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June 4, 2025

Mamadou Balde
Municipal Solid Waste Permits – MC 124
Waste Permits Division
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

RE: Technical Notice of Deficiency Dated March 12, 2025
Walker Aero Environmental, LLC - J-V Dirt & Loam
Austin, Travis County, Texas
Municipal Solid Waste Permit Number 2310
Tracking No. 30726937; RN101495976/CN604364968
Permit Limited Scope Major Amendment

Dear Mr. Balde,

On behalf of Walker Aero Environmental, LLC, INTERA is submitting this response to your technical Notice of Deficiency (NOD) dated March 12, 2025 regarding the amendment application dated January 13, 2025 for the Walker Aero Environmental composting facility, J-V Dirt + Loam, MSW Permit No. 2310. The January 13, 2025 application was submitted pursuant to 30 TAC §305.62(a) relating to amendment requested by the permittee and 30 TAC §305.62(j) regarding limited scope major amendments. Walker Aero is requesting a permit amendment to update the legal description of the property, which has been reduced in size, and to modify the groundwater monitoring system.

A response to each of the NOD items in your letter is given in Enclosure A. Enclosure A also indicates the location of the subject revisions for each NOD item in the revised application document by section and page number. Enclosure B provides an original, one unmarked hard copy, and one marked copy (with tracked changes) of the revised application document. Enclosure C, which is included only with the original copy of this submittal, provides a digital copy of the revised application document. An unmarked, hard copy of this submittal is being transmitted to the TCEQ Region Austin Office.

Please contact me at 512-425-2057 or [redacted] or Adam Mihalick of Walker Aero Environmental at 281-850-8400 or [redacted] if you have any questions.

Sincerely,

INTERA Incorporated

Kathy L. McGee P.E.
Principal Engineer

Enclosure
Cc: TCEQ Region Austin Office
Adam Mihalick, Walker Aero Environmental
Colton Juby, J-V Dirt + Loam

Enclosure A
TNOD Responses

Enclosure B

Responses to the March 12, 2025 Technical Notice of Deficiency

JV Dirt + Loam, MSW Permit No. 2310

NOD Item	Response	Location
1. Use rule Title 30 of Texas Administrative Code (30 TAC) §305.62(j)(2) as the basis of this limited scope amendment. Since the application is more specifically based on Good Cause as provided in Title 30 of Texas Administrative Code (30 TAC) §305.62(d)(2) submit a summary of the new information that was not available at the time of the permit issuance on March 15, 2005. Include this information in the application and application cover letter .	The transmittal letter and the application have been revised to identify that the application is being submitted as a limited scope major amendment pursuant to 30 TAC 305.62(j)(2). Also included as the basis for the amendment application is 30 TAC 305.62 (a), which states that the permittee may request an amendment. Good Cause as addressed in 30 TAC 305.62(d)(2) is not applicable to this application, as this regulation applies to amendments initiated by the TCEQ. (30 TAC 305.62(d): " Good cause for amendments. If good cause exists, **the executive director may initiate** and the commission may order a major amendment, a minor amendment, modification, or minor modification to a permit and the executive director may request an updated application if necessary." [emphasis added])	Transmittal letter; Section 3.0, Page 3-2
2. Reformat the application contents for clarity and completeness.		
a. In accordance with §330.57(d) revise the names and/or titles of attachments such that the names/titles in the application are not duplicated (different Attachments in the application are referenced with the same name). Names and titles must be uniquely identifiable: For subsets of the main attachments use "Appendix," "Figure," and "Table" with the appropriate suffix and page number.	The names and/or titles of attachments in the pending application conformed with those in the prior amendment application which are affected by this amendment request to minimize changes to the application documents. Names and titles have been changed in the application revisions to eliminate the use of the word "Attachments" in subsets to the main attachments, except where that term is used in the historical documents being re-submitted.	Throughout Attachments I and J, including fly sheets and references in the text.
b. Revise the table of contents (TOC) in accordance with 30 TAC §332.47(2) & §330.57(g)(3) to list the main sections of the application with corresponding page number.	The TOC has been revised to identify the page numbers of the main sections of the application, including attachments.	Table of Contents, Page ii
c. Revise the application in accordance with §330.57(g)(5) & §332.47(2) such that all pages have a date and a uniquely identifiable page number.	The appliction has been revised such that all pages have a date and uniquely identifiable page number. As a result, the entire application is being resubmitted.	Entire application
3. Revise the facility site plan to update the units layout and correct labeling discrepancies between the aerial photograph (D2) and the drawings in Attachments 10 & 13.	The drawings in Attachment I, Attachments 10 and 13, are historical drawings that are not representative of as-built conditions. These historical figures were produced under the supervision of another professional geoscientist, and therefore, all discrepancies cannot be eliminated. Layout of the units and facility roads are depicted on the Facility Layout Map provided as Attachment D-2 in the enclosed, replacement application.	Attachment D, Page D-3

Enclosure B
Responses to the March 12, 2025 Technical Notice of Deficiency
JV Dirt + Loam, MSW Permit No. 2310

NOD Item	Response	Location
4. The facility permitted area has been reduced from 80 acres to 76.92 acres.		
a. Revise the site layout to show the area reduction and updated permit boundary.	The Facility Map provided in Attachment D-2 in the pending application depicts the updated permit boundary, including the revised portion of the boundary along FM 973, consistent with the survey plat providedin Attachment E.	Attachment D, Page D-3
b. On a map drawn to scale show the buffer zone as revised;	Attachment D-2 in the enclosed, replacement application depicts the buffer zone provided around the facility perimeter, as revised.	Attachment D, Page D-3
c. Outline and label all facility units/compartments including stockpiles, composting/curing pads, retention ponds and ancillaries.	Attachment D-2 in the enclosed, replacement application depicts faciity units, ponds, and other facility features.	Attachment D, Page D-3
5. Show the approximate location or projected position of the facility on each of the submitted maps and profiles (examples: Figures 4, 28, 12, and 16).	The regional geologic maps and cross-sections included in the pending application as attachments to Attachment I have been revised and are included as appendices to Attachment I in the enclosed, replacement application to show the approximate location or projected position of the facility.	Attachment I, Appendix I.1, Page I.1-2 Attachment I, Appendix I.3, Page I.3-2 Attachment I, Appendix I.4, Page I.4-2 Attachment I, Appendix I.5, Page I.5-2 Attachment I, Appendix I.6, Page I.6-2 Attachment I, Appendix I.9, Page I.9-2
6. Table 3 (Attachment I) - Monitoring Well Locations and Elevations is not sealed. Submit surveyed locations and elevations sealed by a Texas Registered Professional Land Surveyor (RPLS), in accordance with 330.421(d). Elevation of the monitoring wells must be certified to be within 1 hundredth of 1 foot.	Historical monitoring well locations and elevations shown in the pending application cannot now be sealed by a RPLS. Accordingly, locations and elevations of the existing monitoring wells have been re-surveyed, and this information is included in Appendix I.15 of the enclosed, replacement application.	Attachment I, Appendix I.15, Page I.15-2
7.a. Drawings 13a, 13b, and 13c referenced as water level elevation maps in Attachment I, Section 3.2.2 should be called water level location points.	The references to the identified drawings in the text of Attachment I, Section 3.2.2 have been changed to be "maps of water level location points" in the enclosed, revised application. The titles to these drawings, Water Level Elevations, are historical figures prepared under the supervision of another geoscientist and therefore cannot be changed.	Attachment I, Section 3.2.2, Page I-10

NOD Item	Response	Location
7.b. Provide contour maps corresponding to your interpretation of water level at the site between December 2003 and June 2004.	Countour maps representative of each month with available data between December 2003 and September 2004 have been provided in Appendix I.13B of the enclosed, replacement application.	Attachment I, Appendix I.13B, Pages I.13B-3 through I.13B-11
7.c. Discuss changes of flow direction and hydraulic gradient between the 2003-2004 data and 2023-2024 maps in Attachment 15. Indicate the estimated gradients for the different data sets.	Estimated gradients for the 2003-2004 and 2023-2024 data sets are identified in Attachment I, Sections 3.2.2 and 3.3.2 of the enclosed, revised application. Input values for the gradient calculations are found in Appendix I.13B. Differences in the data sets are discussed in Attachment I, Section 3.3.2.	Attachment I, Section 3.2.2, Page I-11 Attachment I, Section 3.3.2, Pages I-14 and I-15 Attachment I, Appendix I.13, Page I.13B-2
8. Based on the information provided in Attachment I (Section 3.2, 3.3 & 3.4) and the maps in Attachment 15, groundwater flow direction at the site is highly variable and poorly constrained. Discuss the basis of siting proposed MW-9 as an upgradient monitoring well.	Section 3.4.2 of the enclosed, revised application discusses the basis for siting proposed MW-9 as an upgradient monitoring well. As shown on the revised 2023 and 2024 contour maps in Attachment I, Appendix I.15 and discussed in Section 3.3.2, the groundwater flow direction depicted in the revised contour maps is predominantly to the southwest, the expected flow direction towards the Colorado River. As such, the proposed location of MW-9 as an upgradient monitoring well is appropriate under typical conditions. However, variable flow directions have been reported during times of drought. With the addition of another proposed well, MW-10, to be located along the northeastern perimeter of the facility (see response to Item10), wells will be present alongside all four sides of the facility, ensuring that upgradient groundwater level data will be collected regardless of flow direction variations.	Attachment I, Section 3.4.2, Page I-16 and I-17

Enclosure B
Responses to the March 12, 2025 Technical Notice of Deficiency
JV Dirt + Loam, MSW Permit No. 2310

NOD Item	Response	Location
9. Based on the Boring Logs in Attachment 8, the Taylor Clay is described in several boreholes as greenish in color, a probable indication of weathering. Weathered clay formations are commonly known to be aqueous but the presence of water in this stratum is interpreted in the application to be uniquely due to leakage from the above alluvions. Discuss the basis for excluding the presence of groundwater within the Taylor Clay considering: a) the inconsistency of water level in different piezometers, as described in Attachment I, Section 3.1; and b) the water level discrepancies between MW-1, MW-2, MW-3 noted in Section 3.2 and shown in Attachment 15.	As noted in the revised, enclosed application, the supervising geologist for the original borings and piezometers at the facility characterized the clay as both dark greenish-gray and unweathered based on actual field observations. The basis for excluding the presence of groundwater in the Taylor Clay is discussed in revised Sections 3.1.2 and 3.2.2. Although it is INTERA's opinion that groundwater is not present within the Taylor Clay at the site, it should be noted that the rationale for monitoring alluvial wells is not based solely on that opinion. As stated in Section 3.4.1, a release from the facility would preferentially flow laterally through the alluvial aquifer rather than through the Taylor Clay, due to the the extremely low hydraulic conductivity of the clay and the lack of secondary features.	Attachment I, Section 3.1.2, Pages I-8 and I-9 Attachment I, Section 3.2.2, Page I-12 and I-13
10. It does not appear that the information submitted supports a unique groundwater flow direction to the west-northwest. Review and revise the existing groundwater monitoring plan to ensure groundwater protection at the site is in accordance with 30 TAC §332.47(6)(C) and 30 TAC §330.403(a). Consider specifically that there is potential for groundwater flow to the east-northeast where no monitoring wells exist or are proposed.	As noted in the response to Item 8, above, the revised 2023 and 2024 contour maps in Attachment I, Appendix I.15 indicate a fairly consistent groundwater flow direction predominantly to the southwest, the expected flow direction towards the Colorado River. However, due to fluctuations in the direction of groundwater flow observed in the historical data, another well, MW-10, is proposed in the enclosed, revised application. This well is proposed to be located along the northeastern perimeter of the facility to ensure complete coverage of downgradient groundwater quality.	Attachment I, Section 3.4.2, Pages I-16 and I-17 Attachment I, Appendix 17, Page I.17-2 Attachment J, Page J-5 Attachment J, Appendix J.1, Page J.1-2

