

Appendix F
Boring Logs and Well Drawings



Well Number: GW-1

Client: USEPA

Driller: WDC

Drilling Method: Air Rotary w/ Casing Hammer

Project: ASARCO Hayden RI

Project Number: 335404.FI.04

Logged by: M. Henley

Start Date: Jan. 7th 2006

Well Registration ID: 55-210190

Collar Elevation: 2016.65 ft amsl

Northing: 509690.0344

Easting: 729513.0141

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 21 | Grab | | | | | |
| 26 | Grab | | slight increase in sand fraction and slightly coarser grains. | -25 25 | | |
| 31 | Grab | | SC Clayey Sand with trace silt, SC, light pink-brown, moist, medium density, close to 50% clay and almost a CL but still gritty with visible sand grains | -29 29 | | |
| 36 | Grab | | SC-CL same with lenses of Sandy Clay, CL | -35 35 | | |



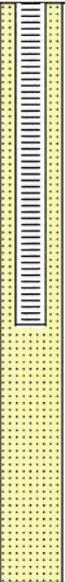
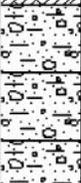
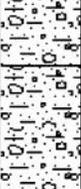
Well Number: GW-1

Sheet: 4 of 4

Client: USEPA
Project: ASARCO Hayden RI
Logged by: M. Henley
Well Registration ID: 55-210190
Northing: 509690.0344

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan. 7th 2006
Collar Elevation: 2016.65 ft amsl
Easting: 729513.0141

Drilling Method: Air Rotary w/ Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|---|--|--------------|--|-------|
| | Sample Type | Soil Log | | | | |
| | |  | | -57 57 |  | |
| | Grab |  | Tertiary CONGLOMERATE: Moderately weathered coarse Sands and Gravels with a Clay matrix, medium bedding, light brown to brown, slightly damp to damp | | | |
| 61 | |  | zones of an increase in sand or an increase in gravel | -62 62 | | |
| | |  | decrease moisture | -64 64 | | |
| | Grab |  | End of Log | -65 65 | | |
| 66 | | | | | | |
| 71 | | | | | | |
| 76 | | | | | | |



Well Number: GW-2

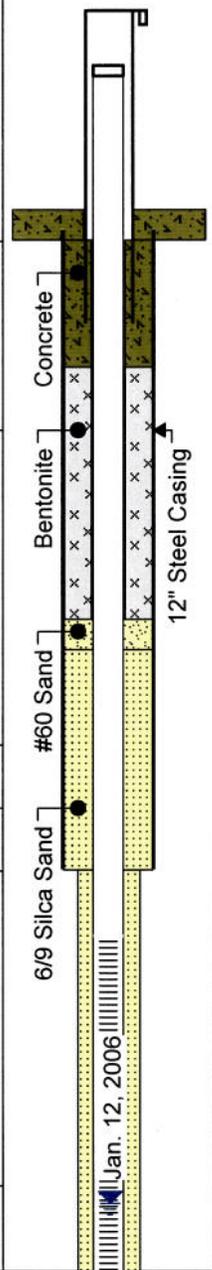
Sheet: 1 of 3

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210191
Northing: 515725.8338

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan 4th - Jan 5th, 2006
Collar Elevation: 1948.24 ft amsl
Easting: 728356.3312

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| -4 | | | | | | |
| | | | Ground Surface | 0 | | |
| 1 | | | SM FILL: Silty Sand with some gravel, SM, brown-grey, slightly damp, medium density | 0 | | |
| | | | | 3 | | |
| 6 | Grab | | SC ALLUVIUM: Clayey Sand with trace gravel, SC, brown, slightly damp, medium density | 3 | | |
| | | | increase in clay | 8 | | |
| | | | decrease in clay | 9 | | |
| 11 | Grab | | Clayey Sand with little gravel, SC, brown, slightly damp, medium density | 10 | | |
| | | | | 15 | | |
| 16 | | | saturated, producing small amount of water | 15 | | |





