Quality Assurance Project Plan
Former Fort Ord, California
Volume I, Appendix A

Final Addendum No. 1
Well Installation and Decommissioning

Prepared for:
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

On behalf of:
U.S. Department of the Army
Fort Ord BRAC
4463 Gigling Road, Room 101
Seaside, CA 93955

USACE Contract No. W91238-19-C-0027
Task No. 13

Prepared by:
Ahtna Global, LLC
9699 Blue Larkspur Lane, Suite 201
Monterey, CA 93940-6552

Report Date: December 2023

Report Version: Final

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Acronyms and Abbreviations

Ahtna	Ahtna Global, LLC
Army	U.S. Department of the Army
bgs	below ground surface
BLL	black legless lizard
BRAC	Base Realignment and Closure
CCRWQCB	California Regional Water Quality Control Board, Central Coast Region
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
CQCR	Contractor Quality Control Report
CQM	Construction Quality Management
CPR	cardiopulmonary resuscitation
CTS	California tiger salamander
DTSC	California Department of Toxic Substances Control
FOCAG	Fort Ord Community Action Group
FONR	Fort Ord Natural Reserve
GIS	geographic information system
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMP	Habitat Management Plan
IDW	investigation-derived waste
N/A	not applicable
OU1	former Operable Unit 1 (clean and closed)
OU2	Operable Unit 2
OUCTP	Operable Unit Carbon Tetrachloride Plume
PDB	passive diffusion bag
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SGS	SGS North America, Inc.
Sites 2/12	Sites 2 and 12
SOP	standard operating procedure
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

On behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, Ahtna Global, LLC (Ahtna) prepared this *Quality Assurance Project Plan, Former Fort Ord, California, Volume 1, Appendix A, Addendum No. 1, Well Installation and Decommissioning* (QAPP Addendum)[1] under USACE Contract Number W91238-19-C-0027. This QAPP Addendum describes well installation, well decommissioning, and management of previously decommissioned wells to be performed at the former Fort Ord (Figure 1). This work is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund"). This QAPP Addendum details quality assurance (QA) and quality control (QC) procedures for well installation, well decommissioning, and decommissioned well management activities.

This document is an addendum to the *Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Final Revision 11, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume* (Groundwater QAPP Revision 11; Ahtna, 2023a) and provides additional project-specific details. Groundwater QAPP Revision 11 will be referenced as appropriate in the worksheets contained herein. Groundwater sampling and analysis is addressed in Groundwater QAPP Revision 11 (Ahtna, 2023a); therefore, this QAPP Addendum specifically discusses well installation, well decommissioning, and management of previously decommissioned wells at the former Fort Ord, California and only includes Optimized UFP-QAPP Worksheets #1 & 2, #4, 7 & 8, #9, #14 & 16, #17, #18, #21, and #22 with additional information applicable to this project. Other worksheets and information are available in Groundwater QAPP Revision 11 (Ahtna, 2023a).

[1] This document is an addendum to Appendix A to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is the governing document for sampling and analysis of groundwater (Appendix A), soil (Appendix B), soil gas (Appendix C), landfill gas (Appendix D), and per- and polyfluoroalkyl substances (Appendix E). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

2.0 Worksheet #1 & 2: Title and Approval Page

Site Name/Project Name: Former Fort Ord/Superfund Response Actions

Site Location: Former Fort Ord, California

Document Title: Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Addendum No. 1, Final, Well Installation and Decommissioning

Lead Organization: U.S. Army Corps of Engineers

Preparer's Name, Organization, and Contact Info: Shaelyn Hession and Holly Dillon, Ahtna
9699 Blue Larkspur Lane, Suite 203, Monterey, CA 93940
(831) 324-3299 (831) 200-6072
hdillon@ahtna.net shession@ahtna.net

Preparation Date: December 14, 2023

Project Role	Name Organization	Signature	Date
Investigative Organization's Project Manager	Derek Lieberman Ahtna		12/14/2023
Investigative Organization's Quality Control Manager	Bruce Wilcer Ahtna		12/14/2023
Investigative Organization's Project Chemist	Eric Schmidt Ahtna		12/14/2023
Lead Organization's Technical Lead	Erin Corr USACE	CORR.ERIN.NICOLE.1609085602 Digitally signed by CORR.ERIN.NICOLE.1609085602 Date: 2023.12.14 15:07:18 -08'00'	
Lead Organization's Project Chemist	Kyle Bayliff USACE	BAYLIFF.KYLE.WESLEY.1553766881 Digitally signed by BAYLIFF.KYLE.WESLEY.1553766881 Date: 2023.12.14 15:21:11 -08'00'	

Plans and reports from previous investigations relevant to this project:

Site Name/Project Name:	Former Fort Ord/Superfund Response Actions
Site Location:	Monterey County, California
Site Number/Code:	Not Applicable (N/A)
Operable Units:	OU2, OUCTP, and Sites 2/12
Contractor Name:	Ahtna Global, LLC
Contract Number:	W91238-19-C-0027
Contract Title:	FY19 – FY24 Fort Ord Groundwater Remediation and Landfill Operation and Maintenance Contract
Work Assignment Number:	N/A
Guidance used to prepare QAPP:	Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1.
Regulatory Program:	CERCLA as amended by the Superfund Amendment and Reauthorization Act
Approval Entities:	U.S. Environmental Protection Agency (USEPA), California Department of Toxic Substance Control (DTSC), and Regional Water Quality Control Board, Central Coast Region (CCRWQCB) (collectively the "regulatory agencies")
Data Users:	U.S. Department of the Army (Army), USACE, USEPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public
Organizational partners (stakeholders) and connection with lead organization:	USACE, Army (lead agency/owner), USEPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)
The QAPP is (select one):	Generic:____ Project-Specific:_X_

Dates and titles of QAPP documents written for previous site work:

Title	Approval Date
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Draft Revision 11	In Progress*
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 10	March 2022
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 9	November 2021
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 8	February 2021
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 7	August 2019
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 6	March 2018
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 5	June 2017
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 4	March 2016
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 3	June 2015
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 2	February 2014
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 1	December 21, 2012
Draft Final Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Groundwater Extraction and Treatment Systems at Operable Unit 2 and Sites 2 and 12; Groundwater Monitoring Program at Sites 2 and 12, Operable Unit 1, Operable Unit 2, and Operable Unit Carbon Tetrachloride Plume	May 31, 2011
Draft Final, QAPP/CDQMP Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP	January 20, 2010
Final Sampling and Analysis Plan, Operable Unit 2 and Sites 2 and 12 Groundwater Treatment Systems, Former Fort Ord	August 20, 2009

*Draft version of document is currently in review and available in the Administrative Record (BW-2785R; Ahtna, 2023a).

3.0 Worksheet #4, 7 & 8: Personnel Qualifications and Sign-Off Sheet

Organization: Ahtna

Name	Project Title/Role	Education/ Experience	Specialized Training/ Certifications[1]	Signature[2]	Date
Kelly O'Meara	Program Manager	Resume on file	HAZWOPER		12/14/23
Derek Lieberman	Project Manager	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER, CQM		12/14/23
Eric Schmidt	Project Chemist	Resume on file	HAZWOPER, CQM		12/14/23
Holly Dillon	Task Lead	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		12/14/23
Bruce Wilcer	QC Manager	Resume on file	HAZWOPER, CQM		12/14/23
Teri Farrell-Bage	Database Manager	Resume on file	Not applicable		12/14/23
Andrew Mauck	GIS Manager	Resume on file	Not applicable		12/14/23

Notes:

[1] Specialized Training/Certifications Key:
CPR: cardiopulmonary resuscitation
CQM: Construction Quality Management
H&S: health and safety training including, but not limited to, hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces
HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response
MEC: munitions and explosives of concern recognition and safety training
PE: registered Professional Engineer

[2] Signatures indicate personnel have read and agree to implement this QAPP as written.

4.0 Worksheet #9: Project Planning Session Summary

Project Name: Former Fort Ord Well Installation and Well Abandonment (Task 13) **Projected Start Date:** October 2023 **Project Manager:** Derek Lieberman, Ahtna	**Site Name:** Former Fort Ord **Site Location:** Former Fort Ord, CA
Date of Session: July 25, 2023 **Scoping Session Purpose:** Discuss the scope of work	

Name	Title	Affiliation	Telephone #	E-mail Address
Derek Lieberman	Project Manager	Ahtna	(831) 224-3327	dlieberman@ahtna.net
Andrew Mauck	Field and GIS Technician	Ahtna	(831) 402-0727	amauck@ahtna.net
Holly Dillon	Task Lead	Ahtna	(831) 324-3299	hdillon@ahtna.net

Planning Session Summary:
Reviewed Task 13 scope of work and technical basis documents.

Action Items:
Based on this review, Ahtna will:

- Initiate the QAPP Addendum.
- Review groundwater data from the Second Quarter 2023 Groundwater Monitoring event and conduct sampling at additional wells to determine the locations for the three new A-Aquifer OUCTP monitoring wells along Neeson Road.
- Develop an inspection checklist to prioritize the previously decommissioned wells for topping off grout.
- Identify the 20 previously decommissioned well locations to be addressed based on depth of grout settlement and relative safety risk.
- Inform Fort Ord Natural Reserve (FONR) and Fort Ord Dunes State Park personnel before inspecting previous well locations on their property.

5.0 Worksheet #14 & 16: Project Tasks & Schedule

5.1 Project Tasks

Applicable SOP(s) for the project tasks outlined in this Worksheet are listed in Worksheet #21 and provided in detail in Attachment A.

5.1.1 Well Installation

Three (3) A-Aquifer monitoring wells will be installed in the OUCTP area to an approximate depth of 120 feet. The purpose of these wells is to further delineate OUCTP north of MW-BW-94-AR. The proposed well locations are in the developed area outside the FONR (Figure 2) to avoid impacts to sensitive species. Well construction details are summarized in Table 1. Typical well construction details are shown in Figure 3 and detailed information is provided in Worksheet #17, Section 6.11.

The new monitoring wells will be developed to ensure they are working properly before sampling occurs. Detailed information about well development is provided in Worksheet #17, Section 6.12. Groundwater samples will be collected and analyzed for chemicals of concern (COCs) as outlined in Groundwater QAPP Revision 11 (Ahtna, 2023a). After the initial sampling event following well installation and development, the new wells will be added to the basewide groundwater monitoring program and sampled per Groundwater QAPP Revision 11 (Ahtna, 2023a).

Groundwater well installation will follow the procedures outlined in SOP# FSOP-601.01, well development in SOP# FSOP-602.01, equipment decontamination SOP# FSOP-801.01, and investigation-derived waste (IDW) management SOP# FSOP-802.00 (Attachment A). Field forms are in Attachment B.

5.1.2 Well Decommissioning

Nine monitoring wells and one steel conductor pipe[2] will be decommissioned as shown in Figure 4 and listed in Table 2. These wells are either no longer functional or are no longer part of the Sites 2 and 12 (Sites 2/12), Operable Unit 2 (OU2), or Operable Unit Carbon Tetrachloride Plume (OUCTP) monitoring programs and therefore can be decommissioned as recommended in the associated annual groundwater monitoring reports (Ahtna, 2023b; 2023c; and 2023d).

Decommissioned wells will be grouted to the surface. Well casings will be cut off five (5) feet below ground surface (bgs) and removed, except for the steel conductor pipe, which is located in the FONR and will be cut off at one foot bgs to minimize soil disturbance in the area. Surface expressions of the well and any protective bollards will be entirely removed (either stick up or flush mount).

[2] The steel conductor pipe was discovered by the property owner and its origin is unknown. A review of Army files found no record of the pipe. The pipe is 10-inch diameter carbon steel that extends to approximately 25 feet bgs and does not penetrate a groundwater aquifer. Video logging to the total depth of the pipe was performed on September 1, 2022, which identified debris at the bottom of the pipe consisting primarily of animal remains. There was no evidence of materials in the pipe that would require testing for hazard determination or would require removal and disposal or treatment prior to decommissioning of the pipe. Additionally, the pipe is located in a remote area with no identified potential sources of contamination that have warranted historical sampling of soil or groundwater in the uppermost A-Aquifer (HLA, 1995).

Decommissioning will follow the procedures outlined in SOP# FSOP-603.01 and IDW management SOP# FSOP-802.00 (Attachment A). Field forms are shown in Attachment B. Detailed information about well decommissioning is provided in Worksheet #17, Section 6.11.

5.1.3 Decommissioned Well Management

An inspection of wells that were decommissioned in the FONR and Fort Ord Dunes State Park between 2014 and 2017 will be conducted as shown in Figure 5 and Figure 6 and listed in Table 3. Some subsidence or settlement of the near surface grout material may have occurred at some of these locations, which may result in shallow holes or depressions that could present a safety hazard for humans and wildlife. For this task, the previously decommissioned wells that can be relocated will be inspected and a measurement of grout settlement made at each location. Twenty (20) locations that represent the largest safety risk will be prioritized and additional grout will be placed in each of those locations up to ground level.

Fieldwork will be coordinated with appropriate management personnel at FONR and Fort Ord Dunes State Park. Soil disturbance in the well areas will be minimized to the extent practicable to mitigate impacts to native plant species. In some cases, it is expected well locations will have to be accessed on foot instead of by vehicle. Within 72 hours of the initial placement of the grout, the grout will be inspected, and more grout added if additional settlement has occurred. Additional procedures for decommissioned well management are provided in Worksheet #17, Section 6.11.

5.2 Investigation-Derived Waste Management and Equipment Decontamination

Liquid, solid, personal protective equipment and miscellaneous waste will be managed per the applicable provisions in SOP FSOP-802.00 (Attachment A).

5.2.1 Investigation-Derived Waste – Liquid

Liquid investigation-derived waste (IDW) will be contained in labeled drums or tanks and will be treated at the OU2 GWTP. The OU2 groundwater remedy consists of a groundwater pump and treatment system designed to remediate water containing COCs by pumping it through liquid-phase granular activated carbon. Accumulated sediment from well development activities will be disposed of at the Fort Ord Landfills.

5.2.2 Investigation-Derived Waste – Soil

Soil IDW will be contained in drums or bins onsite and will be characterized and disposed of in accordance with applicable laws and regulations. One representative composite sample of borehole cuttings (soil IDW) will be collected from each drilling location (three total) and analyzed for OUCTP A-Aquifer groundwater COCs by USEPA Method 8260D as listed in the Groundwater QAPP Revision 11 (Ahtna, 2023a) to evaluate for the presence or absence of other sources of contamination in the vadose zone in the area of the new wells that could affect groundwater. Soil IDW will be disposed of at the Fort Ord Landfills, consistent with the *Record of Decision, Basewide Remedial Investigation Sites* (Army, 1997b) in conjunction with the *Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill* (Army, 1997a) and the *Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), Operable Unit*

2, Fort Ord Landfills (Army, 2006), which designates CAMU regulations as ARARs for the Fort Ord Landfills (Title 22 California Code of Regulations, Section 66264.552).

5.2.3 Investigation-Derived Waste – Solid Waste

Solid non-hazardous waste, such as disposable personal protective equipment and non-reusable sampling equipment, will be disposed of in a waste receptacle located at the OU2 GWTP at 11000 Engineering Equipment Road, Marina, California.

5.3 Documentation and Records

Field records will be maintained and be sufficient to thoroughly document field activities. The information will be recorded in a permanently bound notebook with sequentially numbered pages. The following information will be recorded for field activities: (1) location, (2) date and time, (3) people performing activity, (4) weather conditions, and (5) logs of the activities being conducted. For field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument will be recorded. Record sample identification numbers and chain of custody numbers, personnel present on site, site conditions, visitors to the site, and significant events and observations.

Each day of fieldwork, Ahtna will prepare a Project Field Report to describe onsite personnel, visitors, equipment, hours of operation, a summary of activities, quality and safety issues, corrective actions, and photographs. These daily Project Field Reports will be submitted to USACE weekly during fieldwork activities. A logbook will be kept, and documentation will follow the procedures outlined in SOP #FSOP-001.01 (Attachment A). Field forms are shown in Attachment B.

A Well Installation and Decommissioning Completion Report (Completion Report) will be prepared to document field activities described in Section 5.1. The Completion Report will include field data and documentation (well logs, photographs, etc.) collected as part of these activities. Analytical data will also be summarized and interpreted in the Completion Report.

The fieldwork and analytical data will also be summarized in the associated OUCTP, Sites 2/12, and OU2 quarterly groundwater monitoring reports and summarized in the OUCTP, Sites 2/12, and OU2 Annual Reports to be prepared after the Third Quarter 2024 groundwater monitoring event.

5.4 Project Schedule

The project schedule below is subject to change based on QAPP Addendum document review and approval, subcontractor availability, biological limitations, and field conditions. After this QAPP Addendum document is finalized, the updated schedule will be maintained, discussed with appropriate parties, and made available upon request.

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Baseline Habitat Survey, FONR	Denise Duffy and Associates	May 2023	Jun 2023	Habitat Checklist	Aug 2023

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Decommissioned well inspection	Ahtna	Aug 2023	Sept 2023	CQCR	Oct 2023
Decommissioned well management	Ahtna	Sept 2023	Oct 2023	CQCR	Oct 2023
Well decommissioning	Ahtna/ Driller	Oct 2023	Oct 2023	CQCR	Nov 2023
Geophysical Utility Clearance	Advanced Geological Services	Oct 2023	Oct 2023	Maps of detected utilities, GPS coordinates of detected features	Oct 2023
A-Aquifer monitoring well installation	Ahtna/ Driller	Nov 2023	Nov 2023	CQCR	Dec 2023
IDW soil sampling	Ahtna	Nov 2023	Nov 2023	CQCR	Dec 2023
IDW soil analyses	SGS	Nov 2023	Dec 2023	Report of analyses/ data package	Dec 2023
Monitoring well development	Ahtna/ Driller	Nov 2023	Nov 2023	CQCR	Dec 2023
Well survey	Surveyor	Dec 2023	Dec 2023	Horizontal and vertical coordinates	Jan 2024
Sample collection, groundwater	Ahtna	Dec 2023	Dec 2023	CQCR	Dec 2023
Groundwater sample analyses	SGS	Dec 2023	Dec 2023	Report of Analyses/ Data Package	Jan 2024
Data validation	Laboratory Data Consultants	Dec 2023	Jan 2024	VSR	Feb 2024
Reporting	Ahtna	Jan 2024	Apr 2024	Draft Completion Report	Apr 2024

Notes:
CQCR: Contractor Quality Control Report
HMP: habitat management plan
VSR: Validation Summary Report

5.5 Other Tasks

See Groundwater QAPP Revision 11 Worksheet #14 & 16 (Ahtna, 2023a) for information about:

- QC Tasks
- Data Management Tasks
- Sample Tracking
- Data Types
- Data Tracking and Management
- Computer Database
- Geographic Information System
- Data Management Documentation
- Presentation of Data
- Assessment and Audit Tasks
- Data Review Tasks

6.0 Worksheet #17: Sampling Design and Rationale

The field activities will be conducted in general accordance with the SOPs included in Attachment A. Daily field conditions and tasks will be recorded in the Field Logbook and Daily Field Report forms in Attachment B.

6.1 Sampling Equipment and Materials

The following sections present the scope of work and sampling approach for sampling activities proposed for the QAPP Addendum.

6.1.1 Baseline Groundwater Sampling

Baseline groundwater samples from the three (3) newly installed monitoring wells will be collected. The samples will be analyzed for the OUCTP A-Aquifer COCs outlined in Groundwater QAPP Revision 11 (Ahtna, 2023a). Subsequent sampling will be conducted as part of the Fort Ord Basewide quarterly GWMP and subject to QAPP decision rules to determine sampling frequency.

Baseline sampling includes installation of a weighted rope with identified stations at approximately five-foot intervals in the screened well zone, placement of passive diffusion bags (PDBs) at each saturated station for profiling the water column and collecting samples at least two weeks after placement of the PDBs.

Groundwater samples will be collected and analyzed according to Groundwater QAPP Revision 11 (Ahtna, 2023a).

6.1.2 Soil IDW Sampling

Soil IDW sampling will be conducted following installation of the three (3) new monitoring wells as a composite sample from each borehole for a total of three (3) soil IDW samples. The soil samples will be collected according to the SOPs in Attachment A and analyzed for the OUCTP A-Aquifer COCs listed in Groundwater QAPP Revision 11 (Ahtna, 2023a).

6.1.3 Analytical

Baseline sampling will be conducted after the development of new wells and during the next scheduled quarterly sampling event associated with the GWMP following well development. Accordingly, QC samples will also be collected and samples will be analyzed by USEPA Method 8260-SIM for volatile organic analysis following sampling and laboratory analytical protocols identified in Groundwater QAPP Revision 11 (Ahtna, 2023a).

The target analyte list for the baseline samples will be OUCTP A-Aquifer per Groundwater QAPP Revision 11 (Ahtna, 2023a). Laboratory analytical data collected under this task will be maintained, uploaded to the FODIS site, and validated in accordance with Groundwater QAPP Revision 11 (Ahtna, 2023a)

6.1.4 Reporting

The QAPP Addendum activities will be documented in the OUCTP Annual Report and in a Completion Report.

6.2 Environmental Protection Plan

Environmental protection is defined as maintaining the environment in its natural state, to the extent possible, during and after fieldwork activities and returning the disturbed site to conditions similar to those present prior to these activities. Environmental protection will consist of protecting air, water, land, and biological resources.

6.3 Air Resources Protection

Fieldwork activities will be conducted to minimize the release of airborne particulates within and outside of the boundaries of the site. Dust and particulates will be controlled in accordance with the Accident Prevention Plan (Ahtna, 2021) to minimize contaminate dispersion and to protect human health and the environment. It is anticipated, based on the proposed activities, that significant dust will not be generated. The use of water to control dust will be minimized to avoid impact to natural resources. Visual air monitoring will be conducted to verify the effectiveness of the program.

6.4 Land Resources Protection

Fieldwork within the FONR will be coordinated with the USACE Technical Lead, Onsite Biologist, Fort Ord Base Realignment and Closure (BRAC) Office Biologist, and the University of California, which manages the area, to minimize impact to natural resources and ongoing research projects. Coordination will include:

- Scheduling FONR fieldwork to be conducted between June 1 and Oct 31 (i.e., outside the primary growing season for rare plants) as determined by the Onsite Biologist and approved by University of California and the BRAC Office Biologist, to avoid the flowering periods of special-status species.
- Maintaining site security.
- Defining acceptable and unacceptable work areas, access routes, and turnaround and staging locations in the Habitat Checklist (Attachment C).
- Ensuring implementation of the conservation measures identified in the HMP (USACE, 1997) and Programmatic Biological Opinion (USFWS, 2017).

Prior to intrusive activities within the FONR, the Onsite Biologist will review existing habitat surveys to determine the quantity and specific location of threatened or endangered plants and animals within the planned well construction areas. This habitat survey data and information provided by the University of California will be used to minimize impact to the habitat and special-status species within FONR. Where practicable, adjustments will be made to construction plans (e.g., adjustments to monitoring well locations) and coordinated with the University of California to minimize the impact on natural resources.

The field activities in the FONR include well decommissioning (well drilling and development and groundwater monitoring activities will occur outside the FONR). Decommissioned well management activities will occur with the FONR and Fort Ord dunes State Park, but do not involve intrusive work. The specific locations where well decommissioning activities will occur are shown in Figure 4 and will be identified in the Habitat Checklist (Attachment C) prior to commencing fieldwork. Field personnel will receive training to familiarize them with the site restrictions necessary to minimize impacts to the habitat and special-status species on FONR lands. During each of these activities, staging areas and specific access routes will be established to minimize excess impact to the ground surface, such as

rutting and erosion. Mats will be used where necessary to protect vegetation and prevent damage to the ground surface, including activities such as the operation of vehicles off of existing roads and creation of new access routes.

The Onsite Biologist will monitor work as necessary to ensure conservation measures are implemented. Baseline and 3-year follow-up monitoring will be conducted to determine if special-status species have been adversely impacted and if corrective measures are recommended. Because the corrective actions will take place in the FONR, which is one of several sites administered by the University of California, the Onsite Biologist will coordinate with the University of California, the USACE Technical Lead, and the BRAC Office Biologist prior to implementation.

Following the well decommissioning activities, disturbed land around the wells will be restored as closely as possible to its original condition by limited grading after coordination with the USACE Technical Lead and the BRAC Office Biologist.

6.5 Water Resources Protection

The potential for impact to surface water resources is assumed to be minimal because there is no surface water drainage or storm drains that lead to surface water within the project sites. Equipment maintenance and fueling will be conducted offsite and away from open storm drain inlets.

6.6 Material Handling

Both hazardous and non-hazardous wastes may be generated during fieldwork activities. These wastes will be managed as described in Worksheet #14 & 16, Section 5.2.

Chemicals brought onsite will be managed per the Hazard Communication Program in the Accident Prevention Plan (Ahtna, 2021).

6.7 HMP Species

Project activities undertaken must protect and maintain the special-status species found within FONR. Efforts are taken to avoid or minimize impacts to HMP species, with emphasis on three federally listed plant species: Monterey spineflower, Monterey gilia, and Yadon's piperia. Special-status species listed in the HMP and Programmatic Biological Opinion (USFWS, 2017) that occur or may occur on FONR include:

- Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*) – federally endangered, state threatened
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) – federally threatened
- Seaside bird's beak (*Cordylanthus rigidus* ssp. *littoralis*) – state endangered
- Sandmat manzanita (*Arctostaphylos pumila*)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Eastwood's goldenbush (*Ericameria fasciculata*)
- Yadon's piperia (*Piperia yadonii*) – federally endangered
- Coast wallflower (*Erysimum ammophilum*)
- California black legless lizard (*Anniella pulchra nigra*; BLL) – state species of concern

- California tiger salamander (*Ambystoma californiense*; CTS) – federally threatened, state threatened
- Monterey ornate shrew (*Sorex ornatus salarius*) – state species of concern

Monterey gilia, Monterey spineflower, Seaside bird's beak, and coast wallflower are annual herb species that may occur within maritime chaparral, coastal scrub, grasslands, dune scrub, or disturbed areas. Sandmat manzanita, Monterey manzanita, Monterey ceanothus, and Eastwood's goldenbush are perennial shrub species that typically occur in maritime chaparral, but individuals can also be found mixed with oak woodland or coastal scrub habitats. Yadon's piperia is a perennial herb that is typically found in maritime chaparral and Monterey pine habitats.

The BLL is a rare variety of the California legless lizard (*A. Pulchra*) that inhabits areas with sandy soils on the former Fort Ord. The Monterey ornate shrew is a rare variety of the ornate shrew (*S. ornatus*) found in riparian forest and oak woodland habitats. The CTS is typically found in vernal or seasonal ponds on the former Fort Ord. The CTS may also be found aestivating in small mammal burrows or under logs in upland areas within 2.2 kilometers of vernal ponds.

As identified in the Programmatic Biological Opinion (USFWS, 2017), success criteria for contaminated groundwater remediation are as follows:

After the final monitoring period for each of the federally listed species or designated Monterey spineflower critical habitat, species reestablishment will be considered successful when:

1. *densities and acreage of HMP annual species are within a normal range compared with information from reference sites, and;*
2. *the number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.*

If the success criteria are not met, based on the evaluation of the monitoring data, corrective measures will be developed in coordination with the U.S. Fish and Wildlife Service, as specified in the Programmatic Biological Opinion (USFWS, 2017).

6.8 HMP Species Protection

The Onsite Biologist will identify areas containing populations of Monterey gilia and Monterey spineflower during baseline surveys. Access routes will be delineated with rope or flagging tape to ensure personnel and equipment stay within designated work areas and prohibit access to protected areas. The Onsite Biologist will ensure conservation measures are implemented during well installation activities in the FONR and will be available to resolve unanticipated resource issues as they arise.

The field activities will include drilling and well installation, well development and surveying, well decommissioning, decommissioned well management, and groundwater monitoring. Ahtna will communicate to personnel working at the site the resources of concern and habitat protection requirements prior to the start of remediation activities. Staging areas, access routes, and turnaround areas will be clearly delineated and shown to field personnel. Field personnel will be instructed to lock the access gate behind them after each entry to and exit from the FONR. If a BLL or CTS is discovered during the proposed activities, the Onsite Biologist will be immediately notified. The Onsite Biologist will coordinate with the BRAC Office Biologist to confirm appropriate conservation steps, including relocation, if necessary. The Onsite Biologist will fill out the field observation form with the necessary

information and then relocate the individual, if necessary, to suitable nearby habitat. If the Onsite and/or BRAC Office Biologist are not available onsite during observation of CTS or BLL, onsite personnel may carefully relocate BLL away from fieldwork if harm is imminent and fill out the biological observation form (Attachment C). Work must stop if CTS is observed until an approved Biologist has removed the CTS from the project site.

When driving vehicles and heavy equipment through the inner roads of the northern FONR area, personnel must walk in front of vehicles to ensure there are no Coast Horned Lizards in the road before the vehicle passes. If Coast Horned Lizards are observed, they must be relocated away from the vehicle's path. Observations of Coast Horned Lizards may be reported to the University of California and the BRAC Office Biologist for tracking purposes.

Some limited vegetation clearance may be necessary to access well locations. If necessary, vegetation clearance will be coordinated with the University of California, the BRAC Office Biologist, and USACE Technical Lead, and conducted following standard best management practices to protect the existing oak trees and special-status species. Tree branches may be trimmed as necessary to provide access, but no trees will be removed. Vegetation removed from work areas will be consolidated with other construction debris and taken to an appropriate disposal facility.

6.9 Pre-Field Activities

6.9.1 Notification and Access

Property owners will be notified of fieldwork activities at least three days before the start of work. Site users will be coordinated with for site access, limited access to the project site during construction, and scheduling changes.

6.9.2 Permitting

Permits for monitoring well installation and monitoring well decommissioning will be obtained from the Monterey County Department of Health; however, no permit fees are required to be paid because the former Fort Ord is a CERCLA site. No permits are required for managing previously decommissioned wells.

6.9.3 Utility Clearance

A utility clearance will be performed at each proposed well location before drilling activities commence to avoid encountering underground utilities and other potential obstructions. Clearance activities include notification of utility agencies and/or utility protection organizations, as appropriate, in addition to performing onsite surveys using the appropriate geophysical equipment. Locations of utilities will be marked on the ground surface with indications of the assumed type of utility. Prior to initiating intrusive activities, utility location information will be reviewed, including field markings and available drawings, to ensure the boring is a minimum of 3 feet away from a marked utility. The boring will be hand augured (or similar method) to a depth of 5 feet bgs.

6.9.4 Habitat Clearance

The Onsite Biologist will survey proposed soil boring and new monitoring well locations, access routes, and staging areas in the FONR prior to fieldwork activities for Monterey gilia, Monterey spineflower, and piperia. Identified plants will be GPS-located and mapped. The baseline survey will be conducted during the peak blooming period for Monterey gilia and Monterey spineflower. The maps will be used to field-

identify and mark areas that personnel may not enter, areas that are permitted to access, stage equipment, and turn vehicles around.

6.9.5 Traffic Control Plan

The new monitoring well locations are in areas with low to moderate public and/or property user traffic. Traffic control around the project site with proper safety delineators and protocol will be adhered to as described in the APP (Ahtna, 2021).

6.10 Support Facilities

Support facilities include lockable containers, chemical toilets, portable containment tanks and bins with lids. Lockable support facilities will be secured when project personnel are not on site. Decontamination facilities will consist of portable secondary containment for personnel and an equipment decontamination pad. Decontamination water will be collected in portable tanks for disposal (see Section 5.2). It is anticipated most of the support facilities will be located in the vicinity of the Ahtna field offices adjacent to the OU2 groundwater treatment plant (GWTP).

6.11 Field Activities

The specific methods and material requirements for well decommissioning and well installation are presented in this section.

6.11.1 Borehole Drilling and Logging

Three monitoring wells will be installed by a California-licensed contractor using a truck- or track-mounted rotosonic (rotary-vibratory) or hollow-stem auger drill rig. The work area footprint for these drill rigs, including support vehicles and drilling equipment, is expected to be approximately 25 feet by 50 feet or 1,250 square feet. The borehole diameter will be sized to assure proper borehole sidewall clearance for well construction. The proposed monitoring well casing diameter is 3 inches (Table 1); therefore, the borehole diameter will be 8 inches. Figure 2 shows the proposed locations of these monitoring wells. The borings will be completed under the supervision of the Project Geologist/Engineer who will be responsible for oversight of borehole logging, well installation, and development activities. General procedures for borehole drilling and logging include:

6.11.2 Well Construction

The specific methods and material requirements for well installation are presented in this section. Monitoring wells will be constructed in accordance with ASTM D5092 – Standard Practice for Design and Installation of Groundwater Monitoring Wells and Federal, State, and local regulations to the extent practicable; however, well construction requirements found in Monterey County Code Chapter 15.08 will take precedence. Well construction details will be recorded in the field using the forms in Attachment B. Well depths and location of the screen interval are estimated based on known site conditions (Table 1); however, final depths and screen intervals will be determined in the field by the Project Geologist/Engineer using geologic logs. The Project Geologist/Engineer will evaluate the geologic logs based on selected soil samples and compare them to logs from nearby monitoring well locations. Each monitoring well screen interval will be placed within permeable geologic materials that correlate with existing nearby monitoring wells.

6.11.3 Well Construction Materials

Well construction materials will be in accordance with *Water Well Standards: State of California Bulletin 74-81 and Supplement 74-90* (CDWR, 1981 and 1991). Well construction materials will be new, clean, and in good condition. Casing for the proposed wells will consist of flush joint, threaded, 3-inch diameter Schedule 80 polyvinyl chloride (PVC) manufactured per ASTM F480. Joints between casing pipe and screen will be compatible.

The well screen will consist of new 3-inch diameter slotted Schedule 80 PVC. The monitoring well screen lengths will be comprised of 10-foot sections. The screen slot size will be 0.020-inch. A 3-inch diameter PVC bottom cap will be installed at the bottom of each monitoring well. A lockable expansion cap will be placed at the top of the PVC well casing for secure access to the well.

Wells will be constructed with centering guides of stainless steel and placed such that the well screen is positioned within the center of the borehole.

The filter pack sand will consist of clean, washed, rounded to subrounded siliceous material that is free from calcareous grains or material (#3 or #2/12 sand). A transition sand (#60) will be placed directly above the filter pack sand. Filter pack material will be protected from contamination prior to placement by either storing it in plastic-lined bags or in a location protected from the weather and contamination on plastic sheeting. Filter pack materials will be transported to the site in a manner that prevents contamination by other soils, oil and grease, and other chemicals.

The bentonite seal will be placed directly above the transition sand. A bentonite-cement grout seal will be used in the construction of monitoring wells and placed directly above the bentonite seal. Wells will be grouted to within 36 inches of land surface. The bentonite grout used in the construction of the well will contain standard bentonite-cement grout mixed in the ratio of 5 pounds bentonite gel, one 94-pound bag of Type 1 Portland cement, and 7 gallons of clean, potable water. The grout will have a weight of approximately 15.3 pounds per gallon. Cement will meet requirements of ASTM C150-00. Neither additives nor borehole cuttings will be mixed with the grout.

6.11.4 Assembly of Well

Each well will be installed within the completed boring and equipped with 30-foot long screens. The estimated screen interval depths for the monitoring wells will be approximately 90 to 120 feet bgs. The final position of the well screen will be determined in the field by the Project Geologist.

If the protective plastic shipping sleeve is damaged, the affected screen and casing material will be decontaminated immediately prior to installation in the borehole. Care will be taken to ensure the casing does not contact the ground. Joints and other accessory parts will be securely fastened prior to installation in the borehole. The screen and 3-inch diameter casing will be placed in the hole in such a manner as to avoid jarring impacts and to ensure the assembly is not damaged. The well will be plumb, true, and centered in the hole by the use of centralizers (see Section 6.11.3, paragraph 3).

Filter pack sand will be placed around the monitoring well screen and will extend two to three feet above the top of the well screen. Once the filter pack is placed, the well screen will be gently surged for approximately 30 minutes to mitigate bridging that may have occurred during filter pack placement. Once surging is complete, sand will be added as needed and a one- to two-foot thick layer of transition sand will be placed above the filter pack. The filter pack will be placed from the bottom of the borehole up, in such a manner as to ensure uniform placement around the screen. During placement of the sand

pack, frequent measurement of the top of the sand pack will be made to confirm uniform placement of the material and that no bridging has occurred.

A three to five-foot thick bentonite pellet or chip seal will be installed at the top of the filter pack to isolate it from the surface and given a sufficient hydration time before the bentonite-cement grout seal is placed on top. A bentonite-cement grout seal will be used in the construction of monitoring wells and placed directly above the bentonite seal to within 36 inches of ground surface. The bentonite grout will contain materials of the type and proportions described in the Construction Materials section above. Monitoring wells will be constructed with a concrete surface seal that will extend to a minimum of 36 inches below the land surface and will be set directly above the bentonite-cement grout seal.

6.11.5 Well Surface Completion

Surface completion of each monitoring well will consist of either a flush vault or stovepipe. The 8-inch diameter traffic-rated flush-mounted steel vault will be a minimum of 12 inches deep set in the concrete surface seal and be equipped with a bolt-down watertight cover. The top of the vault will be raised slightly above existing grade, and the surface of the cement seal will slope away from the vault to the existing grade to promote surface drainage away from the well. The vault will be installed such that there are no more than 6 inches and no less than 5 inches between the top of the monitoring well casing and the top of the vault cover. The cover of the vault will have the wording “monitoring well” on its outer surface.

A stovepipe, or stickup, completion would include the 3-inch diameter well casing extending approximately 3 feet above the ground. The PVC well casing will be surrounded by a steel casing with lockable lid and filled to just below the well casing with sand pack material. If the well is in a vehicle traffic area, the steel casing will be flanked on at least three sides with traffic-rated bollards. The bollards and stovepipe will be set in a concrete pad as described above. The bollards and stovepipe will be painted yellow to alert vehicles of their presence.

6.11.6 Well Decommissioning

Wells to be decommissioned are shown in Figure 4, listed in Table 2, and well boring logs and construction diagrams presented in Attachment D. Nine monitoring wells at Sites 2/12, OU2, and OUCTP and one steel conductor pipe located in the FONR will be decommissioned.

Monitoring wells will be decommissioned in accordance with ASTM D5299 – Standard Practice for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices and Federal, State, and local regulations, though well decommissioning requirements found in Monterey County Code Chapter 15.08 will take precedence over ASTM D5299 and well decommissioning will be consistent with previous practices at the former Fort Ord.

Decommissioning activities are described in detail in SOP FSOP-603.01 (Appendix A)[3] and generally include:

- The total depth will be checked immediately before decommissioning to identify any obstructions that may interfere with filling and sealing the casing and/or well screen. If encountered, obstructions will be removed before filling and sealing efforts begin. Obstructions have been identified in four wells (Table 2).

[3] Conforms with ASTM D5299.

- Wells will be abandoned in place by injecting the sealing material directly into the well casing (pressure grouting), consistent with previous practices at the former Fort Ord and Monterey County requirements. Sealing material will consist of 3 to 5 percent bentonite neat cement grout. Grout will be carefully mixed using clean, potable water.
- The well will be pressure filled with sealing material consisting of 3 to 5 percent bentonite neat cement grout using a tremie or grout pipe from the bottom of the well to within 5 feet bgs. Bentonite neat cement grout will be a minimum of 9.1 pounds per gallon and will be free of organic matter.
- At a minimum, the volume of sealing material placed will equal the calculated volume of the well casing and screen. The grout will be pressurized for a minimum of 15 minutes at 15 pounds per square inch. Additional grout will be added if settlement occurs after pressurization.
- Excess grout will be placed in portable metal bins or equivalent and disposed of as solid IDW. Displaced water will be containerized and disposed of as liquid IDW as described under General Requirements.
- The surface completion will be removed, including concrete base pads, flush mount well boxes or vaults, risers, and bollards, if present.
- Well materials, including casing and annular materials, will be removed to 5 feet bgs.
- A concrete cap will be placed on top of the cement grout to prevent settling.
- The excavation will be backfilled with native material and regraded to match the surrounding topography/conditions.
- Debris (well casing, excess sealing material, and trash) and surface components from the decommissioned well (bollards, well pad, protective casing, and well boxes) will be transported to the Fort Ord Landfills staging area pending recycling or proper disposal.

6.11.7 Previously Decommissioned Well Management

The previously decommissioned wells are shown in Figure 5 and Figure 6 and listed in Table 3. Wells will be inspected according to the criteria listed below for the assessment.

- Reconnaissance: Each former well location will be inspected within a 10-foot radius of the recorded GPS coordinates for the former well. If a well cannot be found after a reasonable search effort, it will be assumed the previous decommissioning effort was successful in mitigating safety risk and no further action is required.
- Grout Settlement: Upon locating a former well, grout settlement in the well casing will be measured in inches bgs. Locations with more than 6 inches bgs of grout settlement will be added to the potential priority list of wells to be managed. The wells with the most grout settlement will generally have a higher priority.
- Safety Risk: The area around the previously decommissioned well will be examined to determine accessibility by vehicles, pedestrians, or wildlife. Locations that are easily accessible and deemed a potential safety risk for humans or wildlife due to grout settlement will have a higher priority for management measures.
- Documentation: The previous decommissioned well location and surrounding area will be photo documented. Table 3 will be completed after the inspection.

Based on the results of the inspections, an assessment will be conducted to identify the twenty (20) locations for management. The safety risk for each location will be categorized as low, medium, or high:

- Low: well cannot be found or grout has settled 6 inches or less.
- Medium: grout has settled more than 6 inches but accessibility is limited.
- High: grout has settled more than 6 inches and well location is readily accessible.

If there are fewer than 20 locations with high safety risk, locations with medium safety risk will be selected, prioritized by the depth of grout settlement. For the 20 selected locations, decommissioned well management measures will include:

- Topping off the settled grout to no more than 6 inches bgs.
- Performing a secondary inspection no less than 72 hours after topping off the grout to ensure there was no further settlement at the location.
- If necessary, adding grout after the secondary inspection is conducted if grout has settled more than 6 inches bgs.

6.12 Post-Field Activities

The specific methods for well development, surveying, follow-up habitat monitoring, sampling, and reporting are presented in this section.

6.12.1 Well Development

Development of the groundwater monitoring wells will be conducted no less than two days following the placement of the grout seal atop the bentonite seal. The monitoring wells will be developed in accordance with ASTM D5521 to assure inflow is physically and chemically representative of that portion of the aquifer adjacent to the screened interval. The total depth of the monitoring well and the depth-to-water data will be used to calculate the volume of water in the monitoring well casing. For each casing volume of water removed, measured water quality parameters (temperature, specific conductance, pH, and turbidity) will be recorded in the well development log (Attachment B). Water quality parameters will be measured with a Horiba Multi-Meter (FSOP-603.01 in Appendix A) in the following units:

- Temperature degrees Celsius (°C)
- Specific conductance micromhos per centimeter (µmhos/cm)
- pH standard pH units = -log [H+]
- Turbidity Nephelometric Turbidity Units (NTU)

A minimum of ten (10) casing volumes of water will be removed from each well, and water quality parameters will be monitored, with successful development indicated by three successive measurements of the parameters showing:

- pH has changed less than 0.1 pH units
- Temperature has changed 1°C or less and is approximately equal to ambient groundwater temperature[4]
- Conductivity has changed less than 10 percent
- Consistent turbidity readings measured five minutes apart, with no more than 10 percent change

[4] Groundwater temperatures from recent quarterly groundwater monitoring program events will be referenced.

If well parameters have not stabilized after ten (10) well volumes have been purged, additional well purging will be performed until parameters stabilize, or a maximum of fifteen (15) well volumes have been purged, whichever occurs first.

In addition to the collection of water quality parameters, water levels will be recorded during development to gauge drawdown of water within the monitoring well. In the event recharge of water in the casing fails to keep up with the drawdown of the water table by the purging tool, well development will continue at a reduced rate of purging. If insufficient water recovery continues (e.g., the well runs dry), the monitoring well will be considered to be developed even though water quality parameters have not stabilized.

6.12.2 Surveying

Following well installation, each well will be surveyed by a professional California-licensed land surveyor for northing and easting coordinates and elevation with respect to MSL in compliance with established protocol. Surveying will be conducted using North American 1983 Datum, California State Plane Zone 4 horizontal and National Geodetic Vertical Datum 1929. The top of each well casing will be surveyed within 0.1-foot horizontal and 0.01-foot vertical accuracy. Soil boring locations will be GPS-located.

6.12.3 Groundwater Monitoring Program

Baseline sampling will be conducted after the development of wells and during the next scheduled quarterly sampling event associated with the GWMP following well development. Accordingly, QC samples will be collected and samples will be analyzed by USEPA Method 8260-SIM for volatile organic analysis following sampling and laboratory analytical protocols identified in Groundwater QAPP Revision 11 (Ahtna, 2023a). Baseline sampling includes installation of hardware including a weighted rope with identified stations at approximately five-foot intervals in the screened well zone. PDBs will be placed at each saturated station for at least two weeks prior to sampling. Subsequent sampling will be conducted as part of the Fort Ord Basewide quarterly GWMP and subject to QAPP decision rules to determine sampling frequency.

6.12.4 Follow-Up Habitat Monitoring

The Onsite Biologist will conduct three years of annual follow-up habitat monitoring in the areas of the FONR disturbed during well installation field activities. Habitat monitoring will be conducted in accordance with the HMP (USACE, 1997) and the Programmatic Biological Opinion (USFWS, 2017). Follow-up surveys will be conducted during the peak blooming period for the species being monitored (Monterey gilia and Monterey spineflower). Each year for the three-year follow-up habitat monitoring period an evaluation report will be prepared and provided to BRAC detailing updated special-status plant species populations and document impacts during the well installation.

6.12.5 Deliverables and Reporting

Field daily reports will be presented weekly in CQCRs during field activities.

Electronic data deliverables will be provided by the laboratory performing analyses in accordance with Groundwater QAPP Revision 11 (Ahtna, 2023a). Preliminary and validated sample analytical results will be presented at project meetings and in the appropriate quarterly and annual reports.

A Completion Report will be prepared following completion of field activities. The Completion Report will describe well installation, decommissioning, and decommissioned well management activities and

present geologic logs, well completion diagrams, well development records, and sample analytical results.

Information will also be presented in the associated OUCTP, Sites 2/12, and OU2 quarterly and annual groundwater monitoring reports.

Results of the follow-up habitat monitoring of the special-status plant species in impacted areas will be reported annually for three years after well installations are completed.

7.0 Worksheet #18: Sampling Locations and Methods

This Worksheet facilitates completeness checks to ensure planned samples have been collected and appropriate methods have been used.

Well ID	Matrix	Depth (ft bgs)[1]	Type	Analyte/Analytical Group	Sampling SOP[2]	Comments
MW-BW-101-A	GW	90-120	PDB	VOCs/OUCTP A-Aquifer	#2	None
MW-BW-102-A	GW	90-120	PDB	VOCs/OUCTP A-Aquifer	#2	None
MW-BW-103-A	GW	90-120	PDB	VOCs/OUCTP A-Aquifer	#2	None

Notes:

[1] Baseline sampling includes placement of PDBs at each saturated sampling station for profiling the water column.

[2] PDB sampling protocol is in Attachment A to Groundwater QAPP Revision 11 (Ahtna, 2023a).

ft bgs: feet below ground surface
GW: groundwater
OUCTP: Operable Unit Carbon Tetrachloride Plume
PDB: passive diffusion bag
SOP: standard operating procedure
VOC: volatile organic compound

8.0 Worksheet #21: Field SOPs

SOP #	Title, Revision, Date	Originating Organization	Equipment Type	Modified for Project Work? Y/N	Comments
FSOP-001.01	Fieldwork Documentation, Revision 1, 10/10/22	Ahtna	Bound, waterproof field logbook Waterproof, indelible pens/25markers in black or blue ink Digital camera/video, cell phone, or other devices capable of digital imagery Electronic device(s) for recording and storing field-related data (e.g., data loggers and GPS units) Batteries and charging blocks	N	
FSOP-002.02	Sample Management, Revision 2, 5/15/23	Ahtna	Sample container, coolers, ice, chain of custody, labels, plastic bags, bubble wrap, and tape. Appropriate PPE	N	
FSOP-301.00	Hollow Stem Auger Drilling, Revision 0, 4/1/22	Ahtna	Color chart for logging soil (e.g., Munsell™ chart) Hand lens Appropriate PPE	N	
FSOP-302.00	Sonic Drilling	Ahtna	Color chart for logging soil (e.g., Munsell™ chart) Hand lens Appropriate PPE	N	
FSOP-601.01	Groundwater Well Installation, Revision 1, 10/10/22	Ahtna	Measuring tape	N	
FSOP-602.01	Groundwater Well Development, Revision 1, 10/10/22	Ahtna	Horiba Multi-Meter Water level indicator Measuring tape	N	

SOP #	Title, Revision, Date	Originating Organization	Equipment Type	Modified for Project Work? Y/N	Comments
FSOP-603.01	Groundwater Well Decommissioning, Revision 1, 10/10/22	Ahtna	Measuring tape	N	
FSOP-801.01	Equipment Decontamination, Revision 1, 10/10/22	Ahtna	Gloves Brushes, typically stiff bristle Plastic buckets or tubs Anionic detergent (Liquinox™, or similar) Spray or rinse bottles, or pump sprayer High-pressure hot water sprayer for cleaning large equipment Face shield Splash protection/ apron/Tyvek™ Waste containers for IDW Paper towels Clean tap water Garbage bags Plastic sheeting	N	
FSOP-802.00	Investigation Derived Waste Management, Revision 0, 4/1/22	Ahtna	PPE 55-gallon drums or other approved containers Drum/bung wrench and drum funnel Forklift or vehicle with drum grappler Photoionization detector (PID) Vendor-supplied roll-off bin(s), with liners if applicable Laboratory-supplied sample containers Wood pallets (as necessary) Non-porous (e.g., stainless steel) trowels	Y	Waste manifests not required because no IDW will leave the former Fort Ord Secondary containment not required because IDW is subject to immediate disposal.

SOP #	Title, Revision, Date	Originating Organization	Equipment Type	Modified for Project Work? Y/N	Comments
Horiba GZ000014434 2	Multi-Water Quality Checker U-50 Series Instruction Manual	Horiba	Multi-Water Quality Checker U-50 Series Calibration supplies Appropriate PPE	N	See Groundwater QAPP Revision 11 (Ahtna, 2023a)

9.0 Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person
Electric Water Level Sounder	Calibrated against steel tape	Maintain in proper working order, store in a secure location, decon after each use	Check battery and sensitivity daily prior to use	Inspect tape for damage prior to use	Quarterly prior to use	Calibrates with steel tape to within 0.05 ft/100 feet depth to water	Send into factory for repair	Field Supervisor
Horiba Multi-Meter	Calibrated with solutions	Decon after each use, store according to manufacturer directions	Check battery prior to use	Inspect for damage prior to use	Quarterly prior to use	According to manufacturer instructions	Check manual or send to factory for repair	Field Supervisor

10.0 References[5]

Ahtna Global, LLC (Ahtna), 2021. *Accident Prevention Plan, Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California.* November.

