DRAFT

23 FEBRUARY 2017

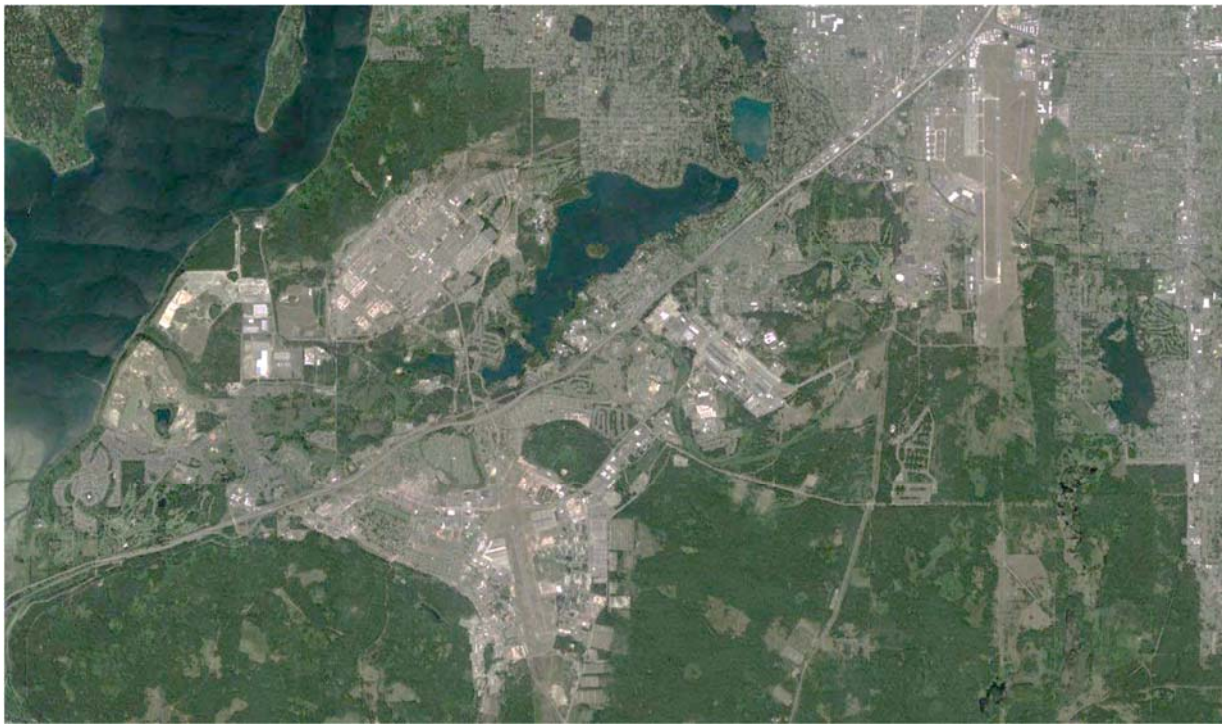
2016 Fort Lewis Agreed Order Groundwater Monitoring Plan

Building 4131 Former UST Site (AOC 8-2)
Building A0111 Former UST Site (AOC 8-4)
Building A1033 Former UST Site (AOC 9-2)
Gray Army Fuel Facility (AOC 10-8)

Joint Base Lewis-McChord

Pierce County, Washington

Joint Base Lewis-McChord Public Works – Environmental Division
IMLM-PWE
MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433



DEPARTMENT OF THE ARMY
HEADQUARTERS, JOINT BASE LEWIS-MCCHORD
1010 LIGGETT AVENUE, BOX 339500, MAIL STOP 14A
JOINT BASE LEWIS-MCCHORD, WA 98433-9500

REPLY TO ATTENTION OF

Public Works

February 21, 2017

Mr. Charles Hoffman
Washington Department of Ecology
Attention: Hazardous Waste and Toxics Reduction Program
PO Box 47600
Olympia, Washington 98504-7600

Dear Mr. Hoffman:

Enclosed for your review is one paper copy of the 2016 Draft Fort Lewis Agreed Order Groundwater Monitoring Plan: Building 4131 Former UST Site (AOC 8-2); Building A0111 Former UST Site (AOC 8-4); Building A1033 Former UST Site (AOC 9-2); Gray Army Fuel Facility (AOC 10-8), Joint Base Lewis-McChord. This document updates changes made to the Fort Lewis Agreed Order Sampling and Analysis Plan dated February 2014.

This document includes sampling procedures following guidance from WAC 173-340-820 and other applicable Ecology guidance. A Sampling and Analysis Plan, Quality Assurance Project Plan compliant with QA/ QC protocol outlined in WAC 173-340-820 and a Site Specific Health and Safety Plan per 29 CFR 1910.120 are also included in this document.

If you have any questions or need clarification, please contact me at (253) 477-3742.

Sincerely,

GHEBRESLLASSIE.MESERET.C.1015675159
Digitally signed by GHEBRESLLASSIE.MESERET.C.1015675159
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=GHEBRESLLASSIE.MESERET.C.1015675159
Date: 2017.02.21 13:07:22 -08'00'

Meseret Ghebresllassie
Installation Restoration Program Manager
Public Works Department

DRAFT

2016 FORT LEWIS AGREED ORDER GROUNDWATER MONITORING PLAN

BUILDING 4131 FORMER UST SITE (AOC 8-2)
BUILDING A0111 FORMER UST SITE (AOC 8-4)
BUILDING A1033 FORMER UST SITE (AOC 9-2)
GRAY ARMY FUEL FACILITY (AOC 10-8)

FEBRUARY 23, 2017

JOINT BASE LEWIS-MCCHORD
PIERCE COUNTY, WASHINGTON

SEALASKA ENVIRONMENTAL SERVICES, LLC
POULSBO, WASHINGTON

Prepared by: _____
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Senior Geologist
(360-930-3195)

Approved by: _____
Scott Elkind, PE
Project Manager
(360-626-3991)

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APPENDICES

FIGURES

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TABLES

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
AS	air sparge
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylenes
CFR	Code of Federal Regulations
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERS	Environmental Remediation Services
FLAO	Fort Lewis Agreed Order
GAAF	Gray Army Airfield
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
µg/L	micrograms per liter
mL	milliliter
MTCA	Model Toxics Control Act
MW	monitoring well
Plan	Groundwater Monitoring Plan
PPE	personal protective equipment
PQL	Practical Quantification Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
Sealaska	Sealaska Environmental Services, LLC
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVE	soil vapor extraction
TPH-D	diesel-range total petroleum hydrocarbons
TPH-G	gasoline-range total petroleum hydrocarbons

ACRONYMS AND ABBREVIATIONS (continued)

TPH-HO	heavy oil-range total petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
UST	Underground Storage Tank
VOC	volatile organic compound
WAC	Washington Administrative Code

1 INTRODUCTION

This Groundwater Monitoring Plan (Plan) describes groundwater sampling activities at Fort Lewis Agree Order (FLAO) sites on Joint Base Lewis-McChord (JBLM) near Tacoma, Washington (Figure 1-1). The FLAO sites are being addressed in accordance with the requirements of the 40 Code of Federal Regulations (CFR) 300.420(c)(4)(i) and Washington State Department of Ecology (Ecology) Washington Administrative Code (WAC) 173-340-820. This plan is an update of the Fort Lewis Agreed Order Groundwater Sampling and Analysis Plan (Versar 2014) dated February 2014. This document includes:

- Sampling and Analysis (SAP);
- Quality Assurance Project Plan (QAPP); and
- Site Safety and Health Plan (SSHP).

1.1 SITE LOCATION AND USE

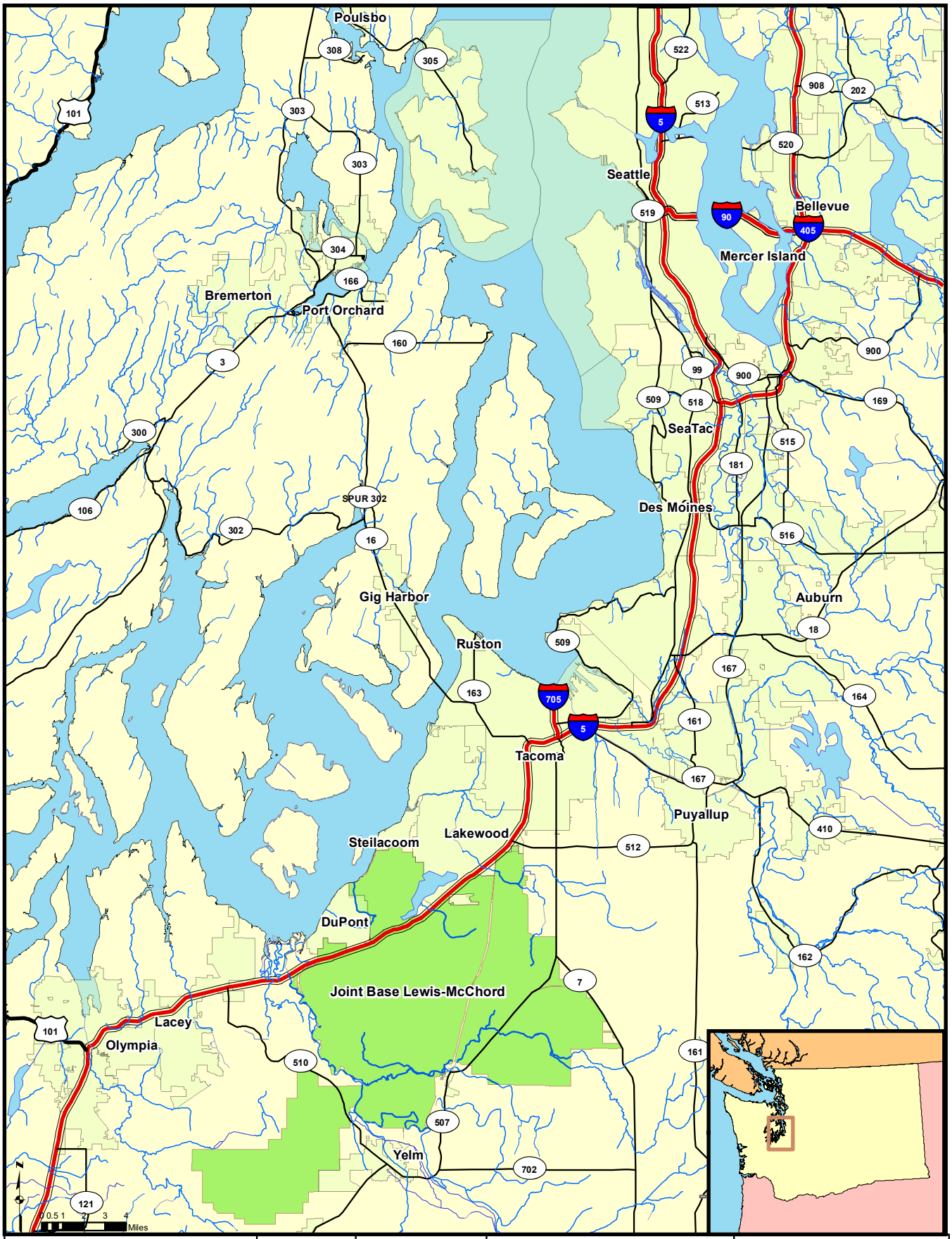
The FLAO contains four sites:

- Building 4131 Former Underground Storage Tank (UST) Site (Area of Concern [AOC] 8-2);
- Building A0111 Former UST Site (AOC 8-4)
- Building A1033 Former UST Site (AOC 9-2); and
- Gray Army Airfield (GAAF) Fuel Facility (AOC 10-8).

Locations of the four AOCs are presented on Figure 1-2. These sites are being addressed in accordance with Washington Ecology's Model Toxics Control Act (MTCA) regulations.

1.1.1 Building 4131 Former UST Site (AOC 8-2)

The site is situated near the Pendleton underpass of Interstate 5 where Pendleton Avenue and Lewis Drive intersect (Figure 1-2). A 500-gallon heating oil tank was removed from the former building and UST site in 1996. The site is not currently being used. The land use of the site is designated for Open Space in the JBLM Master Plan.



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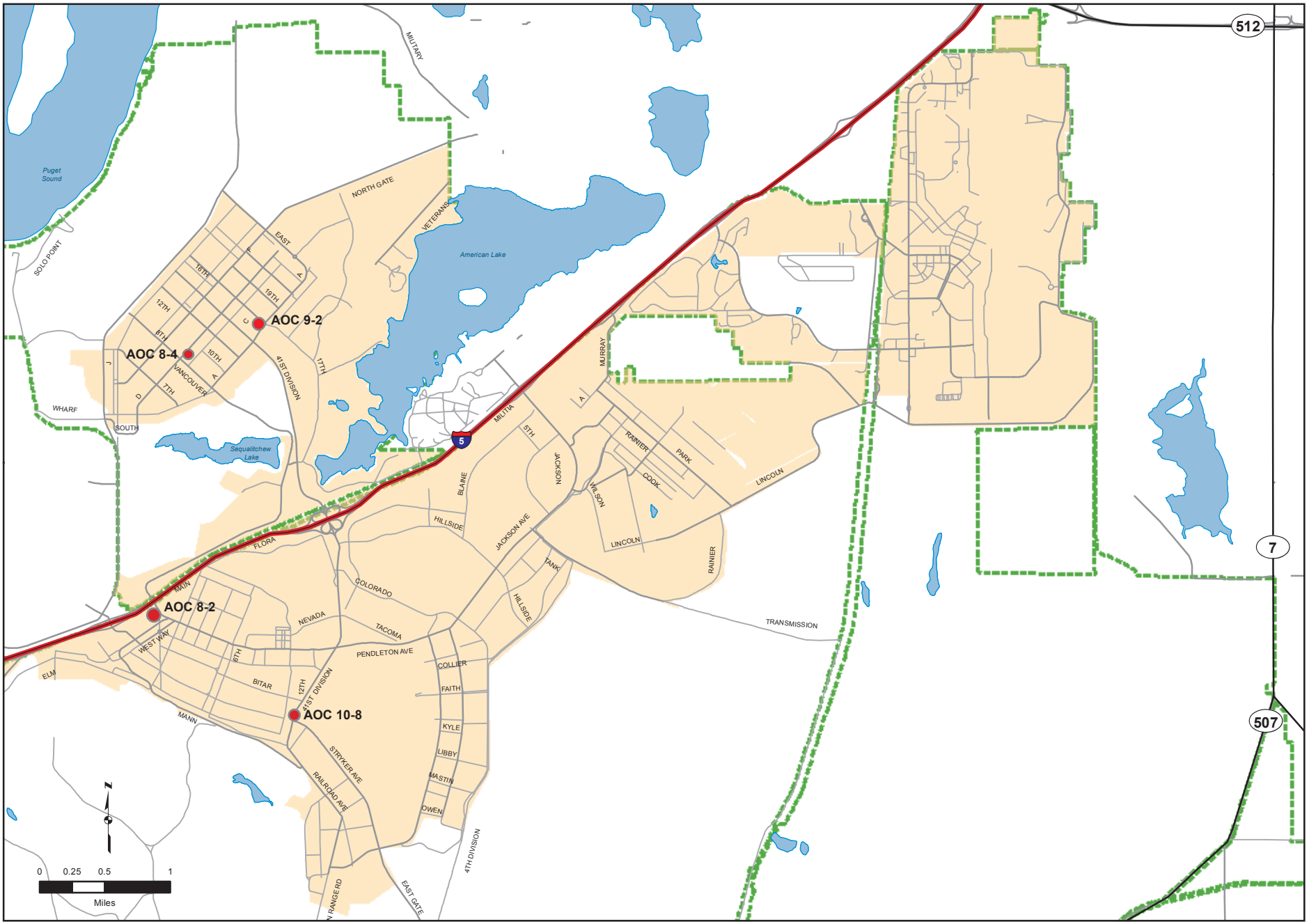
Map Data: Coordinate System: UTM Zone 10 Horizontal Datus: WGS 84	**USACE**	**SEALASKA**	**Figure 1-1** **Joint Base Lewis-McChord** **Location Map**	**Contract #** **W912DW-11-D-1031** **Task Order 0001**



Legend

Cantonment Area JBLM Boundary

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

USACE

SEALASKA

Figure 1-2
Projects Location Map

Path: H:\JBLM\MXD\FLAO_FIG_1-2_P_LOC.mxd
Date: 9/25/2014

1.1.2 Building A0111 Former UST Site (AOC 8-4)

The site is located on Lewis North near the intersection of D Street and 9th Street (Figure 1-2). A 300-gallon heating oil tank and associated soil contamination were removed from the former building and UST site in 1996. A chemical battalion administration building was constructed on the site in 2010 and 2011. Most of the construction and landscaping was completed in August 2011. The land use of the site is designated for Administration in the JBLM Master Plan.

1.1.3 Building A1033 Former UST Site (AOC 9-2)

This site is a former gas station located on North Fort Lewis near the intersection of 17th Street and A Street (Figure 1-2). Significant soil contamination was encountered during the removal of two 4,000-gallon gasoline USTs in 1994. As a result, approximately 1,138 cubic yards of petroleum contaminated soil was removed in 1994. The final 1994 excavation measured approximately 50′ x 65′ x 35′ deep. It should also be noted that a 10,000-gallon UST, associated piping, and fuel dispenser were removed in 1998. No additional soil removal took place during the 1998 tank removal since no evidence of a release from this tank was discovered.

A credit union and Domino's Pizza are currently located on the site. A combination air sparge (AS)/soil vapor extraction (SVE) system was constructed in 2009 under the building in order to intercept petroleum vapors in the vadose zone preventing them from migrating into the building (Versar 2009). The SVE system has been operating since February 2010. A pilot test was conducted on the AS/SVE system in November 2011. The land use of the site is designated for Community Services in the JBLM Master Plan.

1.1.4 GAAF Fuel Facility (AOC 10-8)

The GAAF Fuel Facility is located on the northwest side of Gray Army Airfield adjacent to Building 3034 (Figure 1-2). Four 25,000-gallon jet fuel USTs were removed from the site in 1998. The site is currently used as a parking lot and right-of-way. The land use of the site is designated as Aviation in the JBLM Master Plan.

1.2 SITE INVESTIGATIONS

1.2.1 Building 4131 Former UST Site (AOC 8-2)

Detailed background information is included in the FLAO Remedial Investigation Work Plan (United States Army Corps of Engineers and Fort Lewis Public Works 2004) and the latest groundwater monitoring report for the site (Versar 2012).

In summary, six monitoring wells (MWs) have been installed (4131-MW01 through 4131 MW06). Diesel-range total petroleum hydrocarbons (TPH-D) have consistently been detected above the MTCA Method A groundwater cleanup level of 500 micrograms per liter (µg/L) in 4131-MW02 and 4131-MW03 and once in 4131-MW04. TPH-D has never been detected in downgradient monitoring well 4131-MW05. The TPH-D plume has been delineated. Groundwater monitoring at this site has been conducted since 2005.

1.2.2 Building A0111 Former UST Site (AOC 8-4)

Background information is included in the FLAO Remedial Investigation Report (Bussey 2008). In summary, eight monitoring wells have been installed to date (A0111-MW01 through A0111-MW08) and groundwater monitoring events have been conducted since 2005.

Monitoring wells A0111-MW01 through A0111-MW03 were decommissioned by Krazan and Associates in February 2010 because they were within the footprint of a new, chemical battalion administration building. Three new monitoring wells, designated as A0111-MW06 through A0111-MW08 were constructed and developed in February 2010 to replace the three decommissioned wells. Wells A0111-MW06 through A0111-MW08 were initially sampled on 1 March 2010 after development.

1.2.3 Building A1033 Former UST Site (AOC 9-2)

Detailed background information is included in the FLAO Remedial Investigation Report (Bussey 2008). Eight monitoring wells have been installed (95 A17-1, 95 A17-2, 95 A17-3A, 95 A17-4, 96 A17-5, 96 A17-6, 07 A17-7, and 10 A17- 08). Groundwater monitoring events have been conducted from 1995 to present.

The primary exceedances at the site are gasoline-range total petroleum hydrocarbons (TPH-G) as well as benzene, toluene, ethylbenzene, and xylenes (BTEX) above MTCA Method A groundwater cleanup levels. TPH-G has been detected at or above the MTCA Method A cleanup level of 800 µg/L in monitoring wells: 95 A17-2, 95 A17-3A, 07 A17-7, and 10 A17-8. Benzene has been detected at or above the MTCA Method A cleanup level of

5 µg/L in monitoring wells: 95 A17-3A, 07 A17-7, and 10 A17-8. Toluene, ethylbenzene, and total xylenes are typically detected above their respective MTCA Method A cleanup levels of 1,000 µg/L, 700 µg/L, and 1,000 µg/L in samples collected from 95 A17-3A and 10 A17 8 and occasionally in other wells.

1.2.4 GAAF Fuel Facility (AOC 10-8)

Detailed background information is included in the FLAO Remedial Investigation Report (Bussey 2008). In summary, five monitoring wells have been installed to date from 2005 through 2009 (AOC 10-8-MW01 through AOC 10-8-MW04 and AOC 10-8-B05). Initially the monitoring wells were designated as JP-MW-1 through JPMW- 4, and then changed to AOC 10-8-MW01 through AOC 10-8-MW04 in a groundwater SAP dated 18 October 2005. Beginning with the August 2010 and 2011 monitoring report these monitoring wells are referred to as JP-MW-1 through JP-MW-4 per the original numbering (Versar 2012). Groundwater monitoring events were conducted from 1993 to 1995 and from 2004 to present. In 2007 the site was paved over and is currently a parking lot. During construction activities JP-MW-4 was paved over and is no longer accessible and AOC 10-8-B05 was damaged. The casing has been cracked and bent and personnel are unable to collect samples from the well using a pump. Beginning in 2008 samples have been collected from AOC 10-8-B05 using a disposable bailer.

1.3 SITE HYDROGEOLOGY

The aquifer of interest for all four sites is the upper Vashon Aquifer. The unconfined upper Vashon Aquifer consists of glacial outwash deposits generally underlain by lower permeability Vashon Till deposits. Depth to groundwater is typically 20 to 30 feet below ground surface (bgs) at AOC 8-2, 15 to 20 feet bgs at AOC 8-4, 20 to 30 feet bgs at AOC 9-2, and 35 to 45 feet bgs at AOC 10-8. The regional direction of groundwater flow in the Vashon Aquifer across the JBLM Cantonment Area is generally to the west, with eventual discharge at Puget Sound. Local flow direction at each site is generally:

- To the southwest at AOC 8-2;
- To the northwest at AOC 8-4;
- To the west at AOC 9-2; and
- To the northwest at AOC 10-8.

The closest potential downgradient receptor to each site is:

- JBLM production Well 17 and the City of Dupont's Bell Hill Wells are located approximately 1/4 mile southwest and 2/3 mile northwest of AOC 8-2, respectively. However, these wells are screened in deeper aquifers than the upper Vashon Aquifer.
- There are no potential receptors currently located downgradient of either AOC 8-4 or AOC 9-2.
- JBLM production Well 17 is located approximately 1.5 miles west of AOC 10-8 and is screened at a depth of approximately 460 to 480 feet bgs (below the upper Vashon Aquifer).

1.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team includes representative from Ecology, Sealaska Environmental Services LLC (Sealaska), JBLM Public Works and ALS Environmental Labs of Kelso, Washington (Table 1-1). Meseret Ghebresllassie is the JBLM Installation Restoration Program (IRP) Program Manager. Ms. Ghebresllassie will ensure that the overall goals of the program meet the Defense Environmental Restoration Program objectives. The Department of Defense is the lead agency for this project, but will have assistance from Mr. Charles Hoffman of the Hazardous Waste and Toxics Reduction Program with Ecology. The Sealaska Project Manager, Scott Elkind, will oversee the long-term groundwater monitoring. Samples will be analyzed by ALS Environmental of Kelso, Washington.

Table 1-1. Personnel Roles and Responsibilities

Organization	Name	Title	Responsibilities
Washington Department of Ecology	Charles Hoffman	Hazardous Waste & Toxics Reduction	Regulatory overview
Joint Base Lewis-McChord Public Works	Meseret Ghebresllassie	Installation Restoration Program Manager	Final review, report signatory
Sealaska Environmental Services	Scott Elkind	Project Manager	Overall project management
	V. Sunrise Patterson	Long-Term Monitoring Field Lead	Field lead, Site Safety and Health Officer; report preparation
	Will Kaage, Tom Malamakal	Field Technicians	Collect field samples, report preparation
Tetra Tech	Keir Craigie	Project Chemist/Quality Control Manager	Data quality review. Oversee data quality control.
ALS Environmental Labs	Kurt Clarkson	Laboratory Project Manager	Lab contact, quality control, final analytical report signatory

2 SAMPLING AND ANALYSIS PLAN (SAP)

This section presents required planning and documentation to support groundwater sampling at FLAO sites in general accordance with 40 CFR 300.420(c)(4), applicable Ecology regulations WAC 173-340-820 and WAC 173-340-810, and US Environmental Protection Agency (EPA) guidance. Descriptions of all MWs currently being used to measure depth to water or sample are presented in Table 2-1. Boring logs and well completion diagrams for all of the current wells at all four FLAO sites are presented in Appendix A.

2.1 GROUNDWATER MEASUREMENT, SAMPLING, AND ANALYSIS

Groundwater sampling events will be conducted by Sealaska personnel semiannually in the wet (February or March) and dry (August or September) seasons (Table 2-2). Proposed monitoring locations are presented on Figures 2-1 through 2-4.

During each monitoring and sampling event an electronic water level indicator will be used to measure depth to water in each monitoring. All measurements will be recorded to the nearest 0.01-foot from the measuring point on the top of the monitoring well casing (notch or mark or north side of casing).

Monitoring wells at AOC 8-2 are sampled using dedicated Well Wizard bladder pumps.

Monitoring wells at AOC 8-4 are purged and sampled using a peristaltic pump and dedicated sample tubing.

Monitoring wells 95 A17-3a, 95 A17-4, and 07 A17-7 at AOC 9-2 have dedicated bladder pumps in them. During construction of the credit union contractors hit monitoring well 95 A17-2's monument and broke the bladder pump inside of it. The monument was repaired, however; the pump fell down to the bottom of the well and efforts to retrieve the pump have been unsuccessful. Well 95 A17-2 is currently sampled using a peristaltic pump and dedicated tubing during each sampling event. A strong gasoline odor comes from 10 A17-8 when the air sparge system is running and the pressure cap is not secured to the casing. The cap is tightened down when the well is not being sampled. The wells at site AOC 9-2 should only be sampled when the air sparge system is not running.

Due to an obstruction in monitoring well AOC 10-8-B05 (AOC 10-8), personnel use a disposable bailer to purge three well volumes from AOC 10-8-B05 prior to sampling. A submersible Grundfos pump is used to sample JP-MW02.

Table 2-1. Monitoring Well Construction Details

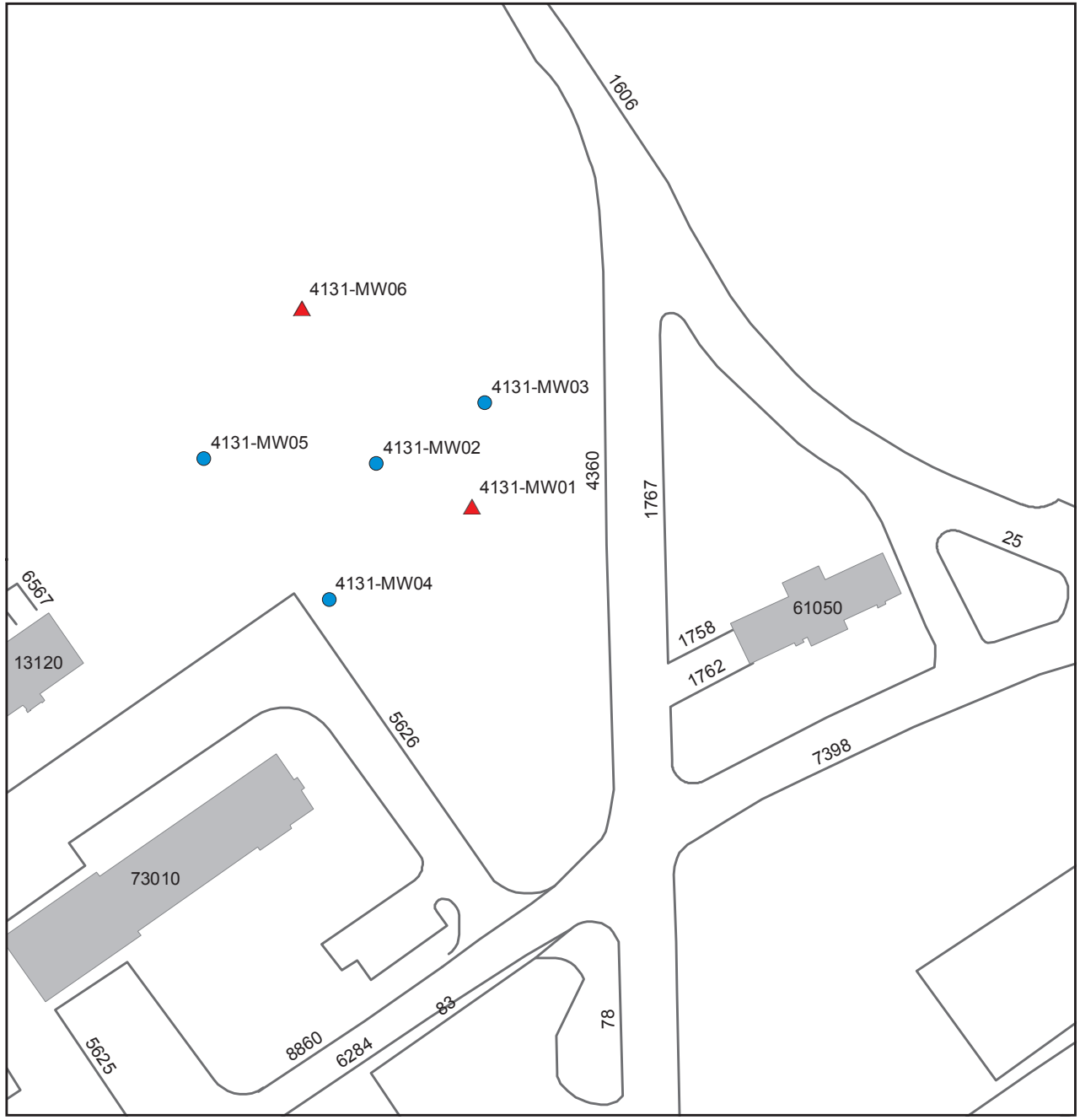
Location ID	Northing WGS 84	Easting WGS 84	TOC Elevation (ft AMSL)	Well Depth (ft bgs)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Completion Date
Building 04131 AOC-8-2							
4131-MW01	5215634.5	529115.8	266.57	37.5	27.5	37.5	21-Feb-05
4131-MW02	5215643.6	529095.4	265.39	33	23	33	23-Feb-05
4131-MW03	5215656.6	529118.6	267.42	34	24	34	22-Feb-05
4131-MW04	5215614.5	529085.2	264.98	34	23	33	22-Dec-05
4131-MW05	5215644.6	529058.4	264.49	34	23	33	20-Dec-05
4131-MW06	5215676.9	529079.3	266.45	35	23	33	20-Dec-05
Building AO111 AOC-8-4							
A0111-MW04	5218894.39	529498.24	230.88	28.5	17	27	19-Dec-05
A0111-MW05	5218864.97	529469.978	230.84	29	17	27	19-Dec-05
A0111-MW06	5218832.28	529534.8	227.69	29	19	29	5-Mar-10
A0111-MW07	5218911.85	529523.91	230.88	30	20	30	5-Mar-10
A0111-MW08	5218871.71	529489.3	231.24	30	20	30	5-Mar-10
Building A1033 AOC 9-2							
95-A17-1	5219211.8	530441.04	236.9	42.5	27.1	42.1	18-Aug-95
95-A17-2	5219199.78	530377.39	235.9	42.2	27.0	42.0	17-Aug-95
95-A17-3a	5219229.15	530377.99	235.9	44.5	29.3	44.3	17-Aug-95
95-A17-4	5219240.22	530396.92	236.8	42.5	26.6	42.0	18-Aug-95
96-A17-5	5219268.15	530331.27	233.9	45.0	29.8	44.8	22-Jan-96
96-A17-6	5219288.6	530365.07	235.1	45.0	29.8	44.8	22-Jan-96
07-A17-7	5219226	530335	233.2	37	22	37	21-Jun-07
10-A17-8	5219219.2	530397.6	235.8	39	29	39	8-Oct-10
Building 3034 - GAAF Fuel Facility AOC 10-8							
AOC 10-8-B05	5214424.45	530833.657	281.39	47.5	37.5	47.5	1-May-05
JP-MW-01	5214386.4	530828.5	281.56	51.7	39.6	49.6	27-May-93
JP-MW-02	5214452.6	530794.3	279.33	50.0	39.2	49.2	27-May-93
JP-MW-03	5214456.9	530848.1	280.7	50.3	39.6	49.6	25-May-93

Notes:
TOC = Top of casing
ft AMSL = Feet above mean sea level
ft bgs = Feet below ground surface

Table 2-2. Proposed Groundwater Sampling Schedule

	Wet Season Sampling Event				Dry Season Sampling Event			
Well ID	DTW Measured	TPH-D / TPH-HO	TPH-G	BTEX	DTW Measured	TPH-D / TPH-HO	TPH-G	BTEX
AOC 8-2								
4131-MW01	X				X			
4131-MW02	X	X			X	X		
4131-MW03	X	X			X	X		
4131-MW04	X	X			X	X		
4131-MW05	X	X			X	X		
4131-MW06	X				X			
AOC 8-4								
A0111-MW04	X	X			X	X		
A0111-MW05[1]	X				X			
A0111-MW06[1]	X				X			
A0111-MW07[1]	X				X			
A0111-MW08	X	X			X	X		
AOC 9-2								
95-A17-1	X				X			
95-A17-2	X		X	X	X		X	X
95-A17-3a	X		X	X	X		X	X
95-A17-4	X		X	X	X			
96-A17-5	X				X			
96-A17-6	X				X			
07-A17-7	X		X	X	X		X	X
10-A17-8	X		X	X	X		X	X
AOC 10-8								
AOC 10-8-B05	X	X			X	X		
JP-MW01	X				X			
JP-MW02	X	X			X	X		
JP-MW03	X				X			
Duplicate		X	X	X		X	X	X
Trip Blank				X				X
Total	23	9	6	7	23	9	5	6

Notes:
Wet season sampling event is typically conducted in February - April
Dry season sampling event is typically conducted in August - October
[1] – Site AOC 8-4 wells A0111-MW04, A0111-MW05, and A0111-MW06 have never had TPH concentrations detected above cleanup criteria. These wells will only have DTW readings taken beginning in 2017.
DTW = Depth to Water
TPH-D/TPH-HO = Diesel- and heavy oil-range total petroleum hydrocarbons analyzed by method NWTPH-Dx
TPH-G = Gasoline-range total petroleum hydrocarbons analyzed using method NWTPH-Gx
BTEX = Benzene, toluene, ethylbenzene, and total xylenes analyzed using EPA Method 8260C



Notes:

Wet season depth to water measured and samples collected typically during February or March

Dry season depth to water measured and samples collected typically during August or September

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

Legend

- Monitoring Well - Depth to Water Measured and Sampled
- Monitoring Well - Depth to Water Measured

N

0 20 40 80
Feet

USACE

SEALASKA

Figure 2-1
AOC 8-2
Sample Locations

Path: P:\Production\Fig\JBLM\MXD\FLAO_FIG_2-1_AOC_8-2.mxd
Date: 12/2/2014

Notes:

Wet season depth to water measured and samples collected typically during February or March

Dry season depth to water measured and samples collected typically during August or September

AO111-MW05 sampled during wet season only

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

Legend

- Monitoring Well -Sampled

N

0 12.5 25 50

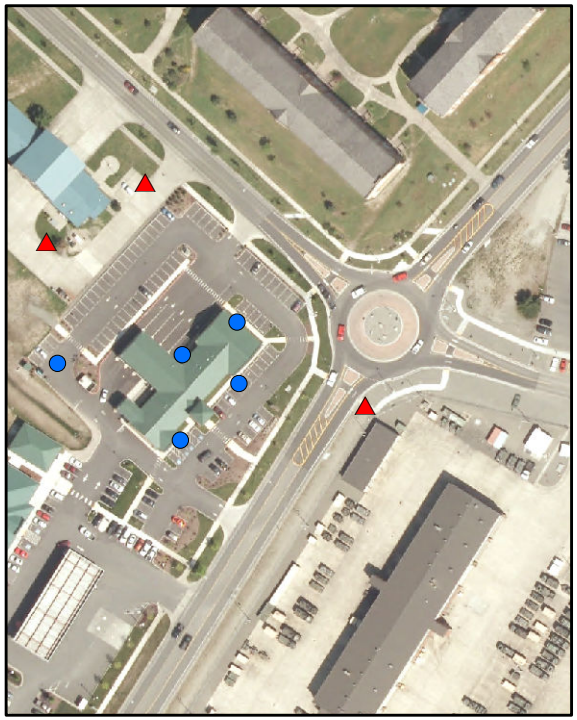
Feet

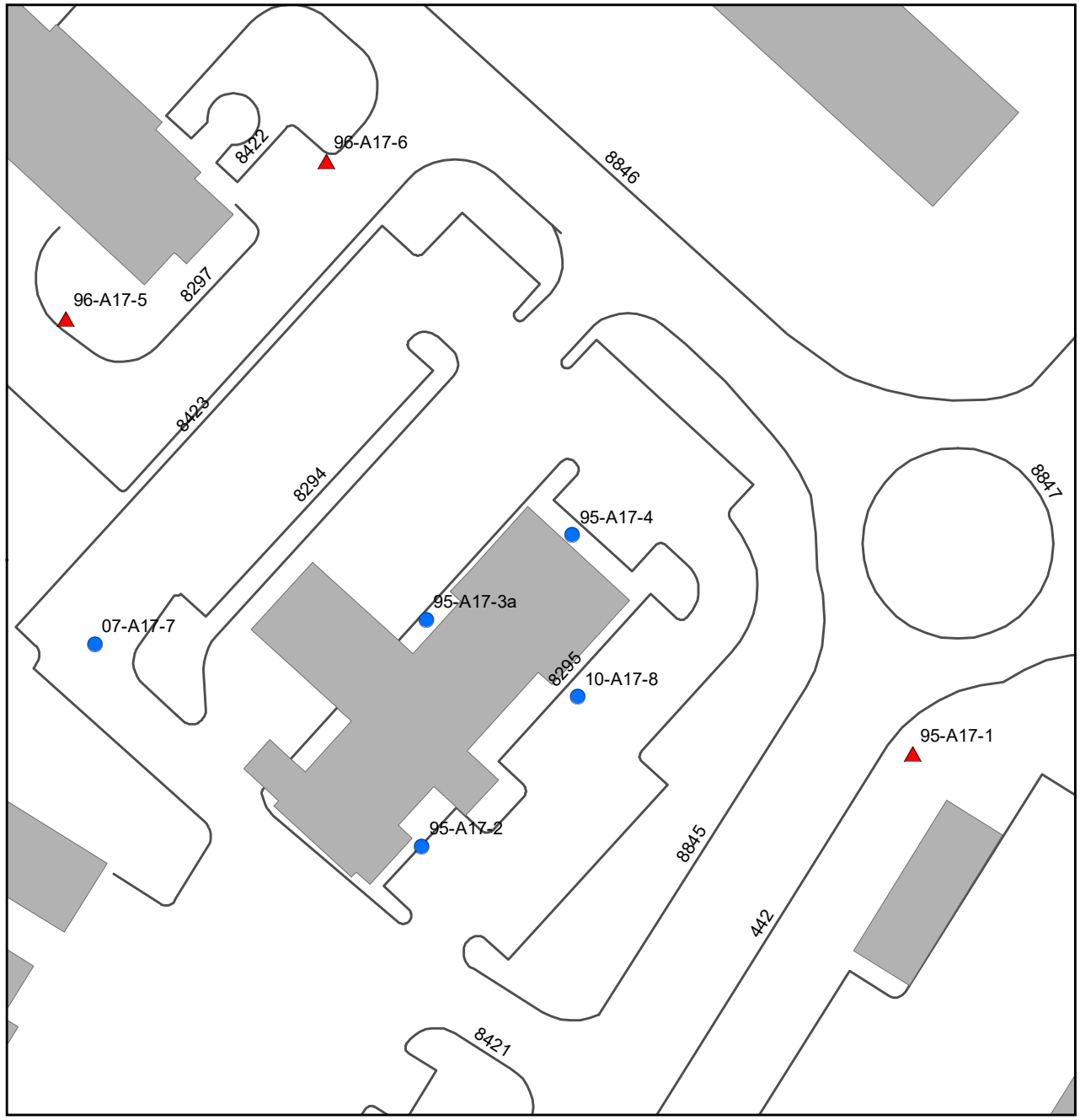
USACE

SEALASKA

Figure 2-2
AOC 8-4
Sample Locations

Path: P:\Dropbox (SES)\Fig\JBLM\MXD\FLAO_FIG_2-2_AOC_8-4.mxd
Date: 2/1/2017





Notes:

Wet season depth to water measured and samples collected typically during February or March

Dry season depth to water measured and samples collected typically during August or September

95-A17-4 sampled during wet season only

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

Legend

- Monitoring Well - Depth to Water Measurement and Sample
- Monitoring Well - Depth to Water Measurement

N

0 12.5 25 50
Feet

USACE

SEALASKA

Figure 2-3
AOC 9-2
Sample Locations

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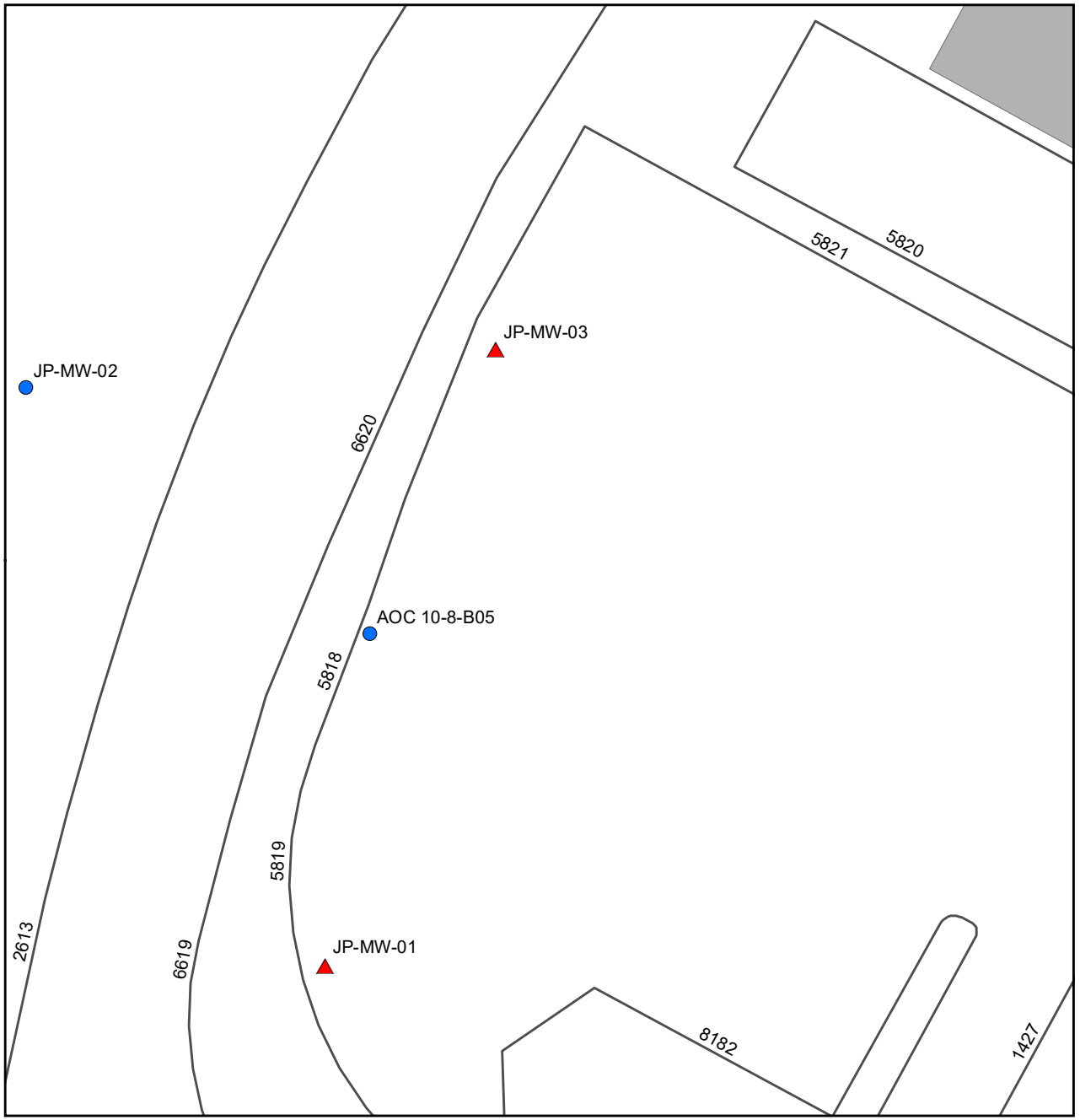
Date: 2/1/2017



Notes:

Wet season depth to water measured and samples collected typically during February or March

Dry season depth to water measured and samples collected typically during August or September

Map Data:
Coordinate System: UTM, Zone 10
Horizontal Datum: WGS 84

Legend

- Monitoring Well - Depth to Water Measured and Sampled
- Monitoring Well - Depth to Water Measured

N

0 10 20 40
Feet

USACE

SEALASKA

Figure 2-4
AOC 10-8
Sample Locations

Path: P:\Dropbox (SES)\Fig\JBLM\MXD\FLAO_FIG_2-4_AOC_10-8.mxd
Date: 2/1/2017

Standard Operating Procedures for collection of groundwater samples are included as Appendix B.