Enclosure B
Revised Application

Enclosure C
Marked Application Revisions

Limited Scope Amendment Application
MSW Permit No. 2310

J-V Dirt + Loam Facility – Travis County, Texas

Walker Aero Environmental LLC, Permittee

Prepared for:

American AllWaste LLC
12141 Wickchester Ln, Suite 325
Houston

J-V Dirt + Loam
3600 FM 973
Austin, Texas 7707978725

Prepared by:

INTERA Incorporated
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Austin, Texas, 78759

JANUARY 13, 2025

~~REVISED~~REVISION 1 FEBRUARY 4, 2025

REVISION 2 JUNE 4, 2025

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1.0 Plain Language Summary Forms

2.0 Public Involvement Plan Form

3.0 Application Form TCEQ 00653b

Geologic and Hydrogeologic Report
JV Dirt + Loam Facility - Travis County, Texas

MSW Permit No. 2310 Limited Scope Amendment Application
Walker Aero Environmental LLC, Permittee

Prepared for:

JV Dirt + Loam
3600 FM 973
Austin, Texas 78725

Prepared by:

INTERA Incorporated
9600 Great Hill Trail, Suite 300W
Austin, Texas 78759

JANUARY 13, 2025 REISSUE
REVISED JUNE 4, 2025

Originally Prepared and Revised by Mark S. Katterjohn, P.G.
December 10,2003
February 10, 2004
April 16, 2004
April 22, 2013

Preface

INTERA has prepared the following revised Geologic and Hydrogeologic Report as part of the January 13, 2025 limited scope permit amendment application for the JV Dirt + Loam (JV Dirt) composting facility. This report describes the hydrogeologic conditions in the vicinity of the JV Dirt facility in accordance with 30 TAC §332.47(6)(B) of the Texas Commission on Environmental Quality (TCEQ) composting rules. As noted on the cover of this report, it is a revision of the prior Geologic and Hydrogeologic Report prepared and last revised by Mark S. Katterjohn, P.G. on April 22, 2013. The following Geologic and Hydrogeologic Report provides information and data from the April 22, 2013 version of this report that has been verified to the extent practicable given the historical nature of the information, as well as data collected by INTERA in 2023 and 2024. This report re-evaluates the data in the April 2013 report and evaluates subsequently obtained data to present an updated characterization of site hydrogeology.

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~~Attachment~~Appendix I.2 Table 1. Geologic Units and Their Water-Bearing Properties, Texas Department of Water Resources, Report 276
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~~Attachment~~Appendix I.3 Figure 28. Cross-Section C-C', Texas Department of Water Resources, Report 276

~~Attachment~~Appendix I.4 Figure 12. Sulfate, Chloride, and Dissolved-Solids Content in Water from Selected Wells in the Lower, Middle, and Upper Trinity Aquifers and Edwards and Associated Limestones Aquifer, Texas Department of Water Resources, Report 276

~~Attachment~~Appendix I.5 Figure 6. Approximate Altitude of and Depth to Top of the Lower Trinity Aquifer, Texas Department of Water Resources, Report 276

~~Attachment~~Appendix I.6 Figure 22. Approximate Altitude of Water Levels in Selected Wells Completed in the Alluvium and Terrace Deposits, Spring 1978, Texas Department of Water Resources, Report 276

~~Attachment~~Appendix I.7 Boring Location Map and Survey Information

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~~Attachment~~Appendix I.9 Figure 16. Approximate Altitude of and Depth to top of the Edwards Aquifer, Texas Water Development Board, Report 293

~~Attachment~~Appendix I.10 Site-Specific Cross-Sections

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~~Attachment~~Appendix I.12 Piezometer and Monitoring Well Information

~~Attachment~~Appendix I.13 2003 and 2004 Groundwater Elevation Data

~~Attachment~~Appendix I.14 Monitoring Well Plugging Reports

~~Attachment~~Appendix I.15 2023 and 2024 Groundwater Elevation Data

~~Attachment~~Appendix I.16 Monitoring Well System Certification Report, February 19, 2014

~~Attachment~~Appendix I.17 Monitoring Well Location Map

1.0 Regional Geology

According to the Geologic Atlas of Texas, Austin Sheet (Bureau of Economic Geology, 1974), the site is located over Quaternary fluviatile terrace deposits along the Colorado River. The Quaternary deposits are underlain by the Cretaceous age Navarro (Kemp Clay, Corsicana Marl, and Neylandville Formation) and Taylor Groups and the older Austin Chalk Formation. The Cretaceous age Eagle Ford, Buda Limestone and Del Rio Clay formations underlie the Austin Chalk. A map of the geology of Travis County (Texas Department of Water Resources (TDWR), 1983) is presented as ~~**Attachment**~~ **Appendix I.1.**

Tables describing the geologic units, their water-bearing properties and their hydraulic characteristics are presented as ~~**Attachment**~~ **Appendix I.2.** ~~**Attachment**~~ **Appendix I.3** presents a stratigraphic cross-section typical of the geology beneath the site.

According to TDWR Report 276, the Quaternary alluvial and terrace deposits consist of stratified deposits of unconsolidated calcareous gravel, sand, and clay with the coarser materials typically occurring at the base of the units. The alluvial deposits, which are of Recent or Holocene age and were deposited by the Colorado River, can be up to 60 feet thick. The alluvial deposits rest on the underlying Navarro and Taylor Groups. The alluvium is reported to yield small to very large quantities of fresh to slightly saline water.

The TDWR report indicates that Pleistocene age terrace deposits occur at higher elevations than the Colorado River flood plain. The terrace deposits range from 0 to 60 feet in thickness with the thickest sediments occurring along the Colorado River. The terrace deposits yield very small to moderate quantities of fresh to slightly saline groundwater. As shown in ~~Attachment~~ Appendix I.3, hydraulic conductivities of the alluvial and terrace deposits are reported to range from 8,200 to 14,600 gallons per day per foot squared (gpd/ft^2) or 3.8 x 10^{-1} to 6.9 x 10^{-1} centimeters per sec (cm/sec).

The underlying Navarro and Taylor Groups are similar in composition and represent the uppermost portion of the Gulf Series of the Cretaceous System (~~Attachment~~ Appendix I.2). These sediments are described as massive beds of shale and marl with clayey chalk and montmorillonitic clay with minor beds of sand and some nodular and phosphatic zones. The combined Navarro and Taylor Groups range from 900 to 1,200 feet thick and are thinner in the outcrop area. These groups are reported to yield very small quantities of fresh to moderately saline groundwater in the upper 50 feet of the weathered outcrop portion. Although no published pumping test data are readily available for the Navarro and Taylor Groups, the hydraulic conductivity of unweathered marine clays typically range from approximately 1 x 10^{-7} to 1 x 10^{-10} cm/sec (Freeze and Cherry, 1979). Higher hydraulic conductivities could be expected in areas where the clays are exposed and weathered.

According to TDWR Report 276, the Austin Chalk consists of massive beds of chalk and marl with bentonitic seams, glauconite, and pyrite nodules. The thickness within Travis County ranges from 300 to 500 feet. As shown in ~~Attachment~~ Appendix I.1, the outcrop area occurs primarily within the Balcones fault zone to the west of the facility. The Austin Chalk yields small to very small quantities of groundwater generally within the outcrop area.

The Eagle Ford, Buda Limestone and Del Rio Clay formations are not known to yield water within Travis County (TDWR, 1983). These units consist of massive calcareous shale, massive limestone, and clay and marl, respectively. The approximate maximum combined thickness of these units is 170 feet. According to the cross-section in ~~Attachment~~ Appendix I.3, the base of these combined units is anticipated to occur at a depth of over 1,000 feet beneath the facility. According to Freeze and Cherry (1979), the hydraulic conductivity of these formations is expected to range from approximately 1 x 10^{-6} to 1 x 10^{-11} cm/sec.

1.2 Active Geologic Processes

There are no active geologic processes within the vicinity of the facility. ~~Attachment~~ Appendix I.1 (geology map of Travis County) shows the principal faults and fault zones in the area. As shown in the ~~attachment~~appendix, no faults occur within 6 miles of the facility.

1.3 Regional Aquifers

The primary regional aquifers in Travis County are the Edwards Aquifer, the Trinity Group, and the alluvium and terrace deposits. However, groundwater within the vicinity of the facility is only produced from the surficial Quaternary terrace deposits, as this is the only primary regional aquifer within the upper 1,000 feet beneath the site. As shown in ~~Attachment~~ Appendix I.3, saline groundwater occurs at approximately 1,000 feet below ground surface within the Edwards and associated limestone formations. Slightly saline groundwater occurs within the Lower Trinity Aquifer at approximately 2,300 feet beneath the site (**~~Attachment~~Appendices I.4 and I.5**). Therefore, the discussion of the regional aquifers within the vicinity of the site has been limited to the alluvium and terrace deposits.

The Quaternary alluvium and terrace deposits represent the uppermost aquifer in the vicinity of the site and are hereafter referred to as the alluvial aquifer. According to records within the Texas Water Development Board (TDWB) Groundwater Database, wells completed within these hydrogeologic units have total depths ranging from about 40 to 60 feet below ground surface. Groundwater usage from wells installed near the site is for domestic or livestock purposes.

The primary source of recharge to the aquifer is rainfall, although lakes and streams that cross the outcrop area can contribute as well. Additionally, small amounts of recharge may be contributed by the Colorado River during flood stage. **~~Attachment~~ Appendix I.6** presents the outcrop (recharge) area and approximate water surface elevation within the alluvium and terrace aquifer. Groundwater within this predominantly sand and gravel aquifer occurs under water table conditions. As shown in ~~Attachment~~ Appendix I.6**,** groundwater flows toward and discharges into the Colorado River.

~~Attachment~~ Appendix I.2 presents the results of pumping tests performed in the alluvial aquifer as documented by the prior version of this geologic and hydrogeologic report (Katterjohn, 2013), also referenced herein as the Katterjohn Report. The hydraulic conductivity is shown to range from 8,200 to 14,600 gallons per day per foot squared (gpd/ft^2) and the transmissivity is shown to range from about 230,000 to 320,000 gallons per day per foot (gpd/ft). The storage coefficient of the alluvium was reported to vary from 0.08 to 0.15.