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U.S. Army Corps of Engineers (USACE), 1997. *Installation-Wide Multispecies Habitat Management Plan, Former Fort Ord, California*. April. AR# BW-1787.

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Army, 1997b. *Record of Decision, Basewide Remedial Investigation Sites, Fort Ord, California.* January 13. AR# RI-025.

Army, 2006. *Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), Operable Unit 2, Fort Ord Landfills, Former Fort Ord, California*. August. AR# OU2-656.

U.S. Fish and Wildlife Service (USFWS), 2017. *Reinitiation of Formal Consultation for Cleanup and*

[5] At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g., BW-1234). To find the referenced document, this number may be typed into the online search tool at: http://www.fortordcleanup.com/documents/search/. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn.

Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (Original Consultation #8-8-09-F-74, 81440-2009-F-0334). June 7. AR# BW-2747A.

TABLES

Table 1. Proposed Monitoring Well Construction Details

Proposed Well ID	Site	Aquifer	Location and Access	Casing Diameter (inches)	Approximate Total Depth (ft bgs)	Approximate Screen Depth (ft bgs)	Screen Length (ft)	Surface Completion
MW-BW-101-A	OUCTP	A	commercial, paved road	3	120	90 to 120	30	Flush vault
MW-BW-102-A								
MW-BW-103-A								

Acronyms and Abbreviations:
bgs: below ground surface
ft: feet
OUCTP: Operable Unit Carbon Tetrachloride Plume

Table 2. Wells to be Decommissioned Construction Details

Well ID	Site	Aquifer	Casing Diameter (inches)	Total Depth (ft btoc)		Screen Depth (ft btoc)	Screen Length (ft)	Surface Completion
				Constructed	2022-3Q			
MW-12-05-180	2/12	Upper 180-Foot Aquifer	4	86.69	86.56	69-89	20	Flush vault
MW-12-07-180#	2/12	Upper 180-Foot Aquifer	4	96.00	95.46	73-93	20	Flush vault
MW-12-08-180	2/12	Upper 180-Foot Aquifer	4	101.00	102.25	78-98	20	Flush vault
MW-12-12-180L	2/12	Lower 180-Foot Aquifer	5	179.00	178.65	161-176	15	Flush vault
MW-OU2-20-180X	OU2	Upper 180-Foot Aquifer	6	185.50	N/A	160-185	25	Stickup Monument
MW-OU2-26-A^	OU2	A-Aquifer	5	150.00	N/A	119.5-149.5	30	Flush vault
MW-OU2-37-A^	OU2	A-Aquifer	5	164.00	N/A	152-162	10	Flush vault
MW-OU2-37-180^	OU2	Upper 180-Foot Aquifer	5	185.00	N/A	173-183	10	Flush vault
MW-OU2-68-180^	OUCTP	Lower 180-Foot Aquifer	5	278.00	N/A	257-277	20	Stickup Monument
Unidentified Pipe*	N/A	N/A	10	N/A	N/A	N/A	N/A	Stickup Monument

Notes:

Well casing cracked

^ Well screen blocked by obstruction or fill material

* Unidentified Pipe: 10-inch diameter steel conductor pipe in the southern Fort Ord Natural Reserve (FONR)

Acronyms and Abbreviations:

2/12: Sites 2 and 12
btoc: below top of casing
ft: feet
N/A: not applicable
OU2: Operable Unit 2
OUCTP: Operable Unit Carbon Tetrachloride Plume

Table 3. Previously Decommissioned Wells Inspection Details

Decommissioned Well ID	Site	Year Decommissioned	Date of Inspection	Depth of Grout Settlement (in bgs)	Accessibility Safety Risk*	Top 20 Priority List
MW-02-01-180	2	2014	TBD	TBD	TBD	TBD
MW-02-02-180	2	2014	TBD	TBD	TBD	TBD
MW-02-02-180X	2	2014	TBD	TBD	TBD	TBD
MW-02-03-180	2	2014	TBD	TBD	TBD	TBD
MW-02-04-180	2	2014	TBD	TBD	TBD	TBD
MW-02-07-180	2	2014	TBD	TBD	TBD	TBD
MW-02-09-180	2	2014	TBD	TBD	TBD	TBD
MW-02-11-180	2	2014	TBD	TBD	TBD	TBD
MW-02-11-180X	2	2014	TBD	TBD	TBD	TBD
MW-02-14-180M	2	2014	TBD	TBD	TBD	TBD
MW-02-14-180U	2	2014	TBD	TBD	TBD	TBD
MW-02-15-180M	2	2014	TBD	TBD	TBD	TBD
MW-02-15-180U	2	2014	TBD	TBD	TBD	TBD
MW-B-23-180	2	2014	TBD	TBD	TBD	TBD
PZ-02-01-180L	2	2014	TBD	TBD	TBD	TBD
PZ-02-01-180M	2	2014	TBD	TBD	TBD	TBD
PZ-02-01-180U	2	2014	TBD	TBD	TBD	TBD
PZ-02-03-180	2	2014	TBD	TBD	TBD	TBD
PZ-02-04-180	2	2014	TBD	TBD	TBD	TBD
PZ-02-05-180	2	2014	TBD	TBD	TBD	TBD
MW-OU1-22-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-23-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-24-AR	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-25-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-29-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-40-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-51-A	OU1	2014	TBD	TBD	TBD	TBD
MW-OU1-ERD-08-A	OU1	2014	TBD	TBD	TBD	TBD
PZ-OU1-46-AD2	OU1	2014	TBD	TBD	TBD	TBD
EW-OU1-49-A	OU1	2017	TBD	TBD	TBD	TBD
EW-OU1-52-A	OU1	2017	TBD	TBD	TBD	TBD
EW-OU1-53-A	OU1	2017	TBD	TBD	TBD	TBD
EW-OU1-71-A	OU1	2017	TBD	TBD	TBD	TBD
EW-OU1-72-A	OU1	2017	TBD	TBD	TBD	TBD
IW-OU1-02-A	OU1	2017	TBD	TBD	TBD	TBD
IW-OU1-10-A	OU1	2017	TBD	TBD	TBD	TBD
IW-OU1-73-A	OU1	2017	TBD	TBD	TBD	TBD

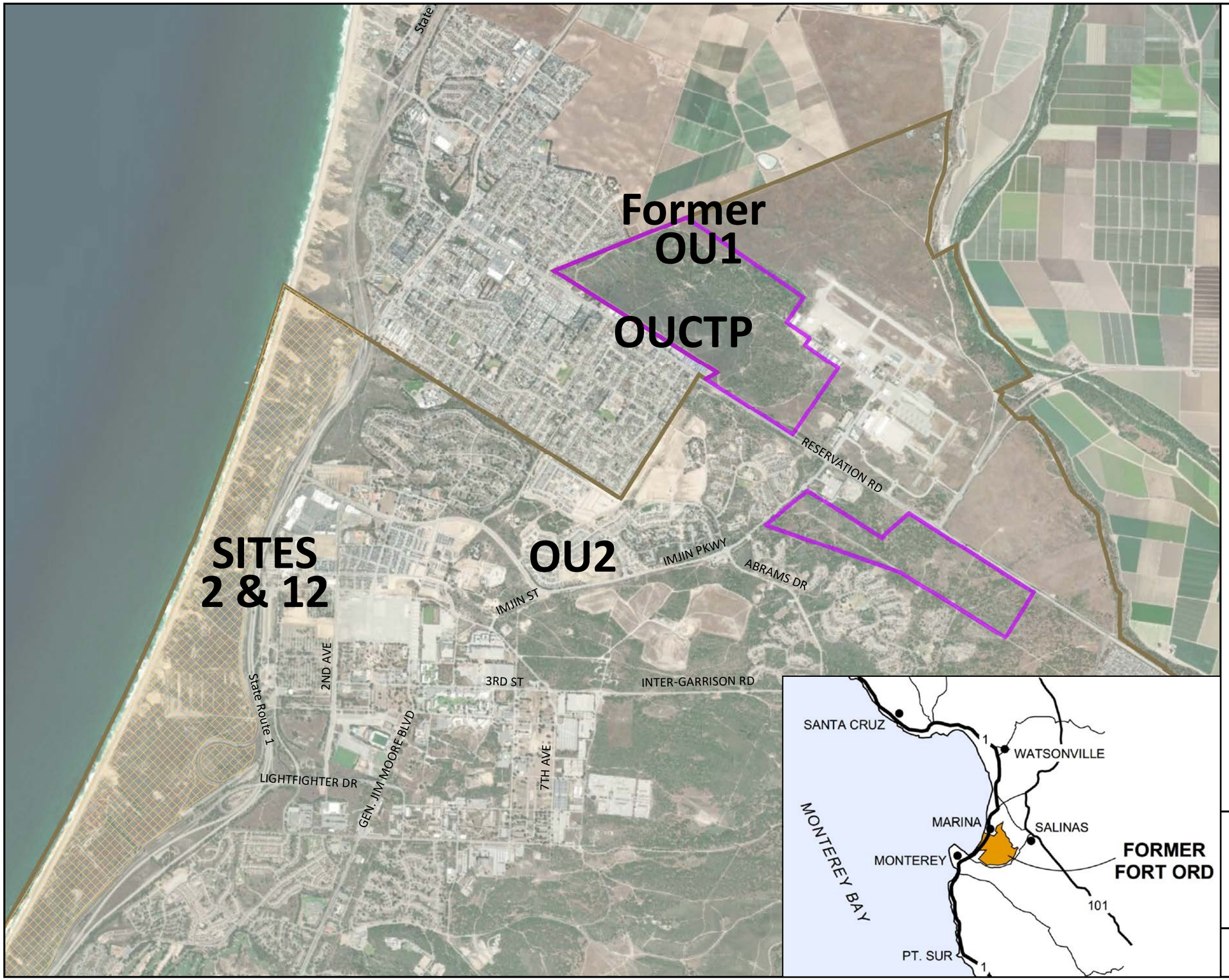
Table 3. Previously Decommissioned Wells Inspection Details

Decommissioned Well ID	Site	Year Decommissioned	Date of Inspection	Depth of Grout Settlement (in bgs)	Accessibility Safety Risk*	Top 20 Priority List
IW-OU1-74-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-26-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-46-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-46-AD	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-50-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-59-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-82-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-83-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-84-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-85-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-86-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-87-A	OU1	2017	TBD	TBD	TBD	TBD
MW-OU1-88-A	OU1	2017	TBD	TBD	TBD	TBD
PZ-OU1-02-A1	OU1	2017	TBD	TBD	TBD	TBD
PZ-OU1-10-A1	OU1	2017	TBD	TBD	TBD	TBD
PZ-OU1-49-A1	OU1	2017	TBD	TBD	TBD	TBD

Acronyms and Abbreviations:
2-12: Sites 2 and 12
bgs: below ground surface
in: inches
OU1: former Operable Unit 1 (clean and closed)
OU2: Operable Unit 2
TBD: to be determined

Note:
* Relative safety risk levels:
Low: well cannot be found or grout has settled 6 inches or less.
Medium: grout has settled more than 6 inches but accessibility is limited.
High: grout has settled more than 6 inches and well location is readily accessible.

FIGURES



EXPLANATION

- Fort Ord Natural Reserve
- Fort Ord Dunes State Park
- Former Fort Ord boundary

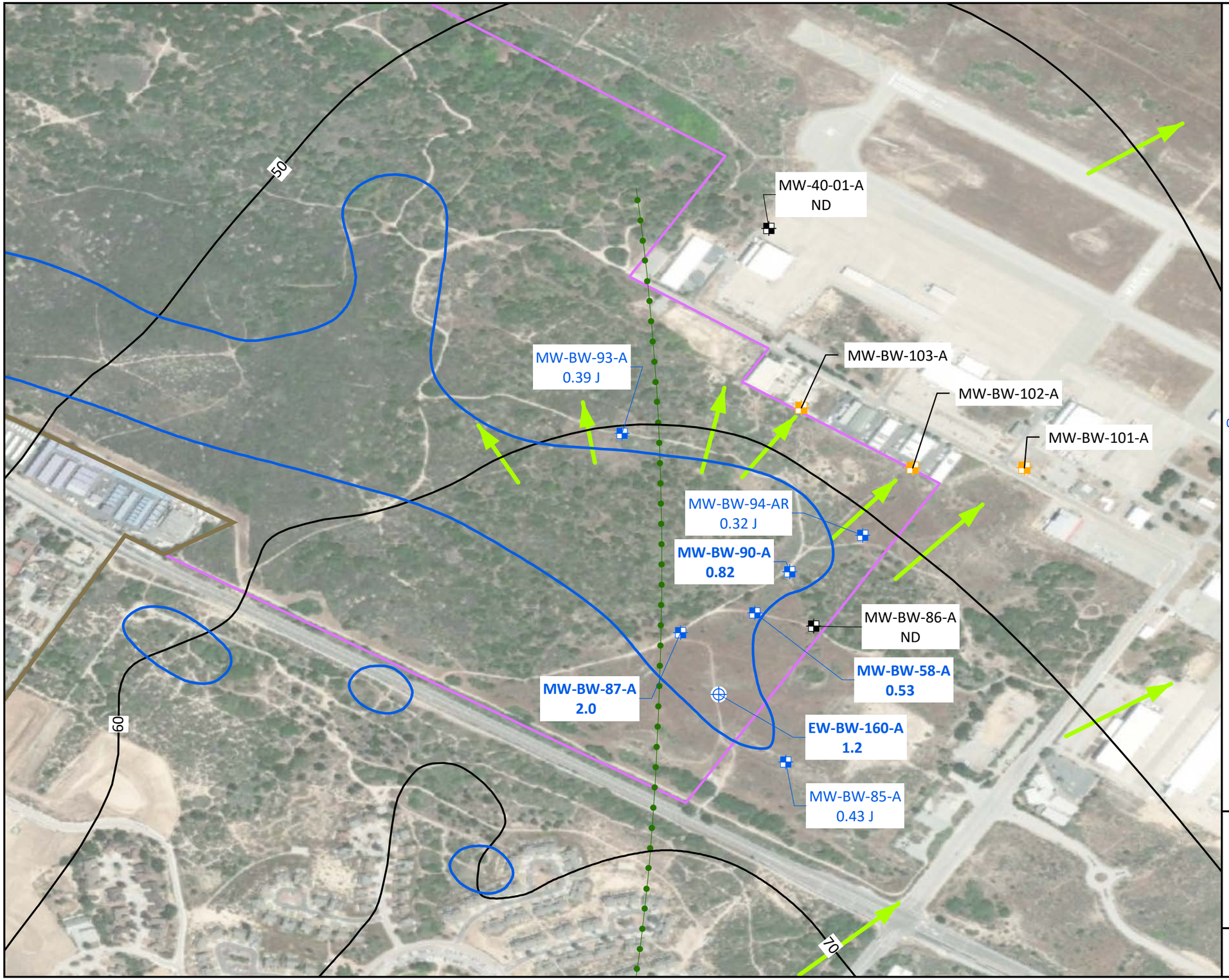
N
W E
S

0 2,500 5,000
Feet

FORMER FORT ORD
LOCATION MAP
Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

Ahtna | Date: 10/4/2023 | Figure: 1

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date: 06/11/2022



Groundwater elevation contour

General groundwater flow direction

Groundwater divide

Fort Ord Natural Reserve

Former Fort Ord

Well Type and COC Concentration

OUCTP extraction well with carbon tetrachloride (CT) detection

OUCTP monitoring well with CT detection

OUCTP monitoring well non-detect for CT detection

Proposed wells north of MW-BW-94-AR

Chemicals of Concern (COC) Aquifer Cleanup Level (ACL) Exceedance Contour in µg/L

0.5 — CT plume extent

MW-BW-90-A 0.82 — Well ID - Bold when CT exceeds the ACL. (*Indicates: Sample not used for contouring) CT concentrations (µg/L) and lab qualifier.

N

W E

S

0 500 1,000

Feet

NOTES:

(1) All groundwater data is from the 3Q2023 groundwater monitoring event and is included in the Operable Unit Carbon Tetrachloride Plume, Fourth Quarter 2022 - Third Quarter 2023, Groundwater Monitoring Report.

(2) Groundwater contours and isolines are based on one interpretation of the data that was available at the time this report was prepared; other interpretations may be possible.

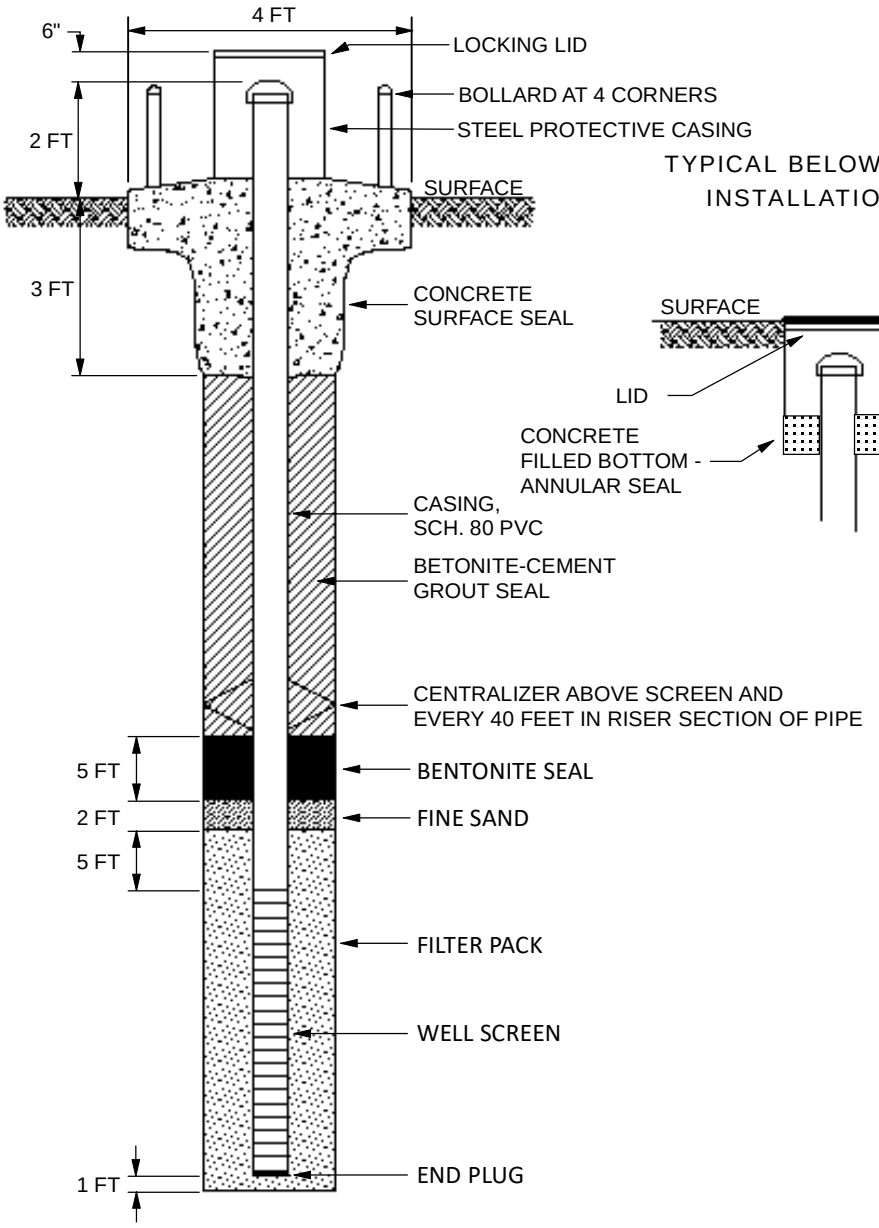
(3) Aquifer Cleanup Level (ACL) for Carbon Tetrachloride (CT) is 0.5 µg/L.

OUCTP A-AQUIFER
NEW MONITORING WELL LOCATIONS
Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

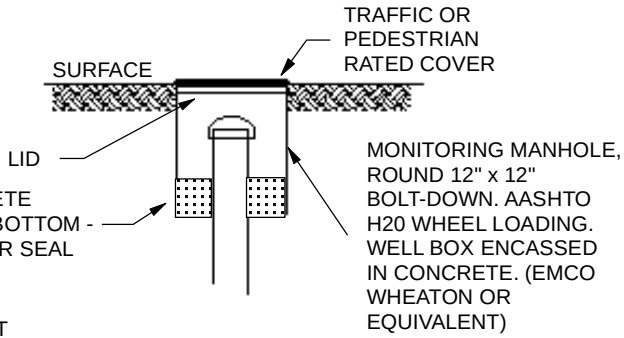
Ahtna | Date: 10/10/2023 | Figure: 2

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date: 06/11/2022

TYPICAL ABOVE-GROUND
INSTALLATION BOX



TYPICAL BELOW-GROUND
INSTALLATION BOX

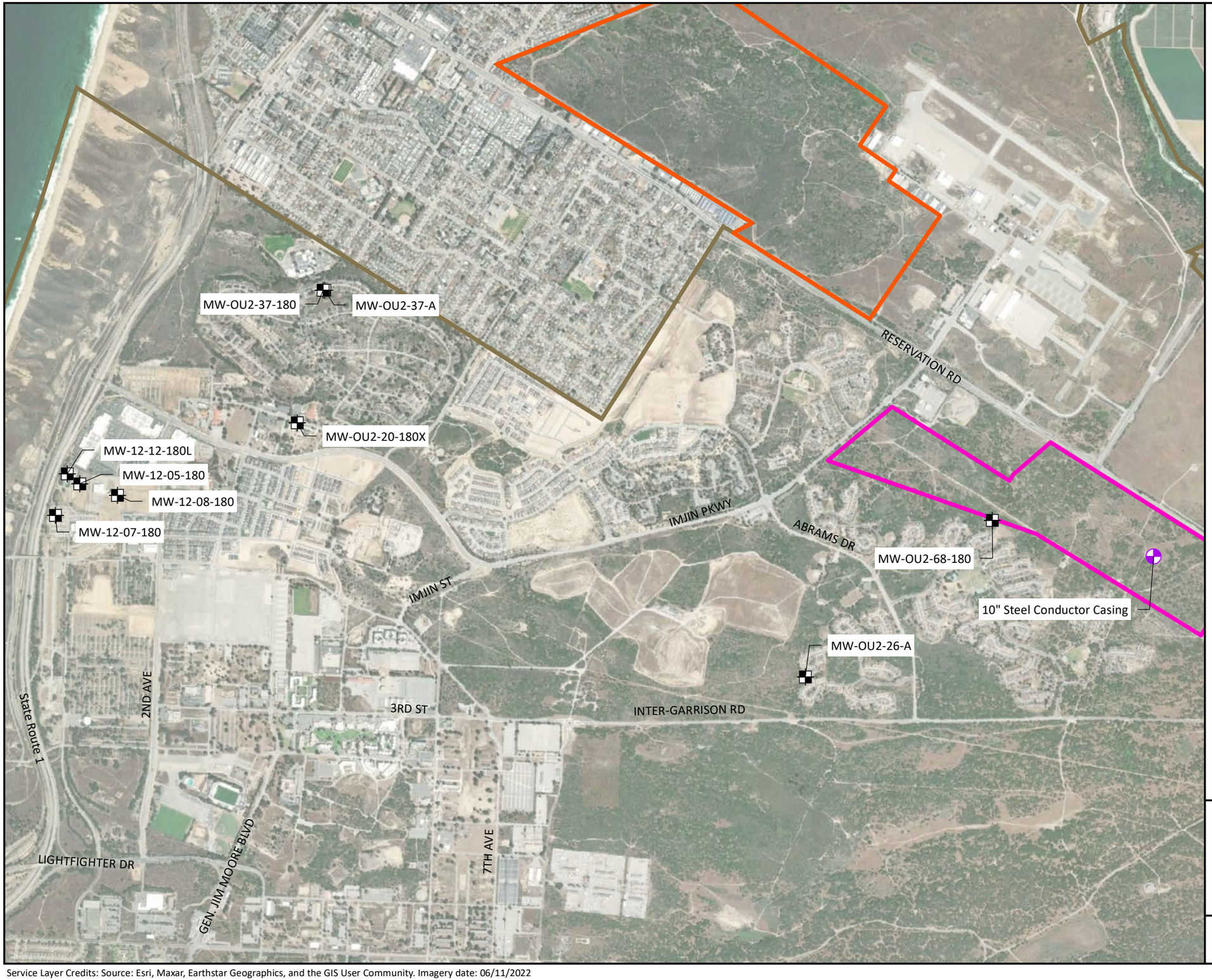


NOT TO SCALE

TYPICAL GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

Ahtna	Date: 10/4/2023	Figure: 3



EXPLANATION

- Monitoring well to be decommissioned
- 10" steel conductor casing to be decommissioned[1]
- Fort Ord Natural Reserve (north)
- Fort Ord Natural Reserve (south-east)
- Former Fort Ord boundary

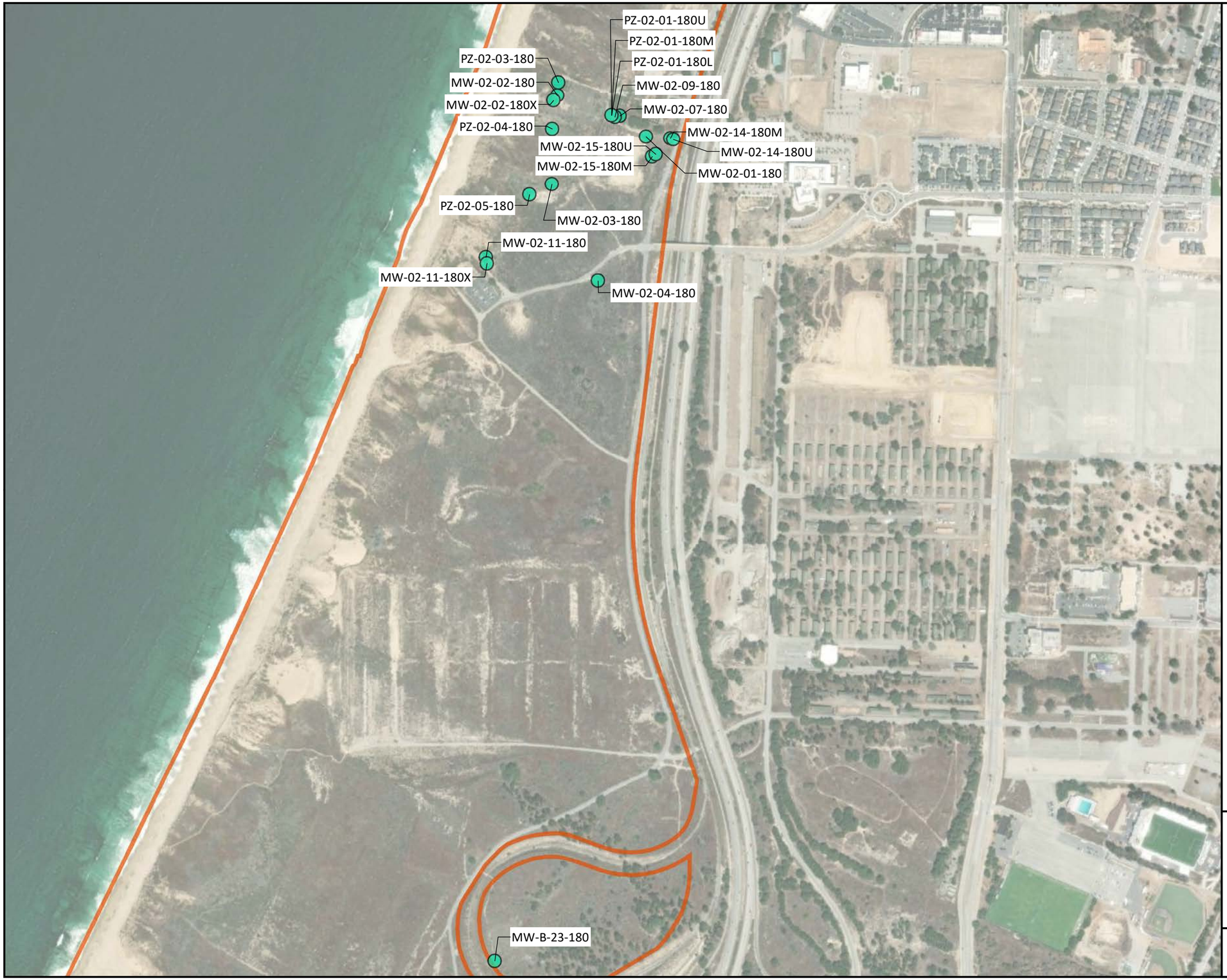
N
W E
S

0 2,500 5,000
Feet

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date: 06/11/2022

MONITORING WELLS
TO BE DECOMMISSIONED
Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

Ahtna | Date: 10/4/2023 | Figure: 4



EXPLANATION

- Previously Decommissioned Site 2 Well
- Fort Ord Dunes State Park

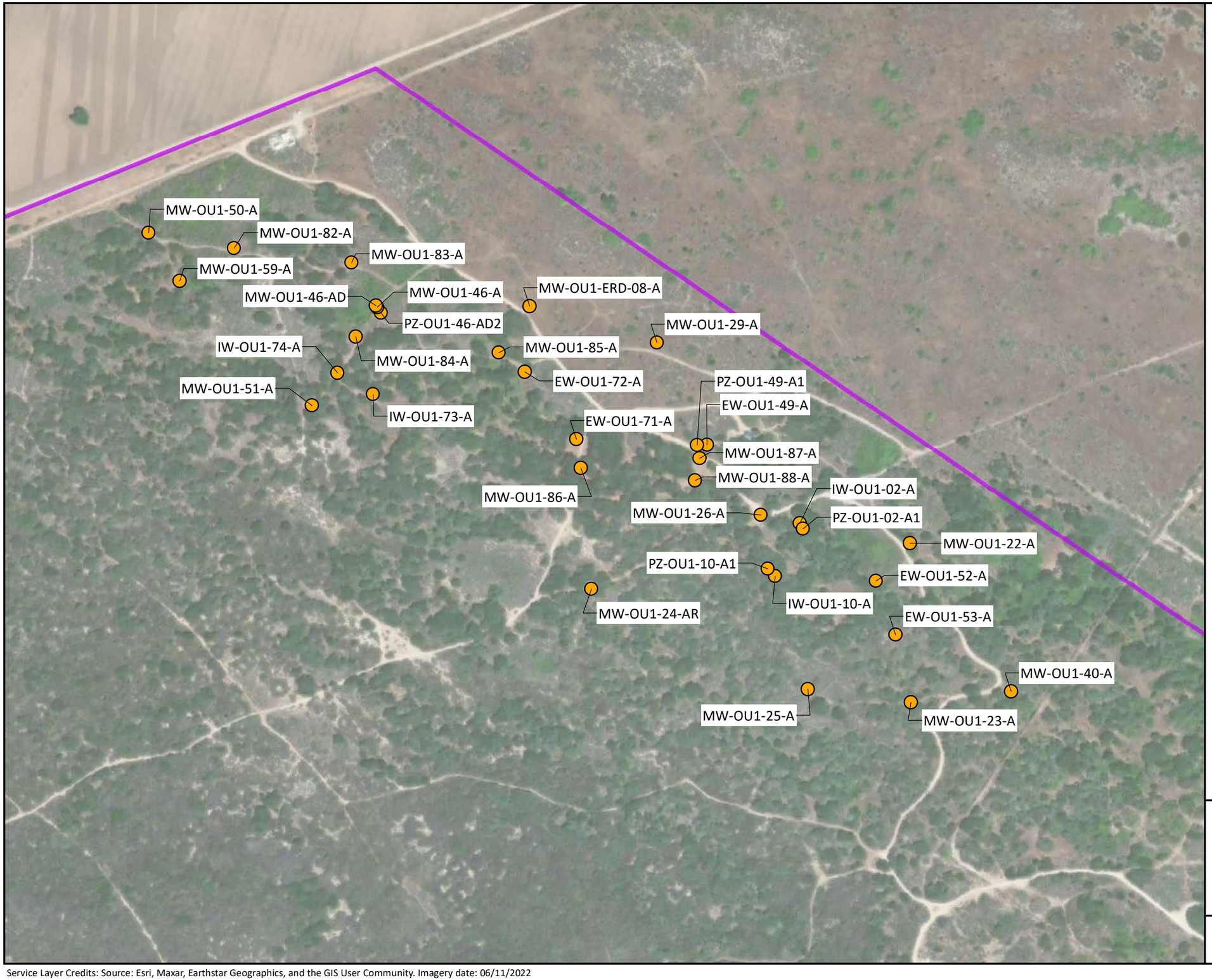
N
W E
S

0 750 1,500
Feet

PREVIOUSLY DECOMMISSIONED WELLS
FORT ORD DUNES STATE PARK
Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

Ahtna | Date: 10/4/2023 | Figure: 5

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date: 06/11/2022



EXPLANATION

- Previously Decommissioned Operable Unit 1 Well
- Fort Ord Natural Reserve

N
W E
S

0 250 500
Feet

PREVIOUSLY DECOMMISSIONED WELLS
FORT ORD NATURAL RESERVE
Quality Assurance Project Plan
Former Fort Ord, California, Volume I
Appendix A, Addendum No. 1
Well Installation and Decommissioning

Ahtna | Date: 10/4/2023 | Figure: 6

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date: 06/11/2022

ATTACHMENTS

ATTACHMENT A

Standard Operating Procedures (SOPs)

Field SOPs

SOP #	Title
FSOP-001.01	Fieldwork Documentation
FSOP-002.02	Sample Management
FSOP-301.00	Hollow Stem Auger Drilling
FSOP-302.00	Sonic Drilling
FSOP-601.01	Groundwater Well Installation
FSOP-602.01	Groundwater Well Development
FSOP-603.01	Groundwater Well Decommissioning
FSOP-801.01	Equipment Decontamination
FSOP-802.00	Investigation Derived Waste (IDW) Management
Horiba GZ0000144342	Multi-Water Quality Checker U-50 Series Instruction Manual - See Groundwater QAPP Revision 11 (Ahtna, 2023a)

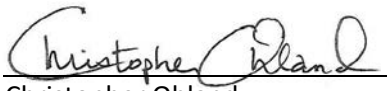
Analytical SOP

SOP #	Title
MS010.9	Analysis of Volatile Organics by GC/MS Select Ion Monitoring (SIM) (VOCs by 8260 SIM) - See Groundwater QAPP Revision 11 (Ahtna, 2023a)

Fieldwork Documentation

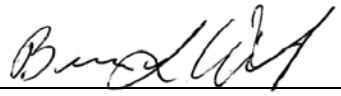
Document Number	FSOP-001
Revision	1
Department	Ahtna Southwest Operations
Previous Document Number	Original Document
Originally Released	April 1, 2022
Effective Date	October 10, 2022

Approvals



Christopher Ohland
SWE Quality Assurance Manager

October 10, 2022
Date



Bruce Wilcer

October 10, 2022
Date

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS- friendly supplies and procedures.

Table of Contents

1.0 Introduction

1.1 Purpose

This SOP provides field personnel with the procedures for:

- Recording real-time, chronological logs of field activities and circumstances in field logbooks/notepads, field forms, and digital/electronic media
- Documenting fieldwork and fieldwork variances
- Ensuring documentation is reviewed, organized, and safely stored until the project closed out

Adequate documentation is necessary to describe the work performed and variances to work plans if any. Attention to detail is vital since field documentation protects our client and Ahtna with secure, legally defensible evidence and has been helpful in administrative, legal, and cost-recovery requirements. For example, field documentation may be used as evidence in legal proceedings to defend procedures and techniques employed during site investigations. Therefore, field documentation must be factual, complete, accurate, consistent, and not contain subjective language. These principles also apply when photographic or videography techniques document site activities. The goal of written, digital, and photographic/video graphics documentation is to represent field activities that accurately portray site conditions or procedures.

1.2 Scope

The scope of this SOP includes data entry and format requirements for various field documentation.

When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Project].

Written records

- Field logbooks
- Field notepads
- Field forms

Digital records

- Audio
- Photographic/video
- Data loggers

Digital data entry using field tablets is described in the EQuIS Collect User Guide.

- **Note**: *It is important to review contracts and Performance Work Statements to identify specific documentation and format requirements applicable to your project*.
- **Note**: *Contracts may contain requirements for field records. The typical* language states: "*The Contractor shall maintain field records sufficiently to recreate all field activities. The information shall be recorded in a permanently bound notebook with sequentially numbered pages. At the end of each workday, the Contractor shall complete a daily log.*"

- **Note**: *Contracts issued by the USACE may contain requirements for the project archive, both ongoing and after completion of the contract.*

1.3 Roles and Responsibilities

Field Team. A Field Team is one or more individuals working together. Each Field Team is responsible for maintaining a field log of their activities, as applicable

Field Team Lead (FTL). The FTL provides direction and oversight of the fieldwork. The FTL is responsible for reviewing and confirming the adequacy of the field documentation during fieldwork as soon as possible and before releasing the daily quality control report. The FTL keeps the Project (PL) informed of field variances or problems encountered in the field.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to comply with this SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project. The PL documents changes as a variance to the plans and forwards the variance to the Program Manager (PgM) for approval. The PL is also responsible for confirming the adequacy of the field documentation after fieldwork. An entry confirming which information was reviewed must be added to the post-event field documentation package (Section 5.0).

Program Manager (PgM). For each SWE Program, the PgM is responsible for providing written instruction to their Field Team, which complies with the requirements of this SOP and the client-contracted specifications.

Site Supervisor.[1] The Site Supervisor is responsible for maintaining a project-specific FLB/notepad and field forms of their activities, as applicable, and providing copies to the PL for review.

Safety Representative. The Safety Representative meets the experience and training requirements of USACE EM-385-1-1 (USACE, 2014). The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. If the circumstance warrants, the FTL approves those actions and notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of Quality Control. Method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

SWE Quality Assurance Manager and SWE Field QC Manager report to the SWE Vice-President. When mentioned in this SOP, The "SWE" prefix is shown to distinguish from the QC Lead assignment shown in the project organization chart.

[1] In this context, a Site Supervisor is a person assigned to oversee long-term operations or construction work; the roles and responsibilities are like that of the Field Team Leader.

1.4 Definitions

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

> [PFAS Project]: Use field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

Field Notepad – An unbound, company notepad containing pre-printed heading block and space (straight-lined, grid lined, or open) for recording information. This can be an alternative to the FLB. The notepad can be paper or electronic (Word, Excel, Access, etc.) as long as a hard copy of the individual sheets is sequentially numbered and maintained in a properly labeled binder/file folder.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. A listing of the most commonly used SWE field forms is provided in Section 2, "Relevant Documents." Each data entry field should have an entry or indicate that data for that field is not available or not required.

> [PFAS Project]: Record of field events will be maintained on loose paper (PFAS-free) secured on Masonite or aluminum clipboards. Plastic clipboards, binders, or spiral hard cover notebooks are not acceptable. Field logbooks are permanently assigned to a specific project.
>
> In addition, Field Form FFRM-004.00 "Daily PFAS Sampling Checklist, must be completed each day of fieldwork when activities may compromise environmental media that is sampled.

Data Loggers – Field equipment providing digital/electronic information to supplement field forms. Examples include water-level transducers for aquifer tests, flow sensors and meters in pump and treat systems, and air monitoring equipment (Section 4.1.7).

Digital/Electronic Files – Any documentation that preserves an accurate historical record of field activities but is recorded electronically through field instruments and digital devices. These records should be referenced in the FLB. Digital/electronic information includes global positioning system (GPS) coordinates, photographs, and videos.

2.0 Relevant Documents

SWE file folder m:\\Environmental\Quality Control Procedures\SWE Field Forms\ has the current, approved form templates.

3.0 Equipment List

[PFAS Project]: Products containing waterproof features (e.g., Post-it-notes, waterproof coated paper) cannot be used on per- and polyfluoroalkyl substances (PFAS) projects.

- Applicable field forms

  [PFAS Project]: Work activities will be maintained on loose paper (PFAS-free) secured on Masonite or aluminum clipboards. Plastic clipboards, binders, or spiral hard cover notebooks are not acceptable.

- Bound, waterproof field logbook (FLB; e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation or notepad

  [PFAS Project]: Use field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

- Waterproof, indelible pens/markers in black or blue ink

  [PFAS Project]: Ball-point pens: do not use markers, felt pens, or pens with water resistant ink

- Digital camera/video, cell phone, or other devices capable of digital imagery
- Electronic device(s) for recording and storing field-related data (e.g., data loggers and GPS units)
- Batteries and charging blocks

4.0 Procedures

This section describes various mechanisms of recording documentation, including requirements and procedures. Before fieldwork, each project should define project instructions that identify the mechanism for documentation. The instruction is intended to promote procedural consistency, defined roles and responsibilities, and common language across project teams, promoting efficient reviews and cross-team utilization and training. Once established, project staff shall follow the project instruction.

4.1 Document Control and Storage

4.1.1 Project File

While in the field, the fieldwork documentation project file is managed by the FTL and consists of:

- Written records: FLB/notepads, field forms
- Digital/electronic records: photos, videos, GPS records
- Downloads from electronic devices such as data loggers

The PL is responsible for providing the location and details for storage. All field documentation is a part of the project file and should be maintained with safe document handling and archiving procedures. Hardcopy documentation and digital files are official records of fieldwork. Scans of official records are helpful for ease of access to project information and generating reports but are not official records.

The PL is responsible for all forms of field documentation, and scans of paperwork, digital records, and downloads from electronic devices are placed in the m:\\ drive project file. All original documents shall be assembled into a data package, submitted to the PL, and archived in the project file. The goal is that all documentation is organized by task/event and stored in a single location.

4.1.2 Problems in the Field and Variances from Project Plans

Variances or problems encountered during the fieldwork that cannot be resolved promptly must be communicated promptly in writing to the FTL /Site Supervisor, who will notify the PL. This may be completed by sending a variance notice by email or other means to promptly communicate the variance or problem and allow for the continuation of the fieldwork. The PL shall provide written approval of recommended solutions or provide an approved alternate solution.

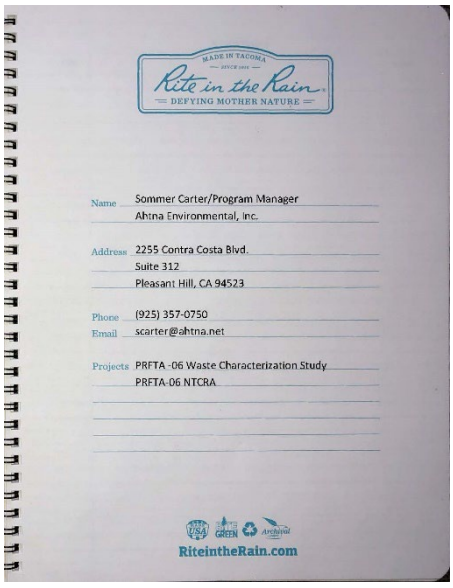
The need for a corrective action addressing variances or problems in the field will be determined by the PL in collaboration with the FTL/Site Supervisor. The PL will notify the PgM and SWE Field QC Manager of any needed corrective action for their concurrence or follow-up.

Documentation of variances to project plans, problems encountered, or corrective actions will be kept in the FLB/notepad or forms.

4.1.3 Field Logbook

Field logbooks can be spiral- or adhesive-bound and are distributed by the PgM or designee. The cover of the FLB is labeled with the project number and name of the Installation/Site(s).

The inside cover of the FLB contains the name, address, phone, and email address of the PgM and a list of projects the FLB is used to record. The information is updated if the project is assigned to another PgM.



The FLB shall be project/task-specific. The Field Team uses the FLB to record details of their responsibility (e.g., sampling, QC, safety, oversight, etc.) and provide them to the FTL/Site Supervisor for their review before submitting daily QC reports (DQCRs).

The FLB records are scanned, and the scan is saved as a PDF file on the Ahtna server in the project folder to create an electronic record for project reports. The PL shall ensure the FLBs are stored safely until project closeout. The field job box could be used for temporary storage.

4.1.4 Field Notepads

Three-ring punched, loose-leaf notepads or individual sheets can be printed on field form SWE-FFRM-001.[2] Each sheet contains a heading block, and block entries must be filled in on the first page of a new date.

Example Heading Block for Long-Term O&M or Construction

Installation/Site	Sharpe Army Depot/Sitewide	Project Number	05206.000.01.0000
Site Supervisor	Paul Marsden	Date	July 27, 2021
Subject	Telephone Record	Recorded By	Izzy Done

Example Heading Block for Environmental Studies

Project Number	05206.000.01.0000	FTL	Who Dunnit
Installation/Site	MOTCO Site 2	Recorded By	Izzy Done
Event Name	1Q 2021 GW Sampling and LF Inspection	Date	July 27, 2021

Notepads (loose-leaf paper) are used by the Field Team to record details of their responsibility (e.g., sampling, plant operations, QC, safety, oversight, etc.) and provided to the FTL/Site Supervisor for their review before submitting DQCRs.

The PL shall ensure the sheets are stored in three-ring binders or another filing system (Section 5.0), labeled with the Installation/Site name, project number, and a descriptive name of the project. If an FLB or field form is also used, a scanned copy of the FLB pages and original copies of the field forms are stored in the binder. The sheets are sequentially numbered and reviewed by the FTL/Site Supervisor. The PL reviews and approves the Site Supervisor's notepad sheets. The PL is responsible for safely storing the binder or other filing system until project closeout.

The notepad binder will be kept in the site office project file or job box. As soon as possible, the unbound records shall be scanned and saved on the Ahtna server in the m:\\ drive project folder to create an electronic record to ensure document preservation and use in project reports.

4.1.5 Field Forms

SWE-approved field form templates are available at M:\Environmental\Quality Control Procedures\SWE Field Forms\. Activity-specific SOPs reference the field forms that should be used. If preferred, individual sheets can be printed on pre-punched three-hole paper (or punched later). If the printer is capable, use a heavy paper stock for a durable form. Field forms supplement the FLB/notepad and provide a way to record detailed information using a structured format. When new forms are available, they will be posted

[2] Project-specific format designs may be used. Computer applications such as Microsoft Word or similar may also be used as long as the header information is shown, and printed copies are stored in three-ring binders.

in the template folder. The SWE Technical Writer oversees version control and will notify SWE staff when the form is posted.

Each sheet contains a heading block to enter the Installation/Site name, descriptive activity name, FTL, project number, and QAPP SOP number for the performed activity-specific fieldwork. Depending on the activity, the names of staff assigned with lead roles, weather conditions, date of recorded information, or other information may appear on the form. The heading block entries must be filled-in for each sheet to bind the field form to the project/activity.

Example Field Form Heading Block

Project Number	05108.001.02	FTL	Jared Wilson
Installation/Site	MOTCO/Site 1	SOP No.	FSOP-002
Activity Name	1Q 2021 GW Sampling and LF Inspection	Date	08/06/2021
Field Team (name/organization)	Jared Wilson/Ahtna, Izzy Done/Forever Waiting		
Weather Forecast	Sunny, 65–80°F, SW winds 5–10 mph		

Field forms are used by the Field Team to record details of their responsibility (e.g., sampling, O&M operations, QC, safety, oversight, etc.) and provided to the FTL/Site Supervisor for their review before submitting DQCRs.

The PL shall ensure the sheets are stored in three-ring binders or another filing system (Section 5.0), labeled with the Installation/Site name, project number, and a descriptive name of the project. If an FLB/notepad is also used, a scanned copy of the FLB/notepad pages and original copies of the field forms are stored in the binder. The sheets are sequentially numbered, reviewed, and approved by the PL. As soon as possible, the unbound forms shall be scanned and saved on the Ahtna server in the m:\\folder to create an electronic record to ensure document preservation and use in project reports.

The PL is responsible for safely storing the binder or other filing system until project closeout.

4.1.6 Electronic Files

Photographs and Video

All original digital field documentation (Section 1.4) shall be downloaded as soon as possible to a designated location for project use. Exclude files that are unnecessary due to unusable image quality or content. As soon as possible, the date/time, location, direction (compass point or radial degree), and purpose of the image should be documented before the information is forgotten. The use of metadata and smartphone applications to gather this information can assist. Files can be edited but maintain the original file and save the edited file with a suffix description. Alternately, use field form SWE-FFRM-002 to log photos. This form is helpful for tasks where few pictures will be taken.

The PL is responsible for providing the location and storage details. Files should be uploaded to the project folders and caption descriptions documented as soon as possible after the fieldwork ends.

Data Loggers

Examples of data loggers include equipment used in combination with:

- Water-level transducers for aquifer tests
- Flow sensors and meters in pump and treat systems
- Air monitoring equipment (e.g., particle counters)

The use of data loggers should be recorded in an FLB/notepad or field form and include the type of logger, make, model, S/N, calibration if required, and any input specifications used.

Document data acquisition activities using data loggers (data logging equipment) and related observations in the FLB.notepad. Written notes provide a permanent record of field activities that support digital data temporarily stored on various data loggers.

Specific steps and guidelines for the data acquisition activity being performed should be reviewed in the respective SOP guiding the activity.

The observations and data will be recorded in the FLB/notepad or field form. Because of the variability of features and operation of various data loggers, each field SOP and manufacturer's instructions should be carefully reviewed before beginning field activities.

The PL is responsible for providing the location and details for storage. Files should be uploaded to the project folders as soon as possible after the fieldwork ends. Files should not be edited. If needed, modifications to the captured data should be noted in the project reports. Hardcopy printouts in comma-delimited format (or similar) are recommended should the source file become corrupt.

Global Positioning Systems

GPS data acquisition activities and related observations will be digitally-recorded and later downloaded, and the file saved as described above.

Alternately, the GPS data can be recorded in field documentation to provide a permanent record of field activities supporting digital data that is temporarily stored on the GPS unit. As applicable, observations and data may be recorded in an FLB/notepad or field forms. The field forms will record the survey location identifier (e.g., well/boring location, structural feature) and corresponding coordinates and elevation.

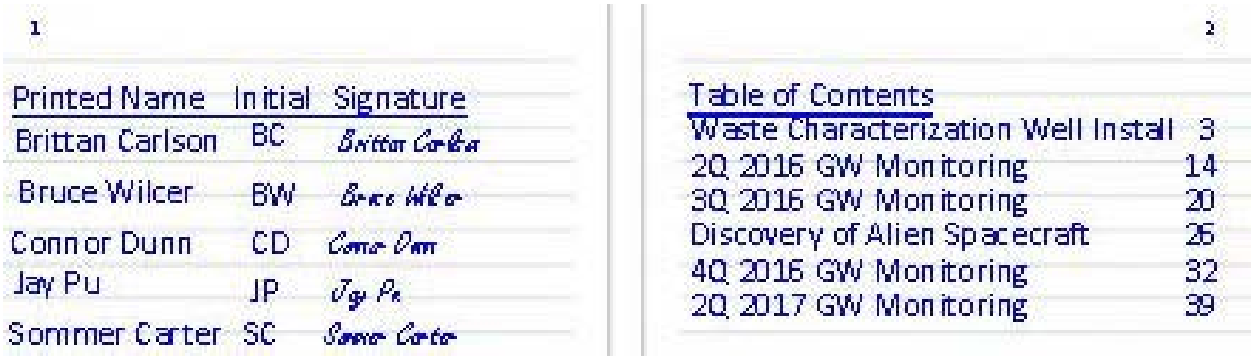
The GPS operator should also be thoroughly familiar with the manufacturer's instructions and SOP for Global Positioning System (FSOP-103) before performing GPS work in the field.