When using a submersible or bladder pump, the pump intake is positioned approximately two to four feet above the bottom of the monitoring well screen. A variable frequency drive controller will be used to limit the purging flow rate to less than one liter per minute. During purging, relative water levels will be monitored with an electronic water level indicator and water quality parameters such as pH, specific conductivity, temperature, dissolved oxygen, and turbidity are measured with a pre-calibrated Horiba or similar meter to verify stabilization. Acceptable stabilization criteria (EPA 2002) are listed on the Well Inspection, Purging, and Field Measurement Form included in Appendix C. Groundwater samples will be collected immediately after the field measurements have stabilized without turning off the pumping system. In the event that drawdown is excessive or that water quality parameters do not stabilize, then the monitoring well will be purged until three well volumes have been removed or the pump is covered by less than two feet of water, whichever occurs first.

Groundwater samples collected from AOC 8-2, AOC 8-4, and AOC 10-8 will be analyzed for TPH-D and heavy oil-range total petroleum hydrocarbons (TPH-HO) by Ecology Method NWTPH-Dx. Groundwater samples collected from AOC 9-2 will be analyzed for TPH-G by Ecology Method NWTPH-G and BTEX by EPA Method 8260C. Sample containers will be provided by the analytical laboratory. All 40-mL sample bottles for TPH-G and BTEX analyses will be filled to a positive meniscus so that these containers do not contain any headspace. All other 9 sample containers will be filled completely in order to provide the laboratory with sufficient sample volume for analysis. Table 2-3 presents the appropriate sample containers, preservation, and holding time for these analyses.

2.2 AOC 9-2 AIR SPARGE / SOIL VAPOR EXTRACTION SYSTEM MONITORING AND SAMPLING

Performance monitoring of an AS/SVE currently in operation at AOC 9-2 will involve groundwater and air sampling to observe trends in TPH-G and BTEX concentrations in groundwater and soil vapor. Details for air sample collection, including equipment descriptions and procedures applicable to performance and confirmation monitoring of the system are described in the sample and analysis section of the Draft Interim Action Work Plan for Area of Concern 9-2 (Versar 2013).

Table 2-3. Sample Preparation and PQLs

Analytical Method	Container Description	Preservation	Holding Time	Typical Lab PQLs (µg/L)	MTCA Method A Cleanup Level (µg/L)
EPA Method 8260C (Total VOCs)	Three 40mL glass VOA vials with Teflon septa lids*	Cool to 4ºC, HCl preserved, no headspace	14 days	0.2 to 1.5	Benzene = 5.0 Toluene = 1,000 Ethylbenzene = 700 Total Xylenes = 1,000
NWTPH-Gx (TPH-G)	Two 40mL glass VOA vials with Teflon septa lids	Cool to 4ºC, HCl preserved, no headspace	14 days	100	800
NWTPH-Dx (TPH-D, TPH-HO)	Two 1L amber glass jars	Cool to 4ºC, HCl preserved	14 days	250, 500	500

Notes:
*For location requiring matric spike/matrix spike duplicate (MS/MSD) samples, a total of nine VOA vials will be collected.
PQL = Practical quantification limit
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act - Chapter 173-340 WAC
VOCs = Volatile organic compounds which include Benzene, Toluene, Ethylbenzene, and Xylenes
mL = milliliters
HCl = Hydrochloric acid
TCE = Trichloroethylene
TPH-G = Gasoline range total petroleum hydrocarbons
TPH-D / TPH-HO = Diesel and heavy oil range total petroleum hydrocarbons
VOA = Volatile organic analysis

2.3 FIELD RECORDKEEPING

Sealaska personnel will document activities for each sampling event in the field logbook and on the Well Inspection, Purging, and Field Measurement Form. A copy of this form is included in Appendix C. Once completed, the original signed forms will be maintained for at least 3 years.

2.4 EQUIPMENT DECONTAMINATION PROCEDURES

All non-dedicated monitoring and sampling equipment will be cleaned before use. Non-dedicated equipment will include an electronic water level indicator and submersible pump (with cable).

Following use at each monitoring location, the affected portions of the water level indicator will be scrubbed with potable water containing diluted detergent (i.e., Liquinox) before being sufficiently rinsed with potable water. Likewise, the outside of the pump and affected portions of the cable will be scrubbed with potable water containing diluted detergent. Then, the inside of the pump will be flushed with potable water containing diluted detergent followed by flushing with potable water. Finally, the pump and cable will be sufficiently rinsed with potable water. Disposable nitrile gloves will be changed before working at the next monitoring location.

Dedicated tubing will be stored in the monitoring well to prevent cross-contamination.

Personal decontamination is discussed in the Site Safety and Health Plan (Section 4).

2.5 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated during sampling events will consist of purge water, decontamination water, and personal protective equipment (PPE) (e.g., nitrile gloves). IDW will be handled and disposed of as follows:

- Purge water and decontamination water from monitoring wells will be collected in 5-gallon buckets and sampled for waste characterization. If all results are below cleanup criteria, the water will be discharged at the Logistics Center Landfill 2 pump and treat system. If results are above cleanup criteria, the water will be disposed of through the new Industrial Wastewater Treatment Plant (with prior permission of JBLM Public Works) or disposed of offsite.
- Disposable Personal Protective Equipment (PPE) and equipment will be disposed of in a Sealaska dumpster as part of the normal solid waste stream.

2.6 SAMPLE LABELING, HANDLING AND SHIPMENT

Sample labels will clearly indicate the site location, sample name, date, time, sampler's initials, parameters to be analyzed, preservative added (if any), and any pertinent comments. Sample nomenclature will consist of the monitoring well name (e.g., 4131-MW01).

Sample packaging and shipping procedures are based on EPA specifications and United States Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24. All samples will be transported as "Environmental Samples" and not as hazardous material. Samples will be sent by courier or hand-delivered to ALS for analysis as soon as reasonably possible. VOCs have a holding time of 14 days. The following are general packaging procedures:

- Sample labels will be securely attached to each sample container.
- Plastic bubble-wrap bags, sheets, or Styrofoam packing material will be used to protect sample containers.
- Insulated plastic or metal-clad plastic coolers will be used as shipping containers.
- All samples will be chilled with the addition of ice or blue ice.
- The original chain-of-custody form (see example in Appendix C) will be placed inside the cooler in a sealed plastic bag.
- A signed custody seal will be placed over the lid of the cooler and covered with clear plastic tape.
- The cooler drain, if present, will be taped shut.
- The cooler will be securely taped shut with strapping tape.
- The cooler will be shipped, sent by courier, or hand-delivered to ALS for analysis.

2.7 CHAIN-OF-CUSTODY DOCUMENTATION

Chain-of-custody procedures are employed to maintain and document sample possession. A sample is considered under a person's custody if it is in that person's physical possession, within visual sight of that person after taking physical possession, secured by that person so that the sample cannot be tampered with, or secured by that person in an area that is restricted to authorized personnel only.

All requested information will be filled-in on the custody record and will sign and date the record in the first "relinquished by" box. Original signed custody records listing the samples in the cooler will accompany all shipments of samples (note: it is possible that more than

one custody form will be needed per cooler to list all the samples contained in the cooler). A copy of the chain-of-custody will be placed in the project files. An example of a filled out chain-of-custody form is included in Appendix C.

2.8 PROJECT REPORTING

After completion of each sampling event, an annual groundwater monitoring report will be prepared that includes:

- Investigation chronology;
- Discussion of sampling methodology including any deviations from this SAP;
- A site map for each site showing relevant surface features, sampling locations, groundwater elevations measured during each event, and contaminant concentrations detected during each event.;
- Summary table of groundwater elevations and contaminant concentrations from all sampling events along with comparison to applicable cleanup levels;
- Brief discussion of QA/QC review and verification process including implications for project data as described in the QAPP;
- Evaluation of the data and comparison to cleanup criteria;
- Copies of original field forms;
- Laboratory certificates of analysis with chain-of-custody records; and

A draft report will be submitted to United States Army Corps of Engineers (USACE), JBLM IRP Program Manager, and United States Army Environmental Command (USAEC) for review and comment. Once revisions have been addressed to reviewer's satisfaction, a draft copy of the report will be submitted to the Ecology Project Manager. Comments provided by Ecology will be addressed and a final report will be produced. If no comments are received from Ecology within 3 months following submittal of the draft report, the draft report will be considered "Final."

2.9 DATA MANAGEMENT

An Access® based database was developed in 2004 for data collected for the Logistics Center. It is currently planned that this database will be expanded to include data from the FLAO sites. As of the writing of this plan the final update has not been completed. Laboratory data will be submitted in Excel® or ASCII format and entered into the database. Laboratory data packages will also be submitted electronically and hardcopy as PDFs.

Parameters, formats, and other submittal requirements are discussed in the QAPP (Section 3).

2.10 PROJECT SCHEDULE

The wet season or high water level sampling event will be conducted between the beginning of February and the end of April of each year. The dry season or low water level sampling event will be conducted between the beginning of August and end of October. Monitoring at each of the sites described in this report will continue until one of the following occur: a) the SAP for each site is superseded by a Compliance Monitoring Plan for that site; b) a Cleanup Action Plan is approved and implemented which requires no further monitoring based on the approved remedy, or c), all chemicals of concern are below applicable MTCA cleanup levels established for the site for four successive monitoring events over a two-year period. Proposed modifications to the groundwater sampling described in this report may be implemented upon receiving written approval from Ecology.

3 QUALITY ASSURANCE PROJECT PLAN (QAPP)

The following QAPP outlines Sealaska commitment of compliance with Quality Assurance (QA)/Quality Control (QC) protocol of a SAP per WAC 173-340-820. Sealaska personnel will ensure that field and analytical procedures produce acceptable data to support site-specific long-term trends of contaminant concentrations.

The purpose of QA/QC procedures for this site is to provide assurance that the field and analytical procedures produce data of acceptable quality to evaluate long-term trends of contaminant concentrations at the site.

3.1 DATA QUALITY OBJECTIVES

DQOs define the type, quantity, and quality of data that are needed to answer specific environmental questions, and support environmental decisions. DQOs are developed using a systematic planning process described in the Guidance for the Data Quality Objectives Process (EPA 2006). The DQOs consist of the following seven iterative steps:

1. State the problem.
2. Identify the goals of the study.
3. Identify information inputs.
4. Define the boundaries of the study.
5. Develop the analytic approach.
6. Specify performance or acceptance criteria.
7. Develop the plan for obtaining data.

Step 1: State the problem.

- Petroleum hydrocarbon contamination (TPH-D, TPH-HO, and TPH-G) and BTEX is present in groundwater at the FLAO Sites. Monitoring is required to assess concentration trends in groundwater at the sites.

Step 2: Identify the goals of the study.

- Assess the presence, concentration, and potential migration of petroleum hydrocarbons within the areas sampled.
- Determine if contaminated groundwater is exceeding Ecology MTCA Method A Cleanup Level for TPH-D, TPH-HO, TPH-G, and/or BTEX. Cleanup levels are provided in Table 2-3.

Step 3: Identify information inputs.

- Groundwater data collected semiannually during first (wet) and third (dry) quarters.
- Available historical data.

Step 4: Define the boundaries of the study.

- Groundwater sampling locations for the study area are shown in Figures 2-1 through 2-4.

Step 5: Develop the analytic approach.

- If concentrations of contaminants of concern in the aquifer remain above the cleanup levels provided in Table 2-3, then monitoring and/or remediation will continue at the sites.
- If petroleum hydrocarbon or BTEX concentrations in a monitoring well or portions of the aquifer have been reduced below cleanup levels for four consecutive sampling events, then monitoring for that area may be recommended to be reduced or eliminated.
- If petroleum hydrocarbon or BTEX concentrations demonstrate decreasing trends approaching cleanup levels, then analyses may be reduced.

Step 6: Specify performance or acceptance criteria.

- To minimize sampling error, samples will be collected by Sealaska personnel who are trained in the collection of groundwater samples and who will use procedures described in the Standard Operating Procedures (Appendix B).
- Groundwater samples for laboratory testing will be analyzed by an accredited laboratory. The primary laboratory for this project is ALS Environmental located in Kelso, Washington. The laboratory is accredited by the U.S. Department of Defense Environmental Laboratory Accreditation Program and Ecology.

Step 7: Develop the plan for obtaining data.

- Depth to water measurements and groundwater samples will be collected semiannually from groundwater monitoring wells.

3.2 FIELD QUALITY CONTROL SAMPLES

As shown in Table 2-2, it is expected that the following field QC samples will be submitted with the primary samples collected during each sampling event:

- One field duplicate sample will be collected from AOC 8-2, AOC 8-4, or AOC 10-8 during each sampling event and analyzed for TPH-D and TPH-HO using method NWTPH-Dx. The duplicate will use sequential well numbers beginning with MW90. Examples of a typical field duplicate sample IDs would be: AOC121212MW90 and AOC121212MW91.

- One field duplicate sample will be collected from AOC 9-2 during each event and analyzed for TPH-G using method NWTPH-Gx and BTEX using EPA Method 8260C. The duplicate will the well number 96A1712. The typical field duplicate sample ID would be: AOC12121296A1712.
- One matrix spike/matrix spike duplicate (MS/MSD) will be collected from AOC 9-2 for each event. MS/MSD samples will be selected by the field staff and three times the normal sample volume will be collected to accommodate the extra sample required to perform the MS/MSD analysis.
- A trip blank will accompany the samples collected from AOC 9-2 from each sampling event and be analyzed for BTEX using EPA Method 8260C.

3.3 LABORATORY QUALITY CONTROL

The project laboratory will be responsible for conducting laboratory QC procedures and reporting laboratory QC results in accordance with its standard operating procedures. The laboratory will perform and report the following laboratory QC results per sampling event for BTEX analyzed using EPA Method 8260C and total petroleum hydrocarbons as diesel and heavy oil by NWTPH-Dx and as gasoline by NWTPH-Gx: method blank, blank spike, matrix spike, and matrix spike duplicate. The current project laboratory's control limits for acceptable spike recoveries and the relative percent difference (RPD) on spike duplicates are presented in Table 3-1. The laboratory will also follow Method 8260C QC requirement guidelines (DoD/DoE 2013).

The laboratory will also perform and report results of surrogate recovery for every VOC sample analyzed. The current project laboratory's control limits for acceptable surrogate recoveries are presented in Table 3-2.

3.4 PRACTICAL QUANTIFICATION LIMITS (PQLS)

Table 2-3 presents a comparison of MTCA Method A groundwater cleanup levels with expectations for PQLs by analyte. Although the expected PQLs for benzene, TPH-G, TPH-D, and TPH-HO do not satisfy the Ecology ideal to have PQLs at least 10 times lower than the most stringent regulatory criteria (Ecology 2001), all expected PQLs are less than or equal to the MTCA Method A groundwater cleanup levels and are within an acceptable range (Ecology 1995). Thus, it is expected that the project laboratory will be able to achieve PQLs of appropriate sensitivity for comparisons with regulatory standards.

The current project laboratory's control limits for acceptable spike recoveries and the relative percent difference (RPD) on spike duplicates are presented in Table 3-1. The current project laboratory's control limits for acceptable surrogate recoveries are presented in Table 3-2.

3.5 QA/QC REVIEW AND VERIFICATION

Overall data quality will be reviewed and verified to determine if the data is suitable for use. Project data as well as QA/QC data will be evaluated in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity. This will include review of:

- Field QC results including:
    - Field duplicate RPD
- Laboratory QC results including:
    - Laboratory control samples
    - Blanks
    - Matrix spike results
    - Surrogate recovery
    - Holding times
- PQLs

Results of this evaluation will be summarized in the project report. Corrective action for field or laboratory procedures will be taken as needed in consultation with Ecology.

Table 3-1. Spike Recovery and Spike Duplicate Control Limits

Analytical Method	Analyte	Acceptable Blank Spike Recovery Range (%)	Acceptable Matrix Spike/ Matrix Spike Duplicate Recovery Range (%)	Acceptable Spike Duplicate RPD (%)
NWTPH-Gx	Gasoline Range Organics	70 – 130	70 – 130	≤20
NWTPH-Dx	Diesel Range Organics	70 – 130	70 - 130	≤20
	Residual Range Organics	70 - 130	70 - 130	≤20
EPA Method 8260C	Benzene	79 - 120	79 - 120	≤20
	Toluene	80 - 121	80 - 121	≤20
	1,1-Dichloroethane	77 - 125	77 - 125	≤20
	Trichloroethylene	79 - 123	79 - 123	≤20
	Chlorobenzene	82 - 118	82 - 118	≤20

Table 3-2. Surrogate Recovery Control Limits

Analytical Method	Surrogate Analyte	Acceptable Surrogate Recovery Range (%)
NWTPH-Gx	1,4-Difluorobenzene	50 - 150
NWTPH-Dx	o-Terphenyl	50 - 150
	n-Tricontane	50 - 150
EPA Method 8260C	1,2-Dichloroethane-d4	70 - 120
	4-Bromofluorobenzene	75 - 120
	Dibromofluoromethane	85 - 115
	Toluene-d8	85 - 120

4 SITE SAFETY AND HEALTH PLAN

The following SSHP is a short summary of the full Site SSHP located within the Accident Prevention Plan (Sealaska 2014) where additional information on site health and safety requirements can be found. The SSHP is designed to show plans for compliance with 29 CFR 1910.120, WAC 173-340-810, WAC 296-62-300 (Part R), and USACE Safety and Health Requirements Manual (EM 385-1-1). A copy of the SSHP will be maintained on-site during all field activities.

4.1 SITE SAFETY AND HEALTH OFFICER

Personnel involved with the groundwater sampling program at the FLAO sites, including the Site Safety and Health Officer (SSHO), are included in Table 1-1. Subcontractors and site visitors are not expected to be onsite during groundwater monitoring and sampling activities described above. However, if subcontractors or visitors are present in the future, they will be briefed on health and safety concerns in regards to groundwater monitoring and sampling, before entering the site.

4.2 HAZARD ANALYSIS

The overall hazard level associated with activities described in this Plan is low. An analysis of the potential physical and chemical hazards associated with field tasks described or implied in the Plan is presented in Table 4-1.

4.3 TRAINING

All site workers are appropriately trained in accordance with 29 CFR 1910.120(e). The work described in the SAP above entails 40-hour initial HAZWOPER training, three days of supervised fieldwork, and 8-hour annual HAZWOPER refreshers.

4.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

All fieldwork described in this SAP will be completed with PPE to include safety vest, steel-toe boots, safety glasses, face-shield, or goggles, PVC or nitrile gloves, hard hat (as necessary), and hearing protection (as necessary). Level D PPE has been selected for this planned fieldwork on the basis of previous investigations (Table 4-2).

Table 4-1. Groundwater Monitoring and Sampling Task Safety Analysis

Task	Potential Hazard	Actions
Mobilize to work site	Traffic accident	Vehicle Operation - valid driver's license, seat belt use, routine vehicle inspections, and no cell phone use while driving. Slow to 10 mph when passing troops on foot on road. Yield to pedestrians in crosswalks.
Groundwater monitoring and sampling	Worker requirements	Medical clearance for hazardous waste work. HAZWOPER (40 hrs.) and current refresher for workers. Additional (8 hrs.) supervisor training for the field lead, SSHO, and all other on-site supervisors.
	Struck by vehicles	Sampling vehicle(s) placed between workers and oncoming traffic. High visibility safety vests in traffic areas. No work will be done after twilight or before sun up. Gate will be closed upon entry and exit to the landfill limiting access to other motorists and pedestrians.
	Temperature stress	If temperature is above 80°F or below 40°F, administrative controls will be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, and provisions for emergency heating or cooling).
	Lifting (musculoskeletal injuries)	If equipment is to be moved, an evaluation of potential pinch points and/or weight strain will be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs., or has to be moved by maneuvering through awkward positioning. Honda portable generator will not be moved out of the back of the sampling truck until all work has been completed for the day. Electric cord from Grundfos pump is long enough to reach from the truck to all wells if needed.
	Electric shock	Portable electrical tools and all portable electrical equipment that poses a shock hazard must be connected through ground fault circuit interrupters.
	Battery Fire/Explosion	Use only batteries that are not installed in vehicles and are not being charged during use for powering equipment.
	Fire	Fire extinguisher rated 2A and 5B (serviced annually and inspected monthly) located in back of cab of sampling vehicle. Fire extinguisher maintenance office is located in Bldg. 02014 on Pendleton Ave. and N. 3rd St. in back of the old fire station at JBLM.
	Chemical exposure	Wash hands before eating or drinking. Nitrile gloves for chemical/contaminant contact. Chemical containers labeled with identity and hazard. MSDSs on site for all chemicals in use. Site-specific training must address chemicals, hazards, and proper handling.
	IDW Control	No IDW will be stored onsite. Purge water will be containerized in five-gallon buckets and sampled for waste characterization. If all results are below cleanup criteria, the water will be discharged at the Logistics Center Landfill 2 pump and treat system. If results are above cleanup criteria, the water will be disposed of through the new Industrial Wastewater Treatment Plant (with prior permission of JBLM Public Works) or disposed of offsite. All disposable PPE and field equipment will be containerized in a Sealaska dumpster as part of the normal solid waste stream.

Table 4-2. Groundwater Monitoring and Sampling PPE Requirements

Personal Protective Equipment (PPE)	Comments
Safety Shoes	Mandatory
Hard Hat	If overhead hazards are present
Safety Glasses With Side Shields, Face Shields, or Goggles	Mandatory
Hearing Protection	As necessary (not needed during routine sampling)
Gloves	Nitrile, PVC, or similar for potentially contaminated material. Heavy duty work gloves for material handling.
Safety Cones/Barricades	As needed when working in areas with traffic or other similar potential hazards.
Safety Vest	Mandatory
Knee Pads	Optional
Caution Tape	As needed, to exclude unauthorized personnel

4.5 MEDICAL SURVEILLANCE

Sealaska personnel participate in the Sealaska Medical Surveillance program that meets the requirements of 29 CFR 1910.120(f). Sealaska site personnel to whom this requirement applies must pass this examination and have a copy of their medical clearance on file before they are allowed to perform any work.

4.6 EXPOSURE MONITORING

Because of low concentrations of the contaminants occurring in the groundwater at these sites, exposure monitoring is not necessary as exposures for personnel to these materials is not likely to exceed permissible exposure limits. However, during groundwater monitoring, well purging and sampling, total organic vapor levels in the breathing zone of workers will be measured with a photoionization detector, with background level and breathing zone level results noted in the field logbook.

4.7 SITE CONTROL

Due to the nature and scope of fieldwork described in the SAP, traffic cones or barricades will be used to establish zones to control hazards such as vehicular traffic. These zones will be established around each work area and safe distances will be maintained between workers and traffic. All site workers will also wear reflective safety vests to increase their visibility to those outside the work zone.

4.8 PERSONAL DECONTAMINATION PROCEDURES

Non-disposable PPE or clothing that becomes contaminated during site work will be appropriately cleaned before being put back in service or else replaced. In the event of skin

contact with contaminated media, the affected skin will be washed immediately as appropriate. As standard procedure, the field technicians will wash hands and face before eating, drinking, or performing any other hand-to-mouth contact, as well as immediately after completing work.

4.9 CONFINED SPACES

The scope of work described in this compliance Plan does not include confined space entry. Confined space entry is not anticipated or allowed as part of this SAP.

4.10 SPILL CONTAINMENT

Due to the nature and small quantities of liquid waste being generated during groundwater monitoring events, a site-specific spill containment program is not warranted. No drums will be handled as part of this work. Care will be taken in transporting purge water to the Landfill 2 pump and treat system. Five-gallon buckets will be covered with a snap-on lid prior to transportation in the sampling truck. The truck is equipped with hydrophobic spill pads which can be used if it is determined that a spill needs to be cleaned up.

4.11 EMERGENCY CONTACTS

All Emergencies	**Dial 911**
Hospitals	
Saint Clare Hospital 11315 Bridgeport Way SW Lakewood, Washington 98499	(253) 985-1711
U.S. Coast Guard	(206) 217-6000 or VHF Ch. 16
Washington State Poison Center	1-800-222-1222
Agency for Toxic Substances and Disease Registry	1-888-422-8737
JBLM IRP Program Manager, Meseret Ghebresllassie	(253) 477-3742 (office)
Sealaska Project Manager, Scott Elkind	(360) 930-3187 (office) (360) 626-3991 (cellular)
Sealaska SSHO, V. Sunrise Patterson	(206) 499-9896 (cellular)
Sealaska Alternate SSHO, Will Kaage	(360) 367-9318 (cellular)
Sealaska Certified Industrial Hygienist (CIH), Steve Frost	(206) 214-8990 (cellular)

The route to the nearest hospital with written directions is shown as Figure 4-1.

1

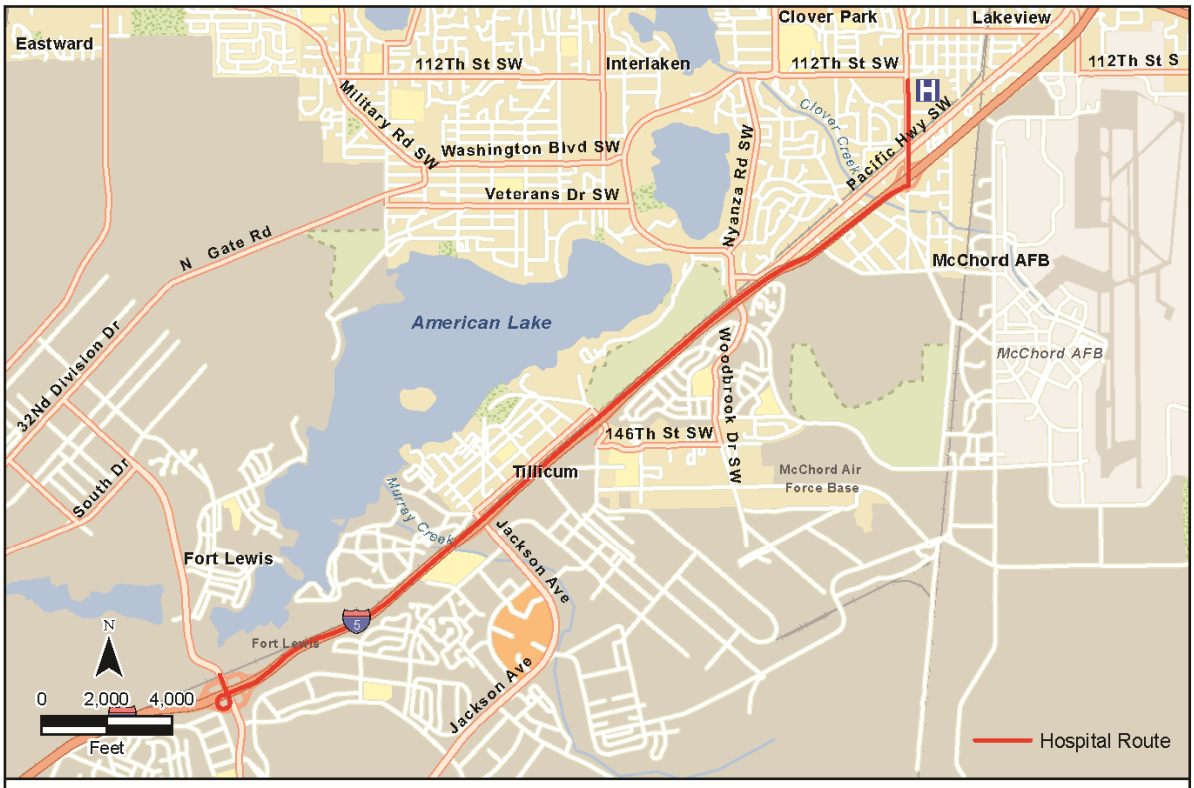


Figure 4-1
Hospital Route

Driving directions from Fort Lewis Gate to St. Clare Hospital,

11315 Bridgeport Way SW, Lakewood, WA.

- Start out going northwest on 41st Division Drive S. for 0.01 mile
- Merge onto I-5 North toward Tacoma / Seattle and travel for 4.8 miles
- Take Exit 125 Lakewood/Joint Base Lewis-McCord, turn left at the end of the off-ramp at the light onto Bridgeport Way SW.
- Go about 3/10 of a mile. St. Clare Hospital is on the right.

Hospital Phone Numbers:

Main: 253-588-1711

Emergency 253-985-6700

5 REFERENCES

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Versar. 2014. Fort Lewis Agreed Order Groundwater Sampling and Analysis Plan; Building 4131 Former UST Site (AOC 8-2), Building A0111 Former UST Site (AOC 8-4), Building A1033 Former UST Site (AOC 9-2), Gary Army Fuel Facility (AOC 10-8); Joint Base Lewis McChord, Washington 98433. February.

APPENDIX A

BORING LOGS AND WELL COMPLETION DIAGRAMS

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance(N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

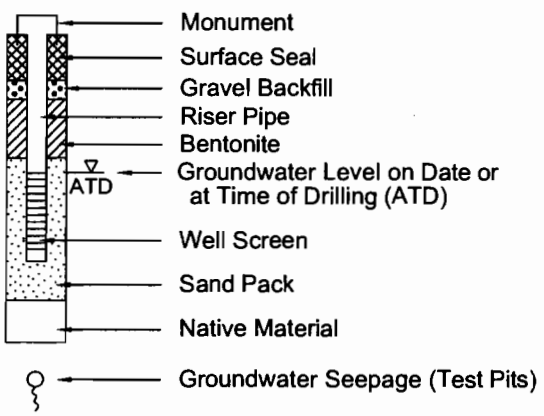
Sampling Test Symbols

Boring Samples		Test Pit Samples	
⊠	Split Spoon	⊠	Grab (Jar)
⧅	Shelby Tube	⧄	Bag
▥	Cuttings	⧅	Shelby Tube
◧	Core Run		
*	No Sample Recovery		
P	Tube Pushed, Not Driven		

Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
	Water Content in Percent Liquid Limit Natural Plastic Limit
PID	Photoionization Detector Reading
CA	Chemical Analysis
PF	Petroflag Screen

Groundwater Observation Wells



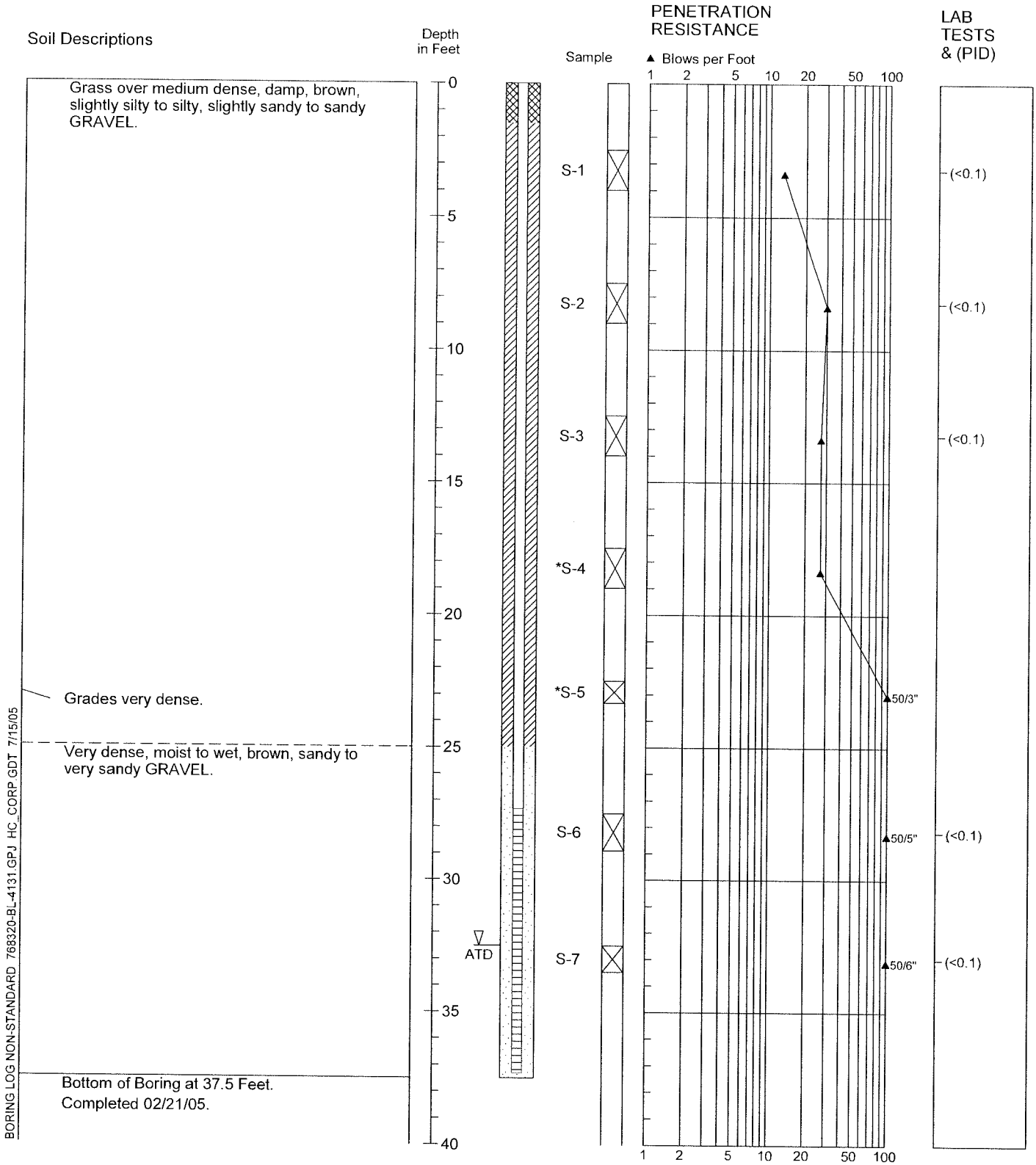
768330-001.DWG (HC Standards\SRF\ A-1.dwg) KZL 6/03/05

HARTCROWSER

7683-30 12/05

Figure A-1

Monitoring Well Log 4131-MW01



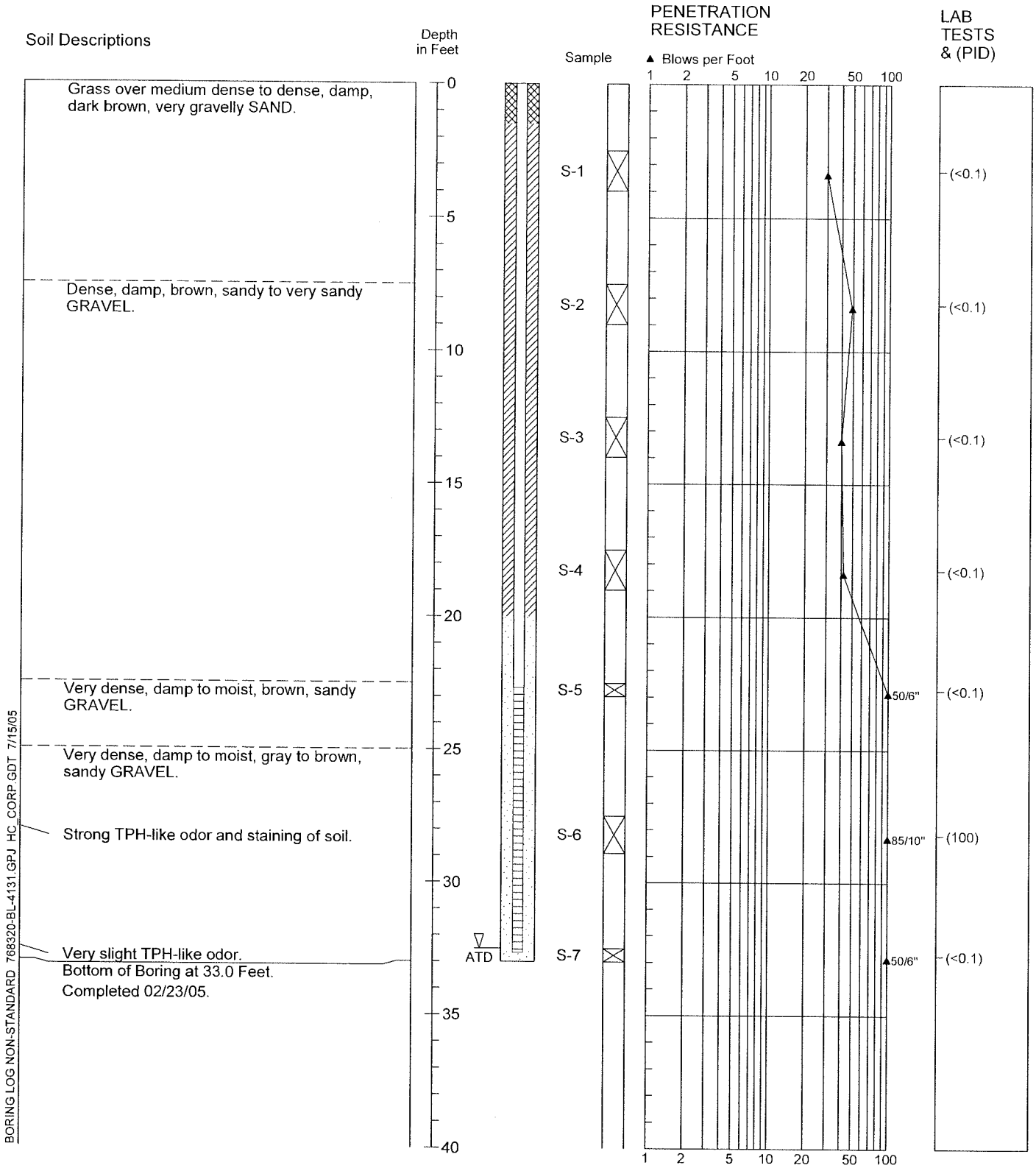
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-20 02/05

Figure A-2

Monitoring Well Log 4131-MW02



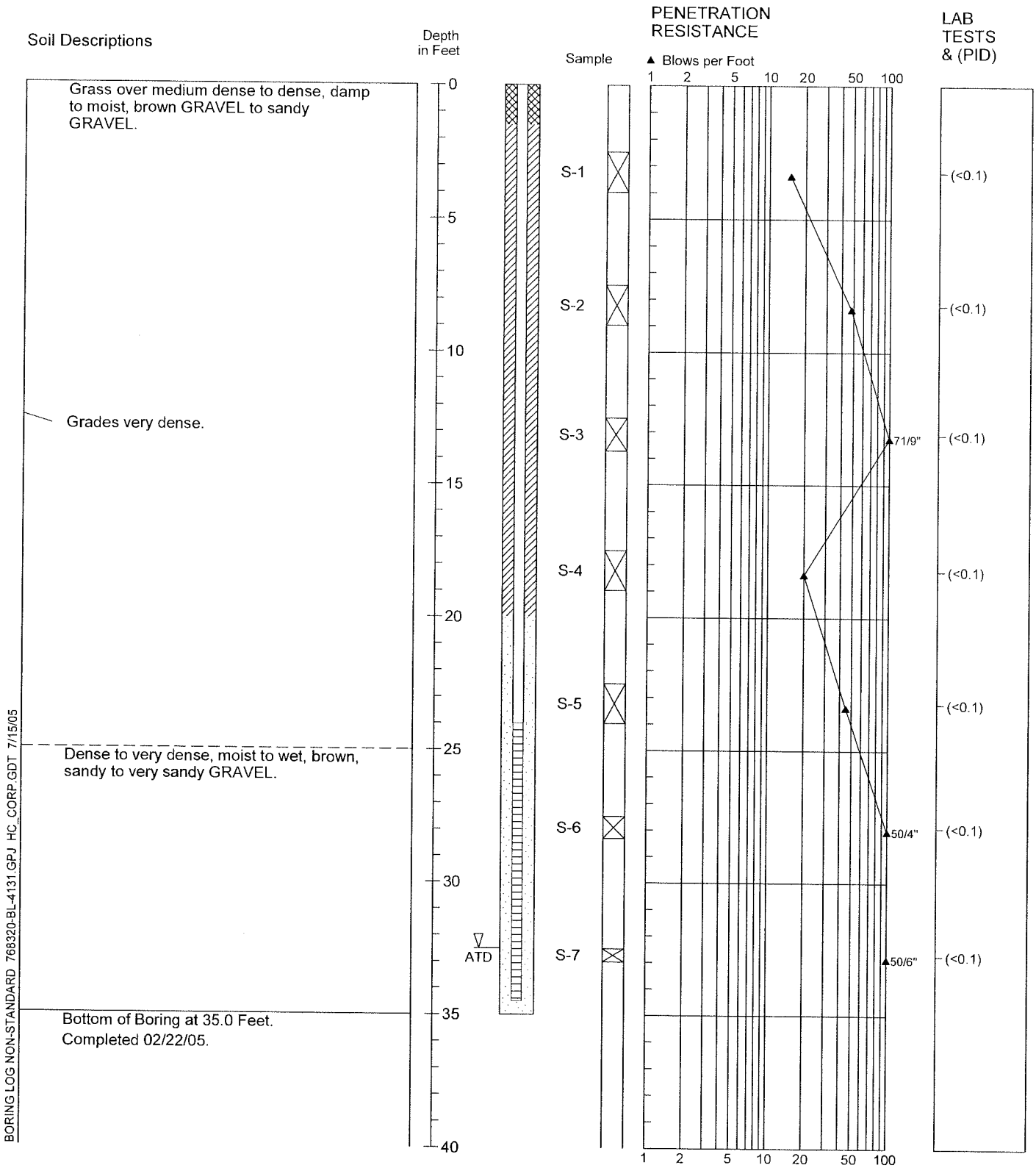
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-20 02/05

Figure A-3

Monitoring Well Log 4131-MW03



BORING LOG NON-STANDARD 768320-BL-4131.GPJ HC_CORP.GDT 7/15/05

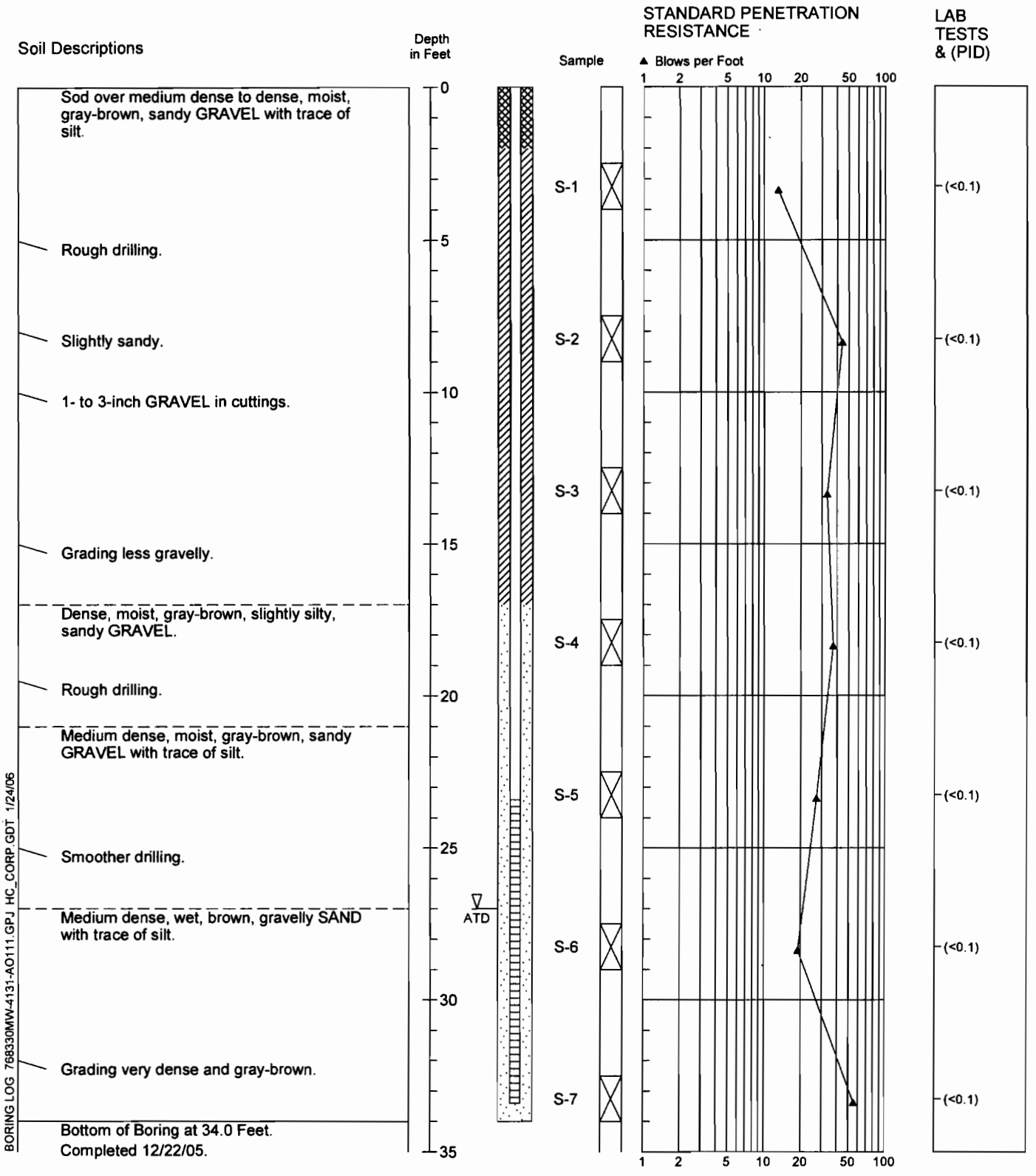
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-20 02/05