2.0 Subsurface Investigation

A subsurface investigation was conducted at the facility in August and September 2003 to comply with 30 TAC §332.47(6)(B) of Subchapter D of the composting rules. The Katterjohn Report indicates that the investigation was performed in accordance with the subsurface and groundwater investigation plan submitted on July 23, 2003 and approved by TCEQ on September 4, 2003. In accordance with 30 TAC §332.47(6)(B)(iv)(I), eighteen soil borings were drilled to establish the subsurface stratigraphy and to determine geotechnical properties of the soils beneath the facility. This number conforms to the minimum number of borings required for a site larger than 5 acres. Per the referenced regulation, the minimum number of borings required for the approximately 80-acre site is three borings plus one boring for each additional five acres (above the initial 5 acres) or fraction thereof. A borehole location map and survey information are included as ~~Attachment~~ Appendix I.**7.**

The soil borings were drilled to a minimum depth of 30 feet below the elevation of the deepest proposed excavation on-site as described by the Katterjohn Report. The design elevation of the deepest excavation (EDE) at the facility was 395 feet above mean sea level (MSL)[1] (about 10 feet below the top of the clay) corresponding to the bottom of the liner for the storage pond. The post-construction elevation of the base of the storage pond was designed at an elevation of 395 feet MSL. The soil borings were drilled to a total depth of about 70 feet below the depth that the clay was encountered in each boring. ~~Attachment~~ Appendix I.**8** presents a summary of the borehole information.

According to 30 TAC §332.47(6)(B)(iv)(II), if no aquifers exist within 50 feet of the elevation of the deepest excavation, at least one boring shall be drilled to the top of the first perennial aquifer beneath the site or to a depth of 300 feet below the deepest excavation. However, the regulation allows the executive director to waive the requirement of the deep boring if it can be demonstrated that the uppermost aquifer is more than 300 feet below the deepest excavation. As mentioned above, the Edwards Aquifer is the uppermost aquifer beneath the deepest planned excavation at the site. As shown in ~~Attachment~~ Appendix I.**9,** the top of the Edwards Aquifer occurs at a minimum depth of 900 feet beneath the composting facility. Therefore, in accordance with the approved subsurface investigation plan, a deep boring to 300 feet was not drilled.

The Katterjohn Report indicates that the soil borings were drilled in accordance with established field exploration methods, as follows. The borings were drilled using a combination of hollow-stem augers and air rotary methods and equipment. Hollow-stem augers were used to drill through the sand and gravel overburden and into the upper few feet of the Taylor Clay. A temporary 4-inch PVC surface casing was reportedly set through the augers at each boring in an attempt to prevent groundwater within the shallow alluvial aquifer from entering the borehole. After allowing the surface casing cement to set for a minimum of 24 hours, drilling and sampling of the underlying clays continued through the surface casing. Drilling and continuous sampling of the underlying Taylor Clay formation was performed using a combination of core barrel sampling and air rotary drilling techniques. In some borings, samples were

[1] Page 3 of the Katterjohn Report indicates that the elevation of the deepest planned excavation for the facility was 395 feet MSL, while on page 9, the report states that the base of the deepest excavation was designed to be at an elevation of 392 feet MSL, three feet below the elevation of the base of the storage pond. Elevation 392 feet MSL is believed to be correctly referenced here as the elevation of the deepest excavation.

collected at 5-foot intervals using a split-spoon sampler. If piezometers were not installed, the soil borings were backfilled with a bentonite grout mixture in accordance with applicable rules.

The recovered soils were examined and described using the Unified Soil Classification System. Soil descriptions also include features such as fractures, fissures, slickensides, lenses, seams, etc., if present. Descriptions of the encountered soils were recorded on the boring logs included in ~~Attachment~~ Appendix I.8.

As shown on the boring logs, Quaternary sand and gravel deposits outcrop at the surface and are underlain by the Taylor Clay. These alluvial and terrace deposits typically consist of a fine-grained, compact, dry to damp, light brown sand that is underlain by a pebble to cobble-sized sandy gravel. Saturation was noted at the base of these surficial deposits in some locations.

The summary table in ~~Attachment~~ Appendix I.8 shows the top of the Taylor Clay occurs at depths ranging from 6 to 34 feet below ground surface. The depth to the Taylor Clay varies due to the amount of overlying material that was previously removed by sand and gravel operations. The Taylor Clay predominantly consists of a massive, unweathered, high plasticity, stiff to very stiff, dry to damp, dark greenish gray clay. No secondary features, such as fractures, fissures, slickensides or lenses, were observed in the borings except at a depth of 33 feet in B-07; no water was observed in this boring. At some locations, the clay becomes silty or is interbedded with dry, friable, silty clay. The Taylor Clay serves as an aquiclude for the overlying saturated alluvium and is over 400 feet thick beneath the facility based on regional cross sections.

As required by 30 TAC §332.47(6)(B)(iv)(V), cross-sections depicting the generalized strata beneath of the facility are included in **~~Attachment~~ Appendix I.10.** The cross-sections show the lithology and observed water levels within piezometers that were installed as part of the groundwater investigation. As shown in the cross-sections, the top of the Taylor Clay is relatively flat with elevations ranging from 401.4 to 407.1 feet MSL with most elevations ranging between 403 and 405 feet MSL.

Soil samples that are representative of the Taylor Clay were collected for geotechnical analysis. A total of fifteen soil samples were collected from five locations and analyzed for Atterberg limits, percent passing No. 200 sieve, and moisture content using ASTM Standards D4318, D1140, and D2216, respectively. The soil samples were collected at depths of approximately 20 feet, 40 feet, and 60 feet beneath the top of the clay at boring locations B-02, B-05, B-09, B-12, and B-18. In addition, separate samples of soil collected at the three sampling depths at location B-18 were run as duplicate analyses. Further, one soil sample was collected for vertical permeability analysis from a depth of 40 feet beneath the top of the clay at boring location B-02.

Results of the geotechnical analyses are presented in **~~Attachment~~ Appendix I.11.** As shown in the results, the Taylor Clay at the site exhibits a narrow range of geotechnical properties with the liquid limit ranging from 56 to 74 percent, a plasticity index ranging from 37 to 53 percent and a percent passing No. 200 sieve ranging from 92 to 99 percent. The moisture content of the soils ranged from 15.2 to 19.6 percent. The Taylor Clay at the site is practically impermeable with a reported hydraulic conductivity of 1.8 x 10^{-9} cm/sec (~~Attachment~~ Appendix I.11).

3.0 Groundwater Investigation and Subsequent Data

In accordance with 30 TAC §332.47(6)(B)(v), a groundwater investigation was conducted in 2003 to determine the hydraulic characteristics of water-bearing zones, if any, encountered within the formations underlying the then-proposed composting facility. Groundwater is known to occur within the alluvial sand and gravel aquifer but would not be anticipated to occur within the underlying Taylor Clay formation due to its known lithology and hydraulic characteristics. The Katterjohn Report indicates that the 2003 groundwater investigation was aimed at determining whether any distinct water-bearing zones occur within the Taylor Clay since the overlying sand and gravels were originally going to be removed during construction of the entire monitored portion of the composting facility.

Eighteen borings were drilled during the subsurface investigation in August and September 2003 as described in Section 2.0. The associated boring logs in ~~Attachment~~ Appendix I.8 document that no groundwater was encountered within the Taylor Clay in five of these soil borings (B-01, B-05, B-07, B-08 and B-13); thus, no piezometers were installed at these locations. Groundwater was observed within the remaining thirteen soil borings, and Section 3.1.1 describes installation of piezometers at these thirteen locations. However, as discussed in the following subsections, the observed groundwater was not from any permeable water-bearing zone within the clays, although Katterjohn (2013) posited that the observed groundwater might also have originated from isolated low-permeable zones within the clays. INTERA believes that the collective data do not support that possibility, and instead, the data demonstrate that the observed groundwater originated from the overlying alluvial aquifer due to leakage around the base of the surface casing as discussed in Section 3.1.3.

In December 2003, three monitoring wells were completed in the Taylor Clay as described in Section 3.2.1. The stated purpose of these wells was to evaluate potential hydraulic lift on the bottom liner of the stormwater pond and to further investigate the possibility that the groundwater observed in the piezometers was derived from more permeable zones in the Taylor Clay. These three wells comprised the approved groundwater monitoring network when the original municipal solid waste (MSW) permit (No. 2310) was issued in 2005. No wells were proposed or required to be installed in the alluvial aquifer at that time because the original designs for the facility called for excavation of the alluvial materials across the waste management area of the site and construction of the composting and curing pads on the exposed Taylor Clay.

The design of the facility was revised as approved in the July 31, 2013 modification of MSW Permit No. 2310. The revised designs for the facility eliminated excavation of the alluvial materials except where the stormwater storage pond was to be constructed, with the composting and curing pads for the facility to be constructed over the alluvium. Due to this design change, the permit modification application proposed the installation of five alluvial monitoring wells along the downgradient facility boundary. A description of the alluvial well installation procedures and a discussion of data associated with these wells is presented in Section 3.3.

3.1 Taylor Clay Piezometer Installation and Water Level Data

Although the low permeability Taylor Clay is described as predominantly dry, logs for the site investigation borings indicated that water was observed within thirteen borings during drilling.

However, at these locations, water was observed as a mud smear on the outside of the core barrel sampler and/or the sample core. As shown on boring logs B-02 and B-03, which are typical logs for the site, the interior of the clay in the recovered core sample was dry indicating the water entered the boring from the overlying alluvial aquifer and not from the clay formation. Further, no secondary features were observed within the clays (except at B-07 where no water was observed in the boring) that would allow the inflow of the amount of water observed within the borings during drilling. Regardless, piezometers were installed within the thirteen soil borings in which groundwater was observed.

Section 3.1.1 describes piezometer installation and completion. Data obtained from the piezometers were used to establish the maximum seasonal high groundwater elevation in the alluvial aquifer and are discussed in Section 3.1.2.

3.1.1 Piezometer Installation

Piezometer installation was completed in two mobilizations. Initial piezometers consisted of B-11, B-12, and B-15 through B-18 and were installed in August 2003. The remaining piezometers, B-02 through B-04, B-06, B-09R and B-10, were installed in September 2003.

The piezometers were constructed of 2-inch Schedule 40 PVC with 10 feet of 0.01-inch slot screen. Completion depths of the initial piezometers were based on the depth that groundwater was first observed within the boring (typically within 10 feet of drilling out the bottom of the surface casing). After it was determined that the groundwater was entering the borehole as leakage from the overlying alluvium around the surface casing, subsequent piezometers were completed approximately 15 to 20 feet deeper to provide a better seal between the base of the surface casing and the screened interval.

With the exception of B-09R, in which a new boring was drilled for piezometer installation, the soil borings were grouted back to the total depth of the piezometer. A sand filter pack was placed within the borehole annulus of each piezometer and generally extended approximately 1 to 2 feet above the top of the screened interval. A minimum of two feet of bentonite pellets were placed on top of the sand pack. The remainder of the annulus was sealed with a bentonite cement slurry to within 1 foot of the ground surface. Piezometer completion details are presented as ~~Attachment~~ Appendix I.**12~~A~~.**

All piezometers were developed by bailing. A summary of the well development is included ~~as~~in ~~Attachment~~Appendix -I.12~~B~~. During development, with the exception of B-15, the piezometers were bailed dry. The piezometer at location B-15 continued to make water during development indicating a direct hydraulic connection with the overlying alluvial aquifer resulting from rapid seepage of water from the alluvial aquifer into B-15.