4.2 Field Logbook

The FLB is the written record of all fieldwork elements, such as Ahtna staff, subcontractors, visitors at the site, weather forecast/conditions, field equipment calibrations, construction activities, and sample collection activities. Fieldwork can be recorded on a notepad or forms described in Sections 4.3 and 4.4. When field forms are used, a brief description of the activity is added to the FLB/notepad, and details are added to the form.

4.2.1 Guidelines

Pages 1 and 2 of the FLB should be reserved to provide a signature page and table of contents. The signature page lists the employee's name, initials, and signature. The printed name and signature bind the employee to their written documentation, and the initial is helpful when limited space is available for writing a full name on subsequent pages. Each initial on page 1 must be unique. Page 2 is not required but helpful to quickly locate information in the FLB. If more space is needed, the back cover pages could be used. An entry for a significant event and the page number that initiates the documentation is typical. Open space on pages 1 and 2 does not need to be lined out, as the list will grow during work execution.



1

Printed Name	Initial	Signature
Brittan Carlson	BC	Brittan Carlson
Bruce Wilcer	BW	Bruce Wilcer
Connor Dunn	CD	Connor Dunn
Jay Pu	JP	Jay Pu
Sommer Carter	SC	Sommer Carter

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Field documentation shall adhere to the following guidelines:

- Write entries in blue or black waterproof ballpoint pen (older copier machines do not recognize other colors). Avoid felt tip pens. *Do not use a pencil*.
- List personnel making entries in the FLB and include initials and signatures on the inside cover page.
- Use a table of contents on page 2 (recommended but not required).
- Start a new page at the beginning of each day.
- Entries should be chronological – a time notation should introduce each entry.
- Language should be objective, factual, and free of personal feelings or inappropriate terminology.
- Do not erase or scratch out errors. Draw a single line through the error, then insert the corrected material. The person who corrected it shall initial and date the correction. If an explanation is needed, add that in the next available blank area in the FLB and cross-reference the error and explanation.
- The FLB shall be signed at the end of each day. Signatures shall be written on a single diagonal line drawn across the blank portion of the page following the day's last entry.
- All FLB shall be returned to the FTL/Site Supervisor for review and safe storage. The FTL/Site Supervisor shall review daily as soon as possible and before the DQCR is released.

4.2.2 Entries to Include

Initial daily entries shall include the following:

- **Date and time**: The time shall be based on military time (i.e., 2100 instead of 9 pm)
- **Field Team Leader**: Name of the Field Team Leader or Site Supervisor
- **Safety Representative**: Name of the task Safety Representative (meets EM 385-1-1 requirements)
- **QC Lead**: Name of the task QC Lead

- **Site Personnel**: Full name, title/role, and affiliation of personnel onsite, including visitors and subcontractors, with arrival and departure time noted
- **Planned Activities**: General description of various work activities for the day
- **Weather**: Weather forecast (temperature, cloud cover, wind speed, and direction). Changing weather that impact site conditions should be recorded throughout the day
- **Notes**: Taken By: Name(s) the FLB/notepad author(s)

The following are examples of ongoing daily entries. Use those and others as applicable:

- When field forms are used, record a brief description of the field activity, then record details on the field form. Do not duplicate information referenced on the field forms in the daily field documentation
- Participation in the Site Safety Tailgate Meeting, details can be added to the Site Safety and Tailgate Meeting form
- Level of personal protective equipment (PPE) and describe upgrade and downgrade of PPE levels
- Type of field instrumentation and calibrations performed, details can be added to the equipment calibration form
- Work start/stop times
- Time and location of activities
- Site physical conditions, changing weather conditions, major task decisions, or other valuable site investigation information and other essential observations
- Level of PPE and describe upgrade and downgrade of PPE levels
- All relevant field observations, major task decisions, or other valuable site investigation information
- Location of work areas if the survey has not been completed
- Survey and location of any sampling points, including swing-tie measurements
- Decontamination times and methods
- All field measurements. If field measurements of this type are being recorded on dedicated field forms, it is not necessary to record in the FLB, but the use of the form should be noted
- Type, amount, method, and location of storing and disposal for investigation-derived waste
- Changes/deviations/variances from the work plan and reason for deviations change/variance.
- Thoroughly document all FTL/Site Supervisor or PL-approved directives, guidance, or potential corrective actions from client and oversite government personnel. Directives that give personnel specific authority to make critical decisions must be documented in the FLB
- Communications with the FTL, Site Supervisor, or PL or client about decisions being made in the field
- Work deficiencies and corrective actions
- Approved work variances
- Persons contacted and topics discussed

4.2.3 Documentation of Project Variances

Thoroughly document all variances from the Performance Work Statements, Work Plans, and QAPP or changes in fieldwork procedures. Problems, delays, or any unusual occurrences such as improper equipment or breakdowns should be included, along with PL-approved resolutions. Summarize the content and conclusions of all relevant meetings, discussions, and telephone conversations that involve you.

4.2.4 References to Locations

This section applies to new locations. Established locations are referred to by the location name or code. Previously established locations are typically shown on site maps/figures.

Whenever an activity (sample collection, field measurement/monitoring, etc.) is performed at a new location (i.e., the location has not been surveyed and shown in a figure), mark the location with a survey stake or similar marker, a detailed description of the location must be recorded in the FLB/notepad or field form and accompanied by a photo, sketch, or point on an attached map as part of the daily field documentation package (sketches with accompanying photographs when appropriate, with north arrow and approximate scale). Record unusual site physical conditions or signs of contamination such as oily discharges, discolored surfaces, unusual odors, dead or distressed vegetation, including types of plants, if possible.

4.3 Notepads

When notepads are used, the requirement and procedures for the FLB (Section 4.2) also apply to the notepad documentation.

4.4 Field Forms

Field forms are used in addition to FLBs/notepads. Field forms are activity-specific and may be completed for each location/sample/well, etc., or one per field event as appropriate. Each form contains a heading block to bind the field form to the FLB/notepad. Field forms augment but do not replace the FLB/notepads. Avoid duplicating information recorded in the FLB/notepad and field form.

The forms include space (check box, table cell, and underlined space) for recording the information necessary for the project to ensure complete and proper information is recorded. Each space must be completed on a field form, and if not needed, then struck out or listing “not applicable.” Blank space can be misunderstood as missing information. Version-controlled template files of the forms are stored in the M:\Environmental\Quality Control Procedures\SWE Field Forms.

Field forms may be modified for project-specific use with the SWE Quality Assurance Manager’s approval.

All unbound data documentation is a part of the field records and should be maintained with safe document handling and archiving procedures. These records should be recorded in the same manner as notes in the FLB/field notpad using black or blue waterproof, indelible ink, and on weatherproof paper as necessary (projects testing for PFAS cannot use products with fluorinated constituents).

4.5 Field Documentation Data Package

After a short-term, specific event (e.g., well installation, sample collection, landfill inspection, and similar), copies of the FLB pages and hardcopies of loose-leaf documentation and relevant correspondence (emails and phone records) should be organized assembled into an event-based data package. The package should include a cover page listing the Installation/Site, project number, and event description.

The PL is responsible for the safe storage of the data package until project closeout. A copy of the package should be scanned and saved in the m:\\ drive project folder. The scan file could replace other scanned files described in the project instructions (Section 4.0).

If the fieldwork is a long-term task such as operating an O&M treatment system, remedial actions (e.g., excavation and disposal), or other qualifying fieldwork, the timeframe for producing the data package should be defined in the PgMs project instructions, but that period should not exceed one per year or end of the contract period.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and QC procedures for field documentation review will be performed by the FTL/Site Supervisor and checked by the PL to ensure the content and level of detail comply with this SOP. The FTL/Site Supervisor can approve variances and fieldwork problems in coordination with the PL. The FTL/Site Supervisor should try to resolve the issue so that work can continue; however, should the variance/incident/problem affect the contracted scope of work or a project decision made from the evaluation of date, the resolution must be coordinated with PgM and SWE Field QC Manager if corrective action is needed. The PgM should notify the SWE Quality Assurance Manager of all corrective actions.

6.0 Documentation Review

The FTL is responsible for the daily review of the fieldwork documentation for compliance with requirements (Section 4.0 “Procedures”) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

The PL is responsible for reviewing and signing approved documents stored in the project file (Section 4.1).

7.0 References

U.S. Department of Defense, 2013. *DoD Environmental Field Sampling Handbook, Revision 1.0*. April.

Sample Management

Document Number	SWE-FSOP-002
Revision	2
Department	Southwest Operations
Previous Document Number	Original Document
Originally Released	October 10, 2022
Effective Date	May 15, 2023

Approvals

Christopher Ohland — May 15, 2023
Christopher Ohland — Date
SWE Quality Assurance Manager

Bruce Wilcer — May 15, 2023
Bruce Wilcer — Date
SWE Field Quality Control Manager

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS-friendly supplies and procedures.
Rev 2, 05/09/2023: Inserted Section 4.5 with procedures for filling out a chain of custody form.

Table of Contents

1.0 Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation requirements to maintain sample custody and the labeling, packaging, and shipping of multimedia samples after they are collected.

Proper sample management from sample collection to laboratory receipt is essential to ensure the legal defensibility of the sample. Sample management is also needed to maintain sample integrity and successfully transport samples to the testing laboratory in an acceptable condition.

1.2 Scope

The scope of this SOP applies to field staff collecting samples. The field staff may be employed by Ahtna or by a subcontractor. Trained environmental professionals will be engaged in or directly supervise the subcontractors' collection and handling of environmental samples.

When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Project].

1.3 Responsibilities

Field Team. A Field Team is one or more individuals working together. The Field Team is responsible for the oversight of and/or collection of groundwater samples as specified in this SOP.

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of USACE EM-385-1-1 (USACE, 2014). The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. The FTL approves those actions or, if the circumstance warrants, notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of the Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Air or Ground Waybill. A shipping document that identifies the sender and addressee, transport carrier, size, and priority of a shipment transported by aircraft.

Chain of Custody. In legal contexts, is the chronological documentation or paper trail that records the sequence of custody, control, transfer, analysis, and disposition of materials, including physical or electronic evidence.

Dangerous Goods. Under the International Air Transport Association (IATA) definition, dangerous goods are articles or substances that can pose a hazard to health, safety, property, or the environment and are shown in the list of dangerous goods in the IATA regulations (IATA 1.0).

Environmental sample. According to the Department of Transportation (DOT) 49 Code of Federal Regulations (CFR) Section 172.101 Appendix A, any sample that has less than reportable quantities of any hazardous constituents.

Excepted Quantity (DOT & IATA Definition). A hazardous substance whose class is permitted on passenger aircraft but in such a small defined amount poses a low risk during transport by aircraft. Hazardous substances that meet the definition of Excepted Quantity may be exempted from documentation, packaging, marking, and labeling requirements typically required when presenting hazardous materials for passenger air transportation. Items shipped as excepted quantities are limited to volumes as specified in IATA Dangerous Goods Regulations, Table 2.6.A and DOT 49 CFR 173.4a.

Hazardous materials. DOT defines a hazardous material as any item or chemical which, when being transported or moved in commerce, is a risk to public safety or the environment and is regulated as such under its Pipeline and Hazardous Materials Safety Administration regulations (49 CFR 100-199), which includes the Hazardous Materials Regulations (49 CFR 171-180).

Sample label. An adhesive paper placed on sample containers or a tag tied to a sample container to designate a sample identification number and other identifying information.

2.0 Relevant Documents

This SOP is intended to be used in conjunction with the following SOPs, and as such, the equipment and materials needed for those activities are not included in this SOP:

Standard Operating Procedures

- SWE-FSOP-001, Field Documentation
- SWE-FSOP-400 Series, various sampling SOPs

Field Forms

- SWE-FFRM-004, Daily PFAS Sampling Checklist
- SWE-FFRM-002, Chain of Custody

3.0 Equipment List

- Gel or bag ice (determine which is appropriate)

  [PFAS Project]: Ice in polyethylene bags

- Bubble wrap and/or foam inserts

  [PFAS Project]: Avoid packing materials that contain PFAS and materials that absorb water, including paper, cardboard, and Styrofoam; as they become soggy, they lose cushioning properties.

- Clear, strapping, or duct tape

  [PFAS Project]: Use PFAS-free tape

- Coolers
- Heavy-duty plastic bags
- [PFAS Project]: Use HDPE bags1
- [PFAS Project]: Use HDPE bags1
- Plastic zip-top bags (i.e., quart and gallon)
- Chain of Custody forms
- Air or Ground Waybills
- Sample container labels
- Custody seals for coolers

4.0 Procedures

4.1 Sample Custody

Six aspects of sample custody.

- Use appropriate sampling equipment
- Properly handle and document samples, starting from the time of collection
- Keep samples within temperature controls and safely located until offsite transport
- Properly pack and transport samples from the field site to the laboratory
- Complete the chain of custody (COC) form and include with shipment
- Verify laboratory receipt of samples
- Ensure laboratory has a custody program (subcontractor responsibility)

4.2 Proper Sampling Equipment

The supplies needed to collect samples must be made of material that will not release contaminants to the sample or hold contaminants to the sampling equipment. Equipment specifications are described in

[1] [PFAS Project]: LDPE bags may be used for bagging samples if special precautions are taken. LDPE bags should be kept separate from other sampling supplies in the staging area and should not come into direct contact with the sample media. Gloves should be changed after handling LDPE bags.

project work plans. Shipping coolers should be inspected for defects and must be decontaminated before use.

> [PFAS Projects]: Surfaces in contact with the sampled media should not contain Teflon® or other PFAS-containing material.

Use new, certified sample containers suitable for the media being analyzed. Containers should be provided by the analytical lab or supplier in the appropriate quantity to accommodate required volumes for the field sample, duplicates, and any amounts required for laboratory QC processes. Certification requirements are specified in the USEPA *Specifications and Guidance for Contaminant Free Sample Containers* (EPA, 1992).

4.3 Sample Collection and Handling

Each person handling the samples must document from whom and when the item was received and to whom and when it was delivered. Documentation of handling samples is part of the custody record, which provides the mechanism for tracking samples from the time of sample collection thru laboratory analysis and disposal.

A sample is considered to be "in custody" for legal proceedings if it is:

- In a person's actual possession
- In view after being in physical possession
- Locked up so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel only.

If any one of these is not in place at all times, sample custody is broken. The FTL should notify the PL of actions taken and document the PL decision. If corrective action is needed, the Program Manager and SWE Field Quality Control Manager should be notified.

Sampling procedures are described in the SWE-FSOP-400 series of SOPs. The Field Team is responsible for logging the sample collection in field logbooks/notepads or field forms as described in SWE-FSOP-001, "Field Documentation."

Sample custody begins at the time of sample collection, and its custody is assigned to the Field Team sample custodian. Custody transfers must be documented. Typical transfers include:

- Transfer of samples from contractors, if used, to Ahtna staff
- Transfer of samples to a transporter
- Transfer of samples to the laboratory
- Transfer of samples within the laboratory

When samples are transferred, the transfer is noted in the field logbook/notepad or field form SWE-FFRM-002, "Chain of Custody," or similar form. The name of the organization/individual and date/time of the transfer and organization/name and date/time of the recipient. For samples shipped by ground or air carrier, the unique airbill number or bill of laden should be recorded.

4.4 Sample Integrity

To reduce the possibility of invalidating the results, all collected samples must be placed in laboratory-supplied containers and labeled (Figure 1).

Sample preservation before laboratory analysis is accomplished by adding the sample into pre-preserved sample containers or adding the preservative after filling the container. Preservation requirements are described in Worksheet# 19/30 of the project Quality Assurance Project Plan (QAPP).

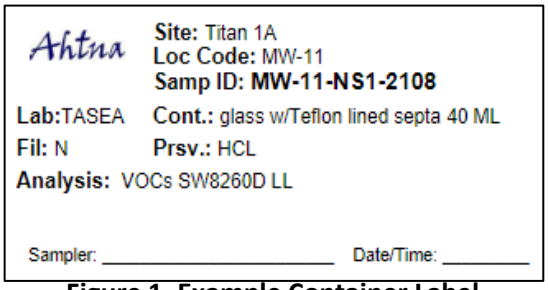

Figure 1. Example Container Label

With few exceptions (i.e., metal analyses), samples must be cooled as soon as possible after sample collection, and after that, maintained between 0°C–6°C. Samples must be kept in the custodians' possession or stored safely at all times.

Sample containers should be pre-labeled as much as practical before sample collection. Labels should be affixed to the sample container before or at sampling and must adhere firmly to the container. Labels can be further secured by placing clear packaging tape over the label, but not for volatile organic compounds (VOC) or gasoline range organics (GRO) analyses.

Sample containers that are weighed by the laboratory before use should not have any additional labels placed on the container, affecting the weight. For those containers, use the label already provided on the jar. Only one label should be placed on each sample container.

Use the specifications defined in the project work plans. Unless the QAPP specifies otherwise, sample labels should be written in indelible ink and contain, at a minimum, the following information:

- Project number/Site
- Field sample ID
- Container type and preservative
- Filtered (Y/N)
- Laboratory name
- Analysis requested (abbreviated)
- Sampler's organization and initials
- Collection date and time (24-hour clock)

4.5 Chain of Custody

Fill out a COC form or use the COC form filled out in the field. The COC should only list the samples and bottles (specific to the analyses requested) added to the cooler. If a pre-filled COC is used and has sample IDs listed that aren't being used, strike out the unneeded sample line(s), initial, and date. Check to ensure that the sample labels are intact, completed with the correct information, and that sample identification matches the COC record exactly.

The following information will be written on the COC form by the sample controller/shipper:

- Site name;
- Name of receiving laboratory;
- Sample IDs for all samples in a particular cooler/shipping container;
- Sample matrix or matrix code (e.g., SO for soil);
- Sample type (environmental, trip blank, equipment blank, etc.);
- Analysis requested by method number unless other arrangements are made with the receiving laboratory;
- Number of containers;
- Quality Control (QC) required (to indicate the sample is to be used for matrix spike/matrix spike duplicate analyses);
- Date of collection (mm/dd/yy or m/d/yy: 04/03/23 or 4/3/23 is April 3, 2023);
- Time of collection (military format);
- Signature of individual who prepares the COC form;
- Cooler identification (ID);
- Carrier service and airbill number.
- Signature of individual relinquishing samples along with the date and time of relinquishment.Control of the COC record will be:
- Fed Ex Shipments
    - The COC should be signed as “relinquished” by the sampler/FTL at the time it is placed inside the cooler.
    - If a triplicate form is used;
        - Original (top copy) is sealed in a waterproof zip-top bag with a custody seal (initialed and dated) and taped inside the top of the shipping container; retain the two remaining copies for Project File/submittal to the Project Manager.
    - If a single-page COC is used:
        - Scan or photograph the signed original for Project File/submittal to the Project Manager and then place the original signed copy in a waterproof zip-top bag with a custody seal (initialed and dated) and taped inside the top of the shipping container
- Laboratory Courier Shipments
    - The COC is not placed in the cooler. The COC should be signed as “relinquished” by the sampler/FTL and the courier will then take possession of the cooler and sign and write date and time in the adjacent “received” section;
    - If a triplicate form is used.
        - Original (top copy) is given to the courier; retain the two remaining copies for Project File/submittal to the Project Manager.
    - If a single-page COC is used:
        - The signed original is scanned or photographed for Project File/submittal to the Project Manager, and the original is given to the courier.

[PFAS Project]: The COC record will be placed in a re-sealable plastic Ziploc® (or equivalent) bag, the bag sealed shut to prevent water intrusion from the bagged wet ice in the cooler, and the bag taped (using PFAS-free tape) to the inside lid of the cooler.

4.6 Sample Packing

The following steps must be followed when packing sample containers for shipment:

1. Choose a cooler with structural integrity that will withstand shipment. Ensure the cooler is large enough to contain all the samples to be shipped along with the appropriate amount of ice. Use a cooler that has been pre-cooled and not one that has been in a hot vehicle or out in the sun. Secure and tape the cooler drain plug with duct tape.

   [PFAS Project]: Use ice in polyethylene bags.

2. Be sure that the caps on all sample containers are tight and do not leak but do not overtighten.
3. Wrap and package containers sufficiently to prevent cross-contamination or exposure to melt water and ensure that containers remain intact during shipment.

   [PFAS Project]: Seal each sample container in a HDPE bag to prevent melt water from getting into the sample or degrading the sample label. Taping the end of bags with duct tape will provide added protection against melt water.[1]

4. Place the containers into the cooler with caps up. No containers should be placed on their sides, as there is significantly less chance of breakage when packed vertically.
5. Use enough ice (double-bagged) to ensure that samples are received by the laboratory at the proper temperature of 0°C–6°C. For temperature-sensitive analyses, it may be necessary to cool the samples in onsite chillers. Refer to the project work plans. Although not required, the Field Team should:
   - Place a layer of ice on the bottom of the cooler.
   - Place a bag of ice vertically on one end of the cooler, followed by a set of samples. Follow this with another vertical bag of ice and repeat until the cooler is full. Make sure all samples are lined on both sides with ice.
   - Place more bags of ice flat on top of the samples.
   - Cover this with an insulating layer, such as bubble wrap.

   [PFAS Project]: Avoid packing materials that contain PFAS and materials that absorb water, including paper, cardboard, and Styrofoam; as they become soggy, they lose cushioning properties

6. Place a temperature blank in the cooler, and VOC/GRO trip blank is needed.
7. Fill excess space between sample containers and walls of the cooler with additional bubble wrap.
8. Enclose the COC form in a Ziploc bag, seal the bag, and attach it to the inside cooler cover.
9. Place a signed and dated custody seal on the outside spanning the area where the cooler lid meets the cooler's body.

   Exception. Coolers containing sample(s) that are picked up by the contracted laboratory-employed courier services do not need to show a custody seal. Custody is maintained because the samples are under the care of the courier and laboratory-employed service center staff.

[PFAS Project]: Custody seals will be pre-printed on PFAS-free paper.

10. Secure the cooler with packing tape over the custody seal.

    [PFAS Project]: PFAS-free tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

4.7 Offsite Transport

Samples taken over multiple days should be sent to the laboratory with sufficient time to allow the laboratory to meet holding time requirements. If the requested analyses have a short holding time (less than 48 hours), samples should be delivered to the laboratory for analysis as soon as possible following sample collection: preferably same day or overnight for morning delivery. Notify the laboratory Project Manager when short holding times are anticipated.

Samples can be stored onsite if: samples are left in a secure location, protected from breakage and contamination, and if the preservation specification requires, in a temperature-controlled device (e.g., ice-packed cooler or onsite refrigerator).

Sample coolers are transported to the laboratory by an Ahtna- or laboratory-employed staff or by an overnight air carrier. Coordinate delivery schedules with the laboratory Project Manager in advance. For sample transport using professional air carriers, only services that provide a tracking number can be used. The tracking number is needed to maintain sample custody. The tracking number must be listed on the chain of custody form, and a copy of the shipping receipt and tracking number should be logged in the field logbook/notepad. The package should be addressed to the "Sample Custodian."

Transportation regulations followed by air carriers are airline-specific; some use only IATA, and others allow either IATA or DOT. Ground and vessel transportation is guided by DOT regulations. If shipping by highway or rail, no shipping paperwork is required as stated in 49 CFR 173.4a(h)1. These regulations have requirements to identify, document, label, and package samples if the shipment contains dangerous goods.

Note: United Parcel Service and Federal Express follow IATA for air shipments and DOT for ground shipments

The shipper is responsible for identifying, documenting, and packaging samples for air shipment that contains dangerous goods or whether the shipment is exempted for limited quantities. Because most multimedia samples collected for environmental projects returned in preserved containers are exempted, specific procedures are not provided in this SOP. Contact the Field QC Manager if dangerous goods shipment is suspected.

Shipments of the following may contain dangerous goods:

- If the hazardous material has a UN code
- Unknown hazardous waste from drums, sludges, or appears suspicious
- Odor, PID measurements, and physical characteristics indicate a hazard
- Explosives or radioactive materials

Keep in mind that IATA requirements and the FAA and TSA "Prohibited Items List" will not allow shippers to check dangerous goods, in any quantity, as baggage on a commercial flight.

Each sample collected will be recorded on a COC form. Each COC form(s) in a cooler or shipping container should be specific to the samples in the cooler and not samples in multiple/other coolers.

4.8 Laboratory Acknowledgment

Once the samples arrive at the laboratory, the laboratory Sample Custodian checks the shipment for:

- Levels of liquid samples to assess whether leaks have occurred
- Shipment contents match the COC form
- Check the cooler temperaure and pH if preserved.

Note: VOC/GRO analyses are checked at the sample analysis time.

The laboratory will provide notification of sample acknowledgment. The notification summarizes the work order, sample login descrepences and resolution, and discussions between the laboratory Project Manager and the Field Team. The FTL is responsible for reviewing the notification for completeness and accuracy.

4.9 Document Control

Sampling field forms should be completed in their entirety. If an entry is not applicable, indicate "n/a" (not applicable) or line out the entry.

After a task or project, all field documentation, including the field logbook, field datasheets, and electronic data, shall be scanned and placed in the appropriate folder on the server. All original documents shall be submitted to the PL and kept in the project file. See FSOP-001 (Field Documentation).

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control method described in the project work plans.

Verify the laboratory notice of sample acknowledgment.

6.0 Documentation Review

The FTL is responsible for daily review of the field sample management and fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

International Air Transport Association (IATA), 2019. Dangerous Goods Regulations.

Code of Federal Regulations, 49 CFR 173.4a. Excepted Quantities

USEPA Specifications and Guidance for Contaminant Free Sample Containers. EPA540/R-93/051. (December 1992)

Hollow Stem Auger Drilling

Document Number	SWE-FSOP-301
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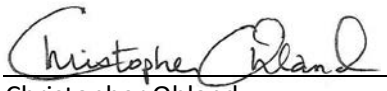
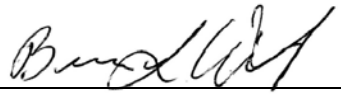
Approvals



Christopher Ohland
SWE Quality Assurance Manager

April 1, 2022
Date



Bruce Wilcer
SWE Field Quality Control Manager

April 1, 2022
Date

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Table of Contents

1.0 Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation of drilling operations involving hollow stem auger (HSA).

1.2 Scope

The scope of this SOP applies to field staff conducting drilling oversight. The SOP includes guidance for activities related to the performance, management, and completion of HSA drilling activities, including a description of staff responsibilities, relevant documentation, equipment, procedures, and quality control. Potential hazards related to drilling are addressed in project-specific Accident Prevention Plans (APP) and Site Safety and Health Plans.

1.3 Responsibilities

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Field Geologist. A Field Geologist is responsible for overseeing drilling activities according to project specifications. The Field Geologist is a registered geologist or a person performing work under the supervision of a registered geologist.

Project Geologist. The registered Project Geologist is responsible for oversight of the drilling subcontractor, logging geologic materials per SWE-FSOP-201, "Soil Classification," and field documentation. When a Field Geologist performs the oversight, the Project Geologist is responsible for fieldwork variances/deficiencies, completeness and accuracy of field documentation, and approval of the boring logs.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of the current version of U.S. Army Corps of Engineers EM-385-1-1 *Safety and Health Requirements*. The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. If the circumstance warrants, the FTL approves those actions and notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of the Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Boring Log - A written and/or graphical description of exploration procedures and subsurface conditions encountered during drilling, sampling, and coring.

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. Each data entry field should have an entry or indicate that data for that field is not available or not required.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

Field Notepad – A unbound notepad or loose-leaf paper with consecutively numbered pages.

2.0 Relevant Documents

This SOP focuses on the oversight and documentation of HSA drilling activities and should be used in conjunction with other applicable SOPs, including the following:

Standard Operating Procedures

- SWE-FSOP-001, Fieldwork Documentation
- SWE-FSOP-002, Field Sample Management
- SWE-FSOP-201, Soil Classification
- SWE-FSOP-601, Well Installation
- SWE-FSOP-801, Equipment Decontamination
- SWE-FSOP-802, Investigation Derived Waste Management

Field Forms

- SWE-FFRM-400, Soil Boring Log

Project-specific work plans should be reviewed to be familiar with the appropriate SOPs and related field forms necessary to complete the drilling activities.

3.0 Equipment List

The list below identifies equipment expected to be used by staff while supervising HSA drilling activities.

- A bound, waterproof field logbook (FLB; e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation
- Waterproof, indelible pens/markers in black or blue ink
- Color chart for logging soil (e.g., Munsell™ chart)
- Hand lens for examining soil
- Digital camera/video, cell phone, or other devices capable of digital imagery
- Appropriate PPE

Refer to project work plans to confirm equipment required for the specific drilling activity. This may include, but is not limited to various field forms, sample containers, incremental sampling devices, and sample homogenizing equipment.

4.0 Procedures

Procedures are provided for:

- Pre-Field Tasks (Section 4.1)
- Mobilization and Setup (Section 4.2)
- Drilling Procedures (Section 4.3)
- Borehole Abandonment (Section 4.4)
- Demobilization/Site Restoration (Section 4.5)

Hollow stem auger drilling is a method using rotating auger flights (typically in 5-foot lengths) connected to make an auger "string" with a bit on the bottom of the first flight (sometimes called the "lead auger"). Each HSA flight consists of a hollow pipe with an outer spiral plate, which, when rotated, forces soil cuttings upward along the borehole wall to the surface. The auger string is advanced by rotation, with a pressure exerted by the rig, forcing the bit to cut the soil at the bottom and direct cuttings to the augers.

A retractable plug with a pilot bit is placed at the bottom of the auger string to prevent cuttings from entering the hollow stem.

When the plug/bit assembly is retracted, a sampler may be sent through the hollow center to "push" or "drive" sample soil at the bottom of the borehole without requiring the augers to be removed. A wireline sampler may also be attached inside the lead auger to collect a continuous core as the borehole is advanced.

The HSA method is commonly used for drilling, sampling, and logging of soil, collecting soil gas and screening-level water samples, and installing smaller diameter soil vapor and groundwater monitoring wells. The most reliable method for logging soils during HSA drilling is collecting relatively intact samples through the hollow stem. An advantage of the HSA method is that soil samples can be readily obtained from the bottom of the hole without requiring the removal of the auger string (unlike air or mud rotary methods).

When constructing wells using HSA methods, the well casing assembly may be placed through the hollow stem, and the auger can be progressively pulled as construction materials are added to the borehole (see SWE-FSOP-601 Groundwater Well Installation).

The HSA methodology may also be used to drill out small diameter monitoring wells during decommissioning (see SWE-FSOP-603 Groundwater Well Decommissioning).

4.1 Pre-Field Tasks

Preparation and coordination tasks for HSA drilling generally include the activities described below.

4.1.1 Clearances

Before starting any HSA boring, confirm that drilling locations have been appropriately cleared of potential overhead, surface, and subsurface hazards per the project work plans. This should include a utility locating subcontractor to identify subsurface infrastructure and anomalies. The clearance process also includes completing public utility locating service calls (e.g., Dig Alert, USA North 811, etc.) and completing any coordination and permitting procedures with the onsite Department/Directorate of Public Works personnel required by the project contract.

- Review available forms and diagrams that document the selected location of the drilling location relative to underground/overhead utility lines, surface structures, or buried objects.
- Copies of the site clearance documents should be kept onsite.
- Confirm that, before drilling, the borehole location will be investigated to the maximum expected depth of any utilities (commonly 5 feet or greater) using a hand auger, shovel, or air knife.

4.1.2 Health and Safety

- Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan.
- All personnel at the site should have appropriate training and qualifications as per the health and safety plan.
- All personnel within the exclusion zone should pay close attention to rig operations during drilling. The rotating auger blades can snag or catch loose clothing and cause severe injury or death.
- Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the driller of any unforeseen hazard—or when anyone is approaching the exclusion zone.

4.1.3 Site Conditions and Drilling Logistics

The site will be prepared as per the project work plans. Before mobilizing, the logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction will be determined.

Before mobilization, the FTL and/or the Field Geologist should assess the drilling site with the driller. This assessment should identify potential hazards (i.e., slip/trip/fall, overhead power lines) and determine how drilling operations may impact the environment (i.e., dust, debris, noise). As per the project work plans, potential hazards should be evaluated and corrected, or the borehole location changed or shifted.

- Drill site space requirements commonly include not only area for the rig, but also swing-out clearances, access for a support truck, and forklift carrying pipe or debris bins.
- The FTL and/or the Field Geologist should inform the driller of the appropriate equipment (e.g., cookie-cutter, etc.) to penetrate the surface cover (e.g., asphalt, concrete, cement, etc.).
- Appropriate cuttings and other IDW containment should be set onsite prior to the commencement of drilling.

Lubricating compound used on tools and augers must approved in advance and must not contain any compounds that are incompatible with project objectives, laboratory analyses, or water quality guidelines.

4.1.4 Rig Decontamination and Preparation

- All drilling and sampling equipment should be decontaminated before drilling.
- The drilling equipment shall be inspected for proper maintenance and appropriate decontamination before each time the rig is mobilized to a site.
- All clutches, brakes, and drive heads should be in proper working order.
- All cables and hydraulic hoses should be in good condition.
- All auger joints and bits should also be in good condition (e.g., no cracked or bent blades, bits are not excessively worn, etc.).
- Any observed leakage of fluids from the rig should be immediately repaired and decontaminated again before it is allowed to mobilize.

4.1.5 Calibration

Before mobilization, all safety sampling and monitoring equipment will be appropriately calibrated per the project work plans.

4.1.6 Personal Protective Equipment (PPE)

Don the appropriate PPE, as specified in the project work plans and APP.

4.2 Mobilization and Setup

The standard procedure for HSA drilling is described below. The drilling will be conducted per the project work plans.

4.2.1 Site Preparation

The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

- Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan.
- Plastic sheeting (e.g., Visqueen™) may be required beneath the rig.
- Appropriate cuttings and other IDW containment should be set onsite prior to the commencement of drilling.
- If drilling is to be conducted in the saturated zone, provisions should be made to ensure adequate containment of formation water produced during drilling operations.

4.2.2 Discussion of Site Conditions

Before drilling operations begin, the following must be completed:

- The FTL should assess the drilling site with the driller. This assessment should identify potential hazards and determine how drilling operations may impact the environment.
- Potential hazards should be evaluated and corrected, or the borehole location changed or shifted, as per the project work plans.
- If a shallow subsurface hazard (i.e., unidentifiable utility or trapped vapors) may exist, the driller should be informed of the potential hazard before breaking ground. Drilling should then commence slowly to allow continuous visual inspection and/or monitoring, and if necessary, stop for probing.

4.2.3 Mobilization

- The drill rig is mobilized to the site and located over the borehole.
- The drill rig is leveled with a set of hydraulic pads attached to the front and rear of the drill rig.

Note: *The driller should always raise the mast slowly and carefully to prevent tipping or damage to the drill rig. The driller should also avoid obstructions or hazards*.

4.3 Drilling Procedures

A hand auger will be used to advance the borehole from 0 to 5 ft bgs to check that underground utilities are not present at each borehole location. The driller should be informed of any known shallow subsurface hazards (unidentifiable utility, trapped vapors, etc.). Drilling the surface hole should commence slowly to allow continuous visual inspection and, if necessary, any interruptions for probing until the anticipated maximum depth of any suspected obstructions is exceeded.

4.3.1 Borehole Drilling

During drilling operations, and as the borehole is advanced, the Field Geologist will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings; and
- Supervise the collection of, and prepare the soil, soil vapor, and groundwater samples.
- For specific soil and groundwater sampling procedures, refer to the project-specific work plans and appropriate FSOP.

4.3.2 Ongoing Monitoring

As drilling progresses, the Field Geologist should observe and frequently communicate with the driller regarding drilling conditions. This includes relative penetration rates (indicative of fast or slow drilling) and chattering or bucking of the rig.

- The Field Geologist will oversee or conduct appropriate health and safety sampling and monitoring.
- The conditions described above, including the relative drilling rate, should be recorded on the boring log.
- The Field Geologist should know the total depth of the borehole at all times during drilling.
- During drilling, track and note changes in the drilling process (e.g., sounds, rotation speed, sudden drops, etc.) that may indicate changes in lithology, material density, etc., and collect representative soil samples as required by the project work plans.
- Drilling should not progress faster than the Field Geologist can adequately observe conditions, compile boring logs, and supervise safety and sampling activities.
- The Field Geologist should also observe the rig operations, including the make-up and tightening of connections as other auger joints are added to the auger string.
- Any observed problems that include significant downtime, along with their causes, are recorded in the FLB.
- Cuttings and fluids containment during drilling should be observed and supervised by the Field Geologist, as per specifications in the project work plans.

If any potentially unsafe conditions are evident during the above drilling observations, the Field Geologist (or any onsite person) may suspend drilling operations at any time and take appropriate actions as per the health and safety plan.

In the event suspension of drilling activities occur:

- The FTL and Safety Representative must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may be continued; and
- The observed problem, suspension, and corrective action are entered on the FLB.

4.3.3 Boring Log

During drilling, the Field Geologist compiles a boring log. Use field form SWE-FFRM-400. The log will be compiled preferably from soil samples recovered while drilling. Logs should only be compiled from cuttings if this is the only option. Observations of drilling conditions are also entered on the log. If total depth was reached prematurely due to refusal, the cause should be noted on the boring log and the FLB.

Subsurface soil samples may be collected with a split spoon sampler or other compatible devices during drilling. This is done with augers remaining in place. Soil samples can be readily obtained at discrete intervals with these methods.

If a monitoring well is to be installed in the borehole, activities will be supervised by the Field Geologist following FSOP-601, “Well Installation.”

4.4 Borehole Abandonment

If the borehole is to be abandoned after completion, expected quantities of grout to be used should be calculated in advance and tracked during placement.

In general, grout consists of a neat cement mixture containing three to five percent bentonite powder to water by weight. The grout is emplaced as a slurry. The type and composition of the grout mixture should be specified in the project work plans.

The borehole will be tremie-grouted from bottom to top through the inside of the augers as they are retracted to ensure that grout level does not fall below the bottom opening of the lead auger. When the grout has reached the prescribed level (e.g., ground surface or less if special site restoration is required), allow the grout to settle and cure.

Contain any water or fluids displaced by the neat cement and contain as IDW. Excess neat cement shall be placed in portable metal bins or equivalent and disposed of as solid IDW after it is allowed to set.

After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement has hardened, and no settlement has occurred.

Restore the final surface per the work plan and applicable specifications (e.g., repair asphalt/cement, soil placement) as necessary.

If a monitoring well is to be installed in the borehole, activities will be supervised by the Field Geologist following FSOP-601, “Well Installation.”

4.5 Demobilization/Site Restoration

After drilling, sampling, and well installation or borehole abandonment is completed, the augers and tools should be laid down, the mast lowered, and the rig moved off the location. Demobilization/site restoration will be supervised by the FTL/Field Geologist or appropriate designee.

All debris generated by the drilling operation should be disposed of appropriately. The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans. All abandoned borings should be topped off and completed per the project work plans. Any hazards remaining due to drilling activities should be identified, and appropriate barriers and markers should be put in place, as per the APP. All soil cuttings and fluids should be adequately contained, clearly labeled, and maintained to comply with the project work plans.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for drilling and field documentation review will be performed by the FTL or PM to check that procedures and documentation content and level of detail comply with this SOP. If a deficiency or a variance was taken to the SOP, the PM should document the deficiency/variance and determine the need for corrective action in coordination with the QA Manager.

If a non-registered geologist performs the oversight, a registered Project Geologist is responsible for reviewing the fieldwork documentation for the accurate and complete representation of the drilling and approval of final logs.

6.0 Documentation Review

The FTL is responsible for daily review of the activities performed at the site and fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

None cited

Sonic Drilling

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Approvals

Christopher Ohland — April 1, 2022
Christopher Ohland — Date
SWE Quality Assurance Manager

Bruce Wilcer — April 1, 2022
Bruce Wilcer — Date
SWE Field Quality Control Manager

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Table of Contents

1.0 Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation of drilling operations involving sonic (also known as Rotosonic) drilling equipment.

1.2 Scope

The scope of this SOP applies to field staff conducting drilling oversight. The SOP includes guidance for the performance, management, and completion of sonic drilling activities, including a description of staff responsibilities, relevant documentation, equipment, procedures, and quality control. Potential hazards related to drilling are addressed in project-specific Accident Prevention Plans (APP) and Site Safety and Health Plans.

1.3 Responsibilities

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Field Geologist. A Field Geologist is responsible for overseeing drilling activities according to project specifications. The Field Geologist is a registered geologist or a person performing work under the supervision of a registered geologist.

Project Geologist. The registered Project Geologist is responsible for oversight of the drilling subcontractor, logging geologic materials per SWE-FSOP-201, "Soil Classification," and field documentation. When a Field Geologist performs the oversight, the Project Geologist is responsible for fieldwork variances/deficiencies, completeness and accuracy of field documentation, and approval of the boring logs.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of the current version of U.S. Army Corps of Engineers EM-385-1-1 *Safety and Health Requirements*. The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. If the circumstance warrants, the FTL approves those actions and notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of the Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Boring Log - A written and/or graphical description of exploration procedures and subsurface conditions encountered during drilling, sampling, and coring.

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. Each data entry field should have an entry or indicate that data for that field is not available or not required.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

Field Notepad – A unbound notepad or loose-leaf paper with consecutively numbered pages.

2.0 Relevant Documents

This SOP focuses on the oversight and documentation of sonic drilling activities and should be used in conjunction with other applicable SOPs, including the following:

Standard Operating Procedures

- SWE-FSOP-001, Fieldwork Documentation
- SWE-FSOP-002, Field Sample Management
- SWE-FSOP-201, Soil Classification
- SWE-FSOP-601, Well Installation
- SWE-FSOP-801, Equipment Decontamination
- SWE-FSOP-802, Investigation Derived Waste Management

Field Forms

- SWE-FFRM-400, Soil Boring Log

Review the project-specific work plans to become familiar with the appropriate SOPs and related field forms necessary to complete the drilling activities.

3.0 Equipment List

The list below identifies equipment expected to be used by staff while supervising sonic drilling activities.

- A bound, waterproof field logbook (FLB; e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation
- Waterproof, indelible pens/markers in black or blue ink
- Color chart for logging soil (e.g., Munsell™ chart)
- Hand lens for examining soil
- Digital camera/video, cell phone, or other devices capable of digital imagery
- Appropriate PPE

Refer to project work plans to confirm equipment required for the specific drilling activity. This may include but is not limited to various field forms, sample containers, incremental sampling devices, and sample homogenizing equipment.

4.0 Procedures

Procedures are provided for:

- Pre-Field Tasks (Section 4.1)
- Mobilization and Setup (Section 4.2)
- Drilling Procedures (Section 4.3)
- Borehole Abandonment (Section 4.4)
- Demobilization/Site Restoration (Section 4.5)

Sonic drilling is commonly used where the Project Geologist deems issues around difficult drilling and intact core sample recovery affect the success of the work.

Sonic drilling is a method of drilling that employs two opposite-rotating elements (oscillators) in the drill head that act as counterweights working against one another. By adjusting or tuning the oscillations, high-frequency resonance is generated down the tool string to the end of the core barrel (bit), driving the bit downwards.

Cuttings are recovered as core samples or displaced outside of the borehole. Cuttings are usually transferred into a polyethylene sample bag or Lexan liner for logging and storage.

The core barrel is advanced, and the casing is advanced over the core barrel before retraction. Water may be added when working at greater depths, but it is beneficial to drill dry if the depth to groundwater needs to be determined.

A continuous core provides a detailed look at the soil at the depths drilled. This results in a better understanding of the subsurface conditions. Cuttings produced by this method are typically intact as a core sample, allowing for accurate logging.

Additional considerations in using sonic drilling techniques include the potential of volatilizing contaminants due to the heat generated by the oscillating bit.

4.1 Pre-Field Tasks

Preparation and coordination tasks for sonic drilling generally include the activities described below.

4.1.1 Clearances

Before starting any sonic boring, confirm that drilling locations have been appropriately cleared of potential overhead, surface, and subsurface hazards per the project work plans. This should include a utility locating subcontractor to identify subsurface infrastructure and anomalies. The clearance process also includes completing public utility locating service calls (e.g., Dig Alert, USA North 811, etc.) and completing any coordination and permitting procedures with the onsite Department/Directorate of Public Works personnel required by the project contract.

- Review available forms and diagrams that document the selected location of the drilling location relative to underground/overhead utility lines, surface structures, or buried objects.
- Copies of the site clearance documents should be kept onsite.

4.1.2 Health and Safety

- Hold Tailgate Safety Meetings in the manner and frequency stated in the health and safety plan.
- All personnel at the site should have appropriate training and qualifications as per the health and safety plan.
- All personnel within the exclusion zone should pay close attention to rig operations during drilling. The rotating or swinging drilling components can snag or catch loose clothing or strike personnel and cause severe injury or death.
- Hearing protection is especially critical when sonic drilling, as the rig can generate high-frequency noise and considerable noise when drilling through gravel and cobbles.
- Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the driller of any unforeseen hazard—or when anyone is approaching the exclusion zone.

4.1.3 Site Conditions and Drilling Logistics

Prepare the site per the project work plans. Before mobilizing, determine the logistics of drilling, logging, sampling, cuttings/fluid containment, and well construction. The FTL or the Field Geologist should assess the drilling site with the driller. This assessment should identify potential hazards (i.e., slip/trip/fall, overhead power lines) and determine how drilling operations may impact the environment (i.e., dust, debris, noise). As per the project work plans, potential hazards should be evaluated and corrected, or the borehole location changed or shifted.

- Drill site space requirements commonly include an area for the rig and swing-out clearances, access for a pipe truck, and forklift carrying pipe or debris bins.
- The FTL or the Field Geologist should inform the driller of the appropriate equipment (e.g., cookie-cutter, etc.) to penetrate the surface cover (e.g., asphalt, concrete, cement, etc.).
- Lubricating compounds used on drill pipe and drive casing threads must be approved in advance and must not contain compounds incompatible with project objectives, laboratory analyses, or water quality guidelines.
- Drive casings of various lengths should be provided by the subcontractor to facilitate emplacement of the sand pack, bentonite seal, and grout during well construction. One 3-foot, two 5-foot, and two 10-foot lengths and enough standard-length drive casing joints are recommended.
- A hydraulic casing extractor must be used to remove the drive casing from the borehole. Do not extract the casing by "hammering up" with the casing hammer. The hydraulic casing extractor should have sufficient pulling capacity and clamping mechanisms to extract the casing safely and smoothly with the appropriate lifting force.

4.1.4 Rig Decontamination and Preparation

- All drilling and sampling equipment should be decontaminated before drilling

- The drilling equipment shall be inspected for proper maintenance and appropriate decontamination before each time the rig is mobilized to a site
- All clutches, brakes, and drive heads should be properly working
- All cables and hydraulic hoses should be in good condition
- Any observed leakage of fluids from the rig should be immediately repaired and decontaminated again before it is allowed to mobilize

4.1.5 Calibration

Before mobilization, calibrate the safety-related sampling and monitoring equipment.

4.1.6 Personal Protective Equipment (PPE)

Don the appropriate PPE as specified in the project work plans and APP.

4.2 Mobilization and Setup

The standard procedure for sonic drilling is described below and the project work plans may include additional specifications.

4.2.1 Site Preparation

The logistics of drilling, logging, sampling, cuttings/fluid containment, and well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

- As per the site health and safety plan, appropriate barriers and markers should be in place before drilling
- Plastic sheeting (e.g., Visqueen™) may be required beneath the rig
- Appropriate cuttings and other IDW containment should be set onsite before the commencement of drilling
- If drilling is conducted in the saturated zone, provisions should be made to ensure adequate containment of formation water produced during drilling operations

4.2.2 Discussion of Site Conditions

Before drilling operations begin, the following must be completed:

- The FTL or Field Geologist should assess the drilling site with the driller. This assessment should identify potential hazards and determine how drilling operations may impact the environment.
- As per the project work plans, potential hazards should be evaluated and corrected, or the borehole location changed or shifted.
- If a shallow subsurface hazard (i.e., unidentifiable utility or trapped vapors) may exist, the driller should be informed of the potential hazard before breaking ground. Drilling should then commence slowly to allow continuous visual inspection and monitoring and, if necessary, stop for probing.

4.2.3 Mobilization

Once the site is prepared, the rig is mobilized and located over the borehole location.

- The drill rig is mobilized to the site and located over the borehole location
- The drill rig is leveled with a set of hydraulic pads attached to the front and rear of the drill rig
- The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig and avoid obstructions or hazards

4.3 Drilling Procedures

Before drilling, use a hand auger, shovel, or air knife to clear the borehole to the maximum expected depth of any utilities (commonly 5 feet or greater) to check that underground utilities are not present at the borehole. The driller should be informed of any known shallow subsurface hazards (unidentifiable utility, trapped vapors, etc.). Drilling the surface hole should commence slowly to allow continuous visual inspection and, if necessary, any interruptions for probing until the anticipated maximum depth of any suspected obstructions is exceeded.

4.3.1 Borehole Drilling

During drilling operations, and as the borehole is advanced, the Field Geologist will generally:

- Observe and monitor rig operations
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance
- Prepare a lithologic log from soil samples or cuttings per SWE-FSOP-201, “Soil Classification”
- Supervise the collection of, and prepare the soil, soil vapor, and groundwater samples
- Soil sampling for volatile organic compounds may require removing (tripping out) the entire inner drill string to collect a representative sample
- Groundwater sampling may be performed by retracting the outer casing and allowing water to flow in and be sampled using a bailer or by using a hydropunch-type sampler
- For specific soil and groundwater sampling procedures, refer to the project-specific work plans and appropriate FSOP

4.3.2 Ongoing Monitoring

The Field Geologist should observe and frequently communicate with the driller regarding drilling conditions as drilling progresses. This includes relative penetration rates (indicative of fast or slow drilling) and chattering or bucking of the rig.

- The Field Geologist oversees or conducts appropriate health and safety sampling and monitoring.
- The conditions described above, including the relative drilling rate, should be recorded on the boring log.
- The Field Geologist should know the total depth of the borehole during drilling.
- Drilling should not progress faster than the Field Geologist can adequately observe conditions, compile boring logs, and supervise safety and sampling activities.
- The Field Geologist should also observe the rig operations, including the make-up and tightening of connections as sections are added to the drill string.

- During drilling, track and note changes in the drilling process (e.g., sounds, rotation speed, sudden drops, etc.) that may indicate changes in lithology, material density, etc., and collect representative soil samples as required by the project work plans.
- Any observed problems that include significant downtime and their causes are recorded in the FLB/notepad.
- Cuttings and fluids containment during drilling should be observed and supervised by the Field Geologist, as per specifications in the project work plans.

