
    17 3.000E+00 1.911E+03 0.0487 292.65    18 3.500E+00 1.816E+03 0.0499 292.65
    19 4.000E+00 1.742E+03 0.0509 292.65    20 4.500E+00 1.681E+03 0.0518 292.65
    21 5.080E+00 1.623E+03 0.0527 292.65    22 7.620E+00 1.453E+03 0.0559 292.65
    23 1.016E+01 1.352E+03 0.0582 292.65    24 1.270E+01 1.283E+03 0.0600 292.65
    25 1.524E+01 1.233E+03 0.0615 292.65    26 1.778E+01 1.194E+03 0.0627 292.65
    27 2.032E+01 1.164E+03 0.0637 292.65    28 2.286E+01 1.139E+03 0.0646 292.65
    29 2.540E+01 1.119E+03 0.0653 292.65    30 2.794E+01 1.102E+03 0.0660 292.65
    31 3.048E+01 1.089E+03 0.0665 292.65    32 3.302E+01 1.077E+03 0.0670 292.65
    33 3.556E+01 1.068E+03 0.0673 292.65    34 3.810E+01 1.060E+03 0.0677 292.65
    35 4.064E+01 1.054E+03 0.0679 292.65    36 4.318E+01 1.049E+03 0.0681 292.65
    37 4.572E+01 1.045E+03 0.0683 292.65    38 4.826E+01 1.037E+03 0.0503 292.65
    39 5.080E+01 1.235E+03 0.0502 292.65    40 5.334E+01 1.141E+03 0.0502 292.65
    41 5.588E+01 1.118E+03 0.0502 292.65    42 5.842E+01 1.129E+03 0.0502 292.65
    43 6.096E+01 1.136E+03 0.0502 292.65

 Initial Water Storage =   3.6139 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04491     0.06522     0.05024
 Head (cm)         = 1.04627E+06 2.30896E+03 1.12200E+03 1.13548E+03
```

```
 LiqWater Flow (cm)=-6.00077E-12-3.37137E-02-1.16958E-02 7.17472E-09
 IsoVapor Flow (cm)=-3.60676E-02-2.12870E-05-2.97586E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6139+ 0.0000+ 0.0000 - 0.0361- 0.0000-  0.0000 =    3.5778 vs.    3.5779

 Mass Balance = -1.1454E-05 cm;  Time step attempts =   74 and successes =   59
   Evaporation:  Potential =  0.7655 cm, Actual =  0.0361 cm
 RHMEAN = 46.8 %;  TMEAN = 285.9 K;  HDRY =  1.0463E+06 cm;  DAYUBC =    59

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.05566     0.05020
 Head (cm)         = 8.48906E+05 1.36533E+05 1.46520E+03 1.22725E+03
 LiqWater Flow (cm)=-5.05373E-12-2.08012E-04-4.32763E-03 3.78323E-09
 IsoVapor Flow (cm)=-1.46930E-02-1.44844E-02-4.12622E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1727+ 0.0000+ 0.0000 - 0.0147- 0.0000-  0.0000 =    3.1581 vs.    3.1581

 Mass Balance = -2.7162E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2151 cm, Actual =  0.0147 cm
 RHMEAN = 54.0 %;  TMEAN = 277.0 K;  HDRY =  8.4891E+05 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0228E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0228E+02     [cm]
 Actual Evaporation                 =  1.9269E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.8821E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.7750E-06     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.8821E+01     [cm]
Actual Rainfall                    =  1.8821E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1581E+00     [cm]
Mass Balance Error                 =  7.9892E-03     [cm]
Total Successful Time Steps        =     60369
Total Attempted Time Steps         =     73990
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30877
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.4787E-01	0.050	1.3790E+01	0.150	9.2170E+00
0.250	7.9422E+00	0.350	7.0846E+00	0.450	6.2951E+00
0.550	5.7758E+00	0.650	5.3168E+00	0.750	4.7933E+00
0.850	4.3870E+00	0.950	4.1347E+00	1.125	3.8738E+00
1.375	3.0384E+00	1.625	2.5022E+00	1.875	1.9957E+00
2.250	1.7168E+00	2.750	1.1506E+00	3.250	7.2996E-01
3.750	5.8479E-01	4.250	4.2780E-01	4.790	2.9940E-01
6.350	1.8255E-01	8.890	-1.0399E-01	11.430	-2.4825E-01
13.970	-2.9196E-01	16.510	-3.1574E-01	19.050	-2.9196E-01
21.590	-2.6731E-01	24.130	-2.4208E-01	26.670	-2.1639E-01
29.210	-1.9030E-01	31.750	-1.6389E-01	34.290	-1.3720E-01
36.830	-1.1027E-01	39.370	-8.3143E-02	41.910	-5.5835E-02
44.450	-2.8371E-02	46.990	-4.1043E-04	49.530	6.4138E-04
52.070	3.9823E-05	54.610	-5.4667E-06	57.150	-7.2319E-06
59.690	-1.8881E-06	60.960	1.7750E-06		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                    Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 8.489E+05 0.0300 292.65     2 1.000E-01 8.031E+05 0.0300 292.65
     3 2.000E-01 7.587E+05 0.0300 292.65     4 3.000E-01 7.157E+05 0.0300 292.65
     5 4.000E-01 6.740E+05 0.0300 292.65     6 5.000E-01 6.335E+05 0.0300 292.65
     7 6.000E-01 5.942E+05 0.0300 292.65     8 7.000E-01 5.559E+05 0.0300 292.65
     9 8.000E-01 5.187E+05 0.0300 292.65    10 9.000E-01 4.825E+05 0.0300 292.65
    11 1.000E+00 4.472E+05 0.0300 292.65    12 1.250E+00 3.628E+05 0.0300 292.65
    13 1.500E+00 2.832E+05 0.0300 292.65    14 1.750E+00 2.079E+05 0.0301 292.65
    15 2.000E+00 1.365E+05 0.0301 292.65    16 2.500E+00 3.984E+03 0.0378 292.65
    17 3.000E+00 3.113E+03 0.0404 292.65    18 3.500E+00 2.772E+03 0.0420 292.65
    19 4.000E+00 2.568E+03 0.0431 292.65    20 4.500E+00 2.424E+03 0.0441 292.65
    21 5.080E+00 2.301E+03 0.0450 292.65    22 7.620E+00 1.992E+03 0.0478 292.65
    23 1.016E+01 1.831E+03 0.0497 292.65    24 1.270E+01 1.727E+03 0.0511 292.65
    25 1.524E+01 1.653E+03 0.0522 292.65    26 1.778E+01 1.597E+03 0.0532 292.65
    27 2.032E+01 1.553E+03 0.0539 292.65    28 2.286E+01 1.518E+03 0.0546 292.65
    29 2.540E+01 1.489E+03 0.0552 292.65    30 2.794E+01 1.465E+03 0.0557 292.65
    31 3.048E+01 1.445E+03 0.0561 292.65    32 3.302E+01 1.429E+03 0.0564 292.65
    33 3.556E+01 1.416E+03 0.0567 292.65    34 3.810E+01 1.405E+03 0.0570 292.65
    35 4.064E+01 1.396E+03 0.0572 292.65    36 4.318E+01 1.390E+03 0.0573 292.65
    37 4.572E+01 1.385E+03 0.0574 292.65    38 4.826E+01 1.362E+03 0.0502 292.65
    39 5.080E+01 1.249E+03 0.0502 292.65    40 5.334E+01 1.231E+03 0.0502 292.65
    41 5.588E+01 1.230E+03 0.0502 292.65    42 5.842E+01 1.228E+03 0.0502 292.65
    43 6.096E+01 1.227E+03 0.0502 292.65

 Initial Water Storage =   3.1581 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.05541     0.05020
 Head (cm)         = 8.74418E+05 1.41905E+05 1.47744E+03 1.22731E+03
```

```
 LiqWater Flow (cm)=-4.53698E-12-1.03361E-04-4.30247E-03 3.78171E-09
 IsoVapor Flow (cm)=-1.49669E-02-1.48596E-02-4.25620E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1581+ 0.0000+ 0.0000 - 0.0150- 0.0000-  0.0000 =    3.1431 vs.    3.1431

 Mass Balance = -6.6952E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2193 cm, Actual =  0.0150 cm
 RHMEAN = 53.0 %;  TMEAN = 277.3 K;  HDRY =  8.7442E+05 cm;  DAYUBC =    24

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04464     0.04900     0.05011
 Head (cm)         = 8.82736E+05 2.34469E+03 1.88501E+03 1.54402E+03
 LiqWater Flow (cm)= 1.69846E-01 9.42150E-02-1.98821E-03 5.69678E-10
 IsoVapor Flow (cm)=-5.79369E-02 1.82264E-04-6.44867E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8341+ 0.2032+ 0.0000 - 0.0913- 0.0000-  0.0000 =    2.9460 vs.    2.9456

 Mass Balance =  4.5777E-04 cm;  Time step attempts = 1811 and successes = 1382
   Evaporation:  Potential =  0.2283 cm, Actual =  0.0913 cm
 RHMEAN = 52.7 %;  TMEAN = 276.2 K;  HDRY =  8.8274E+05 cm;  DAYUBC =   325
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0416E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0416E+02     [cm]
 Actual Evaporation                 =  1.1101E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.0897E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.7343E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.0897E+01     [cm]
Actual Rainfall                    =  1.0897E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.9456E+00     [cm]
Mass Balance Error                 =  7.5948E-03     [cm]
Total Successful Time Steps        =     61541
Total Attempted Time Steps         =     76196
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31424
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.0488E-01	0.050	8.2830E+00	0.150	6.5620E+00
0.250	5.9107E+00	0.350	5.4484E+00	0.450	5.0285E+00
0.550	4.6886E+00	0.650	4.3356E+00	0.750	4.1038E+00
0.850	3.8920E+00	0.950	3.7253E+00	1.125	3.5500E+00
1.375	3.0756E+00	1.625	2.8258E+00	1.875	2.5772E+00
2.250	2.3776E+00	2.750	1.9976E+00	3.250	1.6936E+00
3.750	1.4480E+00	4.250	1.1336E+00	4.790	8.9895E-01
6.350	6.1827E-01	8.890	3.5760E-02	11.430	-1.3507E-01
13.970	-2.2022E-01	16.510	-2.0491E-01	19.050	-1.8883E-01
21.590	-1.7250E-01	24.130	-1.5597E-01	26.670	-1.3926E-01
29.210	-1.2241E-01	31.750	-1.0543E-01	34.290	-8.8307E-02
36.830	-7.1069E-02	39.370	-5.3727E-02	41.910	-3.6289E-02
44.450	-1.8763E-02	46.990	-6.6172E-04	49.530	1.3729E-05
52.070	-7.0077E-06	54.610	-8.2532E-06	57.150	-6.5131E-06
59.690	-2.1460E-06	60.960	6.7343E-07		

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
Date of Run: 15 Sep 2025
Time of Run: 17:35:47.28
Title:
Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants

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Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	8.827E+05	0.0300	292.65	2	1.000E-01	7.491E+05	0.0300	292.65
3	2.000E-01	6.318E+05	0.0300	292.65	4	3.000E-01	5.236E+05	0.0300	292.65
5	4.000E-01	4.220E+05	0.0300	292.65	6	5.000E-01	3.269E+05	0.0300	292.65
7	6.000E-01	2.383E+05	0.0301	292.65	8	7.000E-01	1.551E+05	0.0301	292.65
9	8.000E-01	7.667E+04	0.0302	292.65	10	9.000E-01	4.341E+03	0.0370	292.65
11	1.000E+00	3.540E+03	0.0389	292.65	12	1.250E+00	2.899E+03	0.0414	292.65
13	1.500E+00	2.626E+03	0.0428	292.65	14	1.750E+00	2.460E+03	0.0438	292.65
15	2.000E+00	2.345E+03	0.0446	292.65	16	2.500E+00	2.192E+03	0.0459	292.65
17	3.000E+00	2.097E+03	0.0467	292.65	18	3.500E+00	2.034E+03	0.0473	292.65
19	4.000E+00	1.993E+03	0.0478	292.65	20	4.500E+00	1.966E+03	0.0481	292.65
21	5.080E+00	1.951E+03	0.0482	292.65	22	7.620E+00	2.040E+03	0.0473	292.65
23	1.016E+01	2.243E+03	0.0454	292.65	24	1.270E+01	2.280E+03	0.0451	292.65
25	1.524E+01	2.193E+03	0.0459	292.65	26	1.778E+01	2.100E+03	0.0467	292.65
27	2.032E+01	2.026E+03	0.0474	292.65	28	2.286E+01	1.968E+03	0.0480	292.65
29	2.540E+01	1.922E+03	0.0486	292.65	30	2.794E+01	1.885E+03	0.0490	292.65
31	3.048E+01	1.855E+03	0.0494	292.65	32	3.302E+01	1.831E+03	0.0497	292.65
33	3.556E+01	1.811E+03	0.0499	292.65	34	3.810E+01	1.795E+03	0.0501	292.65
35	4.064E+01	1.783E+03	0.0503	292.65	36	4.318E+01	1.775E+03	0.0504	292.65
37	4.572E+01	1.769E+03	0.0505	292.65	38	4.826E+01	1.727E+03	0.0501	292.65
39	5.080E+01	1.629E+03	0.0501	292.65	40	5.334E+01	1.583E+03	0.0501	292.65
41	5.588E+01	1.560E+03	0.0501	292.65	42	5.842E+01	1.548E+03	0.0501	292.65
43	6.096E+01	1.544E+03	0.0501	292.65					

Initial Water Storage = 2.9456 cm

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number	= 1	15	30	43
Depth (cm)	= 0.00000	2.00000	27.94000	60.96000
Water (cm3/cm3)	= 0.03002	0.04044	0.04889	0.05011
Head (cm)	= 4.99787E+05	3.10879E+03	1.89439E+03	1.54447E+03

```
 LiqWater Flow (cm)=-1.02167E-10-1.49731E-02-1.97279E-03 5.68307E-10
 IsoVapor Flow (cm)=-2.30510E-02-2.46817E-05-6.55152E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.9456+ 0.0000+ 0.0000 - 0.0231- 0.0000-  0.0000 =     2.9225 vs.     2.9225

 Mass Balance = -2.0511E-05 cm;  Time step attempts =  130 and successes =  108
   Evaporation:  Potential =  0.2228 cm, Actual =  0.0231 cm
 RHMEAN = 69.6 %;  TMEAN = 276.2 K;  HDRY =  4.9979E+05 cm;  DAYUBC =   106

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 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.05015     0.07316     0.05012
 Head (cm)         = 8.15596E+05 1.79425E+03 9.44111E+02 1.48670E+03
 LiqWater Flow (cm)=-3.72389E-11-5.97659E-02-2.62037E-02 7.75130E-10
 IsoVapor Flow (cm)=-5.99088E-02-1.16725E-05-2.72928E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.9826+ 0.0000+ 0.0000 - 0.0599- 0.0000-  0.0000 =     3.9227 vs.     3.9227

 Mass Balance = -1.0969E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3809 cm, Actual =  0.0599 cm
 RHMEAN = 55.3 %;  TMEAN = 277.9 K;  HDRY =  8.1560E+05 cm;  DAYUBC =    77
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0470E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0470E+02     [cm]
 Actual Evaporation                 =  1.6515E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.7501E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.8946E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.7501E+01     [cm]
Actual Rainfall                    =  1.7501E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.9227E+00     [cm]
Mass Balance Error                 =  8.0348E-03     [cm]
Total Successful Time Steps        =     60109
Total Attempted Time Steps         =     73676
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30270
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.8518E-01	0.050	1.2313E+01	0.150	9.4304E+00
0.250	8.5348E+00	0.350	7.8240E+00	0.450	7.3196E+00
0.550	6.8618E+00	0.650	6.3546E+00	0.750	5.8116E+00
0.850	5.3160E+00	0.950	5.0528E+00	1.125	4.7842E+00
1.375	4.2036E+00	1.625	3.8071E+00	1.875	3.4933E+00
2.250	3.2140E+00	2.750	2.6954E+00	3.250	2.3251E+00
3.750	2.0780E+00	4.250	1.8400E+00	4.790	1.7359E+00
6.350	1.5867E+00	8.890	1.2521E+00	11.430	1.0246E+00
13.970	8.7760E-01	16.510	7.5010E-01	19.050	6.9241E-01
21.590	6.3439E-01	24.130	5.7517E-01	26.670	5.1479E-01
29.210	4.5333E-01	31.750	3.9090E-01	34.290	3.2760E-01
36.830	2.6353E-01	39.370	1.9880E-01	41.910	1.3349E-01
44.450	6.7693E-02	46.990	1.7328E-03	49.530	1.0438E-04
52.070	9.3589E-06	54.610	2.8122E-06	57.150	9.9961E-07
59.690	3.5831E-07	60.960	1.8946E-07		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 8.156E+05 0.0300 292.65     2 1.000E-01 6.414E+05 0.0300 292.65
     3 2.000E-01 4.868E+05 0.0300 292.65     4 3.000E-01 3.478E+05 0.0300 292.65
     5 4.000E-01 2.215E+05 0.0301 292.65     6 5.000E-01 1.058E+05 0.0302 292.65
     7 6.000E-01 2.719E+03 0.0423 292.65     8 7.000E-01 2.542E+03 0.0433 292.65
     9 8.000E-01 2.411E+03 0.0442 292.65    10 9.000E-01 2.308E+03 0.0449 292.65
    11 1.000E+00 2.224E+03 0.0456 292.65    12 1.250E+00 2.066E+03 0.0470 292.65
    13 1.500E+00 1.952E+03 0.0482 292.65    14 1.750E+00 1.865E+03 0.0492 292.65
    15 2.000E+00 1.794E+03 0.0502 292.65    16 2.500E+00 1.685E+03 0.0517 292.65
    17 3.000E+00 1.603E+03 0.0530 292.65    18 3.500E+00 1.539E+03 0.0542 292.65
    19 4.000E+00 1.485E+03 0.0552 292.65    20 4.500E+00 1.440E+03 0.0562 292.65
    21 5.080E+00 1.396E+03 0.0572 292.65    22 7.620E+00 1.260E+03 0.0607 292.65
    23 1.016E+01 1.174E+03 0.0634 292.65    24 1.270E+01 1.114E+03 0.0655 292.65
    25 1.524E+01 1.069E+03 0.0673 292.65    26 1.778E+01 1.033E+03 0.0688 292.65
    27 2.032E+01 1.004E+03 0.0701 292.65    28 2.286E+01 9.804E+02 0.0713 292.65
    29 2.540E+01 9.606E+02 0.0723 292.65    30 2.794E+01 9.441E+02 0.0732 292.65
    31 3.048E+01 9.302E+02 0.0739 292.65    32 3.302E+01 9.185E+02 0.0746 292.65
    33 3.556E+01 9.087E+02 0.0751 292.65    34 3.810E+01 9.007E+02 0.0756 292.65
    35 4.064E+01 8.941E+02 0.0760 292.65    36 4.318E+01 8.889E+02 0.0763 292.65
    37 4.572E+01 8.851E+02 0.0766 292.65    38 4.826E+01 8.748E+02 0.0505 292.65
    39 5.080E+01 1.185E+03 0.0502 292.65    40 5.334E+01 1.360E+03 0.0502 292.65
    41 5.588E+01 1.440E+03 0.0501 292.65    42 5.842E+01 1.476E+03 0.0501 292.65
    43 6.096E+01 1.487E+03 0.0501 292.65

 Initial Water Storage =   3.9227 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04804     0.07187     0.05012
 Head (cm)         = 1.31147E+06 1.96913E+03 9.68844E+02 1.48562E+03
```

```
 LiqWater Flow (cm)=-5.45174E-12-5.75570E-02-2.40460E-02 7.79741E-10
 IsoVapor Flow (cm)=-6.56139E-02-1.54583E-05-2.84470E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9227+ 0.0000+ 0.0000 - 0.0656- 0.0000-  0.0000 =    3.8571 vs.    3.8571

 Mass Balance = -3.5469E-05 cm;  Time step attempts =  189 and successes =  145
   Evaporation:  Potential =  0.6492 cm, Actual =  0.0656 cm
 RHMEAN = 38.6 %;  TMEAN = 280.9 K;  HDRY =  1.3115E+06 cm;  DAYUBC =   145

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04876     0.05010
 Head (cm)         = 2.20848E+06 1.23333E+06 1.90527E+03 1.57860E+03
 LiqWater Flow (cm)=-6.03901E-14-7.02484E-13-2.21993E-03 4.74343E-10
 IsoVapor Flow (cm)=-8.33690E-03-8.33663E-03-7.45309E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8070+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.7987 vs.    2.7987

 Mass Balance = -4.3809E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5595 cm, Actual =  0.0083 cm
 RHMEAN = 20.1 %;  TMEAN = 279.3 K;  HDRY =  2.2085E+06 cm;  DAYUBC =    24
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2069E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2069E+02     [cm]
 Actual Evaporation                 =  1.1811E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.0693E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.0777E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.0693E+01     [cm]
Actual Rainfall                    =  1.0693E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.7987E+00     [cm]
Mass Balance Error                 =  6.9012E-03     [cm]
Total Successful Time Steps        =     58851
Total Attempted Time Steps         =     72478
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31350
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.1171E+00	0.050	8.1387E+00	0.150	6.8730E+00
0.250	5.8920E+00	0.350	5.4591E+00	0.450	5.0176E+00
0.550	4.6325E+00	0.650	4.4048E+00	0.750	4.1812E+00
0.850	3.8716E+00	0.950	3.4818E+00	1.125	3.2178E+00
1.375	2.7133E+00	1.625	2.2174E+00	1.875	1.8604E+00
2.250	1.5131E+00	2.750	9.4054E-01	3.250	5.7947E-01
3.750	3.3322E-01	4.250	1.6185E-01	4.790	-3.5484E-02
6.350	-2.3036E-01	8.890	-6.5524E-01	11.430	-7.7073E-01
13.970	-8.0941E-01	16.510	-7.5379E-01	19.050	-6.9637E-01
21.590	-6.3767E-01	24.130	-5.7781E-01	26.670	-5.1687E-01
29.210	-4.5495E-01	31.750	-3.9215E-01	34.290	-3.2855E-01
36.830	-2.6423E-01	39.370	-1.9929E-01	41.910	-1.3380E-01
44.450	-6.7844E-02	46.990	-1.2262E-03	49.530	8.6885E-05
52.070	8.8971E-06	54.610	2.5161E-06	57.150	5.7301E-07
59.690	2.8313E-07	60.960	4.0777E-07		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 2.208E+06 0.0300 292.65     2 1.000E-01 2.140E+06 0.0300 292.65
     3 2.000E-01 2.075E+06 0.0300 292.65     4 3.000E-01 2.012E+06 0.0300 292.65
     5 4.000E-01 1.953E+06 0.0300 292.65     6 5.000E-01 1.895E+06 0.0300 292.65
     7 6.000E-01 1.840E+06 0.0300 292.65     8 7.000E-01 1.787E+06 0.0300 292.65
     9 8.000E-01 1.736E+06 0.0300 292.65    10 9.000E-01 1.686E+06 0.0300 292.65
    11 1.000E+00 1.638E+06 0.0300 292.65    12 1.250E+00 1.525E+06 0.0300 292.65
    13 1.500E+00 1.421E+06 0.0300 292.65    14 1.750E+00 1.324E+06 0.0300 292.65
    15 2.000E+00 1.233E+06 0.0300 292.65    16 2.500E+00 1.068E+06 0.0300 292.65
    17 3.000E+00 9.208E+05 0.0300 292.65    18 3.500E+00 7.879E+05 0.0300 292.65
    19 4.000E+00 6.668E+05 0.0300 292.65    20 4.500E+00 5.555E+05 0.0300 292.65
    21 5.080E+00 4.368E+05 0.0300 292.65    22 7.620E+00 8.161E+03 0.0333 292.65
    23 1.016E+01 2.805E+03 0.0418 292.65    24 1.270E+01 2.482E+03 0.0437 292.65
    25 1.524E+01 2.291E+03 0.0450 292.65    26 1.778E+01 2.164E+03 0.0461 292.65
    27 2.032E+01 2.072E+03 0.0470 292.65    28 2.286E+01 2.003E+03 0.0477 292.65
    29 2.540E+01 1.948E+03 0.0483 292.65    30 2.794E+01 1.905E+03 0.0488 292.65
    31 3.048E+01 1.871E+03 0.0492 292.65    32 3.302E+01 1.843E+03 0.0495 292.65
    33 3.556E+01 1.821E+03 0.0498 292.65    34 3.810E+01 1.803E+03 0.0500 292.65
    35 4.064E+01 1.790E+03 0.0502 292.65    36 4.318E+01 1.780E+03 0.0503 292.65
    37 4.572E+01 1.774E+03 0.0504 292.65    38 4.826E+01 1.730E+03 0.0501 292.65
    39 5.080E+01 1.634E+03 0.0501 292.65    40 5.334E+01 1.599E+03 0.0501 292.65
    41 5.588E+01 1.587E+03 0.0501 292.65    42 5.842E+01 1.581E+03 0.0501 292.65
    43 6.096E+01 1.579E+03 0.0501 292.65

 Initial Water Storage =   2.7987 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04864     0.05010
 Head (cm)         = 8.54706E+05 5.78860E+05 1.91576E+03 1.57890E+03
```

```
 LiqWater Flow (cm)=-1.47709E-12-1.03590E-11-2.18952E-03 4.73594E-10
 IsoVapor Flow (cm)=-4.74133E-03-4.76431E-03-7.54881E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.7987+ 0.0000+ 0.0000 - 0.0047- 0.0000-  0.0000 =    2.7939 vs.    2.7939

 Mass Balance = -6.6750E-06 cm;  Time step attempts =   49 and successes =   47
   Evaporation:  Potential =  0.4078 cm, Actual =  0.0047 cm
 RHMEAN = 53.8 %;  TMEAN = 283.7 K;  HDRY =  8.5471E+05 cm;  DAYUBC =    42

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04154     0.05920     0.05026
 Head (cm)         = 5.47835E+05 2.85906E+03 1.31418E+03 1.09478E+03
 LiqWater Flow (cm)=-3.92395E-11-1.54343E-02-7.49488E-03 9.64090E-09
 IsoVapor Flow (cm)=-1.51909E-02-3.17686E-05-4.07197E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3330+ 0.0000+ 0.0000 - 0.0152- 0.0000-  0.0000 =    3.3178 vs.    3.3178

 Mass Balance = -3.4530E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.2091 cm, Actual =  0.0152 cm
 RHMEAN = 67.2 %;  TMEAN = 283.2 K;  HDRY =  5.4784E+05 cm;  DAYUBC =    76
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  2.9889E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.9889E+02     [cm]
 Actual Evaporation                 =  3.0460E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.0988E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.6258E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  3.0988E+01     [cm]
Actual Rainfall                    =  3.0988E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.3178E+00     [cm]
Mass Balance Error                 =  8.5157E-03     [cm]
Total Successful Time Steps        =     55326
Total Attempted Time Steps         =     67735
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     26759
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	5.2762E-01	0.050	1.8751E+01	0.150	1.2580E+01
0.250	1.0738E+01	0.350	8.9341E+00	0.450	7.9781E+00
0.550	7.1826E+00	0.650	6.2100E+00	0.750	5.7581E+00
0.850	5.4258E+00	0.950	5.0525E+00	1.125	4.6271E+00
1.375	4.0184E+00	1.625	3.3488E+00	1.875	2.7157E+00
2.250	2.3008E+00	2.750	1.7181E+00	3.250	1.4196E+00
3.750	1.1969E+00	4.250	1.0548E+00	4.790	8.7744E-01
6.350	7.4422E-01	8.890	5.4986E-01	11.430	3.8105E-01
13.970	3.5384E-01	16.510	3.2805E-01	19.050	3.0229E-01
21.590	2.7640E-01	24.130	2.5028E-01	26.670	2.2390E-01
29.210	1.9725E-01	31.750	1.7036E-01	34.290	1.4323E-01
36.830	1.1587E-01	39.370	8.8301E-02	41.910	6.0553E-02
44.450	3.2642E-02	46.990	4.6758E-03	49.530	4.5062E-03
52.070	1.8701E-03	54.610	4.4094E-04	57.150	7.4566E-05
59.690	1.2860E-05	60.960	6.6258E-07		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                    Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 5.478E+05 0.0300 292.65     2 1.000E-01 5.095E+05 0.0300 292.65
     3 2.000E-01 4.723E+05 0.0300 292.65     4 3.000E-01 4.360E+05 0.0300 292.65
     5 4.000E-01 4.007E+05 0.0300 292.65     6 5.000E-01 3.662E+05 0.0300 292.65
     7 6.000E-01 3.326E+05 0.0300 292.65     8 7.000E-01 2.998E+05 0.0300 292.65
     9 8.000E-01 2.677E+05 0.0300 292.65    10 9.000E-01 2.364E+05 0.0301 292.65
    11 1.000E+00 2.058E+05 0.0301 292.65    12 1.250E+00 1.320E+05 0.0301 292.65
    13 1.500E+00 6.199E+04 0.0303 292.65    14 1.750E+00 3.064E+03 0.0406 292.65
    15 2.000E+00 2.859E+03 0.0415 292.65    16 2.500E+00 2.589E+03 0.0430 292.65
    17 3.000E+00 2.412E+03 0.0441 292.65    18 3.500E+00 2.283E+03 0.0451 292.65
    19 4.000E+00 2.182E+03 0.0460 292.65    20 4.500E+00 2.100E+03 0.0467 292.65
    21 5.080E+00 2.022E+03 0.0475 292.65    22 7.620E+00 1.793E+03 0.0502 292.65
    23 1.016E+01 1.657E+03 0.0522 292.65    24 1.270E+01 1.564E+03 0.0537 292.65
    25 1.524E+01 1.496E+03 0.0550 292.65    26 1.778E+01 1.443E+03 0.0561 292.65
    27 2.032E+01 1.400E+03 0.0571 292.65    28 2.286E+01 1.366E+03 0.0579 292.65
    29 2.540E+01 1.338E+03 0.0586 292.65    30 2.794E+01 1.314E+03 0.0592 292.65
    31 3.048E+01 1.295E+03 0.0597 292.65    32 3.302E+01 1.278E+03 0.0602 292.65
    33 3.556E+01 1.265E+03 0.0606 292.65    34 3.810E+01 1.254E+03 0.0609 292.65
    35 4.064E+01 1.246E+03 0.0611 292.65    36 4.318E+01 1.239E+03 0.0613 292.65
    37 4.572E+01 1.235E+03 0.0614 292.65    38 4.826E+01 1.202E+03 0.0502 292.65
    39 5.080E+01 7.460E+02 0.0507 292.65    40 5.334E+01 7.758E+02 0.0506 292.65
    41 5.588E+01 9.195E+02 0.0504 292.65    42 5.842E+01 1.050E+03 0.0503 292.65
    43 6.096E+01 1.095E+03 0.0503 292.65

 Initial Water Storage =   3.3178 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04035     0.05882     0.05026
 Head (cm)         = 6.47479E+05 3.13075E+03 1.32889E+03 1.09300E+03
```

```
 LiqWater Flow (cm)=-2.12061E-11-1.62724E-02-7.19156E-03 9.77095E-09
 IsoVapor Flow (cm)=-1.72057E-02-3.90605E-05-4.12967E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3178+ 0.0000+ 0.0000 - 0.0172- 0.0000-  0.0000 =    3.3006 vs.    3.3006

 Mass Balance = -2.7958E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.3008 cm, Actual =  0.0172 cm
 RHMEAN = 62.5 %;  TMEAN = 283.7 K;  HDRY =  6.4748E+05 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04879     0.05167
 Head (cm)         = 1.93021E+06 1.28460E+06 1.90298E+03 5.21252E+02
 LiqWater Flow (cm)=-7.69435E-14-5.89533E-13-2.30467E-03 4.43588E-06
 IsoVapor Flow (cm)=-6.63769E-03-6.63467E-03-7.66530E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8171+ 0.0000+ 0.0000 - 0.0066- 0.0000-  0.0000 =    2.8105 vs.    2.8105

 Mass Balance = -7.2760E-06 cm;  Time step attempts =   50 and successes =   39
   Evaporation:  Potential =  0.2782 cm, Actual =  0.0066 cm
 RHMEAN = 24.7 %;  TMEAN = 286.8 K;  HDRY =  1.9302E+06 cm;  DAYUBC =    39
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  2.9999E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.9999E+02     [cm]
 Actual Evaporation                 =  3.3189E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.2690E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.7260E-04     [cm]
```

Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.2690E+01	[cm]
Actual Rainfall	=	3.2690E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	2.8105E+00	[cm]
Mass Balance Error	=	7.3410E-03	[cm]
Total Successful Time Steps	=	59159	
Total Attempted Time Steps	=	72323	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	28803	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.9929E-01	0.050	1.6211E+01	0.150	1.0283E+01
0.250	8.3461E+00	0.350	7.1739E+00	0.450	6.1775E+00
0.550	5.3781E+00	0.650	4.7355E+00	0.750	4.3997E+00
0.850	4.0475E+00	0.950	3.6663E+00	1.125	3.3779E+00
1.375	2.7271E+00	1.625	2.4224E+00	1.875	2.1279E+00
2.250	1.7830E+00	2.750	1.2704E+00	3.250	8.9599E-01
3.750	6.8205E-01	4.250	4.4568E-01	4.790	2.6262E-01
6.350	2.5745E-02	8.890	-3.7580E-01	11.430	-3.5593E-01
13.970	-3.3167E-01	16.510	-3.0695E-01	19.050	-2.8183E-01
21.590	-2.5635E-01	24.130	-2.3057E-01	26.670	-2.0450E-01
29.210	-1.7814E-01	31.750	-1.5152E-01	34.290	-1.2466E-01
36.830	-9.7583E-02	39.370	-7.0311E-02	41.910	-4.2869E-02
44.450	-1.5287E-02	46.990	1.2761E-02	49.530	1.6059E-02
52.070	1.1583E-02	54.610	8.7807E-03	57.150	5.5357E-03
59.690	2.2357E-03	60.960	6.7260E-04		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.930E+06 0.0300 292.65     2 1.000E-01 1.889E+06 0.0300 292.65
     3 2.000E-01 1.849E+06 0.0300 292.65     4 3.000E-01 1.812E+06 0.0300 292.65
     5 4.000E-01 1.774E+06 0.0300 292.65     6 5.000E-01 1.738E+06 0.0300 292.65
     7 6.000E-01 1.703E+06 0.0300 292.65     8 7.000E-01 1.668E+06 0.0300 292.65
     9 8.000E-01 1.634E+06 0.0300 292.65    10 9.000E-01 1.602E+06 0.0300 292.65
    11 1.000E+00 1.570E+06 0.0300 292.65    12 1.250E+00 1.493E+06 0.0300 292.65
    13 1.500E+00 1.420E+06 0.0300 292.65    14 1.750E+00 1.351E+06 0.0300 292.65
    15 2.000E+00 1.285E+06 0.0300 292.65    16 2.500E+00 1.161E+06 0.0300 292.65
    17 3.000E+00 1.048E+06 0.0300 292.65    18 3.500E+00 9.438E+05 0.0300 292.65
    19 4.000E+00 8.466E+05 0.0300 292.65    20 4.500E+00 7.559E+05 0.0300 292.65
    21 5.080E+00 6.576E+05 0.0300 292.65    22 7.620E+00 2.936E+05 0.0300 292.65
    23 1.016E+01 2.712E+03 0.0423 292.65    24 1.270E+01 2.435E+03 0.0440 292.65
    25 1.524E+01 2.275E+03 0.0452 292.65    26 1.778E+01 2.159E+03 0.0462 292.65
    27 2.032E+01 2.071E+03 0.0470 292.65    28 2.286E+01 2.002E+03 0.0477 292.65
    29 2.540E+01 1.947E+03 0.0483 292.65    30 2.794E+01 1.903E+03 0.0488 292.65
    31 3.048E+01 1.867E+03 0.0492 292.65    32 3.302E+01 1.839E+03 0.0496 292.65
    33 3.556E+01 1.816E+03 0.0499 292.65    34 3.810E+01 1.798E+03 0.0501 292.65
    35 4.064E+01 1.784E+03 0.0503 292.65    36 4.318E+01 1.774E+03 0.0504 292.65
    37 4.572E+01 1.768E+03 0.0505 292.65    38 4.826E+01 1.539E+03 0.0501 292.65
    39 5.080E+01 5.803E+02 0.0513 292.65    40 5.334E+01 5.486E+02 0.0515 292.65
    41 5.588E+01 5.322E+02 0.0516 292.65    42 5.842E+01 5.239E+02 0.0516 292.65
    43 6.096E+01 5.213E+02 0.0517 292.65

 Initial Water Storage =   2.8105 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.04867     0.05166
 Head (cm)         = 2.25090E+06 1.43704E+06 1.91291E+03 5.21705E+02
```

```
 LiqWater Flow (cm)= 1.93955E-02 6.18236E-08-2.25475E-03 4.40417E-06
 IsoVapor Flow (cm)=-2.42458E-02-4.85178E-03-7.70157E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.8105+ 0.0254+ 0.0000 - 0.0302- 0.0000-  0.0000 =     2.8056 vs.     2.8056

 Mass Balance = -1.5219E-05 cm;  Time step attempts =  901 and successes =  704
   Evaporation:  Potential =  1.4538 cm, Actual =  0.0302 cm
 RHMEAN = 19.5 %;  TMEAN = 287.9 K;  HDRY =  2.2509E+06 cm;  DAYUBC =   379

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03980     0.04722     0.05085
 Head (cm)         = 6.05038E+05 3.27684E+03 2.04689E+03 6.82283E+02
 LiqWater Flow (cm)= 3.69131E-02 3.43640E-03-8.99606E-04 4.81035E-07
 IsoVapor Flow (cm)=-2.80920E-02-1.09397E-05-4.70002E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.8503+ 0.0508+ 0.0000 - 0.0420- 0.0000-  0.0000 =     2.8591 vs.     2.8590

 Mass Balance =  1.0953E-04 cm;  Time step attempts =  942 and successes =  725
   Evaporation:  Potential =  0.2209 cm, Actual =  0.0420 cm
 RHMEAN = 64.5 %;  TMEAN = 276.8 K;  HDRY =  6.0504E+05 cm;  DAYUBC =   275
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.3548E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3548E+02     [cm]
 Actual Evaporation                 =  2.1120E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.1184E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.1766E-04     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1184E+01     [cm]
Actual Rainfall                    =  2.1184E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8590E+00     [cm]
Mass Balance Error                 =  1.4171E-02     [cm]
Total Successful Time Steps        =    213861
Total Attempted Time Steps         =    270799
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     95875
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	6.3285E-02	0.050	1.4300E+01	0.150	1.2390E+01
0.250	1.0336E+01	0.350	8.6629E+00	0.450	7.3714E+00
0.550	6.3320E+00	0.650	5.4749E+00	0.750	4.7834E+00
0.850	4.1890E+00	0.950	3.6614E+00	1.125	3.1270E+00
1.375	2.2598E+00	1.625	1.7576E+00	1.875	1.4602E+00
2.250	1.2039E+00	2.750	9.4591E-01	3.250	7.8806E-01
3.750	6.8879E-01	4.250	6.1434E-01	4.790	5.5346E-01
6.350	4.7368E-01	8.890	3.8271E-01	11.430	2.1977E-01
13.970	1.6295E-01	16.510	1.1483E-01	19.050	7.0051E-02
21.590	2.6902E-02	24.130	-2.6562E-02	26.670	-4.9678E-02
29.210	-4.6270E-02	31.750	-4.1948E-02	34.290	-3.7127E-02
36.830	-3.1962E-02	39.370	-2.6548E-02	41.910	-2.0954E-02
44.450	-1.5234E-02	46.990	-5.7524E-03	49.530	-1.0552E-03
52.070	-5.3722E-03	54.610	-4.2211E-03	57.150	-2.3370E-03
59.690	-3.7211E-04	60.960	6.1766E-04		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 6.050E+05 0.0300 292.65     2 1.000E-01 5.546E+05 0.0300 292.65
     3 2.000E-01 5.060E+05 0.0300 292.65     4 3.000E-01 4.590E+05 0.0300 292.65
     5 4.000E-01 4.136E+05 0.0300 292.65     6 5.000E-01 3.696E+05 0.0300 292.65
     7 6.000E-01 3.271E+05 0.0300 292.65     8 7.000E-01 2.858E+05 0.0300 292.65
     9 8.000E-01 2.458E+05 0.0301 292.65    10 9.000E-01 2.070E+05 0.0301 292.65
    11 1.000E+00 1.694E+05 0.0301 292.65    12 1.250E+00 8.031E+04 0.0302 292.65
    13 1.500E+00 4.003E+03 0.0377 292.65    14 1.750E+00 3.529E+03 0.0390 292.65
    15 2.000E+00 3.277E+03 0.0398 292.65    16 2.500E+00 2.981E+03 0.0410 292.65
    17 3.000E+00 2.814E+03 0.0418 292.65    18 3.500E+00 2.708E+03 0.0423 292.65
    19 4.000E+00 2.635E+03 0.0427 292.65    20 4.500E+00 2.582E+03 0.0430 292.65
    21 5.080E+00 2.536E+03 0.0433 292.65    22 7.620E+00 2.426E+03 0.0441 292.65
    23 1.016E+01 2.328E+03 0.0448 292.65    24 1.270E+01 2.251E+03 0.0454 292.65
    25 1.524E+01 2.195E+03 0.0458 292.65    26 1.778E+01 2.154E+03 0.0462 292.65
    27 2.032E+01 2.122E+03 0.0465 292.65    28 2.286E+01 2.095E+03 0.0468 292.65
    29 2.540E+01 2.070E+03 0.0470 292.65    30 2.794E+01 2.047E+03 0.0472 292.65
    31 3.048E+01 2.026E+03 0.0474 292.65    32 3.302E+01 2.007E+03 0.0476 292.65
    33 3.556E+01 1.990E+03 0.0478 292.65    34 3.810E+01 1.976E+03 0.0480 292.65
    35 4.064E+01 1.965E+03 0.0481 292.65    36 4.318E+01 1.957E+03 0.0482 292.65
    37 4.572E+01 1.951E+03 0.0482 292.65    38 4.826E+01 1.749E+03 0.0501 292.65
    39 5.080E+01 1.083E+03 0.0503 292.65    40 5.334E+01 7.887E+02 0.0506 292.65
    41 5.588E+01 7.170E+02 0.0508 292.65    42 5.842E+01 6.899E+02 0.0508 292.65
    43 6.096E+01 6.823E+02 0.0509 292.65

 Initial Water Storage =   2.8590 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03011     0.04720     0.05085
 Head (cm)         = 8.36981E+05 1.36252E+05 2.04888E+03 6.82685E+02
```

```
 LiqWater Flow (cm)=-7.16283E-12-6.19291E-03-8.54894E-04 4.78706E-07
 IsoVapor Flow (cm)=-1.85916E-02-4.51350E-03-4.51250E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.8590+ 0.0000+ 0.0000 - 0.0186- 0.0000-  0.0000 =     2.8404 vs.     2.8404

 Mass Balance = -3.6319E-05 cm;  Time step attempts =  144 and successes =  111
   Evaporation:  Potential =  0.4122 cm, Actual =  0.0186 cm
 RHMEAN = 54.5 %;  TMEAN = 278.7 K;  HDRY =  8.3698E+05 cm;  DAYUBC =   111

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.06059     0.05056
 Head (cm)         = 1.64351E+06 2.11002E+05 1.26377E+03 8.07957E+02
 LiqWater Flow (cm)=-5.34070E-13-2.22420E-04-8.97308E-03 1.19115E-07
 IsoVapor Flow (cm)=-2.22025E-02-2.19628E-02-3.99009E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.3848+ 0.0000+ 0.0000 - 0.0222- 0.0000-  0.0000 =     3.3626 vs.     3.3626

 Mass Balance =  3.2649E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.6772 cm, Actual =  0.0222 cm
 RHMEAN = 30.4 %;  TMEAN = 283.4 K;  HDRY =  1.6435E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0482E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0482E+02     [cm]
 Actual Evaporation                 =  2.5192E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.5705E+01     [cm]
 Total Basal Liquid Flux (drainage) =  8.7779E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.5705E+01     [cm]
Actual Rainfall                    =  2.5705E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.3626E+00     [cm]
Mass Balance Error                 =  9.4584E-03     [cm]
Total Successful Time Steps        =     70064
Total Attempted Time Steps         =     86834
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     33200
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	5.1315E-01	0.050	1.8188E+01	0.150	1.3512E+01
0.250	1.1284E+01	0.350	9.7944E+00	0.450	8.7670E+00
0.550	7.8405E+00	0.650	7.0364E+00	0.750	6.4523E+00
0.850	5.9187E+00	0.950	5.4691E+00	1.125	5.0811E+00
1.375	4.1835E+00	1.625	3.4597E+00	1.875	3.0074E+00
2.250	2.5544E+00	2.750	1.9239E+00	3.250	1.5652E+00
3.750	1.3407E+00	4.250	1.1565E+00	4.790	1.0161E+00
6.350	8.7322E-01	8.890	5.4227E-01	11.430	4.6263E-01
13.970	4.3811E-01	16.510	4.1152E-01	19.050	3.8299E-01
21.590	3.5274E-01	24.130	3.2099E-01	26.670	2.8798E-01
29.210	2.5392E-01	31.750	2.1900E-01	34.290	1.8339E-01
36.830	1.4719E-01	39.370	1.1054E-01	41.910	7.3510E-02
44.450	3.6196E-02	46.990	-1.0662E-03	49.530	3.0182E-04
52.070	-7.2875E-04	54.610	-1.0247E-03	57.150	-7.2724E-04
59.690	-2.0337E-04	60.960	8.7779E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.644E+06 0.0300 292.65     2 1.000E-01 1.523E+06 0.0300 292.65
     3 2.000E-01 1.413E+06 0.0300 292.65     4 3.000E-01 1.311E+06 0.0300 292.65
     5 4.000E-01 1.215E+06 0.0300 292.65     6 5.000E-01 1.126E+06 0.0300 292.65
     7 6.000E-01 1.042E+06 0.0300 292.65     8 7.000E-01 9.634E+05 0.0300 292.65
     9 8.000E-01 8.887E+05 0.0300 292.65    10 9.000E-01 8.177E+05 0.0300 292.65
    11 1.000E+00 7.502E+05 0.0300 292.65    12 1.250E+00 5.945E+05 0.0300 292.65
    13 1.500E+00 4.545E+05 0.0300 292.65    14 1.750E+00 3.273E+05 0.0300 292.65
    15 2.000E+00 2.110E+05 0.0301 292.65    16 2.500E+00 2.932E+03 0.0412 292.65
    17 3.000E+00 2.546E+03 0.0433 292.65    18 3.500E+00 2.334E+03 0.0447 292.65
    19 4.000E+00 2.191E+03 0.0459 292.65    20 4.500E+00 2.085E+03 0.0468 292.65
    21 5.080E+00 1.991E+03 0.0478 292.65    22 7.620E+00 1.739E+03 0.0509 292.65
    23 1.016E+01 1.601E+03 0.0531 292.65    24 1.270E+01 1.509E+03 0.0548 292.65
    25 1.524E+01 1.442E+03 0.0562 292.65    26 1.778E+01 1.390E+03 0.0573 292.65
    27 2.032E+01 1.348E+03 0.0583 292.65    28 2.286E+01 1.315E+03 0.0592 292.65
    29 2.540E+01 1.287E+03 0.0599 292.65    30 2.794E+01 1.264E+03 0.0606 292.65
    31 3.048E+01 1.245E+03 0.0611 292.65    32 3.302E+01 1.229E+03 0.0616 292.65
    33 3.556E+01 1.215E+03 0.0620 292.65    34 3.810E+01 1.205E+03 0.0624 292.65
    35 4.064E+01 1.196E+03 0.0626 292.65    36 4.318E+01 1.190E+03 0.0628 292.65
    37 4.572E+01 1.186E+03 0.0630 292.65    38 4.826E+01 1.164E+03 0.0502 292.65
    39 5.080E+01 9.495E+02 0.0504 292.65    40 5.334E+01 8.838E+02 0.0504 292.65
    41 5.588E+01 8.386E+02 0.0505 292.65    42 5.842E+01 8.151E+02 0.0505 292.65
    43 6.096E+01 8.080E+02 0.0506 292.65

 Initial Water Storage =   3.3626 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03006     0.06014     0.05056
 Head (cm)         = 1.92914E+06 2.30598E+05 1.27963E+03 8.08190E+02
```

```
 LiqWater Flow (cm)=-3.13727E-13-1.14092E-04-8.52089E-03 1.18833E-07
 IsoVapor Flow (cm)=-2.40347E-02-2.39143E-02-4.03528E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.3626+ 0.0000+ 0.0000 - 0.0240- 0.0000-  0.0000 =    3.3385 vs.    3.3385

 Mass Balance = -2.9499E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.5619 cm, Actual =  0.0240 cm
 RHMEAN = 24.7 %;  TMEAN = 276.2 K;  HDRY =  1.9291E+06 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.05017     0.05045
 Head (cm)         = 1.38020E+06 8.69982E+05 1.79324E+03 8.82110E+02
 LiqWater Flow (cm)=-2.72083E-13-2.37867E-12-2.23536E-03 5.75497E-08
 IsoVapor Flow (cm)=-6.60513E-03-6.60704E-03-5.70817E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8920+ 0.0000+ 0.0000 - 0.0066- 0.0000-  0.0000 =    2.8854 vs.    2.8854

 Mass Balance = -8.6051E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.3319 cm, Actual =  0.0066 cm
 RHMEAN = 36.7 %;  TMEAN = 279.8 K;  HDRY =  1.3802E+06 cm;  DAYUBC =    72
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2814E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2814E+02     [cm]
 Actual Evaporation                 =  2.5490E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.5019E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.5488E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.5019E+01     [cm]
Actual Rainfall                    =  2.5019E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8854E+00     [cm]
Mass Balance Error                 =  6.6330E-03     [cm]
Total Successful Time Steps        =     55076
Total Attempted Time Steps         =     67117
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     27369
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-4.7054E-01	0.050	1.6178E+01	0.150	7.4897E+00
0.250	5.7656E+00	0.350	4.6058E+00	0.450	3.8431E+00
0.550	3.3108E+00	0.650	2.9942E+00	0.750	2.8271E+00
0.850	2.6661E+00	0.950	2.5075E+00	1.125	2.4116E+00
1.375	2.1264E+00	1.625	1.9193E+00	1.875	1.7370E+00
2.250	1.5482E+00	2.750	1.2958E+00	3.250	1.0281E+00
3.750	8.7567E-01	4.250	7.1550E-01	4.790	4.9960E-01
6.350	3.3813E-01	8.890	2.8987E-02	11.430	-2.3982E-02
13.970	-7.4610E-02	16.510	-1.1730E-01	19.050	-1.5619E-01
21.590	-1.9422E-01	24.130	-2.1211E-01	26.670	-2.2184E-01
29.210	-1.9620E-01	31.750	-1.6942E-01	34.290	-1.4214E-01
36.830	-1.1444E-01	39.370	-8.6382E-02	41.910	-5.8052E-02
44.450	-2.9497E-02	46.990	4.3460E-04	49.530	3.1020E-03
52.070	1.0744E-03	54.610	1.7985E-04	57.150	-9.6364E-05
59.690	-4.7676E-05	60.960	2.5488E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.380E+06 0.0300 292.65     2 1.000E-01 1.350E+06 0.0300 292.65
     3 2.000E-01 1.320E+06 0.0300 292.65     4 3.000E-01 1.291E+06 0.0300 292.65
     5 4.000E-01 1.262E+06 0.0300 292.65     6 5.000E-01 1.234E+06 0.0300 292.65
     7 6.000E-01 1.206E+06 0.0300 292.65     8 7.000E-01 1.179E+06 0.0300 292.65
     9 8.000E-01 1.153E+06 0.0300 292.65    10 9.000E-01 1.127E+06 0.0300 292.65
    11 1.000E+00 1.102E+06 0.0300 292.65    12 1.250E+00 1.040E+06 0.0300 292.65
    13 1.500E+00 9.809E+05 0.0300 292.65    14 1.750E+00 9.243E+05 0.0300 292.65
    15 2.000E+00 8.700E+05 0.0300 292.65    16 2.500E+00 7.673E+05 0.0300 292.65
    17 3.000E+00 6.717E+05 0.0300 292.65    18 3.500E+00 5.823E+05 0.0300 292.65
    19 4.000E+00 4.984E+05 0.0300 292.65    20 4.500E+00 4.193E+05 0.0300 292.65
    21 5.080E+00 3.328E+05 0.0300 292.65    22 7.620E+00 2.721E+03 0.0422 292.65
    23 1.016E+01 2.367E+03 0.0445 292.65    24 1.270E+01 2.185E+03 0.0459 292.65
    25 1.524E+01 2.067E+03 0.0470 292.65    26 1.778E+01 1.982E+03 0.0479 292.65
    27 2.032E+01 1.918E+03 0.0486 292.65    28 2.286E+01 1.867E+03 0.0492 292.65
    29 2.540E+01 1.826E+03 0.0497 292.65    30 2.794E+01 1.793E+03 0.0502 292.65
    31 3.048E+01 1.766E+03 0.0505 292.65    32 3.302E+01 1.745E+03 0.0508 292.65
    33 3.556E+01 1.727E+03 0.0511 292.65    34 3.810E+01 1.713E+03 0.0513 292.65
    35 4.064E+01 1.703E+03 0.0515 292.65    36 4.318E+01 1.695E+03 0.0516 292.65
    37 4.572E+01 1.689E+03 0.0517 292.65    38 4.826E+01 1.590E+03 0.0501 292.65
    39 5.080E+01 1.053E+03 0.0503 292.65    40 5.334E+01 8.655E+02 0.0505 292.65
    41 5.588E+01 8.476E+02 0.0505 292.65    42 5.842E+01 8.690E+02 0.0505 292.65
    43 6.096E+01 8.821E+02 0.0504 292.65

 Initial Water Storage =   2.8854 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.05003     0.05045
 Head (cm)         = 1.61006E+06 9.83207E+05 1.80325E+03 8.81709E+02
```

```
 LiqWater Flow (cm)=-1.65072E-13-1.56529E-12-2.22452E-03 5.77680E-08
 IsoVapor Flow (cm)=-7.19504E-03-7.19188E-03-5.82876E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8854+ 0.0000+ 0.0000 - 0.0072- 0.0000-  0.0000 =    2.8782 vs.    2.8782

 Mass Balance =  1.0888E-06 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.4194 cm, Actual =  0.0072 cm
 RHMEAN = 31.1 %;  TMEAN = 281.8 K;  HDRY =  1.6101E+06 cm;  DAYUBC =    24

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.05140     0.06992     0.05029
 Head (cm)         = 1.02625E+06 1.70623E+03 1.00895E+03 1.04442E+03
 LiqWater Flow (cm)=-1.18078E-09-8.72441E-02 1.11995E-02 1.43161E-08
 IsoVapor Flow (cm)=-1.10828E-01-8.84836E-06 8.55545E-08 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.9301+ 0.0000+ 0.0000 - 0.1108- 0.0000-  0.0000 =    3.8193 vs.    3.8193