The location and elevation of each piezometer were surveyed by a surveyor licensed in the State of Texas. The surveyor provided elevations of the top of PVC casing and ground surface at each location (~~Attachment~~ Appendix I.7~~A~~). Top of casing elevation measurements were made to the nearest 0.01 foot and are included in ~~Attachment~~ Appendix I.12~~A~~.

3.1.2 Water Level Data and Maximum Seasonal Groundwater Elevation

Groundwater levels were periodically measured in the piezometers after their installation. These water level measurements and calculated groundwater surface elevations are presented in **~~Attachment~~ Appendix I.13A.** Notations of water levels relative to well development or well purging are also indicated in ~~Attachment~~Appendix -I.13A.

~~After the initial piezometers had been installed, water level measurements and selective bailing were conducted to determine the origin of the water observed within the boreholes.~~ On August 27, 2003, water levels were measured in piezometers B-11, B-12 and B-15 through B-18 (~~Attachment~~ Appendix I.13A). Water levels within piezometers B-15 through B-18 were above their respective screened intervals ~~and appeared to be representative of the overlying aquifer. However,~~, while water levels within piezometers B-11 and B-12 were within their respective screened intervals. ~~and,~~ ~~at the time,~~The water in piezometers B-11 and B-12 were thought to represent residual water that had entered the borehole from the overlying aquifer during drilling. Initial water levels within piezometers ~~B-11 and~~ B-14 through B-18 were representative of the alluvial aquifer. This is clearly depicted on the cross-sections presented in Attachment 10.

Water level measurements taken in the piezometers over time show that groundwater elevations within piezometers B-15 through B-18 remained representative of the alluvial aquifer. These water levels are believed to indicate direct hydraulic communication with the overlying aquifer through a leaky surface casing seal. Further, based on the observed recovery rates and the fact that piezometer B-15 could not be bailed dry during well development (Appendix I.12), these observations indicated the piezometers were not completely sealed off from the overlying alluvial aquifer. The Katterjohn Report states that vibrations and turbulence caused by air rotary drilling through the surface casing sufficiently disturbed and eroded away the soils to cause the seal around the base of the surface casing to fail. Further, the Katterjohn Report notes that this was corroborated by the surface casing failure at boring B-09 in which air circulation was lost and gravels fell into the borehole from a washout at the bottom of the surface casing. Instead of returning to the surface through the surface casing, airflow from the drilling process was reported to discharge from the ground surface approximately 20 feet away from the borehole.

Even though piezometers B-11 and B-12 had water levels that were not initially representative of the overlying aquifer, groundwater levels within these piezometers slowly increased between the time piezometers were developed on September 3, 2003 and measured after development on September 22, 2003. This increase indicated some seepage influence from the overlying aquifer. In fact, the water levels within piezometer B-11 eventually increased to elevations comparable to the alluvial aquifer (see water level measurements and historical water level charts in ~~Attachment~~ Appendix I.13A).

In addition to the water level measurements, two ~~of the~~ piezometers, ~~(~~B-16 and B-17~~)~~, were bailed on August 27, 2003 and groundwater recovery was monitored to assess the source of the groundwater. Piezometer B-16 bailed dry after 6.5 gallons were purged from the well, and B-17 bailed dry after 5.5 gallons had been removed. B-16 recovered about 18.2 feet after 5 hours, and B-17 recovered about 5.1 feet after approximately 4.5 hours. Relatively rapid recovery of the water levels was likely a result of leakage through the cased off area between the saturated sands/gravels and the underlying clay. Based on a review of the boring logs completed in the Taylor Clay, there is little evidence of any saturated zones present in the Taylor Clay. Logs of the site borings installed in the Taylor Clay describe the unit predominantly as a dry, stiff high-plasticity clay. No secondary features that could transmit groundwater vertically or horizontally into the Taylor Clay were identified in borings found to contain groundwater. ~~Attachment~~ Appendix I.13A contains the purging and recovery data for piezometers B-16 and B-17.

~~To assess whether water was entering the piezometers from the overlying aquifer or whether the Taylor Clay itself exhibited groundwater-bearing characteristics, t~~The piezometers installed in September 2003 were completed with the top of their screened intervals at depths about 15 to 20 feet deeper into the clays than the piezometers installed in August 2003, to minimize the potential for infiltration. Water levels measured prior to and subsequent to well development within these piezometers (B-02 through B-04, B-06, and B-10) showed that ~~the~~ water levels were reduced by bailing and did not significantly recover, thus indicating either the water was residual water that had entered the well borehole during drilling or slow leakage from the alluvial aquifer into these piezometers. Water levels within piezometers B-09R and B-14 recovered to pre-development levels over a period of a week.

To further evaluate whether groundwater occurs within the Taylor Clay, six piezometers with water levels within their screened intervals (B-03, B-04, B-06, B-09R, B-10 and B-12) were bailed dry on December 1, 2003 and allowed to recover. Water level measurements were recorded daily for four days and after 1 week. As shown in ~~Attachment~~ Appendix I.13A, the water levels within each of the piezometers only recovered between 18 to 32 percent of their pre-bailing water levels within one week. Subsequent water levels continued to slowly rise ~~but remained below their pre-bailed levels in piezometers B-04, B-06 and B-09R~~. Although the water levels within these piezometers ~~B-03 and B-10~~ eventually recovered beyond their pre-bailing levels, the levels remained below the top of the Taylor Clay. ~~within the screened intervals of the wells. As shown in **Attachment 13,** the water level within B-12 slowly rose to a level above its screened interval but remained below the top of the Taylor Clay.~~ Water levels in piezometer B-02, which was not bailed in December 2003, also showed a slow increase over time while remaining below the top of the Taylor Clay.

Appendix I.13A shows that ~~,~~ the groundwater elevations in piezometers B-02 through B-04, B-06, B-09R, B-10, and B-12 remained below the top of the Taylor Clay and were quite variable over time. Groundwater elevations measured in these piezometers on October 3, 2003 varied between 371.03 ft msl (in B-10) and 394.74 ft msl (in B-12). Piezometers B-03, B-04, B-06, B-09R, B-10, and B-12 were bailed dry December 1, 2003. Groundwater elevations measured in these piezometers on December 8, 2003 varied between 369.78 ft msl (in B-10) and 391.71 ft msl (in B-12). The final available measurements recorded for piezometers B-02 through B-04, B-06, B-09R, B-10, and B-12 were collected on September 25, 2004. As shown in Appendix I.13A, groundwater elevations in B-02 through B-04, B-06, B-09R, B-10, and B-12 were all increasing between December 2003 and September 2004. The rise in groundwater elevation in each of these piezometers between December 8, 2003 and September 25, 2004 are provided below:

Piezometer	*12/8/03 Groundwater Elev. (ft msl)*	*9/25/2004 Groundwater Elev. (ft msl)*	*Rise (in feet)*
B-02	386.54	389.42	2.88
B-03	372.56	379.03	6.47

B-04	373.42	378.03	4.61
B-06	375.05	388.51	13.46
B-09R	374.22	380.22	6.00
B-10	369.78	378.56	8.78
B-12	391.71	406.05	14.34

Between these dates, groundwater elevations measured in these piezometers had risen between 2.88 feet (in B-02, which was not bailed) and 14.34 feet (in B-12). Groundwater in B-12 increased to an elevation above the top of the Taylor Clay and in-line with groundwater elevations representative of the overlying alluvium. INTERA believes that groundwater elevations in the rest of these piezometers would have eventually risen above the top of the Taylor Clay and stabilized at levels in-line with alluvial groundwater elevations due to leakage from the overlying saturated alluvium. If a laterally continuous groundwater bearing unit was present and screened by the piezometers, expected groundwater elevations would be similar to one another. The highly variable elevations of groundwater present in these piezometers screened within the Taylor Clay do not support the presence of a laterally continuous groundwater bearing unit in the Taylor Clay.

Results of the groundwater investigation show that groundwater occurs at the site within the surficial alluvial aquifer but that no viable or distinct water-bearing zones were found within the underlying clays. The boring logs in ~~Attachment~~ Appendix I.8 and the cross sections in ~~Attachment~~ Appendix I.10 show that saturation exists within the basal sandy gravel overlying the Taylor Clay. Shallow ponds (former sand and gravel mining pits) were located at the site prior to its development as a composting facility; the surficial sands and gravels had been excavated in these areas to below the level of saturation within the alluvial aquifer. These ponds and a number of piezometers were in direct hydraulic communication with and had water levels representative of the alluvial aquifer due to leakage of groundwater from the aquifer into the piezometers.

As shown on the cross-sections in Appendix I.10 and the water level summary table in Appendix I.13A, water levels for the alluvial aquifer and ponds occur at elevations ranging between 407 and 409 feet MSL. According to Katterjohn (2013), these water levels represent the highest water level elevations to be reasonably expected at the site, as the groundwater investigation water level elevations were measured during the second highest rainfall month (June 2004) at ABIA since October 1942. In addition, the 2013 Katterjohn Report notes that 2004 was the third highest year in total rainfall since October 1942, and further, that this period of high rainfall extended through March of 2005. ~~when the last water level measurements were recorded at the site (**Attachment 13**).~~

~~Initial water levels within piezometers B-11 and B-14 through B-18 were representative of the alluvial aquifer. This is clearly depicted on the cross-sections presented in **Attachment 10**. The water levels within piezometer B-2 in February and March of 2005 were also reported by Katterjohn (2013) as reflective of the shallow alluvial aquifer water level, with the highest water level recorded at the site (411.05 feet MSL in B-2) occurring in February 2005, during this extended rainfall period. T~~The Katterjohn Report indicates that the maximum seasonal groundwater elevation within the shallow alluvial aquifer at the site is reasonably expected to be less than 412 feet MSL, given the historical rainfall data and ~~**Attachment 13**~~ groundwater elevation data.

~~Water level measurements taken in the piezometers over time show that groundwater elevations within piezometers B-15 through B-18 remained representative of the alluvial aquifer. These water levels are believed to indicate direct hydraulic communication with the overlying aquifer through a leaky surface casing seal. Further, based on the observed recovery rates and the fact that piezometer B-15 could not be bailed dry during well development (**Attachment 12B**), these observations indicated the piezometers were not completely sealed off from the overlying alluvial aquifer. The Katterjohn Report states that vibrations and turbulence caused by air rotary drilling through the surface casing sufficiently disturbed and eroded away the soils to cause the seal around the base of the surface casing to fail. Further, the Katterjohn Report notes that this was corroborated by the surface casing failure at boring B-09 in which air circulation was lost and gravels fell into the borehole from a washout at the bottom of the surface casing. Instead of returning to the surface through the surface casing, airflow from the drilling process was reported to discharge from the ground surface approximately 20 feet away from the borehole.~~

~~Even though piezometers B-11 and B-12 had water levels that were not initially representative of the overlying aquifer, the potential for seepage of groundwater from the overlying aquifer still existed. As shown in **Attachment 13,** the water levels within piezometers B-11 and B-12 slowly increased between the time piezometers were developed on September 3 and measured after development on September 22, 2003. This increase indicated some seepage influence from the overlying aquifer. In fact, the water levels within piezometers B-11 eventually increased to elevations comparable to the alluvial aquifer (see water level measurements and historical water level charts in **Attachment 13**).~~

3.2 Taylor Clay Monitoring Well Installation and Water Level Data

Three monitoring wells (MW-1, MW-2, and MW-3) were installed in the Taylor Clay around the perimeter of the facility the week of December 1, 2003. The Taylor Clay well locations are shown in ~~**Attachment**~~**Appendices 7 and 17**. Section 3.2.1 describes monitoring well installation and completion. Groundwater elevation data obtained from the wells are discussed in Section 3.2.2.

