APPENDIX 3.6
GROUNDWATER FLUX ESTIMATE SUMMARY
Texas Custodial Trust

Appendix 3-6

Groundwater Flux Estimate
Summary

Former ASARCO Smelter Site
El Paso, Texas

July 2016
Groundwater Flux Estimate Summary

Former ASARCO Smelter Site
El Paso, Texas

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Acronyms and Abbreviation

AA  assessment area

cfs cubic feet per second

COC  constituents of concern

ET  Evapotranspiration

ft amsl  Feet above mean sea level

GHB  Groundwater Hydraulic Barrier

PBA  Parker Brothers Arroyo

PCL  protective concentration level

PRACR  Post Response Action Care Reports

RAER  Response Action Effectiveness Reports

RAP  Response Action Plan

Site  Former Asarco Smelter Site
1. Introduction

This technical memorandum documents the approach to groundwater flux estimation, provides supporting documentation for the final groundwater flux estimates and accompanying alluvial groundwater level reductions anticipated to occur as a result of implementation of components of the Response Action Plan (RAP) at the Former ASARCO Smelter Site located in El Paso, Texas (Site). As discussed in the Site Description presented in Worksheet 1.0 of the RAP, the affected property at the Site is divided into ten assessment areas (AAs). The six Plant Site AAs are defined by historical arroyo drainages (Figure 1). The reduction in groundwater levels underpins the flux estimates and are the result of 1) the installation of low permeability and evapotranspiration (ET) soil covers across the Plant Site AAs and within the Upper Parker Brothers Arroyo (PBA) AA; and 2) operation of a groundwater hydraulic barrier (GHB) in the East Property AA, upgradient of the Upper and Lower PBA AA.

Figure 1 presents the current Plant Site cover types and areas. The following sections detail assumptions made and the source of estimated parameters pertinent to the Plant Site and PBA groundwater flux estimates, including arroyo dimensions and saturated thickness, hydraulic conductivity, and hydraulic gradient.
2. Current Arroyo Flux Estimates

Groundwater flux was estimated for five Plant Site arroyos, including: PBA, Acid Plant Arroyo, Pond 5/6 Arroyo, Pond 1 Arroyo, and South Terrace Arroyo. The Plant Entrance Arroyo was excluded from this evaluation because historical groundwater quality data in this area (from groundwater monitoring wells EP-89 and EP-110) illustrates that groundwater in this arroyo has not been impacted by Site activities (Malcolm Pirnie, 2014a and 2014b).

Calculation of groundwater flux requires information on the following parameters: hydraulic conductivity, hydraulic gradient, arroyo width, and the saturated thickness of the arroyo. These parameters were determined based on analysis of groundwater monitoring data and estimates made regarding the physical characteristics of the arroyos. Physical characteristics of each arroyo were evaluated to determine both spatially- and temporally-representative flow channels (width and saturated thickness). Average parameter values were selected to represent temporal or spatial variability in cases where multiple estimates for individual parameters were considered representative of that arroyo. Additional details concerning the estimation of parameters for individual arroyos are provided in the following sub-sections.

2.1 Hydraulic Conductivity

Hydraulic conductivity has been estimated at a number of locations within each arroyo using the observed hydraulic response to various aquifer tests (both pumping and rising/falling head tests). The process for selecting a single hydraulic conductivity estimate to represent a particular arroyo included review of all available hydraulic conductivity estimates for the arroyo and assessment of the representativeness of those estimates based on the observed spatial variability, if any was observed. The sources of the hydraulic conductivity estimates are summarized below and the supporting documentation, including a compilation of hydraulic testing reports and memoranda, are included in Attachment 1.
Groundwater Flux Estimate Summary

Former ASARCO Smelter Site
El Paso, Texas

2.2 Hydraulic Gradient

Hydraulic gradient was estimated using the observed groundwater elevations and distances between representative well pairs in each respective arroyo. Well pairs were selected to be most representative of the flowing channel of each arroyo by including an upgradient well determined to be within the arroyo channel and a downgradient well located at the outlet of the arroyo to the floodplain, where available. Additionally, arroyo well pairs (Figure 2) were selected to be consistent with the well network to be carried forward during RAP implementation to support groundwater monitoring programs for the Response Action Effectiveness Reports (RAER) and Post Response Action Care Reports (PRACRs) under the Texas Risk Reduction Program. The upgradient well for the Pond 5/6 Arroyo well pair is actually more centrally located along the longitudinal axis of the arroyo than near its head. A new well (New Well 2 – Figure 2) is anticipated to be constructed at the head of the arroyo, near the Union Pacific Railroad right of way, but is not currently included in this gradient evaluation. The table below summarizes information for the proposed well pairs along with the timespan available for hydraulic gradient calculations for each arroyo.
2.3 Arroyo Width

Arroyo widths were determined using geologic cross sections based on boring logs (Attachment 2), hydraulic conductivity evaluations within and near arroyos that indicate the location and width of the coarse-grained sediments associated with the arroyo center, and historical aerial and topographic arroyo delineations. As there is variability in the width of the arroyos across the site from east to west (upstream to downstream), the central or downgradient portion of the arroyos were used to estimate the arroyo width for the purposes of the flux estimation, and most accurately represent arroyo discharge. The table below includes estimated arroyo widths and sources.

<table>
<thead>
<tr>
<th>Arroyo</th>
<th>Channel Width (feet)</th>
<th>Arroyo Width Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>100</td>
<td>As observed during channel excavation during PRB installation</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>200</td>
<td>Geologic cross section and hydraulic conductivity value interpretations</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>200</td>
<td>Geologic cross section and hydraulic conductivity value interpretations</td>
</tr>
<tr>
<td>Pond 1</td>
<td>200</td>
<td>Geologic cross section and hydraulic conductivity value interpretations</td>
</tr>
<tr>
<td>South Terrace</td>
<td>200</td>
<td>Geologic cross section and hydraulic conductivity value interpretations</td>
</tr>
</tbody>
</table>
2.4 Saturated Thickness

The representative saturated thickness of each arroyo was determined using observations of saturated conditions during drilling and as measured in completed groundwater monitoring wells. Alluvial saturated thickness estimation incorporated both measured water columns in representative groundwater monitoring wells, and observations of the bedrock top during drilling of that well or adjacent boreholes, as shown in the geologic cross sections (Attachment 2). Select representative boring logs and boring logs for supporting bedrock elevations are presented in Attachment 3. The table below includes estimated arroyo saturated thicknesses and data sources.

<table>
<thead>
<tr>
<th>Arroyo</th>
<th>Saturated Thickness (feet)</th>
<th>Arroyo Saturated Thickness Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>25</td>
<td>Saturated thickness observed at PRB-2. Bedrock surface observed during PRB installation.</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>15</td>
<td>EP-114 average; span 1999-2012 (26 data points). The bottom of well EP-114 is at an elevation similar to where bedrock was encountered in adjacent well MW-49 (approximately 3,700 feet above mean sea level [ft amsl]).</td>
</tr>
<tr>
<td>Pond 1</td>
<td>30</td>
<td>Downgradient well EX-8; 2008 (1 data point). Bedrock surface observed during drilling.</td>
</tr>
<tr>
<td>South Terrace</td>
<td>27</td>
<td>EP-72R average; span 2012-2014 (3 data points). The bottom of well EP-72R is at an elevation similar to where bedrock was encountered in adjacent well EX-9 and wells to the north (approximately 3,700 ft amsl).</td>
</tr>
</tbody>
</table>

2.5 Groundwater Flux Estimates

For the parameters listed above, current arroyo groundwater flux estimates were made using Darcy’s Law, as described below. Estimated groundwater flux has served as a basis for project groundwater decisions and development of Site-specific protective concentration levels (PCLs) for constituents of concern (COCs) in groundwater. Additionally, Darcy flux estimates will be used in the assessment of the effectiveness of the
response action following implementation. Groundwater flux was calculated using Darcy’s Law described in the following equation:

\[
Q = KiA
\]

In which

\[
Q = \text{Darcy Flux (cubic feet per second)}
\]

\[
K = \text{hydraulic conductivity (feet per day)}
\]

\[
i = \text{gradient (feet per foot)}
\]

\[
A = \text{arroyo width x saturated thickness (square feet)}
\]

Calculated groundwater flux in each arroyo is presented in the table below.

<table>
<thead>
<tr>
<th>Arroyo</th>
<th>Calculated Groundwater Flux (cubic feet per second; cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>0.060</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>0.003</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>0.005</td>
</tr>
<tr>
<td>Pond 1</td>
<td>0.003</td>
</tr>
<tr>
<td>South Terrace</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Groundwater flux through the Plant Site arroyos south of PBA (Acid Plant Arroyo, Pond 5/6 Arroyo, Pond 1 Arroyo, and South Terrace Arroyo) is primarily the result of infiltration of precipitation through the ground surface on the Plant Site, as recharge occurring along the eastern Site boundary is assumed to be minimal due to the Campus Andesite Mountain, the Interstate Highway I-10 right of way, and the Union Pacific Railroad right of way. As a result, construction of low permeability and ET soil covers on the Plant Site will reduce groundwater flux through the arroyos, which will be evidenced by decreased alluvial groundwater levels beneath the Plant Site. It is anticipated that groundwater level decreases will be most evident at wells east of the floodplain, near the central to upper portions of each arroyo. Site cover design and evaluation of the proposed Plant Site cap south of PBA was provided by Geosyntec (Appendix 3.7 of the RAP). The cover system will be constructed as detailed in Worksheet 2.0 of the RAP. Plant slope cover systems along the western edge of the site are not included in this analysis as it is anticipated that these covers will not significantly affect groundwater flux through the Plant Site.

Geosyntec evaluated current and potential future groundwater recharge using the UNSAT-H computer code to assess the effect of current Site conditions and potential Site caps on infiltration rates. The model included precipitation, runoff, evapotranspiration, soil water storage, and infiltration processes. Each cover material and area on the Site was categorized with a representative infiltration rate to estimate current and potential future recharge through the specific surface cover. The Geosyntec report was submitted to the Texas Commission on Environmental Quality (TCEQ). The TCEQ provided comments on the report in a letter dated May 22, 2105. The comments were addressed in a Response to May 22, 2015 Comment Letter, and the documents were all approved by the agency on August 17, 2015.

Based on the overall Plant Site capping design by Geosyntec, cover areas and types for each arroyo provide area-specific estimates of current and potential infiltration rates and the resulting final potential flux reductions, due to the reduction in gradient. Figures 1 and 3 illustrate approximate current and future Plant Site cover areas. A summary of current and future cover area percentages in each individual arroyo is presented in the table below.
## Groundwater Flux Estimate Summary

Former ASARCO Smelter Site
El Paso, Texas

<table>
<thead>
<tr>
<th>Arroyo Area</th>
<th>Approximate Percentage of Current Cover</th>
<th>Approximate Percentage of Proposed Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>75% No Cover, 10% Concrete and Building Pads, 5% Asphalt, 5% Category II Paved Area, 5% Damaged Asphalt</td>
<td>50% Compacted Native Soil with Vegetation, 30% Category II Soil Cover, 10% Lined Channel with Culverts, 10% Low Permeability Cover</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>30% Category II Paved Area, 25% Existing Asphalt, 20% Concrete and Building Pads, 10% Damaged Asphalt, 15% No Cover</td>
<td>75% Category II Soil Cover, 20% Lined Stormwater Pond, 5% Asphalt</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>30% Existing Asphalt, 20% Category II Paved Area, 15% Concrete and Building Pads, 15% No Cover, 10% Damaged Asphalt, 10% Lined Landfill Cell</td>
<td>50% Category II Soil Cover, 25% Asphalt, 15% Category II Paved Area, 10% Low Permeability Cover</td>
</tr>
<tr>
<td>Pond 1</td>
<td>35% Existing Asphalt, 20% No Cover, 15% Category II Paved Area, 10% Damaged Asphalt, 10% Lined Landfill Cell, 10% Concrete and Building Pads</td>
<td>45% Category II Soil Cover, 15% Asphalt, 10% Lined Landfill Cell, 10% Category II Paved Area, 10% Compacted Native Soil with Vegetation, 5% Low Permeability Cover, 5% Concrete and Building Pads</td>
</tr>
<tr>
<td>South Terrace</td>
<td>30% Category II Paved Area, 30% No Cover, 20% Lined Stormwater Pond, 15% Existing Asphalt, 5% Damaged Asphalt</td>
<td>40% Category II Soil Cover, 25% Category II Paved Area, 20% Lined Stormwater Pond, 10% Existing Asphalt, 5% Compacted Soil with Vegetation</td>
</tr>
</tbody>
</table>

The modeling conducted by Geosyntec resulted in variable bulk infiltration reductions per arroyo, dependent on the amount and type of cover proposed. The following table presents the flux reductions anticipated due to capping and other remedy implementation (e.g., in the case of the PBA, upgradient groundwater pumping and rerouting, PBA channel construction and grading) for each arroyo area. Reduction calculations are provided in Attachment 4.

<table>
<thead>
<tr>
<th>Arroyo Area</th>
<th>Current flux (cfs)</th>
<th>Projected Future flux (cfs)</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>0.060</td>
<td>0.010</td>
<td>84%</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>0.003</td>
<td>0.001</td>
<td>82%</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>0.005</td>
<td>0.001</td>
<td>82%</td>
</tr>
<tr>
<td>Pond 1</td>
<td>0.003</td>
<td>0.001</td>
<td>62%</td>
</tr>
<tr>
<td>South Terrace</td>
<td>0.003</td>
<td>0.001</td>
<td>78%</td>
</tr>
</tbody>
</table>

The resulting reduced flux for each per arroyo was used for conservative PCL calculations in the RAP.

Plant Site potential future groundwater flux was calculated by applying the percent infiltration reduction to the current flux estimate determined from arroyo characteristics. The reductions across the Plant Site
ranged from 62% in the Pond 1 Arroyo to 84% in PBA. PBA groundwater flux reduction was estimated to be approximately 84% as a result of the following remedial actions:

- Implementation of the upgradient GHB system in the north arroyo of the East Property AA, which is anticipated to extract groundwater at approximately 15 to 25 gpm. Extracted groundwater will be discharged downgradient of PBA. PBA groundwater flux near PRB-2 was estimated to be approximately 25 gpm (Malcolm Pirnie, 2012)
- Lining and grading of the PBA channel, Ephemeral Pond and surrounding areas currently contributing significant recharge to groundwater.
- Cover installation at the Boneyard and adjacent area.

Potential increased extraction from the GHB would result in further decreases of flux and water levels in PBA, if necessary. Final GHB extraction flow rates will be determined through ongoing system optimization.

3.1 Monitoring Well Pairs

As previously discussed, representative well pairs were selected in each arroyo and parameters of saturated thickness, arroyo width, hydraulic gradient, and hydraulic conductivity were used to estimate current and future groundwater flux in each arroyo. The well pairs will continue to be used during remedial action implementation to monitor the water level decreases resulting from the Site capping and groundwater extraction occurring upgradient of PBA. The well pairs for each arroyo are as follows (Worksheet 3.2 of the RAP).

<table>
<thead>
<tr>
<th>Arroyo Area</th>
<th>Well Pair</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>EP-78, EX-1</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>Former EP-25 location (New Well 3), EP-114</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>MW-131 or New Well 2, Former EP-26 location (New Well 5 (EP-26R))</td>
</tr>
<tr>
<td>Pond 1</td>
<td>EP-68, EX-8</td>
</tr>
</tbody>
</table>

Pressure transducers with data logging capability were installed into the water column of each existing well pair and will measure and record high-resolution water levels. Transducers will be installed in future wells New Well 3 and New Well 5 (EP-26R) upon completion of the wells. The water level data will be used to evaluate changes resulting from capping and other flux reduction measures.

3.2 Projected Arroyo Water Levels

Potential water level decreases resulting from implementation of the response action were calculated to develop initial metrics for remedy performance monitoring, as described in Worksheet 3.2 of the RAP for the
RAERs and PRACRs. Additional characterization data, such as groundwater quality monitored at downgradient locations, will also be used to evaluate response action effectiveness. As a result of the reduction of COC contributions from the arroyos to floodplain groundwater, natural recovery of the impacted groundwater in the Rio Grande floodplain will occur. The water level reductions in upgradient monitoring wells on the Plant Site will be used to assess flux reductions. The reduction in upgradient water levels will be directly related to reductions in hydraulic gradient and saturated thickness. Assumptions in water level reduction calculations include the following:

- Negligible arroyo groundwater recharge occurs east of the Plant Site.
- Decreases in infiltration will not result in reduction of the channel width in the arroyos.
- The water level in the floodplain, as represented by the downgradient well in each monitoring well pair, will not change significantly as a result of reduced Plant Site infiltration. This is due to floodplain groundwater being hydraulically connected to a larger water body (i.e., surface water and alluvial groundwater surrounding the Rio Grande and American Canal).
- Calculated decreases in water levels will occur at the upgradient well in each arroyo well pair.
- Decreased PBA groundwater flux will result from the upgradient GHB system operation in the North Arroyo of the East Property AA, grading and lining of the PBA channel, Ephemeral Pond and surrounding areas, and cover installation in the Boneyard and adjacent areas.
- The flux estimates are based on the hydraulic conductivity, hydraulic gradient, arroyo width, and the saturated thickness of the arroyo, which are in some cases average values to account for spatial variations both transverse and longitudinally within each arroyo.

Projected water level decreases were calculated using Darcy’s Law, as defined above. According to the empirical equation, groundwater flux is directly proportional to cross sectional area multiplied by hydraulic gradient (change in water head over a given distance) and hydraulic conductivity. Since it is assumed that hydraulic conductivity and flowing channel width of each arroyo will remain constant, and the floodplain water level will remain constant, change in groundwater flux is proportional to change in hydraulic head through the channel and the change in saturated thickness within the channel. Due to the assumptions listed above and conservation of mass, the change in hydraulic head must equal the change in saturated thickness in each arroyo. Therefore, the anticipated change in flux due to the reduction in infiltration rates from Site capping and upgradient remedies (in PBA) can be used to directly calculate the change in water level (thus hydraulic gradient) using Darcy’s Law.

The calculation method used to determine the change in water level at the upgradient well was based on Solver, a Microsoft Excel-based iterative analysis confined by user-defined parameters, where applicable. The calculated groundwater flux resulting from implementation of the Site cap was used to estimate the non-constant parameters: saturated thickness and hydraulic gradient (i.e., hydraulic conductivity and arroyo width remain constant). A constraint on the evaluation was that the change in saturated thickness must
equal the change in the vertical component of hydraulic gradient. This method of hydraulic gradient and saturated thickness estimation was applied to each arroyo area using arroyo-specific parameters.

The Solver calculation (iterative) method results were confirmed by a closed-form quadratic equation, which followed the same assumptions above. Estimated water level reduction calculations can be found in Attachment 5. The resulting water level decreases (rounded to the nearest 0.5 feet) and hydraulic gradients are as follows:

<table>
<thead>
<tr>
<th>Arroyo</th>
<th>Water Level Decrease at Upgradient Well (feet)</th>
<th>Well Identifier</th>
<th>Hydraulic Gradient (feet per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA</td>
<td>14.5</td>
<td>EP-78</td>
<td>0.007</td>
</tr>
<tr>
<td>Acid Plant</td>
<td>9.5</td>
<td>New Well 3</td>
<td>0.02</td>
</tr>
<tr>
<td>Pond 5/6</td>
<td>2.5</td>
<td>MW-131</td>
<td>0.003</td>
</tr>
<tr>
<td>Pond 1</td>
<td>3.5</td>
<td>EP-68</td>
<td>0.002</td>
</tr>
<tr>
<td>South Terrace</td>
<td>7.5</td>
<td>EP-72R</td>
<td>0.007</td>
</tr>
</tbody>
</table>

As previously noted, pressure transducers deployed in the upgradient and downgradient wells of each arroyo well pair will be used to monitor and record water level decreases. Although infiltration reductions will be realized upon completion of the capping activities, and decreases to PBA alluvial groundwater recharge will occur due to GHB pumping, it is anticipated that the groundwater response in each arroyo will lag behind for at up to a full year due to draindown of the unsaturated zone. The high resolution water level data from the pressure transducers will be used to assess temporal trends and illustrate stable water levels indicative of the response action implementation.

The projected water level decreases resulting from RAP implementation rely on several simplifying assumptions, including homogeneous and representative groundwater flux parameters for each arroyo, negligible groundwater flow occurring at the upgradient-most portion of each Site arroyo, that decreased water levels do not significantly affect the saturated portion of each arroyo’s width, and that the projected water level decreases occur at the upgradient well identified in each arroyo monitoring pair. Because these simplifying assumptions may not fully represent the complexities of each arroyo, the projected water level decreases will be used as one of several lines of evidence in monitoring the performance of the response action. Other lines of evidence that will be used to indicate flux reduction as a result of Site capping and remedial action include groundwater quality monitoring and potentially using alternative flux estimation tools such as tracer tests conducted prior to and following implementation of Site remedies.
4. References


FORMER EL PASO SMELTER SITE
EL PASO, TEXAS

PROPOSED ARROYO WELL PAIRS
FOR WATER LEVEL ANALYSIS

FIGURE 2

LEGEND
- Property Boundary
- Historical Arroyo Trace Lines
- Historical Drainage Divide

Proposed Wells for RAP

1. New Well 2 was not used for flux estimates or gradient reduction calculations.
2. New Well 3 will be installed in place of the former EP-25.

Notes:
See Note 4

NOTE:
1. PBA Only - Areas with no cover indicated on map are treated as compacted native soil with vegetation.
2. "Lined Channels with Culverts" cover area includes geosynthetic clay liner, hydroturf and lined stormwater management channels.
3. "Category II Soil Cover" cover area includes Desert Armor Cover System, Evaporative Transpiration Soil Cover, Closure Turf System, or Lined Armor Stone.
4. East Property cover area and Affected Off-Site Property are not included in flux reduction calculations.
Attachment 1

Source of Hydraulic Conductivity Estimate Documents
MEMO

To: 
Copies: 

From: 
Gastón Leone 
Aaron Kempf 

Date: 
May 16, 2012 

Subject: 
Evaluation of EX-3 Pumping Test Conducted at the Former ASARCO Smelter, El Paso, Texas 

Background 

Multiple pumping tests were conducted by CDM from April to August of 2008 to assess the local aquifer hydraulic conductivity. Tests were conducted at wells EX-1, EX-2, and EX-3. Data collected from the tests conducted at wells EX-1 and EX-2 were evaluated by CDM using a Theis Time Drawdown evaluation using the water level response at adjacent monitoring wells. Well EX-2 was the observation well for the test conducted at well EX-1, while EX-1 was the observation well for the test conducted at well EX-2. The results of tests conducted at EX-1 and EX-2 indicate that the aquifer transmissivity was 9,422 and 10,480 square feet per day (ft²/day), respectively. Storage coefficients were 0.006 and 0.004 (dimensionless) for these two tests. These results are presented as Attachment 1 (CDM, 2009).

Pumping Test at Well EX-3 

Data collected from the test conducted at well EX-3 was not analyzed by CDM. However, a detailed log of pumping rates, EX-3 water levels, and a well construction log were provided by CDM (Attachment 1; CDM, 2009). These results were analyzed by ARCADIS to estimate aquifer hydraulic conductivity in the vicinity of the proposed permeable reactive barriers located in Parker Brothers Arroyo. This constant-rate pumping test was approximately 60 minutes in duration, with pumping rates ranging from 19 to 24 gallons per minute. Total water level drawdown was approximately 0.9 feet.
The observed water level response in the test well was analyzed using the parameter estimation program AQTESOLV™ (Version 4.5). The Theis Solution for unconfined aquifers was used to simulate the observed water levels to provide estimates of localized aquifer transmissivity and storativity. Significant assumptions of the Theis Solution for unconfined aquifers are that the aquifer is unbounded and homogeneous, water is instantaneously released from storage, and flow through the water bearing zone is horizontal and uniform across the well axis. These assumptions are consistent with the site conceptual model.

The estimated aquifer transmissivity was approximately 4,500 ft²/day, and storativity was 0.007. The aquifer saturated thickness of 39 feet was used to calculate the hydraulic conductivity of approximately 116 feet per day (Attachment 2). These results are consistent with expected values based on the lithologic descriptions provided in the EX-3 boring log (CDM, 2009).

Reference


Attachments:

Attachment 1 – 2009 CDM Groundwater Remediation Status Report
Attachment 2 – EX-3 AQTESOLV™ Output
Attachment 1

2009 CDM Groundwater Remediation Status Report
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Appendices

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Appendix B As-built Construction Drawings – Phase I Groundwater Remediation
Section 1
Introduction

Ongoing and future environmental activities at the El Paso smelter remain focused on complying with the August 1996 Agreed Order between ASARCO LLC (ASARCO) and the Texas Natural Resource Conservation Commission (now the Texas Commission on Environmental Quality [TCEQ]). Since 1996, ASARCO has expended in excess of $30 million implementing corrective action measures in accordance with the Agreed Order.

ASARCO has completed significant work in support of the implementation of a groundwater remedy at the smelter facility. This work is represented by remedial investigations, a feasibility study identifying a recommended remedial approach, initial extraction well and pipeline construction, slurry wall design and studies, and water treatment pilot testing and design.

The groundwater remedy focuses on containment and treatment of site-derived groundwater. This document serves as an overview of the implementation status of groundwater remediation, including:

- well installation, aquifer characterization, and slurry wall design;

- conveyance; and

- water treatment plant preliminary design.
Section 2
Well Installation, Aquifer Characterization, and Slurry Wall Design

Section 2.1 describes 2008 groundwater remediation well installation and aquifer characterization activities. Section 2.2 summarizes the status of slurry wall design. Background and detail information on groundwater characterization is contained in the February 2008 Evaluation and Cost Assessment for Expansion of ASARCO El Paso Groundwater Remediation (EECA) document and is not repeated here.

2.1 Well Installation

ASARCO installed seven extraction wells and two monitoring wells during 2008. Installed extraction wells include EX-1, EX-2, EX-3, EX-4, EX-7, EX-8, and EX-9. Installed observation wells include OBS-1 and EP-85D. Figure 1 identifies the location of the groundwater remediation extraction and monitoring wells installed during 2008. Well logs and well completion reports for the new extraction and observation wells are included in Appendix A.

Extraction wells have been installed in three key areas, including, the Parker Brothers Arroyo, Rio Grande Floodplain, and within the south area. Extraction wells EX-1, EX-2, and EX-3 are within the arroyo area and confirm high hydraulic conductivities in this area where the majority of the site groundwater flux occurs. Extraction well EX-4 is located on the Rio Grande floodplain in close proximity to the proposed slurry wall location. High hydraulic conductivity occurs in this area with groundwater flux and flow direction influenced by the Rio Grande River.

Extraction wells EX-7, EX-8, and EX-9 are located in within the southern portion of the site to confirm design assumptions of minor groundwater flux across the southern section of the smelter facility. Following well development, these extraction wells were pumped for approximately one hour to confirm design pump sizes. Maximum pumping rates during the one hour test were as follows; EX-7 pumped at 5 gpm, EX-8 pumped at 9 gpm, EX-9 pumped at 3 gpm. It is anticipated that the long-term sustainable pumping rate from these south end arroyo locations will be approximately half of that achieved during the short-term testing. With extraction wells now in place, the actual pumping rate across the south end is expected to be similar to the 10 gpm projected during site characterization efforts.

2.2 Aquifer Characterization

Two pumping tests were performed near the base of the Parker Brothers Arroyo; east of Paisano Drive. The first test was performed on April 16, 2008 and the second test was performed on May 20 – 21, 2008. For the April test, Well EX-2 was pumped at a constant rate of 25 gpm for 1 hour and 42 minutes while simultaneously monitoring the aquifer response (drawdown) in observation wells OBS-1 and EX-1 located at distances of 37.5 feet and 75 feet, respectively, from the pumping well (EX-2).
Following the period of constant-rate pumping, aquifer recovery was monitored in the two observation wells for 31 minutes.

For the May test, Well EX-1 was pumped at a constant rate of 40 gpm for 23.2 hours followed by a recovery period of approximately 17 hours. Throughout the pumping and recovery periods for the May test, aquifer response was monitored in the pumping well (EX-1) and seven observation wells, including EX-2, EP-122D, EP-122-OSB-4, EP-81, EP-73, EP-85, and EP-114. Observation wells were located at distances ranging from 75 feet to 574 feet from the pumping well (EX-1).

Drawdown and recovery data for the April and May test were measured and recorded with down-hole pressure transducers and compensated for barometric pressure prior to analysis. Direct plots of the time-drawdown/recovery data were used to assess whether sufficient aquifer response occurred in each of the respective observation wells to use for aquifer analysis.

From this assessment, it was determined that adequate response was observed only in the pumping well and at the closest observation points (OBS-1 and EX-1 for the April test and the pumping well [EX-1] and EX-2 for the May test). Results are included in Appendix A. Close inspection of the time-drawdown/recovery plots for observation points EP-122D, EP-122-OSB-4, EP-81, EP-73, EP-85, and EP-114 suggest that the aquifer did not respond to pumping well EX-1 at these locations during the May test. Water level fluctuations exhibited in the plots were on the order of tenths or hundredths of a foot and were not consistent with the stress and response periods applied to the aquifer. It is most likely that water level fluctuations observed in these wells was in response to fluctuations of stage in the Rio Grande River and/or to changing barometric pressure.

AquiferWin32 Version 3.05 (Environmental Simulations, Inc. 2004) was used to analyze the pumping test data. The pumping test analysis components of the AquiferWin32 software provide for matching drawdown/recovery data with “type-curves” to evaluate the aquifer response to pumping and to estimate aquifer transmissivity and storage.

Theisian response was observed in each of the wells monitored during both pumping tests where aquifer response occurred. The type-curve for the Theis solution for unconfined approximation (1935) was determined to provide the best match for the drawdown data collected. Recovery data were consistent with the drawdown data and were analyzed using the Theis recovery solution (1945). Results were consistent for all analyses with transmissivity ranging from 9,241 ft²/day to 11,540 ft²/day and storage ranging from 0.004 to 0.006. Results are summarized in Table 2-1.
Table 2-1 Pumping Test Results

<table>
<thead>
<tr>
<th>Test Date</th>
<th>Well</th>
<th>Pumping Well</th>
<th>Constant Rate Discharge (GPM)</th>
<th>Distance From Pumping Well (Feet)</th>
<th>Analysis</th>
<th>Transmissivity (ft²/day)</th>
<th>Storage Coefficient (dimensionless)</th>
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<tr>
<td>April '08</td>
<td>EX-1</td>
<td>EX-2</td>
<td>25</td>
<td>75</td>
<td>Theis: Time-Drawdown</td>
<td>9,422</td>
<td>0.006</td>
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<td>April '08</td>
<td>OBS-1</td>
<td>EX-2</td>
<td>25</td>
<td>37.5</td>
<td>Theis: Time-Drawdown</td>
<td>9,855</td>
<td>0.006</td>
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<tr>
<td>April '08</td>
<td>OBS-1</td>
<td>EX-2</td>
<td>25</td>
<td>37.5</td>
<td>Theis: Time-Recovery</td>
<td>11,540</td>
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</tr>
<tr>
<td>May '08</td>
<td>EX-1</td>
<td>EX-1</td>
<td>40</td>
<td>---</td>
<td>Theis: Time-Recovery</td>
<td>6,361</td>
<td>---</td>
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<tr>
<td>May '08</td>
<td>EX-2</td>
<td>EX-1</td>
<td>40</td>
<td>75</td>
<td>Theis: Time-Drawdown</td>
<td>10,480</td>
<td>0.004</td>
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<tr>
<td>May '08</td>
<td>EX-2</td>
<td>EX-1</td>
<td>40</td>
<td>75</td>
<td>Theis: Time-Recovery</td>
<td>9,241</td>
<td>---</td>
</tr>
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</table>

2.3 Slurry Wall Design

Figure 2 includes the proposed slurry wall location. The schematic diagram in Figure 2 depicts the expected relationship between the slurry wall and groundwater extraction wells that will result in the containment, extraction, and treatment of site-derived groundwater. The proposed slurry wall location was corroborated with the results of groundwater modeling conducted to optimize the capture of contamination and protection against seeps to downgradient receptors. The presence of an underlying bedrock aquitard ranging between 45 to 75 feet below ground surface beneath the alluvial deposits allows for the barrier wall to offer hydraulic containment of impacted groundwater.

Design elements of a soil-bentonite slurry wall involve establishing the alignment and depth of the wall. In 2008, ASARCO completed the acquisition of approximately 5,430 lineal feet of seismic refraction survey data to support the preliminary slurry wall design by identifying the topographic bedrock surface in the lower part of the Parker Brother Arroyo, Smeltertown and adjacent floodplain areas. Results are included in a July 2008 memorandum, Summary of Refraction Seismic Survey prepared by ARCADIS.

In addition, ASARCO will implement the installation of four additional soil borings and collect soil samples along the slurry wall alignment to perform permeability and compatibility testing of various soil-bentonite "backfill" mix designs. In conjunction
with the four additional soil borings, approximately 20 cone penetrometer borings will be advanced along the proposed slurry wall alignment to confirm the bedrock topography and composition and continuously characterize the alluvial stratigraphy.

ASARCO has identified and selected a specialty subcontractor, Remedial Construction Services, L.P. (RECON) to begin permit approval with the Texas Department of Transportation (TxDOT) for the proposed slurry wall alignment. Concurrent with these activities, ASARCO has begun preparing a DRAFT Slurry Wall Construction Manual.
Section 3
Conveyance and Instrumentation

3.1 Construction
During July and August 2008, ASARCO completed Phase I construction activities of the groundwater remediation system. In addition to the well installation, development, and aquifer performance testing described in Section 2, ASARCO completed construction of conveyance and instrumentation required to initiate pilot water treatment testing.

Construction included the installation of well vaults, pipeline, and electrical to EX-1, EX-2, EX-3, EX-4, EX-7, and EX-8 extraction wells. Currently, the system is operated manually with pump starters located in each well vault. Flow meters and valves at each wellhead are used to set the desired pumping rate. Pump controllers are on site and ready for installation during Phase II construction activities.

3.2 As-Built Drawings
The as-built construction drawings are included as Appendix B.
Section 4
Water Treatment Plant Preliminary Design

This section presents the preliminary design for the water treatment facility to be constructed at the ASARCO Smelter in El Paso, Texas to treat site-derived groundwater. Treatment remedies were evaluated and documented in the February 2008 Engineering Evaluation and Cost Assessment for Expansion of ASARCO El Paso Groundwater Remediation (EECA).

This section includes the current implementation status of water treatment elements, including:

- Design basis;
- Treatability testing;
- Process Description; and
- Capital and O&M costs.

Section 4.1 Design Basis

The following subsections summarize the primary design criteria for the proposed El Paso Smelter groundwater treatment system, including source water flow, feed water quality, and target effluent standards.

4.1.1 Source Water Flows

Preliminary groundwater modeling was performed by ARCADIS to determine groundwater flux across the site. This modeling data was included in the preparation of the EECA. From the model, it was estimated that with the inclusion of a slurry wall, approximately 36 gpm would be the required pumping rate to achieve capture of the site groundwater.

After the groundwater extraction wells were installed and pumping tests were performed, the groundwater model was revised based upon the new data (Table 4-1). Using the most current information, it is estimated that the required pumping rate could be as high as 70 gpm in conjunction with a slurry wall in order to achieve capture of the site groundwater. Actual flows will vary seasonally, and according to ARCADIS, could range from 40 gpm to 120 gpm.
Site groundwater flux will be managed with the implementation of a slurry wall. In-situ storage upgradient of the slurry wall will attenuate seasonal variations in site groundwater flows. As such, the treatment plant will be sized to process 70 gpm continuously, with a higher peaking capacity for short durations.

### 4.1.2 Design Feed Water Quality

Table 4-2 summarizes the anticipated water quality for each extraction well and the flow-weighted average of the combined feed to the treatment facility. Water quality from each well was obtained as a single sample after well development. A review of the water quality shows that the water quality from the different extraction wells is generally similar with respect to metals and common ions. The notable exception is EX-4, which has much higher hardness, alkalinity and total suspended solids (TSS) concentrations than the other wells; this is not unusual due to its relative proximity to the Rio Grande River. All analyses are based on total (not dissolved) concentrations.

Once full-scale, continuous pumping is implemented at the site, water quality of the captured water may change as compared to the current extraction well water quality data. However, changes are expected to be moderate and have little effect on the water treatment plant’s ability to meet discharge requirements.

### 4.1.3 Target Effluent Standards

ASARCO continues to evaluate the range of discharge options available for this site. Consequently, for purposes of this design, CDM has assumed that the treated water must meet the Federal maximum contaminant levels (MCLs) or secondary MCLs, which are conservative. These discharge standards are considered to represent the most stringent requirements of discharge options under consideration. As such, the water treatment design and cost required to meet these standards is similarly conservative. Table 4-2 includes the target effluent standards.

### 4.2 Treatability Testing

Treatability tests were conducted to evaluate various treatment options and conditions for purposes of developing a final treatment system that will meet the
<table>
<thead>
<tr>
<th>Description</th>
<th>EX-1</th>
<th>EX-2</th>
<th>EX-3</th>
<th>EX-4</th>
<th>EX-7</th>
<th>EX-8</th>
<th>EX-9</th>
<th>Combined Feed All Wells</th>
<th>MCLs</th>
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<td>956</td>
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<td>3</td>
<td>4</td>
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<td>Bromide</td>
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<td>301</td>
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<td>518</td>
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<td>1,160</td>
<td>2,810</td>
<td>2,900</td>
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<td>814</td>
<td>2,189</td>
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<td>Iron (+3)</td>
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<td>19.10</td>
<td>7.06</td>
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<td>1.57</td>
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<td>6.71</td>
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<td>0.01</td>
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<td>Manganese</td>
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</tr>
<tr>
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<td>-</td>
<td>0.00</td>
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<td>3.60</td>
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<td>0.09</td>
<td>0.39</td>
<td>0.43</td>
<td>1.28</td>
<td>5.00^1</td>
</tr>
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</table>

**Gases**

| Carbon Dioxide    | 8    | 8    | 4    | 48    | 8     | 9     | 1     | 26                       |      |

**Other**

| TSS               | -    | -    | 438  | 1,970 | 8     | 119   | 64    | 1,062                    |      |
| Oil and Grease    | -    | -    | -    | -     | -     | -     | -     | -                        |      |
| TDS (180 Deg C)   | 2,941| 2,995| 2,419| 6,636 | 5,065 | 5,177 | 1,380 | 4,862                    | 1,000 |
| Conductivity, microS/cm | 5,433.4 | 5,523.8 | 4,354.4 | 12,558.3 | 9,188.4 | 9,555.9 | 2,496.7 | 9,100.8 |

| Total Hardness, mg/L CaCO3 | 693.2 | 681.8 | 454.7 | 1,648.8 | 1,153.6 | 1,139.2 | 424.4 | 1,167.5 |

All values in Total mg/L, unless noted otherwise

1 Secondary MCL
target discharge criteria. These tests included iron co-precipitation jar testing conducted by CDM; iron co-precipitation jar, bench-scale, and on-site pilot testing by an equipment vendor (Stewart Environmental); and bench-scale testing by a water treatment vendor to evaluate various effluent polishing options. This section presents a summary of the major findings from each of these studies.

4.2.1 CDM Jar Testing

CDM performed bench scale testing on September 11, 2007 in order to evaluate the efficacy of pH adjustment and iron coagulation for arsenic removal. Iron coagulation is the conventional approach to removing arsenic from industrial water sources. Initial tests were conducted using groundwater collected from monitoring well EP-13, which contained very high arsenic concentrations, as well as other site constituents of concern (COCs). Test procedures consisted of 9 jar tests using 3 different iron dosages (ferric sulfate) at 3 different pHs to determine optimum conditions for arsenic removal.

Major conclusions of the initial bench testing were that high iron dosages at lower pHs (~8 s.u.) were most effective at arsenic removal. In these tests, arsenic was not removed to below the MCL due to the higher than expected arsenic concentrations (31.7 ppm) in the test water. In the test, arsenic removal ranged from 98.9% to 99.7%. EP-13 exhibits some of the worst water quality at the site. Water collected in a full-scale pump and treat approach will be a composite of site water and will have significantly lower arsenic concentrations. Lower arsenic concentrations will allow the MCL to be more easily met. Therefore, it was determined from the bench testing that arsenic removal using iron is feasible for full-scale conditions at the site.

4.2.2 Vendor Pilot Testing

Stewart Environmental performed subsequent bench and pilot-scale testing of arsenic co-precipitation technology and microfiltration for solids removal. Initially, Stewart performed laboratory testing to identify any potential issues with microfiltration and to determine optimum reagent dosing. The lab screening did not identify any serious issues with the proposed treatment technology. In August 2008, Stewart Environmental performed an onsite pilot-scale treatment test of extracted groundwater at the Smelter. The results of the test are presented in Table 4-3.

Two primary test trials were performed during the pilot test: 1) at pH 8.5 and a target iron-to-arsenic ratio of 20:1 and 2) pH 10.0 and an iron-to-arsenic ratio of 30:1. In general, higher pH's do a better job of removing metals while a lower pH requires less iron for arsenic removal. Two subsequent "subtests" were performed at each pH to determine the effects of varying iron dosages and the addition of an oxidant to convert arsenic to the more oxidized form (Arsenic +5), which is removed more efficiently with iron coagulation.

Results indicated that both primary trials were successful at removing metals to very low levels, although the raw water collected during the test had lower concentrations of COCs than anticipated. Arsenic was not successfully removed to below MCLs.
during the pilot tests. This was due to several factors, but most significantly, the original iron-to-arsenic target ratios were not achieved.

In order to address the arsenic removal issues during the pilot test, a follow-on bench scale test was performed in order to verify that arsenic could be removed to below MCLs with the proper iron dosages. A sample from the extraction wells was collected on October 14, 2008 and the final testing was performed shortly thereafter. Results from this jar testing confirmed that with the proper iron-to-arsenic ratios, arsenic could be removed to below the MCL. Jar testing results showed that iron-to-arsenic ratios of 30:1, 40:1, and 50:1 removed arsenic to below the MCL concentration of 0.010 mg/L.

In addition to these results, operational data collected from the pilot test resulted in a few significant findings. They are:

- Sludge production (expressed as total suspended solids, TSS) was more than two times greater at pH 10 than at pH 8.5.
- The caustic demand is approximately three times greater at pH of 10 compared to a pH of 8.5.

Table 4-3
Pilot Test Results (average³)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MF Permeate pH 8.5</th>
<th>MF Permeate pH 10.0</th>
<th>Discharge Limits MCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaOH Dose (100%)</td>
<td>92</td>
<td>281</td>
<td>--</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Aluminum</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>0.05*</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.454</td>
<td>0.455</td>
<td>0.01</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt;0.002</td>
<td>&lt;0.002</td>
<td>0.005</td>
</tr>
<tr>
<td>Copper</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>1.0*</td>
</tr>
<tr>
<td>Iron</td>
<td>&lt;0.01</td>
<td>0.02</td>
<td>0.3*</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>0.015</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.01</td>
<td>0.004</td>
<td>0.05*</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.005</td>
<td>0.01</td>
<td>5*</td>
</tr>
<tr>
<td>TSS²</td>
<td>207</td>
<td>461</td>
<td>--</td>
</tr>
</tbody>
</table>

NOTES:
1. Data presented is the average of all samples collected for a particular test run
2. TSS concentrations are expressed as dry solids generated – calculated from pilot results, metals going to metal hydroxides & calcium going to calcium carbonate.