Figure A-4

Boring Log & Construction Data for Monitoring Well 4131-MW04



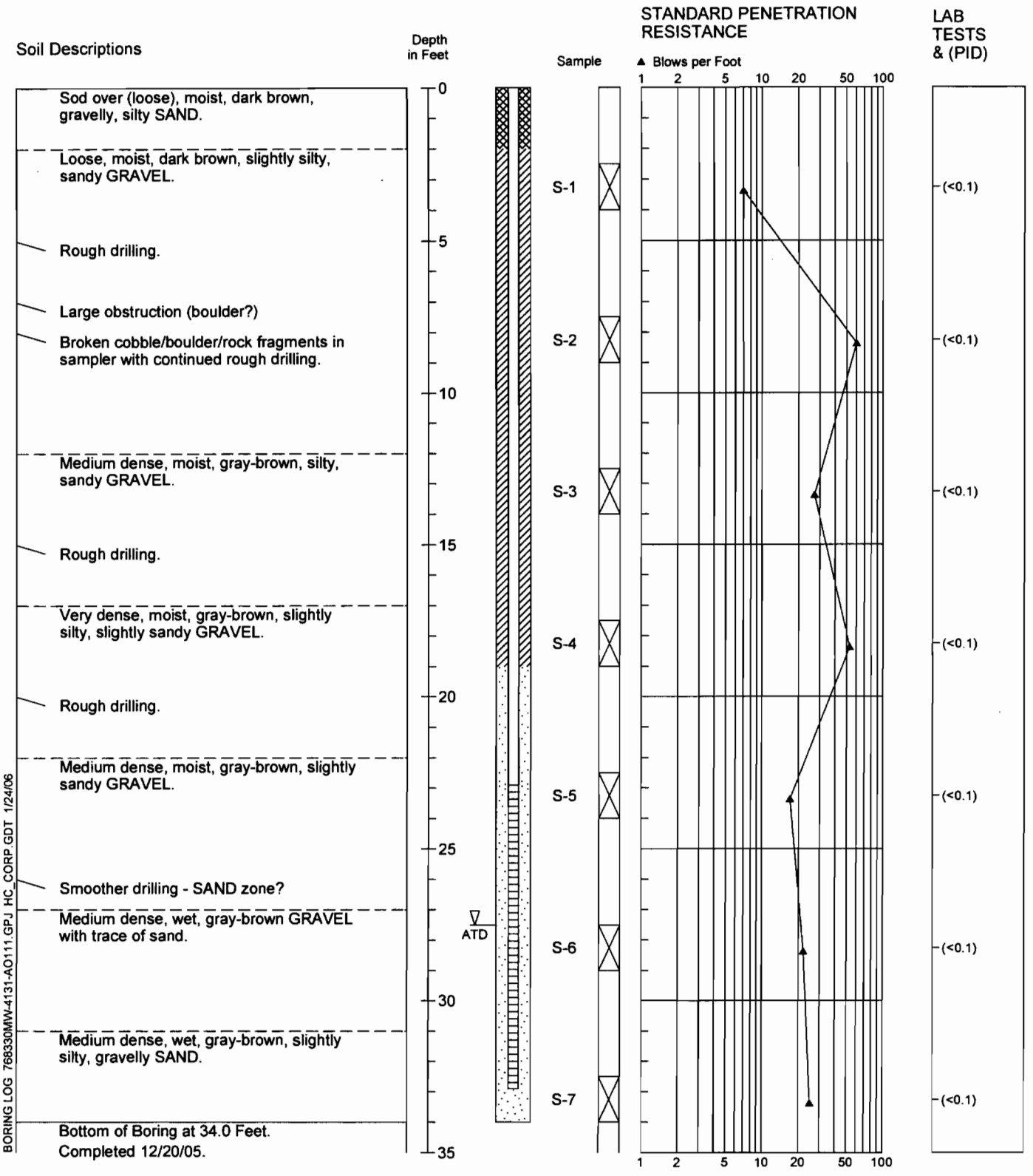
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 *12/05*

Figure A-2

Boring Log & Construction Data for Monitoring Well 4131-MW05



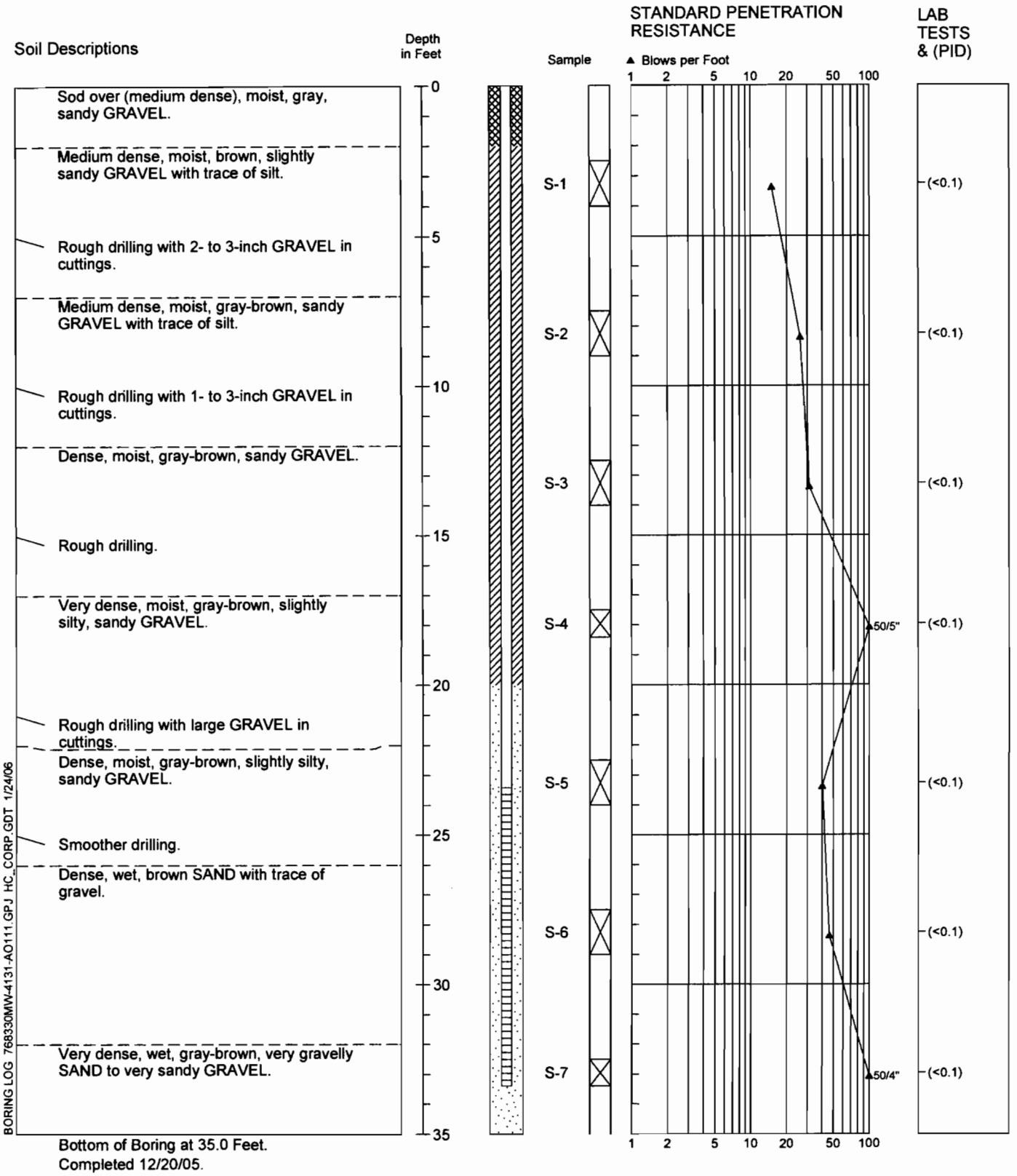
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 *12/05*

Figure A-3

Boring Log & Construction Data for Monitoring Well 4131-MW06



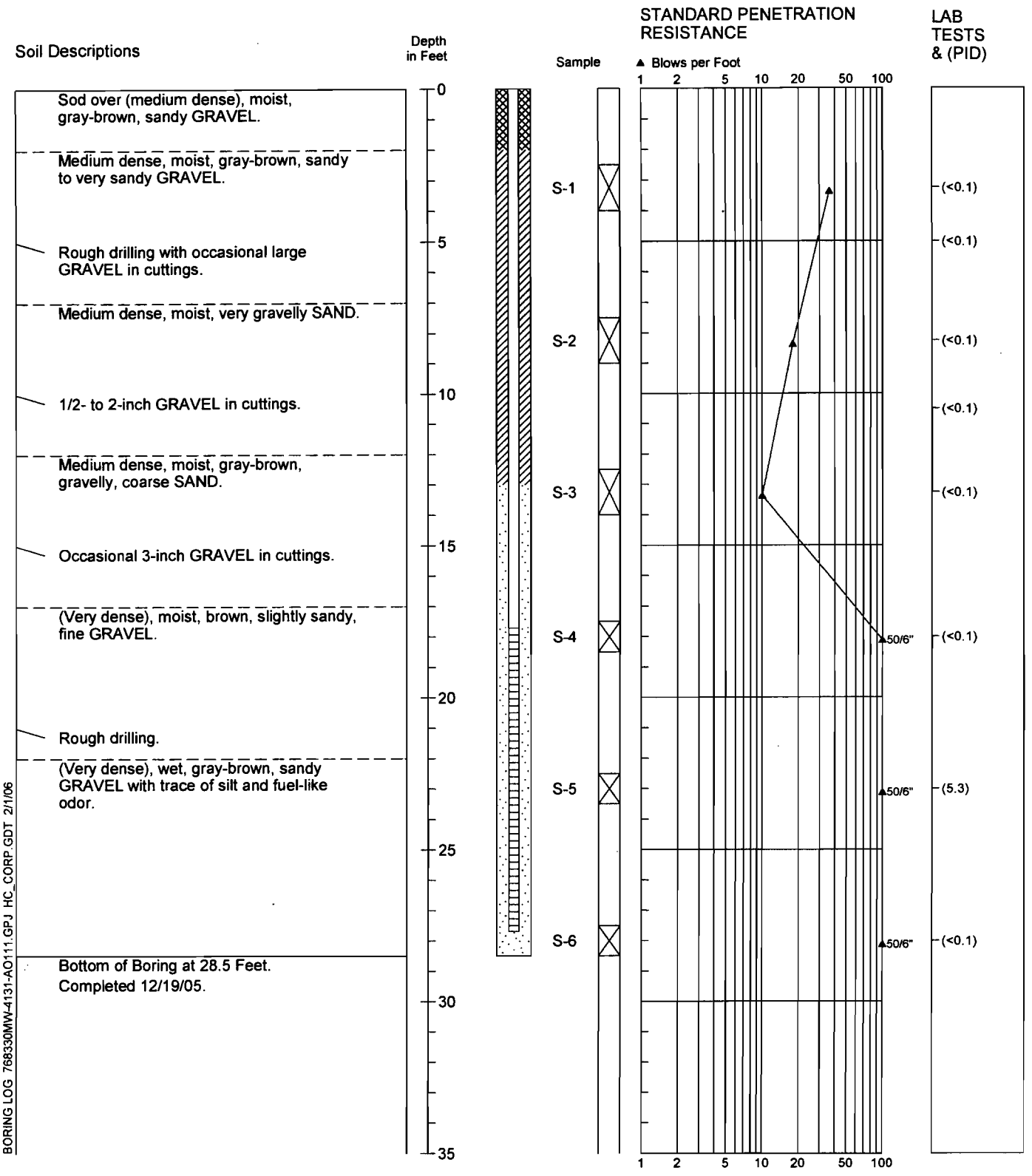
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 12/05

Figure A-4

Boring Log/Construction Data Monitoring Well A0111-MW04



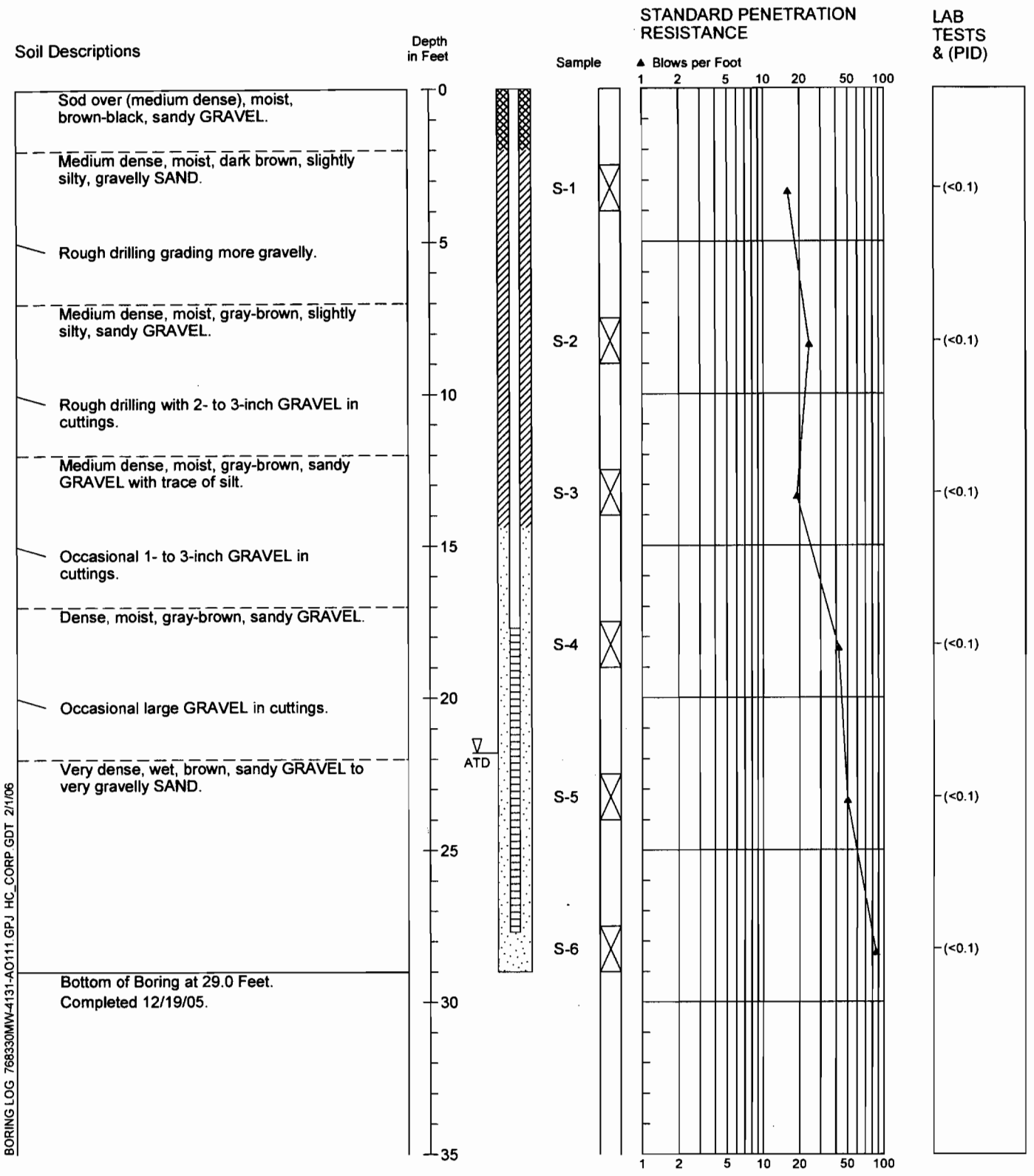
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 12/05

Figure A-5

Boring Log/Construction Data Monitoring Well A0111-MW05



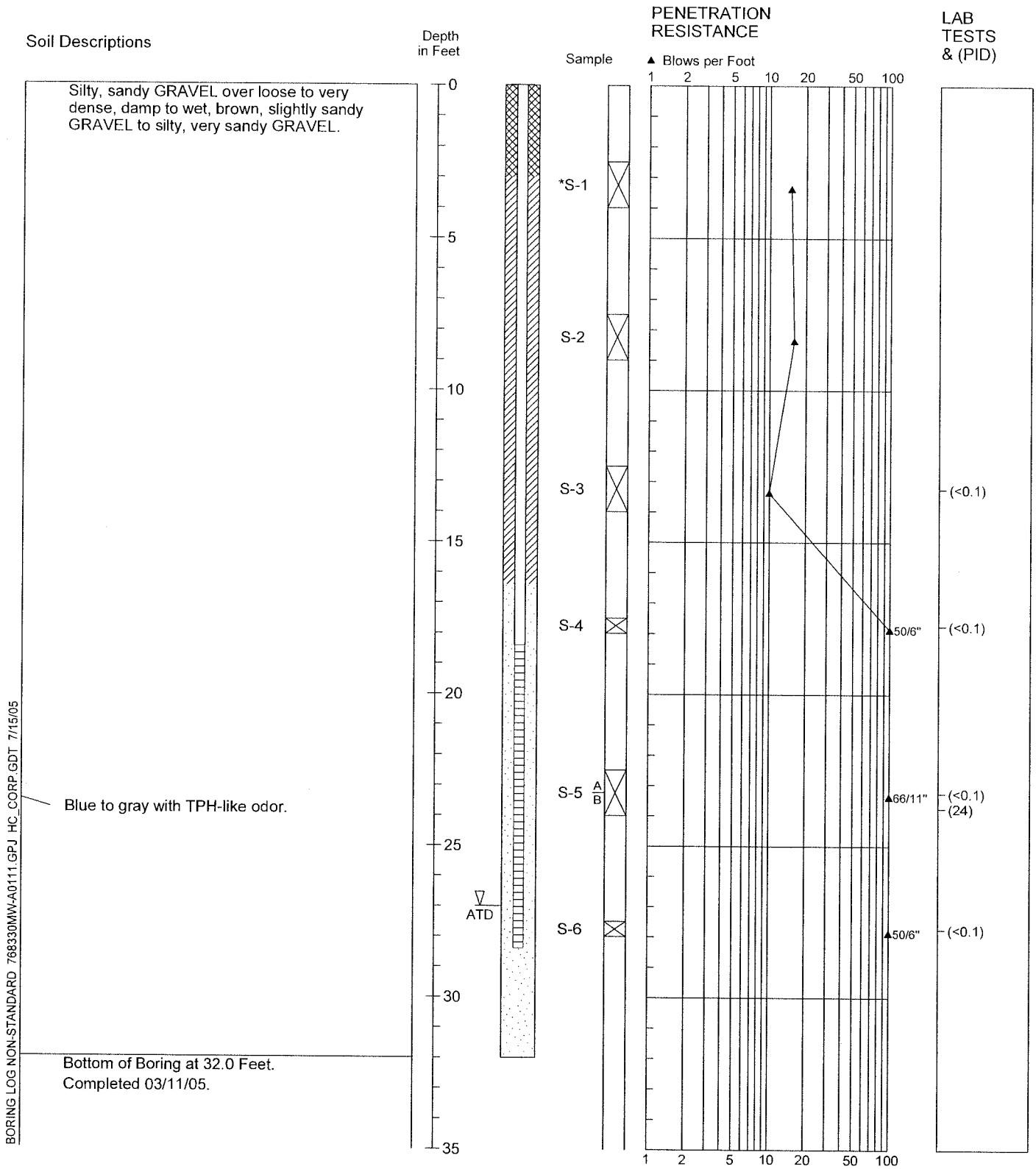
HARTCROWSER

7683-30 *12/05*

Figure A-6

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

Monitoring Well Log A0111-MW01



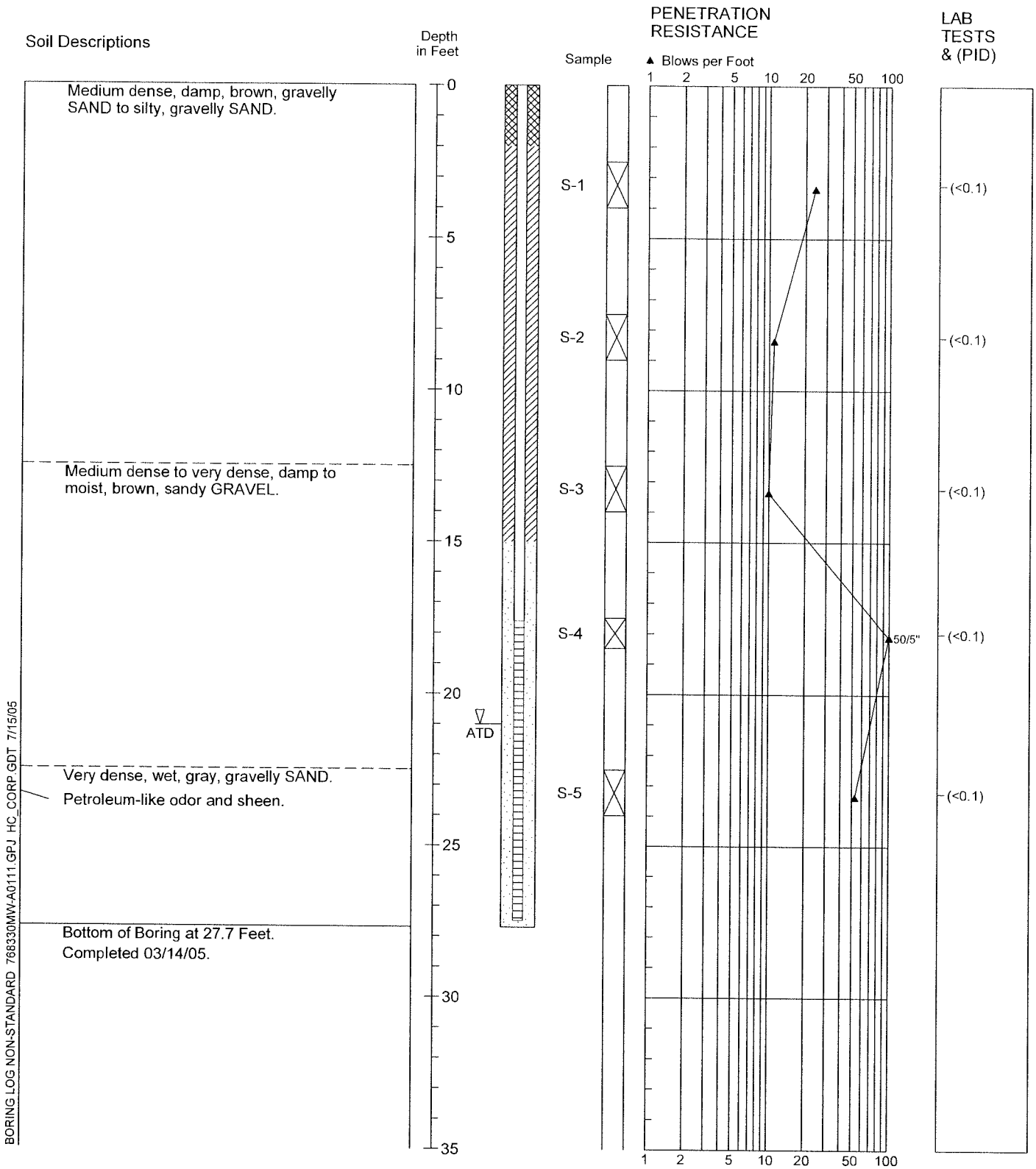
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 *03/05*

Figure A-6

Monitoring Well Log A0111-MW02



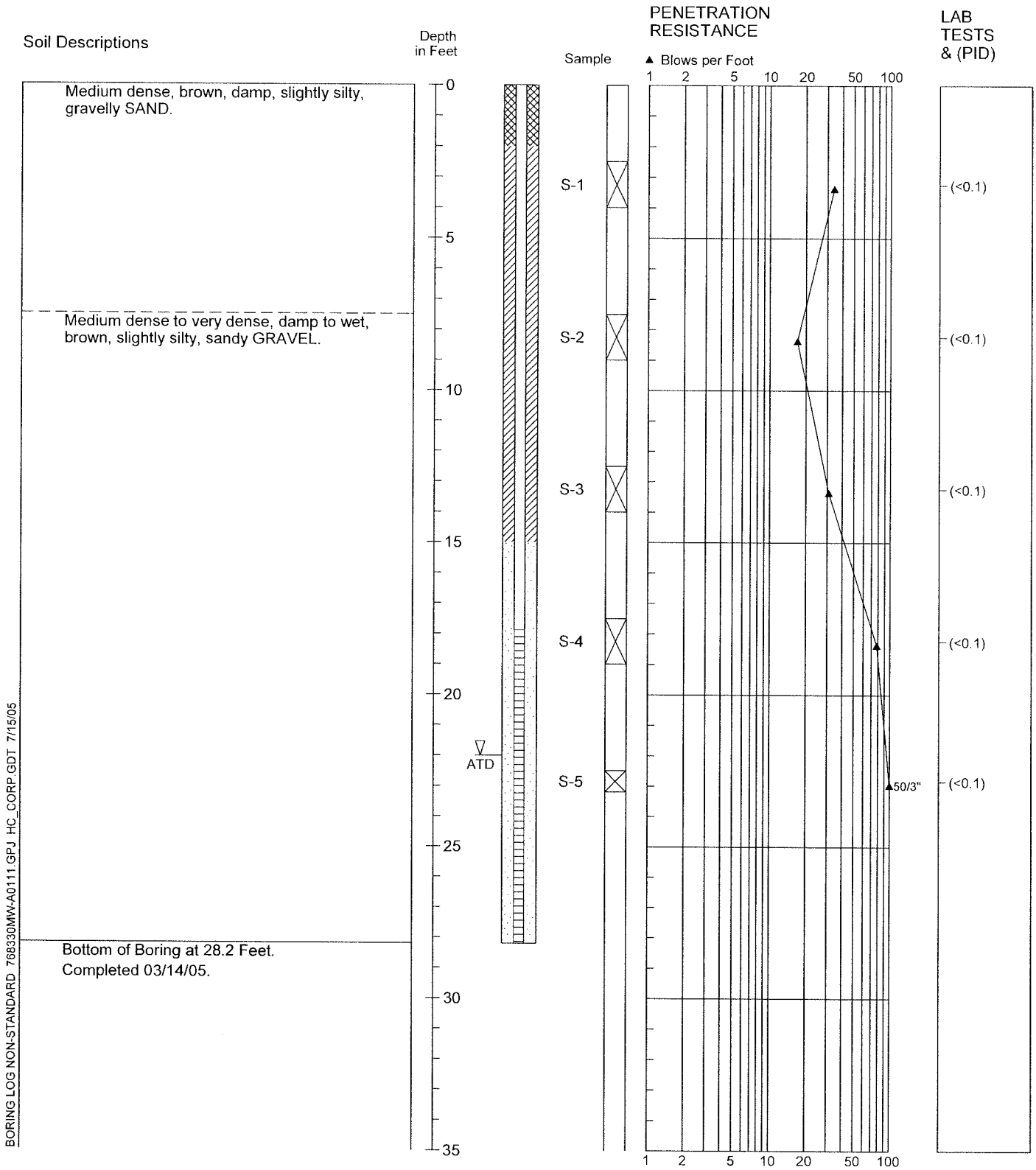
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 03/05

Figure A-7

Monitoring Well Log A0111-MW03



BORING LOG NON-STANDARD 768330MW-A0111.GPJ HC_CORP.GDT 7/15/05

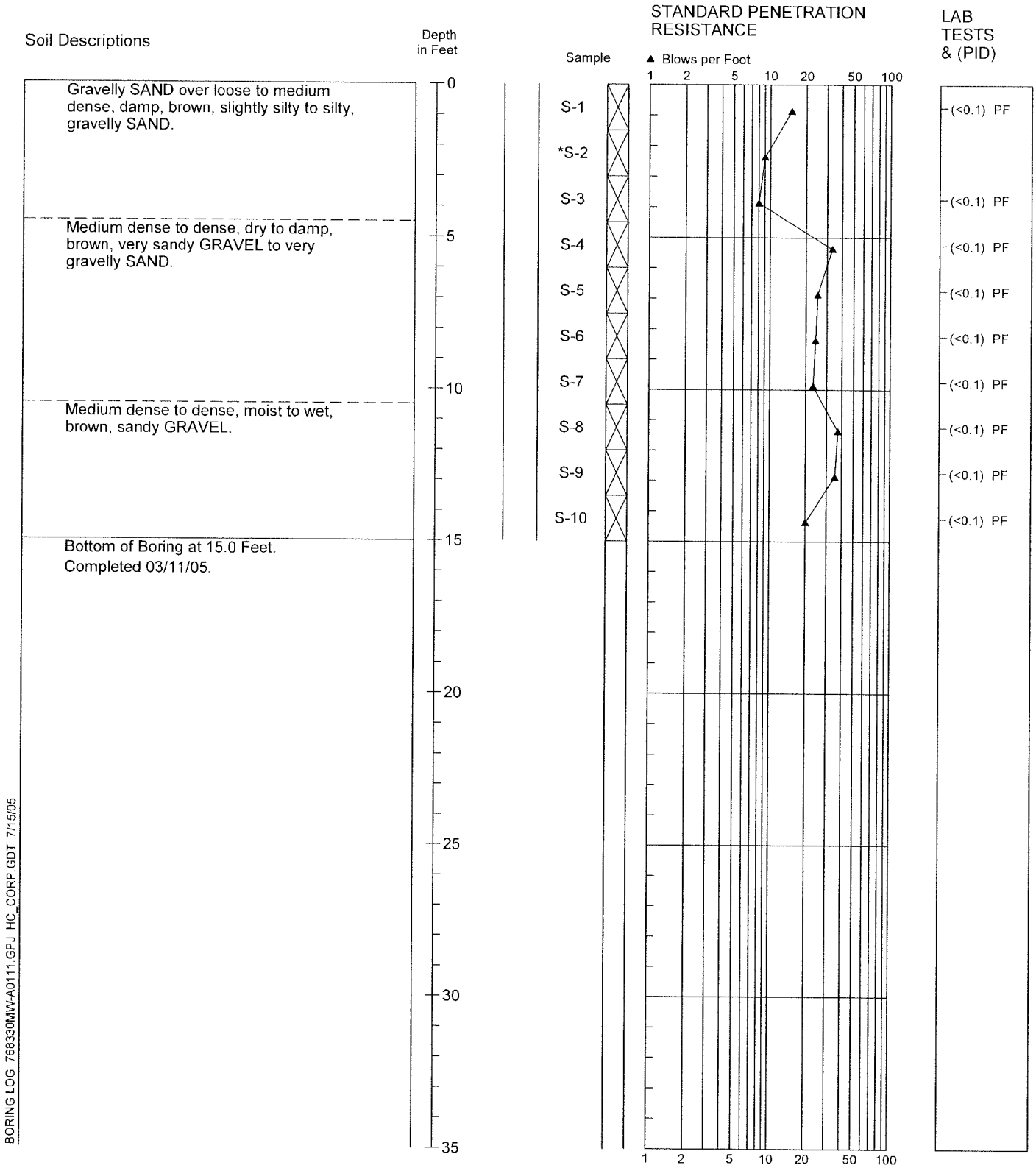
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 *03/05*

Figure A-8

Boring Log A0111-B01



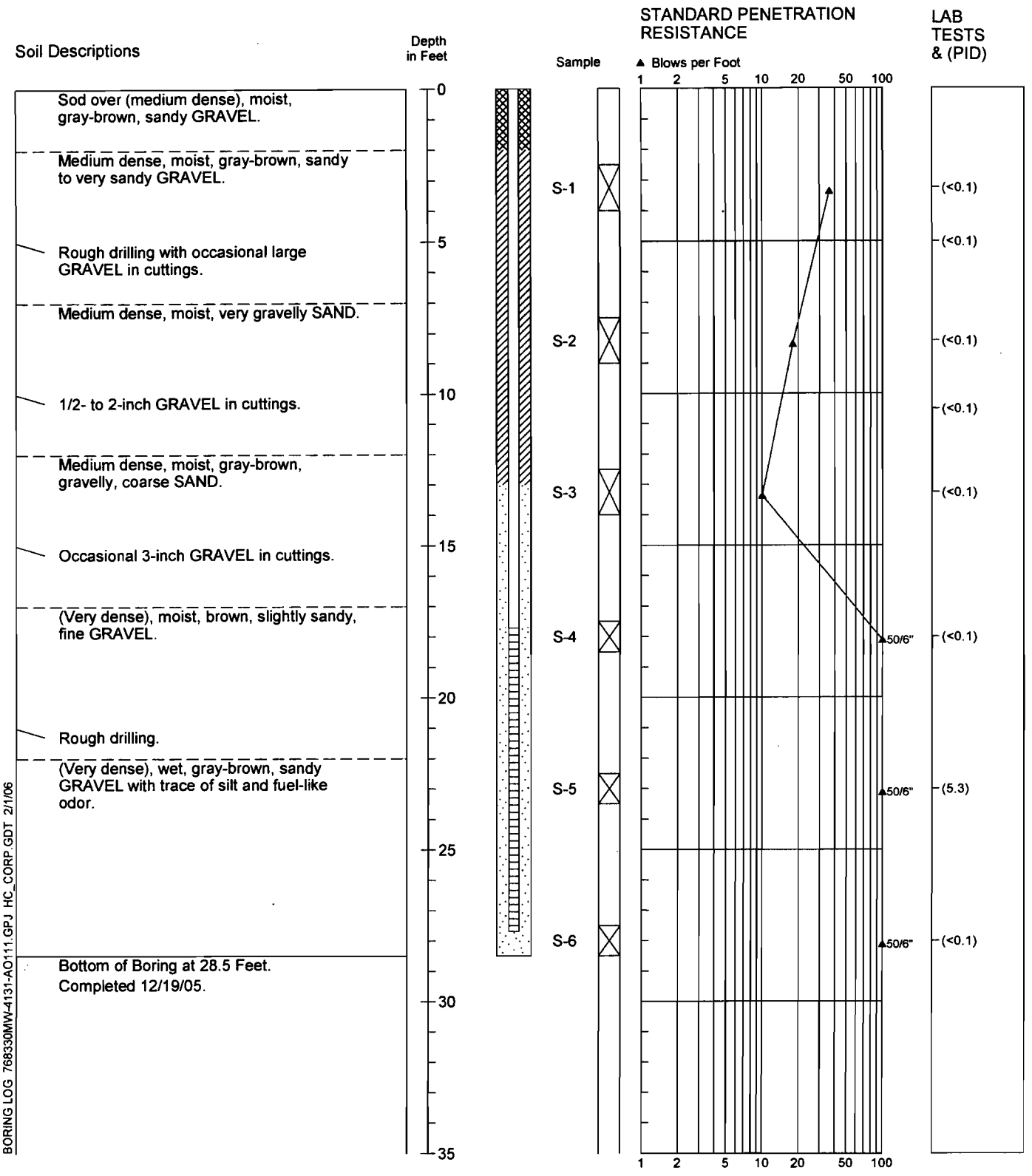
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 03/05

Figure A-9

Boring Log/Construction Data Monitoring Well A0111-MW04



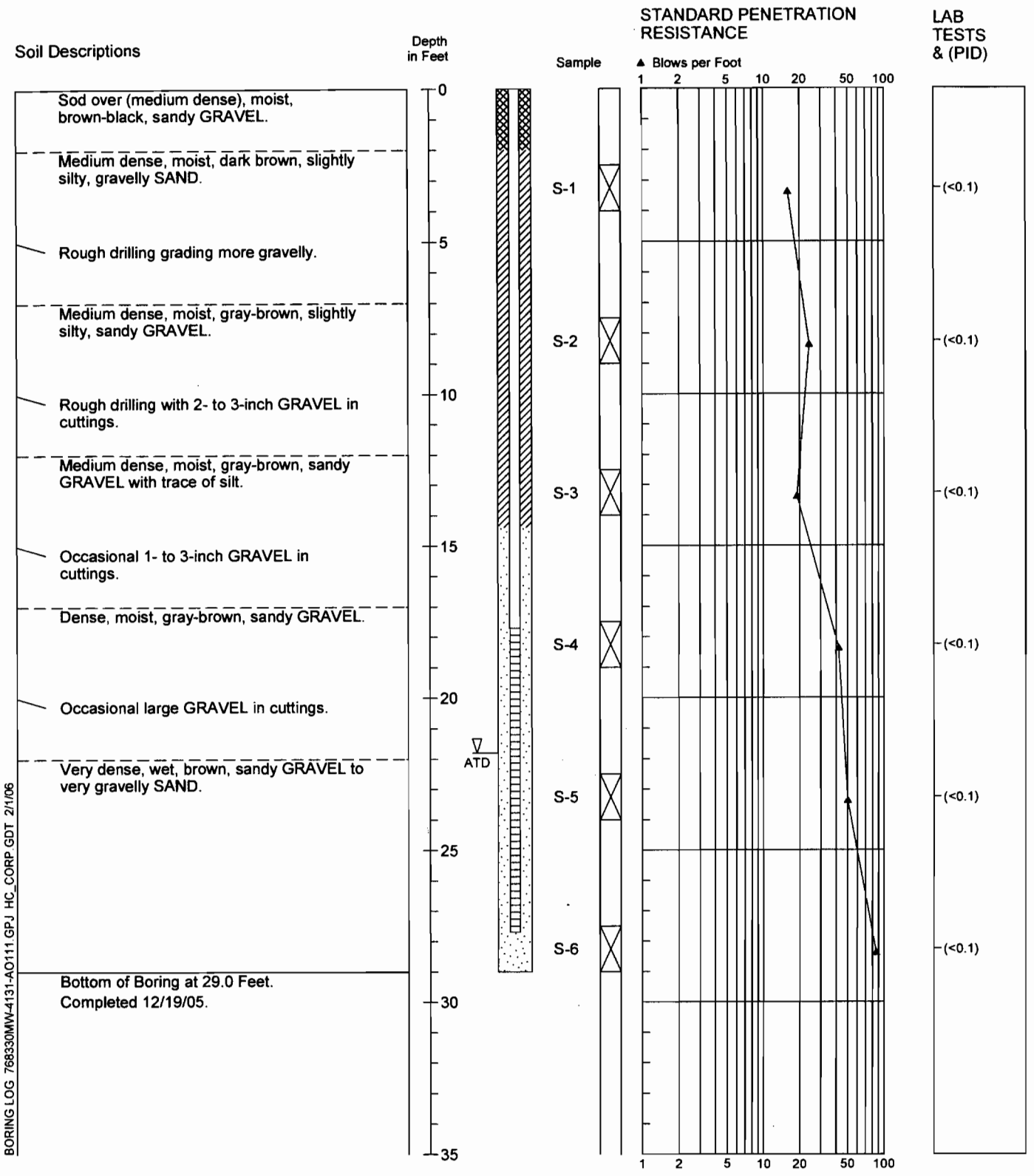
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-30 12/05

Figure A-5

Boring Log/Construction Data Monitoring Well A0111-MW05



HARTCROWSER

7683-30 *12/05*

Figure A-6

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING F-1

PROJECT: Fort Lewis Monitoring Well Relocation
PROJECT NO.: 094-10002
LOGGED BY: RN
CONTRACTOR:
SAMPLE METHOD:
DATE: February, 2010
PAGE: 1 of 1
SURFACE ELEVATION:
BORING TYPE: Hollow Stem Auger
LOCATION: Fort Lewis, Pierce Co, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 30 50 70 90	Natural Moisture Content and Atterberg Limits 0 20 40 60 80 100
			Fill Materials					
			Silty Sand with Some Gravel (SM) Loose to medium dense, silty fine to medium grained sand with some gravel, brown to dark brown, moist. P.I.D. = 0.0	5 5 6	11			
5			P.I.D. = 0.0	2 3 7	10			
10			**Silty Gravel with Cobbles and Sand (GM)** Medium dense, gravel with cobbles, silt and sand, brown, moist. P.I.D. = 0.0	8 7 20	27			
15			**Silty Gravel with Cobbles and Sand (GM)** Dense, gravel with cobbles, silt and sand, brown, moist. P.I.D. = 0.0	8 19 25	44			
20		▽	**Well-Graded Gravel with Cobbles, Silt and Sand (GW)** Dense, gravel with cobbles, silt and sand, brown, moist. P.I.D. = 0.0					
25			**Poorly-Graded Gravel with Cobbles and Silt (GP)** Dense, gravel with cobbles, boulders and silt, brown, moist.					
30			End of Exploratory Boring					
35								

Water Level Initial: ▽ Final: ▼

Water Observations: Groundwater encountered at approximately 19 feet below grade.

Notes:

A0111-MW07

KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING F-2

PROJECT: Fort Lewis Monitoring Well Relocation
PROJECT NO.: 094-10002
LOGGED BY: RN
CONTRACTOR:
SAMPLE METHOD:
DATE: February, 2010
PAGE: 1 of 1
SURFACE ELEVATION:
BORING TYPE: Hollow Stem Auger
LOCATION: Fort Lewis, Pierce Co, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES
			Fill Materials			
			Silty Sand with Some Gravel (SM) Medium dense, silty fine to medium grained sand with some gravel, brown, moist. No P.I.D.			
5			**Silty Sand with Some Gravel, Cobbles and Silt (SM)** Very dense, silty fine to medium grained sand with some gravel, cobbles, and silt, dark brown, moist. P.I.D. = 0.0	20 36 31	67	
10			**Gravel with Cobbles, Boulders, Sand and Silt (GP)** Dense, gravel with cobbles, boulders, sand and silt, dark brown, moist. P.I.D. = N/A	7 18 16	34	
15			**Silty Sand with Gravel and Cobbles (SM)** Medium dense, silty fine to medium grained sand with some gravel and cobbles, medium dense, moist to saturated. P.I.D. = 0.0	5 9 11	20	
20		▼	**Gravel with Silt (GP-GM)** Very dense, gravel with silt, brown, saturated. - No Visual or Olfactory Indications of Pollutants	31 50(6)	100	
25			**Gravel with Cobbles and Silt (GP-GM)** Very dense, gravel with cobbles and silt, brown, saturated.			
30						
			End of Exploratory Boring			
35						

N-VALUE (GRAPH): 10 30 50 70 90

Natural Moisture Content and Atterberg Limits: 0 20 40 60 80 100

Water Level Initial: ▽ Final: ▼

Water Observations: Groundwater encountered at approximately 21 feet below grade.

Notes:

A0111-MW08

KRAZAN AND ASSOCIATES
11715 North Creek Parkway South
Suite C-106
Bothell, Washington 98011

LOG OF EXPLORATORY BORING F-3

PROJECT: Fort Lewis Monitoring Well Relocation
PROJECT NO.: 094-10002
LOGGED BY: RN
CONTRACTOR:
SAMPLE METHOD:
DATE: February, 2010
PAGE: 1 of 1
SURFACE ELEVATION:
BORING TYPE: Hollow Stem Auger
LOCATION: Fort Lewis, Pierce Co, WA

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	BLOW COUNTS (per 6")	N-VALUE (Last 12" of SPT)	SAMPLES	N-VALUE (GRAPH) 10 30 50 70 90	Natural Moisture Content and Atterberg Limits 0 20 40 60 80 100
			Fill Materials Loose, silty sand with gravel, sod and debris.					
			Silty Sand with Some Gravel (SM) Loose to medium dense, silty fine to medium sand with some gravel, brown, moist. P.I.D. = 0.0					
5			**Gravel with Some Cobbles, Silt and Sand (GP-GM)** Medium dense, gravel with cobbles, silt and sand, brown, moist.					
			Gravel with Silt and Sand (GP-GM) Dense, gravel with silt and sand, brown, moist. P.I.D. = 0.0	18 27 22	49			
10			**Silty Sand with Gravel (SM)** Medium dense, silty sand with gravel, brown, moist. P.I.D. = 0.0					
				7 9 11	20			
			Gravel with Silt and Sand (GP-GM) Medium dense, gravel with silt and sand, brown, moist.					
15			**Silty Sand with Gravel (SM)** Medium dense, silty sand with gravel, brown, moist to saturated. P.I.D. = 0.0					
				5 7 10	17			
20			**Gravel with Silt and Sand (GP-GM)** Medium dense, gravel with silt and sand, brown, moist. P.I.D. = 0.0					
25								
30			End of Exploratory Boring					
35								

Water Level Initial: ▽ Final: ▽

Water Observations: Groundwater encountered at approximately 19 feet below grade.