If any potentially unsafe conditions are evident during the above drilling observations, the Field Geologist (or any onsite person) may suspend drilling operations and take appropriate actions as per the health and safety plan.

In the event suspension of drilling activities occur:

- The FTL and Safety Representative must be informed of the situation
- Appropriate corrective action must be implemented before drilling may be continued
- The observed problem, suspension, and actions taken are entered on the FLB/notepad

4.3.3 Boring Log

During drilling, the Field Geologist compiles a boring log. Use field form SWE-FFRM-400. It is expected that the log can be compiled from continuous cores or fairly representative cuttings within the core barrel recovered while drilling. Observations of drilling conditions are also entered on the log. If total depth was reached prematurely due to refusal, the cause should be noted on the boring log and the FLB.

If a monitoring well is to be installed in the borehole, a Field Geologist must supervise the work following FSOP-601, “Well Installation.”

4.4 Borehole Abandonment

If the borehole is to be abandoned after completion, the anticipated quantity of grout determined in advance and tracked during placement.

Grout consists of a neat cement mixture containing three to five percent bentonite powder to water by weight. The grout is emplaced as a slurry. The type and composition of the grout mixture should be specified in the project work plans or as determined by the Project Geologist.

Tremie-grout the borehole from bottom to top through the inside of the casing as it is retracted to ensure the grout level does not fall below the bottom opening of the casing. When the grout has reached the prescribed level (e.g., ground surface or less if special site restoration is required), allow the grout to settle and cure.

Contain any water or fluids displaced by the neat cement and contain IDW. Excess neat cement shall be placed in portable metal bins or equivalent and disposed of as solid IDW after it is allowed to set.

After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement hardens, and no settlement has occurred.

Restore the final surface per the work plan and applicable specifications (e.g., repair asphalt/cement, soil placement).

If a monitoring well is to be installed in the borehole, activities will be supervised by the Field Geologist following FSOP-601, "Well Installation."

4.5 Demobilization/Site Restoration

After drilling, sampling, and well installation or borehole abandonment is completed, the casing, drill string, and tools should be laid down, the mast lowered, and the rig moved off the location. The FTL or designee should supervise the demobilization/site restoration.

All debris generated by the drilling operation should be disposed of appropriately. The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans. All abandoned borings should be topped off and completed per the project work plans. All monitoring wells should also have their surface completions finished per the project work plans. Any hazards remaining due to drilling activities should be identified, and appropriate barriers and markers should be put in place, as per the APP. All soil cuttings and fluids should be adequately contained, clearly labeled, and maintained to comply with the project work plans.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for drilling and field documentation review will be performed by the FTL or PL to check that procedures and documentation content and level of detail comply with this SOP. If a deficiency or a variance was taken to the SOP, the PL should document the deficiency/variance and determine the need for corrective action in coordination with the QA Manager.

If a non-registered geologist performs the oversight, a registered Project Geologist is responsible for reviewing the fieldwork documentation for the accurate and complete representation of the drilling and approval of final logs.

6.0 Documentation Review

The FTL is responsible for daily review of the activities performed at the site and fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

None cited

Groundwater Well Installation

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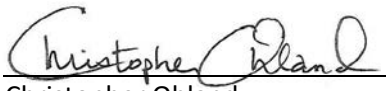
Approvals



October 10, 2022
Christopher Ohland
SWE Quality Assurance Manager
Date

October 10, 2022
Bruce Wilcer
SWE Field Quality Control Manager
Date

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS-friendly supplies and procedures

Table of Contents

Introduction

1.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide field staff with the proper techniques and documentation requirements to install groundwater monitoring, extraction, and temporary wells (hereafter referred to as "groundwater wells")

1.2 Scope

The scope of this SOP applies to field staff conducting well installation oversight. The SOP includes guidance for the performance, management, and completion of installation activities, including a description of staff responsibilities, relevant documentation, equipment, procedures, and quality control. Project-specific accident prevention plans (APP) and Site Safety and Health Plans address potential hazards related to well installation.

Per- and polyfluoroalkyl substances (PFAS) friendly procedures are also provided in this SOP. When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Projects].

1.3 Responsibilities

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Field Geologist. A Field Geologist is responsible for field completion drilling activities, including borehole logging and well construction according to project specifications. The Field Geologist is a registered geologist or a person performing work under the supervision of a registered geologist.

Project Geologist. The registered Project Geologist is responsible for oversight of the drilling subcontractor, well design, well installation activities, and field documentation. When a Field Geologist performs the oversight, the Project Geologist is responsible for fieldwork variances/deficiencies, completeness, and accuracy of field documentation.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of the current version of U.S. Army Corps of Engineers EM-385-1-1 *Safety and Health Requirements*. The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. If the circumstance warrants, the FTL approves those actions and notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of the Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Air Rotary Casing Hammer Drilling. A drilling method using a nonrotating drive casing that is advanced simultaneously with a slightly smaller diameter rotary bit attached to a string of drill pipe. Air is forced down through the center drill pipe to the bit, and the upward return stream through the space between the drive casing and the drill pipe removes cuttings from the bottom of the borehole.

Annular Space. The space between any of the following:

- Concentric drill pipes
- An inner drill pipe and outer drive casing
- Drill pipe or drive casing and the borehole wall
- Well screen or casing and the borehole wall

Borehole. Any hole drilled into the subsurface to identify lithology, collect soil samples, and install groundwater wells.

Cuttings. Pieces of soil, sediment, or rock-cut by a bit in drilling borings.

Extraction Well. A well used primarily to remove contaminated groundwater.

Filter Pack. Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole to increase the effective diameter of the well and prevent fine-grained material from entering the well.

Grout. For this SOP, the term "grout" consists of a neat cement grout generally containing three to five percent bentonite powder to water by weight. The grout is emplaced as a slurry. When correctly set and cured, it can restrict the movement of water.

Hollow Stem Auger Drilling. A drilling method using augers with open centers. The augers are advanced with a screwing or rotating motion into the ground. Cuttings are brought to the surface by the rotating action of the augers, thereby clearing the borehole.

Monitoring Well. A well that provides the collection of representative groundwater samples, the detection and collection of representative light and dense non-aqueous phase organic liquids, and the measurement of fluid levels.

Mud Rotary Drilling. For this SOP, the term "mud rotary drilling" refers to direct circulation (as opposed to reverse circulation) mud rotary drilling. Mud rotary drilling uses a rotating drill bit, and drilling mud is pumped through the inside of the drill pipe and the bit. The mud flows upward in the annular space between the borehole and the drill pipe, carrying the cuttings in suspension to the surface.

Sonic Drilling. A drilling method using high-frequency, resonant energy generated inside the sonic head to advance a core barrel or casing into subsurface formations. Sonic drilling is most often used when

drilling (whether through particular ground materials or to a particular depth) is difficult, and the integrity of the core sample is extremely important.

Tremie. A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space.

Well Screen. A perforated, wire-wound, continuous wrap, or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand and fine particulates.

2.0 Relevant Documents

This SOP focuses on the oversight and documentation of well installation activities and should be used in conjunction with state, county, and local well standards and other applicable SOPs, including the following:

Standard Operating Procedures

- SWE-FSOP-001 Field Documentation
- SWE-FSOP-300 Series (various drilling methods)
- SWE-FSOP-801 Equipment Decontamination
- SWE-FSOP-802 Investigation Derived Waste Management

Field Forms

- SWE-FFRM-401, Well Construction
- SWE-FFRM-004, Daily PFAS Sampling Checklist [PFAS Projects]

3.0 Equipment and Materials List

The list below identifies equipment expected to be used by staff while supervising well-installation activities.

- A bound, waterproof field logbook (FLB; e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation

  [PFAS Project]: Field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

- Waterproof, indelible pens/markers in black or blue ink

  [PFAS Project]: Use ball-point pens. Do not use markers, felt pens, or pens with water resistant ink.

- Digital camera/video, cell phone, or other devices capable of digital imagery
- Appropriate PPE

The following materials are usually required for monitoring well installation. Review project-specific work plans for specific or unique materials or installation procedures.

- Steel protective locking cover or flush-mount well box and locking cap

- Flush-threaded riser pipe/"blank casing, " typically Schedule 40 or Schedule 80 polyvinyl chloride (PVC), typically sized at two-inch or four-inch diameter for permanent monitoring wells and work-plan-specified diameters for temporary wells, extraction wells, etc.
- Flush-threaded well screen, typically matching diameter and wall thickness of the riser pipe/"blank casing," with a slot size determined in advance based on site conditions and project objectives
- Measuring tape
- Plastic sheeting to protect decontaminated well materials

  [PFAS Project]: Clean, dry well materials should be stored within a protective medium (e.g., HDPE bag) or staged in a clean area for future use.

- Threaded or slip end cap
- Centralizer(s), as needed
- Silica sand (sized based on the formation material)
- Bentonite pellets or chips (for well seal or borehole fill according to project requirements)
- Pure bentonite powder and cement (for grouting wells; confirm the type of each and mixture specifications)
- Tremie pipe

4.0 Procedures

Procedures are provided for:

- Pre-Fieldwork tasks (Section 4.1)
- Field Preparation (Section 4.2)
- Mobilization and Set-Up (Section 4.3)
- Well Installation (Section 4.4)
- Temporary Monitoring Wells (Section 4.5)
- Demobilization/Site Restoration (Section 4.6)

4.1 Pre-Fieldwork Tasks

It is essential to be thoroughly familiar and compliant with state, county, or local well installation standards, codes, etc. They may contain requirements that must be used in conjunction with procedures presented in this SOP.

Site-specific factors must be considered in the selection of well installation and completion materials, specification of well designs, and well-drilling methods. The well design and other specifications are incorporated into project work plans or as the FTL/PL directs.

4.1.1 Clearances

Before starting any sonic boring, confirm that drilling locations have been appropriately cleared of potential overhead, surface, and subsurface hazards per the project work plans. This should include a utility locating subcontractor to identify subsurface infrastructure and anomalies. The clearance process also includes completing public utility locating service calls (e.g., Dig Alert, USA North 811, etc.) and

completing any coordination and permitting procedures with the onsite Department/Directorate of Public Works personnel required by the project contract.

- Review available forms and diagrams that document the selected location of the drilling location relative to underground/overhead utility lines, surface structures, or buried objects.
- Copies of the site clearance documents should be kept onsite.

4.1.2 Health and Safety

- Hold Tailgate Safety Meetings in the manner and frequency stated in the health and safety plan.
- All personnel at the site should have appropriate training and qualifications as per the health and safety plan.
- All personnel within the exclusion zone should pay close attention to rig operations during drilling. The rotating or swinging drilling components can snag or catch loose clothing or strike personnel and cause severe injury or death.
- Hearing protection is especially critical when sonic drilling, as the rig can generate high-frequency noise and considerable noise when drilling through gravel and cobbles.
- Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the driller of any unforeseen hazard—or when anyone is approaching the exclusion zone.

4.1.3 Site Conditions and Drilling Logistics

Prepare the site per the project work plans. Before mobilizing, determine the logistics of drilling, logging, sampling, cuttings/fluid containment, and well construction. The FTL or the Field Geologist should assess the drilling site with the driller. This assessment should identify potential hazards (i.e., slip/trip/fall, overhead power lines) and determine how drilling operations may impact the environment (i.e., dust, debris, noise). As per the project work plans, potential hazards should be evaluated and corrected, or the borehole location changed or shifted.

- Drill site space requirements commonly include an area for the rig and swing-out clearances, access for a pipe truck, and forklift carrying pipe or debris bins.
- The FTL or the Field Geologist should inform the driller of the appropriate equipment (e.g., cookie-cutter, etc.) to penetrate the surface cover (e.g., asphalt, concrete, cement, etc.).
- Lubricating compounds used on drill pipe and drive casing threads must be approved in advance and must not contain compounds incompatible with project objectives, laboratory analyses, or water quality guidelines.
- Drive casings of various lengths should be provided by the subcontractor to facilitate emplacement of the sand pack, bentonite seal, and grout during well construction. One 3-foot, two 5-foot, and two 10-foot lengths and enough standard-length drive casing joints are recommended.
- A hydraulic casing extractor must be used to remove the drive casing from the borehole. Do not extract the casing by "hammering up" with the casing hammer. The hydraulic casing extractor should have sufficient pulling capacity and clamping mechanisms to extract the casing safely and smoothly with the appropriate lifting force.

4.1.4 Rig Decontamination and Preparation

- All drilling and sampling equipment should be decontaminated before drilling per SWE-FSOP-801. "Equipment Decontamination"
- The drilling equipment shall be inspected for proper maintenance and appropriate decontamination before each time the rig is mobilized to a site
- All clutches, brakes, and drive heads should be properly working
- All cables and hydraulic hoses should be in good condition
- Any observed leakage of fluids from the rig should be immediately repaired and decontaminated again before it is allowed to mobilize

4.1.5 Calibrations

Before mobilization, calibrate the safety-related sampling and monitoring equipment.

4.1.6 Personal Protective Equipment (PPE)

Provide workers with the appropriate PPE as specified by the project work plans.

4.2 Mobilization and Set-Up

The standard procedure for installing groundwater wells is described below, and the project work plans may include additional specifications.

4.2.1 Site Preparation

The logistics of drilling, cuttings/fluid containment, and well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

- As per the site health and safety plan, appropriate barriers and markers should be in place before drilling
- Plastic sheeting (e.g., Visqueen™) may be required beneath the rig
- Appropriate cuttings and other IDW containment should be set onsite before the commencement of drilling
- If drilling is conducted in the saturated zone, provisions should be made to ensure adequate containment of formation water produced during drilling operations
- Clear the work site of all brush and minor obstructions and then mobilize the rig to the monitoring well location

4.2.2 Discussion of Site Conditions

Before drilling operations begin, the following must be completed:

- The FTL or Field Geologist should assess the drilling site with the driller. This assessment should identify potential hazards and determine how drilling operations may impact the environment.
- As per the project work plans, potential hazards should be evaluated and corrected, or the borehole location changed or shifted.
- If a shallow subsurface hazard (i.e., unidentifiable utility or trapped vapors) may exist, the driller should be informed of the potential hazard before breaking ground. Drilling should then commence slowly to allow continuous visual inspection and monitoring and, if necessary, stop for probing.

4.2.3 Mobilization

Once the site is prepared, the rig is mobilized and located over the borehole.

- The drill rig is mobilized to the site and located over the borehole location
- The drill rig is leveled with a set of hydraulic pads attached to the front and rear of the drill rig
- The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig and avoid obstructions or hazards

4.3 Well Installation Procedures

4.3.1 Drilling

The following procedures assume that the drilling of the borehole occurred per the project work plan and appropriate SOPs (see SWE-FSOP-300 Series [various drilling methods]).

During fieldwork, the Field Geologist will generally:

- Observe and monitor rig operations
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance

4.3.2 Borehole Preparation

At total depth, remove soil cuttings through circulation or rapidly spin the augers before constructing the well. Review logs and notes with the driller for any zones or depths exhibiting drilling problems that may affect the well installation. Condition the hole or take other actions mutually agreed upon by the Field Team (FTL, PL, Field/Project geologist, driller) to aid in the well installation.

Remove the drill pipe and bit if using rotary techniques, or remove the center bit if using the hollow stem auger technique. Install the well construction materials inside the open borehole or through the drive casing or augers center.

Measure the total depth of the completed boring using a weighted sounding line. The borehole depth is checked to assure that formation material has not heaved to fill the borehole. If heaving has taken place, discuss cleaning, re-drilling, or installation options in the open section of the boring with the Field Team (FTL, PL, Field/Project geologist, or driller).

4.3.3 Grouting Overdrilled Boreholes

If the hole was over drilled to a depth greater than needed for well installation, backfill material such as grout, bentonite pellets, or bentonite chips (as specified in the project work plans) may be added to the bottom of the boring to raise the bottom of the hole to the desired depth.

- Before placing materials, confirm the borehole dimensions and calculate the estimated volume of material required, including allowances for hydration of dry materials.
- Closely monitor the progress of borehole backfilling by frequently tagging the level in the borehole and comparing against estimated fill quantities. This is especially important if irregularities in the borehole are suspected (e.g., voids, sloughing).

- Pump grout through a tremie pipe and fill the borehole from the bottom of the boring upward. During grouting, submerge the tremie pipe below the top of the grout column in the borehole to prevent free fall and bridging.
- Add gradually to prevent bridging if bentonite solids (chips/pellets) are used.
- Obtain approval of the final depth of the borehole in advance from the FTL or PL. Stop grout or bentonite addition when the general level has reached approximately one foot below the desired base of the well string (casing, screen, end plug or sump, etc.). Hydrate the bentonite plug for at least one hour before installing a filter pack.

4.3.4 Assembling and Installing Well Casing

Before installation, inspect the casing, screen, silt traps, end caps, centralizers, locking covers, and any other well construction materials to confirm that no damage has occurred during shipment and decontamination activities.

During the inspection, confirm that all well component materials, dimensions, and quantities are accurate before proceeding. This includes confirming that the slot size on well screens matches project specifications.

If centralizers (commonly stainless steel) are used, confirm placement throughout the well string with the FTL, PL, or Field/Project geologist as appropriate.

Assemble and carefully lower the well string through the open borehole, drive casing, or inside the augers until the well string is at the desired depth. Suspend the well string by the installation rig, so it does not rest on the bottom of the boring. If the well string was dropped, lowered abruptly, or for any other reason suspected of being damaged during placement, the string should be removed from the boring and inspected.

In certain instances, the well string may rise after being placed in the borehole due to heaving sands. If this occurs, the driller must not place any drilling equipment (drill pipe, hammers, etc.) to prevent the casing from rising.

The Field Geologist notes the amount of rise and consults with Project Geologist for an appropriate course of action.

Record the following information in the FLB/notepad or field form SWE-FFRM-401, “Well Construction.”

- Diameter of the well boring
- Total depth of well boring
- Length of blank casing
- Length of well screen
- Length of the well end cap or silt trap
- Depth to base of well string
- Depth to top and bottom of well screen
- Depths of centralizers, if used

4.3.5 Installing Filter Pack

Based on borehole and well casing dimensions, calculating volumes of filter pack, bentonite pellets/slurry, and grout required. If the project work plans require, determine the filter pack and well screen slot size for the monitoring or extraction well.

Place a layer of filter pack (one to two feet, unless otherwise specified in the project-specific work plans) at the bottom of the borehole.

- When constructing wells within a cased hole or through hollow stem augers, install the filter pack by pouring and allowing it to free-fall through the center of the drive casing/augers or tremie according to project work plans. Add filter pack slowly while withdrawing the drive casing/augers. Take care to minimize the height of the filter pack inside the auger/drive casing during pouring to avoid potentially "sand locking" the well casing and pulling it up with the auger/drive casing.
- Using drive casing or augers, pull the drive casing or augers slowly during filter pack installation in increments no greater than five feet.
- For the mud rotary drilling technique, tremie the filter pack into the annular space around the screen. If approved, clean, potable water may be used to assist with the filter pack tremie operation.

Monitor filter pack settlement by initially measuring the sand level (before beginning to withdraw the drive casing/augers). Repeatedly take depth soundings using a weighted tape to continually monitor the level of the sand in the auger/drive casing as it is removed. Monitor the top of the well casing to detect any movement due to settlement or from drive casing/auger removal. If the top of the well casing moves upwards at any time during the well installation process, the driller should not be allowed to set drilling equipment (downhole hammers, drill pipe, etc.) on the top of the casing to prevent further movement, which could cause the well casing to bend or break in the borehole.

Add filter pack until its height is approximately two feet above the top of the screen (unless otherwise specified in the project work plans), and conduct verification of its placement (by sounding). Then gently surge the filter pack using a surge block or swab to settle the packing material and reduce the possibility of bridging.

Resound the height of the filter pack and add more filter pack, placed as necessary. Once filter pack placement is complete, measure and record the depth to the top of the pack in the FLB/notpad or field form SWE-FFRM-401, "Well Construction."

4.3.6 Installing Seals

Install a three-foot thick (unless otherwise specified in the project work plans) bentonite seal on top of the filter pack. If pellets or chips are used, add them gradually to avoid bridging. Take repeated depth soundings using a weighted tape to ascertain the top of the bentonite seal. Allow the seal to hydrate for at least 30 minutes before proceeding with the grouting operation.

After hydration of the bentonite seal, pump grout through a tremie pipe and fill from the top of the bentonite seal upward.

- Unless otherwise specified, cement grouts should be mixed using approximately 6 to 7 gallons of water per 94-pound bag of Type I/II Portland cement to a density of approximately 15 pounds/gallon.
- If needed, add bentonite (5 to 10 percent) to the cement grout to strengthen the mix and delay the setting time.
- Specific mixtures and other types of cement and grout proposed should be evaluated on a case-by-case basis by the field geologist and communicated to the drillers.

During grout installation, maintain the bottom of the tremie pipe below the top of the grout to prevent free fall and bridging. When using drive casing or hollow stem auger techniques, raise the drive casing/augers in short increments during grout pouring, keeping the bottom of the drive casing/augers below the top of the grout. It is essential to calculate the approximate volume of grout required; note reduced/excessive volumes, which may indicate irregularities in the annulus or grout flow into a formation. Cease grouting when the grout level has risen to approximately one to two feet of the ground surface, depending on the surface completion type (flush-mount versus aboveground). Monitor grout levels to ensure that grout taken into the formation is replaced by additional grout. If settling occurs, additional topping off of the grout may be necessary.

4.3.7 Protective Casing

For aboveground completions, place the protective steel casing (e.g., lockable "stovepipe") over the top of the well casing and insert it into the freshly grouted annulus. Before installation, place a 2-inch thick temporary spacer between the PVC well cap and the bottom of the protective casing cover to keep the protective casing from settling onto the well cap. Note: confirm the final clearance required between the top of the well casing and the cover; additional room may be needed for dedicated well equipment.

After the protective casing is set in the grout, a drainage hole may be drilled into the protective casing if required in project work plans. The drainage hole is positioned approximately two inches above ground surface. Paint the protective casing with rust-preventive colored paint. Make sure the well is protected from potential vapors from paint.

Label the wellhead to provide information such as well number, depth, and date of the installation based on project requirements.

Wait 24 hours after grouting before installing concrete pad and steel guard posts (bollards) for aboveground completions or street boxes or vaults for flush-mount completions.

Aboveground Completions

A concrete pad, usually 3-foot by 3-foot by 4-inch thick, is constructed at ground surface around the protective steel casing. The concrete is sloped away from the protective casing to promote surface drainage away from the well.

Where traffic conditions warrant extra protection, embed three to four steel guard posts (bollards) to a depth approximately 1.5 feet below ground surface with three to four feet of stickup depending on project requirements. Install the posts in concrete-filled post holes spaced equally around the well, commonly at 1.5 feet from the protective steel casing (check work plan for exact specifications). Where posts are removed for well access, embed mounting sleeves into the concrete.

Flush-Mount (or Subgrade) Completions

Before installing any street box or vault over a well, confirm all clearances between the well cap and inside vault lid and the final height of the vault top above ground surface. Where installations are in parking lots, roads, concrete slabs, etc., consider the final height of the surrounding surface.

Set and cement into position a street box or vault, usually one inch to a few inches above ground surface, depending on design requirements. Raise the top of the street box or vault slightly above grade, and the cement sloped to grade to promote surface drainage away from the well.

4.4 Temporary Monitoring Wells

4.4.1 Temporary Well Materials

Materials used in installing temporary monitoring wells are the same standard materials used in the installation of permanent monitoring wells.

Sand used for the filter pack (if any) should be as specified in the work plan. The well screen and casing should be stainless steel (for ruggedness and suitability for steam cleaning and solvent rinsing) or polyvinyl chloride. Appropriate Quality Assurance (QA) and Quality Control (QC) must be performed to ensure no introduction of contaminants.

4.4.2 Temporary Well Borehole Construction

Ensure that borehole construction for temporary wells is of sufficient diameter to accommodate the well casing and associated well construction materials.

For well installation in an open borehole using a drill rig, ensure the annular space is approximately 2 inches to allow the uniform deposition of well materials around the screen and riser and allow the passage of tremie pipes and well materials without unduly disturbing the borehole wall. Alternatively, boreholes may be constructed using hand augers or portable powered augers (generally limited to depths of ten feet or less). If a drill rig is used to advance the borehole, the augers must be pulled back the length of the well screen or entirely removed before sampling.

When hand augers are used, the borehole is advanced to the desired depth (or to the point where borehole collapse occurs). When borehole collapse occurs, the auger bucket is typically left in the hole at the point of collapse while the temporary well is assembled above ground. When the well is completely assembled, a final auger bucket of material is quickly removed, and the well is immediately inserted into the borehole, pushing, as needed, to achieve maximum penetration into the saturated materials.

4.4.3 Temporary Monitoring Well Types

Temporary monitoring wells are constructed in various ways depending on project requirements and site conditions. A few acceptable examples are described below. Because temporary well purposes and construction are project-specific, detailed procedures for construction should be included in project work plans.

1. **No Filter Pack.** After the borehole is completed, the casing and screen are simply inserted. This is the least expensive and fastest well to install. **Note:** *This type of well is extremely sensitive to*

turbidity fluctuations because there is no filter pack. Take care not to disturb the casing during purging and sampling.

2. **Traditional Filter Pack**. The screen and casing are inserted into the borehole, and the sand is poured into the annular space surrounding the screen and casing. **Note**: *Occasionally, it may be difficult to effectively place a filter pack around shallow open boreholes due to collapse. This method requires more sand than the "inner filter pack." As the filter pack is placed, it mixes with the muddy water in the borehole, which may increase the amount of time needed to purge the well to an acceptable level of turbidity*.
3. **Well-in-a-Well**. The borehole is advanced to the desired depth. A 1-inch well screen and sufficient riser are inserted into a 2-inch well screen with sufficient riser and then centered. Filter pack material is then placed into the annular space surrounding the 1-inch well screen, approximately 6 inches above the screen. The assembled well is then inserted into the borehole.

Temporary wells are commonly used for short periods (days/weeks) and should be decommissioned when no longer needed. See FSOP-603 Well Decommissioning for procedures.

4.5 Demobilization/Site Restoration

All debris generated by the drilling operation/well construction should be disposed of appropriately. The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans. All monitoring wells should finish their surface completions as per the project work plans. Any hazards remaining due to drilling activities should be identified, and appropriate barriers and markers should be put in place, as per the APP. All soil cuttings and fluids should be adequately contained, clearly labeled, and maintained to comply with the project work plans.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for well installation field documentation review will be performed by the FTL or PL to check that procedures and documentation content and level of detail comply with this SOP. If a deficiency or a variance was taken to the SOP, the PL should document the deficiency/variance and determine the need for corrective action in coordination with the QA Manager.

If a non-registered geologist performs the oversight, a registered Project Geologist is responsible for reviewing the fieldwork documentation for the accurate and complete representation of the drilling and approval of final logs/forms.

6.0 Documentation Review

The FTL is responsible for the daily review of the fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

The PL is responsible for the review and signoff of final approved documents stored in the project file.

7.0 References

None cited.

Groundwater Well Development

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Approvals

Christopher Ohland — October 10, 2022
Christopher Ohland
SWE Quality Assurance Manager
Date

Bruce Wilcer — October 10, 2022
Bruce Wilcer
SWE Field Quality Control Manager
Date

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS-friendly supplies and procedures

Table of Contents

Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation of for developing temporary and permanent groundwater monitoring and extraction wells (hereafter referred to as "groundwater wells") after their installation and before their designated use. This method may also be used as part of rehabilitation or re-development of a well during its lifecycle.

The details within this SOP should be used in conjunction with project-specific work plans, Accident Prevention Plans (APP) and Site Safety and Health Plans.

1.2 Scope

The scope of this SOP applies to field staff performing or conducting oversight of groundwater well development. The SOP includes guidance for the performance, management, and completion of development activities, including a description of staff responsibilities, relevant documentation, equipment, procedures, and quality control. Project-specific APP and Site Safety and Health Plans address potential hazards related to well development.

Per- and polyfluoroalkyl substances (PFAS) friendly procedures are also provided in this SOP. When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Projects].

1.2.1 Resources and Requirements

In addition to project-specific procedures and requirements, it is essential to be thoroughly familiar and compliant with state, county, or local well installation (and development) standards, codes, etc. as they may contain requirements that must be used in conjunction with, or instead of procedures presented in this FSOP.

1.3 Responsibilities

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Field Geologist. A Field Geologist is responsible for overseeing development activities according to project specifications. The Field Geologist is a registered geologist or a person performing work under the supervision of a registered geologist.

Project Geologist. The registered Project Geologist is responsible for oversight of the well development subcontractor and field documentation. When a Field Geologist performs the oversight, the Project Geologist is responsible for fieldwork variances/deficiencies, completeness and accuracy of field documentation, and approval of the well development completion.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is

responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of the current version of U.S. Army Corps of Engineers EM-385-1-1 *Safety and Health Requirements*. The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. If the circumstance warrants, the FTL approves those actions and notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of the Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Bailer. A bottom-filling cylindrical tube with an open top and check valve at the bottom used to remove water and sediment from a borehole or well.

Bailing. A well development technique uses a bailer raised and lowered in the well to create a strong inward and outward movement of water from the formation, break sand bridges, and remove water and fine-grained materials from the well.

Extraction Well. A well designed to extract fluids (such as water, gas, free product, or a combination) from the subsurface.

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. Each data entry field should have an entry or indicate that data for that field is not available or not required.

> [PFAS Project]: Record of field events will be maintained on loose paper (PFAS-free) secured on Masonite or aluminum clipboards. Plastic clipboards, binders, or spiral hard cover notebooks are not acceptable. Field logbooks are permanently assigned to a specific project.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

> [PFAS Project]: Use field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

Field Notepad – A unbound notepad or loose-leaf paper with consecutively numbered pages.

Investigation Derived Waste (IDW). Waste that is generated in the process of investigating or examining a contaminated site.

Monitoring Well. A well that provides the collection of representative groundwater samples, the detection and collection of representative light and dense nonaqueous phase organic liquids, and the measurement of fluid levels.

Mudwall. A layer of fine-grained soils formed around the boring annulus during drilling can impede the formation water's free flow into a well.

Piezometer. A tube placed in soil to depths below the water table extends to the soil surface and opens to the atmosphere. The bottom of the piezometer is perforated or slotted to allow groundwater water under positive hydrostatic pressure to enter the tube.

Surging. A well development technique in which a surge block is alternately raised and lowered within the well casing or screen to create a strong inward and outward movement of water through the well screen. Surging helps remove fine-grain material from the boring wall and the filter pack.

Turbidimeter. An instrument measuring the turbidity (the cloudiness or haziness of fluid caused by individual particles) of a liquid.

Well Casing. A durable pipe placed in a borehole to prevent the walls of the borehole from caving in, and to seal off surface drainage or undesirable water, gas, or other fluids, and prevent their entrance into the well.

Well development. The act of removing fine-grained sediment and drilling fluids from the sand pack and formation in the immediate vicinity of the well, thus increasing the porosity and permeability of the materials surrounding the intake portion of the well.

Well Screen. A perforated, wire-wound, continuous wrap, or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand and fine particulates.

2.0 Relevant Documents

Standard Operating Procedures

- SWE-FSOP-001, Field Documentation
- SWE-FSOP-101, Water Quality Measurements
- SWE-FSOP-102, Groundwater and NAPL Measurements
- SWE-FSOP-801, Equipment Decontamination
- SWE-FSOP-802, IDW Management

Field Forms

- SWE-FFRM-004, Daily PFAS Sampling Checklist [PFAS Projects]
- SWE-FFRM-402, Well Development
- SWE-FFRM-501, Water Level/NAPL Measurements
- SWE-FFRM-801, Equipment Calibration

3.0 Equipment List

The list below identifies equipment expected to be used by staff while supervising well development activities.

- A bound, waterproof field logbook (e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation

  [PFAS Project]: Use field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

- Waterproof, indelible pens/markers in black or blue ink

  [PFAS Project]: Ball-point pens: do not use markers, felt pens, or pens with water resistant ink

- Digital camera/video, cell phone, or other devices capable of digital imagery

For monitoring well development, the following materials are usually required. Review project-specific work plans for specific or unique materials or installation procedures:

- Surge block on a cable or line (commonly on a development rig)
- Submersible pump, peristaltic pump, and bailer (Note: bladder and gear pumps are not recommended because of pump damage from fine sediments)
- Groundwater purge container, tank, or drum of known volume for flow estimation
- Water quality monitoring instrument(s) (e.g., YSI Water Quality Meter) capable of measuring parameters such as dissolved oxygen (DO), oxidation-reduction potential (ORP), conductivity, pH, turbidity, and temperature
- Clear glass jars (at least 2)

  [PFAS Project]: Two clear PFAS-free containers

- Water level indicator
- Measuring tape/sounder
- Decontamination equipment including soap (i.e., Liquinox™), de-ionized and tap water
- Plastic sheeting to protect decontaminated tools

  [PFAS Project]: Clean, dry development equipment should be stored within a protective medium (e.g., HDPE sheeting) or staged in a clean area for future use.

4.0 Procedures

This section contains procedures for developing groundwater wells. Additional guidance can be found in SWE-FSOPs listed in Section 2.0 and references in Section 7.0.

Procedures are provided for:

- Preparation Tasks (Section 4.1)
- Mobilization and Setup (Section 4.2)

- Development Procedures (Section 4.3)
- Documentation (Section 4.4)
- Demobilization/Site Restoration (Section 4.5)

4.1 Pre-Field Tasks

Preparation and coordination tasks for sonic drilling generally include the activities described below.

4.1.1 Clearances

Before starting well development, confirm that groundwater well locations have been appropriately cleared of potential overhead, surface, and subsurface hazards per the project work plans. Before raising the mast on any development rig, ensure appropriate clearances are maintained from nearby/overhead structures and power and communication lines.

4.1.2 Health and Safety

- Hold Tailgate Safety Meetings in the manner and frequency stated in the health and safety plan.
- All personnel at the site should have appropriate training and qualifications as per the health and safety plan.
- All personnel within the exclusion zone should pay close attention to rig operations during well developmnet. Rotating or swinging components can snag or catch loose clothing or strike personnel and cause severe injury or death.

4.1.3 Rig Decontamination and Preparation

Decontaminate all downhole equipment, sounders, bailers, pumps, and other materials used during well development. Procedures should follow SWE-FSOP-801 (Equipment Decontamination).

[PFAS Project]: In general, all well development equipment will be washed with certified PFAS-free potable water and detergents such as Alconox, Liquinox or Citranox and should end with a triple rinsing with laboratory certified PFAS-free de-ionized water. If another source is used, a sample should be collected and tested for PFAS. If the concentrations are low enough to meet project Data Quality Objectives, the water is acceptable for use.

Wherever possible, development equipment should also be rinsed immediately before use.

4.1.4 Calibrations

Before mobilization, calibrate the safety-related sampling and monitoring equipment, water quality meters, and other measuring devices according to the instrument manufacturer's specifications.

4.1.5 Personal Protective Equipment (PPE)

Provide workers with and don the appropriate PPE specified by the project work plans.

4.2 Mobilization and Setup

The standard procedure for well development is described below. Project work plans may have additional specifications.

4.2.1 Site Preparation

Before mobilizing, the logistics of well development, fluid containment, and site management should be determined. The site should be prepared as per the project work plans.

- Appropriate barriers and markers should be in place prior to well development, as per the site health and safety plan
- Plastic sheeting (e.g., Visqueen™) may be required beneath the rig
- Appropriate IDW containment should be set onsite prior to the commencement of well development

4.2.2 Discussion of Site Conditions

Before development operations begin, the following must be completed:

- The FTL or designee should assess the well site with the driller. This assessment should identify potential hazards and determine how operations may impact the environment
- As per the project work plans, potential hazards should be evaluated and corrected
- Potential hazards should be evaluated and corrected
- If hazard(s) (e.g., free product, vapors) may exist, the driller should be informed of the potential hazard(s) before starting work

4.2.3 Mobilization

Once the site is prepared, the rig is mobilized and located over the groundwater well.

- Level the rig with a set of hydraulic pads attached to the front and rear of the rig
- Raise the mast slowly and carefully to prevent tipping or damaging the rig and avoid obstructions or hazards
- Appropriate barriers and markers should be in place before drilling, as per the site health and safety plan

4.3 Development Procedures

Perform well development as soon as practical after well installation, but in compliance with applicable state or local requirements for seal curing times, which may range from a minimum of 48 to 72 hours following well installation.

> [PFAS Project]: The cap and all internal components of the well casing above the water table shall be rinsed with PFAS-free water to remove all traces of soil, sediment, and cuttings, before and/or during well development. Dedicated materials shall be used for well development.

Record details of development activities in the Well Development form (SWE-FFRM-402.00).

1. Measure and record the water level and total depth of the well using a water level indicator per SWE-FSOP-102 (Groundwater and NAPL Measurements). Note any accumulated sediment thickness, and record information in the FLB and on form SWE-FFRM-402.00 (Well Development).
2. Begin well development by removing any accumulated sediment from the bottom of the well using the bailer. Repeat this process until as much accumulated sediment as possible has been removed from the bottom of the well.

3. Begin surging the entire well screen using a surge block. A general rule for well development is to start slowly and gently, and gradually increase agitation as the well is developed. After a minimum of fifteen minutes, remove the surge block and immediately begin to bail the sediment-laden water. The length of time required at this stage will depend on various conditions such as water clarity, sediment levels, etc. Contain all development water for proper disposal, according to the site-specific work plan and SWE-FSOP-802 (Investigation Derived Waste Management).
4. Repeat surging and bailing for several cycles developing the well from the bottom of the screened interval upward by alternately using the surge block and the bailer. Record the surge interval and duration of surging and bailing.
5. During development, monitor the clarity of the water removed from the well. Measurements can be collected using a calibrated turbidity meter, with results recorded on the development log or FLB/notepad.

   [PFAS Project]: Fill a clear PFAS-free container with development water to observe turbidity if necessary.

6. Once it is determined that the well has been adequately developed using the bailer and surge block, use an appropriately sized pump to continue development, typically placed near the bottom of the screen interval. Wells with screen lengths greater than ten feet may be pumped from multiple depths during this process.
7. Pumping should begin at a rate to minimize drawdown. Monitor groundwater levels with a sounder and adjust accordingly. Ideally, the pump should be operated at the maximum discharge rate as long as groundwater levels remain above the pump intake. Collect water quality parameters to check for water quality stability, emphasizing turbidity until the well is determined to be fully developed. Generally, at least ten well volumes are removed or until turbidity reaches the desired level (DTSC, 2014). Typically, 5 NTUs is considered satisfactory. If turbidity stabilization cannot be achieved, contact the FTL for their recommendation.
8. If the well recovers naturally (i.e., drawdown can be controlled/eliminated during pumping), continue development with formation water only. However, if the well is purged dry at any point during development, the process to complete the well development should be determined by the FTL.
9. Variability in geologic, ambient water, and well construction characteristics create conditions where exact criteria for determining adequate completion of well development are not feasible. The purpose of the well, type of contaminant, and geologic conditions must be considered when deciding on the appropriate level of development. Therefore, determining what constitutes acceptable development is considered a professional judgment determined by the Project Geologist or PL.
10. Measure and record a final depth to water and total well depth after well development.
11. Manage development water generated during well development as IDW, in accordance with the designated work plan or site waste management plan, and SWE-FSOP-802 (Investigation Derived Waste Management).

4.4 Demobilization/Site Restoration

After well development is completed, the tools should be laid down, the mast lowered, and the rig moved off the location. The FTL or designee should supervise the demobilization/site restoration.

Any debris generated by the well development operation should be disposed of appropriately. The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans. Any hazards remaining due to well developnment activities should be identified, and appropriate barriers and markers should be put in place, as per the APP. All fluids should be adequately contained, clearly labeled, and maintained to comply with the project work plans.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for drilling and field documentation review will be performed by the FTL or PL to check that procedures and documentation content and level of detail comply with this SOP. If a deficiency or a variance was taken to the SOP, the PL should document the deficiency/variance and determine the need for corrective action in coordination with the QA Manager.

If a non-registered geologist performs the oversight, a registered Project Geologist is responsible for reviewing the fieldwork documentation for the accurate and complete representation of the drilling and approval of final logs.

6.0 Documentation Review

The FTL is responsible for daily review of the activities performed at the site and fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

Department of Toxic Substances Control (DTSC), California Environmental Protection Agency, 2014. *Well Design and Construction for Monitoring Groundwater at Contaminated Sites*. June.

Environmental Protection Agency (EPA), Region 4, Science and Ecosystem Support Division, Athens, Georgia, 2018. *Design and Installation of Monitoring Wells*. SESDGUID-101-R2. January 16. https://www.epa.gov/quality/design-and-installation-monitoring-wells

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Groundwater Well Decommissioning

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Christopher Ohland — October 10, 2022
Christopher Ohland — Date
SWE Quality Assurance Manager

Bruce Wilcer — October 10, 2022
Bruce Wilcer — Date
SWE Field Quality Control Manager

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS-friendly supplies and procedures

Table of Contents

1.0 Introduction

Improperly decommissioned wells pose a potential threat to groundwater quality because they may act as a conduit for surface pollutants and allow migration into the subsurface or allow mixing of groundwater through interconnecting isolated aquifers. Other terms commonly used for a decommissioned well include “destroyed” or “permanently sealed.”

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation during decommissioning of groundwater monitoring wells, extraction wells, temporary wells (hereafter referred to as “groundwater wells”), and piezometers.

1.2 Scope

The scope of this SOP applies to field staff conducting well decommissioning oversight. The SOP includes guidance for the performance, management, and completion of decommissioning groundwater wells using drilling and in-place methods and includes descriptions of staff responsibilities, relevant documentation, equipment, procedures, and quality control. Potential hazards related to well decommissioning is addressed in project-specific Accident Prevention Plans (APP) and Site Safety and Health Plans.

Per- and polyfluoroalkyl substances (PFAS) friendly procedures are also provided in this SOP. When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Projects].

1.3 Responsibilities

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Field Geologist. A Field Geologist is responsible for overseeing drilling activities according to project specifications. The Field Geologist is a registered geologist or a person performing work under the supervision of a registered geologist.

Project Geologist. The registered Project Geologist is responsible for oversight of the drilling subcontractor, proper completion of work activities, and field documentation. When a Field Geologist performs the oversight, the Project Geologist is responsible for fieldwork variances/deficiencies, completeness, and accuracy of field documentation.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of the current version of U.S. Army Corps of Engineers EM-385-1-1 Safety and Health Requirements. The Safety

Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the FTL of safety deficiencies and incidents and actions to correct those. The FTL approves those actions or, if the circumstance warrants, notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Abandoned Well. In general, a well that has not been used for a prescribed duration identified in the applicable well standard (e.g., one year). This status may also be termed "permanently inactive." If the well may be used in the future, some level of maintenance may be required.

Annular Space. The space between any of the following:

- An inner drill pipe and outer drive casing
- Drill pipe or drive casing and the borehole wall
- Well screen or casing and the borehole wall

Borehole – Any hole drilled into the subsurface to identify lithology, collect soil samples, and install groundwater wells.

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. Each data entry field should have an entry or indicate that data for that field is not available or not required.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

Field Notepad – A unbound notepad or loose-leaf paper with consecutively numbered pages.

Filter Pack – Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole to increase the effective diameter of the well and prevent fine-grained material from entering the well.

Grout – For this SOP, the term "grout" consists of a neat cement grout generally containing three to five percent bentonite powder to water by weight. The grout acts as a surface seal and is emplaced as a slurry. When set and cured, it can restrict the movement of water.

Tremie – A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space.

Well Decommissioning. The process of eliminating a well structure and borehole as a possible means for the preferential migration of poor-quality water, pollutants, and contaminants; and to prevent a possible hazard to humans and animals. This usually requires removing all well materials and grouting the remaining borehole or grouting the well in place.

Well Screen – A perforated, wire-wound, continuous wrap, or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand and fine particulates.

2.0 Relevant Documents

This SOP focuses on the decommissioning of groundwater monitoring wells and associated tasks and should be used in conjunction with other project documents applicable SOPs, including the following:

Standard Operating Procedures

- SWE-FSOP-001 Field Documentation
- SWE-FSOP-300 Series (various drilling methods)
- SWE-FSOP-801 Equipment Decontamination
- SWE-FSOP-802 Investigation-Derived Waste (IDW) Management

Field Forms

- SWE-FFRM-004, Daily PFAS Sampling Checklist [PFAS Projects]

Well construction details and a copy of the well construction diagram should be carefully reviewed to identify details regarding materials and dimensions of the casing, screen, seals, and filter packs.

3.0 Equipment List

The list below identifies equipment expected to be used by staff while supervising the decommissioning of monitoring wells.

- A bound, waterproof field logbook (FLB; e.g., Rite in the Rain™ or similar) with pre-numbered consecutive pages for field documentation

  [PFAS Project]: Field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.

- Waterproof, indelible pens/markers in black or blue ink

  [PFAS Project]: Use ball-point pens. Do not use markers, felt pens, or pens with water resistant ink.

- Digital camera/video, cell phone, or other devices capable of digital imagery
- Appropriate PPE

The following materials are commonly used during well decommissioning and may or may not involve using a drill rig depending on requirements; review project-specific work plans for specific or unique materials or decommissioning procedures.

- Measuring tape
- Plastic sheeting to protect decontaminated equipment

  [PFAS Project]: Clean, dry well materials should be stored within a protective medium (e.g., HDPE bag) or staged in a clean area for future use.

- Cement and pure bentonite powder (for grouting wells/boreholes; confirm the type of each and mixture specifications)
- Bentonite chips/pellets
- Tremie pipe
- Grout pump

4.0 Procedures

Procedures are provided for:

- Pre-Field Tasks (Section 4.1)
- Preparation (Section 4.2)
- Mobilization and Setup (Section 4.3)
- Well Decommissioning (Section 4.4)
- Demobilization/Site Restoration (Section 4.5)

In general, the preferred method to decommission a well is to remove the well casing and screen from the borehole, clean out the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. However, some circumstances and ordinances may allow in-place well decommissioning where appropriate and approved. General procedures are described here because of variability in well construction, materials, nature of aquifer materials associated with the well, and acceptable decommissioning methods. Therefore, it is strongly recommended to document in project-specific work plans the appropriate and allowable well decommissioning method(s), approved before starting work, and clearly understood by all field personnel. Additional guidance can be found in SWE-FSOPs in Section 2.0.

4.1 Pre-Field Tasks

Planning well-decommissioning methodologies depend on several factors including, but not limited to:

- Total depth of the well
- Depth to groundwater
- Casing material, diameter, and condition
- Original seal condition within the annulus
- Well plumbness
- Hydrogeologic conditions
- Level of contamination if present, and the zone(s) where the contamination occurs
- Access to the well and surrounding site conditions

4.2 Preparation

4.2.1 Confirm Clearances

Before mobilization of a rig to the well site, ensure that the well location has been appropriately cleared for underground utilities, buried objects, overhead hazards, and permits issued per the project work plans.

- Review all forms and diagrams documenting the location of the well site and the location of any identified underground utility lines or other buried objects, especially if decommissioning activities will affect areas outside the original borehole diameter.
- It may be necessary for military installations/government property to obtain dig permits from the Department/Directorate of Public Works (DPW) or similar office before proceeding with work.
- Contact State 811 call-before-you-dig services (e.g., USA North 811, Dig Alert, etc.) to request that the location of buried utilities be marked with paint or flags so that you do not unintentionally contact an underground utility line. Confirm responses from each utility and retain copies of the confirmations.
- Before raising the mast on any drilling rig, ensure appropriate clearances are maintained from overhead structures and power and communication lines.

4.2.2 Health and Safety

- Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan.
- All personnel at the site should have appropriate training and qualifications as per the health and safety plan.
- All personnel within the exclusion zone should pay close attention to rig operations during drilling. The rotating or swinging drilling components can snag or catch loose clothing or strike personnel and cause severe injury or death.
- Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the driller of any unforeseen hazard—or when anyone is approaching the exclusion zone.

4.2.1 Personal Protective Equipment (PPE)

Don the appropriate PPE as specified in the project work plans and APP.

4.2.2 Decontamination

Decontaminate all downhole equipment, appropriate portions of the rig, and materials per SWE-FSOP-801 (Equipment Decontamination).

4.2.3 Calibrations

Calibrate health and safety monitoring equipment according to the instrument manufacturer's specifications.

4.3 Mobilization and Setup

4.3.1 Site Preparation

The logistics of well decommissioning should be determined before mobilizing. The site should be prepared as per the project work plans.

- Clear the work site of all brush and obstructions and then mobilize the rig to the well location.
- As per the site health and safety plan, appropriate barriers and markers should be in place before drilling.
- Plastic sheeting (e.g., Visqueen™) may be required beneath the rig.
- Appropriate cuttings and other IDW containment should be set onsite before the commencement of drilling.
- Provisions should ensure adequate containment if formation water is expected to be produced during decommissioning operations.

4.4 Well Decommissioning

4.4.1 Preliminary Work

Investigate the well before it is decommissioned to determine its condition and details of its construction.

- Remove all undesirable hardware and equipment, including dedicated pumps, wiring, conveyance piping, and well-related debris.
- Remove contaminants in the form of oil from oil-lubricated pumps or pollutants and contaminants that could interfere with well decommissioning. Remove and dispose of the contaminants appropriately as IDW (see SWE-FSOP-802, IDW Management).
- Run a video log of the well if the condition of the well casing is suspect or of concern.
- Calculate expected quantities of grout during any well decommissioning in advance.
- Be prepared to continuously track grout quantities in the FLB during the grouting process to verify that the volume of the grout placed equals or exceeds the volume to be filled and sealed.

4.4.2 Sealing in Place

Where state regulations and conditions permit, it may be permissible to grout a well casing in place. Decommissioning a well in place is allowed where it is agreed (usually by enforcing agency) that it cannot or should not be removed. The procedure consists of cementing the sand pack, well screen, and casing in place, usually with a cement bentonite grout. The type and composition of the grout mixture should be specified in the project work plans. The grout is commonly pumped through a tremie pipe inside the well.

- The well should be sounded in advance to ensure no obstructions exist that interfere with filling and sealing the entire well.
- If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to the bottom to attempt to ascertain the type of debris. The granular well debris should then be removed from the well to the extent possible by bailing, pumping, or other appropriate techniques.
- The surface pad should be demolished and the area around the casing excavated if necessary to allow the casing to be cut off below ground surface.

Circumstances may require perforation of the casing across low permeability zones, at excess sand pack intervals (i.e., behind blank casing), and intervals of known or suspected poor cement seals. Perforation techniques may include using a perforation gun (with explosives) or a tool such as a Mills Knife Perforator. Well end caps may also be punctured based on specific requirements.

The grouting is commonly conducted in successive stages across the perforated intervals. In some instances, local ordinances or regulatory agencies may require pressure grouting techniques to complete in-place well decommissioning. Specific procedures and safety measures, especially when working with pressurized systems, need to be developed in advance and clearly understood by all field personnel before activities start.