CDM
Some calcium carbonate scaling was observed in the membranes during the higher pH tests. This scaling was easily cleaned from the membranes, but would indicate that more frequent cleanings may be required at higher pHs.

Using a blower to oxidize iron and strip carbon dioxide will reduce the rate of scale formation at the higher pHs.

Sodium hypochlorite will not be necessary to meet the MCL for the arsenic. However, this reagent could be added at a later time if it is deemed necessary or beneficial.

4.2.3 Polishing Steps Testing
Following the iron co-precipitation tests, additional tests were conducted to provide additional polishing of the treated effluent for further removal of nitrate, selenium and potentially arsenic, to meet the MCLs. The technologies used for the polishing tests were: 1) anoxic biological treatment, 2) zero valent iron (ZVI) and 3) ion exchange. Major findings from these tests are described below.

Biologic Removal
Beginning in September 2008, Apex Engineering performed biologic column test. Approximately 200 gallons of filtrate water (treated effluent) from the pilot test was collected and shipped to a testing lab in Osburr, ID. This test used Microfiltration filtrate water generated from the prior on-site MF pilot test at the El Paso smelter. The test columns were set up with washed gravel media and bacterial inoculum, a mixture of water and biomass. This inoculum contained denitrifying and sulfate-reducing bacteria.

The theory behind the test was that denitrifying bacteria will reduce nitrate to nitrogen gas, and selenium-reducing bacteria will reduce selenate or selenite to elemental selenium. Nitrogen gas will vent from the system, while elemental selenium is a solid that will precipitate within the columns. Methanol was added to the test columns to provide a carbon source, and phosphate was also added as a nutrient.

Nitrate removal was readily accomplished; effluent nitrate concentrations were reduced to less than 0.01 ppm early in the testing. Selenium removal proved more difficult, as expected. The selenium concentrations were significantly reduced, but the target of 0.005 mg/L was not achieved in the column test. The lowest concentrations measured were around 0.010 mg/L. However, with additional experimentation or operating experience, greater selenium removal could potentially be achieved.

Zero Valent Iron and Ion Exchange Media
The performance of zero valent iron (ZVI) and ion exchange (IX) adsorption for arsenic, selenium, and nitrate removal was also tested on a bench-scale. The testing
procedure consisted of jar tests using various IX resins and ZVI to determine characteristic adsorption isotherms.

Jar testing was performed during the week of October 20, 2008. General results indicate that arsenic was easily removed to below the MCL using both ZVI and IX media. However, selenium and nitrate were not removed via ZVI or IX adsorption.

4.3 Process Description
Based on the results of treatability testing and the design criteria, a full-scale treatment process was developed to achieve MCLs at this site. This section provides a description of the major treatment plant components. The Process Flow Diagram (PFD) is shown in Figure 4-1. The proposed layout of the treatment plant is shown in Figure 4-2.

4.3.1 Groundwater Collection
Currently, seven groundwater extraction wells are installed (EX-1 through 4, and EX-7 through 9). Additional extraction wells will be installed as part of the full scale system in order to maintain complete capture of the site groundwater.

Groundwater wells will operate to dewater each well to the extent required to extract the average groundwater flux through the Site. Individual wells will pump to a common header prior to being pumped to the water treatment plant. Pumps will operate at a constant speed with a low level shut off to protect the pumps.

All groundwater will be pumped to a feed equalization tank.

4.3.2 Plant Description
The new treatment system will be constructed near the old lunchroom. This section describes the major components of the new treatment plant.

Equalization Tank
The equalization tank will be a 20,000 gallon lined carbon steel tank with duplex feed pumps (one duty, one on standby) with variable frequency drives (VFD), electromagnetic flowmeter, and level controls. The tank will allow for approximately 1.6 hours of storage capacity at nominal feed rates and typical operating conditions (i.e., tank is half full).

The centrifugal feed pumps will access water from the bottom of the feed tank and pump to the iron mix tank. The feed pumps will be operated by VFDs in order to maintain a constant flow setpoint to the treatment system. An emergency gravity overflow pipe will be installed to route flow out of the feed tank to contingency storage (yet to be defined). High and low level setpoints in the tank will trigger alarms and protect the pump from running dry.
Because the feed into the tank (from the well field) will be relatively stable, the feed equalization tank will maintain a near constant level under normal operating conditions.

**Iron Mix Tank**

The first step in the treatment process is the iron mix tank. Feed water will be pumped into this 2,300 gallon steel tank. The tank will be continuously mixed using a vertical-mount agitator. In the iron mix tank, ferric chloride will be metered into the tank at a fixed rate (set by the operator). Ferric chloride will be dosed based upon the influent arsenic concentration. Process water from the iron mix tank will overflow by gravity to the neutralization tank.

**Neutralization Tank**

Feed water will flow via gravity into this 2,300 gallon steel tank, which will provide a residence time of over 20 minutes at the design flow of 70 gpm. In the neutralization tank, sodium hydroxide will be metered into the tank.

A solution of 25% sodium hydroxide (caustic) will be added to the tank to raise the pH of the raw water to 8.5. A pH probe and controller will automatically adjust the caustic metering rate in order to maintain the pH setpoint in the neutralization tank. The tank will be continuously mixed using a vertical-mount agitator. The tank will overflow by gravity to the MF Skid concentration tank.

**Microfiltration System**

The MF system will remove metal-bearing suspended solids by filtering the water through a 0.2 micron filter. This system is provided as a skid-mounted unit. This first unit operation in the MF skid is the concentration tank. Water will flow by gravity from the neutralization tank into the concentration tank where a high flow centrifugal pump will pull water from the concentration tank and pump it through the membrane modules at a rate roughly ten times the plant feed rate (approximately 700 gpm).

Water will permeate the microfilters at a rate roughly even to the influent feed. The remainder of the flow will be recirculated back to the concentration tank. The MF system will operate based upon the level in the concentration tank – the MF pump will vary its speed in order to produce more or less filtrate to maintain the level setpoint in the concentration tank.

As water permeates the filters, leaving the suspended solids behind, these solids will build up on the membrane surface and in the recirculated process water. The MF system uses an automatic, pneumatic back pulse system to force permeate water back through the membrane pores in order to keep the membranes cleared of solids build-up. In addition, the high cross-flow velocity of the water across the membranes helps to maintain a clean surface. However, eventually, membranes performance will decrease due to solids build-up and membranes will require maintenance cleaning.
At a predetermined frequency (approximately once per week) or when the pressure drop across the membranes reaches a predefined setpoint, the membranes will be cleaned. Depending on the MF system manufacturer, this will be accomplished using integrated cleaning equipment, or a separate clean-in-place (CIP) skid. A standby membrane module is included in the MF skid to allow continuous operation while membrane cleaning is performed. The standby filtration module will be brought online and one of the “plugged” modules will be taken out of service. Cleaning will be accomplished by circulating a dilute acid solution through the membrane for roughly 15 to 30 minutes; the cleaning solution will then be rinsed from the module. When complete, the clean membrane will be brought on-line and another module will be brought off-line for cleaning. This will be repeated until all modules have been cleaned. The total cleaning process will be mostly automated, but will require some operator attention. The cleaning process will take up to 2 hours to complete per membrane module. The spent cleaning solution will be transferred from the CIP skid to a neutralization skid; the waste will be neutralized and then transferred or metered to the feed tank for re-treatment.

As solids build-up in the concentration tank, the sludge must be removed. This will be accomplished using a sludge blowdown pump. The pump will continuously purge sludge from the concentration tank at a fixed rate. The blowdown rate will be an operator adjustable parameter based on periodic measurements of TSS concentrations in the concentrate tank. The variable speed blowdown pump will be operated on a VFD, which will modulate to maintain the sludge flow setpoint.

Permeate Tank

Permeate water from the MF system will flow by gravity into a 2,300 gallon carbon steel permeate tank. The permeate tank will be continuously mixed. A solution of 93% sulfuric acid will be metered into the tank to lower the pH of the treated water to between 6 and 8.5. A pH probe and controller will automatically adjust the acid metering rate in order to maintain the desired pH setpoint. The pH adjustment will also be required to maintain optimum conditions for the subsequent biologic polishing.

Methanol, which is required by the subsequent biologic polishing system, will also be added to the permeate tank. Methanol will be metered automatically to maintain a fixed dose in the MF filtrate based on the influent nitrate and selenium concentrations.

Biologic Selenium and Nitrate Polishing

In order to remove nitrate and selenium, fixed film biologic reactors will polish the MF effluent. Bench scale testing demonstrated the ability of the biologic columns to remove nitrate and selenium. The biologic system will be supplemented with methanol, to provide a carbon source for the biologic activity.

The bio-reactors would consist of large concrete tanks filled with gravel. MF filtrate will flow by gravity to the biological reactors.
Section 4  
Water Treatment Plant Preliminary Design

Sludge Handling

In order to maintain a near-constant solids concentration in the MF system, solids will be continuously purged from the concentration tank via a variable speed centrifugal pump. The sludge blowdown rate will be a setpoint based upon a percentage of the flow rate – the blowdown pump speed will modulate to maintain the desired blowdown rate. The sludge handling process will consist of a sludge thickening tank, sludge pumps, and a filter press.

Water will flow from the MF concentration tank to the sludge thickening tank. A coagulant and flocculant will be added to the blowdown to produce a fast settling floc in the sludge tank. The sludge tank will continuously overflow with decant/supernatant (“free” of solids), while the solids settle to the bottom of the tank and accumulate. As the solids level in the tank builds, the solids will be pumped from the tank to the filter press for dewatering. It is assumed that the sludge will be dewatered to approximately 40% solids by weight. Filtrate from the press will be pumped back to the feed tank. Pressing will be performed manually by the operator as necessary.

The filter cake will either be disposed of on-site in a permitted facility or hauled off-site for disposal. Based on experience from other projects, we do not anticipate that the filter cake will require management as a hazardous material.

Miscellaneous Chemical Metering Systems

Chemical metering systems for the treatment plant will consist of:

- Caustic metering system (NaOH)
- Sulfuric acid metering system (H₂SO₄)
- Ferric chloride (FeCl₃)
- Flocculant and coagulant
- Methanol (CH₃OH)

The caustic metering system will consist of a tank and metering pump. The tank will be sized to allow for roughly three months of caustic storage. The caustic will be delivered in roughly 3,800 gallon bulk trucks as a 25% solution. A metering pump will meter caustic to the neutralization tank. The caustic rate will be metered automatically based on a pH setpoint in the tank.

The sulfuric acid system will consist of a tote (275 gallons) of a concentrated sulfuric acid (93% by weight) and a metering pump. Because a large portion of the alkalinity is removed in the precipitation and filtration process, the quantity of acid required to neutralize the permeate will be relatively small. The sulfuric acid tote will be stored on a secondary containment system, away from the caustic soda storage tank. Similar
to the caustic metering system, the sulfuric acid will be metered automatically based upon a pH setpoint in the final pH adjust tank.

The ferric chloride system will consist of a storage tank and metering pump. Ferric chloride will be added at a rate proportional to the influent arsenic concentration. The rate will be fixed by the operator, and entered as a setpoint into the control system. A flow controller (in conjunction with an electromagnetic flow meter) will maintain the proper metering pump speed to maintain the proper ferric chloride addition rate.

The flocculant and coagulant metering systems will consist of two storage tanks, two metering pumps, a mix tank, mixer, and transfer pump. Flocculant and coagulant will be added to the sludge blowdown prior to entering the sludge tank. These chemicals will be added via a dedicated solenoid-driven diaphragm metering pump. These pumps will be equipped with an integrated flow switch. Chemicals will be metered at a manually adjusted rate, since the sludge blowdown rate is held at a constant rate. The chemical metering pumps will be switched so that they will shut down if the sludge blowdown stops (plant shutdown, etc...). To minimize costs, flocculants and coagulants will be purchased as dry polymer. Polymer will be made up in a mix tank. The polymer will be added through a "hootonanny", where it is mixed with plant water. Once mixed up in the mix tank, the solution will be transferred to a use/storage tank.

Methanol will be stored in a steel tank. Methanol will be metered into the head of the biologic reactors via a peristaltic pump. The methanol addition rate will be set by the operator in order to maintain a calculated dose based on the average plant flowrate.

4.4 Process Control Description

The operation of the water treatment plant will be controlled with a Programmable Logic controller (PLC) that is part of the MF package. This PLC will have sufficient spare capacity to incorporate all of the additional plant operations.

A provision for remote access supervisory control and data acquisition (SCADA) will be included in the plant control system. This will allow an operator to access the plant control system remotely, on-line. Critical process parameters and plant equipment status can be monitored, and equipment can be controlled remotely if necessary. The SCADA system will alert the operator to critical plant alarms via telephone 24 hours per day.

4.5 Material Balance

The proposed treatment approach, as described above, was modeled using a comprehensive spreadsheet modeling program during completion of the EECA document. The spreadsheet model is based upon mass balance and chemical equilibrium calculations to determine treatment performance. The spreadsheet model output provides the projected water quality characteristics of each major process
stream. The material balance will require updating to the 70 gpm flow projection, as the initial material balance was completed assuming 38 gpm influent flow.

4.6 Capital and O&M Costs

This section includes a refined cost estimate for construction and operation of the new water treatment facility. Costs are preliminary and based on the level of design currently completed. In general, costs were determined to be higher than estimated during the EECA cost evaluation. The primary reason for the higher cost was due to higher than expected flows determined from the pumping tests in the extraction wells and an escalation in costs since the time the EECA was prepared.

4.6.1 Capital Costs

Table 4-4 summarizes CDM’s estimate of the installed capital costs for the selected treatment option. This includes costs for labor, materials, subcontractor, equipment, and insurance. Capital costs also include engineering design, project management and construction oversight. CDM prepared this estimate based upon a factored estimate approach as prescribed in *Plant Design and Economics for Chemical Engineers*. Cost accuracies should be assumed to be +30%/-20%.

The major assumptions used in the development of the capital costs are as follows:

- Estimates of plant equipment are based on budgetary quotations from vendors for a design capacity of 70 gpm. Equipment redundancy is included for critical pumps and equipment items.

- A treatment plant building will not be required to house the WTP. A small control building and chemical containment areas will be constructed as required. Additionally, an awning will be constructed over the major equipment to protect them from the elements. All large tanks will be located outside.

- Power is available – no major infrastructure upgrades for power supply will be required “upstream” of a new main disconnect for the plant power supply.

- Plant water of acceptable quality is available at the smelter for use at the WTP.
### Table 4-4
El Paso Water Treatment Plant
Capital Cost Estimate

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>33%</td>
<td>876,207</td>
</tr>
<tr>
<td>Installation</td>
<td>13%</td>
<td>345,173</td>
</tr>
<tr>
<td>I&amp;C</td>
<td>5%</td>
<td>132,759</td>
</tr>
<tr>
<td>Plumbing</td>
<td>6%</td>
<td>159,310</td>
</tr>
<tr>
<td>Electrical</td>
<td>5%</td>
<td>132,759</td>
</tr>
<tr>
<td>Building</td>
<td>5%</td>
<td>132,759</td>
</tr>
<tr>
<td>Land/Site work</td>
<td>4%</td>
<td>106,207</td>
</tr>
<tr>
<td>Utilities</td>
<td>8%</td>
<td>212,414</td>
</tr>
<tr>
<td><strong>TOTAL DIRECT</strong></td>
<td>79%</td>
<td>2,097,587</td>
</tr>
<tr>
<td>Engineering</td>
<td>8%</td>
<td>212,414</td>
</tr>
<tr>
<td>Construction Expenses</td>
<td>8%</td>
<td>212,414</td>
</tr>
<tr>
<td>Contingencies</td>
<td>5%</td>
<td>132,759</td>
</tr>
<tr>
<td><strong>TOTAL INDIRECT</strong></td>
<td>21%</td>
<td>557,587</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100%</td>
<td>2,655,174</td>
</tr>
<tr>
<td>Contingency</td>
<td>20%</td>
<td>3,186,209</td>
</tr>
<tr>
<td>Polishing Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO</td>
<td></td>
<td>293,410</td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td></td>
<td>3,479,619</td>
</tr>
</tbody>
</table>

|                      | 30% | 1,043,886 |
|                      | -20%| (695,924) |
| **COST RANGE**       | MAX | 4,523,504 |
| **TOTAL**            | MIN | 2,783,695 |

#### 4.6.2 Operations and Maintenance Costs

Operations and maintenance costs will require updating to reflect a design flow of 70 gpm. Annual estimated chemical costs have been updated to reflect the higher design flow. Chemical consumption costs are estimated as $50,000 per year. The following assumptions will be used to estimate the O&M costs:

- **Flow:** Operating costs are based on the average flow of 70 gpm for the combined water chemistry.

- **Reagents:** The anticipated caustic consumption is based on raising the pH to 8.5, which the pilot test demonstrated was sufficient to achieve metals removal as well as promote arsenic removal. Ferric chloride consumption was based on a 30:1 ratio of iron-to-arsenic and the feed water quality. Reagent costs were last obtained from Univar in October and November 2008.
Section 4
Water Treatment Plant Preliminary Design

- **Sludge:** Waste sludge production rates are based on mass balance calculations and dewatering to 40% dry solids. All treatment sludges will be considered non-hazardous and will be dried and disposed of in an approved facility. Hauling and disposal costs are estimated to be $75 per cubic yard.

- **Labor:** Labor costs assume that a single full-time operator would be required to operate the plant at $35 per hour.

- **Energy:** Electricity consumption is calculated based on the estimated flows and pressures for all pumps in the treatment process. Energy costs are based on a unit rate of $0.02074 per kW-hr and do not include demand surcharges. Heating costs are not included in the estimate.

- **Maintenance:** The spare parts/maintenance cost for all equipment is estimated to be 2.0% of the fixed capital.

- **Analytical:** Analytical costs were estimated to be once per week (52 samples per year) at $150 per sample to cover permit sampling requirements and general plant operations.
Appendix A
<table>
<thead>
<tr>
<th>DEPTH, FT.</th>
<th>SYMBOL (USCS)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>SL</td>
<td>SLAG</td>
</tr>
<tr>
<td>-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td>SW</td>
<td>SAND, well graded, fine to course grained</td>
</tr>
<tr>
<td>-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-25</td>
<td>ML</td>
<td>SILT, clayey</td>
</tr>
<tr>
<td>-30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-35</td>
<td>SW</td>
<td>SAND, well graded, fine to coarse grained, silty</td>
</tr>
<tr>
<td>-40</td>
<td>ML</td>
<td>SILT, clayey w/ diesel odor</td>
</tr>
<tr>
<td>-45</td>
<td>SP/</td>
<td>SAND, poorly graded, gradational contact with overlying silt; with coarse gravel, well graded</td>
</tr>
<tr>
<td>-50</td>
<td>CW</td>
<td></td>
</tr>
<tr>
<td>-55</td>
<td>SH</td>
<td>SHALE, gray green to black</td>
</tr>
<tr>
<td>-60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WELL DETAILS**

- **Sample Description**
- **Sampling Interval**
- **Moisture**
- **Organic Vapor Concentration (PPM)**
- **Depth, FT.**
- **Stratigraphy**
- **WATER LEVEL**

---

Client: ASARCO INC.
Job No.: 24712-63700-CM-WELL
Well No.: EX-1

Site: EL PASO SMELTER
Top of Casing Elevation: ___________
Total Depth: 47' Casing Type & Size: 6" SCH 80 Slot Size: 0.020 Drilling Method: ARCH
Comments: PARKER BROS. ARROYO
Date Drilled: 4/9/08

Logged by: J. FAUBION

ASARCO, INC.
3201 W. PAISANO STREET
EL PASO, TEXAS

RECOVERY WELL COMPLETION DETAIL

FIGURE A-1
<table>
<thead>
<tr>
<th>Depth, ft.</th>
<th>Symbol (USCS)</th>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>SP/SW</td>
<td>SAND, poorly graded, interbedded with gravel.</td>
</tr>
<tr>
<td>75</td>
<td>SH/SH</td>
<td>SHALE, gray-green to black.</td>
</tr>
<tr>
<td>70</td>
<td>SH/ML</td>
<td>SAND, well graded, fine to coarse grained, silty.</td>
</tr>
<tr>
<td>65</td>
<td>ML/ML</td>
<td>Silt, clayey.</td>
</tr>
<tr>
<td>60</td>
<td>ML/SL</td>
<td>SAND, well graded, fine to course grained.</td>
</tr>
<tr>
<td>55</td>
<td>Silt/Slag</td>
<td>Sample No.</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>Sampling Interval</td>
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<tr>
<td>45</td>
<td></td>
<td>Moisture</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Organic Carbon (ppm).</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td>Depth, ft.</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Stratigraphy</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Water Level</td>
</tr>
</tbody>
</table>

**RECOVERY WELL NO. EX-2**

- **Client:** ASARCO INC.
- **Job No.:** 24712.63700-CM
- **Top of Casing Elevation:** 6" SCH 80 PVC SCREEN (0.020" SLOT)
- **Drilled by:** J. FUBION

![Diagram of well details](image-url)
<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
<th>MOISTURE</th>
<th>VAPOR CONC. (PPM)</th>
<th>DEPTH, FT.</th>
<th>STRATIGRAPHY</th>
<th>WATER LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL</td>
<td>SLAG</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP</td>
<td>ALLUVIUM, well graded sand, fine to coarse grained, with gravel and cobbles</td>
<td></td>
<td></td>
<td>-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-20</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>-30</td>
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<td></td>
<td></td>
<td>-60</td>
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</tr>
<tr>
<td>SH</td>
<td>SHALE, gray, soft, with clay</td>
<td></td>
<td></td>
<td>37</td>
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<td></td>
</tr>
</tbody>
</table>

Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: EX-3  
Site: EL PASO SMELTER  
Top of Casing Elevation:  
Total Depth: 46'  
Casing Type & Size: 6" SCH 80  
Slot Size: 0.20"  
Drilling Method: ARCH  
Comments: PARKER BROS. ARROYO  
Date Drilled: 7/31/08  
Logged by: C.T. IRWIN  

ASARCO, INC.  
3201 W. PAISANO STREET  
EL PASO, TEXAS  
RECOVERY WELL COMPLETION DETAIL  
FIGURE A-1
### RECOVERY WELL NO. EX-4

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
<th>DEPTH, FT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW</td>
<td>ALLUVIUM: well graded sand, fine to coarse grained, with gravel and cobbles</td>
<td>0-20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-45</td>
</tr>
<tr>
<td></td>
<td>58-75: coarse gravel with sand</td>
<td>50-75</td>
</tr>
<tr>
<td>SH</td>
<td>SHALE, gray, hard</td>
<td>70-110</td>
</tr>
</tbody>
</table>

**Well Details**

- **Client:** ASARCO INC.
- **Job No.:** 24712-63700-CM-WELL
- **Well No.:** EX-4
- **Site:** EL PASO SMELTER
- **Total Depth:** 75' Casing Type & Size: 6" SCH 80 Slot Size: 0.020
- **Driller:** WDC
- **Date Drilled:** 7/25/08
- **Logged by:** C.T. IRWIN

**Additional Details**

- **6" SCH 80 PVC Casing**
- **10/20 SILICA SAND**
- **6" SCH 80 PVC SCREEN (0.020 SLOT)**
- **CEMENT/BENTONITE GROUT**
- **BENTONITE SEAL**
- **GROUTING**
- **Cement Sufficiently Grouted**
- **SHALE, gray, hard**

**Recovery Well Completion Detail**
## RECOVERY WELL NO. EX-7

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<th>DEPTH, FT.</th>
<th>SYMBOL/USCS</th>
<th>SAMPLE DESCRIPTION</th>
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<th>SAMPLING INTERVAL</th>
<th>MOISTURE</th>
<th>ORGANIC VAPOR CONC. (PPM)</th>
<th>DEPTH, FT.</th>
<th>STRATIGRAPHY</th>
<th>WATER LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>SL</td>
<td>SLAG</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>GW</td>
<td>ALLUVIUM: well graded sand, fine to coarse grained, with gravel and cobbles 40: casing refusal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td>ANDESITE</td>
<td></td>
<td></td>
<td></td>
<td></td>
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**Client:** ASARCO INC.  
**Job No.:** 24712-63700-CM-WELL  
**Well No.:** EX-7  
**Site:** EL PASO SMELTER  
**Top of Casing Elevation:**  
**Total Depth:** 85'  
**Casing Type & Size:** 6" SCH 80  
**Slot Size:** 0.020"  
**Drilling Method:** ARCH  
**Comments:**  
**Date Drilled:** 7/22/08  
**Logged by:** C.T. IRWIN

---

**CDM**  
3201 W. PAISANO STREET  
EL PASO, TEXAS  
RECOVERY WELL COMPLETION DETAIL  
FIGURE A-1
### Recovery Well No. EX-8

<table>
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<th>Sample Description</th>
<th>Sample No.</th>
<th>Sampling Interval</th>
<th>Moisture</th>
<th>Organic Vapor Conc. (PPM)</th>
<th>Stratigraphy</th>
<th>Water Level</th>
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<tbody>
<tr>
<td>5</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>60</td>
<td>casing refusal petroleum odor</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SH</td>
<td>SHALE, green/gray, soft</td>
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</table>

**Well Details**

- **Client:** ASARCO INC.
- **Job No.:** 24712-63700-CM-WELL
- **Well No.:** EX-8
- **Site:** EL PASO SMELTER
- **Top of Casing Elevation:**
- **Total Depth:** 100 ft
- **Casing Type & Size:** 6" SCH 80 Slot Size: 0.020
- **Drilling Method:** ARCH
- **Comments:**
- **Date Drilled:** 7/18/08
- **Logged by:** C.T. IRWIN

**ASARCO, INC.**
3201 W. PAISANO STREET
EL PASO, TEXAS

**Figure A-1**
<table>
<thead>
<tr>
<th>DEPTH, FT.</th>
<th>SYMBOLS</th>
<th>SAMPLE DESCRIPTION</th>
<th>SAMPLE NO.</th>
<th>SAMPLING INTERVAL</th>
<th>MOISTURE</th>
<th>ORGANIC VAPOR CONC. (PPM)</th>
<th>DEPTH, FT. STRATIGRAPHY</th>
<th>WATER LEVEL</th>
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</thead>
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<tr>
<td>0</td>
<td>GW</td>
<td>ALLUVIUM: well graded sand, fine to x-coarse grained, with gravel and cobbles</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>SLAG</td>
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<tr>
<td>50</td>
<td>GW</td>
<td>ALLUVIUM: SAA 62: casing refusal AND ANDESITE AND QUARTZITE</td>
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Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: EX-9  
Site: EL PASO SMELTER  
Top of Casing Elevation:  
Total Depth: 75'  
Casing Type & Size: 6" SCH 80  
Slot Size: 0.020  
Drilling Method: ARCH  
Comments:  
Date Drilled: 7/16/08  
Driller: WDC  
Logged by: C.T. IRWIN
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<th>SYMBOL (USCS)</th>
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<th>SAMPLE NO.</th>
<th>SAMPLING INTERVAL</th>
<th>MOISTURE</th>
<th>ORGANIC VAPOR CONC. (PPM)</th>
<th>DEPTH (FT.)</th>
<th>STRATIGRAPHY</th>
<th>WATER LEVEL</th>
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<td></td>
<td></td>
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<tr>
<td>15</td>
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<td>SILT, clayey</td>
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<td>SW</td>
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</tr>
<tr>
<td>40</td>
<td>SH</td>
<td>SHALE, gray green to dark black</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</table>

Client: ASARCO INC.  Job No.: 24712-63700-CM-WELL  Well No.: OBS-1
Site: EL PASO SMELTER  Top of Casing Elevation:
Total Depth: 47' Casing Type & Size: 2" SCH 40  Slot Size: .020  Drilling Method: ARCH
Comments:  Date Drilled: 4/10/08
Driller: WDC  Logged by: J. FAUBION

ASARCO, INC.
3201 W. PAISANO STREET
EL PASO, TEXAS

OBSERVATION WELL COMPLETION DETAIL  FIGURE A-1
## MONITORING WELL NO. EP-85D

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<tr>
<th>SYMBOL</th>
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<th>WATER LEVEL</th>
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<tbody>
<tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>37</td>
<td>casing refusal</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SS</td>
<td>SANDSTONE, gray, hard</td>
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</tbody>
</table>

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**Client:** ASARCO INC.  
**Job No.:** 24712-63700-CM-WELL  
**Well No.:** EP-85D  
**Site:** EL PASO SMELTER  
**Top of Casing Elevation:**  
**Total Depth:** 37  
**Casing Type & Size:** 4" SCH 80  
**Slot Size:** 0.020  
**Drilling Method:** ARCH  
**Comments:** PARKER BROS. ARROYO - DEEP INTERVAL WELL  
**Date Drilled:** 7/30/08  
**Logged by:** C.T. IRWIN  

**ASARCO, INC.**  
3201 W. PAISANO STREET  
EL PASO, TEXAS  

**MONITORING WELL COMPLETION DETAIL**  
**FIGURE A-1**
OBS-1 Time-Recovery

- Pumping Well Name: EX-2
- Monitoring Well Name: OBS-1
- Pumping Rate: 4928 cu ft/d
- Transmissivity: 11540 sq ft/d
- Date: April 16, 2008

Graph showing drawdown (ft) over time (d) with data points and a trend line.
EX-2 Time-Drawdown

EX-2 Time-Drawdown

Pumping Well Name: EX-1
Monitoring Well Name: EX-2
Pumping Rate: 7,896.5 gpm
Transmissivity: 1048.9 sq ft
Storage Coefficient: 0.004
Date: May 20-21, 2008
<table>
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<tr>
<th>Time</th>
<th>Totalizer</th>
<th>DTW</th>
<th>Temperature</th>
<th>Conductivity</th>
<th>pH</th>
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</thead>
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Client: Asacrc Inc.  
Well No.: EX-7
Site: El Paso Smelter  
Date: 8/13/08
Depth to Bottom: 88 (w/2.5 ft stick up)  
Screen Depth: 60-80 bgs
Depth to Water: 63.4 (w/2.5 ft. stick up)  
Pump Depth: 86 (w/2.5 ft. stick up)
Water Column Height: 25

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Well No.: EX-8  
Site: El Paso Smelter  
Date: 8/13/08  
Depth to Bottom: 103 (w/2.5 ft stick up)  
Screen Depth: 65-95 bgs  
Depth to Water: 58.8 (w/2.5 ft. stick up)  
Pump Depth: 103 (w/2.5 ft. stick up)  
Water Column Height: 44  

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Client: Asacrco Inc.  
Well No.: EX-9  

Site: El Paso Smelter  
Date: 8/14/08  

Depth to Bottom: 80 (w/2.5 ft. stick up)  
Depth to Water: 63 (w/2.5 ft. stick up)  
Screen Depth: 55-75 bgs  
Water Column Height: 17  
Pump Depth: 80 (w/2.5 ft. stick up)  

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Appendix B
# ASARCO GROUNDWATER REMEDIATION
## PHASE 1
### ASARCO
#### FIELD SCALE - PILOT TEST
##### AS-CONSTRUCTED DRAWINGS
###### EL PASO, TX
##### OCTOBER 2008

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<td>FIGURE 1</td>
<td>2008 WELL INSTALLATION LOCATIONS</td>
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<td>FIGURE 2A</td>
<td>EXISTING CONSTRUCTED INFRASTRUCTURE</td>
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<td>WELL ASSEMBLY DETAILS</td>
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<td>VAULT DETAILS</td>
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**CDM** Camp Dresser & McKee Inc.
**HELENA, MONTANA**

Consulting  
Engineering  
Construction  
Operations
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**EXISTING MCC IN REC MCC ROOM #2**

**ELEVATION**

**NOTES:**

1. CONTRACTOR SHALL PROVIDE (1) NEW 480V 2 POLE MCC.
2. SPACE AVAILABLE SHOWN VOTED BREAKERS WILL BE IN SPACE IN EXISTING ALLEY.
3. SPACE AVAILABLE VOTED BREAKERS WILL BE IN SPACE IN EXISTING ALLEY.

**PROJECT:**

EL PASO SMELTER GROUNDWATER REMEDIATION PROJECT

**COM:**

AGARCO

PANEL SCHEDULES AND MCC ELEVATION

SHEET: E-10

AUGUST 2000

PROJECT NO. COM-2000 SHEET NO. E-10
Attachment 2

EX-3 AQTESOLV™ Output
EX-3 PUMPING TEST

Data Set: G:\...\EX-3.aqt
Date: 02/01/13
Time: 15:09:25

PROJECT INFORMATION

Company: ARCADIS
Client: Asarco
Location: El Paso, TX
Test Well: EX-3
Test Date: 8/12/08

WELL DATA

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<tr>
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</table>

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

\[ T = 4515 \text{ ft}^2/\text{day} \]

\[ \frac{K_z}{K_r} = 1. \]

\[ S = 0.006761 \]

\[ b = 39 \text{ ft} \]
Aquifer Testing and Data Analysis Report

ASARCO, Inc. El Paso Smelter, El Paso, Texas

Prepared for:
ASARCO, Inc.

Prepared by:
ARCADIS G&M, Inc.
8222 South 48th Street
Suite 140
Phoenix
Arizona 85044
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:
AZ001022.0003

Date:
02 March 2005
1.0 Introduction

2.0 Methods
   2.1 Rising-Head / Falling Head Aquifer Test Methods
   2.2 Pumping Aquifer Test Methods

3.0 Analysis

4.0 Results

Tables
   1 Aquifer Testing Results and Summary of Monitor Well Construction Details
   2 Aquifer Tests Listed By Arroyo Locations
   3 Summary of Hydraulic Conductivity Data

Figures
   1 Site and Vicinity Map
   2 Tested Monitor Well Locations
   3 Arroyo Areas and Test Well Locations

Appendices
   A Aquifer Testing Data
   B Soil Boring Logs
1.0 Introduction

ARCADIS G&M, Inc. (ARCADIS), on behalf of ASARCO Inc. (ASARCO), has conducted an aquifer testing program in certain areas of the ASARCO El Paso Smelter site (the Site) (See Figures 1 and 2). The purpose for the aquifer testing program was to gather additional site-specific information to further characterize the groundwater system at the Site.

The aquifer testing program was conducted as a part of a larger groundwater corrective action program to evaluate potential in-situ treatment technologies for use at the site. Existing groundwater monitoring wells were chosen for testing to provide site-specific data with particular attention to select areas of interest. Particular areas of interest for further investigation were identified in the report, ASARCO Incorporated El Paso Smelter Groundwater Corrective Action Feasibility Evaluation Draft, and included the Parker Brothers Arroyo, the Acid Plant Arroyo, the Ponds 5 & 6 Arroyo and the floodplain of the Rio Grande. Preferential flow paths for shallow groundwater have been recognized at the site. The preferential flow paths are typically coincident with historic arroyo drainages that formerly existed at the site. This is especially the case for the movement of light non-aqueous phase liquid, (LNAPL), which is present in certain arroyos. The arroyos were filled in over time with slag and fill materials to increase the quantities of level ground at the Site for expansion of operational facilities.

Much work has been done to determine if the arroyos influence the movement of metals in groundwater and are pathways for constituents of concern (COC) from historic site operations. Groundwater elevations across the upland, on-facility area of the Site are below the bottom of the arroyo centerlines, so water is not specifically channeled into the fill materials within the arroyos. Elevated concentrations of COC occur in wells that are located in former arroyo areas as well as those that are not. As such, groundwater flow appears to be both strongly influenced by, but can also be independent of the historic arroyo flow paths. This report details aquifer testing field activities and the subsequent analysis of the collected data.

---


2.0 Methods

A total of 45 rising head/falling head type aquifer tests and three pumping type aquifer tests were performed on select environmental groundwater monitor wells in on-facility and off-facility areas at the Site. Figure 2 shows the locations of the wells that were tested. The aquifer testing took place at the Site between September 22 and 29, 2004. The testing took place as part of a larger field effort that included the development of recently installed monitor and dual phase hydrocarbon extraction wells and baseline groundwater sampling of the newly installed wells.

2.1 Rising-Head / Falling Head Aquifer Test Methods

The rising head/falling head type aquifer test involves inducing a rapid change in water level in a test well. By measuring and recording the rate of return to static conditions (recovery), one is able to estimate the local horizontal hydraulic conductivity of the material surrounding the well. Rising head/falling head test data are generally evaluated using analytical solutions to the equations that govern groundwater flow.

Rising head/falling head aquifer tests were conducted in the 45 groundwater monitor wells listed in Table 1 by the following method:

A solid, 4-foot high-density polyethylene (HDPE) cylinder (a slug), was used to rapidly displace water in each well being tested. A transducer/data logger, (a self contained unit), was first hung from a cable in the monitor well below the level that slug would travel. After the groundwater in the well had returned to the equilibrium static water level as measured before placing the instrument, the slug was rapidly lowered in the well until it is below the static water level. After the groundwater in the well had returned to the equilibrium static water level (or within one-tenth of a foot of the static water level), the slug was rapidly raised out of the water. When the groundwater in the well had once again returned to equilibrium, the test was deemed complete. The recorded data within the transducer/data logger was downloaded to a laptop computer for evaluation.

2.2 Pumping Aquifer Test Methods

Site-specific aquifer properties can be measured by stressing an aquifer by pumping a well and observing the drawdown and subsequent recovery of water levels in the pumping well and in observation wells. In July of 2004 three groundwater monitor wells were installed approximately fourteen feet from previously existing monitor
wells. The new monitor wells are screened in approximately the same depth intervals as the previously existing monitor wells, creating well pairs that are suitable for use in groundwater studies.


For each of the well pairs, the newly installed monitor wells were used as pumping wells to stress the target aquifers, and the previously existing wells were used as observation wells. A transducer/data logger was placed in each of the monitor wells to be tested. The transducer/data logger was placed in the pumping well below the submersible pump that was used for each test. A 2-inch Grundfos® Redi-Flo II pump was used for the pumping aquifer tests.

Following placement of the transducer/data loggers, the well pump was started and set to discharge at a steady rate that was measured using a flow meter/totalizer. The wells were each pumped continuously for 24 hours, at which point the pump was shut down for at least 24 hours while groundwater level recovery data was collected. Following collection of the recovery data, each test was deemed to be over and the transducers/data loggers were retrieved from the wells.

All equipment that entered the groundwater monitor wells was decontaminated prior to and after use in the field as per the site Sampling and Analysis Plan (SAP). Water produced during aquifer testing was brought to Site locations specified by ASARCO.

3.0 Analysis

The data gathered from the rising head/falling head and pumping aquifer tests were analyzed using the AQTESOLV computer program. The AQTESOLV program assists in graphically and automatically matching type curves or straight lines to water well draw down and recovery data to solve empirical and partial differential equations describing the flow of fluid through a porous media. Rising head/falling head aquifer test results generally represent hydraulic conductivities of the sedimentary materials immediately surrounding the tested wells. Pumping aquifer test results represent the

---

average hydraulic properties of the area between the screened intervals of the pumping and observation wells involved in the test.

The data produced by the rising head/falling head tests were also analyzed using the Bouwer and Rice solution for single well slug tests in an unconfined aquifer as the default solution. The Bouwer and Rice solution was chosen due to its simplicity and suitability for use in partially penetrated aquifers. The Butler solution for single well slug tests that exhibit inertial displacement was used for the analysis of rising head/falling head tests conducted in monitor well MW-132D. The solution accounts for the oscillatory water-level response sometimes observed in aquifers of high hydraulic conductivity.

The data from the pumping test at EP-49/MW-49 were also evaluated using several methods including the Theis solution, the Cooper-jacob method, Moench, and Neuman solutions. The Theis solution for predicting water-level changes in response to pumping in an unconfined aquifer assuming unsteady flow was chosen for the analysis of the data from the pumping test conducted at the EP-49/MW-49 well pair. Results of analysis of the data by the Cooper-Jacob, Moench, and Neuman solutions were very similar to the Theis solution. The Theis solution was chosen due to its simplicity and suitability to the aquifer conditions.

The data produced in the pumping tests of the EP-131/MW-131 and EP-132/MW-132S well pairs was analyzed using the Neuman solution for unsteady flow to a partially penetrating well in an unconfined aquifer with delayed gravity response. The type curves for this solution were a better fit for the data from the EP-131/MW-131 and EP-

---


132/MW-132S well pairs than the Theis solution. Curve matched plots of the data and the analysis results produced by AQTESOLV are provided in Appendix A. Lithologic logs for all of the monitor wells tested during this aquifer testing program are included in Appendix B.

4.0 Results

The construction of wells in alluvial sediments typically described as heterogeneous formations have screened intervals that commonly include some variation in physical properties. Results from aquifer testing should be considered to be an average of aquifer properties across the screened intervals.

Results from the analysis of the data produced from the rising head/falling head and the pumping aquifer tests are presented in Table 1. The locations of the tested monitor wells are shown on Figure 2. Hydraulic conductivity (K), is the coefficient of permeability in Darcy’s equation describing the movement of water through a porous media:

\[ Q = -KA \frac{dh}{dl} \]

Where Q is a volume of water or discharge, A is a unit cross-sectional area, and \( \frac{dh}{dl} \) is a hydraulic gradient or change of water elevation over a distance.

Hydraulic conductivity (K values), are expressed in feet per day (ft/day), under a hydraulic gradient of one. Transmissivity is the amount of water that can be transmitted horizontally through a unit width of the full thickness of the aquifer under a hydraulic gradient of one, expressed in feet squared per day (ft²/day). Storativity is the amount of water that aquifer formation material will absorb or expel from storage per unit area per change in head. Storativity is a dimensionless number.

Table 2 presents results for aquifer tests for each of the arroyo areas delineated at the Site, and for the floodplain of the Rio Grande. Delineation of arroyo drainages and drainage divides was made based on historic pre-development topography of the site\(^8\). Figure 3 illustrates approximate historic arroyo areas with the locations of tested wells.

---

highlighted. Table 3 presents a statistical summary of hydraulic conductivity data for each of the arroyo areas and for the floodplain of the Rio Grande.

Aquifer testing results presented in Table 3 indicate the following:

- There is significant variability of hydraulic conductivities within most of the arroyos and floodplain evaluated, excepting the South Terrace Arroyo. The highest variability of hydraulic conductivity within the arroyos was noted in the Parker Brothers Arroyo. The highest variability for hydraulic conductivity overall was within the floodplain of the Rio Grande.

- Both the arithmetic mean and the geographic mean of the hydraulic conductivities for the sedimentary water table aquifers at the Site are generally higher in the floodplain of the Rio Grande then in the upland and arroyo areas.

