Table 4-1
Summary of Remedial Investigation and Feasibility Study Information
Asarco El Paso Copper Smelter
Phase III RI Report

Investigation Area (IA)	Reference Figure	Groundwater	Soil	Source	Preliminary Soil Impact Summary			Remediation Status	Comments
		Primary COCs	Primary COCs	Material	CAT. 1 (cy) Volume	CAT. 2 (sf) Area	CAT. 3 (sf) Area		
1. CONVERTER BUILDING/BAGHOUSE AREA	4-1	Arsenic Cadmium Lead	Arsenic Lead	Previously Ponded Fluids and Smelter Byproducts	0	56,100	NA	•Institutional controls implemented(1) •Operational controls to be implemented(2) •Existing pavement and buildings contribute to Cat II cap •Leaks fixed, or improvements implemented before potential operation •Storm water control elements implemented in 1999 •444 cy Cat I materials removed in 1999	•Slag underlies portions of the area at depth
2. BONEYARD/SLAG AREA	4-2	Arsenic	Arsenic Cadmium	Acid Plants sludge	700	174,800	275,000		•Slag underlies the area with thicknesses of 8 to 63 feet •Additional Investigations required to delineate extent of Cat. I materials
3. ACID PLANT 1 AND 2 AREA	4-3	Arsenic Cadmium Lead	Arsenic Cadmium Lead	Previously Ponded Fluids and Smelter Byproducts	NA	254,600	NA	•Institutional controls implemented(1) •Operational controls implemented(2) •Existing roads and buildings contribute to Cat II cap •Paving in potential spill areas •Repair of leaks and operation improvements •Storm water control elements implemented	•Slag underlies the area at depth, with thicknesses of 14 to 40 feet

Table 4-1
Summary of Remedial Investigation and Feasibility Study Information
Asarco El Paso Copper Smelter
Phase III RI Report

Investigation Area (IA)	Reference Figure	Groundwater Primary COCs	Soil Primary COCs	Source Material	Preliminary Soil Impact Summary CAT. 1 (cy) Volume	CAT. 2 (sf) Area	CAT. 3 (sf) Area	Remediation Status	Comments
4. FRONT SLOPE/WESTERN PLANT BOUNDARY AREA General	4-4			Fugitive Dust, Process Water Spills	4,000	75,300	146,200	·Institutional controls implemented[(1)] ·Operational controls implemented[(2)] ·Storm water control elements implemented	·Additional investigation needed in all slope areas of IA-4 ·Actual areas of category materials are smaller than shown on Figure ·Slag underlies portions of area at depth ·Upgradient Impacts to Groundwater
5. HISTORIC SMELTERTOWN AREA	4-5	Arsenic Lead	Lead	Historic Material Staging in Area	300	405,000	NA	·Institutional controls implemented[(1)] ·Operational controls implemented[(2)]	·Also site of Diesel remediation ·Confirmation sampling required for former Category II areas
6. GROUNDWATER	NA	NA	NA		NA	NA	NA	·Storm water control elements implemented ·Remedial Activities associated with other IAs	·See IAs 1-5, 8-14 for groundwater discussions
7. SURFACE WATER	NA	NA	NA		NA	NA	NA	·Institutional controls implemented[(1)] ·Operational controls implemented[(2)] ·Implementing sitewide stormwater controls ·Remedial Activities associated with other IAs ·Storm water control elements implemented	·No impacts from Facility operations occur to the Rio Grande or American Canal

Table 4-1
Summary of Remedial Investigation and Feasibility Study Information
Asarco El Paso Copper Smelter
Phase III RI Report

Investigation Area (IA)	Reference Figure	Groundwater Primary COCs	Soil Primary COCs	Source Material	Preliminary Soil Impact Summary CAT. 1 (cy) Volume	CAT. 2 (sf) Area	CAT. 3 (sf) Area	Remediation Status	Comments
8. BEDDING AND UNLOADING BUILDINGS AREA	4-6	Arsenic Lead	Arsenic Cadmium Lead	•Ore unloading spillage •Previous watering for dust control	0	275,000	NA	•Institutional controls implemented(1) •Operational controls implemented(2) •Existing roads and buildings contribute to Cat II cap •Pump and drainage control upgrade	•Slag underlies portions of the area at depth, with thicknesses of 3 to 33 feet where present.
9. PONDS 1, 5 AND 6 General	4-7				27,100cy Total Cat. I for Ponds 1, 5 and 6	306,000	NA	•Institutional controls implemented(1) •Operational controls implemented(2) •Existing roads and buildings contribute to Cat II cap •Storm water control elements implemented	•Pond areas are planned to be used for onsite deposit of Category I materials
•Pond 1		Arsenic	Arsenic Cadmium Lead(1)	Pond Sediments	10,400	NA	NA	•Institutional controls implemented(1) •Operational controls implemented(2)	
•Ponds 5 & 6 and Canal Area associated with Pond 6		Arsenic Lead	Arsenic(1) Cadmium Lead	Pond Sediments	Pond 5: 5,200 Pond 6: 11,500	NA	NA	•Institutional controls implemented(1) •Operational controls implemented(2) •Planned to remove sediments and line for use as Category I material containment •Ponds 5 & 6 taken out of service as part of stormwater controls	•Pond 5 is first area scheduled for Category I material containment

Table 4-1
Summary of Remedial Investigation and Feasibility Study Information
Asarco El Paso Copper Smelter
Phase III RI Report

Investigation Area (IA)	Reference Figure	Groundwater Primary COCs	Soil Primary COCs	Source Material	Preliminary Soil Impact Summary CAT. 1 (cy) Volume	CAT. 2 (sf) Area	CAT. 3 (sf) Area	Remediation Status	Comments
10. PLANT ENTRANCE AREA	4-8	NA	Arsenic Cadmium Lead	Plant stormwater transported sediments and fugitive dust	NA	NA	NA	·Institutional controls implemented[1] ·Operational controls implemented[2] ·Existing roads and buildings contribute to Cat II cap ·Storm water control elements implemented ·Drainage and stormwater collection sump upgrades	·IA-10 was capped with the implementation of stormwater control improvements
11. ARROYOS EAST OF I-10	4-9	Arsenic Lead	Arsenic Lead	Storage of plant debris native geologic formations	122,000	0	50,000	·Institutional controls implemented[1] ·Operational controls implemented[2] ·Planned consolidation and capping of debris	·Additional investigation in southern arroyo in vicinity of EP-97 ·Slag underlies portions of the area at depth
12. EPHEMERAL POND AND POND SEDIMENT STORAGE AREA	4-10	Arsenic	Arsenic Cadmium Lead	Pond sediments storage from Pond 6	2,300	NA	775,000	·Planned sediment removal ·Planned lining of Pond	·Slag underlies the area with thicknesses of 2 to 33 feet ·Additional investigation of soils and groundwater in vicinity of RIBHI
13. SAMPLE MILL AREA	4-11	Arsenic Cadmium Lead	Arsenic Cadmium Lead	Ore processing spillage	1,000	27,600	NA	·Existing roads and buildings contribute to Cat II cap ·Storm water control elements implemented	·Slag underlies portions of the area at depth

Table 4-1
Summary of Remedial Investigation and Feasibility Study Information
Asarco El Paso Copper Smelter
Phase III RI Report

Investigation Area (IA)	Reference Figure	Groundwater Primary COCs	Soil Primary COCs	Source Material	Preliminary Soil Impact Summary CAT. 1 (cy) Volume	CAT. 2 (sf) Area	CAT. 3 (sf) Area	Remediation Status	Comments
14. SOUTH TERRACE AREA	4-12	Arsenic	Lead	Ore storage and handling upgradient impact to groundwater	NA	320,000	NA		*Slag underlies portions of the area at depth
15. FORMER COPPER PLANT	4-13	Arsenic	Lead	Ore processing spillage	NA	249,000	NA		
16. FORMER LEAD AND SINTER PLANT AREAS	4-14	Arsenic	Lead	Ore processing spillage	NA	197,000	NA		
17. FORMER CADMIUM AND ZINC PLANT AREAS	4-15	Arsenic	Lead	Ore processing spillage	NA	215,000	NA		

Notes:
cy: cubic yards
sf: square feet
See Exhibit 1 for location of IAs
COC: Contaminant of Concern
NA: Not Applicable
Primary COCs are in Pond Sediments

(1) Institutional controls include Facility deed restrictions, use of personal protective gear on site, fencing and other access deterrents, and all other items.

(2) Operational controls include inspection, operation of stormwater control components (impoundments, sumps conveyance, etc.) and controls in facility operation.

Table 4-2
Summary of Estimated Costs for Corrective Action Measures
ASARCO El Paso Smelter Phase III RI

Remedial Costs With Disposal at On-Site Repository	Subtotal Remediation Work	Annual Inspections and O&M (1)
Investigation Area #1 -- Converter Building/Baghouse Area	$ 101,000	$ 10,400
Investigation Area #2 -- Bone Yard/Slag Area	$ 768,000	$ 45,000
Investigation Area #3 -- Acid Plants	$ 373,000	$ 24,500
Investigation Area #4 -- Front Slope	$ 729,000	$ 43,000
Investigation Area #5 -- Historic Smelter Town	$ 98,000	$ 10,300
Investigation Area #8 -- Bedding and Unloading Facility	$ 1,278,000	$ 71,500
Investigation Area #9 -- Ponds 1, 5 and 6, Repository	$ 6,286,000	$ 168,300
Investigation Area #11 -- East of I-10 Arroyos (Asarco Property)	$ 1,269,000	$ 71,000
Investigation Area #12 -- Ephemeral Pond/Pond Sediment Storage Area	$ 975,000	$ 55,800
Investigation Area #13 -- Sample Mill Area (Chlorine Leaching Operation Area)	$ 179,000	$ 14,500
Investigation Area #14 -- South Terrace Area	$ 908,000	$ 52,300
Investigation Area #15 -- Former Copper Plant Area	$ 460,000	$ 29,100
Investigation Area #16 -- Former Lead and Sinter Plant Areas	$ 476,000	$ 29,900
Investigation Area #17 -- Former Cadmium and Zinc Plant Areas	$ 331,000	$ 22,400
Total	$ 14,231,000	$ 648,000
Total Capital Outlay	**$14,879,000**	

Other Costs	Annual Expenses	Total
Long-Term Monitoring - Investigation Areas #6 Groundwater & #7 Surface Water	$281,000	$2,917,000

Notes:

(1) Present Value (i=0.5, n=15)

H:\Files\128\1247\Ri Phase III\Report\Tables\Section 4.0\Table 4-2.xls

Table 4-3

Proposed Monitoring Well Samplig Frequencies
El Paso Asarco Smelter, Remedial Investigation

Monitoring Well ID	PROPOSED SAMPLING FREQUENCIES 2002 3rd Qtr	2002 4th Qtr	2003 1st Qtr	2003 2nd Qtr	2003 3rd Qtr	2003 4th Qtr	2004 1st Qtr	2004 2nd Qtr
EM-1				A				A
**EM-2		S		S		S		S
EM-4				A				A
EM-5		S		S		S		S
EM-6				A				A
EP-4				A				A
*EP-5	Q	Q	Q	Q	Q	Q	Q	Q
*EP-6	Q	Q	Q	Q	Q	Q	Q	Q
*EP-7	Q	Q	Q	Q	Q	Q	Q	Q
EP-12		S		S		S		S
**EP-13	Q	Q	Q	Q	Q	Q	Q	Q
EP-14		S		S		S		S
EP-15				A				A
**EP-20	Q	Q	Q	Q	Q	Q	Q	Q
EP-21		S		S		S		S
EP-22		S		S		S		S
EP-23		S		S		S		S
EP-24		S		S		S		S
EP-25		S		S		S		S
EP-26		S		S		S		S
EP-29		S		S		S		S
EP-35		S		S		S		S
EP-43				A				A
EP-49	Q	Q	Q	Q	Q	Q	Q	Q
EP-51		S		S		S		S
EP-52				A				A
**EP-53	Q	Q	Q	Q	Q	Q	Q	Q
EP-54	Q	Q	Q	Q	Q	Q	Q	Q
EP-55	Q	Q	Q	Q	Q	Q	Q	Q
**EP-56	Q	Q	Q	Q	Q	Q	Q	Q
EP-57				A				A
EP-58		S		S		S		S
**EP-59	Q	Q	Q	Q	Q	Q	Q	Q
EP-60				A				A
EP-61				A				A
**EP-62	Q	Q	Q	Q	Q	Q	Q	Q
EP-63				A				A
EP-64		S		S		S		S
EP-65				A				A
EP-66	Q	Q	Q	Q	Q	Q	Q	Q
EP-67				A				A
EP-68				A				A
EP-70				A				A
EP-71				A				A
EP-72				A				A
EP-73				A				A
**EP-75	Q	Q	Q	Q	Q	Q	Q	Q
EP-76		S		S		S		S
**EP-77	Q	Q	Q	Q	Q	Q	Q	Q

Table 4-3

Proposed Monitoring Well Samplig Frequencies
El Paso Asarco Smelter, Remedial Investigation

Monitoring Well ID	PROPOSED SAMPLING FREQUENCIES							
	2002		2003				2004	
	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr
**EP-78	Q	Q	Q	Q	Q	Q	Q	Q
EP-79				A				A
*EP-80	Q	Q	Q	Q	Q	Q	Q	Q
EP-81				A				A
EP-82				A				A
EP-83				A				A
EP-84				A				A
**EP-85	Q	Q	Q	Q	Q	Q	Q	Q
EP-86				A				A
EP-88				A				A
EP-89				A				A
EP-90				A				A
EP-93				A				A
EP-94				A				A
EP-95				A				A
EP-96				A				A
EP-97				A				A
EP-98				A				A
**EP-99	Q	Q	Q	Q	Q	Q	Q	Q
EP-100				A				A
**EP-101	Q	Q	Q	Q	Q	Q	Q	Q
EP-103				A				A
EP-104		S		S		S		S
**EP-105		S		S		S		S
EP-106				A				A
EP-107				A				A
EP-108		S		S		S		S
EP-109				A				A
EP-110				A				A
*EP-111	Q	Q	Q	Q	Q	Q	Q	Q
*EP-112	Q	Q	Q	Q	Q	Q	Q	Q
*EP-113	Q	Q	Q	Q	Q	Q	Q	Q
**EP-114	Q	Q	Q	Q	Q	Q	Q	Q
EP-115				A				A
**EP-116	Q	Q	Q	Q	Q	Q	Q	Q
EP-117	Q	Q	Q	Q	Q	Q	Q	Q
**EP-118		S		S		S		S
**EP-119	Q	Q	Q	Q	Q	Q	Q	Q
EP-120				A				A
EP-121		S		S		S		S
EP-122	Q	Q	Q	Q	Q	Q	Q	Q
EP-123		S		S		S		S
EP-124	Q	Q	Q	Q	Q	Q	Q	Q
EP-125				A				A
EP-126				A				A
*EP-127	Q	Q	Q	Q	Q	Q	Q	Q
*EP-128	Q	Q	Q	Q	Q	Q	Q	Q
EP-129				A				A
EP-129				A				A

Table 4-3

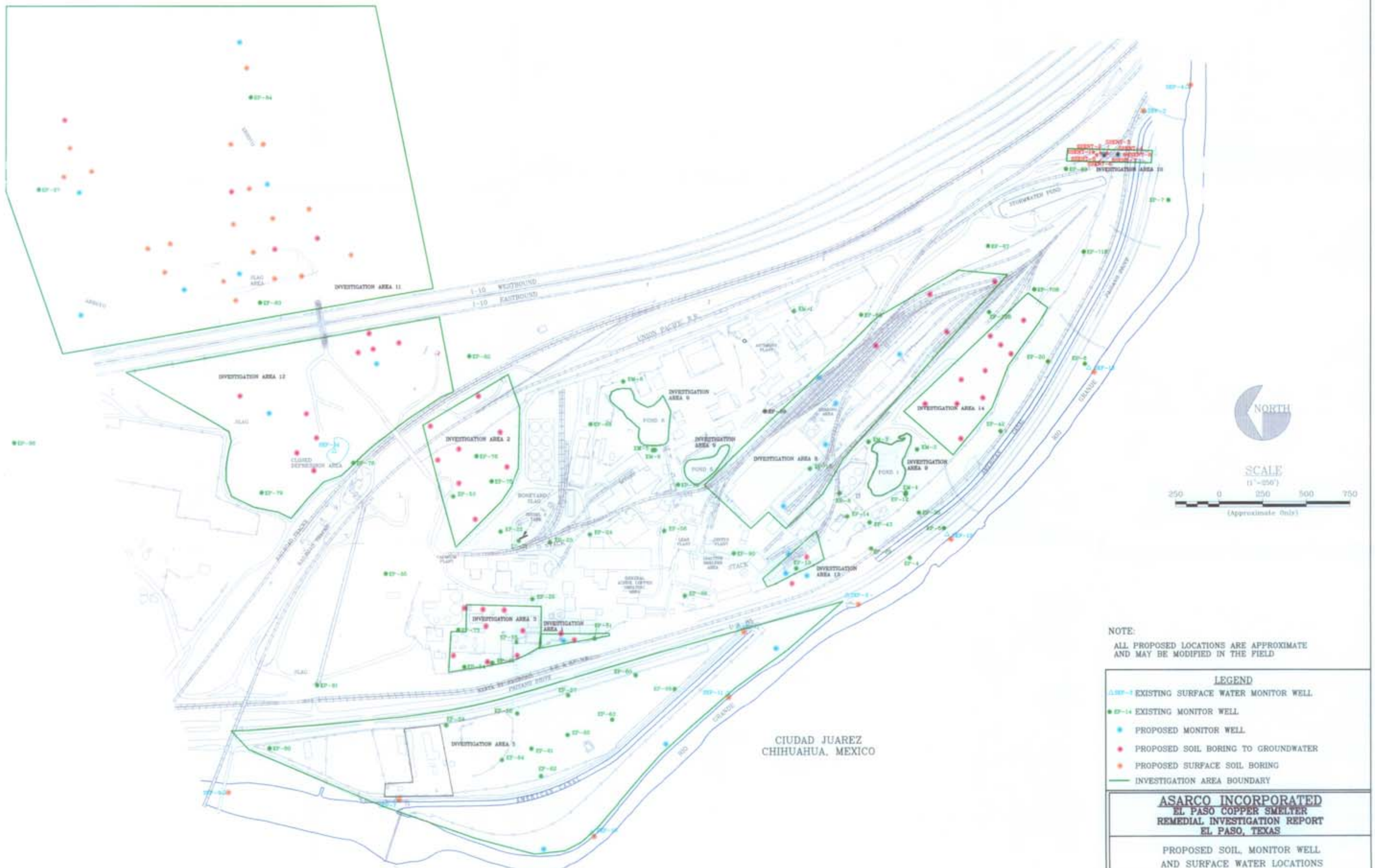
Proposed Monitoring Well Samplig Frequencies
El Paso Asarco Smelter, Remedial Investigation

Monitoring Well ID	PROPOSED SAMPLING FREQUENCIES							
	2002		2003				2004	
	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr
EP-130				A				A
EP-131				A				A
**EP-132	Q	Q	Q	Q	Q	Q	Q	Q

Note

Q = Quarterly
S = Semiannually
A = Annually
All monitoring wells will be gauged for water levels quarterly.
* Compliance Monitoring Wells (Adjacent to the River)
** Monitoring Wells Within Known Major Contaminant Flow Paths and Arroyos

FIGURES



NOTE:
ALL PROPOSED LOCATIONS ARE APPROXIMATE AND MAY BE MODIFIED IN THE FIELD

LEGEND

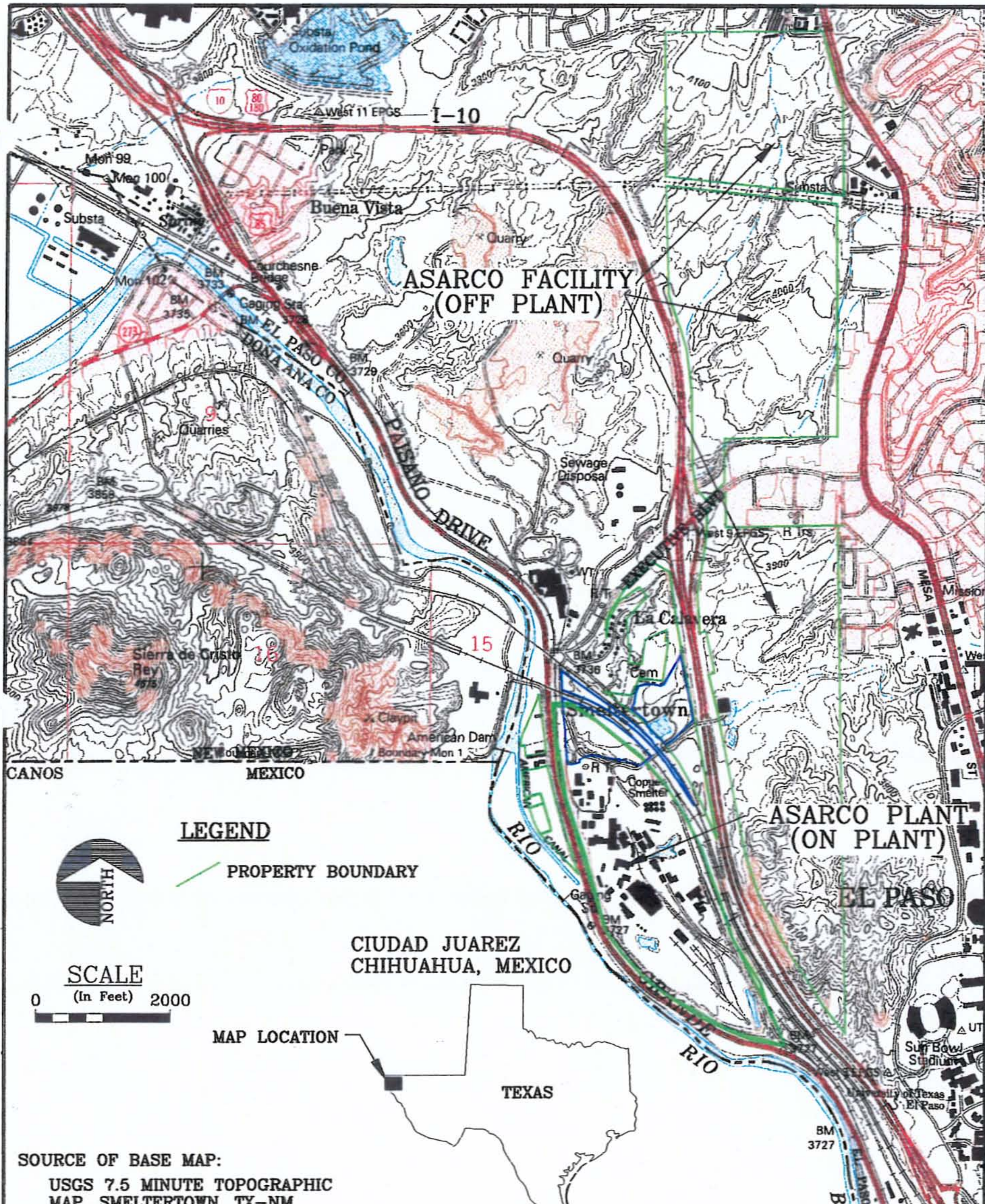
- SWP-3 EXISTING SURFACE WATER MONITOR WELL
- EP-14 EXISTING MONITOR WELL
- PROPOSED MONITOR WELL
- PROPOSED SOIL BORING TO GROUNDWATER
- PROPOSED SURFACE SOIL BORING
- INVESTIGATION AREA BOUNDARY

ASARCO INCORPORATED
EL PASO COPPER SMELTER
REMEDIAL INVESTIGATION REPORT
EL PASO, TEXAS

PROPOSED SOIL, MONITOR WELL AND SURFACE WATER LOCATIONS

Hydrometrics, Inc.
Consulting Scientists, Engineers, and Contractors
Tucson, Arizona

EXHIBIT
2



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SOURCE OF BASE MAP:
USGS 7.5 MINUTE TOPOGRAPHIC MAP, SMELTERTOWN, TX-NM QUADRANGLE, (1994)

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

PROJECT VICINITY MAP

FIGURE 1-1

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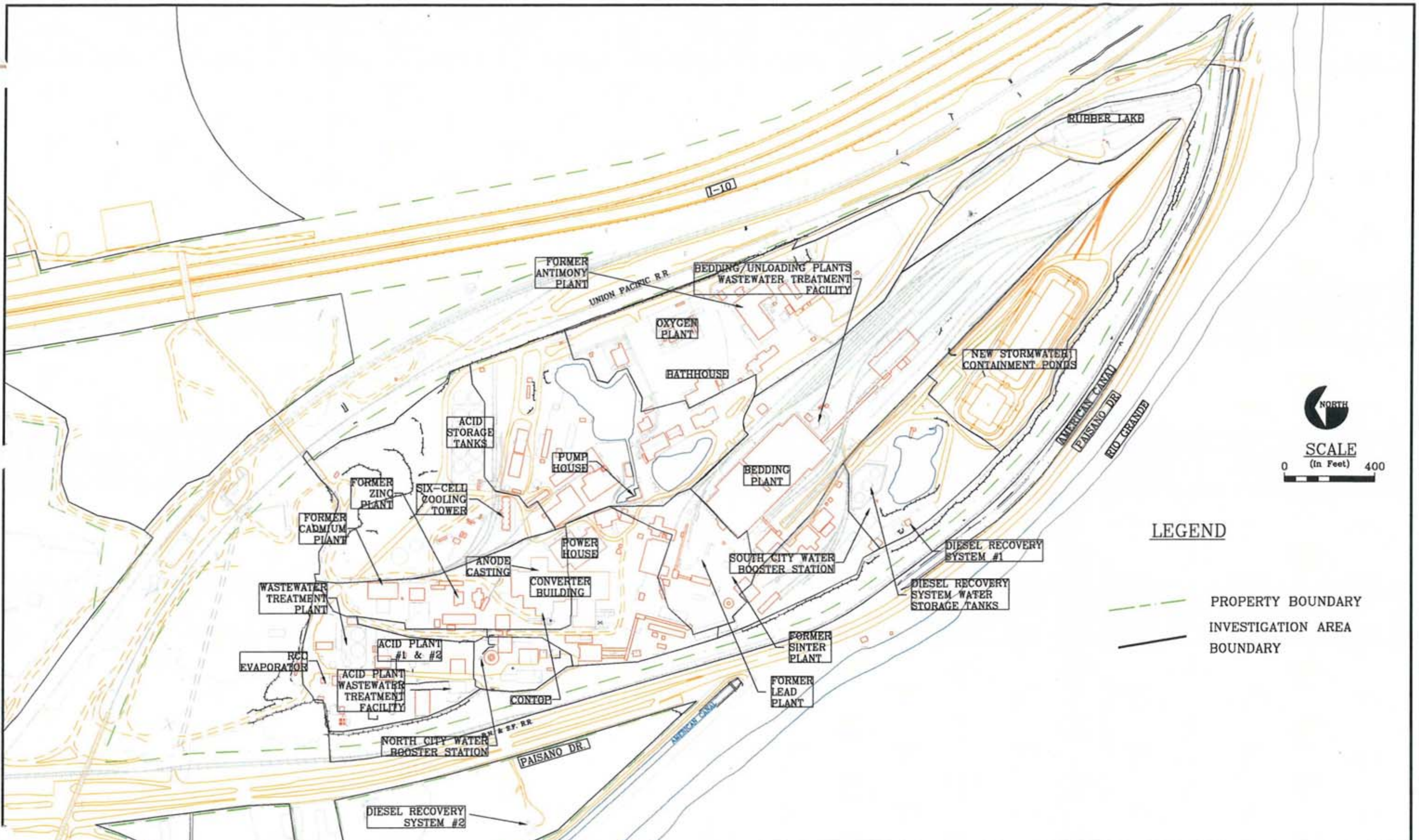
Hydrometrics, Inc. ®



ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

PLANT COMPONENTS

FIGURE 1-2

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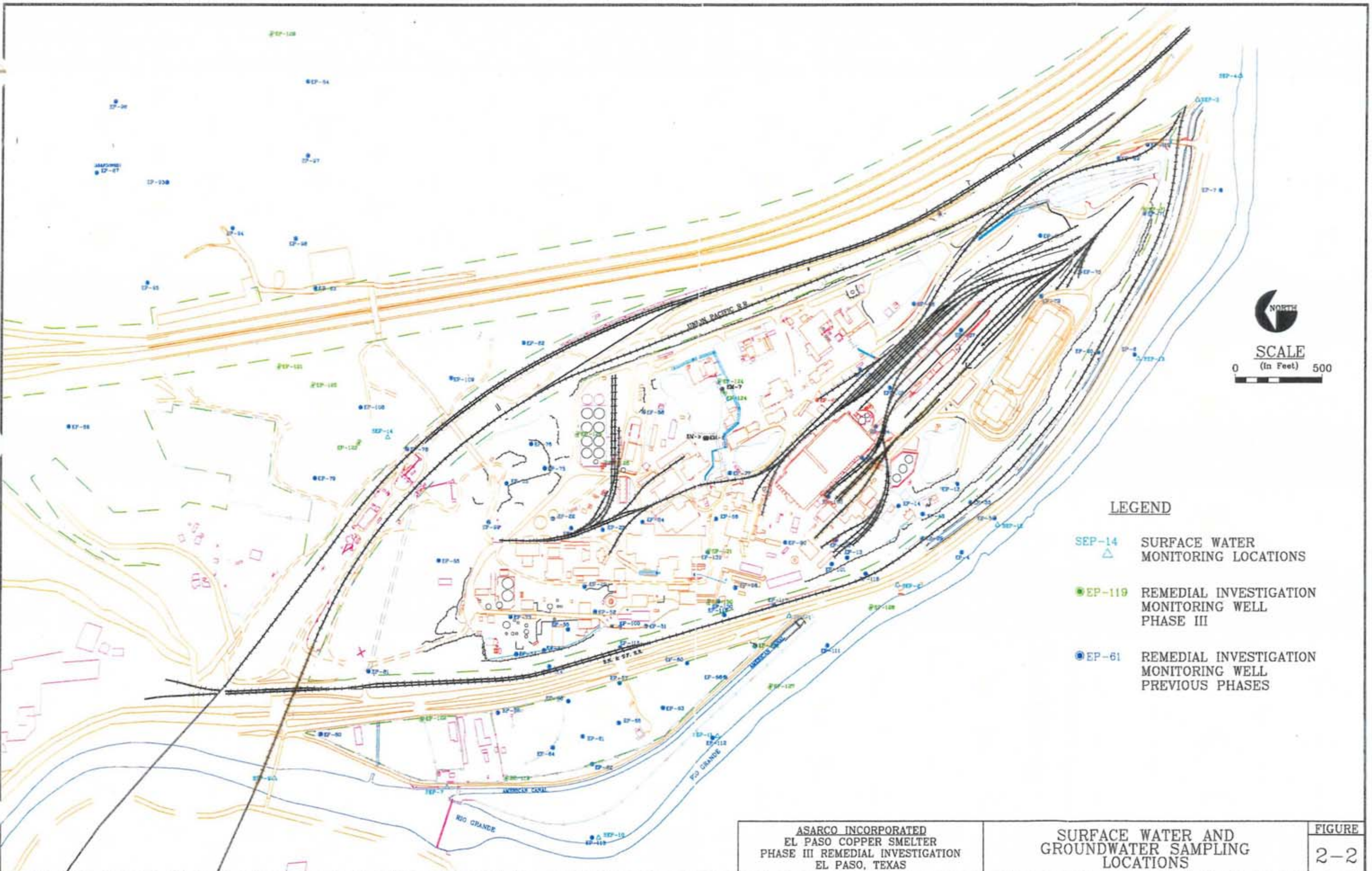

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

SURFACE WATER AND GROUNDWATER SAMPLING LOCATIONS

FIGURE 2-2

Hydrometrics, Inc.

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EL PASO, TEXAS

SOIL SAMPLE LOCATIONS

FIGURE 2–2a

Hydrometrics, Inc.

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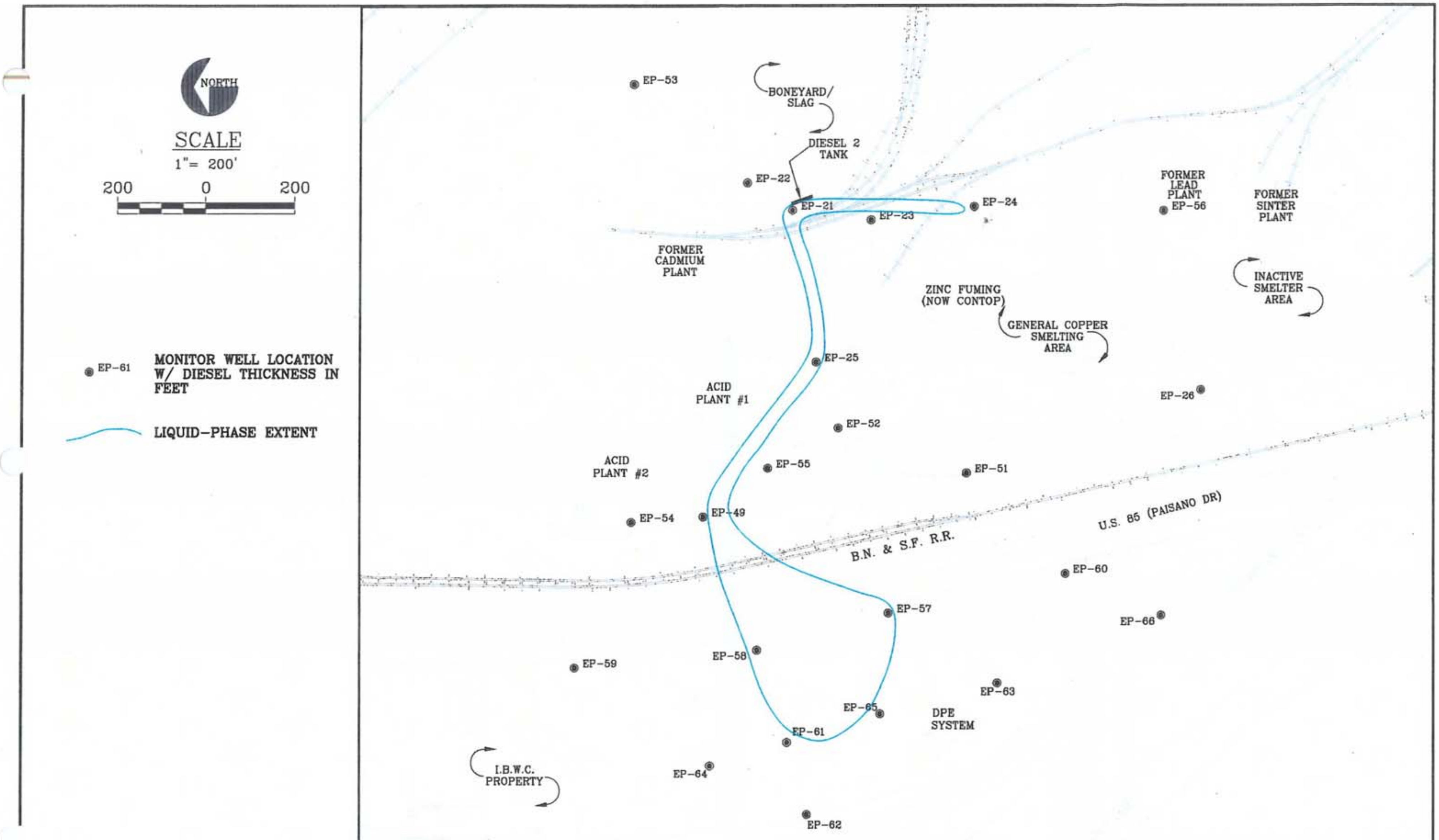

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

ESTIMATED EXTENT OF
LIQUID PHASE DIESEL
AUGUST 2001

FIGURE
1-3

Hydrometrics, Inc.

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EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

PROCESS POND, STORM WATER EVAPORATION PONDS AND HISTORIC ARROYO LOCATIONS

FIGURE 2-1

Hydrometrics, Inc.

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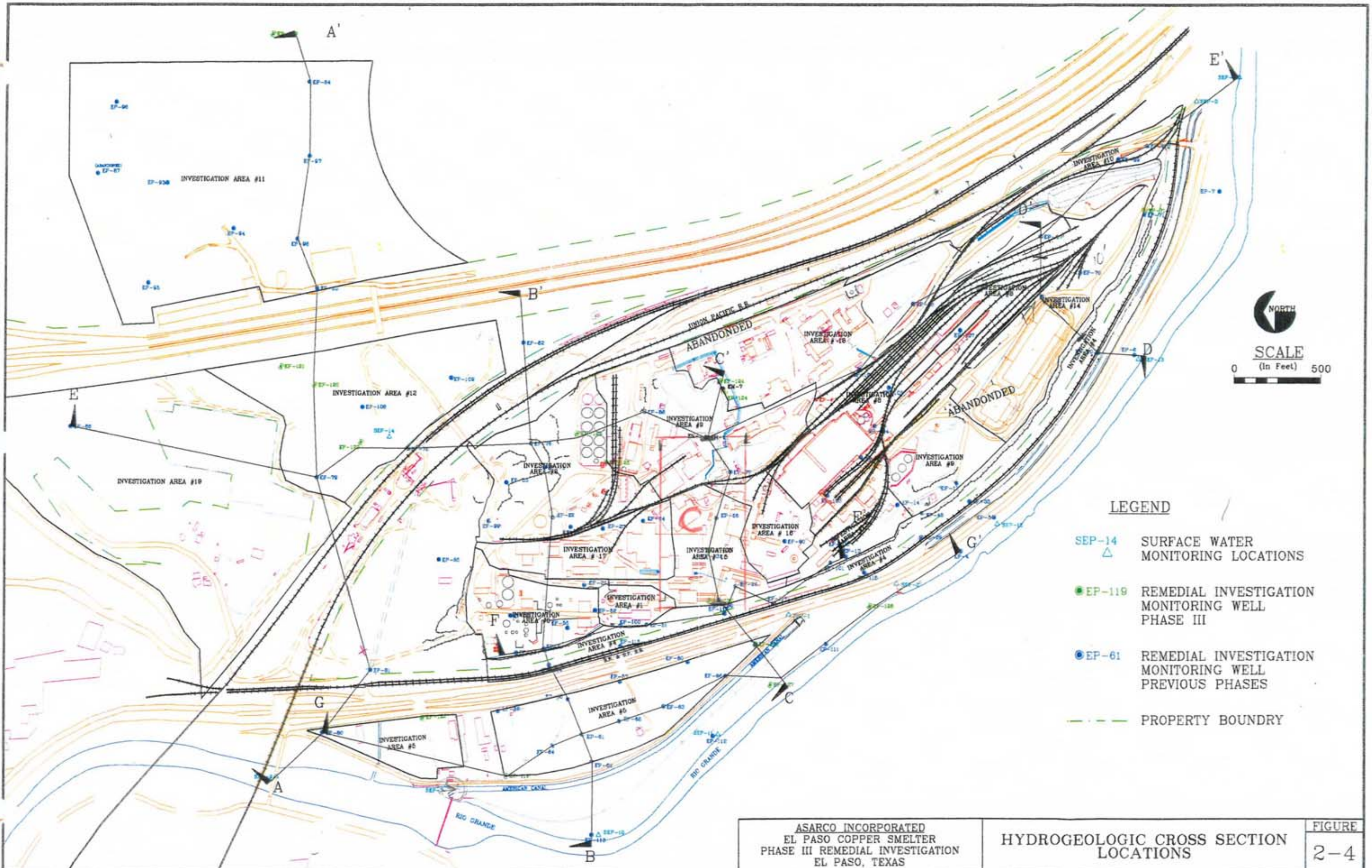

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

HYDROGEOLOGIC CROSS SECTION LOCATIONS

FIGURE 2-4

Hydrometrics, Inc.

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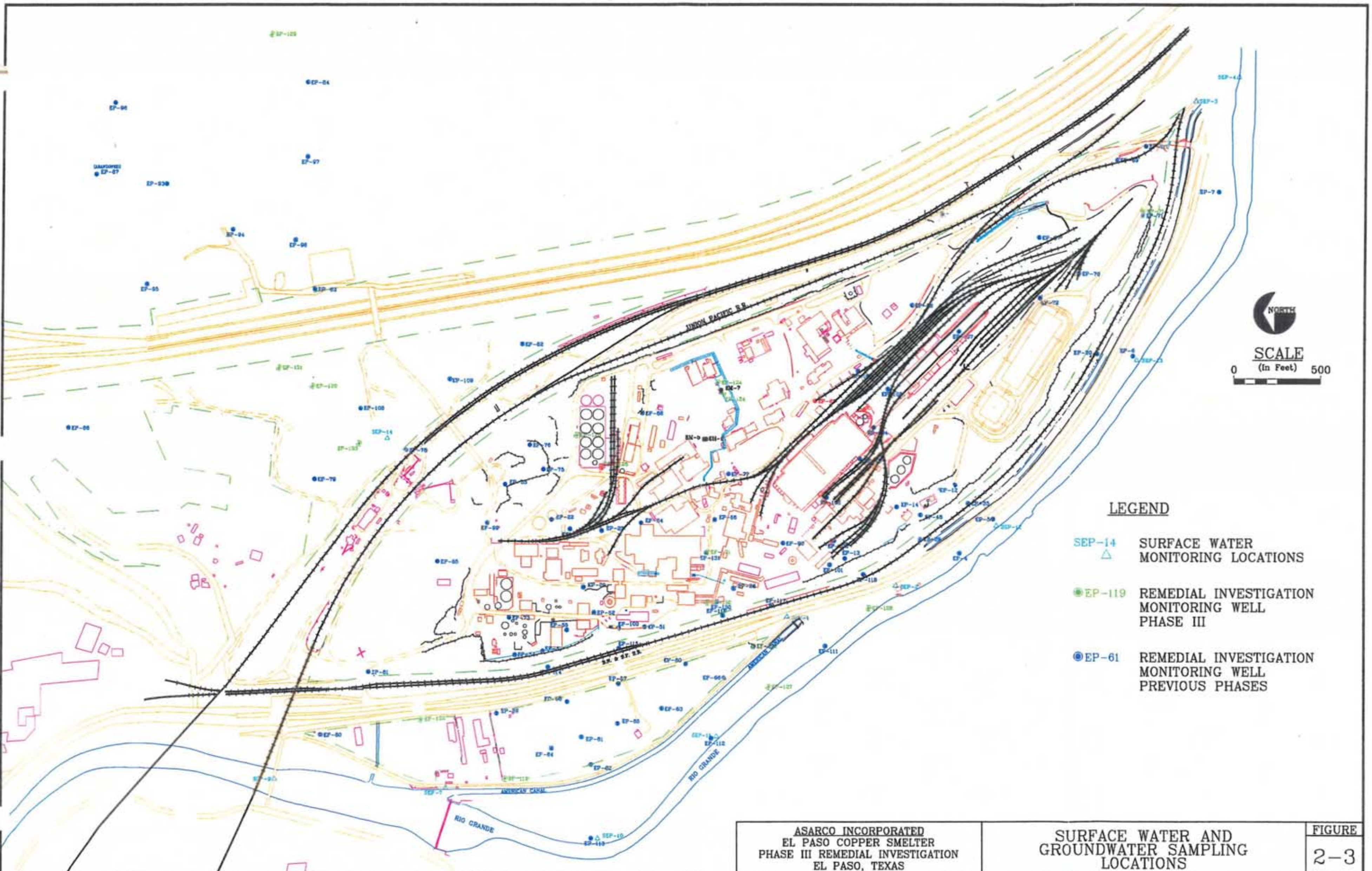

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ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

SOIL SAMPLE LOCATIONS

FIGURE 2-2b

Hydrometrics, Inc.

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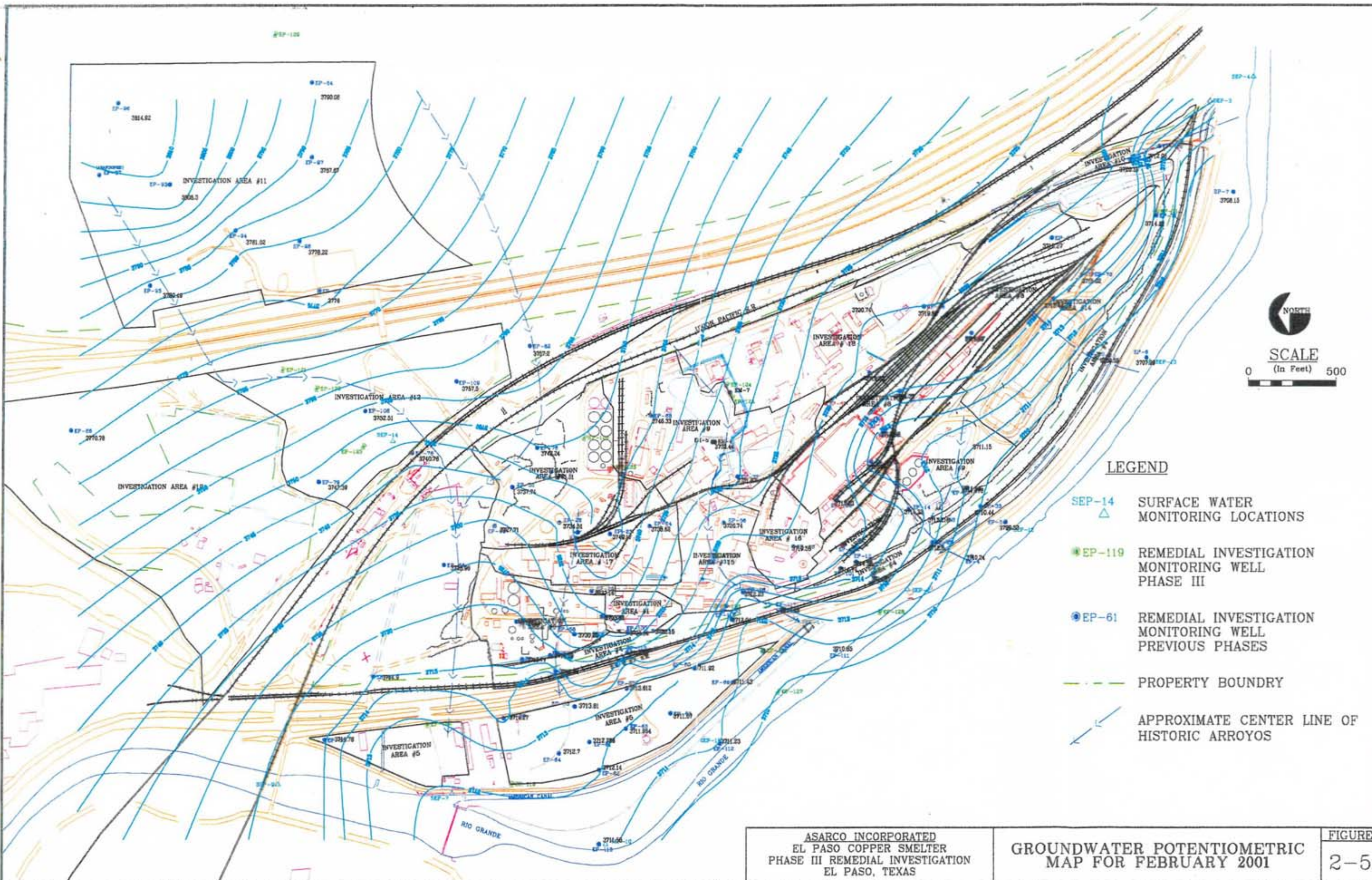

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EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

GROUNDWATER POTENTIOMETRIC MAP FOR FEBRUARY 2001

FIGURE 2-5

Hydrometrics, Inc.