3.2.1 Installation of Taylor Clay Wells

Monitoring wells MW-1, MW-2 and MW-3 were installed through an 8-inch diameter surface casing set approximately 10 feet into the Taylor Clay. Since the three monitoring wells were partly installed to evaluate the potential for hydraulic lift on the originally planned storage pond liner, the wells were installed with screened intervals corresponding to elevations from 360 to 370 feet MSL. The base of the deepest excavation (i.e., the bottom of the liner of the storage pond) was designed to be at an elevation of 392 feet MSL with the post-construction elevation of the bottom of the storage pond at 395 feet MSL.

The Taylor Clay monitoring wells were installed using hollow-stem auger drilling techniques. The wells were constructed of 2-inch Schedule 40 PVC casing with 10 feet of 0.010-inch slotted Schedule 40 PVC well screen. The sand filter pack extends 2 feet above the top of the screened interval. Four feet of bentonite pellets were placed on top of the sand pack. The remainder of the annulus was sealed with a cement slurry to within one foot of the ground surface.

Each monitoring well was constructed with an above-ground surface completion consisting of an approximately 2.5-foot PVC casing stickup and a locking well protective steel cover secured in a 3-ft x 3-ft x 4-in concrete pad. Four bollards (painted yellow) were installed around each monitoring well completion. Well installation logs for MW-1, MW-2, and MW-3 are included in ~~Attachment~~ Appendix I.12.

Of the three Taylor Clay monitoring wells, groundwater was only encountered within monitoring well MW-3, which is located adjacent to piezometer B-12 on the east side of the property, at the time of well installation. The well installation log for MW-3 (in ~~Attachment~~ Appendix I.12) indicates that water was observed on the augers from 68 to 73 feet below ground surface. Although groundwater was encountered within piezometer B-03 on the south side of the property, no water has been encountered within adjacent monitoring well MW-2. As in soil boring B-07, no groundwater was encountered at the location of monitoring well MW-1 at the time of well installation.

The location and elevation of each Taylor Clay monitoring well were surveyed by a surveyor licensed in the State of Texas. The surveyor provided elevations of the top of PVC casing and ground surface at each location (~~Attachment~~ Appendix I.7~~A~~). Top of casing elevation measurements were made to the nearest 0.01 foot and are included in ~~Attachment~~ Appendix I.12~~A~~.

3.2.2 Water Level Data

Static water level elevations measured on December 1, 2003, February 5, 2004, and April 15, 2004 are shown on the maps of water level location points ~~water level elevation maps~~ in Appendix I.13A (F~~f~~igure Nos.~~s~~ Attachment~~s~~ 13A, Attachment 13B, and Attachment 13C, respectively). The water level elevations are coded to reflect those that are above the top of the Taylor Clay and those that are below the top of the Taylor Clay. All groundwater elevations above the top of the Taylor Clay are representative of the alluvial aquifer. Groundwater elevations below the top of the Taylor Clay are not contoured, as there is not believed to be a water-bearing unit within the formation at the site. It is noted that while MW-1 was dry when installed in December 2003, water levels measured on February 5, 2004 indicated the presence of approximately 8.4 feet of water within the screened interval.

Water levels measured within piezometers and monitoring wells on February 5, 2004 (Appendix I.13A, Figure Attachment 13B) ranged from 368.35 feet MSL in monitoring well MW-1 to 400.59 feet MSL in monitoring well MW-3. Water level elevations measured on April 15, 2004 (Appendix I.13A, Figure Attachment 13C) ranged from 388.23 feet MSL in monitoring well MW-1 to 407.08 feet MSL in monitoring well MW-3. Although these elevations are above the elevation of the base of the bottom liner of the pond, the water observed in the Taylor Clay wells is believed to be the result of leakage through the cased off area between the saturated alluvium and the underlying clay, posing insignificant risk for hydraulic lift. The negligible potential for hydraulic lift is further supported by the fact that no groundwater was detected within monitoring well MW-2, which had a screened bottom elevation of about 360 feet MSL.

Utilizing piezometers/monitoring wells with water levels representative of the alluvial aquifer, groundwater gradient maps were prepared for representative gauging events performed in December 2003 and February – September 2004 and are provided as **Figures I.13B-1 through I.13B-9** in

Appendix -I.13B. Variable groundwater flow directions are depicted on the December 2003 gradient map (Figure I.13B-1). Groundwater flow direction is to the east-northeast and northwest. An easterly gradient was calculated at 0.00159 between piezometers B-14 and B-15. A northwesterly gradient was calculated at 0.00197 between piezometers B-17 and B-15. Input values for calculated gradients are provided in **Table I.13B-1** in Appendix I.13B.

The east and northeastern flow direction continued to be observed in the February, March, April, and May 2004 gradient maps (see Figures I.13B-2 through I.13B-5). Easterly gradients between piezometers B-14 and B-15 ranged between 0.00412 and 0.00491 during these months. More northeasterly gradients were calculated between 0.000789 and 0.00326 during these months. In June 2004 gradients were observed to the east-northeast and to the south-southeast (see Figure I.13B-6). An easterly gradient was calculated at 0.00355 between piezometers B-14 and B-15 and a south-southeasterly gradient was calculated at 0.00112 between piezometers B-16 and B-11.

A southerly flow direction was observed in July 2004 (see Figure I.13B-7). A gradient of 0.00219 was calculated between piezometers B-16 and B-11. Gradients to the south/southwest were observed in August and September 2004 (see Figures I.13B-8 and I.13B-9). A gradient of 0.00172 was calculated for both months.

Significant drought was present in the area of the J-V Dirt + Loam site in the year 2003. According to NOWData – NOAA Online Weather Data, the total recorded rainfall in 2003 at Austin-Bergstrom Airport was 23.38 inches, versus the annual average rainfall amount of 36.25 over the period of record that goes back to 1891. Only 2.23 inches were recorded for October, November, and December 2003, combined. Increased monthly rainfall totals were observed starting in 2004. Monthly totals from January to May 2004 ranged between 1.96 inches (in March) and 5.38 inches (in February). A significant rainfall total was recorded (14.18 inches) for June 2004. Based on these rainfall totals, it appears that variable groundwater flow directions or groundwater flow to the east-northeast are apparent during times of drought. Southerly gradients began to be observed in June 2004 following the increased monthly rainfall totals. The expected groundwater flow direction to the south/southwest appears to correlate with non-drought conditions as observed in June 2004.

Routine groundwater monitoring conducted after facility startup indicates the following about groundwater occurrence in the Taylor Clay monitoring wells:

1. The wells frequently do not produce sufficient water for sampling.
2. Water at MW-1 and MW-3 has been sufficient for completing four quarters of background sampling, yielding one sample each 2006, one sample each in 2007, and two samples each in 2008.
3. All wells were reported dry during 2009, 2010 and 2011.
4. Water at MW-2 has been sufficient for sampling three times, yielding two samples in 2012 and one sample in 2014.
5. All wells were reported dry from third quarter 2014 through third quarter 2020.

The wells were not monitored from fourth quarter 2020 through second quarter 2023.[2]

INTERA began conducting groundwater monitoring at the facility in July 2023. Both MW-1 and MW-3 contained water sufficient for sampling at that time. MW-2 could not be located and was suspected of having been inadvertently covered by a large dirt berm. This well was recently unearthed and plugged as documented in the plugging report provided in ~~Attachment~~ Appendix I.**14**.

MW-1 and MW-3 were gauged on July 20, 2023, and the groundwater level in MW-1 was also measured on July 21, 2023. Both wells were gauged on August 3, 2023 and October 25, 2023, and water level measurements were collected from MW-1 in June 2024. (MW-3 had to be plugged in February 2024 to facilitate a TxDOT expansion project associated with Farm to Market Highway 973, leaving MW-1 as the remaining Taylor Clay well. The plugging report for MW-3 is provided in ~~Attachment~~ Appendix I.14.) The following table presents the groundwater level measurements collected from MW-1 and MW-3 in 2023 and June 2024.

Well	MW-1		MW-3	
TOC Elevation	~~433.32~~434.10 (2025 Survey)		435.62	
Top of Taylor Clay Elevation	402.8		406.0	
Date	Depth to Water (ft)	Groundwater Elev. (feet MSL)	Depth to Water (ft)	Groundwater Elev. (feet MSL)
7/20/23	24.72	~~408.60~~409.38	26.90	408.72
7/21/23	69.60	~~363.72~~364.50	NM	NM
8/3/23	61.16	~~372.16~~372.94	27.63	407.99
10/25/23	35.26	~~398.06~~398.84	28.07	407.55
6/6/24	27.36	~~405.96~~406.74	Plugged	Plugged

NM - Not Measured

As shown in the table, the July 20, 2023 groundwater elevation in MW-1 was determined to be ~~408.60~~409.38 feet MSL prior to purging, and the concurrent groundwater elevation in MW-3 was determined to be 408.72 feet MSL prior to purging. These groundwater levels represent equilibrated conditions, as the wells had not been sampled since March 2020. Both of these elevations are above the Taylor Clay and are in-line with groundwater elevations present in the shallow wells screened in the alluvium as shown on the July 2023 groundwater gradient map in ~~Attachment~~ Appendix I.**15**.

Groundwater in both wells MW-1 and MW-3 were at similar elevations prior to 2023 purging and sampling activities. Following purging/sampling, MW-1's recharge was observed to be extremely slow,

[2] Reference the July 25, 2023 letter from John D. Cruz, American AllWaste, to Megan Henson, TCEQ re: J-V Dirt + Loam, Municipal Solid Waste (MSW) Permit No. 2310, Groundwater Monitoring Program, RN101495976/ CN604364968.

increasing only 8.44 feet over thirteen days between July 21st and August 3rd and another 25.9 feet between August 3rd and October 25th. MW-3 recharges quickly, with the August and October 2023 groundwater elevations being similar to the July 2023 measurement. Both wells appear to be in connection with the overlying saturated sands and gravels, but groundwater from the uppermost groundwater bearing unit appears to be trickling into MW-1 and quickly recharging MW-3. When the wells were gauged prior to sampling in June 2024, MW-1 was still recovering.