- As expected, bedrock aquifers at the site appear to have low hydraulic conductivity.

- The sediments of the Rio Grande floodplain are highly stratified and include zones of highly permeable coarse-grained sediments separated by finer grained sediments of low permeability. An upper sandy interval from approximately 20 to 40 feet bgs and a lower gravelly sand interval from approximately 50 to 68 feet bgs is separated by a highly plastic, sticky clay (fat clay) layer in the area of monitor well MW-132D.
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### Aquifer Testing Results and Summary of Monitor Well Construction Details

**ASARCO El Paso Smelter Site, El Paso, Texas**

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<th>Ground Surface Elevation (ft msl)</th>
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<th>Total Depth Drilled (ft bgs)</th>
<th>Total Depth Cased (ft bgs)</th>
<th>Casing Size (ID) (in)</th>
<th>Screened Interval (ft bgs)</th>
<th>Static Water Level (ft bgs)</th>
<th>Well Depth from Measuring Point (ft)</th>
<th>Water Column Height (ft)</th>
<th>Date Measured</th>
<th>Hydraulic Conductivity (ft/day) Slug-In</th>
<th>Hydraulic Conductivity (ft/day) Slug-Out</th>
<th>Pumping Aquifer Test Hydraulic Conductivity</th>
<th>Pumping Aquifer Test Hydraulic Storativity</th>
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**Notes:**
- ft = Feet
- bgs = Below ground surface
- ID = Inside diameter
- bnp = Below measuring point
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<th>Hydraulic Conductivity (ft/day) Slug-In</th>
<th>Hydraulic Conductivity (ft/day) Slug-Out</th>
<th>Pumping Aquifer Test Hydraulic Conductivity</th>
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Notes:
1 Area 1 - Parker Brothers Arroyo
2 From Hydrometrics, 2001
3 Not used for calculation of aquifer statistics in Table 3
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<td>4</td>
<td>2.18</td>
<td>2.18</td>
<td></td>
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<td>EP-105</td>
<td>4</td>
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<td>0.17</td>
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<tr>
<td>EP-67</td>
<td>5</td>
<td>3.23</td>
<td>3.17</td>
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<td>7</td>
<td>3.75</td>
<td>2.58</td>
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<td>0.89</td>
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<td>EP-80</td>
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<td>3</td>
<td>2.9</td>
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<td>EP-112</td>
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<td>43.26</td>
<td>45.32</td>
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<td>4.63</td>
<td>7.93</td>
<td></td>
<td></td>
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<td>EP-122</td>
<td>7</td>
<td>27.04</td>
<td>25.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP-128</td>
<td>7</td>
<td>60.73</td>
<td>72.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MW-132D(^{(3)})</td>
<td>7</td>
<td>222.2</td>
<td>540</td>
<td>Deep Alluvial Aquifer, Not Included in Statistical Calculations</td>
<td></td>
</tr>
<tr>
<td>MW-132S</td>
<td>7</td>
<td>15.7</td>
<td>20.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP-132</td>
<td>7</td>
<td>1.06</td>
<td>2.08</td>
<td>10.17</td>
<td>1.24</td>
</tr>
<tr>
<td>EP-133</td>
<td>7</td>
<td>27.87</td>
<td>31.29</td>
<td></td>
<td></td>
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<tr>
<td>EP-134</td>
<td>7</td>
<td>19.73</td>
<td>19.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP-135</td>
<td>7</td>
<td>0.52</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1 Area 1 - Parker Brothers Arroyo
2 From Hydrometrics, 2001
3 Not used for calculation of aquifer statistics in Table 3
### TABLE 3
**Summary of Hydraulic Conductivity Data**
**ASARCO El Paso Smelter Site, El Paso, Texas**

#### Part A - Water Table Aquifers Composed of Unconsolidated Sedimentary Material

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
<th>Number of Tests</th>
<th>Minimum Hydraulic Conductivity (ft/day)</th>
<th>Maximum Hydraulic Conductivity (ft/day)</th>
<th>Standard Deviation</th>
<th>Arith. Mean Hydraulic Conductivity (ft/day)</th>
<th>Geo. Mean Hydraulic Conductivity (ft/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Parkers Brothers Arroyo</td>
<td>20</td>
<td>0.26</td>
<td>123.2</td>
<td>22.49</td>
<td>10.04</td>
<td>3.33</td>
</tr>
<tr>
<td>2</td>
<td>Acid Plant Arroyo</td>
<td>4</td>
<td>1.86</td>
<td>4.7</td>
<td>1.12</td>
<td>3.25</td>
<td>3.07</td>
</tr>
<tr>
<td>3</td>
<td>Ponds 5 &amp; 6 Arroyo</td>
<td>6</td>
<td>0.61</td>
<td>25.1</td>
<td>9.20</td>
<td>8.30</td>
<td>4.54</td>
</tr>
<tr>
<td>4</td>
<td>Pond 1 Arroyo</td>
<td>6</td>
<td>0.17</td>
<td>10.9</td>
<td>3.47</td>
<td>2.74</td>
<td>1.09</td>
</tr>
<tr>
<td>5</td>
<td>South Terrace Arroyo</td>
<td>1</td>
<td>3.17</td>
<td>3.23</td>
<td>0.04</td>
<td>3.20</td>
<td>3.20</td>
</tr>
<tr>
<td>6</td>
<td>Plant Entrance Arroyo</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>Rio Grande Floodplain</td>
<td>13</td>
<td>0.45</td>
<td>72.06</td>
<td>19.90</td>
<td>18.01</td>
<td>7.75</td>
</tr>
</tbody>
</table>

Notes: Part A statistical analysis is made for test data for monitor wells that are screened in the water table aquifer only.

#### Part B - Bedrock and Lower Sedimentary Aquifers

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
<th>Test Well</th>
<th>Minimum Hydraulic Conductivity (ft/day)</th>
<th>Maximum Hydraulic Conductivity (ft/day)</th>
<th>Standard Deviation</th>
<th>Arith. Mean Hydraulic Conductivity (ft/day)</th>
<th>Geo. Mean Hydraulic Conductivity (ft/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Ponds 5 &amp; 6 Arroyo</td>
<td>EM-06</td>
<td>0.47</td>
<td>0.87</td>
<td>0.28</td>
<td>0.67</td>
<td>0.64</td>
</tr>
<tr>
<td>7</td>
<td>Rio Grande Floodplain</td>
<td>MW-132D</td>
<td>222.2</td>
<td>540</td>
<td>224.72</td>
<td>381.10</td>
<td>346.39</td>
</tr>
</tbody>
</table>

Notes: Part B statistical analysis is made for bedrock well EM-06 and lower alluvial aquifer well MW-132D.
Appendix A

Aquifer Testing Data
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EM-6slugin.aqt
Date: 12/05/04
Time: 13:21:43

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 51.27 ft

WELL DATA (EM-6)

Initial Displacement: 4.16 ft
Total Well Penetration Depth: 51.27 ft
Casing Radius: 0.167 ft
Static Water Column Height: 51.27 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.8724 ft/day
Kz/Kr = 1.

Ss = 3.127E-16 ft^{-1}
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EM-6slugout.aqt
Date: 12/05/04
Time: 13:21:02

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 51.27 ft

WELL DATA (EM-6)
Initial Displacement: 2.51 ft
Total Well Penetration Depth: 51.27 ft
Casing Radius: 0.167 ft
Static Water Column Height: 51.27 ft
Screen Length: 10 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Confined
Solution Method: KGS Model

\[
\begin{align*}
Kr &= 0.4752 \text{ ft/day} \\
Kz/Kr &= 0.1 \\
Ss &= 1.928 \times 10^{-6} \text{ ft}^{-1}
\end{align*}
\]
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-12slugin.aqt
Date: 12/05/04
Time: 13:22:24

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-12)

Initial Displacement: 1.99 ft
Total Well Penetration Depth: 12.19 ft
Casing Radius: 0.167 ft
Static Water Column Height: 12.19 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.2567 ft/day
Solution Method: Bouwer-Rice
y0 = 1.572 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-12slugout.aqt
Date: 12/05/04
Time: 13:22:57

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 20 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-12)
Initial Displacement: 3.7 ft
Total Well Penetration Depth: 10.69 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.69 ft
Screen Length: 20 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
\( K = 0.1734 \text{ ft/day} \)
\( y_0 = 1.696 \text{ ft} \)
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-14slugin.aqt
Date: 12/05/04
Time: 13:27:46

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-14)

Initial Displacement: 1.67 ft
Total Well Penetration Depth: 9.3 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.3 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.419 ft/day
y0 = 1.107 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtessolv Slugtest Files\EP-14slugout.aqt
Date: 12/05/04
Time: 13:24:39

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20 ft  Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-14)

Initial Displacement: 4.17 ft  Static Water Column Height: 9.3 ft
Total Well Penetration Depth: 9.3 ft  Screen Length: 20 ft
Casing Radius: 0.167 ft  Wellbore Radius: 0.3 ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined  Solution Method: Bouwer-Rice
K = 1.604 ft/day  y0 = 1.603 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-29slugin.aqt
Date: 12/05/04
Time: 13:28:13

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-29)

Initial Displacement: 3.53 ft
Total Well Penetration Depth: 22.02 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.02 ft
Screen Length: 30. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.683 ft/day
y0 = 1.612 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-29slugout.aqt
Date: 12/05/04
Time: 13:29:02

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40, ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-29)

Initial Displacement: 2.76 ft
Total Well Penetration Depth: 22.02 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.02 ft
Screen Length: 30. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 6.694 ft/day
y0 = 1.542 ft
**WELL TEST ANALYSIS**

Data Set: C:\ASARCO\Aquifer Tests\Pumping Tests\MW-49Pumpingtest.aqt  
Date: 12/05/04  
Time: 19:25:53  

**PROJECT INFORMATION**  
Company: ARCADIS  
Client: ASARCO  
Project: AZ001022  
Location: El Pao, Texas  
Test Well: MW-49

**WELL DATA**

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>X (ft)</th>
<th>Y (ft)</th>
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<tbody>
<tr>
<td>MW-49</td>
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<td>0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Observation Wells</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-49</td>
<td>15</td>
<td>0</td>
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</tbody>
</table>

**SOLUTION**

Aquifer Model: Unconfined  

$\ T = 64.33 \text{ ft}^2/\text{day}$  

$\ \frac{K_z}{K_r} = 1.$  

Solution Method: Theis  

$\ S = 0.01322$  

$\ b = 19.95 \text{ ft}$
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtiesolv Slugtest Files\EP-54slugout.aqt
Date: 12/05/04
Time: 15:58:02

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-54)

Initial Displacement: 1.9 ft
Total Well Penetration Depth: 9.3 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.3 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.2631 ft/day
y0 = 0.3563 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-59slugin.aqt
Date: 12/05/04
Time: 13:30:39

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25, ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-59)

Initial Displacement: 4.01 ft
Total Well Penetration Depth: 8.63 ft
Casing Radius: 0.167 ft
Static Water Column Height: 8.63 ft
Screen Length: 20, ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

\[ K = 3.752 \text{ ft/day} \]
\[ y_0 = 2.302 \text{ ft} \]
## WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-59slugout.aqt  
Date: 12/05/04  
Time: 13:31:01

## PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

## AQUIFER DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Saturated Thickness</td>
<td>25 ft</td>
</tr>
<tr>
<td>Anisotropy Ratio (Kz/Kr)</td>
<td>0.1</td>
</tr>
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</table>

## WELL DATA (EP-59)

<table>
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<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Initial Displacement</td>
<td>3.86 ft</td>
</tr>
<tr>
<td>Total Well Penetration Depth</td>
<td>8.63 ft</td>
</tr>
<tr>
<td>Casing Radius</td>
<td>0.167 ft</td>
</tr>
<tr>
<td>Static Water Column Height</td>
<td>8.63 ft</td>
</tr>
<tr>
<td>Screen Length</td>
<td>20 ft</td>
</tr>
<tr>
<td>Wellbore Radius</td>
<td>0.3 ft</td>
</tr>
<tr>
<td>Gravel Pack Porosity</td>
<td>0.3</td>
</tr>
</tbody>
</table>

## SOLUTION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquifer Model</td>
<td>Unconfined</td>
</tr>
<tr>
<td>Solution Method</td>
<td>Bouwer-Rice</td>
</tr>
<tr>
<td>K</td>
<td>2.579 ft/day</td>
</tr>
<tr>
<td>y0</td>
<td>2.655 ft</td>
</tr>
</tbody>
</table>
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-61slugin.aqt
Date: 12/05/04
Time: 13:31:41

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-61)

Initial Displacement: 1.84 ft
Total Well Penetration Depth: 7.78 ft
Casing Radius: 0.167 ft
Static Water Column Height: 7.78 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.894 ft/day
Solution Method: Bouwer-Rice
y0 = 1.393 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-61slugout.aqt
Date: 12/05/04
Time: 13:32:09

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20, ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-61)

Initial Displacement: 3.61 ft
Total Well Penetration Depth: 7.78 ft
Casing Radius: 0.167 ft
Static Water Column Height: 7.78 ft
Screen Length: 10, ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.832 ft/day
y0 = 2.252 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-67slugin.aqt
Date: 12/05/04  Time: 13:35:00

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft  Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-67)

Initial Displacement: 3.15 ft  Static Water Column Height: 17.84 ft
Total Well Penetration Depth: 17.84 ft  Screen Length: 20. ft
Casing Radius: 0.167 ft  Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined  Solution Method: Bouwer-Rice
K = 3.231 ft/day  y0 = 1.33 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-67slugout.aqt
Date: 12/05/04
Time: 15:59:10

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-67)

Initial Displacement: 4.15 ft
Total Well Penetration Depth: 17.84 ft
Casing Radius: 0.167 ft
Static Water Column Height: 17.84 ft
Screen Length: 20 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.165 ft/day
y0 = 1.407 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-68slugin.aqt
Date: 12/05/04
Time: 13:35:55

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-68)

Initial Displacement: 2.72 ft
Total Well Penetration Depth: 19.23 ft
Casing Radius: 0.167 ft
Static Water Column Height: 19.23 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.184 ft/day
y0 = 1.271 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-68slugout.aqt
Date: 12/05/04
Time: 13:36:15

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 25 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-68)
Initial Displacement: 3.61 ft
Total Well Penetration Depth: 19.23 ft
Casing Radius: 0.167 ft
Static Water Column Height: 19.23 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.184 ft/day
y0 = 1.393 ft
## WELL TEST ANALYSIS

Data Set: C:\ASARCO\AQUIFER TESTS\Slug Tests\Aqtesolv Slugtest Files\EP-73slugin.aqt  
Date: 12/05/04  
Time: 13:36:47

## PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

## AQUIFER DATA

Saturated Thickness: 20 ft  
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (EP-73)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Displacement</td>
<td>2.76 ft</td>
</tr>
<tr>
<td>Total Well Penetration Depth</td>
<td>11.94 ft</td>
</tr>
<tr>
<td>Casing Radius</td>
<td>0.167 ft</td>
</tr>
<tr>
<td>Static Water Column Height</td>
<td>11.94 ft</td>
</tr>
<tr>
<td>Screen Length</td>
<td>20 ft</td>
</tr>
<tr>
<td>Wellbore Radius</td>
<td>0.3 ft</td>
</tr>
<tr>
<td>Gravel Pack Porosity</td>
<td>0.3</td>
</tr>
</tbody>
</table>

## SOLUTION

Aquifer Model: Unconfined  
Solution Method: Bouwer-Rice  
\[ K = 3.652 \text{ ft/day} \]  
\[ y_0 = 1.599 \text{ ft} \]
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-73slugout.aqt
Date: 12/05/04  Time: 13:37:10

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft  Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-73)

Initial Displacement: 3.88 ft
Total Well Penetration Depth: 11.94 ft
Casing Radius: 0.167 ft
Static Water Column Height: 11.94 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined  Solution Method: Bouwer-Rice
K = 4.188 ft/day  y0 = 2.058 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-78slugin.agt
Date: 12/05/04

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

ACQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-78)

Initial Displacement: 4.24 ft
Total Well Penetration Depth: 15.29 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.29 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 18.28 ft/day
y0 = 4.112 ft
**WELL TEST ANALYSIS**

Data Set: C:\VASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-78slugout.aqt
Date: 12/05/04
Time: 13:38:04

**PROJECT INFORMATION**

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

**AQUIFER DATA**

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

**WELL DATA (EP-78)**

Initial Displacement: 4.43 ft
Total Well Penetration Depth: 15.29 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.29 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

**SOLUTION**

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 17.32 ft/day
y0 = 4.076 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-79slugin.aqt
Date: 12/05/04
Time: 13:38:28

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-79)

Initial Displacement: 2.99 ft
Total Well Penetration Depth: 9.1 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.1 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.448 ft/day
y0 = 1.267 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-79slugout.aqt
Date: 12/05/04
Time: 13:36:53

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-79)

Initial Displacement: 4. ft
Total Well Penetration Depth: 9.1 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.1 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.082 ft/day
y0 = 1,455 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\ Slug Tests\ Aqtesolv Slugtest Files\ EP-80slugin.aqt
Date: 12/05/04
Time: 13:39:18

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-80)

Initial Displacement: 3.7 ft
Total Well Penetration Depth: 15.1 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.1 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.997 ft/day
y0 = 2.953 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-80slugout.aqt
Date: 12/05/04
Time: 13:39:44

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-80)

Initial Displacement: 5.52 ft
Total Well Penetration Depth: 15.1 ft
Casing Radius: 0.167 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3
Static Water Column Height: 15.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.898 ft/day
y0 = 3.443 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-81slugin.aqt
Date: 12/05/04
Time: 13:40:11

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-81)

Initial Displacement: 2.87 ft
Total Well Penetration Depth: 9.72 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.72 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.644 ft/day
y0 = 1.648 ft
### WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-81slugout.aqt  
Date: 12/05/04  
Time: 13:40:34

### PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

### AQUIFER DATA

| Saturated Thickness: 25, ft | Anisotropy Ratio (Kz/Kr): 0.1 |

### WELL DATA (EP-81)

<table>
<thead>
<tr>
<th>Initial Displacement: 4.79 ft</th>
<th>Static Water Column Height: 9.72 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Well Penetration Depth: 9.72 ft</td>
<td>Screen Length: 15, ft</td>
</tr>
<tr>
<td>Casing Radius: 0.167 ft</td>
<td>Wellbore Radius: 0.3 ft</td>
</tr>
<tr>
<td></td>
<td>Gravel Pack Porosity: 0.3</td>
</tr>
</tbody>
</table>

### SOLUTION

Aquifer Model: Unconfined  
Solution Method: Bouwer-Rice  
\[ K = 1.128 \text{ ft/day} \]  
\[ y_0 = 2.034 \text{ ft} \]
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-82slugin.aqt
Date: 12/05/04
Time: 13:40:59

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-82)

Initial Displacement: 4.08 ft
Total Well Penetration Depth: 15.14 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.14 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 7.61 ft/day
y0 = 1.895 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-82slugout.aqt
Date: 12/05/04
Time: 13:41:23

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-82)

Initial Displacement: 4.22 ft
Total Well Penetration Depth: 15.14 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.14 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.647 ft/day
y0 = 1.802 ft
### WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-83slugin.aqt  
Date: 12/05/04  
Time: 13:41:49

### PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

### AQUIFER DATA

<table>
<thead>
<tr>
<th>Saturated Thickness: 40, ft</th>
<th>Anisotropy Ratio (Kz/Kr): 0.1</th>
</tr>
</thead>
</table>

### WELL DATA (EP-83)

<table>
<thead>
<tr>
<th>Initial Displacement: 4.01 ft</th>
<th>Static Water Column Height: 24.4 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Well Penetration Depth: 24.4 ft</td>
<td>Screen Length: 15, ft</td>
</tr>
<tr>
<td>Casing Radius: 0.167 ft</td>
<td>Wellbore Radius: 0.3 ft</td>
</tr>
<tr>
<td></td>
<td>Gravel Pack Porosity: 0.3</td>
</tr>
</tbody>
</table>

### SOLUTION

<table>
<thead>
<tr>
<th>Aquifer Model: Unconfined</th>
<th>Solution Method: Bouwer-Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>K = 3.437 ft/day</td>
<td>y0 = 3.531 ft</td>
</tr>
</tbody>
</table>
### WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtесolvl Slugtest Files\EP-83slugout.aqt  
Date: 12/05/04  
Time: 13:43:06

### PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

### AQUIFER DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturated Thickness</td>
<td>40. ft</td>
</tr>
<tr>
<td>Anisotropy Ratio (Kz/Kr)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### WELL DATA (EP-83)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Displacement</td>
<td>3.87 ft</td>
</tr>
<tr>
<td>Total Well Penetration Depth</td>
<td>24.4 ft</td>
</tr>
<tr>
<td>Casing Radius</td>
<td>0.167 ft</td>
</tr>
<tr>
<td>Static Water Column Height</td>
<td>24.4 ft</td>
</tr>
<tr>
<td>Screen Length</td>
<td>15. ft</td>
</tr>
<tr>
<td>Wellbore Radius</td>
<td>0.3 ft</td>
</tr>
<tr>
<td>Gravel Pack Porosity</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### SOLUTION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquifer Model</td>
<td>Unconfined</td>
</tr>
<tr>
<td>Solution Method</td>
<td>Bouwer-Rice</td>
</tr>
<tr>
<td>$K$</td>
<td>2.937 ft/day</td>
</tr>
<tr>
<td>$y_0$</td>
<td>3.392 ft</td>
</tr>
</tbody>
</table>
### WELL TEST ANALYSIS

**Data Set:** C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-84slugin.aqt  
**Date:** 12/05/04  
**Time:** 13:43:45

### PROJECT INFORMATION

- **Company:** ARCADIS  
- **Client:** ASARCO Inc.  
- **Project:** AZ001022  
- **Location:** El Paso Smelter

### AQUIFER DATA

- **Saturated Thickness:** 40. ft  
- **Anisotropy Ratio (Kz/Kr):** 0.1

### WELL DATA (EP-84)

- **Initial Displacement:** 1.24 ft  
- **Total Well Penetration Depth:** 9.16 ft  
- **Casing Radius:** 0.167 ft  
- **Static Water Column Height:** 9.16 ft  
- **Screen Length:** 10. ft  
- **Wellbore Radius:** 0.3 ft  
- **Gravel Pack Porosity:** 0.3

### SOLUTION

- **Aquifer Model:** Unconfined  
- **Solution Method:** Bouwer-Rice  
- **K:** 70.68 ft/day  
- **y0:** 0.5547 ft
WELL TEST ANALYSIS

Data Set: C:\VASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-84slugout.aqt
Date: 12/05/04
Time: 13:44:08

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-84)

Initial Displacement: 2.02 ft
Total Well Penetration Depth: 9.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.16 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 123.2 ft/day
y0 = 1.297 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-90slugin.aqt
Date: 12/05/04
Time: 13:44:32

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-90)

Initial Displacement: 2.15 ft
Total Well Penetration Depth: 13.2 ft
Casing Radius: 0.167 ft
Static Water Column Height: 13.2 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6083 ft/day
y0 = 1.185 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-90slugout.aqt
Date: 12/05/04  Time: 13:44:55

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft  Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-90)

Initial Displacement: 4.07 ft  Static Water Column Height: 13.2 ft
Total Well Penetration Depth: 13.2 ft  Screen Length: 20. ft
Casing Radius: 0.167 ft  Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined  Solution Method: Bouwer-Rice
K = 0.817 ft/day  y0 = 1.428 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-93\slugin.aqt
Date: 12/05/04
Time: 13:45:22

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 40, ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-93)
Initial Displacement: 3.22 ft
Total Well Penetration Depth: 10.43 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.43 ft
Screen Length: 20, ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
K = 0.6998 ft/day
Solution Method: Bouwer-Rice
y0 = 1.751 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-93slugout.aqt
Date: 12/05/04
Time: 13:45:47

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-93)

Initial Displacement: 4.27 ft
Total Well Penetration Depth: 10.43 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.43 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.937 ft/day
y0 = 5.432 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-94slugin.aqt
Date: 12/05/04
Time: 13:46:16

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-94)

Initial Displacement: 3.44 ft
Total Well Penetration Depth: 15.83 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.83 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.387 ft/day
y0 = 2.608 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-94slugout.aqt
Date: 12/05/04
Time: 13:46:49

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-94)

Initial Displacement: 4.24 ft
Total Well Penetration Depth: 15.83 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.83 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.813 ft/day
y0 = 2.595 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-95slugin.aqt
Date: 12/05/04
Time: 13:47:13

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-95)

Initial Displacement: 4.08 ft
Total Well Penetration Depth: 39.03 ft
Casing Radius: 0.167 ft
Static Water Column Height: 39.03 ft
Screen Length: 25. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 23.24 ft/day
y0 = 5.246 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-95slugout.aqt
Date: 12/05/04
Time: 13:47:39

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-95)

Initial Displacement: 4.47 ft
Total Well Penetration Depth: 39.03 ft
Casing Radius: 0.167 ft
Static Water Column Height: 39.03 ft
Screen Length: 25. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 12.91 ft/day
y0 = 5.328 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-97slugin.aqt
Date: 12/05/04
Time: 13:48:26

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-97)

Initial Displacement: 2.46 ft
Total Well Penetration Depth: 9.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.16 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.323 ft/day
y0 = 0.734 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtresolv Slugtest Files\EP-97slugout.aqt
Date: 12/05/04
Time: 13:48:51

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-97)

Initial Displacement: 4.94 ft
Total Well Penetration Depth: 9.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.16 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 9.296 ft/day
y0 = 4.493 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-98slugin.aqt
Date: 12/05/04
Time: 13:49:18

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-98)

Initial Displacement: 2.83 ft
Total Well Penetration Depth: 16.37 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.37 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.8373 ft/day
Solution Method: Bouwer-Rice
y0 = 2.374 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-98slugout.aqt
Date: 12/05/04
Time: 13:49:41

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-98)

Initial Displacement: 4.11 ft
Total Well Penetration Depth: 16.37 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.37 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6216 ft/day
y0 = 2.351 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-105slugin.aqt
Date: 12/05/04
Time: 13:50:26

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-105)

Initial Displacement: 2.58 ft
Total Well Penetration Depth: 10.77 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.77 ft
Screen Length: 30. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.1793 ft/day
y0 = 2.845 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aqui fer Tests\Slug Tests\Aqtesol\ Slugtest Files\EP-105slugout.aqt
Date: 12/05/04
Time: 13:50:51

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-105)
Initial Displacement: 3.19 ft
Total Well Penetration Depth: 10.77 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.77 ft
Screen Length: 30. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.1646 ft/day
y0 = 2.061 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-108slugin.aqt
Date: 12/05/04
Time: 13:51:18

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-108)

Initial Displacement: 4.26 ft
Total Well Penetration Depth: 21.63 ft
Casing Radius: 0.167 ft
Static Water Column Height: 21.63 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6591 ft/day
y0 = 2.157 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-108slugout.aqt
Date: 12/05/04  Time: 13:51:42

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-108)

Initial Displacement: 4.27 ft
Total Well Penetration Depth: 21.63 ft
Casing Radius: 0.167 ft
Static Water Column Height: 21.63 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.9099 ft/day
y0 = 2.477 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-109slugin.aqt
Date: 12/05/04
Time: 13:52:07

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-109)

Initial Displacement: 5. ft
Static Water Column Height: 24.31 ft
Total Well Penetration Depth: 24.31 ft
Screen Length: 25. ft
Casing Radius: 0.167 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6269 ft/day
y0 = 2.047 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-109slugout.aqt
Date: 12/05/04
Time: 13:52:33

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-109)

Initial Displacement: 3.65 ft
Total Well Penetration Depth: 24.31 ft
Casing Radius: 0.167 ft
Static Water Column Height: 24.31 ft
Screen Length: 25. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.748 ft/day
Solution Method: Bouwer-Rice
y0 = 2.259 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-112slugin.aqt
Date: 12/05/04
Time: 13:52:57

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-112)

Initial Displacement: 2.96 ft
Total Well Penetration Depth: 13.38 ft
Casing Radius: 0.167 ft
Static Water Column Height: 13.38 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 43.26 ft/day
y0 = 2.022 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-112slugout.aqt
Date: 12/05/04
Time: 13:53:20

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-112)

Initial Displacement: 3.09 ft
Total Well Penetration Depth: 13.38 ft
Casing Radius: 0.167 ft
Static Water Column Height: 13.38 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 45.32 ft/day
y0 = 2.499 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-114slugin.agt
Date: 12/05/04
Time: 13:53:44

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-114)

Initial Displacement: 2.5 ft
Total Well Penetration Depth: 16.42 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 16.42 ft
Screen Length: 20. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.019 ft/day
y0 = 0.9707 ft
WELL TEST ANALYSIS
Data Set: C: \ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-114slugout.aqt
Date: 12/05/04
Time: 13:54:09

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-114)
Initial Displacement: 2.73 ft
Total Well Penetration Depth: 16.42 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 16.42 ft
Screen Length: 20. ft
Wellbore Radius: 0.25 ft
Gravel Pack Porosity: 0.25

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.642 ft/day
y0 = 1.763 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Agtesolv Slugtest Files\EP-119slugin.aqt
Date: 12/05/04
Time: 13:54:37

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-119)

Initial Displacement: 1.77 ft
Total Well Penetration Depth: 9.87 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.87 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.631 ft/day
y0 = 1.039 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-119slugout.aqt
Date: 12/05/04
Time: 13:55:01

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-119)

Initial Displacement: 3.43 ft
Total Well Penetration Depth: 9.87 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.87 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 7.931 ft/day
y0 = 1.961 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-120slugin.aqt
Date: 12/05/04
Time: 13:55:24

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-120)

Initial Displacement: 3.26 ft
Total Well Penetration Depth: 15.39 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.39 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.8875 ft/day
Solution Method: Bouwer-Rice
y0 = 1.22 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-120slugout.aqt
Date: 12/05/04
Time: 13:55:47

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-120)

Initial Displacement: 4.25 ft
Total Well Penetration Depth: 15.39 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.39 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.708 ft/day
y0 = 2.578 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-121slugin.aqt
Date: 12/05/04
Time: 13:56:13

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-121)

Initial Displacement: 3.45 ft
Total Well Penetration Depth: 16.66 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.66 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.309 ft/day
y0 = 1.453 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-121slugout.aqt
Date: 12/05/04 Time: 13:56:37

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-121)

Initial Displacement: 4.13 ft
Total Well Penetration Depth: 16.66 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.66 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.947 ft/day
y0 = 2.188 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtessolv Slugtest Files\EP-122slugin.aqt
Date: 12/05/04
Time: 13:57:01

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-122)

Initial Displacement: 3.1 ft
Total Well Penetration Depth: 9.89 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.89 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 27.04 ft/day
y0 = 1.756 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-122slugout.aqt
Date: 12/05/04
Time: 13:57:26

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-122)

Initial Displacement: 4.18 ft
Total Well Penetration Depth: 9.89 ft
Casing Radius: 0.167 ft
Static Water Column Height: 9.89 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K \ = \ 25.62 \ \text{ft/day}
y_0 = 4.481 \ \text{ft}
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-123slugin.aqt
Date: 12/05/04  Time: 13:57:51

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft  Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-123)

Initial Displacement: 2.77 ft  Static Water Column Height: 14.27 ft
Total Well Penetration Depth: 14.27 ft  Screen Length: 20. ft
Casing Radius: 0.167 ft  Wellbore Radius: 0.3 ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined  Solution Method: Bouwer-Rice
K = 15.25 ft/day  y0 = 2.195 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-123slugout.aqt
Date: 12/05/04
Time: 13:58:26

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-123)

Initial Displacement: 4.25 ft
Total Well Penetration Depth: 14.27 ft
Casing Radius: 0.167 ft
Static Water Column Height: 14.27 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 21.37 ft/day
y0 = 5.386 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-124slugin.aqt
Date: 12/05/04
Time: 13:58:48

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-124)

Initial Displacement: 2.72 ft
Total Well Penetration Depth: 4.76 ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.76 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 3.175 ft/day
y0 = 1.26 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-124slugout.aqt
Date: 12/05/04
Time: 13:59:11

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-124)

Initial Displacement: 3.61 ft
Total Well Penetration Depth: 4.76 ft
Casing Radius: 0.167 ft
Static Water Column Height: 4.76 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.175 ft/day
y0 = 1.381 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-125slugin.agt
Date: 12/05/04
Time: 13:59:38

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-125)

Initial Displacement: 3.91 ft
Total Well Penetration Depth: 20.43 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.43 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 1.863 ft/day
Solution Method: Bouwer-Rice
y0 = 2.374 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-125slugout.aqt
Date: 12/05/04 Time: 14:00:04

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-125)
Initial Displacement: 4.37 ft
Total Well Penetration Depth: 20.43 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.43 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.042 ft/day
y0 = 1.642 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-128slugin.aqt
Date: 12/05/04
Time: 14:01:25

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-128)

Initial Displacement: 2.65 ft
Total Well Penetration Depth: 16.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.32 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 60.73 ft/day
y0 = 1.917 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-128slugout.aqt
Date: 12/05/04
Time: 14:01:46

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-128)

Initial Displacement: 3.35 ft
Total Well Penetration Depth: 16.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 16.32 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 72.06 ft/day
y0 = 2.922 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-129slugin.aqt
Date: 12/05/04
Time: 14:02:27

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-129)

Initial Displacement: 4.06 ft
Total Well Penetration Depth: 22.9 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.9 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.448 ft/day

y0 = 1.443 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-129slugout.aqt
Date: 12/05/04
Time: 14:03:19

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 40 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-129)
Initial Displacement: 4.87 ft
Total Well Penetration Depth: 22.9 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.9 ft
Screen Length: 20 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.249 ft/day
y0 = 1.445 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-131slugin.aqt
Date: 12/05/04
Time: 14:04:40

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-131)

Initial Displacement: 3. ft
Total Well Penetration Depth: 15.37 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.37 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 3.853 ft/day
y0 = 1.764 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-131slugout.aqt
Date: 12/05/04
Time: 14:05:15

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-131)

Initial Displacement: 3.8 ft
Total Well Penetration Depth: 15.37 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.37 ft
Screen Length: 20 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.309 ft/day
γ0 = 4.188 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\MW-131slugin.aqt
Date: 12/05/04
Time: 14:13:57

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-131)

Initial Displacement: 1.12 ft
Total Well Penetration Depth: 13.06 ft
Casing Radius: 0.0835 ft
Static Water Column Height: 13.06 ft
Screen Length: 20 ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 11.02 ft/day
y0 = 0.4515 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\MW-131slugout.aqt
Date: 12/05/04
Time: 14:14:58

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 20, ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-131)

Initial Displacement: 1.41 ft
Total Well Penetration Depth: 13.06 ft
Casing Radius: 0.0835 ft
Static Water Column Height: 13.06 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 24.62 ft/day
y0 = 0.5092 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Pumping Tests\MW-131Pumpingtest.aqt
Date: 12/05/04 Time: 16:00:16

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO
Project: AZ001022
Location: El Paso, Texas
Test Well: MW-131

AQUIFER DATA

Saturated Thickness: 20, ft

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (ft)</td>
</tr>
<tr>
<td>MW-131</td>
<td>0</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Unconfined

\[ T = 502, \text{ ft}^2/\text{day} \]
\[ S = 0.008137 \]
\[ \beta = 0.01567 \]

Solution Method: Neuman
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-132slugin.aqt
Date: 12/05/04
Time: 14:06:02

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 27. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-132)

Initial Displacement: 3.01 ft
Total Well Penetration Depth: 14.54 ft
Casing Radius: 0.167 ft
Static Water Column Height: 14.54 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.062 ft/day
y0 = 1.295 ft
# WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-132slugout.agt  
Date: 12/05/04  
Time: 14:06:25

## PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

## AQUIFER DATA

- Saturated Thickness: 27 ft  
- Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (EP-132)

- Initial Displacement: 4.39 ft  
- Total Well Penetration Depth: 14.54 ft  
- Casing Radius: 0.167 ft  
- Static Water Column Height: 14.54 ft  
- Screen Length: 20 ft  
- Wellbore Radius: 0.3 ft  
- Gravel Pack Porosity: 0.3

## SOLUTION

- Aquifer Model: Unconfined  
- Solution Method: Bouwer-Rice  
- K = 2.081 ft/day  
- y0 = 3.27 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\MW-132Sslugin.aqt
Date: 12/05/04

Time: 14:17:55

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 27. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-132S)

Initial Displacement: 1.84 ft
Total Well Penetration Depth: 14.29 ft
Casing Radius: 0.083 ft

Static Water Column Height: 14.29 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 15.7 ft/day

Solution Method: Bouwer-Rice
y0 = 0.517 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\MW-132\slugout.aqt
Date: 12/05/04
Time: 14:18:21

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 27. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-132S)

Initial Displacement: 1.57 ft
Total Well Penetration Depth: 14.29 ft
Casing Radius: 0.083 ft
Static Water Column Height: 14.29 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 20.11 ft/day
Solution Method: Bouwer-Rice
y0 = 0.608 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Pumping Tests\MW-132Pumpingtest.aqt
Date: 12/05/04
Time: 17:03:45

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO
Project: AZ001022
Location: El Paso, Texas
Test Well: MW-132S

AQUIFER DATA
Saturated Thickness: 82.63 ft

WELL DATA

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-132</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-132</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>

SOLUTION
Aquifer Model: Unconfined
Solution Method: Neuman

\[
T = 885.1 \text{ ft}^2/\text{day} \\
S = 1.235 \\
\beta = 0.004
\]
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\MW-132Dslugin.aqt
Date: 12/05/04
Time: 19:22:11

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 18.5 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-132D)

Initial Displacement: 1.23 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 54.62 ft
Screen Length: 10. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Butler
K = 222.2 ft/day
C(D) = 0.2029
### WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtessolv Slugtest Files\MW-132Dslugout1.aqt  
Date: 12/05/04  
Time: 19:33:43

### PROJECT INFORMATION

Company: ARCADIS  
Client: ASARCO Inc.  
Project: AZ001022  
Location: El Paso Smelter

### AQUIFER DATA

- Saturated Thickness: 18.5 ft  
- Anisotropy Ratio (Kz/Kr): 0.1

### WELL DATA (MW-132D)

- Initial Displacement: 1.13 ft  
- Total Well Penetration Depth: 18. ft  
- Casing Radius: 0.083 ft  
- Static Water Column Height: 54.62 ft  
- Screen Length: 10. ft  
- Wellbore Radius: 0.3 ft  
- Gravel Pack Porosity: 0.3

### SOLUTION

- Aquifer Model: Confined  
- Solution Method: Butler  
- \( K = 540. \) ft/day  
- \( C(D) = 0.1023 \)
WELL TEST ANALYSIS

Data Set:  C:\ASARCO\Aquifer Tests\Slug Tests\Aqtessolv Slugtest Files\EP-133slugin.aqt
Date: 12/05/04
Time: 14:09:03

PROJECT INFORMATION

Company:  ARCADIS
Client:  ASARCO Inc.
Project:  AZ001022
Location:  El Paso Smelter

AQUIFER DATA

Saturated Thickness:  25. ft
Anisotropy Ratio (Kz/Kr):  0.1

WELL DATA (EP-133)

Initial Displacement:  3.22 ft
Total Well Penetration Depth:  8.98 ft
Casing Radius:  0.167 ft
Static Water Column Height:  8.98 ft
Screen Length:  15. ft
Wellbore Radius:  0.3 ft
Gravel Pack Porosity:  0.3

SOLUTION

Aquifer Model:  Unconfined
Solution Method:  Bouwer-Rice
K = 27.87 ft/day
y0 = 2.364 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-133slugout.aqt
Date: 12/05/04
Time: 14:10:10

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-133)

Initial Displacement: 4.35 ft
Total Well Penetration Depth: 8.98 ft
Casing Radius: 0.167 ft
Static Water Column Height: 8.98 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 31.29 ft/day
y0 = 4.167 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-134slugin.aqt
Date: 12/05/04
Time: 14:10:45

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-134)

Initial Displacement: 3.38 ft
Total Well Penetration Depth: 16.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.8 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 19.73 ft/day
y0 = 2.475 ft
WELL TEST ANALYSIS
Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-134slugout.aqt
Date: 12/05/04
Time: 14:11:09

PROJECT INFORMATION
Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-134)
Initial Displacement: 3.5 ft
Total Well Penetration Depth: 16.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 10.8 ft
Screen Length: 15. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 19.73 ft/day
y0 = 2.592 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-135slugin.aqt
Date: 12/05/04
Time: 14:11:34

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-135)

Initial Displacement: 3.78 ft
Total Well Penetration Depth: 15.82 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.82 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.5194 ft/day
y0 = 1.32 ft
WELL TEST ANALYSIS

Data Set: C:\ASARCO\Aquifer Tests\Slug Tests\Aqtesolv Slugtest Files\EP-135slugout.aqt
Date: 12/05/04
Time: 14:12:00

PROJECT INFORMATION

Company: ARCADIS
Client: ASARCO Inc.
Project: AZ001022
Location: El Paso Smelter

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (EP-135)

Initial Displacement: 3.93 ft
Total Well Penetration Depth: 15.82 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.82 ft
Screen Length: 20. ft
Wellbore Radius: 0.3 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.4467 ft/day
y0 = 1.411 ft
Appendix B

Soil Boring Logs
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation: D2487.

### MAJOR DIVISION

<table>
<thead>
<tr>
<th>GRADE GROUP &amp; TYPICAL DESCRIPTION</th>
<th>TYPICAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAVELS (less than 5% passing No. 200 sieve)</td>
<td>Clean Gravels, gravel-sand mixtures or sand-gravel-cobble mixtures</td>
</tr>
<tr>
<td>GRAVES WITH FINES (more than 12% passing No. 200 sieve)</td>
<td>Limits plot below &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
</tr>
<tr>
<td>Clean Sands (less than 5% passing No. 200 sieve)</td>
<td>Limits plot above &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
</tr>
<tr>
<td>BANDS WITH FINES (more than 12% passing No. 200 sieve)</td>
<td>Limits plot above &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
</tr>
<tr>
<td>SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)</td>
<td>ML Inorganic silts, silt with slight plasticity</td>
</tr>
<tr>
<td>SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)</td>
<td>MH Inorganic silts of high plasticity, silty soils, plastic silts</td>
</tr>
<tr>
<td>CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)</td>
<td>CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays</td>
</tr>
<tr>
<td>CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)</td>
<td>CH Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity</td>
</tr>
</tbody>
</table>

NOTE: Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

### PLASTICITY CHART

![Plasticity Chart](chart.png)

### DEFINITIONS OF SOIL FRACTIONS

<table>
<thead>
<tr>
<th>SOIL COMPONENT</th>
<th>PARTICLE SIZE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td>Above 300mm (12in.)</td>
</tr>
<tr>
<td>Cobbles</td>
<td>300mm to 75mm (12in. to 3in.)</td>
</tr>
<tr>
<td>Gravel</td>
<td>75mm to 19mm (3in. to 3/4in.)</td>
</tr>
<tr>
<td>Coarse gravel</td>
<td>75mm to 19mm (3in. to 3/4in.)</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>19mm (3/4in.) to No. 4 sieve</td>
</tr>
<tr>
<td>Sand</td>
<td>No. 4 to No. 200</td>
</tr>
<tr>
<td>Coarse</td>
<td>No. 4 to No. 10</td>
</tr>
<tr>
<td>Medium</td>
<td>No 10 to No. 40</td>
</tr>
<tr>
<td>Fine</td>
<td>No 40 to No 200</td>
</tr>
<tr>
<td>Fines (silt or clay)</td>
<td>Below No 200 sieve</td>
</tr>
</tbody>
</table>
**TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS**

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. **Relative Density.** Terms for description of relative density of cohesionless, uncedemented sands and sand-gravel mixtures.