- Calculate the expected quantities of grout in advance (Section 4.4.1). Calculated quantity should include the volume of the well casing and void space in the surrounding filter pack.
- If tremieing is required, pump the grout via a tremie pipe (or equivalent) placed near the bottom of the well, with the tremie pipe progressively removed as grouting progresses. Grout should be pumped under sufficient pressure (e.g., capping the well casing if necessary, for pressure grouting, especially for shallow wells) to permeate the well screen and sand pack.
- Contain well water displaced by the neat cement as IDW.
- Place excess neat cement in portable metal bins or equivalent and dispose of as solid IDW after it is allowed to set.
- Top off wells with fresh, neat cement to offset any settling that may have occurred overnight.
- Complete the final well surface according to project work plans, including covering the area with native soil, repaving the surface if the well was installed in a paved area, etc.

4.4.3 Removal of Well Materials

Several factors such as aquifer locations and characteristics, project requirements, local ordinances, and regulatory requirements may necessitate the removal of all materials associated with a groundwater well during decommissioning. Materials to be removed could include well casing, screens, filter pack, seals, surface monuments, and protective covers. Removal of all well materials is usually required if the following conditions exist:

- The well is located in an area of known or potential pollution or contamination, and
- The well's annular seal, casing, screen, filter pack, or other components were not constructed or maintained according to applicable standards so that well decommissioning by merely filling the well casing with sealing material (Sealing in Place: Section 4.4.2) would not prevent potential water-quality degradation caused by the movement of poor-quality water, pollutants, or contaminants through the decommissioned well structure.

Removal of well materials may be accomplished by drilling or over drilling, or if the well is shallow and permitted, by pulling the well casing from the ground followed by removing the seal and filter pack materials.

Temporary Well Decommissioning

Temporary well boreholes must be decommissioned after sampling and removing the screen and riser.

1. Backfilling the holes with cuttings for shallow holes in uniform materials with expected low contamination levels may be allowed but must be confirmed before proceeding.
2. If contaminated soil, groundwater, or waste materials were encountered or a confining layer was breached, soil cuttings should not be permitted.
3. If the borehole cannot be backfilled with the soil cuttings, then reference the project Site Waste Management Plan and SWE-FSOP-802 (IDW Management) regarding the disposal of the cuttings as IDW.
4. Calculate expected quantities of grout to be used in advance (Section 4.4.1).
5. Contain well water displaced by the neat cement as IDW.
6. Place excess neat cement in portable metal bins or equivalent and dispose of as solid IDW after it is allowed to set.
7. After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement has hardened and no settlement has occurred.

Casing Pulling

Casing pulling involves removing the well casing by lifting the well structure (if possible) from the borehole. Casing pulling may be an acceptable method to use when no contamination is present, or contamination is present, and the well does not penetrate a confining layer. Also, the well construction materials and well depth must be such that pulling will not break the aboveground portion of the well. Because of its brittleness, a PVC well casing may be more challenging than a metal casing to remove from the borehole. Wells with little or no grouted annular space and/or sound well casings are usually best suited for removal.

General procedures for well casing removal are as follows:

1. Calculate expected quantities of grout to be used in advance (Section 4.4.1).
2. Knock out the bottom of the screen with a steel drill rod/pipe, which will allow grout to flow out the bottom of the casing into the borehole as the casing is removed.
3. Ensure that sealing grouts, when used, are correctly mixed and prepared in accordance with the work plan and/or enforcing agency guidelines before placement. If bentonite chips are used instead of grout, they will require hydration after placement.
4. Do not add grout into the casing via free-fall placement. Add sealing grout to the well through the tremie pipe until the materials are near the ground surface.
5. Add sealing material as the casing is withdrawn to maintain a grout column inside the casing. Allowing the materials to vacate the well casing during removal may cause the borehole to slough and compromise the seal. Keeping the column close to full will help avoid this and also fill any borehole void space should the casing break while being pulled.
6. Contain well water displaced by the neat cement as IDW.
7. When the grout has reached the prescribed level (commonly 2 to 5 feet below ground surface), allow the grout to settle and cure.

8. Place excess neat cement in portable metal bins or equivalent and dispose of as solid IDW after it is allowed to set.
9. After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement has hardened and no settlement has occurred.
10. Complete by filling the remaining 2 to 5 feet with approved material (e.g., native soil, sand, or gravel) and restoring the final surface per the work plan and applicable specifications (e.g., repair asphalt/cement).

Because the ability to decommission a well using this method depends on numerous factors related to its construction and the surrounding environment as well as local ordinances and agency acceptance, the decision of whether or not to use this method and the specific approach should be made on an individual well basis with appropriate approvals in place.

Removal by Overdrilling

Overdrilling to remove a well may be accomplished using a hollow stem auger over the well casing down to the bottom of the borehole, thereby removing the grout and filter pack materials surrounding the well casing.

1. Calculate expected quantities of grout to be used in advance (Section 4.4.1).
2. Select the auger size so that the inside diameter of the augers is greater than the well casing and screen and the outside diameter of the augers is equal to or slightly larger than the original borehole.
3. Center the auger over the casing with the center plug and pilot bit removed or a small guide plug inserted in the casing. Then drill out the cement seal, bentonite seal, and sand pack with the augers as they are advanced or washed over the well casing and screen.
4. Once the cement seal, bentonite seal, and sand have been drilled out and circulated to the surface, pull the well casing and screen from inside the augers.
5. Tremie-grout the clean borehole from bottom to top through the inside of the augers as they are retracted.
6. Add grout while augers are removed to ensure that grout level does not fall below the bottom of the augers.
7. When the grout has reached the prescribed level (commonly 2 to 5 feet below ground surface), allow the grout to settle and cure.
8. Contain well water displaced by the neat cement as IDW.
9. Place excess neat cement in portable metal bins or equivalent and dispose of as solid IDW after it is allowed to set.
10. After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement has hardened and no settlement has occurred.
11. Complete by filling the remaining 2 to 5 feet with approved material (e.g., native soil, sand, or gravel) and restoring the final surface per the work plan and applicable specifications (e.g., repair asphalt/cement).

Removal by Drilling Well Materials Out

When neither of the decommissioning methods described above can be successfully employed, it may be necessary to physically drill out the well casing in pieces and annular space materials. This can be an effective option when the well has been damaged, broken, filled, or plugged with soil or other extraneous media. The concern with re-drilling a monitoring well borehole is that augers or drill bits will not necessarily follow the original borehole to the completed well depth. Based on the condition of the well and approved procedures, an extension, pilot bit, or "stinger" may be used ahead of the cutting head or bit to align the drilling by using the well casing as the guide.

General procedures are as follows:

1. Calculate expected quantities of grout to be used in advance (Section 4.4.1).
2. Remove the wellhead and re-drill the well while attempting to keep the augers/drill head centered on the well casing, and drill to the bottom of the casing.
3. A "stinger" extending beyond the drill bit or end of the augers may be incorporated to keep the bit/augers centered over the casing.
4. Select the diameter of the augers/drill bit to match or exceed the diameter of the original borehole.
5. Retrieve as much of the well materials as possible, as cuttings, and place them in containers as IDW.
6. Tremie-grout the clean borehole from bottom to top through the inside of the augers or drill string as they are retracted.
7. Grout should be added while augers/drill string are removed to ensure that the grout level does not fall below the bottom opening of the tools.
8. When the grout has reached the prescribed level (commonly 2 to 5 feet below ground surface), allow the grout to settle and cure.
9. Contain well water displaced by the neat cement as IDW.
10. Place excess neat cement in portable metal bins or equivalent and dispose of as solid IDW after it is allowed to set.
11. After 24 hours, check the grout for settling, add additional grout if necessary. Grouting is complete when the neat cement has hardened and no settlement has occurred.
12. Complete by filling the remaining 2 to 5 feet with approved material (e.g., native soil, sand, or gravel) and restoring the final surface per the work plan and applicable specifications (e.g., repair asphalt/cement).

4.4.4 Documentation

Record all measurements and pertinent information in the FLB or other appropriate form(s) as specified in the project work plans and conformance with SWE-FSOP-001 (Field Documentation):

- Date
- Site
- Well or boring number
- Location
- Observed field conditions
- Weather conditions

- Any unusual circumstances
- During drilling, track and note changes in the drilling process (e.g., sounds, rotation speed, sudden drops, etc.)
- See SWE-FSOP-001 (Field Documentation) for additional procedures related to field documentation.

4.5 Demobilization/Site Restoration

After well installation decommissioning is completed, the casing, drill string, and tools should be laid down, the mast lowered, and the rig moved off the location. The FTL or designee supervises the demobilization/site restoration.

All debris generated by the drilling operation should be disposed of appropriately. The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans. All abandoned borings should be topped off and completed per the project work plans. Any hazards remaining due to drilling activities should be identified, and appropriate barriers and markers should be put in place, as per the APP. All fluids and waste should be adequately contained, clearly labeled, and maintained to comply with the project work plans.

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control Method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for drilling and field documentation review will be performed by the FTL or PL to check that procedures and documentation content and level of detail comply with this SOP. If a deficiency or a variance was taken to the SOP, the PL should document the deficiency/variance and determine the need for corrective action in coordination with the QA Manager.

If a non-registered geologist performs the oversight, a registered Project Geologist is responsible for reviewing the fieldwork documentation for the accurate and complete representation of the drilling and approval of final logs.

6.0 Documentation Review

The FTL is responsible for daily review of the activities performed at the site and fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

None cited.

Equipment Decontamination

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Approvals

Christopher Ohland — October 10, 2022
Christopher Ohland — Date
SWE Quality Assurance Manager

Bruce Wilcer — October 10, 2022
Bruce Wilcer — Date
SWE Field Quality Control Manager

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Rev 1, 10/10/2022: Revised to include PFAS-friendly supplies and procedures

Table of Contents

1.0 Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques and documentation requirements to decontaminate field equipment and personal protective equipment (PPE). Decontamination is necessary to prevent sample cross-contamination, exposure to contaminants, and unintended contaminant transport.

Equipment is decontaminated so that environmental contaminants are not transported offsite or across boundries defining a contaminant mass. Equipment that comes into contact with contaminants are decontaminated to minimize cross-contamination of multi-media samples. These samples are packaged and submitted for laboratory tests, where, in most instances, the laboratory performs sub-part per million tests; thus, care must be taken to minimize cross-contamination of the collected sample.

1.2 Scope

The scope of this SOP applies to field staff working with sampling equipment that comes into contact with environmental contaminants. The SOP also address activities that use industrial equipment such as drill rigs and tools and activities that use larger equipment such as trucks, loaders, excavators, and others.

Decontamination procedures described here are applicable to fieldwork involving modified Level D PPE (steel-toed boots, hard hat, safety glasses, and disposable nitrile gloves) where contact with hazardous substances is limited.

When required by the project, use the PFAS-free equipment, materials, and procedures recommended in this SOP which are indicated by [PFAS Project].

1.3 Responsibilities

Field Team. A Field Team is one or more individuals working together. The Field Team is responsible for the oversight of and/or collection of groundwater samples as specified in this SOP.

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of USACE EM-385-1-1 (USACE, 2014). The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the PL of safety deficiencies and incidents and actions to correct those. The PL approves those actions or notifies the Site Safety and Health Officer for their approval if the circumstance warrants involvement.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Exclusion Zone. Location at a site delineated by the presence of contamination or where contamination is suspected. The outer boundary of the Exclusion Zone is identified as the "Hotline," and is commonly marked with placards, hazard tape, or signs.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

Contamination Reduction Zone. A location outside the Hotline designated for decontamination of equipment and personnel that serves as the transition between contaminated and clean areas.

PFAS-free water – Water purchased as certified PFAS-free or water taken from a municipal water system or waterwater supply well that approved for use. Typically, the water is sampled for PFAS tests and demonstrated to be PFAS free or concentrations that are low enough for the Data Quality Objectives defined for the project (i.e., PFAS may be present but at acceptable concentrations.

Support Zone. A location outside of the Contamination Reduction Zone that is not expected to be contaminated and is upwind of suspected contaminants. The Support Zone commonly contains administrative and support personnel, field offices, facilities, etc.

Investigation Derived Waste (IDW). Waste that may be classified as hazardous or non-hazardous and is generated during site-related work.

Personal Protective Equipment (PPE). Personal health and safety equipment used to protect an individual from contaminant exposure and physical injury.

2.0 Relevant Documents

Field SOPs

- SWE-FSOP-001, Field Documentation
- SWE-FSOP-802, Investigation Derived Waste Management

Field Forms

- SWE-FSOP-004, Daily PFAS Sampling Checklist [PFAS Projects]

3.0 Equipment List

- Bound FLB with consecutive page numbers and waterproof, indelible pens/markers

  [PFAS Project]: Use field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used.
- Gloves (select type based on activity and hazard)

- Brushes, typically stiff bristle
- Plastic buckets or tubs
- Anionic detergent (Liquinox™, or similar)
- Spray or rinse bottles, or pump sprayer
- High-pressure hot water sprayer for cleaning large equipment
- Face shield
- Splash protection/apron/Tyvek™

  [PFAS Project]: Use uncoated HDPE suits (e.g., certain Tyvek® products)
- Waste containers for IDW (see SWE-FSOP-802)
- Paper towels
- Clean tap water

  [PFAS Project]: PFAS-free potable water
- Distilled water

  [PFAS Project]: Laboratory-certified PFAS-free deionized water
- Garbage bags
- Plastic sheeting

4.0 Procedures

Procedures are provided for:

- Pre-fieldwork tasks (Section 4.1)
- Decontamination relative to four different aspects of work (Section 4.2 to 4.6)

Document control (Section 4.7)

4.1 Pre-Fieldwork Tasks

Identify an onsite decontamination area(s) for small items (e.g., sampling equipment, hand tools, etc.) as well as larger equipment such as drill rigs and tooling, trucks, loaders, excavators, and others. Select the area(s) so that decontamination fluids and soil wastes can be managed in a controlled area with minimal risk to the surrounding environment.

Decontamination is critical for maintaining the integrity of a sampling program. Check equipment carefully prior to sampling, and if there is any doubt about the effectiveness of the decontamination, repeat the decontamination process as an extra precaution.

Decontaminate all non-disposable sampling equipment prior to use. Decontaminate industrial equipment used in investigation such as geophysical equipment, drill rigs and tooling, and others before their use at a site.

If equipment will not be used immediately, establish means of storage that maintain the cleanliness of equipment. That may be suspending equipment off the ground or wrapping in a protective material.

Identify the types and locations of IDW containers before generating IDW from decontamination activities.

4.2 Decontamination Area

The decontamination area should be large enough to allow temporary storage of cleaned equipment and materials before use, as well as to stage drums and bins of IDW. In the case of large decontamination areas (for example, for hollow-stem auger decontamination), line each area with heavy-gauge plastic sheeting and include a collection system designed to capture potential liquid and solid decontamination IDW. Lay out decontamination areas in such a way as to prevent overspray while performing equipment and personnel decontamination.

Smaller decontamination tasks, such as surface water and sediment sampling equipment decontamination may take place at the sampling locations. In this case, all required decontamination supplies and equipment must be mobilized to the site, and smaller decontamination areas for personnel and portable equipment provided as necessary. These locations will include basins or tubs to capture decontamination IDW, which will be transferred to larger containers as necessary.

4.3 Personnel and PPE Decontamination

Personnel decontamination first involves the removal of gross contamination. Scrape and wipe contaminated solids such as mud from the outermost layer of protective clothing and boots, and remove gloves by rolling off the hands starting at the cuff in such a way that the gloves are turned inside out during removal. If necessary, don a clean pair of gloves to complete the boot cleaning process. Boots can be cleaned while being worn or following removal. Remove any remaining contamination using soapy water, brushes, or other similar means such as a pressure washer, if available.

Once all debris is removed, rinse PPE with clean water.

[PFAS Project]: Once all debris is removed, PPE should be rinsed with clean PFAS-free potable water.

If boots are dry and not laden with gross solid materials, a brush can simply be used to knock off or remove any residual solid materials. If the boots have contacted liquid phase contaminants, it is important that the contaminants be removed using soapy water and a brush, followed by a clean water rinse. If the contaminants have adsorbed into the boots, the boots must be disposed of and a replacement pair obtained before conducting any further field activities.

Following removal and cleaning of reusable PPE, field personnel should wash their hands or any exposed body parts which may have been in contact with the associated hazardous substances.

> ***Note**. Disposable PPE such as gloves and suits that have no visible solids (lightly soiled) may not need to be cleaned as described above. If the PL approves, these PPE items are disposed in accordance with SWE-FSOP-802, "IDW Management."*

4.4 Sampling and Hand-Held Equipment Decontamination

4.4.1 Pre-Sampling

1. Consolidate containers and equipment for decontamination. Decontaminate new and not-previously-decontaminated equipment/material before use. If the prior use is unknown, assume the equipment/material needs to be decontaminated.

[PFAS Project]: Wash water-resistant equipment thoroughly and vigorously with PFAS-free potable water containing laboratory-grade detergent (Alconox, Liquinox, or Citranox) and a polyethylene or polyvinyl chloride (PVC) brush. Rinse equipment thoroughly three times with certified PFAS-free deionized water or another source acceptable for project use.

2. Unless the equipment will be used immediately, wrap in new aluminum foil, plastic, or other appropriate material to keep it clean until needed. For large bulky equipment, clean plastic sheeting can be substituted for aluminum foil. If the protective wrapping on a piece of pre-cleaned equipment has been torn or if there is a question of its cleanliness, the equipment should be considered contaminated and undergo full decontamination procedures before use.

   [PFAS Project]: Do not use aluminum foil, as PFAS are sometimes used as a protective layer.

4.4.2 Post-Sampling

This section applies broadly to all hand tools (trowels, bowls, hand augers, slide hammer samplers, and other specialized and non-specialized tools), as well as meters and gauges (multimeters, water-level indicators, etc.). All non-disposable sampling equipment should be cleaned prior to the next use.

Follow these cleaning procedures:

1. Remove as much gross contamination (such as pieces of soil) as possible from equipment at the sampling site.
2. Wash water-resistant equipment thoroughly and vigorously with potable water containing detergent such as Liquinox or equivalent, and use a bristle brush or similar utensil to remove any remaining residual contamination.
3. Rinse equipment thoroughly with potable water (1st rinse).
4. Rinse equipment thoroughly with distilled or deionized water (2nd rinse).
5. For sensitive field instruments, rinse equipment with distilled, deionized, or reagent grade water (3rd rinse).

   ***Note**: Rinse waters are not reused and should be discarded in an appropriate IDW container.*
6. Air dry at a location where dust or other fugitive contaminants will not contact the sampling equipment. Alternatively, wet equipment may be dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.

   ***Note**: For non-dedicated bladder pumps used during sampling, reusable pump components should be decontaminated using steam cleaning and/or Steps 3 through 6 above. Insert a new bladder into the pump housing and use new tubing cut to the required length between each monitoring well sampled. Do not reuse wetted components. Follow the bladder pump manufacturers' guidelines and specifications for changing wetted components in between sample points.*

   ***Note**: For rigs and variable speed pumps used during well development, all wetted components shall be steam cleaned and rinsed using clean potable water.*

   [PFAS Project]: In cases where dry decontamination is required, the following steps shall be followed at the sampling site:

   1. Remove as much debris or contamination as possible using a dry polyethylene or PVC brush or paper towel.

2. Spray equipment with water mixed with Alconox or Liquinox.
3. Wipe down with a clean, dry paper towel.
4. Spray equipment with laboratory-certified PFAS-free water.
5. Wipe down with a clean, dry paper towel.
6. Repeat Steps 4 and 5 twice more (for a total of three rinses with laboratory-certified PFAS-free water).

Store clean, dry sampling equipment within a protective medium (e.g., plastic bag, etc.) or staged in a clean area for future use. Cleaning and decontamination wastes must be properly contained and disposed of in accordance with project IDW management procedures. Use disposable sampling equipment whenever possible (e.g., drum samplers, bailers, spoons, etc.) to minimize the need to decontaminate these items.

4.5 Large Equipment Decontamination

Perform gross decontamination of large equipment before delivery to the site, before transporting equipment from one contaminated location to another, and before leaving the site.

Gross decontamination focuses on minimizing the spread of contaminated media as a result of equipment movement or transport. This decontamination process uses dry methods (brooms, wipes, shovels, etc.) within the exclusion zone in order to remove large, easily dislodged deposits of soil and other contaminated media prior to exiting the exclusion zone.

When equipment is no longer needed and will be removed permanently from the site, it shall be decontaminated using brushes and/or a pressure washer with a detergent wash followed by a water rinse.

> [PFAS Project]: To the extent practical, rinse parts of equipment that come into direct contact with samples with PFAS-free water. When equipment is no longer needed on site and will be removed permanently from the site, it shall be decontaminated using brushes and/or a pressure washer with Alconox, Liquinox, or Citranox wash followed by a triple rinsing with PFAS-free water rinse.

Final decontamination shall occur within a decontamination pad to allow for the collection of decontamination materials, solids, and water.

Additionally, large equipment should be free of leaks (i.e., hydraulic fluid, oil, gas, etc.) that could become a source of contamination.

4.6 Dry Decontamination

In cases where dry decontamination or larger equipment is required, follow this procedure at the site:

1. Remove as much debris or contamination as possible using a dry brush, broom, shovel, or paper towel.
2. Check crevices, tire treads, hinges, and other surfaces that may trap contaminants; remove visible residue with a brush, scraper, etc.
3. Inspect all surfaces and, where necessary,wipe them down with a clean, dry paper towel as a final step.
4. Dispose of all paper towels with other IDW and disposable sampling supplies.

4.7 Document Control

After a task or project, all field documentation, including the field logbook/notepads, field forms, and electronic data, shall be scanned and placed on the server in the appropriate folder. All original documents shall be submitted to the PL and kept in the project file. See FSOP-001 (Field Documentation).

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control method described in the project work plans.

6.0 Documentation Review

The FTL is responsible for the daily review of the fieldwork documentation for compliance with requirements (Section 4.0 “Procedures”) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

Not applicable.

Investigation Derived Waste Management

Document Number	SWE-FSOP-802
Revision	0
Department	Southwest Operations
Previous Document Number	Original Document
Originally Released	April 1, 2022
Effective Date	April 1, 2022

Approvals

April 1, 2022

Christopher Ohland
SWE Quality Assurance Manager

Date

April 1, 2022

Bruce Wilcer
SWE Field Quality Control Manager

Date

Project-Specific Modification[1]

[1] Document project-specific modifications in this section. No other modification to the SOP is authorized.

Revision History

Table of Contents

1.0 Introduction

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field staff in the proper techniques, and documentation for handling, labeling, tracking, and disposing of investigation derived waste (IDW) encountered or generated during environmental field activities. This SOP gives descriptions of equipment, field development procedures, field data collection, and personnel responsibilities.

1.2 Scope

The scope of this SOP is to describe procedures for projects that generate IDW.

Materials that may become IDW include but are not limited to:

- Personal protective equipment (PPE) includes disposable coveralls, gloves, booties, respirator canisters, splash suits, and other non-soil, solid wastes
- Disposable equipment and items include plastic ground and equipment covers, aluminum foil, conduit pipe, disposal samplers (e.g., bailers), tubing, and others
- Soil cuttings/spoils from boreholes/trenches and other soil wastes generated during sampling
- Drilling mud or water used or generated during drilling
- Groundwater obtained through well development or well purging
- Cleaning fluids such as spent solvents and wash water
- Packing and shipping materials
- Sediment from surface water bodies (rivers, lakes, ponds)
- Wash and rinse waste from decontamination activities

These types of IDW may require classification as non-hazardous or hazardous waste and should be containerized, stored, profiled, transported, and disposed of appropriately according to regulatory and client-specific requirements. Review project-specific work plans and waste management plans to confirm appropriate procedures for each site.

1.3 Responsibilities

Field Team. A Field Team is one or more individuals working together. The Field Team is responsible for the oversight of IDW as specified in this SOP.

Field Team Lead (FTL). The FTL is responsible for reviewing project work plans to understand the health and safety needs, procedural specifications, and field documentation requirements. The FTL is responsible for reviewing and confirming the adequacy of the fieldwork documentation.

Project Lead (PL). The PL is responsible for providing adequate resources to the field staff and ensuring the Field Team has adequate experience and training to comply with the SOP successfully. The PL is responsible for approving and documenting techniques not described in this SOP but are considered the best methods for the current project.

Safety Representative. The Safety Representative meets the experience and training requirements of USACE EM-385-1-1 (USACE, 2014). The Safety Representative oversees site-specific health and safety activities and ensures compliance with the project requirements. The Safety Representative notifies the

FTL of safety deficiencies and incidents and actions to correct those. The FTL approves those actions or, if the circumstance warrants, notifies the PL and Site Safety and Health Officer for their approval.

Quality Control Lead (QC Lead). The QC Lead ensures work inspections are performed using the 3-Phases of Quality Control method described in the project work plans. The QC Lead notifies the PL of quality deficiencies and actions to correct those. The PL approves those actions or notifies the SWE Field QC Manager for their approval if the circumstance warrants involvement.

1.4 Definitions

Field Documentation – The combination of field logbooks/notepads, field forms, digital/electronic forms, and other documentation in the project file.

Field Forms – Any documentation that preserves an accurate historical record of field activities but is recorded on unbound paper. These forms should be referenced in the FLB. Each data entry field should have an entry or indicate that data for that field is not available or not required.

Field Logbook (FLB) – A portable, bound, weatherproof notebook with consecutively numbered pages.

Field Notepad – A unbound notepad or loose-leaf paper with consecutively numbered pages.

Investigation Derived Waste (IDW). Waste that is generated in the process of investigating or examining a contaminated site.

Personal Protective Equipment (PPE). Personal health and safety equipment is used to protect the individual from contaminant exposure and physical injury.

2.0 Relevant Documents

This SOP focuses on the IDW management task and applications and should be used in conjunction with other applicable SOPs and forms, including the following:

2.1.1 Standard Operating Procedures

- SWE-FSOP-001, Field Documentation
- SWE-FSOP-801, Equipment Decontamination

3.0 Equipment List

The following materials and equipment may be needed for IDW management:

- Bound field logbook (FLB) with consecutive page numbers and waterproof, indelible pens/markers
- PPE as outlined in site-specific Accident Prevention Plans (APPs)
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Liquinox™, plastic sheeting, paper towels, sponges, garden-type water sprayers, large plastic bags (minimum 0.85 mil), potable water, distilled water, and deionized water)
- Department of Transportation (DOT)-rated 55-gallon drums or other approved containers for containing soil cuttings, decontamination water, and formation water
- Drum/bung wrench and drum funnel

- Heavy equipment forklift or vehicle with drum grappler (as necessary)
- Photoionization detector (PID)
- Vendor-supplied roll-off bin(s), with liners if applicable
- Laboratory-supplied sample containers
- Wood pallets (as necessary)
- Non-porous (e.g., stainless steel) trowels
- Field notebook/notepad and waterproof permanent marking pens
- Waste manifests
- Secondary containment materials (i.e., spill containment platform/pallet with drain, absorbent pads)

4.0 Procedures

The procedures below are provided for managing non-liquid and liquid IDW generated during field activities.

4.1 IDW Staging Area

Identify an onsite area for staging drums, bins, and other storage containers. The area should be large enough to allow temporary storage and safe access to the drums and bins of IDW. If IDW is left onsite without supervision, then the area must be secured from unauthorized access and containers labeled appropriately. Hazardous IDW may not be accumulated for more than 90 days.

4.2 Soil IDW

Place IDW (soil cuttings/spoils generated during drilling, trenching, soil sampling, or other) into DOT-rated 55-gallon drums, appropriately-sized containers/bins, or stockpiles at the point of generation. In most cases, mixing the cuttings from several borings or sampling locations is permissible to fill the containers or entire stockpiles but must be confirmed in advance by the PL/FTL. Ask the FTL whether potentially hazardous solids should be segregated from non-hazardous.

When drums or containers are full or daily activities are completed, the drum lids and rings will be fastened. Full drums or containers will be transported to the designated IDW accumulation area regularly to avoid the accumulation of drums or containers at investigation sites for extended periods.

Waste profiling analyses will be performed before disposal (Section 4.5). Each project may have unique waste profiling, storage, and disposal—review project-specific work plans and coordinate activities between the PL and client.

Unless approved, hazardous soil cuttings and excavation spoils must not be used to fill boreholes, test pits, or excavations. Place soil cuttings/spoils on plastic sheets or containerize them when generated; dispose of the plastic sheets with the used PPE or soil cuttings.

4.3 Liquid IDW

Contain liquids in DOT-rated drums or appropriately-sized watertight containers at the point of generation. Mixing the water from several sampling locations, decontamination water, process water,

and other IDW sources may be permissible to fill the drums but should be confirmed in advance with the PL or FTL. Ask the FTL whether potentially hazardous liquids should be segregated from non-hazardous.

When drums or containers are full or daily activities are completed, the drum lids and rings will be fastened. Full drums or containers will be transported to the designated IDW accumulation area regularly to avoid accumulating drums or containers at investigation sites for extended periods. All drums or containers will be labeled appropriately at the end of each day's activities. Perform waste profiling before disposal (Section 4.5). Each project may have unique requirements for waste profiling, storage, and disposal—review project-specific plans and coordinate activities with the PL or FTL.

4.4 PPE and Other Consumable Supplies

Inspect equipment and PPE (e.g., plastic sheets, screens, coveralls, boot covers, or other) to determine proper disposal procedures. If there is no evidence of contamination, materials can be disposed of with regular trash.

Decontaminate and discard PPE and other used supplies in plastic bags and sealed in metal barrels for final storage, transport, and disposal. Decontamination procedures consist of brushing off or using small amounts of water to scrub off potential gross contamination (see SWE-FSOP-801, Equipment Decontamination).

4.5 Waste Profiling

Waste profiling requirements will be coordinated by the PL with the client and disposal facility. At a minimum, a representative sample of the solid and aqueous IDW will be collected and analyzed for all chemicals of potential concern. When approved by the PL, generator knowledge is an acceptable alternative to laboratory testing. The PL will also coordinate with the client, disposal facility, and waste transporter to manage the completion of the waste manifest and ensure that an adequate number of manifests are available for the amounts and types of material to be disposed of. An example manifest is provided in Attachment 1.

Waste manifests are signed by the client or client's representative (usually identified on the manifest as the "owner" and/or "generator"). Field personnel are not allowed to sign manifests under any circumstances.

4.6 Labeling

Apply a label immediately after adding soil or groundwater to drums or soil to bins. If the waste generated has not been profiled, apply a "Pending Analysis" label (Figure 1). Add the contents, date(s) of generation, the origin of materials, address of generation, and contact information to the label. Because drum and container labels may be exposed to the elements, it is essential to use waterproof markers to fill in the information on labels and possibly clear packaging tape over the labels to preserve the information.

Once the material has been profiled, remove the "Pending Analysis" label and add the appropriate "Non-Hazardous" (Figure 2) or "Hazardous" label (Figure 3). Add the shipper, address, date(s) of generation, contents, and contact information to the label.

Figure 1 – Label: Pending Analysis

Figure 2– Label: Non-Hazardous

Figure 3– Label: Hazardous

4.7 Disposal of IDW

Soil and groundwater IDW will be placed in drums or appropriately configured bins and stored in a designated hazardous/non-hazardous waste storage area, the location and use of which will be coordinated with the client. Manifesting and disposal of IDW during field activities will be coordinated with the client before the initiation of field activities. As applicable, field activities that generate IDW will be conducted consistent with sustainable practices (e.g., reducing the volume of routine waste or IDW generated by decreasing materials consumption).

4.8 Document Control

The FTL is responsible for documenting or reviewing field team documentation of IDW management, including collection, sampling, labeling (if applicable), staging, and ultimate disposition of IDW. Disposition may include manifesting the waste and transportation offsite or releasing the waste to the client for ultimate disposal. The information entered in field documentation concerning IDW should include the following:

- Project Name
- Names of personnel
- Site location
- Type of activities
- Date waste generated
- Boring, well, or site number(s)
- Matrix
- Type of container(s)
- Estimated volume
- Disposition of contents
- Comments (field evidence of contamination [e.g., PID reading, odors])
- Any variance to procedures described in this SOP

After completing a task or project, all field documentation, including the field logbook, field datasheets, and electronic data, shall be scanned and placed on the server in the appropriate folder. All original documents shall be submitted to the PL and kept in the project file. See FSOP-001 (Field Documentation).

5.0 Quality Assurance/Quality Control

Conduct the 3-Phases of Quality Control method described in the project work plans.

Quality Assurance (QA) and Quality Control (QC) procedures for IDW field documentation review will be performed by the PL and QC Manager to confirm that content and level of detail comply with the applicable planning documents. Identification of errors and corrections made during QA/QC reviews will follow documentation requirements described in SWE-FSOP-001 (Fieldwork Documentation).

6.0 Documentation Review

The FTL is responsible for reviewing hazardous waste characteristics, ensuring the disposal facility is licensed to receive the IDW, and reviewing waste manifests and bills of lading.

The FTL is responsible for the daily review of fieldwork documentation for compliance with requirements (Section 4.0) and legibility. Errors and omissions should be explained and revisions to an entry signed and dated by the FTL.

7.0 References

None cited.

Attachments

Attachment 1.
Uniform Hazardous Waste Manifest

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) **A7 2002939203-001** **SC PPW 12/9/2008** Form Approved. OMB No.2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of 1	3. Emergency Response Phone	4. Manifest Tracking Number

5. Generator's Name and Mailing Address — Generator's Site Address(if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name — U.S.EPA ID Number

7. Transporter 2 Company Name — U.S.EPA ID Number

8. Designed Facility Name and Site Address — U.S.EPA ID Number

Facility's Phone:

9a. HM	9b. U.S. DOT Description (Including Proper Shipping Name, Hazard Class, ID Number, and Packing Group(If any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		

14.Special Handling Instructions and Additional Information

Contract retained by generator confers agency authority on initial transporter to add or substitute additional transporters on generator's behalf for purposes of transportation efficiency, convenience, or safety

15. GENERATION'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I Certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name — Signature — Month Day Year

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit :

Transporter Signature (for exports only): Date leaving U.S. :

17. Transporter Acknowledgement of Receipt of Materials

Transporter 1 Printed/Typed Name — Signature — Month Day Year

Transporter 2 Printer/Typed Name — Signature — Month Day Year

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a.

Printed/Typed Name — Signature — Month Day Year

EPA Form 8700-22v (Rev. 3-05) Prevolus editions are obsolete.

ATTACHMENT B

Field Documentation Forms

Title
Example Field Daily Logbook
Water Level Field Data Worksheet
Water Level Indicator Calibration by Steel Tape
Site Safety Tailgate Meeting
Fort Ord Munitions and Explosives of Concern (MEC) Incident Reporting Form
Chain of Custody Record
Example Sample Labels
Project Field Report
Borehole Log
Well Installation Log
Well Development

Former Ft. Ord, CA
3/1/2020
1Q2020 Groundwater Monitoring
Project #
Weather: (am) Clear, cool 48°
(pm) Overcast, 63°
Team #2
Ahtna Rep. - Shaelyn Hession
Blaine Tech Rep. - Ross Mikovich

0800 - Arrived at MW-002-18-A
W.L. = 78.40 T.D. = 110.6
0810 - Sample collected from station #2
#2010Y0U2100F
0815 - Duplicate sample #2010Y0U2101D
0820 - Labled Trip Blank #2010Y0U2102A
Lid requires new paint & I.D.

0835 - Arrived at MW-BW-75-A
W.L. = 84.32 T.D. = 126.3
Required new lock - replaced.

0845 - Arrived at MW-BW-14-A
W.L. = 63.11 T.D. = 97.5

3/1/2020
1Q2020 FO GWM
Team #2
S. Hession
R. Mikovich

0900 - Arrived at MW-BW-07-180
W.L. = 121.63 T.D. = 194.6
0910 - Sample collected from station #1
#2010Y0BW103F
0915 - Station #2 sample # 2010Y0BW104F
0920 - Station #3 sample # 2010Y0BW105F
0925 - Station #4 sample # 2010Y0BW106F
0930 - Station #5 sample # 2010Y0BW107F
No PDB's installed.

1000 - Return to staging area.
Unload equipment
QC all samples, placed in refrigerator.
1030 - Team #2 offsite

Steve Worley

Ahtna

Water Level/NAPL Measurements

Project Number		Field Team Leader	
Installation/Site		QAPP SOP No.	
Event Name		Date	
Field Team (name/affiliation)			
Weather Condition			

Type of Meter **(check those that apply)**

☐ Water Level	Make/Serial#	_____	Correction (in)	_____	Last Calibration	_____
☐ Interface	Make/Serial#	_____	Correction (in)	_____	Last Calibration	_____

Field Measurements

Location ID	Time	Ref. Point	Depth to		Total Depth (ft)	Location-Specific Comment
		TOC[1]	NAPL (ft)	Water (ft)		

[1] If other than TOC, explain in location-specific comment
Non-aqueous phase layer (NAPL)—either light (LNAPL) or dense (DNAPL); top of casing (TOC)

(Comment)

Initial _____ Signature _____ Date _____

Fort Ord Groundwater Monitoring Program

Water Level Indicator Calibration by Steel Tape

Event:	
Well #:	
Steel Tape DTW:	
Date:	

Serial #	Measured DTW	Calibration Correction

Reviewed By:	
Date:	

Ahtna

Site Safety Tailgate Meeting

Installation/Site Name		Project Number	
Event Name		Safety Representative	
Date		Field Team Leader	
Weather Forecast:			

Participants (attach loose-leaf sheet if additional space is needed)

Printed Name and Initials	Affiliation	Role	Signature

Scope of Today's Work

Health and Safety Topics Discussed (✓ applicable topics)

☐ Weather Factors	☐ Chem. of Concern	☐ Lifting Safety	☐ Sanitation
☐ AHA Review	☐ PPE Requirements	☐ Recent near miss/injuries/lessons	☐ _____
☐ Site emergency SOP, rally point, etc.	☐ Slip/Trip/Fall Hazards	☐ BBS Hazard Triggers[1]	☐ _____
☐ Changed Conditions	☐ Site Controls	☐ BBS Trigger Controls[2]	☐ _____
☐ Equipment Hazards	☐ Biological Hazards	☐ Traffic Control	☐ _____
	☐ COVID 19 SOPs		☐ _____

[1] Behavior-based Safety Hazard Triggers: Distractions, rushing, short-cuts, frustration, exhaustion, complacency, anger, multi-tasking, not focusing on task

[2] Behavior-based Safety Trigger Controls: Communicating, accountability, patience, relaxation techniques, healthy lifestyle, and adequate sleep

Comments:

Individual in the Safety Representative role acknowledges that the checked (✓) topics were discussed.

Name (Print) _____ Signature _____ Date _____

FORT ORD MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)
INCIDENT REPORTING FORM

If you recognize any object that resembles munitions or explosives on current or former Fort Ord property, retreat to a safe location, and report the finding to the **appropriate agencies immediately** (see below)

A. PROVIDE THE FOLLOWING INFORMATION:

Name of Person Reporting:	Telephone:
Agency:	Fax:
Date & Time of Incident/Discovery:	
Description of Item Found (refer to the "Safety Alert" pamphlet if possible):	
Location (direction from nearest road/building, attach map if possible):	
GPS Coordinate Location: (Type of Instrument, NAD83 California State Plan Coordinates Zone IV, feet)	
Describe how the item was found:	

CONTACT THE APPROPRIATE AGENCIES IMMEDIATELY:

Initial when completed	Mon– Thu (6 a.m. – 5 p.m.) Contact and FAX Form to:	Contact Number	Date & Time Called
	USACE Ordnance Safety Specialist or MMRP Site Safety Manager	Ph: (831) 884-9925 ext.226 Cell: (831) 760-2571 Fax:(831) 884-9030 Ph: (831) 242-7919 Fax:(831) 242-7019 Cell: (831) 760-2575	
	Fri – Sun (24 Hours) 60th Civ Engr Sqdn EOD	Phone: (707) 424-5517	
	Note: If 60th Civ Engr Sqdn EOD is contacted, notify the MMRP Site Safety Manager: (831) 242-7919, Cell (831) 760-2575.		

B. To be completed by USACE Ordnance Safety Specialist when applicable (Mon – Thu)

Form Received By:		Date & Time:
Identification of Item Found:		
Extent of Area Surveyed:		Name of digital file for picture (date):
Disposition of Item:		
Fax completed form to MMRP Site Safety Mgr Bldg 4463 Gigling Rd, POM (Fort Ord) when response complete	Fax: (831) 242-7091 Phone: (831) 242-7919	Date & Time:

C. To be completed by MMRP Site Safety Manager:

Acknowledge Completed Form Received:	Date & Time:
Regulatory Agencies Notified (Date):	

Ahtna

Chain of Custody Record

COC Number _____
COC Form _____ of _____

Project Number		Lab Work Order	
Installation/Site		Lab Turnaround Time	◉ 2 w ○ 1 w ○ 3 d ○ 2 d ○ 24 h ○ _____
Activity		Transporter Name	
Purchase Order#		Waybill Number	
Field Team Leader *(name, phone, email)*		Ahtna POC *(name, phone, email)*	

Laboratory Sequence No.	Field Sample ID	Date	Time	Matrix[2]	#.Bottles/Canisters	Preservation Used[1]							Use for Matrix Spike/Dup	Laboratory Point of Contact: *(Laboratory Organization)*, *(Laboratory Project Manager)*, *(Telephone)*, *(Email address)*	Sample Specific Comments

(Comments)

(Relinquished by Field Team/Company)	*(Date/Time)*	*(Received By Field or Laboratory Sample Custodian/Organization)*	*(Date/Time)*	*(Relinquished by/Organization)*	*(Date/Time)*
(Received by/Organization)	*(Date/Time)*	*(Relinquished By/Organization)*	*(Date/Time)*	*(Received by/Organization)*	*(Date/Time)*

[1] Preservation Used: HCl (1), HNO3 (2), H2SO4 (3), NaOH (4), H3PO4, Other _____ (6), Other _____ (7), Other _____ (8), Other _____ (9)

[2] Ambient air (AA), indoor air (AI), soil gas (GS), sediment (SE), soil (SO), ground water (WG), surface water (WS), process water (WT)

Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

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Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

Ahtna

PROJECT FIELD REPORT

GENERAL	
1) USACE Contract No.:	**2) Date:**
3) Program Manager	**4) Report No.:**
5) Project Manager:	**6) SSHO (Designee):**
7) Superintendent:	**8) QC Manager:**
9) Weather:	**10) Temperature:**

SUMMARY	
11) Work Performed:	
12) Project Issues:	
13) Unresolved Issues:	
14) Hours Worked:	**15) Accumulated Hours:**

CONTRACTOR PERSONNEL

16) Prime Contractor and Subcontractor Onsite:

Name	Company	Position/Title	Hours

GOVERNMENT PERSONNEL

17) Government Personnel Onsite:

Name	Company	Position/Title	Arrive/Depart (Day)

VISITING PERSONNEL

18) Visitors Onsite:

Name	Company	Position/Title	Arrive/Depart (Day)

DETAIL

19) Equipment Status:	MOB'D	ACTIVE	DEMOB'D
1.			
2.			
3.			
4.			

20) Work Planned for Following Workday: None

1.

2.

21) Safety Issues:

Ahtna

PROJECT FIELD REPORT

22) Quality Control:
1.
2.
23) Other:
1.
24) Attachments:
1. 2. 3.
25) Report Submitted by:

Photos:
Description:
Description:
Description:
Description:

Borehole Log

Project Number		Location ID	
Installation/Site		Start Date/Hour	
Driller		End Date/Hour	
Drilling Method		Field Geologist	
Sampling Method		Borehole Diameter (inch)	
Depth to Water (ft)		Borehole Total Depth (ft)	

Depth BGS (ft)	Interval (ft)	Recovery (ft)	Type	Blow Counts 6-6-6"	Soil Description Lithology, USGS Classification, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Interpretations	Comments Casing Depth, Drilling Rate, Drilling Fluid Loss, Tests, and Instrumentation

Ahtna

Borehole Log

Depth BGS (ft)	Interval (ft)	Recovery (ft)	Type	Blow Counts 6-6-6" (N)	Soil Description Lithology, USGS Classification, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Interpretations	Comments Casing Depth, Drilling Rate, Drilling Fluid Loss, Tests, and Instrumentation

Ahtna

Borehole Log

Depth BGS (ft)	Interval (ft)	Recovery (ft)	Type	Blow Counts 6-6-6" (N)	Soil Description Lithology, USGS Classification, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Interpretations	Comments Casing Depth, Drilling Rate, Drilling Fluid Loss, Tests, and Instrumentation

Ahtna

Borehole Log

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Ahtna

Borehole Log

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Ahtna

Borehole Log

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Ahtna

Borehole Log

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Ahtna

Borehole Log

Depth BGS (ft)	Interval (ft)	Recovery (ft)	Type	Blow Counts 6-6-6" (N)	Soil Description Lithology, USGS Classification, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Interpretations	Comments Casing Depth, Drilling Rate, Drilling Fluid Loss, Tests, and Instrumentation

Ahtna

Borehole Log

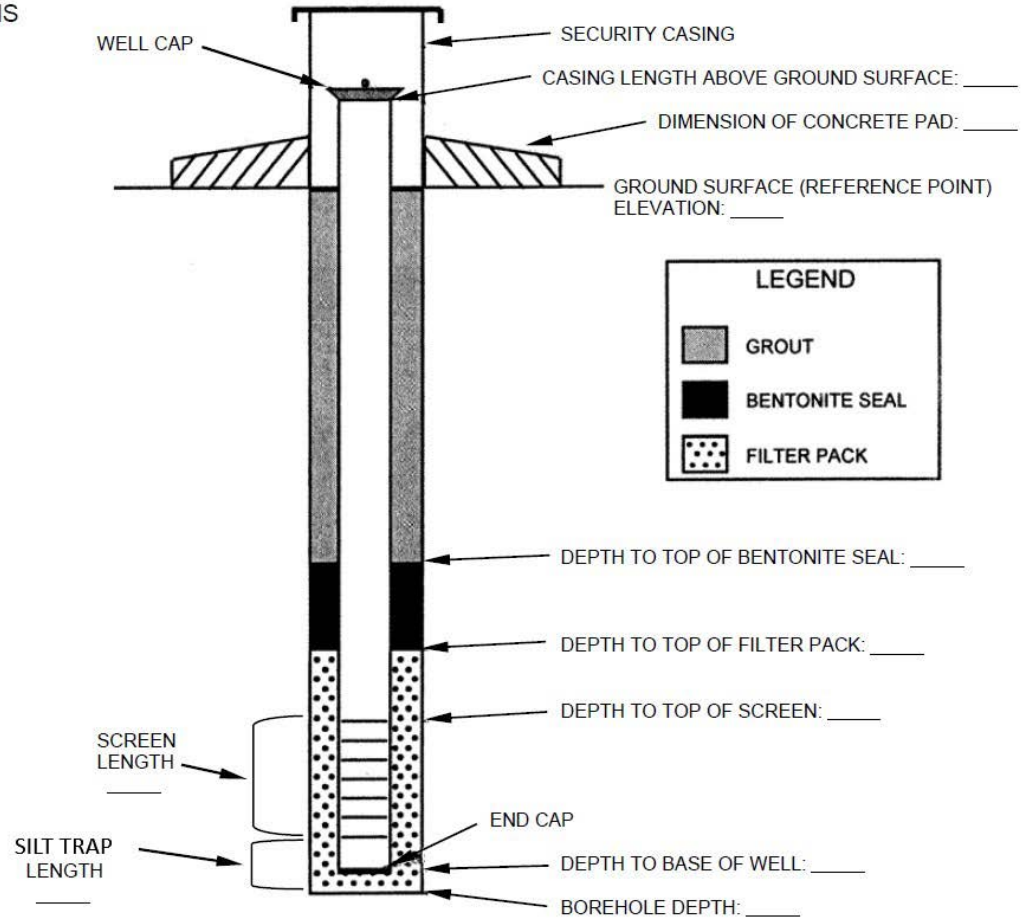
Depth BGS (ft)	Interval (ft)	Recovery (ft)	Type	Blow Counts 6-6-6" (N)	Soil Description Lithology, USGS Classification, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Interpretations	Comments Casing Depth, Drilling Rate, Drilling Fluid Loss, Tests, and Instrumentation

Well Installation Log

Project Number		Location ID	
Installation/Site		Construction Start Date	
Driller		Well Completion Date	
Field Geologist		Borehole Diameter (in)	
Casing Material		Casing Diameter (in)	
Screen Material		Slot Size (in)	
Type of Bentonite		Amt. of Bentonite (linear ft)	
Filter Pack Type		Amt. of Filter Pack (linear ft)	
Well Cap Type		End Cap Type	
Description/Dimension of Security Casing			

(ALL MEASUREMENTS IN FEET, UNLESS INDICATED OTHERWISE)

SPECIAL CONDITIONS
(describe and draw)



Comments:

Reviewed By		Date	

Well Development

Project Number		Well Location Name	
Installation/Site		SOP No.	
Field Team Leader		Date	
Contractor/Technician			

Description of Technique and Equipment Used (e.g., surge block, pump, bailer description, sizes, etc.)

Well Parameters

			Initial	Final
1-ft Casing Vol. (gal/ft) [1]		Total Depth (ft TOC)		
Water Column (ft)		Depth to Water (ft TOC)		
One Well Volume (gal) [2]		Screened Interval (ft TOC)	Top	Bottom
Pump Depth/s		Total Volume Removed		

[1] 1-ft casing volume (gal/ft) = (π × r2 × h × CF); where r = I.D. radius (in); h = 1-ft well height (i.e., 12 in); CF = conversion factor for cubic inch to gallon (0.00433 gal/cubic inch)

[2] One well volume (gal) = h × 1-ft casing volume (gal/ft) × height of water column (ft)

Well Diam. (ID)	1-ft Casing Vol. (gal/ft)**	
	Sch 40	Sch 80
2	0.17	0.15
3	0.38	0.34
4	0.66	0.59
6	1.50	1.35
8	2.60	2.37

Example: 100ft well, Water Level at 80ft, 4" diameter
100-80 = 20 20 x 0.66 = 13.2 gallons (1 well volume)
Typical Development is 10 volumes or 132 gallons for this example
*Check with PM and review work plan to determine what criteria constitutes the completion of development.

**Confirm inner diameter to calculate the volume

Field Measurements

Time	DTW	Purge Vol.	Flow Rate	Temp.	pH	Spec. Cond.	DO	ORP	Turbidity
(hh:mm)	(ft TOC)	(Gal)	(gpm)	(°C) ±3%	(S.U.) ±0.1	(µS/cm) ±3%	(mg/L) ±0.2	(mV) ±10	(NTU) <5

Observations (color, odor, NAPL, other)

Ahtna

Well Development

Time	DTW	Purge Vol.	Flow Rate	Temp.	pH	Spec. Cond.	DO	ORP	Turbidity
(hh:mm)	(ft TOC)	(Gal)	(gpm)	(°C) ±3%	(S.U.) ±0.1	(µS/cm) ±3%	(mg/L) ±0.2	(mV) ±10	(NTU) <5

Observations (color, odor, NAPL, other)

ATTACHMENT C

Habitat and Biological Monitoring Forms

- Habitat Checklist Example
- Habitat and Biological Monitoring Training Fact Sheet
- Biological Observation Form – CTS/BLL

SITE HABITAT CHECKLIST

The following are requirements to minimize biological disturbances to protected species and habitat. Please notify the Ahtna Biologist (Denise Duffy and Associates) at 831-373-4341 *before* proceeding, if work tasks or work boundaries change, additional vegetation removal is necessary, vegetation cutting methods change, or any other conditions change.