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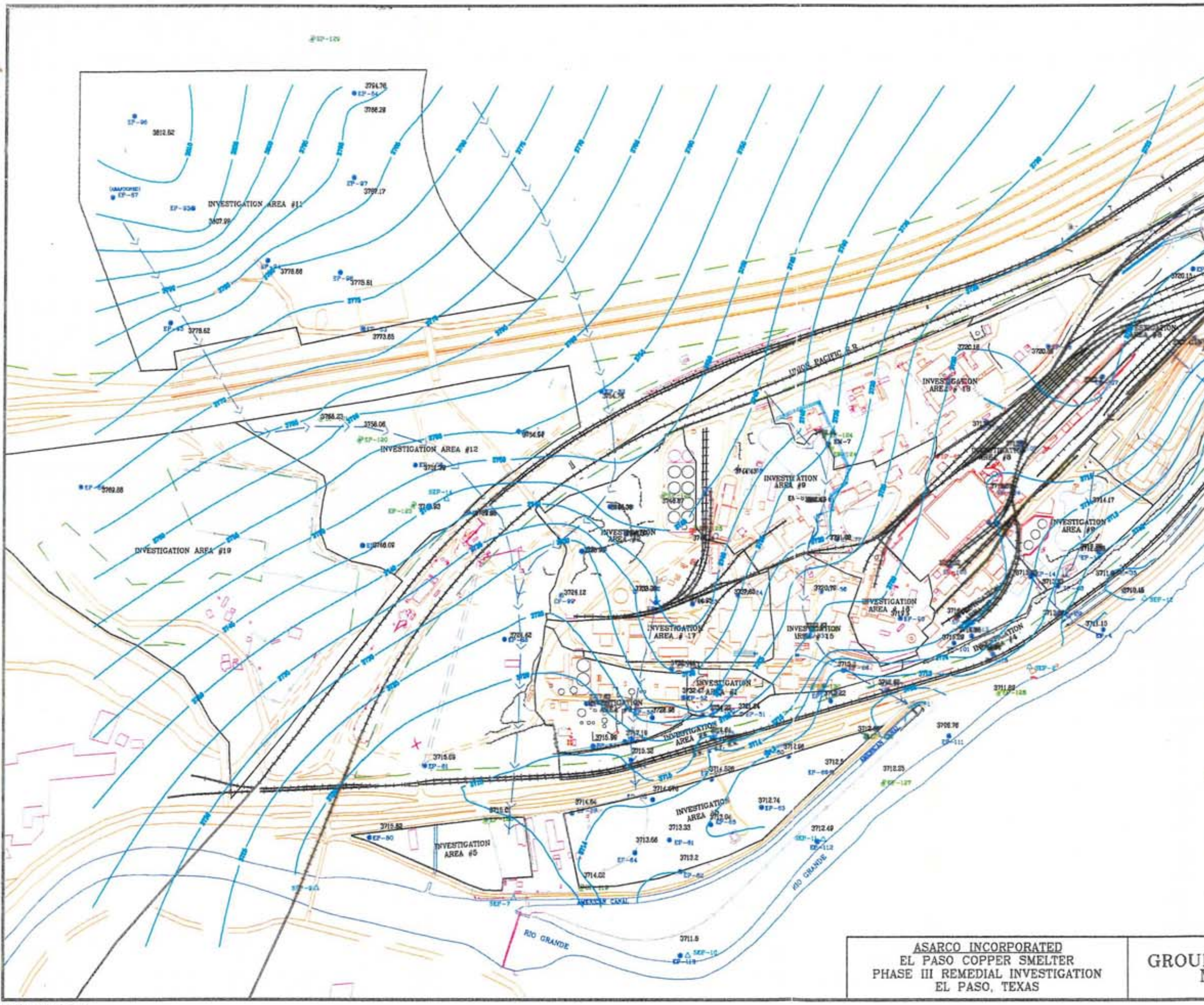


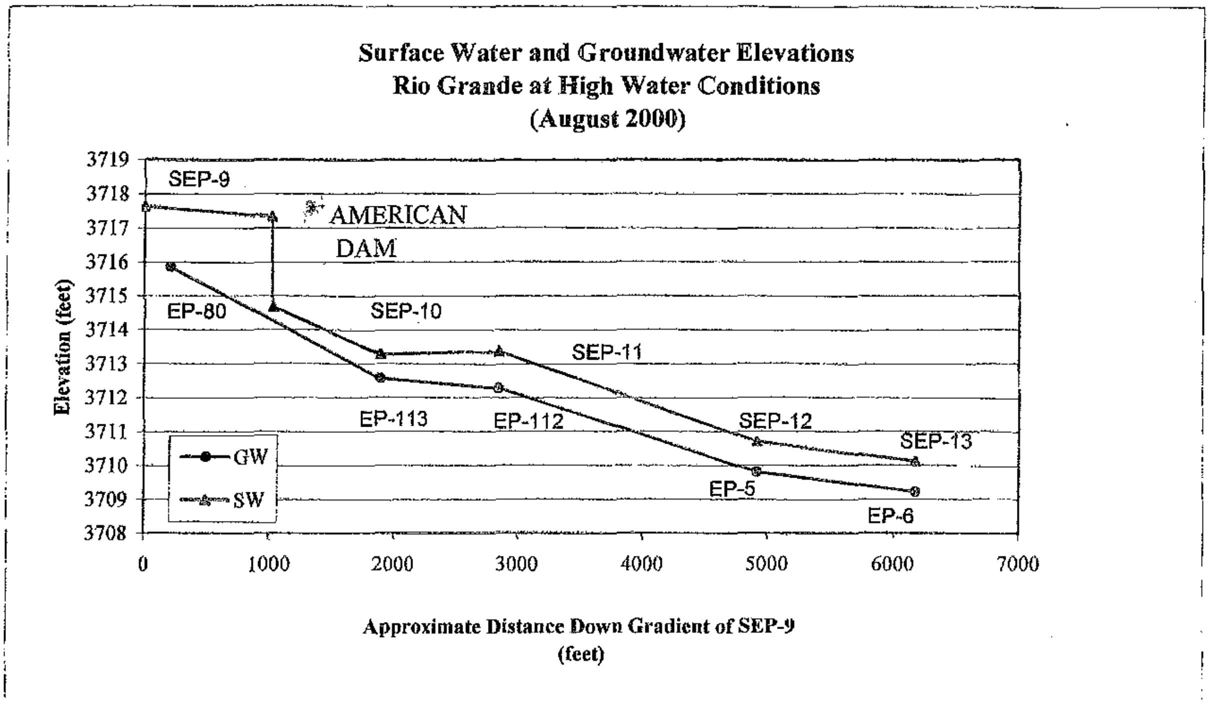
LEGEND

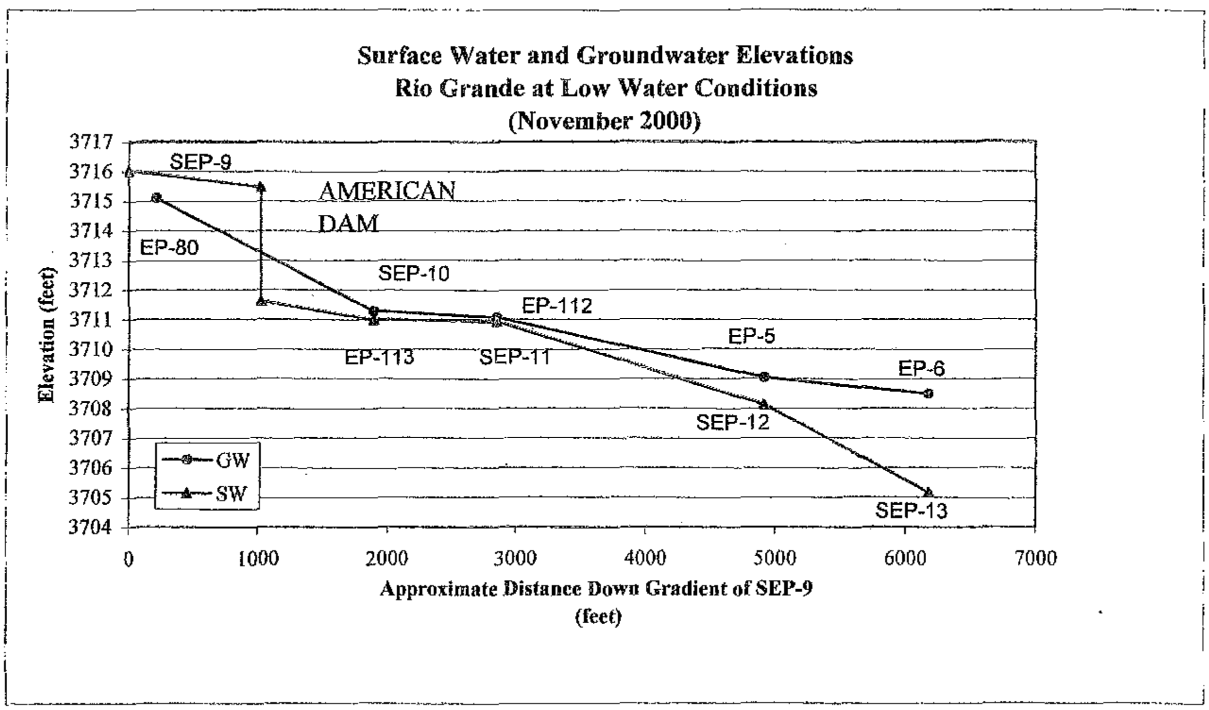
SEP-14 △	SURFACE WATER MONITORING LOCATIONS
EP-119	REMEDIAL INVESTIGATION MONITORING WELL PHASE III
EP-61	REMEDIAL INVESTIGATION MONITORING WELL PREVIOUS PHASES
— · —	PROPERTY BOUNDRY
↙	APPROXIMATE CENTER LINE OF HISTORIC ARROYOS

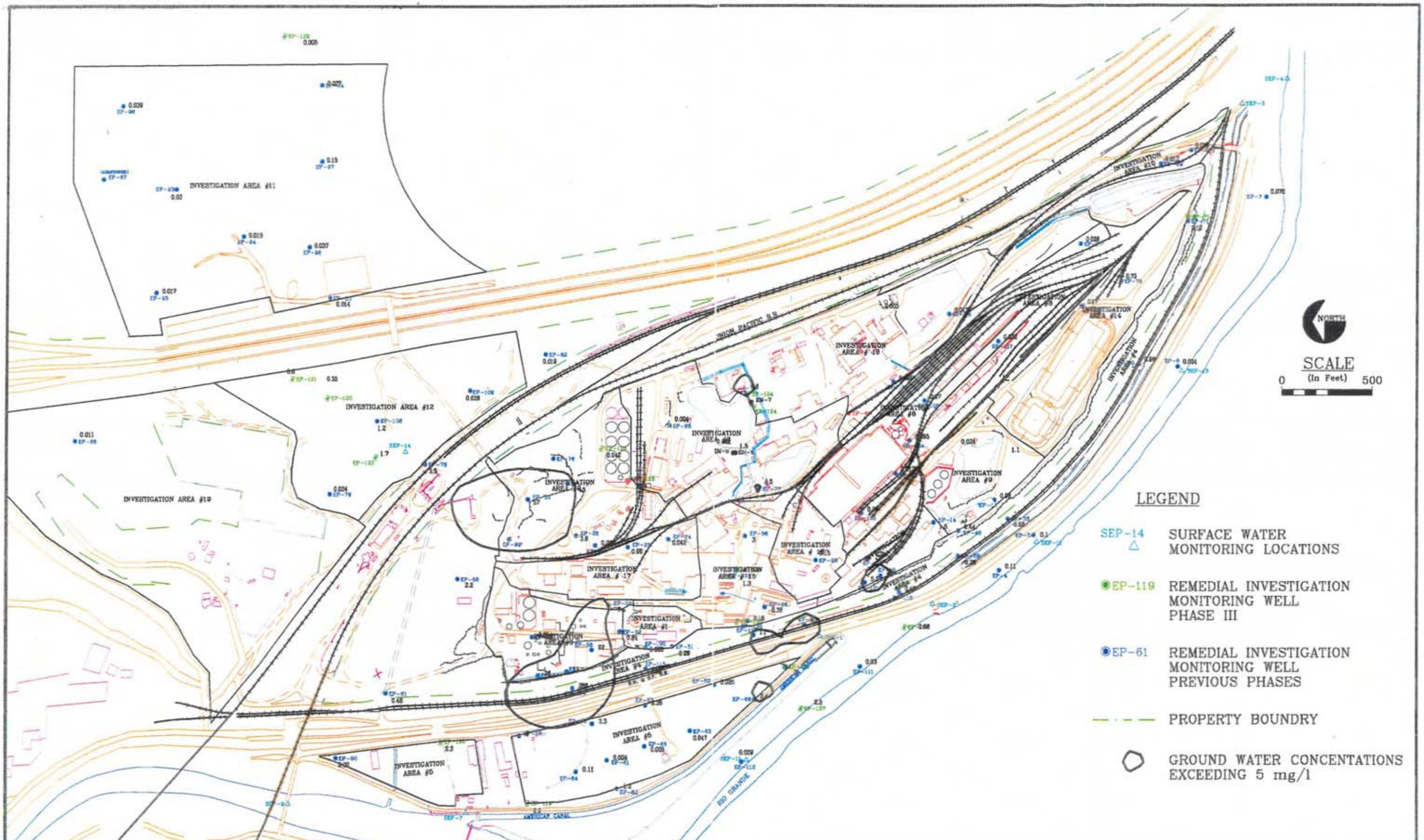
ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	GROUNDWATER POTENTIOMETRIC MAP FOR AUGUST 2001	FIGURE 2-6

Figure 2-7

Groundwater Elevations Compared to Adjacent Surface Water Elevations Along the Rio Grande
Asarco El Paso Smelter, Phase III RI







ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

TOTAL ARSENIC CONCENTRATIONS IN GROUNDWATER AUGUST 2001

FIGURE 2-8

Hydrometrics, Inc.

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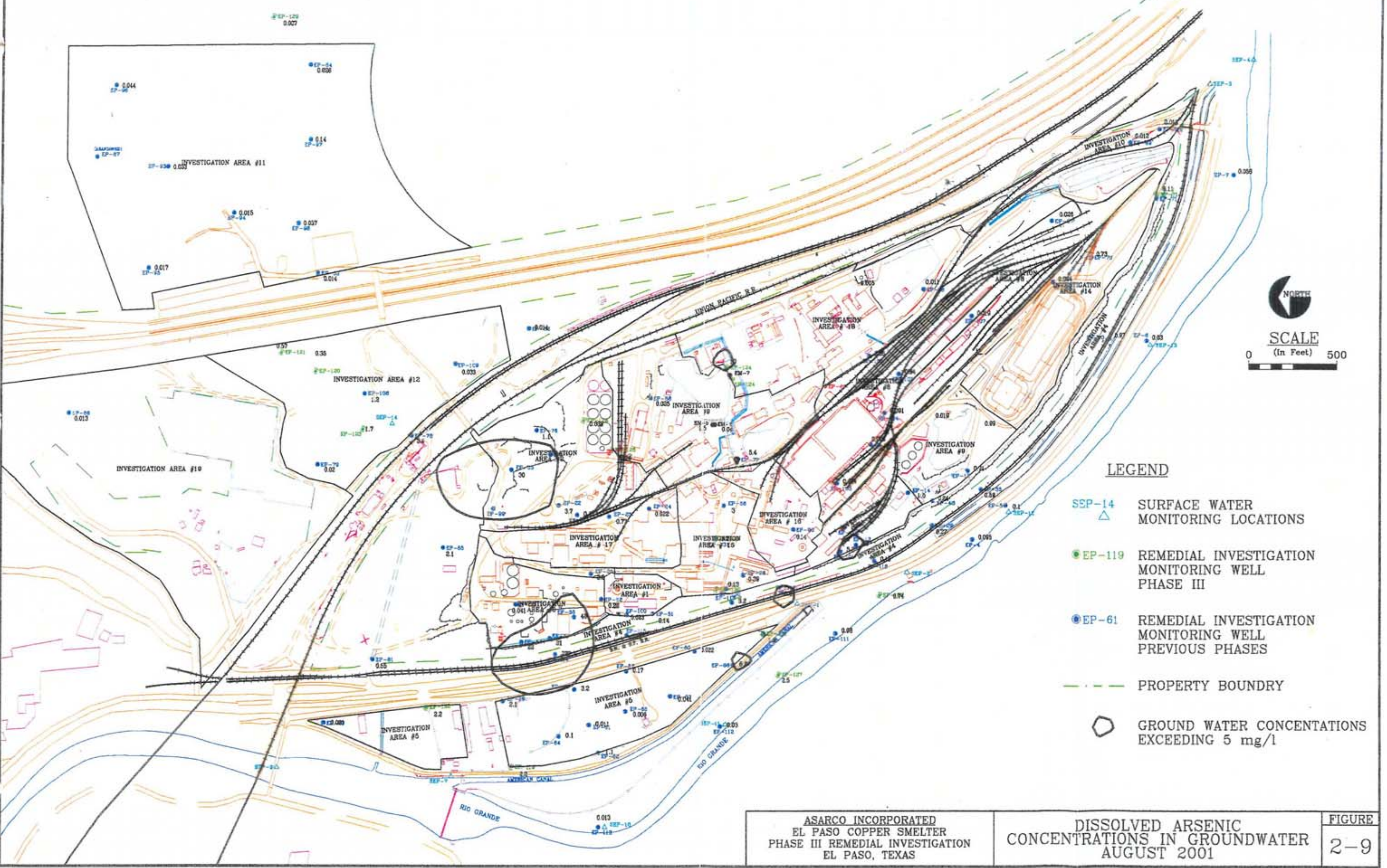

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

DISSOLVED ARSENIC CONCENTRATIONS IN GROUNDWATER AUGUST 2001

FIGURE 2-9

Hydrometrics, Inc.

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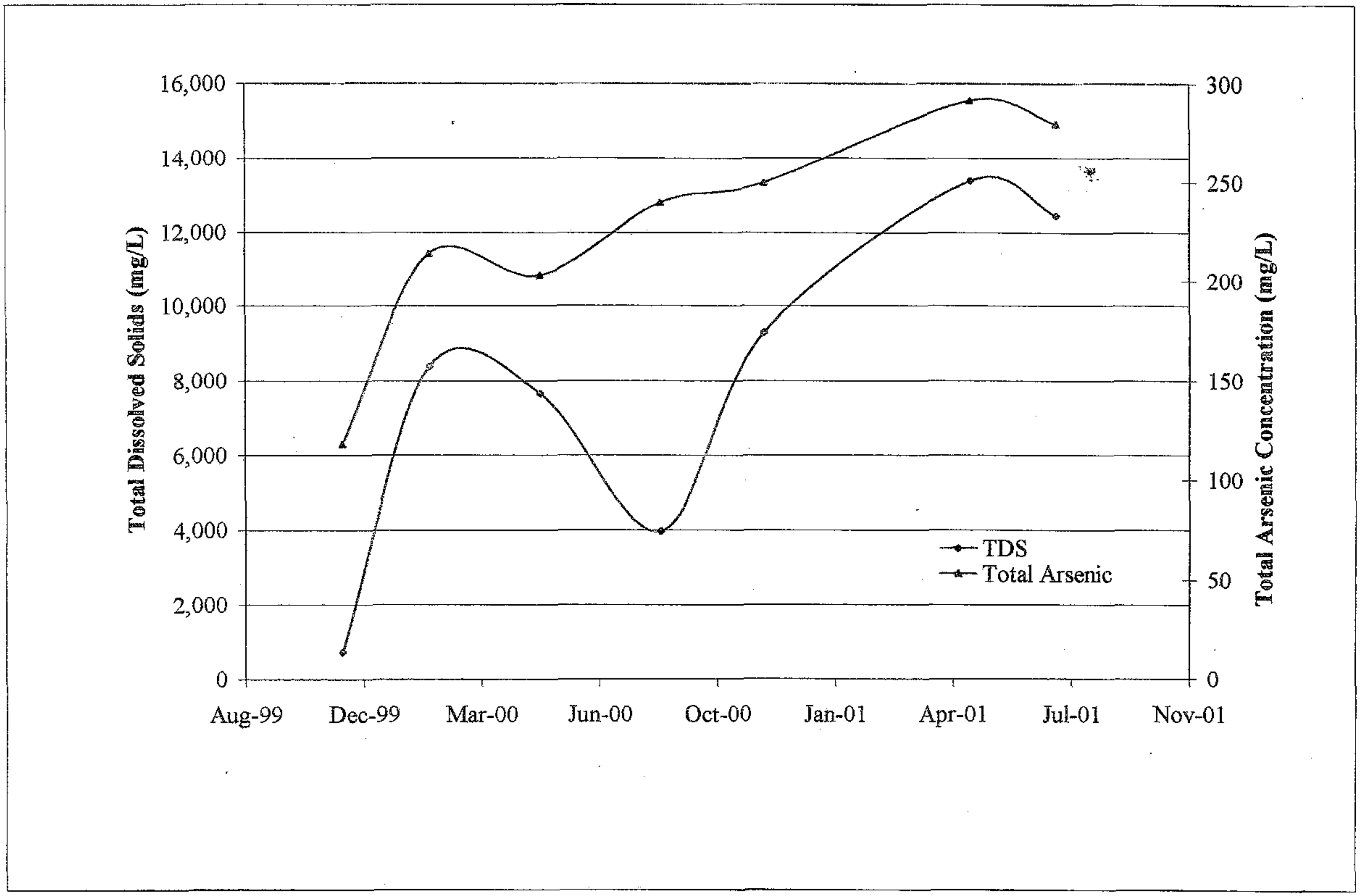
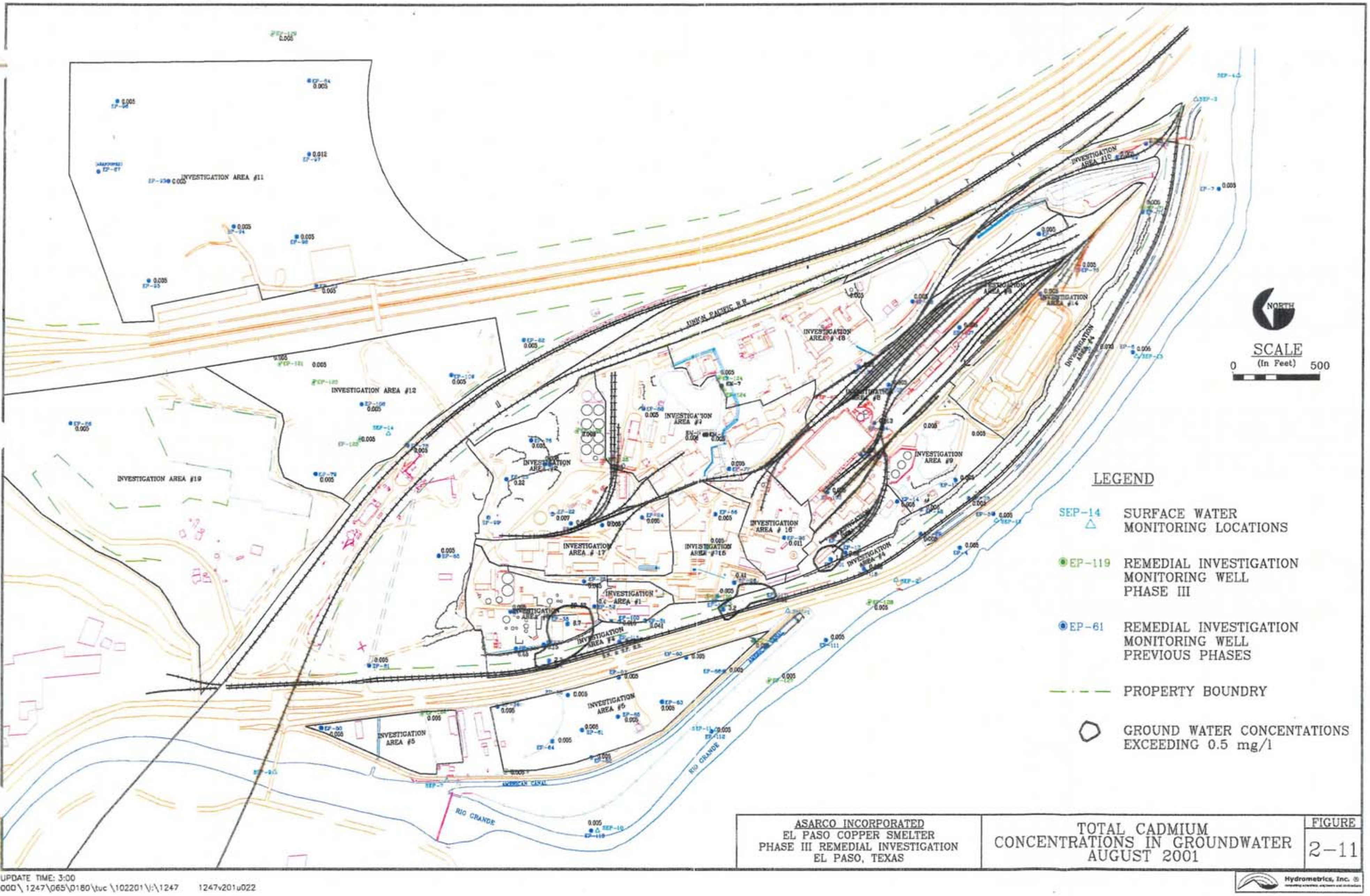
Drawing Name: 247\1247v201u121.dwg Last Modified: Oct 23, 2001 - 5:00pm Plotted on: N 2001 - 12:11pm by MEDDY

Figure 2-10

Comparison of Total Dissolved Solids and Total Arsenic Concentration Trend at Monitoring Well EP-114





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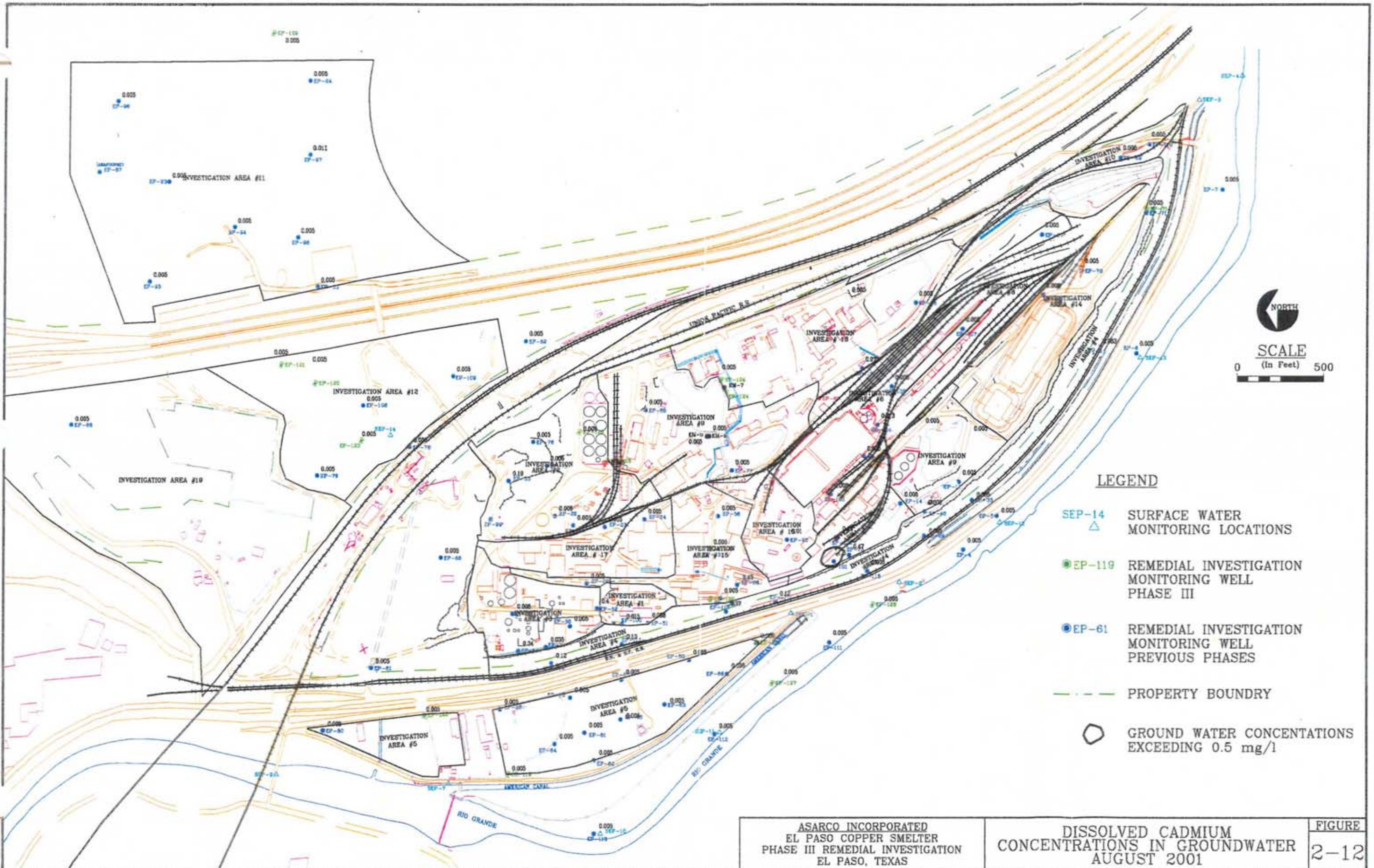

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

DISSOLVED CADMIUM CONCENTRATIONS IN GROUNDWATER AUGUST 2001

FIGURE 2–12

Hydrometrics, Inc.

UPDATE TIME: 3:00
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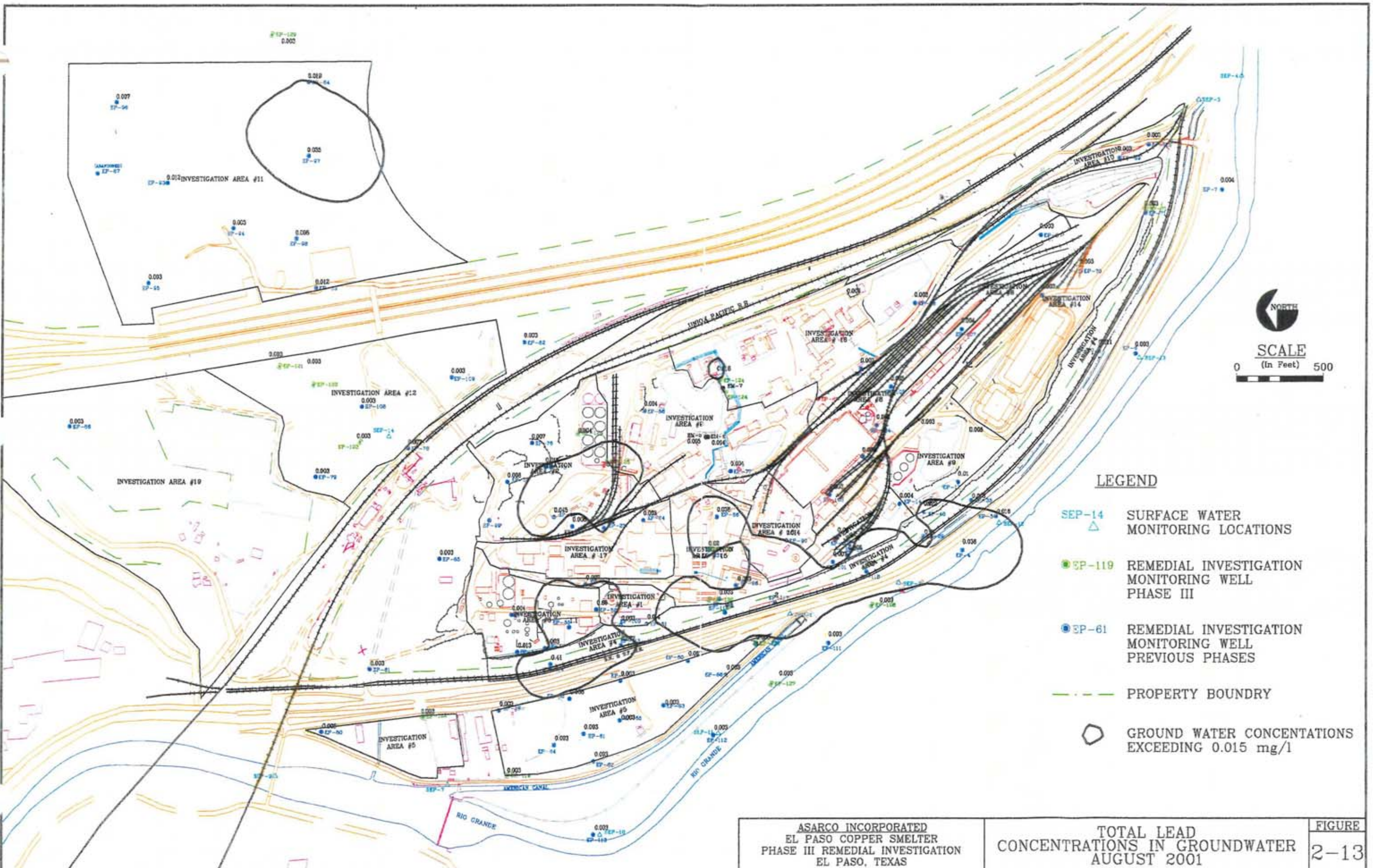
Drawing Name: \1247\1247v201u123.dwg Last Modified: Oct 23, 2001 - 1:12pm Plotted on: N 29, 2001 - 12:26pm by MEDDY



ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

TOTAL LEAD CONCENTRATIONS IN GROUNDWATER AUGUST 2001

FIGURE 2-13

Hydrometrics, Inc.

UPDATE TIME: 3:00
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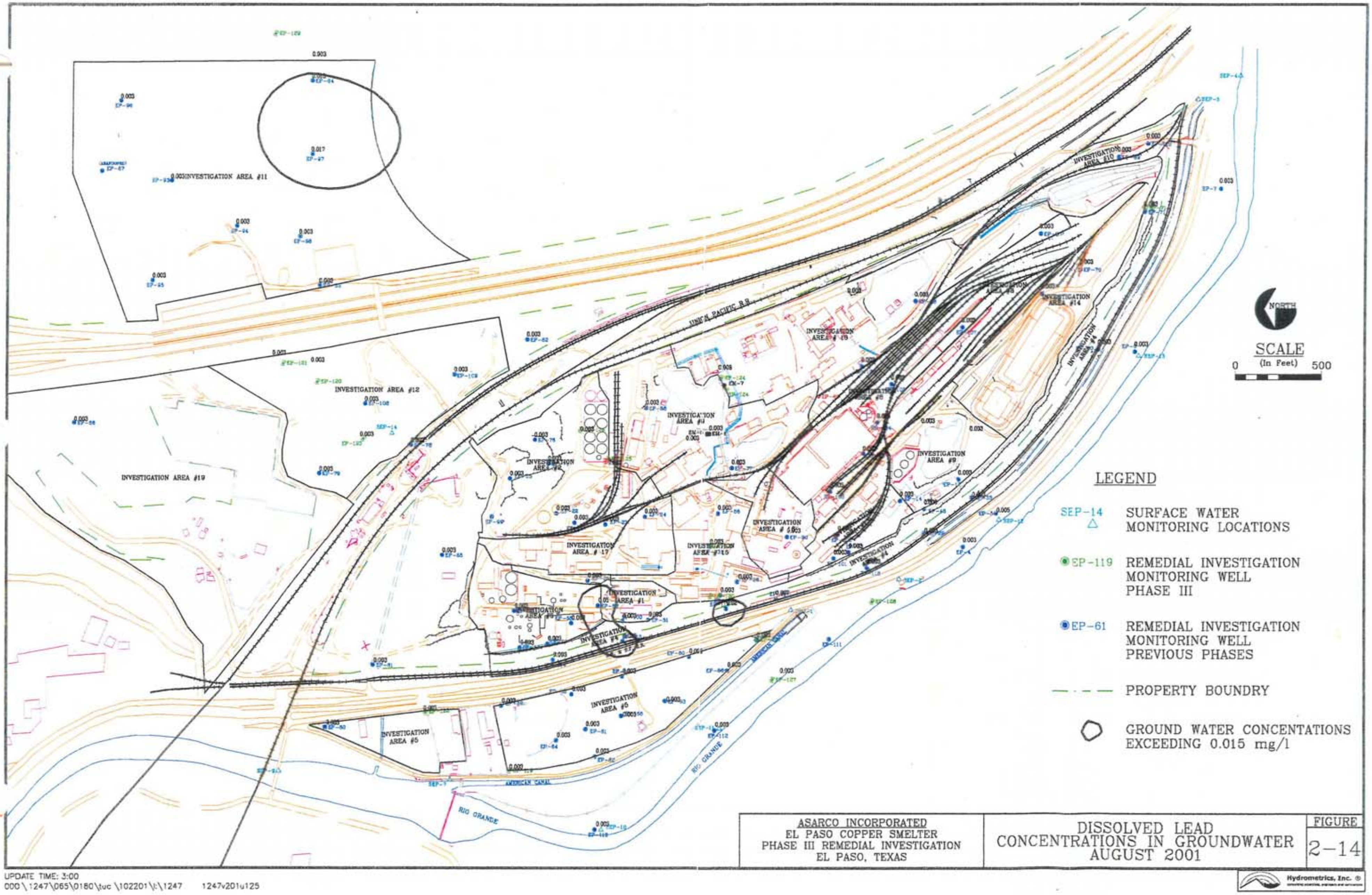
Drawing Name: 1247\1247v201u124.dwg Last Modified: Oct 23, 2001 - 2:18pm Plotted on: Nov ?, 2001 - 12:33pm by MEDDY



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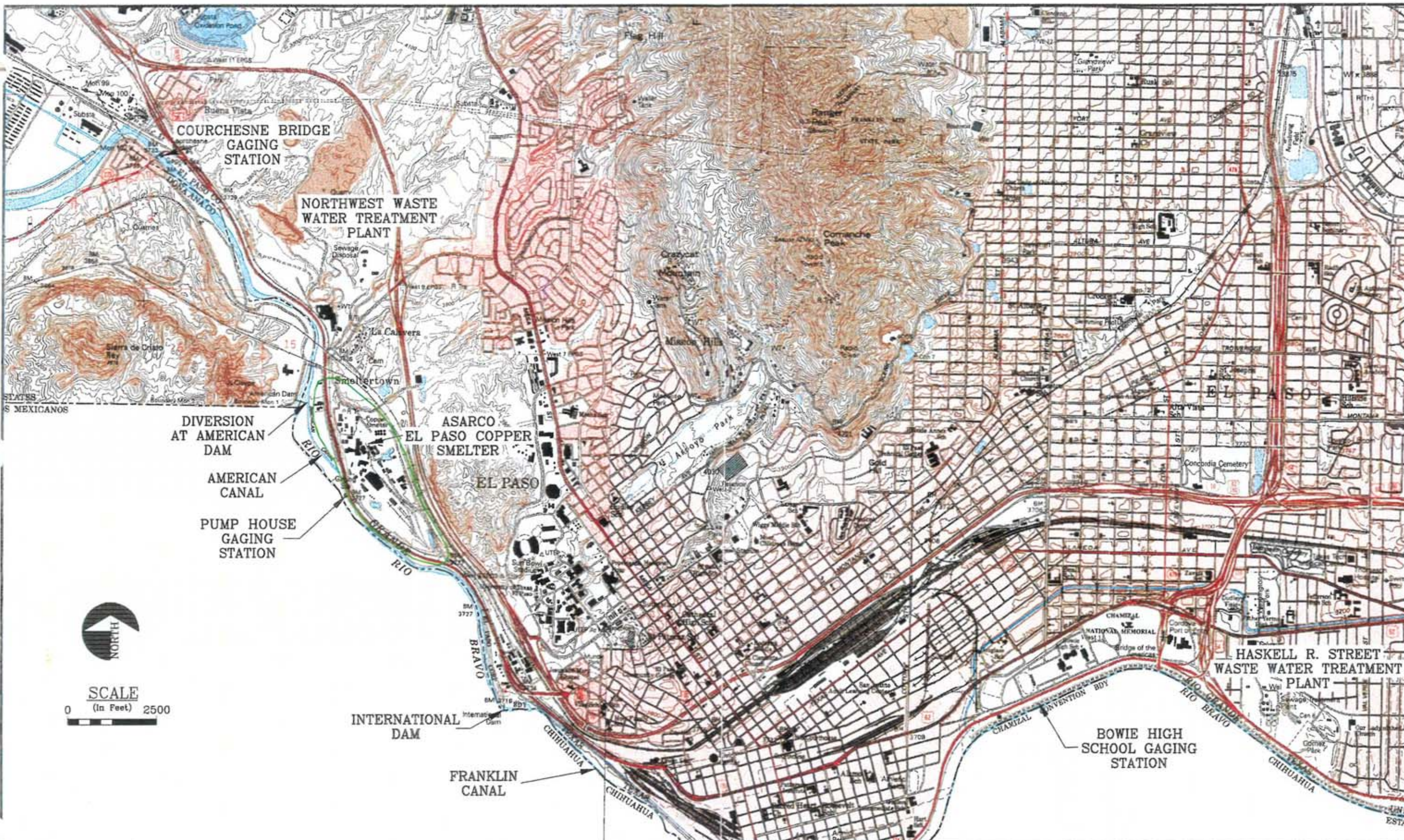

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	IBWC SURFACE WATER MONITORING LOCATIONS	FIGURE 2-15

UPDATE TIME: 11:00
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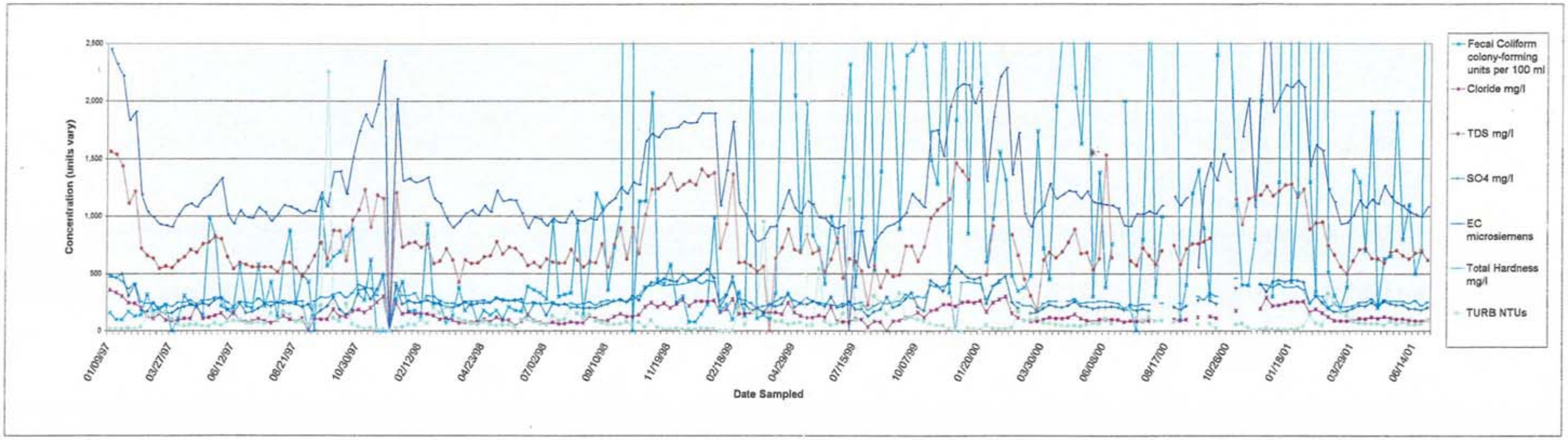
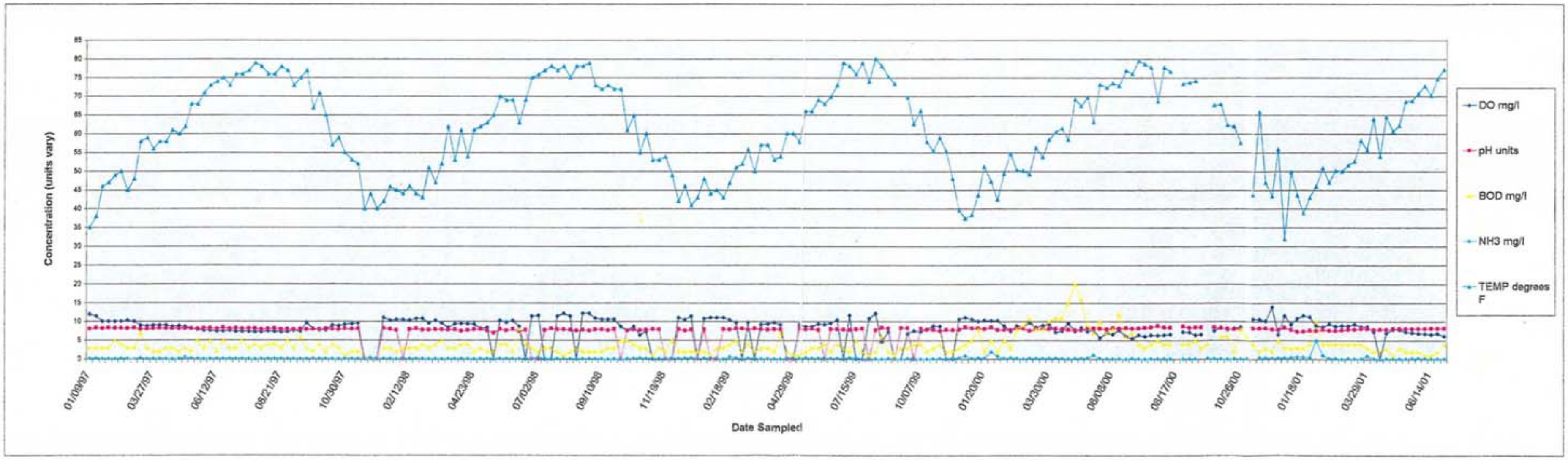
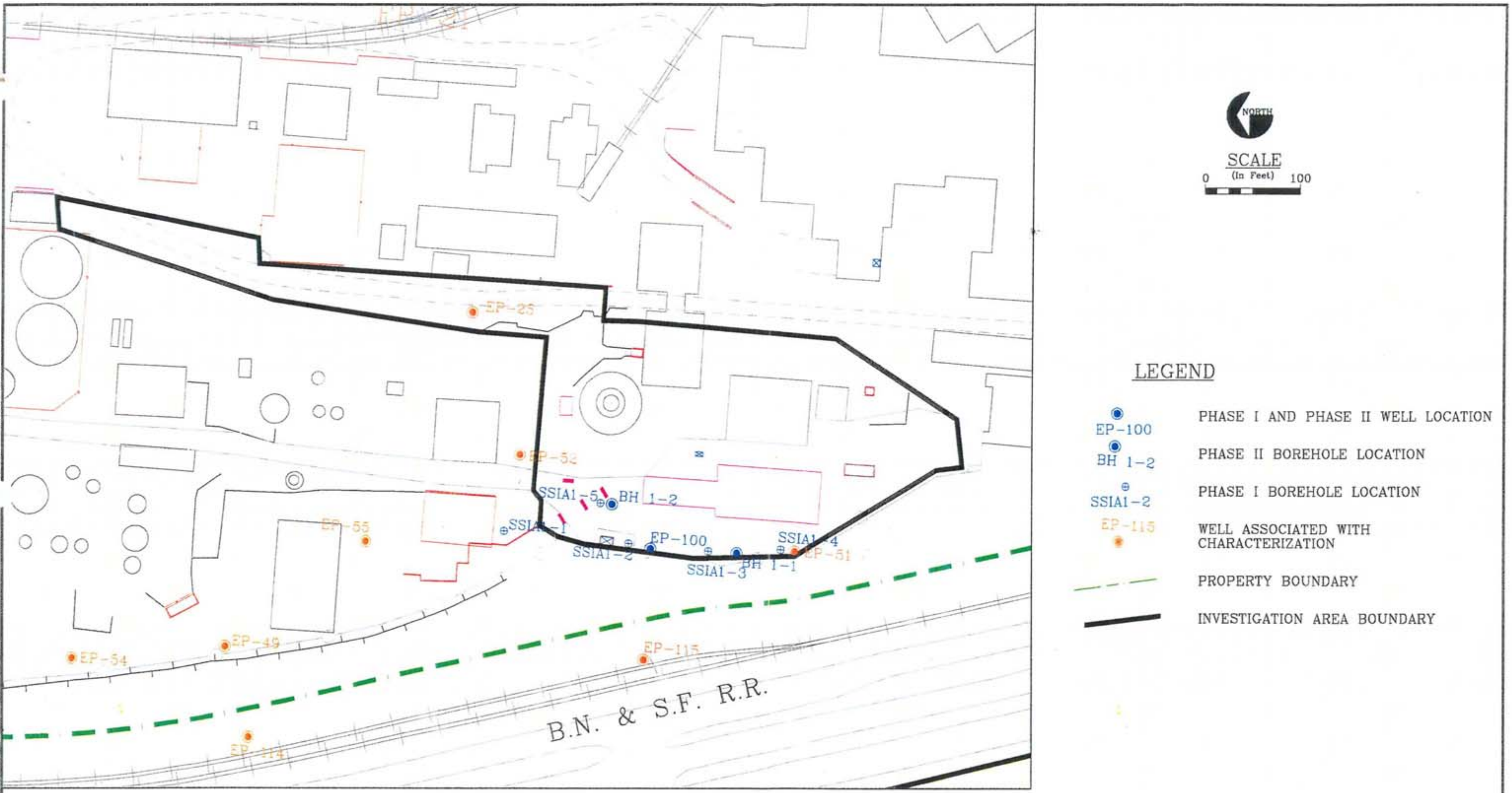
1247v201v050

Hydrometrics, Inc.