Well Number: GW-2

Sheet: 2 of 3

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210191
Northing: 515725.8338

Driller: WDC
Project Number: 335404.F1.04
Start Date: Jan 4th - Jan 5th, 2006
Collar Elevation: 1948.24 ft amsl
Easting: 728356.3312

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 21 | Grab | | GC Clayey Gravel with sand, GC, brown, wet, medium density | -17 17 | | |
| | | | decrease in moisture to damp | -23 23 | | |
| 26 | Grab | | SC Clayey Sand with trace silt and gravel, SC, light brown, damp, medium density | -24 24 | | |
| | | | increase in density, more difficult drilling | -27 27 | | |
| 31 | Grab | | Tertiary CONGLOMERATE: Moderately weathered coarse Sands and Gravels with a Clay matrix, brown, damp | -28 28 | | |
| | | | | -34 34 | | |
| 36 | Grab | | | | | |



Well Number: GW-2

Sheet: 3 of 3

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210191
Northing: 515725.8338

Driller: WDC
Project Number: 335404.F1.04
Start Date: Jan 4th - Jan 5th, 2006
Collar Elevation: 1948.24 ft amsl
Easting: 728356.3312

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 41 | Grab | | Precambrian DIABASE: heavily altered primary mafics seemed to be altered to chlorite and very clayey after contact with water in formation, greenish color due to alteration and redish color due weathering, and partially altered plagioclase minerals. increase in water | -37 37 | | |
| | | | saturated, producing water | -40 40 | | |
| 46 | Grab | | | | | |
| 51 | | | | | | |
| 56 | Grab | | End of Log | -55 55 | | |



Well Number: GW-3

Sheet: 1 of 5

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210192
Northing: 509731.6744

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan. 11th 2006
Collar Elevation: 1926.56 ft amsl
Easting: 723638.6705

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|---|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| -4 | | | | | | |
| | | | Ground Surface | 0 | | |
| 1 | | | SC-SM FILL and TAILINGS: Clayey Silty Sand, SC-SM, light brown, slightly damp, medium density | 0 | | |
| | | | SC TAILINGS: Clayey Sand, SC, pinkish brown, damp, medium density | -2 2 | | |
| 6 | Grab | | increase in clay | -5 5 | | |
| 11 | Grab | | ML Sandy Silt with some clay, ML, light red-brown, damp, firm | -10 10 | | |
| 16 | Grab | | slightly darker red | -15 15 | | |



Well Number: GW-3

Sheet: 2 of 5

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210192
Northing: 509731.6744

Driller: WDC
Project Number: 335404.F1.04
Start Date: Jan. 11th 2006
Collar Elevation: 1926.56 ft amsl
Easting: 723638.6705

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 21 | Grab | | | | | |
| | | | | -23 23 | | |
| 26 | Grab | | SP ALLUVIUM: Poorly Graded Sand with trace clay and silt, SP, brown, damp-moist, medium density, medium to coarse sand | | | |
| | | | increase in gravel | -28 28 | | |
| 31 | Grab | | Poorly Graded Sand with some gravel, SP, brown, damp, dense | -30 30 | | |
| | | | increase in gravel and trace cobbles | -33 33 | | |
| 36 | Grab | | SP-GP Poorly Graded Sand and Gravel, SP-GP, brown, damp, dense | | | |



Well Number: GW-3

Sheet: 3 of 5

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210192
Northing: 509731.6744

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan. 11th 2006
Collar Elevation: 1926.56 ft amsl
Easting: 723638.6705

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|---|------------------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 41 | Grab | | | -42 | | |
| | | | GP Gravel Layer | 42 -43 | | |
| 46 | Grab | | SP-GP Poorly Graded Sand and Gravel with trace fines, SP-GP, brown, wet, dense | 43 | | |
| 51 | Grab | | GP Poorly Graded Sandy Gravel with trace clay, GP, brown, saturate, dense | -49 49 | | |
| 56 | Grab | | SP Coarse Sand Layer | -55 55 -56 56 | | |