<table>
<thead>
<tr>
<th>N</th>
<th>Relative Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>Very loose</td>
</tr>
<tr>
<td>5-10</td>
<td>Loose</td>
</tr>
<tr>
<td>11-30</td>
<td>Medium dense</td>
</tr>
<tr>
<td>31-50</td>
<td>Dense</td>
</tr>
<tr>
<td>50+</td>
<td>Very dense</td>
</tr>
</tbody>
</table>

2. **Relative Consistency.** Terms for description of clays which are saturated or near saturation.

<table>
<thead>
<tr>
<th>N</th>
<th>Relative Consistency</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Very soft</td>
<td>Easily penetrated several inches with fist.</td>
</tr>
<tr>
<td>3-4</td>
<td>Soft</td>
<td>Easily penetrated several inches with thumb.</td>
</tr>
<tr>
<td>5-8</td>
<td>Medium stiff</td>
<td>Can be penetrated several inches with thumb with moderate effort.</td>
</tr>
<tr>
<td>9-15</td>
<td>Stiff</td>
<td>Readily indented with thumb, but penetrated only with great effort.</td>
</tr>
<tr>
<td>16-30</td>
<td>Very stiff</td>
<td>Readily indented with thumbnail.</td>
</tr>
<tr>
<td>30+</td>
<td>Hard</td>
<td>Indented only with difficulty by thumbnail.</td>
</tr>
</tbody>
</table>

3. **Relative Firmness.** Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

<table>
<thead>
<tr>
<th>N</th>
<th>Relative Firmness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>Very soft</td>
</tr>
<tr>
<td>5-8</td>
<td>Soft</td>
</tr>
<tr>
<td>9-15</td>
<td>Moderately firm</td>
</tr>
<tr>
<td>16-30</td>
<td>Firm</td>
</tr>
<tr>
<td>31-50</td>
<td>Very firm</td>
</tr>
<tr>
<td>50+</td>
<td>Hard</td>
</tr>
</tbody>
</table>
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso
State: Texas
Property Owner: ASARCO, Inc
Legal Description: Asarco Plant
Descriptive Location: Parking lot in front of warehouse.
Recorded By: AJH
Drilling Company: Earl & Sons
Driller: Mark T.
Drilling Method: Air Rotary
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 22
Date Hole Stated: 5/19/90
Date Hole Finished: 5/19/90

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>Y/N</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40 PVC</td>
<td>0 - 22 feet</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>6 inch steel</td>
<td></td>
</tr>
<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>0.020-inch slot, Sch 40 PVC</td>
<td>11 - 21 feet</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>12/20 Silica Sand</td>
<td>8 - 22 feet</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite/Cement Grout</td>
<td>5 - 8 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Concrete</td>
<td>0 - 2 feet</td>
</tr>
</tbody>
</table>

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 14.36
Surface Casing Height (ft): 0
Date: 5/98
Riser Height (ft): 0.25
MP Description: Top of PVC
Ground Surface Elevation (ft): 3775.25
MP Height Above or Below Ground (ft): 0
MP Elevation (ft): 3776.5

Remarks: Water level 14.43' in open hole - bgs. Clay layer is believed to be restricting downward movement of ground water.

WELL CONSTRUCTION

GRAPHICS

GEODELOGICAL DESCRIPTION

0.0 - 3.0'
Slag
predominantly gravel size slag with minor amounts of dirt fill
[Slag Fill]

3.0 - 17.0'
Slag
dry, black, unconsolidated
[Slag Fill]

17.0 - 20.0'
Slag
dry, black, unconsolidated, wet
[Slag Fill]

20.0 - 22.0'
Clay
dark gray to black, tacky, calcareous, origin unknown

Bottom of Hole 22.0
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
Tucson, Arizona

**Monitor Well Log**

**Hole Name: EP-06**

**Date Hole Started:** 2/18/90  
**Date Hole Finished:** 2/18/90

---

**Client:** ASARCO, Inc.

**Project:** Asarco El Paso Agreed Order RI

**County:** El Paso  
**State:** Texas

**Property Owner:** ASARCO, Inc.  
**Property Description:** Asarco Plant

**Descriptive Location:** approximately 30 feet from Rio Grande and 600 feet down from canal tunnel

**Recorded By:** MRW

**Drilling Company:** Raba-Kistner

**Driller:** Manny

**Drilling Method:** Hollow Stem Auger

**Drilling Fluids Used:** None

**Purpose of Hole:** Install Monitor Well

**Target Aquifer:** NA

**Hole Diameter (in):** 6-inch

**Total Depth Drilled (ft):** 8

---

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>Y/N</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>2-inch, flush threaded, Sch 40, PVC</td>
<td>0 - 8 feet</td>
</tr>
<tr>
<td>Screen Casing Used?</td>
<td>Y</td>
<td>8 inch steel</td>
<td>+2 - 2 feet</td>
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<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>0.010-inch slot, Sch 40, PVC</td>
<td>3 - 8 feet</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>12/20 silica sand</td>
<td>2 - 8 feet</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite/Cement Grout</td>
<td>0 - 2 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Bentonite/Cement Grout</td>
<td>NA</td>
</tr>
</tbody>
</table>

**DEVELOPMENT/SAMPLING**

- **Well Developed?:** N
- **Water Samples Taken?:** N
- **Boring Samples Taken?:** N

- **Static Water Level Below MP:** 7.48 ft
- **Surface Casing Height (ft):** 2.0 ft
- **Date:** 5/98
- **Riser Height (ft):** 1.5 ft
- **MP Description:** Top of PVC
- **Ground Surface Elevation (ft):** 3714.72 ft
- **MP Height Above or Below Ground (ft):** 1.5 ft
- **MP Elevation (ft):** 3716.22 ft

---

**WELL CONSTRUCTION**

0.1 Concrete Pad

2.0 10/20 Silica Sand

0.010 Slot Screen

3.0 0.0 Bentonite Grout

7.0 - 8.0 Gravelly Sand
- Gravels to 5 inches with coarse to medium grained sand
- [Alluvium]

Bottom of Hole 8.0

---

**GEOLOGICAL DESCRIPTION**

0.0 - 3.0
- Gravel and Sand
- Gravel and Sand [Fill]

3.0 - 7.0
- Sand
- Poorly graded fine to medium grained sand, predominantly medium grained [Sand]
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso
State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: Approximately 50' from Rio Grande opposite of plant entrance.
Recorded By: MRW
Drilling Company: Raba-Kistner
Driller: Manny
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 8

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
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<tbody>
<tr>
<td>Y/N</td>
<td>2-inch, flush threaded, Sch 40, PVC</td>
<td>0 - 8 feet</td>
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<tr>
<td>Surface Casing Used?</td>
<td>Y 8 inch steel</td>
<td>+2 - 2 feet</td>
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<tr>
<td>Screen/Perforations?</td>
<td>Y 0.010-inch slot, Sch 40, PVC</td>
<td>8 - 8 feet</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y 12/20 Silica Sand</td>
<td>2 - 8 feet</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y Bentonite/Cement Grout</td>
<td>0 - 2 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y Bentonite/Cement Grout</td>
<td>0 - 2 feet</td>
</tr>
</tbody>
</table>

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 6.94
Surface Casing Height (ft): 2.0
Date: 5/98
Riser Height (ft): 1.5
MP Description: Top of PVC
Ground Surface Elevation (ft): 3720.60
MP Height Above or Below Ground (ft): 1.5
MP Elevation (ft): 3722.1

Remarks:

WELL CONSTRUCTION

GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 3.5' SAND - fine grained to medium grained sand, brown
[Alluvium]

3.5 - 4.5' SILTY CLAY - medium plasticity clay with silt, brown to dark brown
[Alluvium]

4.5 - 8.0' SAND - fine to medium grained sand, predominately fine grained sand, tan
[Alluvium]

Bottom of Hole: 8.0

Sheet 1 of 1
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: 200 feet SE of lunchroom.
Recorded By: RC (AES)
Drilling Company: Layne Christensen Co.
Driller: Gary
Drilling Method: Air Rotary
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 80

WELL COMPLETION
Y/N DESCRIPTION INTERVAL
Well Installed? Y 4-inch, flush threaded, Sch 40, PVC 0 - 72 feet
Surface Casing Used? Y 8 inch steel +2 - 2 feet
Screen/Perforations? Y 0.010-inch slot, Sch 40, PVC 52 - 72 feet
Sand Pack? Y 12/20 Silica Sand 50 - 75 feet
Annular Seal? Y Bentonite/Cement Grout 0 - 48 feet
Surface Seal? N

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water LevelBelow MP: 62.0 Surface Casing Height (ft): 2.0
Riser Height (ft): 1.5
MP Description: Top of PVC
Ground Surface Elevation (ft): 3771.73
MP Height Above or Below Ground (ft): 1.5
MP Elevation (ft): 3773.23

Remarks: Drilled 0 - 80 feet with air rotary rig (5 - 7/8" Tricone Bit). Completed hole with Becker hammer rig because hole caved behind air rotary rig.

WELL CONSTRUCTION
0.0 - Cement Grout
0.0 - 2.0' PVC riser
2.0 - RUBBLE
2.0 - 7.0' Silty SAND - Brown medium to fine
7.0 - 14.0' [Alluvium]
14.0 - 17.0' Silty SAND - Tan, Fine
[Alluvium]
17.0 - 26.0' Silty SAND - Brown, medium to fine, some gravel
[Alluvium]
26.0 - 34.0' Sandy GRAVEL - some silt, well-graded
[Alluvium]
34.0 - 36.0' Silty SAND - light brown, very fine with little gravel
[Alluvium]
36.0 - 40.0' Sandy GRAVEL - tan, some silt
[Alluvium]
40.0 - 60.0' GRAVEL - coarse well rounded
[Alluvium]
60.0 - 67.0' Gravelly SAND - tan, with rock chips, hard at 60 feet
[Alluvium]
67.0 - 80.0' Sandy GRAVEL - tan, line, with coarse gravel
[Alluvium]

GEOLOGICAL DESCRIPTION

Bottom of Hole: 80.0
0.010 Slot Screen 52.0

Sheet 1 of 1
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order R1
County: El Paso
State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: 50 feet NE of lunchroom

Recorded By: RC (AES)
Drilling Company: Layne Christensen Co.
Driller: Gary
Drilling Method: Air Rotary
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 78

WELL COMPLETION

Well Installed? Y
Surface Casing Used? Y
Screen/Perforations? Y
Sand Pack? Y
Annular Seal? Y
Surface Seal? Y

DEVELOPMENT/SAMPLING

Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 58.58
Surface Casing Height (ft): 0
Date: 5/98
Riser Height (ft): -0.25
MP Description: Top of PVC
Ground Surface Elevation (ft): 3775.23
MP Height Above or Below Ground (ft): -0.25
MP Elevation (ft): 3774.98

Remarks: Drilled 0 - 50 feet with 5 - 7/8" tricone bit on 2/23/90. Bentonite above 40 feet. Drilled 50 - 78 feet with 5 7/8" tricone bit on 2/24/90. Hole caved behind bit. Well was worked over with casing hammer rig and well installed on 2/24/90.
WELL COMPLETION

<table>
<thead>
<tr>
<th>Description</th>
<th>Y/N</th>
<th>INTERVAL</th>
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<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>0 - 37 feet</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>0 - .5 feet</td>
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<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>7 - 37 feet</td>
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<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>5 - 37 feet</td>
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<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>3 - 5 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>0 - 3 feet</td>
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</table>

DEVELOPMENT/SAMPLING

<table>
<thead>
<tr>
<th>Description</th>
<th>Y/N</th>
<th>INTERVAL</th>
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<tbody>
<tr>
<td>Well Developed?</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Water Samples Taken?</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Boring Samples Taken?</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

Static Water Level Below MP: 13.80
Date: 5/98
MP Height Above or Below Ground (ft): -0.25
MP Description: Top of PVC
Ground Surface Elevation (ft): 3727.50
Riser Height (ft): -0.25

Remarks:
- cp - 650 7 7/8" hole, completion - 7 - 37' 4" SS 0.02 slotted wellscreen, 0 - 7' 4" scd 40 solid PVC, 5 - 37' 10/20 silica sand, 3 - 5' 1" hydrated bentonite pallets, 0 - 3' cement, 12' vault at surface, SS bottom plug, expansion top plug, 2' radial pad.
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: Plant area near acid plant at Northwest end of plant

Recorded By: WHAJH
Drilling Company: Ruen
Driller: Will
Drilling Method: Schramm Air Rotary
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: NA
Hole Diameter (in): 8-inch
Total Depth Drilled (ft): 71

WELL CONSTRUCTION

0.0 Cement Grout
0.0 Concrete Pad
24.0 PVC riser
25.0 Screen/Perforations
32.0 Medium Bentonite Chips
35.0 Silica Sand
39.0 0.2 Slot Screen SS
Bottom of Hole 71.0

GEOLOGICAL DESCRIPTION

0.0 - 57.0'
SLAG AND GRAVEL FILL - loose to medium dense, black to brown, caves easily, all slag past 2 - feet, no scattered gravels, highly fractured, losing approximately 50 % of air, scattered soft and hard pockets. Caved badly at 37 feet. Very loose and fractured at 63 feet.
(Slag Fill)

57.0 - 62.0'
SILTY SAND with GRAVEL -medium dense to dense, slightly moist, light brown
(Alluvium)

62.0 - 72.0'
SANDY GRAVEL - dense, slightly moist, light brown, free water at 65 feet.
(Alluvium)

WELL COMPLETION  Y/N  DESCRIPTION  INTERVAL
Well Installed?  Y  4-inch, flush threaded, Sch 40, PVC  0 - 69 feet
Surface Casing Used?  Y  12 inch Vault  0 - .5 feet
Screen/Perforations?  Y  0.020-inch 304 slotted stainless steel  39 - 69 feet
Sand Pack?  Y  10/20 silica sand  35 - 69 feet
Annular Seal?  Y  Bentonite Chips  32 - 35 feet
Surface Seal?  Y  Bentonite/Cement Grout  0 - 32 feet

DEVELOPMENT/SAMPLING
Well Developed?  N
Water Samples Taken?  N
Boring Samples Taken?  N

Static Water Level Below MP: 63.53
Surface Casing Height (ft): 0
Date: 5/98
Riser Height (ft): -0.25
MP Description: Top of PVC
Ground Surface Elevation (ft): 3785.84
MP Height Above or Below Ground (ft): -0.25
MP Elevation (ft): 3785.59

Remarks: Schramm 7 7/8 - inch hole. centralizer @ 64 feet

Sheet 1 of 1
Soil Boring Log
Boring Number: MW-49
Project: ASARCO - El Paso Smelter Site
Address: 2301 W. Paisano Dr., El Paso, Texas

Project Number: AZ001022.0003
Date Drilled: 7/24/04 - 7/29/04
Manager: Robert Mongrain
Logged by: Gordon Levin
Checked by:
Groundwater Encountered:
Depth: NM  Time: n/a
Date: n/a

Drilling Co.: Layne Christensen
Driller: Mike Boyle
Drilling Method: ODEX
Sample Method: Split Spoon
Ground Elevation:
Degree Off Vertical: 0
Hole Diameter: 7"
Total Depth: 97'

NOTES:
BGS - below ground surface

U.S.C.S. Soil Symbol and Lithology Description

GW: Silty Sand and Gravel fill - Sand 30-50% very fine to coarse grained, well graded, angular to subangular. Fines 20-30% nonplastic, Gravel 20-50% subangular to well rounded, pebbles to 1.5" gravel, quartz, sandstone, limestone, andesite, slag, broken glass.


NOTES.
Soil Boring Log (continued)
Boring Number: MW-49

NOTES:
BGS - below ground surface

U.S.C.S. Soil Symbol and Lithology Description

GP: Sandy Gravel - Gravel 60% subangular to rounded, fine to 1", andesite, limestone, slag. Sand 30% very fine and coarse graded, gap graded, quartz, plagioclase, chert, dark grains. Pale Brown 10 YR 7/4, moist, no odor.

SW: Clayey Gravely Sand - Sand 60-90% very fine to coarse grained, well graded, angular to subangular, quartz, lithics, fining down. Fines 10-30% plastic sticky clay. Gravel 0 to 30% fine to 3/4 inch subangular to rounded, limestone, and dolostone. Pale Brown 10 YR 7/3.


GM: Sandy Gravel - Gravel 40-70% fine to 1 inch, angular to subangular, limestone, dolostone, mudstone. Sand 20 to 40% coarse and fine grained, gap graded, angular to subrounded, qtz, spar, limestone, andesite. Fines 10 to 40% plastic, wet. Pale Brown 10 yr 6/3. Diesel odor


SW: Sand - Sand fine to coarse grained, well graded coarsening down, angular to sub rounded.

LIMESTONE: Boulder - Limestone - Hard, brittle, Grey 10 YR 5/1

HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Hole Name: EP-54
Date Hole Started: 2/9/94 Date Hole Finished: 2/9/94

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: NW corner of Acid Plant

Recorded By: Wally Wilson
Drilling Company: GPI
Driller: Jose Landeros
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None

Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colluvial
Hole Diameter (in): 10 inch
Total Depth Drilled (ft): 80

WELL COMPLETION
Y/N DESCRIPTION INTERVAL
Well Installed? Y 2-inch, flush threaded, Sch 40, PVC 0 - 80 Feet
Surface Casing Used? Y 6 inch steel 42 - 2 Feet
Screen/Perforations? Y 0.020-inch slot, Sch 40 PVC 60 - 80 feet
Sand Pack? Y 10/20 silica Sand 56 - 80 Feet
Annular Seal? Y Bentonite Chips 0 - 56 Feet
Surface Seal? Y Bentonite Chips

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 69.25
Date: 5/98
MP Description: Top of PVC
MP Height Above or Below Ground (ft): 1.5

Surface Casing Height (ft): 2.0
Riser Height (ft): 1.5
Ground Surface Elevation (ft): 3765.87
MP Elevation (ft): 3787.37

Remarks:

WELL CONSTRUCTION

GEOLOGICAL DESCRIPTION

0.0 - 64.0' Gravely Sand
Gravel w/ SLAG crushed angular, gravel fine to coarse (slag), sand, fine to coarse (slag) black [Artificial Fill]

64.0 - 80.0' Clayey SAND
10 YR 6/3, pale brown, sand, fine to medium, quartz, clay soft, wet, medium dense, no sample recovery 65 - 70' [Alluvium]
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso
State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: Old Smelter Town

Recorded By: Wally Wilson
Drilling Company: GPI
Driller: J. Landeros
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Alluvial
Hole Diameter (in): 12-inch
Total Depth Drilled (ft): 30

WELL COMPLETION

<table>
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<tr>
<th>Description</th>
<th>Y/N</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>+1.6 - 20 feet</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>+2 - 3 feet</td>
</tr>
<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>10 - 20 feet</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>8 - 30 feet</td>
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<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>3 - 8 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>N</td>
<td>+.25 - 3 feet</td>
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</table>

DEVELOPMENT/SAMPLING

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Developed?</td>
</tr>
<tr>
<td>Water Samples Taken?</td>
</tr>
<tr>
<td>Boring Samples Taken?</td>
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</table>

Static Water Level Below MP: 13.20
Surface Casing Height (ft): 2.0
Date: 5/98
Riser Height (ft): 1.6
MP Description: Top of PVC
Ground Surface Elevation (ft): 1.6
MP Height Above or Below Ground (ft): 3728.37

Remarks: Monitoring well constructed through 8-inch ID hollow stem augers; all couplings are then flush threaded. Soil samples collected with 5-foot continuous split spoon sampler. Soil color notation (10 YR 5/4) based on Munsell Soil Color System. Head space analysis of soil samples performed by Micro-Tip organic vapor analyzer.

WELL CONSTRUCTION

GEOLOGICAL DESCRIPTION

0.0 - 3.0'
Gravel with Sand and Silt -10 YR 5/3, brown gravel 60%, fine to medium, subrounded, max dia 3/4; Sand 20%, fine to medium, moderately sorted; quartz and malic grains; fines 20%, silt, nonplastic; loose, dry.
[Alluvium]

3.0 - 12.2'
Sand -10 YR 5/2, grayish-brown sand 90%, fine to medium, moderately sorted; gravel 5%, fine, rounded, max dia 1/2, fines 5%, silt, very loose; moist to wet
[Alluvium]

12.5 - 16.0'
Clayey Sand -10 YR 5/2, grayish-brown sand 65%, fine to medium; fines 30%, clay soft and moderately plastic; gravel 5%, fine, rounded, max dia 1/2; loose, wet
[Alluvium]

16.0 - 17.5'
Fat Clay -10 YR 4/2, dark grayish-brown, fines 90%, clay firm, moderate to high plasticity; sand 10%, fine to medium, firm, wet
[Alluvium]

17.5 - 18.5'
Clayey Sand -10 YR 5/2, grayish-brown sand 65%, fine to medium; fines 30%, clay soft and moderately plastic; gravel 5%, fine, rounded, max dia 1/2; loose, wet
[Alluvium]

18.5 - 19.0'
Fat Clay -10 YR 4/2, dark grayish-brown, fines 90%, clay firm, moderate to high plasticity; sand 10%, fine to medium, firm, wet
[Alluvium]

19.0 - 30.0'
Clayey Sand -10 YR 5/2, grayish-brown sand 65%, fine to medium; fines 30%, clay soft and moderately plastic; gravel 5%, fine, rounded, max dia 1/2; loose, wet
[Alluvium]
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  
State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location:

Recorded By: WRW
Drilling Company: GPI
Driller: J. Landeros
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: NA
Hole Diameter (in): 12-inch
Total Depth Drilled (ft): 20

WELL COMPLETION

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>Y/N</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
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<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
<td>+1.6 - 17 feet</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>8-inch steel</td>
<td>+2 - 3 feet</td>
</tr>
<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>.02-inch slot SS</td>
<td>7 - 17 feet</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>10/20 silica sand</td>
<td>5 - 20 feet</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite Chips</td>
<td>3 - 5 feet</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Concrete</td>
<td>+.25 - .2 feet</td>
</tr>
</tbody>
</table>

DEVELOPMENT/SAMPLING

Well Developed? | N |
Water Samples Taken? | Y | Bailier |
Boring Samples Taken? | Y | Split Spoon |

Static Water Level Below MP: 10.73
Surface Casing Height (ft): 2.0
Date: 5/98
Riser Height (ft): 1.6
MP Description: Top of PVC
Ground Surface Elevation (ft): 3721.35
MP Height Above or Below Ground (ft): 1.6
MP Elevation (ft): 3722.95

Remarks: Free product detected prior to well construction. After construction, product level not measurable

---

WELL CONSTRUCTION

- 0.0 - 7.0'
  - 0.0 - 7.0': SAND with Gravel
  - 10 yr 5/3, brown, sand 80%, fine to coarse, poorly sorted, quartz grains; gravel 15%, fine to medium, subrounded, max. dia. 3/4" - inch; fines 5%, silt, nonplastic, very loose; dry.
    [Alluvium]

- 4 inch 0.02 slot SS

- 7.0 - 10.0'
  - 7.0 - 10.0': Clayey SAND
  - 10 YR 5/2, grayish brown, sand 70%, fine to medium; fines 25%, clay, soft, moderately plastic; gravel 5%, fine rounded, max. dia. 3/4" - inch; fines 5%, silt, nonplastic, very loose; dry.
    [Alluvium]

- 10.0 - 17.0'
  - 10.0 - 17.0': Fat CLAY with Sand
  - 10 YR 4/2, dark grayish brown lines 85%, clay, firm, moderate to high plasticity; sand 15%, fine to coarse; firm; wet - strong petroleum odor.
    [Alluvium]

- 17.0 - 20.0'
  - 17.0 - 20.0': Clayey SAND
  - 10 YR 5/2, grayish brown sand 65%, fine to medium; fines 35%, clay, soft, moderately plastic; loose; moist to wet.
    [Alluvium]
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Monitor Well Log
Hole Name: EP-67
Date Hole Started: 5/28/97  Date Hole Finished: 5/28/97

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: Truck Staging Area

Recorded By: Lairy Johnson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colluvial
Hole Diameter (in): 6 inch
Total Depth Drilled (ft): 59

WELL COMPLETION Y/N DESCRIPTION INTERVAL
Well Installed? Y 4-inch, flush threaded, Sch 40, PVC 0 - 57.3
Surface Casing Used? Y 6-inch steel +2.5 - 2.5 feet
Screen/Perforations? Y 4"Sch 40 PVC FT 20 slot 37.3 - 57.3
Sand Pack? Y 12-20 CSSI 34.2 - 57.3
Annular Seal? Y Bentonite Chips 9.5 - 34.2
Surface Seal? Y Grout 0 - 9.5 feet

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? Y XRF 5 foot intervals

Static Water Level Below MP: 41.72
Surface Casing Height (ft): 2.5
Date: 5/98
Riser Height (ft): 2.0
MP Description: Top of PVC
Ground Surface Elevation (ft): 3759.07
MP Height Above or Below Ground (ft): 2.0
MP Elevation (ft): 3761.07

Remarks: Samples were collected with a 2-inch-ID split spoon and grab samples

WELL CONSTRUCTION

GEOLOGICAL DESCRIPTION

0.0 - 6.0
Gravelly SAND -Grayish-brown (5YR 3/2) Fine to coarse gravel to 2 inches, dense. [Fill]
[Artificial Fill]

6.0 - 7.5
Silty SAND -Light brown (5YR 6/4) Fine grained, dense uniform.
[Aluvium]

7.5 - 9.0
SAND - Pale yellow brown (10YR 6/2) Fine to coarse grained, loose, some boulders.
[Aluvium]

9.0 - 18.0
Gravelly SAND - Pale yellow brown (10YR 6/2) Fine to coarse with boulders, composed of
limestone, quartzite or andesite.
[Aluvium]

18.0 - 47.0
GRAVEL. Grayish-orange (5YR 7/2) to very pale orange (10YR 8/2) 'Boulders and gravel of
fine-grained quartzite and andesite, moist. 'Cuttings are from andesite.' Water @ 45'.
[Aluvium]

34.2
10/20 Silica Sand

31.9
Bentonite pellets

37.3
0.020 Slot Screen

47.0 - 59.0
Andesite Boulders -Limestone and andesite (pulverized @ 47).
[Aluvium]

Bottom of Hole 59.0

Sheet 1 of 1
## WELL CONSTRUCTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 2.0</td>
<td>Medium Bentonite Chips</td>
</tr>
<tr>
<td>2.0</td>
<td>Concrete</td>
</tr>
<tr>
<td>62.0</td>
<td>Bottom of Hole</td>
</tr>
<tr>
<td>60.0</td>
<td>12/20 Silica Sand</td>
</tr>
<tr>
<td>0.020 Slot Screen</td>
<td></td>
</tr>
</tbody>
</table>

### GEOLOGICAL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 10.0</td>
<td>Silty, Gravely SAND - 15% silt, 15% gravel, 70% sand; reddish-brown (5YR 4/4), fine to medium-grained, quartzite, friable, moist. [Fill]</td>
</tr>
<tr>
<td>10.0 - 18.0</td>
<td>Sandy GRAVEL - 30% sand, 5% silt, 65% gravel; dark brown (10YR 4/3), medium to coarse, subangular to subrounded (max 2'), medium dense, moist. [Alluvium]</td>
</tr>
<tr>
<td>18.0 - 21.0</td>
<td>Gravely SAND - 20% gravel, 10% silt, 70% sand; yellowish-brown (10YR 5/4), line to medium-grained, gravel subrounded, medium dense, moist. [Alluvium]</td>
</tr>
<tr>
<td>21.0 - 25.0</td>
<td>CLAY - Dark yellowish-brown (10YR 4/4), hard, medium plasticity, small veins of gypsum, moist. [Alluvium]</td>
</tr>
<tr>
<td>25.0 - 28.0</td>
<td>Gravelly CLAY with Sand - 20% gravel, 10% sand, 70% clay; dark yellowish-brown (10YR 4/6), medium plasticity, firm; gravel line to medium-grained, subrounded (max 1'), sand medium to coarse, medium dense, moist. [Alluvium]</td>
</tr>
<tr>
<td>28.0 - 30.0</td>
<td>Gravelly SAND with Clay - 15% clay, 30% gravel, 55% sand; dark yellowish-brown (10YR 4/6), fine to coarse gravel, subangular to subrounded (max 1.5'), [Alluvium]</td>
</tr>
<tr>
<td>30.0 - 78.0</td>
<td>Clayey GRAVEL with Sand - yellow (10YR 7/8); gravel medium to coarse, subangular, igneous, andesite cobbles common; clay firm, low plasticity; sand fine to coarse, dense, moist to wet, andesite boulders common at bottom (48', 55', 68' and 79'). [Alluvium]</td>
</tr>
</tbody>
</table>

---

**HYDROMETRICS INC.**
Consulting Scientists and Engineers
Tucson, Arizona

**Monitor Well Log**

**Hole Name:** EP-68

**Date Hole Started:** 5/29/97  **Date Hole Finished:** 5/29/97

### WELL COMPLETION

<table>
<thead>
<tr>
<th>Description</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y/N</td>
<td>Well Installed?</td>
</tr>
<tr>
<td></td>
<td>Surface Casing Used?</td>
</tr>
<tr>
<td></td>
<td>Screen/Perforations?</td>
</tr>
<tr>
<td></td>
<td>Sand Pack?</td>
</tr>
<tr>
<td></td>
<td>Annular Seal?</td>
</tr>
<tr>
<td></td>
<td>Surface Seal?</td>
</tr>
</tbody>
</table>

### DEVELOPMENT/SAMPLING

- **Well Developed?** N
- **Water Samples Taken?** N
- **Boring Samples Taken?** N

**Static Water Level Below MP:** 63.1
**Surface Casing Height (ft):** 2.5
**Date:** 5/98
**Riser Height (ft):** 2.0
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3781.76
**MP Height Above or Below Ground (ft):** 2.0
**MP Elevation (ft):** 3783.76
# Well Log

**Hole Name:** EP-73  
**Client:** ASARCO, Inc.  
**Project:** Asarco El Paso Agreed Order RI  
**County:** El Paso  
**State:** Texas  
**Property Owner:** ASARCO, Inc.  
**Legal Description:** Asarco Plant  
**Descriptive Location:** East of Acid Plant 2  
**Recorded By:** Lary Johnson  
**Drilling Company:** Layne  
**Driller:** Neil Hale  
**Drilling Method:** Stratex  
**Purpose of Hole:** Monitor Well  
**Target Aquifer:** Alluvial/Colluvial  
**Hole Diameter (in):** 10 inch  
**Total Depth Drilled (ft):** 80  
**Date Started:** 6/1/97  
**Date Finished:** 6/1/97

## WELL COMPLETION

<table>
<thead>
<tr>
<th>DETAILS</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40 PVC</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>8 - inch steel</td>
</tr>
<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>4&quot; Sch 40 PVC FT 20 slot</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>12-20 CSSI</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite Chips</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Grout</td>
</tr>
<tr>
<td>DEVELOPMENT/SAMPLING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Developed?</td>
<td>Y</td>
<td>Submersible Pump</td>
</tr>
<tr>
<td>Water Samples Taken?</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Boring Samples Taken?</td>
<td>Y</td>
<td>XRF</td>
</tr>
<tr>
<td>Static Water Level Below MP:</td>
<td>71.10</td>
<td>Surface Casing Height (ft):</td>
</tr>
<tr>
<td>Date:</td>
<td>5/98</td>
<td>Riser Height (ft):</td>
</tr>
<tr>
<td>MP Description:</td>
<td>Top of PVC</td>
<td>Ground Surface Elevation (ft):</td>
</tr>
<tr>
<td>MP Height Above or Below Ground (ft):</td>
<td>2.0</td>
<td>MP Elevation (ft):</td>
</tr>
</tbody>
</table>

**Remarks:** Samples were collected with a 2-inch ID split spoon and grab samples

## WELL CONSTRUCTION

- 0.0 Cement Grout
- 8.4 Medium Bentonite Chips
- 57.8 13/20 Silica Sand
- 60.0 0.020 Slot Screen
- 60.0 Bottom of Hole

## GEOLOGICAL DESCRIPTION

- **0.0 - 15.0':** SLAG - concoidal fractures  
- **15.0 - 17.0':** CLAYEY GRAVEL - with sand, (10y5/0) brown, gravel 50% fine - coarse, angular-subangular, clay 30% mod plastic, soft sand 20% fine-coarse, loose, wet perched in slag on clayey soils (FILL)  
- **17.0 - 21.0':** SILTY SAND - with gravel, sand very fine - fine, silt 40%, gravel medium - coarse, subangular-subrounded, medium dense, moist  
- **21.0 - 45.0':** SLAG and GRAVEL - Slag 50%, gravel 30% medium-coarse, subangular, sand 10%, fine-medium, silt 10%, gravel quartzite, dry  
- **45.0 - 80.0':** GRAVELLY, SILTY SAND - (10y6/1), gray medium plasticity, low strength, friable, mottled orange and red, dry, interbedded with reddish brown to reddish, yellow quartzite, wet at 68 feet
**WELL CONSTRUCTION**

- 0.0: Cement Grout
- 10.0: Medium Bentonite Chips
- 31.1: 12/20 Silica Sand

**GEOLOGICAL DESCRIPTION**

- 0.0 - 23.0:
  - SLAG
  - Black (10YR 2/1)
  - Gravel-sized, angular, non-concordial fracturing; wet at 5', perched from adjacent pond
- [Fill] [Slag Fill]

- 23.0 - 25.0:
  - Sandy CLAY
  - 70% clay, 30% sand
  - Very dark gray (10YR 3/2)
  - Clay medium plasticity, soft; sand line, gravel (scarce) fine; saturated
  - [Alluvium]
  - [Alluvium]

- 25.0 - 41.0:
  - Sandy GRAVEL
  - 70% gravel, 30% sand
  - Dark brown (10YR 4/3)
  - Gravel line to coarse, subangular to subrounded, quartzite, andesite, limestone; sand medium to coarse, medium dense; dry to moist, cobbles and boulders at 30'
  - [Alluvium]

- 41.0 - 45.0:
  - Gravel
  - Gray (10YR 5/1)
  - Mudstone (very fine grain), dense, appears to be formation (?); water at 33.05'
  - [Alluvium]

**WELL COMPLETION**

- WELL COMPLETION: YES
- DESCRIPTION: 4-inch, flush threaded, Sch 40, PVC
- INTERVAL: 0 - 45 Feet
- Well Installed?: YES
- Surface Casing Used?: YES
- Screen/Perforations?: YES
- Sand Pack?: YES
- Annular Seal?: YES
- Surface Seal?: YES
- DEVELOPMENT/SAMPLING: WELL DEVELOPED?: YES
- Water Samples Taken?: NO
- Boring Samples Taken?: YES

**STATIC WATER LEVEL BELOW MP:** 33.05
**SURFACE CASING HEIGHT (FT):** 3.0
**DATE:** 5/98
**RISER HEIGHT (FT):** 2.5
**MP DESCRIPTION:** Top of PVC
**GROUND SURFACE ELEVATION (FT):** 3770.96
**MP HEIGHT ABOVE OR BELOW GROUND (FT):** 2.5
**MP ELEVATION (FT):** 3773.46
WELL CONSTRUCTION

0.0 Cement Grout
3.0 Medium Bentonite Chips
6.0 12/20 Silica Sand

GEODETICAL DESCRIPTION

0.0 - 5.0'
SLAG - (10 yr/2/1) black, gravel to cobble sized angular fragments of poured slag
[Silag Fill]

5.0 - 22.0'
Sandy CLAY - (10 yr/4/3) dark yellow brown, clay medium plasticity, firm, dry strength, firm, sand
[Silt Clay] [Alluvium]

22.0 - 26.0'
Sandy CLAY with gravel - (10 yr/4/3) dark yellow brown, clay medium plasticity, firm, high dry
strength, sand 20% medium-coarse, gravel 20% fine size rounded Quartzite and limestone
max. 1/2 inch, firm, moist. [Alluvium]

26.0 - 55.0'
Sandy GRAVEL - pale brown, gravel, fine-coarse, subrounded-subangular. Quartzite, Chert,
Andesite, sand fine-coarse, 30%, fines 5% silt, dense dry. [Alluvium]
WELL CONSTRUCTION

GEOLOGICAL DESCRIPTION

0.0 - 3.0'  
Gravelly SAND - 10 YR 3/3, Yellow sand, fine-medium, gravel 40% fine to coarse; rounded-subrounded, quartzite and dolomite, max 1 1/2", +3' about 1% in upper 2'. Fines 5% silt; medium dense, dry - moist at 3'  
[Alluvium]

3.0 - 8.0'
SAND - 10 YR 3/3 yellow brown, fine to medium-grained, gravel 5% fine to medium-grained, rounded, max diameter 1", loose; moist.  
[Alluvium]

8.0 - 21.0'
Clayey SAND - 10 YR 3/3 yellow brown, fine to coarse-grained; clay 40%, medium plasticity, soft; loose - soft; moist - saturated; 0.5 - 1" clay layers. Saturated @ 10'.  
[Alluvium]

21.0 - 24.0'
SAND - Gray, medium to coarse-grained; gravel <5%, fine to medium-grained, rounded; fines <5%, medium dense; saturated.  
[Alluvium]

24.0 - 26.5'
Clayey SAND - Dark gray, fine to medium-grained; clay 40%, nonplastic, soft; medium dense; saturated.  
[Alluvium]
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: Parker Bros. entrance
Recorded By: WR Wilson
Drilling Company: Layne
Driller: Rod
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colluvial
Hole Diameter (in): 9 inch
Total Depth Drilled (ft): 28
Remarks: Samples were collected with 2-inch ID split spoon and grab samples

WELL CONSTRUCTION

- Cement Grout: 0.0
- Medium Bentonite Chips: 3.0
- 12/20 Silica Sand: 9.0
- 0.010 Slot Screen: 11.0

Bottom of Hole: 28.0

GEOLOGICAL DESCRIPTION

0.0 - 4.0'
SLAG - mixed with gravelly clay and gravel-sized fragments of slag. [Slag Fill]

4.0 - 8.0'
Clayey SAND with gravel - Dark yellow brown sand, fine to coarse-grained; clay 40%, medium plasticity, soft; gravel 20%, fine to medium-grained, rounded, max 1", loose, medium dense; moist. [Alluvium]

8.0 - 15.0'
SAND - Dark yellow brown, fine to medium-grained; <10% fines; gravel 5%, fine-grained, medium dense, moist - saturated. Water @ 14'. [Alluvium]

15.0 - 28.0'
Clayey SAND - Dark yellow brown, fine to coarse-grained with clean coarse layers @ 0.5; clay 40%, medium plasticity, soft, high dry strength; gravel 5%, fine-grained, rounded; loose, medium dense, saturated. Sands heave @ 25'. [Alluvium]
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: E of Plant/ W of N10
South of Parker Brothers
Recorded By: Lairy Johnson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colliuvial
Hole Diameter (in): 9 inch
Total Depth Drilled (ft): 32

### WELL CONSTRUCTION

- **Medium Bentonite**: 0.0
- **Chips**:
- **12/20 Silica Sand**: 13.0
- **0.010 Slot Screen**: 15.0
- **Bottom of Hole**: 32.0

### GEOLOGICAL DESCRIPTION

0.0 - 32.0' Gravelly SAND - fine to coarse grained, gap graded, loose, gravel 1/4" to 8" dia., pale yellow brown (10yR6/2), dry, gravels volcanicx, andesite Rhyolite at 10 feet gravels are quartzite and limestone, wet at 20-1/2 feet, stopping at 30 feet no bedrock [Alluvium]

### WELL COMPLETION

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>Y/N</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
<td>0 - 30 feet</td>
</tr>
<tr>
<td>Surface Casing Used?</td>
<td>Y</td>
<td>8 - inch steel</td>
<td>+3.0 - 2.5 feet</td>
</tr>
<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>4&quot; Sch 40 PVC FT 20 slot</td>
<td>15 - 30</td>
</tr>
<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>12-20 CSSI</td>
<td>13 - 30</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite Chips</td>
<td>0 - 13</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Grout</td>
<td>0</td>
</tr>
</tbody>
</table>

### DEVELOPMENT/SAMPLING

<table>
<thead>
<tr>
<th>WELL DEVELOPED?</th>
<th>SUBMERSIBLE PUMP</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Submersible Pump</td>
<td>15 - 30 Feet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER SAMPLES TAKEN?</th>
<th>ZRF</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>XRF</td>
<td>5 foot intervals</td>
</tr>
</tbody>
</table>

**Static Water Level Below MP**: 16.92
**Surface Casing Height (ft)**: 3.0
**Riser Height (ft)**: 2.5
**Ground Surface Elevation (ft)**: 3771.15
**MP Height Above or Below Ground (ft)**: 2.5
**MP Elevation (ft)**: 3773.65
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: 200' North of # Bridge

Recorded By: Larry Johnson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colluvial
Hole Diameter (in): 9 inch
Total Depth Drilled (ft): 50

WELL COMPLETION  Y/N  DESCRIPTION  INTERVAL
Well Installed?  Y  4-inch, flush threaded, Sch 40, PVC  0 - 50 Feet
Surface Casing Used?  Y  8-inch steel  4.25 - 2 feet
Screen/Perforations?  Y  4*Sch 40 PVC FT 20 slot  35-50
Sand Pack?  Y  12-20 CSSI  32.4-50
Annular Seal?  Y  Bentonite Chips  10-20.4
Surface Seal?  Y  Grout  0 - 10 feet

DEVELOPMENT/SAMPLING
Well Developed?  Y  Submersible Pump  35 - 50 Feet
Water Samples Taken?  N
Boring Samples Taken?  Y  XRF  5 foot intervals

Static Water Level Below MP: 27.91  Surface Casing Height (ft): 2.5
Date: 5/98  Riser Height (ft): 2.0
MP Description: Top of PVC  Ground Surface Elevation (ft): 3801.73
MP Height Above or Below Ground (ft): 2.0  MP Elevation (ft): 3803.73

Remarks: Samples were collected with a 2-inch ID split spoon and grab samples

WELL CONSTRUCTION

GRAPHICS

GEological DESCRIPTION

0.0 - 7.0`
SLAG  black (5 YR 2/2)  - 10 YR 2/2
   [Slag Fill]