Figure 2-16 IBWC Water Quality Data for Rio Grande at Courchesne Bridge, 1997 through June 2001
ASARCO El Paso Smelter
Phase III RI







NOTE: NO SAMPLE LOCATIONS FOR PHASE III INVESTIGAITION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 1 (CONVERTER BUILDING/ BAGHOUSE AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-23

Hydrometrics, Inc.

247\1247v201u131.dwg Last Modified: Nov 12, 2001 - 4:02pm Plotted on: N... 2001 - 4:02pm by MEDDY

PDATE TIME: 3:00
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NOTE: LOCATIONS FOR RIBH2, RIBH4, RIBH5 AND RIBH6 ARE LOCATED OUTSIDE THE LIMITS OF THIS FIGURE.

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 2 (BONEYARD AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-24

Hydrometrics, Inc.

Drawing Name: 47\1247v201u101.dwg Last Modified: Nov 01, 2001 - 4:40pm Plotted on: No 2001 - 8:41am by MEDDY

UPDATE TIME: 3:00
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NOTE: NO SAMPLE LOCATIONS FOR PHASE III INVESTIGAITION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 3 (ACID PLANT AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-25

Hydrometrics, Inc.

Drawing Name: ...\1247\1247v201u102.dwg Last Modified: Nov 01, 2001 - 4:14pm Plotted on: Nov 07, 2001 - 8:43am by MLDDY

UPDATE TIME: 3:00
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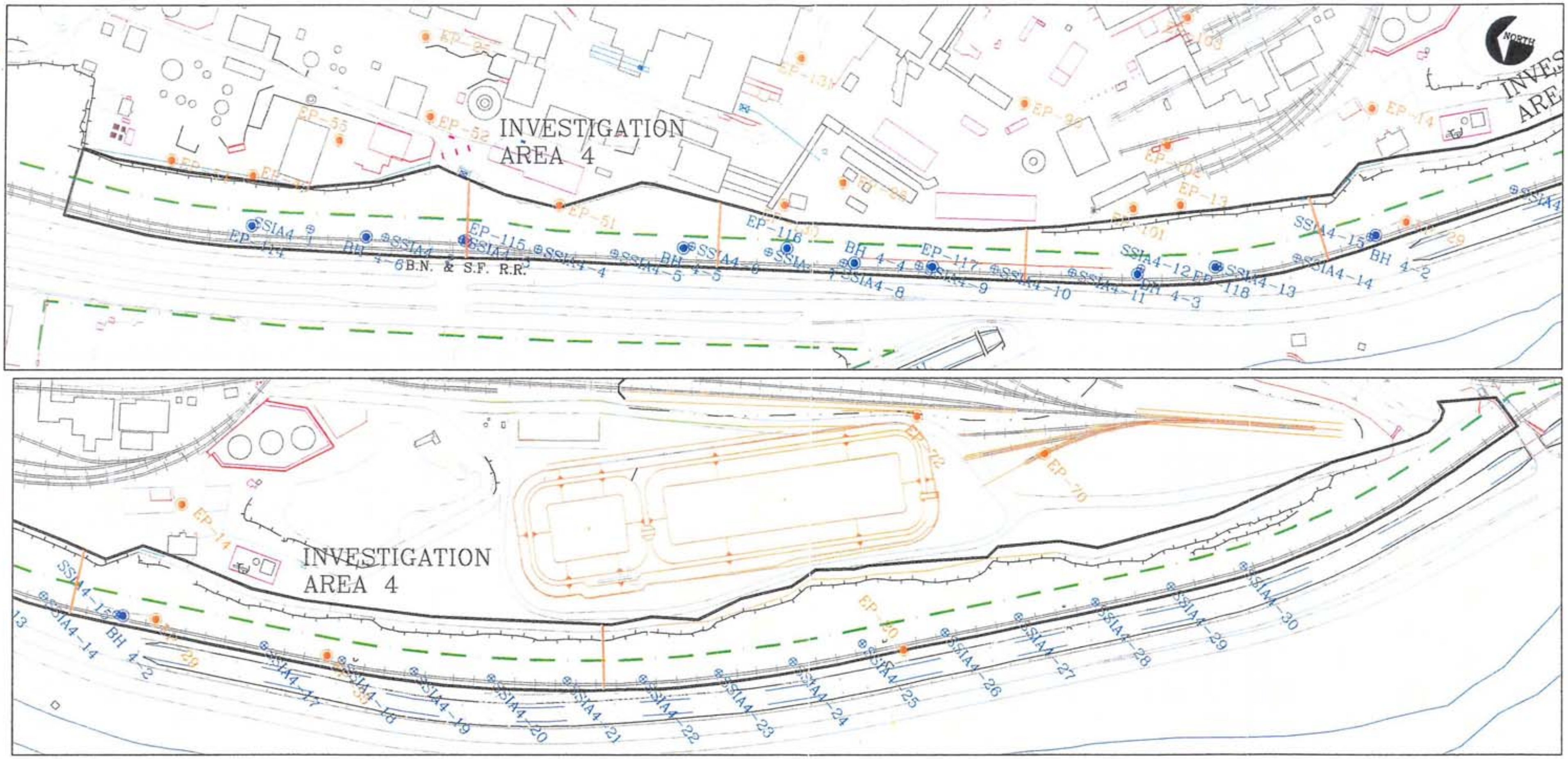


LEGEND

EP−114	PHASE I AND PHASE II WELL LOCATION
BH 4−2	PHASE II BOREHOLE LOCATION
SSIA4−14	PHASE I BOREHOLE LOCATION
EP−29	WELL ASSOCIATED WITH CHARACTERIZATION

PROPERTY BOUNDARY

INVESTIGATION AREA BOUNDARY

NORTH

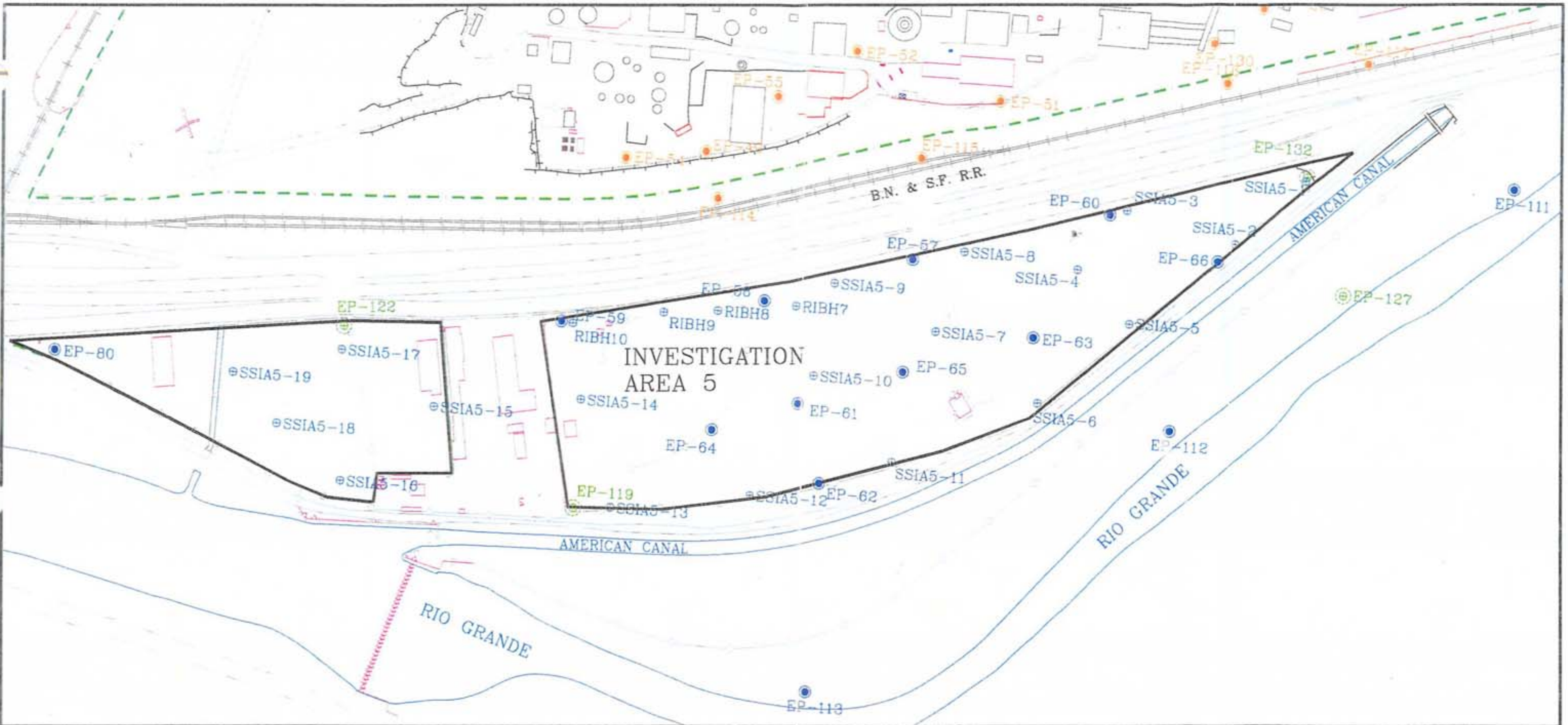
SCALE
(In Feet)
0 200'
APPROXIMATE

NOTE: NO SAMPLE LOCATIONS FOR PHASE III INVESTIGAITION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 4 (FRONT SLOPE/WESTERN FACILITY AREA) SOIL SAMPLING LOCATIONS	FIGURE 2−26

UPDATE TIME: 3:00
000\1247\065\0180\tuc\101801\l:\1247 1247v201u103

Hydrometrics, Inc.



LEGEND

NORTH

SCALE
(In Feet)
0 200
APPROXIMATE

EP-119	PHASE III WELL LOCATION	EP-114	WELL ASSOCIATED WITH CHARACTERIZATION
EP-64	PHASE I AND PHASE II WELL LOCATION		PROPERTY BOUNDARY
SSIA5-10	PHASE I BOREHOLE LOCATION		INVESTIGATION AREA BOUNDARY

NOTE: LOCATIONS FOR EP-118 AND EP-128 ARE LOCATED OUTSIDE THE LIMITS OF THIS FIGURE.

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 5
(HISTORIC SMELTER TOWN AREA)
SOIL SAMPLING LOCATIONS

FIGURE
2-27

Hydrometrics, Inc.

Drawing Name: 1247v201u104.dwg Last Modified: Nov 01, 2001 - 4:14pm Plotted on: Nov 0 1 - 8:46am by MEDDY

UPDATE TIME: 3:00
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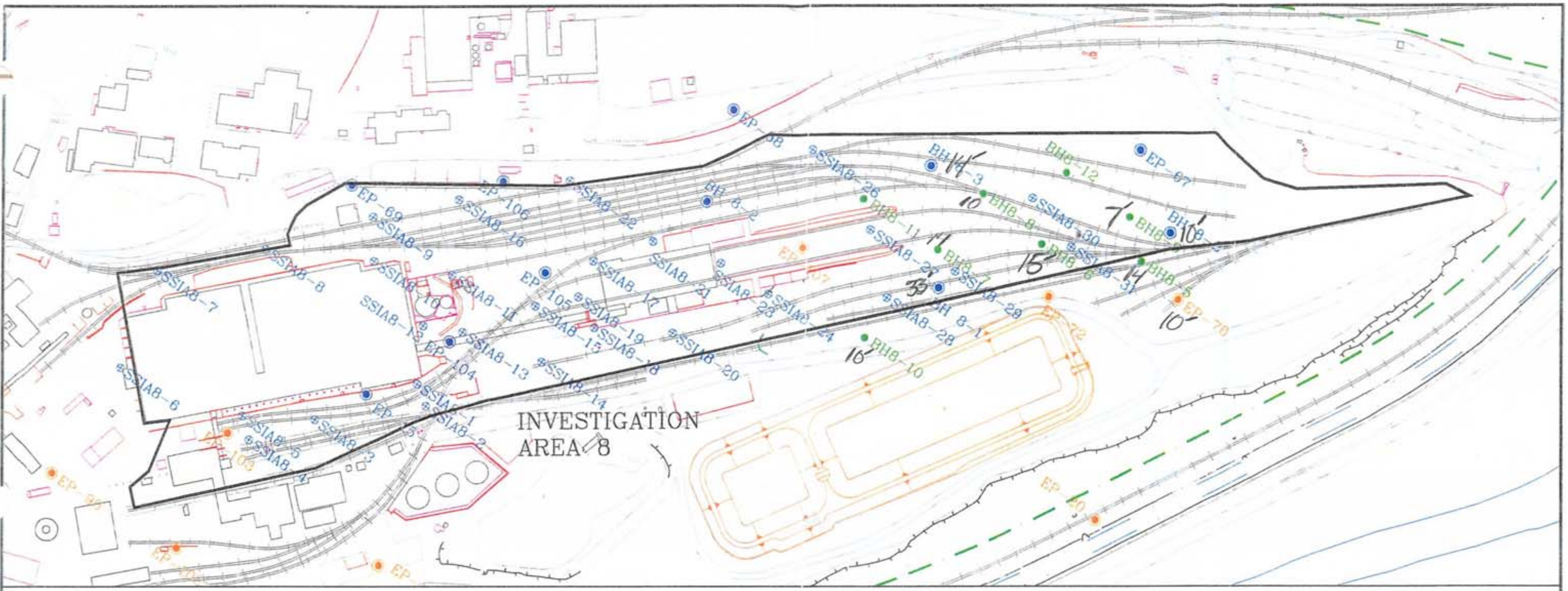

LEGEND

BH12-22	PHASE III BOREHOLE LOCATION
EP-15	PHASE I AND PHASE II WELL LOCATION
BH 8-3	PHASE II BOREHOLE LOCATION
SSIA8-13	PHASE I BOREHOLE LOCATION
EP-70	WELL ASSOCIATED WITH CHARACTERIZATION
	PROPERTY BOUNDARY
	INVESTIGATION AREA BOUNDARY

NORTH

SCALE
0 (In Feet) 200'
APPROXIMATE

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 8 SOIL SAMPLING LOCATIONS	FIGURE 2-28

Hydrometrics, Inc.

UPDATE TIME: 3:00
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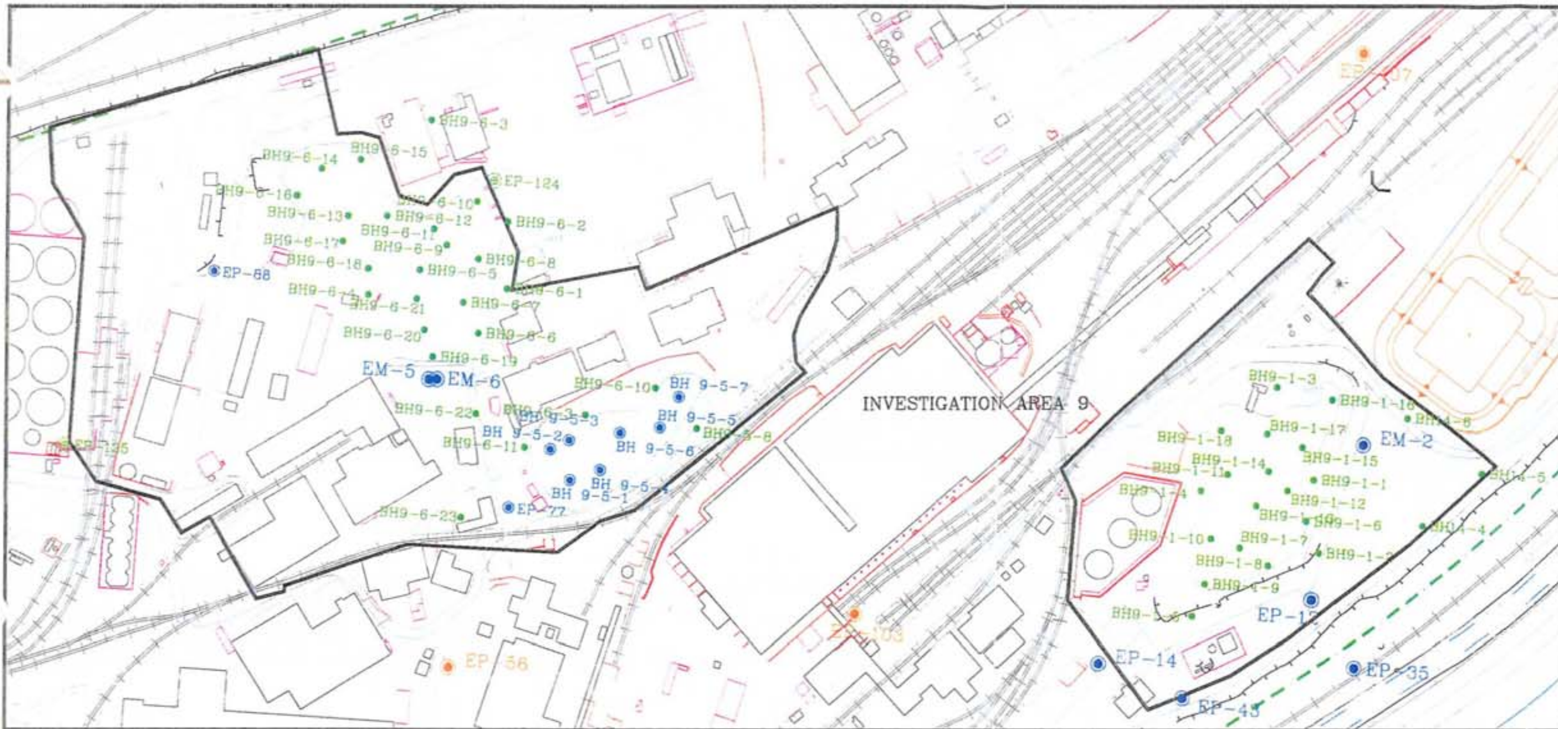
Drawing Name: I:\1247v201u105.dwg Last Modified: Nov 01, 2001 - 4:14pm Plotted on: Nov 01 - 8:52am by MEDDY



LEGEND

EP-125	PHASE III WELL LOCATION
BH9-5-2	PHASE III BOREHOLE LOCATION
EP-12	PHASE I AND PHASE II WELL LOCATION
BH9-5-4	PHASE II BOREHOLE LOCATION
EP-56	WELL ASSOCIATED WITH CHARACTERIZATION
	PROPERTY BOUNDARY
	INVESTIGATION AREA BOUNDARY

NOTE: LOCATIONS FOR EP-4, EP-26, EP-29, EP-66, EP-80, EP-116 AND EP-117 ARE LOCATED OUTSIDE THE LIMITS OF THIS FIGURE.

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 9
(PONDS 1, 5 AND 6)
SOIL SAMPLING LOCATIONS

FIGURE 2-29

UPDATE TIME: 0730
00C\1247\065\0036\tue\102201\I:\1247 1247v201u106
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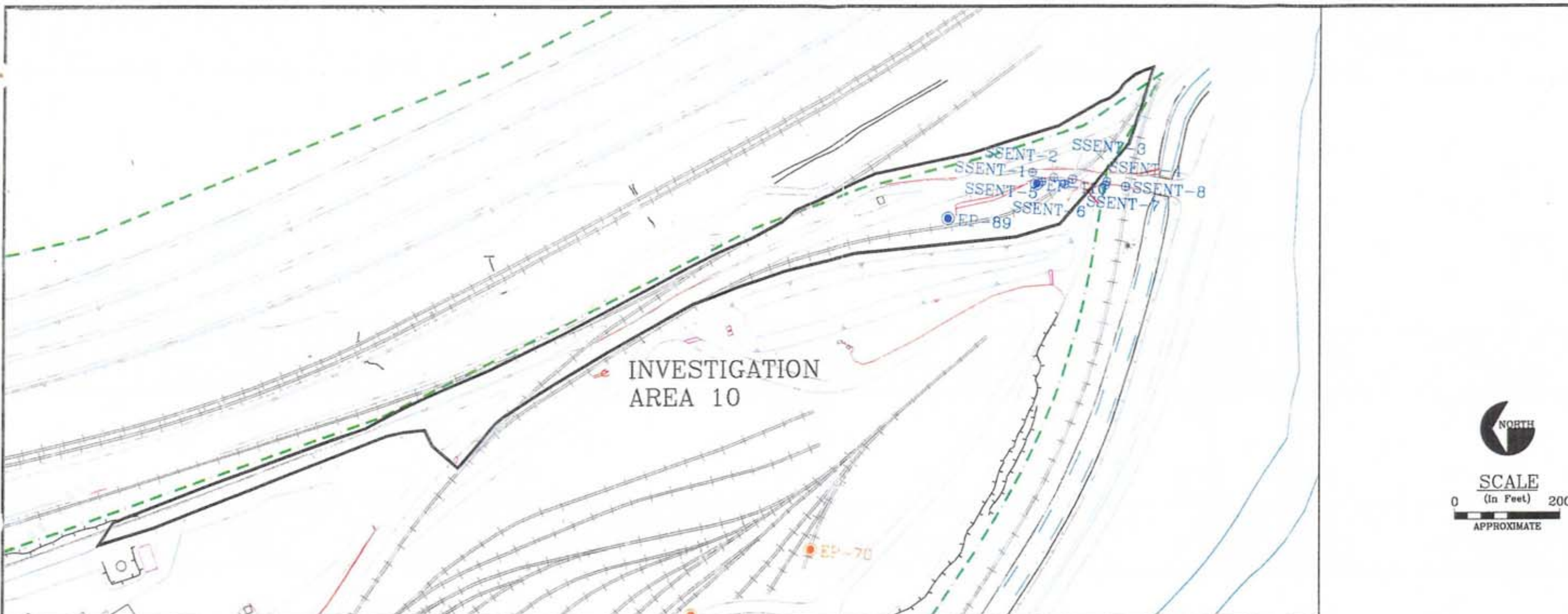

LEGEND

Symbol	Description
EP-89	PHASE I AND PHASE II WELL LOCATION
SSENT-6	PHASE I BOREHOLE LOCATION
EP-70	WELL ASSOCIATED WITH CHARACTERIZATION
	PROPERTY BOUNDARY
	INVESTIGATION AREA BOUNDARY

NOTE: NO SAMPLE LOCATIONS FOR PHASE III INVESTIGAITION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 10 (PLANT ENTRANCE AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-30

Hydrometrics, Inc.

Drawing Nam 1247\1247v201u107.dwg Last Modified: Nov 06, 2001 - 9:28am Plotted on: , 2001 - 9:00am by MEDOY

UPDATE TIME: 3:00
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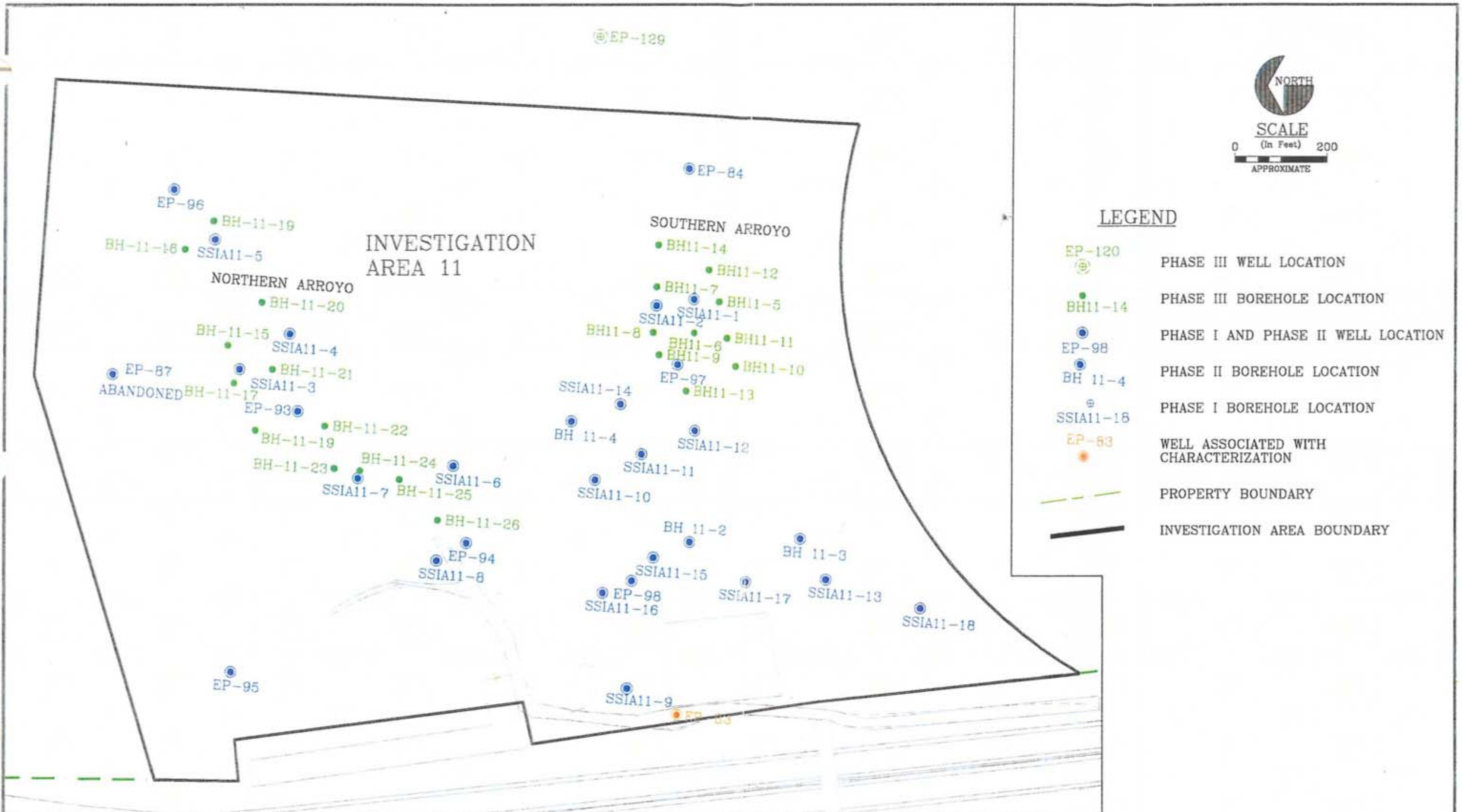

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 11 (ARROYOS EAST OF I-10) SOIL SAMPLING LOCATIONS	FIGURE 2-31

Hydrometrics, Inc.

UPDATE TIME: 3:00
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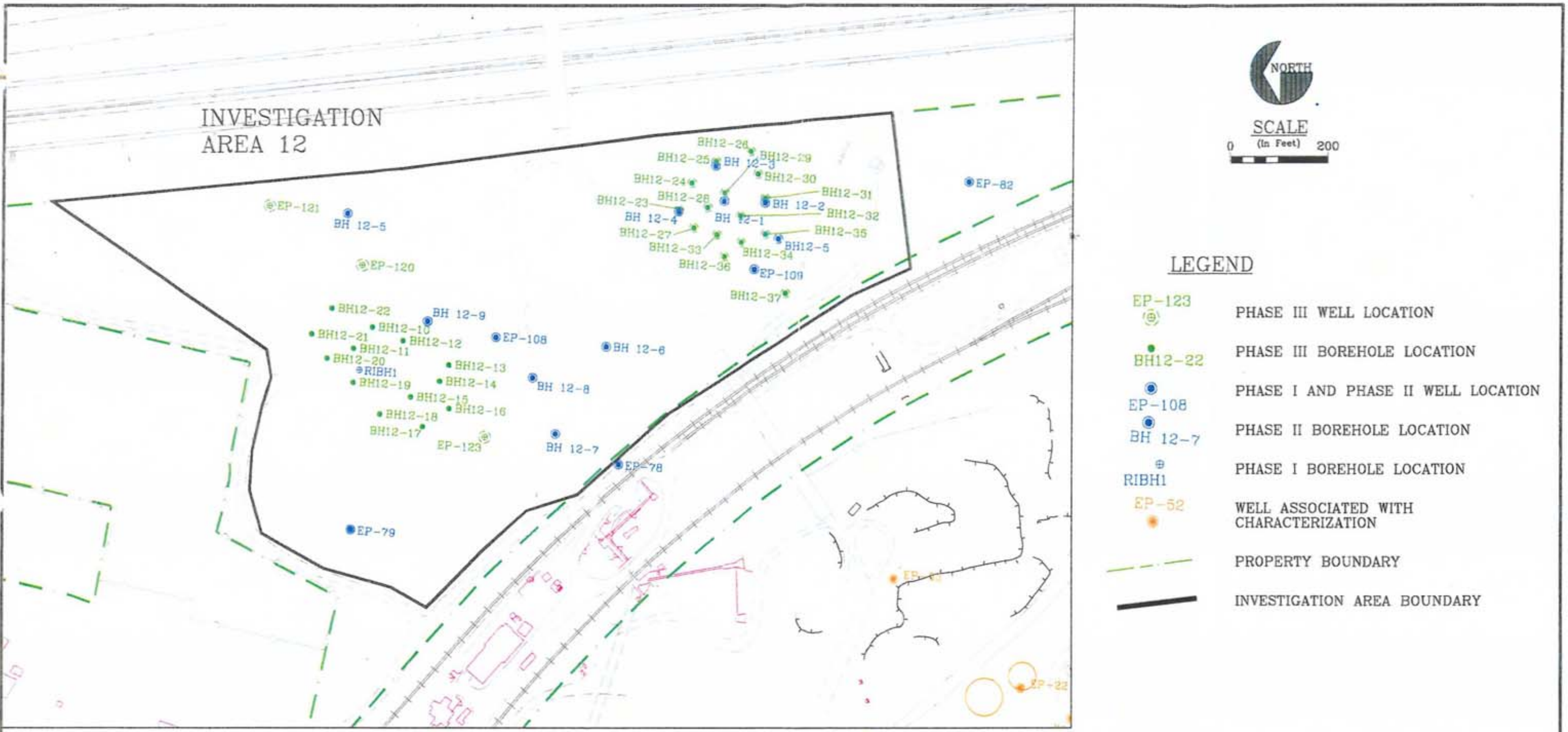
Drawing Name: ...1247\1247v201u108.dwg Last Modified: Nov 06, 2001 - 1:24pm Plotted on: ...7, 2001 - 9:02am by MEDDY



NOTE: THE LOCATION FOR EP-86 IS LOCATED OUTSIDE THE LIMITS OF THIS FIGURE.

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 12 (EPHEMERIAL POND AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-32

Hydrometrics, Inc.

UPDATE TIME: 3:00
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Drawing No \1247\1247v201u100.dwg Last Modified: Nov 07, 2001 - 11:34am Plotted on: 07, 2001 - 11:35am by MEDDY

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 13
(SAMPLE MILL AREA)
SOIL SAMPLING LOCATIONS

FIGURE 2-33

Hydrometrics, Inc.

Drawing Name: I:\...\1247v201u109.dwg Last Modified: Nov 06, 2001 - 1:36pm Plotted on: Nov ..001 - 9:04am by MEDDY

UPDATE TIME: 3:00
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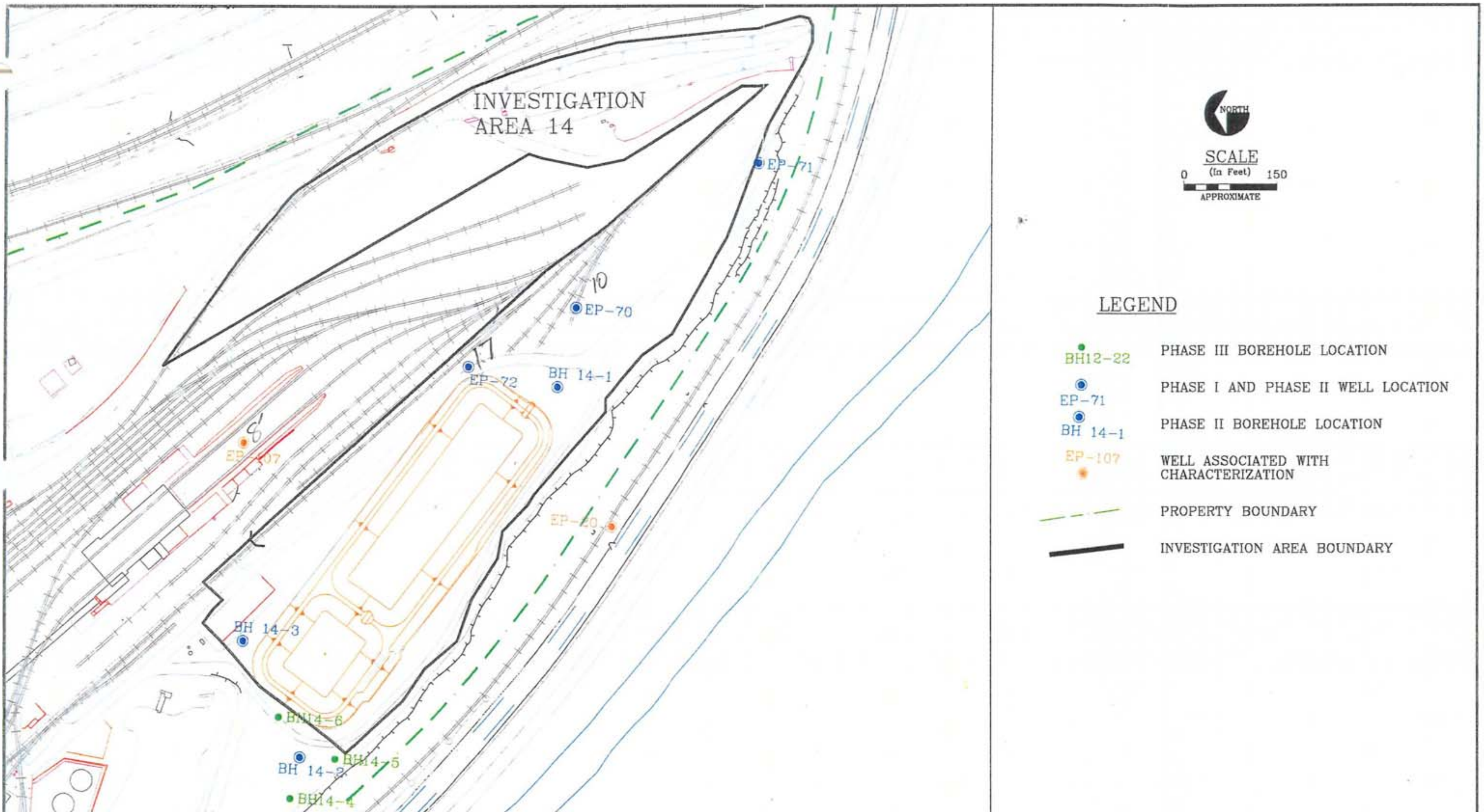

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 14 (SOUTH TERRACE AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-34

Hydrometrics, Inc.

Drawing Name: \1247\1247v201u110.dwg Last Modified: Nov 06, 2001 - 1:24pm Plotted on: Nov 07, 2001 - 9:06am by MEDDY

UPDATE TIME: 3:00
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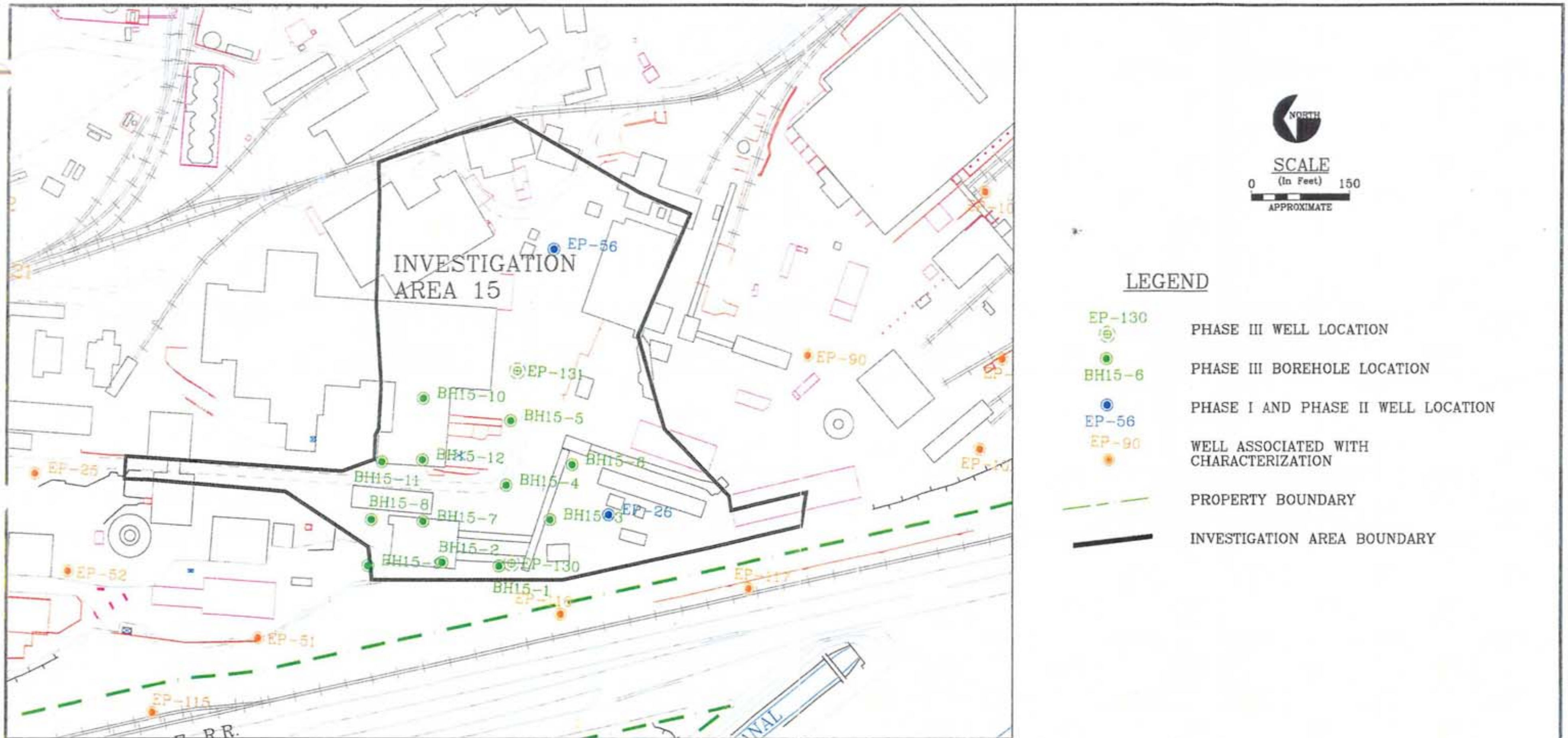

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 15
(FORMER COPPER PLANT AREA)
SOIL SAMPLING LOCATIONS

FIGURE 2-35

Hydrometrics, Inc.

UPDATE TIME: 3:00
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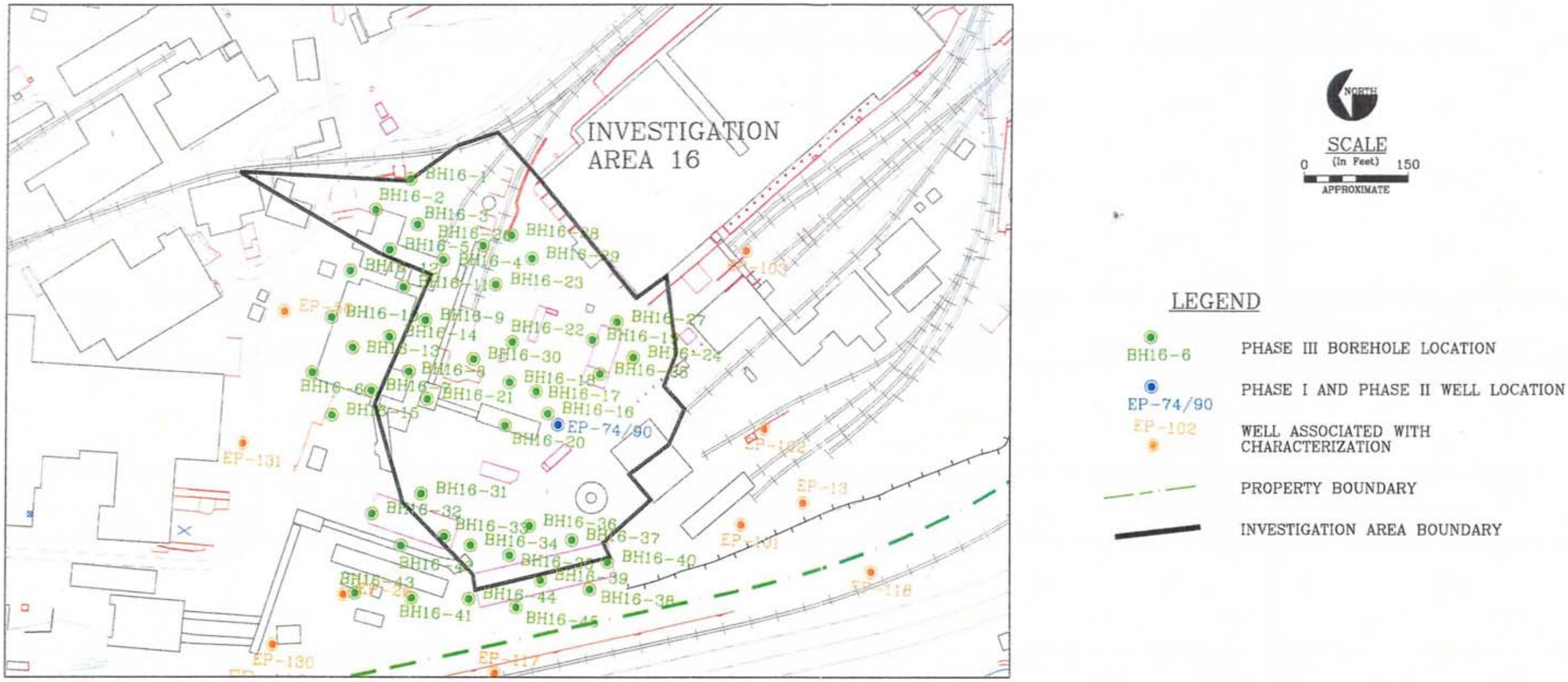

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 16
(FORMER LEAD AND SINTER PLANTS)
SOIL SAMPLING LOCATIONS

FIGURE 2-36

Hydrometrics, Inc.