Notes:

APPENDIX B
DOE REPORTS/DRILLER'S LOGS

A0111-MW06

MONITORING WELL LOG F-1

SHEET 1 of 1

PROJECT No: 094-10002 | DATE: February 2010 | EASTING:

SITE: Fort Lewis , WA | LOGGED BY: RN | NORTHING:

CLIENT: | CONTRACTOR: The Remediators | ELEVATION:

WATER LEVEL	WELL DEPTH (m)	WELL	LEGEND	DEPTH (m)	DESCRIPTION	ODOUR	PID (ppmv)	SAMPLE LABEL	DEPTH (m)
	Cover			0	Ground Surface				
					Sand and Gravel				
				1	Dark Brown Silt				
				2	Sand and Gravel				
	Hole Plug				Occasional Large Gravels				
				3					
				4	Cobbles/Large Gravel				
				5					
	Silica Sand 10/20			6					
				7	Dense Sand and Gravel				
				8					
				9					
				10					

NOTES Depth in meters. Soil boring data includes interpretations and classifications based on notes from the driller's soil boring logs.

Descriptions are based on observations and hand testing of grab samples. Mechanical Tests were not performed unless otherwise stated.

First Occurrence of Groundwater Approximately 19 Feet (5.8 m) below Grade.
Static Groundwater Level Approximately 19 Feet (5.8 m) below Grade.

Reviewed By: | FILE

A0111-MW07

MONITORING WELL LOG F-2

SHEET 1 of 1

PROJECT No: 094-10002 | DATE: February 2010 | EASTING:

SITE: Fort Lewis , WA | LOGGED BY: RN | NORTHING:

CLIENT: | CONTRACTOR: The Remediators | ELEVATION:

	WATER LEVEL	WELL DEPTH (m)	WELL	LEGEND	DEPTH (m)	DESCRIPTION	ODOUR	PID (ppmv)	SAMPLE LABEL	DEPTH (m)
0		Cover				Ground Surface				
						Sand and Gravel				
1						Small Amount of Dark Brown Silt				
2						Gravels - Sand				
		Hole Plug								
3						Large Gravels				
4										
5										
6										
7		Silica Sand 10/20								
8										
9										
10										

NOTES Depth in meters. Soil boring data includes interpretations and classifications based on notes from the driller's soil boring logs.

Descriptions are based on observations and hand testing of grab samples. Mechanical Tests were not performed unless otherwise stated.

First Occurrence of Groundwater Approximately 21 Feet (6.4 m) below Grade.
Static Groundwater Level Approximately 21 Feet (6.4 m) below Grade.

Reviewed By: | FILE

A0111-MW08

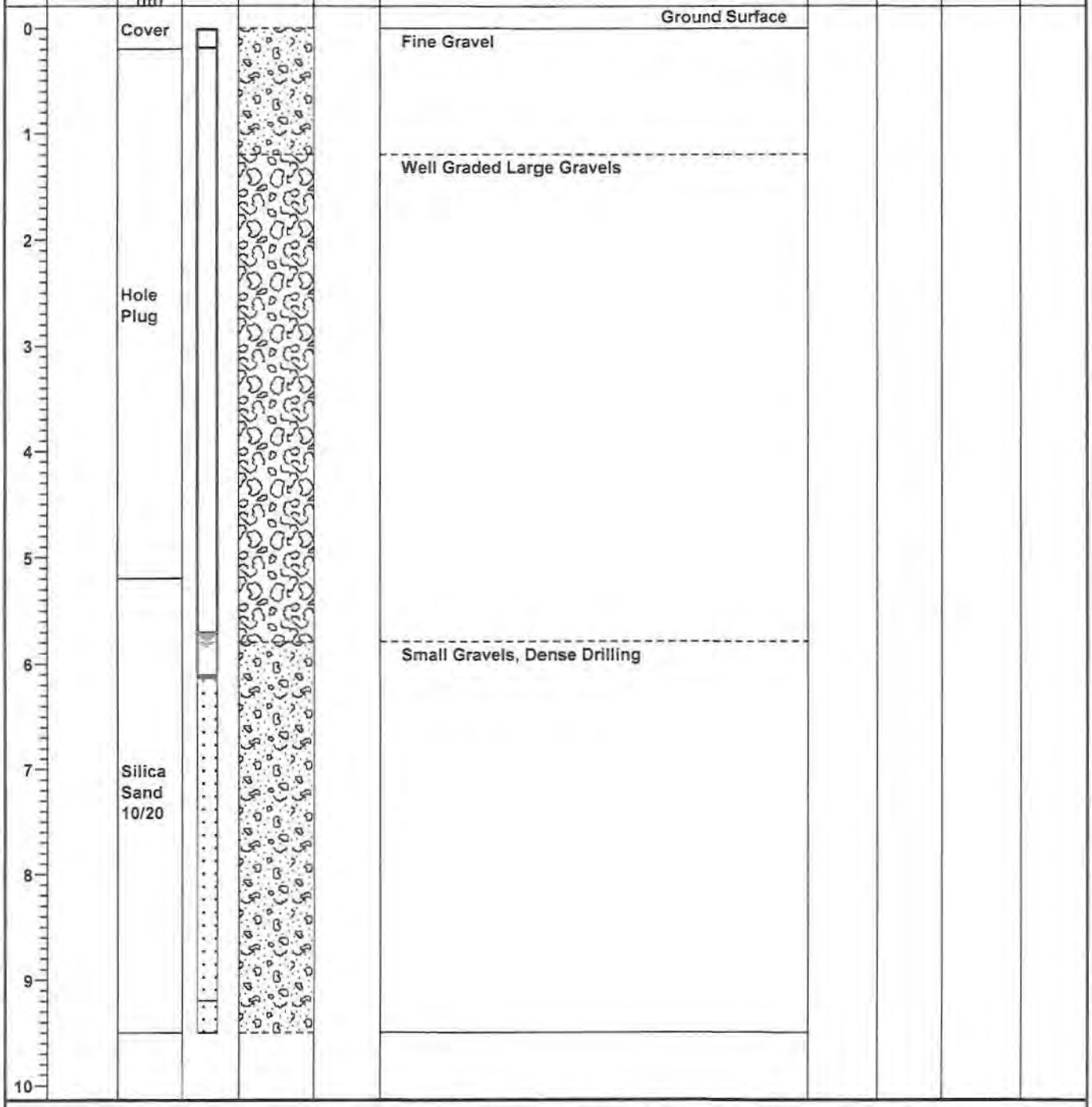
MONITORING WELL LOG F-3

SHEET 1 of 1

PROJECT No: 094-10002 | DATE: February 2010 | EASTING:

SITE: Fort Lewis , WA | LOGGED BY: RN | NORTHING:

CLIENT: | CONTRACTOR: The Remediators | ELEVATION:



NOTES Depth in meters. Soil boring data includes interpretations and classifications based on notes from the driller's soil boring logs.

Descriptions are based on observations and hand testing of grab samples. Mechanical Tests were not performed unless otherwise stated.

First Occurrence of Groundwater Approximately 19 Feet (5.8 m) below Grade.
Static Groundwater Level Approximately 19 Feet (5.8 m) below Grade.

Reviewed By: | FILE

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT Notice of Intent No. RE04334

Construction/Decommission *("x" in circle)*
- (x) Construction
- ( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* RE04334

Type of Well *("x" in circle)*
- (x) Resource Protection
- ( ) Geotech Soil Boring

Consulting Firm KRAZAN

Property Owner U.S ARMY

Site Address EATON ST

Unique Ecology Well ID Tag No: BBC-917

City MADRONA County: PIERCE

Location SE 1/4 SE 1/4 Sec 21 Twn 19 R 01 E/W or WWM (circle one)

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) T CHANGBAI

Driller/Engineer/Trainee Signature T Chang

Driller or Trainee License No. 1681

Cased or Uncased Diameter 2" Static Level 19' ±

Work/Decommission Start Date 28-FEB 2010

Work/Decommission Completed Date 5 MARCH 2010

If trainee, licensed driller's Signature and License no. N/A

Construction/Design	Well Data	Formation Description	
	Flush mount cover & concrete pad T-plus locking	ORGANICS SAND & GRAVEL	0
	16' – 1' 1/4" hole plus hydrated	PK BROWN SILT	5'
	2" PVC blank	SAND & GRAVEL	
	9' to surface seal	OCCASIONAL LARGE GRAVELS	10'
	19' – 16' 10/20 silica sand	Cobbles / large Gravel	20'
	29' – 19'	Dense SAND & Gravel	
	2" PVC screen .020 slot		25'
	Bottom of screen 29' 30' 2 sq 10/20 silica sand	Bottom 30'	30'

Scale 1"= NONE Page 1 of 1

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT Notice of Intent No. RE04334

Construction/Decommission *("x" in circle)*
- (x) Construction
- ( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm KRAZAN

Unique Ecology Well ID Tag No: BBC-918

Type of Well *("x" in circle)*
- (x) Resource Protection
- ( ) Geotech Soil Boring

Property Owner US ARMY

Site Address FT LEWIS

City Mcnard County: Pierce

Location SE 1/4 SE 1/4 Sec 04 Twn 19 R 01 (EWM) or WWM circle one

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) J CAMPBELL

Driller/Engineer/Trainee Signature J Campbell

Driller or Trainee License No. 1681

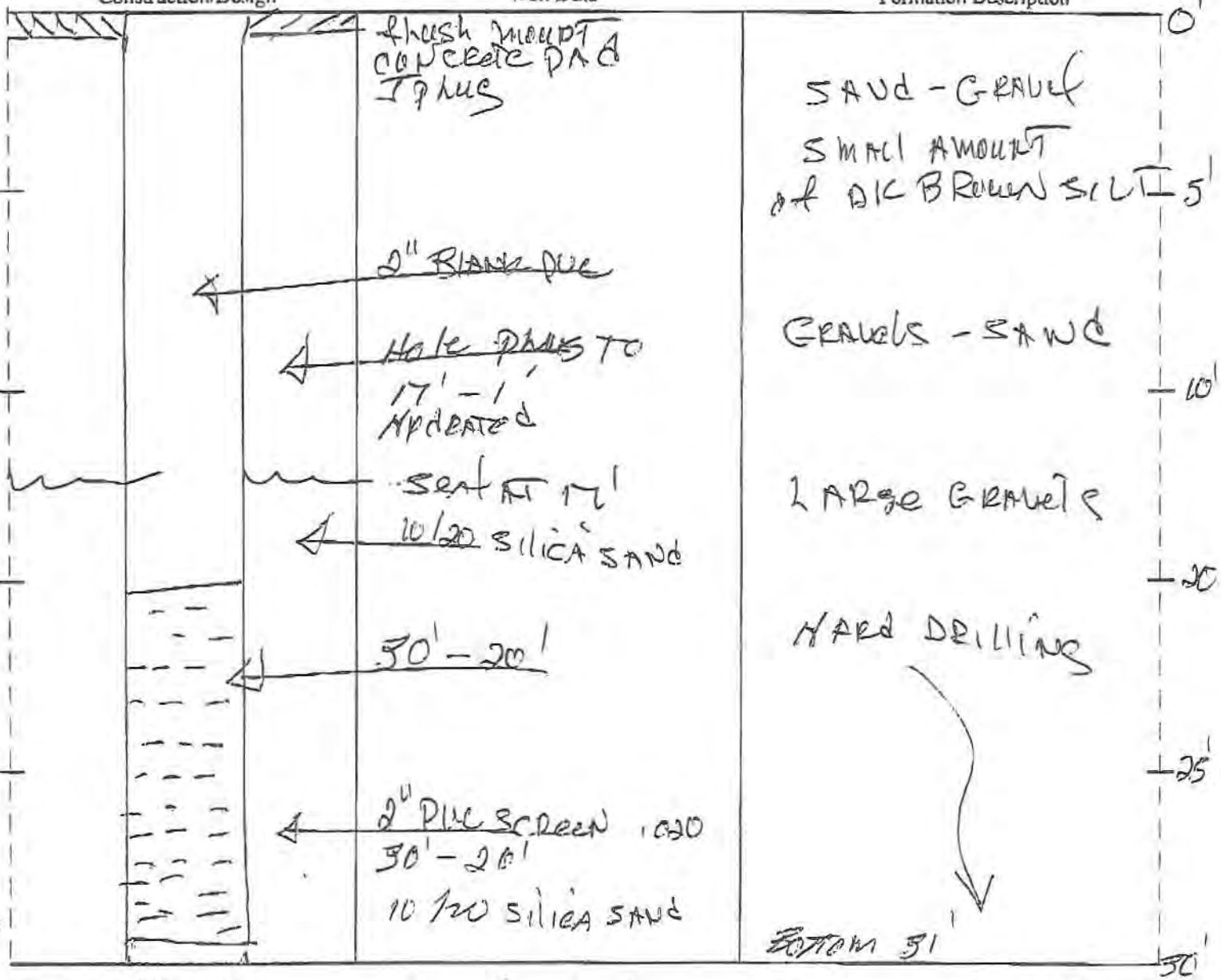
Tax Parcel No. _____

Cased or Uncased Diameter 2" Static Level 21 ±

Work/Decommission Start Date 25 Feb 2010

Work/Decommission Completed Date 5 March 2010

If trainee, licensed driller's Signature and License no. NA NA

Construction/Design	Well Data	Formation Description
	flush mount concrete pad 1 ft sq 2" Blank PVC Hole plugged to 17'-1' Updated Sand at 17' 10/20 silica sand 30'-20' 2" PVC screen .020 30'-20' 10/20 silica sand	0' SAND-GRAVEL small amount of DK BROWN SILT 5' GRAVELS-SAND 10' LARGE GRAVELS 20' HARD DRILLING 25' Bottom 31' 30'

Scale 1"= NO SCALE

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. RE ML13.84

Construction/Decommission *("x" in circle)*

- ⊗ Construction
- O Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

Type of Well *("x" in circle)*

- ⊗ Resource Protection
- O Geotech Soil Boring

Consulting Firm: KRAZAN

Unique Ecology Well ID Tag No: BBL-019

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print): T CAMPBELL

Driller/Engineer/Trainee Signature: T Camp

Driller or Trainee License No.: 1628

If trainee, licensed driller's Signature and License no.: N/A N/A

Property Owner: US ARMY

Site Address: E lh 7 @ SC

City: McCHORD County: Pierce

Location: SE 1/4 SE 1/4 Sec 21 Twn 19 R 01 EWM circle one or WWM

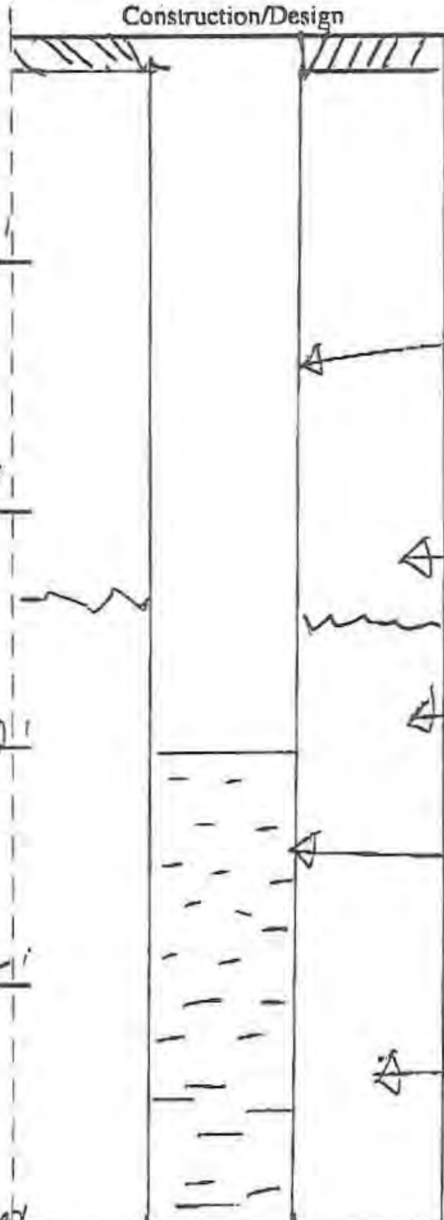
Lat/Long (s, t, r still REQUIRED): Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ______

Cased or Uncased Diameter: 2" Static Level: 19' ±

Work/Decommission Start Date: 28-Feb 2010

Work/Decommission Completed Date: 5 MARCH 2010

Construction/Design	Well Data	Formation Description
	flush mount concrete slab J plug 2" BLANK Seal Hole plug - 17' - 1' 10/20 silica sand 30' - 17' 2" PVC screen .020 30' - 20' 10/20 silica sand	0' fine gravel well graded 5 10 large gravels 20 small gravels dense drilling 25 Bottom 31' 30'

Scale 1" = NONE

Page 1 of 1

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT Notice of Intent No. AE 08306

Construction/Decommission *("x" in circle)*

O Construction

⊘ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* NA

Type of Well *("x" in circle)*

⊘ Resource Protection

O Geotech Soil Boring

Property Owner US ARMY

Site Address 8TH AVE S.

City MCCHORD County: PIERCE

Location SE 1/4 SE 1/4 Sec. 24 Twn 19 R 01 E/W/WWM *circle one*

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

Cased or Uncased Diameter ____ Static Level ____

Work/Decommission Start Date 25-Feb 2010

Work/Decommission Completed Date 5 March 2010

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) T Campbell

Driller/Engineer/Trainee Signature T Campbell

Driller or Trainee License No. 1681

If trainee, licensed driller's Signature and License no. NA NA

Construction/Design	Well Data	Formation Description
	Well # AKF 138 CASING Removed & BACKFILLED WITH BENNONITE chips & HYDRATED, WATER CONCRETE PAD Removed & HOLE BACKFILLED WITH BENNONITE chips PIPE DISPOSED OF TO A PROPER DISPOSAL STATION 29' +/-	

Scale 1"= NONE

Page 1 of 1

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. AE08508

Construction/Decommission *("x" in circle)*

O Construction
Ø Decommission *ORIGINAL INSTALLATION Notice of Intent Number* NA

Type of Well *("x" in circle)*

Ø Resource Protection
O Geotech Soil Boring

Consulting Firm KRAZAN

Unique Ecology Well ID Tag No: AKF 137

Property Owner US ARMY

Site Address 8 D C ST

City Mcord County: PIERCE

Location SE 1/4 SE 1/4 Sec 24 Twn 19 R 01 E WM or WWM circle one

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

Cased or Uncased Diameter ____ Static Level ____

Work/Decommission Start Date 28 FEB 2010

Work/Decommission Completed Date 5 March 2010

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) L Campbell

Driller/Engineer/Trainee Signature T Campbell

Driller or Trainee License No. 1681

If trainee, licensed driller's Signature and License no. NA NA

Construction/Design	Well Data	Formation Description
	Well # AKF137 CASING BROKE off Below surface CLEAN OUT & KNOCK BOTTOM OUT WITH STEEL BAR & fill WITH BENNOMITE med & Hydrate, CLEAN WATER, CONCRETE PAD HOLE filled WITH BENNOMITE Chips med & Hydrated - LEFT CASING IN GROUND Depth of Well 29' ±	

Scale 1"= N ONE

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AF 08508

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)*

O Construction

Ø Decommission *ORIGINAL INSTALLATION Notice of Intent Number* NA

Type of Well *("x" in circle)*

Ø Resource Protection

O Geotech Soil Boring

Property Owner U S ARMY

Site Address 8TH ST

City Mound County: Pierce

Location SE 1/4 SE 1/4 Sec 24 Twn 19 R 01 E/W WWM *Circle one*

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

Cased or Uncased Diameter ____ Static Level ____

Work/Decommission Start Date 28-FEB 2010

Work/Decommission Completed Date 5 MARCH 2010

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Ø Driller ☐ Engineer ☐ Trainee Name (Print) ____

Driller/Engineer/Trainee Signature T CAMPBELL

Driller or Trainee License No. 1 CAMPT*051

If trainee, licensed driller's Signature and License no. NA

Construction/Design	Well Data	Formation Description
	Well # AKF 136 CASING BROKE OFF CLEAN OUT ROCKS & SILT KNOCKED BOTTOM OUT BACKFILL WITH BENTONITE CHIPS & HYDRATE WITH CLEAN WATER, BACKFILLED HOLE UNDERCONCRETE PAD WITH BENONE CHIPS MET & HYDRATED CASING LEFT IN GROUND DEPTH OF WELL 28 +/-	

Scale 1"= N/A

Page 1 of 1

ECY 050-12 (Rev 2/01)

HTRW DRILLING LOG	DISTRICT: Seattle	HOLE NUMBER: 95-A17-1
1. COMPANY NAME: R & R Drilling	2. DRILL SUBCONTRACTOR: N/A	SHEET 1 SHEETS 3 OF

PROJECT: Building 10A33, Groundwater Investigation

NAME OF DRILLER: Rodney Gilseth

4. LOCATION: North Fort Lewis, WA
N: 660,582.112 DATUM NAD 83/86
E: 1,118,058.673

7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2½" ID Split spoon sampler w/300 lb. hammer
4" ID hollow stem auger

6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-61

8. HOLE LOCATION: SEE SKETCH BELOW

9. SURFACE ELEVATION: 235.516 BRASS MONUMENT DATUM NGVD 29

10. DATE STARTED: 17AUG95

11. DATE COMPLETED: 17AUG95

12. OVERBURDEN THICKNESS: 43.0'+

15. DEPTH GROUNDWATER ENCOUNTERED: 29.0'±

13. DEPTH DRILLED INTO ROCK: --

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED

14. TOTAL DEPTH OF THE HOLE: 43.0'

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 28.9' bgs, 18AUG95; 29.23' bgs, 21AUG95

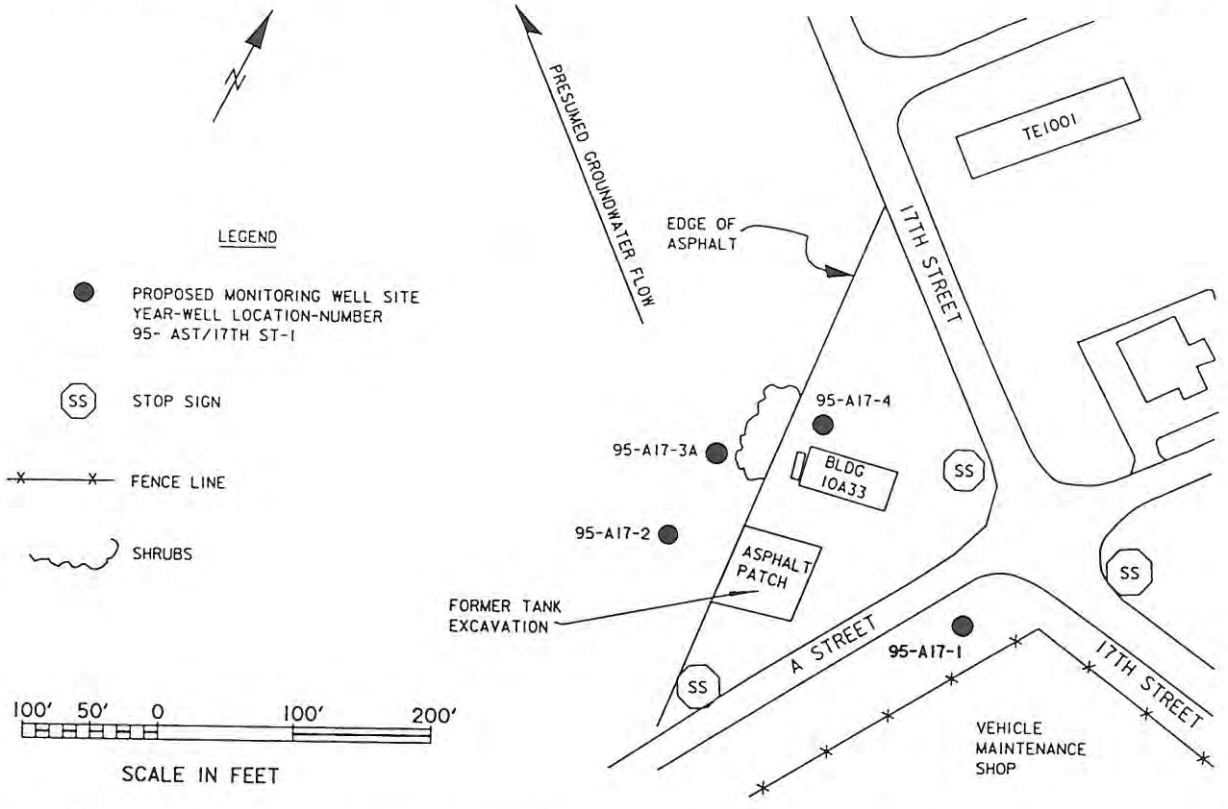
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	3		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X			

LOCATION SKETCH/COMMENTS:

SCALE: 1" = 100'



Soil I.D. using visual & manual procedures on cuttings returned on auger
hts/split spoon drive samples and drill action.

JECT	HOLE NO.
Bldg 10A33 Groundwater Investigation	95-A17-1

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33al.dgn
DATE AND TIME PLOTTED: 5-OCT-1995 12:39

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Richard Eckerlin

Hole No.: 95-A17-1

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
235.5		GM, Silty Sandy GRAVEL (1"-), loose, dry, brown	PID = 0 ppm				Soil I.D. using visual on cuttings brought to surface by auger flights.
		Gravel (3"-) @ 3.5'					
	5						
	10						
225.5		13.0'					
		GP-GM, Sandy GRAVEL w/silt, (2"-), loose, dry, brown	0 ppm				
	15						
	20	Moist @ 20.0'; 4" cobble					
	25						
		No noticeable petroleum odor in sample A	48 ppm	A		N = 40/6 50/4	A 27.5 - 28.3 ft
206.5		▼					
205.5	30	SP-SM, SAND w/silt (coarse to medium), saturated, brown	0 ppm	B		10/6, 38/6 50/3	B 32.5 - 33.7 ft
	35	Gravels to 2"					
							At 37.5' depth bgs, added water to top of auger to control heaving sand.
195.5	40	GP, Sandy GRAVEL, saturated, brown	0 ppm				
192.5		Bottom @ 43.0'		C		20/6, 50/2	C 42.5 - 43.1 ft
	45						Drill sample time is 50 min. for 0 to 43.0'.
	50						

OJECT: Bldg. 10A33 GW Investigation

HOLE NO.: 95-A17-1

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33al.dgn

DATE AND TIME PLOTTED: 5-OCT-1995 12:39

U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT Well No. 95-A17-1

WELL COMPLETION REPORT

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 8/18/95
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RODNEY GILSETH
INSPECTOR RICHARD ECKERLIN
DEPTH 43.0'

HOLE DATA
Size: 8" IN. TO 43.0' FT.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

CASING
TYPE NONE
MFR.
HT. ABOVE GND. SURF.
DRIVE SHOE
Size: ____ in. to ____ ft.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

SCREEN
TYPE 0.020" SLOTTED PIPE SCH 40
MFR. ENVIRONMENTAL WELL PRODUCTS
COMPOSITION PVC DIA. 2"

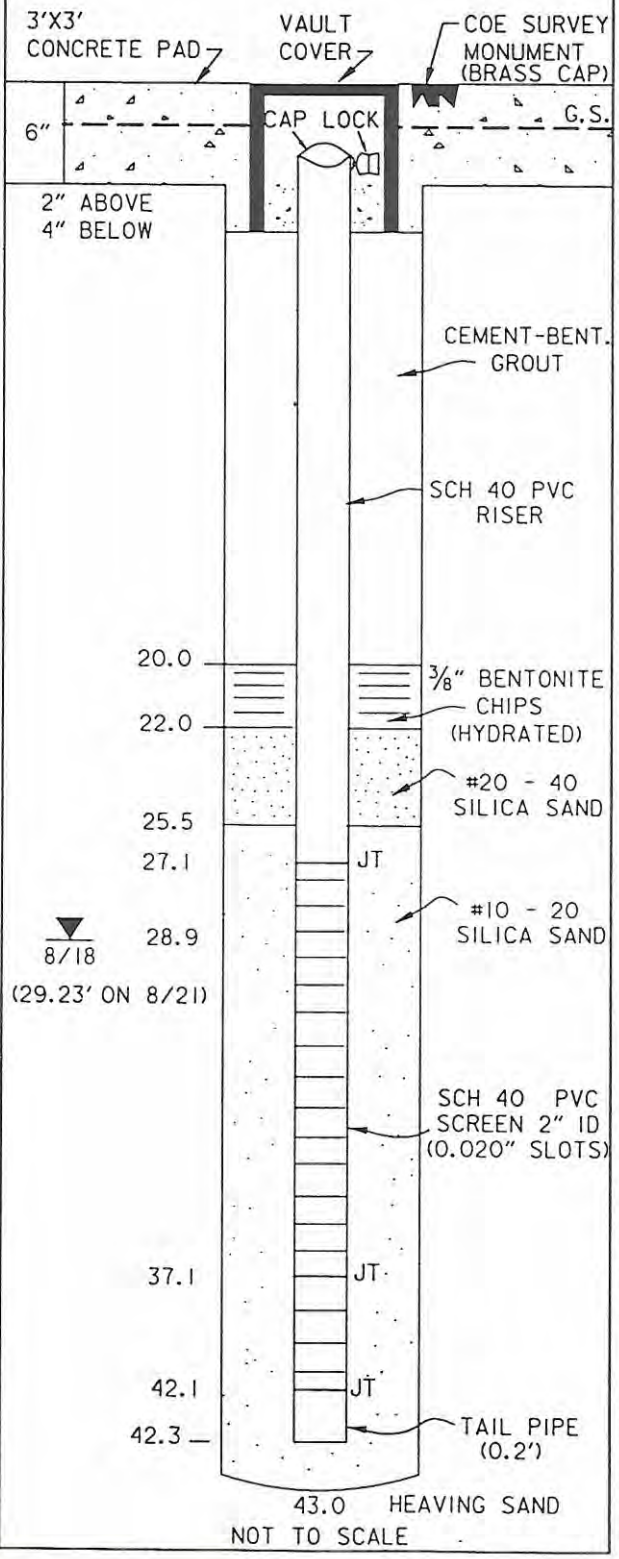
FITTINGS:	LENGTH	DIA.
PACKER	N/A	
RISER	27.1'	2"
TAILPIPE	0.2'	2"

FILTER
SOURCE CSSI COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 10-20
INST. METHOD POURED DOWN AUGER
VOLUME USED 400 LBS (10-20); 150 LBS (20-40)
DEPTH 25.5' TO 42.3' FT.

GROUT
COMPOSITION CEMENT - BENTONITE (5%)
VOLUME USED 8 EA 94 LB SACKS
INST. METHOD PUMPED THROUGH AUGER
DEPTH 0.5' TO 20.0' FT.
DEPTH ____ TO ____ FT.

REMARKS: 1. O-RINGS AT PVC JOINTS
2. 4" ID AUGER
SAND PROVIDED IN 50 LB SACKS
3. MORRIS INDISTORIES VAULT 13" LENGTH, 3 BOLTS, 8½" ID
5. HYDRATED BENTONITE FOR 2 HOURS

WELL DETAIL (AS BUILT)



DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a1.dgn
DATE AND TIME PLOTTED: 5-OCT-1995

HTRW DRILLING LOG	DISTRICT: Seattle	HOLE NUMBER: 95-A17-2
1. COMPANY NAME: R & R Drilling	2. DRILL SUBCONTRACTOR: N/A	SHEET 1 SHEETS OF 3

PROJECT: Building 10A33, Groundwater estigation

NAME OF DRILLER: Rodney Gilseth

4. LOCATION: North Fort Lewis, WA
N: 660,549.309 DATUM NAD 83/86
E: 1,117,848.620

7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4" ID Hollow stem auger; 2½" split spoon & 300 lb. hammer.

6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-61

8. HOLE LOCATION: SEE SKETCH BELOW

9. SURFACE ELEVATION: 234.976 BRASS CAP DATUM NGVD 29

10. DATE STARTED: 16AUG95

11. DATE COMPLETED: 16AUG95

12. OVERBURDEN THICKNESS: 42.2'

15. DEPTH GROUNDWATER ENCOUNTERED: 30'

13. DEPTH DRILLED INTO ROCK: 0

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED

14. TOTAL DEPTH OF THE HOLE: 42.2'

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 29.7' bgs, 17AUG95; 29.77' bgs, 21AUG95

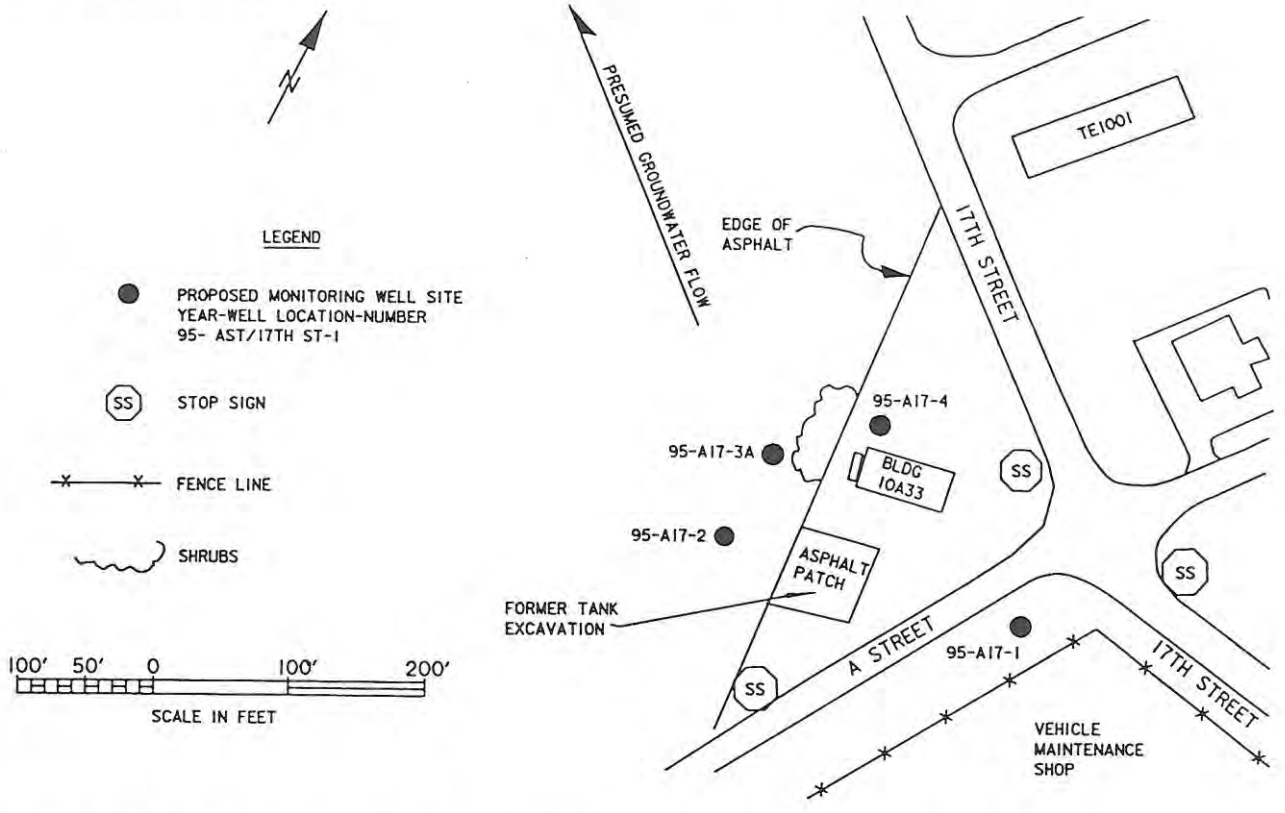
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED
	4	

19. TOTAL NUMBER OF CORE BOXES: N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X			

LOCATION SKETCH/COMMENTS:



Soil I.D. using visual & manual procedures on cuttings returned on auger hts/split spoon drive samples and drill action.

JECT	HOLE NO.
Bldg 10A33 Groundwater Investigation	95-A17-2

DESIGN FILE: /oenps/projects/ma/f1/geotech/welog/10a33a2.dgn

DATE AND TIME PLOTTED: 5-OCT-1995 13:23

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Richard E. Smith

Hole No.: 95-A17-2

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
235.0		GP-GM, rounded to sub-rounded, fine to medium GRAVEL with cobbles, fine to medium sand (20%) and brown silt (5 - 10%).	PID = 0 ppm				
	5		PID = 0 ppm				At 5.0', stopped to adjust rig. Cobbles knocking auger off vertical.
	10		PID = 0 ppm				Smooth drilling to 10.0', then slightly harder drilling.
	15	14 - 15': large cobbles	PID = 0 ppm				Bit bouncing @ 14.0' - 15.0', then soft drilling, again.
	20		PID = 0 ppm				
		3" gravel in sampler; moist		A		42 - 6" 50 - 5"	A: 22.5' - 23.4' collecting drive sample.
210.0	25		PID = 0 ppm	No Return 0% recovery			
		GP-GC, rounded to sub-rounded coarse GRAVEL with medium to coarse angular sand (20%) and pockets of tan clay (10 - 15%)		B		40 - 6" 50 - 5"	B: 27.5' - 28.4'
205.0	30	▼	PID = 0 ppm	20% recovery			
		Large green rock with small black crystals in sampler; wet.		C		42 - 6" 50 - 4"	C: 32.5' - 33.4'. Very soft drilling @ 33.0'.
	35	SP, fine to medium, angular to sub-rounded SAND, loose, wet, gray	PID = 0 ppm	0% recovery			
				D		50 - 6" 50 - 4"	D: 37.5' - 38.4'
	40		PID = 0 ppm	100% recovery			
197.0		Bottom @ 42.2'					At 42.2', driller added water to keep heaving sand out. Drill/sample time 60 min. for 0.00' to 42.2'.
	45						
	50						

PROJECT: Bldg. 10A33 GW Investigation

HOLE NO.: 95-A17-2

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33g2.dgn

DATE AND TIME PLOTTED: 5-OCT-1995 12:50

U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT Well No. 95-A17-2

WELL COMPLETION REPORT

Sheet 3 of 3

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 17 AUG 95
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RODNEY GILSETH
INSPECTOR RICHARD SMITH/RICHARD ECKERLIN
DEPTH 42.2'

HOLE DATA
Size: 8" IN. TO 42.2' FT.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

CASING
TYPE NONE
MFR.
HT. ABOVE GND. SURF.
DRIVE SHOE
Size: ____ in. to ____ ft.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

SCREEN
TYPE 0.020" SLOTTED PIPE SCH 40
MFR. ENVIRONMENTAL WELL PRODUCTS
COMPOSITION PVC DIA. 2"

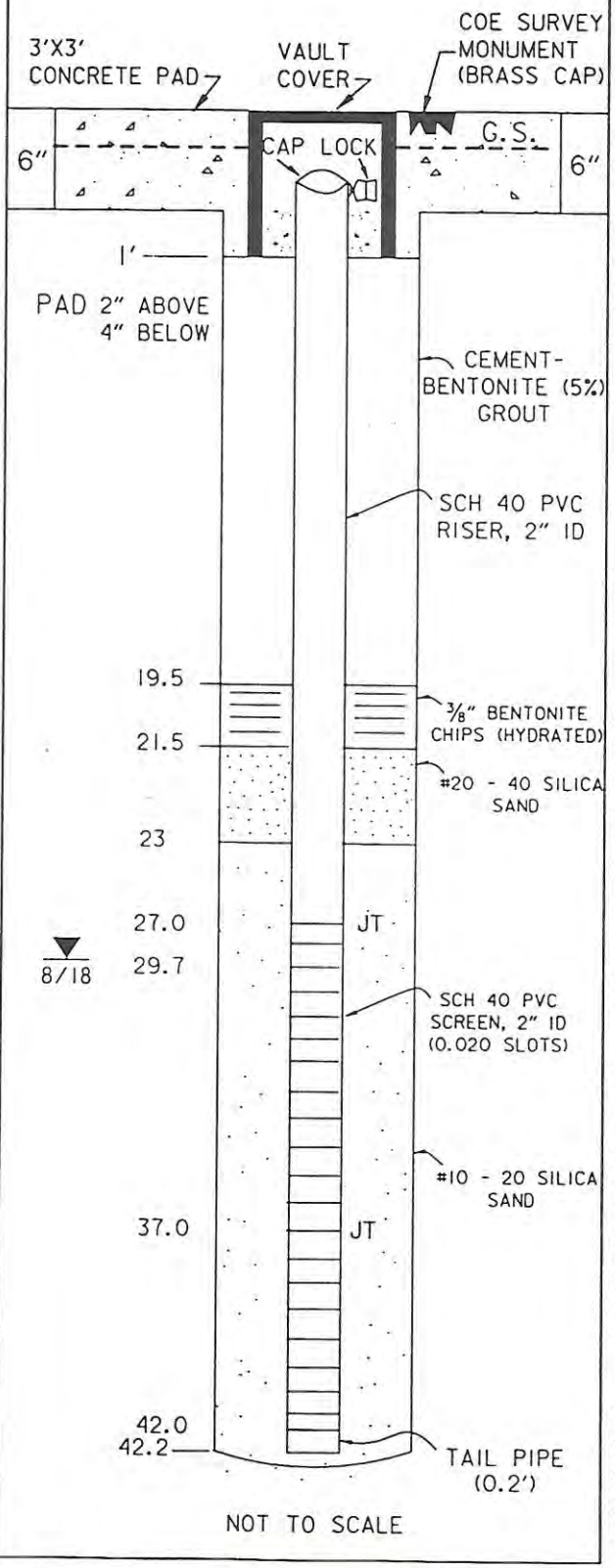
FITTINGS:	LENGTH	DIA.
PACKER	N/A	
RISER	27.0'	2"
TAILPIPE	0.2"	2"

FILTER
SOURCE CSSI-COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 10/20
INST. METHOD POURED THROUGH AUGER
VOLUME USED 500 LBS (10-20); 50 LBS (20-40)
DEPTH 23.0' TO 42.2' FT.

GROUT
COMPOSITION CEMENT/BENTONITE 5%
VOLUME USED 6 EA 94 LB SACKS
INST. METHOD PUMPED DOWN AUGER
DEPTH 1.0' TO 19.5' FT.
DEPTH ____ TO ____ FT.

REMARKS: 1. O-RINGS ON PVC JOINTS
2. 4" AUGER ID
3. HYDRATED BENTONITE FOR 2 HRS
4. SAND IN 50 LB SACKS
5. MORRIS INDUSTRIES, INC. VAULT = 13" IN LENGTH; 3-BOLT COVER, 8½" ID

WELL DETAIL (AS BUILT)



DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a2.dgn
DATE AND TIME PLOTTED: 5-OCT-1995

HTRW DRILLING LOG	DISTRICT: Seattle	HOLE NUMBER: 95-A17-3/3A
1. COMPANY NAME: R & R Drilling	2. DRILL SUBCONTRACTOR: N/A	SHEET 1 SHEETS OF 3

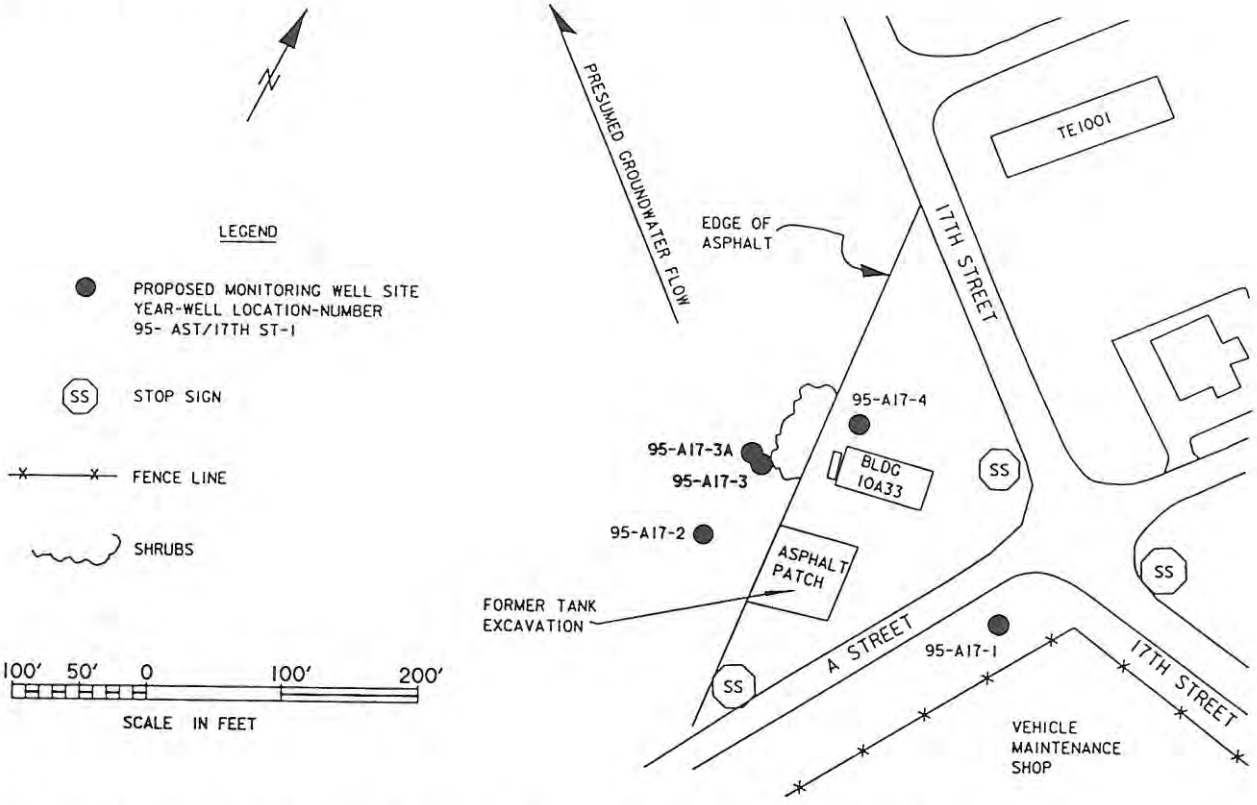
PROJECT: Building 10A33, Groundwater vestigation	4. LOCATION: North Fort Lewis, WA N: 660,645.575 DATUM NAD 83/86 E: 1,117,853.635
NAME OF DRILLER: Rodney Gilseth	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Split spoon samples	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-61
taken in 95-A17-3 located 10.0'± East	8. HOLE LOCATION: SEE SKETCH BELOW
(Well 95-A17-3 was lost during riser	9. SURFACE ELEVATION: 235.422 BRASS CAP DATUM NGVD 29
installation)	10. DATE STARTED: 16AUG95 — 11. DATE COMPLETED: 16AUG95
12. OVERBURDEN THICKNESS: 44.5'+	15. DEPTH GROUNDWATER ENCOUNTERED: 30.0'
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF THE HOLE: 44.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 29.8' bgs, 16AUG95; 30.2' bgs, 21AUG95.