The variable groundwater elevations observed in the three monitoring wells screened in the Taylor Clay provides additional evidence that a laterally continuous groundwater bearing unit is not present. While groundwater in both MW-1 and MW-3 equilibrated to levels in-line with groundwater elevations measured in wells screened in the overlying alluvium, MW-2 was initially dry. MW-2 was installed next to piezometer B-03 and screened at a slightly lower depth. Piezometer B-03 had measurable groundwater following its installation, but MW-2 remained dry. It appears that piezometer B-03 was a leaky well and that MW-2 was initially sealed off from the overlying saturated alluvium.

3.3 Alluvial Monitoring Well Installation and Water Level Data

Original facility plans called for the sands and gravels of the alluvium and terrace deposits to be removed and the entire composting facility constructed in the underlying Taylor Clay. However, construction plans for the facility were amended from those originally planned. Under the amended construction plans, the composting and curing pads were to be completed above the alluvial (uppermost) aquifer, while the storm water pond was still to be completed into the Taylor Clay. As discussed below, additional monitoring wells were installed within the alluvial aquifer to appropriately monitor this zone.

3.3.1 Installation of Alluvial Wells

After the permit was amended in 2014, five alluvial groundwater monitoring wells (MW-4 through MW-~~-~~8) were installed along the southern portion of the northwestern site perimeter and along the western portion of the southwestern site perimeter. ~~(Attachment 17).~~ Boring logs and original survey data for all wells are provided in ~~Attachment~~ **Appendix I.16**, and a monitoring well location map is provided as **Appendix I.17**. The alluvial monitoring wells were installed using hollow-stem auger drilling techniques. The wells were constructed of 2-inch Schedule 40 PVC casing with 10 feet of 0.010-inch slotted Schedule 40 PVC well screen extending to the bottom of the sand and gravel alluvium. A sand filter pack extends 2 feet above the top of the screened interval. Bentonite pellets were placed on top of the sand pack to within 2 to 3 feet of the ground surface.

Each alluvial monitoring well was constructed with an above-ground surface completion consisting of an approximately 2.5-foot PVC casing stickup and a locking well protective steel cover secured in a 3-ft x 3-ft x 4-in concrete pad. Four bollards (painted yellow) were installed around each monitoring well completion. Following installation, wells MW-4, MW-7, and MW-8 were each dry. MW-5 and MW-6 were both developed. Approximately 6.2 well volumes (5 gallons) were removed from MW-5 and 6.4 well volumes (7 gallons) were removed from MW-6.

The location and elevation of each alluvial monitoring well was surveyed by a surveyor licensed in the State of Texas. The surveyor provided the elevations of the top of PVC casing, top of pad and ground surface at each location. Top of casing elevation measurements were made to the nearest 0.01 foot. Original sSurvey information for the alluvial monitoring wells is provided in Attachment Appendix I.16.

3.3.2 Water Level Data

Groundwater monitoring began in the alluvial wells in February 2014. Groundwater sufficient for background sampling was present in MW-5 and MW-6 in February 2014 and again in June 2014, but wells MW-4, MW-7, and MW-8 were reported to be dry during both of these events. Between September 2014 and June 2020, all of the alluvial wells were reported to be dry. Prior to third quarter 2023, the four samples collected in 2014 from MW-5 and MW-6 were the only samples collected from the alluvial wells.

INTERA began conducting groundwater monitoring at the facility on July 20, 2023. At that time, sufficient groundwater for sampling was present in alluvial wells MW-4, MW-5, and MW-6, although water present in MW-4 was not sufficient to support purging of the well prior to sampling. MW-7 was measured to have under 4 inches of water in the well and could not be sampled. MW-8 was measured to be dry. INTERA returned to the site on August 3, 2023 to re-sample wells MW-4, MW-5, and MW-6 for analysis of additional monitoring parameters. Each of the site wells was also gauged during this event. Groundwater elevations from both the July and August 2023 sampling events are provided in Attachment Appendix I.15.

In September 2023, INTERA performed a video inspection of monitoring wells MW-4, MW-7, and MW-8 to investigate total depth discrepancies between the measured depths collected from recent sampling events and historical measurements. It was discovered that disposable bailers were present in the bottoms of wells MW-4, MW-7, and MW-8. After removal of these bailers, total depth measurements were collected and were in-line with historical measurements. Groundwater was present in each of these wells. In October 2023, adequate water was present in MW-4 and MW-7 to bail the wells dry and collect supplemental groundwater samples. MW-8 was also bailed dry but did not recharge and contained insufficient groundwater for sampling.

Water levels in each site monitoring well were gauged prior to sampling during the primary and supplemental sampling events conducted in June 2024. For the supplemental event, insufficient groundwater for sampling was present in wells MW-7 and MW-8. Groundwater elevations from both June 2024 sampling events are provided in Attachment Appendix I.15.

The groundwater monitoring wells at the facility were resurveyed in May 2025. The resurveyed wells included MW-1 (screened in the Taylor Cclay) and MW-4 through MW-8 (screened in the saturated alluvium above the Taylor Clay). -Elevation and location information from the 2025 survey are provided on the Monitoring Well Exhibit included in Appendix I.15. Using the top of casing elevations from the May 2025 survey, new groundwater elevations were calculated for the gauging events conducted in July 2023, October 2023, and June 2024. Attachment Appendix I.15 provides revised groundwater gradient maps for the alluvial aquifer based on the July 2023, October 2023, and June 2024 gauging results.

The revised July 2023 gradient map now generally shows groundwater flow direction to the southwest. A southwesterly gradient of 0.00455 was calculated between MW-7 and MW-6. Groundwater flow in the revised October 2023 map is primarily depicted to the southwest, as well. A southwesterly gradient of 0.00796 was calculated between wells MW-7 and MW-6. Groundwater flow in the revised June 2024 map is also to the southwest. A southwesterly gradient of 0.00454 was calculated between MW-7 and MW-6. Input values for calculated gradients are provided in Table I.13B-1 located in ~~Appendix~~ Appendix I.13B.

The groundwater flow direction in each of these revised maps is predominantly to the southwest the expected flow direction towards the Colorado River. This southwesterly flow pattern is distinctly different than the variable flow directions observed over the piezometer data collection period from December 2003 through September 2004, which were frequently between the east-northeast and the south-southeast. ~~-~~As discussed earlier, drought conditions in 2003 likely contributed to the variable groundwater flow directions observed in both 2003 and 2004. It should also be noted that in both 2003 and 2004 there was significant land disturbance in and around the facility due to sand and gravel mining. By 2023, most of the surrounding areas had been backfilled and reclaimed to the north, west, and south of the facility. This has allowed the natural gradient to return in areas where the alluvium was not disturbed.

~~Groundwater flow in the July 2023 gradient map is depicted to the north towards the site's water filled gravel pit, while groundwater flow in the October 2023 map is depicted both to the east towards MW-3 and to the south. Groundwater flow directions on both of these maps are anomalous when compared with the expected groundwater flow direction towards the nearby Colorado River. However, the groundwater gradient in the June 2024 gradient map is in line with the expected flow direction, with apparent groundwater flow at the site to the southwest towards the Colorado River.~~

~~The anomalous flow directions in the July and October 2023 gradient maps may be attributed to the following conditions present at the site and adjoining areas.~~

~~The underlying Taylor Clay, while relatively flat, is undulating with elevations for the contact varying over 8 feet between site monitoring wells. Given that recently measured groundwater thicknesses in the alluvium varied between 0.60 feet and 6.27 feet, the undulating nature of the underly clay may contribute to anomalous groundwater elevations.~~

~~Groundwater present in the alluvium may be influenced by the site's remaining water filled gravel pit and other nearby ponds formed from sand and gravel surface mining. These ponds could serve as recharge features to the shallow groundwater during rainy periods or groundwater could discharge to the pits/ponds during drought conditions. The site's water filled gravel pit and other nearby ponds may contribute to the anomalous groundwater elevations.~~

~~The site and surrounding areas have been highly disturbed by sand and gravel mining activities. Areas to the west, southwest, and south of the site were mined and have been backfilled. With the alluvial layer removed from these areas and likely backfilled with less transmissive material, natural groundwater flow directions have clearly been altered between the site and the Colorado River.~~

~~Despite variation in groundwater flow directions, groundwater within the alluvial aquifer is expected to principally flow in a southwesterly direction towards the Colorado River. Monitoring wells MW-4, MW-5, and MW-6 provide evidence that the expected groundwater gradient is still present in undisturbed areas as depicted on the gradient maps provided in **AttachmentAppendix 15**.~~

Water level elevations in the alluvial wells show a very low groundwater gradient of averaging 0.00568approximately 0.001 feet/foot. Given the hydraulic conductivities of the alluvial and terrace deposits are reported to range from 3.8 x 10^{-1} to 6.9 x 10^{-1} cm/sec or 1,100 to 2,000 ft/day, and assuming an effective porosity of 30 percent (0.30), the groundwater flow rate beneath the site is estimated to range from 4 21 to 7 38 feet/day.

3.4 Monitoring Well System

In accordance with 30 TAC 332.47(6)(C)(ii), the groundwater monitoring system for a composting facility must be designed and installed such that the system will reasonably assure detection of any contamination of the groundwater before it migrates beyond the boundaries of the site. Conclusions regarding the existing monitoring well system's capability to meet this standard are provided below.

3.4.1 Monitoring Zone

INTERA has concluded that the monitoring wells completed in the Taylor Clay will not serve as meaningful detection monitoring wells for the following reasons.

- The clay is predominantly uniform and characterized as a dry, stiff, and high plasticity clay with no distinct water bearing zones and no apparent secondary features that would account for the presence of groundwater. Although the clay is reported as dark greenish gray in color, which can indicate weathering, Katterjohn (2013) characterized it as unweathered based on actual field observations. Where water was observed during the subsurface investigation, it manifested as a mud smear on the outside of the core barrel sampler and/or the sample core while the interior of the clay in the recovered core sample was dry, indicating the water entered the boring from the overlying alluvial aquifer. In addition, no groundwater was found within the clays beneath the western portion of the site (e.g., at boring locations B-01, B-07, B-08 and B-13) or in the vicinity of boring B-05 (see Attachment Appendix I.7).
- Equilibrated groundwater elevations in Taylor Clay wells MW-1 and MW-3, when measured in July 2023, were above the Taylor Clay contact and in-line with groundwater elevations present in the shallow wells screened in the alluvium. This provides strong evidence that the groundwater present in these Taylor Clay wells was indeed the result of leakage from the overlying alluvium.
- The Taylor Clay serves as an aquiclude for the overlying saturated alluvium and is over 400 feet thick beneath the facility. Geotechnical testing of a clay sample collected in the Taylor Clay had a reported hydraulic conductivity of 1.8 x 10^{-9} cm/sec.
- Although the original plans for the facility called for removal of all the overburden overlying the Taylor Clay, the facility was not built as planned, and alluvial materials underlie the composting and curing pads.

Based on the above, a release from the facility would preferentially flow laterally via the alluvial aquifer. Vertical migration through the Taylor Clay would be severely impeded and would not extend a significant distance into the clay due to its extremely low hydraulic conductivity and the lack of secondary features. Further, contiguous transmissive zones containing groundwater were not found in the Taylor Clay so that there is no viable pathway for lateral migration of a release through the clays.