Drawing Nam... \1247\1247v201u112.dwg Last Modified: Nov 06, 2001 - 1:24pm Plotted on: ...7, 2001 - 9:11am by MEDDY

UPDATE TIME: 3:00
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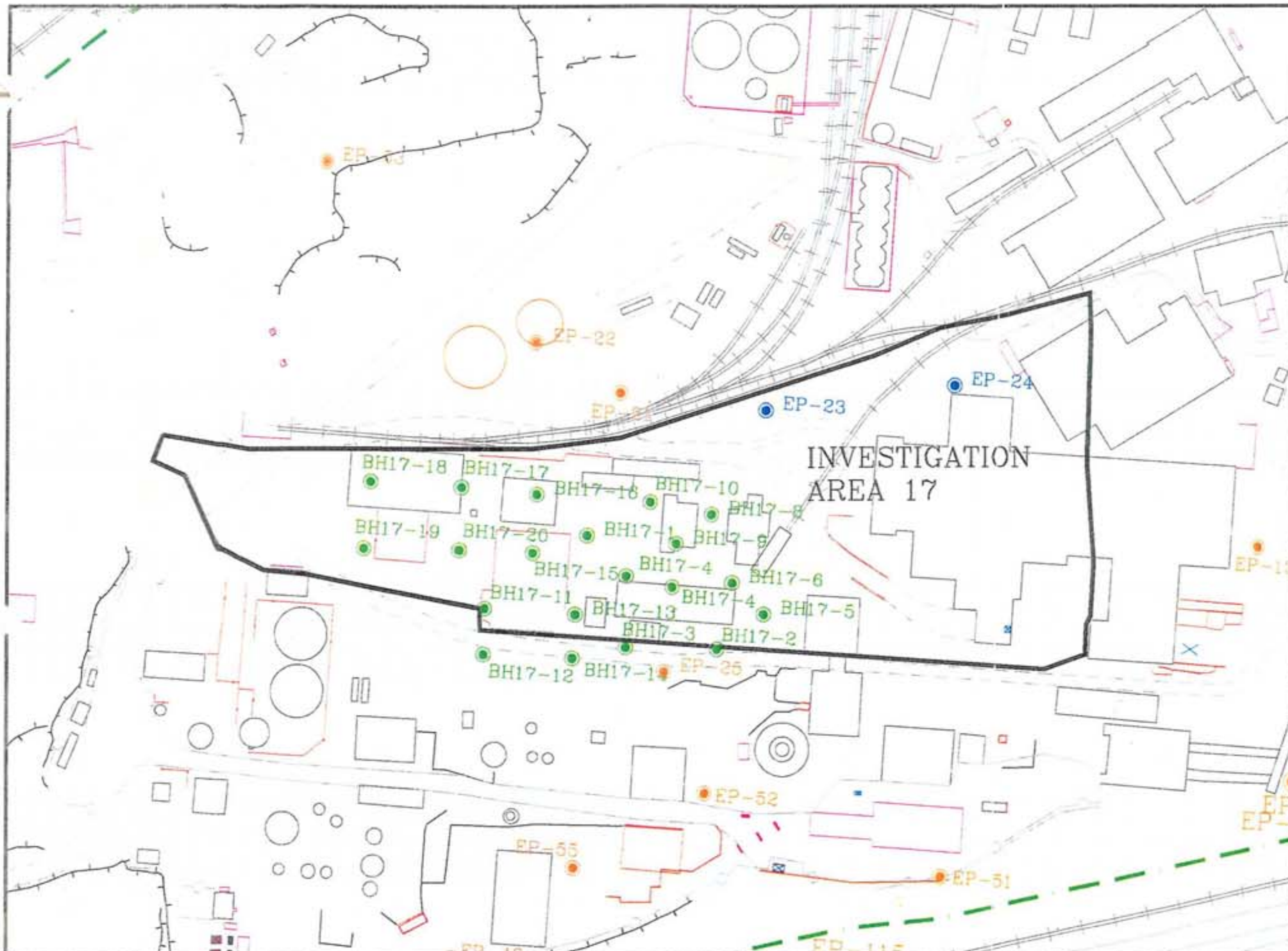

NORTH

SCALE
(In Feet)
0 150
APPROXIMATE

LEGEND

BH17-6	PHASE III BOREHOLE LOCATION
EP-23	PHASE I AND PHASE II WELL LOCATION
EP-25	WELL ASSOCIATED WITH CHARACTERIZATION
	PROPERTY BOUNDARY
	INVESTIGATION AREA BOUNDARY

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 17 (FORMER CADMIUM AND ZINC PLANTS) SOIL SAMPLING LOCATIONS	FIGURE 2-37

Hydrometrics, Inc.

Drawing No \1247\1247v201u113.dwg Last Modified: Nov 06, 2001 - 2:20pm Plotted on: ?7, 2001 - 9:13am by MEDDY

UPDATE TIME: 3:00
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ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 18 (FORMER ANTIMONY PLANT AREA) SOIL SAMPLING LOCATIONS	FIGURE 2-38

Hydrometrics, Inc.

Drawing Name: ...1247\1247v201u114.dwg Last Modified: Nov 07, 2001 - 8:22am Plotted on: N... 07, 2001 - 9:14am by MEDDY

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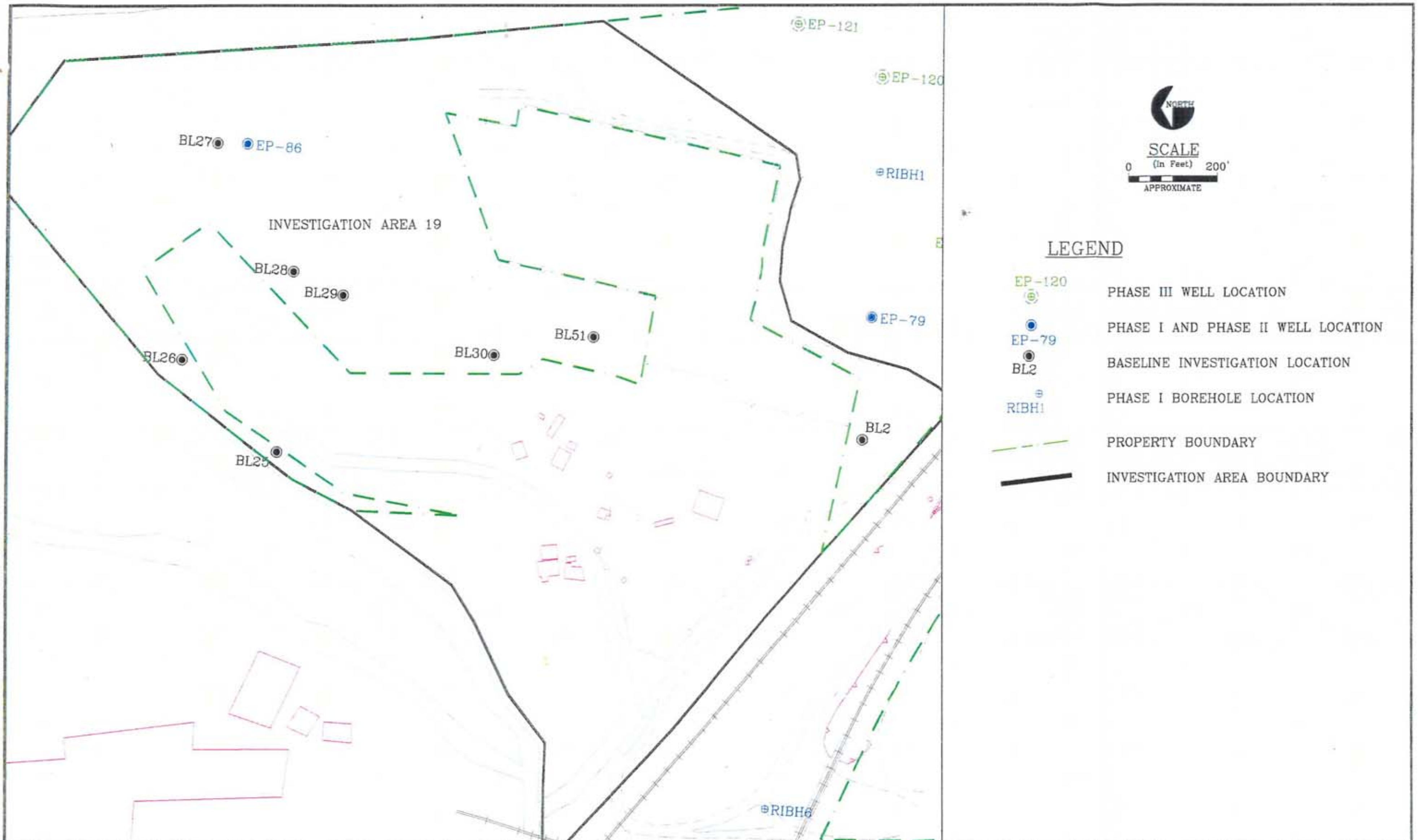

NOTE: PLEASE REFER TO EXHIBIT 1 FOR INVESTIGATION AREA LOCATION

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 19
(LA CALAVERA AREA)
SOIL SAMPLING LOCATIONS

FIGURE 2-39

Hydrometrics, Inc.

UPDATE TIME: 3:00
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Drawing No 247\1247v201u128.dwg Last Modified: Nov 12, 2001 - 1:14pm Plotted on: 2, 2001 - 1:15pm by MEDDY

LEGEND

BL32 — PHASE III TEST LOCATION

PROPERTY BOUNDARY

NORTH

SCALE (In Feet) 0 500

NOTE: PLEASE REFER TO EXHIBIT 1 FOR INVESTIGATION AREA LOCATION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 20 (OTHER ASARCO PROPERTY EAST OF I-10) SOIL SAMPLING LOCATIONS	FIGURE 2-40a

Hydrometrics, Inc.

UPDATE TIME: 3:00
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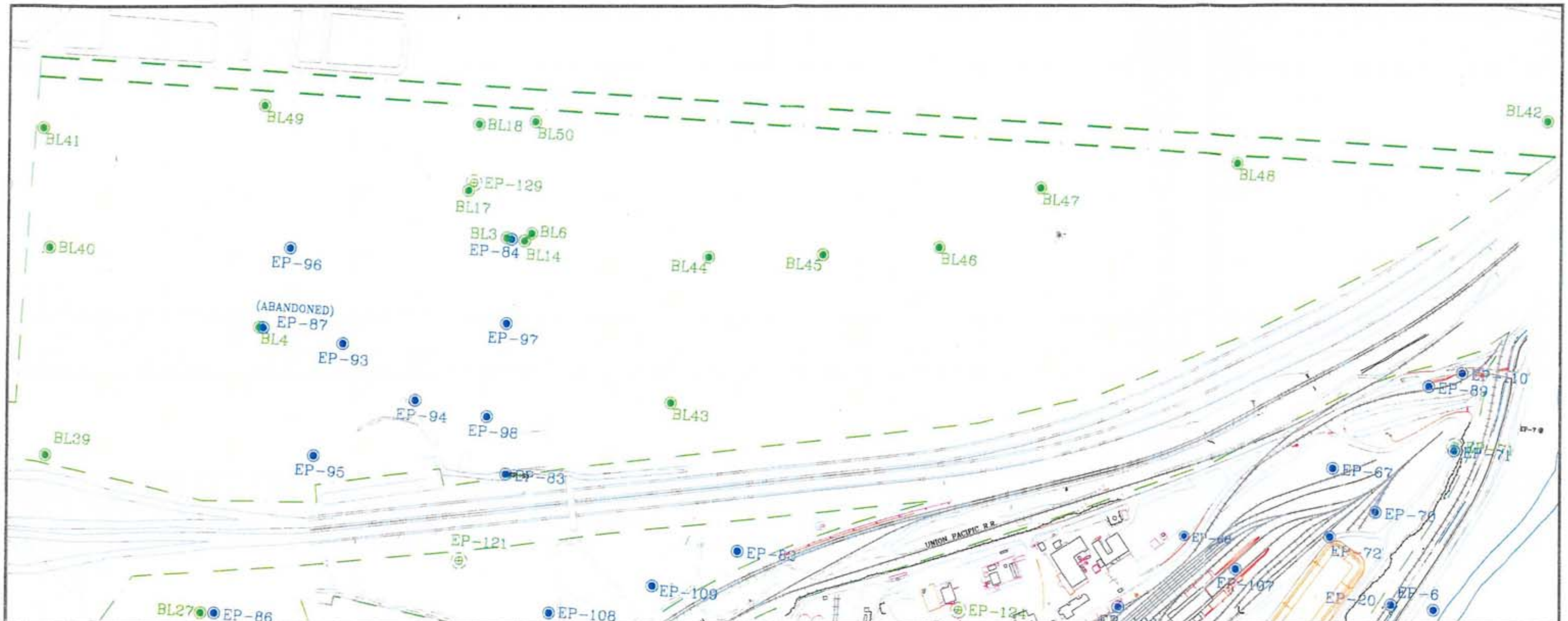
Drawing Name: 147\1247v201u129.dwg Last Modified: Nov 12, 2001 - 10:18am Plotted on: 2, 2001 - 1:20pm by MEDDY



LEGEND

BL44	PHASE III TEST LOCATION
EP-121	PHASE III WELL LOCATION
EP-95	PHASE I AND PHASE II WELL LOCATION
— - —	PROPERTY BOUNDARY

NORTH

SCALE (In Feet) 0 500

NOTE: PLEASE REFER TO EXHIBIT 1 FOR INVESTIGATION AREA LOCATION

ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	INVESTIGATION AREA 20 (OTHER ASARCO RPOPERTY EAST OF I-10) SOIL SAMPLING LOCATIONS	FIGURE 2-40b

Hydrometrics, Inc.

UPDATE TIME: 3:00
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Drawing Name: 247\1247v201u129.dwg Last Modified: Nov 12, 2001 - 10:18am Plotted on: 2, 2001 - 1:18pm by MEDOY

Figure 2-17 IBWC Water Quality Data for Rio Grande at Courchesne Bridge
August 1995 through June 2001
ASARCO El Paso Smelter
Phase III RI

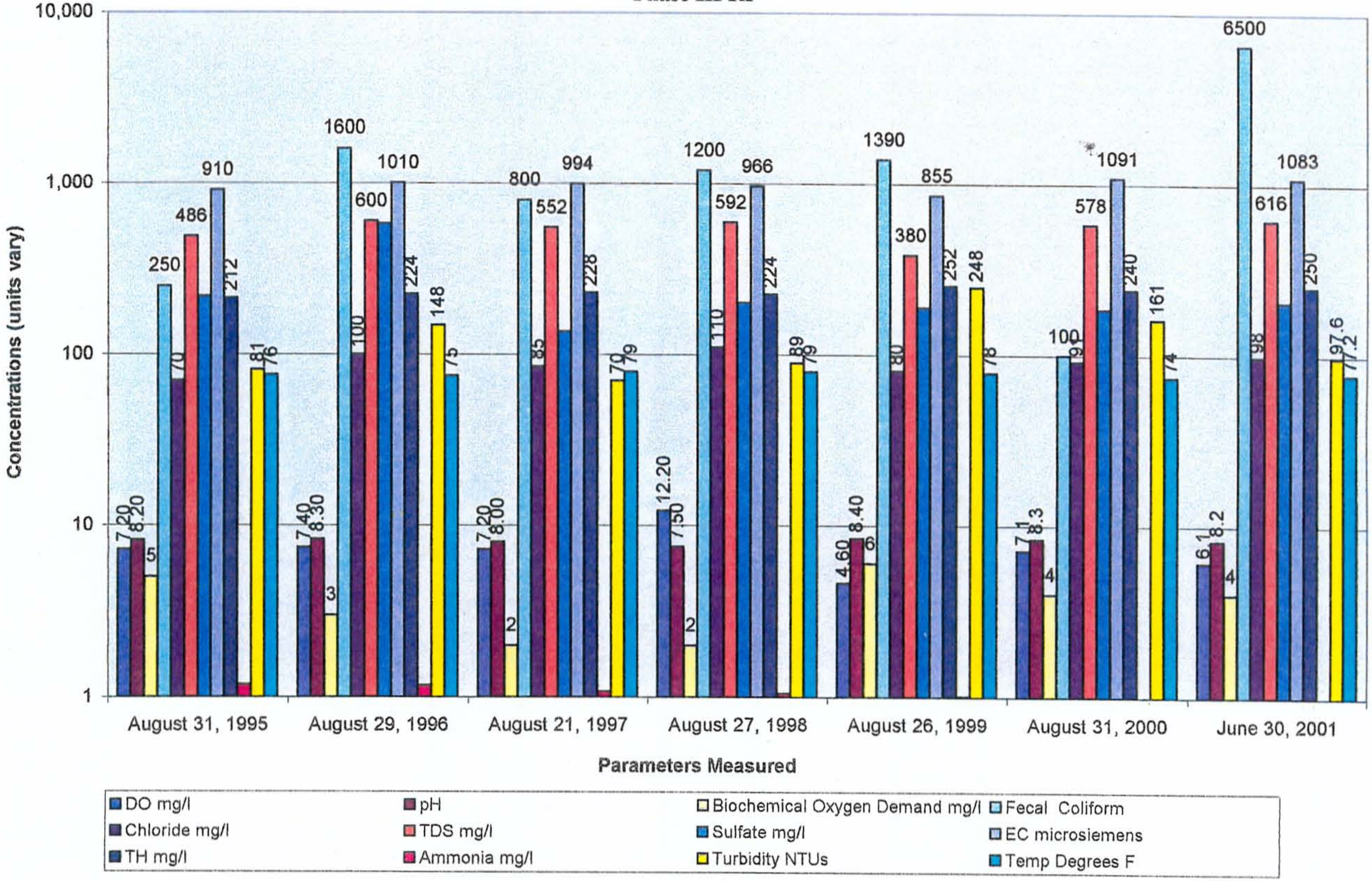
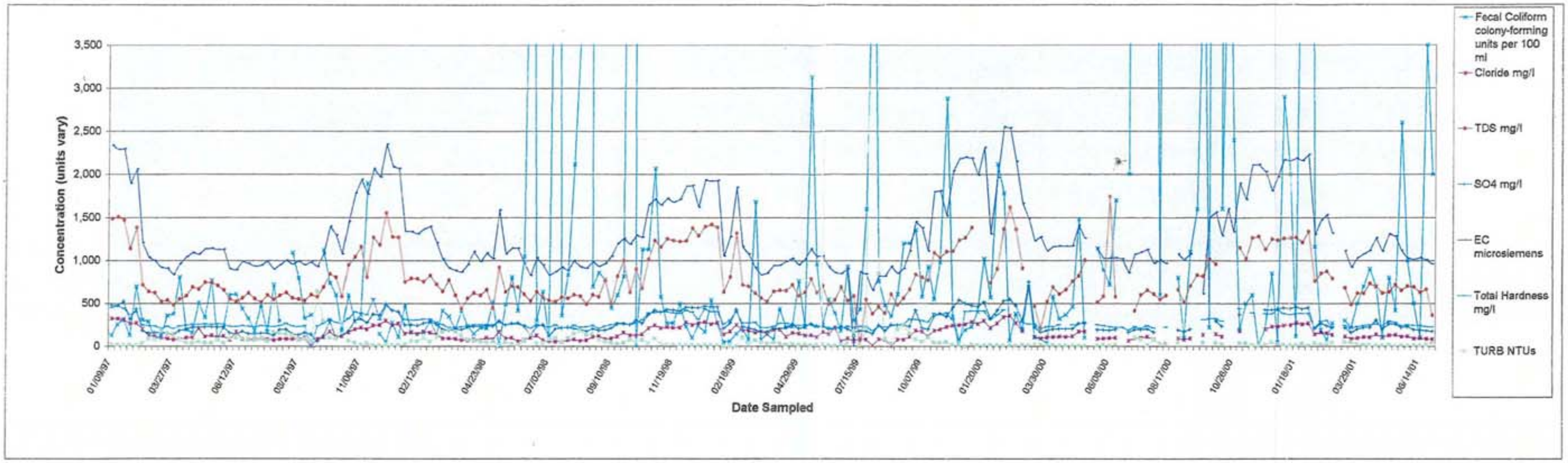


Figure 2-18 IBWC Water Quality Data for Rio Grande at Bowie High Football Stadium, 1997 Through June 2001
ASARCO El Paso Smelter
Phase III RI



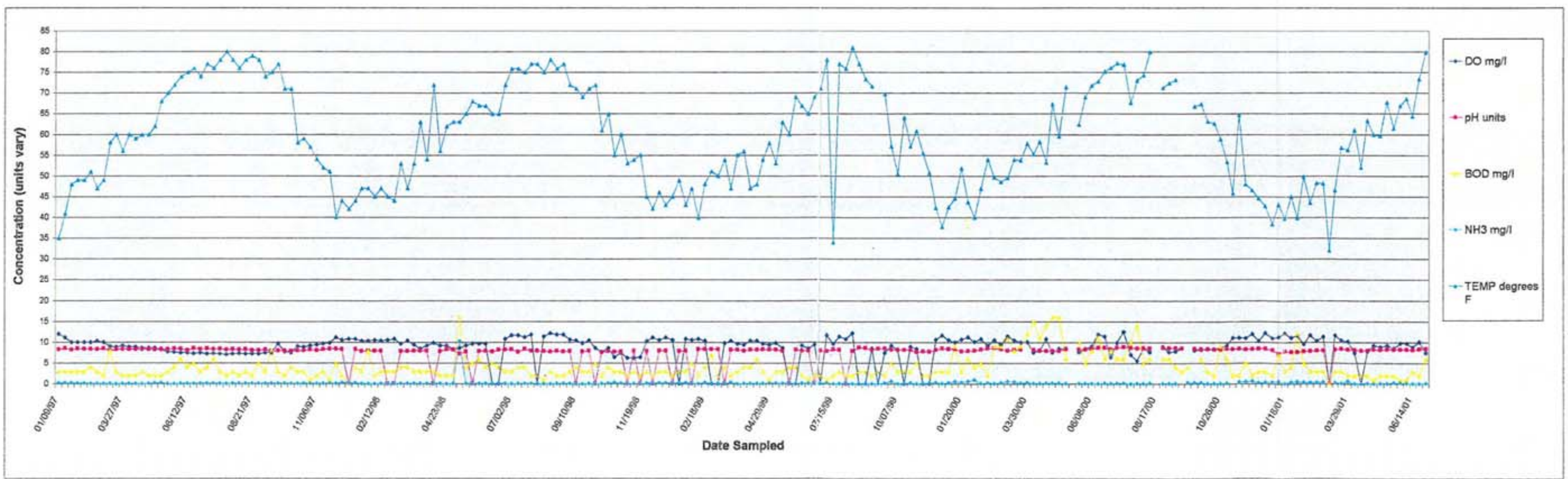
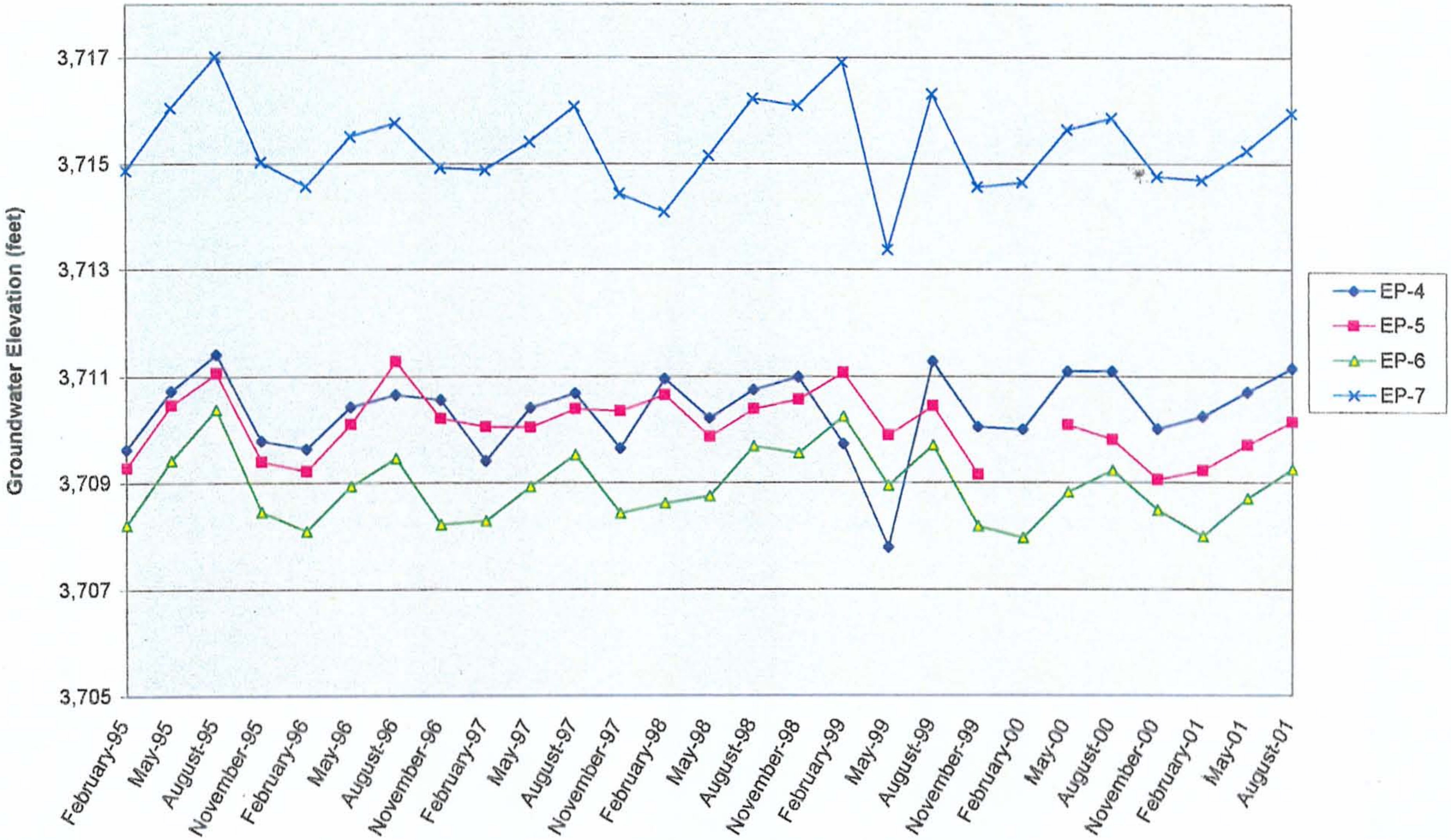
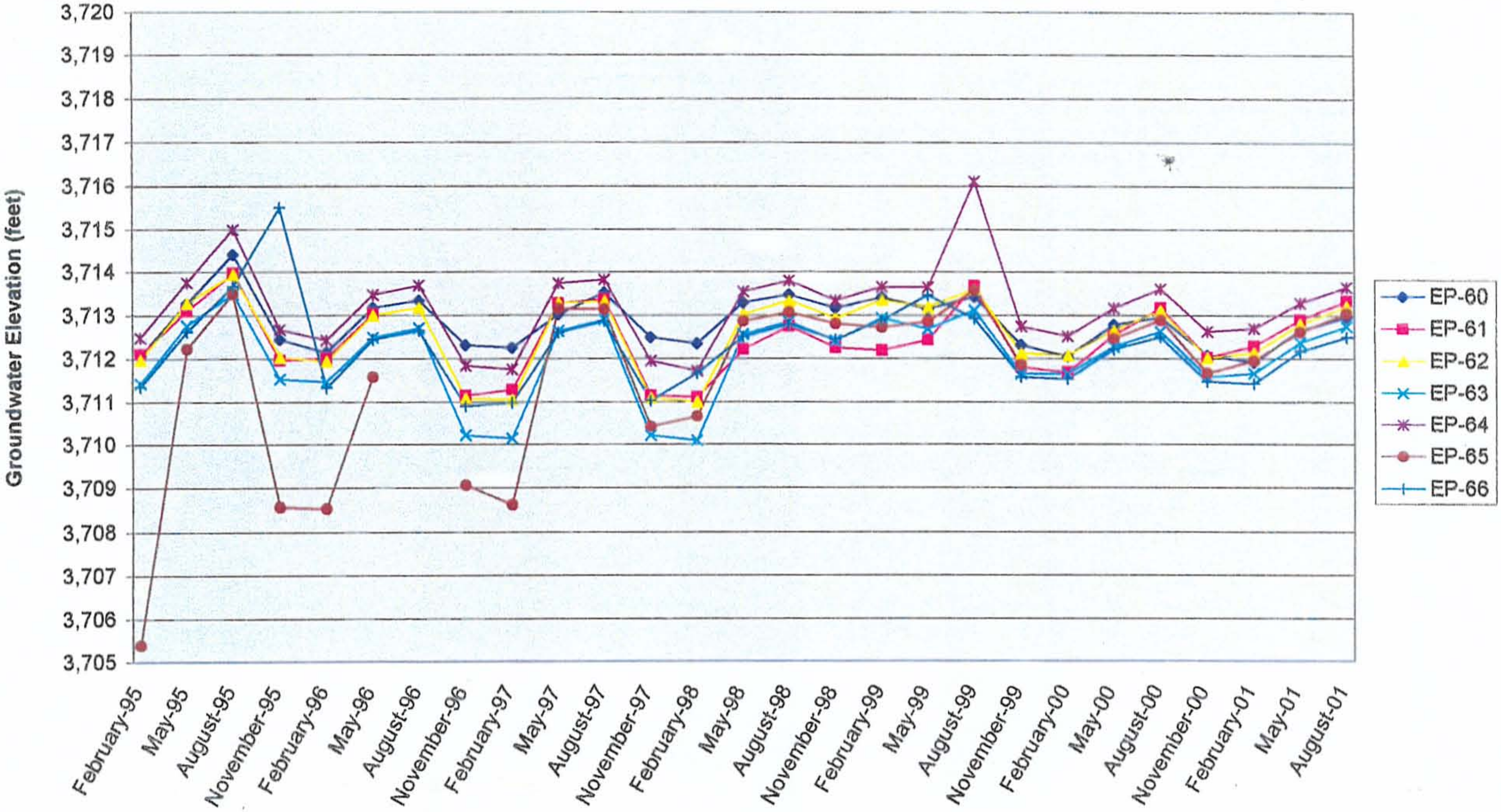


Figure 2-21 Groundwater Elevation of wells adjacent to Rio Grande (in feet), 1995 through August 2001
ASARCO El Paso Smelter, Phase III RI



Note: Depths to water are not adjusted for free-phase hydrocarbon occurrence, which depresses the water table elevation.

Figure 2-22 Groundwater Elevation of Wells Located in Historic Smeltertown Area (in feet), 1995 through August 2001
ASARCO El Paso Smelter, Phase III RI



Note: Depths to water are not adjusted for free-phase hydrocarbon occurrence, which depresses the water table elevation.

Figure 2-20 Rio Grande Daily Mean Flow Volumes at Three Measuring Locations, 1995 through June 2001
ASARCO El Paso Smelter, Phase III RI

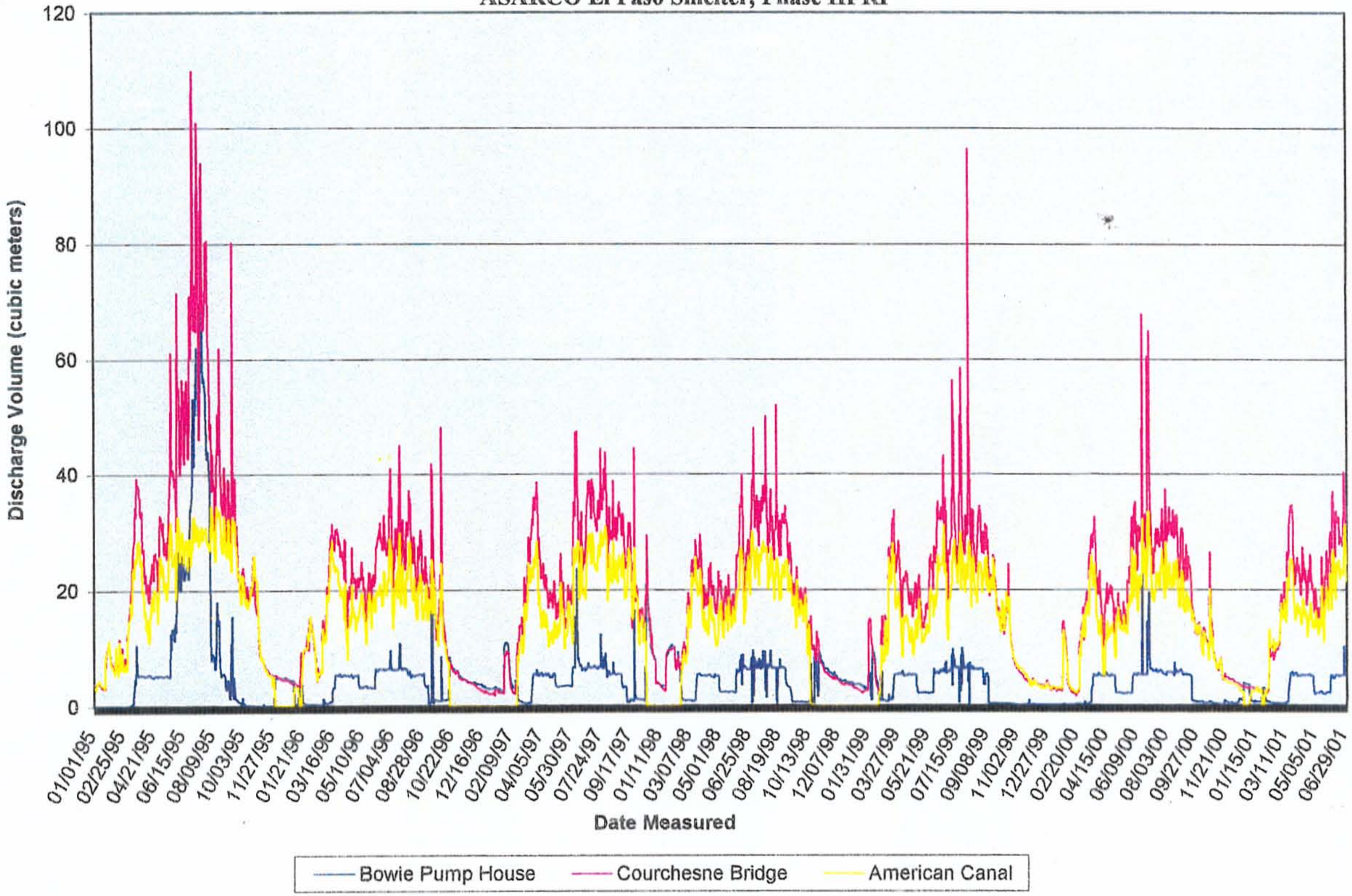
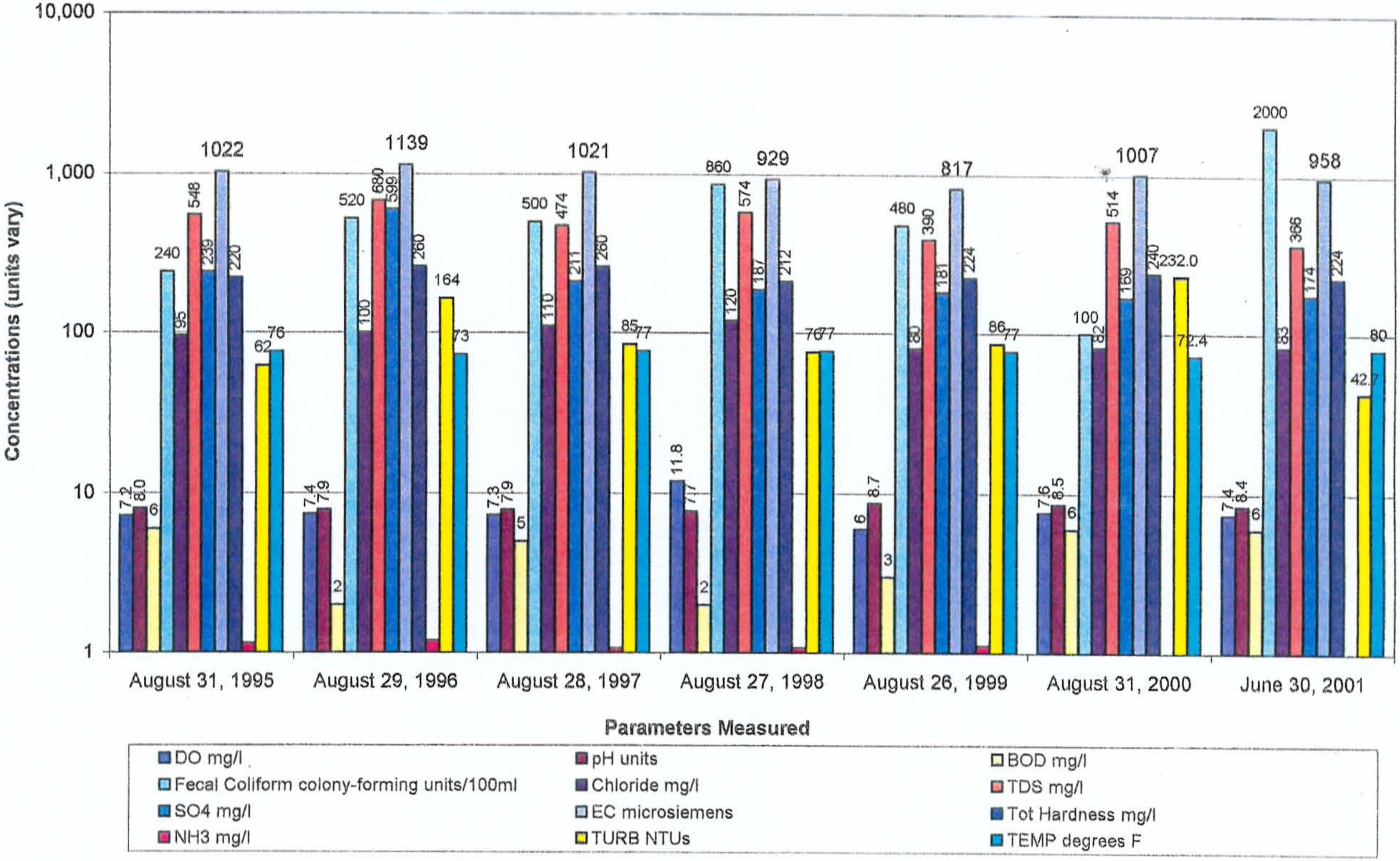
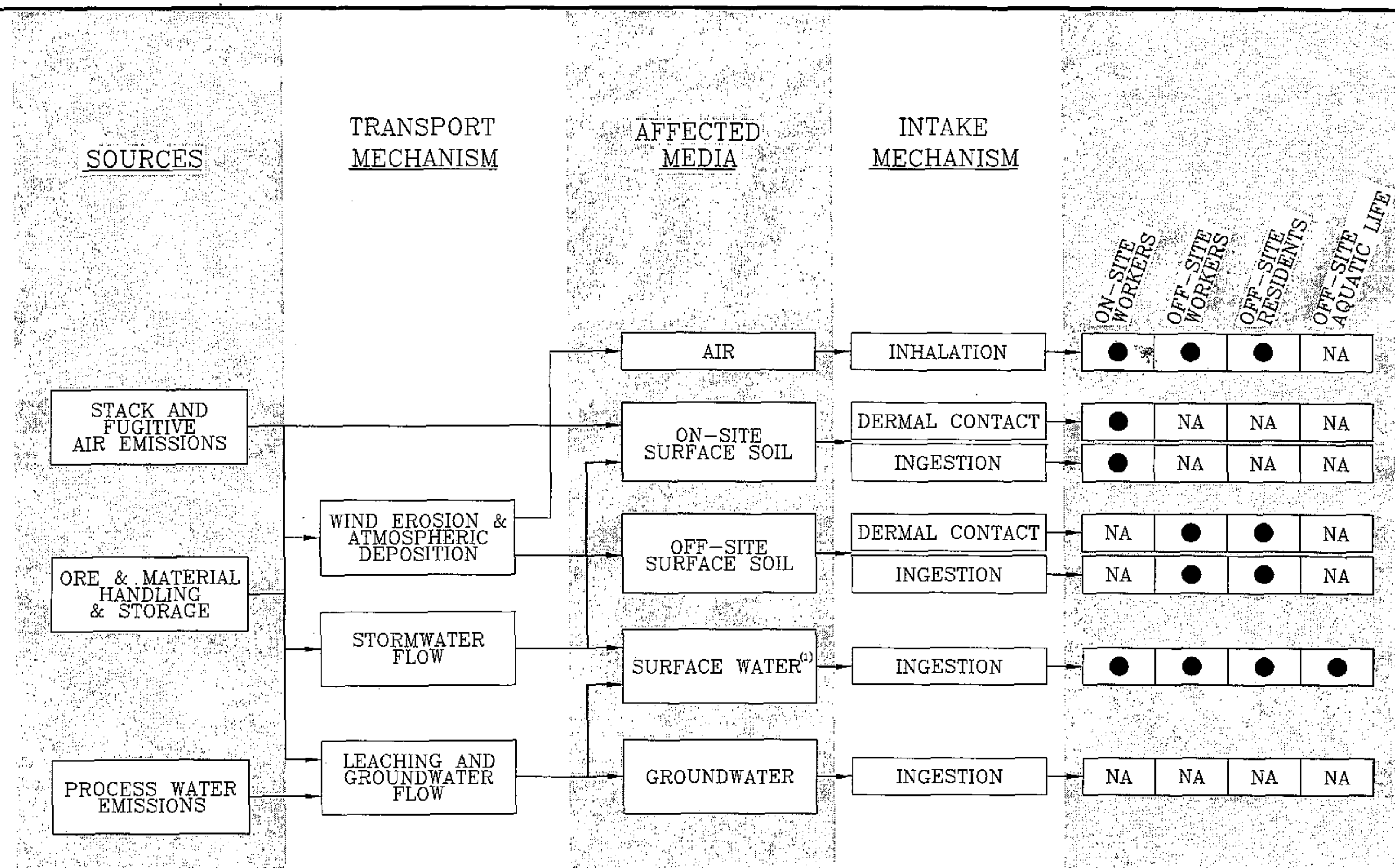


Figure 2-19 IBWC Water Quality Data for Rio Grande at Bowie High Football Stadium
August 1995 through June 2001
ASARCO El Paso Smelter
Phase III RI



H:\Files\128\1247v2\Phase III\Report\Figures\Figure 2-19.xls



LEGEND

● POTENTIAL EXPOSURE PATHWAY

NA NOT AN EXPOSURE PATHWAY, NOT EVALUATED

(1) THE AMERICAN CANAL AND RIO GRANDE

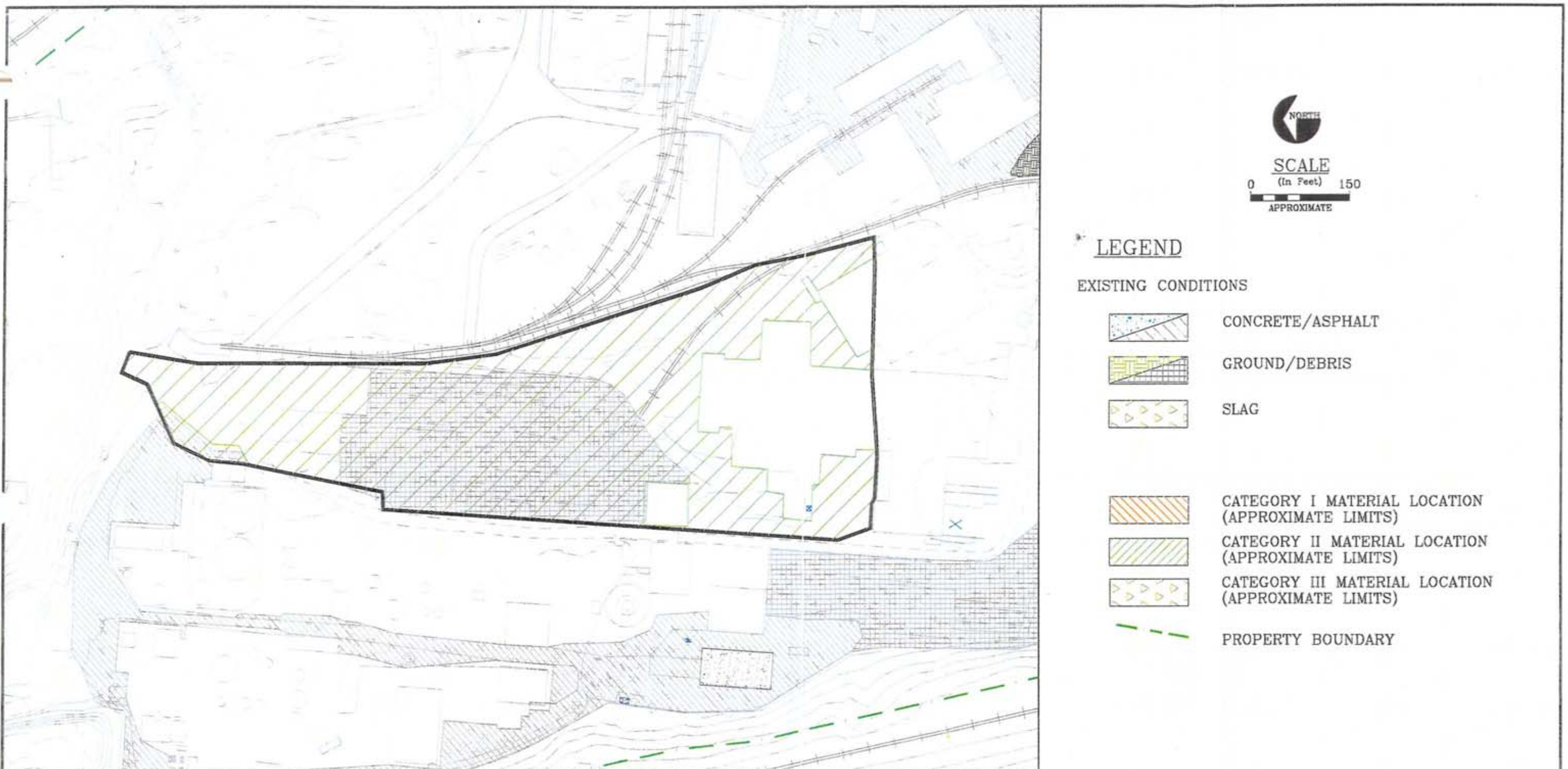
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

BASELINE EXPOSURE PATHWAY FLOW CHART

FIGURE 3-1

UPDATE TIME: 9:30
00MC\ELP\100101\Y:\Land Projects R2\1247\dwg\Phase III
1247v201v048

Hydrometrics, Inc.