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	2		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
None						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
None		X			

LOCATION SKETCH/COMMENTS:



Soil I.D. using visual & manual procedures on cuttings returned on auger
ghts/split spoon drive samples and drill action.

JECT	HOLE NO.
Bldg. 10A33 Groundwater Investigation	95-A17-3/3A

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a3a.dgn
DATE AND TIME PLOTTED: 5-OCT-1995 13:19

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Richard E. Smith

Hole No.: 95-A17-3A

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
235.4		GM, Silty Sandy GRAVEL , loose, dry, brown					
	5		PID = 0 ppm				
			PID = 0 ppm				
225.4	10	GP-GM, rounded to subrounded, fine to medium GRAVEL with 15% Sand (Fine to Medium) and 10 - 15% Silt, loose, slightly moist, brown					Smooth drilling to 10.0', then slightly harder drilling
	15		PID = 0 ppm				
	20		PID = 0 ppm				
	25		PID = 0 ppm				
		Wet at 28.0', and color change to gray-brown					
205.4	30	▼ Gravel smaller and sand 35%	PID = 0 ppm				
		Cobbles and less sand (~10%)					Drilling rough on cobbles @ 33.0'
	35			A		10/6 40/6 50/2	A: 35.5 - 36.6 ft 95-A17-3
199.4		Still in cobbles					No sample return past 38.0'. Easy drilling.
	40	SP, SAND with occ. gravel (1"), medium, saturated, brown		B		50/4"	B: 40.0 - 40.3 ft 95-A17-3
190.9	45	Bottom @ 44.5'					Added water to push out soil plug in auger. Drill Time 20 min. for 0.00 - 44.5'.
	50						

OJECT: Bldg. 10A33 GW Investigation

HOLE NO.: 95-A17-3/3A

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a3a.dgn

DATE AND TIME PLOTTED: 5-OCT-1995 13:13

WELL COMPLETION REPORT

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 17 AUG 95
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RODNEY GILSETH
INSPECTOR RICHARD SMITH
DEPTH 44.5'

HOLE DATA
Size: 8" IN. TO 44.5' FT.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

CASING
TYPE NONE
MFR.
HT. ABOVE GND. SURF.
DRIVE SHOE
Size: ____ in. to ____ ft.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

SCREEN
TYPE 0.020" SLOTTED PIPE SCH 40
MFR. ENVIRONMENTAL WELL PRODUCTS
COMPOSITION PVC DIA. 2"

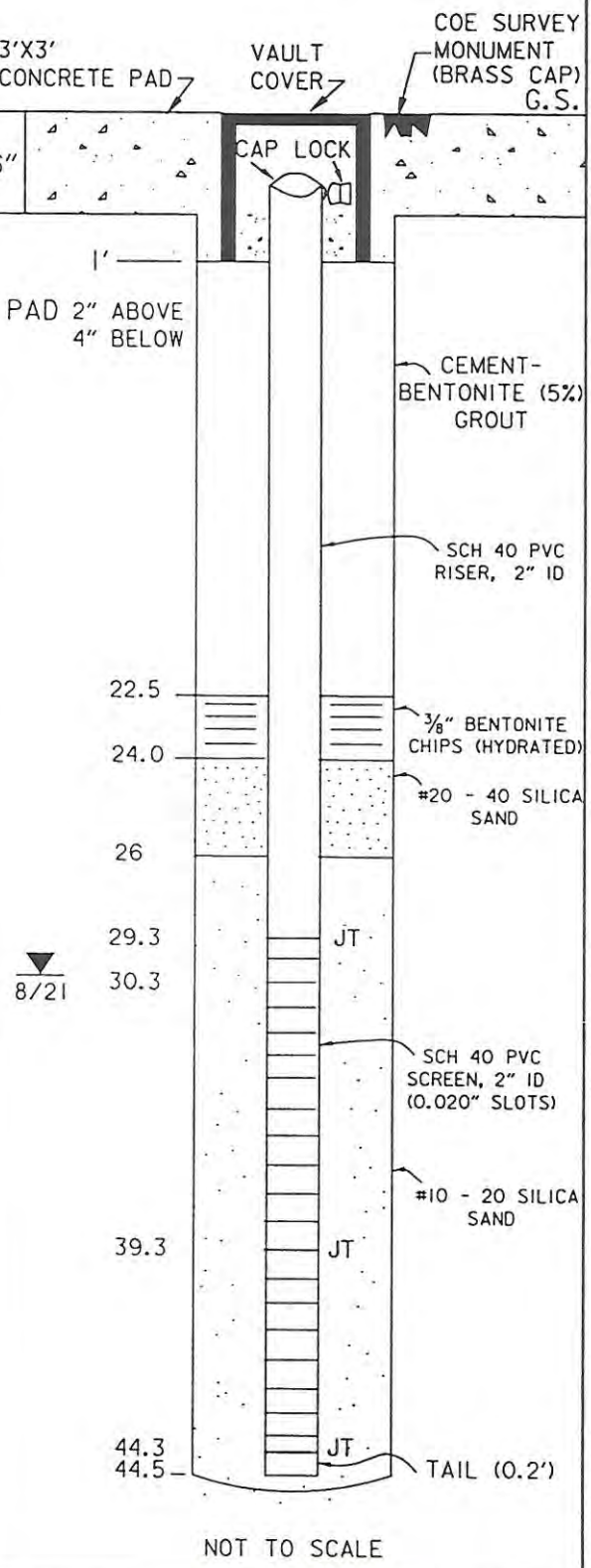
FITTINGS:	LENGTH	DIA.
PACKER	N/A	
RISER	29.3'	2"
TAILPIPE	0.2"	2"

FILTER
SOURCE CSSI-COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 10-20
INST. METHOD POURED DOWN AUGER
VOLUME USED 500 LBS (10-20); 50 LBS (20-40)
DEPTH 26.0' TO 44.5' FT.

GROUT
COMPOSITION CEMENT/BENTONITE (5%)
VOLUME USED 8 EA 94 LB SACKS
INST. METHOD PUMPED DOWN AUGER
DEPTH 1.0' TO 22.5' FT.
DEPTH ____ TO ____ FT.

REMARKS: 1. O-RINGS ON PVC JOINTS
SAND IN 50 LB SACKS
4" ID AUGER
4. HYDRATED BENTONITE FOR 2 HOURS
5. 3-BOLT VAULT COVER, 8½"ID; HGT = 1.0' 1";
BY MORRIS INDUSTRIES, INC.

WELL DETAIL (AS BUILT)



DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a3a.dgn
DATE AND TIME PLOTTED: 5-OCT-1995

HTRW DRILLING LOG	DISTRICT: Seattle	HOLE NUMBER: 95-A17-4
1. COMPANY NAME: R & R Drilling	2. DRILL SUBCONTRACTOR: N/A	SHEET 1 SHEETS OF 3

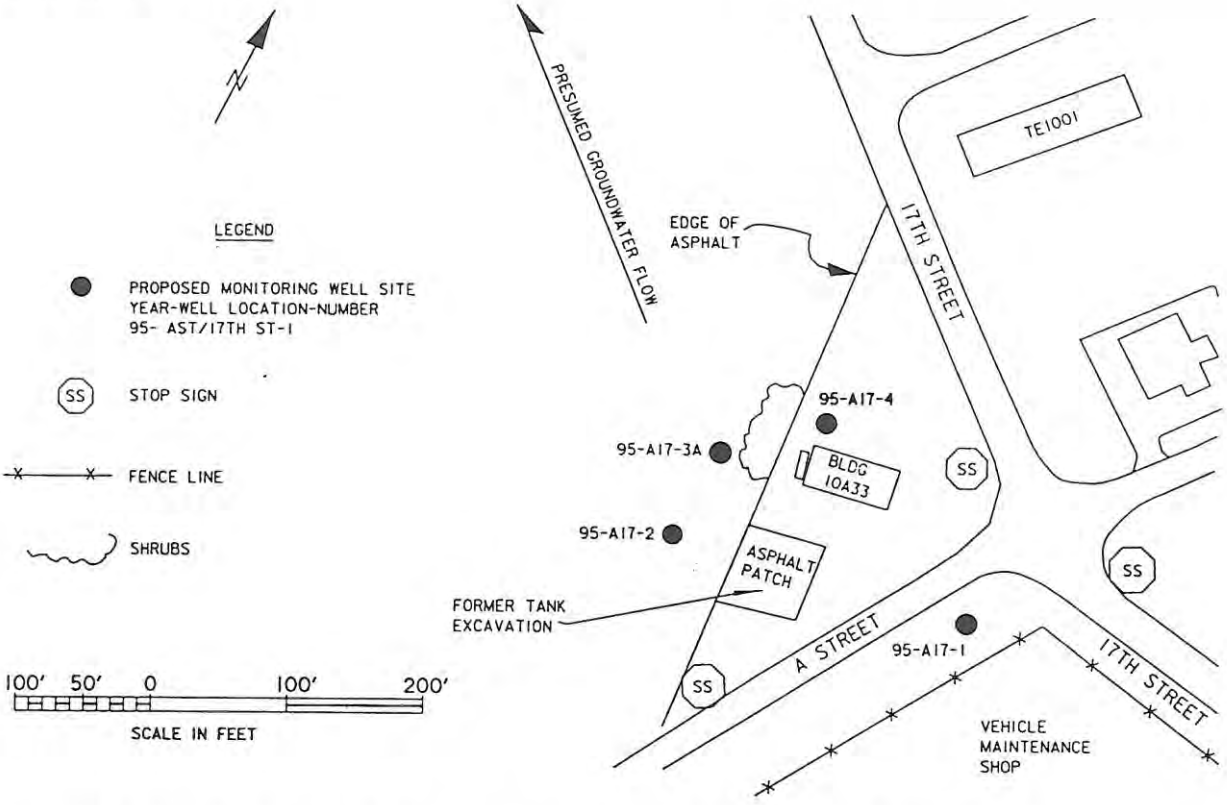
PROJECT: Building 10A33, Groundwater estigation	4. LOCATION: North Fort Lewis, WA N: 660,679.931 DATUM NAD 83/86 E: 1,117,916.877
NAME OF DRILLER: Rodney Gilseth	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4" ID Hollow stem auger; 2½" split spoon with 300# hammer.	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B-61
	8. HOLE LOCATION: SEE SKETCH BELOW
	9. SURFACE ELEVATION: 235.520 BRASS CAP DATUM NGVD 29
	10. DATE STARTED: 18AUG95 — 11. DATE COMPLETED: 18AUG95
12. OVERBURDEN THICKNESS: 42.5'+	15. DEPTH GROUNDWATER ENCOUNTERED: --
13. DEPTH DRILLED INTO ROCK: --	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: --
14. TOTAL DEPTH OF THE HOLE: 42.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 29.57' bgs, 21AUG95

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	2		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X			

LOCATION SKETCH/COMMENTS:



Soil I.D. using visual & manual procedures on cuttings returned by auger hts/split spoon drive samples and drill action.

OJECT	HOLE NO.
Bldg. 10A33 Groundwater Investigation	95-A17-4

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33g4.dgn
DATE AND TIME PLOTTED: 5-OCT-1995 13:47

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Richard Eckerlin

Hole No. 95-A17-4

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
235.5		GM, Silty GRAVEL, loose, dry, brown					Asphalt 1½" > 8" Thick Concrete 6½"
	5						
225.5	10	GM, Silty Sandy GRAVEL with cobbles to 4", compact, dry, brown					
220.0	15	GM, Silty GRAVEL, loose, dry, brown					
	20						
≤10.5	25	GM, Silty Sandy GRAVEL with petroleum (strong odor), moist, gray	PID = 480 ppm	A		48/6 50/5	A 27.5 - 28.5 ft
	30						
			PID = 180 ppm	B		40/6 50/3	B 32.5 - 33.3 ft 820 ppm at hole collar.
	35						
							37.5' Added water to control heaving sand.
	40						
193.0		Bottom @ 42.5'					42.5' At 42.5', too much heaving; can't sample.
	45						Drill/Sample Time 6.5 min. for 0 to 42.5 ft.
	50						

OJECT: Bldg. 10A33 GW Investigation

HOLE NO. 95-A17-4

DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33g4.dgn

DATE AND TIME PLOTTED: 5-OCT-1995 13:42

U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT Well No. 95-A17-4

WELL COMPLETION REPORT

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 18 AUG 95
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RODNEY GILSETH
INSPECTOR RICHARD ECKERLIN
DEPTH 42.5'

HOLE DATA
Size: 8" IN. TO 42.5' FT.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

CASING
TYPE NONE
MFR.
HT. ABOVE GND. SURF.
DRIVE SHOE
Size: ____ in. to ____ ft.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

SCREEN
TYPE 0.020" SLOTTED PIPE SCH 40
MFR. ENVIRONMENTAL WELL PRODUCTS
COMPOSITION PVC DIA. 2"

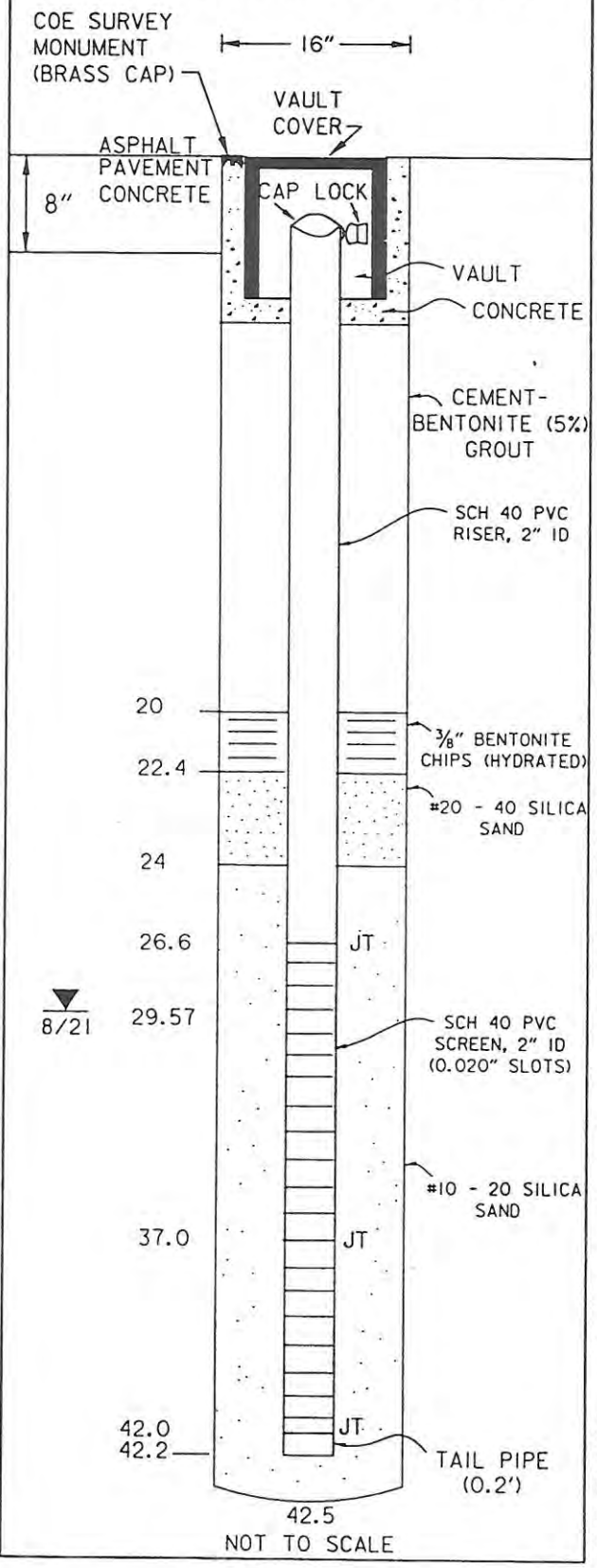
FITTINGS:	LENGTH	DIA.
PACKER	N/A	
RISER	26.6'	2"
TAILPIPE	0.2"	2"

FILTER
SOURCE CSSI-COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 10/20
INST. METHOD POURED DOWN AUGER
VOLUME USED 450 LBS (10-20); 50 LBS (20-40)
DEPTH 24.0' TO 42.2' FT.

GROUT CEMENT/WYOMING BENTONITE
COMPOSITION 5%
VOLUME USED
INST. METHOD PUMPED DOWN AUGER
DEPTH ____ TO ____ FT.
DEPTH ____ TO ____ FT.

REMARKS: 1. O-RINGS ON PVC JTS
4" AUGER ID
SAND IN 50 LB SACKS
4. HYDRATED BENTONITE FOR 2 HOURS
5. MORRIS INDUSTRIES VAULT, 13" LENGTH, 3 BOLTS, 8½" ID

WELL DETAIL (AS BUILT)



DESIGN FILE: /cenps/projects/mc/fl/geotech/welog/10a33a4.dgn
DATE AND TIME PLOTTED: 5-OCT-1995

HTRW DRILLING LOG	DISTRICT Seattle	HOLE NUMBER 96-A17-5
1. COMPANY NAME R & R Drilling	2. DRILL SUBCONTRACTOR N/A	SHEET 1 SHEETS 3 OF

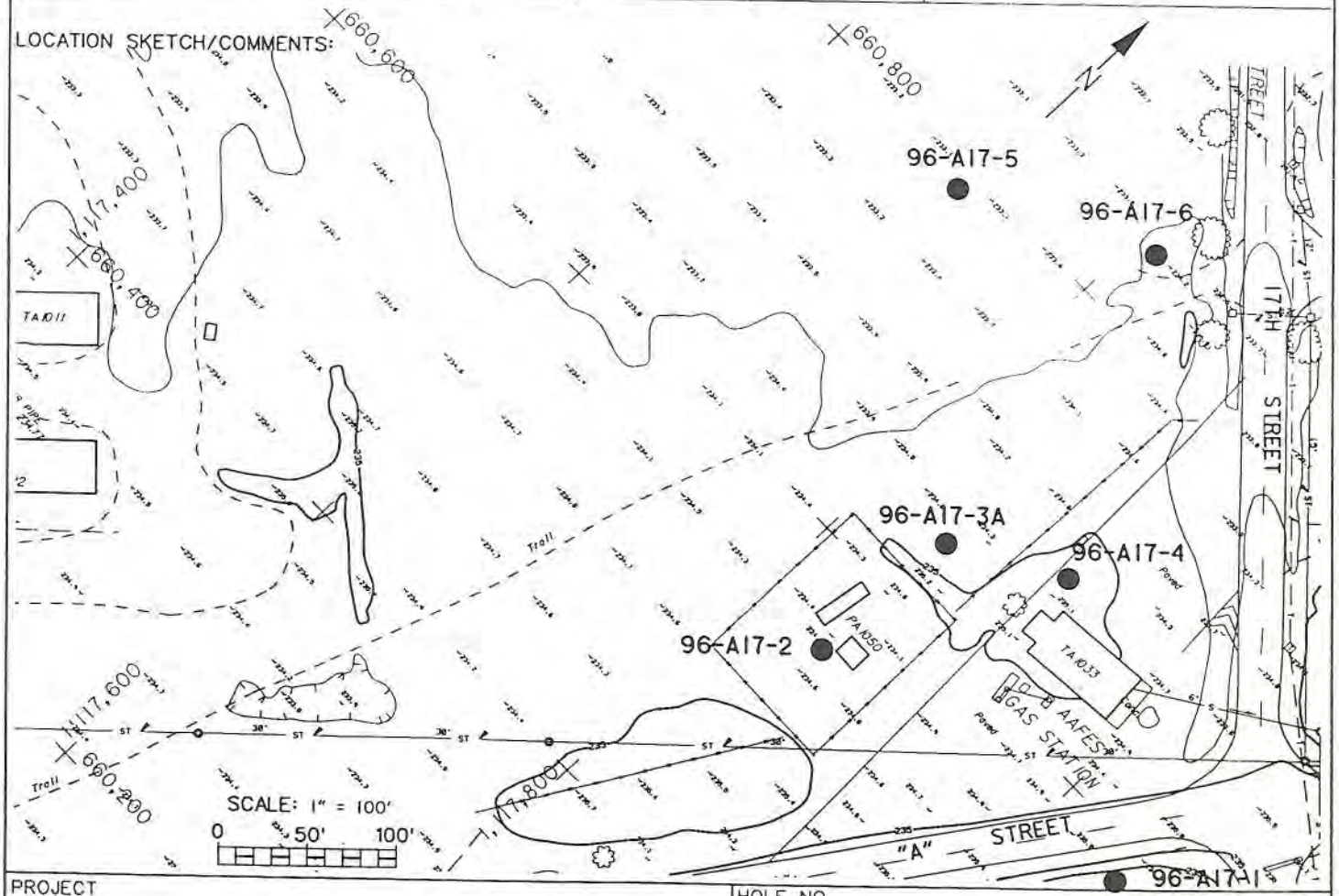
3. PROJECT Building 10A33, Groundwater Investigation	4. LOCATION North Fort Lewis, WA N: 660,778.38 DATUM NAD 83/86 E: 1,117,704.45
5. NAME OF DRILLER Rick Carmel	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2½" ID Split spoon	6. MANUFACTURER'S DESIGNATION OF DRILL Mobile B-61
Sampler w/300 lb. hammer	8. HOLE LOCATION SEE SKETCH BELOW
4" ID hollow stem auger	9. SURFACE ELEVATION 233.92 BRASS MONUMENT DATUM NGVD 29
	10. DATE STARTED 22JAN96 — 11. DATE COMPLETED 22JAN96
12. OVERBURDEN THICKNESS 45.0'+	15. DEPTH GROUNDWATER ENCOUNTERED 24.0'
13. DEPTH DRILLED INTO ROCK --	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF THE HOLE 45.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
N/A		X			

LOCATION SKETCH/COMMENTS:



PROJECT	HOLE NO.
Bldg 10A33 Groundwater Investigation	96-A17-5

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Anna Campbell

Hole No.: 96-A17-5

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
233.9		SM: Silty sand, moist, black, loamy with organic matter					1447 (2:47 pm) 22 JAN96
		GP: Sandy gravel with brown silt/clay coating gravel ½" to 2"					
	5						1448
							No evidence of contamination
							1500
	10						
							1501
	15						
							1504
	20						No evidence of contamination
		▼					
208.9	25	GP: Sandy gravel with silt and organic matter, wet, black. Gravel is small, sub-rounded.	0 ppm			20/6 50/5	1512 Drive sample 25' - 26'
							1516
	30	GP: Sandy gravel with brown silt/clay coating gravel to 2"					
							No evidence of contamination
							1519
	35						
							1522
	40						No evidence of contamination
188.9	45	Bottom of hole 45.0'					1524 (3:24 pm) 22JAN96

PROJECT: Bldg. 10A33 GW Investigation

HOLE NO.: 96-A17-5

DATE AND TIME PLOTTED: 14-MAR-1996 15:17

WELL COMPLETION REPORT

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 22 JAN 96
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RICK CARMEL
INSPECTOR ANNA CAMPBELL
DEPTH 45.0'

HOLE DATA
Size: 8" IN. TO 45.0' FT.
____ IN. TO ____ FT.
____ IN. TO ____ FT.

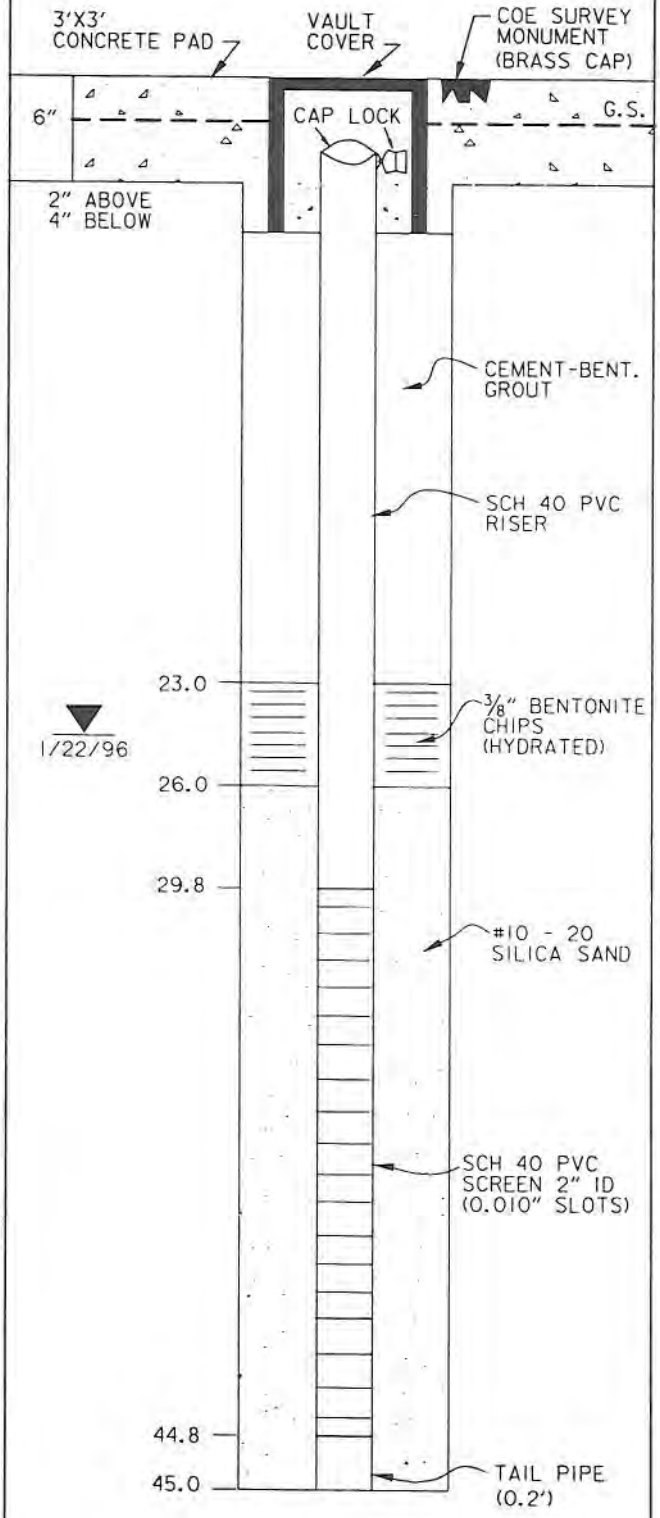
VAULT COVER
TYPE STEEL FLUSH MOUNT COVER
MFR. MORRIS INDUSTRIES
HT. ABOVE GND. SURF. 2"
DRIVE SHOE NONE

SCREEN
TYPE SCH 40 0.010" SLOTS, FLUSH THREADED
MFR. AARDVARK
COMPOSITION PVC DIA. 2"

FILTER
SOURCE CSSI COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 20/40
INST. METHOD POURED DOWN AUGER
VOLUME USED 600 LBS
DEPTH 26.0' TO 45.0' FT.

GROUT
COMPOSITION BENTONITE CEMENT
VOLUME USED 100 GALLONS
INST. METHOD TREMIE
DEPTH 1.0 TO 23.0 FT.
DEPTH ____ TO ____ FT.
REMARKS: BENTONITE SEAL (23.0-26.0)
DOE UNIQUE WELL NO. ABJ 746

WELL DETAIL (AS BUILT)
NOT TO SCALE



NOT TO SCALE

DESIGN FILE: J:\mc\f1\geotech\welog\10a33a5.dgn DATE AND TIME PLOTTED: 15-MAR-1996

HTRW DRILLING LOG	DISTRICT Seattle	HOLE NUMBER 96-A17-6
1. COMPANY NAME R & R Drilling	2. DRILL SUBCONTRACTOR N/A	SHEET 1 SHEETS 3 OF

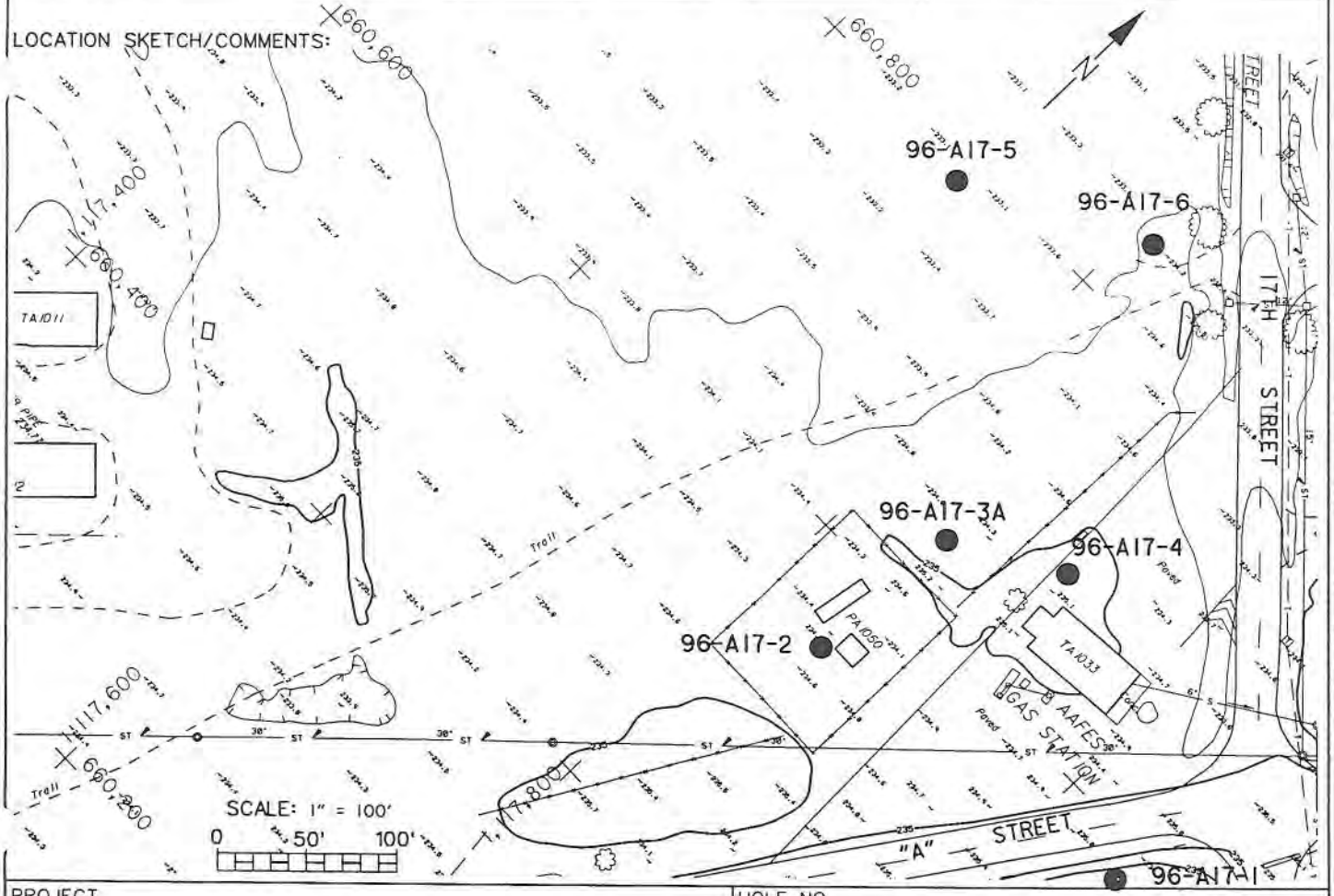
3. PROJECT Building 10A33, Groundwater Investigation	4. LOCATION North Fort Lewis, WA N: 660,841.92 DATUM NAD 83/86 E: 1,117,817.46
5. NAME OF DRILLER Rick Carmel	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2½" ID Split spoon	6. MANUFACTURER'S DESIGNATION OF DRILL Mobile B-61
Sampler w/300 lb. hammer	8. HOLE LOCATION SEE SKETCH BELOW
4" ID hollow stem auger	9. SURFACE ELEVATION 234.65 BRASS MONUMENT DATUM NGVD 29
	10. DATE STARTED 22JAN96 / 11. DATE COMPLETED 22JAN96
12. OVERBURDEN THICKNESS 45.0'	15. DEPTH GROUNDWATER ENCOUNTERED 24.0'
13. DEPTH DRILLED INTO ROCK --	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF THE HOLE 45.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS:	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
N/A		X			

LOCATION SKETCH/COMMENTS:



PROJECT	HOLE NO.
Bldg 10A33 Groundwater Investigation	96-A17-6

DESIGN FILE: j:\gmc\fig\geotech\welog\10a33d6.dgn
DATE AND TIME PLOTTED: 19-JUN-1996 14:40

HTRW DRILLING LOG (CONTINUATION SHEET)

PROJECT: Bldg. 10A33 GW Investigation

INSPECTOR: Anna Campbell

Hole No.: 96-A17-6

SHEET 2 SHEETS OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLING OR CORE BOX RECOVERY (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
234.65 233.15		GM: Organic Sandy silt, moist, black					0900
		GP: Sandy gravel with minor silt and clay. Gravel subrounded to 3", sand gray to brown, moist.					0902
	5						
							0903
	10						
	15						
	20						
		▼					0911
209.65	25	GP: Sandy gravel with black silt (loamy with organic matter roots) Gravel, 2" minus, silt, clay coating, brown				45/6 50/2(R)	0916 - Clean odor/visual Drive sample 25 - 25.7
							0922
	30						
							0925
	35						No evidence of contamination
							0929
	40						
189.65	45	Bottom of hole 45.0'					

PROJECT: Bldg. 10A33 GW Investigation

HOLE NO.: 96-A17-6

U.S. ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT — Well No. 96-A17-6

WELL COMPLETION REPORT

PROJECT BLDG 10-A-33 GROUNDWATER INVESTIGATION
COMPLETION DATE 22 JAN 96
CONTRACTOR R&R DRILLING CO
RIG B-61 MOBILE
OPERATOR RICK CARMEL
INSPECTOR ANNA CAMPBELL
DEPTH 45.0'

HOLE DATA
Size: 8" IN. TO 45.0' FT.
_____ IN. TO _____ FT.
_____ IN. TO _____ FT.

VAULT COVER
TYPE STEEL FLUSH MOUNT COVER
MFR. MORRIS INDUSTRIES
HT. ABOVE GND. SURF. 2"
DRIVE SHOE NONE

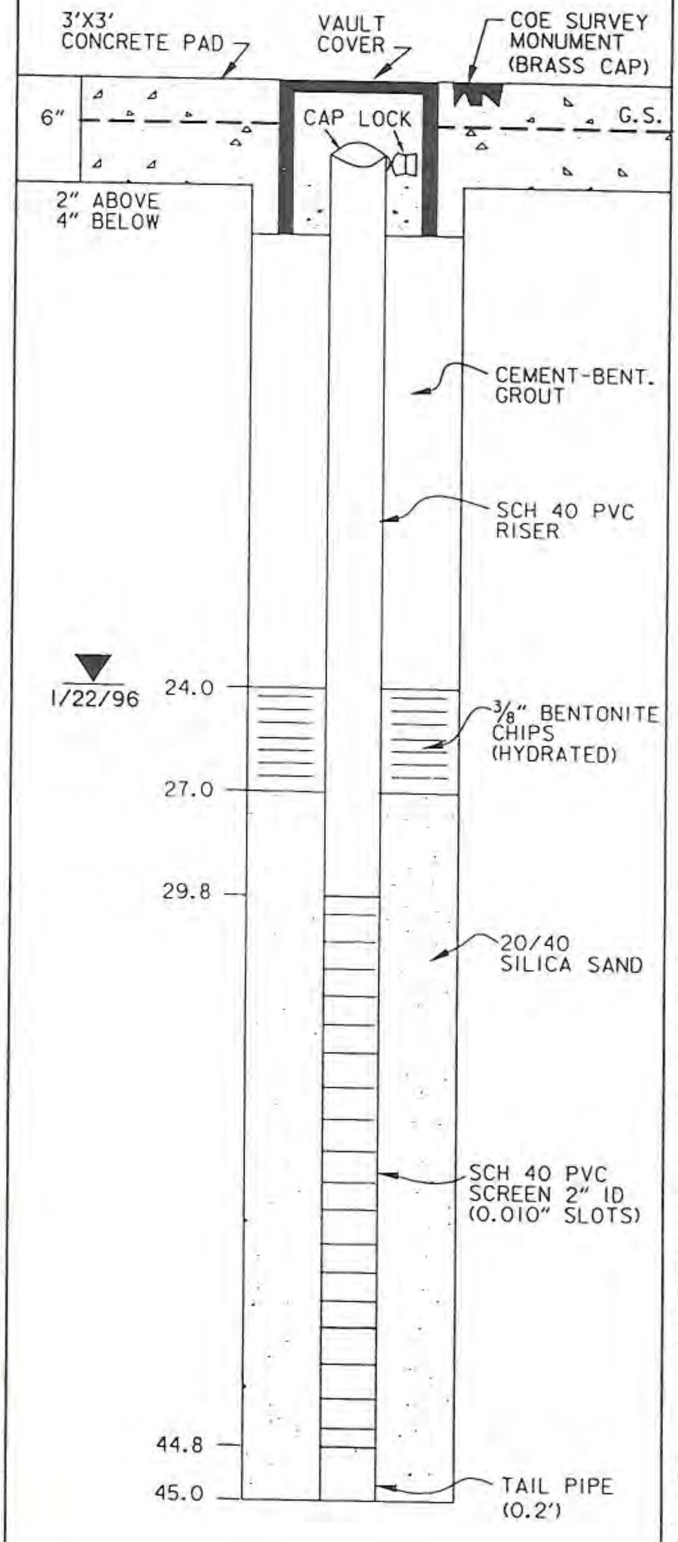
SCREEN
TYPE SCH 40 0.010" SLOTS, FLUSH THREADED
MFR. AARDVARK
COMPOSITION PVC DIA. 2"

FILTER
SOURCE CSSI COLORADO SILICA SAND INC.
COMPOSITION SILICA SAND
GRADATION 20/40
INST. METHOD POURED DOWN AUGER
VOLUME USED 525 LBS
DEPTH 27.0 TO 45.0 FT.

GROUT
COMPOSITION BENTONITE CEMENT
VOLUME USED 100 GALLONS
INST. METHOD TREMIE
DEPTH 1.0 TO 24.0 FT.
DEPTH _____ TO _____ FT.
REMARKS: BENTONITE SEAL (24.0-27.0)
DOE UNIQUE WELL NO. ABJ 747

WELL DETAIL (AS BUILT)

NOT TO SCALE



NOT TO SCALE

DATE AND TIME PLOTTED: 15-MAR-1996

DESIGN FILE: j:dmcdfl0gentechwelog10a3306.dgn

Fort Lewis Agreed Order
Draft Monitoring Well Installation Report
Building A1033 Former UST Site (AOC 9-2)
November 2007

1. Site-Specific Background Information

Six groundwater monitoring wells (MWs) were installed between 1995 and 1996 at the Fort Lewis Agreed Order (FLAO) site known as Building A1033 Former Underground Storage Tank (UST) Site (Area of Concern [AOC] 9-2. There are currently exceedances of Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for total petroleum hydrocarbons in the gasoline range (TPH-G), benzene, ethylbenzene, and total xylenes in MW 95-A17-3A. In a comment to the May 2007 draft FLAO Remedial Investigation Report, the Washington Department of Ecology (Ecology) recommended installation of a MW "100 – 150 feet in the localized downgradient direction (west-northwest) of monitoring location A17-3A to estimate the current extent of the gasoline plume." The objective of this investigation was to address the Ecology comment.

2. Well Installation and Development

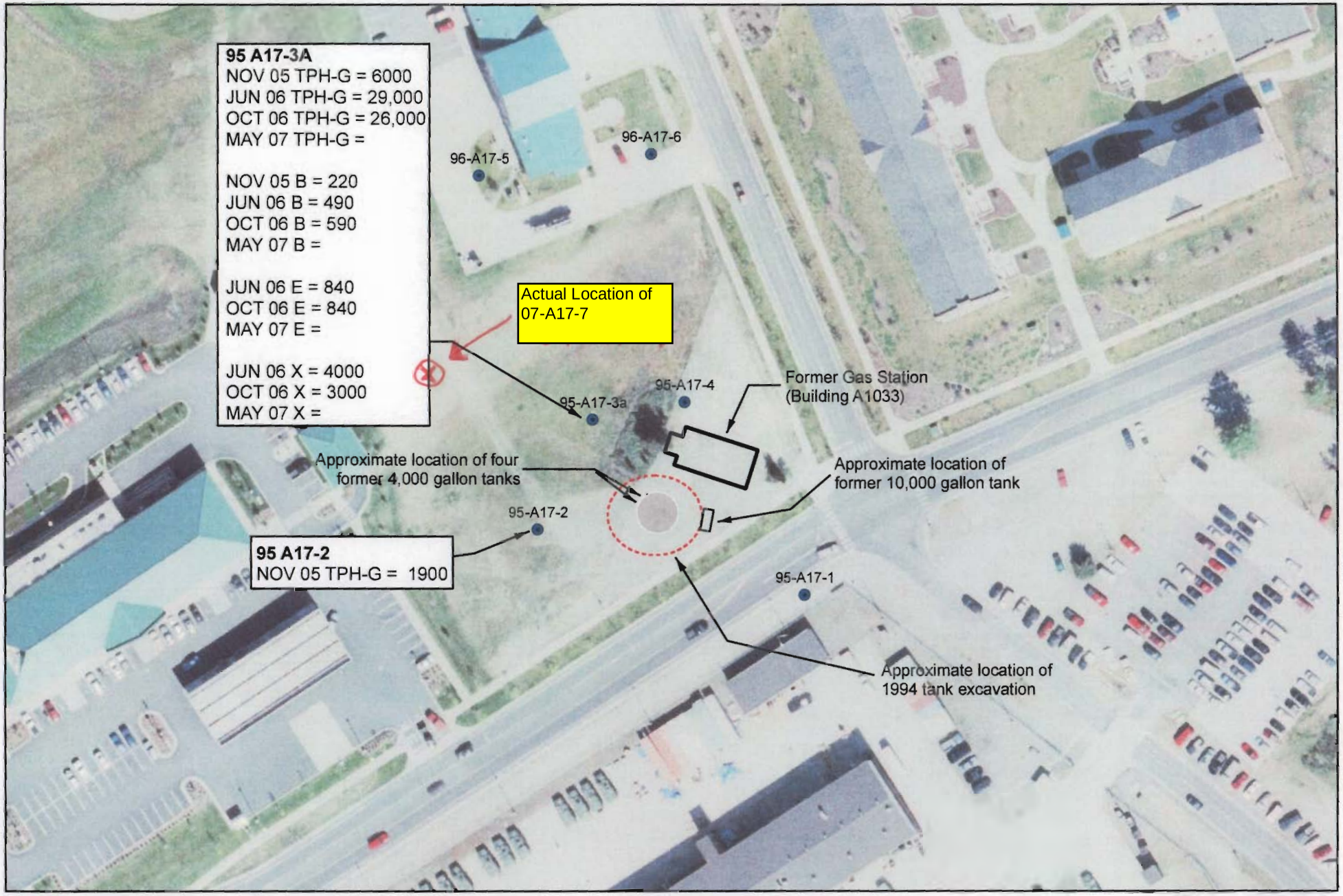
An upper Vashon Aquifer monitoring well (MW) designated as 07-A17-7 was installed in accordance with an October 2007 Sampling and Analysis Plan Addendum. The actual location of MW 07-A17-7 is the same as the proposed location and is shown in the attached figure. The MW was constructed by Cascade Drilling on 8 November 2007 in accordance with Chapter 173-160 Part II of the Washington Administrative Code by a driller licensed in the State of Washington.