 Mass Balance = -4.2886E-05 cm;  Time step attempts =  262 and successes =  209
   Evaporation:  Potential =  0.4897 cm, Actual =  0.1108 cm
 RHMEAN = 47.5 %;  TMEAN = 279.0 K;  HDRY =  1.0263E+06 cm;  DAYUBC =   181
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0884E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0884E+02     [cm]
 Actual Evaporation                 =  2.1105E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.2047E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.3736E-05     [cm]
```

Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.2047E+01	[cm]
Actual Rainfall	=	2.2047E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	3.8193E+00	[cm]
Mass Balance Error	=	7.7945E-03	[cm]
Total Successful Time Steps	=	60065	
Total Attempted Time Steps	=	73986	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	29914	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	9.4177E-01	0.050	1.4571E+01	0.150	1.0366E+01
0.250	8.6301E+00	0.350	7.8599E+00	0.450	7.1707E+00
0.550	6.5331E+00	0.650	5.8628E+00	0.750	5.3560E+00
0.850	5.0144E+00	0.950	4.6261E+00	1.125	4.2428E+00
1.375	3.5465E+00	1.625	3.1706E+00	1.875	2.7008E+00
2.250	2.4901E+00	2.750	2.2167E+00	3.250	2.0035E+00
3.750	1.8544E+00	4.250	1.7575E+00	4.790	1.6510E+00
6.350	1.5309E+00	8.890	1.2039E+00	11.430	1.0484E+00
13.970	9.1629E-01	16.510	7.9111E-01	19.050	6.7398E-01
21.590	5.6876E-01	24.130	4.7515E-01	26.670	3.8369E-01
29.210	3.3177E-01	31.750	2.8218E-01	34.290	2.3347E-01
36.830	1.8558E-01	39.370	1.3838E-01	41.910	9.1719E-02
44.450	4.5386E-02	46.990	2.6152E-04	49.530	8.6803E-04
52.070	-6.6697E-05	54.610	-1.7645E-04	57.150	-1.4104E-04
59.690	-4.4626E-05	60.960	1.3736E-05		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.026E+06 0.0300 292.65     2 1.000E-01 7.520E+05 0.0300 292.65
     3 2.000E-01 5.235E+05 0.0300 292.65     4 3.000E-01 3.276E+05 0.0300 292.65
     5 4.000E-01 1.562E+05 0.0301 292.65     6 5.000E-01 3.437E+03 0.0393 292.65
     7 6.000E-01 2.859E+03 0.0415 292.65     8 7.000E-01 2.576E+03 0.0431 292.65
     9 8.000E-01 2.396E+03 0.0443 292.65    10 9.000E-01 2.266E+03 0.0452 292.65
    11 1.000E+00 2.166E+03 0.0461 292.65    12 1.250E+00 1.988E+03 0.0478 292.65
    13 1.500E+00 1.867E+03 0.0492 292.65    14 1.750E+00 1.777E+03 0.0504 292.65
    15 2.000E+00 1.706E+03 0.0514 292.65    16 2.500E+00 1.599E+03 0.0531 292.65
    17 3.000E+00 1.521E+03 0.0545 292.65    18 3.500E+00 1.460E+03 0.0558 292.65
    19 4.000E+00 1.410E+03 0.0569 292.65    20 4.500E+00 1.369E+03 0.0578 292.65
    21 5.080E+00 1.329E+03 0.0588 292.65    22 7.620E+00 1.211E+03 0.0622 292.65
    23 1.016E+01 1.141E+03 0.0645 292.65    24 1.270E+01 1.096E+03 0.0662 292.65
    25 1.524E+01 1.065E+03 0.0675 292.65    26 1.778E+01 1.043E+03 0.0684 292.65
    27 2.032E+01 1.028E+03 0.0690 292.65    28 2.286E+01 1.018E+03 0.0695 292.65
    29 2.540E+01 1.012E+03 0.0698 292.65    30 2.794E+01 1.009E+03 0.0699 292.65
    31 3.048E+01 1.008E+03 0.0700 292.65    32 3.302E+01 1.008E+03 0.0700 292.65
    33 3.556E+01 1.009E+03 0.0699 292.65    34 3.810E+01 1.011E+03 0.0698 292.65
    35 4.064E+01 1.012E+03 0.0698 292.65    36 4.318E+01 1.012E+03 0.0698 292.65
    37 4.572E+01 1.011E+03 0.0698 292.65    38 4.826E+01 1.028E+03 0.0503 292.65
    39 5.080E+01 9.853E+02 0.0503 292.65    40 5.334E+01 1.032E+03 0.0503 292.65
    41 5.588E+01 1.046E+03 0.0503 292.65    42 5.842E+01 1.046E+03 0.0503 292.65
    43 6.096E+01 1.044E+03 0.0503 292.65

 Initial Water Storage =   3.8193 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03004     0.05005     0.06874     0.05029
 Head (cm)         = 3.26692E+05 1.80221E+03 1.03484E+03 1.04447E+03
```

```
 LiqWater Flow (cm)=-7.55792E-09-5.94702E-02-3.12013E-03 1.43107E-08
 IsoVapor Flow (cm)=-5.89595E-02-1.13378E-05-9.64523E-08 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.8193+ 0.0000+ 0.0000 - 0.0590- 0.0000-  0.0000 =    3.7604 vs.    3.7604

 Mass Balance = -1.3270E-05 cm;  Time step attempts =  402 and successes =  321
   Evaporation:  Potential =  0.1600 cm, Actual =  0.0590 cm
 RHMEAN = 55.0 %;  TMEAN = 276.8 K;  HDRY =  8.2333E+05 cm;  DAYUBC =   123

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04106     0.04680     0.05024
 Head (cm)         = 9.30306E+05 2.96420E+03 2.08955E+03 1.12827E+03
 LiqWater Flow (cm)=-1.13124E-11-2.26587E-02-1.75084E-03 7.57639E-09
 IsoVapor Flow (cm)=-3.91078E-02-2.23882E-05-9.19655E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8979+ 0.0000+ 0.0000 - 0.0391- 0.0000-  0.0000 =    2.8587 vs.    2.8588

 Mass Balance = -5.5538E-05 cm;  Time step attempts =  311 and successes =  256
   Evaporation:  Potential =  0.4364 cm, Actual =  0.0391 cm
 RHMEAN = 50.9 %;  TMEAN = 273.7 K;  HDRY =  9.3031E+05 cm;  DAYUBC =   255
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.0272E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.0272E+02     [cm]
 Actual Evaporation                 =  1.7895E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.6942E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.4306E-06     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.6942E+01     [cm]
Actual Rainfall                    =  1.6942E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8588E+00     [cm]
Mass Balance Error                 =  6.8764E-03     [cm]
Total Successful Time Steps        =     64119
Total Attempted Time Steps         =     78822
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     33409
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.5366E-01	0.050	1.2404E+01	0.150	9.5410E+00
0.250	8.0181E+00	0.350	7.0281E+00	0.450	6.1468E+00
0.550	5.2994E+00	0.650	4.8119E+00	0.750	4.3700E+00
0.850	3.8769E+00	0.950	3.3845E+00	1.125	3.0843E+00
1.375	2.4696E+00	1.625	1.9236E+00	1.875	1.6096E+00
2.250	1.2946E+00	2.750	7.0608E-01	3.250	3.8045E-01
3.750	1.8416E-01	4.250	5.5345E-02	4.790	-4.4717E-02
6.350	-1.6918E-01	8.890	-5.1454E-01	11.430	-6.4497E-01
13.970	-6.7576E-01	16.510	-6.8852E-01	19.050	-6.2981E-01
21.590	-5.6914E-01	24.130	-5.0894E-01	26.670	-4.4947E-01
29.210	-3.9086E-01	31.750	-3.3315E-01	34.290	-2.7634E-01
36.830	-2.2037E-01	39.370	-1.6513E-01	41.910	-1.1044E-01
44.450	-5.6064E-02	46.990	-1.3371E-03	49.530	2.4991E-04
52.070	-1.3946E-05	54.610	-2.5069E-05	57.150	-1.9098E-05
59.690	-4.4275E-06	60.960	4.4306E-06		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 9.303E+05 0.0300 292.65     2 1.000E-01 8.450E+05 0.0300 292.65
     3 2.000E-01 7.646E+05 0.0300 292.65     4 3.000E-01 6.886E+05 0.0300 292.65
     5 4.000E-01 6.167E+05 0.0300 292.65     6 5.000E-01 5.483E+05 0.0300 292.65
     7 6.000E-01 4.831E+05 0.0300 292.65     8 7.000E-01 4.209E+05 0.0300 292.65
     9 8.000E-01 3.613E+05 0.0300 292.65    10 9.000E-01 3.043E+05 0.0300 292.65
    11 1.000E+00 2.495E+05 0.0301 292.65    12 1.250E+00 1.213E+05 0.0301 292.65
    13 1.500E+00 4.258E+03 0.0372 292.65    14 1.750E+00 3.311E+03 0.0397 292.65
    15 2.000E+00 2.964E+03 0.0411 292.65    16 2.500E+00 2.625E+03 0.0428 292.65
    17 3.000E+00 2.445E+03 0.0439 292.65    18 3.500E+00 2.329E+03 0.0448 292.65
    19 4.000E+00 2.248E+03 0.0454 292.65    20 4.500E+00 2.190E+03 0.0459 292.65
    21 5.080E+00 2.141E+03 0.0463 292.65    22 7.620E+00 2.073E+03 0.0470 292.65
    23 1.016E+01 2.144E+03 0.0463 292.65    24 1.270E+01 2.299E+03 0.0450 292.65
    25 1.524E+01 2.404E+03 0.0442 292.65    26 1.778E+01 2.375E+03 0.0444 292.65
    27 2.032E+01 2.291E+03 0.0450 292.65    28 2.286E+01 2.210E+03 0.0457 292.65
    29 2.540E+01 2.143E+03 0.0463 292.65    30 2.794E+01 2.090E+03 0.0468 292.65
    31 3.048E+01 2.047E+03 0.0472 292.65    32 3.302E+01 2.013E+03 0.0476 292.65
    33 3.556E+01 1.987E+03 0.0478 292.65    34 3.810E+01 1.966E+03 0.0481 292.65
    35 4.064E+01 1.950E+03 0.0482 292.65    36 4.318E+01 1.939E+03 0.0484 292.65
    37 4.572E+01 1.932E+03 0.0484 292.65    38 4.826E+01 1.805E+03 0.0501 292.65
    39 5.080E+01 1.457E+03 0.0501 292.65    40 5.334E+01 1.244E+03 0.0502 292.65
    41 5.588E+01 1.161E+03 0.0502 292.65    42 5.842E+01 1.134E+03 0.0502 292.65
    43 6.096E+01 1.128E+03 0.0502 292.65

 Initial Water Storage =   2.8588 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03007     0.04672     0.05024
 Head (cm)         = 1.63309E+06 2.13165E+05 2.09791E+03 1.12853E+03
```

```
 LiqWater Flow (cm)=-6.93514E-13-8.92615E-03-1.71002E-03 7.56218E-09
 IsoVapor Flow (cm)=-2.69927E-02-9.66092E-03-9.19205E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   2.8588+ 0.0000+ 0.0000 - 0.0270- 0.0000-  0.0000 =     2.8318 vs.     2.8319

 Mass Balance = -4.3839E-05 cm;  Time step attempts =  180 and successes =  138
   Evaporation:  Potential =  0.5153 cm, Actual =  0.0270 cm
 RHMEAN = 30.6 %;  TMEAN = 280.1 K;  HDRY =  1.6331E+06 cm;  DAYUBC =   138

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03007     0.05757     0.07834     0.05009
 Head (cm)         = 1.93406E+05 1.37937E+03 8.57116E+02 1.68511E+03
 LiqWater Flow (cm)=-1.48295E-08-7.41189E-02-3.64072E-02 2.77874E-10
 IsoVapor Flow (cm)=-6.01614E-02-5.17880E-06-2.35506E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   4.2409+ 0.0000+ 0.0000 - 0.0602- 0.0000-  0.0000 =     4.1807 vs.     4.1807

 Mass Balance =  1.9180E-05 cm;  Time step attempts =  171 and successes =  151
   Evaporation:  Potential =  0.2528 cm, Actual =  0.0602 cm
 RHMEAN = 78.7 %;  TMEAN = 279.5 K;  HDRY =  3.3014E+05 cm;  DAYUBC =    90
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.4173E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.4173E+02     [cm]
 Actual Evaporation                 =  1.2589E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.3919E+01     [cm]
 Total Basal Liquid Flux (drainage) =  9.2968E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.3919E+01     [cm]
Actual Rainfall                    =  1.3919E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  4.1807E+00     [cm]
Mass Balance Error                 =  8.3141E-03     [cm]
Total Successful Time Steps        =     64938
Total Attempted Time Steps         =     80077
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     33261
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.3302E+00	0.050	1.0626E+01	0.150	8.5538E+00
0.250	7.5587E+00	0.350	6.9268E+00	0.450	6.5789E+00
0.550	6.3023E+00	0.650	6.0189E+00	0.750	5.7703E+00
0.850	5.5641E+00	0.950	5.4138E+00	1.125	5.2522E+00
1.375	4.8883E+00	1.625	4.5547E+00	1.875	4.2961E+00
2.250	4.0180E+00	2.750	3.4990E+00	3.250	3.1340E+00
3.750	2.8882E+00	4.250	2.6059E+00	4.790	2.3704E+00
6.350	2.0845E+00	8.890	1.5819E+00	11.430	1.2372E+00
13.970	1.0454E+00	16.510	9.7340E-01	19.050	8.9864E-01
21.590	8.2211E-01	24.130	7.4424E-01	26.670	6.6517E-01
29.210	5.8500E-01	31.750	5.0381E-01	34.290	4.2168E-01
36.830	3.3870E-01	39.370	2.5496E-01	41.910	1.7056E-01
44.450	8.5566E-02	46.990	7.3096E-04	49.530	2.2898E-05
52.070	-7.1335E-06	54.610	-1.4925E-05	57.150	-1.5449E-05
59.690	-6.1756E-06	60.960	9.2968E-07		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                 -----------------------                 -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.934E+05 0.0301 292.65     2 1.000E-01 7.846E+04 0.0302 292.65
     3 2.000E-01 1.584E+03 0.0534 292.65     4 3.000E-01 1.570E+03 0.0536 292.65
     5 4.000E-01 1.556E+03 0.0539 292.65     6 5.000E-01 1.542E+03 0.0541 292.65
     7 6.000E-01 1.529E+03 0.0544 292.65     8 7.000E-01 1.516E+03 0.0546 292.65
     9 8.000E-01 1.504E+03 0.0549 292.65    10 9.000E-01 1.491E+03 0.0551 292.65
    11 1.000E+00 1.480E+03 0.0554 292.65    12 1.250E+00 1.452E+03 0.0559 292.65
    13 1.500E+00 1.426E+03 0.0565 292.65    14 1.750E+00 1.402E+03 0.0570 292.65
    15 2.000E+00 1.379E+03 0.0576 292.65    16 2.500E+00 1.339E+03 0.0586 292.65
    17 3.000E+00 1.304E+03 0.0595 292.65    18 3.500E+00 1.273E+03 0.0603 292.65
    19 4.000E+00 1.245E+03 0.0611 292.65    20 4.500E+00 1.221E+03 0.0619 292.65
    21 5.080E+00 1.195E+03 0.0627 292.65    22 7.620E+00 1.109E+03 0.0657 292.65
    23 1.016E+01 1.048E+03 0.0682 292.65    24 1.270E+01 1.001E+03 0.0703 292.65
    25 1.524E+01 9.639E+02 0.0721 292.65    26 1.778E+01 9.341E+02 0.0737 292.65
    27 2.032E+01 9.095E+02 0.0751 292.65    28 2.286E+01 8.890E+02 0.0763 292.65
    29 2.540E+01 8.717E+02 0.0774 292.65    30 2.794E+01 8.571E+02 0.0783 292.65
    31 3.048E+01 8.448E+02 0.0792 292.65    32 3.302E+01 8.343E+02 0.0799 292.65
    33 3.556E+01 8.255E+02 0.0805 292.65    34 3.810E+01 8.182E+02 0.0810 292.65
    35 4.064E+01 8.121E+02 0.0815 292.65    36 4.318E+01 8.073E+02 0.0818 292.65
    37 4.572E+01 8.037E+02 0.0821 292.65    38 4.826E+01 7.949E+02 0.0506 292.65
    39 5.080E+01 1.509E+03 0.0501 292.65    40 5.334E+01 1.708E+03 0.0501 292.65
    41 5.588E+01 1.721E+03 0.0501 292.65    42 5.842E+01 1.697E+03 0.0501 292.65
    43 6.096E+01 1.685E+03 0.0501 292.65

 Initial Water Storage =   4.1807 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06537     0.06560     0.07668     0.05009
 Head (cm)         = 1.11780E+03 1.11184E+03 8.83015E+02 1.68690E+03
```

```
 LiqWater Flow (cm)=-1.71788E-03-2.57592E-02-3.23945E-02 2.75352E-10
 IsoVapor Flow (cm)=-5.54926E-05-1.16636E-06-2.45205E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.1807+ 0.0000+ 0.0000 - 0.0000- 0.0000-  0.0000 =    4.1807 vs.    4.1807

 Mass Balance =  2.2094E-05 cm;  Time step attempts =  107 and successes =   95
   Evaporation:  Potential =  0.0878 cm, Actual =  0.0000 cm
 RHMEAN = **** %;  TMEAN = 272.6 K;  HDRY =  1.5303E-10 cm;  DAYUBC =     0

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03009     0.05609     0.05011
 Head (cm)         = 1.03684E+06 1.57500E+05 1.44500E+03 1.53378E+03
 LiqWater Flow (cm)=-2.46492E-12-2.23950E-04-2.66652E-03 6.01803E-10
 IsoVapor Flow (cm)=-1.69046E-02-1.66803E-02-2.61679E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1966+ 0.0000+ 0.0000 - 0.0169- 0.0000-  0.0000 =    3.1797 vs.    3.1797

 Mass Balance = -3.0048E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.8232 cm, Actual =  0.0169 cm
 RHMEAN = 47.1 %;  TMEAN = 284.0 K;  HDRY =  1.0368E+06 cm;  DAYUBC =    24
1

-------------------------------------------------------------------------------
                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1811E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1811E+02     [cm]
 Actual Evaporation                 =  1.4382E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.3386E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.3865E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.3386E+01     [cm]
Actual Rainfall                    =  1.3386E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1797E+00     [cm]
Mass Balance Error                 =  4.9321E-03     [cm]
Total Successful Time Steps        =     52650
Total Attempted Time Steps         =     63414
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     28860
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.9601E-01	0.050	9.6302E+00	0.150	6.8230E+00
0.250	5.7318E+00	0.350	4.8757E+00	0.450	4.3365E+00
0.550	3.8037E+00	0.650	3.3583E+00	0.750	3.0732E+00
0.850	2.7259E+00	0.950	2.3739E+00	1.125	2.1501E+00
1.375	1.7397E+00	1.625	1.4334E+00	1.875	1.0189E+00
2.250	7.7207E-01	2.750	4.0090E-01	3.250	2.1718E-01
3.750	8.5544E-02	4.250	4.4295E-02	4.790	-1.9564E-02
6.350	-1.1548E-01	8.890	-3.9065E-01	11.430	-4.6616E-01
13.970	-5.1804E-01	16.510	-5.5938E-01	19.050	-5.6868E-01
21.590	-5.6579E-01	24.130	-5.3752E-01	26.670	-4.8282E-01
29.210	-4.2647E-01	31.750	-3.6872E-01	34.290	-3.0970E-01
36.830	-2.4957E-01	39.370	-1.8848E-01	41.910	-1.2655E-01
44.450	-6.3968E-02	46.990	-4.7922E-04	49.530	1.7982E-04
52.070	1.1294E-05	54.610	3.1300E-06	57.150	1.1260E-06
59.690	3.6838E-07	60.960	1.3865E-07		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                ----------------------                  ----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.037E+06 0.0300 292.65     2 1.000E-01 9.767E+05 0.0300 292.65
     3 2.000E-01 9.190E+05 0.0300 292.65     4 3.000E-01 8.637E+05 0.0300 292.65
     5 4.000E-01 8.104E+05 0.0300 292.65     6 5.000E-01 7.592E+05 0.0300 292.65
     7 6.000E-01 7.098E+05 0.0300 292.65     8 7.000E-01 6.621E+05 0.0300 292.65
     9 8.000E-01 6.161E+05 0.0300 292.65    10 9.000E-01 5.715E+05 0.0300 292.65
    11 1.000E+00 5.283E+05 0.0300 292.65    12 1.250E+00 4.258E+05 0.0300 292.65
    13 1.500E+00 3.304E+05 0.0300 292.65    14 1.750E+00 2.413E+05 0.0301 292.65
    15 2.000E+00 1.575E+05 0.0301 292.65    16 2.500E+00 3.484E+03 0.0391 292.65
    17 3.000E+00 2.882E+03 0.0414 292.65    18 3.500E+00 2.602E+03 0.0429 292.65
    19 4.000E+00 2.425E+03 0.0441 292.65    20 4.500E+00 2.298E+03 0.0450 292.65
    21 5.080E+00 2.187E+03 0.0459 292.65    22 7.620E+00 1.904E+03 0.0488 292.65
    23 1.016E+01 1.757E+03 0.0507 292.65    24 1.270E+01 1.663E+03 0.0521 292.65
    25 1.524E+01 1.597E+03 0.0532 292.65    26 1.778E+01 1.549E+03 0.0540 292.65
    27 2.032E+01 1.512E+03 0.0547 292.65    28 2.286E+01 1.484E+03 0.0553 292.65
    29 2.540E+01 1.462E+03 0.0557 292.65    30 2.794E+01 1.445E+03 0.0561 292.65
    31 3.048E+01 1.431E+03 0.0564 292.65    32 3.302E+01 1.421E+03 0.0566 292.65
    33 3.556E+01 1.412E+03 0.0568 292.65    34 3.810E+01 1.406E+03 0.0570 292.65
    35 4.064E+01 1.400E+03 0.0571 292.65    36 4.318E+01 1.396E+03 0.0572 292.65
    37 4.572E+01 1.393E+03 0.0573 292.65    38 4.826E+01 1.399E+03 0.0501 292.65
    39 5.080E+01 1.514E+03 0.0501 292.65    40 5.334E+01 1.548E+03 0.0501 292.65
    41 5.588E+01 1.546E+03 0.0501 292.65    42 5.842E+01 1.538E+03 0.0501 292.65
    43 6.096E+01 1.534E+03 0.0501 292.65

 Initial Water Storage =   3.1797 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.05579     0.05011
 Head (cm)         = 6.62341E+05 1.10405E+05 1.45890E+03 1.53421E+03
```

```
 LiqWater Flow (cm)=-1.27037E-11-3.84751E-04-3.13025E-03 6.00400E-10
 IsoVapor Flow (cm)=-1.22067E-02-1.18689E-02-3.09256E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1797+ 0.0000+ 0.0000 - 0.0122- 0.0000-  0.0000 =    3.1675 vs.    3.1675

 Mass Balance = -5.3866E-07 cm;  Time step attempts =   51 and successes =   49
   Evaporation:  Potential =  0.2331 cm, Actual =  0.0122 cm
 RHMEAN = 61.8 %;  TMEAN = 276.2 K;  HDRY =  6.6234E+05 cm;  DAYUBC =    48

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05004     0.05185
 Head (cm)         = 1.00583E+06 5.20808E+05 1.80296E+03 4.99792E+02
 LiqWater Flow (cm)=-1.38143E-12-5.88668E-11-2.18112E-03 6.27447E-06
 IsoVapor Flow (cm)=-8.77296E-03-8.76710E-03-5.72794E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9175+ 0.0000+ 0.0000 - 0.0088- 0.0000-  0.0000 =    2.9088 vs.    2.9088

 Mass Balance = -1.0826E-05 cm;  Time step attempts =   43 and successes =   35
   Evaporation:  Potential =  0.2322 cm, Actual =  0.0088 cm
 RHMEAN = 48.2 %;  TMEAN = 278.2 K;  HDRY =  1.0058E+06 cm;  DAYUBC =    35
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1167E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1167E+02     [cm]
 Actual Evaporation                 =  2.4419E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.4155E+01     [cm]
 Total Basal Liquid Flux (drainage) =  6.8706E-04     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.4155E+01     [cm]
Actual Rainfall                    =  2.4155E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.9088E+00     [cm]
Mass Balance Error                 =  6.5881E-03     [cm]
Total Successful Time Steps        =     52807
Total Attempted Time Steps         =     64683
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     26908
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.6369E-01	0.050	1.2368E+01	0.150	8.1024E+00
0.250	6.9024E+00	0.350	6.0521E+00	0.450	5.4175E+00
0.550	4.8381E+00	0.650	4.3850E+00	0.750	3.9380E+00
0.850	3.5882E+00	0.950	3.3276E+00	1.125	3.0813E+00
1.375	2.3765E+00	1.625	2.1797E+00	1.875	2.0014E+00
2.250	1.8430E+00	2.750	1.4390E+00	3.250	1.2312E+00
3.750	8.8164E-01	4.250	6.3063E-01	4.790	5.1191E-01
6.350	3.9154E-01	8.890	1.2712E-01	11.430	-1.7845E-02
13.970	-1.4013E-01	16.510	-1.6082E-01	19.050	-1.4555E-01
21.590	-1.3010E-01	24.130	-1.1465E-01	26.670	-9.9275E-02
29.210	-8.4029E-02	31.750	-6.8931E-02	34.290	-5.3988E-02
36.830	-3.9195E-02	39.370	-2.4533E-02	41.910	-9.9723E-03
44.450	4.5259E-03	46.990	1.9588E-02	49.530	2.0807E-02
52.070	1.5434E-02	54.610	1.1477E-02	57.150	7.1425E-03
59.690	2.7150E-03	60.960	6.8706E-04		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                    Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.006E+06 0.0300 292.65     2 1.000E-01 9.771E+05 0.0300 292.65
     3 2.000E-01 9.485E+05 0.0300 292.65     4 3.000E-01 9.207E+05 0.0300 292.65
     5 4.000E-01 8.936E+05 0.0300 292.65     6 5.000E-01 8.672E+05 0.0300 292.65
     7 6.000E-01 8.412E+05 0.0300 292.65     8 7.000E-01 8.158E+05 0.0300 292.65
     9 8.000E-01 7.907E+05 0.0300 292.65    10 9.000E-01 7.661E+05 0.0300 292.65
    11 1.000E+00 7.420E+05 0.0300 292.65    12 1.250E+00 6.834E+05 0.0300 292.65
    13 1.500E+00 6.271E+05 0.0300 292.65    14 1.750E+00 5.729E+05 0.0300 292.65
    15 2.000E+00 5.208E+05 0.0300 292.65    16 2.500E+00 4.221E+05 0.0300 292.65
    17 3.000E+00 3.301E+05 0.0300 292.65    18 3.500E+00 2.438E+05 0.0301 292.65
    19 4.000E+00 1.626E+05 0.0301 292.65    20 4.500E+00 8.594E+04 0.0302 292.65
    21 5.080E+00 3.952E+03 0.0378 292.65    22 7.620E+00 2.688E+03 0.0424 292.65
    23 1.016E+01 2.368E+03 0.0445 292.65    24 1.270E+01 2.191E+03 0.0459 292.65
    25 1.524E+01 2.075E+03 0.0469 292.65    26 1.778E+01 1.990E+03 0.0478 292.65
    27 2.032E+01 1.926E+03 0.0485 292.65    28 2.286E+01 1.876E+03 0.0491 292.65
    29 2.540E+01 1.836E+03 0.0496 292.65    30 2.794E+01 1.803E+03 0.0500 292.65
    31 3.048E+01 1.776E+03 0.0504 292.65    32 3.302E+01 1.754E+03 0.0507 292.65
    33 3.556E+01 1.736E+03 0.0510 292.65    34 3.810E+01 1.722E+03 0.0512 292.65
    35 4.064E+01 1.711E+03 0.0513 292.65    36 4.318E+01 1.703E+03 0.0514 292.65
    37 4.572E+01 1.697E+03 0.0515 292.65    38 4.826E+01 1.487E+03 0.0501 292.65
    39 5.080E+01 5.446E+02 0.0515 292.65    40 5.334E+01 5.213E+02 0.0517 292.65
    41 5.588E+01 5.085E+02 0.0518 292.65    42 5.842E+01 5.019E+02 0.0518 292.65
    43 6.096E+01 4.998E+02 0.0519 292.65

 Initial Water Storage =   2.9088 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04991     0.05185
 Head (cm)         = 1.15661E+06 5.84796E+05 1.81255E+03 5.00235E+02
```

```
 LiqWater Flow (cm)=-7.83563E-13-2.42562E-11-2.17015E-03 6.22876E-06
 IsoVapor Flow (cm)=-8.93144E-03-8.92652E-03-5.83959E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9088+ 0.0000+ 0.0000 - 0.0089- 0.0000-  0.0000 =    2.8998 vs.    2.8998

 Mass Balance =  3.3405E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2497 cm, Actual =  0.0089 cm
 RHMEAN = 43.2 %;  TMEAN = 279.8 K;  HDRY =  1.1566E+06 cm;  DAYUBC =    24

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03005     0.03714     0.05082     0.05240
 Head (cm)         = 2.73526E+05 4.27114E+03 1.74601E+03 4.50940E+02
 LiqWater Flow (cm)=-5.09371E-10-9.48934E-03-1.15948E-03 1.46696E-05
 IsoVapor Flow (cm)=-7.63440E-03-1.03328E-04-2.95223E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0179+ 0.0000+ 0.0000 - 0.0076- 0.0000-  0.0000 =    3.0102 vs.    3.0102

 Mass Balance =  3.8508E-06 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.1854 cm, Actual =  0.0076 cm
 RHMEAN = 82.0 %;  TMEAN = 270.4 K;  HDRY =  2.7353E+05 cm;  DAYUBC =    51
1

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                             UNSAT-H Version 3.01
                              SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2121E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2121E+02     [cm]
 Actual Evaporation                 =  2.1655E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.1768E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.0816E-03     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1768E+01     [cm]
Actual Rainfall                    =  2.1768E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.0102E+00     [cm]
Mass Balance Error                 =  7.1795E-03     [cm]
Total Successful Time Steps        =     58450
Total Attempted Time Steps         =     71740
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     29263
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1271E-01	0.050	1.2009E+01	0.150	7.7434E+00
0.250	6.3572E+00	0.350	5.5262E+00	0.450	4.9294E+00
0.550	4.2400E+00	0.650	3.7168E+00	0.750	3.3362E+00
0.850	3.0930E+00	0.950	2.9043E+00	1.125	2.7246E+00
1.375	2.2775E+00	1.625	1.9882E+00	1.875	1.8554E+00
2.250	1.6989E+00	2.750	1.5064E+00	3.250	1.3804E+00
3.750	1.1927E+00	4.250	1.0010E+00	4.790	9.3725E-01
6.350	8.2966E-01	8.890	6.1956E-01	11.430	3.9918E-01
13.970	2.2939E-01	16.510	1.0103E-01	19.050	3.0562E-02
21.590	2.5930E-02	24.130	2.2522E-02	26.670	1.9843E-02
29.210	1.7727E-02	31.750	1.6056E-02	34.290	1.4722E-02
36.830	1.3626E-02	39.370	1.2698E-02	41.910	1.1882E-02
44.450	1.1129E-02	46.990	1.3107E-02	49.530	1.8264E-02
52.070	9.3692E-03	54.610	7.6958E-03	57.150	6.2179E-03
59.690	4.7844E-03	60.960	4.0816E-03		

```
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                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
```

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	2.735E+05	0.0300	292.65	2	1.000E-01	2.564E+05	0.0301	292.65
3	2.000E-01	2.398E+05	0.0301	292.65	4	3.000E-01	2.233E+05	0.0301	292.65
5	4.000E-01	2.069E+05	0.0301	292.65	6	5.000E-01	1.907E+05	0.0301	292.65
7	6.000E-01	1.748E+05	0.0301	292.65	8	7.000E-01	1.590E+05	0.0301	292.65
9	8.000E-01	1.434E+05	0.0301	292.65	10	9.000E-01	1.279E+05	0.0301	292.65
11	1.000E+00	1.126E+05	0.0301	292.65	12	1.250E+00	7.518E+04	0.0302	292.65
13	1.500E+00	3.866E+04	0.0305	292.65	14	1.750E+00	5.848E+03	0.0349	292.65
15	2.000E+00	4.271E+03	0.0371	292.65	16	2.500E+00	3.409E+03	0.0393	292.65
17	3.000E+00	3.043E+03	0.0407	292.65	18	3.500E+00	2.820E+03	0.0417	292.65
19	4.000E+00	2.665E+03	0.0426	292.65	20	4.500E+00	2.547E+03	0.0433	292.65
21	5.080E+00	2.441E+03	0.0439	292.65	22	7.620E+00	2.162E+03	0.0461	292.65
23	1.016E+01	2.019E+03	0.0475	292.65	24	1.270E+01	1.931E+03	0.0485	292.65
25	1.524E+01	1.873E+03	0.0491	292.65	26	1.778E+01	1.833E+03	0.0496	292.65
27	2.032E+01	1.803E+03	0.0500	292.65	28	2.286E+01	1.780E+03	0.0503	292.65
29	2.540E+01	1.762E+03	0.0506	292.65	30	2.794E+01	1.746E+03	0.0508	292.65
31	3.048E+01	1.732E+03	0.0510	292.65	32	3.302E+01	1.720E+03	0.0512	292.65
33	3.556E+01	1.709E+03	0.0514	292.65	34	3.810E+01	1.699E+03	0.0515	292.65
35	4.064E+01	1.691E+03	0.0516	292.65	36	4.318E+01	1.684E+03	0.0517	292.65
37	4.572E+01	1.680E+03	0.0518	292.65	38	4.826E+01	1.429E+03	0.0501	292.65
39	5.080E+01	4.800E+02	0.0520	292.65	40	5.334E+01	4.659E+02	0.0522	292.65
41	5.588E+01	4.573E+02	0.0523	292.65	42	5.842E+01	4.525E+02	0.0524	292.65
43	6.096E+01	4.509E+02	0.0524	292.65					

```
 Initial Water Storage =   3.0102 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03003     0.03417     0.05075     0.05239
 Head (cm)         = 4.46116E+05 6.68903E+03 1.75097E+03 4.51470E+02
```

```
 LiqWater Flow (cm)=-7.72381E-11-8.94834E-03-1.21834E-03 1.45276E-05
 IsoVapor Flow (cm)=-1.15374E-02-1.60151E-04-3.09998E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.0102+ 0.0000+ 0.0000 - 0.0115- 0.0000-  0.0000 =    2.9987 vs.    2.9987

 Mass Balance = -9.1430E-06 cm;  Time step attempts =   55 and successes =   44
   Evaporation:  Potential =  0.2333 cm, Actual =  0.0115 cm
 RHMEAN = 72.3 %;  TMEAN = 276.2 K;  HDRY =  4.4612E+05 cm;  DAYUBC =    44

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03013     0.06276     0.08544     0.05117
 Head (cm)         = 1.20186E+05 1.19275E+03 7.61901E+02 6.00783E+02
 LiqWater Flow (cm)=-6.34932E-02-1.43312E-01-4.41809E-02 1.37268E-06
 IsoVapor Flow (cm)=-9.87435E-02-3.68917E-06-1.71695E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.6754+ 0.0000+ 0.0000 - 0.1642- 0.0000-  0.0000 =    4.5112 vs.    4.5112

 Mass Balance = -2.3310E-05 cm;  Time step attempts =  194 and successes =  147
   Evaporation:  Potential =  0.3290 cm, Actual =  0.1642 cm
 RHMEAN = 70.1 %;  TMEAN = 278.4 K;  HDRY =  4.9048E+05 cm;  DAYUBC =    30
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  2.8444E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  2.8444E+02     [cm]
 Actual Evaporation                 =  2.9170E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.0683E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.7248E-03     [cm]
```

```
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                =  3.0683E+01     [cm]
 Actual Rainfall                    =  3.0683E+01     [cm]
 Actual Irrigation                  =  0.0000E+00     [cm]
 Total Final Moisture Storage       =  4.5112E+00     [cm]
 Mass Balance Error                 =  1.0704E-02     [cm]
 Total Successful Time Steps        =     73933
 Total Attempted Time Steps         =     91409
 Total Time Step Reductions (DHMAX) =         0
 Total Changes in Surface Boundary  =     32787
 Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.5134E+00	0.050	2.0348E+01	0.150	1.4075E+01
0.250	1.1809E+01	0.350	1.0265E+01	0.450	9.0517E+00
0.550	8.1675E+00	0.650	7.6598E+00	0.750	7.1403E+00
0.850	6.4682E+00	0.950	5.8626E+00	1.125	5.4985E+00
1.375	4.5449E+00	1.625	3.8734E+00	1.875	3.4718E+00
2.250	3.0838E+00	2.750	2.3917E+00	3.250	2.0620E+00
3.750	1.7576E+00	4.250	1.5568E+00	4.790	1.4789E+00
6.350	1.3450E+00	8.890	1.2779E+00	11.430	1.2082E+00
13.970	1.1352E+00	16.510	1.0589E+00	19.050	9.7973E-01
21.590	8.9793E-01	24.130	8.1380E-01	26.670	7.2761E-01
29.210	6.3960E-01	31.750	5.5001E-01	34.290	4.5905E-01
36.830	3.6691E-01	39.370	2.7376E-01	41.910	1.7975E-01
44.450	8.4990E-02	46.990	-9.8953E-03	49.530	-7.1173E-03
52.070	-8.7067E-03	54.610	-5.8320E-03	57.150	-2.8514E-03
59.690	1.9202E-04	60.960	1.7248E-03		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.202E+05 0.0301 292.65     2 1.000E-01 1.324E+03 0.0590 292.65
     3 2.000E-01 1.316E+03 0.0592 292.65     4 3.000E-01 1.308E+03 0.0594 292.65
     5 4.000E-01 1.300E+03 0.0596 292.65     6 5.000E-01 1.293E+03 0.0598 292.65
     7 6.000E-01 1.285E+03 0.0600 292.65     8 7.000E-01 1.278E+03 0.0602 292.65
     9 8.000E-01 1.271E+03 0.0604 292.65    10 9.000E-01 1.264E+03 0.0606 292.65
    11 1.000E+00 1.257E+03 0.0608 292.65    12 1.250E+00 1.240E+03 0.0613 292.65
    13 1.500E+00 1.224E+03 0.0618 292.65    14 1.750E+00 1.208E+03 0.0623 292.65
    15 2.000E+00 1.193E+03 0.0628 292.65    16 2.500E+00 1.164E+03 0.0637 292.65
    17 3.000E+00 1.138E+03 0.0646 292.65    18 3.500E+00 1.114E+03 0.0655 292.65
    19 4.000E+00 1.092E+03 0.0664 292.65    20 4.500E+00 1.071E+03 0.0672 292.65
    21 5.080E+00 1.049E+03 0.0681 292.65    22 7.620E+00 9.721E+02 0.0717 292.65
    23 1.016E+01 9.177E+02 0.0746 292.65    24 1.270E+01 8.776E+02 0.0770 292.65
    25 1.524E+01 8.469E+02 0.0790 292.65    26 1.778E+01 8.226E+02 0.0807 292.65
    27 2.032E+01 8.030E+02 0.0822 292.65    28 2.286E+01 7.868E+02 0.0834 292.65
    29 2.540E+01 7.733E+02 0.0845 292.65    30 2.794E+01 7.619E+02 0.0854 292.65
    31 3.048E+01 7.522E+02 0.0863 292.65    32 3.302E+01 7.439E+02 0.0870 292.65
    33 3.556E+01 7.368E+02 0.0876 292.65    34 3.810E+01 7.308E+02 0.0882 292.65
    35 4.064E+01 7.258E+02 0.0886 292.65    36 4.318E+01 7.216E+02 0.0890 292.65
    37 4.572E+01 7.183E+02 0.0893 292.65    38 4.826E+01 7.105E+02 0.0508 292.65
    39 5.080E+01 6.799E+02 0.0509 292.65    40 5.334E+01 6.343E+02 0.0510 292.65
    41 5.588E+01 6.131E+02 0.0511 292.65    42 5.842E+01 6.036E+02 0.0512 292.65
    43 6.096E+01 6.008E+02 0.0512 292.65