IA-17 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	215,000	0
Total	0	0	215,000	0

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 17
(FORMER CADMIUM AND ZINC PLANTS)
CORRECTIVE ACTION MEASURES

FIGURE 4-15

Hydrometrics, Inc.

UPDATE TIME: 10:30
000\1247\065\0036\ELP\103101\i:\1247 1247v201u025

NORTH

SCALE
0 (In Feet) 100
APPROXIMATE

LEGEND

EXISTING CONDITIONS

- CONCRETE/ASPHALT
- GROUND/DEBRIS
- SLAG
- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)
- PROPERTY BOUNDARY

IA-16 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	197,000	0
Total	0	0	197,000	0

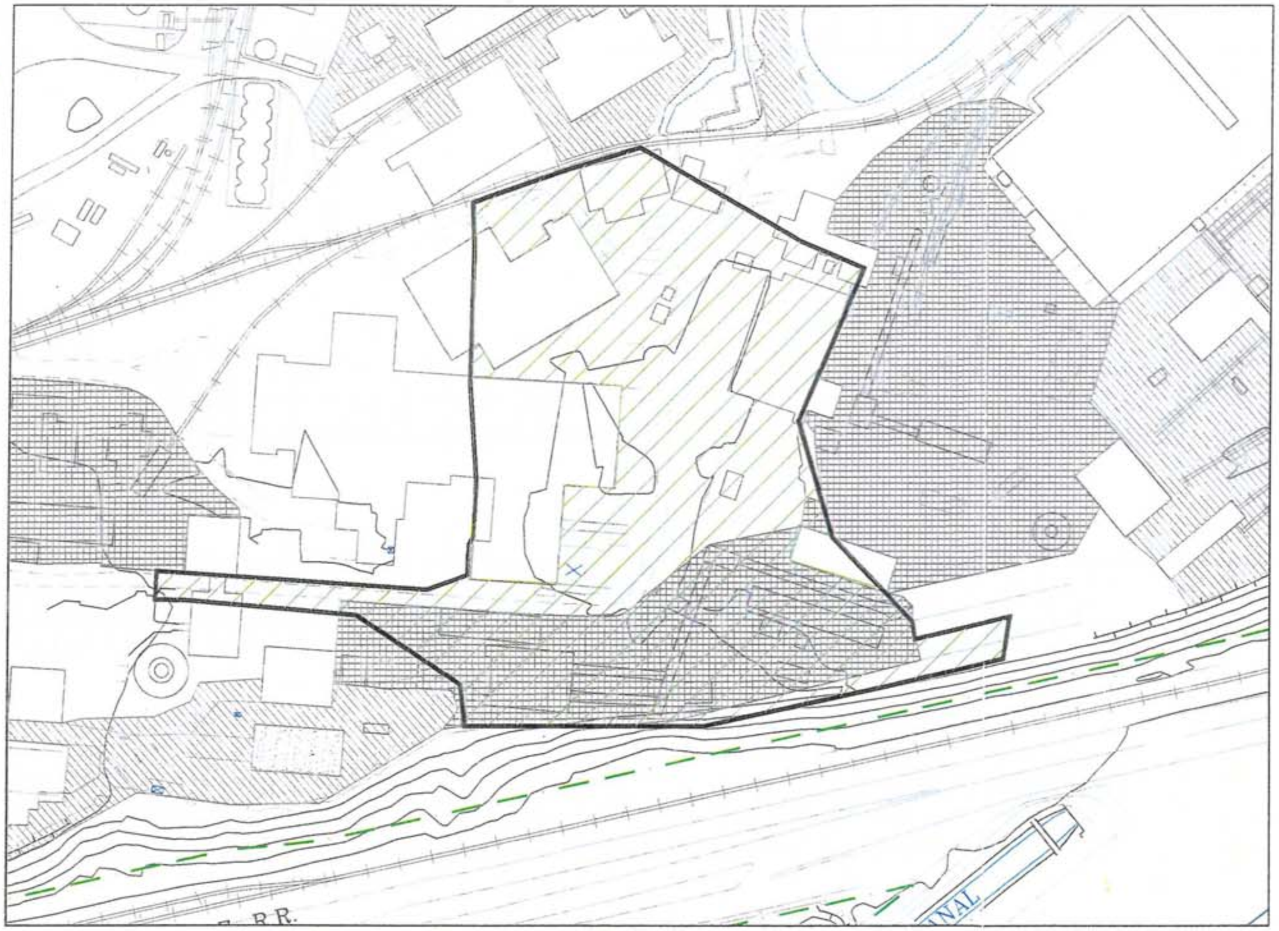
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 16
(LEAD AND SINTER PLANTS)
CORRECTIVE ACTION MEASURES

FIGURE
4–14

UPDATE TIME: 1:30
000\1247\065\0036\ELP\103101\I:\1247 1247v201v024

Hydrometrics, Inc.



NORTH

SCALE
0 (In Feet) 150
APPROXIMATE

LEGEND

EXISTING CONDITIONS

- CONCRETE/ASPHALT
- GROUND/DEBRIS
- SLAG

- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)
- PROPERTY BOUNDARY

IA-15 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	249,000	0
Total	0	0	249,000	0

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 15
COPPER PLANT AREA)
CORRECTIVE ACTION MEASURE

FIGURE
4-13

UPDATE TIME: 1:30
000\1247\065\0036\ELP\103101\I:\1247 1247v201v023

Hydrometrics, Inc.

LEGEND

EXISTING CONDITIONS

- CONCRETE/ASPHALT
- GROUND/DEBRIS
- SLAG

- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)
- PROPERTY BOUNDARY

IA-14 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	320,000	0
Total	0	0	320,000	0

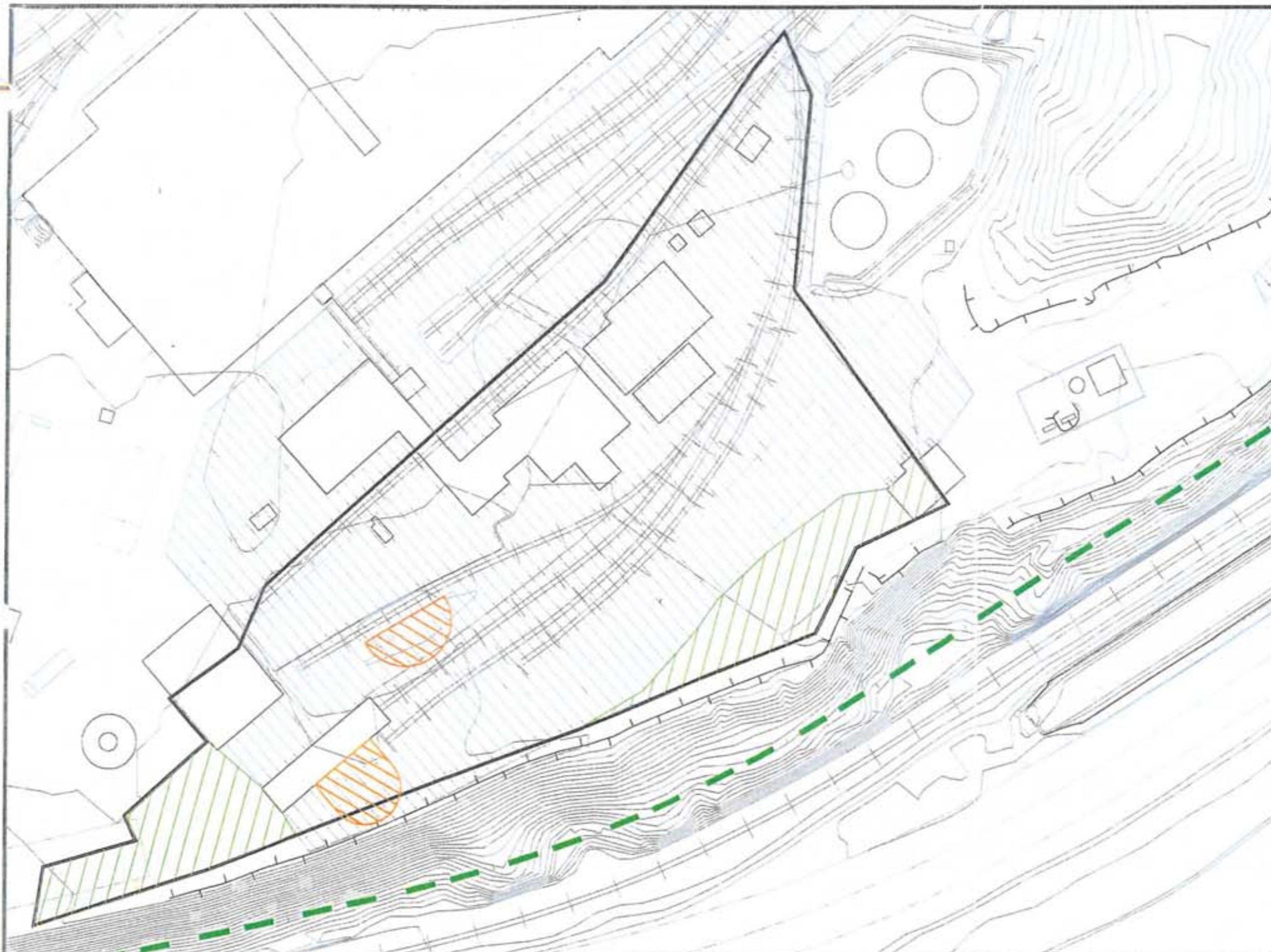
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 14
(SOUTH TERRACE AREA)
CORRECTIVE ACTION MEASURES

FIGURE 4-12

Hydrometrics, Inc.

UPDATE TIME: 1:00
000\1247\065\0036\ELP\103101\V:\1247 1247v201v022



IA-13 SUMMARY

AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	1000	5400	27600	0
Total	1000	5400	27600	0

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

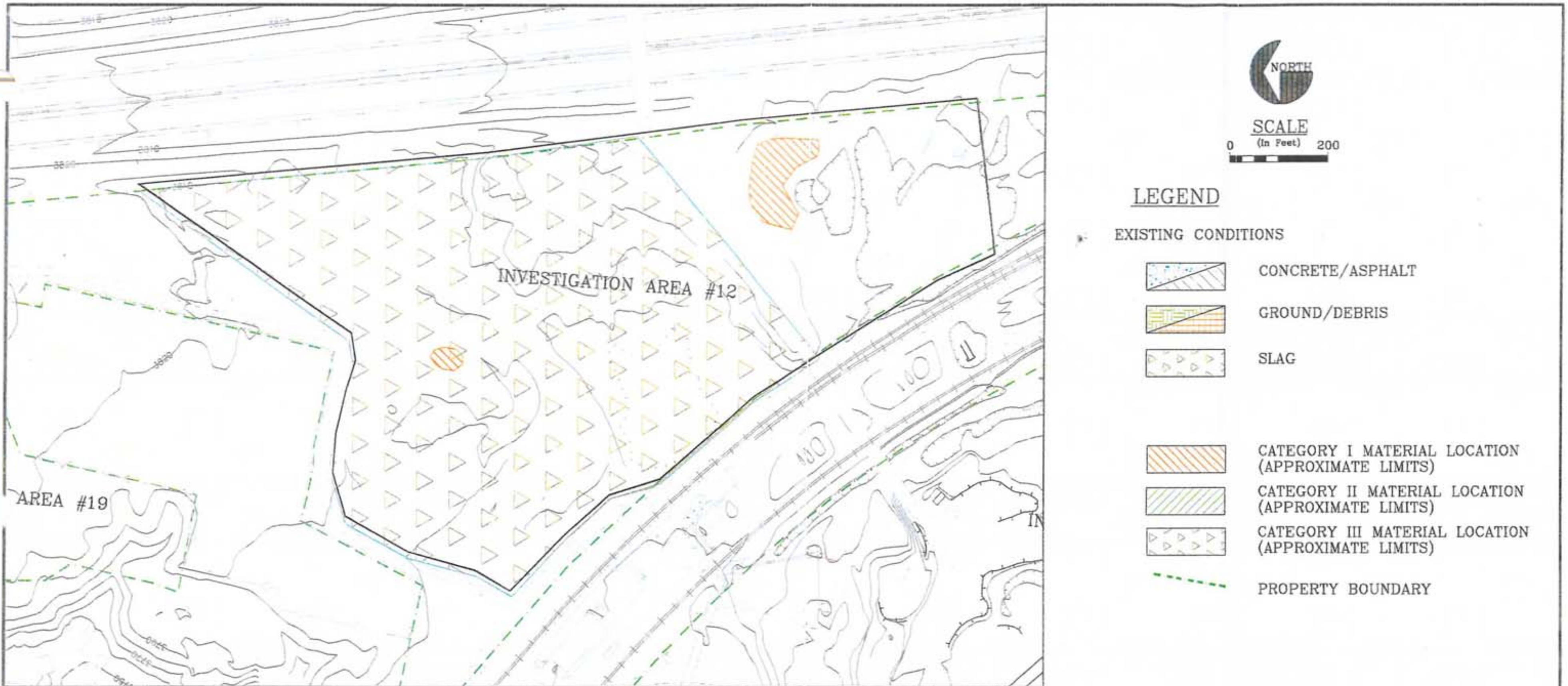
INVESTIGATION AREA 13 (SAMPLE MILL AREA) CORRECTIVE ACTION MEASURES

FIGURE 4-11

Hydrometrics, Inc. ©

Drawing Nor... Land Projects R2\1247\dwg\1247v201v021.dwg Last Modified: Oct 23, 2001 — ...pm Plotted on: Oct 30, 2001 - 8:24am by JGILLIE

UPDATE TIME: 1100
128\1247\065\0036\ELP\102201\I:\1247 1247v201v021



IA-12 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	2300	28,500	0	775,000
Total	2300	28,500	0	775,000

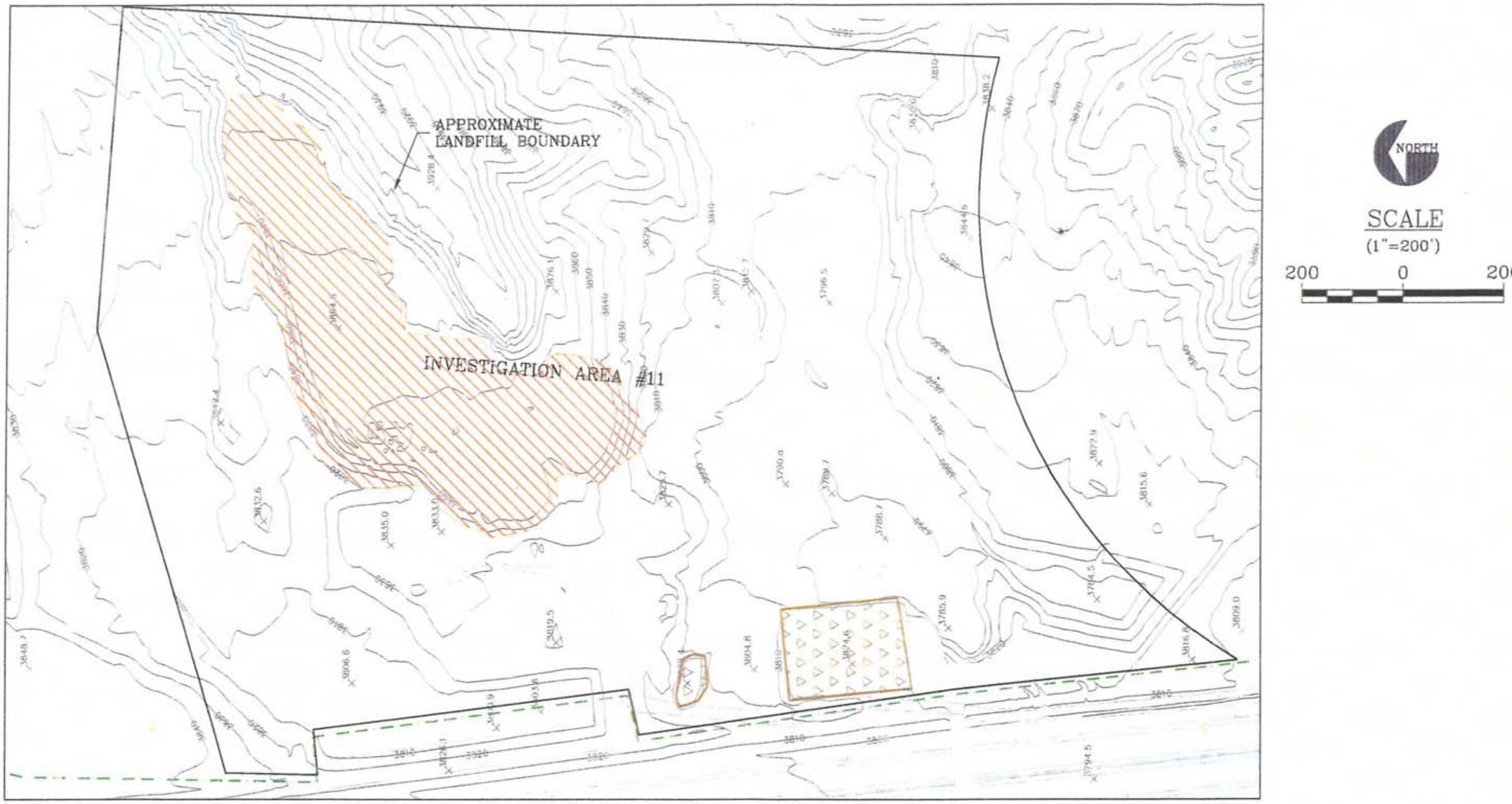
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 12
(EPHEMERIAL POND AREA)
CORRECTIVE ACTION MEASURES

FIGURE 4-10

Hydrometrics, Inc.

UPDATE TIME: 12:00
000\1247\065\0036\ELP\103101\i:\1247 1247v201v020



LEGEND

- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

IA-11 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	100,000	298,000	0	50,000
Total	122,000	298,000	0	50,000

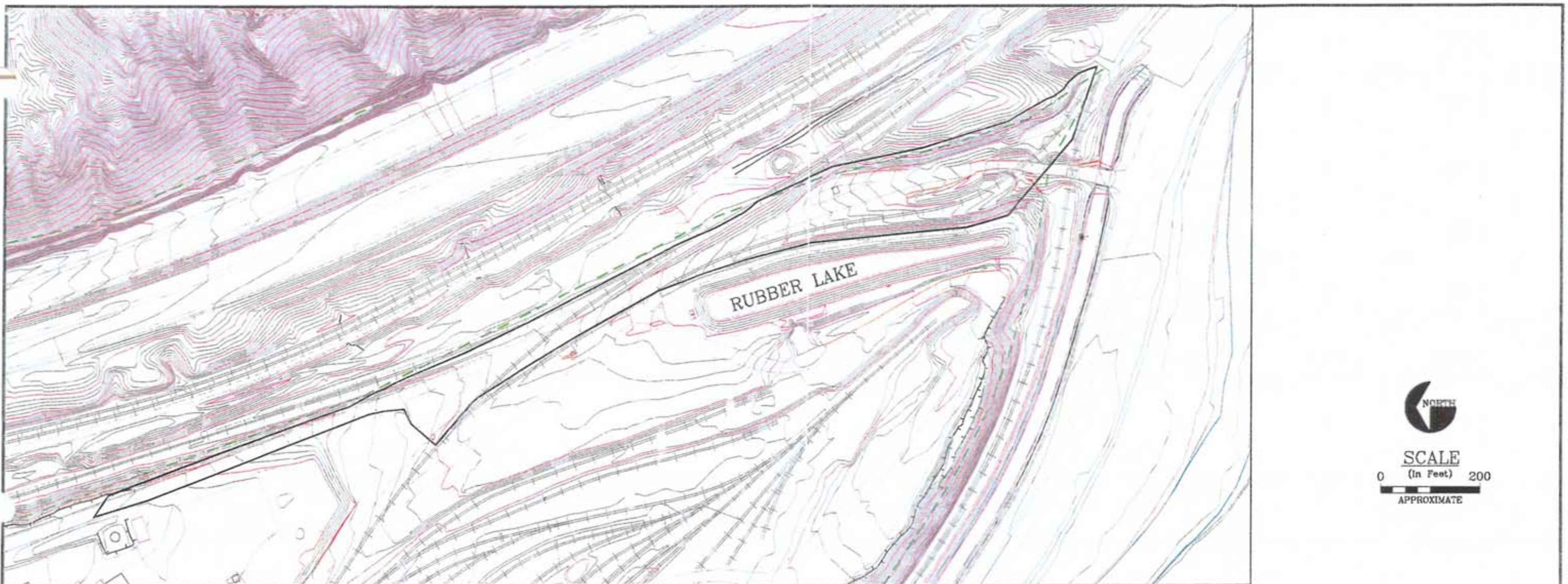
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 11
(ARROYOS EAST OF I-10)
CORRECTIVE ACTION MEASURES

FIGURE 4-9

Hydrometrics, Inc.

UPDATE TIME: 11:30
000\1247\065\00MC\ELP\103101\i:\1247\dwg
1247v201v019



LEGEND

EXISTING CONDITIONS

CONCRETE/ASPHALT

GROUND/DEBRIS

SLAG

CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

PROPERTY BOUNDARY

IA-10 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	0	0
Total	0	0	0	0

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 10
(PLANT ENTRANCE AREA)
CORRECTIVE ACTION MEASURES

FIGURE 4-8

Hydrometrics, Inc.

UPDATE TIME: 1:00
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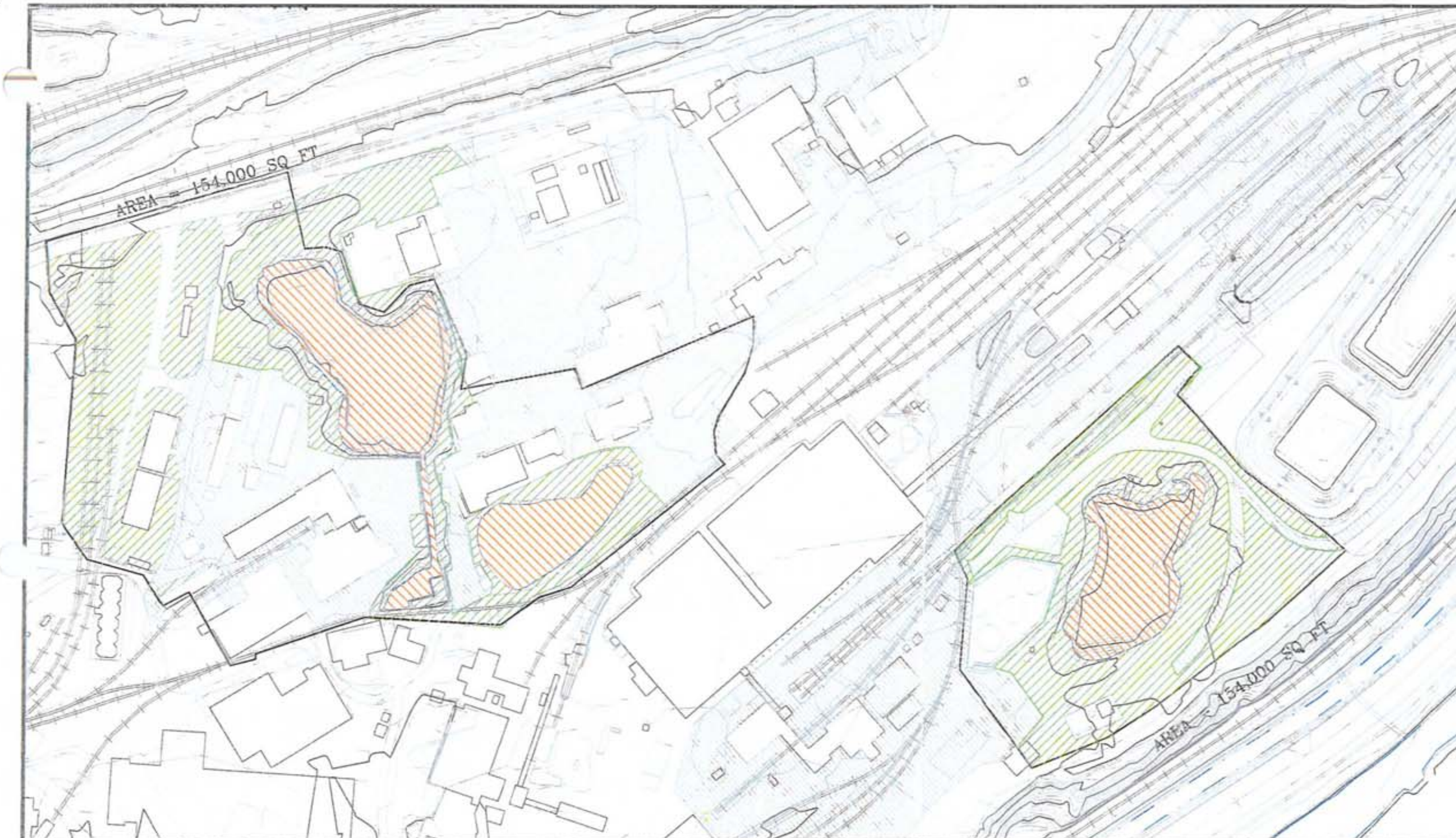

LEGEND

EXISTING CONDITIONS

CONCRETE/ASPHALT

GROUND/DEBRIS

CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

IA-9 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	27,100	154,400	306,000	0
Total	27,100	154,400	306,000	0

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 9 (PONDS 1, 5 AND 6) CORRECTIVE ACTION MEASURES

FIGURE 4-7

UPDATE TIME: 2:35
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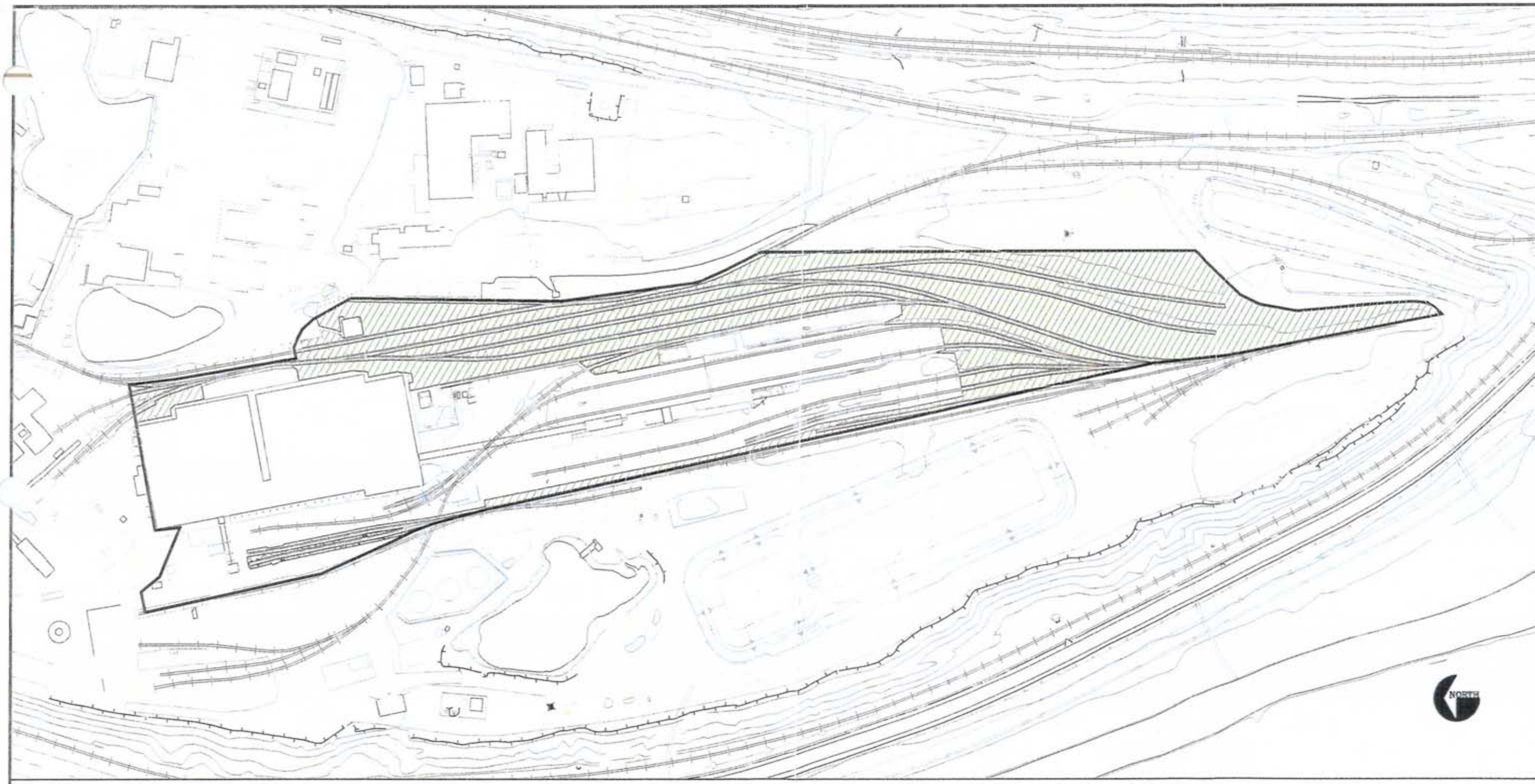
Hydrometrics, Inc.



EXISTING CONDITIONS

CONCRETE/ASPHALT

GROUND/DEBRIS

SLAG

CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

IA-8 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	275,000	0
Total	0	0	275,000	0

SCALE
0 (In Feet) 200'
APPROXIMATE

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

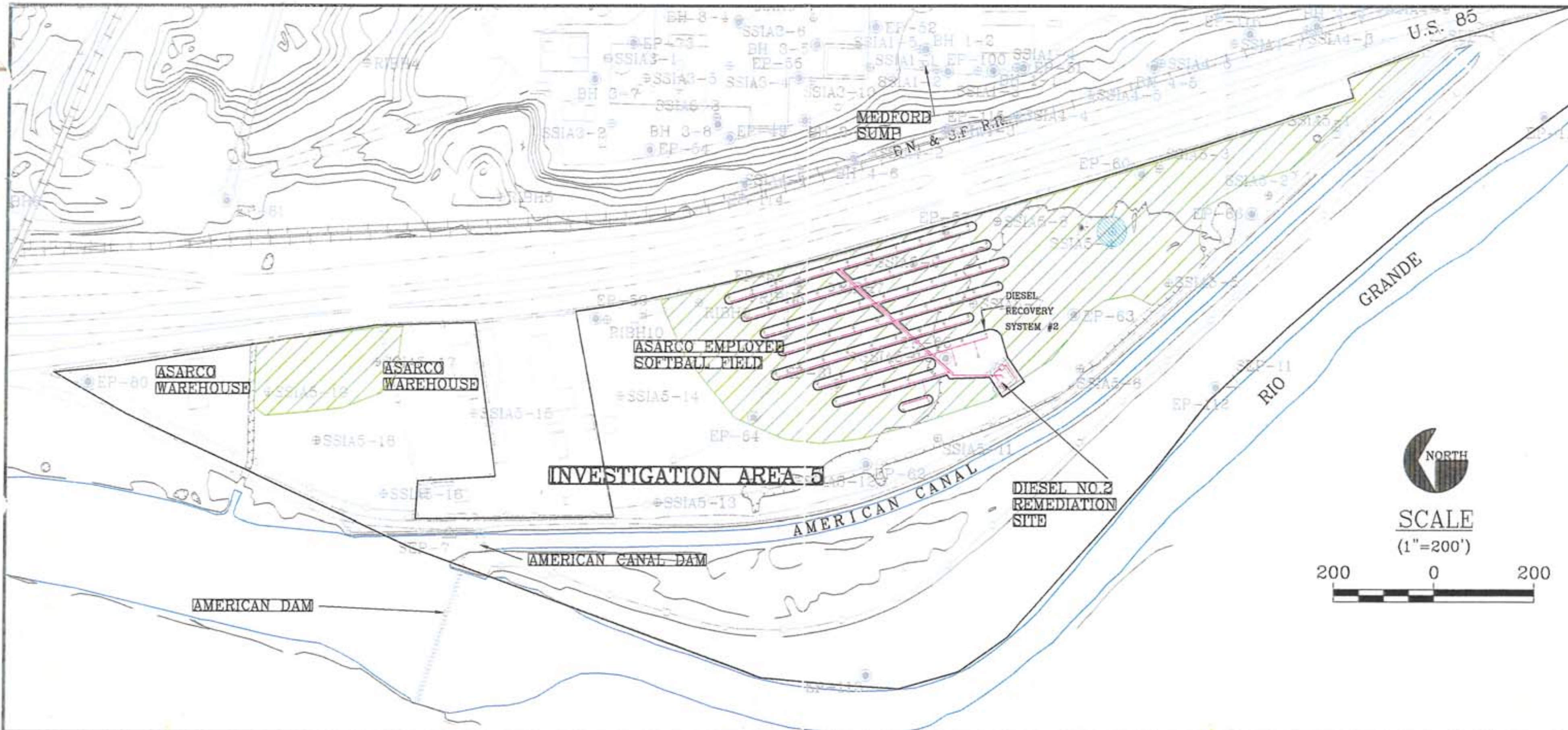
INVESTIGATION AREA 8
CORRECTIVE ACTION MEASURES

FIGURE
4-6

UPDATE TIME: 1700
0036\ELP\102201\1247\dwg

1247v201v016

Hydrometrics, Inc.



LEGEND

CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)

CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)

IA-5 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	300	2800	405,000	0
Total	300	2800	405,000	0

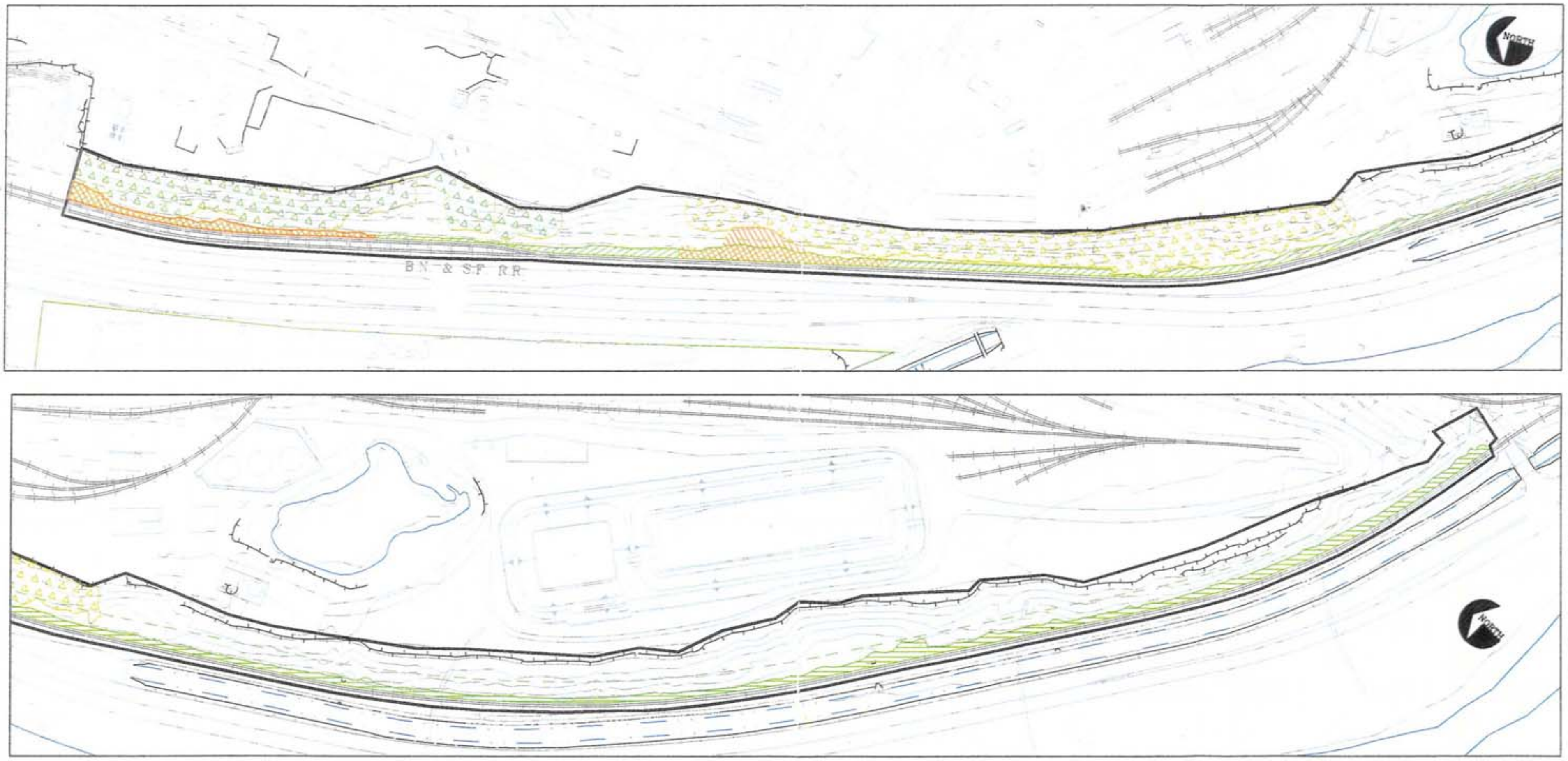
ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 5 (HISTORIC SMELTER TOWN AREA) CORRECTIVE ACTION MEASURES

FIGURE 4-5

UPDATE TIME: 1500
128\1247\065\0036\ELP\102201\I:\Land Project R2\1247\dwg 1247v201v015

Hydrometrics, Inc.



EXISTING CONDITIONS

- CONCRETE/ASPHALT
- GROUND/DEBRIS
- SLAG
- PROPERTY BOUNDARY

- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

SCALE
0 (In Feet) 200'
APPROXIMATE

IA-4 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	4000	22,800	75,300	146,200
Total	4000	22,800	75,300	146,200

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 4
FRONT SLOPE
CORRECTIVE ACTION MEASURES

FIGURE
4-4

UPDATE TIME: 1905
128\ 1247\065\0036\ELP\102301\\Land Project R2\1247\dwg 1247V201V033

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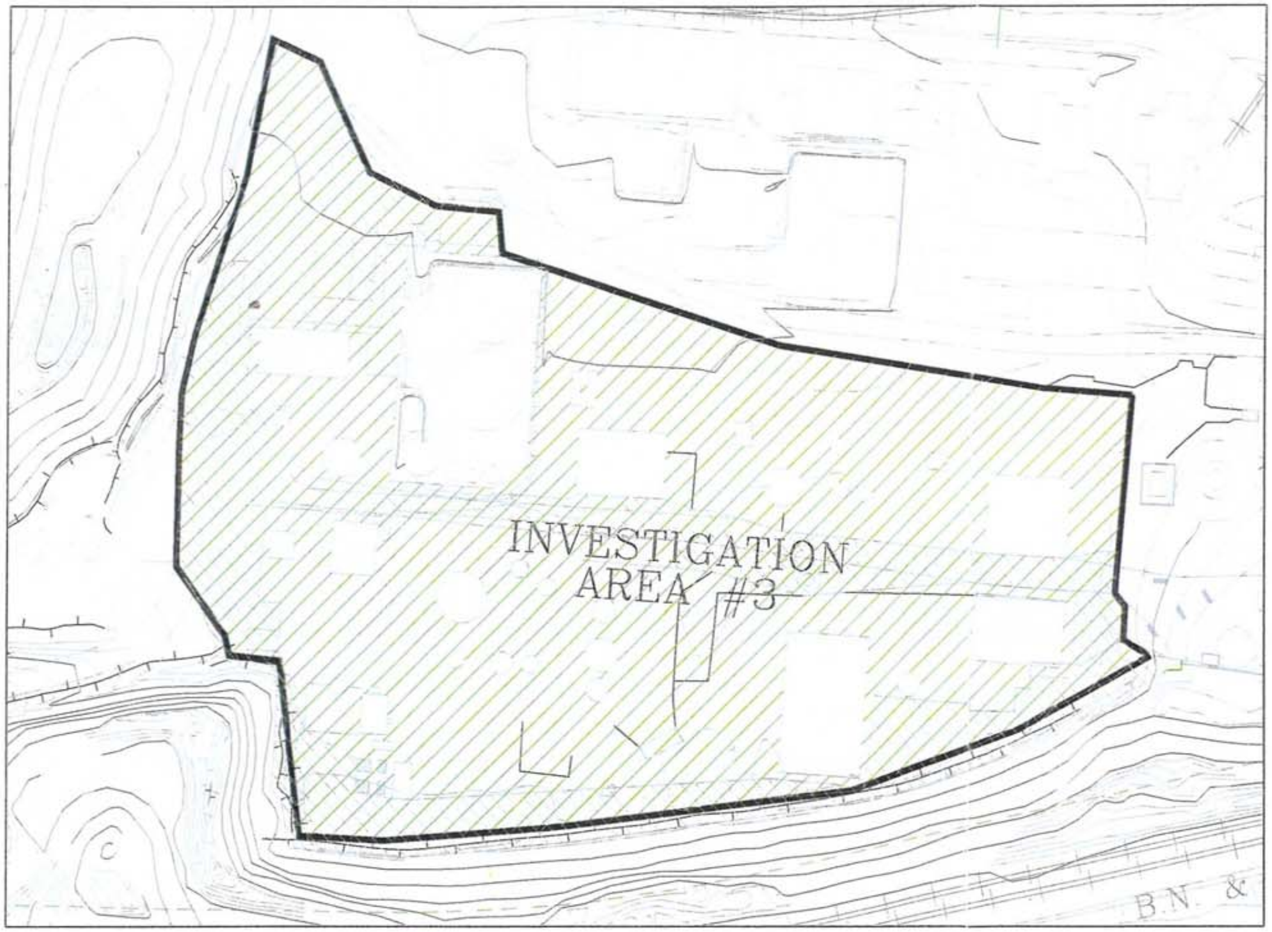

IA-3 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	0	0	254,600	0
Total	0	0	254,600	0

NOTE: CATEGORY II MATERIAL INCLUDES 87,600 SF OF PAVED AREA

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 3
ACID PLANT
CORRECTIVE ACTION MEASURES

FIGURE 4-3

UPDATE TIME: 1905
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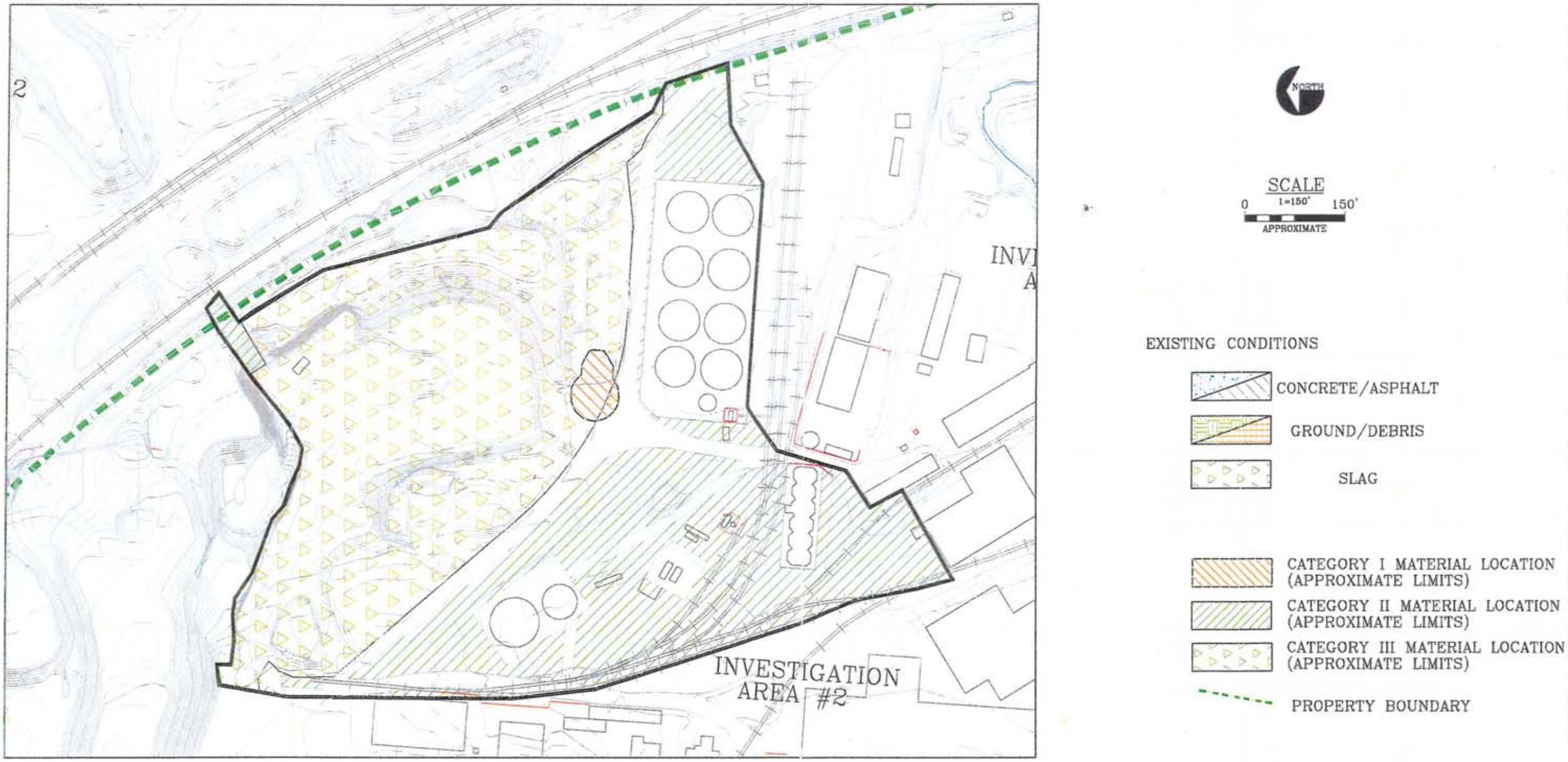
Hydrometrics, Inc.