A copy of the field notes, Boring Log Form, and MW Installation Form used to document the installation and development of MW 07-A17-7 is attached. In summary, 07-A17-7 is a 2-inch diameter MW with a 10-slot, 15-foot-long well screen located from 22 to 37 feet below ground surface. The MW was developed on 15 November 2007 by overpumping with a submersible pump until development water contained no visible sediment and turbidity approached zero. Approximately 400 gallons of water were pumped from the MW during development.

The vertical elevation of the top of casing was determined by level survey to be 234.05 feet.

3. Groundwater Monitoring

Fort Lewis Compliance Cleanup Program will conduct semi-annual groundwater monitoring of TPH-G, benzene, toluene, ethylbenzene, and xylenes in MW 07-A17-7 (in conjunction with existing monitoring) in accordance with the procedures in the October 2006 FLAO Groundwater Monitoring Plan, beginning with the fall 2007 groundwater monitoring event.



Monitoring Well

Note: Additional plume delineation information from direct-push investigation documented in April 2002 Anteon report.

Nov 05 = Data from November 2005 GWM Event
Jun 06 = Data from June 2006 GWM Event
Oct 06 = Data from October 2006 GWM Event
May 07 = Data from May 2007 GWM Event
TPH-G = Detected TPH-G Concentration (ug/L)
B = Detected Benzene Concentration (ug/L)
E = Detected Ethylbenzene Concentration (ug/L)
X = Detected Total Xylenes Concentration (ug/L)

Likey localized direction of groundwater flow

Figure 8A

Building A1033 UST Site (AOC 9-2) Site Map

1:1,200

1 inch equals 100 feet

0 50 100 200 Feet

Map produced by DPW GIS. Reference file L:/angela/mxd/aoc9-2fig8A.mxd; Print file N:/maplibary/monthly/200703/aoc9-2fig8A.pdf

FIELD CHECKLIST

Project/Task Name: AOC 9-2 MW Install Site Location: AE 17th Street

Requested By / Date: TDS 11/2/07 Work Deadline: 11/8/07

SERVICES REQUESTED — **COMPLETED**

(1) Install 07-MW-7 per plan w/ screen from 22-37'	☒ YES ☐ NO
(2) Develop & survey MW & west bound fence	☒ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO
	☐ YES ☐ NO

ADDITIONAL STANDARD INSTRUCTIONS

	COMPLETED		COMPLETED
☒ Ecology NOI / Dig Permit / Utility Locate	☒ YES ☐ NO	☐ Call PM From Site	☐ YES ☐ NO
☒ Relevant Documents / Geology Library Consulted	☒ YES ☐ NO	☒ Health & Safety Meeting	☒ YES ☐ NO
☐ Well Logs from Ecology T____ R____ S____	☐ YES ☐ NO	☐ Draw Site Map _____	☐ YES ☐ NO
☒ Coordinate Contractor/Sub Access & Equipment	☒ YES ☐ NO	☒ Cuttings / Purge Water Characterization & Disposal	
☐ Purchase / Rent Equip _____	☐ YES ☐ NO	☐ Potential HW _____	☐ YES ☐ NO
☐ Coordinate with PM Prior to Departure	☐ YES ☐ NO	☐ Non-Haz _____	☐ YES ☐ NO
☐ Calibrate Equipment Prior to Departure_____	☐ YES ☐ NO	☒ Background SPREAD ON-SITE	☒ YES ☐ NO

SAMPLING REQUIREMENTS

☐ Field Testing: _____

☐ Analytical Chemistry Testing: _____ Laboratory:_____

☐ Analytical Chemistry Testing: _____ Laboratory:_____

☐ Geotechnical Testing: _____ Laboratory:_____

FIELD SUPPLIES NEEDED

☒ Site Map	☒ Water Level Indicator / Interface Probe
☒ Std Field Equip (keys, forms, pens, SAP, HSP, PPE, decon)	☐ Water Quality Meter _____ ☐ Field Test Kits_____
☐ GWM Equip (pump, tubing, generator, compressor)	☐ Sample Kit / Cooler / COC / Ice _____
☐ Drilling Equip (PID, references, knife, baggies)	☐ IDW: ☐ Drums _____ ☐ 5-gal buckets _____
☐ Pump/Slug Test Equip (GWM Equip, slug, stopwatch)	☐ Camera
☐ Survey Equip / GPS	☐ Other:_____

DAILY FIELD REPORT

Date: 11/8/07 Site Location: AOC 9-2 Site Arrival Time: 1100 Site Departure Time: ~~330~~

WEATHER	Clear Sun	Overcast X	Drizzle	Rain	Snow
TEMPERATURE	To 32	32-50	X 50-70	70-85	85 Up
WIND	Calm	Med. X	Strong	Severe	

PEOPLE PRESENT ON-SITE

NAME	ASSOCIATION	TIME ON-SITE AND OFF-SITE
Troy Bussey	FPM	See Sw
Rodney & 2/Cascade helpers	CASCADE DRILLING	↓
GEOFFREY		
AARON		

NOTES ON WORK COMPLETED

11/8/07 MW BORING ADVANCED TO 37';
OFF-SITE @ 1530 WHILE DRILLERS FINISHING WELL COMPLETION

11/9 GOT RESS of CONSTRUCTION DOCUMENTATION FROM RODNEY

11/15 ON-SITE TO DEVELOP & SURVEY
→ SEE DEVELOPMENT FORM

Slight petroleum odor in development water

SURVEY
INSTRUMENT BETWEEN 3A & 7 → NO TURNS OR DIFFERENT INST HEIGHTS

3A BM ~~3 + (7 + 5/8)/12~~ 3 + (7 + 5/8)/12
3A TOC 3 + (10 + 1/4)/12
7 TOC 5 + (0 + 1.5/8)12

SIGNATURE: [signature] DATE: 11/15/07

FORT LEWIS PUBLIC WORKS - RESTORATION PROGRAM
BORING LOG FORM

GENERAL INFORMATION

Boring/MW ID: 07-A17-7
Project/Site Name: ADL 9-2
Field Professional: JS
Start Date/Time: 11/8/07 1115
Stop Date/Time: ↓
Drilling Co.: CASCADE DRILLING
Lisc. Driller: BOB RODNEY
Drilling Method: SONIC
Drill Rig:
Drill Bit:

LOCATION SKETCH

~125' west of 95-A17-3A

North Arrow

SAMPLE COLLECTION

Time	Sample Depth (ft) From	Sample Depth (ft) To	Sampling Method	SPT Blows per 6 in.	% Recov.	Contacts or GW?	Localized Soil/Rock Description	Containerized From	Containerized To	PID (ppm)	Sent to Lab?
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /			NO SAMPLES COLLECTED				
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							
				/ /							

GENERALIZED DESCRIPTION OF SOIL/ROCK ENCOUNTERED IN BORING

Depth of Boring From	Depth of Boring To	USCS/ Rock Ty	Generalized Soil or Rock Description
0	37		CUTTINGS APPEAR TYPICAL OF GLACIAL OUTWASH OR ~~UPPER VASH~~ STEILACOOM GRAVELS AND UPPER VASHON AQUIFER

Typical soil desc: USCS Color, sand grain size, SECONDARY modifier, PRIMARY grain size, tertiary constituents, (stiffness/density), (moisture), detail, [geologic interpretation
Typical rock desc: Rock Type Color, grain description, ROCK TYPE, (strength), (state of weathering), (moisture), detail and bedding, [geologic formation

OTHER RELEVANT INFORMATION

Casing Info (e.g., type, diameter, depths, casing reduction):

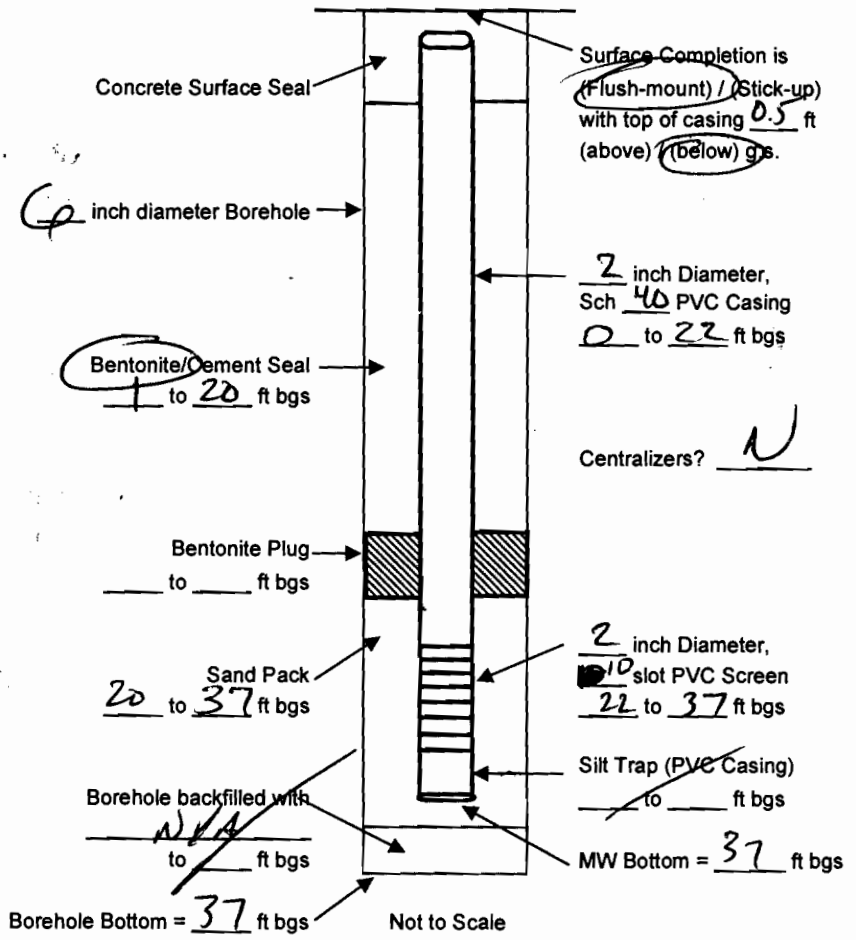
Groundwater Encountered (e.g., time, depth, quantity, casing position):
~32'

Misc. (e.g., drilling rate, drill cuttings, rig decon, etc.):
SAMPLE w/ JEFFREY APPROACH

FORT LEWIS PUBLIC WORKS - RESTORATION PROGRAM
MW INSTALLATION FORM

MW ID 07-MW-7 Installation Start Date/Time 11/8/07 1500 Installation Stop Date/Time 11/9 1645

CONSTRUCTION DETAILS



MATERIALS USED

6	Sacks of 10/20 SILICA	Sand
6	Sacks of Ready mix	Cement
6	Sacks of Bentonite Pellets	
	Sacks of Powdered Bentonite	
	Sacks of Grout	
20	Feet of 2	-inch dia PVC Casing
15	Feet of 2	-inch dia PVC Screen

WELL PROTECTION AND IDENTIFICATION

- [x] Well Cap
- [ ] Locking Steel Cover (Stick-up)
- [ ] Bollards (Stick-up)
- [ ] Lock
- [x] Ecology Well Tag No. BAT610
- [x] Top of Casing Ref Pt. = PVC CASING

WELL DEVELOPMENT

	Following Well Construction			Following Well Development		
Depth To Water (ft below TOC)	28.02	11/15	1145	28.12		1400
Total Well Depth (ft below TOC)	~36.6	↓	↓	~36.6		1400

Development Start Date/Time 11/15/07 1200 Development Stop Date/Time 11/15 1350

Development Method Overpumping Development Water Discharged to Ground

Elapsed Time (min)	pH	Flowrate (gpm)	Sp. Cond. (mS/cm)	Turb (NTU)	D.O. (mg/L)	Temp (oC)	Comments on TSS/Color
5	7.97	4	.190	284	—	13.6	choc. milk
15	7.54		.169	322		13.8	clearing up
30	7.83		.166	210		13.7	gray, milky
45	7.92		.167	72		13.6	slight turbidity
60				59			almost clear
95				30			↓

Total Gallons Removed ~400 gal

Additional Remarks SUFFICIENTLY DEVELOPED

TABLE 2-1. WELL LOCATION AND ELEVATION SURVEY DATA

Control Points	Northing	Easting	Elevation
4-4	646113.600	1479491.310	284.24
4-5	647280.820	1480209.130	282.07
Monitoring Wells			
MW-1	644767.3	1478704.2	282.14 Monument case 281.56 PVC pipe
MW-2	644986.4	1478598.2	279.48 Monument case 279.33 PVC pipe
MW-3	644994.9	1478775.1	280.73 Monument case 280.29 PVC pipe
MW-4	644918.3	1478720.7	281.37 Monument case 281.12 PVC pipe

PROJECT: Fort Lewis JP-4

LOG: SB01 (MW-01)

LOCATION:
Fort Lewis JP-4 Facility
MW-1 Upgradient Well

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: K. Teague
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Split Spoon/Grab
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1030 DATE: 5/25/93
COMPLETE TIME: 1700 DATE: 5/25/93
WEATHER: Overcast, ~ 65° F
INTRUMENTATION: PID, CGI

COMMENTS:
Combustible gas indicator registered 0% LEL during drilling. Attempted sampling with split-spoon for all samples. Because of 0% recovery, samples were collected from the cyclone.

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			0 - 5' Sandy gravel with trace of silt, dark brown, dry to damp.	GW			0	
5		5.0 - 6.5' OVA = O (no response) Recovery limited to lead sample.	5.0 - 6.5' Encountered small cobbles at 5'.	GW	0	30%		
10		No sample, encountered boulder, drilled to 15' to attempt sample.	10 - 11.5' Sandy gravel with silt; some cobbles, dry to damp, light brown.	GW	0	NS	0	
		14-15' Drilling easier (11:08)	Becoming moist at 14'.					
15		15.0 - 16.5' Sampler bouncing, driller attempts to move sampler around in hole to loosen material. Cobble stuck in sampler tip. No recovery. Collected sample from cyclone.	15 - 16.5' Well-graded sandy coarse gravel with some silt, moist, medium brown.	GW	0	NS	0	
20		20 - 21.5 Collected sample from cyclone after no recovery from sampler.	20 - 21.5' Well-graded silty sandy gravel, moist-to-wet, light brown. Coarse gravels beginning to be coated with silty/clay matrix material. No evidence of perched zone.	GM	0	5%	0	
25								

PROJECT NO. 92C0609

Woodward-Clyde Consultants

FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB01	Page 2 of 2

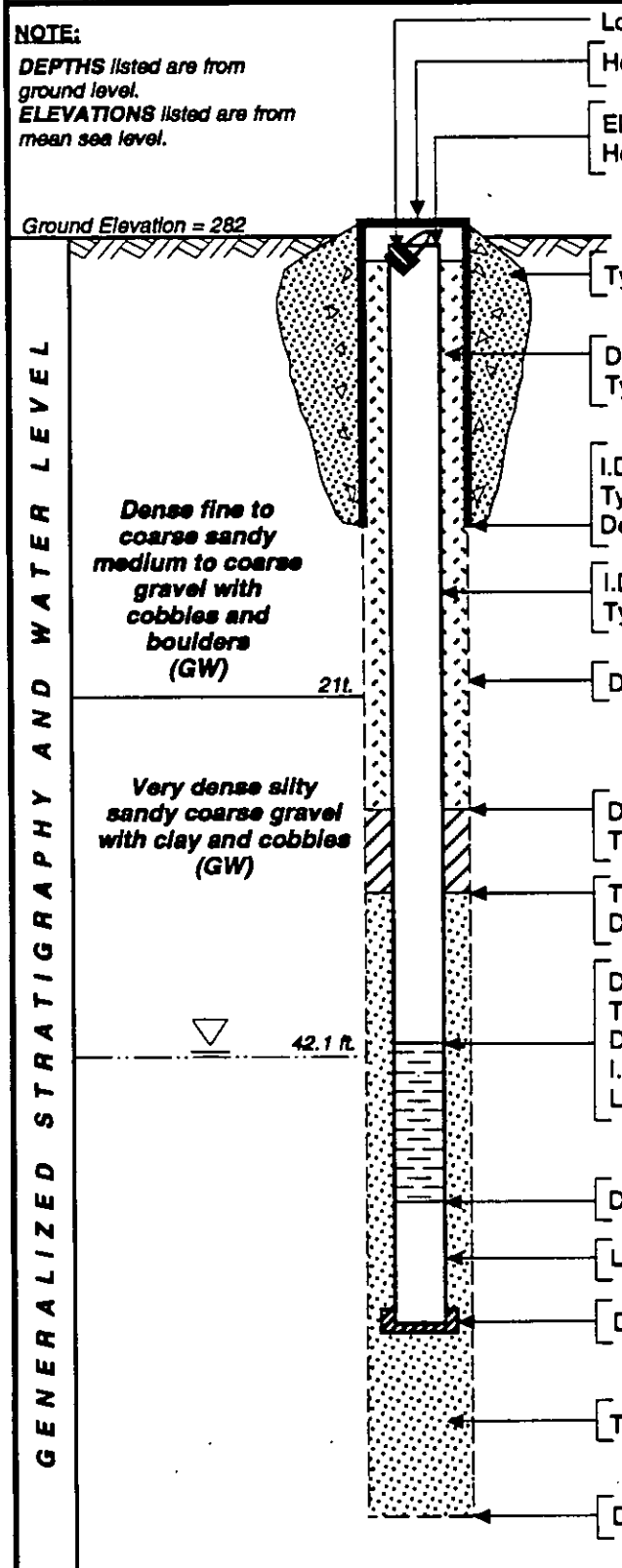
DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25	X	25 - 26.5' Sampled from cyclone.	25 - 26.5' As above.	GW	0	NS	0	
30	X	30 - 31.5'	30 - 31.5' Sandy, silty grave.l, moist, gray-brown. Well graded, finer grained than previously.	GW	0	NS	0	
35	X	35 - 36.5'	35 - 36.5' As above, less silt, gravel is coarser.	GM	0	NS	0	
40	X	40 - 41.5' Sampler bouncing on material, sample from cyclone. [JP-052593-SB01-40.0 ARI] [JP-052593-SB01-40.0 COE] [JP-052593-S01-90.0 ARI DUP]	40.0 - 41.5' Silty sandy coarse gravel with cobbles to 4", moist, gray-brown; well graded.	GW	0	NS	0	
45	X	45 - 46.5' Encountered water at ~ 47'. Drill to ~ 51'.	45 - 46.5' Sandy, coarse gravel, trace of silt, some cobbles, gray-brown, wet, well graded.	GW	0	NS	0	
50								
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-01 (SB-01)**
Fort Lewis WA	WELL LOCATION: **South of JP-4 Facility**
DATE COMPLETED: **5/25/93** TOTAL DEPTH: **51.7 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.56* ft.
Height of top of riser pipe above ground surface: *- 0.58*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.6* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.6* ft.

Depth to top of screened section: *39.6* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.6* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *50.1* ft.

Type of backfill: *native*

Depth of hole below ground surface: *51.7* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4

LOG: SB02 (MW-02)

LOCATION:
Fort Lewis JP-4
Residential Playground, Across
41st Division Drive, West of
JP-4 Facility

COMMENTS:
Samples collected from cyclone.
CGI indicated 0% of LEL during drilling.

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: K. Teague
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab from Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 0845 DATE: 5/26/93
COMPLETE TIME: 1230 DATE: 5/26/93
WEATHER: Overcast, ~ 65° F
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Loose silty, sandy, grassy topsoil, brown, damp to ~ 1'.	GW	0	40%		
			~ 1' Dense fine-to-coarse sandy medium-to-coarse gravel; gray-brown, damp					
5	49 29 45	[Sample 5' 0850]		GW	0	NS	0	
10		[Sample 10' 0900]	10' Dense as above, large boulder, increasing size of cobbles.	GW	0	NS	0	
15		[Sample 15' 0905] from cyclone.	As above.	GW	0	NS	0	
20		[Sample 20' 0910]			0	NS	0	
25		[Sample 25' 0915]	Dense silty sandy coarse gravel, brown, very wet.	GW	0	NS	0	

PROJECT NO. 92C0609

Woodward-Clyde Consultants

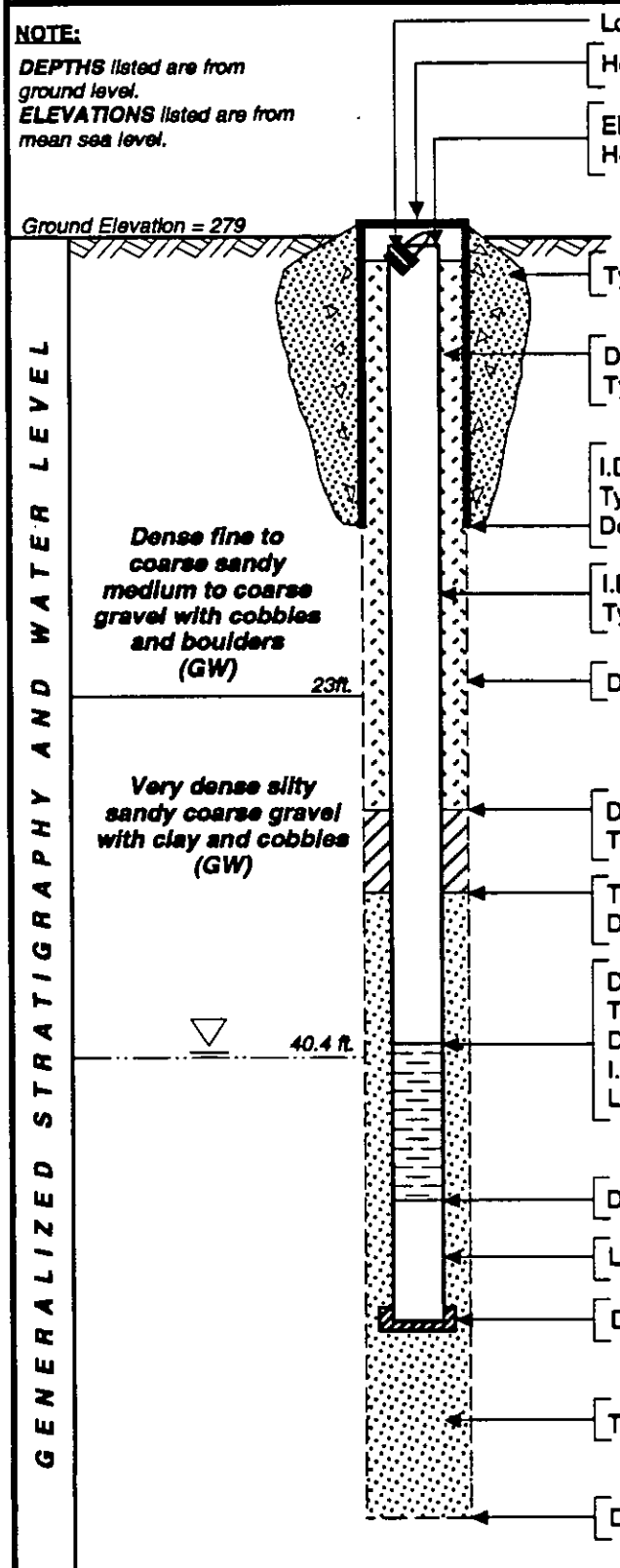
FIGURE

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30		[JP4-52693-SB02-30 COE] [JPR-52693-SB02-30 ARI]]JP4-52693-SB02-75.0 ARI Dup.]	30.0 - 31.5' Very dense, silty clayey coarse sand and coarse gravel with cobbles to 5", damp, light brown.	GM	0	0	0	
			33' Clayey silty matrix coating gravel.	GM	0			
35			35' Very dense, silty coarse sand and coarse gravel with cobbles and some clay.					
40		[Sample 40.0' 0940]	40' As above, increasing moisture. Encountered water at 47' while drilling. Measured water level 41.7'.		0	0	0	
45	X	45 - 46.5'	45 - 46.5' Sandy, coarse gravel, trace of silt, some cobbles, wet, gray-brown; well graded.	GW	NR	NS	0	
50								
55								

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-02 (SB-02)**
Fort Lewis WA	WELL LOCATION: **West of JP-4 Facility**
DATE COMPLETED: **5/27/93** TOTAL DEPTH: **49.7 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.12* ft.
Height of top of riser pipe above ground surface: *- 0.25 ft*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.0* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.2* ft.

Depth to top of screened section: *39.2* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.2* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *49.7* ft.

Type of backfill: *native*

Depth of hole below ground surface: *50.0* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4

LOG: SB03 (MW-03)

LOCATION:
Fort Lewis JP-4
Alongside 41st Division Drive,
outside of JP-4 Fueling Facility,
West of Tank #4

COMMENTS:
Samples collected from cyclone.
CGI indicated 0% of LEL during drilling.

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1315 DATE: 5/26/93
COMPLETE TIME: 1630 DATE: 5/26/93
WEATHER: Sunny and Hot
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Silty fine-to-medium sand with some coarse gravel; brown, damp.	SW				
5		[Sample 5' 1330]	As above.		0	0	0	
10		[Sample 10' 1340]	10' medium-to-coarse sandy, medium-to-coarse gravel, brown, damp (grains rounded)	GW	0			
15		[Sample 15' 1350]	As above.	GW	0			
20		[JP-052693-SB03-20-ARI] [JP-052693-SB03-E0-COE] JP-052693-SB03-75 ARI Dup]	As above.	GW	0			
25			As above.					

PROJECT NO. 92C0609

Woodward-Clyde Consultants

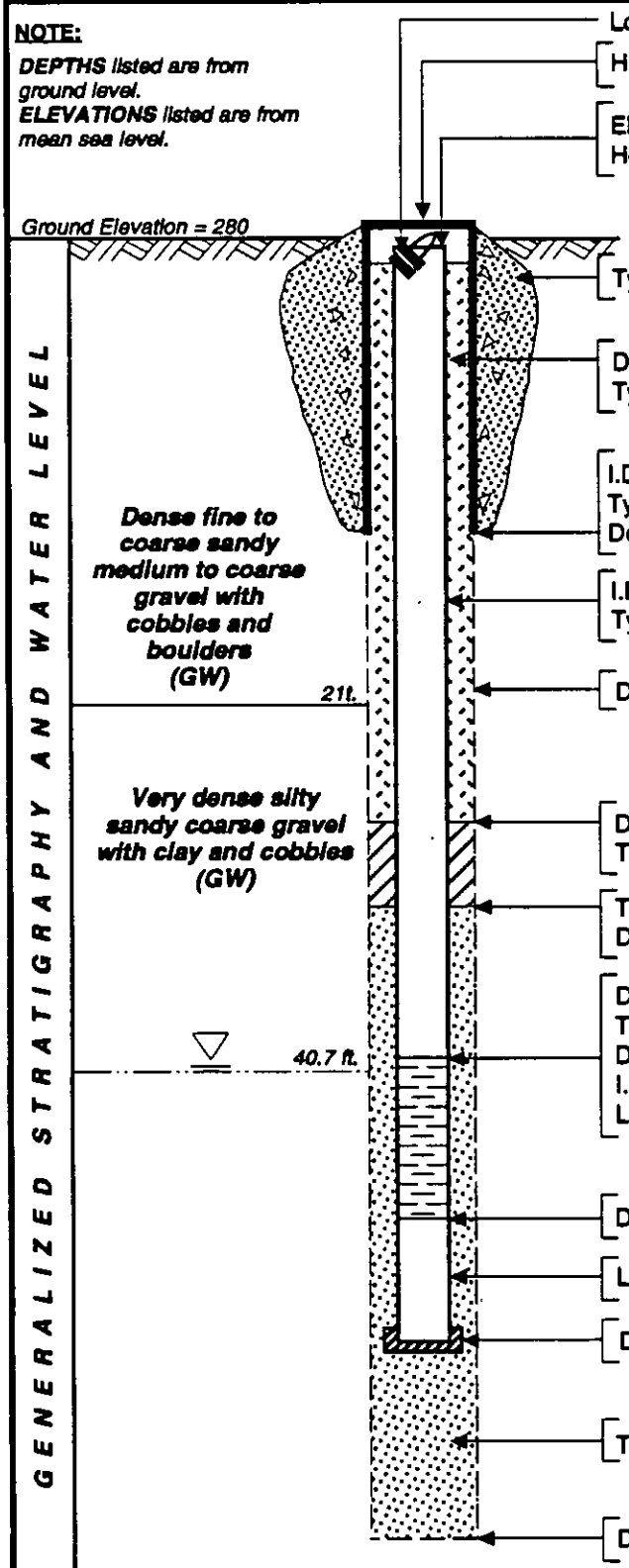
FIGURE

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25			As above.					
30			30' Dense, sandy, medium gravel, brown-gray saturated (flowing water at ≈ 32-34'; probable perched zone. Decreasing water.	GW	0	0	0	
35			35' Dense, sandy medium gravel, brown-gray, wet to moist; no flowing water.					
40			Dense medium-to-coarse sandy medium-to-coarse gravel, gray, moist.	GW				
45			As above, flowing water encountered at 44'.	GW				
50			As above to bottom of boring at 50'.	GW				
55								

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-03 (SB-03**
Fort Lewis WA	WELL LOCATION: **South of JP-4 Facility**
DATE COMPLETED: **5/25/93** TOTAL DEPTH: **50.3 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *280.73* ft.
Height of top of riser pipe above ground surface: *- 0.48*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.6* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.6* ft.

Depth to top of screened section: *39.6* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.6* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *50.1* ft.

Type of backfill: *native*

Depth of hole below ground surface: *50.3* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4	LOG: SB04 (abandoned with bentonite)	Page 1 of 2

LOCATION:
Fort Lewis JP-4
5' South of SB03, Outside of
JP4 Fuel Area Fence

COMMENTS:
No water encountered in suspected perched zone. No samples collected. CGI indicated 0% of LEL during drilling.

[x] MONITORING WELL [ ] TEST BORING

LOGGED BY: G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: None Collected
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1730 DATE: 5/26/93
COMPLETE TIME: 0915 DATE: 5/27/93
WEATHER: Sunny and Hot
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Dense sandy medium-to-coarse gravel with some cobbles; damp, gray-brown.	GW	0			
10			Dense sandy cobbly coarse gravel; gray-brown, moist.	GW	0			
20			As above.					
25			Dense sandy gravelly cobbles.	GW	0			

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB04	Page 2 of 2

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30			As above, increasing moisture.					
			32.5' Silty sandy medium-to-coarse gravel, wet; no free water in boring.	GM				
35			Bottom of boring at 35.0'. No water detected after 16 hours waiting time. Boring abandoned with bentonite chips.					
40								
45								
50								
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB05 (MW-04)	Page 1 of 2

LOCATION:
Fort Lewis JP-4
Outside of JP-4 Fueling Facility
20' NW of Tank #1

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: J. Young, G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab from Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 0920 DATE: 5/27/93
COMPLETE TIME: 1230 DATE: 5/27/93
WEATHER: Party cloudy - temperature in 60's
INTRUMENTATION: PID, CGI

COMMENTS:
Samples collected from cyclone. CGI indicated 0% of LEL during drilling.

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
5		[Sample 5' 1000]	Medium/coarse sandy gravel; dark brown, damp.	GW			0	
10		[Sample 10' 1010]	Coarse sandy gravel with cobbles (rounded); slightly damp	GW			0	
15		[Sample 15' 1015]	As above, large cobbles.	GW			0	
20		[Sample 20' 1020] USCOE replicate also at 20'. Blind duplicate at 20' called SB05-75.0.	20' As above,	GW			0	
25								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB05	Page 2 of 2

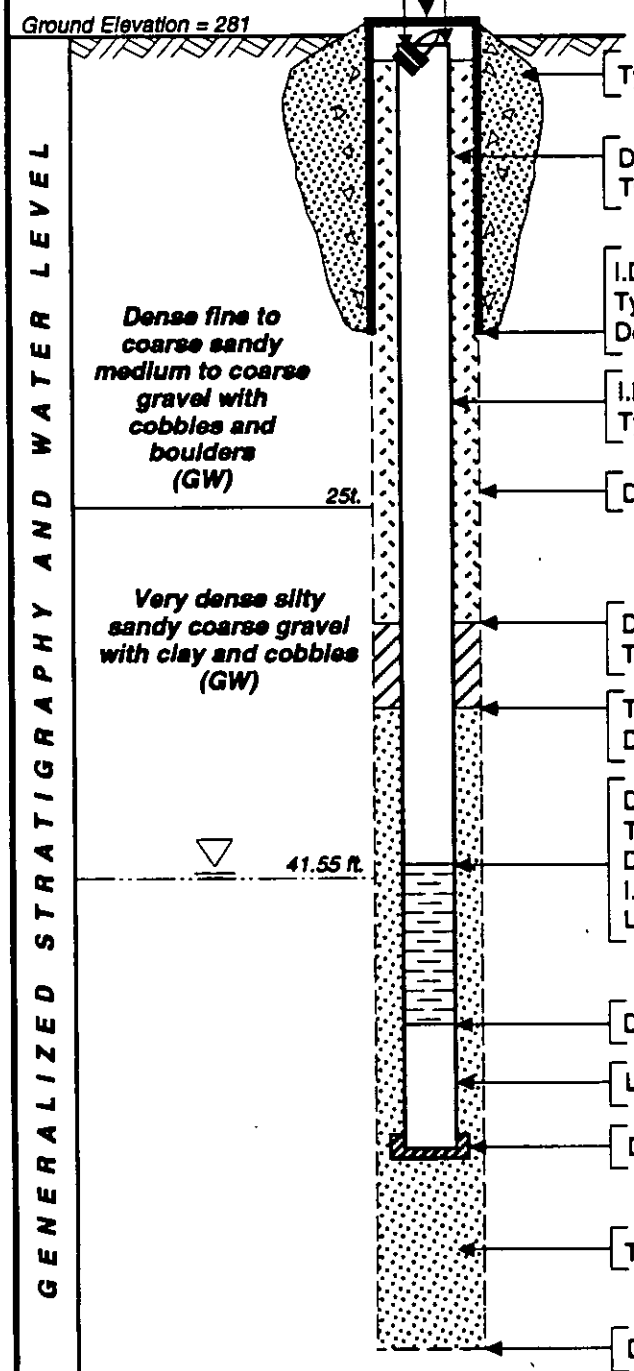
DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30								
35			As above.				0	
40		[Sample 40.0' 1100]	Coarse sandy gravel/cobbles, light brown to gray, wet.	GW	0		0	
45								
50			Bottom of boring at 51.3'.					
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-04 (SB-05)**
Fort Lewis WA	WELL LOCATION: **20' NW of Tank #1**
DATE COMPLETED: **5/27/93** TOTAL DEPTH: **51.3 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.37* ft.
Height of top of riser pipe above ground surface: *-0.25* ft.

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *35.8* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *37.8* ft.

Depth to top of screened section: *40.8* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *50.8* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *51.3* ft.

Type of backfill: *native*

Depth of hole below ground surface: *51.3* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance(N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

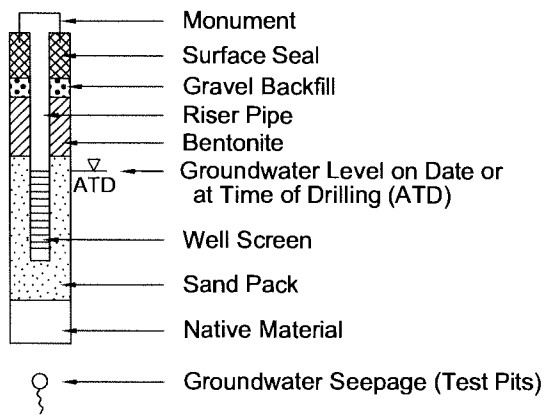
Sampling Test Symbols

Boring Samples		Test Pit Samples	
☒	Split Spoon	☒	Grab (Jar)
▧	Shelby Tube	▨	Bag
▥	Cuttings	▧	Shelby Tube
▯	Core Run		
*	No Sample Recovery		
P	Tube Pushed, Not Driven		

Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
	Water Content in Percent Liquid Limit Natural Plastic Limit
PID	Photoionization Detector Reading
CA	Chemical Analysis
WOR	Weight of Rod

Groundwater Observation Wells



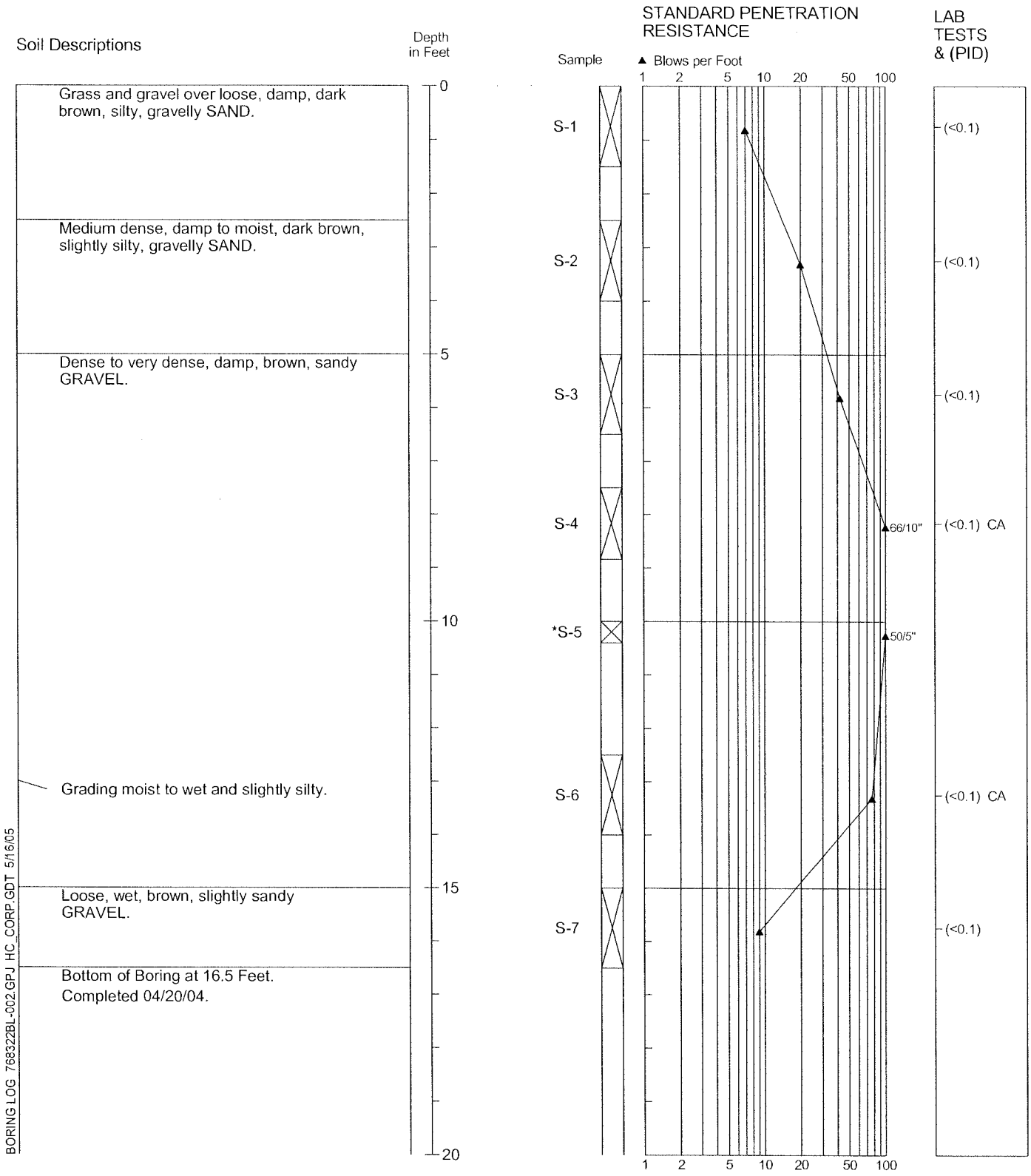
768322-004.DWG CAS 5/16/05 (HC Standards\SRF\ A-1.dwg)

HARTCROWSER

7683-22 5/05

Figure A-1

Boring Log AOC 10-8-B01



BORING LOG 768322BL-002.GPJ HC_CORP.GDT 5/16/05

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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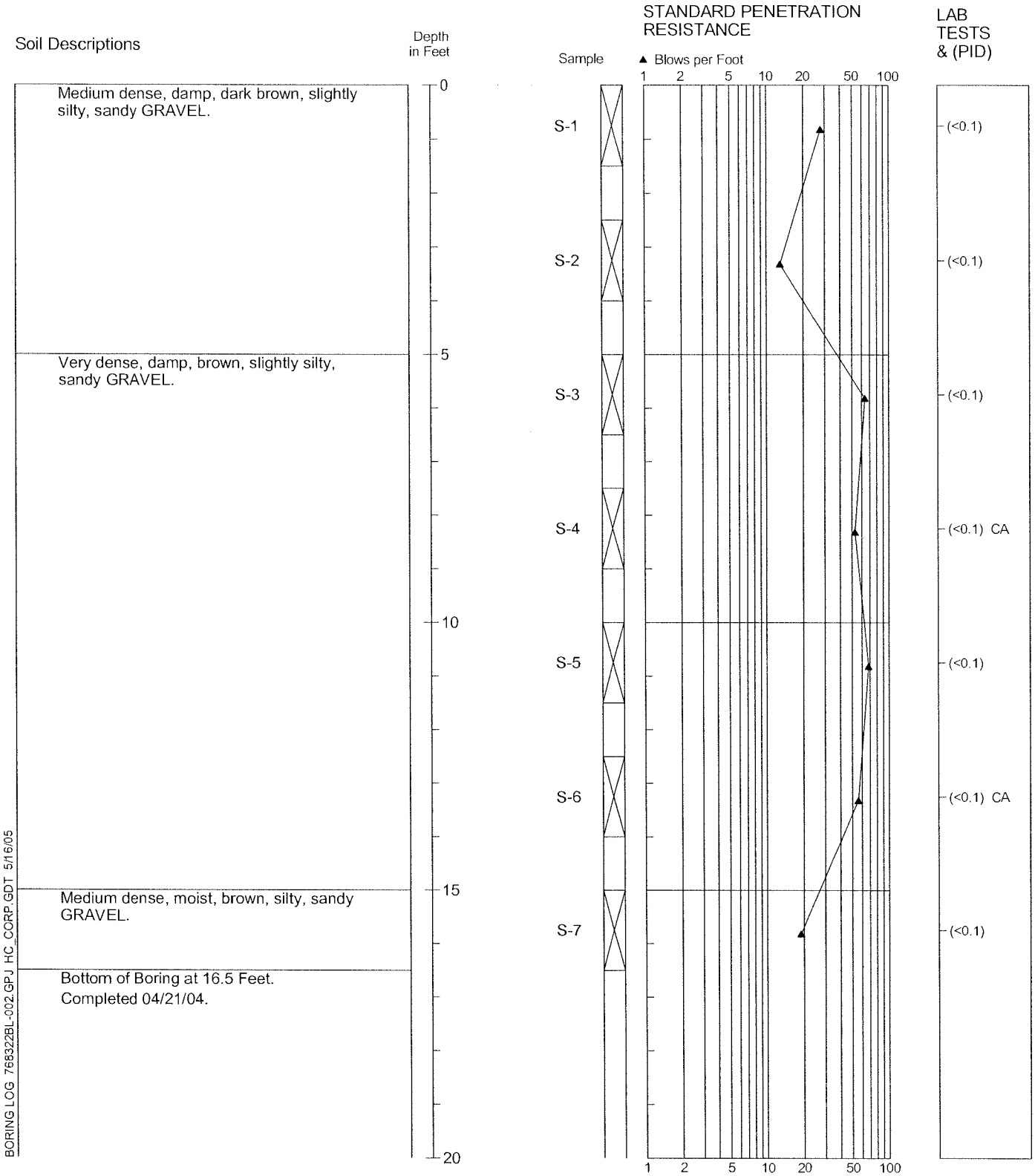
7683-22 04/04