SITE:	University of California – Fort Ord Natural Reserve - South	**Date:**	XX-XX-2023
Work to be conducted:	Well decommissioning		

1. LAND USE:	☒ **Habitat Reserve**	☐ **Development Area**	☐ **Other (specify):**	
2. LAND OWNER:	☐ **Army**	**Location:**		
	☐ **BLM**	**Location:**		
	☒ **Other:**	**Location:**	University of California, Santa Cruz	

3. ENDANGERED SPECIES/	☐ **Yes**	☐ **No**	☐ **Flagged/Marked**
HMP Listed Species:			
Location:			
Grid Numbers:			

Restrictions:

- Restrict all vehicle access and staging to designated flagged routes, and staging areas.
- Stay on roads.
- Report all black legless lizard or California Tiger Salamander encounters to Ahtna field supervisor and biologist immediately.
- Coordinate with biologist first, if additional areas are needed for access or staging of equipment or vehicles.
- Contact number for Ahtna Biologist (Denise Duffy and Associates) is 831-373-4341.
- Contact number for the BRAC Office Biologist is 831-242-7918

4. VERNAL POOLS/PONDS PRESENT	☐ **Yes**	☐ **No**	☐ **Flagged/Marked**
Location:			
Grid Numbers:			
Work Can Proceed in Pools/Ponds:	☐ **Yes**	☐ **No**	

Restrictions:

5. VEGETATION REMOVAL	
☐ **No Removal Needed**	**Location:**
☐ **Manual Removal Needed**	**Location:**
Restrictions:	
☐ **Mechanical Removal Needed:**	**Location:**
Mechanical Removal Restrictions:	

6. EROSION CONCERNS/SITE RESTORATION:

7. SITE ACCESS:

8. ADDITIONAL SITE CONCERNS:

This checklist has been read, approved, and signed by the following:

☐ **Ahtna Biologist: _____ Date: _____**
☐ **Ahtna Field Supervisor: _____ Date: _____**
☐ **Army Natural Resources Specialist: _____ Date: _____**

Fort Ord Species of Concern Identification and Procedures

Fort Ord Animal Species of Concern

California Tiger Salamander (CTS) and Black Legless Lizard (BLL) are species of concern at Fort Ord. CTS are endemic to California and are a threatened species. CTS larvae are yellowish gray typically habitat in vernal pools and metamorphisms into adults in summertime growing to a 3 to 5 inch salamander with yellow spots. As adults during the day CTS spends time underground in animal burrows. BLLs are a California protected species that are small slender lizards 4 to 7 inches long with no legs which forages in loose soil, sand, and leaf litter during the day and may come to the surface at dusk and night. If a CTS or BLL is found, notify Base Realignment and Closure (BRAC) Biologist Bart Kowalski at (831) 595-5569 who will coordinate an approved Biologist to visit the site and handle and remove the CTS as necessary from the work area. BLL may be relocated by onsite personnel.

FONR Plant Species of Concern

There are two plant species in the Fort Ord Natural Reserve (FONR) which is owned by University of California, Santa Cruz (UCSC) with monitored populations, Sand Gilia and Monterey Spineflower. Stay on the driving paths in the FONR, do not drive where prohibited and try not to walk on species of concern plants. Both plants are annual herbs that are native and endemic to California and typically bloom starting in March/April through June/July, but depending on weather conditions may bloom earlier. FONR questions may be directed to Gage Dayton with UCSC at (831) 227-5887.

CA Tiger Salamander

Black Legless Lizard

Monterey Spineflower

Sand Gilia

Coast Horned Lizard

The California species of concern Coast Horned Lizard has a 4-inch rounded flat body, blunt snout, tail, and toad-like body with horns. When moving vehicles or heavy equipment into the inner roads of the northern FONR, have personnel walk in front of the vehicle as directed by UCSC to scare out Coast Horned Lizards that may be in the roadway before the vehicle passes. Notify Bart Kowalski of observances who will notify UCSC. Work does not need to be stopped if encountered, just relocated away from moving vehicles.

BIOLOGICAL OBSERVATION FORM – CTS/BLL

If a California tiger salamander (CTS) or black legless lizard (BLL) is found, notify Bart Kowalski, the BRAC Office Biologist. Only service approved biologist should fill out the CTS field observation form, and only service approved biologist can handle and move CTS out of the way. If CTS is encountered all work needs to stop until service approved biologist gets to the location and relocates the CTS. After completing this form attach a photograph of the specimen (if possible) and a map showing the location of the sighting, and return to BRAC:

Mr. Bart Kowalski
Building 4463, Gigling Rd, Rm 101, Monterey, CA 93944-5004
Office: (831) 242-7918 Cell: (831) 595-5569

Location _____ **Date/Time** _____
(OE site, Range # etc)

Grid # _____ **Northing/Easting or Approx. Coordinates (ft)** _____

Type of Activity (check one or write in)

- ☐ Well Installation/Drilling
- ☐ Vegetation clearance
- ☐ Other _____

Weather: Air Temp._____ Wind _____ Sunny/Cloudy _____

Depth if known _____

Habitat Description (e.g. Maritime chaparral, oak woodland, grassland, vegetation height, presence of surface litter/debris, soil type, plant species where specimen found, etc.):

_____
_____
_____

Description of specimen (live/ injured/ dead, color, condition, behavior etc.):

_____
_____
_____

Length (inches): _____

Other Notes: _____
_____

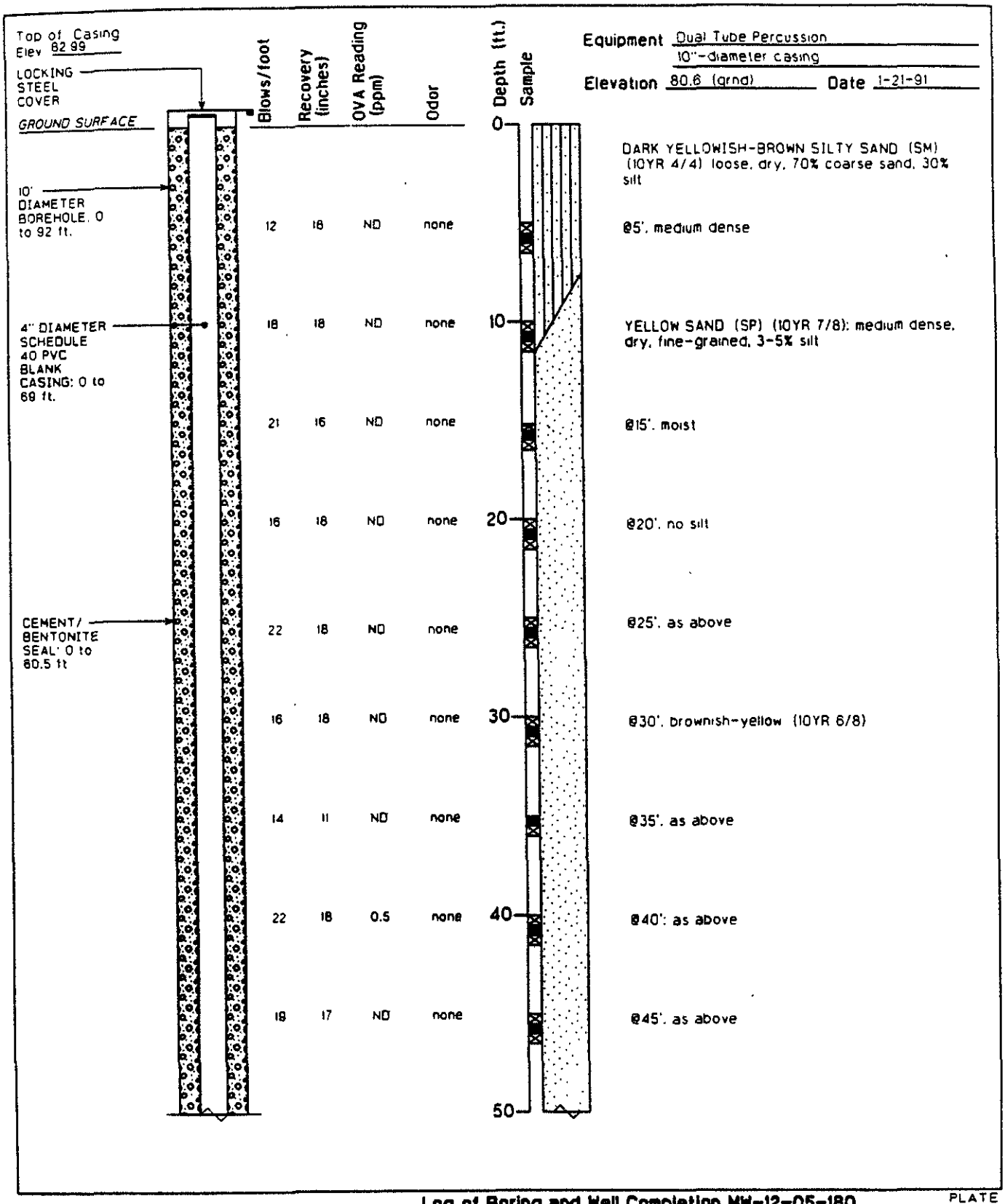
Disposition: Found by: _____

- ☐ Observed, released to same location or adjacent habitat
- ☐ Observation form completed By:_____
- ☐ Injured or killed (placed in a Ziploc or plastic bag, and refrigerated)
- ☐ Other _____

Attachments: ☐ Location map ☐ Photograph (specimen and habitat in which found)

ATTACHMENT D

Wells to be Decommissioned Boring Logs and Construction Diagrams

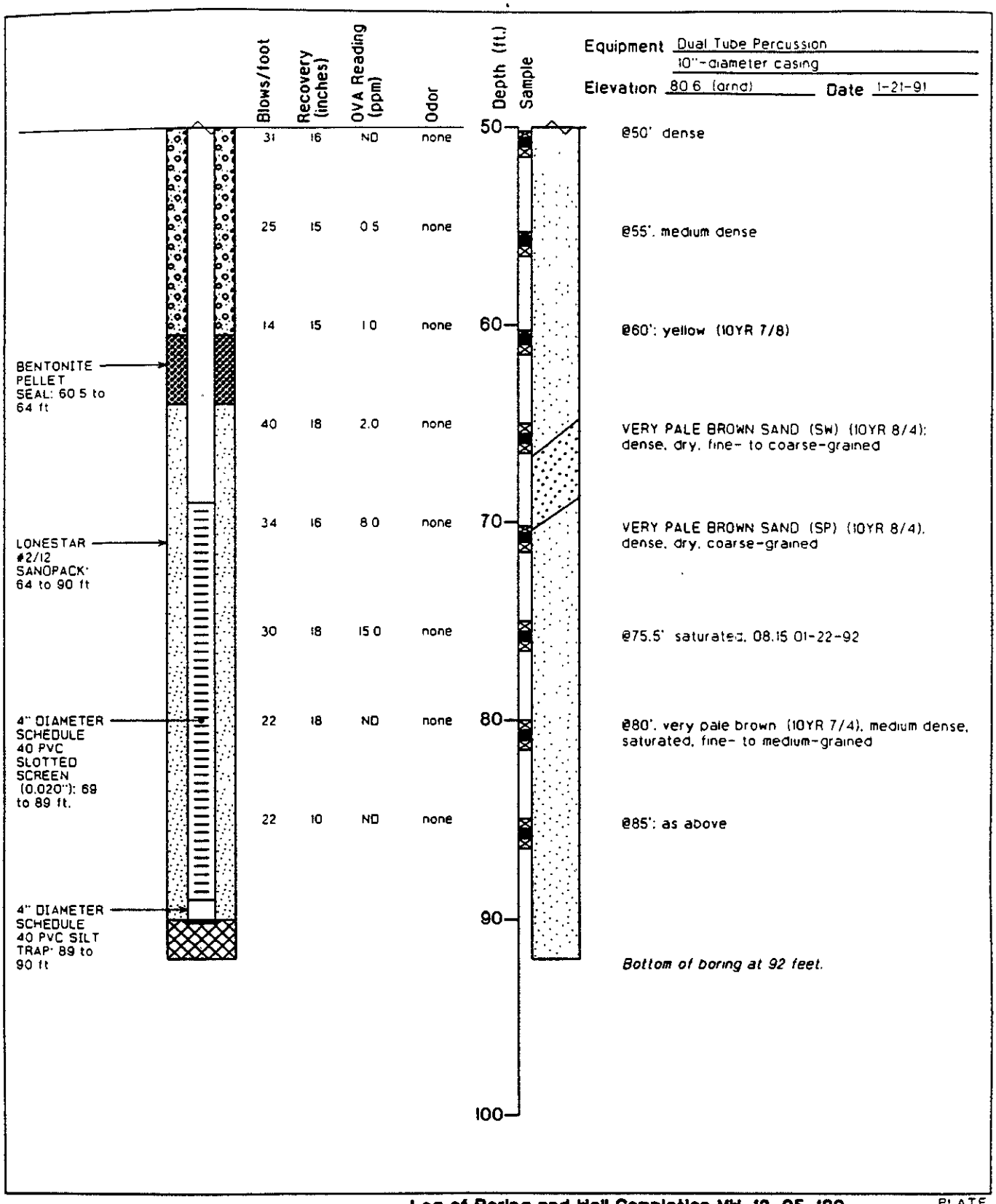


Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-05-180
Data Evaluation and Recommendation Report
Sites 2 and 12
Fort Ord, California

PLATE **B21**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
GTG	10775 560	BPF	12/92	

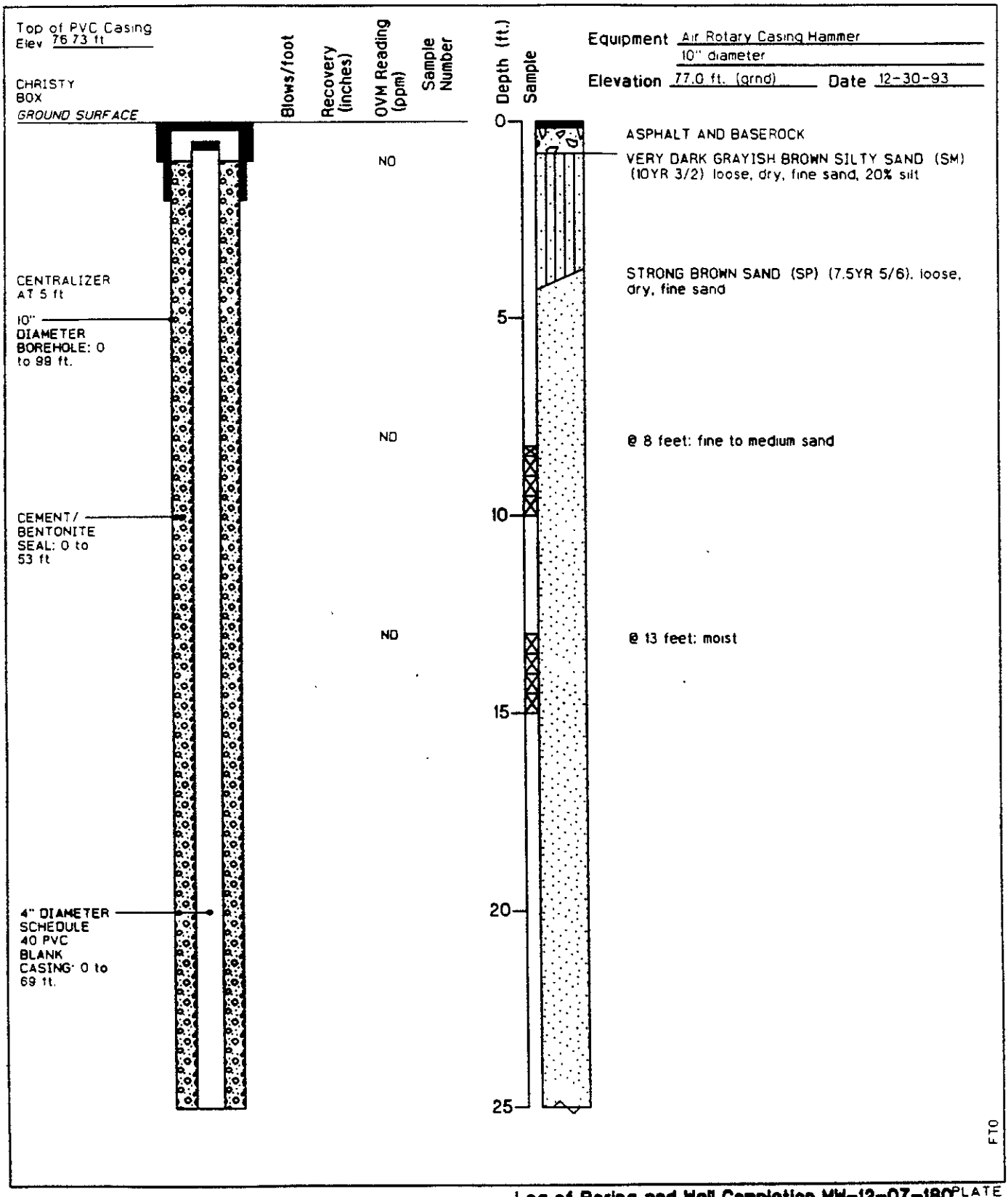


Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-05-180
Data Evaluation and Recommendation Report
Sites 2 and 12
Fort Ord, California

PLATE **B21**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
GTG	10775.560	BPF	12/92	



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-07-180
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

PLATE **B81**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Equipment Air Rotary Casing Hammer
10" diameter

Elevation 77.0 ft. (grnd) Date 12-30-93

Blows/foot	Recovery (inches)	OVM Reading (ppm)	Sample Number	Depth (ft.)	Sample
				25	
		ND			@ 28 feet: brownish yellow (10YR 6/6), medium dense
				30	
				35	
		NA			@ 37 feet, as above
				40	
				45	
				50	

CENTRALIZER AT 30 ft.

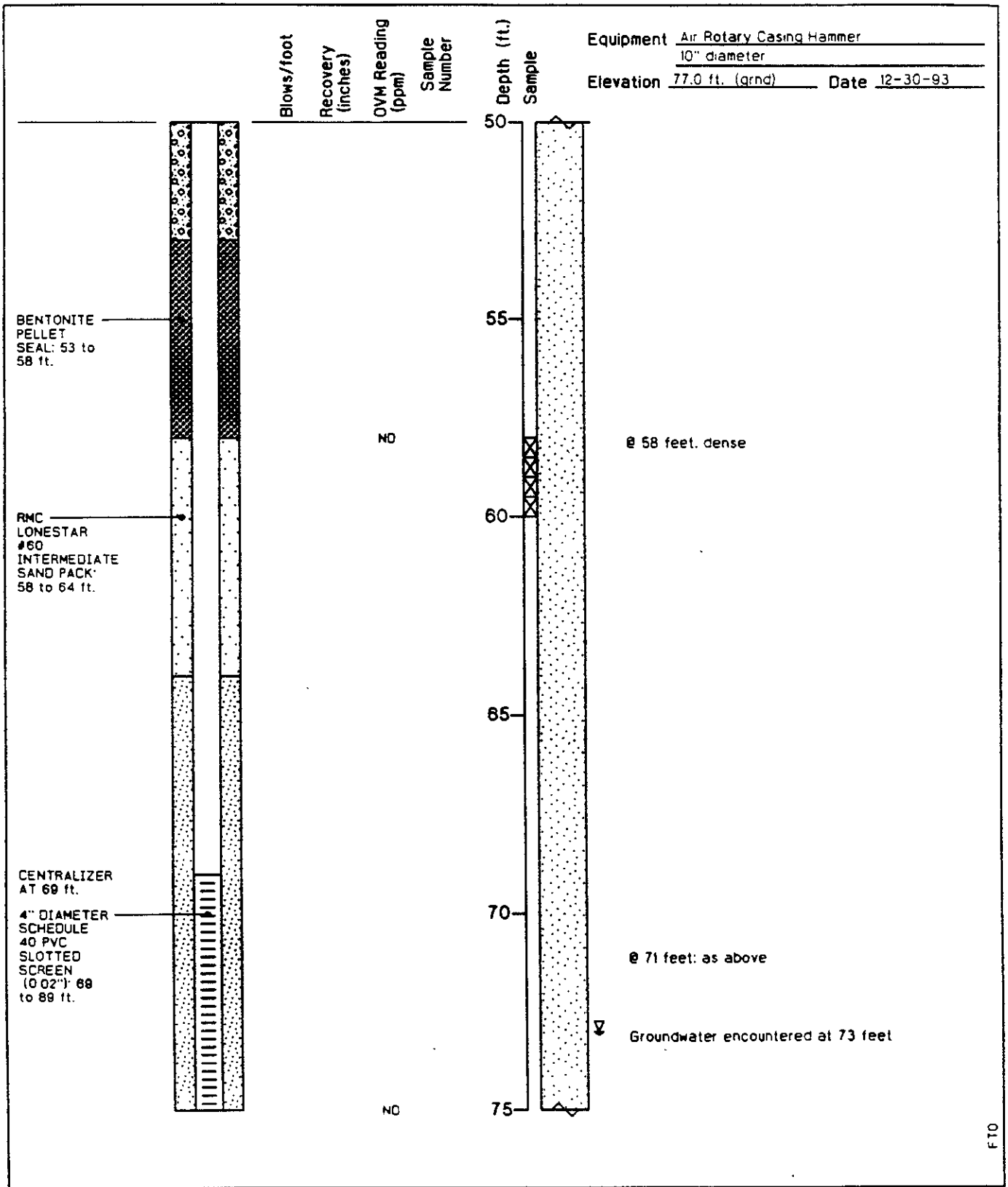
FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-07-180 PLATE B81
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Equipment Air Rotary Casing Hammer
10" diameter
Elevation 77.0 ft. (grnd) Date 12-30-93



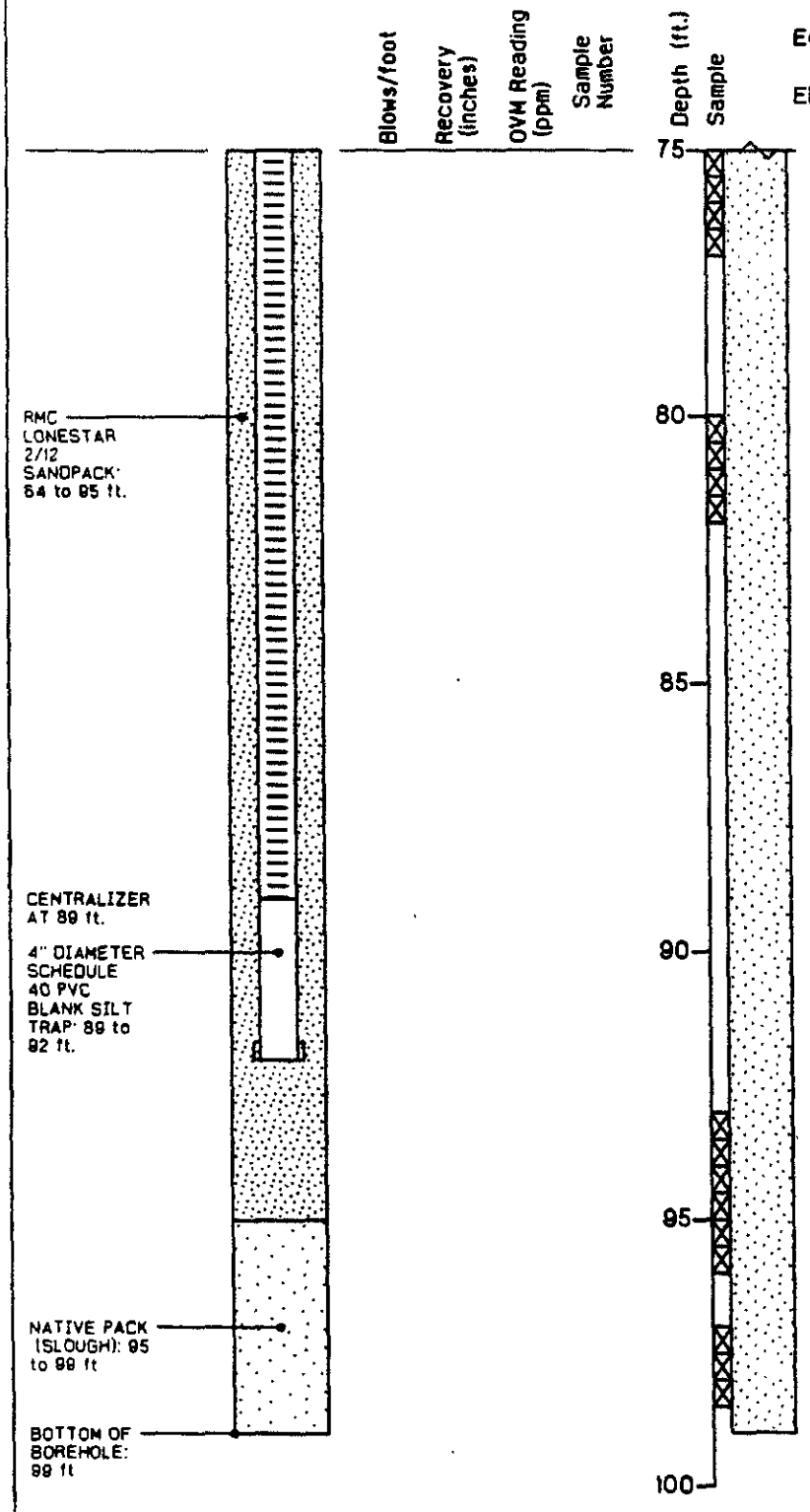
Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-07-180 PLATE
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

B81

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Equipment Air Rotary Casing Hammer
10" diameter
Elevation 77.0 ft. (grnd) Date 12-30-93



@ 75 feet, yellowish brown (10YR 5/8), loose, wet, medium to coarse subrounded sand

@ 80 feet: coarse sand, 20% fine subangular to subrounded gravel

@ 86 feet: 10-15% fine subangular to subrounded gravel

@ 91 feet: decreasing gravel to 5-10%

@ 93 feet: grayish brown to brown (10YR 5/2 to 5/3), trace fine subrounded gravel

@ 97 feet: increase in gravel to 10%

Bottom of boring at 99 feet. Groundwater encountered at 73 ft, boring completed as groundwater Monitoring Well MW-12-07-180.

FTO

Herding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-07-180 PLATE
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California
B81

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23388 041711	BPF	03/94	

Top of PVC Casing
Elev 89.42 ft

CHRISTY
BOX

GROUND SURFACE

10" DIAMETER BOREHOLE: 0 to 107 ft

CEMENT/ BENTONITE SEAL: 0 to 58 ft.

4" DIAMETER SCHEDULE 40 PVC BLANK CASING 0 to 78 ft

Blows/foot	Recovery (inches)	OVM Reading (ppm)	Sample Number	Depth (ft.)	Sample
		ND		0	
		ND		10	
		ND		20	

Equipment Air Rotary Casing Hammer
10" diameter

Elevation 89.6 ft. (grnd) Date 12-21-93

ASPHALT AND BASEROCK

DARK YELLOWISH BROWN SAND (SP) (10YR 3/6) loose, dry, fine sand, 5-10% silt

@ 9 feet: yellowish brown (10YR 5/8), medium dense

@ 20 feet: as above

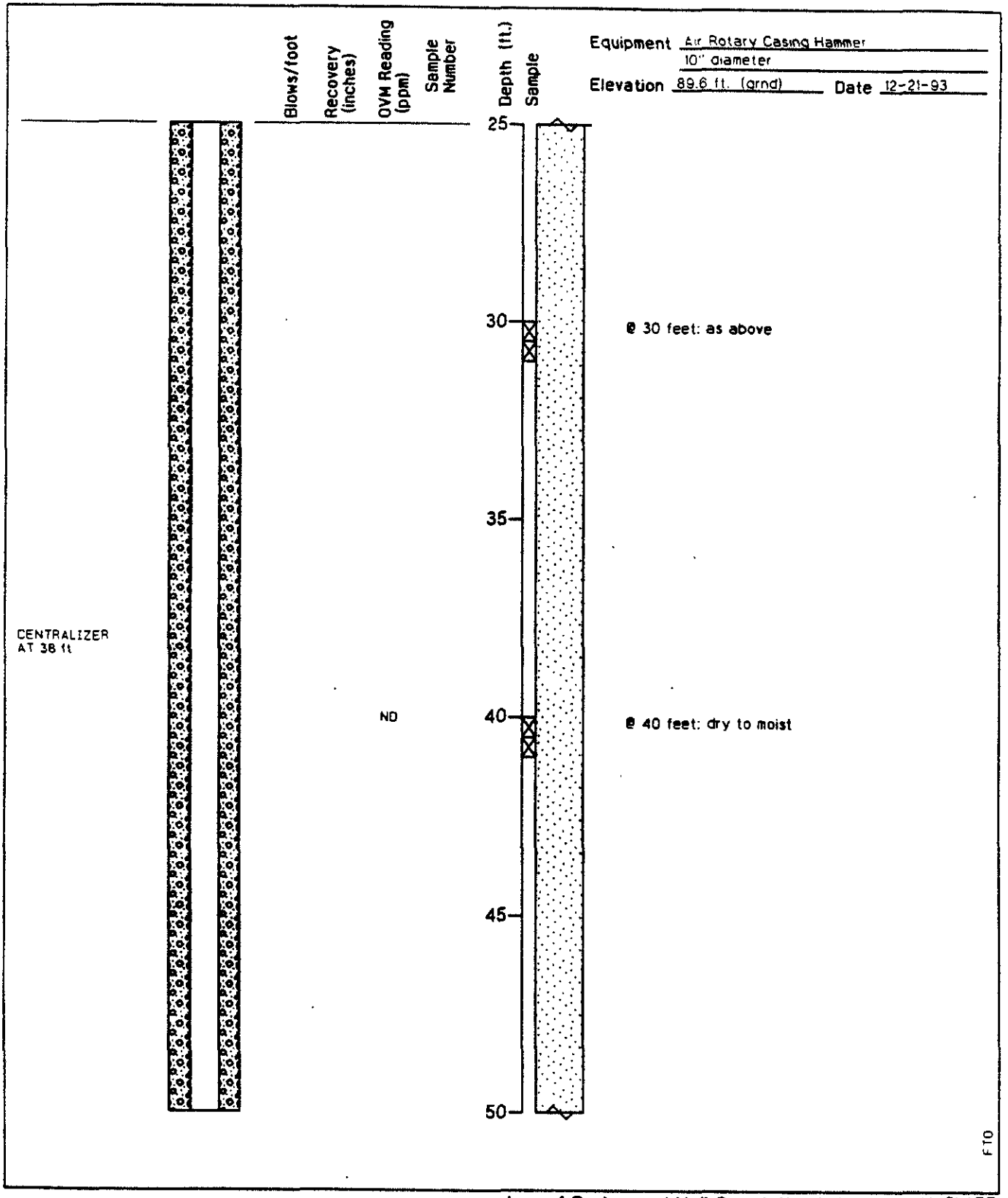
FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-08-180
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

PLATE **B82**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPP	03/94	



Harding Lawson Associates
Engineering and Environmental Services

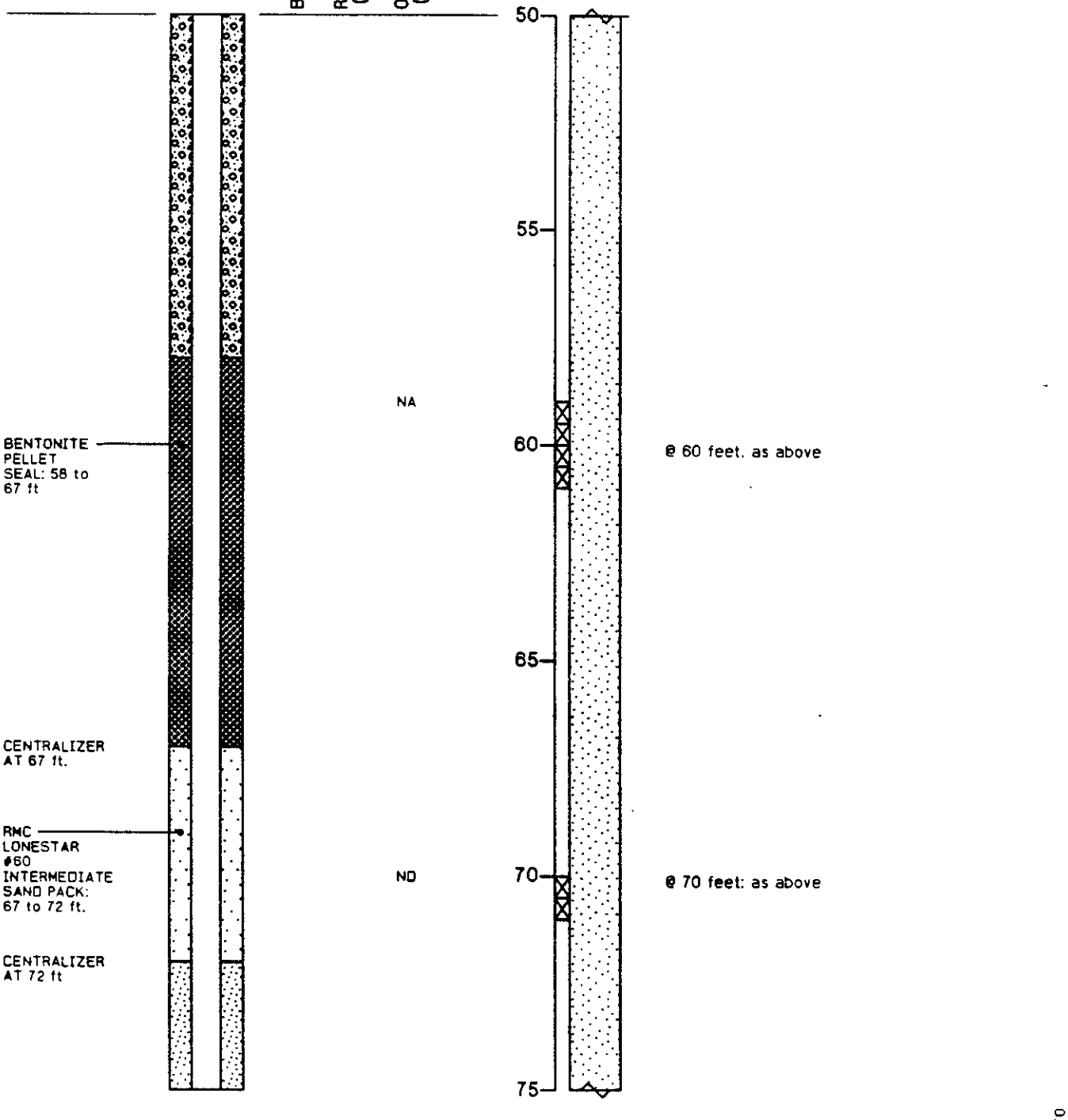
Log of Boring and Well Completion MW-12-08-180

Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

PLATE **B82**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Equipment Air Rotary Casing Hammer
10" diameter
Elevation 89.6 ft. (grnd) Date 12-21-93



FTO

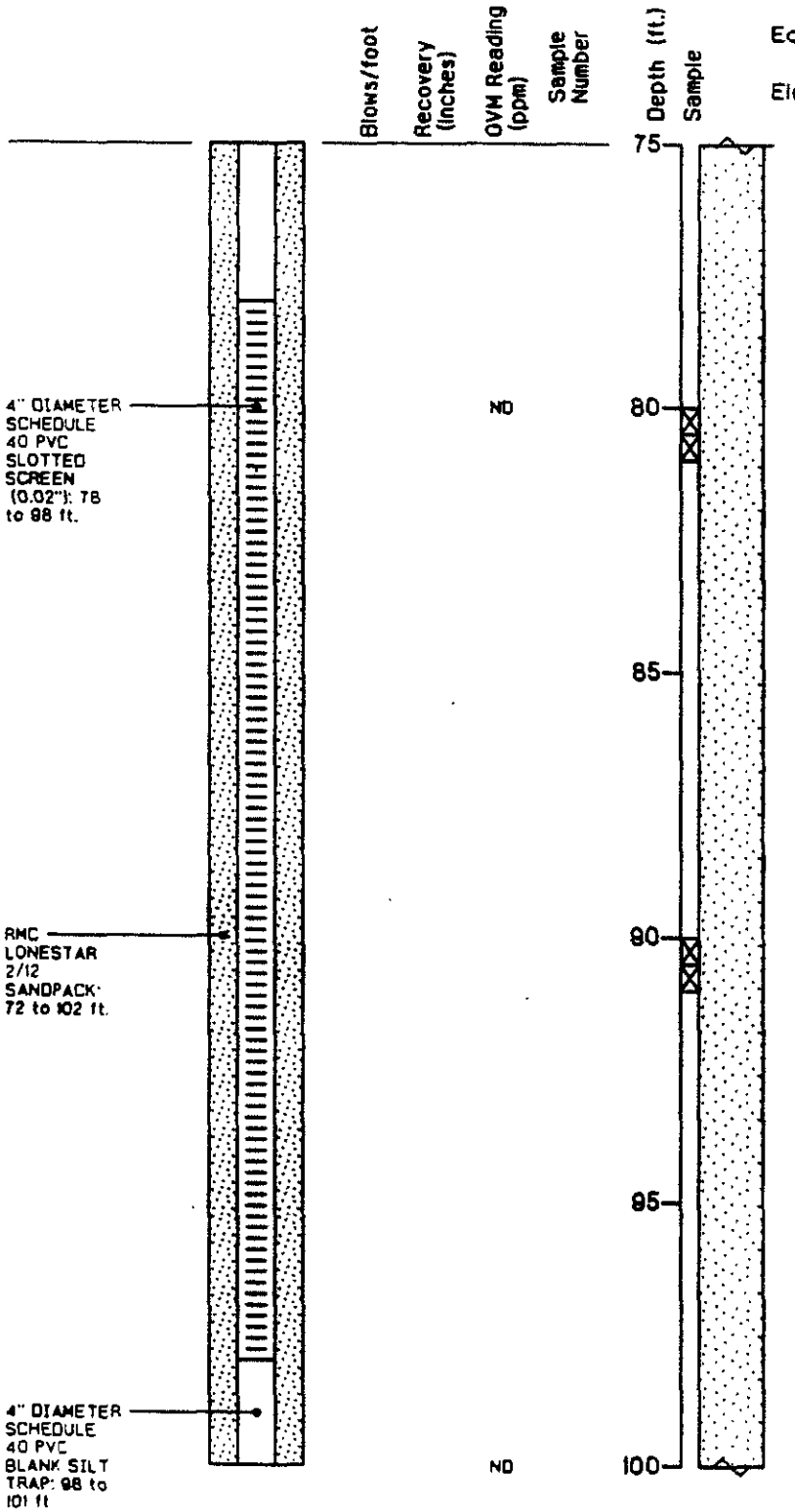
Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-08-180 PLATE
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

B82

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Equipment Air Rotary Casing Hammer
10" diameter
Elevation 89.6 ft. (grnd) Date 12-21-93



@ 80 feet: as above

@ 90 feet: brownish yellow (10YR 6/8), fine to medium

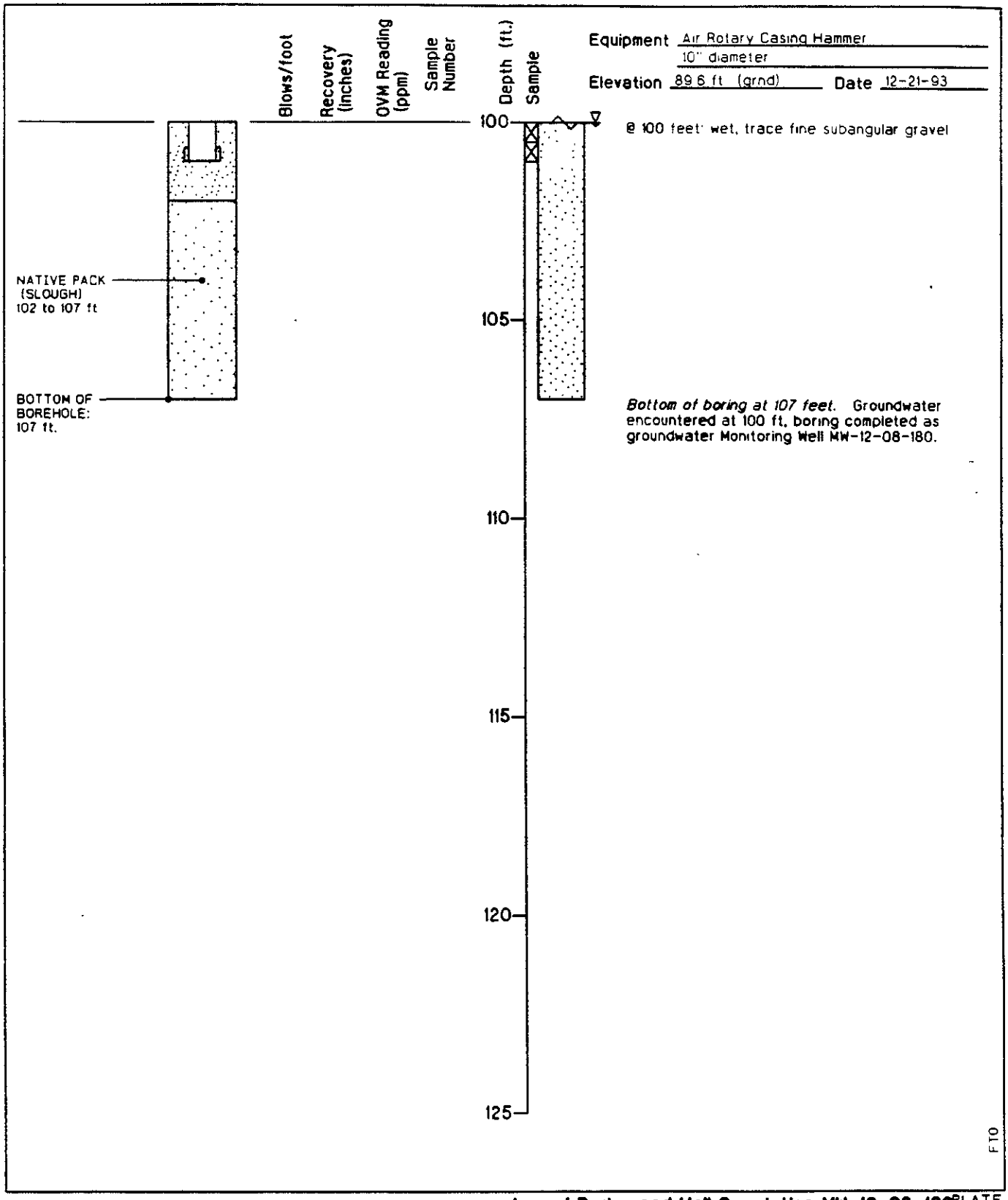
FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-08-180 PLATE
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

B82

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23388 041711	BPF	03/94	



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-12-08-180
Site 12
Volume II-RI, Basewide RI/FS
Fort Ord, California

PLATE **B82**

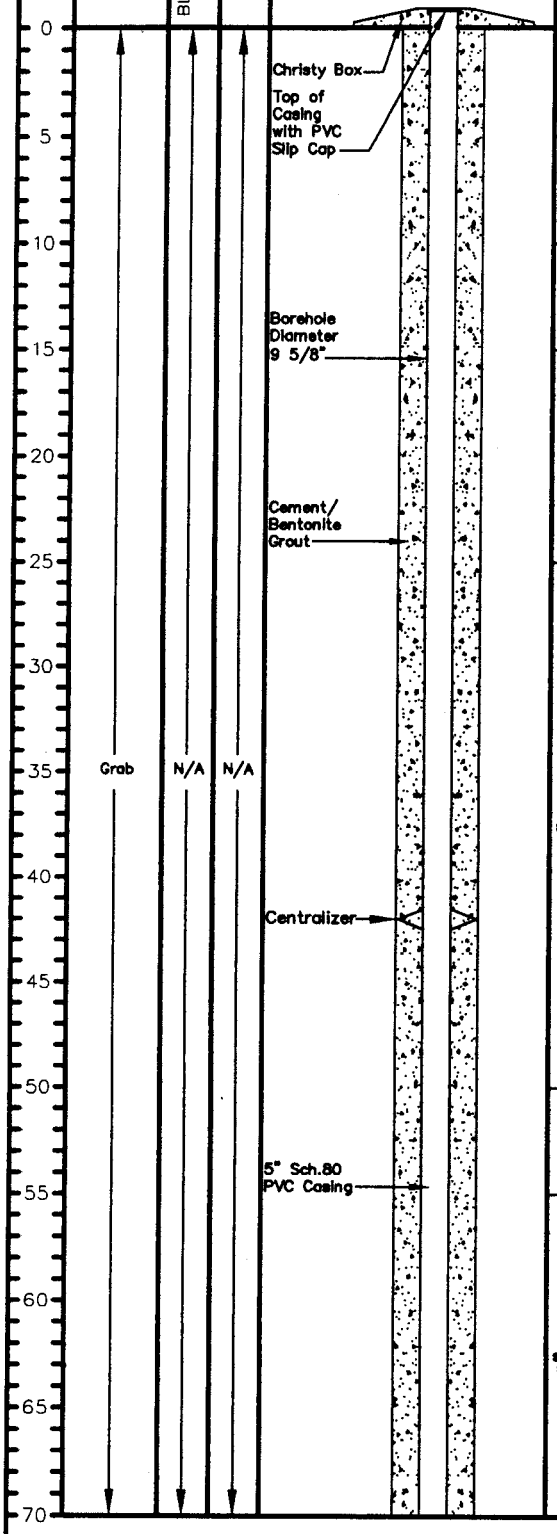
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
BWH	23366 041711	BPF	03/94	

Monitoring Well: MW-12-12-180L

COORDINATES: N: 2137386.60
E: 5736297.77

FIELD GEOLOGIST J. Tarsoly
CHECKED BY R.D.Landon
APPROVED BY M. Miller
TOTAL DEPTH 183 feet

DATE BEGAN 7/31/97
DATE FINISHED 8/7/97
SURFACE ELEV. 73.12 feet
CORE SIZE



USCS	PROFILE	DESCRIPTION
fill		Asphalt/baserock
sm		Poorly graded silty sand, yellowish brown (10YR 5/4), loose, damp, 80% fine to coarse sand (60% quartz, 25–30% feldspar, 10–15% mafics), subangular to subrounded, 10–15% silt, <5% clay, trace organics. 5.0'
sp		Poorly graded sand with organics, dark olive gray (5Y 3/2), loose, damp, 85% medium to coarse sand (85% quartz, 10% feldspar, 5% mafics), subangular, <5% silt, 5% clay, 20–25% organics, wood pieces. 10.0'
sw–sm		Well graded sand with silt, dark grayish brown (10YR 4/2), loose, damp, 75% fine to coarse sand (65% quartz, 30% feldspar, 5% mafics), subangular to subrounded, 10% silt, 10–15% organics. 15.0'
sp		Poorly graded sand, brownish yellow (10YR 6/6), loose, damp, 90% fine to medium sand (65% quartz, 20–25% feldspar, 5–10% mafics), subrounded, 9% silt, trace clay. Soft cm sized silt nodules in trace amounts, yellowish brown (10YR 5/4). Increase in fine sands and silts. 10 mm to 25 mm silt nodules in trace amounts. 25.0'
sw–sm		Well graded sand with silt, very pale brown (10YR 7/4), loose, moist, 90% fine to coarse sands (60% quartz, 35% feldspar, 5% dark/lithic), subangular to subrounded, 9% silt, trace clay, trace wood pieces. Becomes brownish yellow (10YR 6/6), wood pieces no longer present. Trace amounts of silt nodules – cm size. Slight increase in coarse sands and silt, silt nodules no longer present. 50.0'
sm		Moderately sorted silty sand, brownish yellow (10YR 6/6), 85% fine to medium sand (55% quartz, 35% feldspar, 5–10% mafics), subrounded, 15% silt, trace clay. 55.0'
sw–sm		Well graded sand with silt, yellowish brown (10YR 5/4), moist, 90% fine to medium sand (50% quartz, 35% feldspar, 15% mafics), 10% silt. Becomes very pale brown (10YR 7/4). Increase in coarse sand. Increase in coarse sand, increase in moisture content. 70.0'

DRILLER : J. Weddle
DRILLING CO. : Water Development Corp.
DRILLING METHOD : Air Rotary Casing Hammer, 9 5/8" diameter
SAMPLING METHOD : Grab
PROJECT : Ford Ord Sites 2 &12
LOCATION : Fort Ord, California
PROJECT NO. : 761966

DRAWN BY	JAC	CHECKED BY	RDL 10/14/97	FILE NAME & DISK NUMBER	1212180L(OCT97)
DATE	10/8/97	APPROVED BY	MDM 0597		

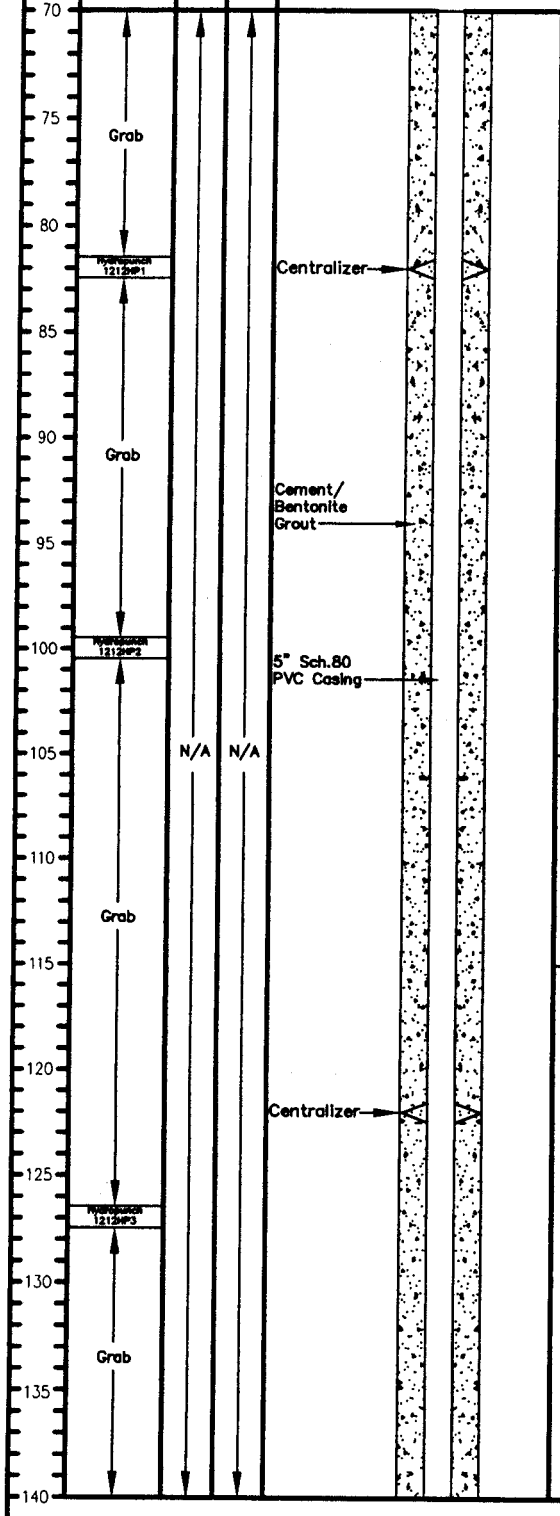
INTERNATIONAL TECHNOLOGY CORPORATION

Monitoring Well: MW-12-12-180L

COORDINATES: N: 2137386.60
E: 5736297.77

FIELD GEOLOGIST J. Tarsoly
CHECKED BY R.D. Landon
APPROVED BY M. Miller
TOTAL DEPTH 183 feet

DATE BEGAN 7/31/97
DATE FINISHED 8/7/97
SURFACE ELEV. 73.12 feet
CORE SIZE



USCS	PROFILE	DESCRIPTION
sp		Poorly graded sand, brownish yellow (10YR 6/6), wet, 95% coarse sand (60% quartz, 30% feldspar, 5–10% mafics), subangular, 5% silt. ▼ 71'
		Increase in moisture content.
		80.0'
sw-sm		Well graded sand with silt, yellowish brown (10YR 5/4), loose, saturated, 85% fine to coarse sand (55% quartz, 35% feldspar, 10% mafics), subangular, 15% silt, trace clay, trace gravels.
		85.0'
sw		Well graded sand, brownish yellow (10YR 6/6), loose, wet, 90% fine to coarse sand, predominately coarse grained (50% quartz, 45% feldspar, 5% mafics), angular to subangular, 7% gravel, trace silt.
		Decrease in gravel content.
		Decrease in gravel content. Predominately coarse sand, increase in silt content (5%).
		Increase in fine and medium sands and silt, increase in moisture content.
		100.0'
sm		Moderately to poorly graded silty sand, pale olive (5Y 6/4), loose, wet/saturated, 70% fine to medium sand (60% quartz, 30% feldspar, 10% mafics), subrounded, 30% silt.
		105.0'
sw		Well graded sand with silt, light brownish gray (10YR 6/2), loose, wet, 70% fine to coarse sand (43% quartz, 30% feldspar, 12% mafics, 15% mica), subangular to subrounded, 5–10% silt, trace amount of gravels.
		Increase in fine grained sands, decrease in coarse sands, becomes yellowish brown (10YR 5/4).
		115.0'
sm		Well graded silty sand, olive (5Y 4/4), loose, wet, 70% fine sand (30% quartz, 30% mafics, 25% mica, 15% feldspar), rounded, 30% silt.
		Well graded silty sand with gravel, yellowish brown (10YR 5/4), loose, wet, 70% fine sand (40% quartz, 25% feldspar, 25% mafics, 10% mica), subrounded to rounded, 15% silt, 10% medium to coarse gravel, 5% clay.
		Moderately well graded silty sand, olive gray (5Y 5/2), loose, saturated, 70% fine sand (45% quartz, 25–30% mafics, 15% mica, 10% feldspar), subrounded to rounded, 30% silt, trace clay.
		Trace amounts of silt nodules, increase in medium sands.