IA-3 SUMMARY				
AREA	CAT. 1 (cy) Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
IA-General	700	5400	175,000	275,000
Total	700	5400	175,000	275,000

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 2
BONE YARD
CORRECTIVE ACTION MEASURES

FIGURE
4-2

Hydrometrics, Inc.

UPDATE TIME: 1230
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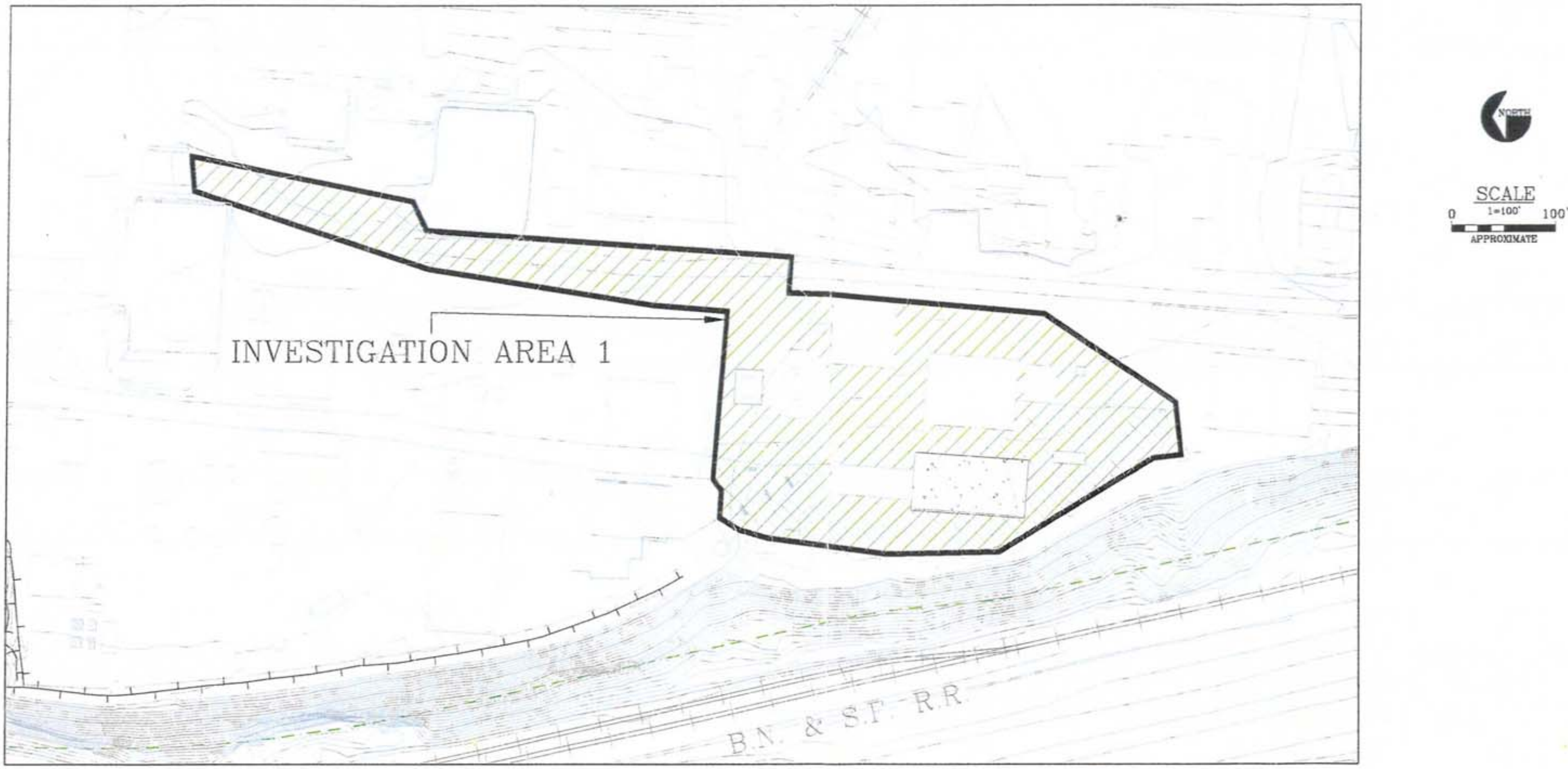
1247V201V031



EXISTING CONDITIONS

- CONCRETE/ASPHALT
- GROUND/DEBRIS
- SLAG

- PROPERTY BOUNDARY
- CATEGORY I MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY II MATERIAL LOCATION (APPROXIMATE LIMITS)
- CATEGORY III MATERIAL LOCATION (APPROXIMATE LIMITS)

IA-1 SUMMARY				
Area	CAT. 1 (cy)* Volume	CAT. 1 (sf) Area	CAT. 2 (sf) Area	CAT. 3 (sf) Area
Medford Sump	0	0	0	0
IA - General	0	0	56,100	0
Total	0	0	56,100	0

*CATEGORY I MATERIALS ASSOCIATED WITH MEDFORD SUMP WERE REMOVED IN 1999

ASARCO INCORPORATED
EL PASO COPPER SMELTER
PHASE III REMEDIAL INVESTIGATION
EL PASO, TEXAS

INVESTIGATION AREA 1 (CONVERTER BUILDING/BAGHOUSE AREA) CORRECTIVE ACTION MESURES

FIGURE 4-1

Hydrometrics, Inc.

UPDATE TIME: 1230
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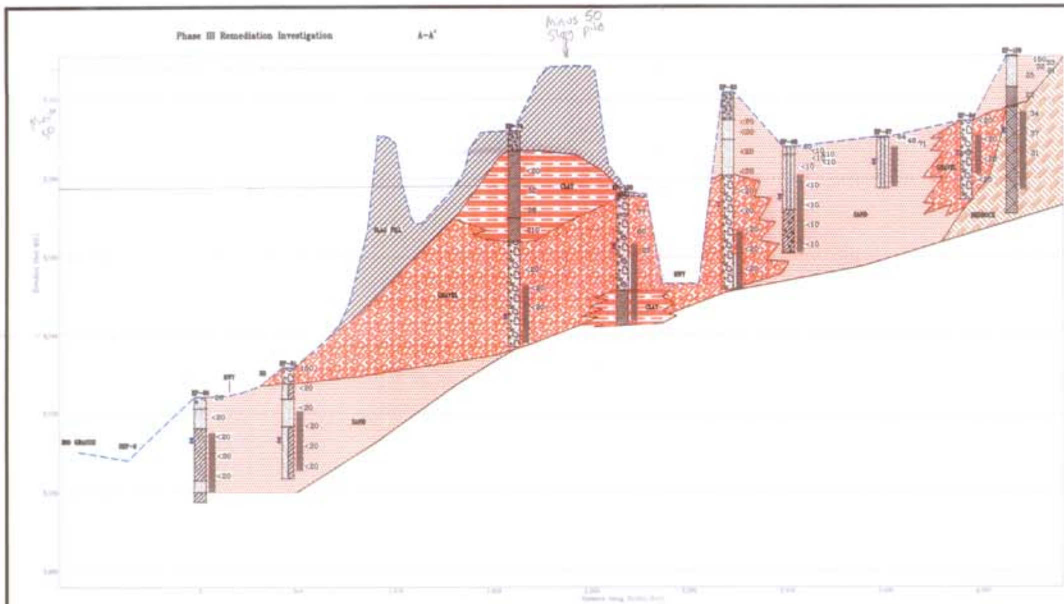
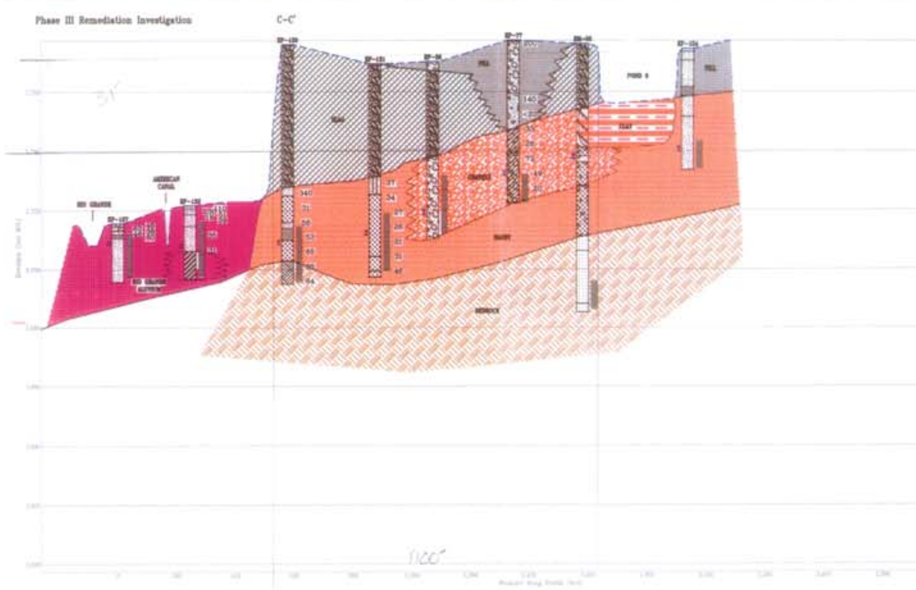
EXHIBITS



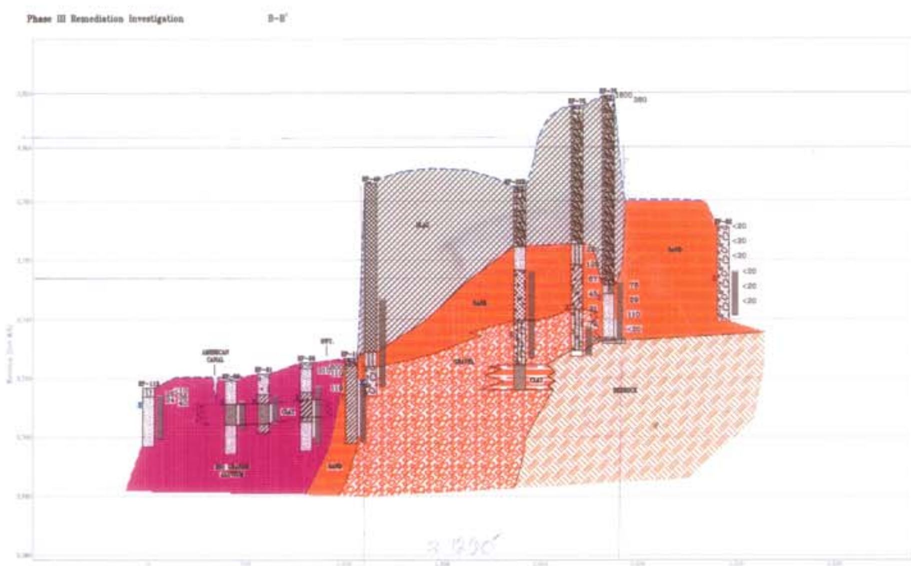
HYDROGEOLOGIC CROSS-SECTION A - A'

(LOOKING NORTH)
HORIZONTAL: 1"=300'
VERTICAL: 1"=15'



HYDROGEOLOGIC CROSS-SECTION C - C'

(LOOKING NORTH)
HORIZONTAL: 1"=200'
VERTICAL: 1"=20'



HYDROGEOLOGIC CROSS-SECTION B - B'

(LOOKING NORTH)
HORIZONTAL: 1"=300'
VERTICAL: 1"=20'

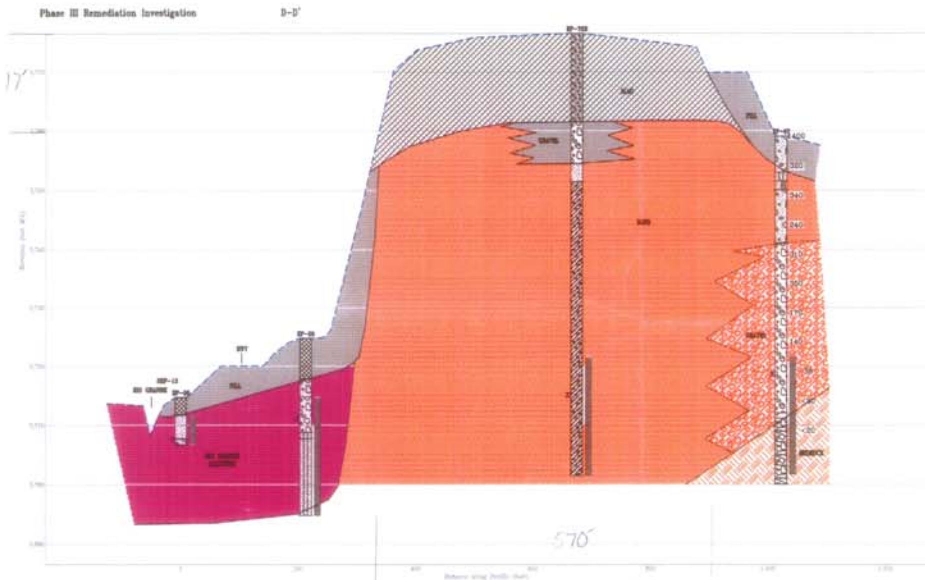
LEGEND

- FILL - sand and gravel
- FILL - slag
- RIO GRANDE ALLUVIUM
- COLLUVIUM - CLAYEY SILTY material, including gravelly clay, sandy clay, silty clay, sandy silt, clayey silt, and organic silt
- COLLUVIUM - SANDY material, including fine- to coarse-grained sand, silty sand and clayey sand
- COLLUVIUM - GRAVELLY material, including gravelly silt, gravelly sand, and silty to sandy gravel
- BEDROCK - includes shale, sandstone and andesite
- EXISTING GROUND
- WATER TABLE LEVEL
- EP-84 BORING LOCATION
- SCREENED INTERVAL

NOTES:

1. ALL CONTACT POINTS INFERRED.
2. WATER TABLE CALCULATED FROM MAY/ JUNE 2001 DATA.
3. As = ARSENIC CONCENTRATION(mg/kg) IN SOIL SAMPLE COLLECTED AT DEPTH INDICATED.
4. CROSS SECTION LOCATION SHOWN ON FIG 2- 4

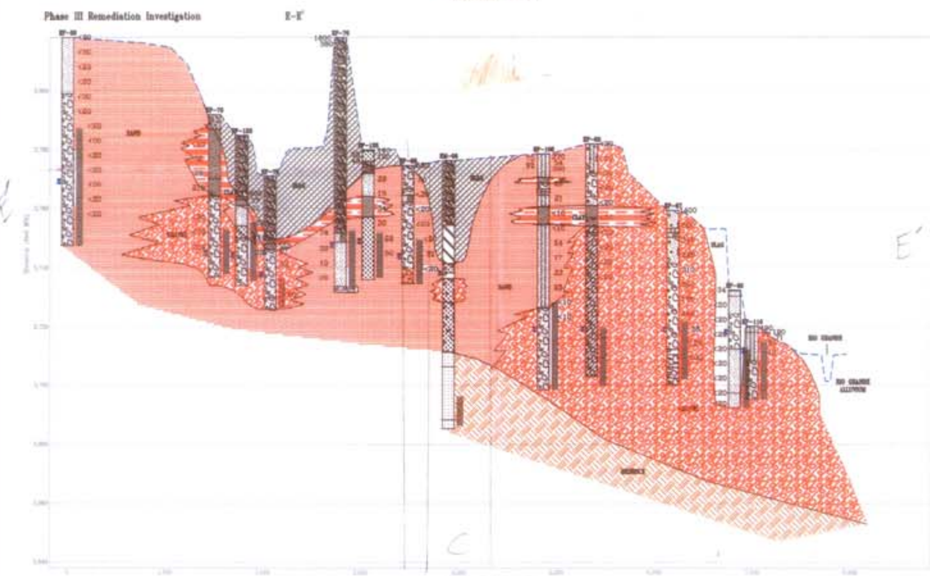
SCALE VERIFICATION BAR IS ONE INCH ON ORIGINAL DRAWING 0 — 1 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	Hydrometrics, Inc. ® consulting scientists, engineers and contractors El Paso, Tx. 79922	ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	HYDROGEOLOGIC CROSS SECTIONS A-A', B-B', C-C'	DRAWING FILE NUMBER tuc 1247V201U008 EXHIBIT 2



HYDROGEOLOGIC CROSS-SECTION D – D'

(LOOKING NORTH)
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

LEGEND

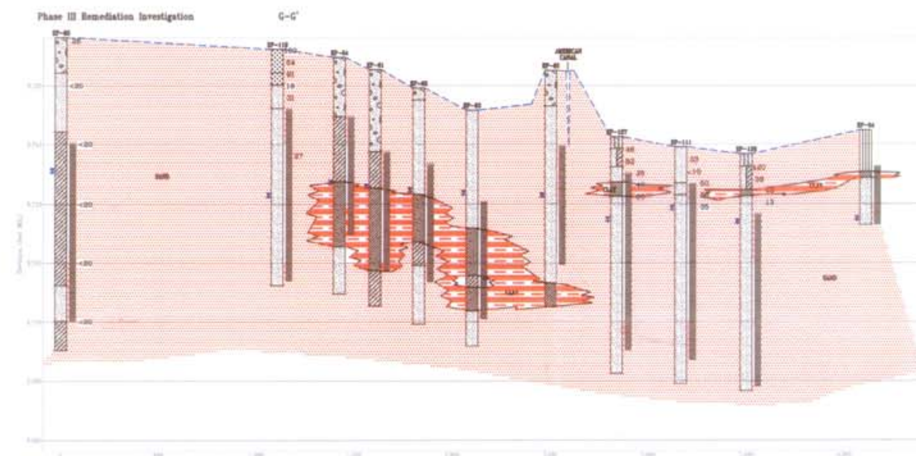


HYDROGEOLOGIC CROSS-SECTION E – E'

(LOOKING NORTH)
HORIZONTAL: 1"=500'
VERTICAL: 1"=20'

HYDROGEOLOGIC CROSS-SECTION F – F'

(LOOKING NORTH)
HORIZONTAL: 1"=200'
VERTICAL: 1"=20'



HYDROGEOLOGIC CROSS-SECTION G – G'

(LOOKING NORTH)
HORIZONTAL: 1"=200'
VERTICAL: 1"=20'

LEGEND

- FILL – sand and gravel
- FILL – slag
- RIO GRANDE ALLUVIUM
- COLLUVIUM – CLAYEY SILTY material, including gravelly clay, sandy clay, silty clay, sandy silt, clayey silt, and organic silt
- COLLUVIUM – SANDY material, including fine- to coarse-grained sand, silty sand and clayey sand
- COLLUVIUM – GRAVELLY material, including gravelly silt, gravelly sand, and silty to sandy gravel
- BEDROCK – includes shale, sandstone and andesite
- EXISTING GROUND
- WATER TABLE LEVEL
- EP-04 BORING LOCATION
- SCREENED INTERVAL

NOTES:

1. ALL CONTACT POINTS INFERRED.
2. WATER TABLE CALCULATED FROM MAY/ JUNE 2001 DATA.
3. As = ARSENIC CONCENTRATION(mg/kg) IN SOIL. SAMPLE COLLECTED AT DEPTH INDICATED.
4. CROSS SECTION LOCATION SHOWN ON FIG 2- 4

SCALE VERIFICATION BAR IS ONE INCH ON ORIGINAL DRAWING 0 — 1 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	Hydrometrics, Inc. ® consulting scientists, engineers and contractors El Paso, Tx. 79922	ASARCO INCORPORATED EL PASO COPPER SMELTER PHASE III REMEDIAL INVESTIGATION EL PASO, TEXAS	HYDROGEOLOGIC CROSS SECTIONS D-D', E-E', F-F', G-G'	DRAWING FILE NUMBER tuc 1247V201U009 AUTOCAD REL. 00 DRAWING (DWG) EXHIBIT 3

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

This Report prepared by Hydrometrics, Inc. (Hydrometrics) summarizes information collected and evaluated as part of a Phase III Remedial Investigation (RI) and general plan for corrective action for the ASARCO Incorporated (Asarco) El Paso Copper Smelter Facility (herein referred to as the Facility) pursuant to, and in accordance with, an Agreed Order (Docket No. 96-0212-MLM-E; TNRCC, 1996). The Facility is defined as all contiguous Asarco properties including the Plant (Figure 1-1). The Plant is defined as all areas actively used for smelter related activities. The "Plant" and "Site" are used interchangeably throughout this Report.

The primary elements of the Agreed Order, and the corresponding actions undertaken by Asarco to comply with it are as follows:

- Characterize the environment (soil, surface water and groundwater) in and around the Facility and determine the nature and extent of potential releases of Constituents of Concern (COCs).

- Submit "Technical Memorandums" that describe a plan to investigate the Closed Plant areas (Figure 1-2) and to evaluate their potential contribution to releases of COCs. Closed Plant areas include:

  - General copper smelting area.
  - Former Lead Plant.
  - Former Sinter Plant.
  - Former Cadmium Plant.
  - Zinc fuming area (now ConTop area).
  - Antimony area.

- Perform a Supplemental Environmental Project (SEP) consisting of the following:
  - Demolish the copper Wedge Roaster Building and the brick flue that served the reverberatory furnace.
  - Demolish the blast furnaces, dross reverberatory furnace, flues and baghouse.
  - Demolish the Zinc Plant area, which included the cooling tubes, flues, rotary kilns and baghouse.

Pursuant to the Agreed Order, two earlier RI Phases (Phase I and Phase II) were conducted between 1997 and 1998, and between 1999 and 2000, respectively. The Phase I RI (Hydrometrics, 1998a) and Phase II (Hydrometrics, 2000a) focused on on-Facility areas. The Phase I and Phase II RIs presented site characterization data, and corrective action alternatives and measures.

To comply with SEP requirements, between 1996 and 2000, all Closed Plant facilities and structures associated with the former Copper Plant, the Lead and Sinter Plants, including the Lead Baghouse and the Lead Blast Furnace, were demolished or decommissioned.

Following demolition, Closed Plant Technical Memorandums were prepared to present general work plans for post closure investigation efforts. After the approval of the Closed Plant Technical Memorandums (Hydrometrics, 2000b), the subsequent Phase III RI evaluation activities at the Closed Plants were performed during the months of March and April of 2001.

This Phase III RI Report provides additional site characterization data and a logical interpretation of the occurrence and distribution of chemical constituents in soil, surface water and groundwater. Corrective action alternatives and measures previously presented in the Phase I and Phase II RIs have been refined in this Phase III Report in consideration of additional site characterization and Plant operations data. Corrective action alternatives and measures presented in this Phase III Report meet corrective action goals and objectives established for the project (Hydrometrics, 1998a) to appropriately achieve Standard No. 3 of the Risk Reduction Rules (Texas Administrative Code, Title 30, Chapter 335, Subchapter S, Risk Reduction Standards).

All work for the Phase III RI was performed in accordance with Texas Natural Resource Conservation Commission (TNRCC) and with the approved RI Work Plan (Hydrometrics, 1996). Modifications were incorporated in this document in accordance with the TNRCC comments on the Phase II RI and the TNRCC Consistency Document (TNRCC, 1998).

A Remedial Design Report (RDR) is submitted as a supplement to this Phase III RI Report under separate cover (Hydrometrics, 2001). Asarco anticipates that in addition to the RDR, other reports associated with this project may be prepared in the future.

1.1 FACILITY BACKGROUND INFORMATION

The Asarco El Paso Copper Smelter is located within the City limits of El Paso, Texas (Figure 1-1). The Plant occupies 64 acres bound by U.S. Interstate Highway 10 to the east and U.S. Highway 85 (Paisano Drive) to the west. The Plant began operations in 1887 as a lead smelter with an initial daily capacity of 150 tons of ore. The original process for smelting involved roasting the ore in heaps, then in hand-reverberatory roasters. After a fire nearly destroyed the Plant, it was rebuilt in 1902.

Copper production began in 1910 with the smelting of concentrates. In 1914, the El Paso Smelter was expanded to process 278 tons/day of lead ore. In 1928, lead production was approximately 400 tons/day, and copper production was 150 tons/day. In the 1930s, the Plant added a Godfrey roaster for cadmium oxide production. In 1948, a blast furnace Slag Fuming Plant for zinc recovery was constructed. In the late 1970s, an Antimony Plant was completed, as well as a Sinter Plant with unloading and bedding systems.

Closing of Plant components began in 1982 with the closing of the zinc-fuming furnace. In 1985, the Lead Plant was closed and certain structures were remodeled as a Mobile Equipment Shop and Storage/Pilot Plant. The Cadmium Plant was shut down in 1992. The Antimony Plant was operated until 1986, and has not been operated since. The entire Plant was temporarily placed on a three-year Care and Maintenance Program (temporary cessation) in February 1999. Prior to cessation of copper production in 1999, the Plant produced approximately 140,000 tons of copper per year.

1.1.1 Physical and Geological Settings

The following is a summary of the physical and geological setting of the Facility. A more detailed description is provided in the Phase I and Phase II RI Reports.

1.1.1.1 Geology and Physiology

The Facility is located in El Paso County within the Rio Grande Valley floodplain at an elevation of approximately 3,600 feet mean sea level (Figure 1-1). Geologically, El Paso County lies within the Basin and Range Province of West Texas. The surficial geology of the region is controlled by three mountain ranges (the Franklin Mountains, the Hueco Mountains and the Sierra de Juarez Range) and the Rio Grande Rift. The following geologic descriptions are based upon published geologic reports of the area (King et al, 1971 and Lovejoy, 1976).

The Franklin Mountains located north of the Facility are a tilted block of approximately 2,000 feet of bedded limestone, which strikes north south and dips to the west at about 30 degrees. The beds range in age from about 135 million to 600 million years and are underlain by a Pre-Cambrian age crystalline basement of igneous and metamorphic bedrock.

The Hueco Mountains are approximately 30 miles to the east of the Franklin Mountains and mark the eastern boundary of the West Texas Basin and Range geologic structural Province. They are a fault block mountain range and contain limestone beds that correlate to those observed in the Franklin Mountains.

The path of the Rio Grande in this region corresponds to the north-south trend of the extensional Rio Grande Rift. The rift separates the Franklin Mountains from the Sierra de Juarez to the south. The rift valley is composed of river sediments and alluvial debris that have eroded from the western slope of the Franklin Mountains.

The Sierra de Juarez Mountains are located to the south of Ciudad Juarez, Chihuahua, Mexico (south of the Facility). They are severely thrust faulted and are thought to have been tectonically transported eastward to their present position. There is no stratigraphic correlation between the Franklin Mountains and the Sierra de Juarez.

The surface geology of the Facility area consists of a mix of colluvial and fluvial sediments. The colluvial sediments are generated by the erosion of a laccolith, which is locally known as the "Campus Andesite", and the erosion of the Franklin Mountains. The erosional sediments occur to the west and are mixed with the fluvial sediments of the Rio Grande.

1.1.1.2 Climate

The area climate is considered arid and consists of very low relative humidity, low precipitation, hot summers and mild winters. The type of vegetation in the area is dependent on the location relative to the Rio Grande. In the river's floodplain area, the vegetation consists of shrubs and trees due to the greater amount of available groundwater. Vegetation in the higher elevations consists of plants typically found in the Chihuahuan Desert.

Spring is the windiest time of the year, creating frequent sand and dust storms. The seasonal wind directions are characterized as being from the south-southeast during June through October, and from the northwest during November through May. The annual lake evaporation for the area is estimated to be 72 inches/year. Pan evaporation tests indicate evaporation rates greater than 100 inches/year. Annually, El Paso is reported to receive 83 percent of the total possible sunshine (Jaco, 1971).

Precipitation averages about eight inches annually, with 75 percent of this precipitation occurring between April and September (Jaco, 1971). Records show a high variation in annual precipitation ranging from a maximum of nearly 18 inches to less than 2.2 inches (Jaco, 1971). The majority of the precipitation comes in the form of intense storms resulting in high precipitation rates over relatively short time intervals.

Temperatures in the El Paso area range from the 30's (degrees Fahrenheit) in the winter months to over 100s in the summer months.

1.1.2 Groundwater and Surface Water

An overview of area groundwater and surface water conditions is presented in the following sections. Section 2.0 presents site specific groundwater and surface water conditions based on RI results and interpretations.

1.1.2.1 Groundwater

The two major aquifers of the region are the Hueco Bolson aquifer, east of the Franklin Mountains, and the Mesilla Bolson aquifer, west of the Franklin Mountains. The Mesilla Bolson underlies the Rio Grande Rift and the river valley. Most of the Mesilla Bolson is in the state of New Mexico, with only the western valley of El Paso County drawing water from the aquifer.

The Hueco Bolson is the principal aquifer for the El Paso-Ciudad Juarez area. Structurally, it is a basin created by the down-dropped block between the Franklin Mountains and the Hueco Mountains and subsequently filled with lacustrine and fluvial deposits. The basin underlies 70 percent of El Paso County and extends several miles into Mexico. The deepest part of the basin underlies the El Paso International Airport and consists of nearly 10,000 feet of sediments before bedrock is encountered. The Hueco Bolson does not exist to a significant extent in the Texas Canyon area where the Facility is located.

The Hueco Bolson provides over two-thirds of the municipal water used in the El Paso region with the balance coming from the Rio Grande. The aquifer extends into Mexico and is also an important source of drinking water for Ciudad Juarez, Mexico.

Groundwater in the Hueco Bolson occurs in both the fluvial deposits and the underlying lacustrine deposits. The primary source of drinking water for the region is extracted from the poorly sorted, irregularly stratified fluvial deposits, which outcrop over most of east El Paso and range from 400 to 1,300 feet thick. Depth to groundwater in the Hueco Bolson aquifer in the area of El Paso is about 400 ft below ground surface (bgs). In the area of the Facility, the Bolson aquifer does not occur to a significant extent because of the proximity of mountains. The deposits consist of unconsolidated sand lenses alternating with gravel, silt, and clay.

1.1.2.2 Surface Water

There are two primary surface water features located near the Facility (Figure 1-1):

1) The Rio Grande.
2) The American Canal.

The American Canal is used by the United States to remove its allotment of water from the Rio Grande. The canal is concrete-lined to reduce the amount of leakage into the subsurface. Local groundwater elevations fluctuate in conjunction with the amount of water in the Rio Grande. Such fluctuations are a result of seasonal releases of water from Elephant Butte Dam, near Truth or Consequences, New Mexico, which is approximately 100 miles north of El Paso. In the spring, water is released for irrigation purposes, and in the fall the amount of water released is restricted to conserve the water over the winter months.

In addition to the Rio Grande and the American Canal, there are local ephemeral drainages in and adjacent to the Facility area and surface water impoundments located within the Facility area. Many of the ephemeral drainages (locally known as "arroyos") area generally dry except during or immediately following precipitation/snow melt. The surface water impoundments are man-made and were historically used for Plant processing purposes. The on-Facility ponds have been decommissioned as part of recent storm water control improvements.

1.1.3 Regulatory Summary

Asarco operates under four Facility permits issued by the TNRCC, and one issued by the EPA. These permits are listed in Table 1-1. Certain wastes are managed within active Solid Waste Management Units (SWMUs) consistent with the TNRCC Notice of Registration Number 31235. The Facility's active SWMUs are listed in Table 1-2.

1.1.4 Related Work

Additional environmental activities at the Facility (other than work associated with the RI) include the following:

- A Storm Water Collection and Reuse System (Dames & Moore, 1998) was constructed during the period 1998 through 2000. These upgrades addressed corrective action measures for many Facility IAs. The storm water control improvements are summarized in Sections 3.0 and 4.0 of the Phase I and Phase II RI Reports.

- Operation and maintenance of the Diesel No. 2, Leaking Petroleum Storage Tank (LPST - ID No. 95987), recovery system at the Facility is on going. With the addition of a new dual phase extraction system, the diesel recovery has substantially increased. As of August 31, 2001, approximately 18,650 gallons of diesel have been recovered and approximately 327,860 gallons of groundwater have been treated. The estimated extent of liquid-phase diesel measured at the site in August of 2001 is in Figure 1-3.

- On November 15, 2000, the TNRCC granted closure of the LPST ID No. 94594 (Diesel No. 1, Figure 1-2). Plugging, abandoning and decommissioning of the recovery system is awaiting access approval from the Burlington Northern Santa Fe Railroad. Asarco expects to complete final closure by the beginning of 2002. The Phase I RI Report provides a detailed discussion of these diesel recovery projects (which were specifically exempted from the RI in the Agreed Order).

1.2 PREVIOUS AND CURRENT RI INVESTIGATIONS

Previous environmental investigations have been completed at the Facility related to diesel fuel releases and the Facility ponds. A summary timeline of milestones related to the operation of the Facility and important environmental actions and reports is in Table 1-3.

1.2.1 History of Process Pond Investigations

Three former surface water impoundments (Ponds 1, 5 and 6) are located at the Facility. The water in Pond 6 was used primarily for general supply, storm water collection, anode cooling and fire water supply. Pond 5 was used for boiler feed backup and some storm water collection. Storm water collection was the primary function of Pond 1. Ponds 1, 5 and 6 were sampled quarterly from August 1997 through May 1998 as part of the Phase I RI, and from August 1998 through February 2000, or until the ponds were dry, as part of the Phase II RI. After completion of the storm water collection reuse system, the ponds were decommissioned (bermed to prevent storm water run-on into the ponds and allowed to evaporate).

Historically, water in the ponds exhibited elevated metal ion concentrations. Therefore, the Texas Water Commission (TWC, formerly the Texas Department of Water Resources and now known as the TNRCC) expressed concern that water contained in the ponds could infiltrate and impact the underlying groundwater system. On August 21, 1985, a Compliance Agreement between Asarco and the TWC was entered that required Asarco to investigate the potential for subsurface contamination caused by potential leakage from the ponds.

Reports entitled "Regional and Local Hydrogeology at the El Paso Plant - September 27, 1985" and "Liner Investigation - Asarco, Inc., El Paso Plant - November 15, 1985" were prepared by Hydro-Search, Inc. in partial fulfillment of the Compliance Agreement between Asarco and the TWC. A report entitled "Groundwater Monitoring Plan, Asarco, Inc., El Paso Plant - October 10, 1985" was also prepared by Hydro-Search, Inc. in order to fulfill requirements of the Compliance Agreement.

In a letter dated December 20, 1989, the TWC provided comments concerning Asarco's October 10, 1985, proposed monitoring plan. In a letter dated February 8, 1990, Asarco provided responses to the TWC's comments. On March 14, 1990, the TWC provided Asarco with a "Notice to Proceed" to begin monitoring activities.

On May 2, 1990, Hydrometrics initiated groundwater monitoring activities, which included the installation of nine monitor wells, EM-1 through EM-8, and EP-12. Monitor well installations were completed in May 1990, and the monitor wells were developed and sampled immediately following installation. The first official quarterly groundwater monitoring event was conducted during the period of August 4 to August 6, 1990. Groundwater sampling has continued on a quarterly basis since.

Results of these investigations identified elevated concentrations of arsenic, cadmium, manganese and selenium in groundwater in several wells. Free-phase hydrocarbons observed in several monitor wells associated with the diesel releases were sampled and analyzed for metals, but none were detected.

For soil classification purposes, split-spoon soil samples were collected at five-foot intervals during monitor well installation, and selected samples from wells EM-2 and EM-7 were submitted for laboratory EP Toxicity metals analyses. Results for well EM-2 did not indicate the presence of metal concentrations above the laboratory detection limits. Results for well EM-7 showed detectable levels of cadmium (0.8 mg/kg) and lead (4.0 mg/kg) only.

In March 1998, Asarco requested that the 1985 Compliance Agreement be terminated because the ponds were addressed by the August 1996 Agreed Order. The TNRCC concurred, and the 1985 Compliance Agreement was terminated in April 1998. In June 1998, Asarco removed all sources of new water to Ponds 1 and 5 (other than direct rainfall), and allowed the standing water in the ponds to evaporate. Currently, all three ponds are dry.

1.2.2 History of Diesel Spill Investigations

Two separate areas of diesel contamination have been identified at the Facility, as described below.

1.2.2.1 Diesel Investigation No. 1

In February 1990, hydrocarbon seepage was observed entering the American Canal at several locations over an approximately 1,000-foot-long section. Asarco requested that Hydrometrics and Raba-Kistner Consultants conduct an investigation (Diesel Investigation No. 1) to evaluate the source of the hydrocarbon seepage, which was determined to be nearby Asarco diesel storage tanks. The area where hydrocarbons were observed in the American Canal was further down stream from where COCs are known to occur in the groundwater. The area where hydrocarbons were observed is also where groundwater intersects the canal to a greater degree than upstream where COCs exist in the groundwater. This issue is further discussed in a letter entitled "Response to TNRCC letter of April 27, 2001" included in Appendix A to this Report.

Details of Diesel Investigation No. 1 activities were previously documented (Hydrometrics, 1990a, 1990b and 1993). Investigation activities included installation and sampling of monitor wells, installation of continuous groundwater and hydrocarbon pumping and treating systems, hydrocarbon removal from the American Canal, surface water sampling in the American Canal and in the Rio Grande, and excavation and removal of contaminated soils. During February, March, and April 1992 a hydrocarbon recovery system consisting of 21 wells was installed.

A plan "A" Risk-based Assessment (Hydrometrics, 1997b) for this site was submitted to, and accepted by, the TNRCC in April 1997. According to the risk-based assessment, levels of COCs were below established cleanup goals, and closure of the site could be requested upon attaining measurable thickness of diesel of less than 0.1 feet for the project site.

Consistent with the risk-based assessment, on November 15, 2000, the TNRCC concurred that the closure requirements for the site were met, and no further corrective action would be necessary for this release incident.

1.2.2.2 Diesel Investigation No. 2

On March 30, 1990, Hydrometrics began investigation activities (Diesel Investigation No. 2) of an 18,000-gallon aboveground diesel storage tank, which was suspected of having a release of hydrocarbons, located near the former Zinc Fuming Plant. A backhoe pit was excavated (March 30, 1990) adjacent to the underground piping to evaluate for potential leaks.

On May 21, 1990, Hydrometrics installed monitor well EP-21 adjacent to the diesel storage tank. Several hundredths of a foot of phase-separated hydrocarbons were encountered in this monitor well. During the period of August 6 to August 9, 1990 Hydrometrics installed six additional monitor wells, EP-22 through EP-27, to help determine the extent of diesel contamination from the 18,000 gallon tank.

Only one of these additional wells, EP-25, contained phase-separated hydrocarbons. Several other monitor wells (EP-49, EP-51, EP-52, EP-54 and EP-55) were installed to assess the plume extent.

During sampling activities in July 1993, phase-separated hydrocarbons were encountered in the downgradient monitor well EP-49.

During January 1994 Hydrometrics installed eleven additional monitor wells to further delineate the Diesel No. 2 hydrocarbon plume in response to the occurrence of phase-separated hydrocarbons in well EP-49.

During the period March through June of 1994, Hydrometrics designed and installed a product recovery trench, an air sparge and soil vapor extraction (SVE) trench, and associated mechanical equipment to help contain and remove diesel fuel from the area of the former Smeltertown. The product recovery trench was placed just ahead of the leading edge of the phase-separated hydrocarbon plume to allow liquid-phase hydrocarbons to migrate into the recovery trench. The air sparge/SVE trench was placed downgradient of the dissolved hydrocarbon plume to provide removal of dissolved hydrocarbons.

The remediation system has been in continuous operation since 1994, and associated groundwater monitoring and sampling has been conducted on a quarterly basis. A Plan "A" Risk-Based Site Assessment for this site (prepared by Hydrometrics) was submitted to and accepted by the TNRCC in October of 1997. According to the risk-based assessment, levels of contaminants of concern were below established clean-up goals. However, due to the measurable thickness of diesel being greater than 0.1 feet, closure of the site has yet to be performed.

During November and December 1997, a pilot test was performed to evaluate the best remediation technology for this project. The study recommended a Dual-Phase Extraction system to recover the remaining product and remediate the affected soils in the Smeltertown portion of the product plume. In 1999, recovery system upgrades consisted of the addition of both a Dual-Phase Extraction (DPE) technology in the area of Smeltertown and Total Fluids recovery (TF) on the Facility-side area near the Acid Plants. The DPE and TF recovery systems were operational on March 12, 1999, and

March 10, 1999, respectively. The recovery system utilizes a manifold system with 70 DPE recovery points, to extract both free-phase and vapor-phase diesel from selected areas of Smeltertown.

Information obtained from operation and maintenance (O&M) and monitoring activities after the implementation of the recovery system indicates that the DPE system has been very effective in removing Phase Separated Hydrocarbons (PSH) in the Smeltertown area and in reducing the thickness of PSH in on-Plant monitoring wells. As of August 31, 2001, approximately 18,650 gallons of PSH had been removed from impacted areas. Additionally, the PSH thickness in EP-25, the most impacted on-Plant monitoring well, has been substantially reduced, from 2.47 feet detected during the second Quarter of 1999, to 0.68 feet detected during the third Quarter of 2001.

1.3 RI BACKGROUND INFORMATION

As described in Section 1.0, Asarco entered into an Agreed Order with the TNRCC in August 1996. To comply with the requirements of the Agreed Order, Asarco submitted a RI Work Plan in November 1996 (Hydrometrics, 1996).

1.3.1 Investigation Areas

In October of 1998, Asarco submitted a Phase I RI Report for ten initial IAs (Hydrometrics, 1998). These IAs (1 through 10) are shown in Exhibit 1. As part of the Agreed Order, specific areas of the Facility were designated by the TNRCC as areas of concern based on historical and current operations and on the results of the 1994 and 1995 multimedia inspection and sampling events. Table 1-4 provides a general description of the IAs.

The number of IAs for the project have increased from 10 during the Phase I investigation, to 14 during the Phase II investigation, to 20 during this Phase III investigation. Four of the additional IAs included in the Phase III RI are associated with previously described Closed Plant areas. These areas are identified as follows:

- IA-15 Former Lead Plant.
- IA-16 Former Cadmium Plant.
- IA-17 Former Zinc Plant.
- IA-18 Former Antimony Plant.

The following two IAs were also added as part of the Phase III RI based on information developed during previous investigations and comments from the TNRCC:

- IA-19 La Calavera area.
- IA-20 Off-Plant on-Facility areas, east of I-10.

The Phase I RI Report presented the results of soil, surface water and groundwater investigations and a general proposal for corrective action for remediation of impacted areas to meet the TNRCC Risk Reduction Standard No. 3 (see Section 2.0 for description). On June 25, 1999, Asarco received comments from the TNRCC on the Phase I RI Report.

As a result of the Phase I RI and the TNRCC comments, a scope of work was developed for a Phase II RI that included four additional IAs (11 through 14, see Exhibit 1). In some cases previous areas were subdivided and in other cases new IAs were defined. The Phase II RI was conducted in 1999 and 2000. Data obtained from this investigation were documented in a Phase II RI Report submitted to the TNRCC in August 2000, with responses to TNRCC comments on the Phase I Report.

The TNRCC accepted with comments the Phase II RI Report in February 2001. Between March and July of 2001, in response to the TNRCC comments and supplemental data requirements identified in the Phase II RI Report, a Phase III RI was carried out. The Phase III RI included six more IAs than were in the Phase II RI (for a total of twenty

IAs). Four of these additional IAs were associated with the Closed Plants investigations (see Section 1.0) and two were associated with off-Plant areas.

In October 2000, after completion of the Closed Plant demolition activities (see Section 1.0), Asarco submitted to the TNRCC the closed plant TMs for review and approval. The documents were evaluated and approved by the TNRCC on January 3, 2001. Evaluation activities were performed at these Plants during the months of March and April of 2001. The Closed Plant investigation results are included as part of this Phase III RI Report.

1.3.1.1 COCs

As presented in the Phase I and Phase II RI Reports, the COCs addressed as part of this Phase III RI are:

- Arsenic
- Cadmium
- Lead
- Selenium

These COCs have been verified based on the conclusions of the Phase II Report. These constituents are consistently detected in soils associated with various Facility areas at elevated concentrations. Based on previous data, arsenic is considered to be the primary COC in groundwater, and arsenic, cadmium and lead are considered to be the primary COCs in soil.

Selenium occurs in detectable concentrations in soils and groundwater near background levels throughout the Facility area. Although selenium is not considered a primary COC, it is monitored. Areas with elevated concentrations of selenium in soil and groundwater generally also have elevated concentrations of arsenic.