 Initial Water Storage =   4.5112 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05546     0.05967     0.08286     0.05117
 Head (cm)         = 1.47496E+03 1.29651E+03 7.93712E+02 6.01038E+02
```

```
 LiqWater Flow (cm)=-5.24966E-02-1.17013E-01-4.46999E-02 1.36790E-06
 IsoVapor Flow (cm)=-7.15645E-02-4.73932E-06-2.01760E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   4.5112+ 0.0000+ 0.0000 - 0.1228- 0.0000-  0.0000 =    4.3884 vs.    4.3884

 Mass Balance = -1.9060E-06 cm;  Time step attempts =  352 and successes =  274
   Evaporation:  Potential =  0.2426 cm, Actual =  0.1228 cm
 RHMEAN = 76.7 %;  TMEAN = 276.5 K;  HDRY =  3.6523E+05 cm;  DAYUBC =    62

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.05004     0.05450     0.06356     0.05079
 Head (cm)         = 1.80298E+03 1.52344E+03 1.16876E+03 7.02518E+02
 LiqWater Flow (cm)= 4.66811E-02 9.74416E-03-3.79147E-03 3.77331E-07
 IsoVapor Flow (cm)=-3.25437E-02-2.30104E-06-1.55793E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.6161+ 0.1016+ 0.0000 - 0.0865- 0.0000-  0.0000 =    3.6313 vs.    3.6312

 Mass Balance =  4.2927E-05 cm;  Time step attempts =  318 and successes =  273
   Evaporation:  Potential =  0.2069 cm, Actual =  0.0865 cm
 RHMEAN = 88.3 %;  TMEAN = 282.9 K;  HDRY =  1.7170E+05 cm;  DAYUBC =    59
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1664E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1664E+02     [cm]
 Actual Evaporation                 =  2.4698E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.3825E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.5834E-04     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.3825E+01     [cm]
Actual Rainfall                    =  2.3825E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.6312E+00     [cm]
Mass Balance Error                 =  6.9570E-03     [cm]
Total Successful Time Steps        =     59852
Total Attempted Time Steps         =     73546
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     29255
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.7278E-01	0.050	1.3549E+01	0.150	7.8886E+00
0.250	6.3369E+00	0.350	5.1669E+00	0.450	4.3629E+00
0.550	3.9008E+00	0.650	3.4830E+00	0.750	3.2630E+00
0.850	2.9031E+00	0.950	2.6077E+00	1.125	2.3241E+00
1.375	1.6848E+00	1.625	1.4288E+00	1.875	1.1923E+00
2.250	9.1418E-01	2.750	5.4712E-01	3.250	2.1084E-01
3.750	8.0325E-02	4.250	3.5609E-03	4.790	-8.5649E-02
6.350	-2.0461E-01	8.890	-4.0931E-01	11.430	-5.4619E-01
13.970	-6.0036E-01	16.510	-6.7511E-01	19.050	-6.3408E-01
21.590	-5.8562E-01	24.130	-5.3433E-01	26.670	-4.8076E-01
29.210	-4.2532E-01	31.750	-3.6834E-01	34.290	-3.1004E-01
36.830	-2.5063E-01	39.370	-1.9029E-01	41.910	-1.2916E-01
44.450	-6.7396E-02	46.990	-3.5432E-03	49.530	1.2433E-03
52.070	-1.6633E-03	54.610	-1.7559E-03	57.150	-1.0308E-03
59.690	-1.8134E-04	60.960	2.5834E-04		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.803E+03 0.0500 292.65     2 1.000E-01 1.781E+03 0.0503 292.65
     3 2.000E-01 1.760E+03 0.0506 292.65     4 3.000E-01 1.741E+03 0.0509 292.65
     5 4.000E-01 1.723E+03 0.0512 292.65     6 5.000E-01 1.705E+03 0.0514 292.65
     7 6.000E-01 1.689E+03 0.0517 292.65     8 7.000E-01 1.674E+03 0.0519 292.65
     9 8.000E-01 1.659E+03 0.0521 292.65    10 9.000E-01 1.645E+03 0.0524 292.65
    11 1.000E+00 1.631E+03 0.0526 292.65    12 1.250E+00 1.600E+03 0.0531 292.65
    13 1.500E+00 1.572E+03 0.0536 292.65    14 1.750E+00 1.547E+03 0.0541 292.65
    15 2.000E+00 1.523E+03 0.0545 292.65    16 2.500E+00 1.483E+03 0.0553 292.65
    17 3.000E+00 1.448E+03 0.0560 292.65    18 3.500E+00 1.418E+03 0.0567 292.65
    19 4.000E+00 1.392E+03 0.0573 292.65    20 4.500E+00 1.369E+03 0.0578 292.65
    21 5.080E+00 1.346E+03 0.0584 292.65    22 7.620E+00 1.277E+03 0.0602 292.65
    23 1.016E+01 1.238E+03 0.0613 292.65    24 1.270E+01 1.216E+03 0.0620 292.65
    25 1.524E+01 1.204E+03 0.0624 292.65    26 1.778E+01 1.196E+03 0.0627 292.65
    27 2.032E+01 1.189E+03 0.0629 292.65    28 2.286E+01 1.182E+03 0.0631 292.65
    29 2.540E+01 1.176E+03 0.0633 292.65    30 2.794E+01 1.169E+03 0.0636 292.65
    31 3.048E+01 1.162E+03 0.0638 292.65    32 3.302E+01 1.156E+03 0.0640 292.65
    33 3.556E+01 1.150E+03 0.0642 292.65    34 3.810E+01 1.145E+03 0.0644 292.65
    35 4.064E+01 1.140E+03 0.0646 292.65    36 4.318E+01 1.136E+03 0.0647 292.65
    37 4.572E+01 1.133E+03 0.0648 292.65    38 4.826E+01 1.120E+03 0.0502 292.65
    39 5.080E+01 8.442E+02 0.0505 292.65    40 5.334E+01 7.456E+02 0.0507 292.65
    41 5.588E+01 7.152E+02 0.0508 292.65    42 5.842E+01 7.049E+02 0.0508 292.65
    43 6.096E+01 7.025E+02 0.0508 292.65

 Initial Water Storage =   3.6312 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.06430     0.06661     0.06693     0.05079
 Head (cm)         = 1.14743E+03 1.08568E+03 1.07774E+03 7.02637E+02
```

```
 LiqWater Flow (cm)= 3.14902E-01 2.35926E-01 1.03990E-02 3.76809E-07
 IsoVapor Flow (cm)=-5.05616E-02-1.06421E-06 1.71256E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.6312+ 0.4572+ 0.0000 - 0.1922- 0.0000-  0.0000 =     3.8963 vs.     3.8961

 Mass Balance =  1.3058E-04 cm;  Time step attempts =  529 and successes =  442
   Evaporation:  Potential =  0.3119 cm, Actual =  0.1922 cm
 RHMEAN = 75.1 %;  TMEAN = 283.7 K;  HDRY =  3.9383E+05 cm;  DAYUBC =    64

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03040     0.06153     0.05061
 Head (cm)         = 1.50332E+06 4.69196E+04 1.23187E+03 7.77678E+02
 LiqWater Flow (cm)=-9.03240E-13-2.26255E-02-9.71717E-03 1.63082E-07
 IsoVapor Flow (cm)=-2.64699E-02-2.88345E-04-3.81421E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.4285+ 0.0000+ 0.0000 - 0.0265- 0.0000-  0.0000 =     3.4020 vs.     3.4020

 Mass Balance = -1.1567E-05 cm;  Time step attempts =   55 and successes =   42
   Evaporation:  Potential =  0.6403 cm, Actual =  0.0265 cm
 RHMEAN = 33.6 %;  TMEAN = 285.7 K;  HDRY =  1.5033E+06 cm;  DAYUBC =    42
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2162E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2162E+02     [cm]
 Actual Evaporation                 =  2.5851E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.5629E+01     [cm]
 Total Basal Liquid Flux (drainage) =  8.7196E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.5629E+01     [cm]
Actual Rainfall                    =  2.5629E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.4020E+00     [cm]
Mass Balance Error                 =  6.9867E-03     [cm]
Total Successful Time Steps        =     53456
Total Attempted Time Steps         =     65118
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     26714
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.2213E-01	0.050	1.6857E+01	0.150	9.2527E+00
0.250	7.8425E+00	0.350	6.5009E+00	0.450	6.0172E+00
0.550	5.5713E+00	0.650	5.3263E+00	0.750	4.9606E+00
0.850	4.5875E+00	0.950	4.1565E+00	1.125	3.9106E+00
1.375	2.9709E+00	1.625	2.4363E+00	1.875	1.9723E+00
2.250	1.6844E+00	2.750	9.6905E-01	3.250	8.4539E-01
3.750	7.0963E-01	4.250	5.8468E-01	4.790	4.7032E-01
6.350	4.0616E-01	8.890	1.6757E-01	11.430	1.2537E-02
13.970	-6.4498E-02	16.510	-5.9786E-02	19.050	-4.8834E-02
21.590	-3.9805E-02	24.130	-3.2405E-02	26.670	-2.6336E-02
29.210	-2.1333E-02	31.750	-1.7160E-02	34.290	-1.3654E-02
36.830	-1.0664E-02	39.370	-8.0665E-03	41.910	-5.7571E-03
44.450	-3.6415E-03	46.990	-1.0137E-03	49.530	1.4848E-03
52.070	-2.8803E-04	54.610	-6.2782E-04	57.150	-4.2068E-04
59.690	-9.0434E-05	60.960	8.7196E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                 -----------------------                 -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.503E+06 0.0300 292.65     2 1.000E-01 1.379E+06 0.0300 292.65
     3 2.000E-01 1.265E+06 0.0300 292.65     4 3.000E-01 1.160E+06 0.0300 292.65
     5 4.000E-01 1.062E+06 0.0300 292.65     6 5.000E-01 9.704E+05 0.0300 292.65
     7 6.000E-01 8.847E+05 0.0300 292.65     8 7.000E-01 8.040E+05 0.0300 292.65
     9 8.000E-01 7.278E+05 0.0300 292.65    10 9.000E-01 6.557E+05 0.0300 292.65
    11 1.000E+00 5.871E+05 0.0300 292.65    12 1.250E+00 4.293E+05 0.0300 292.65
    13 1.500E+00 2.881E+05 0.0300 292.65    14 1.750E+00 1.608E+05 0.0301 292.65
    15 2.000E+00 4.692E+04 0.0304 292.65    16 2.500E+00 2.639E+03 0.0427 292.65
    17 3.000E+00 2.444E+03 0.0439 292.65    18 3.500E+00 2.277E+03 0.0452 292.65
    19 4.000E+00 2.148E+03 0.0463 292.65    20 4.500E+00 2.046E+03 0.0472 292.65
    21 5.080E+00 1.953E+03 0.0482 292.65    22 7.620E+00 1.700E+03 0.0515 292.65
    23 1.016E+01 1.562E+03 0.0538 292.65    24 1.270E+01 1.470E+03 0.0555 292.65
    25 1.524E+01 1.404E+03 0.0570 292.65    26 1.778E+01 1.354E+03 0.0582 292.65
    27 2.032E+01 1.313E+03 0.0592 292.65    28 2.286E+01 1.281E+03 0.0601 292.65
    29 2.540E+01 1.254E+03 0.0609 292.65    30 2.794E+01 1.232E+03 0.0615 292.65
    31 3.048E+01 1.213E+03 0.0621 292.65    32 3.302E+01 1.198E+03 0.0626 292.65
    33 3.556E+01 1.185E+03 0.0630 292.65    34 3.810E+01 1.175E+03 0.0633 292.65
    35 4.064E+01 1.167E+03 0.0636 292.65    36 4.318E+01 1.161E+03 0.0638 292.65
    37 4.572E+01 1.156E+03 0.0640 292.65    38 4.826E+01 1.136E+03 0.0502 292.65
    39 5.080E+01 9.257E+02 0.0504 292.65    40 5.334E+01 8.211E+02 0.0505 292.65
    41 5.588E+01 7.877E+02 0.0506 292.65    42 5.842E+01 7.791E+02 0.0506 292.65
    43 6.096E+01 7.777E+02 0.0506 292.65

 Initial Water Storage =   3.4020 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.03014     0.06103     0.05061
 Head (cm)         = 7.20447E+05 1.14410E+05 1.24858E+03 7.77730E+02
```

```
 LiqWater Flow (cm)=-9.41296E-12-7.83704E-04-9.27695E-03 1.62996E-07
 IsoVapor Flow (cm)=-1.31360E-02-1.22687E-02-3.89091E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.4020+ 0.0000+ 0.0000 - 0.0131- 0.0000-  0.0000 =    3.3889 vs.    3.3889

 Mass Balance = -1.0060E-06 cm;  Time step attempts =   58 and successes =   56
   Evaporation:  Potential =  0.2468 cm, Actual =  0.0131 cm
 RHMEAN = 59.3 %;  TMEAN = 275.7 K;  HDRY =  7.2045E+05 cm;  DAYUBC =    53

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04447     0.05551     0.05045
 Head (cm)         = 8.58098E+05 2.36711E+03 1.47251E+03 8.82114E+02
 LiqWater Flow (cm)=-2.23125E-11-3.41122E-02 4.41607E-03 5.76756E-08
 IsoVapor Flow (cm)=-4.83108E-02-1.76663E-05 3.63275E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2799+ 0.0000+ 0.0000 - 0.0483- 0.0000-  0.0000 =    3.2316 vs.    3.2316

 Mass Balance = -5.7639E-05 cm;  Time step attempts =  293 and successes =  228
   Evaporation:  Potential =  0.4952 cm, Actual =  0.0483 cm
 RHMEAN = 53.7 %;  TMEAN = 279.5 K;  HDRY =  8.5810E+05 cm;  DAYUBC =   227
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2377E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2377E+02     [cm]
 Actual Evaporation                 =  2.1422E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.1260E+01     [cm]
 Total Basal Liquid Flux (drainage) =  3.9114E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.1260E+01     [cm]
Actual Rainfall                    =  2.1260E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.2316E+00     [cm]
Mass Balance Error                 =  8.0353E-03     [cm]
Total Successful Time Steps        =     58101
Total Attempted Time Steps         =     71538
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     28966
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.6230E-01	0.050	1.4549E+01	0.150	1.0475E+01
0.250	9.0283E+00	0.350	8.0494E+00	0.450	7.3823E+00
0.550	6.6063E+00	0.650	5.8517E+00	0.750	5.3948E+00
0.850	4.8779E+00	0.950	4.5168E+00	1.125	4.2655E+00
1.375	3.3820E+00	1.625	2.9954E+00	1.875	2.2928E+00
2.250	1.9388E+00	2.750	1.2631E+00	3.250	9.3559E-01
3.750	7.1133E-01	4.250	5.8516E-01	4.790	4.5431E-01
6.350	2.5657E-01	8.890	-8.7253E-02	11.430	-1.9146E-01
13.970	-2.0297E-01	16.510	-2.0105E-01	19.050	-1.9642E-01
21.590	-1.8906E-01	24.130	-1.7897E-01	26.670	-1.6625E-01
29.210	-1.5106E-01	31.750	-1.3367E-01	34.290	-1.1441E-01
36.830	-9.3621E-02	39.370	-7.1629E-02	41.910	-4.8772E-02
44.450	-2.5337E-02	46.990	-1.3010E-03	49.530	7.1558E-04
52.070	-2.0713E-04	54.610	-4.1797E-04	57.150	-3.1207E-04
59.690	-8.6013E-05	60.960	3.9114E-05		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 8.581E+05 0.0300 292.65     2 1.000E-01 7.469E+05 0.0300 292.65
     3 2.000E-01 6.392E+05 0.0300 292.65     4 3.000E-01 5.432E+05 0.0300 292.65
     5 4.000E-01 4.522E+05 0.0300 292.65     6 5.000E-01 3.670E+05 0.0300 292.65
     7 6.000E-01 2.868E+05 0.0300 292.65     8 7.000E-01 2.110E+05 0.0301 292.65
     9 8.000E-01 1.392E+05 0.0301 292.65    10 9.000E-01 7.089E+04 0.0302 292.65
    11 1.000E+00 6.475E+03 0.0343 292.65    12 1.250E+00 3.156E+03 0.0403 292.65
    13 1.500E+00 2.751E+03 0.0421 292.65    14 1.750E+00 2.522E+03 0.0434 292.65
    15 2.000E+00 2.367E+03 0.0445 292.65    16 2.500E+00 2.162E+03 0.0461 292.65
    17 3.000E+00 2.029E+03 0.0474 292.65    18 3.500E+00 1.932E+03 0.0484 292.65
    19 4.000E+00 1.858E+03 0.0493 292.65    20 4.500E+00 1.799E+03 0.0501 292.65
    21 5.080E+00 1.743E+03 0.0509 292.65    22 7.620E+00 1.590E+03 0.0533 292.65
    23 1.016E+01 1.511E+03 0.0547 292.65    24 1.270E+01 1.468E+03 0.0556 292.65
    25 1.524E+01 1.445E+03 0.0561 292.65    26 1.778E+01 1.437E+03 0.0563 292.65
    27 2.032E+01 1.438E+03 0.0562 292.65    28 2.286E+01 1.446E+03 0.0561 292.65
    29 2.540E+01 1.458E+03 0.0558 292.65    30 2.794E+01 1.473E+03 0.0555 292.65
    31 3.048E+01 1.487E+03 0.0552 292.65    32 3.302E+01 1.499E+03 0.0550 292.65
    33 3.556E+01 1.508E+03 0.0548 292.65    34 3.810E+01 1.514E+03 0.0547 292.65
    35 4.064E+01 1.518E+03 0.0546 292.65    36 4.318E+01 1.518E+03 0.0546 292.65
    37 4.572E+01 1.517E+03 0.0546 292.65    38 4.826E+01 1.465E+03 0.0501 292.65
    39 5.080E+01 9.716E+02 0.0504 292.65    40 5.334E+01 8.870E+02 0.0504 292.65
    41 5.588E+01 8.854E+02 0.0504 292.65    42 5.842E+01 8.844E+02 0.0504 292.65
    43 6.096E+01 8.821E+02 0.0504 292.65

 Initial Water Storage =   3.2316 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04334     0.05545     0.05045
 Head (cm)         = 6.36590E+05 2.53410E+03 1.47512E+03 8.82181E+02
```

```
 LiqWater Flow (cm)=-3.71215E-11-2.40150E-02 3.06965E-03 5.76387E-08
 IsoVapor Flow (cm)=-2.58388E-02-2.26761E-05 2.27088E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.2316+ 0.0000+ 0.0000 - 0.0258- 0.0000-  0.0000 =    3.2058 vs.    3.2058

 Mass Balance = -8.9513E-06 cm;  Time step attempts =   95 and successes =   83
   Evaporation:  Potential =  0.2932 cm, Actual =  0.0258 cm
 RHMEAN = 63.0 %;  TMEAN = 275.9 K;  HDRY =  6.3659E+05 cm;  DAYUBC =    82

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04393     0.06482     0.05028
 Head (cm)         = 1.19840E+06 2.44439E+03 1.13268E+03 1.06308E+03
 LiqWater Flow (cm)=-3.46012E-12-3.24701E-02-1.24756E-02 1.23723E-08
 IsoVapor Flow (cm)=-3.67543E-02-2.62342E-05-3.26469E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5921+ 0.0000+ 0.0000 - 0.0368- 0.0000-  0.0000 =    3.5553 vs.    3.5554

 Mass Balance = -1.4396E-05 cm;  Time step attempts =   70 and successes =   53
   Evaporation:  Potential =  0.4041 cm, Actual =  0.0368 cm
 RHMEAN = 41.9 %;  TMEAN = 278.4 K;  HDRY =  1.1984E+06 cm;  DAYUBC =    53
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1575E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1575E+02     [cm]
 Actual Evaporation                 =  2.0190E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.0523E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.2828E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.0523E+01     [cm]
Actual Rainfall                    =  2.0523E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.5554E+00     [cm]
Mass Balance Error                 =  8.9914E-03     [cm]
Total Successful Time Steps        =     67254
Total Attempted Time Steps         =     83746
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     32257
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	3.3273E-01	0.050	1.3774E+01	0.150	1.0483E+01
0.250	8.7808E+00	0.350	7.3702E+00	0.450	6.5017E+00
0.550	5.8800E+00	0.650	5.2931E+00	0.750	4.8904E+00
0.850	4.5162E+00	0.950	4.1625E+00	1.125	3.9198E+00
1.375	3.3622E+00	1.625	2.8637E+00	1.875	2.5182E+00
2.250	2.2861E+00	2.750	1.8524E+00	3.250	1.5531E+00
3.750	1.3095E+00	4.250	1.1034E+00	4.790	9.3901E-01
6.350	7.9309E-01	8.890	5.6177E-01	11.430	4.1563E-01
13.970	3.2088E-01	16.510	3.0247E-01	19.050	2.8921E-01
21.590	2.7329E-01	24.130	2.5466E-01	26.670	2.3337E-01
29.210	2.0960E-01	31.750	1.8361E-01	34.290	1.5570E-01
36.830	1.2624E-01	39.370	9.5556E-02	41.910	6.3976E-02
44.450	3.1779E-02	46.990	-1.6477E-04	49.530	4.5167E-04
52.070	-6.8048E-05	54.610	-1.5511E-04	57.150	-1.4147E-04
59.690	-4.9737E-05	60.960	1.2828E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                      Initial Conditions
                ----------------------                  ----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.198E+06 0.0300 292.65     2 1.000E-01 1.077E+06 0.0300 292.65
     3 2.000E-01 9.652E+05 0.0300 292.65     4 3.000E-01 8.620E+05 0.0300 292.65
     5 4.000E-01 7.660E+05 0.0300 292.65     6 5.000E-01 6.762E+05 0.0300 292.65
     7 6.000E-01 5.919E+05 0.0300 292.65     8 7.000E-01 5.125E+05 0.0300 292.65
     9 8.000E-01 4.374E+05 0.0300 292.65    10 9.000E-01 3.662E+05 0.0300 292.65
    11 1.000E+00 2.984E+05 0.0300 292.65    12 1.250E+00 1.424E+05 0.0301 292.65
    13 1.500E+00 2.906E+03 0.0413 292.65    14 1.750E+00 2.624E+03 0.0428 292.65
    15 2.000E+00 2.444E+03 0.0439 292.65    16 2.500E+00 2.211E+03 0.0457 292.65
    17 3.000E+00 2.056E+03 0.0471 292.65    18 3.500E+00 1.942E+03 0.0483 292.65
    19 4.000E+00 1.854E+03 0.0494 292.65    20 4.500E+00 1.783E+03 0.0503 292.65
    21 5.080E+00 1.716E+03 0.0513 292.65    22 7.620E+00 1.524E+03 0.0545 292.65
    23 1.016E+01 1.413E+03 0.0568 292.65    24 1.270E+01 1.337E+03 0.0586 292.65
    25 1.524E+01 1.281E+03 0.0601 292.65    26 1.778E+01 1.238E+03 0.0613 292.65
    27 2.032E+01 1.203E+03 0.0624 292.65    28 2.286E+01 1.175E+03 0.0633 292.65
    29 2.540E+01 1.152E+03 0.0641 292.65    30 2.794E+01 1.133E+03 0.0648 292.65
    31 3.048E+01 1.117E+03 0.0654 292.65    32 3.302E+01 1.103E+03 0.0659 292.65
    33 3.556E+01 1.092E+03 0.0664 292.65    34 3.810E+01 1.083E+03 0.0667 292.65
    35 4.064E+01 1.075E+03 0.0670 292.65    36 4.318E+01 1.070E+03 0.0673 292.65
    37 4.572E+01 1.066E+03 0.0674 292.65    38 4.826E+01 1.051E+03 0.0503 292.65
    39 5.080E+01 9.238E+02 0.0504 292.65    40 5.334E+01 1.015E+03 0.0503 292.65
    41 5.588E+01 1.060E+03 0.0503 292.65    42 5.842E+01 1.065E+03 0.0503 292.65
    43 6.096E+01 1.063E+03 0.0503 292.65

 Initial Water Storage =   3.5554 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.04584     0.06416     0.05028
 Head (cm)         = 7.50500E+05 2.19449E+03 1.15133E+03 1.06316E+03
```

```
 LiqWater Flow (cm)=-1.45651E-11-2.47285E-02-1.19994E-02 1.23642E-08
 IsoVapor Flow (cm)=-2.25943E-02-1.72107E-05-3.39095E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.5554+ 0.0000+ 0.0000 - 0.0226- 0.0000-  0.0000 =    3.5328 vs.    3.5328

 Mass Balance = -7.2661E-07 cm;  Time step attempts =   62 and successes =   60
   Evaporation:  Potential =  0.4127 cm, Actual =  0.0226 cm
 RHMEAN = 58.0 %;  TMEAN = 279.5 K;  HDRY =  7.5050E+05 cm;  DAYUBC =    59

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 366, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.04512     0.05025
 Head (cm)         = 8.61063E+05 6.85429E+05 2.28256E+03 1.11631E+03
 LiqWater Flow (cm)=-8.55997E-13-2.64299E-12-1.31436E-03 8.28772E-09
 IsoVapor Flow (cm)=-2.92266E-03-2.92266E-03-1.06713E-06 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6300+ 0.0000+ 0.0000 - 0.0029- 0.0000-  0.0000 =    2.6271 vs.    2.6271

 Mass Balance = -4.5638E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.2451 cm, Actual =  0.0029 cm
 RHMEAN = 53.5 %;  TMEAN = 275.4 K;  HDRY =  8.6106E+05 cm;  DAYUBC =    24
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.2628E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.2628E+02     [cm]
 Actual Evaporation                 =  1.5756E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.4834E+01     [cm]
 Total Basal Liquid Flux (drainage) =  4.5471E-06     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.4834E+01     [cm]
Actual Rainfall                    =  1.4834E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.6271E+00     [cm]
Mass Balance Error                 =  5.9940E-03     [cm]
Total Successful Time Steps        =     50879
Total Attempted Time Steps         =     61797
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     27333
Total Time Actually Simulated      =  3.6600E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6600E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-9.2231E-01	0.050	1.0309E+01	0.150	7.2574E+00
0.250	6.4006E+00	0.350	5.8049E+00	0.450	5.3515E+00
0.550	4.9830E+00	0.650	4.5178E+00	0.750	4.1966E+00
0.850	3.8978E+00	0.950	3.5870E+00	1.125	3.2950E+00
1.375	2.6672E+00	1.625	2.3083E+00	1.875	2.0397E+00
2.250	1.6984E+00	2.750	1.1390E+00	3.250	7.7352E-01
3.750	5.1126E-01	4.250	2.2814E-01	4.790	8.3418E-02
6.350	-1.0243E-01	8.890	-5.9324E-01	11.430	-6.8378E-01
13.970	-6.5666E-01	16.510	-6.0870E-01	19.050	-5.6069E-01
21.590	-5.1231E-01	24.130	-4.6343E-01	26.670	-4.1400E-01
29.210	-3.6402E-01	31.750	-3.1352E-01	34.290	-2.6255E-01
36.830	-2.1114E-01	39.370	-1.5934E-01	41.910	-1.0720E-01
44.450	-5.4744E-02	46.990	-1.6860E-03	49.530	2.2692E-04
52.070	-7.1239E-06	54.610	-1.4950E-05	57.150	-1.0146E-05
59.690	-7.2527E-07	60.960	4.5471E-06		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------               -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 8.611E+05 0.0300 292.65     2 1.000E-01 8.517E+05 0.0300 292.65
     3 2.000E-01 8.425E+05 0.0300 292.65     4 3.000E-01 8.333E+05 0.0300 292.65
     5 4.000E-01 8.241E+05 0.0300 292.65     6 5.000E-01 8.150E+05 0.0300 292.65
     7 6.000E-01 8.060E+05 0.0300 292.65     8 7.000E-01 7.970E+05 0.0300 292.65
     9 8.000E-01 7.881E+05 0.0300 292.65    10 9.000E-01 7.792E+05 0.0300 292.65
    11 1.000E+00 7.705E+05 0.0300 292.65    12 1.250E+00 7.487E+05 0.0300 292.65
    13 1.500E+00 7.273E+05 0.0300 292.65    14 1.750E+00 7.062E+05 0.0300 292.65
    15 2.000E+00 6.854E+05 0.0300 292.65    16 2.500E+00 6.448E+05 0.0300 292.65
    17 3.000E+00 6.053E+05 0.0300 292.65    18 3.500E+00 5.670E+05 0.0300 292.65
    19 4.000E+00 5.297E+05 0.0300 292.65    20 4.500E+00 4.933E+05 0.0300 292.65
    21 5.080E+00 4.523E+05 0.0300 292.65    22 7.620E+00 2.858E+05 0.0300 292.65
    23 1.016E+01 1.373E+05 0.0301 292.65    24 1.270E+01 3.518E+03 0.0390 292.65
    25 1.524E+01 2.963E+03 0.0411 292.65    26 1.778E+01 2.701E+03 0.0424 292.65
    27 2.032E+01 2.539E+03 0.0433 292.65    28 2.286E+01 2.428E+03 0.0440 292.65
    29 2.540E+01 2.345E+03 0.0446 292.65    30 2.794E+01 2.283E+03 0.0451 292.65
    31 3.048E+01 2.234E+03 0.0455 292.65    32 3.302E+01 2.195E+03 0.0458 292.65
    33 3.556E+01 2.164E+03 0.0461 292.65    34 3.810E+01 2.141E+03 0.0463 292.65
    35 4.064E+01 2.123E+03 0.0465 292.65    36 4.318E+01 2.111E+03 0.0466 292.65
    37 4.572E+01 2.103E+03 0.0467 292.65    38 4.826E+01 1.941E+03 0.0501 292.65
    39 5.080E+01 1.605E+03 0.0501 292.65    40 5.334E+01 1.350E+03 0.0502 292.65
    41 5.588E+01 1.201E+03 0.0502 292.65    42 5.842E+01 1.135E+03 0.0502 292.65
    43 6.096E+01 1.116E+03 0.0502 292.65