7.0 - 12.0`
SAND - fine to coarse  - 80 % fine mud dense, gap graded, some slag, grayish orange 10 YR 7/4 dry, slag not present after 9'
   [Alluvium]

12.0 - 21.0`
SAND - fine grained, loose uniform. moderate yellow brown 10YR 5/4, dry
   [Alluvium]

21.0 - 60.0`
Gravelly SAND - fine to coarse grained loose, gap graded, 10 YR 5/4 dry Gravel composed of Quartzite Very Pale Orange 10 YR 8/2 @ 39' Start seeing Andesite in the gravel moist @ 39
   1/2 water @ 44'
   [Alluvium]

Bottom of Hole  50.0'
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Hole Name: EP-84
Date Hole Started: 6/11/97  Date Hole Finished: 6/11/97

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: E of 110 1000'

Recorded By: WR Wilson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Coluval
Hole Diameter (in): 9 inch
Total Depth Drilled (ft): 20

WELL COMPLETION  Y/N  DESCRIPTION  INTERVAL
Well Installed?  Y  4-inch, flush threaded, Sch 40, PVC  0 - 13.5 Feet
Surface Casing Used?  Y  8 - inch steel  +3.5 - 2.0 feet
Screen/Perforations?  Y  4 Sch 40 PVC FT 20 slot  3.1/2 - 13 1/2
Sand Pack?  Y  12-20 CSSI  2.5 - 14
Annular Seal?  Y  Bentonite Chips  1.5 - 2.5
Surface Seal?  Y  Groat  0 - 1.5 feet

DEVELOPMENT/SAMPLING
Well Developed?  Y  Submersible Pump  3.5 - 13.5 Feet
Water Samples Taken?  N  
Boring Samples Taken?  Y  XRF  5 foot intervals

Static Water Level Below MP: 8.38
Surface Casing Height (ft): 3.5
Date: 5/98
Riser Height (ft): 3.0
MP Description: Top of PVC
Ground Surface Elevation (ft): 3794.52
MP Height Above or Below Ground (ft): 3.0
MP Elevation (ft): 3797.52

Remarks: Samples were collected with a 2-inch ID split spoon and grab samples

GEological DESCRIPTION

0.0 - 8.0'
SANDY GRAVEL -loose, gap graded, fine to coarse, all material is weathered andesite, moderate yellow brown 10YR 5/4, most at 1' H2O @ 6'  [Alluvium]

8.0 - 20.0'
Gravelly SAND -with cobbles and boulders, qtzite, cs, Andesite, turning day, some shale, possible pericline shale @ 14' > 2'  [Alluvium]

Sheet 1 of 1
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
Tucson, Arizona

**Monitor Well Log**

**Hole Name:** EP-90

**Date Hole Started:** 12/8/97  **Date Hole Finished:** 12/8/97

---

**Client:** ASARCO, Inc.

**Project:** Asarco El Paso Agreed Order Rt

**County:** El Paso  **State:** Texas

**Property Owner:** ASARCO, Inc.

**Legal Description:** Arco Plant

**Descriptive Location:** Lead Works

**Recorded By:** WR Wilson

**Drilling Company:** Layne

**Driller:** Neil Hale  **Drilling Method:** Stratex

**Drilling Fluids Used:** None

**Purpose of Hole:** Monitor Well

**Target Aquifer:** Alluvial/Colluvial

**Hole Diameter (in):** 10 inch  **Total Depth Drilled (ft):** 72

---

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y/N Y</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
<td>0 - 72 Feet</td>
</tr>
<tr>
<td></td>
<td>8 - inch steel</td>
<td>+2 - 2 feet</td>
</tr>
<tr>
<td></td>
<td>4&quot; Sch 40 PVC FT 20 slot</td>
<td>52 - 72 Feet</td>
</tr>
<tr>
<td></td>
<td>12-20 CSSI</td>
<td>50 - 72 Feet</td>
</tr>
<tr>
<td></td>
<td>Bentonite Chips</td>
<td>10 - 50</td>
</tr>
<tr>
<td></td>
<td>Grout</td>
<td>0 - 10 feet</td>
</tr>
</tbody>
</table>

**DEVELOPMENT/SAMPLING**

**Well Developed?** N

**Water Samples Taken?** N  **Boring Samples Taken?** N

---

**Static Water Level Below MP:** 52.55  **Surface Casing Height (ft):** 2.0

**Date:** 6/97  **Riser Height (ft):** -0.25

**MP Description:** Top of PVC  **Ground Surface Elevation (ft):** 3776.08

**MP Height Above or Below Ground (ft):** -0.25  **MP Elevation (ft):** 3777.83

---

**WELL CONSTRUCTION**

<table>
<thead>
<tr>
<th>GRAPHICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 2.0'</td>
</tr>
<tr>
<td><strong>CONCRETE</strong> - Concrete and brick under concrete</td>
</tr>
</tbody>
</table>

| 2.0 - 12.0' |
| **Clayey SAND with Gravel** -50% sand, 40% clay, 10% gravel |
| Yellow brown (10YR 5/4) |
| Sand fine to medium, clay medium plasticity, soft, gravel medium to coarse, subangular to subrounded, medium dense, moist, some slagg |

| 12.0 - 15.0' |
| **Gravelly SAND with Silt** -40% sand, 40% gravel, 20% silt |
| Pale brown (10YR 6/3) |
| Sand fine to medium, gravel fine to coarse, subangular to subrounded (max. 1'); silt dense, moist |

| 15.0 - 45.0' |
| **Sandy GRAVEL** -70% gravel, 30% sand |
| Pale brown (10YR 6/3) |
| Gravel fine to coarse, subangular up to cobble size; sand fine to coarse, dense, dry, quartz, andesite |

| 45.0 - 65.0' |
| **Sandy GRAVEL with Clay** - Dark yellowish-brown (10YR 4/4) |
| Gravel fine to coarse, subangular to subrounded, quartz, andesite, up to cobbles; sand fine to coarse, clay (15%) medium plasticity, soft, dense, moist (water at 60') |

| 65.0 - 71.0' |
| **SAND** -90% sand, 10% gravel, dark yellowish-brown (10YR 4/4), fine to coarse, subangular to subrounded, dense, wet |

| 69.0 - 71.0' |
| **ANDESITE** (Bedrock) |

---

**GEOLOGICAL DESCRIPTION**

**Remarks:**

---

**Sheet 1 of 1**
### DRILLING AND GEOTECHNICAL NOTES

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>NOTES</th>
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<tbody>
<tr>
<td>5</td>
<td>EP-93-A</td>
<td>SS</td>
<td>1.00</td>
<td>0.0 - 1.0'</td>
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<tr>
<td>5</td>
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<tr>
<td>5</td>
<td>EP-93-D</td>
<td>SS</td>
<td>1.00</td>
<td>3.0 - 4.0' Color Change</td>
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<td>10</td>
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<tr>
<td>15</td>
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<td>15.0 - 17.0'</td>
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</tr>
<tr>
<td>20</td>
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<td>20.0 - 22.0'</td>
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</tr>
<tr>
<td>25</td>
<td>EP-93-I</td>
<td>SS</td>
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<td>25.0 - 27.0'</td>
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</tr>
<tr>
<td>30</td>
<td>EP-93-J</td>
<td>SS</td>
<td>30.0 - 32.0'</td>
<td>30.5 - 32.5'</td>
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</tr>
<tr>
<td>30</td>
<td>EP-93-J2</td>
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<td>30.5 - 32.5'</td>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>45</td>
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<td>45.0 - 47.0'</td>
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</tr>
<tr>
<td>50</td>
<td>EP-93-N</td>
<td>SS</td>
<td>50.0 - 52.0'</td>
<td>H2O = 48'</td>
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</table>

### GEOLOGICAL DESCRIPTION

- **0.0 - 3.0' SAND, Silty**
  Pale yellowish brown, 10 YR 6/2, fine to medium grained, dry, medium dense, with some calcareous nodules.

- **3.0 - 25.0' SAND, Silty**
  Fine to medium grained, dark yellowish brown, 10 YR 4/2, dry, medium fill, dense with fine gravel and calcareous nodules - slag in sample (10 - 12 feet), burnt odor below 10 feet.

- **25.0 - 62.0' SAND, Silty**
  Fine grained, dense, clayey with depth, moderate yellowish brown, 10 YR 5/4, moist, natural soil.
Remedial Investigation Phase II

ASARCO, Inc.
El Paso, Texas

Initial boring 6.25 inches in diameter for sample collection. Hole reamed to 10.25 inches for installation of 4-inch diameter monitor well.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
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</thead>
<tbody>
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<td>SS</td>
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<td>0.0 - 1.0' A2 Duplicate; Steel Frag in Shoe</td>
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<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>EP-94-C</td>
<td>SS</td>
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<td>1.0 - 2.0'</td>
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</tr>
<tr>
<td>20</td>
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<td>SS</td>
<td>2.00</td>
<td>2.0 - 3.0'</td>
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<tr>
<td>25</td>
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<td>3.0 - 4.0' Diller No Sample</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>4.0 - 5.0' Rock in Shoe</td>
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</tr>
<tr>
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<td>EP-94-F</td>
<td>SS</td>
<td>0.10</td>
<td>10.0 - 12.0' Steel Frag in Shoe</td>
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</tr>
<tr>
<td>30</td>
<td>EP-94-G</td>
<td>SS</td>
<td>0.00</td>
<td>15.0 - 17.0' Sampler Refused</td>
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</tr>
<tr>
<td>35</td>
<td>EP-94-H</td>
<td>SS</td>
<td>1.00</td>
<td>20.0 - 22.0'</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>EP-94-I</td>
<td>SS</td>
<td>1.50</td>
<td>25.0 - 27.0'</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>EP-94-J</td>
<td>SS</td>
<td>1.50</td>
<td>30.0 - 32.0'</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>EP-94-K</td>
<td>SS</td>
<td>1.00</td>
<td>35.0 - 37.0'</td>
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</tr>
<tr>
<td>55</td>
<td>EP-94-L</td>
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<td>40.0 - 42.0' Rock in Shoe</td>
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</tr>
<tr>
<td>60</td>
<td>EP-94-M</td>
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<td>45.0 - 47.0' Rock in Shoe, Quarzite</td>
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<tr>
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<td>50.0 - 52.0'</td>
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</tr>
<tr>
<td>65</td>
<td>EP-94-O</td>
<td>SS</td>
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<td>55.0 - 57.0'</td>
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</table>

GEOLOGICAL DESCRIPTION

- **GRAVEL, Sandy**
  - 0.0 - 12.0' Fine to coarse grained, gap graded, loose, pale yellow brown, 10 YR 6/4, gravel - slag, crucibles, iron, andesite (Fill Material), dry, no odor, brick.

- **SAND**
  - 12.0 - 15.0' Fine to coarse grained, gap graded, loose, pale yellow brown, 10 YR 6/4, small gravel.

- **GRAVEL**
  - 15.0 - 24.0' Fine to coarse grained, gap graded, loose, pale yellow brown, 10 YR 6/4, dry, no odor.

- **SAND, Gravelly**
  - 24.0 - 43.0' Fine to coarse grained, medium dense, loose, gap graded, light brown, 5 YR 6/4, dry, no odor, some andesite sediment alternating layers.

- **GRAVEL, Sandy**
  - 43.0 - 65.0' Fine to coarse grained, gap graded, loose, pale yellow brown, 10 YR 6/2, andesite-quartzite gravels, dry, no odor, limestone.
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
El Paso, Texas

Client: ASARCO, Inc.
Project: Remedial Investigation Phase II
County: El Paso
Property Owner: ASARCO, Inc.
Legal Description: ASARCO El Paso Plant
Descriptive Location: East of I-10, center of North Arroyo

Drilling Company: Alliance Environmental
Driller: Oscar Medrano
Drilling Method: Sonic
Drilling Fluids Used: Water
Purpose of Hole: Install Well/Collect Soil Samples
Hole Diameter (in): 8
Total Depth Drilled (ft): 67

Recorded By: H Kutz

Remarks: Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 4-inch diameter monitor well.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>EP-95A</td>
<td>CONT</td>
<td>1.00</td>
<td>0.0 - 1.0'</td>
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</tr>
<tr>
<td>5.0</td>
<td>EP-95B</td>
<td></td>
<td>1.00</td>
<td>1.0 - 2.0'</td>
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</tr>
<tr>
<td>10.0</td>
<td>EP-95C</td>
<td></td>
<td>1.00</td>
<td>2.0 - 3.0'</td>
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<tr>
<td>15.0</td>
<td>EP-95D</td>
<td></td>
<td>1.00</td>
<td>3.0 - 4.0'</td>
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<td>20.0</td>
<td>EP-95E</td>
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<td>1.00</td>
<td>4.0 - 5.0'</td>
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</tr>
<tr>
<td>25.0</td>
<td>EP-95F</td>
<td></td>
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<td>10.0 - 12.0'</td>
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</tr>
<tr>
<td>30.0</td>
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</tr>
<tr>
<td>35.0</td>
<td>EP-95F2</td>
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<td>15.0 - 17.0'</td>
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</tr>
<tr>
<td>40.0</td>
<td>EP-95H</td>
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<td>2.00</td>
<td>20.0 - 22.0'</td>
<td></td>
</tr>
<tr>
<td>45.0</td>
<td>EP-95I</td>
<td></td>
<td>2.00</td>
<td>25.0 - 27.0'</td>
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</tr>
<tr>
<td>50.0</td>
<td>EP-95J</td>
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<td>2.00</td>
<td>30.0 - 32.0'</td>
<td></td>
</tr>
<tr>
<td>55.0</td>
<td>EP-95K</td>
<td></td>
<td>2.00</td>
<td>35.0 - 37.0'</td>
<td></td>
</tr>
</tbody>
</table>

**GEOLOGICAL DESCRIPTION**

0.0 - 6.0' **SAND, Silty**
Fine grained, poorly graded, pale yellowish brown, 10 YR 6/2, medium dense, dry, no odor.

6.0 - 53.0' **GRAVEL, Sandy, Silty, Clayey**
Fine to coarse grained, moderate yellowish brown, 10 YR 5/4, with cobbles at various depths, very dense, dry to moist, no odor (Alluvium) -- with calcareous material -- moist to wet at 38 feet.

53.0 - 58.0' **SANDSTONE**
Highly cemented, fine grained, grayish orange, 10 YR 5/7.

58.0 - 67.0' **SANDSTONE**
Highly cemented, fine grained, medium gray, N5.
Client: ASARCO, Inc.
Project: Remedial Investigation Phase II
County: El Paso
State: Texas
Property Owner: ASARCO, Inc.
Legal Description: ASARCO El Paso Plant
Descriptive Location: East of I-10, center of South Arroyo, in pasture area

Recorded By: H Kutz

Remarks: Initial boring 6.25 inches in diameter for sample collection. Hole reamed to 10.25 inches for installation of 4-inch diameter monitor well.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 1.0'</td>
<td>EP-97-A</td>
<td>SS</td>
<td>0.0 - 1.0'</td>
<td>Orgamics.</td>
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</tr>
<tr>
<td>0.5 - 1.5'</td>
<td>EP-97-A1</td>
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<td>0.5 - 1.5'</td>
<td>Closest to the surface.</td>
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<tr>
<td>1.0 - 2.0'</td>
<td>EP-97-B</td>
<td>SS</td>
<td>1.0 - 2.0'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0 - 4.0'</td>
<td>SS</td>
<td>No Sample</td>
<td>3.0 - 4.0'</td>
<td>No Sample (3 1/2 H2O).</td>
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</tr>
<tr>
<td>4.0 - 5.0'</td>
<td>SS</td>
<td>No Sample</td>
<td>4.0 - 5.0'</td>
<td>No Sample (3 1/2 H2O).</td>
<td></td>
</tr>
</tbody>
</table>

GEOLOGICAL DESCRIPTION

0.0 - 0.2' Surface: Organic Peat
0.2 - 13.0' SAND, Silty, Clayey
Moderate yellowish brown, 10 YR 5/4, moist, soft, no odor. (Auger refusal at 13')
### DRILLING AND GEOFERENCEAL NOTES

<table>
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<tr>
<th>DEPTH (ft)</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>NOTES</th>
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</thead>
<tbody>
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<td>0.0 - 1.0</td>
<td>(Some Slag)</td>
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<td>Sonic Core</td>
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<tr>
<td>10.0 - 12.0</td>
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<td>Sonic Core</td>
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<tr>
<td>15.0 - 17.0</td>
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<td>20.0 - 22.0</td>
<td>EP-98-H</td>
<td>Sonic Core</td>
<td>1.00</td>
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<td></td>
</tr>
</tbody>
</table>

### GEOLOGICAL DESCRIPTION

- **0.0 - 2.0'** SAND, Silty
  - Fine to medium grained, moderate yellowish brown, 10YR 5/4, dry, no odor.

- **2.0 - 16.0'** SAND, Silty, Gravely
  - Fine to coarse grained, very pale orange, 10 YR 8/2, calcareous, with cobbles. (Alluvium)

- **16.0 - 27.0'** SAND, Clayey, Gravely
  - Fine grained, moderate yellowish brown, 10 YR 5/4, moist, no odor, with interbedded clay lenses.
HYDROMETRICS INC.
Consulting Scientists and Engineers
El Paso, Texas

Client: ASARCO, Inc.
Project: Remedial Investigation Phase II
County: El Paso
State: Texas
Property Owner: ASARCO, Inc.
Legal Description: ASARCO El Paso Plant
Descriptive Location: 125’ NW of North East corner of unloading building

Drilling Company: Alliance Environmental
Driller: Oscar Medrano
Drilling Method: Sonic
Drilling Fluids Used: Water
Purpose of Hole: Install Well/Collect Soil Samples
Hole Diameter (in): 8
Total Depth Drilled (ft): 77

Remarks: Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 4-inch diameter monitor well.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
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<td>0.0 - 1.0’</td>
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<tr>
<td>1.0</td>
<td>EP-105-B</td>
<td>Sonic Core</td>
<td>1.00</td>
<td>1.0 - 2.0’</td>
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<td>3.0 - 4.0’</td>
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<td>EP-105-E</td>
<td>Sonic Core</td>
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<td>4.0 - 5.0’</td>
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<td>10.0 - 12.0’</td>
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<tr>
<td>15.0</td>
<td>EP-105-G</td>
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<td>1.00</td>
<td>15.0 - 17.0’</td>
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</tr>
<tr>
<td>20.0</td>
<td>EP-105-H</td>
<td>Sonic Core</td>
<td>1.00</td>
<td>20.0 - 22.0’</td>
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</tr>
<tr>
<td>25.0</td>
<td>EP-105-I</td>
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<td>1.00</td>
<td>25.0 - 27.0’</td>
<td></td>
</tr>
<tr>
<td>30.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GEOLOGICAL DESCRIPTION

0.0 - 2.0’ SAND, Gravelly, Silty
Loose, gap graded, very pale orange, 10 YR 8/2, dry, no odor.

2.0 - 3.5’ SAND, Gravelly, Silty
Silty sand with broken slag gravel and dark fines, loose, gap graded, medium gray, 5Y 6/1, to grayish orange pink, 5YR 7/2, dry, no odor.

2.5 - 4.0’ SLIME
Fine grained, greasy, with some pebbles, moderate greenish yellow, 10 YR 7/4, moist, no odor.

4.0 - 5.5’ SAND, Gravelly, Silty
Fine to medium grained, gap graded, loose, light olive gray, 5YR 6/2, dry, no odor.

5.5 - 9.0’ SLAG
Black, angular, fractured.

9.0 - 11.0’ CLAY
Plastic clay with a few pebbles, grayish brown, 5YR 3/2, moist, no odor.

11.0 - 17.0’ SAND, Gravelly
Medium to coarse grained, with clay lenses, loose, gap graded, pale yellowish brown, 10YR 6/2, dry, no odor.

17.0 - 21.0’ SILT, Clayey
Medium dense, non-plastic, moderate yellowish brown, 10YR 5/4, moist to dry, no odor.

21.0 - 77.0’ SAND, Silty, Gravelly
Fine to coarse grained, gap graded, with clayey silt lenses, loose to moderately dense, dark yellowish orange, 10YR 6/6, dry, no odor.
<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample Number</th>
<th>Sample Type</th>
<th>Blow Count</th>
<th>Recovery (feet)</th>
<th>Drilling and Geotechnical Notes</th>
<th>Geological Description</th>
<th>Graphics</th>
</tr>
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<tbody>
<tr>
<td>35</td>
<td>EP-105-J</td>
<td>Sonic Core</td>
<td>1.00</td>
<td>30.0 - 32.0'</td>
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<td>EP-105-N2</td>
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<td>50.5 - 52.5'</td>
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<td>60.0 - 62.0'</td>
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<tr>
<td>65</td>
<td>EP-105-Q</td>
<td>Sonic Core</td>
<td>1.00</td>
<td>65.0 - 67.0'</td>
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<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
<th>GRAPHICS</th>
<th>GEOLOGICAL DESCRIPTION</th>
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<tbody>
<tr>
<td>70</td>
<td></td>
<td>Sonic Core</td>
<td>1.00</td>
<td>70.0' - 72.0' 70' - 77 solid pebble conglomerate.</td>
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<tr>
<td>75</td>
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<td>Sonic Core</td>
<td>1.00</td>
<td>75.0' - 77.0' Stopped drilling and allowed water in hole to reach equilibrium.</td>
<td></td>
<td></td>
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</tbody>
</table>
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
El Paso, Texas

**Client:** ASARCO, Inc.
**Project:** Remedial Investigation Phase II
**County:** El Paso  
**State:** Texas
**Property Owner:** ASARCO, Inc.
**Legal Description:** ASARCO El Paso Plant
**Descriptive Location:** Centerline of ephemeral pond, approximately 400' E of railroad tracks
**Recorded By:** H Kutz

**Hole Name:** EP-108
**Date Hole Started:** 10/14/99  
**Date Hole Finished:** 10/14/99
**Drilling Company:** Alliance Environmental
**Driller:** Oscar Medrano
**Drilling Method:** Sonic
**Drilling Fluids Used:** Water
**Purpose of Hole:** Install Well/Collect Soil Samples
**Hole Diameter (in):** 8
**Total Depth Drilled (ft):** 42

**Remarks:** Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 4-inch diameter monitor well.

### DRILLING AND GEOTECHNICAL NOTES

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
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<tbody>
<tr>
<td>0.0</td>
<td>EP-108-A</td>
<td>CONT</td>
<td>2.00</td>
<td>10.0 - 12.0'</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>EP-108-B</td>
<td>CONT</td>
<td>1.00</td>
<td>15.0 - 16.0'</td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.0</td>
<td></td>
<td></td>
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</tr>
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<td></td>
<td></td>
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<tr>
<td>40.0</td>
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<td></td>
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</tr>
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</table>

**GEOLOGICAL DESCRIPTION**

- **0.0 - 2.0'** SLAG, Sandy
  - Fine grained, black.
- **2.0 - 10.0'** SLAG
  - Black, angular, fractured.
- **10.0 - 16.0'** SAND, Silty, Clayey
  - Dark yellowish orange, 10 YR 6/6, with coarse gravel, poorly graded, dry, no odor.
- **16.0 - 42.0'** GRAVEL, Sandy, Silty
  - Grayish orange, 10 YR 7/4, calcareous, dry, no odor. (Alluvium)
**HYDROMETRICS INC.**  
Consulting Scientists and Engineers  
El Paso, Texas

**Hole Name:** EP-109  
**Date Hole Started:** 10/15/99  **Date Hole Finished:** 10/15/99

**Client:** ASARCO, Inc.  
**Project:** Remedial Investigation Phase II  
**County:** El Paso  
**State:** Texas  
**Property Owner:** ASARCO, Inc.  
**Legal Description:** ASARCO El Paso Plant  
**Descriptive Location:** South of No. 9 gate roadway, 200' E of railroad tracks

**Drilling Company:** Alliance Environmental  
**Driller:** Oscar Medrano  
**Drilling Method:** Sonic  
**Drilling Fluids Used:** Water  
**Purpose of Hole:** Install Well/Collect Soil Samples  
**Hole Diameter (in):** 8  
**Total Depth Drilled (ft):** 42

**Remarks:** Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 4-inch diameter monitor well.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>EP-109-A</td>
<td>CONT</td>
<td>1.00</td>
<td>0.0 - 1.0'</td>
<td>Slag in Sample</td>
</tr>
<tr>
<td>0.0</td>
<td>EP-109-B</td>
<td>CONT</td>
<td>1.00</td>
<td>1.0 - 2.0'</td>
<td>Slag in Sample</td>
</tr>
<tr>
<td>0.0</td>
<td>EP-109-C</td>
<td>CONT</td>
<td>1.00</td>
<td>2.0 - 3.0'</td>
<td>Slag in Sample</td>
</tr>
<tr>
<td>0.0</td>
<td>EP-109-D</td>
<td>CONT</td>
<td>1.00</td>
<td>3.0 - 4.0'</td>
<td>Slag in Sample</td>
</tr>
<tr>
<td>0.0</td>
<td>EP-109-E</td>
<td>CONT</td>
<td>1.00</td>
<td>4.0 - 5.0'</td>
<td>Slag in Sample</td>
</tr>
<tr>
<td>10.0</td>
<td>EP-109-F</td>
<td>CONT</td>
<td>2.00</td>
<td>10.0 - 12.0'</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>EP-109-G</td>
<td>CONT</td>
<td>2.00</td>
<td>15.0 - 17.0'</td>
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<tr>
<td>20.0</td>
<td>EP-109-H</td>
<td>CONT</td>
<td>2.00</td>
<td>20.0 - 22.0'</td>
<td></td>
</tr>
<tr>
<td>20.5</td>
<td>EP-109-H2</td>
<td>CONT</td>
<td>2.00</td>
<td>20.5 - 22.5'</td>
<td></td>
</tr>
</tbody>
</table>

**GEOLOGICAL DESCRIPTION**

0.0 - 10.0' **SAND, Silty**  
Fine to medium grained, gravelly, poorly graded, moderate yellowish brown, 10 YR 5/4, dry, no odor, with slag, fine to coarse gravels.

10.0 - 12.0' **SAND, Silty**  
Fine grained, poorly graded, brown, 10 YR 5/4, dry, no odor, medium dense.

12.0 - 42.0' **GRAVEL, Sandy, Clayey**  
Fine to coarse grained, poorly graded, grayish orange, 10 YR 7/4, dry, no odor, (Alluvium) with andesite cobbles and boulders below 22 feet.
Remarks: Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 2-inch diameter monitor well.

**GEOLOGICAL DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
</table>
| 0.0 - 3.0' | EP-112-A | SS | 6 | 1.00 | SAND, Silty
Fine grained, pale yellowish brown, 10 YR 6/2, medium dense, dry to moist, no odor. |
| 3.0 - 20.0' | EP-112-B | SS | 8 | 1.00 | SAND
Fine to medium grained, brownish black, 5 YR 5/1, medium dense, moist, no odor, wet at 4 feet. |
| 20 - 25' | EP-112-C | SS | 6 | 2.0 - 3.0' |
| 25 - 30' | EP-112-D | SS | 7 | 3.0 - 4.0' |
| 30 - 35' | EP-112-E | SS | 7 | 4.0 - 5.0' |
Client: ASARCO, Inc.
Project: Remedial Investigation Phase II
County: El Paso
State: Texas
Property Owner: ASARCO, Inc.
Legal Description: ASARCO El Paso Plant
Descriptive Location: Front Slope, by railroad tracks, below Acid Mist Precipitator
Recorded By: H Kutz

Drilling Company: Alliance Environmental
Driller: Dave Hogan
Drilling Method: Hollow Stem Auger
Drilling Fluids Used: None
Purpose of Hole: Install Well/Collect Soil Samples
Hole Diameter (in): 10.25
Total Depth Drilled (ft): 29

Remarks: Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 2-inch diameter monitor well.

DEPTH | SAMPLE NUMBER | SAMPLE TYPE | BLOW COUNT | RECOVERY (feet) | DRILLING AND GEOTEchnical NOTES
--- | --- | --- | --- | --- | ---
| 0.0 | EP-114-A | | 1.00 | 2.5 - 3.5' |
| 5.0 | EP-114-B | | 1.00 | 3.5 - 4.5' |
| 10.0 | EP-114-C | | 1.00 | 4.5 - 5.5' |
| 15.0 | EP-114-D | | 2.00 | 10.0 - 12.0' |

GEOLOGICAL DESCRIPTION

0.0 - 2.5' SLAG
Black, angular, fractured.

2.5 - 29.0' SAND, Silty
Fine to medium grained, moderate yellowish brown, 10YR 5/4, dry, poorly graded, no odor, with some gravel, and interbedded clay lenses at various depths.

Diesel affected soil at 12 feet, water at 13 feet

Coarser gravel below 15 feet
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
El Paso, Texas

**Hole Name:** EP-119

**Client:** Asarco Inc
**Project:** Phase III Remediation Investigation
**County:** El Paso
**State:** Texas
**Property Owner:** Asarco Inc.
**Legal Description:** Investigation Area 5
**Descriptive Location:** NW corner of Smeltiertown

**Recorded By:** Matthew Miles
**Drilling Company:** Tierra Drilling & Envir. Svcs.
**Driller:** John McDuffee & Carlos Guerra
**Drilling Method:** Hollow Stem Auger w/ Split Spoons
**Drilling Fluids Used:** None

**Purpose of Hole:** Install Monitor Well
**Target Aquifer:** Shallow Alluvial
**Hole Diameter (in):** 11"
**Total Depth Drilled (ft):** 20

**WELL COMPLETION**

- **Well Installed?** Y
- **Surface Casing Used?** N
- **Screen/Perforations?** Y 0.02-inch slot, Sch 40 PVC
- **Sand Pack?** Y 10/20 Silica sand
- **Annular Seal?** Y Med bentonite chips
- **Surface Seal?** Y Concrete

**DEVELOPMENT/SAMPLING**

- **Well Developed?** Y Pumped 150 gals
- **Water Samples Taken?** N
- **Boring Samples Taken?** Y Split Spoon

---

**Static Water Level Below MP:** 10.23
**Date:** 4/2/01
**Riser Height (ft):** 3
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3723.09
**MP Height Above or Below Ground (ft):** +3
**MP Elevation (ft):** 3726.09

---

**Remarks:** All soil descriptions and size fraction distributions based on field observations and tests; Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

---

### DEPTH

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
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<tbody>
<tr>
<td>0.0 - 1.0'</td>
<td>EP-119A</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
</tr>
<tr>
<td>1.0 - 2.0'</td>
<td>EP-119B</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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<tr>
<td>2.0 - 3.0'</td>
<td>EP-119C</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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<tr>
<td>3.0 - 4.0'</td>
<td>EP-119D</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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<tr>
<td>4.0 - 5.0'</td>
<td>EP-119E</td>
<td>SS</td>
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<tr>
<td>10.0 - 11.0'</td>
<td>EP-119F</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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</table>

### GEOLOGICAL DESCRIPTION

- **0.0 - 2.0'**
  - Silty Gravelly SAND
  - Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, rounded to sub-rounded, 60% sand, quartz

- **2.0 - 3.0'**
  - Silty Clayey SAND
  - Dark yellowish brown 10YR4/2, fine grained, moist, no odor, rounded to sub-rounded, dense, 60% sand

- **3.0 - 5.0'**
  - SAND
  - Pale yellowish brown 10YR6/2, medium to coarse grained, moist, no odor, sub-angular to sub-rounded, loose, quartz and some feldspar

- **5.0 - 20.0'**
  - Silty clayey SAND
  - Pale yellowish brown 10YR6/2, fine grained, no odor, saturated at 10 ft, rounded to sub-rounded, quartz, feldspar

---

Sheet 1 of 1
Client: Asarco Inc.
Project: Phase III Remediation Investigation
County: El Paso
Property Owner: Asarco Inc.
Legal Description: Investigation Area 5
Descriptive Location: Arroyo W of ephemeral pond
Recorded By: Matthew Miles
Drilling Company: Tierra Drilling & Envir. Svcs.
Driller: John McDuffee & Carlos Guerra
Drilling Method: Hollow Stem Auger w/ Split Spoons
Purpose of Hole: Install Monitor Well
Target Aquifer: Shallow Alluvial
Hole Diameter (in): 11"
Total Depth Drilled (ft): 34
Remarks: All soil descriptions and size fraction distributions based on field observations and tests. Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

### WELL COMPLETION

<table>
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<th>WELL COMPLETION</th>
<th>Y/N</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
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<tbody>
<tr>
<td>Well Installed?</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
<td>0-13 ft bgs</td>
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<td>Surface Casing Used?</td>
<td>N</td>
<td>0.020-inch slot, Sch 40 PVC</td>
<td>13-33 ft bgs</td>
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<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>10/20 Silica sand</td>
<td>10-23 ft bgs</td>
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<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Bentonite chips/grout</td>
<td>1-8/10 ft bgs</td>
</tr>
<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Concrete</td>
<td>0-1 ft bgs</td>
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### DEVELOPMENT/SAMPLING

<table>
<thead>
<tr>
<th>DEVELOPMENT/SAMPLING</th>
<th>Well Developed?</th>
<th>Water Samples Taken?</th>
<th>Boring Samples Taken?</th>
<th>Static Water Level Below MP</th>
<th>Surface Casing Height (ft)</th>
<th>Riser Height (ft)</th>
<th>Ground Surface Elevation (ft)</th>
<th>MP Height Above or Below Ground (ft)</th>
<th>MP Elevation (ft)</th>
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<tr>
<td></td>
<td>Y</td>
<td>N</td>
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<td>3</td>
<td>3776.46</td>
<td>+3</td>
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### DRILLING AND GEOTECHNICAL NOTES

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<tr>
<th>DEPTH</th>
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<th>RECOVERY (need)</th>
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<td>5</td>
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<td>SS</td>
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<td>10</td>
<td>EP-120B</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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<td>15</td>
<td>EP-120C</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
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</tbody>
</table>

### GEOLOGICAL DESCRIPTION

#### 0.0 - 1.0 ft
- **Sand**
  - Black, angular, fractured
- **Slag Fill**
  - 1.0 - 5.0 ft
  - Sandy GRAVEL wifines
  - Pale yellowish brown 10YR6/2, to dark yellowish brown 10YR4/2, fine to coarse grained, moist, no odor, 60% gravel, 30% sand, 10% fines, 10-20% slag
- **Fill**
  - 5.5 - 25.0 ft
  - Sandy GRAVEL
  - Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, angular to rounded, quartzite, quartz, 70% gravel, 30% sand
- **Alluvium**
- **1.0 - 5.0 ft**
  - Sandy Gravelly CLAY
  - Pale yellowish brown 10YR6/2, fine to coarse grained, wet, no odor, low plasticity, dense, 60% clay, 20% gravel, angular, 20% sand, angular to sub-angular
  - **Alluvium**

Sheet 1 of 1
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
El Paso, Texas

**Hole Name:** EP-121

**Monitor Well Log**
Date Hole Started: 4/10/01
Date Hole Finished: 4/12/01

---

**Client:** Asarco Inc.
**Project:** Phase III Remediation Investigation
**County:** El Paso
**State:** Texas
**Property Owner:** Asarco Inc.
**Legal Description:** Investigation Area 5
**Descriptive Location:** Arroyo W of ephemeral pond

**Recorded By:** Matthew Miles
**Drilling Company:** Tierra Drilling & Envr. Svcs
**Driller:** John McDuffee & Carlos Guerra
**Drilling Method:** Hollow Stem Auger w/ Split Spoons
**Drilling Fluids Used:** None

**Purpose of Hole:** Install Monitor Well
**Target Aquifer:** Shallow Alluvial
**Hole Diameter (in):** 11"
**Total Depth Drilled (ft):** 27

**Remarks:** All soil descriptions and size fraction distributions based on field observations and tests. Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

---

**WELL COMPLETION**

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y/N</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
<td>7-12 ft bgs</td>
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<td>Surface Casing Used?</td>
<td>N</td>
<td>12-27 ft bgs</td>
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<tr>
<td>Screen/Perforations?</td>
<td>Y</td>
<td>0.020-inch slot, Sch 40 PVC</td>
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<tr>
<td>Sand Pack?</td>
<td>Y</td>
<td>Silica sand</td>
</tr>
<tr>
<td>Annular Seal?</td>
<td>Y</td>
<td>Med bentonite chips</td>
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<tr>
<td>Surface Seal?</td>
<td>Y</td>
<td>Concrete</td>
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</table>

**DEVELOPMENT/SAMPLING**

<table>
<thead>
<tr>
<th>DEVELOPMENT/SAMPLING</th>
<th>INTERVAL</th>
</tr>
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<tbody>
<tr>
<td>Well Developed?</td>
<td>Y Pumped 125 gals</td>
</tr>
<tr>
<td>Water Samples Taken?</td>
<td>N</td>
</tr>
<tr>
<td>Boring Samples Taken?</td>
<td>Y Split Spoon</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Static Water Level Below MP</th>
<th>Surface Casing Height (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.99</td>
<td>3</td>
</tr>
</tbody>
</table>

**Date:** 4/16/01
**Riser Height (ft):** 3
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3776.14
**MP Height Above or Below Ground (ft):** +3
**MP Elevation (ft):** 3779.14

---

**DEPTH**

<table>
<thead>
<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY (feet)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-121A</td>
<td>SS</td>
<td>1.00</td>
<td>10.0 - 11.0'</td>
</tr>
</tbody>
</table>

---

**GEOLICAL DESCRIPTION**

- **0.0 - 7.0'**
  - **SLAG**
  - Black, angular, fractured, dry, no odor.
  - [Slag Fill]

- **7.0 - 27.0'**
  - **Gravelly SAND**
  - Pale yellowish brown 10YR6/2, fine to coarse grained, moist, no odor,
    sub-angular to sub-rounded, dense, 60% sand, 35% gravel, 5% fines,
    pink rhyolite, yellow felspar.
  - [Aluvium]
### HYDROMETRICS INC.
Consulting Scientists and Engineers
El Paso, Texas

**Client:** Asarco Inc.
**Project:** Phase III Remediation Investigation
**County:** El Paso
**State:** Texas
**Property Owner:** Asarco Inc.
**Legal Description:** Investigation Area 5
**Descriptive Location:** West of Paisano, N of IBWC

**Recorded By:** Matthew Miles
**Drilling Company:** Tierra Drilling & Envir. Svcs
**Driller:** John McDuffee & Carlos Guerra
**Drilling Method:** Hollow Stem Auger w/ Split Spoons
**Drilling Fluids Used:** None
**Purpose of Hole:** Install Monitor Well
**Target Aquifer:** Shallow Alluvial
**Hole Diameter (in):** 11"
**Total Depth Drilled (ft):** 20

**WELL COMPLETION**
- **YN:**
- **DESCRIPTION:**
- **INTERVAL:**
  - Well Installed?: Y
  - 4-inch, flush threaded, Sch 40, PVC: 0-5 ft bgs
  - Surface Casing Used?: N
  - Screen/Perforations?: Y
    - 0.020-inch slot, Sch 40 PVC: 5-20 ft bgs
  - Sand Pack?: Y
    - 20/20 Silica sand: 3-20 ft bgs
  - Annular Seal?: Y
    - Med bentonite chips: 1-3 ft bgs
  - Surface Seal?: Y
    - Concrete: 0-1 ft bgs

**DEVELOPMENT/SAMPLING**
- **Well Developed?:** Y
- **Pumped 125 gals**
- **Water Samples Taken?:** N
- **Boring Samples Taken?:** Y
- **Split Spoon:** 0'-5' continuous

**Static Water Level Below MP:** 12.9
**Surface Casing Height (ft):** 3
**Date:** 5/4/01
**Riser Height (ft):** 3
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3724.59
**MP Height Above or Below Ground (ft):** +3
**MP Elevation (ft):** 3727.59

**Remarks:** All soil descriptions and size fraction distributions based on field observations and tests; Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

### DRILLING AND GEOTECHNICAL NOTES

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (wen)</th>
<th>DRILLING AND GEOTECHNICAL NOTES</th>
</tr>
</thead>
</table>
| EP-122A | SS | N/A | 1.00 | 0.0 - 1.0' | **0.0 - 5.0'**
| EP-122B | SS | N/A | 1.00 | 1.0 - 2.0' | Gravelly SAND w/fines
| Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, rounded to sub-rounded, quartz, feldspar, wood chunks, glass, bricks [Fill] |
| EP-122C | SS | N/A | 1.00 | 2.0 - 3.0' | 5.0 - 8.0'
| Gravelly SAND |
| Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, rounded to sub-rounded, quartz, chert, 20% gravel, 80% sand [Aluvium] |
| EP-122D | SS | N/A | 1.00 | 3.0 - 4.0' | 8.0 - 20.0'
| SAND w/fines |
| Pale yellowish brown 10YR6/2, fine grained, moist, no odor, rounded to sub-rounded, feldspar, quartz, coarser w/ depth, saturated at 10 ft, 85% sand, 15% fines. [Aluvium] |
| EP-122E | SS | N/A | 1.00 | 4.0 - 5.0' | |

Sheet 1 of 1
**Client:** Asarco Inc.  
**Project:** Phase III Remediation Investigation  
**County:** El Paso  
**State:** Texas  
**Property Owner:** Asarco Inc.  
**Legal Description:** Investigation Area 5  
**Descriptive Location:** North of ephemeral pond  
**Recorded By:** Matthew Miles  
**Drilling Company:** Tierra Drilling & Envir. Svs  
**Driller:** John McDuffee & Carlos Guerra  
**Drilling Method:** Hollow Stem Auger w/ Split Spoons  
**Drilling Fluids Used:** None  
**Purpose of Hole:** Install Monitor Well  
**Target Aquifer:** Shallow Alluvial  
**Hole Diameter (in):** 11"  
**Total Depth Drilled (ft):** 51  
**Remarks:** All soil descriptions and size fraction distributions based on field observations and tests; Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (cent)</th>
<th>NOTES</th>
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<tr>
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<tr>
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<td>21.0 - 22.0' EP-123A is a duplicate</td>
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<td>EP-123E</td>
<td>SS</td>
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<td>1.00</td>
<td>30.0 - 31.0' EP-123D</td>
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<tr>
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<td>EP-123F</td>
<td>SS</td>
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<td>35.0 - 36.0' EP-123E</td>
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<td>40.0 - 41.0' EP-123F</td>
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<td>40</td>
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<tr>
<td>55</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**WELL COMPLETION**
- **DESCRIPTION:** 4-inch, flush threaded, Sch 40, PVC
- **INTERVAL:** 0-30.5 ft bgs
- **Surface Casing Used?** Y
- **Screen/Perforations?** Y 0.020-inch slot, Sch 40 PVC
- **Sand Pack?** Y Silica sand
- **Annular Seal?** Y Bentonite chips/grout
- **Surface Seal?** Y Concrete
- **INTERVAL:** 30.5-50.5 ft bgs
- **INTERVAL:** 28.5-50.5 ft bgs
- **INTERVAL:** 1-20 5/26.5-28.5 ft bgs
- **INTERVAL:** 0-1 ft bgs