1.3.2 Source Material Classification

Consistent with the Phase I and Phase II RI Reports, source materials with the potential to contain COCs have been divided into different Categories. The categories are based on Facility operations, visual evidence, and chemical characteristics of soil and groundwater. These categories are summarized as follows:

- **Category I:** Residual by-products typically associated with specific current and/or past Facility operations. These materials are typically associated with elevated concentrations of metals in underlying groundwater.

- **Category II:** Relatively large volumes of residual by-products with typically lower concentrations of COCs than Category I materials. Category II materials alone do not typically contribute to groundwater impacts.

- **Category III:** Slag materials with no anticipated human health or environmental impacts.

The rational for the characterization of the distribution is provided in the Phase I RI Report. Expanded evaluations and conclusions are provided in the Phase II RI and this Phase III RI Report.

1.4 PHASE III RI PROJECT OBJECTIVES

The specific objectives of the Phase III RI are summarized as follows:

- Identification and further delineation of source areas and materials with actual or potential impacts to soil, surface water and groundwater. COCs are arsenic, cadmium and lead, as identified in the Phase I and Phase II RIs.
- Evaluate the Closed Plants as a potential source of COCs.
- Develop data to support the design and implementation of corrective action alternatives and measures to achieve TNRCC Risk Reduction Standard No. 3 (see Section 3.0).

As part of the phase I RI Report, a corrective action alternative analysis was performed. This portion of the Phase I Report (Section 4.2) is included with this report as Appendix Q. Preferred corrective action alternatives identified for this project meet the associated corrective action objectives:

- Reduce the potential for exposure to metals by Facility workers and the public.
- Minimize the potential for transport of metals to groundwater.
- Minimize metal concentrations in the American Canal and Rio Grande River (Rio Grande) resulting from the migration of metals in groundwater and/or wind blown dust from the Facility.

1.5 PHASE III RI WORK PLAN TASKS

Consistent with the Phase I and Phase II RIs, the tasks undertaken in this Phase III RI were developed to identify source areas and materials, groundwater flow pathways, and the vertical and horizontal extent of COCs. The objectives and methodology used in the Phase III RI are consistent with the RI Work Plan developed for the project (Hydrometrics, 1996).

The Phase III RI was implemented subsequent to the review and acceptance of the Phase II RI Report by the TNRCC in February 2001. This Phase III RI Report includes data from on-going monitoring initiated during the Phase I and Phase II RI periods. The Phase III period of record is from March 2000 to August 2001.

Consistent with previous investigations, the following constituents were analyzed in addition to the primary COCs (arsenic, cadmium, lead and selenium):

- Soil and Groundwater
  - Chromium (Cr)
  - Copper (Cu)
  - Iron (Fe)
  - Zinc (Zn)

- Groundwater
  - pH
  - Specific conductivity (SC)
  - Total dissolved solids (TDS)

Sampling and analysis procedures and protocol used during the Phase III RI were consistent with the TNRCC Consistency Document (TNRCC, 1998) and with the RI Work Plan (Hydrometrics, 1996), which includes the following:

- Sampling equipment and techniques.
- Procedures for taking measurements of water level elevations in the monitor wells.
- Procedures for detecting any phase-separated liquids and their thickness, if present.
- Well evacuation procedures, including purged water or water quality prior to sampling and handling.
- Sampling and analysis protocol for field measurements.
- Procedures for decontaminating sampling equipment between sampling events.
- Disposal of field-generated waste.
- Sample handling and preservation techniques, including chain of custody documentation.
- Sampling quality assurance/quality control (QA/QC) procedures.

1.6 PHASE III REPORT ORGANIZATION

This Phase III RI Report provides data that is supplemental to the Phase I and Phase II RI Reports. The Phase I and Phase II RI Reports can be referenced for additional background information concerning the history of the Facility, the environmental setting, and other information.

This Phase III RI Report is organized as follows:

- **Section 1.0:** Presents Phase III RI background and IA information, current regulatory considerations, summary of previous investigations, and organization of the report.
- **Section 2.0:** Presents a summary of RI soil, surface water and groundwater investigation results for the overall Facility and specific IAs and how these results relate to source areas and Plant operations.
- **Section 3.0**: Presents a summary of the revised Baseline Risk Assessment (BLRA) results.
- **Section 4.0:** Presents a general proposal for corrective action. This proposal includes an overview of corrective action processes and alternatives, selected corrective action alternatives and associated cost estimates to assure appropriate remediation in compliance with Texas Administrative Code, Title 30, Chapter 335, Subchapter S, Risk Reduction Standards. A detailed description of all corrective action technologies is presented in the Phase I RI Report.
- **Section 5.0:** Presents conclusions based on the information from the Phase I, Phase II and Phase III RIs.
- **Section 6.0:** Lists the references cited in the report.

SECTION 2.0

REMEDIAL INVESTIGATION RESULTS AND THE RELATIONSHIP BETWEEN SMELTER OPERATIONS AND POTENTIAL SOURCE AREAS AND MATERIALS

2.0 REMEDIAL INVESTIGATION RESULTS AND THE RELATIONSHIP BETWEEN SMELTER OPERATIONS AND POTENTIAL SOURCE AREAS AND MATERIALS

This section of the Report provides an overview of the results of soil, surface water and groundwater investigations conducted as part of the Phase III RI at the Facility as well as the results from the Phase I and II RIs. Phase III RI data were used to better define the extent of elevated metal concentrations, and to further evaluate the release mechanisms and exposure pathways for COCs.

The first part of this section provides an overview of soil, groundwater and surface water investigation results for the overall Facility. For convenience, soil, groundwater and surface water data collected from the Phase I, II and III RI events will be referred to as data "for the period of record" throughout this section of the Report.

Following the overview of soil, groundwater and surface water investigation results, background information, soil, and groundwater investigation results are presented for individual IAs including a description of source areas and materials associated with the IAs. The IA specific information is used to develop corrective action alternatives and measures and to more accurately delineate source areas and material volumes as presented in Section 4.0 of this Report.

All media investigations were conducted by Hydrometrics personnel pursuant to standard operating procedures defined in the RI Work Plan (Hydrometrics, 1996), the TNRCC Consistency Document (TNRCC, 1998) and comments provided by the TNRCC. All laboratory analyses were conducted by Asarco's Technical Services Center (TSC), a certified laboratory in Salt Lake City, Utah.

The number of soil borings, monitor wells and soil samples installed or collected during the period of record is summarized in Table 2-1. The analytes tested in samples of soil and water for the period of record are identified in Table 2-2. Groundwater and surface water quality data are presented and evaluated for monitoring locations developed during Phase III RI activities, as well as for the period of record. Cumulative lists of surface water quality results (general chemistry and metal analysis), for the period of record, are presented in Appendices B and C, respectively. Cumulative lists of groundwater quality results (general chemistry and metal analysis) for the period of record are presented in Appendices D and E, respectively. Phase III RI surface water/groundwater and soil sediments analytical reports are included in Appendices F and G, respectively. Phase III RI surface water/groundwater and soil data validation reports are included in Appendices H and I, respectively. Lithologic logs and completion details for monitoring wells installed during Phase III RI are in Appendix J. Phase III RI graphs of soil sample metal analysis (concentration versus depth) are presented in Appendix K. Water quality trend graphs for total and dissolved arsenic at individual monitoring wells are included in Appendix L. Water table monitoring gauging data is presented in Appendix M.

2.1 OVERVIEW

As described in the Phase I and Phase II RI Reports, materials associated with potential source areas are separated into the following three source material categories based on metal concentrations, distribution and volume of materials, visual characteristics, impacts to groundwater, and degree of potential toxicity. The material categories for the Facility are as follows:

Category I: Category I materials are residual by-products typically associated with specific current and past Facility operations. Based on the results of the RI, Category I materials are associated with distinctly elevated concentrations of metals in underlying groundwater.

Category I materials include but are not limited to the following:

- Sulfuric acid.
- Acid Plant scrubber water/solids (from leaks, etc.).

- Acid Plant water treatment Facility filter cake.
- Liquid leakage from process gas flues going to the Acid Plants.
- Leachate from Sulfuric Acid Reacting with Slag Fill material.
- Cottrell dusts (Reverb, Roaster, Converter, ConTop, and Sinter Plant).
- Spray Chamber dusts (Reverb, Roaster, Converter, and ConTop).
- Converter Building ventilation baghouse dust.
- Baghouse and other dusts from former Lead Plant and Sinter Operations.
- Feed materials, including lead and copper concentrates, speiss and matte.

Category II: Category II materials are large volumes of residual by-products with lower COC concentrations than Category I materials. Category II materials also include smelter debris such as brick, flues and other materials from demolition of smelter facilities taken out of commission in the past which have residual concentrations of metals. Based on the results of the RI, Category II materials do not currently represent a source of metals to the underlying groundwater, but could become a potential source in the future if conditions at the surface are not properly managed.

Category III: Category III materials are copper slag and fumed lead slag. These are largely inert materials with no anticipated human health or environmental impacts.

As discussed in Section 1.0, the Phase III RI data submitted in this Report serve to supplement the data presented in the Phase I and Phase II RI Reports, and to verify or expand the evaluations and conclusions presented in the Phase II RI document. The rational for the distribution and evaluation of Category I, II and III materials was provided in the Phase I RI Report. Key points developed during the Phase I RI about chemical constituents of interest, rational elements and influencing local physical conditions are summarized as follows:

Primary COCs: Arsenic, cadmium and lead were determined to be the primary COCs for this project because they occur in soil and groundwater at elevated concentrations. Selenium was another COC identified in the Phase I RI, which impacts soil and groundwater to a lesser degree. At some locations, the occurrence of elevated concentrations of primary COCs observed in groundwater may be related to former and/or current Facility operations. Other metals and indicator parameters were monitored in soil, groundwater and surface water at the Facility. Elevated concentrations of COCs were not observed in nearby off-Site surface water bodies (the Rio Grande and American Canal) during this and previous Phases of the RI.

Selection of Phase III RI Sample Locations: The Phase III RI provides supplemental data to support evaluation of the location and extent of Category I, II and III materials. Specifically, the Phase III RI focused on the following:

- Identification of Category I materials to be excavated and disposed of an on-Site lined disposal cell, and Category II materials to be capped in place.
- Inclusion of investigation results of associated Closed Plants and off-Plant properties, with the Phase III RI Report to further supplement the RI.

The purpose of this investigation was also to collect data to support the engineering design for the implantation of recommended corrective actions. Field investigations were designed such that previous results can be used to choose locations for subsequent sampling. This phased approach uses the following components:

- Visual identification of features associated with former smelter operations.
- The relationship of soil and operational elements, former arroyos, and potential groundwater impacts at the Facility.
- Evaluation of the previous laboratory testing to estimate both the vertical and horizontal estimated boundaries of the potentially impacted areas of the Facility.

Groundwater, Arroyos and Source Materials: The Phase I and Phase II RI Reports, as well as Section 2.2 of this Report, describe how the flow of groundwater beneath the Plant area is influenced by former arroyos, or drainages. These arroyos are filled in with alluvial and smelter related materials, which generally exhibit higher hydrolic conductivity values than the native rocks and soils, which form the original natural topography. Figure 2-1 shows the former centerlines of these features in the Facility area.

Evidence obtained during the RI shows that these arroyos function as pathways for preferential groundwater flow. As described in this section, evidence for this includes the characteristics of the shallow aquifer elevations indicating areas of relatively greater hydrolic conductivity, and water quality data indicating that the arroyos serve as preferential flow paths for COC migration.

During the RI investigations, lower concentrations of COCs in groundwater beneath the Plant may be attributed to the following:

- Decommissioning of ponds and other smelter components.
- Temporary cessation of smelter operations (no activities since February 1999).
- Engineering controls, such as capping and other storm water control elements implemented at the Plant.

These Plant activities, and their relation to environmental impacts, area discussed in subsequent sections.

The potential for impacts from many of the source areas identified at the Plant have been eliminated or reduced by removal or certain capping of source materials. These corrective actions have been performed in conjunction with the implementation of the Storm Water Control and Reuse System, operational changes, or other institutional control elements. Areas and volumes of source materials subject to corrective action measures and the status of the proposed corrective actions are discussed in more detail in Section 4.0 of this Report.

The key points described above are discussed in the following sections as they relate to the characterization of each of the IAs.

2.2 SOIL INVESTIGATION RESULTS

The Phase III RI was conducted to further delineate soil and groundwater characteristics and impacts at the Facility. The Phase III RI included an expansion of investigations in six of the 20 IAs now under consideration. The results of the Phase III RI soil investigation were used to improve estimates for the location and volume of source materials in six of the 14 IAs considered in the Phase II RI. The results of the Phase III investigation also provide an assessment of source areas and potential groundwater impacts in the six new IAs when applicable. IA soil sampling locations for the period of record are in Exhibit 1. All soil sample locations are shown in Figures 2-2a and 2-2b.

Additional soil data collected as part of the Phase III RI was used to confirm general conclusions formulated during the Phase I and Phase II RIs. In particular, additional data regarding groundwater preferential flow associated with in-filled arroyos was further substantiated.

2.2.1 Field Activity Summary

A total of 263 borings were drilled and sampled as part of the Phase III RI to supplement the 233 borings advanced during the Phase I and Phase II RIs (Table 2-1). Boring depths range from 0.2 to 70 feet bgs. Fourteen of the borings were completed as monitor wells. Twenty-nine of the borings were surface samples (less than 5 feet bgs). Phase III borings were installed to further delineate the horizontal and vertical extent of source areas and materials and to provide information to support Remedial Design (RD) activities.

During drilling activities, soil samples were collected from 1-foot intervals from ground surface to a depth of 5 feet bgs. Samples were collected from 5-foot intervals from a depth of 5 feet bgs to the bottom of the boring. The ground surface was considered the surface of undisturbed native soils.

Slag overlying native soil was logged but not sampled. For instance, when slag was encountered, the borings were advanced to the slag/soil interface and then sampled in five one-foot intervals, from the slag/soil interface to a maximum depth of five feet. Certain borings were advanced and sampled below groundwater/soil interface to provide additional design information. These were modifications to previous Phase I and Phase II boring protocols. Drilling methods used during the Phase III RI were hollow-stem auger, geoprobe and hand auger.

As summarized in Table 2-1, a total of 792 Phase III RI soil samples were collected in addition to the 1,329 soil samples collected during the Phase I and Phase II RI. Soil samples were analyzed using x-ray fluorescence spectrometry (XRF) methods for total arsenic, cadmium, chromium, copper, iron, lead, selenium and zinc.

QA/QC samples were collected at a rate of five-percent, or one QA/QC sample per 20 samples. Laboratory QA/QC procedures required confirmation analysis of 1 in 20 samples collected using Waste Extraction Test (WET) chemistry methods for Total Metals (TMs) analysis using Hydrofluoric Acid (HF) digestion and Inductively Coupled Plasma Mass Spectrometry (ICP). In addition to XRF analysis, select baseline samples were analyzed for total arsenic, cadmium, chromium, copper, iron, lead and selenium and zinc using the ICP method as part of the Phase III investigation.

2.2.1.1 Summary of Soil Sample Results

Data collected as part of the Phase III RI further support the conclusions presented in the Phase I and Phase II RI Reports which identified arsenic, cadmium, lead and selenium as the primary COCs. Concentrations are generally highest in soils near the land surface. This distribution trend is illustrated in depth versus concentration graphs (data averaged over the period of record) in Appendix K. Elevated concentrations of metals in soils are observed throughout the Facility associated with current and past Plant operations.

2.3 GROUNDWATER INVESTIGATION RESULTS

Groundwater investigation results are discussed in the following sections.

2.3.1 Overview

Groundwater conditions have been evaluated at the Facility for the period of record to comply with the requirements of the TNRCC Agreed Order. During the Phase I RI, 24 monitoring wells were installed (on-Plant and off-Plant) to characterize groundwater conditions. To support the groundwater characterization during Phase I RI, groundwater samples for metal analysis were also obtained from approximately 35 pre-existing monitoring wells.

During the Phase II RI, 27 additional monitoring wells were installed to further characterize groundwater conditions associated with the Facility. During the Phase III RI, 14 additional monitoring wells were installed for further groundwater characterization purposes. Surface water and groundwater sampling locations for the period of record are in Figure 2-3.

Groundwater investigation objectives included delineation of hydrogeologic units, evaluation of groundwater flow-paths and groundwater velocities. The following is summary of findings obtained during RI activities:

- The aquifer located underneath the Facility is composed primarily of interbedded and mixed sand, gravels, boulders and bedrock.
- There are a few locations (floodplain of the historic Smeltertown) where the shallow aquifer is composed of finer-grained sediments (e.g., silts and clays).

- The Rio Grande alluvial aquifer (historic Smeltertown Area) consists of reworked colluvial and terrace deposits. In the upper 20 feet, composition of the unit is predominately sand, silts and clays.

- The colluvial fill in which the former arroyos beneath the Facility are cut into generally consist of well-graded silty sands, gravels, cobbles and boulders. Some portions of this unit contain cement of "caliche" calcium carbonate. Locally, this unit is estimated to be 300-400 feet thick in El Paso Canyon (Rose, 1953). In the vicinity of the Facility, the thickness of this unit is estimated to be between 150 and 200 feet.

- The bedrock beneath the Arroyo, Colluvial and Rio Grande alluvial sedimentary units consists of Tertiary age andesite (laccolith), and Cretaceous age sandstones, shales, limestones and siltstones.

- The shallow aquifer beneath the Facility is considered brackish, with a TDS concentration ranging from 3,000 mg/l to 10,000 mg/l (Drever, 1982).

- Groundwater flow in the area of the Facility is generally from the east-northeast to the west-southwest. As the groundwater approaches the Rio Grande, the direction changes to a southerly route which approximates the direction of the Rio Grande at the Facility (Figures 2-5 and 2-6).

- Depth to groundwater is dependent on location within the Facility. The depth of groundwater at the Facility is 40 to 60 feet bgs, depending on the surface elevation. On the Rio Grande floodplain (historic Smeltertown), the depth to groundwater is approximately 10 feet bgs.

- Aquifer elevations fluctuate in conjunction with the amount of water in the Rio Grande and the American Canal. These fluctuations are a result of seasonal releases of water from Elephant Butte Dam, near Truth or Consequences, New Mexico, which is approximately 100 miles north of El Paso. In the spring, water is released for irrigation purposes. In the fall, water releases are restricted to conserve water over the winter months.

- Groundwater at the Facility is not used for drinking water.

2.3.2 Phase III RI Groundwater Results

During the Phase III RI, 14 additional monitoring wells were installed. Following is a discussion of results obtained from the Phase III RI groundwater investigation as they relate to the results from the previous two RI phases.

Pursuant to comments provided by the TNRCC and in accordance with the TNRCC Consistency Document, beginning in August of 1999, groundwater and surface water samples were analyzed for TMs. After extensive review of the groundwater analytical data, it was concluded that laboratory results for TMs may be significantly influenced by turbidity. To further evaluate this phenomenon, dissolved metals have been included in the analyses.

2.3.2.1 Scope of Field Activities for the Phase III Groundwater Investigation

A total of fourteen groundwater monitor wells (EP-119 through EP-132) were installed between April and June 2001 as part of the Phase III RI (Figure 2-3). The Phase III wells supplement the existing monitoring well network constructed during the Phase I and II RI and previous diesel investigations. The present site monitoring and recovery well network now totals 130 wells. Well completion and survey data for each well is summarized in Table 2-3.

The purpose of the Phase III RI groundwater investigation was to further define and evaluate groundwater impacts from potential source areas. Specifically, wells EP-119 and EP-122 (Figure 2-3) were installed at the request of the TNRCC to investigate groundwater flow and water quality conditions in the historic Smeltertown Area (IA-5) downgradient of the Parker Brothers Arroyo. Monitor wells EP-120, EP-121, and EP-123 were installed to investigate a potential historical point source in the slag deposition area of IA-12.

Well EP-124 was installed to replace well EM-7, which became dry after nearby Plant ponds were taken out of use. Wells EP-125 and EP-126 were installed near the bulk acid storage tanks (IA-2) within the perimeter of the former Acid Plant Arroyo. The purpose of these wells is to investigate suspected leaks from the Acid Plant Storage Area and potential historic disposal of acid sludge in the former arroyo.

Wells EP-127 and EP-128 were installed on land owned by the International Boundary and Water Commission (IBWC) to further investigate groundwater conditions at the outlet of the Ponds 5 and 6 Arroyo. Wells EP-130, EP-131, and EP-132 were installed within the perimeter of the Ponds 5 and 6 Arroyo to better define groundwater quality along the former arroyo.

2.3.2.2 Phase III Groundwater Investigation Methodology

All wells were drilled using a hollow stem auger rig. Each borehole was drilled to total depth using 6-inch outside diameter (OD) augers and then overdrilled to total depth using 10-inch OD augers. Total depths for these wells ranged from 20 to 82 feet bgs.

Phase III RI monitor wells were completed within colluvial materials (EP-120, EP-121, EP-123, EP-124, EP-125, EP-126, EP-131) and Rio Grande alluvium (EP-119, EP-122, EP-127, EP-128, EP-132) and bedrock (EP-129). Well EP-129 was completed within shale bedrock, and well EP-130 was completed within colluvial materials and shale bedrock.

In general, continuous soil samples were collected using a split spoon sampler to a depth of five feet bgs and subsequent samples were collected every five feet to total depth. However, as previously noted, samples were not collected in slag materials. As in previous drilling programs, soil samples were examined in the field for lithology, grain size, texture, and color by a geologist. All samples were submitted for metals analysis using XRF methods.

The monitor wells were completed with 4-inch inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) casing with flush joints and threaded couplings within 10-inch diameter boreholes. All wells were completed with 0.020-inch slot well screens.

Lithologic and construction logs for the Phase III RI monitoring wells are in Appendix J and well construction details are summarized in Table 2-3.

Following completion, each monitoring well was developed by pumping to ensure adequate hydraulic continuity with the aquifer. Groundwater sampling was conducted following well completion and development. All construction, development, and sampling of monitoring wells was consistent with the RI Work Plan.

2.3.3 RI Groundwater Characterization Summary

This section provides a summary of site characterization of the site hydrogeology. The Phase III RI information is combined with previously submitted Phase I and Phase II RI information.

2.3.3.1 Site Hydrogeology

Site hydrogeology is discussed in the following sections.

Site Stratigraphy

As described in the Phase I RI, the majority of the Facility is underlain by colluvial deposits composed of poorly sorted silty-sand and gravel. The colluvial deposits are bisected by west and southwest trending arroyos that have been filled-in locally on the Facility with slag, concrete, miscellaneous wastes and native soils. The slag is up to 64 feet thick within the arroyos. Tertiary age andesite, and Cretaceous age sandstone and shale lie beneath the colluvial deposits and have been observed in monitoring well borings on the Facility at depths ranging from 50 to 78 feet bgs.

To the west of I-10 in the Historic Smeltertown Area, there are alluvial deposits associated with the Rio Grande. The Rio Grande alluvial deposits encountered in site monitoring well borings consist primarily of fine-grained sand, and clayey sand. The site stratigraphy is illustrated in a series of cross sections presented in Exhibits 2 and 3. A map illustrating the location of the geological cross sections discussed above is in Figure 2-4.

Significance of Arroyos

Five significant former arroyos are located at the Plant (Figure 2-1):

1. Parker Brothers Arroyo.
2. Ponds 5 and 6 Arroyo.
3. Pond 1 Arroyo.
4. South Terrace Area Arroyo.
5. Acid Plant Arroyo.

The arroyos have been filled over time with a variety of materials including slag cooled-in-place, re-deposited slag, crushed rock, brick, metal, concrete fragments, and native soils. The arroyos influence the direction of seepage flow from surface runoff. Storm runoff from the Plant is now controlled by the recently completed Storm Water Collection and Reuse System (Dames and Moore, 1998). These filled in arroyos form preferential flowpaths beneath the Plant for groundwater and associated metal concentrations. There is a strong correlation between groundwater flow paths and the alignments of the arroyos and metal concentrations in groundwater.

Phase I RI and Phase II RI data support the conclusion that the highest concentrations of arsenic, cadmium and lead in groundwater are largely associated with wells within the arroyo flow paths downgradient from source areas.

The key points described above are discussed in the following sections as they relate to the characterization of each of the IAs.

Aquifer Characteristics

Aquifer tests have been performed on eleven wells on the Plant and on four wells in Smeltertown as part of previous site investigations (Hydrometrics, 1990 and 1998a). The results are summarized in Table 2-4. Hydraulic conductivity values for the colluvium at the Plant area range from 0.1 ft/day to 11 ft/day ($3.5x10^{-5}$ cm/sec to $3.9x10^{-3}$ cm/sec). One higher value of 450 ft/day ($1.6x10^{-2}$ cm/sec) was found at monitor well EP-85, completed in the Parker Brother's Arroyo on the northern end of the Plant.

The generally low to moderate hydraulic conductivities at the Plant correspond to published ranges for silty sands and fine sands (Fetter, 1994) and indicate a significant percentage of fines in the colluvial and alluvial deposits. The higher hydraulic conductivity result at EP-85 suggests more well-sorted sand and gravel locally in this larger arroyo. Coarse-grained colluvial or alluvial deposits were not found in other soil borings locations within this drainage.

The hydraulic conductivity of the Rio Grande alluvium in the Smeltertown area ranges from 0.8 to 7 ft/day ($2.8x10^{-4}$ cm/sec to $2.5x10^{-3}$ cm/sec) with a geometric mean hydraulic conductivity of 4.3 ft/day ($1.5x10^{-3}$ cm/sec). Although the range is similar to results from the colluvium, the mean hydraulic conductivity is slightly higher. This is consistent with hydraulic gradient changes in the historic Smeltertown area (to be discussed in the following section).

Hydraulic Gradients and Groundwater Flow Conditions

Groundwater levels on the site typically fluctuate seasonally by approximately one to three feet with high water table conditions in July and August and low water table conditions occurring from November through February. Potentiometric maps showing seasonal water level trends in February and August 2001 months are in Figures 2-5 and 2-6, respectively.

The general groundwater flow direction across the Site is to the west-southwest, towards the Rio Grande. Flow directions vary locally, particularly on the western half of the Plant where flow lines converge near the arroyos. Flow directions also vary in the Rio Grande alluvium in response to seasonal changes in stream elevations. As discussed in Section 2.4, stream elevations typically peak in August and are lowest in November at the end of the irrigation season.

When water levels are high in the Rio Grande, the stream elevations exceed groundwater elevations in the alluvial aquifer (Figure 2-6). Groundwater flow in the alluvium during these periods is away from and parallel to the river. During periods of low streamflow, groundwater levels are higher than the river (Figure 2-5). Graphs that show the relationship between groundwater and surface during seasonal high and low flow periods are in Figure 2-7.

The hydraulic gradient within the shallow groundwater system beneath the Plant generally ranges from 0.01 to 0.03 feet/foot. Hydraulic gradients in the Rio Grande alluvium are lower, ranging from 0.01 to 0.004 feet/foot with the lowest gradients in the alluvial deposits at the northern end of the Site (Figures 2-5 and 2-6).

The rate of groundwater flux in the shallow alluvial and colluvial groundwater systems appears to be limited by the low to moderate permeabilities that are characteristic for the subsurface stratigraphy in most areas of the Site. For example, ambient groundwater flux in the shallow colluvial groundwater system would be less than one gallon per minute (gpm) per 1,000 foot width of aquifer assuming a mean hydraulic conductivity of 2 ft/day, a mean gradient of 0.025 feet/foot and an estimated saturated thickness of 20 feet.

The average rate of groundwater flow from the site towards the Rio Grande would be on the order of 3 gpm to 5 gpm under these conditions. Higher flow rates may occur locally, but the geologic data and hydraulic conductivity analyses appear to support limited groundwater flux through most areas of the site under non-pumping conditions.

Groundwater Quality

Since the completion of the Phase II RI, Asarco has conducted five additional rounds of quarterly monitoring at the Site. Fourteen additional monitoring wells have been installed as part of the Phase III RI (Figure 2-2). The most recent quarterly monitoring round included 100 groundwater-monitoring sites. Water quality samples from this recent sampling round were analyzed for dissolved and TMs as well as general water chemistry parameters.

A comprehensive record of groundwater quality results that includes general chemistry and metals analysis is included in Appendix D and Appendix E, respectively. Appendix L contains water quality trend graphs. A statistical summary of current site water quality for individual water quality parameters is in Table 2-5.

Groundwater quality data collected during the Phase III RI are similar to previous results reported in the Phase I and Phase II RIs. More detailed data are available in a number of Facility areas. Site-wide water quality trends are summarized below.

Original parameters designated by the TNRCC for this Facility were arsenic, cadmium, chromium, copper, iron, lead, selenium, zinc, pH, specific conductivity and total dissolved solids. Since many of these constituents typically occur together, the following discussion of water quality trends focuses on the primary COCs arsenic, cadmium and lead.

Arsenic

The Phase I RI Report found that arsenic was present in groundwater at concentrations above the Maximum Contaminant Levels (MCL) (0.05 mg/l) under most of the western half of the Plant with higher concentrations (5 to 480 mg/l) of arsenic present in localized Plant areas. In the most recent monitoring round (August 2001), arsenic was detected above the MCL in 62 of the 101 groundwater monitoring sites sampled.

Figures 2-8 and 2-9 show current total and dissolved arsenic data and identify specific areas with higher concentrations of arsenic (5 to 280 mg/l). The areas that contain higher arsenic concentrations in groundwater are similar to observations in previous RI Reports and include:

- The area northwest of the acid storage tanks.
- The Acid Plant Area.
- The area around Ponds 5 and 6.
- The arroyo downgradient of Ponds 5 and 6.
- The lower Ponds 5 and 6 Arroyo and the surrounding area to the north and south.
- In the Rio Grande alluvium west of the Ponds 5 and 6 Arroyo.

While Phase III RI arsenic results are similar to the overall trends previously established for the site, the data show some temporal changes in water quality from the previous Reports. Water quality trend graphs for total and dissolved arsenic at individual monitoring wells are included in Appendix L. Pronounced changes in arsenic concentrations occurred at these locations:

- Arsenic concentrations at EP-53 located northeast of the acid storage tanks decreased from 60 mg/l in 1998 to less than 30 mg/l in August of 2001.
- Arsenic concentrations at EP-13 south of the Ponds 5 and 6 Arroyo have progressively decreased from approximately 50 mg/l in 1997 to 30 mg/l in August 2001.
- Monitor well EP-49 in the Acid Plant Area shows the largest water quality improvement with arsenic concentrations decreasing from 360 mg/l in 1999 to 11 mg/l in August 2001. Downgradient wells EP-57, EP-58 and EP-59 also show improving water quality trends.
- EP-114 located immediately downgradient of the Acid Plant Area shows a reverse trend with total arsenic concentrations increasing from 118 mg/l in 1999 to 280 mg/l in 2001. The arsenic trends at EP-114 appear to correlate closely with high concentrations of suspended solids in the well (Figure 2-10), and consequently may not be an accurate indication of groundwater quality.

- EP-52 in the Acid Plant Area also shows some evidence of recent increases in arsenic concentrations, increasing from 54 to 92 mg/l in 2001. Like EP-114, the data at EP-52 are difficult to interpret due to high suspended solids in the samples. Recent data from EP-52 show dissolved arsenic concentrations less than half of the TMs concentrations with suspended solids greater than 8,000 mg/l.

For TMs data to accurately reflect groundwater quality, the water requires only dissolved and colloidal metals with no other suspended sediment. However, in a fine-grained formation with low recharge it can be difficult to develop an effective sandpack that prevents sediment from entering the well. EP-114 and many other wells on the Plant show very high suspended solids. In these circumstances dissolved metals are typically a better indicator of groundwater quality and transport potential.

With the exception of the areas described above, temporal changes in arsenic concentrations tended to be minor with upgradient and downgradient locations showing variable low-level changes.

Cadmium

The Phase I RI reported detectable cadmium concentrations in 16 groundwater samples and levels above 0.5 mg/l in six separate areas. The current total and dissolved cadmium results are in Figure 2-11 and 2-12. Cadmium was detected above the MCL of 0.005 mg/l during the most recent monitoring round in 26 percent of the monitoring wells. Total cadmium concentrations exceeded 0.5 mg/l at 6 monitoring wells, but dissolved concentrations greater than 0.5 mg/l were only detected at one location. The higher concentrations occur in the following areas:

Monitoring Well No.	Location	Total Cd (mg/l)	Dissolved Cd (mg/l)
EP-13	West of Delumper Station	0.52	0.47
EP-101	West of Delumper Station	1.6	1.5
EP-55	South of Acid Plant	8.7	<0.005
EP-114	Western edge of Plant down-gradient of Acid Plant	2.2	0.12
EP-116	Western edge of Plant between Acid Plant and Lead Plant	3.2	0.37
EP-117	Western edge of Plant between Acid Plant and Lead Plant	0.66	0.12

As indicated above, the highest concentrations of cadmium are along the western Plant boundary. However, cadmium is also detected at other site locations shown in Figures 2-11 and 2-12.

Cadmium concentrations indicate improving water quality trends at EP-49 in the Acid Plant Area, and at EP-5 near Pond 6. EP-13 near the Delumper Station also has declining cadmium concentrations. However, concentrations appear to show the opposite trend at nearby well EP-101. Total cadmium concentrations appear to be strongly influenced at some locations by the presence of suspended solids in the wells. For example, EP-55 has the highest total cadmium concentrations at the Site and an apparent increasing trend. However, dissolved sampling shows no cadmium at this location. Graphs showing total and dissolved cadmium trends over time are in Appendix L.

Lead

Because of the low solubility of lead, it is typically not mobile in groundwater and the dissolved phase is usually only present in groundwater associated with acid source materials and releases. Total Lead positive concentrations are also observed when there is suspended sediment in a sample. This bias is stongly evident in the Phase III RI sampling results for lead.

Total lead was detected above the 0.015 mg/l action level in 20 percent of the groundwater samples and these detections occurred over a range of locations (Figure 2-13). Dissolved lead however, only exceeded the action level in four percent of the samples and these sites are confined to three small areas on the site (Figure 2-14). The dissolved lead was detected at the Acid Plant (EP-52 and EP-115), at the lower end of the Ponds 5 and 6 Arroyo (EP-116), and east of the Facility at EP-84. Maps showing total and dissolved lead results are in Figures 2-13 and 2-14, respectively. No distinct temporal trends were observed for lead data.

2.4 SURFACE WATER INVESTIGATION RESULTS

Surface water investigation results are discussed in the following sections.

2.4.1 Overview

As part of the RI, surface water quality within and in the vicinity of the Facility has been assessed. The Rio Grande and the American Canal are the most prominent surface water bodies in the vicinity of the Facility. The Rio Grande serves as the international boundary between the United States and Mexico, and the American Canal is used by the United States to remove its water allotment from the Rio Grande. The canal is concrete-lined, and is approximately nine feet deep (IBWC, 1998). The majority of the surface water comes from upstream dam releases, precipitation, and surface runoff. Also, within the Facility, there are three unlined ponds, formerly used for the storage of process, river and city waters, and an ephemeral storm water collection pond (Figure 2-1).

Ephemeral streams locally known as "arroyos" primarily control stream runoff in the area. The five main arroyos located at the Facility have been designated as:

Parker Brothers Arroyo

- Ponds 5 and 6 Arroyo
- Pond 1 Arroyo
- South Terrace Area Arroyo
- Acid Plant Arroyo

The arroyos have been filled over time with a variety of fill materials, including slag cooled-in-place and redeposited slag, crushed rock, brick, metal, concrete fragments, and native soils. The fill zones are generally dense or firm, but also contain loose zones in many locations (Sergent, Hauskins & Beckwith, 1976).

Surface water flow and quality in the Rio Grande, near the vicinity of the Facility, are subject to the following influences:

- Effluent discharges from the sewage disposal Facility (Northwest Wastewater Treatment Facility) located north of Smeltertown, just upstream of the Facility.

- The American Dam, which diverts part of the Rio Grande flow to the American Canal. The American Canal removes the United States allocation of water from the Rio Grande.

- The International Dam located south of the University of Texas at El Paso, which diverts water from the American Canal to the Franklin Canal; it is also the location at which Mexico removes water from the Rio Grande.

- The Haskell R. Street Municipal Wastewater Treatment Facility located on Delta Street approximately one mile downstream of the Facility.

- Seasonal irrigation releases to the Rio Grande upstream of the Facility occur from the Elephant Butte Reservoir, as regulated by the Elephant Butte Irrigation District.

Figure 2-1 shows the location of the historic arroyos, the three unlined on-site ponds (Ponds 1, 5 and 6), the ephemeral storm water collection pond, and the storm water evaporation ponds.

To assess the water quality of the two main surface water bodies, Hydrometrics collected quarterly water samples at up to ten monitoring stations along the Rio Grande and the American Canal. In addition, the IBWC continuously monitors the water quality at two locations along the Rio Grande and the water flow along the Rio Grande and the American Canal.

To evaluate the water quality at the unlined ponds, Hydrometrics has collected water samples for analysis on a quarterly basis. Also, to prevent percolation of water stored in the ponds, a Storm Water Collection and Reuse System was completed in 2000. This system eliminated the need for the unlined ponds.

All surface water samples collected as part of the Phase III RI were analyzed in accordance with the parameters listed in Table 2-2. Information collected from these sampling events was used to complement the data obtained during the Phase I and Phase II RIs.

2.4.2 RI Surface Water Characterization Summary

Hydrometrics sampled surface water in the American Canal and in the Rio Grande as part of the long-term surface water monitoring program. Information obtained during the Phase III RI surface water investigation in conjunction with data collected by the IBWC, was used to complement Phase I and Phase II RI data. Hydrometrics performed quarterly sampling activities between May 2000 and August 2001 as part of the Phase III RI. Water samples were collected at up to seven locations in the Rio Grande and at three locations in the American Canal (Figure 2-3).

Surface water monitoring results for samples collected from the Rio Grande and American Canal as part of the Phase III RI are in Tables 2-9 and 2-10. A statistical summary of these data is in Table 2-11.

Surface water monitoring results (general chemistry and metal analysis) for the period of record are in Appendices B and C, respectively. Laboratory reports for surface and groundwater samples obtained during the Phase III RI are in Appendix F. Data validation reports for Phase III RI surface water samples are in Appendix H.

2.4.2.1 IBWC Water Quality - Courchesne Bridge and Bowie High School

During Phase III RI, the IBWC recorded water quality data on a weekly basis (for reasons unrelated to the RI) from two locations along the Rio Grande that includes the Courchesne Bridge and a location across from the Bowie High School football field. The Courchesne Bridge is located upstream of the Facility, approximately 9.5 miles above the Haskell R. Street Wastewater Treatment Facility. It is the closest upgradient sampling point on the Rio Grande in relation to the Facility. The Bowie High School is located downstream from the Facility, about 1.5 miles from the Haskell R. Street Wastewater Treatment Facility. (Figure 2-15).

Parameters tested by the IBWC at each location included dissolved oxygen (DO), pH, biochemical oxygen demand (BOD), fecal coliform, chloride, total dissolved solids (TDS), sulfate, specific conductivity (SC), total hardness, ammonia, turbidity and temperature.

Courchesne Bridge

The average analytical concentrations for the Courchesne Bridge, collected during the Phase III RI period were:

Parameter	**Average Concentration**
• DO	8.1 mg/l
• pH	8.0
• BOD	5 mg/l
• Fecal Coliform	2,669 colony forming units per 100 ml
• Chloride	135 mg/l
• TDS	783 mg/l
• Sulfate	254 mg/l
• SC	1,336 microsiems per centimeter (uS/cm)
• Ammonia	0.29 mg/l
• Total hardness	278 mg/l
• Turbidity	75 NTUs
• Temperature	61.5° F

Bowie High School

The average analytical concentrations for the Bowie High School sampling location were:

Parameter	**Average Concentration**
• DO	9.5 mg/l
• pH	8.2
• BOD	5.7 mg/l
• Fecal Coliform	9,312 colony forming units per 100 ml
• Chloride	147.9 mg/l
• TDS	833 mg/l
• Sulfate	277 mg/l
• SC	1,391 microsiems per centimeter (uS/cm)
• Total hardness	278 mg/l
• Ammonia	0.21 mg/l
• Turbidity	27.2 NTUs
• Temperature	58° F

Table 2-6 and Table 2-7 show a summary of IBWC analytical results collected during the Phase III RI period for Courchesne Bridge and Bowie High School, respectively. Table 2-8 is a summary of IBWC average concentrations at both stations. The measured IBWC water quality parameters for the Rio Grande at the Courchesne Bridge and Bowie High School stations as a function of time for the period January 1997 through June of 2001, are in Figures 2-16, 2-17, 2-18, and 2-19, respectively.

With exception of fecal coliform and turbidity, the surface water quality results at both locations are very similar, which indicates that there is little additional influence on general water quality characteristics in the reach of the Rio Grande between the two sampling points. Fecal coliform was the parameter that exhibited the greatest average variability. The average colony forming units per 100 ml for fecal coliform at Courchesne Bridge and Bowie High School were 2,669 and 9,312, respectively. The variability of turbidity is consistent with the variance detected during Phase I and Phase II RIs.

2.4.2.2 Hydrometrics Water Quality – Rio Grande

During the Phase III RI, Hydrometrics collected water quality data at seven locations (SEP-2, SEP-4, SEP-9, SEP-10, SEP-11, SEP-12, and SEP-13) along the Rio Grande. Permanent rods located three to five feet from the Rio Grande are surveyed and used as reference points to measure water elevations during sample events. Surface water samples were collected during the 2^{nd}, 3^{rd}, and 4^{th} quarters of 2000 and 1^{st}, 2^{nd}, and 3^{rd} quarters of 2001. The following is a summary of water quality and metal concentration results of samples collected during the Phase III RI. Parameters tested by Hydrometrics at each location are in Table 2-2.

Water Quality Parameters

The water quality analytical concentrations for the Rio Grande, obtained during the Phase III RI, indicated the following range of concentrations:

	Concentrations	
Parameter	**Min**	**Max**
• pH	7.90	8.60
• DO	5.20 mg/l	11.50 mg/l
• SC	927 µmhos/cm	2,440 µmhos/cm
• TDS	519 mg/l	1,574 mg/
• TSS	17 mg/l	437 mg/l
• Calcium	57 mg/l	119 mg/l
• Magnesium	14 mg/l	32 mg/l
• Sodium	89 mg/l	334 mg/l
• Potassium	7.3 mg/l	14 mg/l
• Bicarbonate	195 mg/l	342 mg/l
• Carbonate	1.0 mg/l	14.4 mg/l
• Sulfate	172 mg/l	598 mg/l
• Chloride	73 mg/l	315 mg/l
• Fluoride	0.64 mg/l	0.90 mg/l
• Nitrate and Nitrite (as nitrogen)	0.15 mg/l	6.10 mg/l

Total Recoverable Metals (TRMs)

Total Recoverable Metal analysis was not conducted as part of the Phase III RI.

Total Metals (TMs)

The water samples obtained in May and August of 2000 at SEP-9 and SEP-2 exceeded the lead action level of 0.015 mg/l. The total lead concentrations detected at these two locations were 0.026 mg/l and 0.019 mg/l, respectively. Data obtained from subsequent sampling events at these locations indicated metal concentrations are below action levels for lead. The chromium MCL was exceeded only one time. A water sample obtained from SEP-4 in August of 2000 had a metal concentration of 0.013 mg/l. Data from subsequent sampling events indicated metal concentrations are below detection limits (bdl).

Dissolved Metals (DMs)

During the Phase III RI, analysis for dissolved metals was conducted only during the 3rd quarter sampling event (August 2001). In general, water quality results indicate concentrations within acceptable regulatory limits. Most of the metal results obtained from the Rio Grande samples indicated concentrations are bdl on their respective MCLs.

2.4.2.3 Hydrometrics Water Quality – American Canal

During the Phase III RI, Hydrometrics collected water quality data at three locations (SEP-1, SEP-3, and SEP-7) along the American Canal. Surface water samples were collected during the 2nd, 3rd, and 4th quarters of 2000 and 1st, 2nd, and 3rd quarters of 2001.

Analytical results for samples collected from the American Canal as part of the Phase III RI are as follows:

	Concentrations	
Parameter	**Min**	**Max**
• pH	8.2	8.60
• DO	5.6 mg/l	9.5 mg/l
• SC	946 μmhos/cm	1,784 μmhos/cm
• TDS	603 mg/l	1,208 mg/l
• TSS	64 mg/l	311 mg/l
• Calcium	66 mg/l	114 mg/l
• Magnesium	15 mg/l	29 mg/l
• Sodium	99 mg/l	225 mg/l
• Potassium	7.2 mg/l	12 mg/l
• Bicarbonate	203 mg/l	342 mg/l
• Carbonate	1 mg/l	11 mg/l
• Sulfate	187 mg/l	335 mg/l

• Chloride	73 mg/l	222 mg/l
• Fluoride	0.66 mg/l	0.77 mg/l
• Nitrate and Nitrite (as nitrogen)	0.41 mg/l	2.2 mg/l

Total Metals (TMs)

TMs concentrations in samples collected from the American Canal as part of the Phase III investigation were below regulatory limits.

Dissolved Metals (DMs)

During the Phase III RI, DMs analysis was conducted only during the 3rd quarter of 2001 sampling event. In general, surface water monitoring results indicate concentrations of metals are within acceptable regulatory limits. Most of the metal results obtained from the Rio Grande samples indicated concentrations bdl or below their respective MCLs.

2.4.2.4 Sediment Quality – Rio Grande Stream bed

Collection of streambed sediments at Rio Grande surface water sample locations was initiated in August of 1999. Streambed sediment sampling results for the period of record are in Table 2-12. Monitoring results indicate maximum arsenic, cadmium, and lead concentrations of 50 mg/kg, 18 mg/kg, and 380 mg/kg obtained from monitoring stations SEP-10, SEP-4, and SEP-13, respectively. The elevated lead concentrations may be attributed to several upgradient sources that include industrial, municipal and agricultural discharges to the Rio Grande.