Well Number: GW-3

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210192
Northing: 509731.6744

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan. 11th 2006
Collar Elevation: 1926.56 ft amsl
Easting: 723638.6705

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|---|--------------|--------------|---|
| | Sample Type | Soil Log | | | | |
| 81 | Grab | | GP-SP decrease in clay Poorly Graded Sand and Gravel with trace clay, GP-SP, brown, saturated, medium density | -77 77 | | Borehole stopped producing water with increased clay, on top of clay layer similar to what was logged in Well-31. When the bit was pulled out of the borehole it was encased in clay. |
| 86 | Grab | | decrease in water | -86 86 | | |
| 91 | Grab | | GC Clayey Gravel with sand, GC, brown, wet (not producing water), dense | -94 94 | | |
| 96 | Grab | | GC Clayey Gravel with sand, GC, brown, wet (not producing water), dense | -94 94 | | |



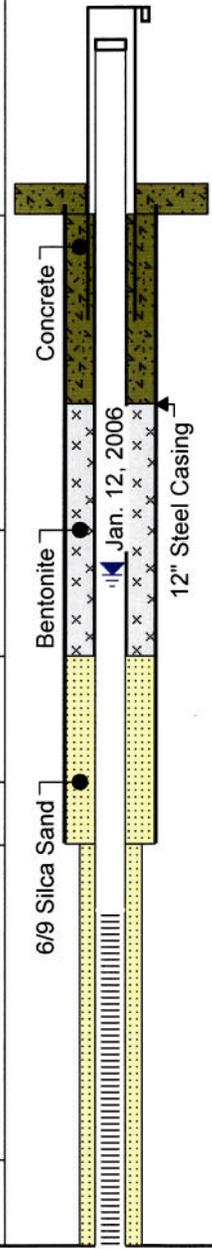
Well Number: GW-6

Client: USEPA
Project: Asarco Hayden Plant Site
Logged by: M. Henley
Well Registration ID: 55-210194
Northing: 511608.624

Driller: WDC
Project Number: 335404.FI.04
Start Date: Jan 10th 2006
Collar Elevation: 2003.6 ft amsl
Easting: 728624.0053

Drilling Method: Air Rotary with Casing Hammer

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|---|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| 4 | | | | | | |
| | | | | 0 | | |
| | | | Ground Surface | 0 | | |
| 1 | | | SM FILL: Silty Sand with little gravel and trace clay, SM, light brown, slightly damp, loose-medium density | | | |
| | | | | -5 | | |
| 6 | Grab | | SC ALLUVIUM: Clayey Sand with little gravel, SC, light brown slightly damp, medium density | 5 | | |
| | | | larger sand grains, increase gravel and clay | -7 | | |
| | | | decrease in gravel | 7 | | |
| | | | | -9 | | |
| 11 | Grab | | Clayey Sand with little gravel and trace silt, SC, light brown, slightly damp, medium density | 9 | | |
| | | | | -10 | | |
| | | | | 10 | | |
| | | | | -15 | | |
| 16 | Grab | | Clayey Sand with little gravel, SC, brown, moist-wet, medium density | 15 | | |



Bottom of hole had water and backfill was moist-wet when we returned to drilling borehole after surface casing was set.