 Initial Water Storage =   2.6271 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03001     0.04504     0.05025
 Head (cm)         = 1.42694E+06 1.08397E+06 2.29221E+03 1.11705E+03
```

```
 LiqWater Flow (cm)=-1.47721E-13-5.34144E-13-1.30647E-03 8.24271E-09
 IsoVapor Flow (cm)=-4.12682E-03-4.11260E-03-1.08211E-06 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.6271+ 0.0000+ 0.0000 - 0.0041- 0.0000-  0.0000 =    2.6229 vs.    2.6229

 Mass Balance =  6.0153E-06 cm;  Time step attempts =   48 and successes =   41
   Evaporation:  Potential =  0.2990 cm, Actual =  0.0041 cm
 RHMEAN = 35.5 %;  TMEAN = 275.9 K;  HDRY =  1.4269E+06 cm;  DAYUBC =    41

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.08653     0.08752     0.07301     0.05058
 Head (cm)         = 7.49185E+02 7.38039E+02 9.46956E+02 7.96306E+02
 LiqWater Flow (cm)= 1.28766E+00 1.16127E+00 9.67814E-02 1.33728E-07
 IsoVapor Flow (cm)= 1.45604E-05 3.41266E-05 2.76437E-06 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8664+ 1.4732+ 0.0000 - 0.1827- 0.0000-  0.0000 =    4.1569 vs.    4.1559

 Mass Balance =  1.0595E-03 cm;  Time step attempts = 2307 and successes = 1729
   Evaporation:  Potential =  0.1864 cm, Actual =  0.1827 cm
 RHMEAN = 91.4 %;  TMEAN = 281.8 K;  HDRY =  1.2349E+05 cm;  DAYUBC =     0
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1796E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1796E+02     [cm]
 Actual Evaporation                 =  2.9019E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  3.0556E+01     [cm]
 Total Basal Liquid Flux (drainage) =  8.2857E-06     [cm]
```

Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	3.0556E+01	[cm]
Actual Rainfall	=	3.0556E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	4.1559E+00	[cm]
Mass Balance Error	=	7.8821E-03	[cm]
Total Successful Time Steps	=	57974	
Total Attempted Time Steps	=	70806	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	27145	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.5367E+00	0.050	1.5375E+01	0.150	8.7842E+00
0.250	7.2983E+00	0.350	6.0681E+00	0.450	5.5426E+00
0.550	5.1104E+00	0.650	4.7733E+00	0.750	4.6095E+00
0.850	4.4096E+00	0.950	4.2644E+00	1.125	4.1658E+00
1.375	3.9068E+00	1.625	3.7132E+00	1.875	3.5227E+00
2.250	3.3130E+00	2.750	2.9895E+00	3.250	2.7765E+00
3.750	2.6101E+00	4.250	2.4357E+00	4.790	2.2728E+00
6.350	2.0253E+00	8.890	1.4800E+00	11.430	1.1812E+00
13.970	8.7885E-01	16.510	6.4813E-01	19.050	5.2711E-01
21.590	4.2666E-01	24.130	3.3465E-01	26.670	2.5230E-01
29.210	1.8129E-01	31.750	1.2366E-01	34.290	8.1509E-02
36.830	5.5178E-02	39.370	3.9243E-02	41.910	2.7028E-02
44.450	1.5685E-02	46.990	5.3446E-03	49.530	7.4396E-03
52.070	4.4976E-03	54.610	2.7253E-03	57.150	1.0627E-03
59.690	2.2001E-04	60.960	8.2857E-06		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                ----------------------                ----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 7.492E+02 0.0865 292.65     2 1.000E-01 7.416E+02 0.0872 292.65
     3 2.000E-01 7.434E+02 0.0870 292.65     4 3.000E-01 7.430E+02 0.0871 292.65
     5 4.000E-01 7.424E+02 0.0871 292.65     6 5.000E-01 7.421E+02 0.0871 292.65
     7 6.000E-01 7.419E+02 0.0872 292.65     8 7.000E-01 7.417E+02 0.0872 292.65
     9 8.000E-01 7.414E+02 0.0872 292.65    10 9.000E-01 7.411E+02 0.0872 292.65
    11 1.000E+00 7.408E+02 0.0873 292.65    12 1.250E+00 7.401E+02 0.0873 292.65
    13 1.500E+00 7.393E+02 0.0874 292.65    14 1.750E+00 7.387E+02 0.0875 292.65
    15 2.000E+00 7.380E+02 0.0875 292.65    16 2.500E+00 7.369E+02 0.0876 292.65
    17 3.000E+00 7.359E+02 0.0877 292.65    18 3.500E+00 7.350E+02 0.0878 292.65
    19 4.000E+00 7.342E+02 0.0879 292.65    20 4.500E+00 7.336E+02 0.0879 292.65
    21 5.080E+00 7.330E+02 0.0880 292.65    22 7.620E+00 7.326E+02 0.0880 292.65
    23 1.016E+01 7.356E+02 0.0877 292.65    24 1.270E+01 7.426E+02 0.0871 292.65
    25 1.524E+01 7.543E+02 0.0861 292.65    26 1.778E+01 7.716E+02 0.0846 292.65
    27 2.032E+01 7.961E+02 0.0827 292.65    28 2.286E+01 8.304E+02 0.0802 292.65
    29 2.540E+01 8.784E+02 0.0770 292.65    30 2.794E+01 9.470E+02 0.0730 292.65
    31 3.048E+01 1.048E+03 0.0682 292.65    32 3.302E+01 1.204E+03 0.0624 292.65
    33 3.556E+01 1.429E+03 0.0564 292.65    34 3.810E+01 1.632E+03 0.0526 292.65
    35 4.064E+01 1.716E+03 0.0513 292.65    36 4.318E+01 1.731E+03 0.0510 292.65
    37 4.572E+01 1.730E+03 0.0511 292.65    38 4.826E+01 1.600E+03 0.0501 292.65
    39 5.080E+01 9.382E+02 0.0504 292.65    40 5.334E+01 7.835E+02 0.0506 292.65
    41 5.588E+01 7.635E+02 0.0506 292.65    42 5.842E+01 7.809E+02 0.0506 292.65
    43 6.096E+01 7.963E+02 0.0506 292.65

 Initial Water Storage =   4.1559 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03007     0.07064     0.07314     0.05058
 Head (cm)         = 1.98374E+05 9.93641E+02 9.44585E+02 7.95756E+02
```

```
 LiqWater Flow (cm)=-6.07483E-02-9.88876E-02 1.20797E-01 1.34505E-07
 IsoVapor Flow (cm)=-7.72573E-02-1.03629E-06 1.24158E-06 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   4.1559+ 0.0508+ 0.0000 - 0.1916- 0.0000-  0.0000 =     4.0150 vs.     4.0151

 Mass Balance = -2.6415E-05 cm;  Time step attempts =  248 and successes =  210
   Evaporation:  Potential =  0.4749 cm, Actual =  0.1916 cm
 RHMEAN = 80.3 %;  TMEAN = 280.4 K;  HDRY =  3.0227E+05 cm;  DAYUBC =    64

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04633     0.05131     0.05046
 Head (cm)         = 7.13118E+05 2.13938E+03 1.71252E+03 8.74989E+02
 LiqWater Flow (cm)=-1.83405E-04-4.47956E-02-1.42134E-03 6.16353E-08
 IsoVapor Flow (cm)=-7.69419E-02-1.12819E-05-3.39111E-07 0.00000E+00

                                              LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
   3.2154+ 0.0000+ 0.0000 - 0.0771- 0.0000-  0.0000 =     3.1383 vs.     3.1383

 Mass Balance = -7.0153E-05 cm;  Time step attempts =  383 and successes =  304
   Evaporation:  Potential =  0.5522 cm, Actual =  0.0771 cm
 RHMEAN = 59.6 %;  TMEAN = 285.7 K;  HDRY =  7.1312E+05 cm;  DAYUBC =   201
1

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                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.1971E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.1971E+02     [cm]
 Actual Evaporation                 =  2.3667E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  2.2657E+01     [cm]
 Total Basal Liquid Flux (drainage) =  3.9583E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  2.2657E+01     [cm]
Actual Rainfall                    =  2.2657E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  3.1383E+00     [cm]
Mass Balance Error                 =  7.6074E-03     [cm]
Total Successful Time Steps        =     62633
Total Attempted Time Steps         =     76742
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     30594
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.0099E+00	0.050	1.3406E+01	0.150	8.0691E+00
0.250	6.4709E+00	0.350	5.6810E+00	0.450	5.1205E+00
0.550	4.5368E+00	0.650	4.0134E+00	0.750	3.6789E+00
0.850	3.4251E+00	0.950	3.1542E+00	1.125	2.7857E+00
1.375	2.2144E+00	1.625	1.7686E+00	1.875	1.4624E+00
2.250	1.2264E+00	2.750	7.0410E-01	3.250	2.8531E-01
3.750	6.1545E-02	4.250	-1.1171E-01	4.790	-2.4058E-01
6.350	-2.9611E-01	8.890	-3.6925E-01	11.430	-3.8787E-01
13.970	-3.9072E-01	16.510	-4.0599E-01	19.050	-3.4356E-01
21.590	-2.6768E-01	24.130	-1.9619E-01	26.670	-1.3155E-01
29.210	-7.6539E-02	31.750	-3.3993E-02	34.290	-6.4978E-03
36.830	5.3791E-03	39.370	6.9308E-03	41.910	4.7725E-03
44.450	1.7352E-03	46.990	-9.0028E-04	49.530	1.3492E-03
52.070	-8.7299E-05	54.610	-3.7467E-04	57.150	-2.4570E-04
59.690	-4.8142E-05	60.960	3.9583E-05		

```
--------------------------------------------------------------------------------
                         UNSAT-H Version 3.01
                         INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                ----------------------                ----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 7.131E+05 0.0300 292.65     2 1.000E-01 5.871E+05 0.0300 292.65
     3 2.000E-01 4.716E+05 0.0300 292.65     4 3.000E-01 3.650E+05 0.0300 292.65
     5 4.000E-01 2.661E+05 0.0301 292.65     6 5.000E-01 1.738E+05 0.0301 292.65
     7 6.000E-01 8.734E+04 0.0302 292.65     8 7.000E-01 6.317E+03 0.0345 292.65
     9 8.000E-01 3.755E+03 0.0383 292.65    10 9.000E-01 3.257E+03 0.0399 292.65
    11 1.000E+00 2.981E+03 0.0410 292.65    12 1.250E+00 2.599E+03 0.0429 292.65
    13 1.500E+00 2.387E+03 0.0443 292.65    14 1.750E+00 2.244E+03 0.0454 292.65
    15 2.000E+00 2.139E+03 0.0463 292.65    16 2.500E+00 1.991E+03 0.0478 292.65
    17 3.000E+00 1.889E+03 0.0489 292.65    18 3.500E+00 1.814E+03 0.0499 292.65
    19 4.000E+00 1.755E+03 0.0507 292.65    20 4.500E+00 1.709E+03 0.0514 292.65
    21 5.080E+00 1.665E+03 0.0520 292.65    22 7.620E+00 1.555E+03 0.0539 292.65
    23 1.016E+01 1.513E+03 0.0547 292.65    24 1.270E+01 1.510E+03 0.0548 292.65
    25 1.524E+01 1.533E+03 0.0543 292.65    26 1.778E+01 1.574E+03 0.0536 292.65
    27 2.032E+01 1.624E+03 0.0527 292.65    28 2.286E+01 1.671E+03 0.0519 292.65
    29 2.540E+01 1.702E+03 0.0515 292.65    30 2.794E+01 1.713E+03 0.0513 292.65
    31 3.048E+01 1.708E+03 0.0514 292.65    32 3.302E+01 1.697E+03 0.0515 292.65
    33 3.556E+01 1.684E+03 0.0517 292.65    34 3.810E+01 1.672E+03 0.0519 292.65
    35 4.064E+01 1.661E+03 0.0521 292.65    36 4.318E+01 1.653E+03 0.0522 292.65
    37 4.572E+01 1.648E+03 0.0523 292.65    38 4.826E+01 1.556E+03 0.0501 292.65
    39 5.080E+01 1.018E+03 0.0503 292.65    40 5.334E+01 8.834E+02 0.0504 292.65
    41 5.588E+01 8.701E+02 0.0505 292.65    42 5.842E+01 8.737E+02 0.0505 292.65
    43 6.096E+01 8.750E+02 0.0505 292.65

 Initial Water Storage =   3.1383 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03002     0.04342     0.05187     0.05046
 Head (cm)         = 7.09845E+05 2.52160E+03 1.67568E+03 8.74950E+02
```

```
 LiqWater Flow (cm)=-3.25950E-11-2.68190E-02 7.28023E-04 6.16577E-08
 IsoVapor Flow (cm)=-3.45174E-02-2.06315E-05 7.62073E-08 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   3.1383+ 0.0000+ 0.0000 - 0.0345- 0.0000-  0.0000 =    3.1038 vs.    3.1039

 Mass Balance = -3.2708E-05 cm;  Time step attempts =  197 and successes =  157
   Evaporation:  Potential =  0.4151 cm, Actual =  0.0345 cm
 RHMEAN = 59.8 %;  TMEAN = 286.2 K;  HDRY =  7.0984E+05 cm;  DAYUBC =   156

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05125     0.05023
 Head (cm)         = 1.53614E+06 5.72974E+05 1.71650E+03 1.14847E+03
 LiqWater Flow (cm)=-3.94946E-13-5.63822E-11-1.45656E-03 6.55251E-09
 IsoVapor Flow (cm)=-1.33724E-02-1.33619E-02-3.27938E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9673+ 0.0000+ 0.0000 - 0.0134- 0.0000-  0.0000 =    2.9539 vs.    2.9539