DRILLER : J. Weddle
DRILLING CO. : Water Development Corp.
DRILLING METHOD : Air Rotary Casing Hammer, 9 5/8" diameter
SAMPLING METHOD : Grab
PROJECT : Ford Ord Sites 2 &12
LOCATION : Fort Ord, California
PROJECT NO. : 761966

DRAWN BY	JAC	CHECKED BY	RDL 10/16/97	FILE NAME & DISK NUMBER	1212180L(OCT97)
DATE	10/8/97	APPROVED BY	MDM 10-15-97		

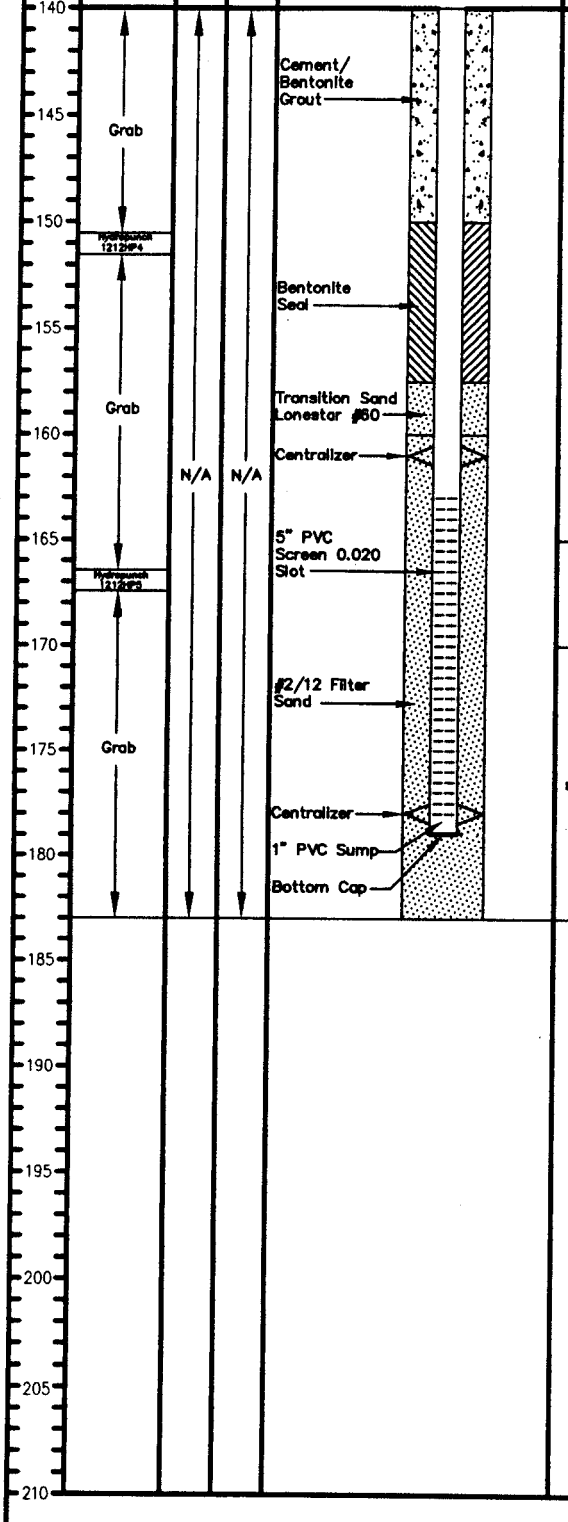
INTERNATIONAL TECHNOLOGY CORPORATION

Monitoring Well: MW-12-12-180L

COORDINATES: N: 2137386.60
E: 5736297.77

FIELD GEOLOGIST J. Tarsoly
CHECKED BY R.D. Landon
APPROVED BY M. Miller
TOTAL DEPTH 183 feet

DATE BEGAN 7/31/97
DATE FINISHED 8/7/97
SURFACE ELEV. 73.12 feet
CORE SIZE



DESCRIPTION

Trace amounts of gravels, increase in fine sands, decrease in moisture content (wet).

10–25 mm sized silt nodules.

Becomes dark olive gray (5Y 3/2), some weakly indurated sands in 10 mm sized nodules, increase in clay content, increase in water content (saturated).

Increase in amount and size of weakly indurated sands, up to 25 mm size.

Becomes dark grayish brown (10YR 4/2) with abundant weakly indurated sandstone material up to 76 mm in size.

Becomes dusky red (10 R 3/4), weakly indurated sand, size decreasing (<10 mm).

Saturated and increase in density.

165.0'

Well graded sandy silt, red (10 R 4/6), loose, saturated, 50% fine sand (60% quartz, 25% feldspar, 10–15% mafics), subrounded to rounded, 50% silt.

170.0'

Poorly to moderately graded silty sand, reddish brown (5YR 4/4), loose, saturated, 80% fine to coarse sand (50% quartz, 25% feldspar, 25% mafics) subrounded, 20% silt, trace clay.

Becomes dark grayish brown (10YR 4/2), increase in fine sands, increase in clay content (5%).

Becomes yellowish brown (10YR 5/4), increase in fine sands, moisture decreases, density increases.

TOTAL DEPTH 183 FEET

DRILLER : J. Weddle
DRILLING CO. : Water Development Corp.
DRILLING METHOD : Air Rotary Casing Hammer, 9 5/8" diameter
SAMPLING METHOD : Grab
PROJECT : Ford Ord Sites 2 &12
LOCATION : Fort Ord, California
PROJECT NO. : 761966

DRAWN BY	JAC	CHECKED BY	KDL 10/14/97	FILE NAME & DISK NUMBER	1212180L(OCT97)
DATE	10/8/97	APPROVED BY	MDM 10-15-97		

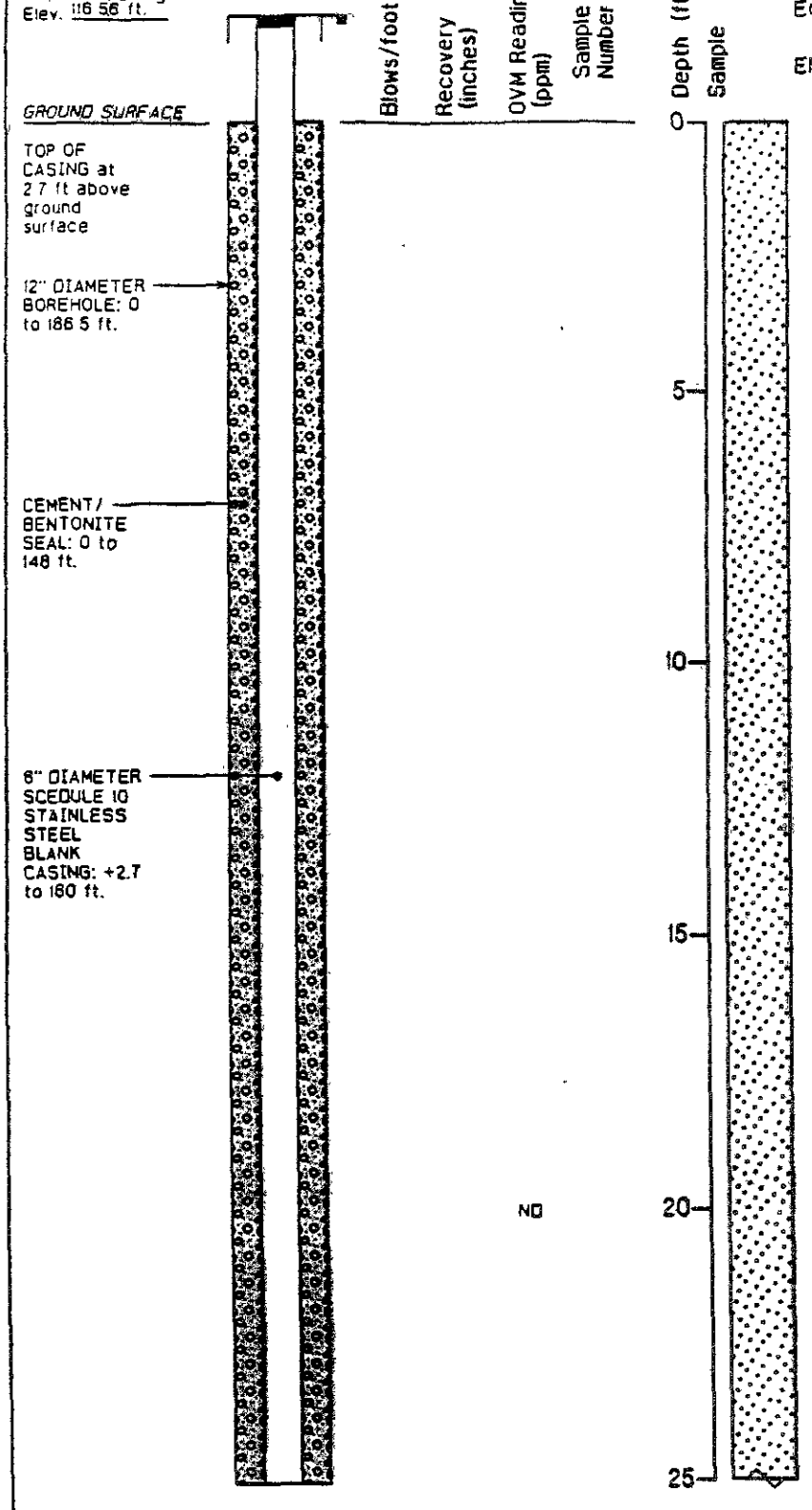
INTERNATIONAL TECHNOLOGY CORPORATION

MW-OU2-20-180A

Top of Casing Elev. 116.56 ft.

Equipment Air Rotary Casing Hammer (SSTH-1500) 12"-diameter

Elevation 113.83 ft. GS Date 09-28-94



YELLOWISH BROWN SAND (SW) (10YR 5/4), loose, medium sand, subangular, spherical, with roots

@ 2 feet: light yellowish brown (10YR 6/4)

@ 10 feet: brown to dark brown (10YR 4/3)

@ 18 feet: very dark grayish brown (10YR 3/2)

@ 20 feet: light yellowish brown (10YR 6/4)

FTD

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180 PLATE

Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

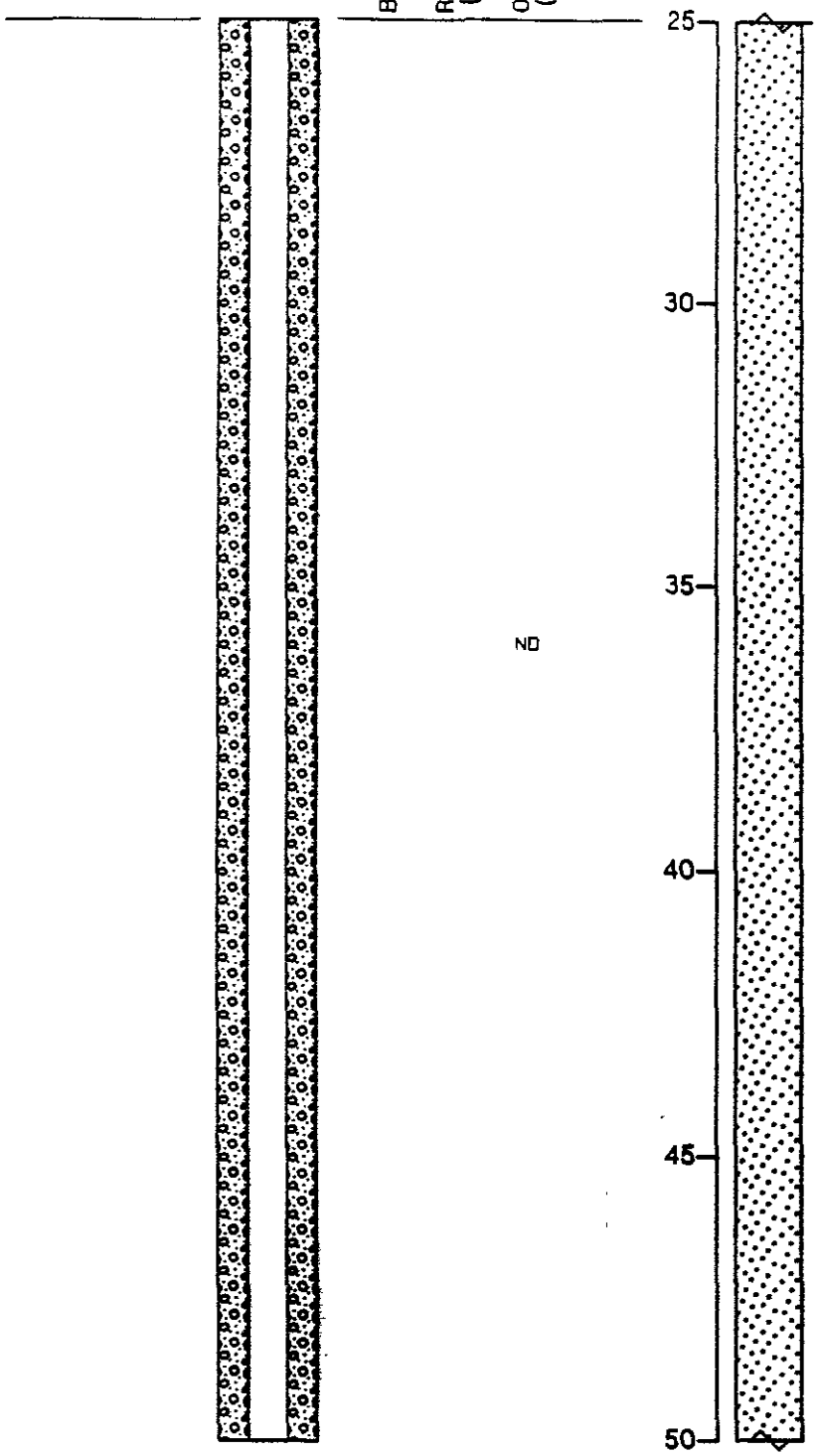
A3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 06223		12/94	

MW-002-20-180A

Equipment Air Rotary Casing Hammer (SSTH-1500)
12"-diameter

Elevation 113.83 ft. GS Date 09-28-94



FTO

Harding Lawson Associates
Engineering and Environmental Services

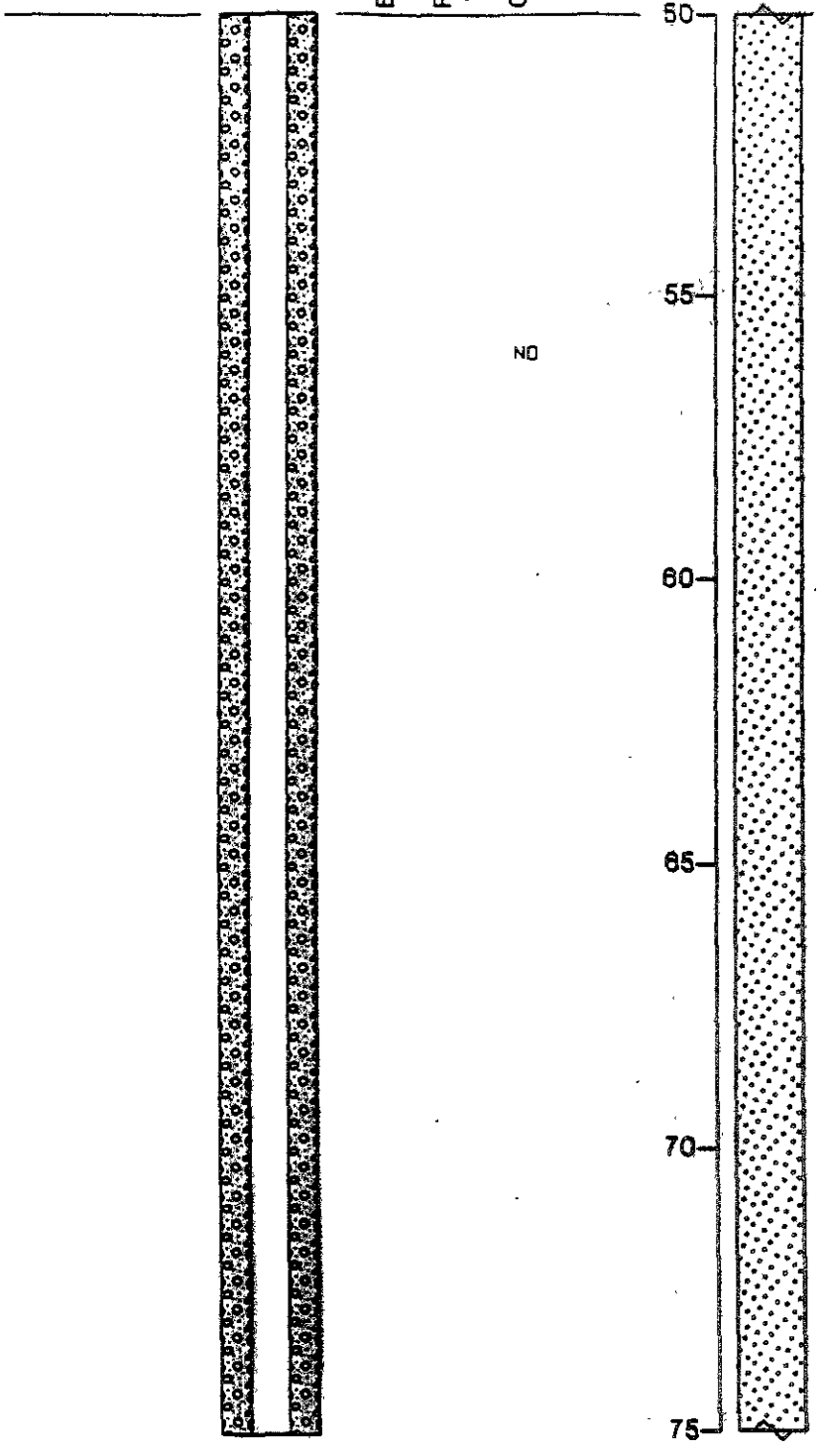
Log of Boring and Well Completion EW-0U2-01-180
Pre-Design Evaluation
0U2 Landfill
Fort Ord, California

PLATE **A3**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 08223	MM	12/94	

MW-OU2-20-180A

Equipment Air Rotary Casing Hammer (SSTH-1500)
12"-diameter
Elevation 113.83 ft. GS Date 09-28-94



FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180 PLATE
Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

A3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 06223		12/94	

MW-OU2-20-180X

Equipment Air Rotary Casing Hammer (SSTH-1500) 12"-diameter

Elevation 113.83 ft. GS Date 09-28-94

Blows/foot	Recovery (inches)	OVM Reading (ppm)	Sample Number	Depth (ft.)	Sample
		ND		75	
				80	
				85	
				90	
		ND		95	
				100	

@ 97 feet: increasing clay content

FTD

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180
Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

PLATE **A3**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 06223		12/94	

MW-OU2-20-180F

Equipment Air Rotary Casing Hammer, (SSTH-1500) 12"-diameter

Elevation 113.83 ft GS Date 09-28-94

Blows/foot	Recovery (inches)	OVM Reading (ppm)	Sample Number	Depth (ft.)	Sample
				100	
				105	
				110	@ 110 feet: decrease/loss of clay
				115	
		ND			@ 116 feet: coarse
				120	
		ND			@ 120 feet: wet, very coarse sand or gravel
				125	

F10

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180 PLATE A3

Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 06223		12/94	

MW-OU2-20-180X

Equipment Air Rotary Casing Hammer (SSTH-1500) 12"-diameter

Elevation 113.83 ft. GS Date 09-28-94

Blows/foot	Recovery (inches)	OVM Reading (ppm)	Sample Number	Depth (ft.)	Sample	
				125		
		ND		130		@ 130 feet: fine
		ND		135		
				140		OLIVE CLAY (CL) (5Y 5/3)
				145		
				150		

FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180
Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

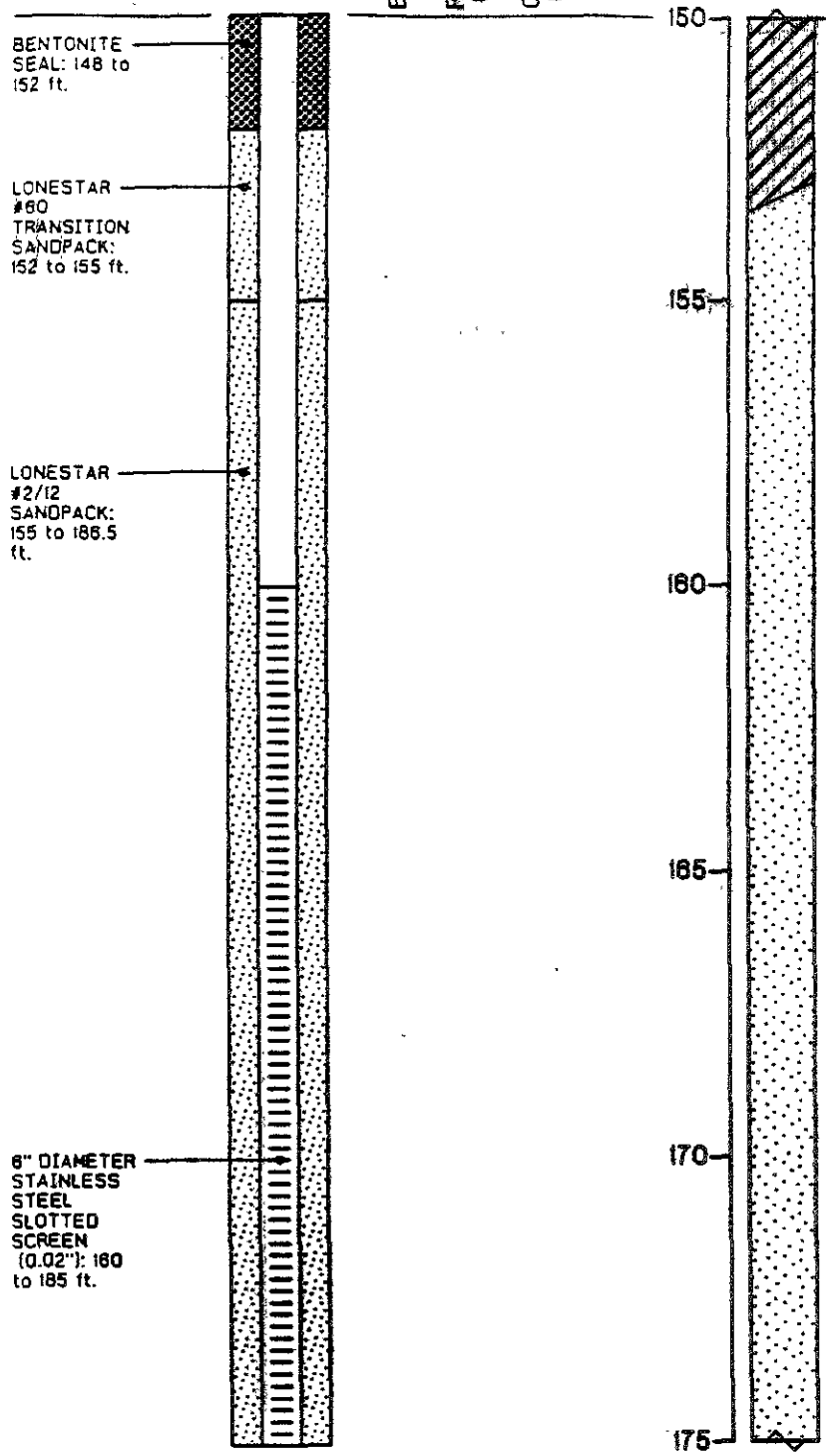
PLATE **A3**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23388 08223		12/94	

MW-OU2-20-180Y

Equipment Air Rotary Casing Hammer (SSTH-1500) 12"-diameter

Elevation 113.83 ft. GS Date 09-28-94



FTO

Harding Lawson Associates
Engineering and Environmental Services

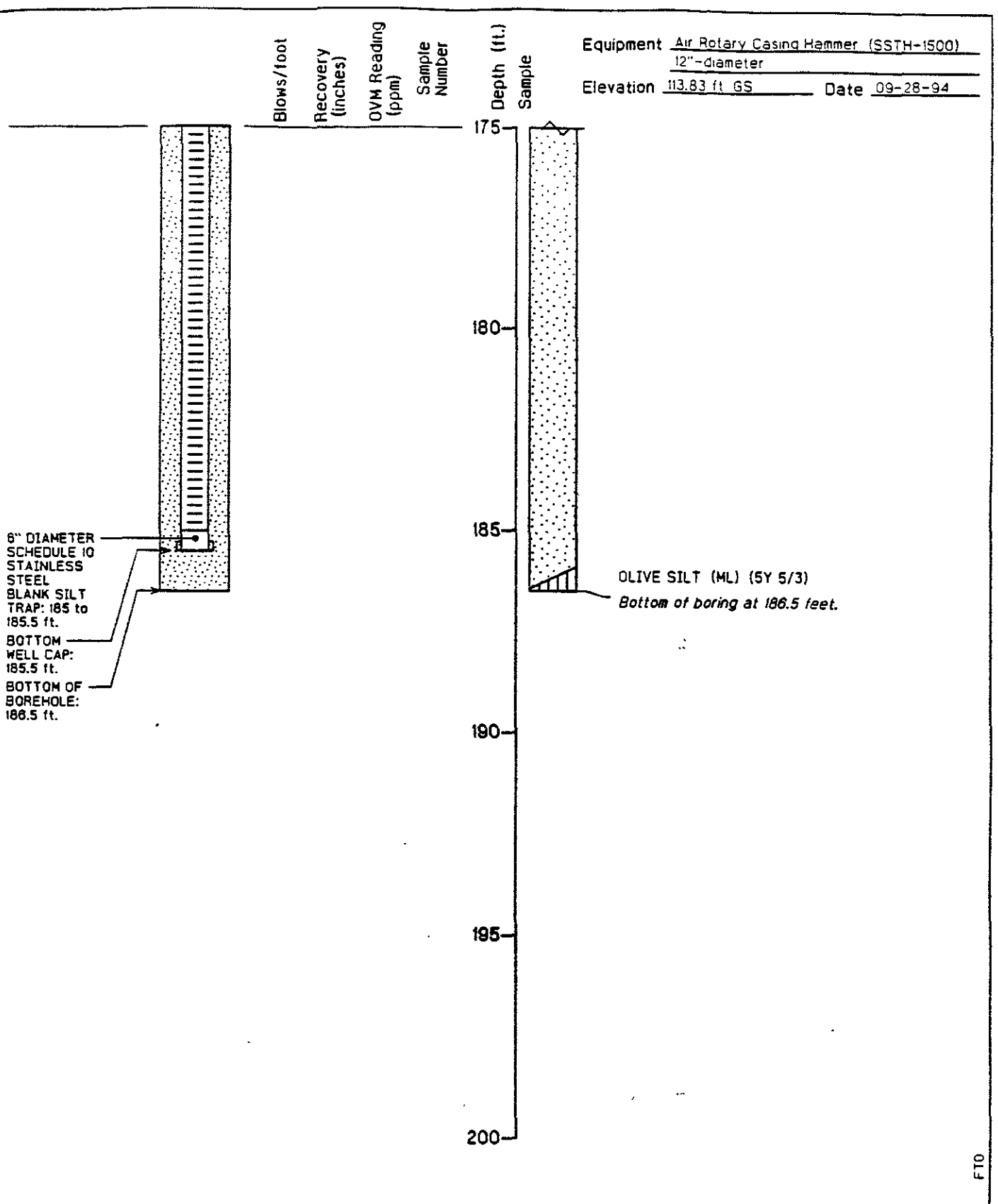
Log of Boring and Well Completion EW-OU2-01-180 PLATE A3
Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23366 06223		12/94	

MW-OU2-20-180

Equipment Air Rotary Casing Hammer (SSTH-1500) 12"-diameter

Elevation 113.83 ft GS Date 09-28-94



FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion EW-OU2-01-180
Pre-Design Evaluation
OU2 Landfill
Fort Ord, California

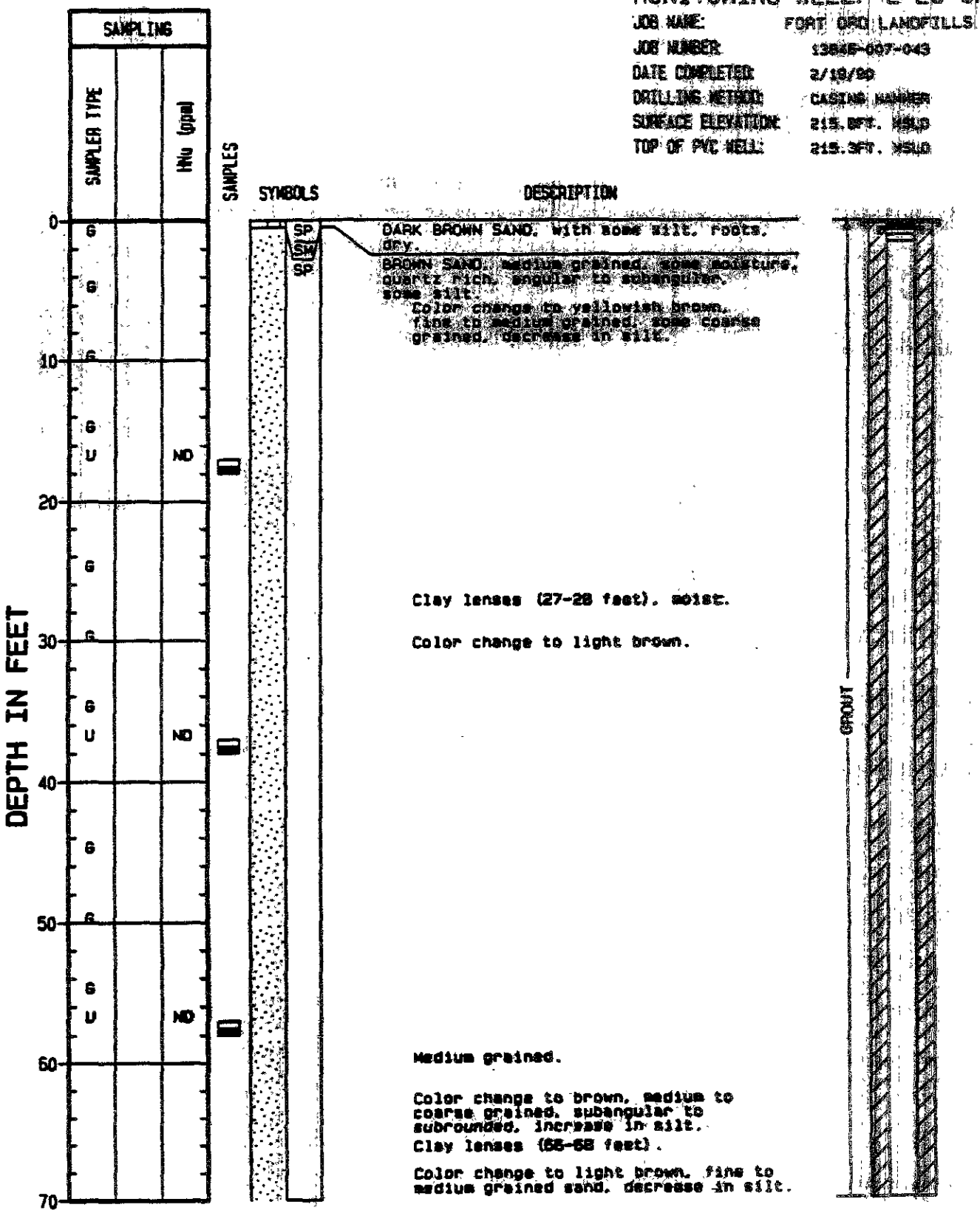
PLATE **A3**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CEG	23368 06223	JSH	12/94	

MW-002-26-A

MONITORING WELL: L-26-UPP

JOB NAME:	FORT ORD LANDFILLS RI/F
JOB NUMBER:	13848-007-043
DATE COMPLETED:	2/19/90
DRILLING METHOD:	CASING HAMMER
SURFACE ELEVATION:	215.8FT. MSLD
TOP OF PVC WELL:	215.3FT. MSLD



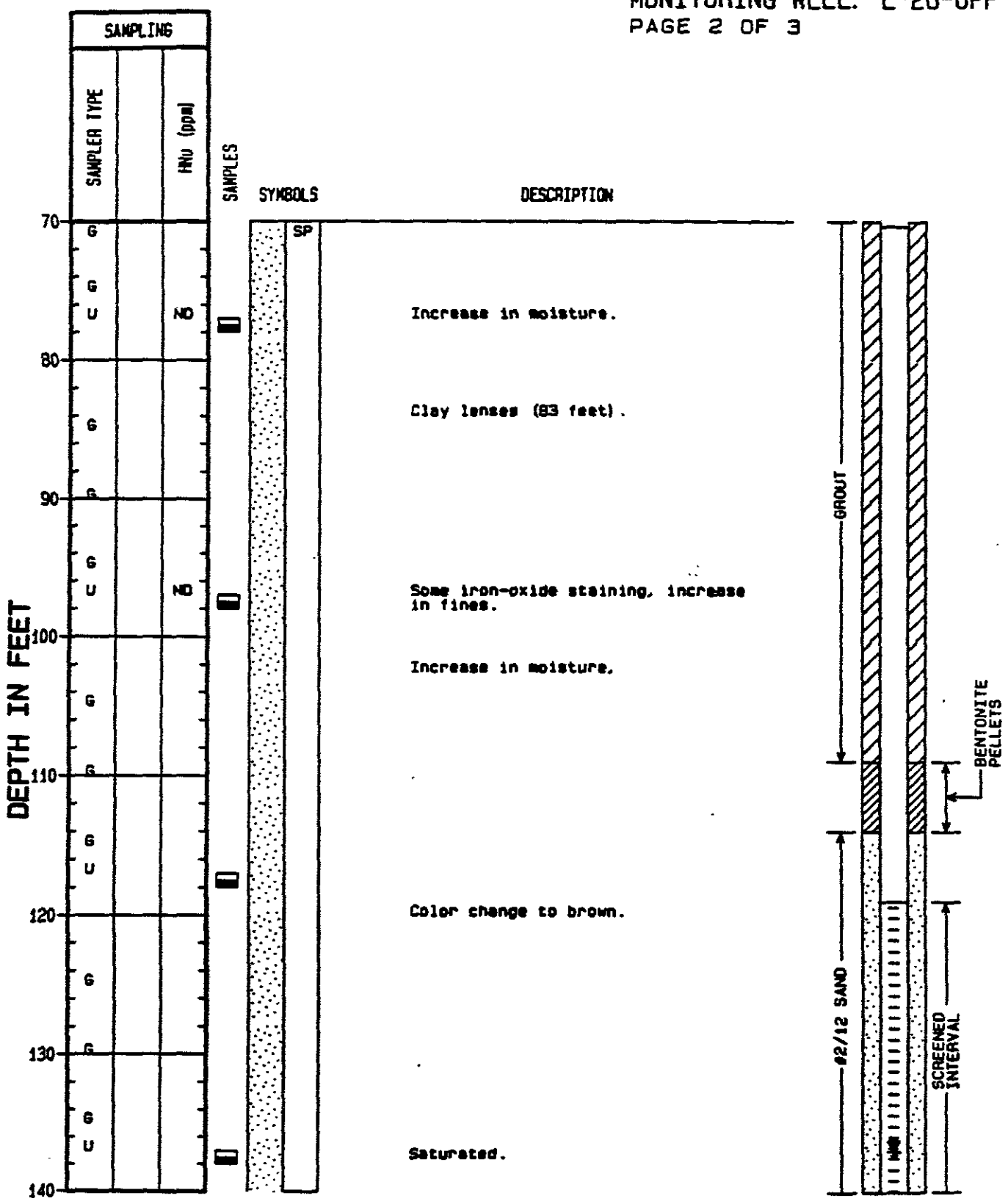
WELL LOG

Dames & Moore

PLATE A-6

MW-002-26-A

MONITORING WELL: L-26-UPP



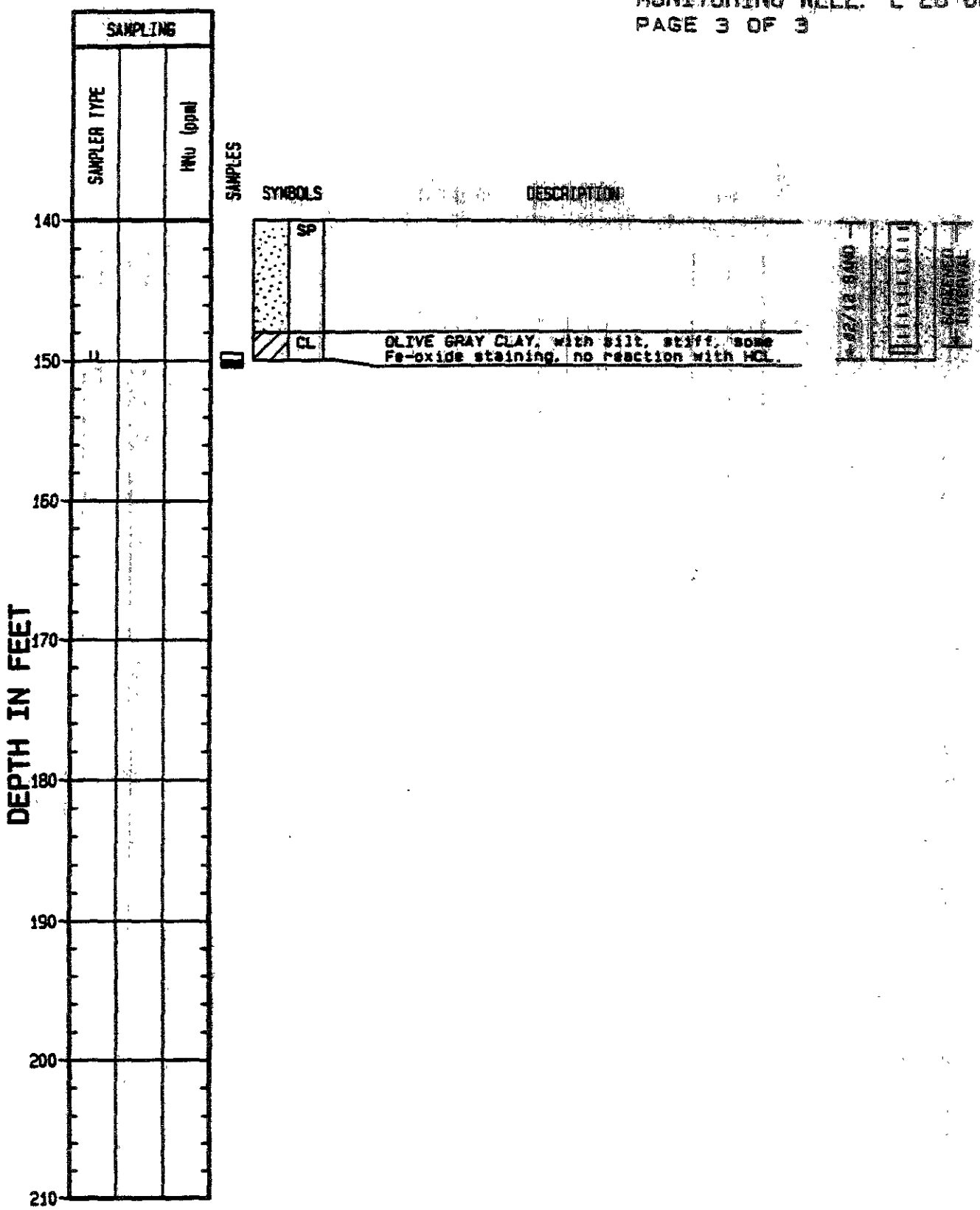
WELL LOG

Dames & Moore

PLATE A-6 (cont'd)

HW-062-26-A

MONITORING WELL: L-26-UPP
PAGE 3 OF 3



WELL LOG

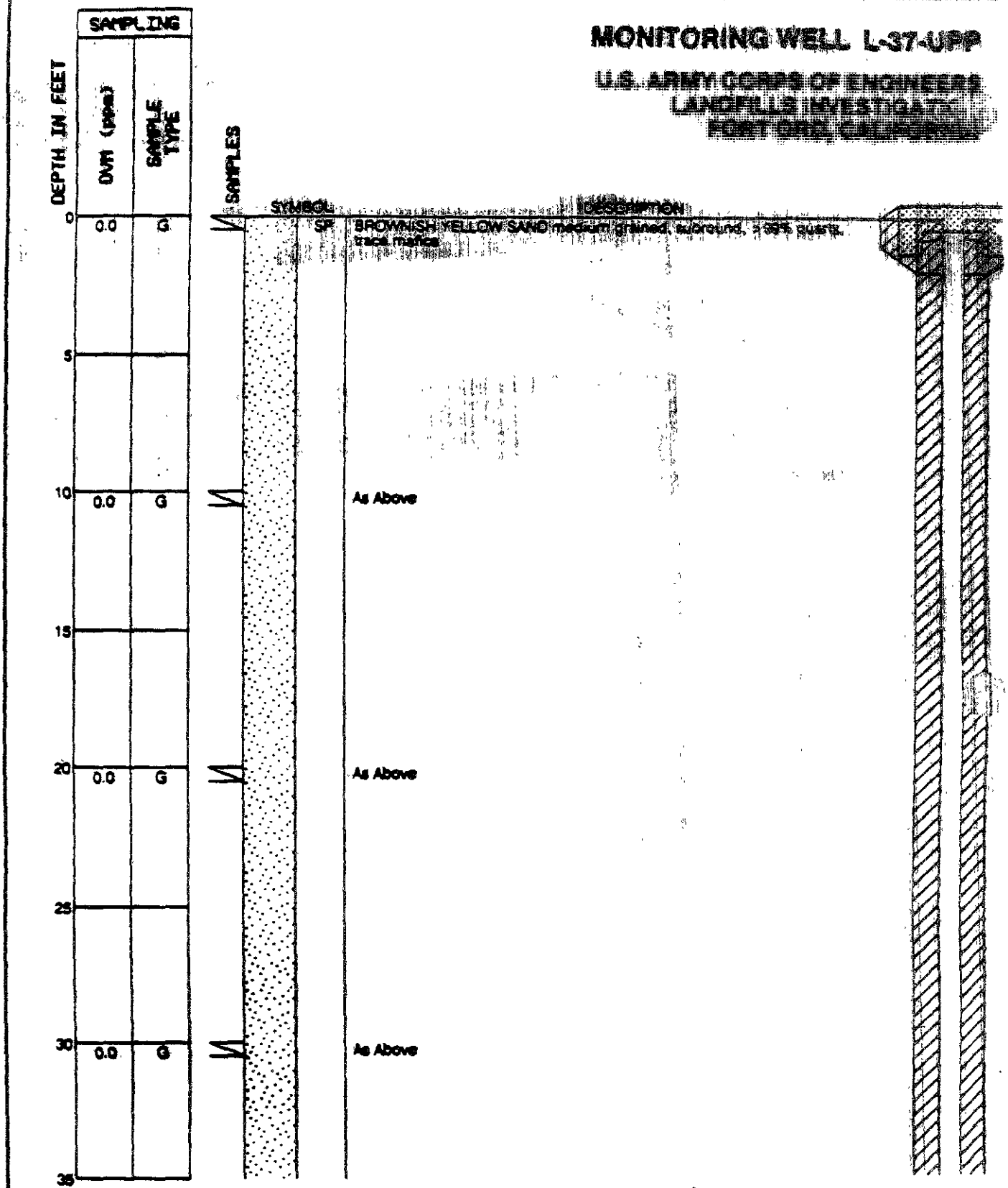
Dames & Moore

PLATE A-6 (cont'd)

MW-OUL-37-A

MONITORING WELL L-37-UPP

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



See Plate A-1 for general log notes and explanation of the terms and symbols.