Well Number: GW-6

Client: USEPA

Driller: WDC

Drilling Method: Air Rotary with Casing Hammer

Project: Asarco Hayden Plant Site

Project Number: 335404.FI.04

Logged by: M. Henley

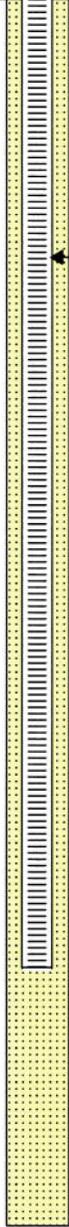
Start Date: Jan 10th 2006

Well Registration ID: 55-210194

Collar Elevation: 2003.6 ft amsl

Northing: 511608.624

Easting: 728624.0053

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|---|---|--------------|---|-------|
| | Sample Type | Soil Log | | | | |
| 21 | Grab |  | wet | -20 20 |  <p>4" Slot 20 Screen</p> | |
| | | | increase in gravel with trace cobbles, increase in density and decrease in water content to moist | -23 23 | | |
| 26 | Grab |  | Tertiary CONGLOMERATE: Moderately weathered coarse Sands and Gravels with a Clay matrix, medium bedding, brown, damp to moist | -24 24 | | |
| | | | alternating layers of moist and damp | -27 27 | | |
| 31 | Grab |  | | | | |
| 36 | Grab | | End of Log | -35 35 | | |



Well Number: GW-1(R)

Client: USEPA
Project: ASARCO Hayden RI
Logged by: M. Henley
Well Registration ID: 55-905332
Northing: 509634.5513

Driller: WDC
Project Number: 335404.FI.04
Start Date: Aug. 8th 2006
Collar Elevation: 2016.82 ft amsl
Easting: 729489.0982

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| -4 | | | | | | |
| | | | Ground Surface | 0 | | |
| 1 | | | SM TAILINGS/FILL: Silty Sand with trace gravel, SM, light brown, slightly damp, loose | 0 | | |
| | | | SM TAILINGS: Silty Sand, SM, light brown - light orange, slightly damp (more moist than at surface), loose | -2 2 | | |
| 6 | Grab | | | | | |
| 11 | Grab | | | | | |
| 16 | Grab | | | | | |



Well Number: GW-1(R)

Client: USEPA
Project: ASARCO Hayden RI
Logged by: M. Henley
Well Registration ID: 55-905332
Northing: 509634.5513

Driller: WDC **Drilling Method:** HSA/Air Rotary Stratex
Project Number: 335404.FI.04
Start Date: Aug. 8th 2006
Collar Elevation: 2016.82 ft amsl
Easting: 729489.0982

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|----------|--|--------------|--------------|-------|
| | Sample Type | Soil Log | | | | |
| | | | | -17 17 | | |
| | | | SM-ML Silty Sand with trace clay, SM, light brown, damp, loose | | | |
| | Grab | | SP Sand with some silt, SP, grey, damp, loose | -19 19 | | |
| 21 | | | | | | |
| | Grab | | CL Silty Clay, CL, light brown, moist, soft-firm | -24 24 | | |
| 26 | | | | | | |
| | Grab | | | | | |
| 31 | | | | | | |
| | Grab | | | | | |
| 36 | | | | | | |

Bentonite (mixed with borehole slough)



Well Number: GW-1(R)

Client: USEPA

Driller: WDC

Drilling Method: HSA/Air Rotary Stratex

Project: ASARCO Hayden RI

Project Number: 335404.FI.04

Logged by: M. Henley

Start Date: Aug. 8th 2006

Well Registration ID: 55-905332

Collar Elevation: 2016.82 ft amsl

Northing: 509634.5513

Easting: 729489.0982

| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|---|--|--------------|--------------|--|
| | Sample Type | Soil Log | | | | |
| | | | | -37 37 | | <p>Very tough drilling - able to break through at 40, probably a boulder or cobble</p> |
| | | | Transition TAILINGS to ALLUVIUM | -38 38 | | |
| | | | Cobble - Boulder | -40 40 | | |
| 41 | Grab | SC ALLUVIUM: Clayey Sand, SC, dark grey-brown, slight purple shade (may still have mix of tailings clay), damp-moist, medium density | | | | |
| | Grab | | | | | |
| 46 | | | increase gravel | -47 47 | | |
| | | | | -48 48 | | |
| | Grab | GC Gravel and Sand with Clay, GC, brown-grey, slightly damp, medium dense | | | | |
| 51 | | | | -52 52 | | |
| | Grab | | Tertiary CONGLOMERATE: Moderately weathered coarse Sands and Gravels with a Clay matrix, medium cementation, medium bedding, light brown to brown, slightly damp to damp | | | |
| 56 | | | | | | |