 Mass Balance = -4.1195E-06 cm;  Time step attempts =   28 and successes =   26
   Evaporation:  Potential =  0.4463 cm, Actual =  0.0134 cm
 RHMEAN = 32.8 %;  TMEAN = 280.9 K;  HDRY =  1.5361E+06 cm;  DAYUBC =    26
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.3745E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.3745E+02     [cm]
 Actual Evaporation                 =  1.1201E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.1024E+01     [cm]
 Total Basal Liquid Flux (drainage) =  1.3305E-05     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.1024E+01     [cm]
Actual Rainfall                    =  1.1024E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.9539E+00     [cm]
Mass Balance Error                 =  7.1438E-03     [cm]
Total Successful Time Steps        =     58525
Total Attempted Time Steps         =     72070
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     31150
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-1.7731E-01	0.050	8.5643E+00	0.150	6.6354E+00
0.250	5.9816E+00	0.350	5.5777E+00	0.450	5.2074E+00
0.550	4.8888E+00	0.650	4.6139E+00	0.750	4.3545E+00
0.850	4.0922E+00	0.950	3.8994E+00	1.125	3.7057E+00
1.375	3.1063E+00	1.625	2.7385E+00	1.875	2.4496E+00
2.250	2.2020E+00	2.750	1.6182E+00	3.250	1.2590E+00
3.750	1.0109E+00	4.250	8.9616E-01	4.790	7.4015E-01
6.350	5.9081E-01	8.890	3.8483E-01	11.430	2.7566E-01
13.970	1.6716E-01	16.510	8.2211E-02	19.050	2.8136E-02
21.590	-5.7786E-03	24.130	-3.0442E-03	26.670	-1.9587E-03
29.210	-1.9442E-03	31.750	-2.3480E-03	34.290	-2.7813E-03
36.830	-3.0714E-03	39.370	-3.1728E-03	41.910	-3.0998E-03
44.450	-2.8948E-03	46.990	-1.5080E-03	49.530	-1.7529E-05
52.070	-1.3331E-04	54.610	-1.8787E-04	57.150	-1.6291E-04
59.690	-5.9882E-05	60.960	1.3305E-05		

```
--------------------------------------------------------------------------------
                          UNSAT-H Version 3.01
                          INITIAL CONDITIONS

 Input File:   C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Results File: C:\Users\kebenson\OneDrive - Burns & McDonnell\NOD El Paso\elpaso
 Date of Run:      15 Sep 2025
 Time of Run:      17:35:47.28
 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
--------------------------------------------------------------------------------
                  Initial Conditions                     Initial Conditions
                 -----------------------                -----------------------
  NODE   DEPTH      HEAD    THETA  TEMP   NODE   DEPTH      HEAD    THETA  TEMP
          (cm)      (cm)   (vol.)   (K)           (cm)      (cm)   (vol.)   (K)
  ---- --------- --------- ------ ------  ---- --------- --------- ------ ------
     1 0.000E+00 1.536E+06 0.0300 292.65     2 1.000E-01 1.469E+06 0.0300 292.65
     3 2.000E-01 1.404E+06 0.0300 292.65     4 3.000E-01 1.342E+06 0.0300 292.65
     5 4.000E-01 1.283E+06 0.0300 292.65     6 5.000E-01 1.227E+06 0.0300 292.65
     7 6.000E-01 1.172E+06 0.0300 292.65     8 7.000E-01 1.120E+06 0.0300 292.65
     9 8.000E-01 1.069E+06 0.0300 292.65    10 9.000E-01 1.020E+06 0.0300 292.65
    11 1.000E+00 9.732E+05 0.0300 292.65    12 1.250E+00 8.618E+05 0.0300 292.65
    13 1.500E+00 7.587E+05 0.0300 292.65    14 1.750E+00 6.627E+05 0.0300 292.65
    15 2.000E+00 5.730E+05 0.0300 292.65    16 2.500E+00 4.093E+05 0.0300 292.65
    17 3.000E+00 2.633E+05 0.0301 292.65    18 3.500E+00 1.314E+05 0.0301 292.65
    19 4.000E+00 1.098E+04 0.0323 292.65    20 4.500E+00 3.539E+03 0.0389 292.65
    21 5.080E+00 3.083E+03 0.0405 292.65    22 7.620E+00 2.376E+03 0.0444 292.65
    23 1.016E+01 2.133E+03 0.0464 292.65    24 1.270E+01 1.997E+03 0.0477 292.65
    25 1.524E+01 1.908E+03 0.0487 292.65    26 1.778E+01 1.845E+03 0.0495 292.65
    27 2.032E+01 1.799E+03 0.0501 292.65    28 2.286E+01 1.764E+03 0.0506 292.65
    29 2.540E+01 1.737E+03 0.0509 292.65    30 2.794E+01 1.716E+03 0.0512 292.65
    31 3.048E+01 1.700E+03 0.0515 292.65    32 3.302E+01 1.688E+03 0.0517 292.65
    33 3.556E+01 1.678E+03 0.0518 292.65    34 3.810E+01 1.670E+03 0.0520 292.65
    35 4.064E+01 1.664E+03 0.0521 292.65    36 4.318E+01 1.659E+03 0.0521 292.65
    37 4.572E+01 1.655E+03 0.0522 292.65    38 4.826E+01 1.614E+03 0.0501 292.65
    39 5.080E+01 1.392E+03 0.0501 292.65    40 5.334E+01 1.261E+03 0.0502 292.65
    41 5.588E+01 1.198E+03 0.0502 292.65    42 5.842E+01 1.162E+03 0.0502 292.65
    43 6.096E+01 1.148E+03 0.0502 292.65

 Initial Water Storage =   2.9539 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03001     0.03002     0.05109     0.05023
 Head (cm)         = 1.41657E+06 6.10843E+05 1.72739E+03 1.14906E+03
```

```
 LiqWater Flow (cm)=-4.53606E-13-3.34251E-11-1.61955E-03 6.52490E-09
 IsoVapor Flow (cm)=-1.16201E-02-1.16201E-02-3.67610E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.9539+ 0.0000+ 0.0000 - 0.0116- 0.0000-  0.0000 =    2.9423 vs.    2.9423

 Mass Balance = -6.2022E-06 cm;  Time step attempts =   64 and successes =   58
   Evaporation:  Potential =  0.3896 cm, Actual =  0.0116 cm
 RHMEAN = 35.8 %;  TMEAN = 281.5 K;  HDRY =  1.4166E+06 cm;  DAYUBC =    57

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number       =       1          15          30          43
 Depth (cm)        =     0.00000     2.00000    27.94000    60.96000
 Water (cm3/cm3)   =     0.03000     0.03001     0.05000     0.05013
 Head (cm)         = 2.16723E+06 1.21638E+06 1.80603E+03 1.46495E+03
 LiqWater Flow (cm)=-6.38283E-14-7.33809E-13-2.53177E-03 8.78066E-10
 IsoVapor Flow (cm)=-8.27982E-03-8.28004E-03-6.56984E-07 0.00000E+00

                                              LIQUID
  PRESTOR   INFIL  RUNOFF    EVAPO   TRANS    DRAIN     NEWSTOR       STORAGE
   2.8696+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =    2.8613 vs.    2.8613

 Mass Balance = -2.8309E-07 cm;  Time step attempts =   78 and successes =   78
   Evaporation:  Potential =  0.8891 cm, Actual =  0.0083 cm
 RHMEAN = 20.8 %;  TMEAN = 286.2 K;  HDRY =  2.1672E+06 cm;  DAYUBC =    77
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 Greater El Paso Landfill 2284A - 2025 ET Cap Design, No Plants
-------------------------------------------------------------------------------

 Transpiration Scheme is:           =    0
 Potential Evapotranspiration       =  3.4447E+02     [cm]
 Potential Transpiration            =  0.0000E+00     [cm]
 Actual Transpiration               =  0.0000E+00     [cm]
 Potential Evaporation              =  3.4447E+02     [cm]
 Actual Evaporation                 =  1.1719E+01     [cm]
 Evaporation during Growth          =  0.0000E+00     [cm]
 Total Runoff                       =  0.0000E+00     [cm]
 Total Infiltration                 =  1.1633E+01     [cm]
 Total Basal Liquid Flux (drainage) =  8.1990E-07     [cm]
```

```
Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
Total Applied Water                =  1.1633E+01     [cm]
Actual Rainfall                    =  1.1633E+01     [cm]
Actual Irrigation                  =  0.0000E+00     [cm]
Total Final Moisture Storage       =  2.8613E+00     [cm]
Mass Balance Error                 =  6.6786E-03     [cm]
Total Successful Time Steps        =     55052
Total Attempted Time Steps         =     67567
Total Time Step Reductions (DHMAX) =         0
Total Changes in Surface Boundary  =     29649
Total Time Actually Simulated      =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-8.5925E-02	0.050	9.0392E+00	0.150	6.9847E+00
0.250	6.2650E+00	0.350	5.6683E+00	0.450	5.2342E+00
0.550	4.8918E+00	0.650	4.5887E+00	0.750	4.2915E+00
0.850	4.0521E+00	0.950	3.7820E+00	1.125	3.5889E+00
1.375	3.1565E+00	1.625	2.8897E+00	1.875	2.5731E+00
2.250	2.3133E+00	2.750	1.8990E+00	3.250	1.4995E+00
3.750	1.2919E+00	4.250	1.1012E+00	4.790	8.7650E-01
6.350	6.6167E-01	8.890	2.7643E-01	11.430	2.1497E-01
13.970	1.5462E-01	16.510	1.0014E-01	19.050	5.0029E-02
21.590	-3.4339E-03	24.130	-1.9952E-02	26.670	-1.6570E-02
29.210	-1.3535E-02	31.750	-1.0882E-02	34.290	-8.5937E-03
36.830	-6.6310E-03	39.370	-4.9339E-03	41.910	-3.4387E-03
44.450	-2.0893E-03	46.990	-1.9108E-04	49.530	3.9153E-05
52.070	-3.3472E-06	54.610	-1.0431E-05	57.150	-1.1550E-05
59.690	-4.7625E-06	60.960	8.1990E-07		

APPENDIX III.I.1.E – LABORATORY SOIL DATA

Summary of Sample Preparation

	Proctor Data		Target Remold Densities	Actual Remold Values		
Sample Number	Optimum Moisture Content (% g/g)	Maximum Dry Bulk Density (g/cm^3)	Dry Bulk Density (g/cm^3)	Moisture Content (% g/g)	Dry Bulk Density (g/cm^3)	% of Max. Dry Bulk Density (%)
El Paso 75%			1.37	6.1	1.41	77.2%
El Paso 80%			1.46	6.1	1.50	82.2%
El Paso 85%	10.9	1.83	1.56	6.2	1.60	87.3%
El Paso 90%			1.65	6.2	1.69	92.4%
El Paso 95%			1.74	6.1	1.79	97.6%

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
El Paso 75%	1.2E-02	X	
El Paso 80%	6.6E-03	X	
El Paso 85%	3.1E-03	X	
El Paso 90%	1.3E-03	X	
El Paso 95%	7.9E-04	X	

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
El Paso 75%	0	46.0
	12	41.3
	38	40.1
	79	18.7
	510	13.8
	11728	5.2
	851293	1.2
El Paso 80%	0	45.2
	12	41.5
	38	39.7
	79	18.8
	510	10.4
	11728	5.6
	851293	1.2
El Paso 85%	0	43.4
	12	40.1
	38	39.3
	79	21.5
	510	10.8
	11728	5.9
	851293	1.3
El Paso 90%	0	37.7
	11	36.1
	40	34.8
	83	33.6
	510	11.5
	11728	6.3
	851293	1.4

TRI/ENVIRONMENTAL, INC.
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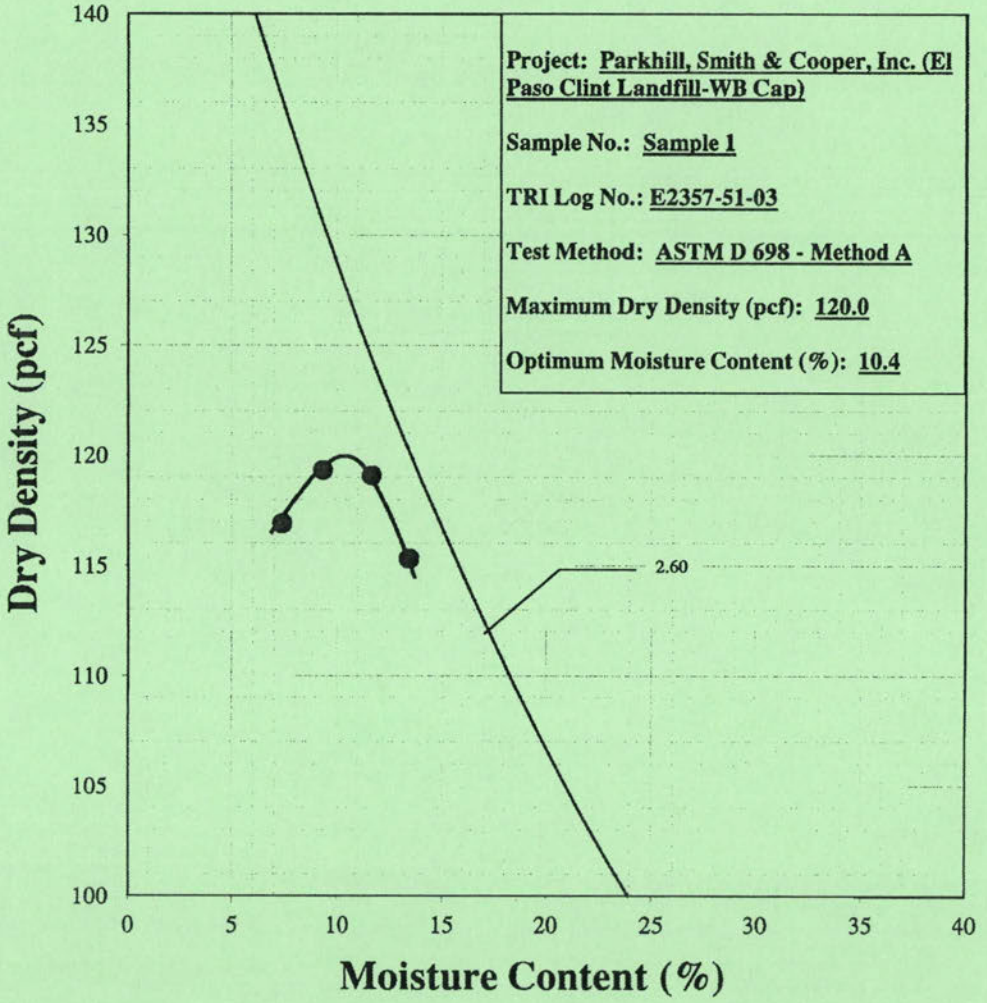
Proctor Compaction Test



John M. Allen, P.E., 09/16/11

Quality Review/Date

Tested by: Joe Vasquez

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

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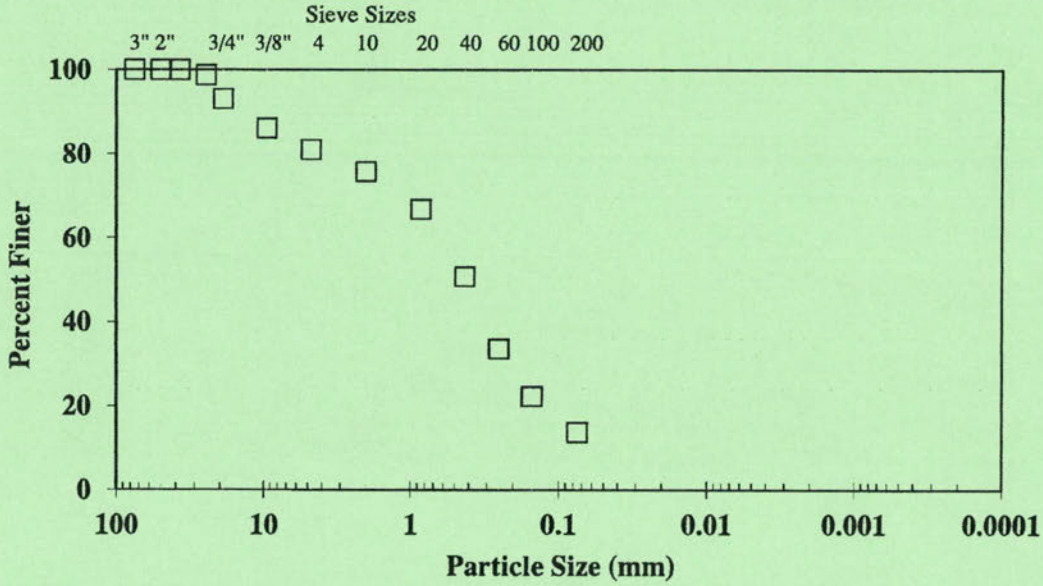
TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

Particle Size Analysis for Soils

Client: Parkhill, Smith, & Cooper, Inc.
Project: El Paso Clint Landfill-WB Cap
Sample: Sample 1

TRI Log#: E2357-51-03
Test Method: ASTM D 422
Test Date: 09/13/11



Sieve Analysis	
Sieve Size	Percentage Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	98.8
3/4 in.	93.1
3/8 in.	86.1
No. 4 (4.75 mm)	81.1
No. 10 (2.00 mm)	75.7
No. 20 (850 µm)	66.8
No. 40 (425 µm)	50.8
No. 60 (250 µm)	33.5
No. 100 (150 µm)	22.3
No. 200 (75 µm)	13.7

Notes: Soil classifies as a silty sand with gravel (SM) in accordance with ASTM D 2487.

Plastic Index (ASTM D 4318) Results	
Liquid Limit	NL
Plastic Limit	NP
Plastic Index	NP
Notes: Specimen was air dried, 3 point Liquid Limit procedure was used.	

John M. Allen, P.E., 09/15/11
Quality Review/Date
Tested by: Joe Vasquez & Tierra Jackson

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

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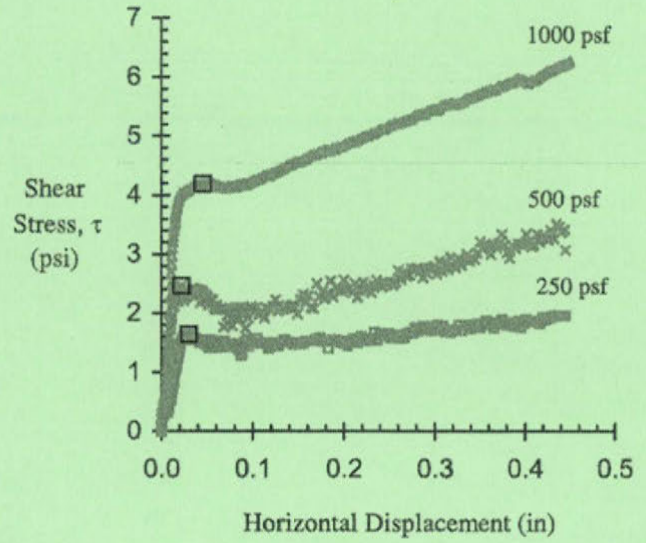
TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

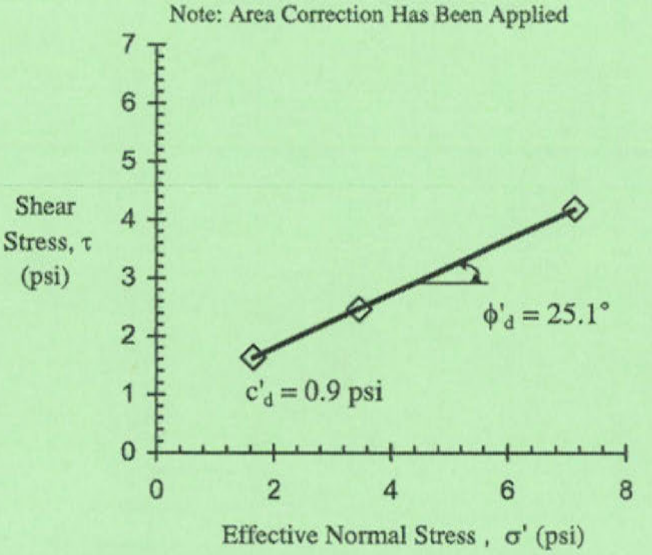
Direct Shear of Soil Under Consolidated-Drained Conditions

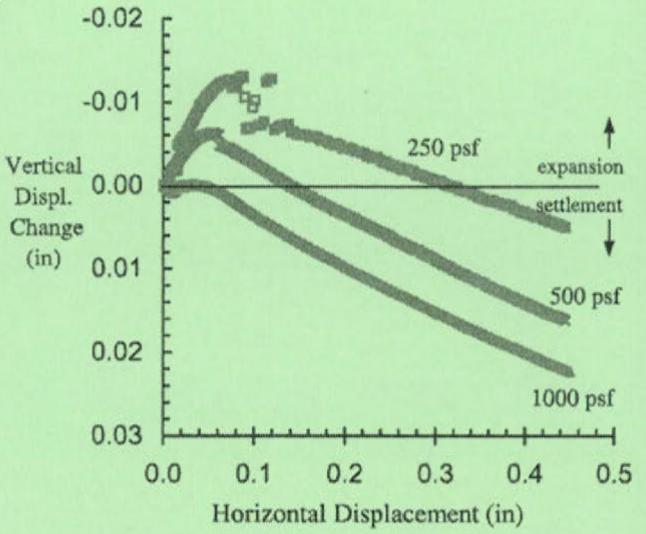
Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1

TRI Log#: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11



Note: Area Correction Has Been Applied





Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	0.99	0.99	1.00
	Water Content, %	10.0	10.1	10.0
	Saturation, %	51.0	51.7	51.2
	Dry Density, pcf	108.2	108.4	108.3
	Void Ratio	0.52	0.51	0.51
Post Consol	Height, in (prior to shear)	0.99	0.98	0.99
	Final Water Content, %	16.8	17.9	16.5
	Dry Density, pcf	108.8	108.9	109.1
	Void Ratio	0.51	0.51	0.50
Peak Normal Stress, σ' (psi)		1.6	3.5	7.1
Peak Shear Stress, τ (psi)		1.6	2.5	4.2
Displacement at Failure (in)		0.03	0.02	0.05
Displacement rate (in/min)		0.001	0.001	0.001
Sample Type	Remolded	ϕ'_d, degrees		**25.1**
G_s (measured)	2.626	c'_d, psi		**0.9**

Note: The soil was air dried and passed through a No. 4 sieve to eliminate any over sized particles. Specimens were remolded a target dry density of 90% standard compaction at optimum moisture content or 108.0 pcf dry density at a moisture content of 10.4 %.

Cheng-Wei Chen, 09/28/11
Analysis & Quality Review/Date
Specimens prepared by: Chirag Rakholia

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

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Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 250

TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

Testing Reading for Specimen No. 1

No.	Vert. Displ. Changes (in)	Horiz. Displ.(in)	Corrected Area (in^2)	Shear Stress (psi)
1	0.000	0.000	4.89	0.00
2	0.000	0.001	4.89	0.10
3	0.000	0.003	4.89	0.39
4	0.001	0.006	4.88	0.37
5	0.001	0.008	4.87	0.38
6	0.001	0.011	4.87	0.52
7	0.001	0.013	4.86	0.76
8	-0.002	0.016	4.85	1.06
9	-0.005	0.018	4.85	1.23
10	-0.005	0.020	4.84	1.42
11	-0.006	0.026	4.83	1.58
12	-0.008	0.033	4.81	1.61
13	-0.009	0.041	4.79	1.53
14	-0.011	0.048	4.77	1.47
15	-0.011	0.056	4.75	1.52
16	-0.012	0.063	4.74	1.46
17	-0.013	0.071	4.72	1.48
18	-0.012	0.078	4.70	1.47
19	-0.013	0.086	4.68	1.37
20	-0.007	0.093	4.66	1.52
21	-0.007	0.105	4.63	1.57
22	-0.013	0.120	4.59	1.44
23	-0.007	0.135	4.56	1.55
24	-0.006	0.150	4.52	1.51
25	-0.006	0.165	4.48	1.53
26	-0.005	0.180	4.44	1.53
27	-0.005	0.195	4.41	1.52
28	-0.004	0.210	4.37	1.55
29	-0.003	0.240	4.29	1.64
30	-0.002	0.270	4.22	1.65
31	-0.001	0.300	4.15	1.77
32	0.001	0.330	4.07	1.71
33	0.002	0.360	4.00	1.84
34	0.003	0.390	3.92	1.77
35	0.004	0.420	3.85	1.92

Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 500

TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

Testing Reading for Specimen No. 2

No.	Vert. Displ. Changes (in)	Horiz. Displ.(in)	Corrected Area (in^2)	Shear Stress (psi)
1	0.000	0.000	4.89	0.00
2	0.000	0.001	4.89	0.08
3	0.000	0.003	4.88	0.36
4	0.000	0.006	4.88	0.74
5	-0.002	0.008	4.87	1.27
6	-0.002	0.011	4.87	1.87
7	-0.002	0.013	4.86	2.22
8	-0.003	0.016	4.85	2.25
9	-0.003	0.018	4.85	2.41
10	-0.004	0.021	4.84	2.44
11	-0.005	0.028	4.82	2.33
12	-0.005	0.036	4.80	2.42
13	-0.006	0.043	4.78	2.18
14	-0.006	0.051	4.77	2.27
15	-0.006	0.057	4.75	2.22
16	-0.005	0.064	4.73	2.07
17	-0.005	0.072	4.71	2.06
18	-0.004	0.079	4.69	1.99
19	-0.004	0.087	4.68	2.09
20	-0.003	0.094	4.66	2.01
21	-0.002	0.108	4.62	1.98
22	-0.001	0.120	4.59	2.06
23	0.000	0.135	4.56	2.07
24	0.001	0.150	4.52	1.98
25	0.002	0.165	4.48	2.09
26	0.002	0.180	4.44	2.24
27	0.003	0.195	4.41	2.38
28	0.004	0.210	4.37	2.35
29	0.006	0.240	4.29	2.49
30	0.007	0.270	4.22	2.63
31	0.009	0.300	4.15	2.80
32	0.011	0.330	4.07	2.82
33	0.012	0.360	4.00	3.15
34	0.014	0.390	3.92	3.10
35	0.015	0.420	3.85	3.32

Client: Parkhill, Smith, Cooper Inc.
Project: El Paso Clint Landfill
Specimen: Sample #1
Normal Stress (psf) : 1000

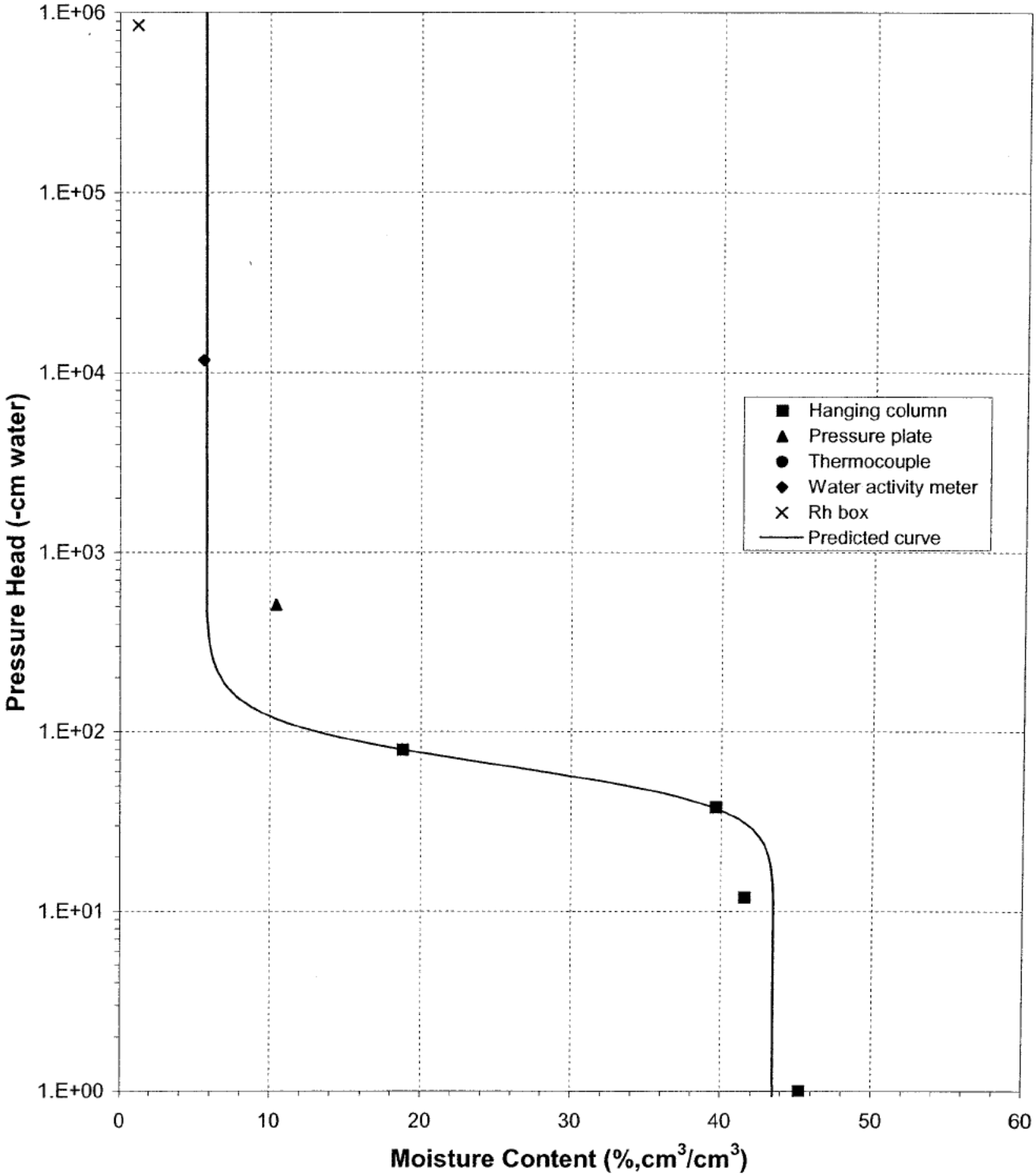
TRI Log No.: E2357-51-03
Test Method: ASTM D 3080
Test Date: 09/20/11
Displacement rate (in/min): 0.001

Testing Reading for Specimen No. 3

No.	Vert. Displ. Changes (in)	Horiz. Displ.(in)	Corrected Area (in^2)	Shear Stress (psi)
1	0.000	0.000	4.89	0.00
2	0.000	0.000	4.90	-0.01
3	0.000	0.003	4.90	0.54
4	0.000	0.006	4.89	0.96
5	0.000	0.008	4.88	1.48
6	0.000	0.011	4.88	2.47
7	0.000	0.013	4.87	3.21
8	0.000	0.016	4.87	3.60
9	0.000	0.018	4.86	3.87
10	0.000	0.021	4.85	4.00
11	0.000	0.023	4.85	4.02
12	0.000	0.026	4.84	4.04
13	0.000	0.032	4.83	4.11
14	0.000	0.038	4.81	4.16
15	0.000	0.045	4.79	4.18
16	0.000	0.053	4.77	4.17
17	0.001	0.060	4.75	4.16
18	0.001	0.068	4.74	4.14
19	0.002	0.075	4.72	4.14
20	0.002	0.083	4.70	4.15
21	0.003	0.090	4.68	4.19
22	0.003	0.098	4.66	4.21
23	0.004	0.110	4.63	4.29
24	0.005	0.125	4.59	4.38
25	0.006	0.140	4.56	4.52
26	0.007	0.155	4.52	4.59
27	0.008	0.170	4.48	4.69
28	0.009	0.185	4.44	4.75
29	0.011	0.215	4.37	4.93
30	0.012	0.245	4.29	5.11
31	0.014	0.275	4.22	5.30
32	0.015	0.305	4.14	5.46
33	0.017	0.335	4.07	5.64
34	0.018	0.365	4.00	5.78
35	0.020	0.395	3.92	5.96
36	0.020	0.410	3.88	5.94

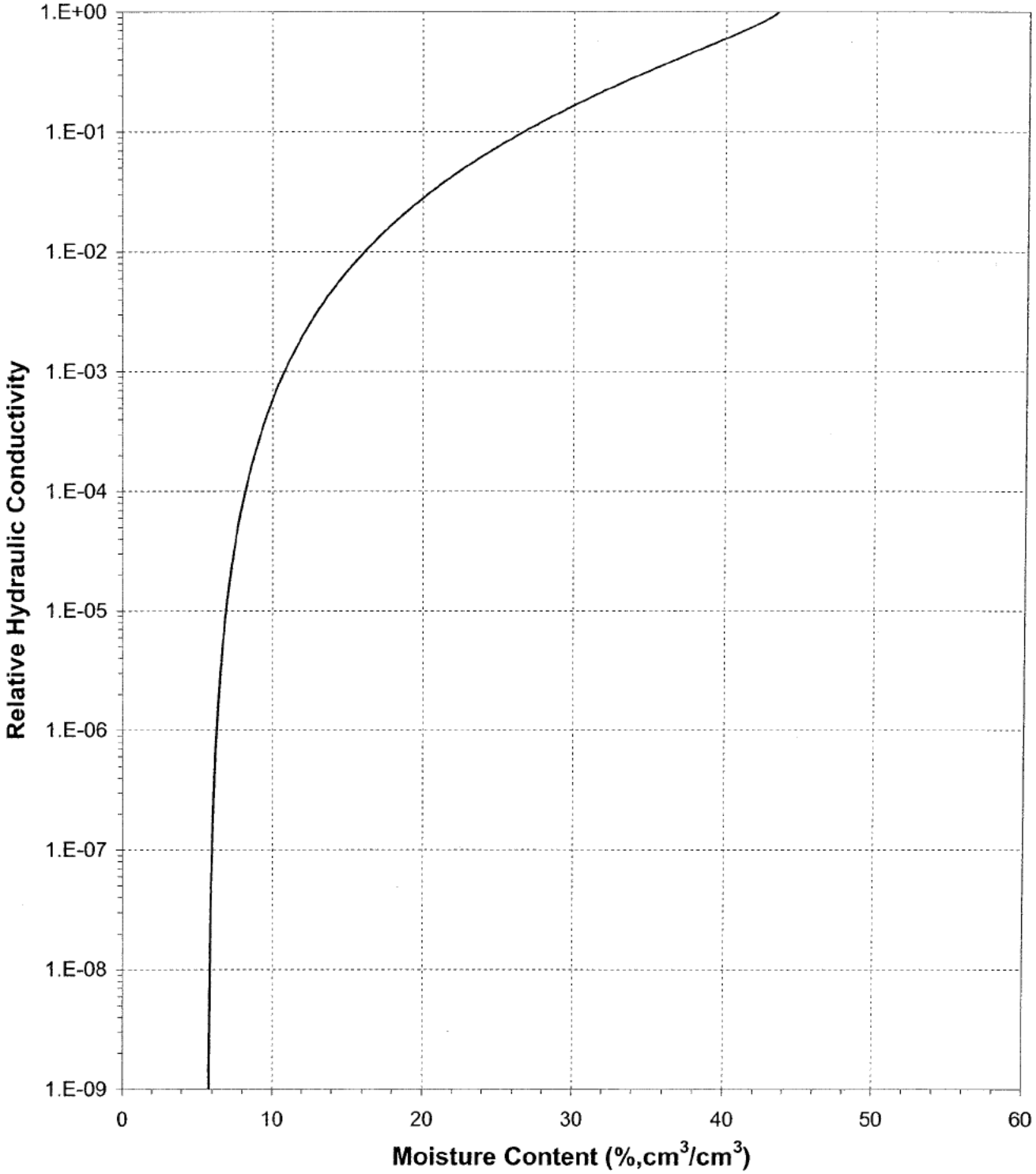
Predicted Water Retention Curve and Data Points

Sample Number: El Paso 80%



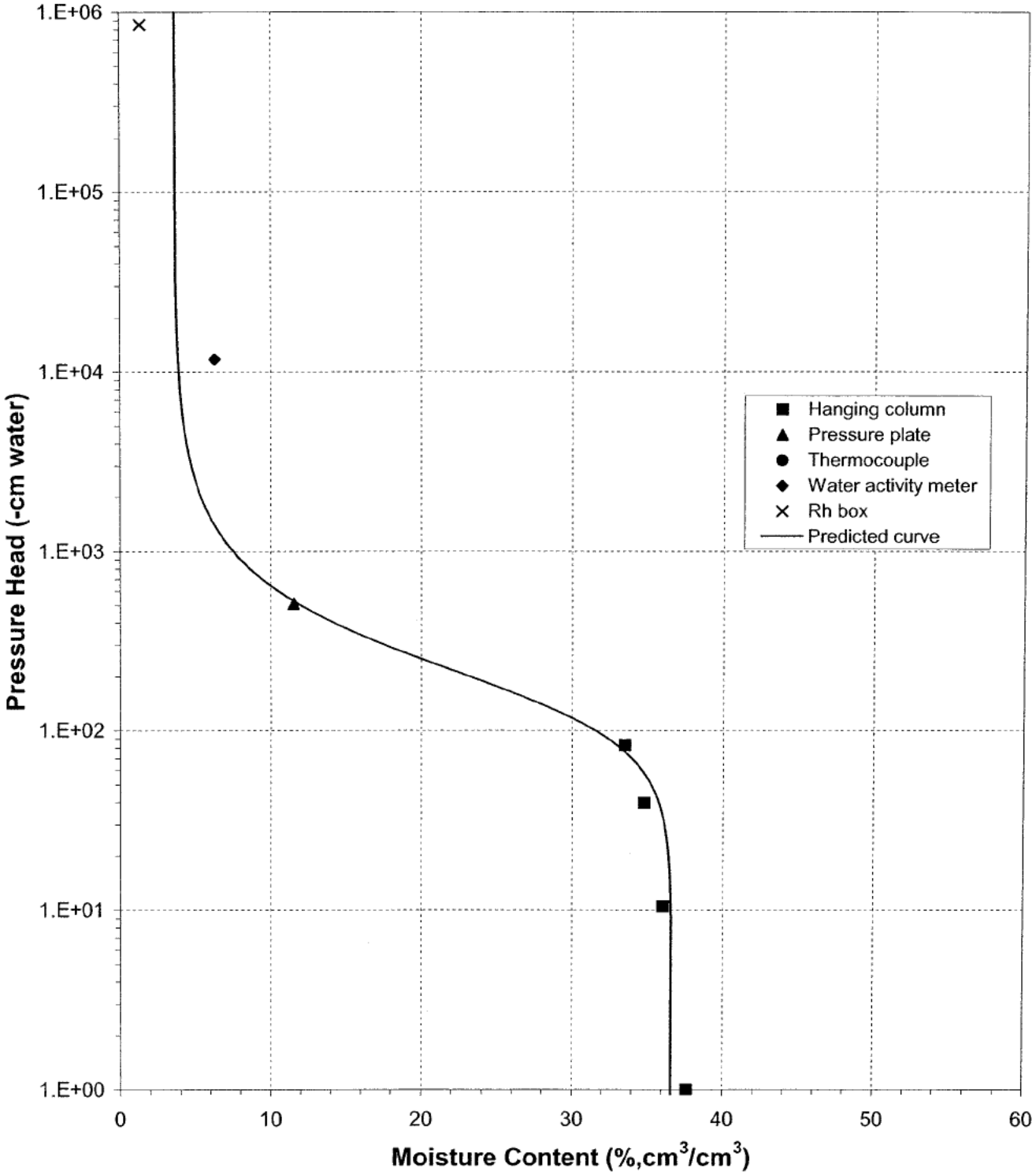
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: El Paso 80%



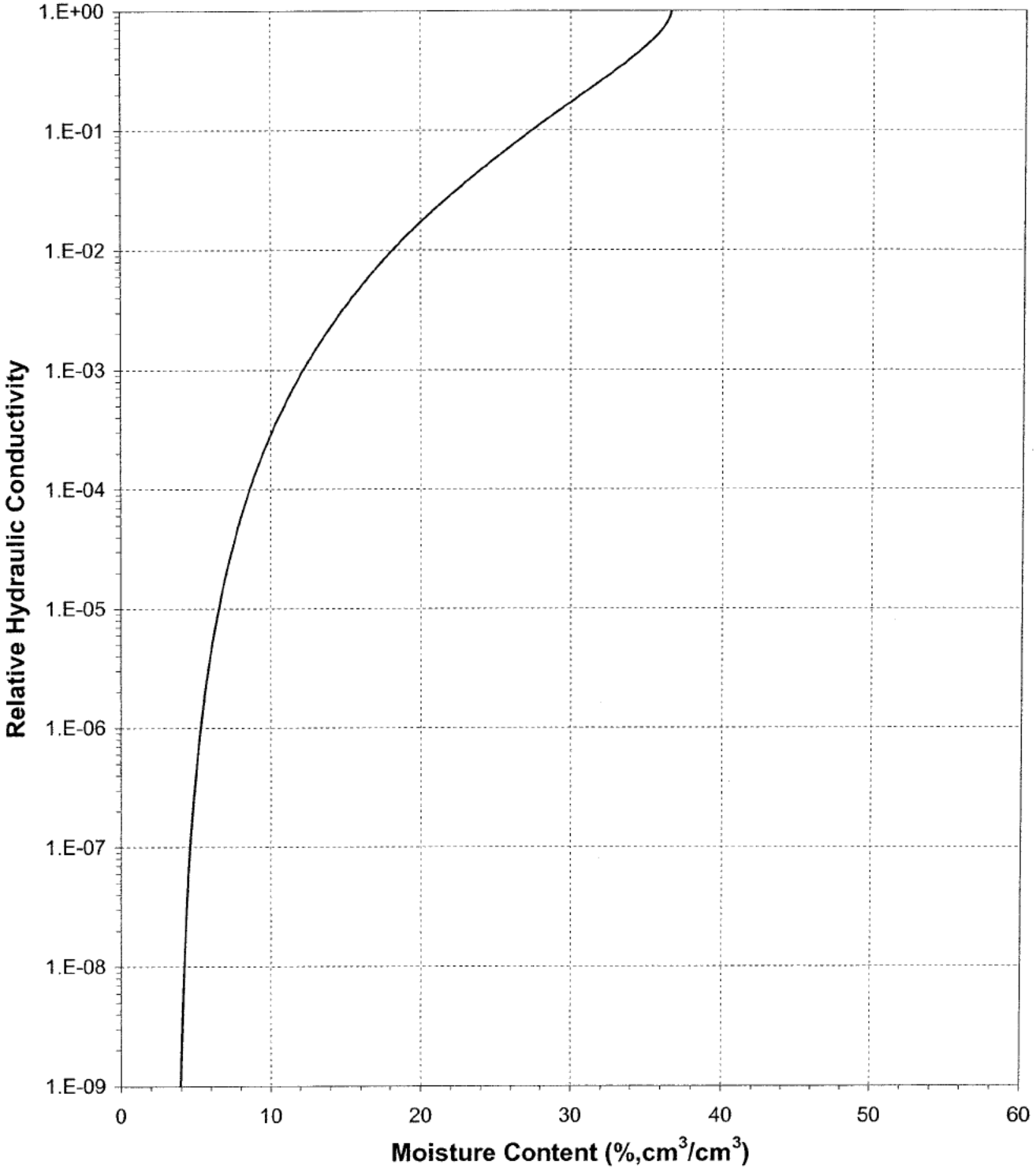
Predicted Water Retention Curve and Data Points

Sample Number: El Paso 90%



Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: El Paso 90%



ATTACHMENT III.I.2 – FINAL COVER QUALITY CONTROL PLAN

BURNS McDONNELL

MSW AUTH NO. 2284A

ATTACHMENT III.I.2 – FINAL COVER QUALITY CONTROL PLAN

CITY OF EL PASO, TEXAS
GREATER EL PASO LANDFILL MAJOR AMENDMENT
PROJECT NO. 155488

REVISION 0
OCTOBER 2024

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List of Abbreviations

Abbreviation	Term/Phrase/Name
ASTM	American Society for Testing Materials
CQA	Construction Quality Assurance
CY	cubic yards
FCER	Final Cover Evaluation Report
FCQCP	Final Cover Quality Control Plan
ft	feet
MSW	municipal solid waste
POR	Construction Quality Assurance Professional of Record
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
TCEQ	Texas Commission on Environmental Quality
WB	Water Balance

III.I.2.1.0 Introduction

This Final Cover Quality Control Plan (FCQCP) has been prepared to provide the Owner, Design Engineer, Construction Quality Assurance Professional of Record, and the Contractor the means to govern the construction quality of the Water Balance (WB) monolithic soil final cover system and to satisfy the environmental protection requirements under Texas Commission on Environmental Quality (TCEQ) regulations. More specifically, the FCQCP addresses the soil components of the Alternate Final Cover system.

III.I.2.1.1 Definitions

This section provides the definitions for terms used in this FCQCP.

ASTM – American Society for Testing and Materials

Construction Quality Assurance (CQA) – A planned system of activities that provides the Owner and permitting agency assurance that the facility was constructed as specified in the design (United States Environmental Protection Agency, 1986). Construction quality assurance includes observations and evaluations of materials, and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project.

Construction Quality Assurance Professional of Record (POR) – The POR is an authorized representative of the Owner and has overall responsibility for construction quality assurance and confirming that the facility was constructed in general accordance with plans and specifications approved by the permitting agency. The POR must be licensed as a Professional Engineer or Geologist in Texas and experienced in geotechnical testing and its interpretations. Experience and/or education may include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance, and quality control testing, and hydrogeology. The credentials of the POR must meet or exceed the minimum requirements of the permitting agency. Any references to monitoring, testing, or observations to be performed by the POR should be interpreted to mean the POR or CQA monitors working under the POR's direction. The POR may also be known in applicable regulations as the CQA Engineer or Resident Project Representative.

Construction Quality Assurance (CQA) Monitors – CQA monitors are representatives of the POR who work under direct supervision of the POR. The CQA monitor is responsible for quality assurance monitoring and performing onsite tests and observations. The CQA monitor is on site full-time during construction and reports directly to the POR. The CQA monitor performing daily QA/QC observation and testing shall have a minimum of four years of directly related experience; or be a graduate engineer or geologist with one year of directly related experience. Field observations, testing, or other activities associated with CQA may be performed by the CQA monitor(s) on behalf of the POR. Additional CQA monitors may be used. If working under the direction of a CQA monitor, the second CQA monitor shall have a minimum of one year of directly related experience.

Contract Documents – These are the official set of documents issued by the Owner. The documents include bidding requirements, contract forms, contract conditions, specifications, contract drawings, addenda, and contract modifications.

Contract Specifications – These are the qualitative requirements for products, materials, and workmanship upon which the contract is based.

Contractor – This is the person or persons, firm, partnership, corporation, or any combination, private or public, who, as an independent contractor, has entered into a contract with the Owner, and who is referred to throughout the contract documents by singular number and masculine gender.

Design Engineer – These individuals or firms are responsible for the design and preparation of the project construction drawings and specifications. Also referred to as “designer” or “engineer.”

Earthwork – This is the construction activity involving the use of soil materials as defined in the construction specifications and **Section III.I.2.2.0** of this plan.

Nonconformance – This is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformances include, but are not limited to, physical defects, test failures, and inadequate documentation.

Owner/Operator – This is the organization that owns and operates the disposal unit (City of El Paso, Texas).

Operator’s Representative – This is the person that is an official representation of the operator responsible for planning, organizing, and controlling the design and construction activities.

Quality Assurance (QA) – This is the planned and systematic pattern of procedures and documentation to ensure that items of work or services meet the requirements of the contract documents. Quality assurance includes quality control. Quality assurance will be performed by the POR and CQA monitor.

Quality Control (QC) – These actions provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents. Quality control will be performed by the contractor.

Final Cover Evaluation Report (FCER) – Upon completion of closure activities, the certification will be in the form of the FCER which will be signed by the POR and include all documentation necessary for certification of closure.

III.I.2.2.0 Construction Quality Assurance for Earthwork

This section of the FCQCP addresses the construction of the soil components of the WB Final Cover system and outlines the program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems.

The scope of earthwork and related construction quality assurance includes the following elements:

- Base Layer
- Infiltration Layer
- Rock Armoring

III.I.2.2.1 Earthwork Construction

The following paragraphs describe soil properties, general construction procedures, and quality assurance/quality control (QA/QC) methods to be used in construction of the various layers of the final cover system.

III.I.2.2.1.1 Base Layer

The base layer will consist of a minimum 6-inch-thick minimum soil layer (measured perpendicular to top of waste) that will be placed on the top of and along the side slopes of the landfill. Material used for this layer will be obtained from the landfill site and will be placed as a single 6-inch lift. Testing of this layer will be completed in accordance with **Section III.I.2.2.3**. Testing results must meet the requirements of **Table III.I.2.2-1**.

Table III.I.2.2-1:Base Layer Testing Requirements

Type of Test	Required Result
Soil Classification	SM, SC, SP, or SW
Soil Density	80% ± 2.5%
Moisture Content	Optimum ± 2%
Hydraulic Conductivity	23.7 cm/hr ± 20%
Thickness	6-inches (min.)

Over-compacted soil in the base layer shall be disked or ripped (or any method approved by the POR) and re-compacted to a density within acceptable limits. If a density test fails, additional tests may be performed to define the over-compacted area. The area to be re-worked will be limited to the area between passing density tests.

The base layer construction will be conducted in a systematic and timely fashion. Delays will be avoided in completing the base layer. Placement of the base layer will cease, however, during rainfall events, in order to prevent over-compaction. Construction will continue once CQA personnel determine that soil can be effectively placed.

III.I.2.2.1.2 Infiltration Layer

The infiltration layer will be placed on top of the base layer, over the entire surface of the final cover. The soil will have a minimum finished thickness of 18-inches. Testing of this layer will be completed in accordance with **Section III.I.2.2.3** of this plan. Testing results must meet the requirements in **Table III.I.2.2-2**. The surface of the soil cover shall be graded in accordance with the Final Grading Plan in Appendix III.A, Drawing III.A.10.

Table III.I.2.2-2:Infiltration Layer Testing Requirements

Type of Test	Required Result
Soil Classification	SM, SC, SP, or SW
Soil Density	90% ± 2.5%
Moisture Content	Optimum ± 2%
Hydraulic Conductivity	4.6 cm/hr ± 20%
Thickness	18-inches (min.)

The infiltration layer shall be placed under continuous QA/QC observation to ensure that a minimum thickness of 18-inches is applied and that existing structures are protected. Placement of the base layer will be stopped during rainfall events, in order to prevent over-compaction of the soil. Construction will continue once CQA personnel determine the soil can be effectively placed. Layer thickness will be verified in accordance with **Section III.I.2.2.3.1** of this FCQCP.

III.I.2.2.1.3 Geonet / Geotextile

The geonet or geotextile shall be installed according to manufacturer's recommendations. The rock material will be carefully placed on top of the geonet or geotextile to avoid damage to the final cover system. The geonet or geotextile will be placed on top of the infiltration layer to support the rock armoring.

Installation of a geonet or geotextile will consist of a 300 mil HDPE geonet, or an 8 oz geotextile placed over the entire landfill cell. It will be placed on top of the infiltration layer to support the rock armoring. The geonet/geotextile material must meet the manufacturer's certifications listed in **Table III.I.2.2-3** or **Table III.I.2.2-4.**

Table III.I.2.2-3:Geonet Manufacturer's Certification Requirements

Test	Type of Test	Standard Test Method	Minimum Frequency	Minimum Average Value
Manufacturer's Certifications	Transmissivity (m^2/sec)	ASTM D4716	1 per 540,000 ft^2	8.0 x 10^{-3}
	Density (g/cm^3)	ASTM D1505	1 per 50,000 ft^2	0.94
	Tensile Strength (lb/in)	ASTM D5035	1 per 50,000 ft^2	75
	Carbon Black Content (%)	ASTM D4218	1 per 50,000 ft^2	2.0
	Thickness (mil)	ASTM D5199	1 per 50,000 ft^2	300

Table III.I.2.2-4: Geotextile Manufacturer's Certification

Test	Type of Test	Standard Test Method	Minimum Frequency	Minimum Average Value
Manufacturer's Certifications	Mass per Unit Area (oz/yd^2)	ASTM D5261	1 per 100,000 ft^2	8.0
	Grab Tensile Strength (lbs)	ASTM D4632	1 per 100,000 ft^2	205
	Grab Elongation (%)	ASTM D4632	1 per 100,000 ft^2	50
	Trapezoid Tear Strength (lbs)	ASTM D4533	1 per 100,000 ft^2	85
	CBR Puncture (lbs)	ASTM D6241	1 per 100,000 ft^2	535
	Apparent Opening Size[1] (US Std. Sieve)	ASTM D4751	1 per 100,000 ft^2	80
	Permittivity (1/sec)	ASTM D4491	1 per 100,000 ft^2	1.35
	UV Resistance (% at 500hr)	ASTM D4355	1 per 100,000 ft^2	70
	Water Flow Rate (gpm/ft^2)	ASTM D4491	1 per 100,000 ft^2	90

[1] – Value represents maximum average roll value

III.I.2.2.1.4 Rock Armoring

Rock armoring will be placed on the top of the infiltration layer in order to prevent erosion. Rock material for this application shall be placed on either a geonet or geotextile for support and must be graded as shown in **Table III.I.2.2-5**.

Table III.I.2.2-5: Rock Gradation

Size	% Passing
4"	100
2 ½"	50-95
2"	0-5
Soundness Loss (ASTM C88) not to exceed 10%	

III.I.2.2.2 Survey and Final Topography

Upon completion of construction of the final cover a topographic survey will be performed by a surveyor registered in the State of Texas. The final contour map shall include all final contours, gas vents, gas monitoring wells, groundwater monitoring wells, drainage structures, fences, gages, access roads, and all other pertinent site features.

III.I.2.2.3 Sampling and Testing

As construction progresses CQA monitors will conduct field and laboratory tests using standards set forth in the technical specifications. Standard operating procedures for soil testing will be prepared for site testing personnel that follow ASTM test methods. These procedures will be for the following tests: soil classification, standard proctor, field density and moisture, hydraulic conductivity, and thickness verification. A summary of the required tests is shown in **Table III.I.2.2-6** and a description of each follows the table.

Table III.I.2.2-6:Conformance Testing

Type of Test	Standard Test Method	Frequency of Testing
Soil Classification	ASTM D2487 and D2488	1 per 1,000 CY
Standard Proctor	ASTM D698	1 per soil type
Soil Density	ASTM D6938	1 per 2,000 CY per layer
Moisture Content	ASTM D2216 or 6938	1 per 2,000 CY per layer
Hydraulic Conductivity	ASTM D5084	1 per 10,000 CY per layer

III.I.2.2.3.1 Soil Classification

Soil samples will be collected for analysis for the purpose of classifying the soil using the Unified Soil Classification System. One sample is required per 1,000 cubic yards (CY) of placed material.

The test procedures to be followed in the laboratory will be ASTM D2487 and D2488 for soil classification.

III.I.2.2.3.2 Standard Proctor

Soil samples will be collected for analysis to determine the compaction characteristics of the soil. One sample is required per soil type. As sandy soils are the only soil type allowed for construction, this is expected to be one test per instance of final cover construction.

The test procedure to be followed in the laboratory will be ASTM D698.

III.I.2.2.3.3 Soil Density and Moisture

Soil testing will be performed in situ or on undisturbed samples for the purpose of determining field density and moisture content. One test is required per 2,000 CY of placed material per layer.

The test procedure to be followed for soil density will be ASTM D6938, which will be performed in the field. The test procedure to be followed for moisture content will be either ASTM D2216 (laboratory) or ASTM D6938 (in situ).

Extra testing must be performed whenever work or materials are suspect, marginal, or of poor quality. Extra testing may be conducted to provide additional data for engineering. Tests that do not meet minimum requirements will not contribute to the total number of tests performed in meeting the required test frequency.

III.I.2.2.3.4 Hydraulic Conductivity

Soil testing will be conducted on undisturbed samples for the purpose of determining hydraulic conductivity. One test is required per 10,000 CY of material placed per layer.

The testing procedure to be followed is ASTM D5084. This test is conducted utilizing an undisturbed large block sample.

III.I.2.2.3.5 Thickness Verification

Cover layer thicknesses will be verified by the CQA monitor. For visual verification, depth gauges will be fabricated and installed by the construction contractor and placed one every 5,000 square feet. There will be a mark at the 6-inch depth so that the CQA monitor can visually verify the thickness of the base layer. The overall height of each depth gauge shall be 2-feet. The CQA monitor will verify that earthwork of the infiltration layer has been completed to the top of each depth gauge prior to placement of geonet or

geotextile and rock armoring. The thickness may be verified by potholing an area to verify the thickness of placed material. A measuring stick/tape would be used to verify the thickness of each material level. Thickness may also be verified using surveying methods to measure the elevation heights of material before and after placement. The POR will then certify the thickness placed by signing, sealing, and submission of the FCER and the accompanying statement of compliance.

III.I.2.3.0 Documentation

The quality assurance plan requires monitoring and documentation of construction activities. Therefore, the POR and CQA monitor will document the means and methods by which the QA requirements have been addressed and satisfied. Documentation may consist of daily recordkeeping, testing and installation reports, nonconformance reports (if necessary), progress reports, photographic records, and design and specification revisions. The appropriate documentation will be included in the FCER. Standard report forms will be provided by the POR prior to construction.

III.I.2.3.1 Preparation of FCER

The POR, on behalf of the Owner, shall submit to TCEQ an FCER for approval of the constructed final cover system. Final cover QA/QC testing will be performed in accordance with this FCQCP and shall be part of the FCER which will also be prepared in accordance with this FCQCP.

At a minimum, the FCER will contain:

- A summary of construction activities.
- Laboratory and field test results.
- Sampling and testing locations.
- A description of significant construction problems and the resolution of these problems.
- Record drawings.
- A statement of compliance with the permit FCQCP and construction plans.
- The reports shall be signed and sealed by a professional engineer or geologist licensed in the State of Texas.

The record drawings will identify the constructed location of work items. The POR will review and verify that the record drawings are correct.

III.I.2.3.2 Reporting Requirements

The FCER will be signed and sealed by the POR, signed by the site operator, and submitted to the Municipal Solid Waste (MSW) Permits Section of Waste Permits Division of TCEQ for approval.

ATTACHMENT III.I.3 – CLOSURE SCHEDULE

Attachment III.I.3
Greater El Paso Landfill, MSW Auth No. 2284A
Final Closure Schedule Chart

	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days
Written notification of closure to TCEQ		—	—							
Public notice of facility closure published in newspaper	—	—	—							
Posting of sign		●								
Initiation of final closure activities				●						
Time interval for completion of final closure activities				—	—	—	—	—	—	
Submit engineering certification of final closure to TCEQ										●
Submit certified copies of Affidavit to the Public and modified deed to TCEQ										●
Note: Schedule is based on anticipated date of beginning of final closure activities. Heavy vertical line signifies final receipt of waste.										

APPENDIX III.J – POST-CLOSURE PLAN

Texas Commission on Environmental Quality

Post-Closure Care Plan for Municipal Solid Waste Type I Landfill Units and Facilities

This form is for use by applicants or site operators of Municipal Solid Waste (MSW) Type I landfills to provide landfill unit or final facility post-closure care closure plans to meet the requirements in 30 TAC Chapter 330, §330.63(h) and as set out under 30 TAC Chapter 330 Subchapter K for a MSW Type I facility.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: Greater El Paso Landfill

MSW Permit No.: 2284A

Site Operator/Permittee Name: City of El Paso/CN601410244

II. Party Responsible for Overseeing and Conducting Post Closure Care Activities

Name (Person or Office Responsible): City of El Paso

Position or Title: Superintendent of Solid Waste

Mailing Address: 7968 San Paulo Drive

City: El Paso

State: Texas

Zip Code: 79915

Telephone Number: 915-621-6702

III. Post-Closure Care Status of Landfill Units at the Facility

Check the applicable box for the post-closure care status of the units at the facility and complete the applicable tables as indicated:

A. ☒ No landfill unit is in post-closure care in this facility at the time this application is submitted (skip Table 1 and complete Table 2 below if you check this item)

B. ☐ This facility includes landfill units currently in post-closure care and landfill units that are not yet in post-closure care (complete Tables 1 and 2 below if you check this item).

C. ☐ This facility contains only landfill units currently in post-closure care (complete Table 1 below if you check this item; do not complete Table 2).

Table 1: Landfill Units Currently in Post-Closure Care

Landfill Unit Name	Drawing Number Showing the Landfill Unit	Date TCEQ Acknowledged Closure of Unit	Date Post-Closure Care Commenced	Projected Date of End of Post-Closure Care

Table 2: Landfill Units Not yet in Post-Closure Care

Category of Landfill Unit (Regarding Status of Waste Receipt)	Landfill Unit Names or Descriptors	Site Development Plan Drawing Titles and Numbers Showing the Units
Stopped Receiving Waste Prior to October 9, 1993		
Received Waste on or after October 9, 1993	**Phase 1 and Phase 2**	**Drawing III.A.3 in Appendix III.A**
Proposed to be Constructed		

Category of Landfill Unit (Regarding Status of Waste Receipt)	Landfill Unit Names or Descriptors	Site Development Plan Drawing Titles and Numbers Showing the Units
Other (enter as applicable)		

IV. Post-Closure Care Maintenance Requirements and Activities to be Conducted

A. Categories of Landfill Units and Applicable Post-Closure Care Maintenance Requirements and Activities

Check the appropriate boxes to indicate the categories of landfill units at the facility and complete the applicable section of the post-closure care maintenance requirements and activities below.

This facility includes landfill units that:

☐ Stopped receiving waste prior to October 9, 1993

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.B below. Skip Subsection IV.B if this item does not apply to your facility.

☒ Received waste on or after October 9, 1993

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.C below. Skip Subsection IV.C if this item does not apply to your facility.

☐ Are proposed to be constructed

If you check this item, complete the post-closure care maintenance requirements and activities specified in Subsection IV.C below. Skip Subsection IV.B, unless your facility also contains units that stopped receiving waste prior to October 9, 1993.

B. Post-Closure Care Maintenance Requirements and Activities for the Landfill Units that Stopped Receiving Waste Prior to October 9, 1993 - NA

The site operator will commence and conduct post-closure care maintenance of the units that stopped receiving waste prior to October 9, 1993 for a minimum of the first **five years** following commencement of post-closure care as specified below and in accordance with applicable rules under 30 TAC §330.463(a). Post-closure care maintenance will start on the date the professional engineer's certification of the completion of closure is accepted in writing by the TCEQ executive director and the site operator will carry out the following activities and operations during the period.

1. Maintenance of Right of Entry and Rights of Way

The site operator will retain the right of entry to and maintain all rights-of-way of the closed units in order to conduct periodic inspections of the units throughout the post-closure care period. TCEQ staff will have access to the site to conduct inspection or investigation that may be necessary during the period.

2. Inspection Activities and Correction of Problems

The site operator will conduct inspection of the closed landfill units at the frequencies indicated in Table 3 below, utilizing the inspection protocol maintained in the site operating record, and will correct all identified problems as needed.

Table 3: Inspection Activities Schedule

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Final Cover Condition		
Vegetation		
Leachate Management Systems		
Landfill Gas Monitoring and Control Systems		

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Groundwater Monitoring Systems		
Drainage Structures		
Ponding of Water		
Other:		

3. Continuation of Monitoring Programs during Post-Closure Care Period

The site operator will continue the monitoring programs listed in Table 4 during the post-closure care period. The monitoring programs will be conducted as specified in the applicable section of the facility's Site Development Plan and applicable rules.

Table 4: Monitoring and Reporting Schedule

Monitoring Program	Frequency of Monitoring	Frequency of Reporting of Results
Groundwater monitoring		
Landfill gas monitoring		
Other:		

4. Detection of a Release, Nature and Extent Investigation, and Corrective Action to Address Release from the MSW Unit

Upon detection of any evidence of a release from the landfill or other associated waste management units at the facility, the site operator will:

- Notify the executive director of the TCEQ of the condition detected;

- Investigate, if so directed by the executive director of the TCEQ, whether a release from the landfill or other associated waste management units at the facility has occurred;
- Investigate the nature and extent of the release, if a release is confirmed;
- Assess measures necessary to correct any impact to groundwater;
- Submit a corrective action plan via a permit modification for TCEQ executive director's review and approval; and
- Conduct corrective action as approved by the TCEQ executive director.

5. Extension of Post-Closure Care Period

If any of the problems listed in Table 3 occurs, or corrective action as indicated in Subsection IV.B.4 above continues, after the end of the five-year post-closure care period or persists for longer than the first five years of post-closure care, the site operator will be responsible for their correction and will continue to conduct post-closure care maintenance until the TCEQ executive director determines that all problems have been adequately resolved.

6. Reduction of Post-Closure Care Period

The site operator may request in writing for the TCEQ executive director to reduce the post-closure care period for the units if all wastes and waste residues have been removed during closure and any new or on-going corrective action to address confirmed releases from the landfill have been completed as acknowledged in writing by the executive director.

C. Post-Closure Care Requirements and Activities for Municipal Solid Waste Landfill Units that Receive Waste on or after October 9, 1993 and for New Units

The site operator will commence and conduct post-closure care maintenance of the units that receive waste on or after October 9, 1993 and new units constructed under this permit as follows and in accordance with applicable rules under 30 TAC §330.463.

1. Commencement of Post-Closure Care

Post-closure care maintenance will start on the date the professional engineer's certification of the completion of closure is accepted in writing by

the TCEQ executive director and the site operator will carry out the following activities and operations during the period.

2. Period of Post-Closure Care

The site operator will conduct post-closure care for the landfill units for a period of **30 years**, unless this time period is increased or reduced by the executive director as discussed in Subsection IV.C.11.

3. Maintenance of Right of Entry and Rights of Way

The site operator will retain the right of entry to the closed units and the facility and will maintain all rights-of-way of the closed units in order to conduct periodic inspection and maintenance of the closed units until the end of the post-closure care period.

4. Inspection Activities

The site operator will conduct periodic inspection of the closed units to identify and document deficiency conditions and conduct maintenance and corrective action to maintain compliance. Sections IV.C. 8.(a)-(c) provide information on the inspection items and deficiency conditions that the site operator will look for during inspection of the major components of the landfill and the site during the post-closure care period. Other inspection and maintenance provisions that apply during the post-closure care period as specified in the facility's site operating plan, site development plan, or applicable rules will remain in effect.

5. Documentation of Inspection

The site operator will document and maintain records of the post-closure care inspections in the site operating record. The records will include:

- The date of inspection;
- Components and items inspected;
- Problems detected or observed; and
- The name of the personnel who conducted the inspection.

6. Corrective Actions

Based on the results of the inspection activities, the site operator will conduct needed restoration and remediation actions on the closed unit no later than

the next scheduled inspection event. Also, the site operator will conduct maintenance action on regular periodic schedule in order to:

- Maintain the integrity and effectiveness of all final cover, facility vegetation, and drainage control systems;
- Correct any effects of settlement, subsidence, ponded water, erosion, or other events or failures detrimental to the integrity of the closed unit; and
- Prevent any surface run-on and run-off from eroding or otherwise damaging the final cover system during the post-closure care period.

7. Documentation of Corrective Actions

The site operator will document and maintain, in the facility's site operating record, records of the restoration, remediation, and maintenance activities performed, including the date of completion of the activities.

8. Inspection Activities Schedules

(a) Final Cover Inspection

Inspection Frequency: Annually

Other Inspection Occasions/Events: N/A

Table 5: Final Cover Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Ground Cover Materials	Growth of undesirable vegetation; animal burrows
Settlement	Concave appearance of cap; desiccation
Subsidence	Concave appearance of cap; desiccation
Ponded Water	Water ponding on final cover
Erosion	Areas with missing or insufficient rock armoring, less than the original 4-inches. Visible debris, litter, and waste.

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Other (enter other events or failures detrimental to the integrity and effectiveness of the final cover):	

(b) *Drainage Control System Inspection*

Inspection Frequency: Annually

Other Inspection Occasions/Events: N/A

Table 6: Drainage Control System Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for during Inspection
Vegetation within Drainage Control Structures	Vegetation growth where undesirable.
Component Failures	Check pipes/culverts for clogging and flushed or replaced as necessary.
Wash Outs	Significant washout of rock armor or underlying layers.
Sediment Build Up	Sediment buildup inside pipe or up/downgradient of pipe inlet/outlet.
Other (enter other events or failures detrimental to the integrity and effectiveness of drainage structures):	

(c) *Access and Rights-of-Way*

Inspection Frequency: Annually

Other Inspection Occasions/Events: N/A

Table 7: Access and Rights of Way Inspection Items

Inspection Item	Types of Deficiency Conditions to be looked for During Inspection
Gates, Gate Locks and Barriers	Compromised integrity of gates and other barriers. Nonfunctioning gate locks.
Fence and other Access Control Barriers	Damage to fence what would allow entry outside of gates; significant ruts in roads or erosion/washout of the roads
Vegetation Control in Areas of the Facility other than the Final Cover	Erosion
Other (enter other access control and rights-of-way inspection items):	

9. Continuation of Operation and Maintenance of the Leachate Collection and Removal Systems (LCRS)

The site operator will continue the operation and maintenance of the LCRS and disposal of leachate during the post-closure care period in accordance with the facility's leachate management plan found in Appendix III.C of the Site Development Plan and consistent with applicable provisions under 30 TAC Sections 330.331 and 330.333.

(a) Performance Monitoring and Inspection of the LCRS

During the post-closure care period, the site operator will monitor the performance of the LCRS on an annual basis to assure continuous compliance with the design criteria and inspect the LCRS components on an annual basis, at a minimum, to determine the need for repair or maintenance. Inspection and monitoring will follow the procedure described in the facility's leachate management plan found in Appendix III.C of the Site Development Plan or in the written inspection protocol maintained in the facility's site operating record. Results of the monitoring and inspection activities will be documented in the site operating record. The items and components of the leachate collection and removal system to be inspected will include but are not limited to the items in Table 8 below.

Table 8: Leachate Collection and Removal System Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Leachate Collection System	Leachate collection sump levels will be measured on an annual basis. Site personnel will verify that leachate level is maintained within the sump and any nonfunctional pumps are fixed.
Storage Facilities	Leaks, tears, or damage to the geomembrane liner.

(b) LCR Maintenance and Repairs

During the post-closure care period, the site operator will perform routine and needed maintenance or repairs of the LCRS items and components based on the monitoring and inspection results. Maintenance and repair will be completed prior to the next scheduled monitoring event and documented within the site operating record.

(c) Discontinuation of Leachate Management

The site operator may submit data and information from the closed units to the TCEQ executive director to demonstrate that leachate no longer poses a threat to human health and the environment. Upon the executive director's approval of the demonstration, the site operator will be allowed to stop managing leachate at the closed unit.

10. Continuation of Monitoring Systems Operation and Maintenance:

The site operator will continue to conduct monitoring systems operation and maintenance activities to ensure the integrity of the containment system and to promptly detect and control releases to the environment during the post-closure care period as follows.

(a) Groundwater Monitoring System

The site operator will continue groundwater monitoring activities (including sampling, analysis, reporting, etc.) in accordance with the approved site-specific Groundwater Sampling and Analysis Plan (GWSAP) found in Appendix III.F of the Site Development Plan, the Groundwater Monitoring System Design found in Appendix III.G of the Site Development Plan and consistent with the provisions under

30 TAC Chapter 330 Subchapter J. Groundwater monitoring will be conducted semiannually or as otherwise approved by the TCEQ executive director during the post-closure care period.

i. Inspection of the Groundwater Monitoring System

During each groundwater monitoring event, the site operator will perform inspection of all the groundwater monitoring wells that are part of the groundwater monitoring system and other items discussed in the GWSAP or the Groundwater Monitoring System Design. The items and components of the groundwater monitoring system to be inspected are included in Table 9:

Table 9: Groundwater Monitoring Systems Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Groundwater Monitoring System	Damage to well casing, protective cover, lock, well cap, concrete pad, and well number designation.

ii. Maintenance and Repair of the Groundwater Monitoring System

The site operator will perform needed maintenance and/or repairs of the groundwater monitoring system items and components based on the inspection results. Maintenance and/or repairs will be performed no later than the next scheduled monitoring event.

iii. Documentation of Inspection, Maintenance, and Repairs

The site operator will document and discuss the results of the groundwater monitoring system inspection, maintenance, and repair activities in the groundwater monitoring report submitted to the TCEQ executive director, and maintain the documents in the site operating record.

(b) Landfill Gas Management System

During the post-closure care, the site operator will continue landfill gas monitoring operations and activities, documentation, and reporting in accordance with the facility's landfill gas management plan and

consistent with the requirements under 30 TAC Chapter 330, Subchapter I.

i. LFG Monitoring and Monitoring System Inspection

All structures and perimeter gas monitoring probes will be sampled quarterly or more frequently as approved by the TCEQ executive director. The site operator will conduct routine inspections of the landfill gas management system components as provided in the landfill gas management plan during the post-closure care period. The items and components to be inspected are included in Table 10.

Table 10: Landfill Gas Management System Inspection

Inspection Item/Component	Types of Deficiency Conditions to be looked for during Inspection
Methane Monitoring System	Compromised integrity of the system resulting in undetected gas migration.
Continuous Monitoring Devices	Malfunctioning, uncalibrated devices or installed in incorrect areas. Lacking power or air flow to the monitor.
Permanent Monitoring Probes	Condition of probe label, protective cover, lock, probe depths, and surrounds including standing water and vegetation.

ii. LFG Management System Maintenance

The site operator will perform routine and needed maintenance of the landfill gas management system including calibration of the monitoring equipment. Needed maintenance and/or repair work will be performed based on the inspection and monitoring results no later than the next scheduled monitoring event.

(c) Continuation of Earth Electrical Resistivity Survey

The site operator will, if applicable, continue earth electrical resistivity surveys as applicable at the frequency stated in the approved site development plan or as otherwise approved by the TCEQ executive director.

11. Detection of a Release, Nature and Extent Investigation, and Corrective Action to Address Release from the MSW Unit

If there is evidence of a release from the landfill or other associated waste management units at the facility, the site operator will:

- Notify the executive director of the TCEQ of the condition detected;
- Investigate, if so directed by the executive director of the TCEQ, whether a release from the landfill or other associated waste management units at the facility has occurred;
- Investigate the nature and extent of the release, if a release is confirmed;
- Assess measures necessary to correct any impact to groundwater;
- Submit a corrective action plan via a permit modification for TCEQ executive director's review and approval; and
- Conduct corrective action as approved by the TCEQ executive director.

12. Revision of the Length of Post-Closure Care Period

(a) The Post-Closure Care Period May Be Decreased

The length of the post-closure care period may be decreased by the TCEQ executive director if the site operator submits a documented certification signed by a licensed professional engineer and including all applicable supporting documentation that demonstrates that the reduced period is sufficient to protect human health and the environment, and the executive director approves the decrease in writing after review.

(b) The Post-Closure Care Period May be Increased

The length of the post-closure care period may be increased by the TCEQ executive director if it is determined that the longer period is necessary to protect human health and the environment.

V. Recordkeeping

The site operator will place a copy of this post-closure plan in the facility's site operating record by the initial receipt of waste at the units proposed at the time of this application. Also, the site operator will document and maintain records of all inspection, monitoring, maintenance, repair, or remediation activities, and detail the results of any inspection and

schedules of any other actions to be taken to maintain compliance, in the site operating record.

VI. Planned Use of the Land during and after the Post-Closure Care Period

Post-closure use of the property will not disturb the final cover, liners, or other containment or monitoring systems unless such disturbance is necessary for the proposed use or to protect human health and the environment and is authorized by the TCEQ executive director consistent with provisions under 30 TAC Chapter 330 Subchapter T.

Description of the Planned Use of the Land during or after the Post-Closure Care Period *(describe the planned use of the land during or after the post-closure care period; if not known at this time, enter "NOT KNOWN")*:

At the present time, there are no proposed uses for the Greater El Paso Landfill following final closure. Any future use of the Facility will be submitted to the TCEQ for approval prior to implementation.

VII. Post-Closure Care and Corrective Action Cost Estimates

A detailed written cost estimate in current dollars for conducting post closure care is provided in *(enter location of the post-closure care cost estimate in the application/permit document)*:

Appendix III.L

The cost estimate for corrective action will be provided as needed, via a permit modification, during the life and/or post-closure care period of the unit or facility.

VIII. Certification of Completion of Post-Closure Care

Upon completion of the post-closure care maintenance period for each municipal solid waste landfill unit, the site operator will submit to the TCEQ executive director for review and approval a certification, signed by an independent licensed professional engineer, verifying that post-closure care has been completed in accordance with the approved post-closure plan. The submittal to the executive director shall include all applicable documentation necessary for the certification of completion of post-closure care. These will include information relating to the condition and status of:

- The final cover integrity and stability, including the condition of the soil, vegetation, drainage structures, etc.

- Groundwater quality at the site, as determined from on-going groundwater detection or assessment monitoring or corrective measures data during the period.
- Landfill gas (methane) migration, as determined from on-going landfill gas monitoring and remediation data during the period.
- Leachate generation rate and quantity as determined from on-going leachate management data over the period.
- The surface water management system.
- Access control structures.

The engineer's certification of post-closure will show that, based on a summary of monitoring and inspection results, the final cover system continues to maintain its integrity, stability, and function; groundwater remains uncontaminated and monitoring is no longer required; landfill gas is not migrating beyond the facility boundary or accumulating in structures at action levels and monitoring is no longer required; leachate generation rate and quantity will not result in greater than 12 inches of head above the liner, no breakouts have occurred, and all slopes remain as approved and leachate management is no longer required; the surface water management system continues to function as designed; and the access control structures remain intact.

Documentation supporting the professional engineer's certification will be furnished to the TCEQ executive director upon request and will be maintained in the site operating record until the executive director acknowledges termination of post-closure in writing.

IX. Voluntary Revocation Request

Upon completion of the post-closure care period for the final unit at the facility, the site operator will submit to the executive director a request for voluntary revocation of the facility permit.

X. Attachments

The following figures and documents are attached as part of this post-closure care plan:

Located in **Appendix III.A**:

Drawing III.A.3 – Existing Site Layout

Drawing III.A.10 – Final Grading Plan

XI. Engineer's Seal and Signature

Name: Tonya Koller

Title: Project Engineer

Date: 9/12/2025

Company Name: Burns & McDonnell

Firm Registration Number: F-845

Professional Engineer's Seal



Signature

APPENDIX III.K – CLOSURE COST ESTIMATE

Texas Commission on Environmental Quality

Closure Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide cost estimates for closure of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover. If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

Facility Name: Greater El Paso Landfill

MSW Permit No.: 2284A

Site Operator/Permittee Name and Mailing Address: City of El Paso, 7968 San Paulo Drive, El Paso, TX 79915

Total Closure Cost Estimate (2024 Dollar Amount): $13,963,373

I. Professional Engineer's Statement, Seal, and Signature

I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Closure Cost Estimate has been completed in substantial conformance with the facility Closure Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: Tonya Koller

Title: Project Engineer

Date: 9/12/2025

Company Name: Burns & McDonnell

Firm Registration Number: F-845

Professional Engineer's Seal



Professional Engineer's Signature

II. Annual Review of Permit Conditions, Cost Estimates, Inflation Factor, and Financial Assurance

The permittee/site operator acknowledges that he/she will:

(1) Review the facility's permit conditions on an annual basis and verify that the current active and inactive waste fill areas of the landfill match the areas on which closure cost estimates are based.

(2) Request in writing via a permit modification application for an increase in the closure cost estimate and the amount of financial assurance provided if changes to the closure plan or the landfill conditions increase the maximum cost of closure at any time during the remaining active life of the landfill.

(3) Request in writing via a permit modification application for a reduction in the cost estimate and the amount of financial assurance provided if the cost estimate exceeds the maximum cost of closure at any time during the remaining active life of the landfill. The permit modification application will include a description of the situation and a detailed justification for the reduction of the closure cost estimate and the amount of financial assurance.

(4) Establish financial assurance for closure of the unit in an amount no less than the current closure cost estimate in accordance with 30 TAC Chapter 37, Subchapter R.

(5) Adjust the current cost estimate for inflation within 60 days prior to the anniversary date of the first establishment of the financial assurance mechanism.

(6) Provide annual inflation adjustments to the closure costs and financial assurance during the active life of the facility, until the facility is officially placed under the post closure care period and all requirements of the final closure plan have been approved in writing by the TCEQ executive director. The adjustment will be made using an inflation factor derived from the most recent annual Implicit Price Deflator for Gross National Product published by the United States Department of Commerce in its Survey of Current Business, as specified in paragraphs (1) and (2) of 30 TAC §37.131. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year.

(7) Provide continuous financial assurance coverage for closure until the facility is officially placed under the post-closure care period.

III. Description of the Closure Cost Estimates Worksheet

The following descriptions of the items on the closure cost estimates worksheet provide guidance for identifying the minimum work or cost elements and estimating the unit or lump sum cost of each item as applicable. Enter additional detail for each item in the field following the item as necessary and as site-specific condition warrants. The cost items are grouped under closure costs for engineering, construction, and storage and processing units. Include attachments to detail any additional work and associated costs necessary to close the site that is not already included as a line item on the worksheet. Reference the attachments and list the work or cost items in the fields under "Additional Engineering Cost Items Not Listed on the Worksheet," "Additional Construction Cost Items Not Listed on the Worksheet," or "Additional Storage and Processing Units Items Not Listed on the Worksheet" as applicable. Provide the total cost of the additional work or cost items in each cost category on the worksheet line that precedes the cost subtotal for each cost group.

1. Engineering Costs

The engineering tasks have been subdivided into seven items and are described below. Other related costs may be added as site-specific issues warrant.

1.1. Topographic Survey

A topographic survey will be required to verify the existing elevation and slopes of the landfill to ensure conformance with the final cover system, drainage system, and final grading designs.

Enter additional topographic survey work or cost element details as site-specific conditions warrant:

1.2. Boundary Survey

The metes and bounds description is required for filing of the affidavit of closure and deed recording of any area of the site which has received waste. Other activities to be included here are publication of the public notice of closing activities.

Enter additional boundary survey work or cost element details as site-specific conditions warrant:

1.3. Site Evaluation