**DEVELOPMENT/SAMPLING**
- **INTERVAL:** Pumped 150 gals

**Static Water Level Below MP:** 43.17
**Surface Casing Height (ft):** 3
**Riser Height (ft):** 3
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3784.93
**MP Height Above or Below Ground (ft):** +3
**MP Elevation (ft):** 3787.93

**GEOLOGICAL DESCRIPTION**
- **0.0 - 0.5':** Crushed SLAG w/ fines
- **Black, angular, fractured, 85% Slag, 15% fines. [Slag Fill]**
- **0.5 - 21.0':** Gravelly SAND w/fines
- **Black fine grained, angular, dry, <5% slag gravel, <5% fines. [Slag Fill]**
- **21.0 - 22.0':** CLAY w/sand
- **Olive gray, moist, no odor, low to med plastic, med dense, <5% slag, roots, organics. [Fill]**
- **22.0 - 24.0':** CLAY
- **Pale yellowish brown 10YR6/2, moist, no odor, dense, med plastic. [Fill]**
- **24.0 - 31.0':** SAND w/fines
- **Pale yellowish brown 10YR6/2, moist, no odor, fine grained, Qtz, feldspar, 95% sand, <5% fines, 1' thick clay dense at 26.5'. [Alluvium]**
- **31.0 - 35.0':** Gravelly SAND
- **Pale yellowish brown 10YR6/2, moist, no odor, coarse grained, rounded to sub-rounded, med dense, 75% sand (Qtz), 25% gravel (limestone-chert). [Alluvium]**
- **35.0 - 51.0':** Sandy GRAVEL w/fines
- **Pale Yellowish brown 10YR6/2, dry, no odor, calcareous, 75% gravel, 20% sand, 5% fines. [Alluvium]**
**HYDROMETRICS INC.**  
Consulting Scientists and Engineers  
El Paso, Texas

**Hole Name: EP-124**  
Date Hole Started: 4/20/01  
Date Hole Finished: 4/21/01

Client: Asarco Inc.  
Project: Phase III Remediation Investigation  
County: El Paso  
State: Texas

Property Owner: Asarco Inc.  
Legal Description: Investigation Area 5  
Descriptive Location: SE of pond 6

Recorded By: Matthew Miles  
Drilling Company: Tierra Drilling & Envir. Svcs.  
Driller: John McDuffee & Carlos Guerra  
Drilling Method: Hollow Stem Auger w/ Split Spoons  
Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well  
Target Aquifer: Shallow Alluvial  
Hole Diameter (in): 11"  
Total Depth Drilled (ft): 41

Static Water Level Below MP: 34.4  
Surface Casing Height (ft): N/A  
Date: 5/8/01  
Riser Height (ft): Flush  
MP Description: Top of PVC  
Ground Surface Elevation (ft): 3774.56  
MP Height Above or Below Ground (ft): 0  
MP Elevation (ft): 3774.56

**REMARKS:** All soil descriptions and size fraction distributions based on field observations and tests.

**DEPT** | **SAMPLE NUMBER** | **SAMPLE TYPE** | **BLOW COUNT** | **RECOVERY (cm)** | **DRILLING AND GEOTECHNICAL NOTES**
---|---|---|---|---|---
5 | EP-124A | SS | 4.12 | 0.00 | 0.0 - 1.0'
5 | EP-124B | SS | 14.14 | 1.00 | 1.0 - 2.0'
5 | EP-124C | SS | 8.13 | 1.00 | 2.0 - 3.0'
5 | EP-124D | SS | 9.5 | 1.00 | 3.0 - 4.0'
5 | EP-124E | SS | 4.4 | 1.00 | 4.0 - 5.0'
10 | EP-124F | SS | 4.3 | 0.00 | 10.0 - 11.0'
15 | EP-124G | SS | 5.5 | 0.00 | 15.0 - 16.0'
20 | EP-124H | SS | 4.9 | 0.00 | 20.0 - 21.0'
25 | EP-124I | SS | 50.4 | 1.00 | 25.0 - 26.0'
30 | EP-124J | SS | 60.6 | 1.00 | 30.0 - 31.0'
35 | EP-124K | SS | 50.2 | 1.00 | 35.0 - 36.0'

**GEOLOGICAL DESCRIPTION**

0.0 - 1.0'  
Gravelly silty SAND  
Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, rounded to angular  
[Aluvium]

1.0 - 4.0'  
Gravelly SAND  
Pale yellowish brown 10YR6/2, medium to coarse grained, moist, no odor, rounded to sub-rounded, clean, quartz, 5-15% silt  
[Aluvium]

4.0 - 13.0'  
Gravelly silty SAND  
Dark yellowish brown 10YR4/2, fine to coarse grained, moist, no odor, angular to rounded, very loose, 10-15% silt (few cobbles)  
[Aluvium]

13.0 - 16.0'  
CLAY  
Dark gray N2, moist, no odor, soft, moderate plasticity, pockets of pale yellowish brown clay  
[Alluvium]

16.0 - 23.0'  
Gravelly SAND  
Pale yellowish brown 10YR6/2, medium to coarse grained, moist, no odor, rounded to sub-rounded, clean, quartz, chert  
[Alluvium]

23.0 - 41.0'  
Gravelly silty SAND  
Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, gap graded, angular to rounded, water at 38 ft  
[Alluvium]
# HYDROMETRICS INC.
Consulting Scientists and Engineers
El Paso, Texas

**Monitor Well Log**

**Hole Name: EP-125**

- **Client:** Asarco Inc.
- **Project:** Phase III Remediation Investigation
- **County:** El Paso
- **State:** Texas
- **Property Owner:** Asarco Inc.
- **Legal Description:** Investigation Area 5
- **Descriptive Location:** North of Bulk Acid Storage Area
- **Recorded By:** Matthew Miles
- **Drilling Company:** Tierra Drilling & Envir. Svcs.
- **Driller:** John McDuffee & Carlos Guerra
- **Drilling Method:** Hollow Stem Auger w/ Split Spoons
- **Purpose of Hole:** Install Monitor Well
- **Target Aquifer:** Shallow Alluvial
- **Hole Diameter (in.):** 11" 
- **Total Depth Drilled (ft):** 56

**Remarks:** All soil descriptions and size fraction distributions based on field observations and tests; Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

## WELL COMPLETION

<table>
<thead>
<tr>
<th>WELL COMPLETION</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
</tr>
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<tbody>
<tr>
<td>Y/N</td>
<td>Y</td>
<td>4-inch, flush threaded, Sch 40, PVC</td>
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<tr>
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<td>N</td>
<td>0-35 ft bgs</td>
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<td>Y</td>
<td>0.020-inch slot, Sch 40 PVC</td>
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<td>35-55 ft bgs</td>
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<tr>
<td></td>
<td>Y</td>
<td>Silica sand</td>
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<tr>
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<td>Y</td>
<td>33-55 ft bgs</td>
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<tr>
<td></td>
<td>Y</td>
<td>Med bentonite chips</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>1-33 ft bgs</td>
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<tr>
<td></td>
<td>Y</td>
<td>Concrete</td>
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<tr>
<td></td>
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<td>0-1 ft bgs</td>
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## DEVELOPMENT/SAMPLING

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<th>DEVELOPMENT/SAMPLING</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Pumped 100 gals</td>
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<tr>
<td>Pumped 100 gals</td>
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## SAMPLE COLLECTION

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<tr>
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<th>DEPTH</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (ft)</th>
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<td>EP-126B</td>
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<tr>
<td>EP-126J</td>
<td>50-55</td>
<td>SS</td>
<td>N/A</td>
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</table>

## GEOLOGICAL DESCRIPTION

- **0.0 - 2.0': Gravely silty SAND**
  - Pale yellowish brown 10YR5/2, fine to coarse grained, dry, no odor, rounded to angular, calcareous [Clay]
  - 2.0 - 5.0': SLAG
    - Black, angular fractured [Slate-Fill]
  - 5.0 - 14.0': Gravely SAND
    - Pale yellowish brown 10YR5/2, medium to coarse grained, dry, no odor, rounded to sub-rounded [Alluvium]
  - 14.0 - 18.0': Sandy gravely SILT
    - Medium yellowish brown 10YR5/4, moist, no odor, non plastic, dense, stiff [Alluvium]
  - 18.0 - 56.0': Gravely silty SAND
    - Medium yellowish brown 10YR5/4, fine to coarse grained, moist, no odor, angular, dense [Alluvium]
Client: Asarco Inc.
Project: Phase III Remediation Investigation
County: El Paso
State: Texas
Property Owner: Asarco Inc.
Legal Description: Investigation Area 5
Descriptive Location: North of IBWC pump house
Recorded By: Matthew Miles
Drilling Company: Tierra Drilling & Envir. Svcs.
Driller: John McDuffee & Carlos Guerra
Drilling Method: Hollow Stem Auger w/ Split Spoons
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Shallow Alluvial
Hole Diameter (in): 11"
Total Depth Drilled (ft): 20

Remarks: All soil descriptions and size fraction distributions based on field observations and tests. Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

DEPT

<table>
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<tr>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BOREHOLE CUT</th>
<th>RECOVERY (feet)</th>
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<tbody>
<tr>
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<td>1.00 0.0-1.0'</td>
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<tr>
<td>EP-126B</td>
<td>SS</td>
<td>N/A</td>
<td>1.00 1.0-2.0'</td>
</tr>
<tr>
<td>EP-126C</td>
<td>SS</td>
<td>N/A</td>
<td>1.00 2.0-3.0'</td>
</tr>
<tr>
<td>EP-126D</td>
<td>SS</td>
<td>N/A</td>
<td>1.00 3.0-4.0'</td>
</tr>
</tbody>
</table>

DRILLING AND GEOTECHNICAL NOTES

GEOLICAL DESCRIPTION

0.0 - 1.0'
Silty SAND
Pale yellowish brown 10YR6/2, dry, no odor, fine grained, rounded, roots, plants
(Aluvium)

1.0 - 3.0'
Silty Clayey SAND
Med yellowish brown 10YR5/4, moist, no odor, med to fine grained, rounded, med dense, roots
(Aluvium)

3.5 - 20.0'
SAND
Brownish gray 5YR4/1, wet, no odor, med to fine grained, clean, rounded, med dense, Qtz, some igneous
(Aluvium)

Sheet 1 of 1
Client: Asarco Inc.
Project: Phase III Remediation Investigation
County: El Paso
Property Owner: Asarco Inc.
Legal Description: Investigation Area 11
Descriptive Location: South arroyo East of I-10

Recorded By: Matthew Miles
Drilling Company: Tierra Drilling & Envir. Svcs.
Driller: John McDuffee & Carlos Guerra
Drilling Method: Hollow Stem Auger w/ Split Spoons
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Shallow Alluvial
Hole Diameter (in): 11"
Total Depth Drilled (ft): 40

Remarks: All soil descriptions and size fraction distributions based on field observations and tests. Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

**WELL COMPLETION**
- **Y/N**
- **DESCRIPTION**
- **INTERVAL**
  - Well Installed? Y
  - 4-inch, flush threaded, Sch 40, PVC
  - 0-15 ft bgs
  - Surface Casing Used? N
  - Screen/Perforations? Y
  - 0.02-inch slot, Sch 40 PVC
  - 15-35 ft bgs
  - Sand Pack? Y
  - Silica sand
  - 13-35 ft bgs
  - Annular Seal? Y
  - Bentonite chips/grout
  - 1-13 ft bgs
  - Surface Seal? Y
  - Concrete
  - 0-1 ft bgs

**DEVELOPMENT/SAMPLING**
- Well Developed? Y
- Pumped 175 gals
- Water Samples Taken? N
- Boring Samples Taken? Y
- Split Spoon
- 0-35' @ 5' interval

**Static Water Level Below MP:** 20.5
**Surface Casing Height (ft):** 3
**Date:** 5/3/01
**Riser Height (ft):** 3
**MP Description:** Top of PVC
**Ground Surface Elevation (ft):** 3810.99
**MP Height Above or Below Ground (ft):** +3
**MP Elevation (ft):** 3813.99

**DRILLING AND GEOTECHNICAL NOTES**

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
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<td>5</td>
<td>EP-129A</td>
<td>SS</td>
<td>N/A</td>
<td>1.00 0.0 - 1.0'</td>
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<tr>
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<td>EP-129B</td>
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<td>1.00 1.0 - 2.0'</td>
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<td>1.00 4.0 - 5.0'</td>
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**GEOLOGICAL DESCRIPTION**

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<th>DESCRIPTION</th>
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<tr>
<td>Gravelly Cobbly SAND</td>
<td></td>
</tr>
<tr>
<td>Med yellowish brown 10YR5/4, dry, no odor, fine to coarse grained, angular to rounded, roots, plants [Alluvium]</td>
<td></td>
</tr>
<tr>
<td>0.2 - 8.0'</td>
<td></td>
</tr>
<tr>
<td>Silty clayey SAND</td>
<td></td>
</tr>
<tr>
<td>Pale yellowish brown 10YR6/2, dry, no odor, fine to coarse grained, gap graded, mostly andesite hash, some limestone, loose, some cobbles [Alluvium]</td>
<td></td>
</tr>
<tr>
<td>8.0 - 13.0'</td>
<td></td>
</tr>
<tr>
<td>Sandy gravelly CLAY</td>
<td></td>
</tr>
<tr>
<td>Med yellowish brown 10YR5/4, moist, no odor, low plasticity, stiff [Alluvium]</td>
<td></td>
</tr>
<tr>
<td>13.0 - 40.0'</td>
<td></td>
</tr>
<tr>
<td>SHALE</td>
<td></td>
</tr>
<tr>
<td>Med bluish gray 5B5/1, dry, no odor, fissile, fractured, laminated, 70 degree dip, calcareous [Bedrock]</td>
<td></td>
</tr>
</tbody>
</table>
HYDROMETRICS INC.  
Consulting Scientists and Engineers  
El Paso, Texas

Client: Asarco Inc.  
Project: Phase III Remediation Investigation  
County: El Paso  
State: Texas  
Property Owner: Asarco Inc.  
Legal Description: Investigation Area 15  
Descriptive Location: South of Converter Bldg.

Recorded By: Alfonso Munoz, Angel Garcia  
Driller: John McDuffee & Carlos Guerra  
Drilling Method: Hollow Stem Auger w/ Split Spoon  
Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well  
Target Aquifer: Shallow Alluvial  
Hole Diameter (in): 10"  
Total Depth Drilled (ft): 72

Remarks: All soil descriptions and size fraction distributions based on field observations and tests. Drilled to depth with 6" OD augers then overdrilled with 10" OD augers.

WELL COMPLETION  
Y/N  DESCRIPTION  INTERVAL
Well Installed?  Y  4-inch, flush threaded, Sch 40, PVC  0-15 ft bgs
Surface Casing Used?  N  
Screen/Perforations?  Y  0.020-inch slot, Sch 40 PVC  50-70 ft bgs
Sand Pack?  Y  Silica sand  33-70 ft bgs
Annular Seal?  Y  Bentonite chips/grout  1-33 ft bgs
Surface Seal?  Y  Concrete  0-1 ft bgs

DEVELOPMENT/SAMPLING
Well Developed?  Y  Pumped 120 gals
Water Samples Taken?  N  
Boring Samples Taken?  Y  Split Spoon  0-5' @ 5' interval

Static Water Level Below MP: 54.3  
Surface Casing Height (ft): 3
Date: 5/30/01  
Riser Height (ft): 3
MP Description: Top of PVC  
Ground Surface Elevation (ft): 3775.98
MP Height Above or Below Ground (ft): +3  
MP Elevation (ft): 3778.98

GEOLICAL DESCRIPTION

**Silty SAND**  
Dark yellowish brown 10YR4/2, fine, dry, loose, silty, no odor, <10% slag

**SLAG**  
Black, angular, fractured  
(Slag F8)

**Gravely Silty SAND**  
Pale yellowish brown 10YR6/2, sub-angular gravel, andesite, moist, no odor, quartz, some volcanics (65%), water @ 54.3 ft

**SAND**  
Pale yellowish brown 10YR6/2, more coarse grained sand than above, less silt and gravel than above, gravel 10 - 20%.
# Soil Boring Log

**Boring Number:** MW-131  
**Project:** ASARCO - El Paso Smelter Site  
**Address:** 2301 W. Paisano Dr., El Paso, Texas

<table>
<thead>
<tr>
<th>Project Number: AZ001022.0003</th>
<th>Drilling Co.: Layne Christensen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Drilled: 7/30/04 - 7/31/04</td>
<td>Driller: Mike Boyle</td>
</tr>
<tr>
<td>Manager: Robert Mongrain</td>
<td>Drilling Method: ODEX</td>
</tr>
<tr>
<td>Logged by: Gordon Levin</td>
<td>Sample Method: Split Spoon</td>
</tr>
<tr>
<td>Checked by:</td>
<td>Ground Elevation:</td>
</tr>
<tr>
<td>Groundwater Encountered:</td>
<td>Degree Off Vertical: 0</td>
</tr>
<tr>
<td>Depth: NM</td>
<td>Hole Diameter: 7&quot;</td>
</tr>
<tr>
<td>Date: n/a</td>
<td>Total Depth: 90'</td>
</tr>
</tbody>
</table>

### U.S.C.S. Soil Symbol and Lithology Description

<table>
<thead>
<tr>
<th>Well Construction</th>
<th>Sample Interval</th>
<th>Drilling Notes</th>
<th>U.S.C.S. Pattern</th>
<th>NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3' Steel Completion with Locking Lid</td>
<td></td>
<td></td>
<td></td>
<td>BGS - below ground surface</td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10% Bentonite - Portland Cement Grout</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7' Diameter Borehole</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bentonite Chips Seal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **GW:** Gravel fill.
  - SLAG: Broken slag over poured slag fill material. Conoidal fracture, angular, microcrystalline, very dark grey 5Y 3/1. Penetrating 10 ft / 8 minutes.
- **VOID:** Lost circulation and drill dropped to 35' like a void.
- **SM:** Sand - Sand 80% fine to coarse grained, well graded, sub angular to well rounded, quartz, micas, feldspars. Finely 15% silty, plastic, moist. Gravel 5% 3/4", rounded, quartzite, mudstone, andesite, limestone. Brown 7.5 YR 5/4.
<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>48.2'</td>
<td>Bentonite Chips Seal</td>
</tr>
<tr>
<td>50'</td>
<td>Sand Pack - 8/12 Colorado Silica</td>
</tr>
<tr>
<td>70'</td>
<td>2&quot; Schedule 40 PVC 0.020 Slot Screen</td>
</tr>
<tr>
<td>72'</td>
<td>Bentonite Chips Seal</td>
</tr>
<tr>
<td>87'</td>
<td>Hole Cave In/Sluff Total Depth 90' bas</td>
</tr>
<tr>
<td>90'</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
- **BGS - below ground surface**
- **U.S.C.S. Soil Symbol and Lithology Description**

- **SW:** More gravel to 1 1/2 inches - quartzite, mudstone, limestone.
- **SM:** Silty Sand - Sand 80% fine and coarse grained, gap graded, angular to sub angular quartz, mica, lithics. Fines 15% nonplastic, Brown 7.5 YR 5/3, no odor.
- **ANDESITE:** Hit a cobble or boulder.
- **CL:** Clay - 90% plastic sticky, moist, Brown 7.5 YR, no odor.
- **CH:** Gravely Clay - fines 60% plastic sticky clay, Gravel 35% angular to subrounded fine to 1 1/4. Andesite and Limestone, sand 5% coarse like gravels. Dry and hard, no odor.
- **CH:** Clay - hard and dry.
- **SC:** Gravely Sand - Sand 75-85% coarse and fine grained, gap graded subangular to subrounded quartz, feldspar, dark minerals, lithics. Coarse 10-20% fine to 3/4" gravel, subangular to rounded, granite, limestone, mudstone, quartz, Fines 5-10% nonplastic, brown 7.5 YR 5/4, no odor.
Client: Asarco Inc.
Project: Phase III Remediation Investigation
County: El Paso
Property Owner: Asarco Inc.
Legal Description: Investigation Area '15
Descriptive Location: SE corner of Smelterville.

Recorded By: Angel Garcia
Drilling Company: Tierra Drilling & Envir. Svcs.
Driller: John McDuffee & Carlos Guerra
Drilling Method: Hollow Stem Auger w/ Split Spoons
Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well
Target Aquifer: Shallow Alluvial
Hole Diameter (in): 10
Total Depth Drilled (ft): 25

Remarks: All soil descriptions and size fraction distributions based on field observations and tests; Drilled to depth with 10” OD augers.

### WELL COMPLETION
- **Y/N**: Y
- **DESCRIPTION**: 4-inch, flush threaded, Sch 40, PVC
- **INTERVAL**: 0-5 ft bgs
- **Surface Casing Used?**: N
- **INTERVAL**: 5-25 ft bgs
- **Screen/Perforations?**: Y
- **INTERVAL**: 5-25 ft bgs
- **INTERVAL**: 1-5 ft bgs
- **Sand Pack?**: Y
- **INTERVAL**: 0-1 ft bgs
- **Annular Seal?**: Y
- **INTERVAL**: Concrete
- **INTERVAL**: Pumped 100 gals

### DEVELOPMENT/SAMPLING
- **INTERVAL**: 0-5’ @ 5’ interval
- **DATE**: 6/04/01
- **Riser Height (ft)**: 3
- **MP Description**: Top of PVC
- **MP Height Above or Below Ground (ft)**: +3
- **Ground Surface Elevation (ft)**: 3721.69
- **MP Casing Height (ft)**: 3
- **Static Water Level Below MP**: 7

### DRILLING AND GEOTECHNICAL NOTES

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (feet)</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>EP-132A</td>
<td>SS</td>
<td>N/A</td>
<td>0.50</td>
<td>0.0 - 1.0'</td>
</tr>
<tr>
<td>5</td>
<td>EP-132B</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
<td>1.0 - 2.0'</td>
</tr>
<tr>
<td>5</td>
<td>EP-132C</td>
<td>SS</td>
<td>N/A</td>
<td>2.00</td>
<td>2.0 - 3.0'</td>
</tr>
<tr>
<td>5</td>
<td>EP-132D</td>
<td>SS</td>
<td>N/A</td>
<td>3.75</td>
<td>3.0 - 4.0'</td>
</tr>
<tr>
<td>5</td>
<td>EP-132E</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
<td>4.0 - 5.0'</td>
</tr>
<tr>
<td>10</td>
<td>EP-132F</td>
<td>SS</td>
<td>N/A</td>
<td>0.40</td>
<td>10.0 - 11.0'</td>
</tr>
<tr>
<td>15</td>
<td>EP-132G</td>
<td>SS</td>
<td>N/A</td>
<td>1.00</td>
<td>15.0 - 16.0'</td>
</tr>
</tbody>
</table>

### GEOLOGICAL DESCRIPTION
- **0.0 - 1.0’**: Gravely SAND
- Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, subrounded, wood chunks, debris
- **1.0 - 3.0’**: Gravely SAND
- Pale yellowish brown 10YR6/2, fine to coarse grained, dry, no odor, subrounded.

- **3.0 - 7.0’**: Gravely SAND
- Pale yellowish brown 10YR5/4, fine to coarse grained, moist, no odor, subrounded.
- **7.0 - 15.0’**: Gravely SAND
- Pale yellowish brown 10YR5/4, fine to coarse grained, wet, water @ 7 ft, no odor, subrounded.
- **15.0 - 25.0’**: Sandy CLAY
- Medium yellowish brown 10YR5/4, wet, no odor, high plasticity, soft.
**Soil Boring Log**

**Boring Number:** MW-132S

**Project:** ASARCO - El Paso Smelter Site

**Address:**

**Project Number:** AZ001022.0003

**Date Drilled:** 7/27/04

**Manager:** Robert Mongrain

**Logged by:** Gordon Levin

**Checked by:**

**Groundwater Encountered:**

**Depth:** NM

**Time:** n/a

**Date:** n/a

**Drilling Co.:** Layne Christensen

**Driller:** Rod Michaels

**Drilling Method:** Hollow Stem Auger

**Sample Method:**

**Ground Elevation:**

**Degree Off Vertical:** 0

**Hole Diameter:** 10"

**Total Depth:** 29'

---

**3' Steel Completion with Locking Lid**

- **Cement**
- **Bentonite Seal**
- **7' Diameter Borehole**
- **Sand Pack - 10/20 Colorado Silica**
- **2' Schedule 40 PVC 0.020 Slot Screen**
- **Total Depth 29' bgs**

**Notes:**

**BGS - below ground surface**

---

**U.S.C.S Soil Symbol and Lithology Description**

**SM:** Silty Sand - Sand 55-70% very fine to medium grained, well graded, Fines 30-45% nonplastic, Reddish Brown 7.5 YR 5/3, slightly moist, slight odor. Gravelly for first 2 feet.

**SM:** Silty Sand - Sand 60-80% fine to coarse grained sand, well graded angular to subangular, quartz, lithics, andesite, Fine 20-40% nonplastic, grading coarsening down, no odor.

**ML:** Clayey Silt - Fines 100% slightly plastic, wet, Reddish Brown 7.5 YR 5/3, no odor.

**SW:** Sand - Sand 70-90% fine to coarse grained, angular to rounded, sand coarsens down, well graded to gap graded down, quartz, lithics, feldspars. Fines 30-10% nonplastic. Becomes very coarse grained, moist, no odor, with some pebbles.

**SM:** Same as above but fine to medium sand.
# Soil Boring Log

**Boring Number:** MW-132D  
**Project:** ASARCO - El Paso Smelter Site  
**Address:** 2301 W. Paisano Dr., El Paso, Texas

<table>
<thead>
<tr>
<th>Well Construction</th>
<th>Sample Interval</th>
<th>Drilling Notes</th>
<th>Depth (feet)</th>
<th>U.S.C.S. Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>3' Steel Completion with Locking Lid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bentonite Seal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7' Diameter Borehole</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
- BGS - below ground surface
- SM: Silty Sand - Sand 60-80% fine to coarse grained sand, well graded angular to subangular, quartz, lithics, andesite, Fines 20-40% nonplastic, grading coarsening down, no odor.
- ML: Clayey Silt - Fines 100% slightly plastic, wet, Reddish Brown 7.5 YR 5/3, no odor.
- SW: Sand - Sand 70-90% fine to coarse grained, subangular to rounded, coarsens down, well graded to gap graded down, quartz, feldsps, Fines 30-10% nonplastic. Becomes very coarse grained, moist, no odor, with some pebbles.
- SM: Same as above but fine to medium grained sand.
- SW: Sand - 90% medium to coarse grained, angular to subangular, subrounded, quartz, feldspar, mica. Fines 10% nonplastic, wet, no odor. Reddish Brown 7.5 YR 5/3.
Soil Boring Log (continued)
Boring Number: MW-132D

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NOTES: BGS - below ground surface</td>
</tr>
<tr>
<td>Bentonite Seal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57'</td>
<td>8/12</td>
<td></td>
<td></td>
<td>Sand Pack - 8/12</td>
</tr>
<tr>
<td>58.5'</td>
<td>Colorado silica</td>
<td></td>
<td></td>
<td>Total Depth 68.5' box</td>
</tr>
<tr>
<td></td>
<td>2' Schedule</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 PVC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.020 Slot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Screen</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SM: Silty Sand - Sand 80% fine to coarse grained, well graded, subangular to subrounded, fining downward, Fines, nonplastic, Reddish Brown 7.5 YR 5/3, wet, no odor.


SV: Gravelly Sand - medium to coarse grained sands and gravel, qtz, chert, sparr, andesite.

SM: Sand - Sand 60% fine to coarse grained, angular to subangular, fines 25% nonplastic silty, pebbles 15% andesite, chert, lithics, qtz, Yellowish Brown 10 YR 6/10.

SW: Gravelly Sand - Sand 55-70% coarse grained sand, angular to subangular, subrounded, quartz, feldspar, andesite, dark minerals, Gravel 30-45% pebbles to 3/4-inch, subangular to subrounded, wet no odor.

LIMESTONE: Microcrystalline, concoidal fracture, Grey 10GY 4/1, Bedrock.
Well Logs Not Currently Available for
WELL TEST ANALYSIS

Data Set: G:\...\EP-158.aqt
Date: 06/06/14
Time: 12:31:37

PROJECT INFORMATION

Company: ARCADIS
Client: Former ASARCO Smelter
Project: 06835001.2014
Location: El Paso, TX
Test Well: EP-158
Test Date: 6/2/2014

WELL DATA

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-158</td>
<td>374220.3</td>
<td>10664674.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-158</td>
<td>374220.3</td>
<td>10664674.5</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Unconfined

\[ T = 8.321 \text{ ft}^2/\text{day} \]

\[ K_z/K_r = 0.1 \]

Solution Method: Theis

\[ S = 0.06057 \]

\[ b = 14.11 \text{ ft} \]
WELL TEST ANALYSIS

Data Set: G:\..\EP-165.aqt
Date: 06/11/14
Time: 12:20:27

PROJECT INFORMATION

Company: ARCADIS
Client: Former ASARCO Smelter
Project: 06835001.2014
Location: El Paso, TX
Test Well: EP-165
Test Date: 5/30/2014

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (ft)</td>
</tr>
<tr>
<td>EP-165</td>
<td>374149.5</td>
</tr>
<tr>
<td>MW-131</td>
<td>374148.5</td>
</tr>
<tr>
<td>EP-167</td>
<td>374120.9</td>
</tr>
</tbody>
</table>

| Well Name     | X (ft)            | Y (ft)            |
|---------------|-------------------|
| EP-165        | 374149.5          | 10664665          |
| MW-131        | 374148.5          | 10664674          |
| EP-167        | 374120.9          | 10664643.45       |

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

\[
T = 725 \text{ ft}^2/\text{day} \\
K_z/K_r = 0.1 \\
S = 0.05 \\
b = 14.22 \text{ ft}
\]
WELL TEST ANALYSIS

Data Set: G:\...\EP-166.aqt
Date: 06/06/14
Time: 12:36:22

PROJECT INFORMATION

Company: ARCADIS
Client: Former ASARCO Smelter
Project: 06835001.2014
Location: El Paso, TX
Test Well: EP-166
Test Date: 5/29/2014

AQUIFER DATA

Saturated Thickness: 9.11 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (ft)</td>
</tr>
<tr>
<td>EP-166</td>
<td>374146.2</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

\[
T = 19.4 \text{ ft}^2/\text{day}
\]
\[
r(w) = 0.417 \text{ ft}
\]
\[
S = 0.06161
\]
\[
r(c) = 0.167 \text{ ft}
\]
WELL TEST ANALYSIS

Data Set: G:\\EP-167.aqt
Date: 06/06/14  Time: 12:34:31

PROJECT INFORMATION

Company: ARCADIS
Client: Former ASARCO Smelter
Project: 06835001.2014
Location: El Paso, TX
Test Well: EP-167
Test Date: 6/2/2014

WELL DATA

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-167</td>
<td>374120.9</td>
<td>10664643.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Name</th>
<th>X (ft)</th>
<th>Y (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP-167</td>
<td>374120.9</td>
<td>10664643.45</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

\[ T = 122.4 \text{ ft}^2/\text{day} \]

\[ S = 0.009511 \]

\[ \frac{K_z}{K_r} = 0.1 \]

\[ b = 10.73 \text{ ft} \]
Corrected Displacement (ft)

10.

1.

0.1

0.01
0.1

1.

10.

100.

1000.

Time (min)
CONSTANT-RATE PUMPING TEST AT MW-131
Data Set: G:\...\MW-131.aqt
Date: 04/18/13

Time: 14:33:32
PROJECT INFORMATION

Company: ARCADIS
Client: Former Asarco Smelter
Project: 006835001.2012
Location: El Paso, TX
Test Well: MW-131
Test Date: 03/28/2013
WELL DATA
Well Name
MW-131

Pumping Wells
X (ft)
0

Y (ft)
0

Well Name
MW-131
MW-158

Observation Wells
X (ft)
0
71.7

SOLUTION
Aquifer Model: Unconfined
T
= 539.2 ft2/day
Kz/Kr = 0.1

Solution Method: Theis
S
b

= 0.07
= 13. ft

Y (ft)
0
0


In accordance with the agreed upon scope of work, including modifications (Scope of Work for Monitoring Well Development Aquifer Testing and Well Abandonment Activities Replacement of American Canal Lining El Paso, Texas, Nov 14, 2012) URS conducted two aquifer pumping tests on June 24 through June 29, 2013 employing extraction wells EX-4 and EX-8 (Figure 1), which were installed by ASARCO in 2008 along the Upper and Middle reaches of the American Canal. This memorandum presents the testing methodology and test results of these aquifer pumping tests along with a preliminary estimate of the volume of water that could be produced on a daily basis during construction dewatering. Alternative construction dewatering schemes and evaluation of the effectiveness of potential engineering solutions for reducing groundwater flow into construction excavations are not discussed in this memorandum.

Groundwater in the test area generally flows from north, where surface runoff infiltrates and recharges the alluvial aquifer along the base of the Franklin Mountains, to the south, where groundwater discharges to the alluvial sediments of the Rio Grande River. Fractured bedrock underlies the alluvial material but does not substantively contribute to the groundwater flow (Groundwater Model Update Report, ASARCO, LLC El Paso Smelter Site, Arcadis, 2009). The thickness and hydraulic conductivity of the alluvial material overlying the fractured bedrock are the primary controls to the quantity and velocity of groundwater flow. Buried stream channels consisting of coarser grained material with a high hydraulic conductivity are a primary concern for construction dewatering. One aspect of this aquifer test was to evaluate the difference between groundwater flow through alluvial material consisting of dense sand and clay with some gravel in the vicinity of EX-8, and coarser grained well graded sand and gravel that more closely represents conditions expected in buried channels, which occur in the vicinity of EX-4. Both production wells penetrated approximately the same thickness of unconsolidated material, which overlies fractured bedrock at an approximate depth of 80 feet below the surface, and pre-test groundwater levels were similar in both wells.
Testing Methodology and Results

A fundamental assumption of the mathematical equations used to predict the hydraulic properties of porous material is that a constant rate of laminar flow through the aquifer over time must be achieved for the results to be valid. To achieve this over a large enough area to measure the hydraulic properties of the subsurface materials below the water table along the canal alignment an aquifer pumping test must be performed at a sufficient production rate and for sufficient time to be able to measure declines in groundwater level resulting from pumping over the area of interest.

URS installed two piezometers, identified as EX-4-10 and EX-4-25 on Figure 2, in June 2013. These piezometers and existing monitoring wells were used to observe groundwater drawdown and recovery during and after the aquifer pumping tests. Logs and well completion schedules of these piezometers are presented in Attachment A to this memorandum, along with logs and well completion schedules of the two production wells EX-4 and EX-8.

Each aquifer pumping test consisted of two separate test elements. Initially a separate step-drawdown test (SDT) was conducted at EX-4 and EX-8 to determine the maximum sustainable pumping yield from the aquifer at each extraction well. Following the SDT a constant-discharge test (CDT) was conducted at each well.

The SDT is used to evaluate head losses during operation of a pumping well. During our SDT each extraction well was pumped at an initial discharge rate for a specific time interval, and then at successively higher discharge rates during additional time intervals or “steps.” Water levels were measured using an electronic pressure transducer and a data-logger in each pumping well for the duration of each new time step. Each individual time step lasted approximately 20 to 30 minutes. The specific pumping rates and time intervals are depicted in drawdown-versus-time graphs presented in Attachment B. Following each SDT the extraction wells were allowed to recover to their pre-test groundwater levels.

Following completion of the SDT and recovery of the extraction well, a CDT was performed in extraction wells EX-4 and EX-8. The CDT was conducted for a period of 6 hours for EX-4 and 15 hours for EX-8 hours. All water (approximately 80,000 gallons at EX-4 and 10,000 gallons at EX-8) was discharged to temporary storage tanks. The basic principle of a CDT is that groundwater is extracted at a constant-rate, near the maximum pumping rate of the sustained safe yield of the well, for a long enough period of time.
such that a stabilized cone of depression is created surrounding the extraction well. Measurements of the
drawdown in the pumping well and selected observation wells at known distances from the pumping well
are made and these data can be used to estimate the hydraulic properties of the aquifer penetrated by the
pumping well. The observation wells for production well EX-4 were EX-4-10 and EX-4-25. The
observation wells for production well EX-8 were EP-44 and EP-45. The locations of all these wells are
shown in Figure 2.

Different pumping rates were used for EX-4 and EX-8. The pumping rates for EX-4 and EX-8 for the
CDT were 230 gpm and 3 gpm respectively. The durations of the pumping portion of the CDT was
limited based on storage volume capacity; however, for EX-4 and EX-8 were 6 and 15 hours respectively,
and the durations of the recovery portions of the CDT for EX-4 and EX-8 were approximately 12 and 12
hours respectively. Drawdown-versus-time graphs depicting the data collected during these two CDT’s
are presented in Attachment C.

Analysis of the pumping test data was completed using the computer program AQTESOLV (Duffield,
2007), which provided automatic test computations of two commonly used mathematical test solutions:
(1) the Theis type-curve method (Theis, 1935) and (2) Cooper-Jacob straight line method (Cooper and
Jacob, 1946). For both CDT’s the extraction wells were assumed to be partially penetrating and the
aquifer was assumed to be unconfined. Note that the calculations do not provide unique solutions and
parameter results are likely to be within a range of values. No constant head or impermeable boundary
conditions were identified during either CDT.

The chemistry of several groundwater samples collected during the aquifer test was evaluated. Appendix
D contains the results of the analytical tests performed. Results were similar to previous groundwater
samples collected and analyzed as part of the long term environmental monitoring of the site.

Estimate of Construction Dewatering Production

Arcadis has prepared a groundwater flow model of the project site based on existing geologic and
hydrogeologic data, and the results of two previous aquifer pumping tests in extraction wells located east
of Route 85 and the American Canal (Groundwater Model Report, ASARCO, LLC El Paso Smelter Site,
Arcadis, September 2007, and Groundwater Model Update Report, ASARCO, LLC El Paso Smelter Site,
Arcadis, November 2008). Along the entire length of the American Canal in the project study area
groundwater is assumed to generally flow through unconsolidated sediments overlying bedrock from higher elevations east of the American Canal westward towards the Rio Grande River. However, buried stream channels, referred to as Historic Arroyo’s, create highly permeable pathways for groundwater flow through the unconsolidated sediments. These buried channels can yield substantial quantities of groundwater and present a challenge for dewatering construction excavations along the American Canal. Extraction wells EX-4 and EX-8 were located in areas that may be representative of buried stream channels. However, the thickness of sediments overlying bedrock in the vicinity of EX-8 is considerably less than the thickness of sediments overlying bedrock in the vicinity of EX-4. Thus, the quantities of groundwater extracted to dewater construction excavations in the vicinity of EX-8 would be much less than dewatering requirements in the vicinity of EX-4.

Table 1 summarizes the results of the two aquifer pumping tests conducted by URS, two previous URS slug tests conducted in wells installed as part of the geotechnical evaluation and aquifer test information derived from the Arcadis groundwater flow model. Figure 3 depicts the locations of AB-3 and AB-8. Table 1 also includes estimates of groundwater pumping rates necessary for construction dewatering along various portions of the American Canal. In order to estimate the volumes needed to dewater the site, URS used an analytical model which incorporates the Theis (1935) aquifer equation to determine the drawdown radially from a pumping well once the transmissivity (T) and storativity (S) of the aquifer material has been determined from the CDT data. Estimates of flow rates assumed from the analytical groundwater model are also included for reference in Table 1

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Representative Area</th>
<th>Average Permeability (ft/d)</th>
<th>Estimated Pumping Rate to Dewater 25-foot section (gpm)¹</th>
<th>Estimated Pumping Rate to Dewater 500-foot section (gpm)¹</th>
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</thead>
<tbody>
<tr>
<td>EX-4</td>
<td>Upper Reach</td>
<td>154</td>
<td>230</td>
<td>4600</td>
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<td>EX-8</td>
<td>Middle Reach</td>
<td>3</td>
<td>10</td>
<td>200</td>
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<td>AB-3</td>
<td>Upper Reach</td>
<td>5</td>
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<td>160</td>
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<tr>
<td>AB-8</td>
<td>Lower Reach</td>
<td>15</td>
<td>30</td>
<td>600</td>
</tr>
<tr>
<td>ARCADIUS Model</td>
<td>U. &amp; M. Reaches</td>
<td>30</td>
<td>40</td>
<td>800</td>
</tr>
</tbody>
</table>

¹ Dewatering requirement based on achieving a minimum groundwater level of at least 3-feet below the centerline of the excavation base. The Theis analytical model was used to simulate drawdown necessary for dewatering.

The results presented in Table 1 suggest that extraction well EX-4 is located within a highly permeable buried stream channel and dewatering excavations that cross this type of hydrostratigraphy will generate
extremely large quantities of groundwater. Construction dewatering requirements for excavations along the Lower and Middle reaches will result in much more modest groundwater production. The ARCADIS groundwater model suggests hydraulic conductivities on the order of 30 ft/day across the Middle and Upper Reaches. Results of the URS aquifer pumping tests suggest that hydraulic conductivities along the Middle Reach are likely to be lower than those observed along the Lower Reach, and that hydraulic conductivities of portions of the Upper Reach have much higher hydraulic conductivities than previously measured or estimated.

Assuming that it will take 30 days to lower groundwater levels to their maximum depth below the base of the proposed excavations, Table 2 presents an estimate of the quantities of groundwater produced during a 30-day dewatering period for a 500-foot long excavation.