Therefore, wells screened in the Taylor Clay do not provide useful information regarding a release from the facility. The alluvium is the uppermost water bearing zone at the site and is the appropriate zone to monitor in accordance with 30 TAC §332.47(6)(C)(ii).

3.4.2 Monitoring Well Network

Section 3.4.1 details the basis for monitoring groundwater quality in the alluvial aquifer instead of the Taylor Clay. The existing alluvial groundwater monitoring wells (MW-4, MW-5, MW-6, MW-7, and MW-8) are appropriately located, downgradient wells for the expected, predominant gradient to the southwest towards the Colorado River. These wells are situated along the southern portion of the northwestern site perimeter and along the western portion of the southwestern site perimeter and are spaced between approximately 470 feet to 500 feet as shown on the monitoring well location map provided as ~~Attachment~~Appendix I.17. There is currently no alluvial monitoring well located upgradient of the waste management area.

Formerly, there were three monitoring wells completed in the Taylor Clay. As noted in Section 3.2.2, MW-2 and MW-3 have been plugged and abandoned due to damage (MW-2) and TxDOT acquisition of a strip of land along the southeastern facility perimeter (MW-3). The remaining Taylor Clay monitoring well, MW-1, should also be plugged and abandoned so that all wells in the monitoring well network are completed in the alluvium. The locations of the Taylor Clay wells are also shown on the monitoring well location map provided as ~~Attachment~~Appendix I.17.

A new alluvial well, proposed well MW-9, is needed in the vicinity of former MW-3, which is located ~~upgradient of the waste management area of the facility,~~ along the southeastern perimeter of the facility, to provide upgradient data for groundwater flow determinations and groundwater quality evaluations. ~~-~~The proposed siting of this upgradient well (MW-9) would be appropriate during periods of normal or abundant rainfall where the groundwater gradient is to the southwest towards the Colorado River. However, during dryer periods, a northeasterly groundwater flow direction has been observed historically in wells screened in the Taylor Clay with groundwater elevations representative of the alluvial aquifer. Since variable groundwater flow directions have historically been observed at the site during times of drought, INTERA proposes that an additional monitoring well (MW-10) be installed on the northeastern perimeter of the facility to ensure complete coverage of downgradient groundwater quality. No new alluvial wells are needed at the MW-1 or MW-2 locations, as these Taylor Clay wells are near existing alluvial wells. MW-1 is located near MW-8 and MW-2 is located near MW-4.

Accordingly, it is proposed to plug the remaining Taylor Clay monitoring well, MW-1, ~~and~~ install a new, upgradient alluvial well (MW-9) on the southeastern side of the facility in the vicinity of MW-3, and install a new alluvial well (MW-10) in the northeastern portion of the facility to complete the alluvial aquifer monitoring well network. The location of the proposed ~~upgradient well, MW-9,~~ wells are~~is~~ shown on the monitoring well location map provided as ~~Attachment~~Appendix I.17.

The groundwater monitoring system described above will reasonably assure detection of any contamination of the groundwater before it migrates beyond the boundaries of the site.

4.0 References

Freeze, R. A. and Cherry, J. A., 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ, 604 p.

Katterjohn, Mark S., Geologic/Hydrogeologic Report, JV Dirt and Loam Composting Site, Permit Application, Last Revised April 22, 2013.

Texas Water Development Board, Geohydrology of the Edwards Aquifer in the Austin Area. Texas, Report 293, March 1986.

Texas Department of Water Resources, Occurrence, Availability and Quality of Ground Water in Travis County. Texas, Report 276, June 1983.

National Weather Service, Southern Region headquarters, Monthly/Annual/Average Precipitation Data, Austin Bergstrom Airport Texas (1942-3012) www.srh.noaa.gov/images/ewx/aus/audmonrain.pdf

AttachmentAppendix I.1

Figure 4. Geologic Map of Travis County
Texas Department of Water Resources Report 276

Appendix I.2

Table 1. Geologic Units and Their Water-Bearing Properties
Texas Department of Water Resources Report 276

Table 3. Results of Pumping Tests
Texas Department of Water Resources Report 276

AttachmentAppendix I.3

Figure 28. Cross-Section C-C'
Texas Department of Water Resources Report 276

AttachmentAppendix I.4

Figure 12. Sulfate, Chloride, and Dissolved-Solids Content in Water from Selected Wells in the Lower, Middle, and Upper Trinity Aquifers and Edwards and Associated Limestones Aquifer Texas Department of Water Resources Report 276

AttachmentAppendix I.5

Figure 6. Approximate Altitude of and Depth to Top of the Lower Trinity Aquifer
Texas Department of Water Resources Report 276

~~Attachment~~Appendix I.6

Figure 22. Approximate Altitude of Water Levels in Selected Wells Completed in the Alluvium and Terrace Deposits, Spring 1978 Texas Department of Water Resources Report 276

AttachmentAppendix I.7

Boring Location Map and Survey Information

~~Attachment~~Appendix I.8

Subsurface Information and Boring Logs

~~Attachment~~Appendix I.9

Figure 16. Approximate Altitude of and Depth to top of the Edwards Aquifer
Texas Water Development Board Report 293

AttachmentAppendix I.10

Site-Specific Cross-Sections

AttachmentAppendix I.11

Geotechnical Analysis Results

AttachmentAppendix I. 12

Piezometer and Monitoring Well Information

AttachmentAppendix I.13
2003 – 2004 Groundwater Elevation Data

Appendix I.13A

Data and Figures from Original Attachment 13

Appendix I.13B

Groundwater Contour Maps

AttachmentAppendix I.14

Monitoring Well Plugging Reports

~~Attachment~~Appendix I.15

2023 and 2024 Groundwater Elevation Data

AttachmentAppendix I.16

Monitoring Well System Certification Report, February 19, 2014

AttachmentAppendix I.17
Monitoring Well Location Map

Groundwater Protection Plan

J-V Dirt + Loam Facility - Travis County, Texas

MSW Permit No. 2310 Limited Scope Amendment Application
Walker Aero Environmental LLC, Permittee

Prepared for:

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JANUARY 13, 2025 REISSUE
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Previous Issue ~~ly~~ Revised April 2013

Preface

INTERA has prepared the following updated Groundwater Protection Plan as part of the January 13, 2025 limited scope permit amendment application for the JV Dirt and Loam (JV Dirt) composting facility. This report, which was most recently revised in April 2013, was prepared to address 30 TAC §332.47(6)(C) of the Texas Commission on Environmental Quality (TCEQ) composting rules. As specified in this rule, groundwater protection consists of a liner system, described in Section 1, and a groundwater monitoring system and monitoring program, described in Sections 2 and 3. The substantive revisions in the following Groundwater Protection Plan are limited to Section 2 and 3 and have been developed based on the updated evaluations contained in the revised Geologic and Hydrogeologic Report that is also being submitted as part of this limited scope amendment application.

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2.0 Groundwater Monitoring Well System....................J-4
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2.3 MW-9 and MW-10 Installation and Completion....................J-6
3.0 Groundwater Sampling Program....................J-7

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AppendixAttachment J.1 Monitoring Well System Locations

AppendixAttachment J.2 TCEQ Letter Dated May 2, 2017 Authorizing Semi-Annual Sampling

1.0 Liner System

All feedstock receiving, mixing, composting, screening, and curing areas, along with the storage pond will have a liner system meeting the TCEQ liner requirements of two feet of compacted clay. The specifications of the clay liner will be as follows:

Property	Test Method	Unit	Specification
Permeability	ASTMD-2434	cm/sec	1 x 10^{-7} or less
Plasticity Index of Clay	ASTM D-423 & D-424		Not less than 15
Liquid Limit of Clay	ASTMD-2216	%	Not less than 30
Clay Particles Passing #200 Sieve	ASTMD-422	%	Not less than 30

The composting pad, curing pad areas and the storage pond will have a two-foot thick clay liner meeting the above specifications. A one-foot thick protective cover over the clay liner will also be provided for the composting pad and the curing pad. The protective cover may be gravel or natural soils on the site.

The Liquid feedstock unloading area and tipping area will be lined with reinforced concrete over a compacted select fill. Two feet of compacted clay meeting the above specifications will be placed under the concrete slab to serve as the liner. The unloading area will use a concrete curb for secondary containment with an area inlet conveying any spilled liquids or stormwater runoff to the storage pond. The tipping area will also have an area inlet and piped drainage system to the leachate and stormwater pond.

1.1 Soil Liner Construction and Testing Procedures/ Quality Assurance Plan

Prior to using source material for liner purposes, laboratory testing of the material shall be performed for gradation, Atterberg limit, its moisture/density relationship, and coefficient of permeability to verify its acceptability as a liner source.

It is recommended that the quality control of the soil plasticity be closely adhered to and maintained during construction. Testing of the Atterberg limits and gradation should be continually checked so that any changes in either physical property can be detected and additional appropriate laboratory testing performed. Any time the Liquid Limit (LL) or Plasticity Index (PI) changes by more than 10 points, a new compaction series should be run in the laboratory to determine the maximum dry density, optimum moisture, and the laboratory coefficient of permeability.

Placement of the clay liner should be in accordance with the following:

1. All surface areas should be properly scarified a minimum of six inches and prepared to receive the liner.
2. The top of each lift should be roughened to a shallow depth prior to the placement of the next lift of soil for compaction.

3. No loose lift should be thicker than the pads of the compactor so that complete bonding with the top of the previous lift is achieved.
4. Equipment and safety limitations prohibit finished grades with slopes greater than 3:1 if the liner is constructed parallel to the surface. For an excavated wall with steeper than 3:1 side slopes, the sidewall liner must be constructed in successive horizontal lifts.
5. It is recommended that the surface of a soil liner be proof rolled when construction is shut down for more than 24 hours to mitigate the effects of desiccation. It is further recommended that it be done on a routine basis during the summer months at the end of each day's liner construction.
6. Any ponded water that accumulates on newly constructed liner surfaces shall be promptly removed. The surface of the completed soil liner prior to coverage with waste must be kept moist to reduce shrinkage cracking, but saturation of these soils by ponding water is not acceptable.

1.2 Soil Liner Compaction

The soil liner shall be installed in lifts not exceeding 9-inches of loosely placed soil or 6-inches of compacted soil. The soil shall be compacted to at least 95% of maximum dry density at optimum moisture content, or up to 5% above optimum moisture content (ASTM D 698). Alternatively, a compaction of at least 90% of maximum dry density and up to 1% drier than optimum moisture or up to 3% above the optimum moisture content.

Field compaction testing shall be performed on each lift by a nuclear density gauge at a frequency of one test for each 8,000 square feet of surface area. Sections of compacted soil, which do not pass both the density and moisture requirements shall be reworked and retested until the section passes.

Compaction shall be performed with a pad/tamping foot roller. The compacted lift thickness must not be greater than the pad length. The minimum width of the compactor should be 1500 pounds per linear foot of drum length, and a minimum of eight passes is recommended for the compaction process.