No streambed sediments were collected from the American Canal at designated surface water sampling locations during the Phase III RI. This was due to consistent high water volume flows in the canal, which made it too dangerous for sampling personnel to collect sediment samples.

Rio Grande Flow and Adjacent Wells

A detailed discussion of water table elevations adjacent to the Rio Grande and flow in the Rio Grande was provided in the Phase I (Section 2.2.10) and Phase II (Section 2.2.5) RI Reports. Water table elevations measured during the Phase III RI verify Phase I and Phase II observations and are briefly summarized in this section.

The IBWC maintains a database with mean daily flow measurements at three points in the Rio Grande. Data from 1995 through 1999 were considered for the Phase I and Phase II RI Reports. Rio Grande monthly mean flow volumes for the period of January 2000 through June 2001 (Phase III RI) for the following stations is in Table 2-13:

- The Courchesne Bridge.
- The Pump House below the American Dam.
- The American Dam diversion for the American Canal.

Historical Rio Grande daily mean flow volumes at these monitoring locations are in Figure 2-20.

As noted in previous Reports, the upgradient measurement location at Courchesne Bridge has the highest mean daily flow rates. Between Courchesne Bridge and the American Canal, additional sources of flow to the Rio Grande in the Facility area include the Northwest Wastewater Treatment Facility, approximately one-mile northwest and upstream of the Facility. The downstream location at the Pump House has the lowest mean daily flow rates influenced in part by the American Dam diversion.

At the American Dam, the United States diverts water from the Rio Grande to the American Canal and then to the Haskell R. Street Wastewater Treatment Facility. The highest flow volumes, during this reporting period, at the Pump House below the American Canal and the Courchesne Bridge occurred on June 19, 2000, where the mean daily discharge volumes were 23 and 68 cubic meters per second, respectively. The highest flow volume at the American Canal Diversion occurred on June 29, 2000 where the mean daily discharge was 33.5 cubic meters per second.

To be consistent with the Phase II RI Report, groundwater elevation in wells EP-4 through EP-7 (Rio Grande area) and wells EP-60 through EP-66 (historic Smeltertown area) were compared to the Rio Grande flow data to evaluate the potential for a correlation. Groundwater elevation data for the period February 1995 through August 2001 is in Table 2-14. Water level measurements in wells EP-4 through EP-7 and EP-60 through EP-66, are presented graphically in Figures 2-21 and 2-22.

Fluctuations in groundwater elevations have been observed over the period of record. These fluctuations are directly related to stage increases in the Rio Grande. Simply stated, water level in the wells are higher when the stage in the Rio Grande is also high, especially during the month of August following the higher discharge volumes in the Rio Grande. Lower groundwater levels in January and February also follow a period of reduced discharges and produce a corresponding low stage in the Rio Grande.

Water Quality – On-Plant Ponds

During the Phase III RI, water samples were obtained from on-Plant Ponds 1 and 6, and from the Ephemeral Pond (SEP-14). As part of the RI water samples have been collected from these ponds on a quarterly basis since August of 1997. Pond 5 was dry in August of 1998 and has not accumulated rainwater since then. As part of the Storm Water Collection and Reuse Project, Ponds 1, 5 and 6 were decommissioned between 1998 and 2000. Pond 1 was dry by September of 1999 and Pond 6 became dry in March of 2001.

On-Plant surface water monitoring results for the period of record are summarized in Table 2-15 and 2-16. Other surface water data including on-Plant samples for the period of record are in Appendices B and C. Laboratory reports for surface and groundwater samples obtained during the Phase III RI are included in Appendix F. Data validation reports for Phase III RI surface water samples are included in Appendix H.

Analytical results for samples collected from the on-Plant ponds for the period of record are summarized as follows:

Parameter	Concentrations Min	Max
• pH	6.5	9.3
• DO	4.1 mg/l	12.4 mg/l
• SC	151 μmhos/cm	215,000 μmhos/cm
• TDS	103 mg/l	147,412 mg/l
• TSS	1.8 mg/l	1,703 mg/l
• Calcium	12 mg/l	850 mg/l
• Magnesium	2.7 mg/l	3,445 mg/l
• Sodium	8.2 mg/l	42,350 mg/l
• Potassium	2.5 mg/l	4,074 mg/l
• Bicarbonate	21 mg/l	587 mg/l
• Carbonate	1 mg/l	41 mg/l
• Sulfate	20 mg/l	80,035 mg/l
• Chloride	1.1 mg/l	24,148 mg/l
• Fluoride	0.2 mg/l	121 mg/l
• Nitrate and Nitrite (as nitrogen)	0.11 mg/l	1,112 mg/l.

Total Recoverable Metals (TRMs)

TRMls were evaluated for the period August of 1998 to August of 1999. During this period, the range in TRMls was as follows:

Metal	Concentrations Min	Max
• Arsenic	0.05 mg/l	1.6 mg/l
• Cadmium	0.01 mg/l	32 mg/l
• Chromium	0.01 mg/l	0.01 mg/l
• Copper	0.15 mg/l	2.2 mg/l

• Iron	0.16 mg/l	3.6 mg/l
• Lead	0.05 mg/l	0.75 mg/l
• Selenium	0.01 mg/l	2.86 mg/l
• Zinc	0.18 mg/l	516 mg/l

Total Metals (TMs)

Analysis for TMs has been performed since October of 1999. During this period, the range in TMs was as follows:

	Concentrations	
Metal	**Min**	**Max**
• Arsenic	0.03 mg/l	2.16 mg/l
• Cadmium	0.01 mg/l	286 mg/l
• Chromium	0.01 mg/l	0.05 mg/l
• Copper	0.25 mg/l	7.12 mg/l
• Iron	0.10 mg/l	2.8 mg/l
• Lead	0.07 mg/l	1.8 mg/l
• Selenium	0.01 mg/l	11 mg/l
• Zinc	0.14 mg/l	58 mg/l

Dissolved Metals (DMs)

Analysis for DMs was performed continuously from 1997 to August of 1999. During the sampling event of the 3rd quarter of 2001 (August 2001), the analysis of DMs was included. DM concentrations in on-Plant ponds for the period of record were as follows:

	Concentrations	
Metal	**Min**	**Max**
• Arsenic	0.05 mg/l	3.7 mg/l
• Cadmium	0.01 mg/l	35 mg/l
• Chromium	0.01 mg/l	0.01 mg/l
• Copper	0.01 mg/l	0.05 mg/l

• Iron	0.10 mg/l	0.76 mg/l
• Lead	0.004 mg/l	0.490 mg/l
• Selenium	0.01 mg/l	2.90 mg/l
• Zinc	0.02 mg/l	137 mg/l

A discussion of Ponds 1, 5 and 6 relative to the Rio Grande was presented in the Phase I RI and Phase II RI Reports (Hydrometrics, 1998 and 2000). Based on the interpretation of groundwater and pond water sample results, water in the ponds may have been a source of metals to the groundwater. Additional information about the potential relationship between pond sediments and metals in groundwater is presented in Section 3.10.2 of Phase II RI Report and in Section 2.5.9 of this Report.

2.4.3 Distribution of COCs

The federal drinking water MCLs, Secondary Maximum Contaminant Level (SMCL), for each of these parameters is provided in Table 2-17 for reference only. Primary drinking water standards are enforceable. However, secondary standards and action levels are included for discussion purposes and are not considered enforceable standards.

2.4.3.1 Distribution of COCs Along the Rio Grande and the American Canal.

Surface water along the Rio Grande is subject to several influences and/or controls. Therefore, stream flow throughout the year is extremely variable. Some influences on the Rio Grande are the effluent discharged from the Northwest Wastewater Treatment Facility, water diverted to the American Canal for use in the United States and Mexico, discharges from the Haskell R. Street Wastewater Treatment Plant, upstream seasonal irrigation releases, and stream runoff during rainfall events.

Flow in the American Canal during the winter is restricted, which indicates that the water samples collected in December and February are not representative of water in the American Canal. It is probable that the water sample results are elevated because the metals have been concentrated due to evaporation or are related to excessive accumulation of sediments in the canal bottom during decreased flow conditions. Only the samples collected during high flow events can be considered as representative of the American Canal waters.

During RI activities, surface water samples along the Rio Grande were collected at seven sampling locations, identified as SEP-2, SEP-4, SEP-9, SEP-10, SEP-11, SEP-12, and SEP-13, and at three locations along the American Canal, identified as SEP-1, SEP-3, and SEP-7. Seven sampling events were performed during the Phase III RI. To date, a total of seventeen sampling events have been conducted at these locations.

All water samples were analyzed for the constituents and parameters listed in Table 2-2. A summary of Rio Grande and American Canal surface water metal concentration results, collected during the Phase III RI, is in Tables 2-10 and 2-11. Surface water quality results (general chemistry and metal analysis) for the period of record are in Appendices B and C, respectively.

Metal Concentrations

Phase III RI results indicated arsenic, cadmium, copper, selenium and zinc concentrations were below the MCL and the SMCL. Lead was detected above its MCL of 0.015 mg/l in the samples collected from sites SEP-2 and SEP-9 on May and August of 2000. Data obtained from subsequent sampling events at these locations indicated metal concentrations were below MCLs for lead. Chromium was detected above its MCL of 0.1 mg/l in the samples collected from sites SEP-4 in August of 2001. Data obtained in subsequent sampling events indicated metal concentrations were bdl.

Water Quality

Most surface water samples were within the pH MCL range of 6.5 to 8.5. The SC, SMCL of 1,000 microsiemens/cm was exceeded in most of the water samples. TDS was detected above the SMCL of 500 mg/l in all surface water samples.

2.4.4 Chemical Comparison

Surface water investigation results obtained as part of the Phase III RI were similar to results obtained during the Phase I and Phase II RIs. With the exception of fecal coliforms and turbidity, surface water quality data collected by the IBWC from the Courchesne Bridge and Bowie High School stations were similar to compared to the Phase I and Phase II RI periods.

Phase III surface water monitoring results for the Rio Grande and American Canal indicated an improvement in water quality compared to Phase I and Phase II RI results. Laboratory reports obtained during Phase III RI indicated most metal concentrations bdl or below their Medium Specific Concentrations. The water quality obtained from the on-Plant ponds also showed a trend similar to that found during Phase I and Phase II RIs.

2.5 INVESTIGATION AREA BACKGROUND INFORMATION AND INVESTIGATION RESULTS

The following sections provide background information for each IA and an evaluation of soil and groundwater impacts based on RI data obtained during the period of record (Phase I, Phase II and Phase III RIs). The background information for each of the IAs is discussed first, followed by a discussion of soil and groundwater data. A summary of relevant findings is presented at the end of each IA discussed. Concentrations of the three primary COCs (arsenic, cadmium and lead) in soil and groundwater samples for the period of record are presented in Tables 2-18 through 2-52.

Phase III RI laboratory reports for groundwater and soil-sediments samples are in Appendices F and G, respectively. Phase III RI data validation reports for groundwater and soil-sediments samples are in Appendices H and I, respectively. Phase III RI soil borings and monitor well completion reports are in Appendix J. Graphs that indicate soil sample metal concentration results versus depth are in Appendix K.

2.5.1 Converter Building/Baghouse Area (IA-1)

Background, soil, groundwater and summary information for the Converter Building/Baghouse Area is presented in the following sections.

2.5.1.1 Background Information

IA-1 is located south of the Acid Plant Mist Precipitator Building and west of the Converter Building Ventilation Baghouse (Exhibit 1, Figure 2-23). This IA includes the Medford Sump, which is used to control storm/process water from the Spray Chamber and the Converter Building Ventilation Baghouse facilities. The Medford Sump accumulates by-products of the smelter operation. These by-products, which accumulate in the Medford Sump area, were considered to be a source of metals to groundwater via the underlying back-filled arroyo.

IA-1 was characterized during the previous RI Phases with two existing monitor wells (EP-51, and EP-52), five shallow borings (surface to 5 feet bgs) and three borings to groundwater, one of which was converted to EP-100. Elevated metal concentrations reduced with depth in borings conducted in the Phase II RI. No additional soil investigation was performed for IA-1 during the Phase III RI.

As discussed in the Phase II RI Report, corrective actions have occurred in this IA, associated with the reconstruction of Medford Sump as part of the Plant Storm Water Control and Reuse System project. Construction activities resulted in the removal and disposal of Category I materials from the Medford Sump area. This excavation eliminated Category I source material in IA-1. Excavated soils were transported to and disposed at a permitted off-Site hazardous waste landfill.

The majority of IA-1 is capped by asphalt or covered by buildings, which limits downward migration of surface fluids. These improvements, along with implemented or planned operational improvements, will assist in eliminating or greatly reducing soil and groundwater impacts in this IA.

2.5.1.2 Soil

During Phase I RI, the soils in this area were characterized by five shallow soil borings, SSIA1-1 through SSIA1-5. In Phase II RI, the IA was further assessed with three deep soil borings, BH-1, BH-2 and EP-100. No additional soil borings were advanced in this IA during the Phase III RI. IA-1 soil sample results for the three main COCs (arsenic, cadmium and lead) for the period of record, is in Table 2-18.

IA-1 soils are characterized as gravelly, silty and clayey fine sands overlain by fill materials, composed of gravelly sand and debris. The soils and subsurface materials in this IA have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Facility operations expanded and changed over time.

A total of fifty-nine soil samples were collected from IA-1 during the Phase I and II RI activities. Analytical results of these samples indicated concentration trends similar to other IAs, with elevated metals concentrations, highest at the surface and reducing with depth. Arsenic and lead appear to be the primary soil COCs in this area, with concentrations ranging from bdl to 22,000 mg/kg for arsenic and from bdl to 20,000 mg/kg for lead.

The general trend observed for concentrations of metals in soils in IA-1 is for the highest concentrations to occur within the first one to five feet bgs, and then decrease with depth. Graphs that indicate the relationship between metal concentrations and depths are presented in Appendix E of the Phase II RI Report (Hydrometrics, 2000). The highest concentrations of metals were observed near the Medford Sump. Borings immediately outside the Medford Sump area have significantly lower metal concentrations.

A cumulative summary of IA-1 soil sample results for the three main COCs (arsenic, cadmium and lead) for the period of record, is presented in Table 2-18. The boundaries of IA-1 and all soil sampling locations are presented in Figure 2-23.

2.5.1.3 Groundwater

Monitoring wells in IA-1 include EP-51, EP-52, EP-100 (Figure 2-23). EP-25 is also in IA-1, but located further to the west in a portion of IA-1 extending into the Acid Plant Area (Figure 2-23). EP-115 is located immediately downgradient of IA-1 in IA-4. Water level monitoring at these wells indicates an average depth to groundwater of approximately 50 feet bgs (Appendix M) and a groundwater flow direction to the west and southwest. There has been a one to four foot decline in groundwater elevations in this area since the Phase II RI, suggesting that Plant improvements have been successful in reducing infiltration recharge to groundwater in this area.

Arsenic, cadmium and lead are all COCs associated with groundwater in IA-1. With the exception of EP-25, arsenic is generally present in groundwater in IA-1 at only moderate concentrations (less than 1.0 mg/l). EP-25, located to the west, exhibits higher arsenic concentrations (7.5 mg/l) that are more characteristic of the adjacent IA-3 Acid Plant Area.

Cadmium and lead in IA-1 groundwater are elevated, particularly at EP-52 which is located northeast of the Medford Sump. The August 2001 monitoring data show dissolved cadmium at EP-52 of 0.4 mg/l and dissolved lead of 0.05 mg/l. Metals concentrations in other wells in this IA are an order magnitude lower. The elevated metals concentrations persist downgradient to EP-115 west of EP-52, but then drop to non-detectable concentrations in the area west of Paisano Drive. Dissolved cadmium and lead groundwater quality trends are shown in Figures 2-12 and 2-14, respectively. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-1 is in Table 2-19.

Generally, average arsenic and cadmium concentrations in groundwater from the Phase II investigation were an order of magnitude less than the corresponding Phase I average concentrations, indicating that the recent sump reconstruction and storm water improvements are having a positive effect.

Water quality data show a gradually improving cadmium trend at EP-52. Lead concentrations have shown less response to recent remedial activities. Storm water improvements and soil excavation is believed to have eliminated or reduced the primary sources of metals to groundwater in IA-1. Additional controls consisting of Acid Plant leak repairs and improved operational procedures are expected to further reduce groundwater metals concentrations in this area.

2.5.1.4 Summary

Selected soils in IA-1 have been impacted by Plant processes, and have contributed to associated groundwater impacts. Arsenic and lead are the principal COCs in this IA. Recent storm water control improvements have been implemented and included removal of the Category I materials. Operational controls consisting of Acid Plant repairs leaks and improved procedures have eliminated or reduced process solution releases in the area. As shown on Figure 4-1 and presented in Table 4-1, most of the Category II materials in IA-1 are currently capped.

With the storm water improvements and soil excavation implemented in IA-1, this source has been eliminated or greatly reduced, as evidenced by the lower Phase III metal concentrations observed at monitor well EP-51. With the addition of the amended asphalt cap in IA-1, the area now serves to control or isolate Category II materials from contact with future storm/process waters. As will be discussed in Section 4.0, these improvements, in combination with improved area cap and associated surface drainage control plan, should eliminate or reduce the potential for metals to migrate to the groundwater in this IA. Specific corrective actions will be discussed in detail in Section 4.0 for IA-1.

2.5.2 Boneyard/Slag Area (IA-2)

Background, soil, groundwater and summary information for the Boneyard/Slag Area is presented in the following sections.

2.5.2.1 Background Information

IA-2 was formerly the location of a Boneyard (for heavy equipment and material storage) located on top of a slag storage area (Exhibit 1, Figure 2-24). The area is located in the footprint of a historic back-filled arroyo. Adjacent to and upgradient of the slag area is a Bulk Acid Storage Facility. As discussed in earlier Reports, materials previously stored at the Boneyard included drums of mixed materials, mist eliminator candles, saddles, fiberglass-reinforced flues, and other miscellaneous equipment (all of which have been removed).

During Phase I and Phase II RI, the subsurface conditions in IA-2 were characterized with five monitor wells and fourteen borings. Data obtained from three existing monitoring wells (EP-21, EP-22, and EP-53) were used to support the groundwater evaluation in this IA. The Category I materials identified as a result of the Phase I RI, (an area of approximately 30,222 square feet located from the surface to a depth of approximately one foot bgs) were excavated, transported to and disposed of at a permitted off-Site hazardous waste landfill in 1998.

Slag resulting from the excavation of the new storm water pond in IA-14, (associated with the Plant Storm Water Control and Reuse System), was deposited on the slag storage area above the remediated surface area. The vertical change in the surface of the slag storage area required monitor wells EP-75 and EP-76 to be extended approximately 18 feet each. The slag storage area in IA-2 was active until February 1999 when smelting operations were temporarily halted.

To properly delineate the extent of soil and groundwater impacts from the sludge historically deposited below the slag and to assess the contribution to these impacts from the adjacent Acid Storage Area, eight additional borings were advanced to groundwater during the Phase III RI.

2.5.2.2 Soil

During the Phase I and Phase II RIs, the soils within this IA were characterized by five monitor wells (EP-75, EP-76, EP-81, EP-85, and EP-99) and fourteen borings (SSIA2-1, SSIA2-2, RIBH-2 to RIBH2-6, and BH2-1 through BH2-7) ranging from 1.5 feet to 76 feet deep. A total of eighty-one soil samples for analysis were collected from these RI activities (Table 2-20). Soil investigation results indicate arsenic, cadmium and lead concentrations range from bdl to 3,700 mg/kg, from bdl to 1,600 mg/kg and from bdl to 10,000 mg/kg, respectively.

During Phase III RI, IA-2 was further characterized with the addition of six borings (BH2-8, BH2-9, BH2-10, BH2-11, BH2-12 and BH2-13) and two monitor wells (EP-125 and EP-126). A total of thirty-seven soil samples were obtained during this investigative phase (Table 2-20). As with the Phase I and Phase II RI, only soil samples beneath the slag were collected from boreholes beginning at depths ranging from 15 to 62 feet bgs. Depth of soil sampling was a function of the thickness of the slag, which was logged but not sampled. Laboratory reports of Phase III RI soil samples indicated arsenic, cadmium and lead concentrations ranging from 13 mg/kg to 930 mg/kg, from bdl to 82 mg/kg, and from 28 mg/kg to 2,900 mg/kg, respectively.

IA-2 soils are characterized as gravely silty and clayey sands overlain by slag and smelter debris materials. The soils and subsurface materials in IA-2 have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or Smelter debris, and re-graded in successive layers as Plant operations expanded and changed through time.

The results of the Phase III RI soil investigation have trends similar to those observed during the previous Phases of the RI. COC concentrations in IA-2 are relatively less than those associated with IA-1.

Impacts from the COCs in IA-2 (arsenic and cadmium) appear minimal. One exception is an isolated zone of impact identified beneath the slag at one location in the vicinity of

BH2-6 at a depth of approximately 9 feet to 23 feet bgs. Elevated concentrations of arsenic and cadmium were encountered in the area of Boring BH-2-6, underlying the slag at a depth of 9 to 42 feet bgs. The highest metal concentration was arsenic (3,700 mg/kg) and occurred in BH-2-6 at the 15 to 17 feet interval.

IA-2 soil investigation results for the three main COCs (arsenic, cadmium and lead) for the period of record, is presented in Table 2-20. The boundaries of IA-2 and all soil sampling locations are presented in Figure 2-24.

As was observed during the Phase I RI, elevated concentrations of COCs may be associated with Acid Plant sludge historically stored in this area and/or the possibility of leaks from the Bulk Acid Storage area south of the Boneyard area.

The infiltration of clean acid from the adjacent Bulk Acid Storage Facility flowing through the slag filled Arroyo was considered a potential source of metals to the groundwater in this IA as discussed in the Phase I RI Report. The soil results from the Phase III RI soil boring and monitor wells have indicated that the possible fluid releases from the Bulk Acid Storage Facility have not adversely impacted the soils in the area between this area and the Boneyard.

The Acid Plant sludge would be characterized as having high metals concentrations due to the process operations of the Acid Plants and not as a result of their contact with slag. It is believed that a discrete area around BH2-6 has identified the general location of the former arroyo deposition site, where Acid Plant sludge was historically stored. The concentrations of COCs observed in this area at the slag and soil inter-phase and deeper in BH2-6, results in the their classification as Category I materials (Figure 4-2). These materials are suspected to be the potential source material contributing to groundwater impacts observed in this IA.

2.5.2.3 Groundwater

There are eight monitoring wells in IA-2. The wells are shown in Figure 2-24 and include EP-21, EP-22, EP-53, EP-75, EP-76, EP-99, EP-125 and EP-126. EP-125 and EP-126 were installed to the north and west of the bulk acid storage tanks during Phase III investigation. The purpose of these wells was to assess whether leaks from the Bulk Acid Storage Area south of the Boneyard area has contributed to groundwater metals concentrations in IA-2.

Water level monitoring data (Appendix M) show groundwater in this area is at a depth of approximately 55 feet bgs. The groundwater flow direction is to the southwest as shown in Figures 2-5 and 2-6 and is consistent with the pre-smelter topographic trend of the Parker Brothers Arroyo. Water levels in most of the wells in this area have declined one to two feet since the Phase II RI, with one well (EP-23) showing a six foot decline in water level.

Arsenic and cadmium are the primary COCs in this IA. Dissolved arsenic concentrations range from 0.022 mg/l to 27 mg/l with the maximum concentrations at monitoring wells EP-53 and EP-75 northwest of the bulk acid storage tanks (Figure 2-24). Water quality trends at EP-53 and EP-75 (Appendix L) show major reductions in arsenic and cadmium concentrations in groundwater over the last three years.

Cadmium concentrations are generally low in IA-2 with the exception of EP-53 which has a cadmium concentration of 0.19 mg/l (dissolved cadmium). Dissolved lead concentrations are bdl in all of the wells in this area. Total lead is present at concentrations varying from 0.004 mg/l to 0.11 mg/l. However, total recoverable lead values (TRC) are more consistent with dissolved values.

Acid Plant sludge was reportedly once stored in this area and may be the source of the observed arsenic and metals concentrations. Infiltration of acid from the adjacent storage Facility was also considered as a possible source of metals to groundwater in IA-2. However, installation and monitoring of wells EP-125 and EP-126 adjacent to this

Facility during the Phase III RI shows comparatively low arsenic concentrations (0.026 to 0.039 mg/l dissolved arsenic) in the vicinity of these tanks. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-2 is presented in Table 2-21.

2.5.2.4 Summary

Primary COCs in soil and groundwater in IA-2 are arsenic and cadmium. Slag (Category III material) is the predominant material near the surface in IA-2, and does not represent a source of metals to the groundwater. As shown on Figure 4-2 and presented in Table 4-1, Category I materials have been identified in IA-2, below slag, impacted soils have been identified in the area near BH2-6 at a depth ranging from 9 to 17 feet bgs. IA-2 Category I material is delineated in Figure 4-2. No further investigation is required to evaluate the extent of Category I materials in this IA. Specific corrective actions for IA-2 will be discussed in detail in Section 4.0.

2.5.3 Acid Plants 1 and 2 Area (IA-3)

Background, soil, groundwater and summary information for the Acid Plants 1 and 2 Area is presented in the following sections.

2.5.3.1 Background Information

IA-3 includes Acid Plants 1 and 2, which are in the northwestern portion of the Plant (Exhibit 1, Figure 2-25). The Acid Plants are used to remove sulfur dioxide from gases generated during the copper smelting process, producing sulfuric acid as a by-product. Acid Plants 1 and 2 are located on a graded surface over the Acid Plant Arroyo, which is filled with slag.

The primary source of impacts to soil and groundwater in IA-3 were water and acid that originated from Acid Plant process components. These fluids have been eliminated or greatly reduced with the implementation of operational controls consisting of the upgrading and lining of sumps, and grading and paving as part of storm water control improvements. Acid Plants 1 and 2 are currently not operational during the temporary Plant shutdown.

IA-3 was characterized during the Phase I RI with four existing monitor wells (EP-49, EP-52, EP-54, and EP-55), one new monitor well (EP-73) and ten surface soil borings (surface to 5 feet bgs). The Phase I RI metal concentrations at 5 feet bgs (the total depth of the borings), did not decrease as a function of depth. Therefore, eight additional borings (BH3-1 through BH3-8) to groundwater and a monitor well (EP-114) at the mouth of the Arroyo were proposed and installed as part of the Phase II RI. No additional investigation was performed in IA-3 during the Phase III RI.

2.5.3.2 Soil

During the Phase I RI, the soils in this area were characterized by eleven soil borings, SSIA3-1 through SSIA3-10, and EP-73. In the Phase II RI, the subsurface conditions of this IA were further assessed with the addition of eight deep soil borings, BH3-1 through BH3-8. (Figure 2-25).

IA-3 soils are characterized as silty sands and gravels overlain by slag, smelter debris and soil fill material. The soils and subsurface materials in IA-3 have been disturbed, reworked, altered and amended during the 100 plus years of operations at the Plant. Topographically low areas were filled in with soils, rock, slag or smelter debris and re-graded in successive layers as Plant operations expanded and changed over time.

A total of 100 soil samples were collected from IA-3 during the Phase I and II RI (Table 2-1), from nineteen borehole locations (Figure 2-25). Soil sample analysis results for IA-3 are summarized in Table 2-22.

Analytical results of these samples indicated concentration trends similar to other IAs, with elevated metals concentrations, highest at the surface and reducing with depth. Metal concentrations as a function of depth are presented graphically in Appendix E of the Phase II RI Report (Hydrometrics, 2000). Arsenic, cadmium and lead are the primary soil COCs in this area, with concentrations ranging from bdl to 7,800 mg/kg for arsenic, from bdl to 1,600 mg/kg for cadmium, and from bdl to 25,000 mg/kg for lead.

Elevated concentrations of COCs in IA-3 are localized and intermittent. Most elevated arsenic, cadmium and lead concentrations are restricted to the first one-foot bgs interval. Some areas have soil impacts to depths up to five feet bgs, and others exhibit elevated concentrations of COCs at depths ranging from about 40 to 60 feet bgs. The deeper intervals occur below slag (Category III) materials. The majority of elevated metal concentrations occur in the area of Borings BH3-5 and SSIA3-10 at depths of 0 to 4.5 feet bgs. The highest concentration of COCs was lead (25,000 mg/kg) and occurred in SSIA3-10 at a depth of 0 to 1.5 feet bgs. Metal concentrations decrease in borings more distant from this location. This material overlies slag in most of IA-3.

A summary of IA-3 soil sample results for the three main COCs, (arsenic, cadmium and lead) for the period of record is in Table 2-22. The boundaries of IA-3 and all soil sampling locations are presented in Figure 2-25.

2.5.3.3 Groundwater

Monitoring wells in IA-3 are EP-49, EP-52, EP-54, EP-55, and EP-73 (Figures 2-25). EP-114 is a downgradient well in IA-4 adjacent to the Acid Plant. The depth to groundwater in IA-3 is approximately 50 to 70 feet bgs. Water levels on the southern portion of the Acid Plant have dropped approximately one foot in elevation since the Phase II RI. Groundwater flow in this area is to the west and southwest.

The primary groundwater COCs are arsenic, cadmium, and lead. The previous accidental releases of low pH, high metal fluids associated with the Acid Plants resulted in elevated concentrations of metals in groundwater, particularly arsenic. Dissolved arsenic concentrations in IA-3 monitoring wells range from 0.041 mg/l to 43 mg/l, with concentrations above 20 mg/l in EP-55, EP-54 and EP-22.

With the storm water improvements and operational controls in this area, this source has been eliminated or greatly reduced. Dissolved arsenic concentrations in EP-49 have dropped from 54 mg/l to 21 mg/l, and dissolved arsenic concentrations at EP-54 have dropped from 50 mg/l to 22 mg/l in the last three years (Appendix E). The downgradient well EP-114, now has the highest arsenic concentrations (227 mg/l dissolved arsenic). At present this well still shows an increasing arsenic trend, but this trend should reverse as source area water quality improvements begin to spread downgradient. A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-3 is presented in Table 2-23.

2.5.3.4 Summary

The former accidental releases of low pH/high metal fluids associated with the gas cleaning and sulfuric acid from the Acid Plants resulted in elevated concentrations of metals, particularly arsenic, in groundwater below IA-3. With the storm water improvements and operational controls in this area, this source has been eliminated or greatly reduced. Impacts to groundwater in IA-3 resulting from localized areas where fluids formerly accumulated are classified as Category II materials (Figure 4-3). Much of the Category II area is currently capped.

At depths greater than 30 to 50 feet below slag, some impacted soil has been identified. Because the source at the surface has been reduced through elimination of leaking and ponding fluids, and the area is below slag (Category III material), additional capping of the area should eliminate or reduce the potential for metals to migrate to the groundwater. Specific corrective actions will be discussed in detail in Section 4.0 for IA-3.

2.5.4 Front Slope/Western Facility Boundary Area (IA-4A)

Background, soil, groundwater and summary information for the Western Facility Boundary Area is presented in the following sections.

2.5.4.1 Background Information

IA-4 includes the western boundary of the Plant and is referred to as the Front Slope (Exhibit 1, Figure 2-26). The Front Slope is composed partially of poured slag, and forms a relatively steep slope between the Plant and Paisano Drive. At the base of the slope is a long flat area, which is the easement for the Burlington Northern and Santa Fe Railroad.

Based on the results of the Phase I RI investigation and subsequent TNRCC comments, the following six sub-areas of concern were identified within IA-4:

- **Sub-area IA-4.1** – Area down-slope of the Acid Plants.
- **Sub-area IA-4.2** – Area down-slope of Medford Sump (Converter Building/Bag House Area).
- **Sub-area IA-4.3** – Area down-slope of the Closed Lead Plant Baghouse.
- **Sub-area IA-4.4** – Area down-slope of the Sinter Plant Gas Cleaning and Sample Mill.
- **Sub-area IA-4.5** – Area down-slope of Diesel 1 and Pond 1.
- **Sub-area IA-4.6** – Area down-slope of the South Terrace.

These six sub-areas are located above back-filled arroyos, most of which are downgradient of Plant components described in other IAs, including Acid Plants 1 and 2 (IA-2) and the Converter Building/Baghouse Area (IA-1). The former Lead, Sinter and Copper Plants are also upgradient of IA-4, and are part of separate investigations. Storm water and operational control improvements implemented in these upgradient IAs have greatly reduced the potential for future impacts to soil and groundwater in this area. Source materials for the sub-areas in IA-4, listed in Table 4-1 and depicted in Figure 4-4, are associated with former Plant operations, the source of which has been corrected as part of Plant improvements.

The soils and subsurface materials in IA-4 have been disturbed, reworked, and otherwise altered during the 100 plus year history of Facility operations. Topographically low areas were filled in with soils, rock, slag or smelter debris, and re-graded in successive layers as Plant operations expanded and changed over time.

The subsurface conditions of IA-4 were characterized during the Phase I RI with three existing monitor wells (EP-13, EP-20, and EP-29), three new monitor wells (EP-70, EP-71 and EP-72) and 30 surface soil borings (surface to 5 feet bgs). Because the Phase I RI did not target the mouths of the Facility Arroyos, six additional borings (BH4-1 through BH4-6) to groundwater and five new monitor wells (EP-114, EP-115, EP-116, EP-117 and EP-118) were proposed and constructed in Phase II RI to better characterize IA-4. No additional investigation was performed for IA-4 during the Phase III RI.

2.5.4.2 Soil

Soil investigation information for the IA-4 sub-areas is presented in the following sections.

Sub-area IA-4.1

IA-4.1 soils down slope of the Acid Plants were characterized by Phase II RI soil borings BH4-6 and EP-114. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-1 and SSIA4-2. These borings were placed to delineate materials in the former arroyo. A total of eleven soil samples were collected from this sub-area of IA-4.1 during the Phase II RI from two borehole locations (Figure 2-26), one of which was completed as a monitor well.

Sub-area IA-4.1 soils are characterized as silty sands and gravels and fill material that have been impacted by runoff and spills from Plant process activities from up slope. The majority of elevated metal concentrations occur at depths of zero to five feet bgs. The highest concentration of COCs observed during Phase I and Phase II RI was lead (1,200 mg/kg) and occurred in SSIA4-2 at a depth of about 1.5 feet.

Soil results for the Phase II RI indicate lower concentrations than were observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 18 mg/kg to 690 mg/kg for arsenic, and 64 mg/kg to 2,800 mg/kg for lead. In the area down slope of the Acid Plants, the highest concentrations of COCs occur within the first one to five feet bgs.

Sub-area IA-4.2

Sub-area IA-4.2 is down slope and west of the Converter Building/Bag House and Medford Sump in IA-1. The soils in the area down slope of the Medford Sump are characterized in Phase II RI by soil borings BH4-5 and EP-115, which was completed as a monitor well. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-3, SSIA4-4 and SSIA4-5 (Figure 2-26). A total of thirteen soil samples were collected from sub-area IA-4.2 during the Phase II RI.

Sub-area IA-4.2 soils are characterized as silty sands and gravels overlain by fill materials that have been impacted by runoff and spills from Plant process activities from up slope. The highest concentration of COCs observed in the Phase I and Phase II RI soil borings was lead. This was taken at SSIA4-5, at a depth of zero to one feet bgs, and showed a level of 23,000 mg/kg.

Arsenic and lead are primary soil COCs in this sub-area, with concentrations ranging from 130 mg/kg to 4,200 mg/kg for arsenic and 470 mg/kg to 8,600 mg/kg for lead. The results of the Phase II RI soil sample analysis reflect similar trends as those observed during the Phase I RI. As with the area down slope of the Acid Plants, concentrations of COCs down slope of the Medford Sump occur primarily within the first one to five feet bgs.

Elevated concentrations of COCs in soils down slope of Medford Sump are attributed to former practices associated with the Medford Sump area, which resulted in ponding of fluids of the area. This source has been eliminated or greatly reduced as part of recent storm water control improvements.

Sub-area IA-4.3

Sub-area IA-4.3 soils in the area down slope from the former Lead Plant are characterized by Phase II RI soil boring BH4-4, and borings EP-116 and EP-117 that were completed as monitor wells (Figure 2-26). The monitor wells were located to further delineate groundwater COCs and associated source materials. In the Phase I RI, the soils in this area were characterized by soil borings SSIA4-6 through SSIA4-10. A total of twenty soil samples were collected from this sub-area during the Phase II RI from three borehole locations.

Sub-area IA-4.3 soils are characterized as silty sands and gravels overlain by fill materials. Phase II RI soil analysis results have trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 45 mg/kg to 18,000 mg/kg for arsenic and 110 mg/kg to 40,000 mg/kg for lead. At three borings, elevated concentrations extend to depths greater than 12 feet bgs.

The majority of elevated metal concentrations occur in the area of borings EP-116 and SSIA4-7, at depths of 0 to 5 feet bgs. The highest concentration of COCs was for lead (40,000 mg/kg) and occurred in SSIA4-7 at a depth of zero to one feet bgs. Metal concentrations decrease in borings increasing in distance from this location.

This sub-area is down slope of the former closed Lead Plant Baghouse. Lead Plant flue and Baghouse dust likely contributes to elevated concentrations of COCs in this sub-area.

Sub-area IA-4.4

Sub-area IA-4.4 soils were characterized by soil borings SSIA4-11 through SSIA4-14, (Figure 2-26). During the Phase II RI, the sub-area was characterized by soil borings BH4-3 and monitor well EP-118. A total of eight soil samples were collected from sub-area IA-4.4 during the Phase II RI from two borehole locations (Figure 2-26).

Sub-area IA-4.4 soils are characterized as silty sands and gravels overlain by fill materials. The area around soil boring BH4-3 is a slag filled arroyo. The slag extends from the surface to seven feet bgs, and extends up slope to the active Facility surface area. The highest concentration of COCs is for lead (10,000 mg/kg) and occurred in EP-118 at a depth of zero to one feet bgs.

Phase II RI soil analytical results have trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary COCs, with concentrations ranging from 54 mg/kg to 1,300 mg/kg for arsenic and 390 mg/kg to 10,000mg/kg for lead. Elevated concentrations are primarily in the first five feet bgs.

Sub-area IA-4.4 is southwest and down slope of the Sample Mill Area. Concentrates and dust transported in storm water and historic deposition of fugitive dust from the Plant are the probable source materials in this sub-area.

Sub-area IA-4.5

Sub-area 4.5 was characterized during the Phase I RI by soil borings SSIA4-15 through SSIA4-21 (Figure 2-26). During the Phase II RI, soil boring BH4-2 was advanced and sampled down slope of the Diesel 1/Pond 1 Area. A total of seven soil samples were collected from sub-area IA-4.5 during the Phase II RI.

IA-4.5 soils are characterized as silty sands and gravels overlain by fill materials. The majority of elevated metal concentrations occur in the area of borings BH4-2, SSIA4-15 and SSIA4-16, at a depth of 0 to 3 feet bgs. The highest concentration of COCs is lead (6,800 mg/kg) and occurred in SSIA4-15 at a depth of zero to one feet bgs. Metal concentrations decrease in borings increasing in distance from this location.

Phase II RI soil sample analysis reflects results having trends similar to those observed during the Phase I RI. Arsenic and lead appear to be the primary soil COCs, with concentrations ranging from 13 mg/kg to 760 mg/kg for arsenic, and 30 mg/kg to 6,500 mg/kg for lead. Metal concentrations are elevated primarily in the first 5 feet bgs. Phase

I RI near-surface concentrations of arsenic in soils (0 to 2 inches bgs) ranged from 52 mg/kg to 480 mg/kg, and lead ranged from 560 mg/kg to 6,800 mg/kg.

The area down slope from the Pond 1 area was originally an arroyo that was filled with slag, smelter debris and fill material in order to increase the useable Plant area. This area was historically used as a construction staging area. The primary potential sources of metals in soil down slope of the Pond 1 area are concentrate and dust transported in storm water and the historic deposition of fugitive dust from the Plant operations.

Sub-area IA-4.6

Sub-area IA-4.6 soils in the area down slope of the South Terrace Area were characterized in the Phase I RI by soil borings SSIA4-22 through SSIA4-30 (Figure 2-26). During the Phase II RI, soil boring BH4-1 was advanced and sampled in sub-area IA-4.6 down-slope of the South Terrace Area. A total of seven soil samples were collected from sub-area IA-4.6 during the Phase II RI.

The analytical results of the Phase II RI soil samples reflect similar trends as those observed during the Phase I RI. Arsenic and lead appear to be the primary soil COCs, with concentrations ranging from 11 mg/kg to 340 mg/kg for arsenic, and 97 mg/kg to 4,100 mg/kg for lead. Metal concentrations are elevated primarily in the first five feet bgs. Phase I near-surface concentrations of arsenic in soils (0 to 2 inches bgs) ranged from 20 mg/kg to 520 mg/kg, and lead ranged from 63 mg/kg to 9,400 mg/kg.

Sub-area IA-4.6 soils are characterized as silty sands and gravels overlain by fill materials. The highest concentration of COCs is lead (9,400 mg/kg) and occurred in SSIA3-25 at a depth of zero to one feet bgs. Metal concentrations decrease in borings at distance from this location.

The area down slope from the South Terrace was originally an arroyo, and part of the original entrance to the Plant. This area was historically used as storage for ore and concentrates and as a construction staging area. The primary potential source of metals in soil down slope of the South Terrace Area is fugitive dust from concentrates previously stored in the area.

A summary of IA-4 soil sample results for the three main COCs (arsenic, cadmium and lead) for the period of record is in Table 2-24. The boundaries of IA-4 and all soil sampling locations are in Figure 2-26.

2.5.4.3 Groundwater

Some of the primary areas with groundwater impacts in IA-4 are in the vicinity of the backfilled arroyos, particularly the Acid Plant Arroyo and the Ponds No. 5 and 6 Arroyo. Potentiometric data and water quality trends suggest that these arroyos form preferential flow paths for groundwater from upgradient source areas. Metals impacts are also evident in areas that are natural collection points for storm water runoff. Ponding of water greatly increases the potential for infiltration and leaching of metals from site soils.

Although fine-grained soils on the Facility tend to adsorb metals and therefore limit vertical migration, infiltration/leaching may produce groundwater impacts where there is recurring infiltration and shallow depths to groundwater. The Burlington Northern & Santa Fe Railroad grade at the base of the front slope is a natural collection point for storm water. Groundwater and soils data indicate there are areas in IA-4 where infiltration/leaching may be a significant source of metals to groundwater.

Monitoring wells in IA-4 include (from north to south): EP-114, EP-115, EP-116, EP-117, EP-118, EP-29, EP-35, EP-20 and EP-71 (Figure 2-26). Depths to groundwater in IA-4 are shallow, and depths typically range from 11 to 14 feet bgs (Appendix M). Groundwater flow is to the west and southwest, but is influenced locally in areas where arroyos bisect the Front Slope.

The primary COCs in groundwater are arsenic, cadmium, and lead. As previously discussed, the highest dissolved arsenic concentrations (227 mg/l) are evident at EP-114 located in the former Acid Plant Arroyo drainage below the Acid Plant. Arsenic concentrations decrease in monitoring wells to the south. EP-115 below IA-1 shows dissolved arsenic concentration of 0.29 mg/l. Arsenic concentrations increase to 3.2 mg/l at EP-116.

Soil analytical data from soil borings in this area show there are high concentrations of metals extending to the depth of the water table in this area (i.e., EP-116) which is an indication that metals are being actively leached in this area. Soil arsenic data for EP-116 is as follows:

- 0-1 feet bgs 18,000 mg/kg
- 1-2 feet bgs 9,800 mg/kg
- 2-2.5 feet bgs 9,200 mg/kg
- 5-7 feet bgs 6,800 mg/kg
- 10-12 feet bgs 5,300 mg/kg

Dissolved arsenic concentrations increase to 6.6 mg/l at EP-117. This well is located in the Ponds 5 and 6 Arroyo. Concentrations of arsenic are evident at monitoring wells along the axis of this arroyo (EP-131, EP-56, EP-77, EM-5 and EP-124). Historical seepage from former process water at the head of this arroyo is the likely source for downgradient water quality trends.

Dissolved arsenic concentrations are less than one mg/l along the southern portion of IA-4. The highest arsenic concentrations (0.97 mg/l is at EP-20) are located at the mouth of the South Terrace Arroyo downgradient of IA-14.

Cadmium is elevated at various sites along the northern portion of IA-4. The highest concentrations of dissolved cadmium are at EP-116 (0.37 mg/l), EP-115 (0.13 mg/l), EP-114 (0.12 mg/l) and EP-117 (0.12 mg/l). EP-20 also shows elevated dissolved cadmium of 0.63 mg/l. Lead follows a similar trend with a maximum concentration of dissolved lead of 0.025 mg/l at EP-115. With the exception of EP-116, water quality trends appear to be stable in wells within IA-4.

A summary of Phase III RI groundwater quality results (metal analysis) for monitoring wells in IA-4 is presented in Table 2-25.

2.5.4.4 Summary

IA-4, which consists of six sub-areas that comprise the western boundary of the Plant, is composed mostly of poured slag and fill materials that form a relatively steep slope between smelter facilities above it and the long, relatively flat area at the base of the slope. This area is downgradient from other IAs in which potential source areas and materials have been identified and corrective actions will be, or have been, implemented.

Groundwater impacts have occurred in IA-4 as a result of the preferential flow paths associated with the backfilled arroyos. The primary COCs in groundwater are arsenic, cadmium and lead. Most of these groundwater impact areas are most likely related to other upgradient IAs rather than IA-4. There are localized areas of impacted soils in IA-4, with arsenic and lead being the principal COCs.

Source materials within each of the sub-areas in IA-4 are listed in Table 4-1 and depicted on Figure 4-4. Category I and III materials exist in this IA. Category III materials are represented by slag covered portions of the front slope. Category I materials are represented by soils with elevated metals at the toe of the front slope occupying the Burlington Northern and Santa Fe Railroad tracks. This area includes the zones associated with arroyos, and zones in between arroyos, which may also be a source for elevated metals in groundwater.

With additional controls to be implemented in the future, COC sources will be further reduced. IA-4 groundwater COC concentrations are also expected to be reduced with these improvements. As will be discussed in Section 4.0, these improvements, in combination with source material removal, will eliminate or reduce the potential for