The evaluation includes a site inspection to identify waste disposal areas, analyze drainage and erosion protection needs, and to determine other site operational features that are not in compliance with the permit. The site evaluation also includes verifying the need for new or relocation of existing groundwater monitoring wells and landfill gas monitoring probes, analysis of groundwater samples, and review of site operating record. The third party consultant who performed the site evaluation will prepare and submit an engineering report to the executive director to document the status of the site.

The report will identify all areas of work and the associated implementation costs necessary to safely close the landfill operations with recommendations on how to fulfill these needs.

Enter additional site evaluation work or cost element details as site-specific conditions warrant:

1.4. Development of Plans

The final closure, plan the final cover system design and specifications, grading and drainage plans, specification for revegetation, design of any other improvements to bring the site into compliance with the permit, the closure schedule, and coordination with the TCEQ and provision of closure notice to the public.

Enter additional development of plans work or cost element details as site-specific conditions warrant:

1.5. Contract Administration (bidding and award)

The third-party consultant will advertise the project, receive the bids, evaluate the bids, award the closure construction contract and administer the contract during construction.

Enter additional contract administration work or cost element details as site-specific conditions warrant:

1.6. Closure Inspection and Testing

The professional of record will observe closure construction, perform cover thickness and permeability verification, and prepare an evaluation report upon completion of closure.

Enter additional closure inspection or testing work or cost element details as site-specific conditions warrant:

1.7. TPDES and other Permits

The third-party consultant will prepare plans, specifications, and other documents necessary for compliance with applicable federal and state laws and requirements, including the Clean Water Act, for the proper closure of the site.

Enter additional TPES or other permits work or cost element details as site-specific conditions warrant:

1.8. Additional Engineering Cost Items Not Listed on the Worksheet

List the Attachment(s) detailing any additional engineering cost items necessary to close the site that is not already included as a line item on the worksheet:

Also, reference these Attachments in the "Units" column on this line of

the worksheet. Provide the total cost of all additional engineering cost items in the "Cost" column.

1.9. Engineering Costs Subtotal

1.9.1. Enter the sum of engineering costs in Items 1.1 through 1.8.

2. Construction Costs

Closure construction costs include those for construction of the final cover system, site grading, and drainage improvements. Other costs may be added as site-specific issues warrant.

2.1. Mobilization

2.1.1. Mobilization of Personnel and Equipment

The cost of mobilizing personnel and construction heavy equipment must be included as part of the construction costs.

Enter additional work or cost element details for mobilization of personnel and equipment as site-specific conditions warrant:

2.2. Final Cover System

The owner or operator must install a final cover system that is designed to minimize infiltration and erosion. The final cover system is subdivided into the sideslope cover and cap cover with their associated components to facilitate cost calculations. If an alternative final cover is proposed, the closure cost estimate will still be based on a design that utilizes the conventional composite cover system.

Enter additional final cover system work or cost element details as site-specific conditions warrant: Due to the costs associated with installing the alternative final cover being greater than the costs associated with installing the prescriptive cover option, the closure cost estimate was completed for the alternative final cover. No prescriptive cover is planned for this facility.

2.2.1. Side Slope Cover

Enter information for Items 2.2.1a through 2.2.1h.

2.2.2. Top Slope Cover

Enter information for Items 2.2.2a through 2.2.2h.

2.2.3. Cells for Class 1 Nonhazardous Industrial Waste

2.3. Site Grading

Site grading includes the final grading of the site, including the landfill cap and sideslopes.

Enter additional site grading work or cost element details as site-specific conditions warrant:

2.4. Site Fencing and Security

Site fencing and security must be included for the area which has received waste and have no existing approved fencing.

Enter additional site fencing and security work or cost element details as site-specific conditions warrant:

2.5. Landfill Gas Monitoring and Control Systems

Enter information for Items 2.5.1 through 2.5.6.

Final installation of the landfill gas monitoring and control systems must include the installation costs of pipes and appurtenances. In the event of a forced closure, the systems may not have been completed, thus, the estimated costs to complete the landfill gas monitoring and control system must be provided.

Enter additional landfill gas monitoring and control systems work or cost element details as site-specific conditions warrant:

2.6. Groundwater Monitoring System

2.6.1. Monitor Well Installation

Upon closure of the site, it may be necessary to relocate the compliance boundary. This requires the installation of new monitor wells.

Enter additional groundwater monitoring system work or cost element details as site-specific conditions warrant:

2.6.2. Piezometer and Monitor Well Plugging and Abandonment

Piezometer or monitor well abandonment is the cost of abandoning (plugging) piezometers or monitor wells that are no longer needed. Determine the number of piezometers or monitor wells to be abandoned and include the total cost.

Enter additional plugging and abandonment work or cost element details as site-specific conditions warrant:

2.7. Leachate Management

2.7.1. Completion of Existing Leachate Collection System

In the event of a forced closure, there may be circumstances where the leachate collection system has not been completed. In this event, the leachate collection system must be closed with a permanent outfalls and permanent cleanouts installed.

Enter additional leachate management work or cost element details as site-specific conditions warrant:

2.8. Stormwater Management

2.8.1. Stormwater Drainage Management System

To reduce the potential long-term impacts of the landfill on surface water quality, drainage features must be incorporated into the final cover design to direct runoff, minimize erosion, control sediments, and avoid ponding of stormwater. The drainage system construction costs must be included.

Enter additional stormwater drainage management work or cost element details as site-specific conditions warrant:

2.9. Additional Construction Cost Items Not Listed on Worksheet

List the Attachments detailing any additional construction cost items necessary to close the site that is not already included as a line item on the worksheet: Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional construction cost items in the "Cost" column.

2.10. Construction Costs Subtotal

2.10.1. Enter the sum of construction costs in Items 2.1 through 2.9.

3. Storage and Processing Unit Closure Costs

For landfills that incorporate storage and/or processing operations that are not separately authorized, all waste and processed and unprocessed materials associated with storage and/or processing units must be removed during the closure process.

3.1. Waste Disposal

The cost of disposal of waste at an authorized facility. *Enter additional waste disposal work or cost element information as necessary.*

3.2. Material Removal and Disinfection

The cost of removal, including transportation, of any remaining processed and unprocessed materials to an authorized off-site location. *Enter additional material removal and disinfection work or cost element information as necessary.*

3.3. Demolition and Disposal

The cost of dismantling and/or disinfection of storage and/or processing units and disposal, as applicable. *Enter additional demolition and disposal work or cost element information as necessary.*

3.4. Additional Storage and Processing Unit Closure Cost Items Not Listed in Worksheet

List the Attachments detailing any additional storage and processing unit closure cost items necessary to close the site that is not already included as a line item on the worksheet. Also, reference these Attachments in the "Units"

column on this line of the worksheet. Provide the total cost of all additional storage and processing unit closure cost items in the "Cost" column.

3.5. Storage and Processing Unit Closure Costs Subtotal

4. Sum of Cost Subtotals

4.1. Enter the sum of engineering, construction, and storage and processing unit closure cost subtotals from lines 1.9.1, 2.10.1, and 3.5.1.

5. Contingency

5.1. Add an amount equal to at least 10 percent of the sum of cost subtotals to cover unanticipated events during implementation of closure activities.

6. Contract Performance Bond

6.1. Add an amount equal to at least 2 percent of the sum of cost subtotals for purchase of a surety bond to guarantee satisfactory completion of the closure activities.

7. Third Party Administration and Project Management Costs

7.1. Add an amount equal to at least 2.5 percent of the sum of cost subtotals to cover the cost for a third party hired by TCEQ to administer the closure activities.

8. Total Closure Cost

8.1. Enter the sum of the amounts on lines 4.1, 5.1, 6.1, and 7.1.

IV. Closure Cost Estimates Worksheet

A. Landfill Data

Total Permitted Waste Disposal Area: **216.4 acres**

Largest Area Requiring Final Cover in the year to follow: **122.5 acres**

Total Filled Area with Constructed Final Cover: **93.9 acres (Phase 1 closure completed; note 34.6 acres will be disturbed for the vertical expansion of Phase 1)**

Total Area Certified Closed: **93.9 acres (Phase 1 closure completed; note 34.6 acres will be disturbed for the vertical expansion of Phase 1)**

Number of Monitor Wells to be Installed for Closure: **0 (already constructed)**

Number of Gas Probes to be Installed for Closure: **0 (already constructed)**

Total Acreage Needing LFG Collection and Control System: **0 acres**

The unit or lump sum cost for each item is based on the work items and cost elements described in Section III of this Closure Cost Estimate document:

Yes ☒ No ☐ Partially ☐

(if "No" or "Partially" is checked, please include attachments describing the additional work items and detailing the unit, quantities, and costs for the additional items)

B. Facility Drawings and Financial Assurance Documentation

- Facility drawings
  - Attach facility drawings showing the closure areas to which the closure cost estimates apply. **See Appendix III.A, Drawing III.A.11 for the largest open area; however, costs have been calculated for the entire Phase 2 area (122.5 acres)**
- Financial assurance documentation
  - For an existing facility, attach a copy of the documentation required to demonstrate financial assurance as specified in 30 TAC Chapter 37, Subchapter R.
  - For a new facility, a copy of the required documentation shall be submitted 60 days prior to the initial receipt of waste.

C. Attachments

- Additional Engineering, Construction, and Storage and Processing Units Cost Items Details

D. Closure Cost Estimates Worksheet

If any item listed in this worksheet is not applicable to the subject facility, enter "NA" (Not Applicable) in the affected field.

Table 1. Closure Cost Estimates Worksheet.

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
1. Engineering Costs						
1.1	Topographic Survey	Acres	122.5	$170	$20,825	Industry Standard Cost (ISC)
1.2	Boundary Survey	LS	1	$12,000	$12,000	ISC
1.3	Site Evaluation	Acres	122.5	$600	$73,500	ISC
1.4	Development of Plans	Lump Sum	NA	NA	$30,000	ISC
1.5	Contract Administration (bidding and award)	Lump Sum	NA	NA	(Included Above)	NA
1.6	Closure Inspection and Testing	Acres	122.5	$1,400	$171,500	ISC
1.7	TPDES and other Permits	Lump Sum	NA	NA	$5,000	ISC
1.8	Additional Engineering Cost Items (describe in attachments)	NA	NA	NA	NA	NA
1.9 Engineering Costs Subtotal						
1.9.1	Engineering Costs Subtotal	NA	NA	NA	$312,825	NA
2. Construction Costs						
2.1 Mobilization						
2.1.1	Mobilization of Personnel and Equipment	Lump Sum	NA	NA	$565,900	5% of Construction Costs
2.2 Final Cover System						
2.2.1 Side Slope Cover and Top Slope Cover						
2.2.1a	Infiltration Layer	Cubic Yards	296,500	$3.40	$1,008,100	Inflated Previously Approved Cost (PAC)
2.2.1b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Greater El Paso Landfill Revision No.: 0

Permit No: 2284A Date: Oct 31, 2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.2.1c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.1d	Flexible Membrane Cover – LLDPE	Square Feet	NA	NA	NA	NA
2.2.1e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.1f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.1g	Erosion Layer	Cubic Yards	NA	NA	NA	NA
2.2.1h	Vegetation	Acres	NA	NA	NA	NA
2.2.1i	Base Layer	Cubic Yards	98,900	$3.40	$336,260	PAC
2.2.1j	Rock Armoring	Tons	121,200	$75	$9,090,000	PAC
2.2.2 Top Slope Cover – NA, Included in the Above						
2.2.2a	Infiltration Layer – Compacted Clay	Cubic Yards	NA	NA	NA	NA
2.2.2b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA
2.2.2c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.2d	Flexible Membrane Cover – LLDPE	Square Feet	NA	NA	NA	NA
2.2.2e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.2f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.2g	Erosion Layer	Cubic Yards	NA	NA	NA	NA
2.2.2h	Vegetation	Acres	NA	NA	NA	NA
2.2.3 Cells for Class 1 Nonhazardous Industrial Waste - NA						
2.2.3a	Dike Construction	specify	NA	NA	NA	NA
2.3 Site Grading						
2.3.1	Site Grading	Acres	122.5	$1200	$147,000	ISC
2.4 Site Fencing and Security						

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Greater El Paso Landfill Revision No.: 0

Permit No: 2284A Date: Oct 31, 2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.4.1	Site Fencing and Security	NA	NA	NA	NA	Already constructed prior to closing
2.5 Landfill Gas Monitoring and Control System – ***Active GCCS not anticipated. An active landfill gas system was installed within Phase 1 at the GEP Landfill in 2010; however, the system was decommissioned due to the lack of sufficient LFG production to run the system. The flare associated with the active system was retained on site. However, all existing GCCS piping has been abandoned.***						
2.5.1	Gas Control Wells	NA	NA	NA	NA	NA
2.5.2	Gas Header Piping	NA	NA	NA	NA	NA
2.5.3	Gas Lateral Piping	NA	NA	NA	NA	NA
2.5.4	Flare Station	Lump Sum			NA	NA
2.5.5	Condensate Sumps	NA	NA	NA	NA	NA
2.5.6	Completion of LFG Monitoring System	NA	NA	NA	NA	NA
2.6 Groundwater Monitoring System						
2.6.1	Groundwater Monitoring Well Installation	Each	NA	NA	NA	Completed prior to Closure
2.6.2	Piezometer and Monitor Well Plugging and Abandonment	Each	NA	NA	NA	Completed prior to Closure
2.7 Leachate Management						
2.7.1	Completion of Leachate Management System	NA	NA	NA	NA	Completed prior to Closure
2.8 Stormwater Management						
2.8.1	Stormwater Drainage Management System	Acres	122.5	$6,000	$735,000	ISC
2.9 Other Cost Items						
2.9.1	Additional Construction Cost Items (describe in attachments)	NA	NA	NA	NA	NA
2.10 Construction Costs Subtotal						

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Greater El Paso Landfill Revision No.: 0

Permit No: 2284A Date: Oct 31, 2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.10.1	Construction Costs Subtotal	NA	NA	NA	$11,882,260	NA
3. Storage and Processing Unit Closure Costs						
3.1	Waste Disposal	☐ Tons ☐ Cubic Yards	NA	NA	NA	NA
3.2	Material Removal and Disinfection	NA	NA	NA	NA	NA
3.3	Demolition and Disposal Units	NA	NA	NA	NA	NA
3.4	Additional Storage and Processing Unit Closure Cost Items (describe in attachments)	NA	NA	NA	NA	NA
3.5 Storage and Processing Unit Closure Costs Subtotal						
3.5.1	Storage and Processing Unit Closure Costs Subtotal	NA	NA	NA	NA	NA
4. Sum of Engineering, Construction, and Storage and Processing Unit Closure Costs						
4.1	Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals	NA	NA	NA	$12,195,085	NA
5. Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$1,219,509	NA
6. Contract Performance Bond						
6.1	Contract Performance Bond (2% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$243,902	NA
7. Third Party Administration and Project Management Costs						
7.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)	NA	NA	NA	$304,877	NA

Closure Cost Estimate for MSW Type I Landfill

Facility Name: Greater El Paso Landfill

Revision No.: 0

Permit No: 2284A

Date: Oct 31, 2024

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
8. Total Closure Costs						
8.1	Total Closure Costs (sum of amounts in Sections 4, 5, 6, and 7)	NA	NA	NA	$13,963,373	NA

[1] For items marked "specify," the responsible professional engineer will enter appropriate unit of measurement

[2] Sources of Unit Costs for Cost Estimates table may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors);
(3) Verifiable Data based on Actual Operations; or
(4) Other sources of cost acceptable to the executive director of the TCEQ.

APPENDIX III.L – POST CLOSURE COST ESTIMATE

Texas Commission on Environmental Quality

Post-Closure Care Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide post-closure care cost estimates for post-closure care of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to conduct post-closure care of the largest waste fill area that has been certified closed in writing by the TCEQ executive director.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: Greater El Paso Landfill

MSW Permit No.: 2284A

Date: 10/31/2024

Revision Number: 0

Site Operator/Permittee Name and Mailing Address: City of El Paso, 7968 San Paulo Drive, El Paso, TX 79915

Total Post-Closure Care Cost Estimate (2024 Dollar Amount): $2,157,660

II. Professional Engineer's Statement, Seal, and Signature

I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Post- Closure Care Cost Estimate has been completed in substantial conformance with the facility Post-Closure Care Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: Tonya Koller

Title: Project Engineer

Date: 10/31/2024

Company Name: Burns & McDonnell

Firm Registration Number: F-845

Professional Engineer's Seal



Signature

III. Annual Review of Permit Conditions, Cost Estimates, Adjustments for Inflation, and Financial Assurance

The site operator/permittee acknowledges that he/she will:

1. Revise and increase the post-closure care cost estimate and the amount of financial assurance provided whenever changes in the post-closure care plan or the landfill conditions increase the maximum cost of post-closure care at any time during the remaining active life of the landfill and until the facility is officially released from the post-closure care period in writing by the executive director.
2. Request a reduction in the post-closure care cost estimate and the amount of financial assurance as a permit modification whenever the post-closure care cost estimate exceeds the maximum cost of post-closure care remaining over the post-closure period. The permit modification will include a detailed justification for the reduction of the post-closure care cost estimate and the amount of financial assurance.
3. Establish financial assurance for post-closure care of the unit in an amount no less than the current post-closure care cost estimate in accordance with 30 TAC Chapter 37
4. Adjust the current post-closure care cost estimate for inflation within 60 days prior to the anniversary date of the first establishment of the financial assurance mechanism.
5. Provide annual inflation adjustments to the post-closure care costs and financial assurance during the active life of the facility and during the post closure care period. The adjustment will be made using an inflation factor derived from the most recent annual Implicit Price Deflator for Gross National Product published by the United States Department of Commerce in its Survey of Current Business, as specified in 30 TAC Chapter 37. The inflation factor is the result of dividing the latest published annual Deflator by the Deflator for the previous year.
6. Provide continuous financial assurance coverage for post-closure care until the facility is officially released in writing by the executive director from the post-closure care period in accordance with all requirements of the post-closure care plan.

IV. Description of Worksheet Items of the Post-Closure Care Cost Estimates

The following descriptions of the worksheet items provide guidance for identifying the minimum work or cost elements for estimating the unit or lump sum cost of each item as applicable. Enter additional detail for each item in the field following the item as necessary and as site-specific conditions warrant. The cost items are grouped under post-closure care costs for engineering, construction, and leachate management. Include attachments to detail any additional work and associated costs necessary for the post-closure care of the unit or facility that is not already included as a line item on the worksheet. Reference the attachments and list the work or cost items in the fields under "Additional Engineering Cost Items Not Listed on the Worksheet," "Additional Construction Cost Items Not Listed on the Worksheet," or Additional Leachate Management Costs Not Listed on the Worksheet" as applicable. Provide the total cost of additional work or cost items in each cost category on the worksheet line that precedes the cost subtotal for each cost group.

1. Engineering Costs

1.1. Site Inspection and Recordkeeping

Regularly scheduled and event-driven site inspection must be performed to identify areas experiencing settlement, subsidence, erosion, or other drainage related problems, and note the conditions of the environmental control and monitoring systems, including leachate collection, groundwater monitoring, and landfill gas monitoring systems. *Enter additional site inspection and recordkeeping work or cost element detail as site-specific conditions warrant.*

1.2. Correctional Plans and Specifications

The cost for an engineering consultant to prepare corrective measure construction plans and specifications to correct problems identified during site inspections. *Enter additional work or cost element details for correctional plans and specifications as site-specific conditions warrant.*

1.3. Site Monitoring

The cost of performing semiannual groundwater (including costs for sampling and analyzing parameters, and assessment and reporting) and quarterly landfill gas monitoring (including costs for sampling and reporting) and the monitoring of other site-specific systems at the landfill during the post-closure period. *Enter additional site monitoring work or cost element details as site-specific conditions warrant.*

1.4. Additional Engineering Cost Items Not Listed on the Worksheet

List the Attachments detailing additional post-closure care engineering cost items not already included as a line item on the worksheet. (Also, reference these Attachments in the "Units" column of this line of the worksheet. Provide the total cost of all additional engineering cost items in the "Cost" column).

2. Construction Costs

2.1. Cap and Sideslopes Repairs and Revegetation

The cost of repair of the cap and cap drainage control structures due to erosion or structural integrity failures and maintaining final cover vegetation to minimize erosion. *Enter additional cap and sideslopes repair and revegetation work or cost element details as site-specific conditions warrant.*

2.2. Mowing and Vegetation Control

The cost of controlling vegetation growth on the final cover and other areas of the landfill. *Enter additional mowing and vegetation control work or cost element details as site-specific conditions warrant.*

2.3. Groundwater Monitoring System Maintenance

The cost of repairs/replacement and routine maintenance. *Enter additional groundwater monitoring system maintenance work or cost element details as site-specific conditions warrant.*

2.4. LFG Monitoring Probes Maintenance

The cost of repairs/replacement and routine maintenance. Enter additional LFG monitoring probes maintenance work or cost element details as site-specific conditions warrant.

2.5. LFG Collection System Maintenance

The cost of repairs and routine maintenance. *Enter additional LFG collection system maintenance work or cost element details as site-specific conditions warrant.*

2.6. Perimeter Fence and Gates Maintenance

The cost of maintaining perimeter fence and gates to restrict unauthorized access to the closed landfill. *Enter additional perimeter fence and gates maintenance work or cost element details as site-specific conditions warrant.*

2.7. Access and Rights of Way Maintenance

The cost of maintaining the access roads and other rights of way to the closed landfill to conduct inspections, environmental sampling, routing

maintenance and other post-closure activities. *Enter additional access and rights of way maintenance work or cost element details as site-specific conditions warrant.*

2.8. Drainage System Cleanout and Repairs

The cost to include costs for maintaining and repairing ditches, conveyance structures, and ponds/basins. *Enter additional drainage system cleanout and repairs work or cost element details as site-specific conditions warrant.*

2.9. Additional Construction and Maintenance Cost Items Not Listed on the Worksheet

List the Attachments detailing any additional construction and maintenance cost items necessary for post-closure care that are not already covered on the worksheet. (Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional construction and maintenance cost items in the "Cost" column.)

3. Leachate Management Costs

3.1. Leachate Collection and Removal System Operation and Maintenance

The cost of operation, routine maintenance and repairs. *Enter additional work or cost element details for leachate collection and removal system operation and maintenance as site-specific conditions warrant.*

3.2. Leachate Disposal

The cost of leachate disposal off-site. *Enter additional work or cost element details for leachate disposal as site-specific conditions warrant*.

3.3. Additional leachate management cost items not listed on the worksheet.

List the Attachments detailing any additional leachate management cost items necessary for post-closure care that are not already covered on the worksheet. (Also, reference these Attachments in the "Units" column on this line of the worksheet. Provide the total cost of all additional leachate management cost items in the "Cost" column.)

4. Sum of Cost Subtotals

Enter the sum of engineering, construction, and storage and leachate management post-closure care cost subtotals from lines 1.5.1, 2.10.1, and 3.5.1.

5. Contingency

The cost added to cover unanticipated events during implementation of post-closure activities. (Enter additional work or cost element information as necessary)

6. Third Party Administration and Project Management Costs

The cost for the third party hired by TCEQ to administer the post-closure activities. (Enter additional work or cost element information as necessary)

V. Post-Closure Care Cost Estimates Worksheet

Post-Closure Care Period – 30 years

Total Permitted Acreage: 312 acres (entire site)

Total Permitted Waste Footprint: 216.4 acres

Number of Groundwater Monitoring Wells: 14

Number of GW Monitoring Events: 2/year

Number of Gas Probes: 20

Number of LFG Monitoring Events: 4/year

The unit or lump sum cost for each item is based on the work items and cost elements described in Section III of this Post-Closure Cost Estimate document:

Yes ☒ No ☐ Partially ☐

If "No" or "Partially" is checked, please attach a written description of work items and cost elements which form the bases of unit or lump sum cost for the affected items.

(NOTE: If any item listed in this worksheet is not applicable to the subject facility, enter Not Applicable (N/A) in the affected fields)

Attachments

Additional Engineering, Construction, and Leachate Management Cost Items Details.

Table 1: Post-Closure Care Cost Estimates

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
1.0 Engineering Costs						
1.1	Site Inspection and Recordkeeping[ii]	HRS	80	$120	$9,600	Current Value of Previously Approved Costs
1.2	Correctional Plans and Specifications	Acres	216.4	$50	$10,820	Industry Standard Cost
1.3 Site Monitoring						
1.3.1 Groundwater Monitoring System						
1.3.1(a)	Sampling and Analysis of GW Monitoring Wells (Quantity = 2 x Number of wells)	Wells	28	$700	$19,600	Current Value of Previously Approved Costs
1.3.1(b)	Piezometers/Well Abandonment	Each	NA	NA	NA	NA
1.3.2 LFG Monitoring System						
1.3.2(a)	LFG Quarterly Monitoring (Quarterly)	Each	4	$1,560	$6,240	Current Value of Previously Approved Costs
1.3.2(b)	LFG Probe Plugging and Abandonment	Each	NA	NA	NA	NA
1.4 Additional Engineering Cost Items (Detail in Attachments)						
1.4.1	Additional Engineering Cost Items (describe in attachments)	NA	NA	NA	NA	NA
1.5 Engineering Costs Subtotal						
1.5.1	Engineering Costs Subtotal	NA	NA	NA	$46,260	NA

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
2.0 Construction and Maintenance Costs						
2.1	Cap and Sideslopes Repairs and Revegetation	Lump Sum	1	$5,000	$5,000	Current Value of Previously Approved Costs
2.2	Mowing and Vegetation Management	NA	NA	NA	NA	NA
2.3	Groundwater Monitoring System Maintenance	Lump Sum	1	$2,500	$2,500	Current Value of Previously Approved Costs
2.4	LFG Monitoring Probes Maintenance	Lump Sum	1	$2,500	$2,500	Current Value of Previously Approved Costs
2.5	LFG Collection System Maintenance	NA	NA	NA	NA	NA
2.6	Perimeter Fence and Gates Maintenance	Lump Sum	1	$1,620	$1,620	Current Value of Previously Approved Costs
2.7	Access Roads Maintenance	Lump Sum	1	$2,000	$2,000	Current Value of Previously Approved Costs
2.8	Drainage System Cleanout/Repairs	Lump Sum	1	$2,800	$2,800	Current Value of Previously Approved Costs
2.9 Additional Construction and Maintenance Cost Items (Details in Attachments)						
2.9.1	Additional Construction and Maintenance Cost Items (details in attachments)	NA	NA	NA	NA	NA
2.10 Construction and Maintenance Costs Subtotal						

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
2.10.1	Construction and Maintenance Costs Subtotal	NA	NA	NA	$16,420	NA
3.0 Leachate Management						
3.1	Leachate Management System Operation and Maintenance	Lump Sum	1	$1,250	$1,250	Current Value of Previously Approved Costs
3.2	Leachate Disposal	NA	NA	NA	NA	NA
3.3 Additional Leachate Management Cost Items (Details in Attachments)						
3.4	Additional Leachate Management Cost Items (details in attachments)	NA	NA	NA	NA	NA
3.5 Leachate Management Costs Subtotal						
3.5.1	Leachate Management Costs Subtotal	NA	NA	NA	$1,250	NA
4.0 Sum of Engineering, Construction, and Leachate Management Costs						
4.1	Sum of Engineering, Construction, and Leachate Management Cost Subtotals	NA	NA	NA	$63,930	NA
5.0 Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)	NA	NA	NA	$6,393	NA
6.0 Third Party Administration and Project Management Costs						
6.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)	NA	NA	NA	$1,599	NA

Post-Closure Care Cost Estimate for MSW Type I Landfills

Facility Name: Greater El Paso Landfill | Revision No.: 0

Permit No: 2284A | Date: Oct 31, 2024

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
7. Total Post-Closure Cost						
7.1	Total Annual Post-Closure Cost (Sum of amounts in Sections 4, 5, and 6)	NA	NA	NA	$71,922	NA
7.2	30 Year Post-Closure Costs (Total Annual Post-Closure Cost x 30)	NA	NA	NA	$2,157, 660	NA

[i] Sources of Unit Cost Estimates may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors); or
(3) Verifiable Data based on Actual Operations

[ii] Example Description for Item No. 1.1 – "Includes costs for site inspection performed at least annually for identification of areas experiencing settlement or subsidence, erosion or other drainage-related problems, inspection of the leachate collection system, gas monitoring system and LFG monitoring system."


BURNS McDONNELL