Liner tie-ins to the ends of other lifts or to existing soils shall be performed using a sloped transition or a stair step transition. On the sloped transition or the stair-step transition, the horizontal length for tie-in shall be 5 feet for every one foot or liner thickness.

1.3 Sieve Analysis

A sieve analysis shall be performed on a sample of soil for each 100,000 square feet of surface area per lift. No less than 30% of the soil shall pass a number 200 sieve, all soil tested shall pass through a l-inch sieve, and on the final lift, all soil tested shall pass a 3/8-inch sieve.

The following table summarizes the required soil tests and frequency of testing.

Summary of Standard Tests on Constructed Soil Liners

Type of Test	Standard Test Method	Frequency of Testin2:
Field Density	ASTM D 1556, D2157, or D2922	1/8,000 ft^2 per 6-inch parallel lift, 1/100 lineal ft per 12 inches sidewall liner (horizontal lifts)
Sieve (Gradation)	ASTM D 422 or D 1140	1/100,000 ft^2 per 6-inch parallel lift, 1/2000 lineal ft per 12 inches sidewall liner (horizontal lifts)
Atterberg Limits	ASTM D 4318	
Coefficient of Permeability	ASTM D 5084 or CoE EM 1110-2-1906	
Thickness	Registered Surveyor	1/5,000 ft^2 (parallel lifts), 50-ft cross-sections (horizontal lift sidewall liners)

A Geotechnical Professional (GP), or his representative, should be on site for all liner construction and testing. The GP shall use the Soil and Liner Evaluation Report provided in the appendix for liner installation documentation and provide to TCEQ as required.

2.0 Groundwater Monitoring Well System

A groundwater monitoring well system has been designed and constructed at the facility in accordance with permit requirements. The purpose of the monitoring well system is to reasonably assure that the system will detect the potential presence of contamination in groundwater before it migrates beyond the boundaries of the site. The existing system was designed based on the results of the subsurface and groundwater investigations previously conducted pursuant to 30 TAC §332.47(6)(B)(v). Data obtained from these investigations has been re-evaluated and subsequent data obtained from the existing monitoring wells has been evaluated as described in the revised Geologic and Hydrogeologic Report that is also being submitted as part of this limited scope amendment application. This revised Groundwater Protection Plan is based upon these updated evaluations.

2.1 Background Information

The subsurface and groundwater investigations conducted in support of the original permit application have documented that the subsurface consists of Quaternary alluvium and terrace deposits underlain by the Taylor Clay, and that groundwater occurs within the lower portion of the Quaternary sands and gravels (alluvial aquifer). Groundwater within the alluvial aquifer is expected to principally flow in a southwesterly direction towards the Colorado River. The underlying Taylor Clay is predominantly uniform and characterized as a dry, stiff, and high plasticity clay with no distinct water bearing zones and no apparent secondary features identified that would account for the presence of groundwater to a typical depth of 70 feet below the top of the clay. The Taylor Clay serves as an aquiclude for the overlying alluvium and is over 400 feet thick beneath the facility. Geotechnical testing of a sample collected from the Taylor Clay at the site had a reported hydraulic conductivity of 1.8×10^{-9} cm/sec.

Nonetheless, water was encountered in some site investigation piezometers that were completed in the clay. The piezometers were installed in the Taylor Clay instead of the alluvium since the original facility designs called for excavation of the alluvial materials across the waste management area of the site and construction of the composting and curing pads on the exposed clay surface. Although INTERA's interpretation of the piezometer data is that the presence of water was consistent with leakage from the alluvial aquifer into the underlying clay, three wells (MW-1 through MW-3) were installed in the Taylor Clay to investigate the potential that the Taylor Clay was actually producing the water observed in the site piezometers and to evaluate potential hydraulic uplift. These three wells comprised the groundwater monitoring system for the facility when it was originally permitted in 2004. As detailed in the revised Geologic and Hydrogeologic Report, however, all groundwater observed in the historical site piezometers and the monitoring wells screened in the Taylor Clay is believed to be the result of leakage through the cased off area between the saturated sands/gravels in the alluvial aquifer and the underlying clay.

The design of the facility was revised as approved in the July 31, 2013 modification of MSW Permit No. 2310. The revised designs for the facility eliminated excavation of the alluvial materials except where the stormwater storage pond was to be constructed, with the composting and curing pads for the facility to be constructed over the alluvium. Due to this design change, the alluvial sands and gravels comprise the uppermost water-bearing zone underlying the facility, and five alluvial monitoring wells

(MW-4 through MW-8) were installed along the downgradient facility boundary as approved by the 2013 permit modification. The suitability of the Taylor Clay monitoring wells to serve as a reliable indication of a potential release was not revisited at that time, and these wells were retained as part of the groundwater monitoring system.

2.2 Monitoring Well Network

Monitoring well locations are depicted on **Appendixttachment J.1**. Installation and completion information for the previously installed wells is found in the Monitoring Well System Certification Report, February 19, 2014, provided in the revised Geologic and Hydrogeologic Report. As documented in the revised Geologic and Hydrogeologic Report, MW-2 and MW-3 have been plugged and abandoned due to damage (MW-2) and TxDOT acquisition of a strip of land along the southeastern facility perimeter (MW-3).

Based on the updated evaluation detailed in the revised Geologic and Hydrogeologic Report, a release from the facility would preferentially flow laterally via the alluvial aquifer. Vertically migration through the Taylor Clay would be severely impeded and would not extend a significant distance into the clay due to its extremely low hydraulic conductivity and the lack of secondary features. Further, contiguous transmissive zones containing groundwater were not found in the Taylor Clay so that there is no viable pathway for lateral migration of a release. Therefore, wells screened in the Taylor Clay do not provide useful information regarding a release from the facility. The alluvium is the uppermost water bearing zone underlying the waste management area of the site and is the appropriate zone to monitor in accordance with 30 TAC §332.47(6)(C)(ii).

The revised Geologic and Hydrogeologic Report details the basis for monitoring groundwater quality in the alluvium only, discontinuing monitoring of the wells completed in the Taylor Clay. Accordingly, it is proposed to plug the remaining Taylor Clay monitoring well, MW-1, and to not replace MW-2 and MW-3 with new wells completed in the Taylor Clay, so that all wells in the monitoring well network are completed in the alluvium.

A new, upgradient alluvial well (MW-9) will be installed on the southeastern side of the facility in the vicinity of former Taylor Clay monitoring well MW-3 to ~~complete the alluvial aquifer monitoring network and~~ provide upgradient data for groundwater flow determinations and groundwater quality evaluations. Since variable groundwater flow directions have historically been observed at the site during times of drought, an additional alluvial well (MW-10) will be installed on the northeastern perimeter of the facility to ensure complete coverage of downgradient groundwater quality. As discussed in the revised Geologic and Hydrogeologic Report, the locations and spacing of the existing alluvial monitoring wells are appropriate for monitoring downgradient water quality based on the principal direction of groundwater flow. In addition, the locations of Taylor Clay monitoring well MW-1 and former Taylor Clay monitoring well MW-2 are near alluvial monitoring wells MW-8 and MW-4, respectively. Therefore, no additional alluvial monitoring wells other than ~~new upgradient well~~the two, proposed wells, MW-9 and MW-10, are needed. The proposed locations of MW-9 and MW-10 are~~is~~ shown on the monitoring well location map provided as ~~Attachment 1.~~Appendix J.1.

As discussed in the revised Geologic and Hydrogeologic Report, the monitoring well system as proposed herein will reasonably assure that the system will detect the potential presence of contamination in groundwater before it migrates beyond the boundaries of the site.

2.3 MW-9 and MW-10 Installation and Completion

The new alluvial aquifer monitoring wells (MW-9 and MW-10) will be constructed of 2-inch Schedule 40 PVC casing with 5 to 10 feet of 0.010-inch slotted Schedule 40 PVC well screen extending to the bottom of the sand and gravel alluvium. The sand filter pack will extend a minimum of 2 feet above the top of the screened interval. A minimum of 2 feet of bentonite pellets will be placed on top of the sand pack. The remainder of the annulus will be sealed with a cement slurry to within 2 to 3 feet of the ground surface.

MW-9 and MW-10 will be constructed with an above-ground surface completion consisting of an approximately 2.5-foot PVC casing stickup and a locking well protective steel cover secured in a 3-ft x 3-ft x 4-in concrete pad. Four bollards (painted yellow) will be installed around each monitoring well completion. Following installation, MW-9 and MW-10 will be developed if groundwater is present.

The location and elevation of MW-9 and MW-10 will be surveyed by a surveyor licensed in the State of Texas. The surveyor will provide the elevations of the top of PVC casing, top of pad, and ground surface. Elevation measurements will be made to the nearest 0.01 foot.

3.0 Groundwater Sampling Program

Records have indicated that the monitoring wells do not regularly produce sufficient water for sampling, and background monitoring has only been completed at wells MW-1 and MW-3. These two wells are therefore subject to annual sampling for the indicator parameters specified in 30 TAC §332.47(6)(C)(ii)(II)(c) and noted below. As indicated in Section 2.0, MW-3 has been plugged. The remainder of the wells, MW-2 and MW-4 through MW-8, are still in their background monitoring period.

Previous monitoring has yielded three samples from MW-2 (now plugged), three samples each from MW-5 and MW-6, and one sample each from MW-4 and MW-7. No samples have previously been collected from MW-8. Due to the reported lack of adequate water for sampling over most of the monitoring history, TCEQ authorized semi- annual background sampling for MW-2 and MW-4 through MW-8 via a letter dated May 2, 2017 (~~Attachment~~ Appendix J.2). Therefore, these wells are currently subject to semi-annual sampling for the background parameters specified in 30 TAC §332.47(6)(C)(ii)(II)(a) and (b) and noted below.

Samples from any monitoring well will not be collected for at least 45 days following collection of a previous sample, unless a replacement sample is necessary. The depth to groundwater below the top of the PVC casing will be measured in each well prior to purging the well for groundwater sampling. For each groundwater sampling event, the groundwater elevation relative to mean sea level will be calculated for each well using the established surveyed top of casing elevation.

Background samples are analyzed for the following constituents:

- Metals - arsenic, copper, mercury, barium, iron, selenium, cadmium, lead, chromium, and zinc
- Other parameters- calcium, magnesium, sodium, carbonate, bicarbonate, sulfate, fluoride, chloride, nitrate (as N), total dissolved solids, phenolphthalein alkalinity as $CaCO_3$, alkalinity as $CaCO_3$, hardness as $CaCO_3$, pH, specific conductance, anion-cation balance, and total organic carbon (four replicates/well).

After background values have been established for each well, the monitoring well will be sampled and analyzed annually for total organic carbon (four replicates), iron, manganese, pH, chloride and total dissolved solids.

A report will be prepared for each monitoring event and will be submitted to TCEQ. The routine groundwater monitoring reports will provide a tabulation of the groundwater level measurements and elevation data, a tabulation of the groundwater quality data obtained for the wells, and a copy of the laboratory analytical report. A copy of each report will be maintained at the facility.

AppendixAttachment J.1
Monitoring Well System Locations

Attachment Appendix J.2
TCEQ Letter Dated May 2, 2017 Authorizing Semi-Annual Sampling