Figure A-2

Boring Log AOC 10-8-B02



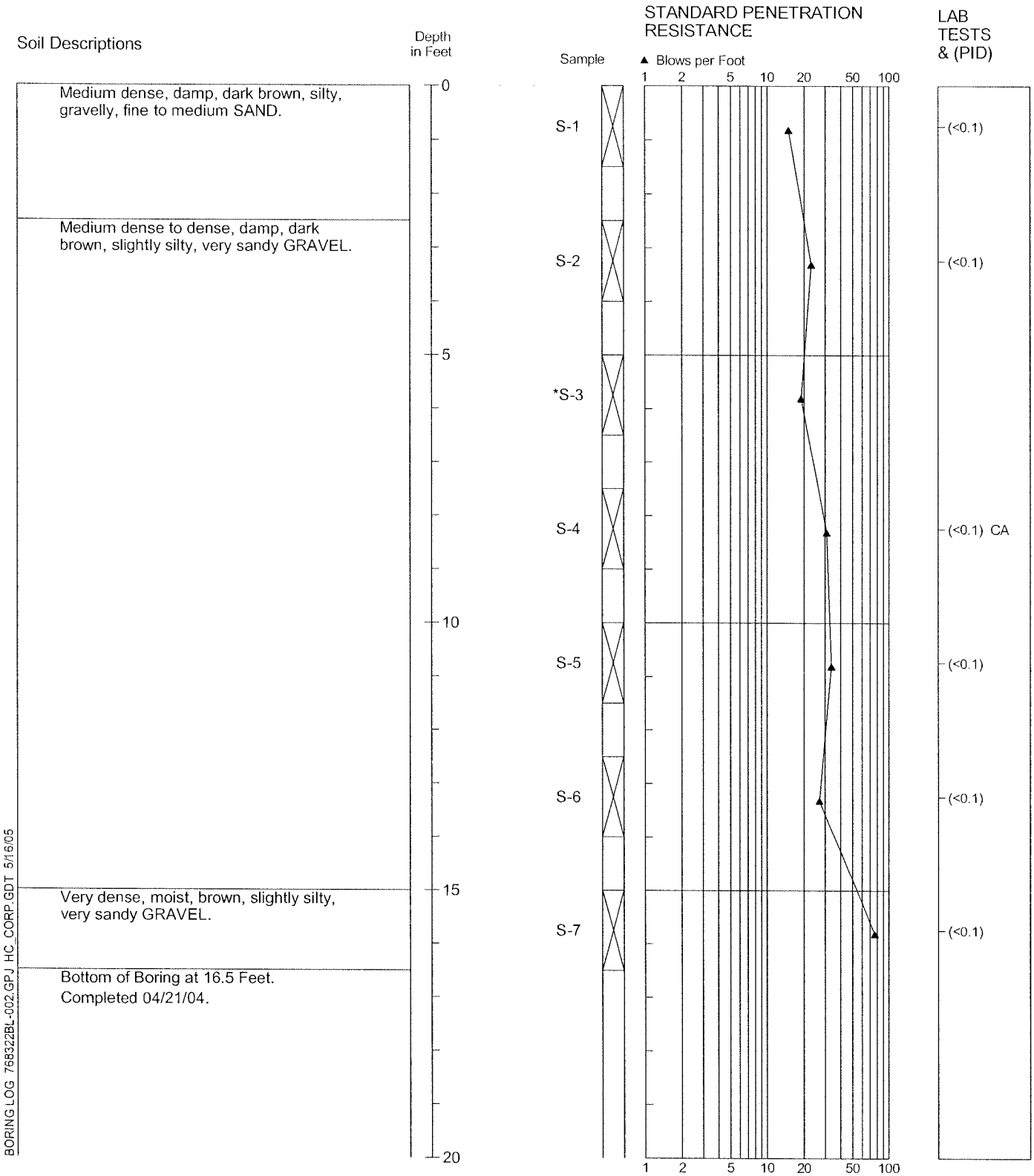
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-3

Boring Log AOC 10-8-B03



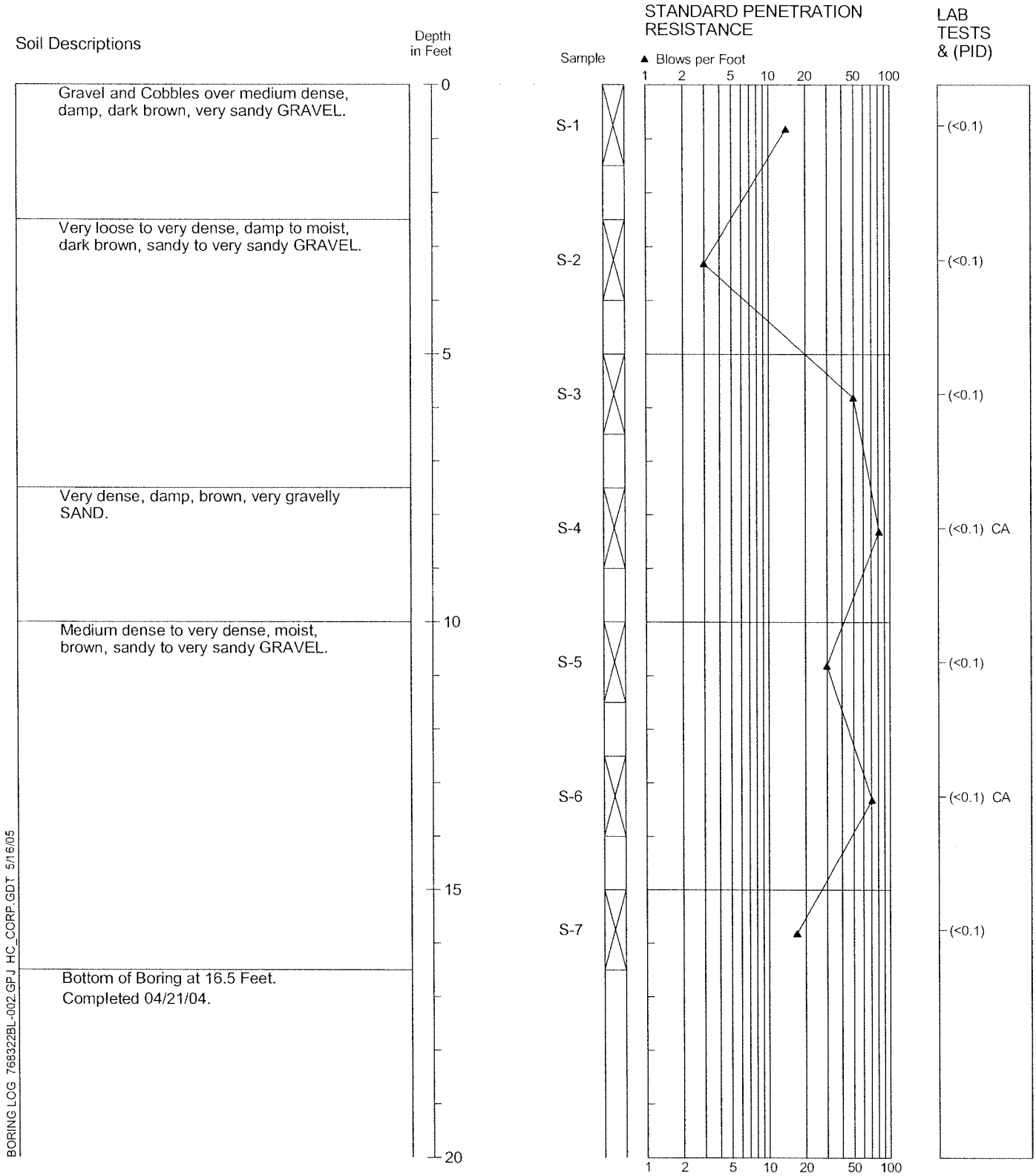
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 04/04

Figure A-4

Boring Log AOC 10-8-B04



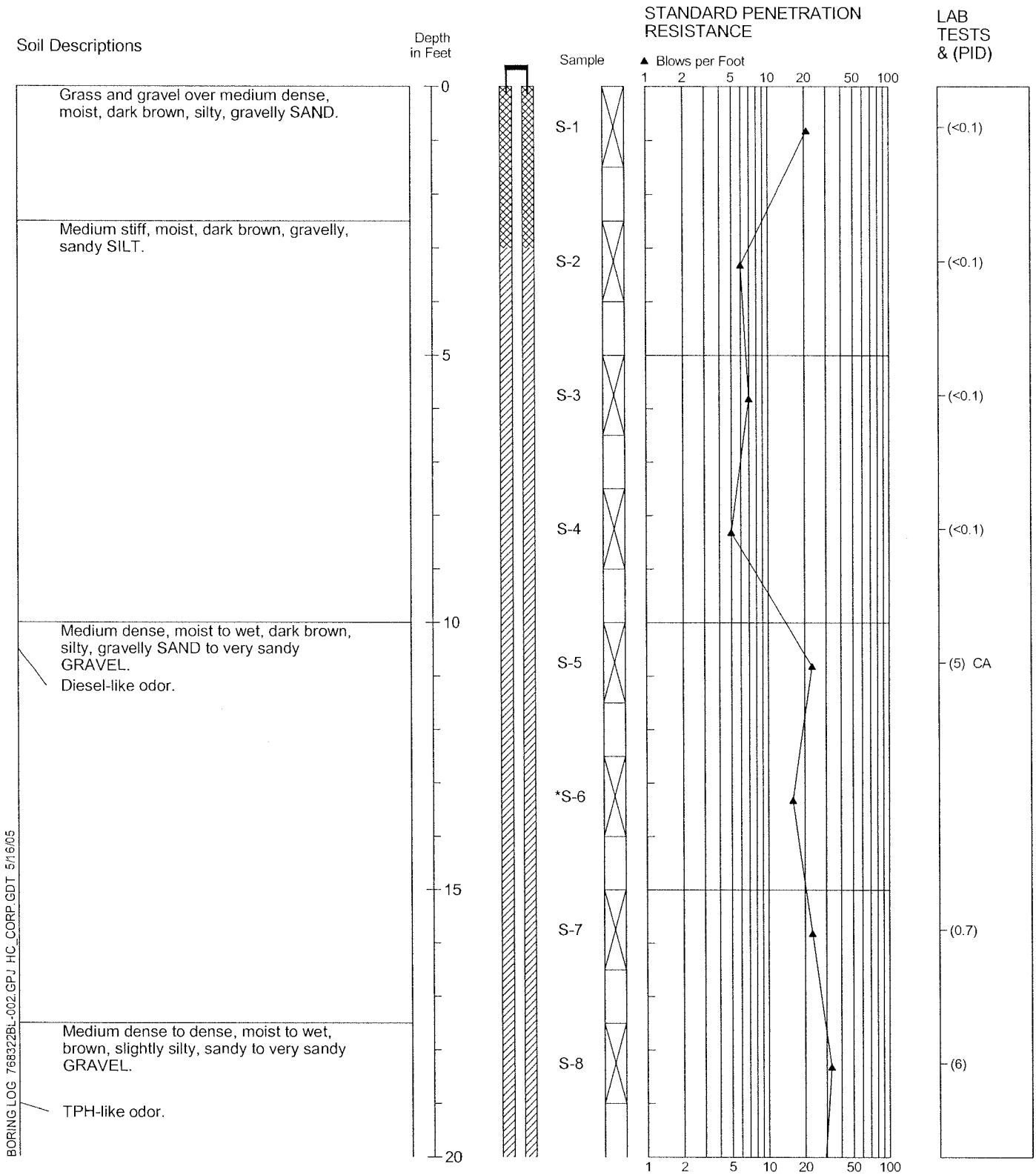
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-5

Boring Log AOC 10-8-B05



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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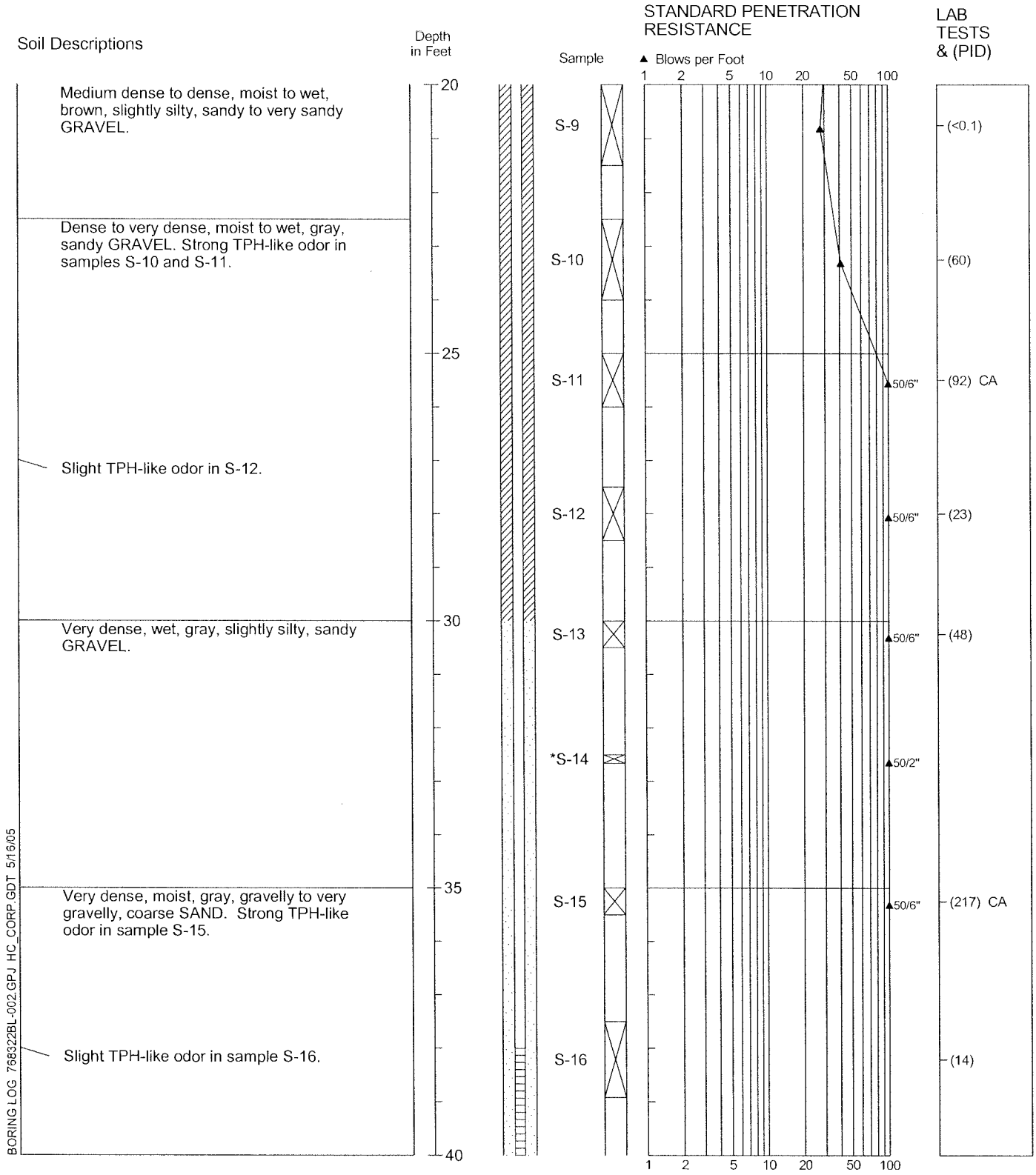
7683-22 *04/04*

Figure A-6 *1/3*

Boring Log AOC 10-8-B05



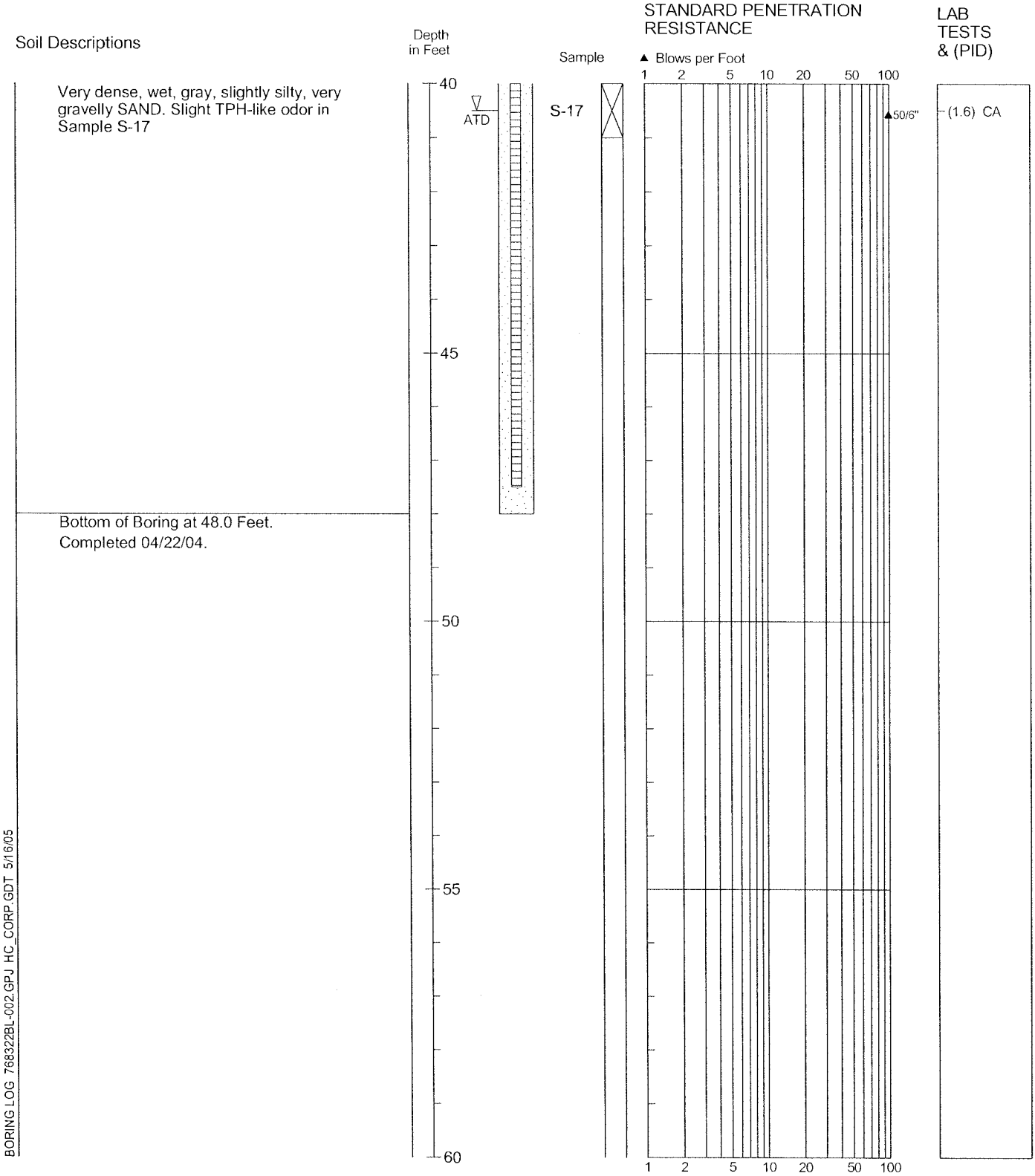
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-6 *2/3*

Boring Log AOC 10-8-B05



BORING LOG 768322BL-002.GPJ HC_CORP.GDT 5/16/05

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-6 *3/3*

TABLE 2-1. WELL LOCATION AND ELEVATION SURVEY DATA

Control Points	Northing	Easting	Elevation
4-4	646113.600	1479491.310	284.24
4-5	647280.820	1480209.130	282.07
Monitoring Wells			
MW-1	644767.3	1478704.2	282.14 Monument case 281.56 PVC pipe
MW-2	644986.4	1478598.2	279.48 Monument case 279.33 PVC pipe
MW-3	644994.9	1478775.1	280.73 Monument case 280.29 PVC pipe
MW-4	644918.3	1478720.7	281.37 Monument case 281.12 PVC pipe

PROJECT: Fort Lewis JP-4

LOG: SB01 (MW-01)

LOCATION:
Fort Lewis JP-4 Facility
MW-1 Upgradient Well

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: K. Teague
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Split Spoon/Grab
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1030 DATE: 5/25/93
COMPLETE TIME: 1700 DATE: 5/25/93
WEATHER: Overcast, ~ 65° F
INTRUMENTATION: PID, CGI

COMMENTS:
Combustible gas indicator registered 0% LEL during drilling. Attempted sampling with split-spoon for all samples. Because of 0% recovery, samples were collected from the cyclone.

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			0 - 5' Sandy gravel with trace of silt, dark brown, dry to damp.	GW			0	
5		5.0 - 6.5' OVA = O (no response) Recovery limited to lead sample.	5.0 - 6.5' Encountered small cobbles at 5'.	GW	0	30%		
10		No sample, encountered boulder, drilled to 15' to attempt sample.	10 - 11.5' Sandy gravel with silt; some cobbles, dry to damp, light brown.	GW	0	NS	0	
		14-15' Drilling easier (11:08)	Becoming moist at 14'.					
15		15.0 - 16.5' Sampler bouncing, driller attempts to move sampler around in hole to loosen material. Cobble stuck in sampler tip. No recovery. Collected sample from cyclone.	15 - 16.5' Well-graded sandy coarse gravel with some silt, moist, medium brown.	GW	0	NS	0	
20		20 - 21.5 Collected sample from cyclone after no recovery from sampler.	20 - 21.5' Well-graded silty sandy gravel, moist-to-wet, light brown. Coarse gravels beginning to be coated with silty/clay matrix material. No evidence of perched zone.	GM	0	5%	0	
25								

PROJECT NO. 92C0609

Woodward-Clyde Consultants

FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB01	Page 2 of 2

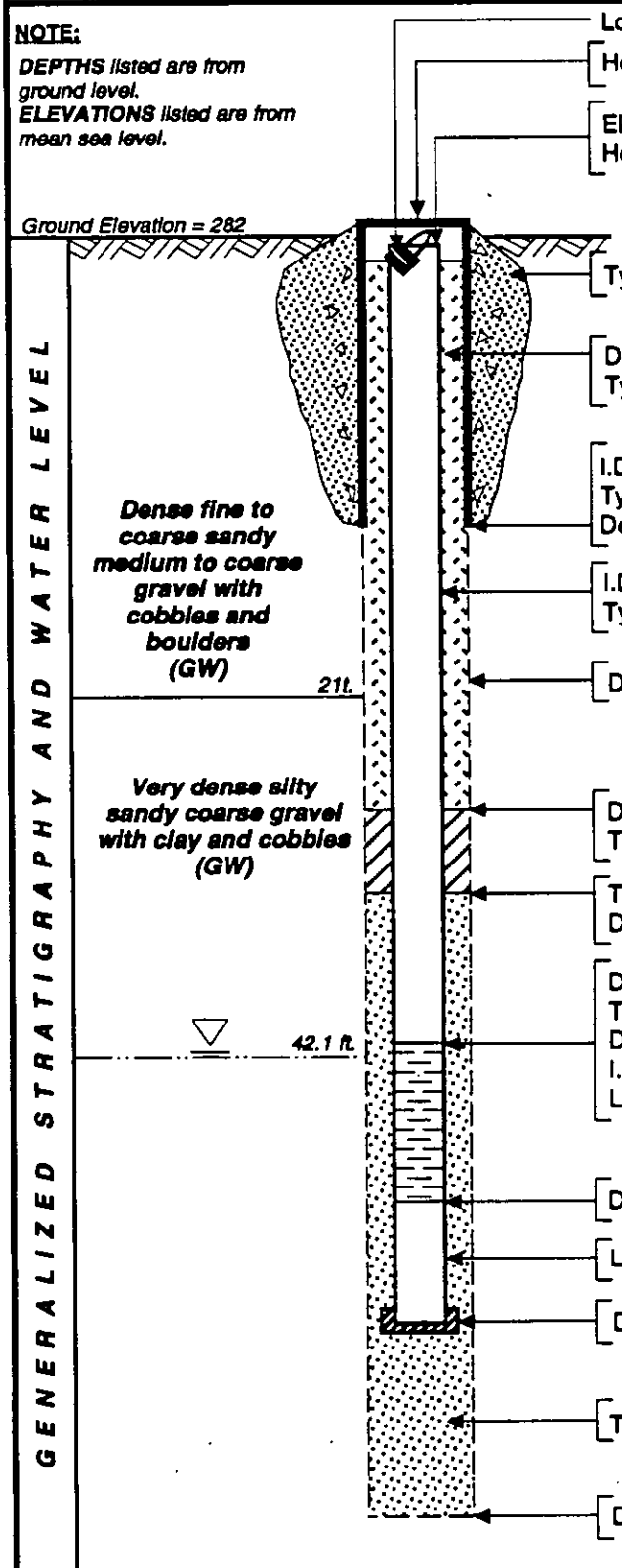
DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25	X	25 - 26.5' Sampled from cyclone.	25 - 26.5' As above.	GW	0	NS	0	
30	X	30 - 31.5'	30 - 31.5' Sandy, silty grave.l, moist, gray-brown. Well graded, finer grained than previously.	GW	0	NS	0	
35	X	35 - 36.5'	35 - 36.5' As above, less silt, gravel is coarser.	GM	0	NS	0	
40	X	40 - 41.5' Sampler bouncing on material, sample from cyclone. [JP-052593-SB01-40.0 ARI] [JP-052593-SB01-40.0 COE] [JP-052593-S01-90.0 ARI DUP]	40.0 - 41.5' Silty sandy coarse gravel with cobbles to 4", moist, gray-brown; well graded.	GW	0	NS	0	
45	X	45 - 46.5' Encountered water at ~ 47'. Drill to ~ 51'.	45 - 46.5' Sandy, coarse gravel, trace of silt, some cobbles, gray-brown, wet, well graded.	GW	0	NS	0	
50								
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-01 (SB-01)**
Fort Lewis WA	WELL LOCATION: **South of JP-4 Facility**
DATE COMPLETED: **5/25/93** TOTAL DEPTH: **51.7 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.56* ft.
Height of top of riser pipe above ground surface: *- 0.58*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.6* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.6* ft.

Depth to top of screened section: *39.6* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.6* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *50.1* ft.

Type of backfill: *native*

Depth of hole below ground surface: *51.7* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4

LOG: SB02 (MW-02)

LOCATION:
Fort Lewis JP-4
Residential Playground, Across
41st Division Drive, West of
JP-4 Facility

COMMENTS:
Samples collected from cyclone.
CGI indicated 0% of LEL during drilling.

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: K. Teague
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab from Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 0845 DATE: 5/26/93
COMPLETE TIME: 1230 DATE: 5/26/93
WEATHER: Overcast, ~ 65° F
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Loose silty, sandy, grassy topsoil, brown, damp to ~ 1'.	GW	0	40%		
			~ 1' Dense fine-to-coarse sandy medium-to-coarse gravel; gray-brown, damp					
5	49 29 45	[Sample 5' 0850]		GW	0	NS	0	
10		[Sample 10' 0900]	10' Dense as above, large boulder, increasing size of cobbles.	GW	0	NS	0	
15		[Sample 15' 0905] from cyclone.	As above.	GW	0	NS	0	
20		[Sample 20' 0910]			0	NS	0	
25		[Sample 25' 0915]	Dense silty sandy coarse gravel, brown, very wet.	GW	0	NS	0	

PROJECT NO. 92C0609

Woodward-Clyde Consultants

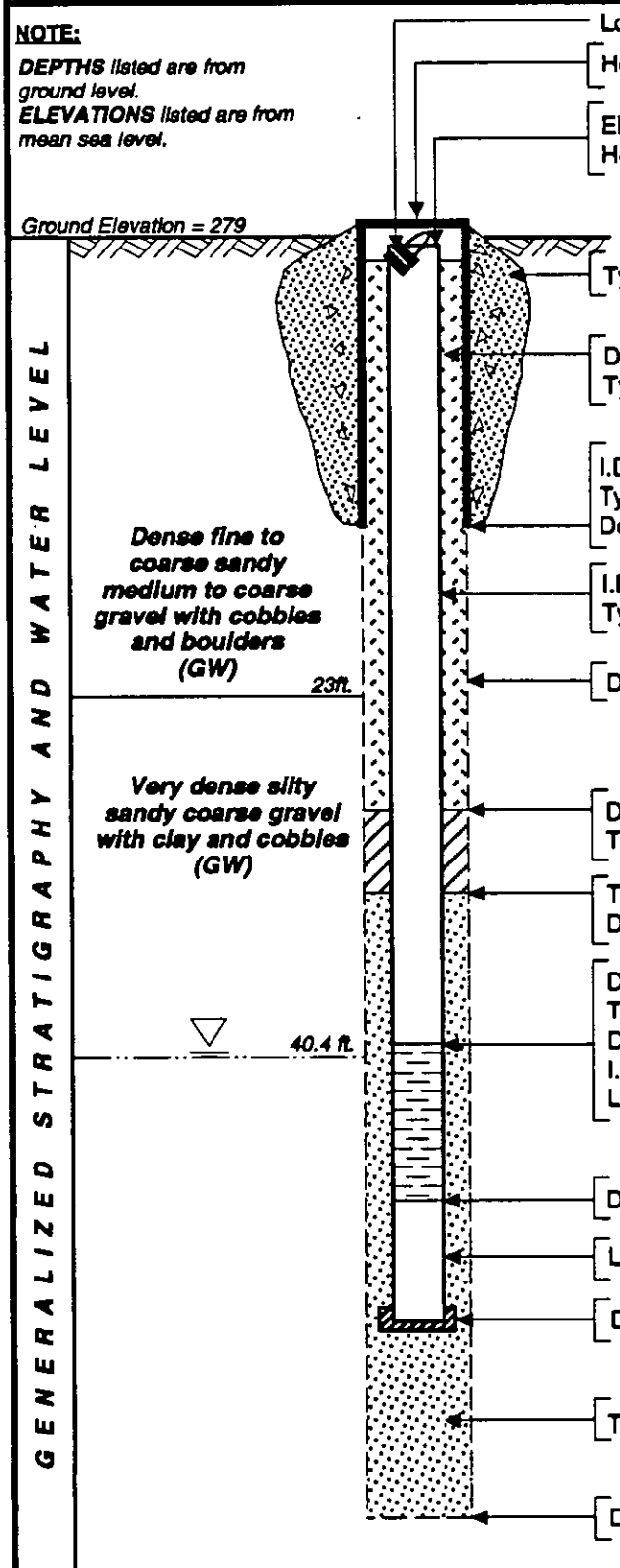
FIGURE

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30		[JP4-52693-SB02-30 COE] [JPR-52693-SB02-30 ARI]]JP4-52693-SB02-75.0 ARI Dup.]	30.0 - 31.5' Very dense, silty clayey coarse sand and coarse gravel with cobbles to 5", damp, light brown.	GM	0	0	0	
			33' Clayey silty matrix coating gravel.	GM	0			
35			35' Very dense, silty coarse sand and coarse gravel with cobbles and some clay.					
40		[Sample 40.0' 0940]	40' As above, increasing moisture. Encountered water at 47' while drilling. Measured water level 41.7'.		0	0	0	
45	X	45 - 46.5'	45 - 46.5' Sandy, coarse gravel, trace of silt, some cobbles, wet, gray-brown; well graded.	GW	NR	NS	0	
50								
55								

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-02 (SB-02)**
Fort Lewis WA	WELL LOCATION: **West of JP-4 Facility**
DATE COMPLETED: **5/27/93** TOTAL DEPTH: **49.7 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.12* ft.
Height of top of riser pipe above ground surface: *- 0.25 ft*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.0* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.2* ft.

Depth to top of screened section: *39.2* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.2* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *49.7* ft.

Type of backfill: *native*

Depth of hole below ground surface: *50.0* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4

LOG: SB03 (MW-03)

LOCATION:
Fort Lewis JP-4
Alongside 41st Division Drive,
outside of JP-4 Fueling Facility,
West of Tank #4

COMMENTS:
Samples collected from cyclone.
CGI indicated 0% of LEL during drilling.

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1315 DATE: 5/26/93
COMPLETE TIME: 1630 DATE: 5/26/93
WEATHER: Sunny and Hot
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Silty fine-to-medium sand with some coarse gravel; brown, damp.	SW				
5		[Sample 5' 1330]	As above.		0	0	0	
10		[Sample 10' 1340]	10' medium-to-coarse sandy, medium-to-coarse gravel, brown, damp (grains rounded)	GW	0			
15		[Sample 15' 1350]	As above.	GW	0			
20		[JP-052693-SB03-20-ARI] [JP-052693-SB03-E0-COE] JP-052693-SB03-75 ARI Dup]	As above.	GW	0			
25			As above.					

PROJECT NO. 92C0609

Woodward-Clyde Consultants

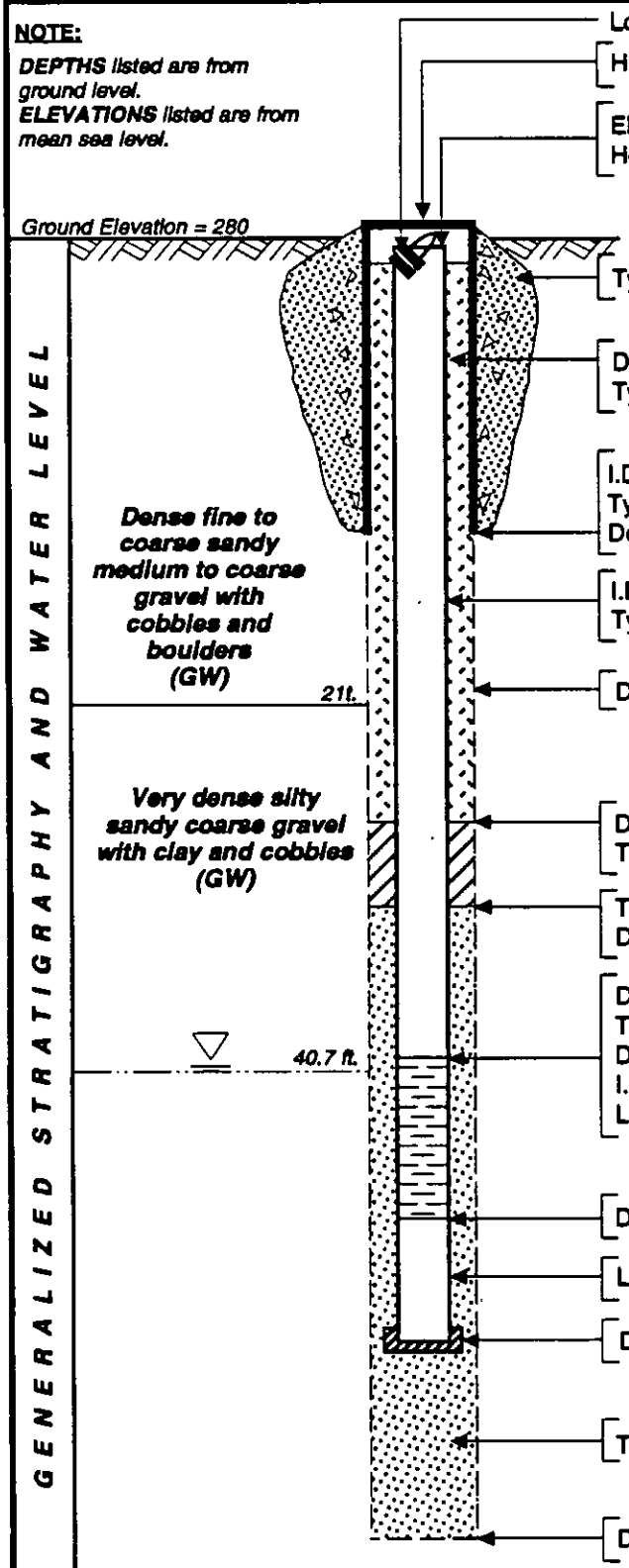
FIGURE

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25			As above.					
30			30' Dense, sandy, medium gravel, brown-gray saturated (flowing water at ≈ 32-34'; probable perched zone. Decreasing water.	GW	0	0	0	
35			35' Dense, sandy medium gravel, brown-gray, wet to moist; no flowing water.					
40			Dense medium-to-coarse sandy medium-to-coarse gravel, gray, moist.	GW				
45			As above, flowing water encountered at 44'.	GW				
50			As above to bottom of boring at 50'.	GW				
55								

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-03 (SB-03**
Fort Lewis WA	WELL LOCATION: **South of JP-4 Facility**
DATE COMPLETED: **5/25/93** TOTAL DEPTH: **50.3 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *280.73* ft.
Height of top of riser pipe above ground surface: *- 0.48*

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *34.6* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *36.6* ft.

Depth to top of screened section: *39.6* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *49.6* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *50.1* ft.

Type of backfill: *native*

Depth of hole below ground surface: *50.3* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

PROJECT: Fort Lewis JP-4	LOG: SB04 (abandoned with bentonite)	Page 1 of 2

LOCATION:
Fort Lewis JP-4
5' South of SB03, Outside of
JP4 Fuel Area Fence

COMMENTS:
No water encountered in suspected perched zone. No samples collected. CGI indicated 0% of LEL during drilling.

[x] MONITORING WELL [ ] TEST BORING

LOGGED BY: G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: None Collected
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 1730 DATE: 5/26/93
COMPLETE TIME: 0915 DATE: 5/27/93
WEATHER: Sunny and Hot
INTRUMENTATION: PID, CGI

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
			Dense sandy medium-to-coarse gravel with some cobbles; damp, gray-brown.	GW	0			
10			Dense sandy cobbly coarse gravel; gray-brown, moist.	GW	0			
20			As above.					
25			Dense sandy gravelly cobbles.	GW	0			

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB04	Page 2 of 2

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30			As above, increasing moisture.					
			32.5' Silty sandy medium-to-coarse gravel, wet; no free water in boring.	GM				
35			Bottom of boring at 35.0'. No water detected after 16 hours waiting time. Boring abandoned with bentonite chips.					
40								
45								
50								
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB05 (MW-04)	Page 1 of 2

LOCATION:
Fort Lewis JP-4
Outside of JP-4 Fueling Facility
20' NW of Tank #1

☒ MONITORING WELL ☐ TEST BORING

LOGGED BY: J. Young, G. Davis
DRILLER: Marion Philips RIG: AP 1000
DRILL METHOD: Dual Wall Percussion Hammer
SAMPLE METHOD: Grab from Cyclone
HAMMER WT: 300 lbs. DROP: 30"
START TIME: 0920 DATE: 5/27/93
COMPLETE TIME: 1230 DATE: 5/27/93
WEATHER: Party cloudy - temperature in 60's
INTRUMENTATION: PID, CGI

COMMENTS:
Samples collected from cyclone. CGI indicated 0% of LEL during drilling.

DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
5		[Sample 5' 1000]	Medium/coarse sandy gravel; dark brown, damp.	GW			0	
10		[Sample 10' 1010]	Coarse sandy gravel with cobbles (rounded); slightly damp	GW			0	
15		[Sample 15' 1015]	As above, large cobbles.	GW			0	
20		[Sample 20' 1020] USCOE replicate also at 20'. Blind duplicate at 20' called SB05-75.0.	20' As above,	GW			0	
25								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

PROJECT: Fort Lewis JP-4	LOG: SB05	Page 2 of 2

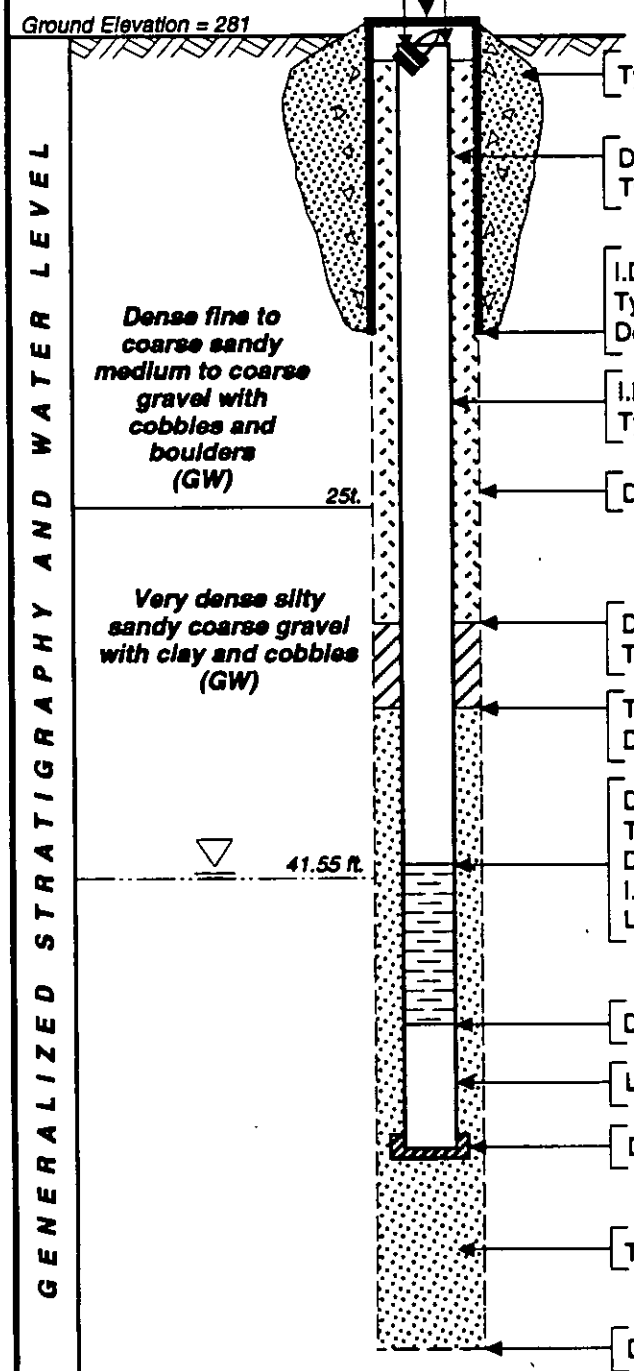
DEPTH (FEET)	BLOWS (6 IN.)	ANALYTICAL SAMPLES	MATERIAL DESCRIPTION	USC	HEAD SPACE READING	% RECOVERY	ODOR	SCREEN
25								
30								
35			As above.				0	
40		[Sample 40.0' 1100]	Coarse sandy gravel/cobbles, light brown to gray, wet.	GW	0		0	
45								
50			Bottom of boring at 51.3'.					
55								

PROJECT NO. 92C0609	Woodward-Clyde Consultants	FIGURE

MONITORING WELL INSTALLATION DETAILS

PROJECT: **Fort Lewis JP-4 Fueling Facility**	WELL NO. **MW-04 (SB-05)**
Fort Lewis WA	WELL LOCATION: **20' NW of Tank #1**
DATE COMPLETED: **5/27/93** TOTAL DEPTH: **51.3 ft**	**DRAWING NOT TO SCALE**

NOTE:
***DEPTHS** listed are from ground level.*
***ELEVATIONS** listed are from mean sea level.*



Locking Cap

Height of top of surface casing above ground surface: *flush*

Elevation of top of riser pipe: *281.37* ft.
Height of top of riser pipe above ground surface: *-0.25* ft.

Type of surface seal: *concrete*

Depth to top of backfill: *2.0* ft.
Type of backfill: *volclay grout*

I.D. of surface casing.
Type of surface casing: *Flush mount*
Depth of surface casing below ground: *NA*

I.D. of riser pipe: *4"*
Type of riser pipe: *Schedule 80 PVC*

Diameter of borehole: *9"*

Depth to top of seal: *35.8* ft.
Type of seal: *3/8" bentonite*

Type of sand pack: *10/20 Silica sand*
Depth of top of sand pack: *37.8* ft.

Depth to top of screened section: *40.8* ft.
Type of screened section: *4" Sch 80 PVC*
Describe openings: *0.020" factory slot*
I.D. of screened section: *4"*
Length of screen: *10* ft.

Depth to bottom of screened section: *50.8* ft.

Length of blank section: *0.5* ft.

Depth to bottom of plugged blank: *51.3* ft.

Type of backfill: *native*

Depth of hole below ground surface: *51.3* ft.