**Table 2. Estimate of groundwater produced during 30-day period of dewatering.**

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Representative Area</th>
<th>Estimate total volume of groundwater produced per 500-foot length of excavation (Mgal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX-4</td>
<td>Upper Reach</td>
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<td>EX-8</td>
<td>Middle Reach</td>
<td>8.6</td>
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<td>AB-3</td>
<td>Upper Reach</td>
<td>6.9</td>
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<td>AB-8</td>
<td>Lower Reach</td>
<td>25.9</td>
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<tr>
<td>ARCADIS Model</td>
<td>U. &amp; M. Reaches</td>
<td>34.5</td>
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</tbody>
</table>
Figures
Figure 1 Location of extraction wells, EX-4 and EX-8, and piezometers used for aquifer testing in 2013.
Figure 2. Potential location of buried stream channels and location of aquifer test wells.
Figure 3. Location of selected wells and borings and potential location of buried stream channels.
Attachment A

Piezometer Logs and Well Completion Diagrams
**Driller's Name:** Nacho Gutierrez

**Consultant Company:** URS Corporation

**Hammer Efficiency:**

**DATE COMPLETED:** 6/26/13

**DATE STARTED:** 6/26/13

**Groundwater Reading: During Drilling:**

**During Drilling (Date-Time):**

**Elevation, feet**

<table>
<thead>
<tr>
<th>Depth, feet</th>
<th>Material Graphs</th>
<th>Field Classification of Materials (Description)</th>
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</thead>
<tbody>
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<td>0</td>
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<td>Very stiff clay; brown; dry.</td>
</tr>
<tr>
<td>5</td>
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<td>Stiff; low plasticity clay with sand; brown; wet.</td>
</tr>
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<td>6</td>
<td>Groundwater level during drilling</td>
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<tr>
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<td></td>
<td>Loose; low plasticity sandy clay; brown; wet.</td>
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<tr>
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<td>Medium dense, well-graded sand; brown; wet.</td>
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</table>

**Blows per Foot**

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<th>Blows per Foot</th>
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<td>10</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
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</tbody>
</table>

**Remarks and Piezometer Installation Notes:**

- SPT Driller indicated that SPT was hitting concrete and suggested to move location 5' away. Move to different location because of presence of concrete.
- Bentonite chips Depth of top of screen = 4 ft
- Silica sand

**Geotechnical Evaluation:**

**Levee Geotechnical Evaluations**

**Channel / River Name / Feature:** Engineering Support Services

**GPS:** Latitude

**County:**

**Levee Station or Milepost:**

**Coordinates:** North

**LOG OF BORING**

**Borehole Location:** El Paso

**Sheet 1 of 4**
<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Material Description</th>
<th>Sample Location</th>
<th>Blows per 6 in.</th>
<th>Blows per Foot</th>
<th>PP or TV, tsf</th>
<th>Water Content, %</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>Fines, % &lt; #200</th>
<th>Remarks and Piezometer Installation Notes</th>
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8/9/2013

Borehole Location: El Paso
Coordinates: North: __________ East: __________
Levee Station or Milepost: __________
GPS: Latitude: __________ Longitude: __________
Channel / River Name / Feature: __________
County: __________

LOG OF BORING
EX-4-10
Sheet 2 of 4

Engineering Support Services
Levee Geotechnical Evaluations
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<th>Depth, feet</th>
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<th>Blows per Foot</th>
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<th>Liquid Limit, %</th>
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8/9/2013

Borehole Location: El Paso
Coordinates: North, East
Levee Station or Milepost:
GPS: Latitude, Longitude
Channel / River Name / Feature:
County:
**FIELD CLASSIFICATION OF MATERIALS**

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</table>

**Remarks and Piezometer Installation Notes**

Depth of bottom of screen = 74 ft

Depth of plug = 79 ft

Depth to rock = 79.5 ft

**8/9/2013**

LOG OF BORING

EX-4-10

Engineering Support Services
Levee Geotechnical Evaluations

<table>
<thead>
<tr>
<th>Borehole Location: El Paso</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Levee Station or Milepost:________</td>
</tr>
<tr>
<td>GPS: Latitude________ Longitude________</td>
</tr>
<tr>
<td>Channel / River Name / Feature:________</td>
</tr>
<tr>
<td>County:________</td>
</tr>
</tbody>
</table>
**DATE STARTED** 6/25/13  **DATE COMPLETED** 6/26/13  **GROUND ELEVATION**  **ELEVATION BASIS**  **TOTAL DEPTH OF BORING** 74.5 ft  
**DRILLING CONTRACTOR** American Exp.  **DRILLER’S NAME** Nacho Gutierrez  **HELPERS’ NAME**  **TOTAL DEPTH OF FILL**  
**DRILLING METHOD**  **DRILL RIG MAKE AND MODEL** CME-85  **CONSULTANT COMPANY** URS Corporation  
**DRILL BIT SIZE AND TYPE (HOLE DIAMETER)** 8.25 OD  **DRILLING ROD TYPE AND DIAMETER**  
**VERTICAL**  **INCLINED**  
**SAMPLER TYPE(S)**  
**BOREHOLE BACKFILL OR COMPLETION**  
**GROUNDWATER READING: DURING DRILLING** 6 ft from surface  **AFTER DRILLING (DATE-TIME)**  

**DATE COMPLETED** 6/26/13

<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Material Group</th>
<th>Description</th>
<th>Sample Location</th>
<th>Sample Number</th>
<th>Blows per 6 in.</th>
<th>Blows per Foot</th>
<th>PP or TV, lb f</th>
<th>Water Content, %</th>
<th>Plasticity Index</th>
<th>PIzometer Type</th>
<th>REMARKS AND PIEZOMETER INSTALLATION NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
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<td>Stiff clay, with some rock fragments; brown; dry.</td>
<td></td>
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<td></td>
<td></td>
<td>Bentonite chips</td>
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<td>1</td>
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<td>Very loose, fine-grained sand; light brown; wet.</td>
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<td>Depth of top of screen = 3.5 ft</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>Groundwater level during drilling</td>
<td></td>
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<td></td>
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<td>Silica sand</td>
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<tr>
<td>10</td>
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<td>Very loose, clayey sand; brown; wet.</td>
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<tr>
<td>15</td>
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<td>Dense, well-graded sand; brown; wet.</td>
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</tr>
</tbody>
</table>

**LOG OF BORING**

**EX-4-25**

**Sheet 1 of 4**

Borehole Location: El Paso  
Coordinates: North East  
Levee Station or Milepost:  
GPS: Latitude Longitude  
Channel / River Name / Feature:  
County:  

**8/9/2013**

**LOG OF BORING**

**EX-4-25**

**Sheet 1 of 4**

Engineering Support Services  
Levee Geotechnical Evaluations
<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Material Overview</th>
<th>Sample Location</th>
<th>Blows per Foot</th>
<th>Blows per 6 in.</th>
<th>PP or TV, tsf</th>
<th>Water Content %</th>
<th>Plasticity Index</th>
<th>Fines % &lt; 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td>Dense, well-graded sand; brown; wet.</td>
<td>8 13 7</td>
<td>20</td>
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</tr>
<tr>
<td>25</td>
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<td>Dense, well-graded sand; brown; wet.</td>
<td>8 15 16</td>
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<tr>
<td>30</td>
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<td>Dense, well-graded sand; brown; wet.</td>
<td>10 13 18</td>
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</tr>
<tr>
<td>35</td>
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<td>Very dense, clayey sand; brown; wet.</td>
<td>14 50/6&quot; 50/6&quot;</td>
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<tr>
<td>40</td>
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<td>Dense, clayey sand; brown; wet.</td>
<td>10 15 16</td>
<td>31</td>
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</tbody>
</table>

8/9/2013

Borehole Location: El Paso
Coordinates: North_________________________ East_________________________
Levee Station or Milepost:_________________________
GPS: Latitude_________________________ Longitude_________________________
Channel / River Name / Feature:_________________________
County:_________________________

LOG OF BORING
EX-4-25
Sheet 2 of 4

Engineering Support Services
Levee Geotechnical Evaluations
<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Material Description</th>
<th>Sample Location</th>
<th>Blows per 6 in.</th>
<th>Blows per Foot</th>
<th>LABORATORY DATA</th>
<th>REMARKS AND PIEZOMETER INSTALLATION NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
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<td>Very dense, clayey sand; dark brown wet.</td>
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<td>50</td>
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<td>Very dense, gravel with sand; wet.</td>
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<td>55</td>
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<td>Very dense, sand with gravel wet.</td>
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<td>60</td>
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<td>Very dense, sand with gravel wet.</td>
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<td>65</td>
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<td>Very dense, gravel with sand; wet.</td>
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<td>70</td>
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</tbody>
</table>

8/9/2013

Borehole Location: El Paso
Coordinates: North_________ East_________
Levee Station or Milepost:________________________
GPS: Latitude_________ Longitude_________
Channel / River Name / Feature:____________________
County:____________________

LOG OF BORING
EX-4-25
Engineering Support Services
Levee Geotechnical Evaluations
### FIELD CLASSIFICATION OF MATERIALS

<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Material Graphic</th>
<th>Description</th>
<th>Sample Location</th>
<th>Blows per 6 in.</th>
<th>Blows per Foot</th>
<th>PP or TV, %</th>
<th>Water Content, %</th>
<th>Plasticity Index</th>
<th>PP or TV, %</th>
<th>Fines, % &lt; #200</th>
<th>Laboratory Data</th>
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<td>Very dense, well-graded sand with gravel; brown; wet.</td>
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</tr>
</tbody>
</table>

**Remarks and Piezometer Installation Notes:**
- Depth of plug = 74 ft
- Depth of bottom of screen = 73.5 ft
- Depth to rock = 74.5 ft

8/9/2013
RECOVERY WELL NO. EX-4

**DEPTH, FT.**

**SAMPLE DESCRIPTION**

- ALLUVIUM: well graded sand, fine to coarse grained, with gravel and cobbles
- 58-75: coarse gravel with sand
- SHALE, gray, hard

**WELL DETAILS**

- Ground Level
- 6" SCH 80 PVC Casing
- CEMENT/BENTONITE GROUT
- BENTONITE SEAL
- 10/20 SILICA SAND

Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: EX-4
Site: EL PASO SMELTER  
Top of Casing Elevation: __________
Total Depth: 75' Casing Type & Size: 6" SCH 80 Slot Size: .020  
Drilling Method: ARCH  
Comments: SMELTEROWN  
Date Drilled: 7/25/08  
Logged by: C.T. IRWIN

ASARCO, INC.  
3201 W. PAISANO STREET  
EL PASO, TEXAS

RECOVERY WELL COMPLETION DETAIL  
FIGURE A-1
<table>
<thead>
<tr>
<th>Depth, FT.</th>
<th>Symbol</th>
<th>Sample Description</th>
<th>Sample No.</th>
<th>Sampling Interval</th>
<th>Moisture</th>
<th>Organic Vapour Conc. (PPM)</th>
<th>Stratigraphy</th>
<th>Water Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>SH</td>
<td>60: casing refusal petroleum odor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Final details:

Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: EX-8

Site: EL PASO SMELTER

Top of Casing Elevation: __________

Total Depth: 100'  
Casing Type & Size: 6" SCH 80  
Slot Size: 0.020"  
Drilling Method: ARCH

Comments: __________  
Date Drilled: 7/18/08

Driller: __________  
Logged by: C.T. IRWIN
Attachment B

Results of Step Drawdown Tests
EX-8 (SRT)

Total Depth - 102.20'
Static Water Level - 60.25'
Screen Interval - 65 to 95'
Pump Intake - 97'
Available drawdown - 30'

Drawdown (Feet)

Elapsed Time (Seconds)
EX-4 (SRT)

Total Depth - 76.95'
Static Water Level - 7.25
Screen Interval - 15 - 75'
Pump Intake - 68'
Available drawdown - 58'

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
Drawdown (Feet)

0 5 10 15 20 25 30 35

65 gpm
130 gpm
195 gpm
230 gpm

Elapsed Time (Seconds)
Attachment C

Results of Constant Discharge Test
EX-8 (CRT)
EX-4 (CRT)
Obs. Wells
- EX-4_PW
- EX-4_10
- EX-4_25

Aquifer Model
Unconfined

Solution
Cooper-Jacob

Parameters
\[ T = 6148.4 \text{ ft}^2/\text{day} \]
Adjusted Time (sec)
Corrected Displacement (ft)

Obs. Wells
+ EX-4_PW
○ EX-4_10
□ EX-4_25

Aquifer Model
Unconfined

Solution
Cooper-Jacob

Parameters
\[ T = 6148.4 \text{ ft}^2/\text{day} \]
Obs. Wells
- EX-8_PW
- EP-44
- EP-45

Aquifer Model
- Unconfined

Solution
- Neuman

Parameters
\[ T = 118. \text{ ft}^2/\text{day} \]
Attachment D

Laboratory Analysis of Groundwater Samples Collected During Aquifer Test
WELL TEST ANALYSIS

Data Set: G:\...\EX-9.aqt
Date: 08/01/13
Time: 12:44:11

PROJECT INFORMATION

Company: ARCADIS
Client: Asarco
Location: El Paso, TX
Test Well: EX-9
Test Date: 8/14/08

WELL DATA

<table>
<thead>
<tr>
<th>Pumping Wells</th>
<th>Observation Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Name</td>
<td>X (ft)</td>
</tr>
<tr>
<td>EX-9</td>
<td>0</td>
</tr>
</tbody>
</table>

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

\[
T = 0.02491 \text{ ft}^2/\text{min}
\]

\[
S = 0.001
\]

\[
b = 17. \text{ ft}
\]
Attachment 2

Geologic Cross Sections
2-1: Historic Geologic Cross Sections
2-2: 2012 Parker Brothers Arroyo Geologic Cross Sections
Attachment 2-1

Historic Geologic Cross Sections
LEGEND:
- Monitoring Wells
- Abandoned Monitoring Wells
- Soil Borings
- Historic Arroyo Trace Lines
- Property Boundary
- Historical Drainage Divide
- Cross-Section A-N

Existing Conditions:
- Asphalt Areas from Site Operations
- Category II Paved Areas
- Category II Areas to be paved
- Lined Landfill Cell
- Lined Stormwater Pond
- Buildings

FORMER EL PASO SMELTER SITE
EL PASO, TEXAS

PLAN VIEW - CROSS SECTION LAYOUT

FIGURE 2-1-1
NOTES:
1. NORTHING AND EASTING COORDINATES ARE TEXAS STATE PLANE, CENTRAL ZONE (NAD 83 DATUM) AND ARE IN U.S. SURVEY FEET.
2. ELEVATIONS ARE BASED ON NGS VERTICAL CONTROL MONUMENT Q460. RECORD ELEVATION IS 3738.19 (NAVD 88 DATUM).
3. MEASURING POINT FOR ALL WELLS IS TOP OF CASING ON THE NORTH SIDE.

DEFINITION:
AMSL = ABOVE MEAN SEA LEVEL
WL = WATER LEVEL

TOTAL ARSENIC CONCENTRATIONS IN GROUNDWATER

ARSENIC CONCENTRATION IN SOILS (mg/kg)

ARSENIC CONCENTRATION IN GROUNDWATER (mg/L)

TOTAL DEPTH OF BOREHOLE IN FEET BELOW GROUND SURFACE

VERTICAL SCALE IN FEET

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION (VE)=10x

LEGEND

SILT
SLAG
BASAL GRAVEL
SAND/GRavel
LOWER PERMEABILITY SAND/GRavel (SILTY, CLAYEY, CEMENTED)
CLAY
SHALE BEDROCK (MESILLA VALLEY FORMATION)
ELEVATION FEET (AMSL)

NOTES:
1. NORTHING AND EASTING COORDINATES ARE TEXAS STATE PLANE, CENTRAL ZONE (NAD 83 DATUM) AND ARE IN U.S. SURVEY FEET.
2. ELEVATIONS ARE BASED ON NGS VERTICAL CONTROL MONUMENT OAGM, RECORD ELEVATION IS 3738.15 (WAVY M DATUM).
3. MEASURING POINT FOR ALL WELLS IS TOP OF CASING ON THE NORTH SIDE.

TOTAL ARSENIC CONCENTRATIONS IN GROUNDWATER:
- ≤0.01 mg/L
- ≤0.01 mg/L
- ≤0.1 mg/L
- ≤1.0 mg/L
- >10 mg/L

EPA ARSENIC MAXIMUM CONTAMINANT LEVEL (MCL) ≤0.01 mg/L.

DEFINITION:
AMSL = ABOVE MEAN SEA LEVEL
HIGH WL = HISTORIC HIGH GROUNDWATER LEVEL
LOW WL = HISTORIC LOW GROUNDWATER LEVEL
WL = WATER LEVEL
BGS = BELOW GROUND SURFACE

LEGEND:
- KL-19 HYDRAULIC CONDUCTIVITY (D2) VALUE IN FEET/FOUNT
- LM-19 DEEP DEPTH OF BEDROCK IN FEET BELOW GROUND SURFACE
- TM-19 TOTAL DEPTH OF BEDROCK
- PAVEMENT AREAS
- SANDSTONE BEDROCK
- SHALE
- Siltstone Bedrock
- Sandstone Bedrock
- Conglomerate (PO RIG)
- Sand and Gravel
- Estimating Current Water Level
- Average High Water Level
- Average Low Water Level
- Trench
- Monitoring Network

CROSS-SECTION E-E'
NOTES:
1. NORTHING AND EASTING COORDINATES ARE TEXAS STATE PLANE, CENTRAL ZONE (NAD 83 DATUM) AND ARE IN U.S. SURVEY FEET.
2. ELEVATIONS ARE BASED ON NGS VERTICAL CONTROL MONUMENT 04655, RECORD ELEVATION IS 3778.19 (MAVD 83 DATUM).
3. MEASURING POINT FOR ALL WELLS IS TOP OF CASING ON THE NORTH SIDE.

DEFINITIONS:
AMS = ABOVE MEAN SEA LEVEL
HIGH WL = HISTORIC HIGH GROUNDWATER LEVEL
LOW WL = HISTORIC LOW GROUNDWATER LEVEL
W = WATER LEVEL
BGS = BELOW GROUND SURFACE

LEGEND:
TOTAL ARSENIC CONCENTRATIONS IN GROUNDWATER:
- <0.01 mg/L
- >0.01 mg/L
- >0.1 mg/L
- >1.0 mg/L
- >10 mg/L

EPA ARSENIC MAXIMUM CONTAMINANT LEVEL (MCL) = 0.05 mg/L
Attachment 2-2

2012 Parker Brothers Arroyo
Geologic Cross Sections
LEGEND:
- Interim Site Monitoring Well
- Abandoned Monitoring Well
- Property Boundary
- Historic Arroyo Trace Lines
- Historic Drainage Divide
- Bedrock

Total Arsenic Contours (mg/L), August - September 2011
- Water Level Contour (feet amsl)
- Cross Section Lines
- Approximate Parker Brothers Arroyo Saturated Thickness Extent
- Permeable Reactive Barrier (PRB; size exaggerated)
- Proposed Landfill Extent

Note:
- amsl - above mean sea level
- mg/L = milligrams per liter
- Arsenic Texas Risk Reduction Rule - Protective Concentration Limit (PCL) = 0.01 mg/L

FORMER EL PASO SMELTER SITE EL PASO, TEXAS FIELD DEMONSTRATION OF GROUNDWATER REMEDY IN PARKER BROTHERS ARROYO

PLAN OVERVIEW - PARKER BROTHERS ARROYO

FIGURE 2-2-1

Note: amsl - above mean sea level
mg/L = milligrams per liter
Arsenic Texas Risk Reduction Rule - Protective Concentration Limit (PCL) = 0.01 mg/L
NOTE:
1. ELEVATIONS ARE BASED ON NGS VERTICAL CONTROL MONUMENT CAMEL, RECORD ELEVATION IS 3708.79 (NAVD 88 DATUM).

LEGEND:

DEFINITIONS:

AVL. = ABOVE MEAN SEA LEVEL
GPM = GALLONS PER MINUTE
MPH = MILES PER HOUR
Ft² = SQUARE FEET
NAVD = NORTH AMERICAN VERTICAL DATUM
NGS = NATIONAL GEODETIC SURVEY
Attachment 3

Select Boring Logs
Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location: Approximately 1370' south of canal tunnel
Recorded By: AJH
Drilling Company: Layne
Driller: Gary
Drilling Method: Air Rotary
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 30

WELL COMPLETION Y/N DESCRIPTION INTERVAL
Well Installed? Y 4-inch, flush threaded, Sch 40, PVC 0 - 30 feet
Surface Casing Used? Y Manhole 0 - .25 feet
Screen/Perforations? Y 0.010-inch slot, Sch 40, PVC 0 - 30 feet
Sand Pack? Y 10/20 silica sand 0 - 30 feet
Annular Seal? Y Bentonite Chips 6 - 7 feet
Surface Seal? Y Bentonite/Cement Grout 0 - 6 feet

DEVELOPMENT/SAMPLING
Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 14.39
Surface Casing Height (ft): 0
Date: 5/98
Riser Height (ft): -0.25
MP Description: Top of PVC
Ground Surface Elevation (ft): 3724.8
MP Height Above or Below Ground (ft): -0.25
MP Elevation (ft): 3724.55

Remarks: Located in what appears to be an old arroyo channel, hole SPUD in fill material at 1230. High variable composition of rock fragments

WELL CONSTRUCTION

GRAPHICS

GEOPHYSICAL DESCRIPTION

0.0 - 7.0'
FILL - poorly sorted, angular to subrounded, calcareous gravel bearing less than 5% coarse sand

7.0 - 10.0'
SANDY GRAVEL - dry, light brown-orange, poorly sorted, calcareous, cuttings clay bearing, fine-coarse sandy gravel

10.0 - 16.0'
SANDY GRAVEL - dry (moist at 14%), yellowish-gray, matrix slightly calcareous, clayey, silty, very coarse sandy gravel

16.0 - 17.0'
SILTY SAND - yellowish-gray mostly non-calcareous, silty, very fine sand

17.0 - 30.0'
SILTY SAND - medium yellow-gray, fine to medium silty sand, 5% gravel fragments
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Hole Name: EP-25
Date Hole Started: 8/8/90  Date Hole Finished: 8/8/90

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso  State: Texas
Property Owner: ASARCO, Inc. Property
Legal Description: Asarco Plant
Descriptive Location:  Approx. 50 yards NE of "ASARCO" stack
Recorded By: MRW
Drilling Company: Layne
Driller: Art Rodriguez
Drilling Method: Percussion Hammer
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: NA
Hole Diameter (in):
Total Depth Drilled (ft): 70

WELL COMPLETION  INTERVAL
Y/N  DESCRIPTION
Well Installed?  Y  2-inch, flush threaded, Sch 40, PVC 0 - 70 feet
Surface Casing Used?  Y  Manhole
Screen/Perforations?  Y  0.010-inch slot, Sch 40, PVC 40 - 70 feet
Sand Pack?  Y  10/20 silica sand 36 - 70 feet
Annular Seal?  Y  Bentonite Chips 34 - 36 feet
Surface Seal?  Y  Cement Grout 0 - 34 feet

DEVELOPMENT/SAMPLING
Well Developed?  N
Water Samples Taken?  N
Boring Samples Taken?  N

Static Water Level Below MP: 47.88
Surface Casing Height (ft):
Date: 5/88
Riser Height (ft):
MP Description: Top of PVC
Ground Surface Elevation (ft):
MP Height Above or Below Ground (ft): MP Elevation (ft): 3786.72

Remarks: Hydrocarbon stained soils at 60' - 60.5'. Very little water after waiting 15 minutes. Let hole sit overnight from 7pm to 7am; moist at bottom of hole but no water (casing may be sealing off water). Well completion includes a 2' X 2' concrete pad with a water tight locking manhole and expansion plug.

WELL CONSTRUCTION

0.3 PVC riser
Cement Grout
0.0

0.0 - 18.0'
SLAG - very hard angular black slag

18.0 - 61.0'
SILTY GRAVEL - primarily well-rounded to angular gravel to 3" with some fine to coarse-grained sand and tan silt; occasional andesite cobbles to 6" at 30 - 40'; black stained soils at 60 - 60.5'

61.0 - 70.0'
CLAVEY SILT - medium plasticity clay and silt with some sand and gravel to 1'; moist to wet

GEOLOGICAL DESCRIPTION

Medium Bentonite Chips
10/20 Silica Sand
34.0

36.0

Bottom of Hole 70.0

Sheet 1 of 1
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Monitor Well Log
Hole Name: EP-26
Date Hole Started: 8/9/90 Date Hole Finished: 8/9/90

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<tr>
<th>WELL COMPLETION</th>
<th>DESCRIPTION</th>
<th>INTERVAL</th>
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<tbody>
<tr>
<td>Y/N</td>
<td>Y</td>
<td>N/PVC</td>
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<td></td>
<td>2-inch, flush threaded, Sch 40, PVC</td>
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<td></td>
<td>0 - 25 feet</td>
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<td>Y</td>
<td>Screen/Perforations</td>
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<td>0.010-inch slot, Sch 40, PVC</td>
<td>30 - 60 feet</td>
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<tr>
<td></td>
<td>Y</td>
<td>Sand Pack</td>
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<td>10/20 silica sand</td>
<td>25 - 60 feet</td>
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<td>Y</td>
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<td>Bentonite Chips</td>
<td>24 - 28 feet</td>
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<tr>
<td></td>
<td>Y</td>
<td>Surface Seal</td>
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<tr>
<td></td>
<td>Bentonite/Cement Grout</td>
<td>0 - 24 feet</td>
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DEVELOPMENT/SAMPLING

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<tr>
<th>Purpose of Hole</th>
<th>Well Developed</th>
<th>Water Samples Taken</th>
<th>Boring Samples Taken</th>
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</thead>
<tbody>
<tr>
<td>Install Monitor Well</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Target Aquifer: NA
Hole Diameter (in): 6-inch
Total Depth Drilled (ft): 60

Date: 5/98
MP Description: Top of PVC
MP Height Above or Below Ground (ft): MP Elevation (ft): 3770.64

Remarks: Wet from 45 - 60 feet. Completion includes 2' x 2' concrete pad with a locking water tight manhole and expansion plug.

WELL CONSTRUCTION

<table>
<thead>
<tr>
<th>-depth (ft)</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Cement Grout</td>
</tr>
<tr>
<td>0.0</td>
<td>Concrete Pad</td>
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</table>

GRAPHICS

GEological Description

<table>
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<th>-depth (ft)</th>
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</thead>
<tbody>
<tr>
<td>24.0</td>
<td>Medium Bentonite</td>
</tr>
<tr>
<td>28.0</td>
<td>Silica Sand</td>
</tr>
</tbody>
</table>

44.0 - 57.0' gravelly sand
- medium to coarse-grained sand with well-rounded gravel to 1 - inch. Moist to wet at 44 feet.
[Alluvium]

57.0 - 60.0' gritty sand
- predominantly fine-grained sand and silt with trace amounts of clay. Occasional gravel to 1/2 - inch.
[Alluvium]
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RL
County: El Paso
State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: South end of Employees Parking

Recorded By: WR Wilson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None

Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colloidal
Hole Diameter (in): 10 inch
Total Depth Drilled (ft): 82

Date Hole Started: 5/29/97
Date Hole Finished: 5/25/97

WELL COMPLETION

Y/N DESCRIPTION INTERVAL
Well Installed? Y 4-inch, flush threaded, Sch 40, PVC 0 - 82 feet
Surface Casing Used? Y 6-inch steel +2.5 - 2 feet
Screen/Perforations? Y 4" Sch 40 PVC FT 20 slot 62 - 82 Feet
Sand Pack? Y 12-20 CSSI 60 - 82 Feet
Annular Seal? Y Bentonite Chips 2 - 60
Surface Seal? Y Grout 0 - 2 feet

DEVELOPMENT/SAMPLING

Well Developed? N
Water Samples Taken? N
Boring Samples Taken? N

Static Water Level Below MP: 63.1
Surface Casing Height (ft): 2.5
Date: 5/96
Riser Height (ft): 2.0
MP Description: Top of PVC
Ground Surface Elevation (ft): 3781.76
MP Height Above or Below Ground (ft): 2.0
MP Elevation (ft): 3783.76

Remarks:

WELL CONSTRUCTION

0.0 - Concrete
2.0 - Medium Bentonite Chips
10.0 - Silty, Gravelly SAND -15% silt, 15% gravel, 70% sand; reddish-brown (3YR 4/4), fine to medium-grained, quartzite, friable, moist. [Fill]
15.0 - Sandy GRAVEL -30% sand, 1% silt, 65% gravel; dark brown (10YR 4/2), medium to coarse, subangular to subrounded (max 2"), medium dense, moist. [Alluvium]
21.0 - Gravelly SAND -20% gravel, 10% silt, 70% sand; yellowish-brown (10YR 5/4), fine to medium-grained, gravel subrounded, medium dense, moist. [Alluvium]
23.0 - CLAY -Dark yellowish-brown (10YR 4/4), hard, medium plasticity, small veins of gypsum, moist. [Alluvium]
25.0 - Gravelly CLAY with Sand -20% gravel, 10% sand, 70% clay; dark yellowish-brown (10YR 4/6), medium plasticity, fine to medium-grained, subrounded (max. 1"), sand medium to coarse, medium dense, moist. [Alluvium]
28.0 - Gravelly SAND with Clay -15% clay, 30% gravel, 65% sand; dark yellowish-brown (10YR 4/8), fine to coarse grained, subrounded to subangular (max. 1.5"), [Alluvium]
30.0 - Clayey GRAVEL with Sand -yellow (10YR 7/8); gravel medium to coarse, subangular, igneous, andesite cobbles common; clay fine, low plasticity; sand fine to coarse, dense, moist to wet, andesite boulders common at bottom (45', 55', 68' and 73'). [Alluvium]
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Monitor Well Log
Hole Name: EP-72R

Date Hole Started: 5/31/97  Date Hole Finished: 6/1/97

Client: ASARCO, Inc.
Project: Aserco El Paso Agreed Order #1
County: El Paso  State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Aserco Plant
Descriptive Location: East Central Storage Yard

Recorded By: Lairy Johnson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None

Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Coluvial
Hole Diameter (in): 10 inch
Total Depth Drilled (ft): 75

WELL COMPLETION  Y/N  DESCRIPTION  INTERVAL
Well Installed?  Y  4-inch, flush threaded, Sch 40, PVC 0 - 75 Feet
Surface Casing Used?  Y  8 - inch steel +2.5 - 2 feet
Screen/Perforations?  Y  4"Sch 40 PVC FT 20 slot 55 - 75
Sand Pack?  Y  12-20 CSSI 52.1 - 75
Annular Seal?  Y  Bentonite Chips 8 - 52.1
Surface Seal?  Y  Grout 0 - 8 feet

DEVELOPMENT/SAMPLING
Well Developed?  N
Water Samples Taken?  N
Boring Samples Taken?  Y  XRF 5 foot intervals

Static Water Level Below MP:  61.70
Riser Height (ft):  2.0
Ground Surface Elevation (ft): 3776.50
MP Elevation (ft): 3778.5

Remarks: Samples were collected with a 2-inch ID split spoon and grab samples

WELL CONSTRUCTION

0,0 Cement Grout
8,0 Medium Bentonite Chips

GEOPHYSICAL DESCRIPTION

0.0 - 15.0'
SLAG

15.0 - 22.0'
GRAVELLY SAND -(10y5/3) brown, Sand fine-coarse, gravel 30% fine-coarse, subrounded-rounded, max. 1/2 inches, medium dense, moist [Alluvium]

22.0 - 25.0'
SAND -(10y5/3), sand fine-medium, gravel 10% fine-medium, rounded, max. 1 inch, medium dense, moist [Alluvium] probable water at 25 feet

25.0 - 75.0'
GRAVELLY CLAYEY SAND -(10y5/3) brown, sand fine medium, gravel 20%, subrounded-subangular, max. 1 inch, clay 10%-15%, medium dense, moist Cobbles of Quartzite, Andesite, Limestone at 47 feet

Bottom of Hole  75.0

Graphics

Sheet 1 of 1
HYDROMETRICS INC.
Consulting Scientists and Engineers
Tucson, Arizona

Client: ASARCO, Inc.
Project: Asarco El Paso Agreed Order RI
County: El Paso State: Texas
Property Owner: ASARCO, Inc.
Legal Description: Asarco Plant
Descriptive Location: Near pond on Parker Bros.

Recorded By: WR Wilson
Drilling Company: Layne
Driller: Neil Hale
Drilling Method: Stratex
Drilling Fluids Used: None
Purpose of Hole: Monitor Well
Target Aquifer: Alluvial/Colluvial
Hole Diameter (in): 9 inch
Total Depth Drilled (ft): 45

WELL COMPLETION Y/N DESCRIPTION INTERVAL
Well Installed? Y 4-inch, flush threaded, Sch 40, PVC 0 - 45 Feet
Surface Casing Used? Y 8 - inch steel +3.0 - 2 Feet
Screen/Perforations? Y 4" Sch 40 PVC FT 20 slot 34.42 - 44.42 Feet
Sand Pack? Y 12-20 CSSI 31.1 - 44.75 Feet
Annular Seal? Y Bentonite Chips 10 - 31
Surface Seal? Y Grout 0 - 10 feet

DEVELOPMENT/GATING
Well Developed? Y Submersible Pump 34.5 - 44.5 Feet
Water Samples Taken? N
Boring Samples Taken? Y XRF

Static Water Level Below MP: 33.05
Date: 5/98
MP Description: Top of PVC
MP Height Above or Below Ground (ft): 2.5
Surface Casing Height (ft): 3.0
Riser Height (ft): 2.5
Ground Surface Elevation (ft): 3770.96
MP Elevation (ft): 3773.46

WELL CONSTRUCTION

GEOLOGICAL DESCRIPTION

0.0 - 23.0
SLAG
Black (10YR 5/2)
Gravel-sized, angular, non-conformal fracturing; wet at 6', perched from adjacent pond [Fill]
[Slag Fill]

23.0 - 25.0
Sandy CLAY
70% clay, 30% sand
Very dark gray (10YR 3/2)
Clay medium plasticity, soft; sand line, gravel (scarcely) line; saturated [Aluminum]
[Allophane]

25.0 - 41.0
Sandy GRAVEL
70% gravel, 30% sand
Dark brown (10YR 4/3)
Gravel line to coarse, subangular to subrounded, quartzite, andesite, limestone; sand medium to coarse, medium dense; dry to moist, cobbles and boulders at 30' [Aluminum]

41.0 - 45.0
Mudstone (very fine grain); dense, appears to be formation (?); water at 33.05'
[Aluminum]

Bottom of Hole 45.0
**HYDROMETRICS INC.**
Consulting Scientists and Engineers
El Paso, Texas

**Soil Boring Log**

**Hole Name: EP-114**

**Client:** ASARCO, Inc.
**Project:** Remedial Investigation Phase II
**County:** El Paso
**State:** Texas
**Property Owner:** ASARCO, Inc.
**Legal Description:** ASARCO El Paso Plant
**Descriptive Location:** Front Slope, by railroad tracks, below Acid Mist Precipitator
**Recorded By:** H Kutz

**Drilling Company:** Alliance Environmental
**Driller:** Dave Hogan
**Drilling Method:** Hollow Stem Auger
**Drilling Fluids Used:** None
**Purpose of Hole:** Install Well/Collect Soil Samples
**Hole Diameter (in):** 10.25
**Total Depth Drilled (ft):** 29

**Remarks:** Initial boring 4 inches in diameter for sample collection. Hole reamed to 8 inches for installation of 2-inch diameter monitor well.

### DEPTH

<table>
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<th>DEPTH</th>
<th>SAMPLE NUMBER</th>
<th>SAMPLE TYPE</th>
<th>BLOW COUNT</th>
<th>RECOVERY (ft)</th>
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<tbody>
<tr>
<td>0.0 - 2.5'</td>
<td>EP-114-A</td>
<td></td>
<td>1.00</td>
<td>2.5 - 3.5'</td>
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<tr>
<td>2.5 - 8.0'</td>
<td>EP-114-B</td>
<td></td>
<td>1.00</td>
<td>3.5 - 4.5'</td>
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<tr>
<td>8.0 - 10.0'</td>
<td>EP-114-C</td>
<td></td>
<td>1.00</td>
<td>4.5 - 5.5'</td>
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<tr>
<td>10.0 - 12.0'</td>
<td>EP-114-D</td>
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<td>2.00</td>
<td>10.0 - 12.0'</td>
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<tr>
<td>12.0 - 15.0'</td>
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<td>20.0 - 25.0'</td>
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</tr>
<tr>
<td>25.0 - 30.0'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### GEOLOGICAL DESCRIPTION

- **0.0 - 2.5' SLAG**
  - Black, angular, fractured.

- **2.5 - 8.0' SAND, Silty**
  - Fine to medium grained, moderate yellowish brown, 10YR 5/4, dry, poorly graded, no odor, with some gravel, and interbedded clay lenses at various depths.
  - Diesel affected soil at 12 feet, water at 13 feet

- **Coarser gravel below 15 feet**
## Well Construction Log

**Date Started:** 2/28/2013  
**Date Finished:** 3/1/2013  
**Drilling Company:** National Exploration  
**Total Depth:** 92 ft bgs  
**Drilling Rig:** CME 85  
**Borehole Diameter:** 12-inches  
**Driller:** Matt Cain  
**Depth to 1st Water:** 56 ft bgs  
**Logged By:** Benny Bludworth  
**Drilling Method:** Hollow Stem Auger  
**Location:** Former El Paso Smelter Site  
**Client:** Project Navigator  
**Logged By:** Garett Ferguson  
**Sampling Interval:** Top 2 ft, every 5 feet  
**Reviewed By:** El Paso, TX 79922  
**Date Started:** 2/28/2013  
**Date Finished:** 3/1/2013  
**Drillers Name:** Matt Cain  
**Logged By:** Garett Ferguson  
**Elevation:** 3780.0 Top of Casing/Ground  
**ID:** EP-158  
**Project #:** 06835001.2012.07F70

### SAMPLING DETAIL

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<thead>
<tr>
<th>Depth (feet bgs)</th>
<th>Recovery (in/min)</th>
<th>Blows per 6&quot;</th>
<th>Drive Interval</th>
<th>Sample ID</th>
<th>USCS Code</th>
<th>Geologic Column</th>
<th>Lithology</th>
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<tbody>
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<td>12/12</td>
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<td>Asphalt</td>
<td>SAND, black, medium-grained with slag, loose, dry</td>
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<tr>
<td>20/24</td>
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<td></td>
<td>SP</td>
<td>SAND, light brown, fine-grained with trace slag and silt; 1/2&quot; rounded SS gravel (10%)</td>
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<td>SP</td>
<td>No Recovery</td>
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<td></td>
<td>SP</td>
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<td>SP</td>
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### WELL CONSTRUCTION

**WELL CASING**  
- Material: Schedule 40 PVC  
- Diameter: 4-inches  
- Casing: 12-inches  
- Depth: 92 ft bgs  
- Elevation: Top of Casing/Ground

**WELL SCREEN**  
- Material: Schedule 40 PVC  
- Diameter: 4-inches  
- Opening: 0.020 slot

**MATERIAL IDENTIFICATION:**  
USCS Classification, density or stiffness, color, moisture content, grain-size description, cementation, angularity, minor constituents, structural or mineralogical features, odors or staining

**Abbreviations:** bgs = below ground surface, NA = not available; not applicable, NR = not reported, PID = photoionization detector, ppm = parts per million, USCS = Unified Soil Classification System

**Notes:** Measuring point is ground surface unless otherwise noted. Well elevation is from top of casing.
**Well Construction Log**

**ID:** EP-158

<table>
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<th>Date Started:</th>
<th>2/28/2013</th>
<th>Northing (NAD83):</th>
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<td>3/1/2013</td>
<td>Easting (NAD83):</td>
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<tr>
<td>Drilling Company:</td>
<td>National Exploration</td>
<td>Total Depth:</td>
<td>92 ft bgs</td>
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<tr>
<td>Drilling Rig:</td>
<td>CME 85</td>
<td>Borehole Diameter:</td>
<td>12-inches</td>
</tr>
<tr>
<td>Driller's Name:</td>
<td>Matt Cain</td>
<td>Depth to 1st Water:</td>
<td>56 ft bgs</td>
</tr>
<tr>
<td>Driller's Assistant(s):</td>
<td>Benny Bludworth</td>
<td>Sampling Interval:</td>
<td>Top 2 ft, every 5 feet</td>
</tr>
<tr>
<td>Logged By:</td>
<td>Garett Ferguson</td>
<td>Location:</td>
<td>Former El Paso Smelter Site</td>
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<td>Reviewed By:</td>
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<td>Client:</td>
<td>Project Navigator</td>
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<td>06835001.2012.07F70</td>
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### SAMPLING DETAIL

<table>
<thead>
<tr>
<th>Depth (feet bgs.)</th>
<th>Recovery (in/in)</th>
<th>Blows per 6&quot;</th>
<th>Depth of First Water</th>
<th>Drive Interval</th>
<th>Sample ID</th>
<th>USCS Code</th>
<th>Geologic Column</th>
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### LITHOLOGY

- **MATERIAL IDENTIFICATION:**
  - USCS Classification, density or stiffness, color, moisture content, grain-size description, cementation, angularity, minor constituents, structural or mineralogical features, odors or staining

### WELL CONSTRUCTION

- **WELL CASING**
  - Material: Schedule 40 PVC
  - Diameter: 4-inches
  - Top of Casing/Ground: 3780.0 ft

- **WELL SCREEN**
  - Material: Schedule 40 PVC
  - Diameter: 4-inches
  - Opening: 0.020 slot

- **SAND PACK**
  - 12/20 Sand

- **ANNULUS SEAL**
  - Bentonite Chips

- **GROUT**
  - Portland Cement

### Abbreviations:
- bgs = below ground surface
- NA = not available
- NR = not reported
- PID = photoionization detector
- ppm = parts per million
- USCS = Unified Soil Classification System

### Notes:
- Measuring point is ground surface unless otherwise noted. Well elevation is from top of casing.
Well Construction Log

**Date Started:** 2/28/2013  
**Date Finished:** 3/1/2013  
**Drilling Company:** National Exploration  
**Total Depth:** 92 ft bgs  
**Location:** Former El Paso Smelter Site  
**Client:** Project Navigator  
**Drill Rig:** CME 85  
**Borehole Diameter:** 12-inches  
**Logged By:** Benny Bludworth  
**ID:** EP-158  
**Depth to 1st Water:** 56 ft bgs  
**Reviewed By:** Garett Ferguson  
**Driller's Name:** Matt Cain  
**Driller's Assistant(s):**  
**Sampling Interval:** Top 2 ft, every 5 feet  
**Elevation:** 3780.0 Top of Casing/Ground  
**Project #:** 06835001.2012.07F70

### Sampling Detail

<table>
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<tr>
<th>Depth (feet bgs)</th>
<th>Recovery (min/6&quot;)</th>
<th>Blows per 6&quot;</th>
<th>Depth of First Water</th>
<th>Sample ID</th>
<th>USCS Code</th>
<th>Geologic Column</th>
<th>Lithology</th>
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<tr>
<td>13/24</td>
<td>13/24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SAND, brown, medium- to coarse-grained, fine LS, SS, andesite gravel (20%), dense, moist</td>
</tr>
<tr>
<td>18/24</td>
<td>13/24</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>SILTY SAND, brown, trace clay, angular SS and LS fragments, dense, saturated at 56 ft bgs</td>
</tr>
<tr>
<td>20/24</td>
<td>13/24</td>
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<td>Not Logged</td>
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<td>20/24</td>
<td>13/24</td>
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<td></td>
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<td></td>
<td>SAND, coarse-grained, dense</td>
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<tr>
<td>16/24</td>
<td>13/24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SAND, coarse-grained with clay and cobbles, very stiff</td>
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<tr>
<td>16/24</td>
<td>13/24</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>CLAY, brown, low plasticity, with gravel (SS), hard, dry. Moist at 75 ft bgs. Increased plasticity at 80 ft bgs. Decreased drill rate at 86 ft bgs (cobbles?). Refusal at 92 ft bgs.</td>
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### Well Construction

<table>
<thead>
<tr>
<th>Material Identification:</th>
</tr>
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<tr>
<td>USCS Classification, density or stiffness, color, moisture content, grain-size description, cementation, angularity, minor constituents, structural or mineralogical features, odors or staining</td>
</tr>
</tbody>
</table>

- **WELL CASING**  
  - Material: Schedule 40 PVC  
  - Diameter: 4-inches  
  - Elevation: 50 ft bgs  
  - Project # 06835001.2012.07F70  
- **WELL SCREEN**  
  - Material: Schedule 40 PVC  
  - Diameter: 4-inches  
  - Opening: 0.020 slot  
- **ANNULUS SEAL**  
  - Bentonite Chips  
- **Bentonite Chips**  
- **GROUT**  
  - Portland Cement

### Abbreviations:

- bgs = below ground surface  
- NA = not available  
- NR = not reported  
- PID = photoionization detector  
- ppm = parts per million  
- USCS = Unified Soil Classification System

### Notes:

- Measuring point is ground surface unless otherwise noted. Well elevation is from top of casing.
### Well Construction Log

**ID:** EP-158  
**Location:** Former El Paso Smelter Site

| Date Started: | 2/28/2013 |
| Date Finished: | 3/1/2013 |
| Drilling Company: | National Exploration |
| Drilling Rig: | CME 85 |
| Driller's Name: | Matt Cain |
| Driller's Assistant(s): | Benny Bludworth |
| Logged By: | Garett Ferguson |
| Reviewed By: | |

**Elevation:** 3780.0 Top of Casing/Ground  
**Project #:** 06835001.2012.07F70

<table>
<thead>
<tr>
<th>Depth (feet bgs)</th>
<th>Recovery (blows per 6&quot;)</th>
<th>Blows per 6&quot;</th>
<th>Depth to 1st Water</th>
<th>Sample ID</th>
<th>USCS Code</th>
<th>Geologic Column</th>
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<td>WELL CASING Material: Schedule 40 PVC Diameter: 4-inches Opening: 0.020 slot</td>
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<td>ANNULUS SEAL Bentonite Chips</td>
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</tr>
</tbody>
</table>

**Well Construction Log**

**Material Identification:**
- USCS Classification, density or stiffness, color, moisture content, grain-size description, cementation, angularity, minor constituents, structural or mineralogical features, odors or staining
- WELL CASING Material: Schedule 40 PVC Diameter: 4-inches Opening: 0.020 slot
- SAND PACK
- ANNULUS SEAL Bentonite Chips
- GROUT Portland Cement

**Abbreviations:**
- bgs = below ground surface
- NA = not available; not applicable
- NR = not reported
- PID = photoionization detector
- ppm = parts per million
- USCS = Unified Soil Classification System

**Notes:**
- Measuring point is ground surface unless otherwise noted.
- Well elevation is from top of casing.
**Well/Boring ID:** EP-165  
**Location:** El Paso, Texas  
**Client:** Texas Custodial Trust  
**Project:** Former Asarco Smelter  
**Project Number:** 06835001.2012

**Date Start:** 4/10/14  
**Date End:** 4/10/14  
**Drilling Company:** Yellow Jacket Drilling Services  
**Driller's Name:** Quinten Stevens  
**Drilling Method:** Air Rotary Stratex - Underream Bit  
**Hole Diameter (in):** 10  
**Rig Type:** Speedstar 50K ARCH  
**Sampling Method:** Cyclone Cuttings

### Stratigraphic Description

- **Northing (ft):** 10664664.58  
- **Easting (ft):** 374149.483  
- **Casing Elevation (ft):** 3778.74  
- **Borehole Depth (ft):** 85  
- **Surface Elevation (ft):** 3778.74  
- **Descriptions By:** G. Ferguson

### Remarks:
- Logged on cyclone cuttings (not representative of in-situ grain size).
**Sample Location**

<table>
<thead>
<tr>
<th>Depth (ft bgs)</th>
<th>Elevation (ft)</th>
<th>Sample Location</th>
<th>Sample ID</th>
<th>Pre-Development Water Level (ft)</th>
<th>Geologic Column</th>
<th>Stratigraphic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(34-55)</td>
<td>Medium to fine SAND with some Silt and trace Gravel; gravel, angular; dry; brown.</td>
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</tr>
<tr>
<td>(55-60)</td>
<td>Medium to coarse SAND with Gravel and some Clay; gravel up to 0.25-inch diameter, angular; moist.</td>
<td></td>
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</tr>
<tr>
<td>(60-65)</td>
<td>Medium to coarse SAND with Gravel and some Clay; gravel up to 0.25-inch diameter, angular; wet.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>(65-70)</td>
<td>Fine SAND with Silt and Clay; wet; brown.</td>
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<tr>
<td>(70-75)</td>
<td>CLAY and coarse Gravel; dry to moist; brown.</td>
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</table>

**Remarks:**

- ft: feet, in: inches, bgs: below ground surface, PVC: Polyvinyl Chloride
- Logged on cyclone cuttings (not representative of in-situ grain size).