CH2MHILL

Well Number: GW-1(R)

Sheet: 4 of 4

Client: USEPA

Driller: WDC

Drilling Method: HSA/Air Rotary Stratex

Project: ASARCO Hayden RI

Project Number: 335404.FI.04

Logged by: M. Henley

Start Date: Aug. 8th 2006

Well Registration ID: 55-905332

Collar Elevation: 2016.82 ft amsl

Northing: 509634.5513

Easting: 729489.0982

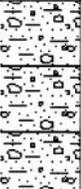
| Depth (ft) | Sample Info | | Soil Description | Depth / Elev | Well Drawing | Notes |
|------------|-------------|---|------------------|--------------|---|-------|
| | Sample Type | Soil Log | | | | |
| 61 | |  | | |  | |
| | | | End of Log | -59 59 | | |
| 66 | | | | | | |
| 71 | | | | | | |
| 76 | | | | | | |

TABLE F-1

Geologic Borehole Log and Monitoring Well Installation Details Summary
 Remedial Investigation Report
 ASARCO LLC Hayden, Arizona Plant Site

| | GW-01 | GW-01R ⁴ | GW-02 ⁵ | GW-03 | GW-06 |
|---|-------------------------------------|-------------------------------------|-----------------------|----------------------|------------|
| Geologic Unit: | | | | | |
| Tailings | 0' to 40' | 0' to 37' | NA | 0' to 23' | NA |
| Alluvium | 40' to 57' | 37' to 52' | 0' to 28' | NA | 0' to 24' |
| Gila Wash Alluvium | NA | NA | NA | 23' to 95' | NA |
| Conglomerate | 57' to 65' | 52' to 60' | 28' to 34' | NA | 24' to 35' |
| Diabase | NA | NA | 34' to 55' | NA | NA |
| TD Boring | 65' | 60' | 55' | 95' | 35' |
| Water Level during Drilling | Alluvium was damp but no free water | Alluvium was damp but no free water | 15' to 24' and at 40' | 49', produced at 75' | 10' |
| Well Construction: | | | | | |
| 12-inch Conductor Casing | 0' to 5.5' | 0' to 10' | 0' to 10' | 0' to 20' | 0' to 10' |
| Grout ² | 0' to 32' | 0' to 20' | 0' to 2' | 0' to 52' | 0' to 3' |
| Bentonite Seal | 32' to 35' | 20' to 35' | 2' to 6' | NA | 3' to 7' |
| #60 Choker Sand | 35' to 39' | 35' to 37' | 6' to 6.5' | 52' to 56' | NA |
| 6-9 Sand Pack | 39' to 61' | 37' to 60' | 6.5' to 31' | 56' to 95' | 7' to 31' |
| Screened Interval | 41' to 61' | 39' to 59' | 11' to 31' | 60' to 90' | 11' to 31' |
| Top of Collar for Standup Casing above Ground Surface | 3.32' | 3.62' | 3.67' | 3.02' | 3.33' |
| Water Level after Completion | 54.23' TOC | 55.96' TOC | 19.28' TOC | 38.49' TOC | 8.71' TOC |

Table Notes:

¹ Depths are feet below ground surface (bgs) and contact depths are estimates within 1 to 2 feet of the contact.

² Grout is cement/bentonite gel mixture, and the top portion (about 2 feet) is actually concrete used for surface pad.

³ Surface pads are about 7" high and circular with a radius of 1 foot.

⁴ GW-01R has a 10-in conductor casing as part of the surface seal

⁵ GW-02 was backfilled with bentonite from 55' to 32.5' bgs

⁶ TOC = Top of Collar