Woodward-Clyde Consultants	PROJECT NO. **92C0609 A**	PAGE 1 OF 1

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance(N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

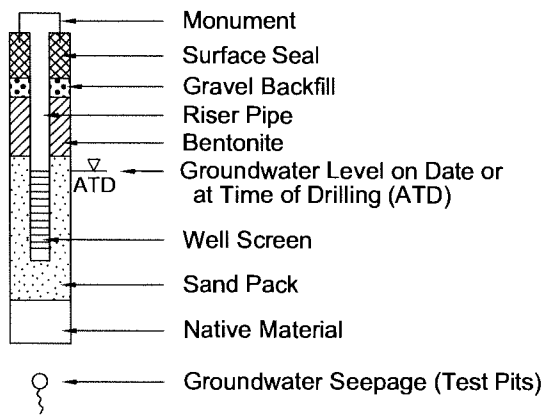
Sampling Test Symbols

Boring Samples		Test Pit Samples	
☒	Split Spoon	☒	Grab (Jar)
▧	Shelby Tube	▨	Bag
▥	Cuttings	▧	Shelby Tube
▯	Core Run		
*	No Sample Recovery		
P	Tube Pushed, Not Driven		

Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
	Water Content in Percent Liquid Limit Natural Plastic Limit
PID	Photoionization Detector Reading
CA	Chemical Analysis
WOR	Weight of Rod

Groundwater Observation Wells



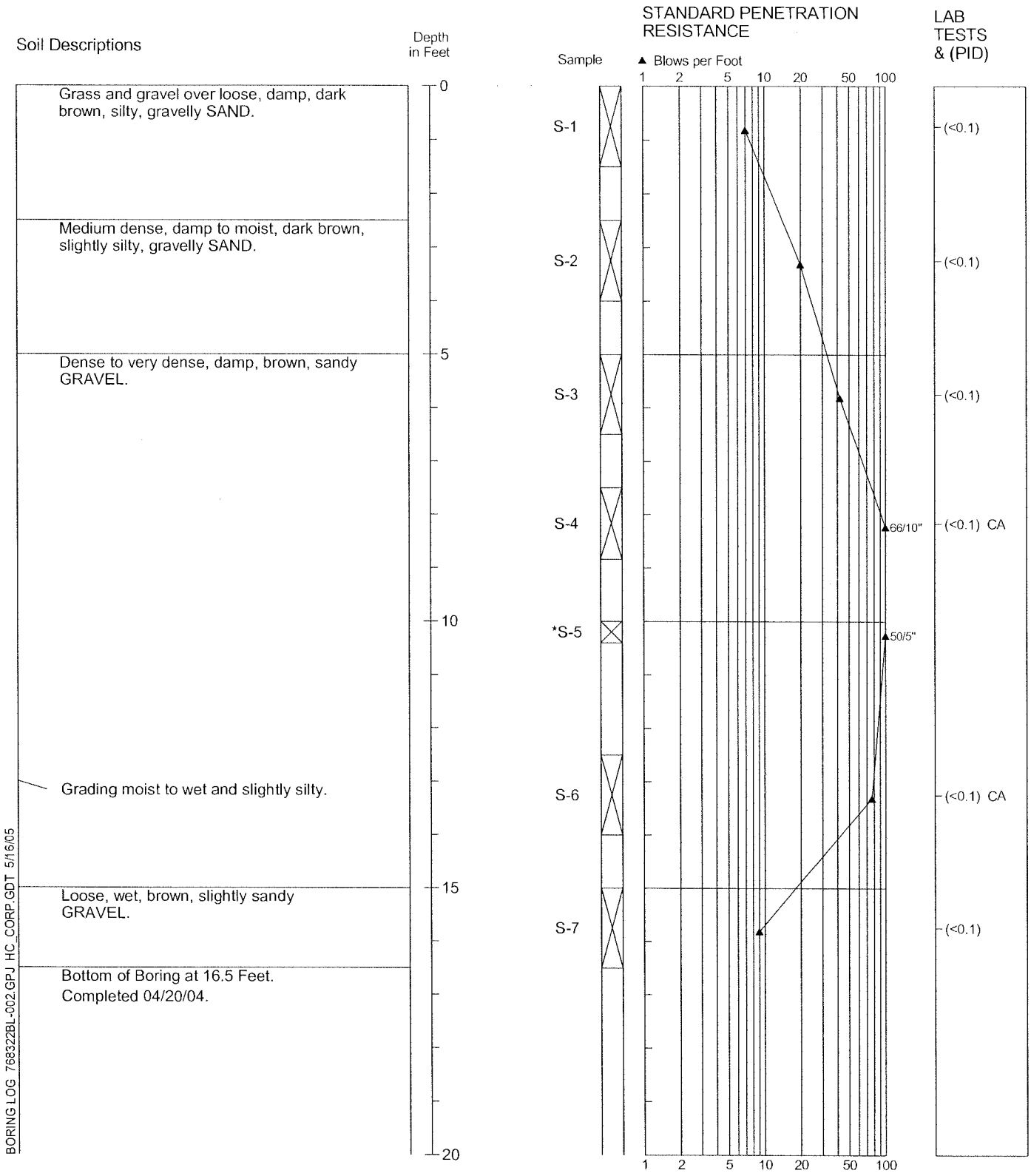
768322-004.DWG CAS 5/16/05 (HC Standards\SRF\ A-1.dwg)

HARTCROWSER

7683-22 5/05

Figure A-1

Boring Log AOC 10-8-B01



BORING LOG 768322BL-002.GPJ HC_CORP.GDT 5/16/05

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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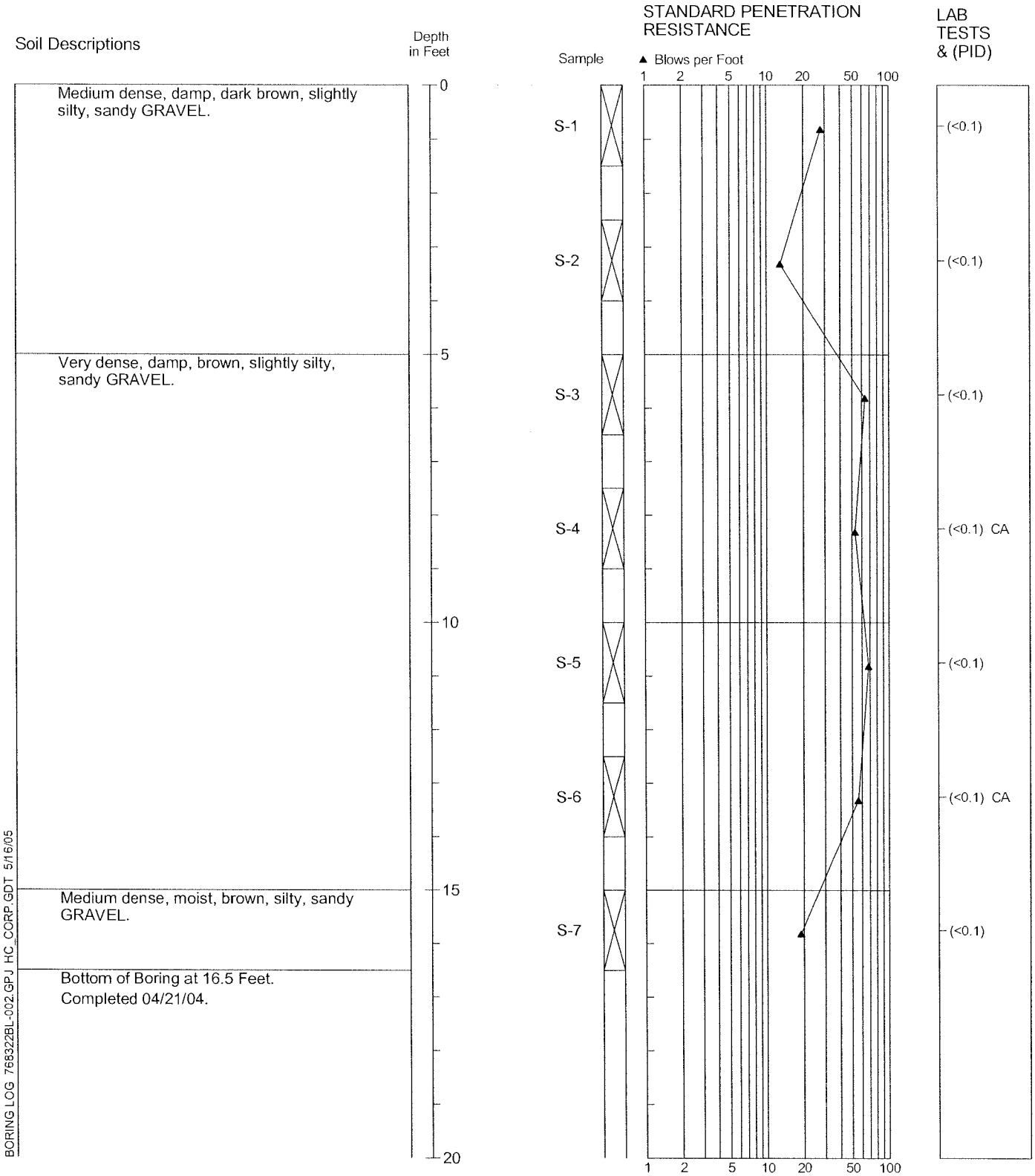
7683-22 04/04

Figure A-2

Boring Log AOC 10-8-B02



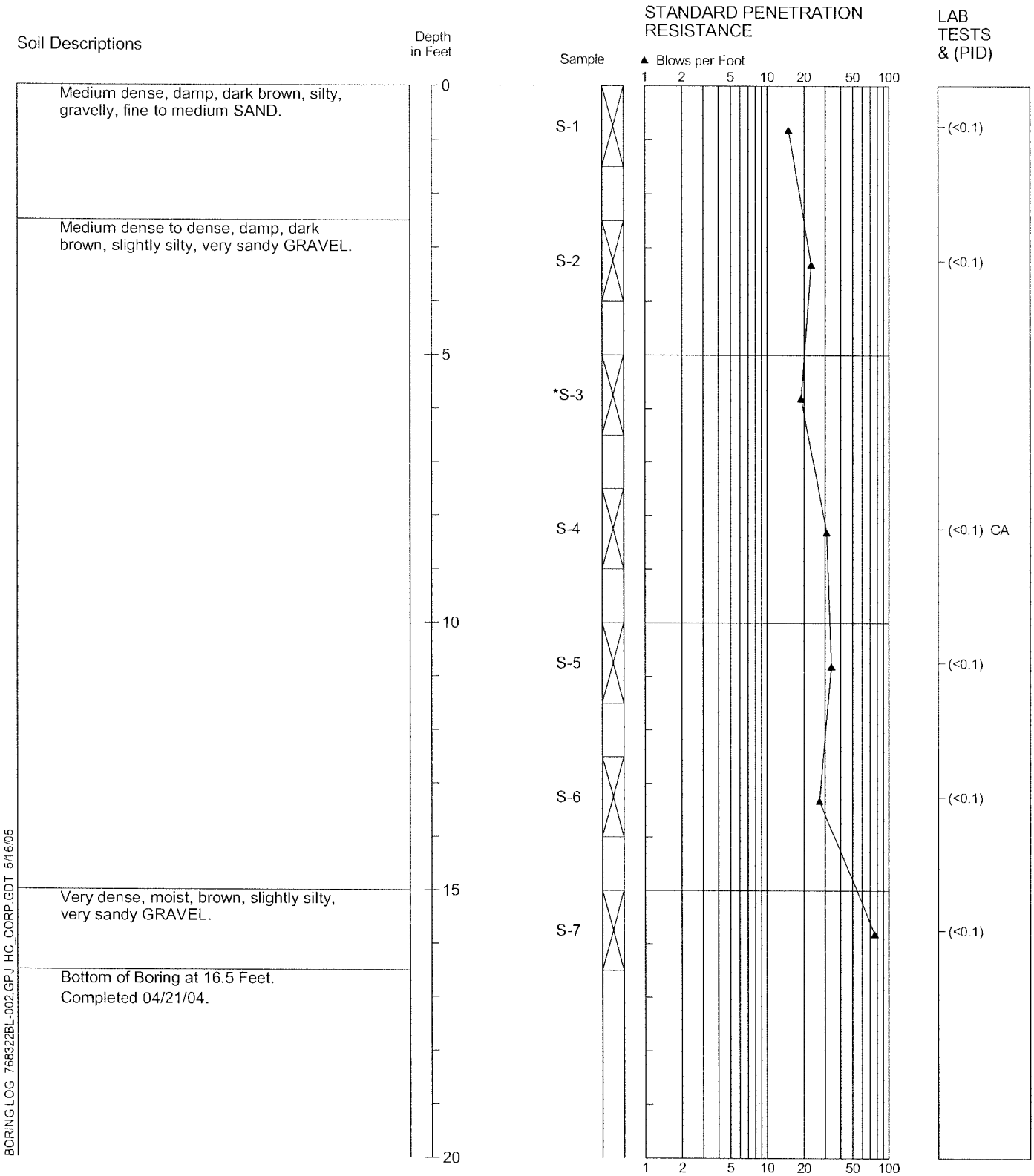
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-3

Boring Log AOC 10-8-B03



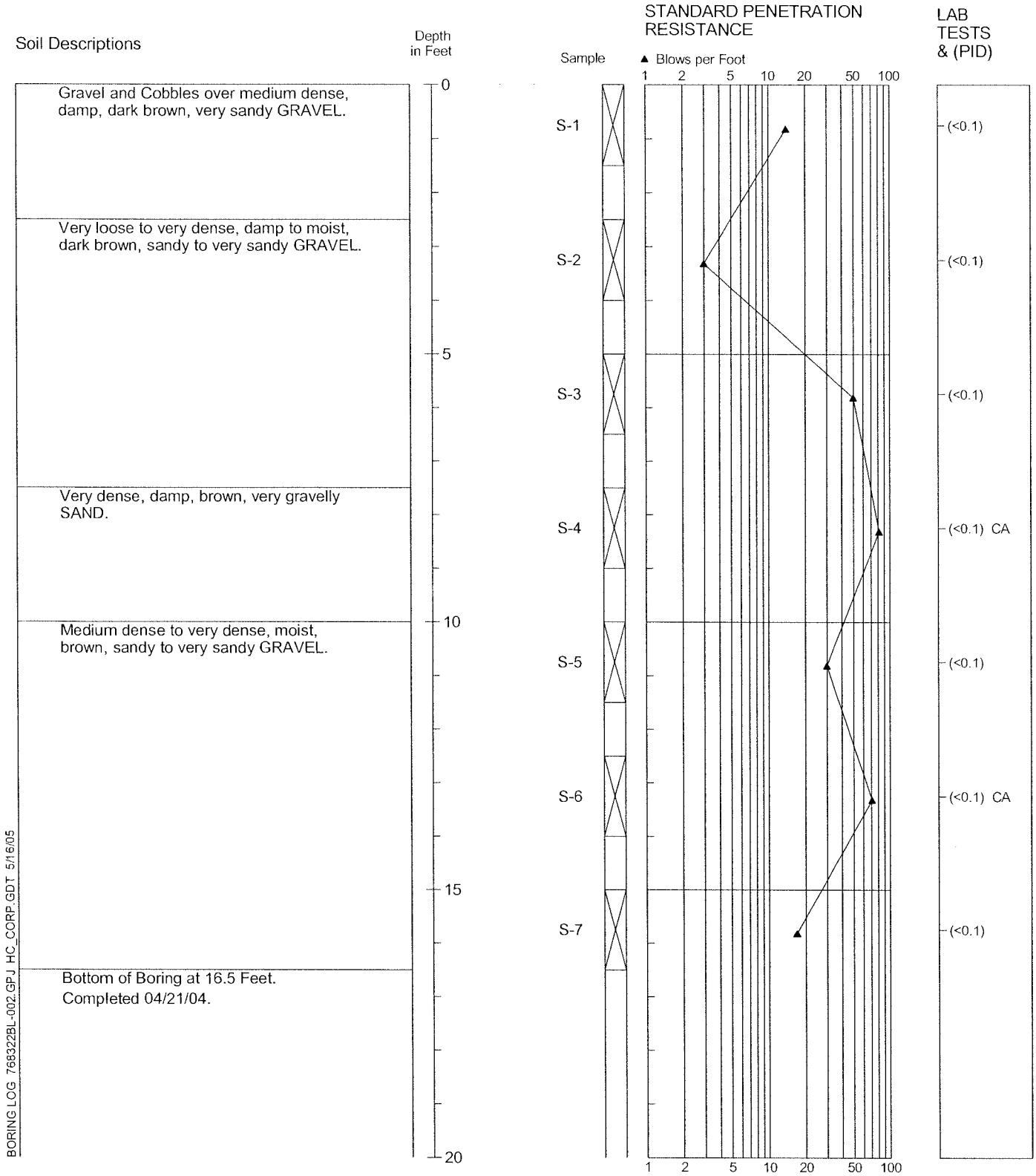
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 04/04

Figure A-4

Boring Log AOC 10-8-B04



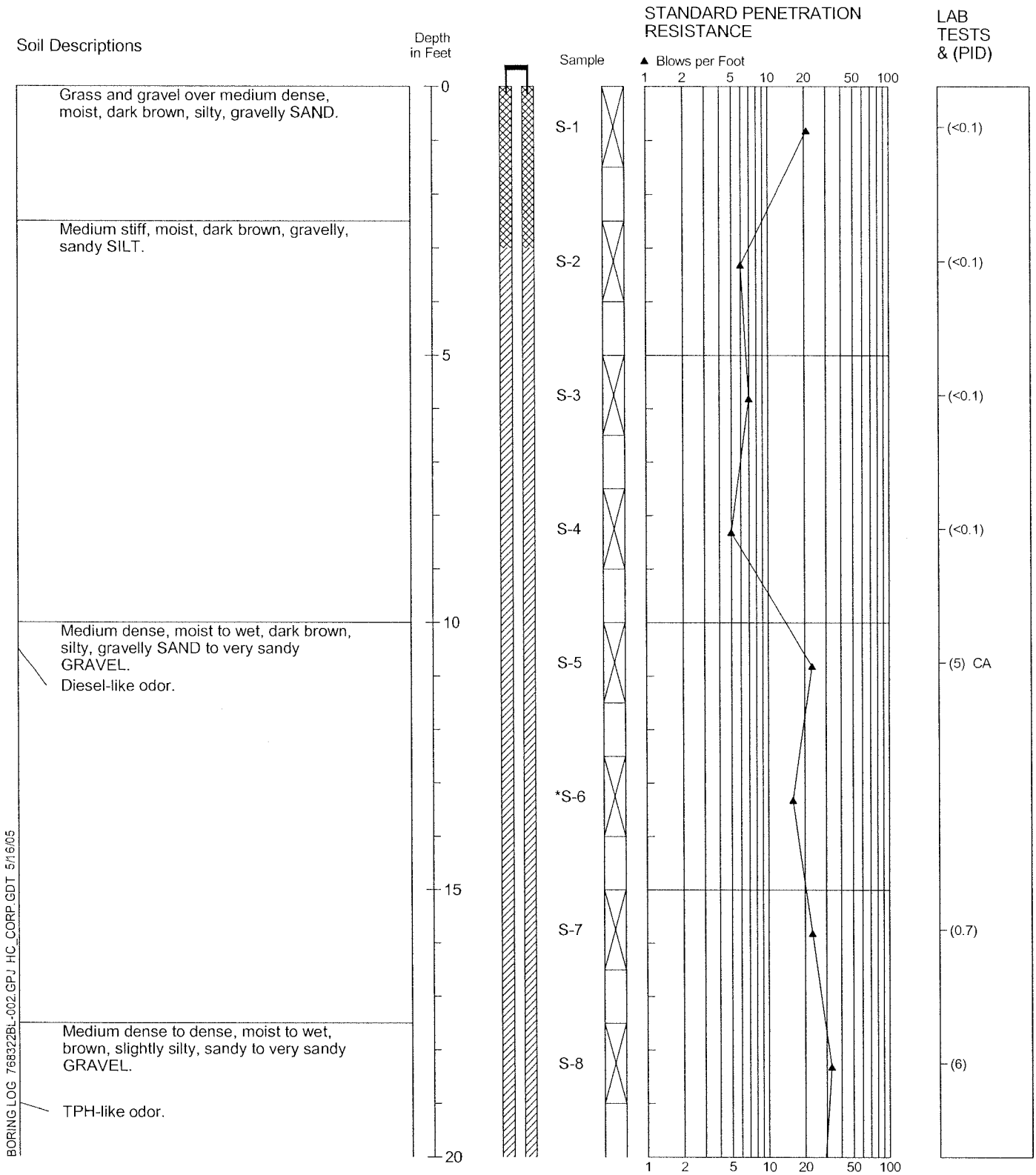
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-5

Boring Log AOC 10-8-B05



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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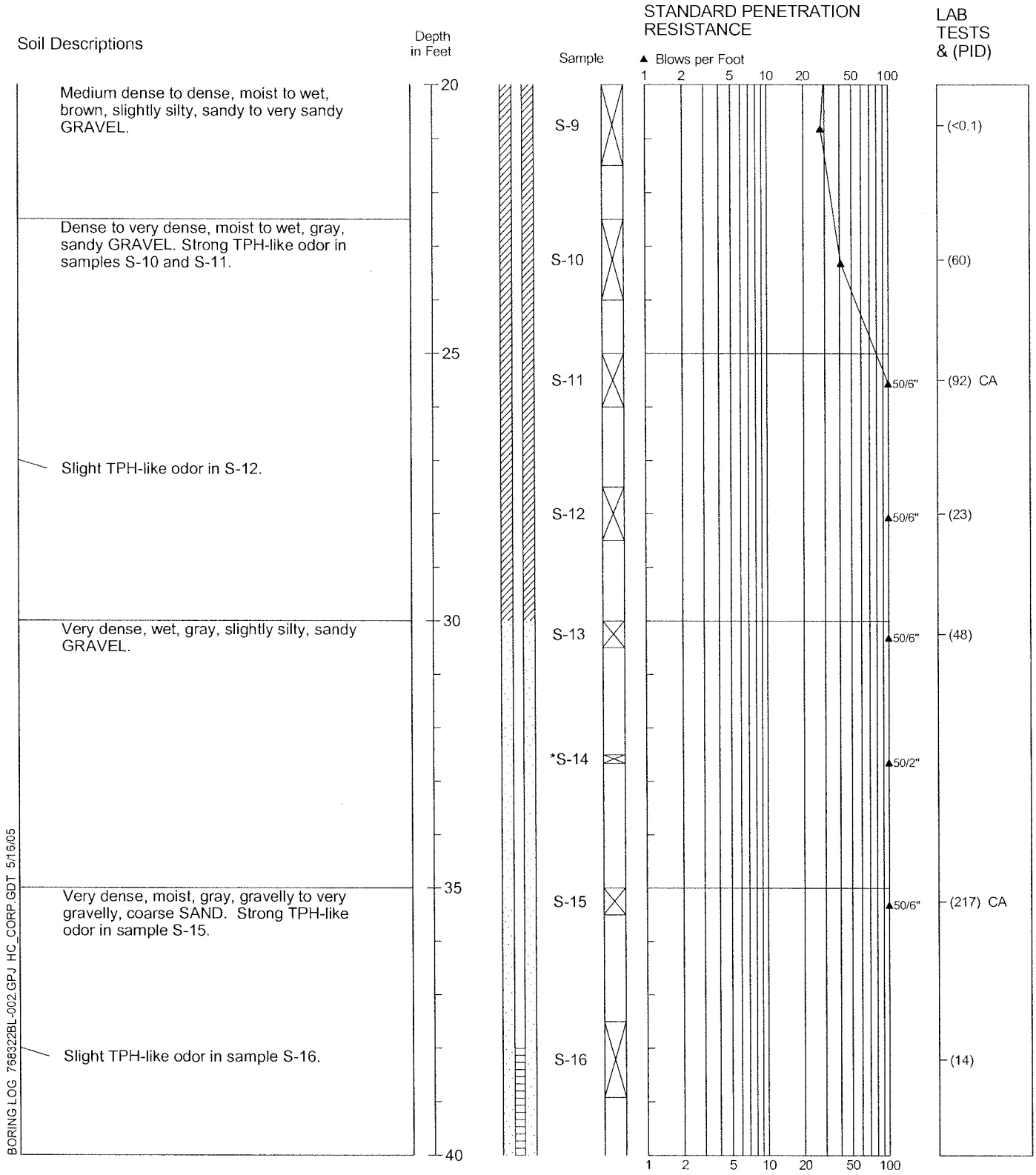
7683-22 *04/04*

Figure A-6 *1/3*

Boring Log AOC 10-8-B05



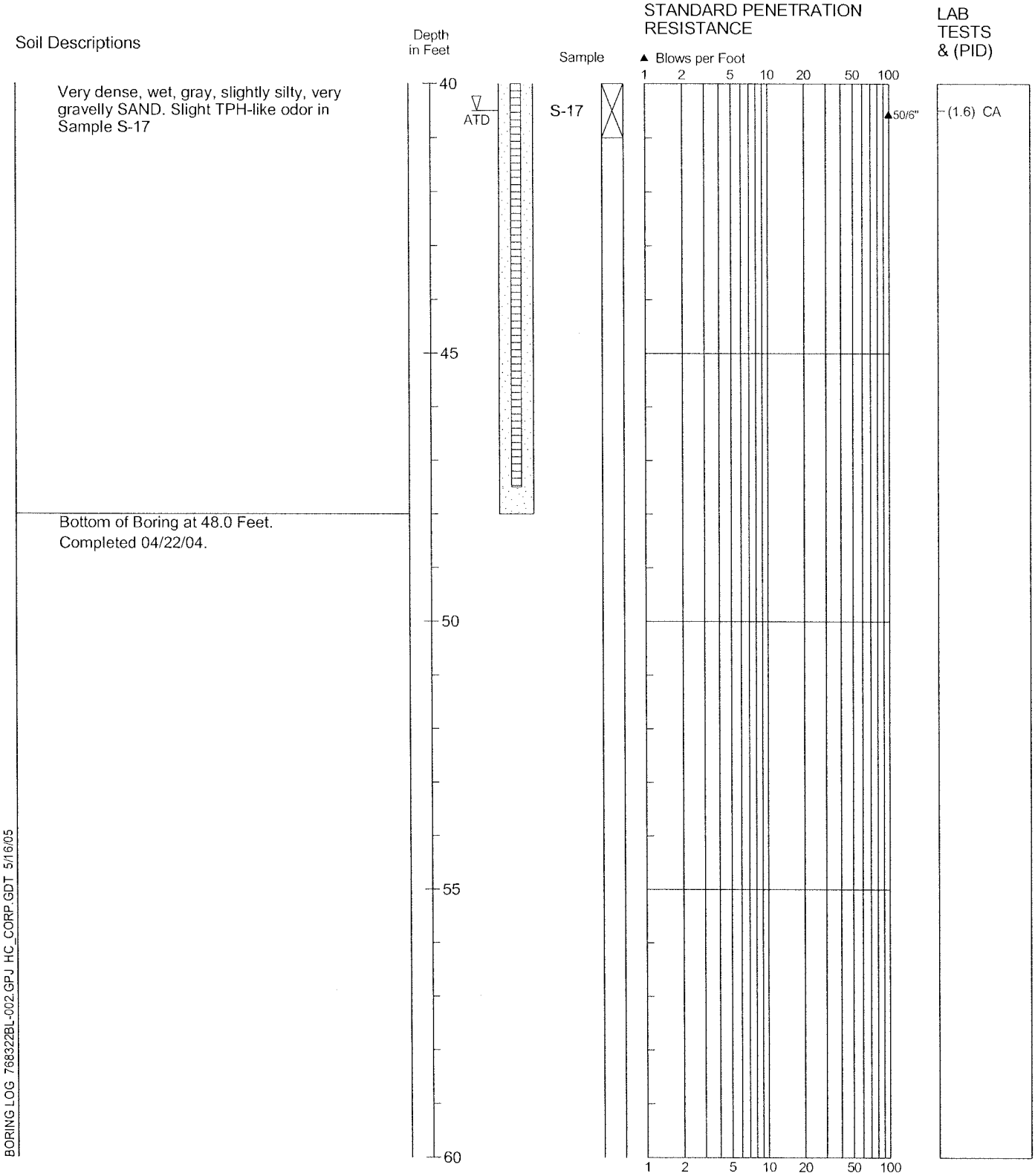
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-6 *2/3*

Boring Log AOC 10-8-B05



BORING LOG 768322BL-002.GPJ HC_CORP.GDT 5/16/05

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7683-22 *04/04*

Figure A-6 *3/3*

APPENDIX B

STANDARD OPERATING PROCEDURES

SOP 1

GROUNDWATER PURGING & SAMPLING MONITORING WELLS USING A SUBMERSIBLE PUMP

This operating procedure provides general information on groundwater purging and sampling from monitoring wells using a submersible pump.

EQUIPMENT REQUIRED

- Level D personal protective equipment (e.g., nitrile gloves, rain gear, steel-toe boots, safety glasses, and high-visibility safety vest)
- Submersible pump (e.g., Grundfos) with reusable tubing
- Pump controller
- Power source (generator)
- Electric water level measurement meter
- Sample containers with preservative
- Insulated cooler(s), chain of custody seals, appropriate cooler packing supplies (e.g., bubble wrap), and ice or blue ice
- Sample labels and appropriate documentation (e.g., chain of custody forms)
- Field log

PROCEDURES

PREPARATION

1. Record necessary data in field log.
2. Don appropriate personal protection equipment, as specified in the Site Safety and Health Plan.
3. Consult the well log for each well to determine the most productive zone. If at all possible, the pump intake shall not be placed within 2-feet of the well bottom or low-water level.
4. Ensure any downhole equipment (pump, tubing, and water level meter) has been properly decontaminated prior to use.

PURGING

1. Set up power source and pump controller.
2. Discharge all purge water to a temporary container for disposal at the Landfill 2 Pump and Treatment system.
3. Begin purging at a rate of 0.1 to 0.5 liters/minute. The appropriate purge rate will be determined by monitoring groundwater draw down controlled by site specific conditions. The water level should stabilize and ideally the pump rate should be sufficiently low enough to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.
4. Measure groundwater levels every 5 minutes to ensure that the groundwater in the well is not being drawn down. If significant draw down occurs, more than 6 inches, lower the speed of the pump or turn the pump entirely off.
5. Repeat until the water level stabilizes to closely match the recharge rate.
6. Purge groundwater for 15 minutes. After 15 minutes, depth to water will be checked and if the level is within 6 inches of the initial depth to water then a sample will be collected. If the water level is 7 inches or lower than the initial depth to water than the well will be given time to recharge.

SAMPLING

1. Collect sample directly from the end of the discharge tubing maintaining the established flow purge rate.
2. Minimize the formation of air bubbles, aeration, and turbulence by using the established flow rate while filling the sample vial for BTEX/TPH-G analysis and pouring the sample water gently down the inside of the bottle.
3. Form a meniscus over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.
4. Screw the Teflon-lined cap on tightly to prevent the container from leaking.
5. Label, package, and ship sample containers to the analytical laboratory as described in the RI/FS Work Plan.
6. Store and ship the samples at 4°C.

SAMPLE COMPLETION/DECONTAMINATION

1. Extract the pump from the well. Decontaminate all sampling equipment that comes in contact with the well water between the sampling locations**.** To decontaminate equipment:
   - Wash the water level meter using a Liquinox solution.
   - Rinse the water level meter with tap water.
2. Gather and dispose of all non-dedicated supplies and equipment properly.

SOP 2

GROUNDWATER PURGING & SAMPLING MONITORING WELLS USING DEDICATED BLADDER PUMP SYSTEMS

This operating procedure provides general information on groundwater purging and sampling using the dedicated (left in place) bladder pump systems.

EQUIPMENT REQUIRED

- Level D personal protective equipment (e.g., nitrile gloves, rain gear, steel-toe boots, safety glasses, and high-visibility safety vest)
- Dedicated bladder pump (Well Wizard dedicated pump with stainless steel casing and Teflon bladder, stainless steel inlet screen, Teflon-lined polyethylene twin bonded tubing with ⅜" OD sample tube and ¼" OD airline, 2" or 4" well caps with ⅜" OD discharge and ¼" OD air supply fittings and access hole for water level measurements, and ⅜" OD dura-flex discharge adapter)
- Pump controller (MicroPurge Smart Controller Model 400)
- 12 volt DC air compressor (QED Environmental Systems, Inc., part no. 3020)
- Electric water level measurement meter
- Sample containers with preservative (40 ml VOA vials preserved with HCl)
- Insulated cooler(s), chain-of-custody seals, appropriate cooler packing supplies (e.g., bubble wrap), and ice or blue ice
- Sample labels and appropriate documentation (e.g., chain-of-custody forms)
- Field log

PROCEDURES

PREPARATION

5. Record necessary data in field log.
6. Don appropriate personal protection equipment, as specified in the Site Safety and Health Plan.
7. Consult the geologic log for each well to determine the most productive zone. If at all possible, the pump intake shall not be placed within 2-feet of the well bottom or low-water level.

PUMP INSTALLATION

Position the pump intake:

- For wells with screen lengths less than or equal to 5 feet: in the middle of the screened interval.
- For wells with longer screens: within the most productive zone as determined by the geologic log.

PURGING

7. Set up air compressor and pump controller.
8. Discharge all purge water to the ground in both monitoring wells.
9. Begin purging at a rate of 0.1 to 0.5 liters/minute. The appropriate purge rate will be determined by monitoring groundwater draw down controlled by site specific conditions. The water level should stabilize and ideally the pump rate should be sufficiently low enough to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.
10. Measure groundwater levels every 5 minutes to ensure that the groundwater in the well is not being drawn down. If significant draw down occurs, more than 6 inches, lower the speed of the pump or turn the pump entirely off.
11. Repeat until the water level stabilizes to closely match the recharge rate.
12. Purge groundwater for 15 minutes. After 15 minutes depth to water will be checked and if the level is within 6 inches of the initial depth to water than a sample will be collected. If the water level is 7 inches or lower than the initial depth to water than the well will be given time to recharge.

SAMPLING

7. Collect sample directly from the end of the discharge tubing maintaining the established flow purge rate.
8. Minimize the formation of air bubbles, aeration, and turbulence by using the established flow rate while filling the sample vial for VOC analysis and pouring the sample water gently down the inside of the bottle. Care should be taken to avoid overfilling the vial.
9. Form a meniscus over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.

10. Screw the Teflon-lined cap on tightly to prevent the container from leaking.
11. Label, package, and ship sample containers to the analytical laboratory as described in the Plan.
12. Store and ship the samples at 4°C.

SAMPLE COMPLETION/DECONTAMINATION

3. Remove the air inlet and discharge lines carefully from their respective well cap fittings. Decontaminate all sampling equipment that comes in contact with the well water (e.g., water level meter) between the sampling locations**.** To decontaminate equipment:
    - Wash the water level meter using a Liquinox solution.
    - Rinse the water level meter with tap water.
4. Gather and dispose of all non-dedicated supplies and equipment properly.

SOP 3

GROUNDWATER PURGING & SAMPLING MONITORING WELLS USING A PERISTALTIC PUMP

This operating procedure provides general information on groundwater purging and sampling using a peristaltic pump.

EQUIPMENT REQUIRED

- Level D personal protective equipment (e.g., nitrile gloves, rain gear, steel-toe boots, safety glasses, and high-visibility safety vest).
- Peristaltic Pump (micropurge sampler)
- Flexible polyethylene or Teflon tubing
- Silicone tubing
- Electric water level measurement meter
- Sample containers with preservative (40 ml VOA vials preserved with HCl)
- Insulated cooler(s), chain-of-custody seals, appropriate cooler packing supplies (e.g., bubble wrap), and ice or blue ice
- Sample labels and appropriate documentation (e.g., chain-of-custody forms)
- Field log

PROCEDURES

PREPARATION

1. Record necessary data in field log.
2. Don appropriate health and safety clothing/equipment, as specified in the health and safety plan.

PUMP INSTALLATION

1. Position the bottom of the new or dedicated Teflon or polyethylene tubing as close as possible to the middle of the screened interval.
2. Connect above-ground portion of Teflon or polyethylene to new or dedicated section of silicone tubing.
3. Connect another section of Teflon or polyethylene to the discharge end of the silicone tubing.

PURGING

1. Place silicone tubing section into the pump's rotating cam. Discharge all purge water to the ground (all three monitoring wells).
2. Begin purging at a rate of about 1.0 liter/minute. The appropriate purge rate will be determined by monitoring groundwater draw down controlled by site specific conditions. The water level should stabilize and ideally the pump rate should be sufficiently low enough to allow an equal or greater amount of water to recharge the well so little or no water level draw down is observed.
3. Measure groundwater levels every 5 minutes to ensure that the groundwater in the well is not being drawn down. If significant draw down occurs, more than 6 inches, lower the speed of the pump or turn the pump entirely off.
4. Repeat until the water level stabilizes to closely match the recharge rate.
5. Purge groundwater for 15 minutes.

SAMPLING

1. Collect sample directly from the end of the discharge tubing maintaining the established flow purge rate.
2. Minimize the formation of air bubbles, aeration, and turbulence by using the established flow rate while filling the sample vial for VOC analysis and pouring the sample water gently down the inside of the bottle. Care should be taken to avoid overfilling the vial.
3. Form a meniscus over the mouth of the vial to eliminate formation of air bubbles and head space prior to capping.
4. Screw the Teflon-lined cap on tightly to prevent the container from leaking.
5. Label, package, and ship sample containers to the analytical laboratory as described in the Plan.
6. Store and ship the samples at 4°C.

SAMPLE COMPLETION/DECONTAMINATION

1. Determine if tubing will remain in the well.
2. If so: Take care to ensure that the tubing does not become clogged with debris or kinked.
3. If not: Remove the air inlet and discharge lines carefully from their respective well cap fittings. Decontaminate all sampling equipment that comes in contact with the well water (e.g., water level meter) between the sampling locations**.** To decontaminate equipment:
   - Wash the water level meter using a Liquinox solution.
   - Rinse the water level meter with tap water.
4. Gather and dispose of all non-dedicated supplies and equipment properly.

SOP 4

FIELD PARAMETER MEASUREMENT FOR GROUNDWATER SAMPLING

Field parameters (temperature, pH, turbidity, oxidation reduction potential, specific conductance, salinity, and dissolved oxygen) will be monitored during purging of the monitoring wells and prior to surface water sampling with a Horiba water quality meter or equivalent. Measurements will be conducted in accordance with the manufacturer's instructions and the following procedures:

- Calibrate or verify calibration of the water quality meter according to Field Procedure 10. For low-flow purging of the monitoring wells:
  - Set up and begin purging well.
  - Determine the flow rate using a graduated cylinder or equivalent.
  - Attach a flow-through cell to the polyethylene tubing. Position the water quality meter probe in the flow-through cell. Begin purging the monitoring well.
  - After the cell has been flushed at least twice, begin monitoring the field parameters, and continue approximately every 3 to 5 minutes during purging. Record water quality measurements the appropriate field logbook or on a well purge data sheet.
  - When the indicator parameters have stabilized for three consecutive readings, the well is considered stabilized and ready for sample collection (per Field Procedures 5 and 9 as applicable). Remove the flow-through cell from the tubing.
- For surface water sampling, position the probe directly in the water body. Record water quality measurements in the appropriate field logbook or on a well purge data sheet.

Decontaminate the water quality meter probe between wells by rinsing it with commercially purchased water. If debris or odor is noted, wash with Liquinox and rinse with commercially purchased water as needed.

SOP 5

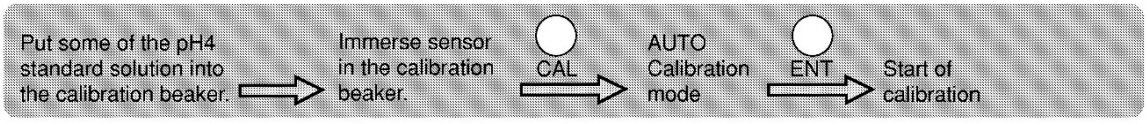
WATER QUALITY METER CALIBRATION

The Horiba® water quality meter or equivalent will be calibrated at the beginning of each day prior to using the instrument to collect field parameters for samples (as detailed below in Steps 1-6). Alternatively, at the discretion of the operator, calibration may be omitted if a calibration check is performed and demonstrates the parameters are within the expected range (as described below in Step 7).

The daily calibration will be performed using the Auto-Calibration function and a standard pH 4 Auto-Calibration solution. The Auto-Calibration function performs a one-point calibration of the pH sensor, conductivity sensor, and turbidity sensor in the standard pH 4 Auto-Calibration solution, while the dissolved oxygen sensor is calibrated in the atmosphere simultaneously. The following procedure is for Horiba® U-20 series, however Horiba® U-50 series follow similar procedures and have similar expected parameter values.

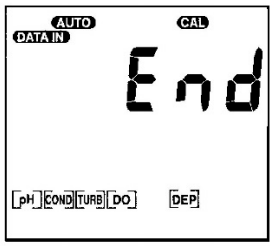
The meter's calibration must be checked at the beginning of the day (immediately following calibration or in lieu of performing a calibration) and at the end of the day to determine if parameter values have drifted from original calibration. Additionally, it is highly recommended that a mid-day calibration check is performed so that any problems can be identified more readily. Calibration checks are not a recalibration of the meter but a check of the calibration to ensure the continued accuracy of the meter. Use of the meter for field samples must be bracketed by calibration checks that are within the expected range.

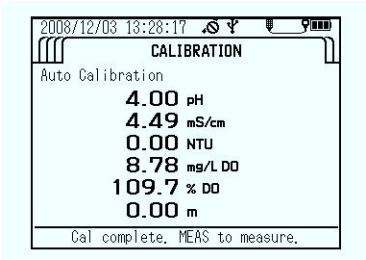
1. Triple-rinse the sensors with commercially available bottled drinking water.
2. Fill the calibration beaker to the marked line with the standard pH 4 Auto-Calibration solution. If using a Horiba® U-50 series, the transparent calibration beaker will need to be inserted into the black calibration beaker upon filling the transparent beaker with the pH 4 Auto-Calibration solution.
3. Immerse the sensors in the beaker.
4. Turn "On" water quality meter.
5. Press **CAL** button, then press **ENT** button to start Auto-Calibration.



Upon completion of the calibration of the pH, conductivity, turbidity, and dissolved oxygen sensors the water quality meter screen will display "END" for the U-20 series or "Cal Complete" for the U-50 series.

*Note – If an error code is displayed, reference manufacturer's Operation/Instruction Manual.





6. Press the **MEAS** button to display measured parameter values. Record, at a minimum, values for pH, turbidity, conductivity, and dissolved oxygen (values for temperature, salinity, and oxygen reduction potential (ORP) may also be recorded to evaluate meter). Expected parameter value ranges are as follows:

    a. 4.00 units for pH (± 10%)

    b. 4.49 mS/cm for conductivity (± 10%)

    c. 0 NTUs for turbidity (+ 10 NTUs)

    d. 8.00 mg/L to 12.00 mg/L for dissolved oxygen (± 10%)

*Note – The age of the Auto-Calibration solution and temperature fluctuations can effect expected parameter value ranges. If the recorded parameter value is outside the expected range, consult the manufacturer's Operations Manual for indicated value tables for parameters at various temperatures. If parameter values are outside of expected ranges, rinse sensors and perform Auto-Calibration again.

REFERENCES

Horiba, Ltd. 2000. Multi Water Quality Monitoring System U-020 Series Operation Manual.

Horiba, Ltd. 2009. Multi Water Quality Checker U-50 Series Instruction Manual.

NAVFAC Northwest. 2015. Standard Operating Procedure: NAVFAC Northwest Field Procedures Manual. Version 5.0. Revised 2015.

APPENDIX C

EXAMPLE FIELD FORMS

ALS Environmental

Field Chain-of-Custody Record

Page _____ of _____

Client Name & Address:	Project No.:	Preservation Code	Sample Matrix Code	Sample for Matrix QC	Analyses Requested								No. of Containers	Matrix Codes: W) Water B) Bulk L) Liquid F) Filter S) Soil G) Wipe C) Solid M) Media Preservation Codes: 1) Cool to 4°C 2) HCl to pH<2, 4°C 3) H_2SO_4 to pH<2, 4°C 4) HNO_3 to pH<2, 4°C 5) NaOH to pH>12, 4°C 6) ZnOAc/NaOH to pH>9, 4°C
	Project Name:													
Phone:														
FAX:	Sampler: *(Signature)*													
e-mail:														

Field Sample Number	Site ID	Date	Time	Depth	ALS Sample Number											Remarks

Possible Hazard Identification

☐ Non-Hazard ☐ Skin Irritant ☐ Rad
☐ Flammable ☐ Poison ☐ Unknown

Sample Disposal

☐ Return to Client ☐ Archive for _____ Months
☐ Disposal by Lab
(fees may be assessed if samples are retained longer than 3 months)

Requested Turn Around Time

☐ 2 Days (Rush) ☐ 7 Days (Rush) ☐ 21 Days
☐ 3 Days (Rush) ☐ 14 Days ☐ Other
(Rush = email data by COB on day due. Surcharges assessed.)

Carrier/Airbill #:

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time

Shipped to:

ALS Environmental
960 West LeVoy Drive
Salt Lake City, UT 84123
Phone: (800) 356-9135
Phone: (801) 266-7700
FAX: (801) 268-9992

White - Laboratory Copy ***Yellow - Client Copy***

Sealaska Environmental Services

Marine Science Center, P.O. Box 869
18743 Front Street, NE, Suite 201
Poulsbo, WA 98370

Well Inspection, Purging, and Field Measurement Form

Contract Number: _____ Task Order: _____ Location: _____ Site Name: _____

Well Data

Well ID: _____ Well Head Locked: Y: ___ N: ___ Depth to Water (ft btoc): _____

Total Well Depth (ft btoc): _____ Exterior Seal Good: Y: ___ N: ___ Depth to Product (ft btoc): _____

Mid Screen Depth (ft btoc): _____ Pooled Water in Well Head: Y: ___ N: ___ Product Thickness (ft): _____

Purge Rate (liters/min): _____ Inner Casing Straight and Clear: Y: ___ N: ___ Volume Purged (liters): _____

Purge Method: Peristaltic/Submersible/Bladder/Other: _____ Remarks: _____

Water Sample Data

Sample ID: _____ Type: _____ Date: _____ Time: _____ # Containers: _____

QC Sample ID: _____ Type: _____ Date: _____ Time: _____ # Containers: _____

Sampling Personnel: _____

Remarks (color, odor, etc.): _____

Time	Purge Vol. (liters)	Depth to Water (ft btoc)	pH	Spec. Cond. (ms/cm)	Turbidity (NTU)	DO (mg/L)	Temp. (ºC)	ORP (mv)	Other
Stabilization Requirements			**(± 0.2 units)**	**(± 10%)**	**(± 10% or <20)**	**(± 10%)**	**(± 10%)**	**(± 10)**	
	0		**Initial Depth to Water (Pre-pumping)**						

Well Volume Calculation

Well volume (liters) = [Well casing volume (liters/ft)] x [Length of water column (ft)]

Well casing diameter (in) → Well casing volume (liters/ft)

1.25" → 0.3 1.5" → 0.4 2" → 0.6 2.5" → 1 3" → 1.4 3.5" → 2 4" → 2.5 6" → 5.5