**Well/Boring ID**: EP-165

**Project Number**: 06835001.2012

**Client**: Texas Custodial Trust

**Project**: Former Asarco Smelter

**Location**: El Paso, Texas

**Sampling Method**: Cyclone Cuttings

**Drill Company**: Yellow Jacket Drilling Services

**Driller's Name**: Quinten Stevens

**Drilling Method**: Air Rotary Stratex - Underream Bit

**Sample ID**: EP-165

**Date Start**: 4/10/14

**Date End**: 4/10/14

**Project Number**: 06835001.2012

**Client**: Texas Custodial Trust

**Project**: Former Asarco Smelter

**Location**: El Paso, Texas
### Stratigraphic Description

<table>
<thead>
<tr>
<th>Depth (ft bgs)</th>
<th>Elevation (ft)</th>
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<th>Pre-Development Water Level (ft)</th>
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</tr>
</tbody>
</table>

(75-85) Dense CLAY with some sand and gravel; sand, coarse; gravel, angular and rounded; dry.

End of boring at 85 feet bgs

---

**Remarks:**

ft: feet  in: inches  bgs: below ground surface  PVC: Polyvinyl Chloride

Logged on cyclone cuttings (not representative of in-situ grain size).

Well/Boring ID: EP-166

Date Start: 4/17/14  Date End: 4/17/14
Drilling Company: Yellow Jacket Drilling Services
Driller's Name: Quinten Stevens
Drilling Method: Air Rotary Stratex - Underream Bit
Hole Diameter (in): 10
Rig Type: Speedstar 50K ARCH
Sampling Method: Cyclone Cuttings

Remarks:
ft: feet  in: inches  bgs: below ground surface  PVC: Polyvinyl Chloride
Logged on cyclone cuttings (not representative of in-situ grain size).
**Well/Boring**

**Stratigraphic Description**

**Borehole Depth (ft):** 85

**Surface Elevation (ft):**

**Date Start:** 4/17/14  **Date End:** 4/17/14

**Drilling Company:** Yellow Jacket Drilling Services

**Driller's Name:** Quinten Stevens

**Drilling Method:** Air Rotary Stratex - Underream Bit

**Hole Diameter (in):** 10

**Rig Type:** Speedstar 50K ARCH

**Sampling Method:** Cyclone Cuttings

**Project Number:** 06835001.2012

**Client:** Texas Custodial Trust

**Project:** Former Asarco Smelter

**Location:** El Paso, Texas

**Well/Boring ID:** EP-166

**Date:** 4/29/2014

**Remarks:**

Logged on cyclone cuttings (not representative of in-situ grain size).


---

**Sample Location**

<table>
<thead>
<tr>
<th>Depth (ft bgs)</th>
<th>Sample Location</th>
<th>Sample ID</th>
<th>Pre-Development Water Level (ft)</th>
<th>Geologic Column</th>
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<td>35</td>
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<tr>
<td>75</td>
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</tbody>
</table>

**Stratigraphic Description**

- **(35-40)** Black slag GRAVEL with coarse Sand; gravel up to 0.25-inch; sand, brown; dry.
- **(40-45)** GRAVEL with coarse Sand; brown; dry.
- **(45-55)** GRAVEL with less coarse Sand; gravel up to 1.5-inch; brown and grey.
- **(55-60)** GRAVEL with Sand, Silt, and Clay; gravel up to 1.5-inch; sand, fine; brown.
- **(60-65)** Sandstone and limestone GRAVEL with trace Sand; sand, fine; brown.
- **(65-70)** GRAVEL with Sand, Silt, and Clay; gravel up to 1.5-inch; sand, fine; brown.
- **(70-75)** CLAY with some Gravel; high plastic; gravel, small; light brown.

**Horizontal coordinates are based on the North American Datum of 1983, Texas Central Zone, U.S. Survey Foot. Elevations are based on the North American Vertical Datum of 1988.**
Remarks:

ft: feet    in: inches    bgs: below ground surface    PVC: Polyvinyl Chloride

Logged on cyclone cuttings (not representative of in-situ grain size).

Date: 4/23/14  Date End: 4/23/14
Drilling Company:  Yellow Jacket Drilling Services
Driller's Name:  Quinten Stevens
Drilling Method:  Air Rotary Stratex - Underream Bit
Hole Diameter (in):  10
Rig Type:  Speedstar 50K ARCH
Sampling Method: Cyclone Cuttings

Borehole Depth (ft):  3781.412
Surface Elevation (ft):  3778.467
Casing Elevation (ft):  77

Well/Boring ID:  EP-167
Client:  Texas Custodial Trust
Project:  Former Asarco Smelter
Location:  El Paso, Texas
Project Number:  06835001.2012

Remarks:
Logged on cyclone cuttings (not representative of in-situ grain size).
**Date Start:** 4/23/14  
**Date End:** 4/23/14  
**Drilling Company:** Yellow Jacket Drilling Services  
**Driller's Name:** Quinten Stevens  
**Drilling Method:** Air Rotary Stratex - Underream Bit  
**Hole Diameter (in):** 10  
**Rig Type:** Speedstar 50K ARCH  
**Sampling Method:** Cyclone Cuttings

---

**Well/Boring ID:** EP-167  
**Project Number:** 06835001.2012  
**Client:** Texas Custodial Trust  
**Project:** Former Asarco Smelter  
**Location:** El Paso, Texas  
**Date Start:** 4/23/14  
**Date End:** 4/23/14  
**Easting (ft):** 374120.939  
**Northing (ft):** 10664643.99  
**Casing Elevation (ft):** 3781.412  
**Borehole Depth (ft):** 77  
**Surface Elevation (ft):** 3778.467  
**Descriptions By:** G. Ferguson

---

**Stratigraphic Description**

<table>
<thead>
<tr>
<th>Depth (ft bgs)</th>
<th>Elevation (ft)</th>
<th>Sample Location</th>
<th>Sample ID</th>
<th>Pre-Development Water Level (ft)</th>
<th>Geologic Column</th>
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<td>00</td>
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<td>Sample 4</td>
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**Remarks:**

Logged on cyclone cuttings (not representative of in-situ grain size).

Stratigraphic Description

Date Start: 4/23/14
Date End: 4/23/14
Drilling Company: Yellow Jacket Drilling Services
Driller's Name: Quinten Stevens
Drilling Method: Air Rotary Stratex - Underream Bit
Hole Diameter (in): 10
Rig Type: Speedstar 50K ARCH
Sampling Method: Cyclone Cuttings

Well/Boring ID: EP-167
Client: Texas Custodial Trust
Project: Former Asarco Smelter
Location: El Paso, Texas
Project Number: 06835001.2012

Remarks:
ft: feet in: inches bgs: below ground surface PVC: Polyvinyl Chloride
Logged on cyclone cuttings (not representative of in-situ grain size).
<table>
<thead>
<tr>
<th>DEPTH, FT.</th>
<th>SYMBOL</th>
<th>SAMPLE DESCRIPTION</th>
<th>SAMPLE NO.</th>
<th>SAMPLING INTERVAL</th>
<th>MOISTURE</th>
<th>ORGANIC VAPOR CONC. (PPM)</th>
<th>DEPTH, FT.</th>
<th>STRATIGRAPHY</th>
<th>WATER LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>GW</td>
<td>ALLUVIUM: well graded sand, fine to x-coarse grained, with gravel and cobbles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ground Level</td>
</tr>
<tr>
<td>60</td>
<td>SH</td>
<td>60: casing refusal petroleum odor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6&quot; SCH 80 PVC CASING</td>
</tr>
<tr>
<td>95</td>
<td></td>
<td>SHALE, green/gray, soft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10/20 SILICA SAND</td>
</tr>
</tbody>
</table>

Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: EX-8  
Site: EL PASO SMELTER  
Top of Casing Elevation:  
Total Depth: 100'  
Casing Type & Size: 6" SCH 80  
Slot Size: 0.020  
Drilling Method: ARCH  
Date Drilled: 7/18/08  
Logged by: C.T. IRWIN
### Recovery Well No. EX-9

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Symbol/USGS</th>
<th>Sample Description</th>
<th>Sample No.</th>
<th>Sampling Interval</th>
<th>Moisture</th>
<th>Organic Vapor Conc. (ppm)</th>
<th>Stratigraphy</th>
<th>Water Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>CW</td>
<td>Alluvium: well graded sand, fine to x-coarse grained, with gravel and cobbles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 - 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - 25</td>
<td></td>
<td>SL SLAG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 - 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 - 40</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>40 - 50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 - 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 - 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70 - 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 - 90</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 - 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 - 110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well Details**

- Ground Level
- Casing/Bentonite Grout
- Cement/Bentonite Screen (0.020" Slot)
- Bentonite Seal
- 6" SCH 80 PVC Casing
- 10/20 Silica Sand

---

**Client:** ASARCO Inc.  
**Job No.:** 24712-63700-CM-WELL  
**Well No.:** EX-9  
**Site:** EL PASO SMELTER  
**Top of Casing Elevation:**  
**Total Depth:** 75'  
**Casing Type & Size:** 6" SCH 80  
**Slot Size:** 0.020"  
**Drilling Method:** ARCH  
**Comments:**  
**Date Drilled:** 7/16/08  
**Driller:** WDC  
**Logged by:** C.T. IRWIN

---

**ASARCO, INC.**  
3201 W. PAISANO STREET  
EL PASO, TEXAS

---

**RECOVERY WELL COMPLETION DETAIL**  
**FIGURE A-1**
# Soil Boring Log

**Boring Number:** MW-49  
**Project:** ASARCO - El Paso Smelter Site  
**Address:** 2301 W. Paisano Dr., El Paso, Texas

## Details
- **Project Number:** AZ0011022.0003  
- **Date Drilled:** 7/24/04 - 7/29/04  
- **Manager:** Robert Mongrain  
- **Logged by:** Gordon Levin  
- **Checked by:**  
- **Groundwater Encountered:** Depth: NM  
  Time: n/a  
  Date: n/a  
- **Drilling Co.:** Layne Christensen  
- **Driller:** Mike Boyle  
- **Drilling Method:** ODEX  
- **Sample Method:** Split Spoon  
- **Ground Elevation:** Degree Off Vertical: 0  
- **Hole Diameter:** 7"  
- **Total Depth:** 97'

## Well Construction

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>U.S.C.S. Pattern</th>
<th>NOTES: BGS - below ground surface</th>
</tr>
</thead>
</table>

### Drilling Notes

- GW: Silty Sand and Gravel fill - Sand 30-50% very fine to coarse grained, well graded, angular to subangular, Fines 20-30% nonplastic, Gravel 20-30% subangular to well rounded, pebbles to 1.5" gravel, quartz, sandstone, limestone, andesite, slag, broken glass.  
- SLAG: Conglomerate fracture, small glassy crystals and pinhead sized voids present in micro-crystalline groundmass hard and brittle. Very Dark Grey 5 Y 3/1

### Lithology Description

- **10% Bentonite - Portland Cement Grout**
- **7" Diameter Borehole**

### 3' Steel Completion with Locking Lid

- **Cement**
- **Slag - Difficulties with rig, but when running drills pretty well.**

### Log Image

![Soil Boring Log Image](G:\ENV\PROJ\1000\1022 El Paso Smelter\Drilling Report\MW-49)
### Soil Boring Log (continued)

**Boring Number:** MW-49

<table>
<thead>
<tr>
<th>Wall Construction</th>
<th>Sample Interval</th>
<th>Drilling Notes</th>
<th>Depth (feet)</th>
<th>U.S.C.S.</th>
<th>NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite Chips Seal</td>
<td>60' - 61'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Pack - 10/20 Colorado Silica</td>
<td>65'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4&quot; Schedule 40 PVC 0.020 Slot Screen</td>
<td>70'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bentonite Chips Seal</td>
<td>75' - 82'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Depth 97' bgs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
- **BGS** - below ground surface
- **U.S.C.S.** Soil Symbol and Lithology Description

---

**GP:** Sandy Gravel - Gravel 60% subangular to rounded, fine to 1", andesite, limestone, slag. Sand 30% very fine and coarse grained, gap graded, quartz, plagioclase, chert, dark grains. Pale Brown 10 YR 7/4, moist, no odor.

**SW:** Clayey Gravelly Sand - Sand 60-90% very fine to coarse grained, well graded, angular to subangular, quartz, lithics, liming down, Fines 10-30% plastic sticky clay. Gravel 0 to 10% fine to 3/4 inch subangular to rounded, limestone, and dolostone, Pale Brown 10 YR 7/3.

**CH:** Clay - plastic sticky clay with minor sand, Pale Brown 10YR 7/3, moist, diesel odor.

**GM:** Sandy Gravel - Gravel 40-70% fine to 1 inch; angular to subangular, limestone, dolostone, mudstone. Sand 20 to 40% coarse and fine grained, gap graded, angular to subrounded. Gravel, sand, limestone, andesite, Fines 10 to 40% plastic, wet. Pale Brown 10 YR 6/3, Diesel odor.

**CH:** Clay - plastic sticky clay. Pale Brown 10YR 7/3, moist, diesel odor.

**SW:** Sand - Sand fine to coarse grained, well graded coarsening down, angular to sub rounded.

**LIMESTONE:** Boulder - Limestone - Hard, brittle, Grey 10 YR 5/1

**SHALE:** Shale - Dry fissile shale, hydrates to plastic sticky clay. Paper thin platy partings, Yellowish Grey, Dark Grey, and Reddish Brown. Grayish Brown 2.5 Y 5/2. Constructed a temporary well to collect deep water sample - MW-49-86-072504

---

G:\ENV\PROJECT1\0001022 El Paso Smelter\Drilling Report\MW-49
# Soil Boring Log

**Boring Number:** MW-131  
**Project:** ASARCO - El Paso Smelter Site  
**Address:** 2301 W. Paisano Dr., El Paso, Texas

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Drilling Co.</th>
<th>Date Drilled</th>
<th>Driller</th>
<th>Manager</th>
<th>Manager</th>
<th>Logged by</th>
<th>Checked by</th>
<th>Groundwater Encountered</th>
<th>Depth (NM)</th>
<th>Time</th>
<th>Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZ001022.0003</td>
<td>Layne Christensen</td>
<td>7/30/04 - 7/31/04</td>
<td>Mike Boyle</td>
<td>Robert Mongrain</td>
<td>Robert Mongrain</td>
<td>Gordon Levin</td>
<td>Gordon Levin</td>
<td>NM</td>
<td>n/a</td>
<td>n/a</td>
<td>BGS - below ground surface</td>
<td></td>
</tr>
</tbody>
</table>

**Drilling Method:** ODEX  
**Sample Method:** Split Spoon  
**Ground Elevation:**
- Degree Off Vertical: 0
- Hole Diameter: 7"
- Total Depth: 90'

---

### U.S.C.S. Soil Symbol and Lithology Description

- **GW:** Gravel fill.
- **SLAG:** Broken slag over poured slag fill material, coconidal fracture, angular, microcrystalline, very dark grey 6Y 3/1. Penetrating 10 ft / 6 minutes.
- **VOID:** Lost circulation and drill dropped to 35' like a void.
- **SM:** Sand - Sand 80% fine to coarse grained, well graded, sub angular to well rounded, quartz, micas, feldspars. Fines 15% silty, plastic, moist. Gravel 5% 3/4", rounded, quartzite, mudstone, andesite, limestone. Brown 7.5 YR 5/4.
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>U.S.C.S. Soil Symbol and Lithology Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>48'</td>
<td>SW: More gravel to 1 1/2 inches - quartzite, mudstone, limestone.</td>
</tr>
<tr>
<td>50'</td>
<td>SM: Silty Sand - Sand 80% fine and coarse grained, gap graded, angular to subangular quartz, mica, lithics. Fines 15% nonplastic. Brown 7.5 YR 5/3, no odor.</td>
</tr>
<tr>
<td>70'</td>
<td>ANDESITE: Hit a cobble or boulder.</td>
</tr>
<tr>
<td>72'</td>
<td>CL: Clay - 90% plastic sticky, moist, Brown 7.5 YR, no odor.</td>
</tr>
<tr>
<td>87'</td>
<td>CH: Gravely Clay - fines 60% plastic sticky clay, Gravel 35% angular to subrounded fine to 1 1/4. Andesite and Limestone, sand 5% coarse like gravels. Dry and hard, no odor.</td>
</tr>
<tr>
<td>90'</td>
<td>CH: Clay - hard and dry.</td>
</tr>
<tr>
<td>93'</td>
<td>SC: Gravely Sand - Sand 75-85% coarse and fine grained, gap graded subangular to subrounded quartz, feldspar, dark minerals, lithics. Coarse 10-20% fine to 3/4&quot; gravel, subangular to rounded, granite, limestone, mudstone, quartz, Fines 5-10% nonplastic, brown 7.5 YR 5/4, no odor.</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Symbol</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td>SL</td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td>SW</td>
</tr>
<tr>
<td>-10</td>
<td>ML</td>
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<tr>
<td>-15</td>
<td>SW</td>
</tr>
<tr>
<td>-20</td>
<td>ML</td>
</tr>
<tr>
<td>-25</td>
<td>SP/GW</td>
</tr>
<tr>
<td>-30</td>
<td></td>
</tr>
<tr>
<td>-35</td>
<td></td>
</tr>
<tr>
<td>-40</td>
<td>SH</td>
</tr>
<tr>
<td>-45</td>
<td></td>
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<tr>
<td>-50</td>
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</tr>
<tr>
<td>-55</td>
<td></td>
</tr>
<tr>
<td>-60</td>
<td></td>
</tr>
</tbody>
</table>

Client: ASARCO INC.  
Job No.: 24712-63700-CM-WELL  
Well No.: OBS-1  
Site: EL PASO SMELTER  
Top of Casing Elevation:  
Total Depth: 47'  
Casing Type & Size: 2" SCH 40  
Slot Size: .020  
Drilling Method: ARCH  
Comments:  
Date Drilled: 4/10/08  
Logged by: J. FAUBION  

ASARCO, INC.  
3201 W. PAISANO STREET  
EL PASO, TEXAS  
OBSERVATION WELL COMPLETION DETAIL  
FIGURE A-1
Attachment 4

Flux Reduction Calculation Sheets
### PBA Drainage Surface Area

**Overall PAD - Existing Conditions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Square Feet</th>
<th>Acre</th>
<th>% cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm²/acre/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm²/acre/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill, Cell 1, 2, and 3</td>
<td>2,000,000.00</td>
<td>66.57</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond, Rubber Lake and Twin</td>
<td>0.00</td>
<td>0%</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>50,717.95</td>
<td>1.48</td>
<td>2%</td>
<td>1.16</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>39,997.10</td>
<td>1.16</td>
<td>1%</td>
<td>0.92</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Existing Asphalt, Harmagized</td>
<td>18,554.43</td>
<td>0.53</td>
<td>1%</td>
<td>0.36</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Category II Impacted Areas</td>
<td>27,875.97</td>
<td>0.84</td>
<td>1%</td>
<td>0.64</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Total</td>
<td>2,900,000.00</td>
<td>66.57</td>
<td>98%</td>
<td>2.90</td>
<td>37.20</td>
<td>279.00</td>
</tr>
</tbody>
</table>

**Overall PAD - Final Conditions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Square Feet</th>
<th>Acre</th>
<th>% cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm²/acre/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm²/acre/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill, Cell 1, 2, and 3</td>
<td>2,000,000.00</td>
<td>66.57</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond, Rubber Lake and Twin</td>
<td>0.00</td>
<td>0%</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>50,717.95</td>
<td>1.48</td>
<td>2%</td>
<td>1.16</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>39,997.10</td>
<td>1.16</td>
<td>1%</td>
<td>0.92</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Existing Asphalt, Harmagized</td>
<td>18,554.43</td>
<td>0.53</td>
<td>1%</td>
<td>0.36</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Category II Impacted Areas</td>
<td>27,875.97</td>
<td>0.84</td>
<td>1%</td>
<td>0.64</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Concrete Pad</td>
<td>0.00</td>
<td>0%</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>1,482,664.87</td>
<td>34.04</td>
<td>51%</td>
<td>34.04</td>
<td>114.02</td>
<td>119.14</td>
</tr>
<tr>
<td>Total</td>
<td>2,000,000.00</td>
<td>66.57</td>
<td>98%</td>
<td>2.90</td>
<td>37.20</td>
<td>279.00</td>
</tr>
</tbody>
</table>

**SUMMARY**

<table>
<thead>
<tr>
<th>Category</th>
<th>Current Flow</th>
<th>Removed Flow</th>
<th>Reduced Infiltration</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBA Drainage flow</td>
<td>0.08 cfs</td>
<td>-0.045 cfs</td>
<td>-0.037 cfs</td>
<td>57.26%</td>
</tr>
<tr>
<td>GHB Flow (15-20 gpm; 20 gpm avg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induced infiltration flow</td>
<td>-0.007 cfs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEW PBA FLOW</td>
<td>0.010 cfs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REDUCTION</td>
<td>94%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

a- Percolation Rate Categories for Existing Conditions were developed as representative of existing and proposed cover material:

- 0.1 cm/year is an assumed value indicative of a liner, impervious or hard, smooth surface over which precipitation would preferentially run off rather than infiltrate
- 13.7 cm/year is a calculated value indicative of the average annual drainage simulated for the Boneyard profile, consisting of 3 feet of gravel with saturated hydraulic conductivity of 5.0 x 10⁻² (Geosyntec 2015)
- 3.35 cm/year is a calculated value indicative of the average annual drainage simulated for a typical site no cover area, consisting of 3 feet of native sandy soil with saturated hydraulic conductivity of 1.0 x 10⁻³ (Geosyntec 2015)
- 0.187 cm/year is a calculated value indicative of the average annual drainage simulated for the ET Site Cover (Category II Soil Cover), consisting of 3 feet of material with saturated hydraulic conductivity of 5.0 x 10⁻⁴ and 1 foot of material with saturated hydraulic conductivity of 5.0 x 10⁻⁵ (Geosyntec 2015)

b- Weighted Percolation Rates (cm²/acre/yr) are calculated by multiplying the cover area (acres) by the applicable percolation rate category (cm/year), resulting in a percolation volume per cover type.
### Acid Plant Current and Proposed Cover Infiltration Rates

**Overall PAD - Existing Conditions**

<table>
<thead>
<tr>
<th>SF</th>
<th>Acre</th>
<th>% Cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm²·acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm²·acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill: Cell 1, 2, and 3</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond, Rubber Lake and Twin</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>93,000.00</td>
<td>2.13%</td>
<td>2.13</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>137,163.39</td>
<td>3.15%</td>
<td>3.15</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>53,341.32</td>
<td>1.22%</td>
<td>1.22</td>
<td>0.00</td>
<td>1.22</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>149,121.27</td>
<td>3.42%</td>
<td>3.42</td>
<td>0.34</td>
<td>0.34</td>
</tr>
<tr>
<td>Areas of No Cover</td>
<td>67,791.06</td>
<td>1.56%</td>
<td>1.56</td>
<td>0.00</td>
<td>1.56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>500,417.04</td>
<td>11.49%</td>
<td></td>
<td><strong>10.19 cm·acres/yr</strong></td>
<td><strong>0.21 gpm</strong></td>
</tr>
</tbody>
</table>

**Overall PAD - Final Conditions**

<table>
<thead>
<tr>
<th>SF</th>
<th>Acre</th>
<th>% Cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm²·acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm²·acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>130,730.08</td>
<td>3.00%</td>
<td>3.00</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>25,775.16</td>
<td>0.59%</td>
<td>0.59</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Soil Cover</td>
<td>339,837.74</td>
<td>7.80%</td>
<td>7.80</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>New Low Perm Covers</td>
<td>4,074.06</td>
<td>0.09%</td>
<td>0.09</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete Pad</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>0.00</td>
<td>0%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>500,417.04</td>
<td>11.49%</td>
<td></td>
<td><strong>1.84 cm·acres/yr</strong></td>
<td><strong>0.04 gpm</strong></td>
</tr>
</tbody>
</table>

**NOTES:**

- Percolation Rate Categories for Existing Conditions were developed as representative of existing and proposed cover material:
  - 0.1 cm/year is an assumed value indicative of a liner, impervious or hard, smooth surface over which precipitation would preferentially run off rather than infiltrate.
  - 13.7 cm/year is a calculated value indicative of the average annual drainage simulated for the Boneyard profile, consisting of 3 feet of gravel with saturated hydraulic conductivity of 5.0 x 10⁻² (Geosyntec 2015).
  - 3.35 cm/year is a calculated value indicative of the average annual drainage simulated for a typical site no cover area, consisting of 3 feet of native sandy soil with saturated hydraulic conductivity of 1.0 x 10⁻³ (Geosyntec 2015).
  - 0.187 cm/year is a calculated value indicative of the average annual drainage simulated for the ET Site Cover (Category II Soil Cover), consisting of 2 feet of material with saturated hydraulic conductivity of 5.0 x 10⁻⁷ and 1 foot of material with saturated hydraulic conductivity of 5.0 x 10⁻⁸ (Geosyntec 2015).
- Weighted Percolation Rates (cm²·acres/year) are calculated by multiplying the cover area (acres) by the applicable percolation rate category (cm/year), resulting in a percolation volume per cover type.

Reduction | 32%
## ASARCO El Paso

### Pond 5,6 Current and Proposed Cover Infiltration Rates

<table>
<thead>
<tr>
<th>Percolation Rate Category</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SF</strong></td>
<td><strong>Acre</strong></td>
<td><strong>% cover</strong></td>
</tr>
<tr>
<td>Overall PAD - Existing Conditions</td>
<td>1,967,861.90</td>
<td>45.18</td>
</tr>
<tr>
<td>Lined Landfill: Cell 1, 2, and 3</td>
<td>129,519.13</td>
<td>2.97</td>
</tr>
<tr>
<td>Lined Stormwater Pond: Rubber Lake and Twin</td>
<td>341,062.00</td>
<td>7.83</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>602,462.07</td>
<td>13.83</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>234,290.81</td>
<td>5.38</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>341,062.00</td>
<td>7.83</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>602,462.07</td>
<td>13.83</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>234,290.81</td>
<td>5.38</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>602,462.07</td>
<td>13.83</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>234,290.81</td>
<td>5.38</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Areas of No Cover</td>
<td>249,502.00</td>
<td>5.73</td>
</tr>
<tr>
<td>Areas of No Cover</td>
<td>249,502.00</td>
<td>5.73</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,967,861.90</td>
<td>45.18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percolation Rate Category</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SF</strong></td>
<td><strong>Acre</strong></td>
<td><strong>% cover</strong></td>
</tr>
<tr>
<td>Overall PAD - Final Conditions</td>
<td>1,967,861.90</td>
<td>45.18</td>
</tr>
<tr>
<td>Lined Landfill: Cell 1, 2, and 3</td>
<td>53,041.35</td>
<td>1.22</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>494,267.33</td>
<td>11.45</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>494,267.33</td>
<td>11.45</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>192,969.88</td>
<td>4.43</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>0.00</td>
<td>0%</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>494,267.33</td>
<td>11.45</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>192,969.88</td>
<td>4.43</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>6,018.21</td>
<td>0.14</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>6,018.21</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,967,861.90</td>
<td>45.18</td>
</tr>
</tbody>
</table>

### NOTES:

**a** - Percolation Rate Categories for Existing Conditions were developed as representative of existing and proposed cover material:
- 0.1 cm/year is an assumed value indicative of a liner, impervious or hard, smooth surface over which precipitation would preferentially run off rather than infiltrate.
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- 0.187 cm/year is a calculated value indicative of the average annual drainage simulated for the ET Site Cover (Category II Soil Cover), consisting of 2 feet of material with saturated hydraulic conductivity of 5.0 x 10^{-5} and 1 foot of material with saturated hydraulic conductivity of 5.0 x 10^{-7} (Geosyntec 2015)

**b** - Weighted Percolation Rates (cm*acres/year) are calculated by multiplying the cover area (acres) by the applicable percolation rate category (cm/year), resulting in a percolation volume per cover type.
### Overall PAD - Existing Conditions

<table>
<thead>
<tr>
<th>Percolation Rate Category</th>
<th>SF</th>
<th>Acre</th>
<th>% cover</th>
<th>Percolation Rate (cm/yr)</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill, Cell 1, 2, and 3</td>
<td>135,700.88</td>
<td>3.12</td>
<td>12%</td>
<td>3.12</td>
<td>0.31</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond, Rubber Lake and Twin</td>
<td>22,457.66</td>
<td>0.52</td>
<td>2%</td>
<td>6.52</td>
<td>0.21</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>92,000.00</td>
<td>2.11</td>
<td>8%</td>
<td>2.11</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>355,522.90</td>
<td>8.16</td>
<td>32%</td>
<td>8.16</td>
<td>0.82</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>136,238.91</td>
<td>3.11</td>
<td>12%</td>
<td>3.11</td>
<td>0.00</td>
<td>10.63</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>154,773.36</td>
<td>3.55</td>
<td>14%</td>
<td>3.55</td>
<td>0.36</td>
<td>0.00</td>
</tr>
<tr>
<td>Areas of No Cover</td>
<td>218,500.00</td>
<td>5.02</td>
<td>20%</td>
<td>5.02</td>
<td>0.00</td>
<td>16.80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,117,213.71</strong></td>
<td><strong>25.65</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>25.65</strong></td>
</tr>
</tbody>
</table>

### Overall PAD - Final Conditions

<table>
<thead>
<tr>
<th>Percolation Rate Category</th>
<th>SF</th>
<th>Acre</th>
<th>% cover</th>
<th>Percolation Rate (cm/yr)</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill, Cell 1, 2, and 3</td>
<td>135,700.88</td>
<td>3.12</td>
<td>12%</td>
<td>3.12</td>
<td>0.31</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond</td>
<td>22,457.66</td>
<td>0.52</td>
<td>2%</td>
<td>6.52</td>
<td>0.21</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>181,379.77</td>
<td>4.16</td>
<td>16%</td>
<td>4.16</td>
<td>0.42</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>133,433.82</td>
<td>3.06</td>
<td>12%</td>
<td>3.06</td>
<td>0.31</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Soil Cover</td>
<td>484,887.94</td>
<td>11.13</td>
<td>43%</td>
<td>11.13</td>
<td>2.08</td>
<td>2.08</td>
</tr>
<tr>
<td>New Low Perm Covers</td>
<td>40,000.00</td>
<td>0.92</td>
<td>4%</td>
<td>0.92</td>
<td>0.00</td>
<td>0.17</td>
</tr>
<tr>
<td>Concrete Pads</td>
<td>19,353.64</td>
<td>0.44</td>
<td>2%</td>
<td>0.44</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>100,000.00</td>
<td>2.39</td>
<td>9%</td>
<td>2.39</td>
<td>7.69</td>
<td>7.69</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,117,213.71</strong></td>
<td><strong>25.65</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>11.07</strong></td>
</tr>
</tbody>
</table>

**Reduction:** 62%
<table>
<thead>
<tr>
<th>Overall PAD - Existing Conditions</th>
<th>SF</th>
<th>Acre</th>
<th>% Cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill: Cell 1, 2, and 3</td>
<td>1,018,245.17</td>
<td>23.38%</td>
<td>0.00%</td>
<td>0.1, 3.35</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond: Rubber Lake and Twin</td>
<td>168,619.83</td>
<td>3.87%</td>
<td>11.7%</td>
<td>0.39, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>24,500.00</td>
<td>0.56%</td>
<td>2%</td>
<td>0.56, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt,</td>
<td>153,793.12</td>
<td>3.53%</td>
<td>15%</td>
<td>0.35, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt, Damaged</td>
<td>59,808.43</td>
<td>1.37%</td>
<td>8%</td>
<td>1.37, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond: Rubber Lake and Twin</td>
<td>168,619.83</td>
<td>3.87%</td>
<td>11.7%</td>
<td>0.39, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>24,500.00</td>
<td>0.56%</td>
<td>2%</td>
<td>0.56, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt,</td>
<td>153,793.12</td>
<td>3.53%</td>
<td>15%</td>
<td>0.35, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>285,231.81</td>
<td>6.62%</td>
<td>28%</td>
<td>6.42, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Areas of No Cover</td>
<td>323,292.18</td>
<td>7.42%</td>
<td>32%</td>
<td>7.42, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>1,018,245.17</td>
<td>23.38%</td>
<td></td>
<td></td>
<td></td>
<td>30.51 cm*acres/yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall PAD - Final Conditions</th>
<th>SF</th>
<th>Acre</th>
<th>% Cover</th>
<th>Percolation Rate Category (cm/yr)</th>
<th>Weighted Percolation Rate (cm*acres/yr)</th>
<th>Total Percolation Rate Per Cover Area (cm*acres/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined Landfill</td>
<td>1,018,245.17</td>
<td>23.38%</td>
<td>0.00%</td>
<td>0.1, 3.35</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Lined Stormwater Pond: Rubber Lake and Twin</td>
<td>168,619.83</td>
<td>3.87%</td>
<td>11.7%</td>
<td>0.39, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concrete and Building Pads</td>
<td>24,500.00</td>
<td>0.56%</td>
<td>2%</td>
<td>0.56, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Existing Asphalt,</td>
<td>126,051.65</td>
<td>2.89%</td>
<td>12%</td>
<td>2.89, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Paved Areas</td>
<td>240,000.00</td>
<td>5.51%</td>
<td>24%</td>
<td>5.51, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Category II Soil Cover</td>
<td>428,852.13</td>
<td>9.87%</td>
<td>43%</td>
<td>9.87, 0.00</td>
<td>0.00, 0.00</td>
<td>1.85</td>
</tr>
<tr>
<td>New Low Perm Covers</td>
<td>3,681.56</td>
<td>0.06%</td>
<td>0%</td>
<td>0.06, 0.00</td>
<td>0.00, 0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Concrete Pad</td>
<td>0.00</td>
<td>0%</td>
<td>0%</td>
<td>0.00, 0.00</td>
<td>0.00, 0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Compacted Native Soil with Vegetation</td>
<td>50,000.00</td>
<td>1.15%</td>
<td>5%</td>
<td>1.15, 0.00</td>
<td>0.00, 3.85</td>
<td>3.85</td>
</tr>
<tr>
<td>Total</td>
<td>1,018,245.17</td>
<td>23.38%</td>
<td></td>
<td></td>
<td></td>
<td>6.93 cm*acres/yr</td>
</tr>
</tbody>
</table>

**NOTES:**

a- Percolation Rate Categories for Existing Conditions were developed as representative of existing and proposed cover material:

- 0.1 cm/year is an assumed value indicative of a liner, impervious or hard, smooth surface over which precipitation would preferably run off rather than infiltrate.
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- 3.35 cm/year is a calculated value indicative of the average annual drainage simulated for a typical site no cover area, consisting of 3 feet of native sandy soil with saturated hydraulic conductivity of 1.0 x 10^-3 (Geosyntec 2015).
- 0.187 cm/year is a calculated value indicative of the average annual drainage simulated for the ET Site Cover (Category II Soil Cover), consisting of 2 feet of material with saturated hydraulic conductivity of 5.0 x 10^-4 and 1 foot of material with saturated hydraulic conductivity of 5.0 x 10^-5 (Geosyntec 2015).

b- Weighted Percolation Rates (cm*acres/year) are calculated by multiplying the cover area (acres) by the applicable percolation rate category (cm/year), resulting in a percolation volume per cover type.
Attachment 5

Water Level Reduction Calculation Sheet
This calculation is based on the following assumptions:
1. Groundwater flux reduction due to limiting infiltration will be caused by lower groundwater levels under the cap
2. The variables in the calculation are the saturated thickness in the arroyo and the ΔY in the gradient
3. When Q is prescribed as 70% of original Q, saturated thickness and ΔY will change by the same magnitude in order to accommodate prescribed Q using solver

Qnew = (X%)*Q  
X% reduction due to capping. Determined by capping and infiltration analysis

\[ Q = K_i A \]  
K_i, hydraulic conductivity, WONT CHANGE  
A = w*b  
area = width*saturated thickness- SATURATED THICKNESS WILL CHANGE

**EXAMPLES:**

<table>
<thead>
<tr>
<th>PBA current</th>
<th>PBA 84% reduced (Qnew= 0.010)</th>
<th>Acid Plant current</th>
<th>Acid Plant 82% reduced (Qnew= 0.0006)</th>
<th>Pond 5,6 current</th>
<th>Pond 5,6 82% reduced (Qnew= 0.0009)</th>
<th>Pond 1 current</th>
<th>Pond 1 62% reduced (Qnew= 0.0003)</th>
<th>South Terrace current</th>
<th>South Terrace 78% reduced (Qnew=0.0007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K (ft/d)</td>
<td>116</td>
<td>116</td>
<td>2.4</td>
<td>2.4</td>
<td>21</td>
<td>21</td>
<td>6.1</td>
<td>6.1</td>
<td>2.1</td>
</tr>
<tr>
<td>ΔY (ft)</td>
<td>24</td>
<td>9.360713147</td>
<td>16.7</td>
<td>9.424234125</td>
<td>3.2</td>
<td>0.781271343</td>
<td>6.3</td>
<td>2.725976946</td>
<td>12.348205651</td>
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<tr>
<td>Ax (ft)</td>
<td>1310</td>
<td>1310</td>
<td>500</td>
<td>500</td>
<td>270</td>
<td>270</td>
<td>1130</td>
<td>1130</td>
<td>450</td>
</tr>
<tr>
<td>w (ft)</td>
<td>300</td>
<td>300</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>b (ft)</td>
<td>25</td>
<td>10.36071315</td>
<td>15</td>
<td>5.27434125</td>
<td>0</td>
<td>6.5612321343</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Q (cfs)</td>
<td>0.0615</td>
<td>0.0615</td>
<td>0.0031</td>
<td>0.0006</td>
<td>0.0002</td>
<td>0.0008</td>
<td>0.0024</td>
<td>0.0009</td>
<td>0.0032</td>
</tr>
<tr>
<td>i (ft/t)</td>
<td>0.018320611</td>
<td>0.007168483</td>
<td>0.0374</td>
<td>0.018848468</td>
<td>0.011851852</td>
<td>0.002819338</td>
<td>0.005575221</td>
<td>0.002412396</td>
<td>0.002444444</td>
</tr>
</tbody>
</table>

**Closed form solution**

| Dh | 14.69 | Dh | 9.51 | Dh | 2.41 | Dh | 3.58 | Dh | 7.63 |

**Dy**

| Dy | 4.81 | Dy | 15.09 | Dy | 2.24 | Dy | 4.41 | Dy | 7.7 |

**Closed form solution**

\[ Dh = 14.69 \]
\[ Dh = 9.51 \]
\[ Dh = 2.41 \]
\[ Dh = 3.58 \]
\[ Dh = 7.63 \]