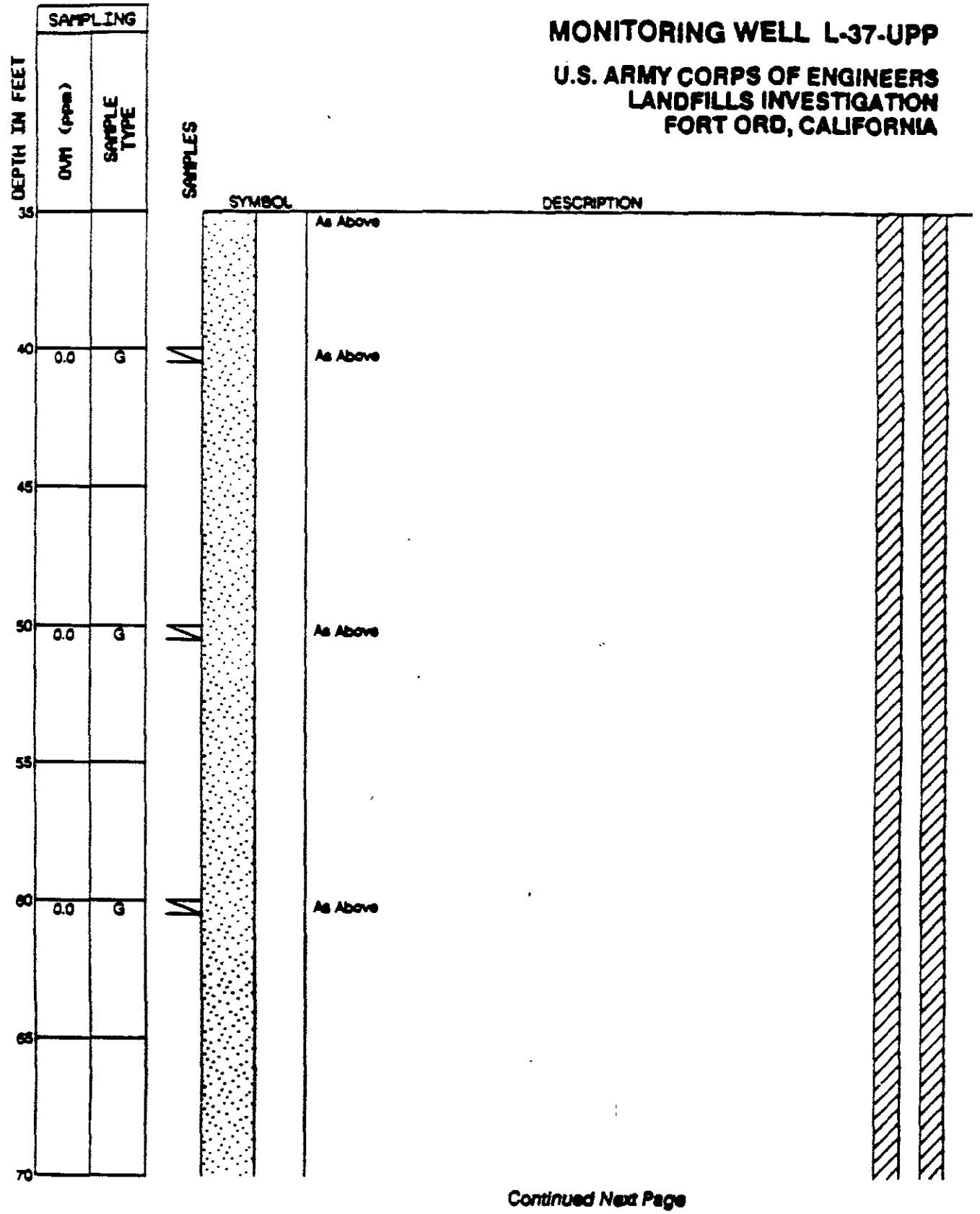
Continued Next Page

Job No.: 13846-007-043 Ser. No.: L-37-UPP	Dames & Moore	Log of Boring
Date Completed: 11/30/93 Boring Depth: 164.0 ft.	Grade Elev: 125.80 FT MSL Coordinates: 5000010.03 N ; 1179129.96 E 1927 Zone IV	Location: FORT ORD, CA
Top of Casing Elev: 125.44 ft. MSL Casing Type: Sch 80 PVC PVC Casing Depth: 164.0 ft. Casing Diam: 5.0 in.	Screened Interval: 152.0-162.0 ft. Effective Interval: 146.0-164.0 ft.	Slot Size: 0.020 in. Sand Pack: #2/12

MW-UUL-37-A

MONITORING WELL L-37-UPP

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



Continued Next Page

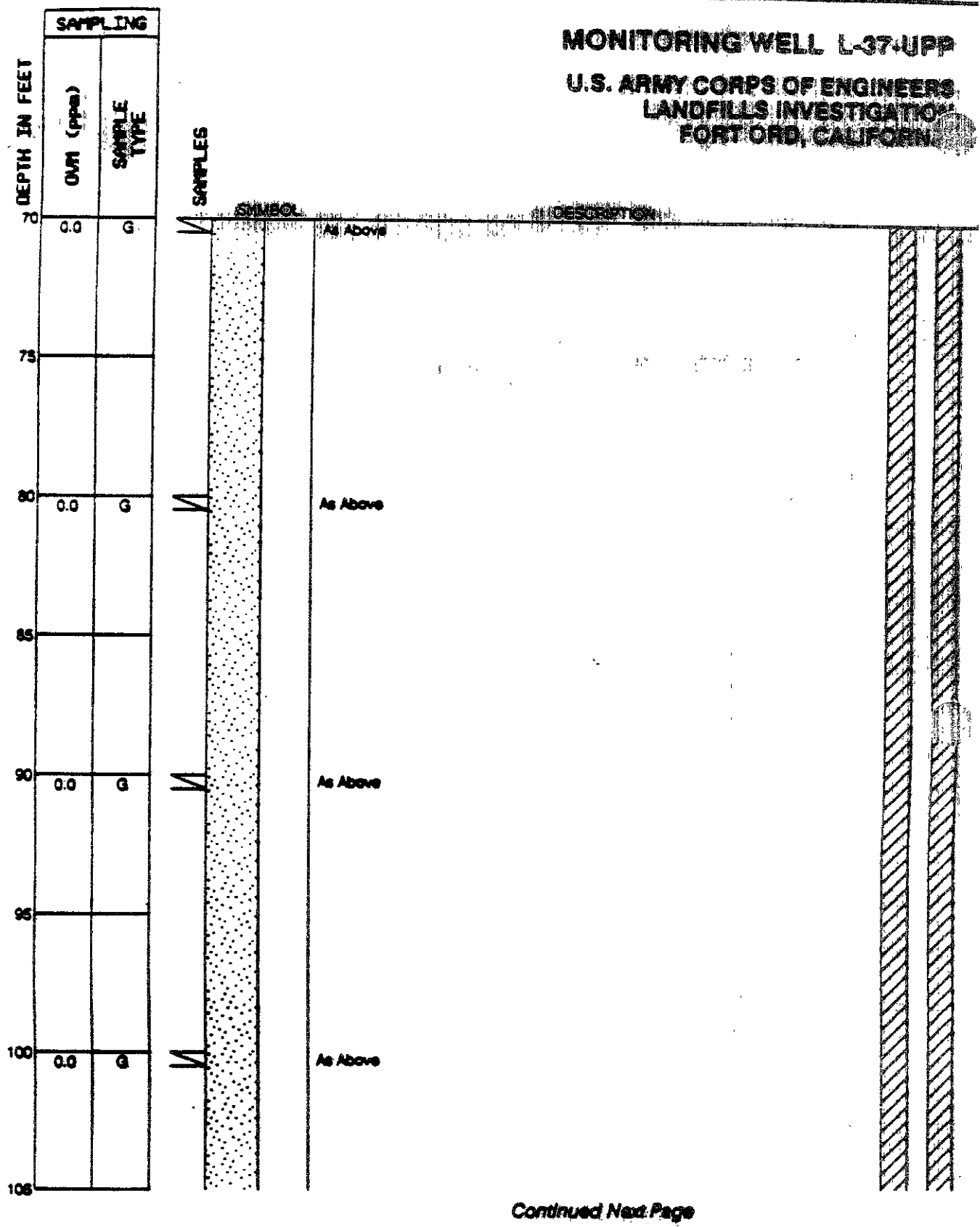
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-UPP	Dames & Moore	Log f Boring

MW-UU-37-A

MONITORING WELL L-37-UPP

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



See Plate A-1 for general log notes and explanation of the terms and symbols.

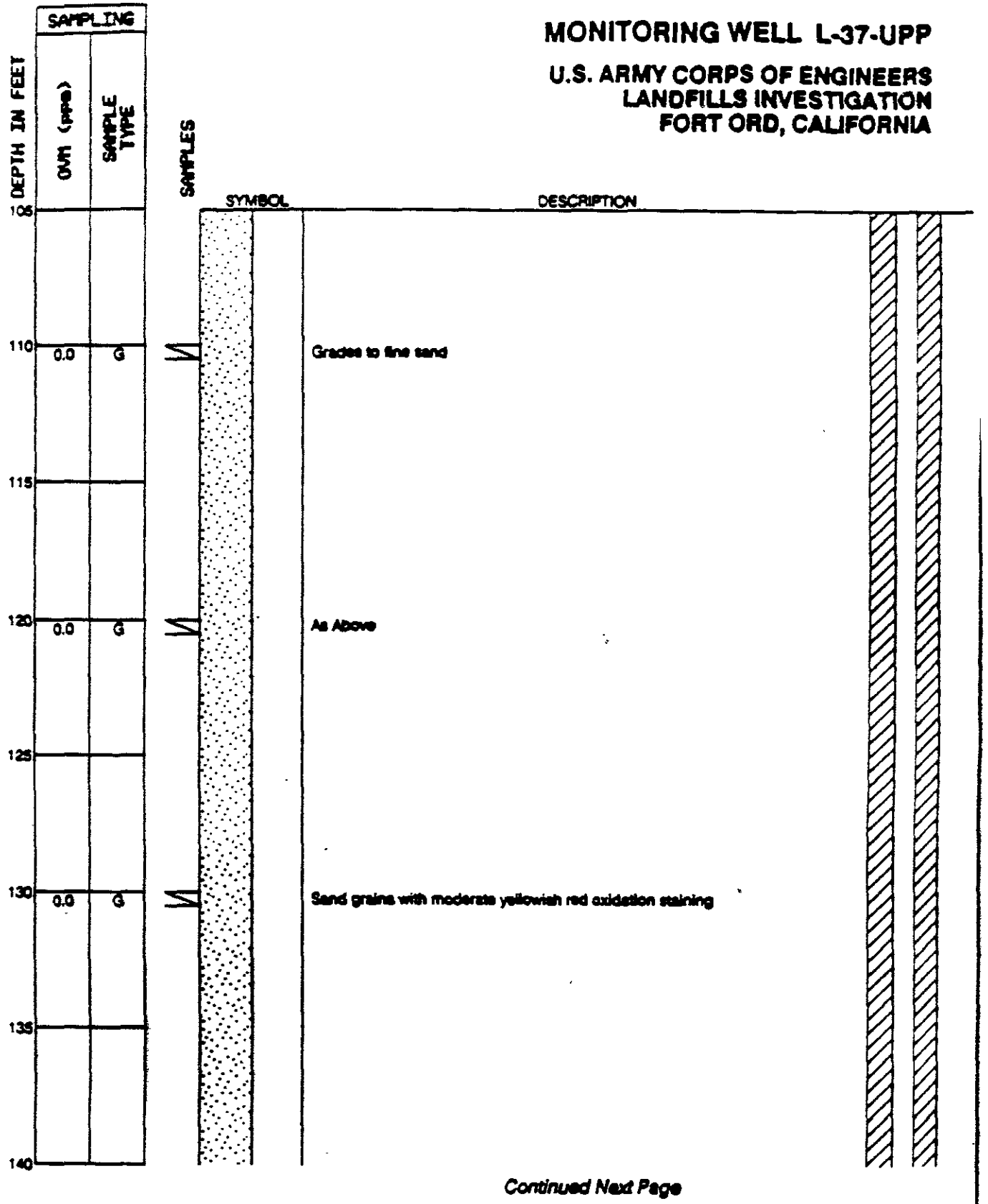
Job No.: 13846-007-043 Ser. No.: L-37-UPP	Dames & Moore	Log of Boring

Log Template: WELL3 March 21, 1994 PAGE 3 of 5

MW-002-37-A

MONITORING WELL L-37-UPP

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



Continued Next Page

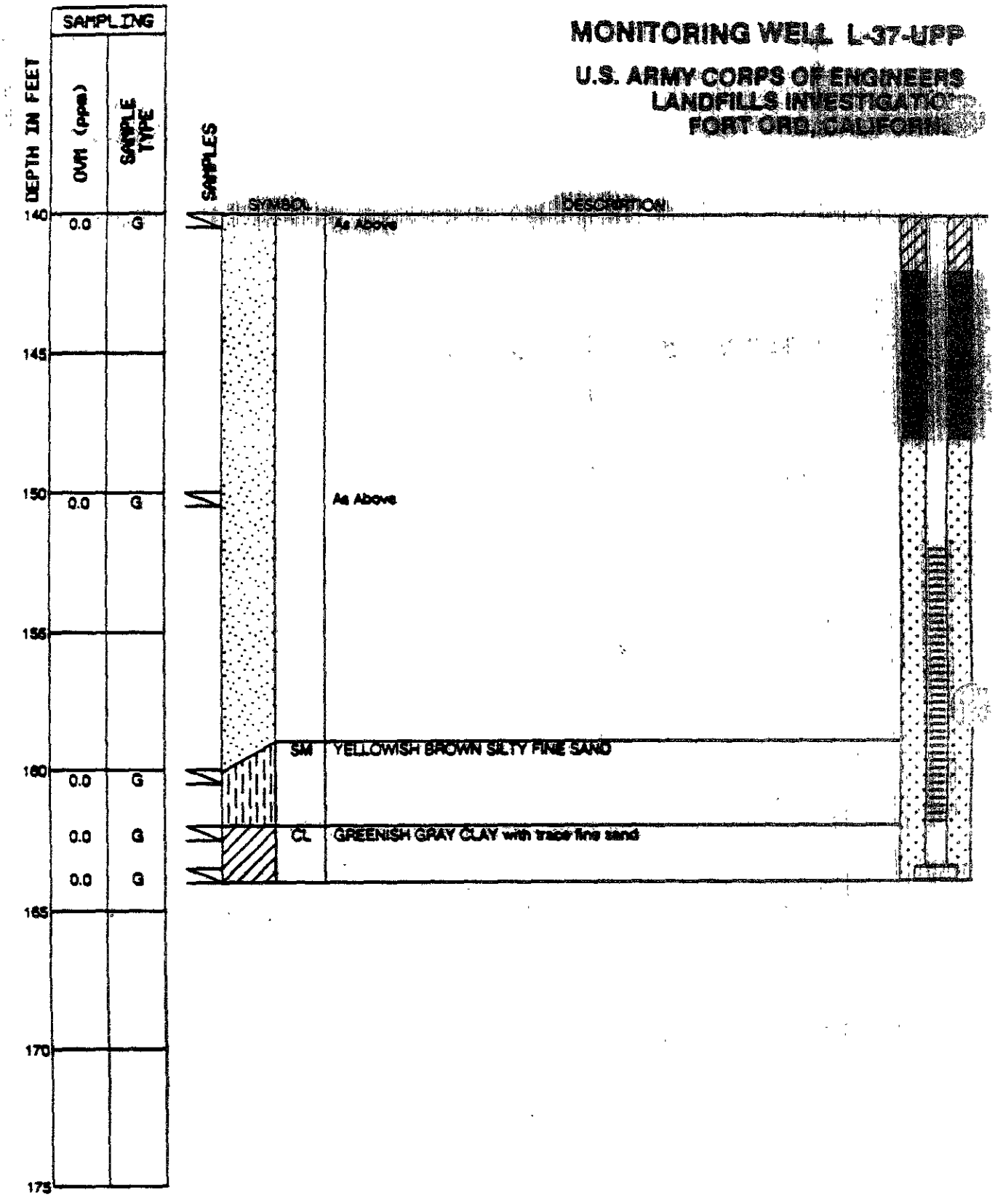
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-UPP	Dames & Moore	Log of Boring

MW-6UL-37-A

MONITORING WELL L-37-UPP

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATIO
FORT ORD, CALIFORNI



See Plate A-1 for general log notes and explanation of the terms and symbols.

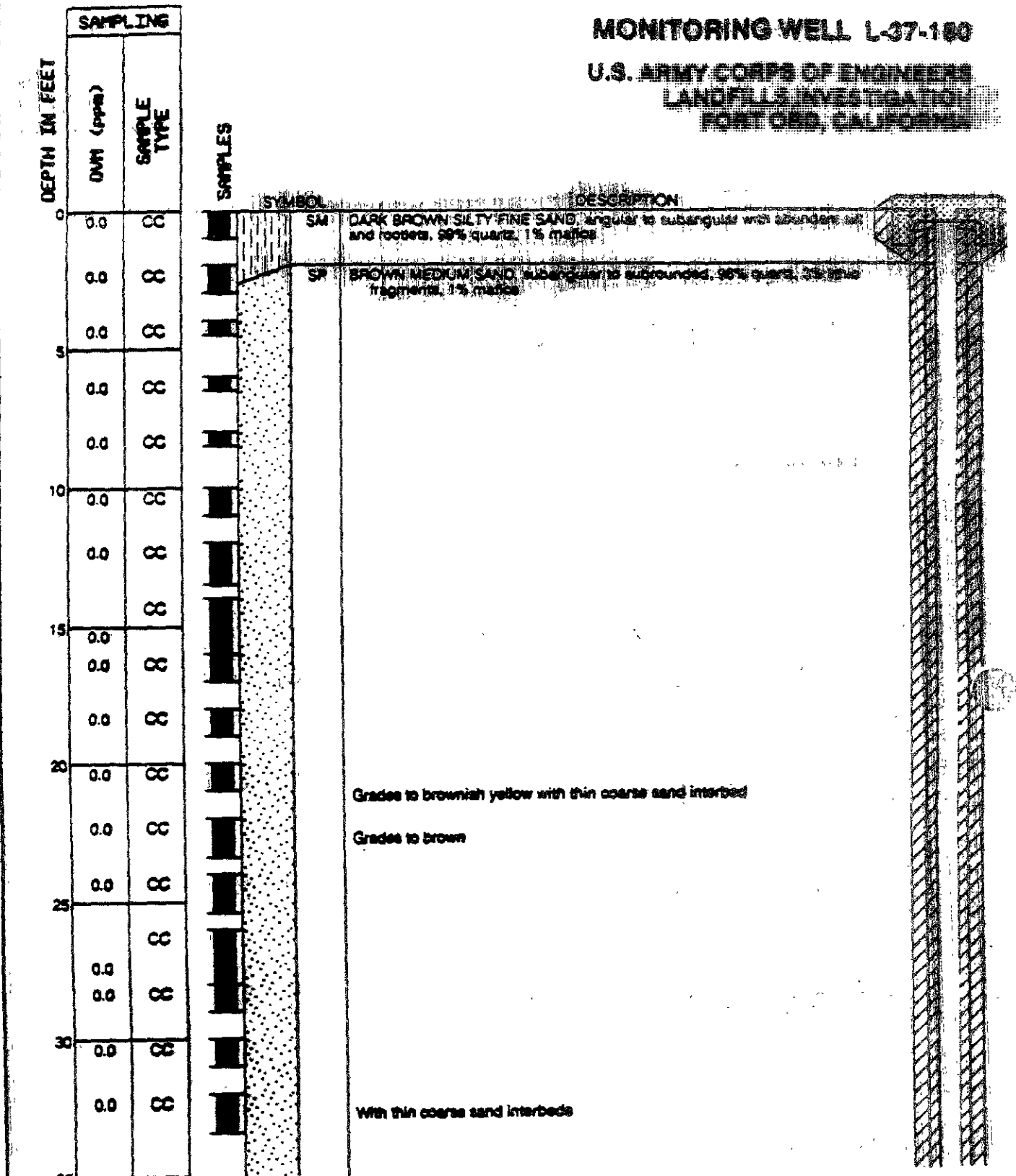
Job No.: 13846-007-043 Ser. No.: L-37-UPP	Dames & Moore	Log of Boring

Log Template: WELL3 March 21, 1994 PAGE 5 of 5

MW-OU2-37-180

MONITORING WELL L-37-180

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



See Plate A-1 for general log notes and explanation of the terms and symbols.

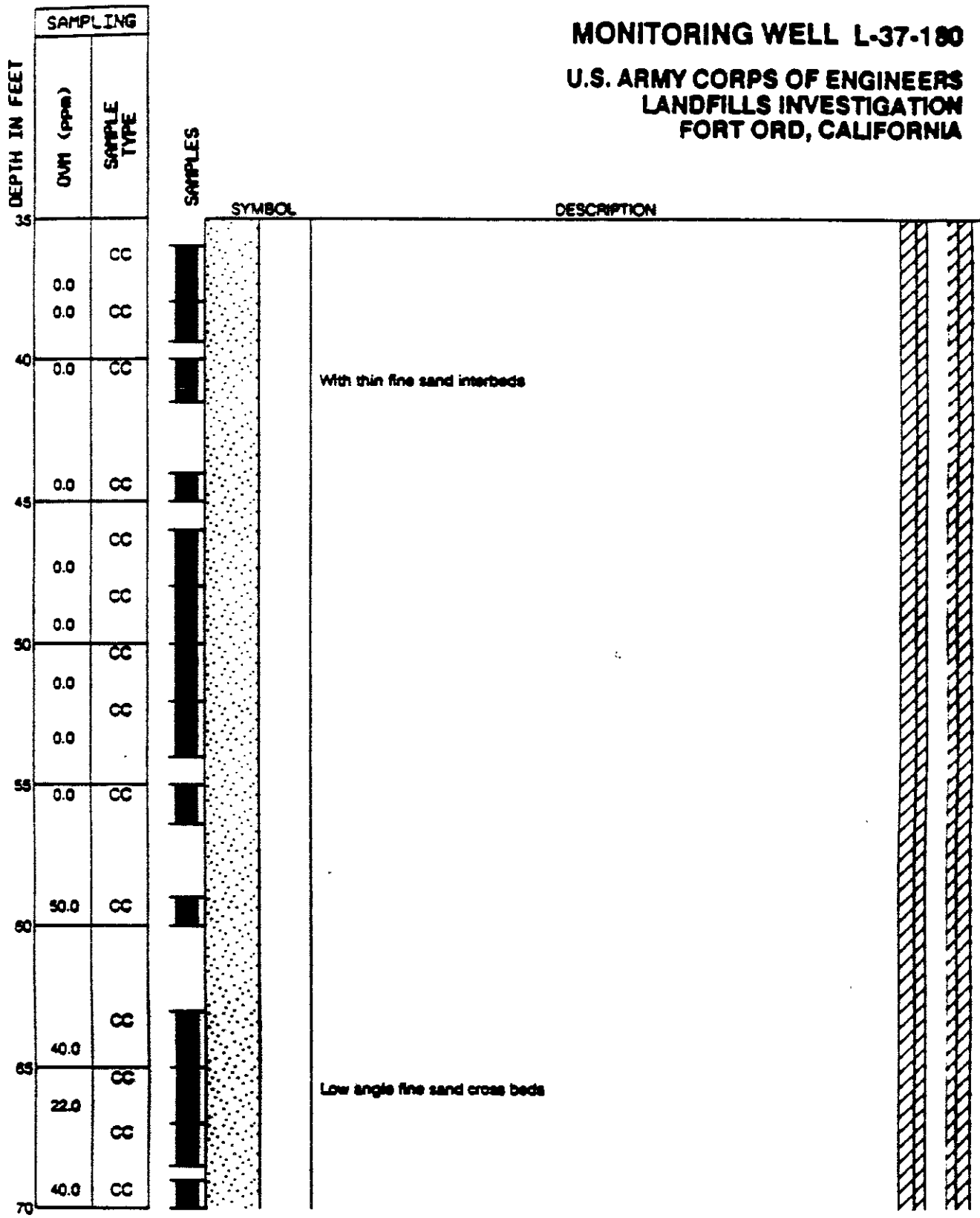
Continued Next Page

Job No.: 13846-007-043 Ser. No.: L-37-180	Dames & Moore	Log of Boring
Date Completed: 11/18/93 Boring Depth: 196.0 ft.	Grade Elev: 126.60 FT MSL Coordinates: 469908.99 N ; 1179118.22 E 1927 Zone IV	Location: FORT ORD, CA
Top of Casing Elev: 126.24 ft. MSL PVC Casing Depth: 185.0 ft.	Casing Type: Sch 80 PVC Casing Diam: 5.0 in.	Screened Interval: 173.0-183.0 ft. Effective Interval: 170.5-186.0 ft.	Slot Size: 0.020 in. Sand Pack: #2/12

MW-042-37-180

MONITORING WELL L-37-180

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



Continued Next Page

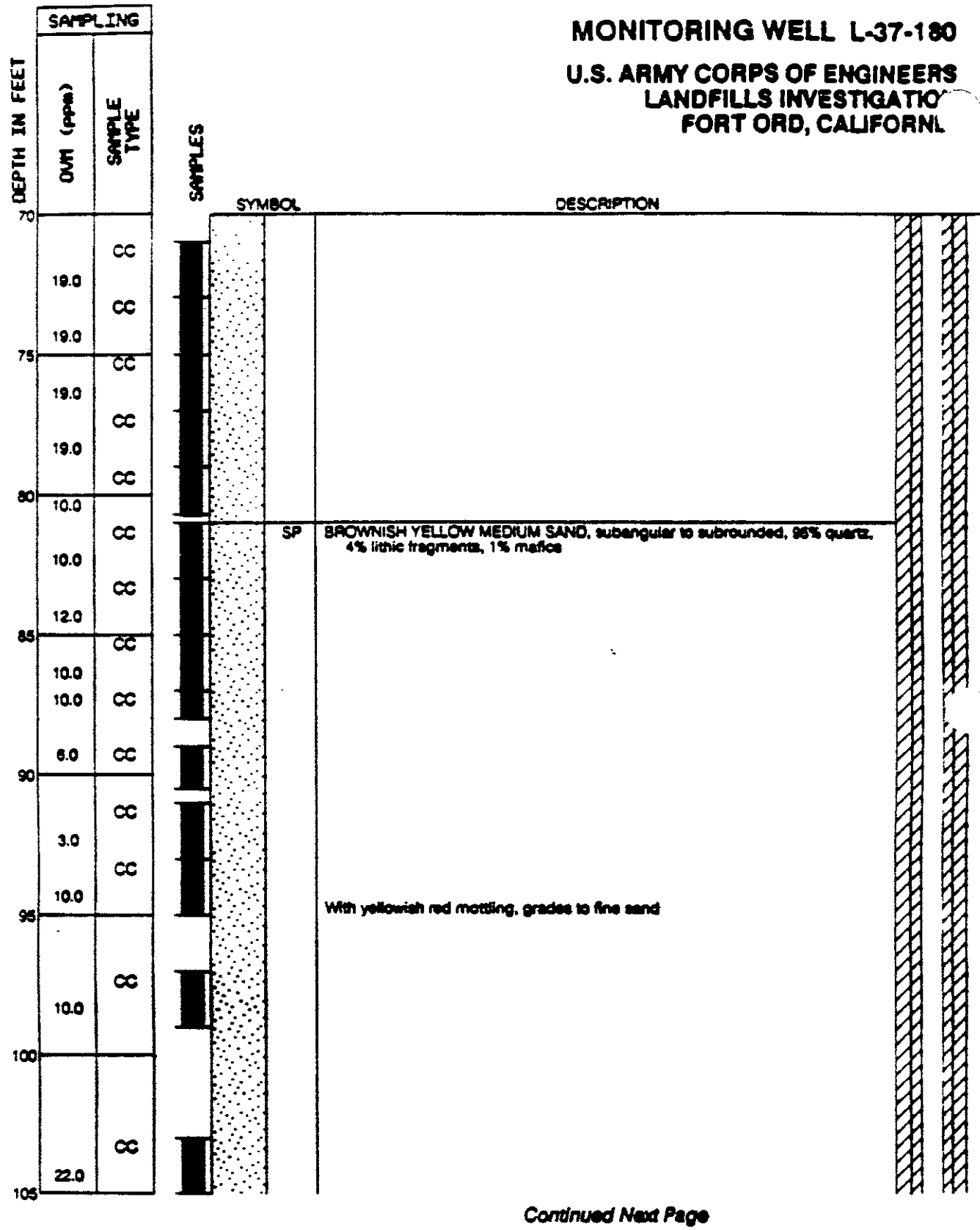
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-180	Dames & Moore	Log of Boring

MW-OU2-37-180

MONITORING WELL L-37-180

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATIO
FORT ORD, CALIFORNI



Continued Next Page

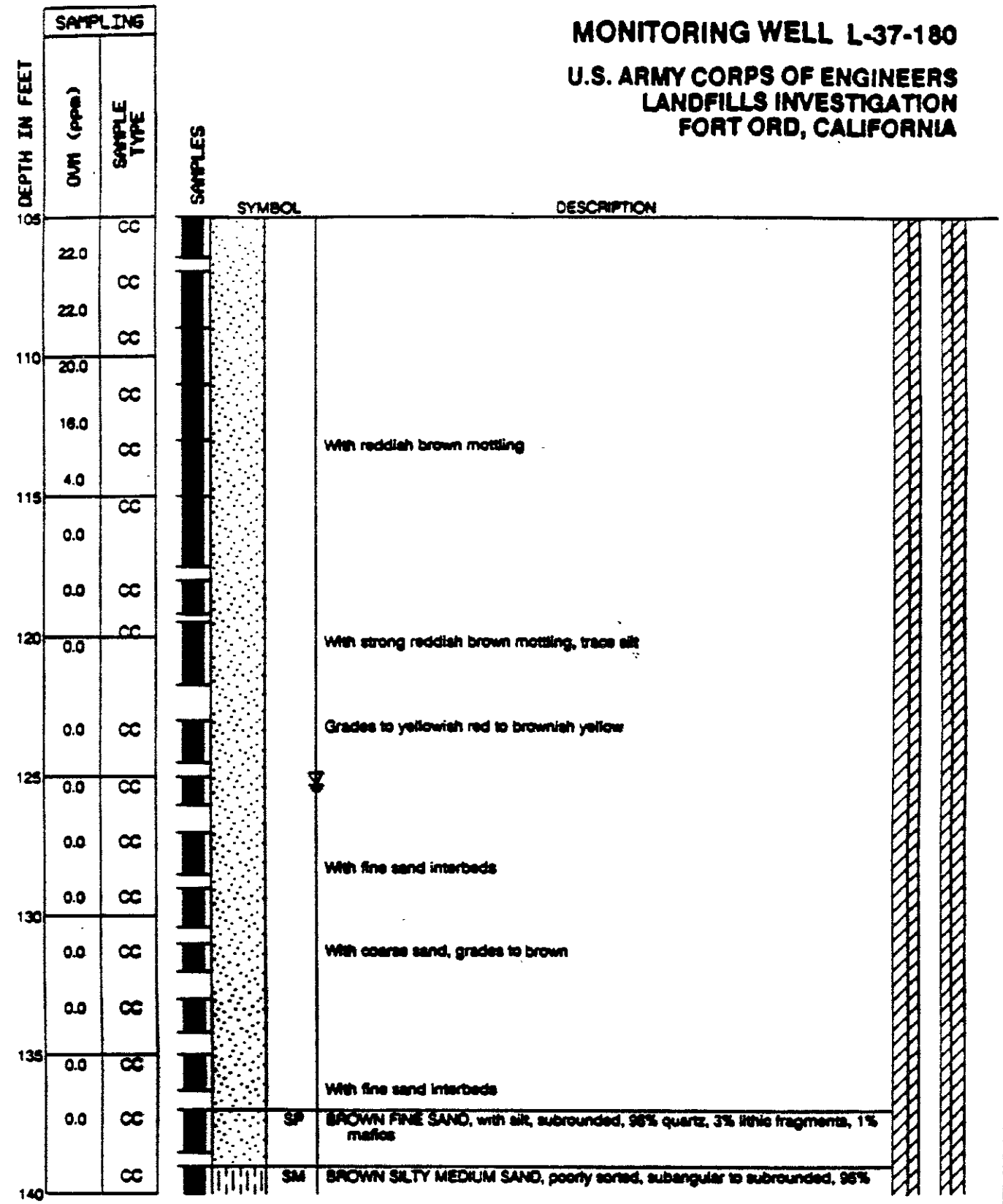
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-180	Dames & Moore	Log f Boring

MW-002-37-180

MONITORING WELL L-37-180

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



Continued Next Page

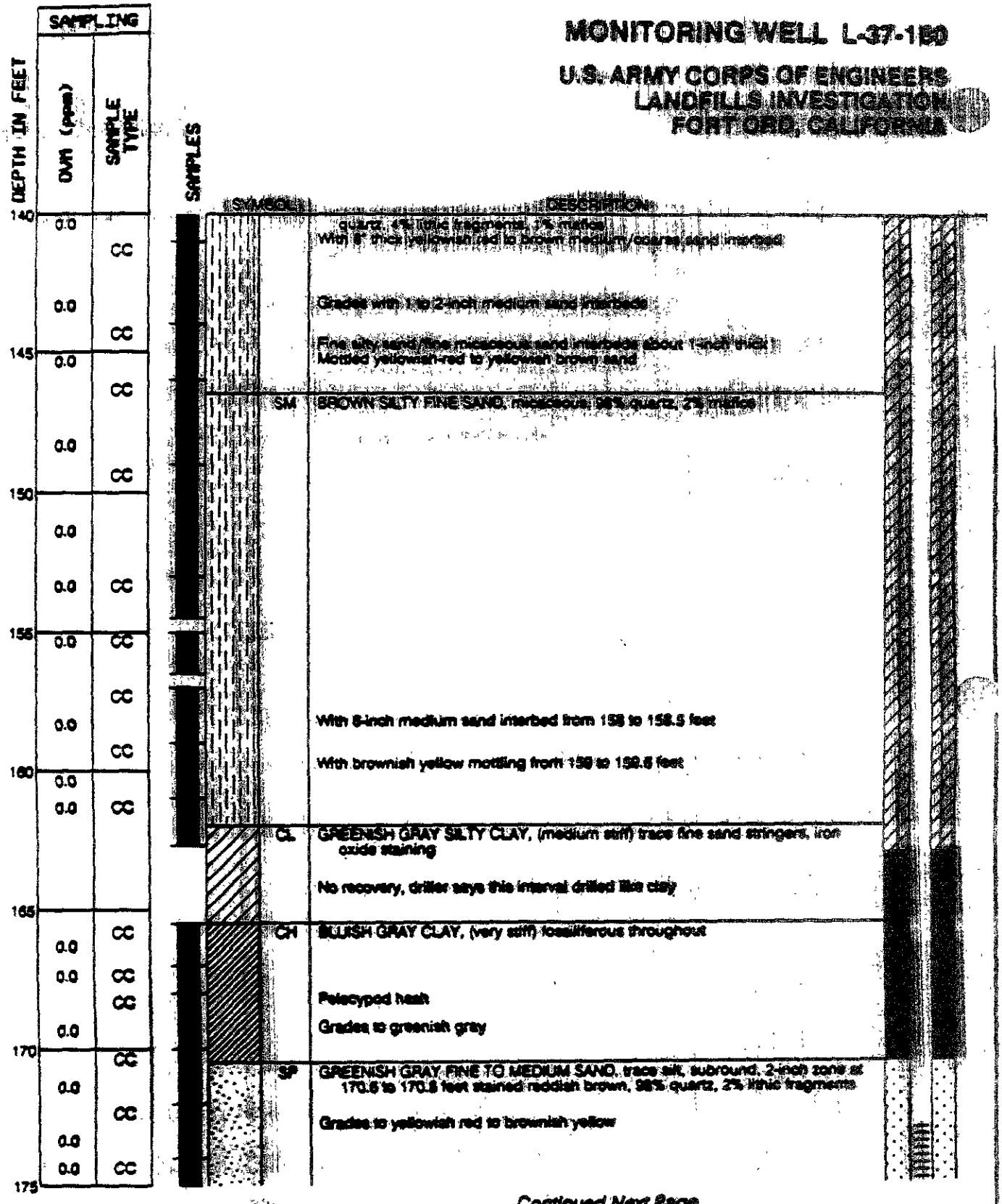
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-180	Dames & Moore	Log of Boring

MW-OU2-37-150

MONITORING WELL L-37-150

U.S. ARMY CORPS OF ENGINEERS LANDFILLS INVESTIGATION FORT ORD, CALIFORNIA



Continued Next Page

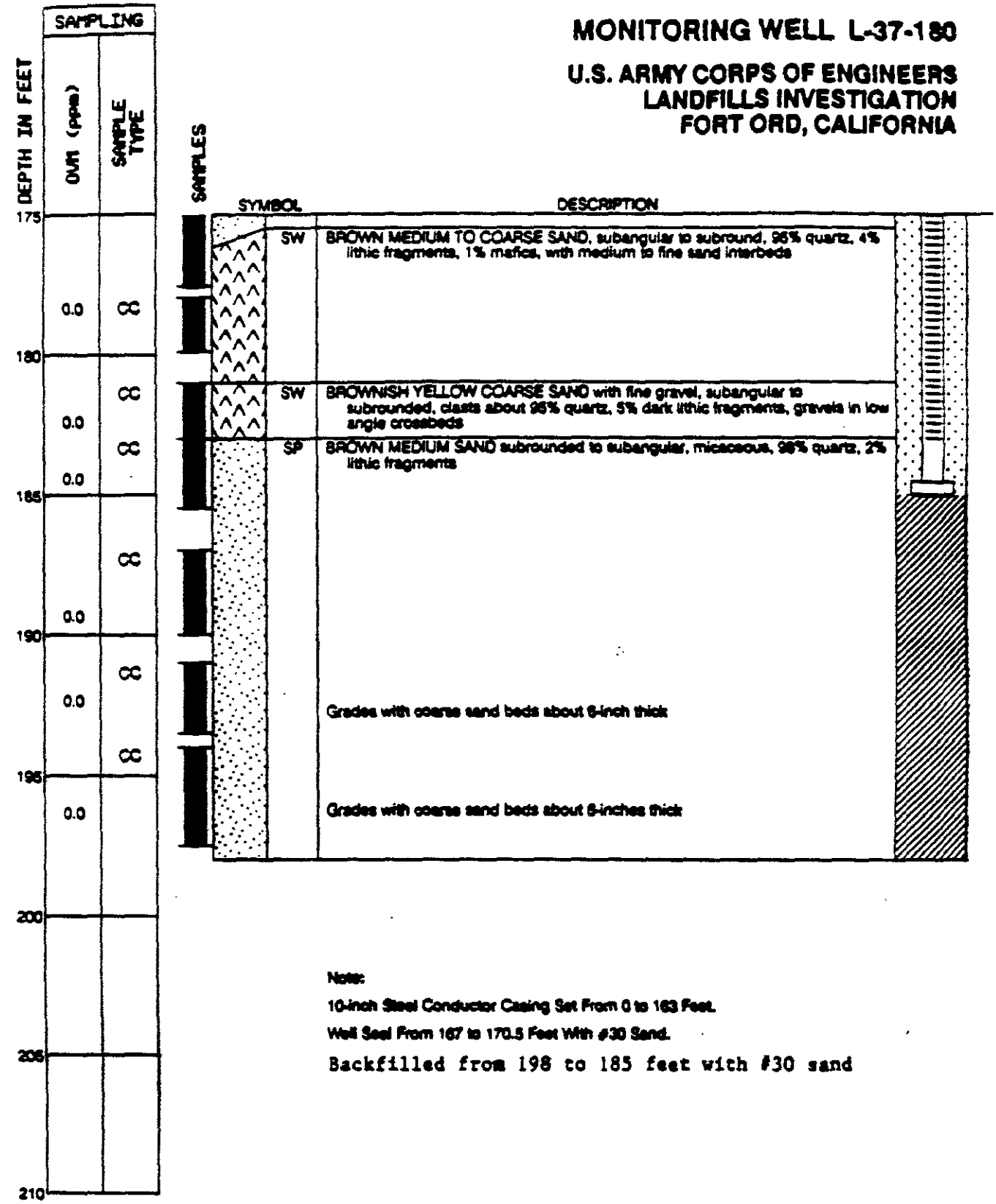
See Plate A-1 for general log notes and explanation of the terms and symbols.

Job No.: 13846-007-043 Ser. No.: L-37-150	Dames & Moore	Log of Boring
Log Template: WELL3	March 21, 1994	PAGE 5 of 6

MW-062-37-180

MONITORING WELL L-37-180

U.S. ARMY CORPS OF ENGINEERS
LANDFILLS INVESTIGATION
FORT ORD, CALIFORNIA



Note:

10-inch Steel Conductor Casing Set From 0 to 163 Feet.

Well Seal From 167 to 170.5 Feet With #30 Sand.

Backfilled from 198 to 185 feet with #30 sand

See Plate A-1 for general log notes and explanation of the terms and symbols.

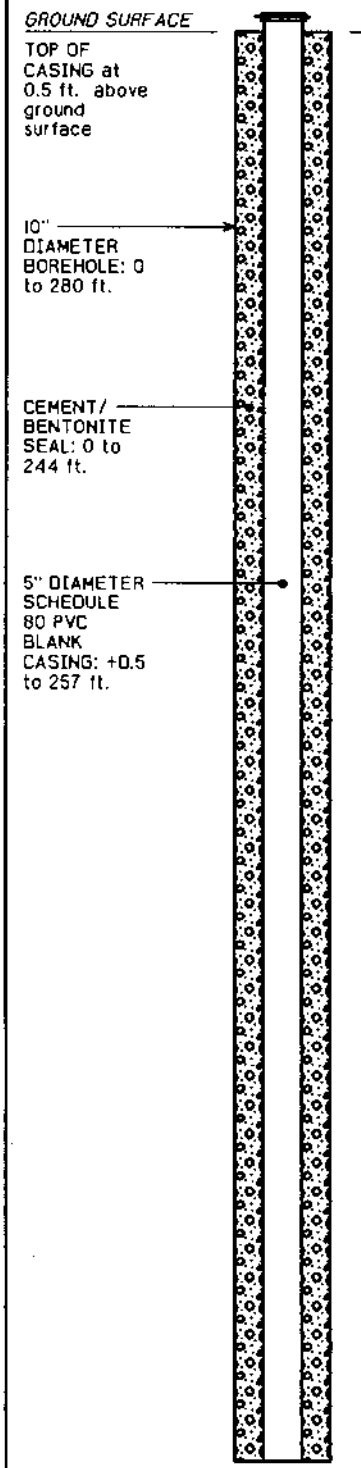
Job No.: 13846-007-043 Ser. No.: L-37-180	Dames & Moore	Log of Boring

Log Template: WELL3 | March 21, 1994 | PAGE 6 of 6

Top of PVC Casing Elev. 162.33

Equipment Speedstar Mud Rotary
10"-diameter

Elevation 161.00 ft. GS **Date** 01-28-99



Depth (ft.)	Sample	Sample Number	OVA Reading (ppm)	Recovery (inches)	Blows/foot
0					
5					
10					
15					
20			0		
25					
30					
35					
40			0		

VERY DARK GRAYISH BROWN WELL GRADED SAND (SW) (2.5Y 3/2) loose, moist, 90% fine to coarse sand, 10% silt, trace roots

@ 5 ft: color change to dark grayish brown (2.5Y 4/2)

@ 7 ft: color change to dark yellowish brown (10YR 4/4)

@ 10 ft: color change to yellowish brown (10YR 4/4)

@ 15 ft: similar to above

@ 20 ft: color change to yellowish brown (2.5Y 6/4)

@ 25 ft: similar to above

@ 30 ft: color change to light olive brown (2.5Y 5/4)

@ 35 ft: similar to above

FTO

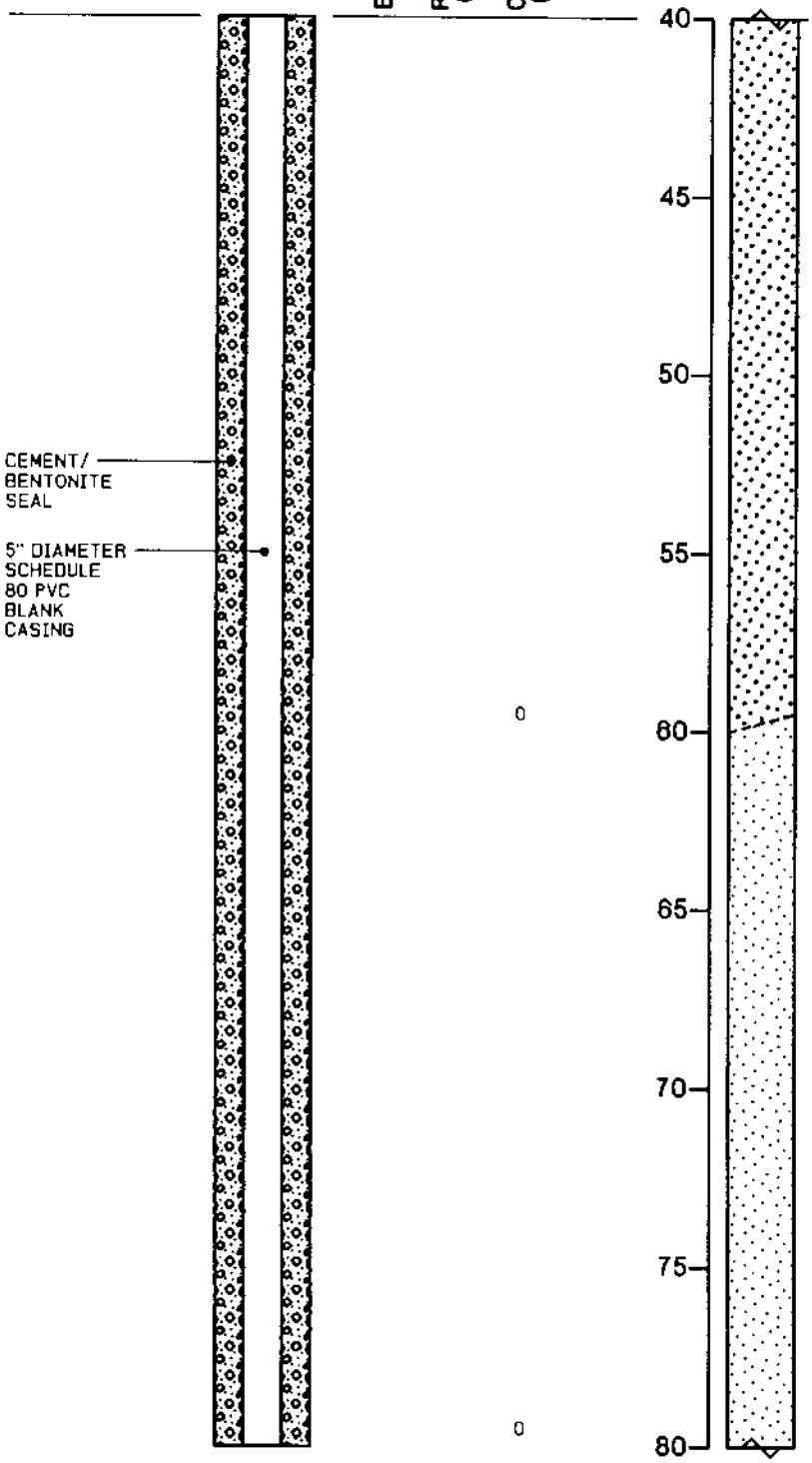
Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-68-180
OU 2 Plume Delineation Investigation Report
Fort Ord, California

PLATE **1-9**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

Equipment Speedstar Mud Rotary
10"-diameter
Elevation 181.00 ft. GS Date 01-28-99



@ 40 ft: color change to light yellowish brown (2.5Y 4/4) 95% fine to coarse sand, 5% fine gravel

@ 45 ft: similar to above, no gravels

@ 50 ft: similar to above

@ 55 ft: similar to above

LIGHT OLIVE BROWN POORLY GRADED SAND (SP) (2.5Y 5/4) loose, dry, 100% fine to medium sand

@ 65 ft: similar to above

@ 70 ft: similar to above

@ 75 ft: similar to above

FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-88-180 PLATE
OU 2 Plume Delineation
Investigation Report
Fort Ord, California
1-9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

Equipment Speedstar Mud Rotary
10"-diameter
Elevation 161.00 ft. GS Date 01-28-99

Blows/foot	Recovery (inches)	OVA Reading (ppm)	Sample Number	Depth (ft.)	Sample
				80	
				85	
				90	
				95	
		0		100	
				105	
				110	
				115	
		0		120	

CEMENT/ BENTONITE SEAL

5" DIAMETER SCHEDULE 80 PVC BLANK CASING

@ 80 ft: similar to above

@ 85 ft: similar to above

@ 90 ft: similar to above

@ 95 ft: color change to olive brown (2.5Y 4/4) loose, wet

@ 100 ft: similar to above

@ 110 ft: similar to above

@ 111 ft: Driller notes: change in drilling rate
GREENISH GRAY FAT CLAY (CH)
(5GY 5/1) firm, moist, 80% clay, 20% silt

@ 115 ft: similar to above

FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-88-180 PLATE
OU 2 Plume Delineation
Investigation Report
Fort Ord, California

1-9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

Equipment Speedstar Mud Rotary
10"-diameter
Elevation 161.00 ft. GS Date 01-28-99

Blows/foot	Recovery (inches)	OVA Reading (ppm)	Sample Number	Depth (ft.)	Sample
				120	
				125	
				130	
				135	
		0		140	
				145	
				150	
				155	
		0		160	

CEMENT/ BENTONITE SEAL

5" DIAMETER SCHEDULE 80 PVC BLANK CASING

@ 120 ft: similar to above

@ 125 ft: color change to olive gray (5Y 5/2)

@ 130 ft: similar to above

@ 135 ft: similar to above

@ 142 ft: Driller notes: increase in drilling rate - possible lenses of sand
olive gray (5Y 5/2) sandy fat clay from cuttings

@ 150 ft: Driller notes: decrease in drilling rate

@ 155 ft: similar to above
Driller notes: firm clay with layers of less firm sand

FTO

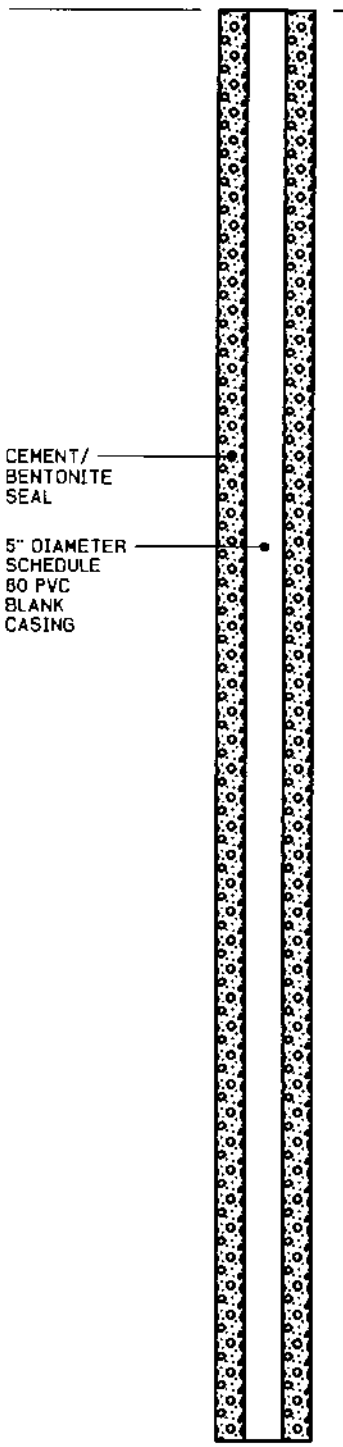
Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-68-160
OU 2 Plume Delineation
Investigation Report
Fort Ord, California

PLATE 1-9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

Equipment Speedstar Mud Rotary
10"-diameter
Elevation 161.00 ft. GS Date 01-28-99



Blows/foot	Recovery (inches)	OVA Reading (ppm)	Sample Number	Depth (ft.)	Sample	
				160		@ 160 ft: similar to above
				165		@ 165 ft: similar to above
				170		@ 170 ft: similar to above
				175		LIGHT OLIVE BROWN POORLY GRADED SAND (SP) (2.5Y 5/3) dense, wet, 95% sand, 5% silt
		0		180		LIGHT OLIVE BROWN WELL GRADED SAND (SW) (2.5Y 5/3) denset, wet, 95% fine to coarse sand, 5% fine subrounded gravel (chert, granitic, quartz)
				185		@ 185 ft: similar to above
						@ 187 ft: Driller notes: decrease in drilling rate
				190		LIGHT OLIVE BROWN SILTY SAND (SM) (2.5Y 5/3) medium dense, moist, 70% fine sand, 30% silt
						OLIVE BROWN POORLY GRADED SAND (SP) (2.5Y 4/4) medium dense, wet, 90% fine sand, 20% silt
				195		
		0		200		@ 198 ft: Driller note: increase in fine gravel LIGHT OLIVE BROWN WELL GRADED SAND (SW) (2.5Y 5/3) dense, wet, 95% fine to coarse sand, 5% fine gravel

FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-68-180
OU 2 Plume Delineation Investigation Report
Fort Ord, California

PLATE **1-9**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

Equipment Speedstar Mud Rotary
10"-diameter
Elevation 161.00 ft. GS Date 01-28-99

Blows/foot	Recovery (inches)	OVA Reading (ppm)	Sample Number	Depth (ft.)	Sample
				200	
				205	
				210	
				215	
		0		220	
				225	
				230	
				235	
		0		240	

CEMENT/ BENTONITE SEAL

5" DIAMETER SCHEDULE 80 PVC BLANK CASING

@ 203 ft: Driller notes: chatter of drill rod similar to above, increase in fine gravel to 10%

OLIVE GRAY POORLY GRADED SAND (SP) (5Y 4/2) dense, wet, 90% fine sand, 20% silt

OLIVE GRAY WELL GRADED SAND (SW) (5Y 5/2) dense, wet, 100% fine to coarse sand, trace fine gravel

@ 220 ft: similar to above

@ 239 ft: Driller notes: change in drilling
DARK YELLOWISH BROWN SILTY SAND (SM) (10YR 4/4) firm, moist, 70% fine sand, 30% silt (also clumps of silt)

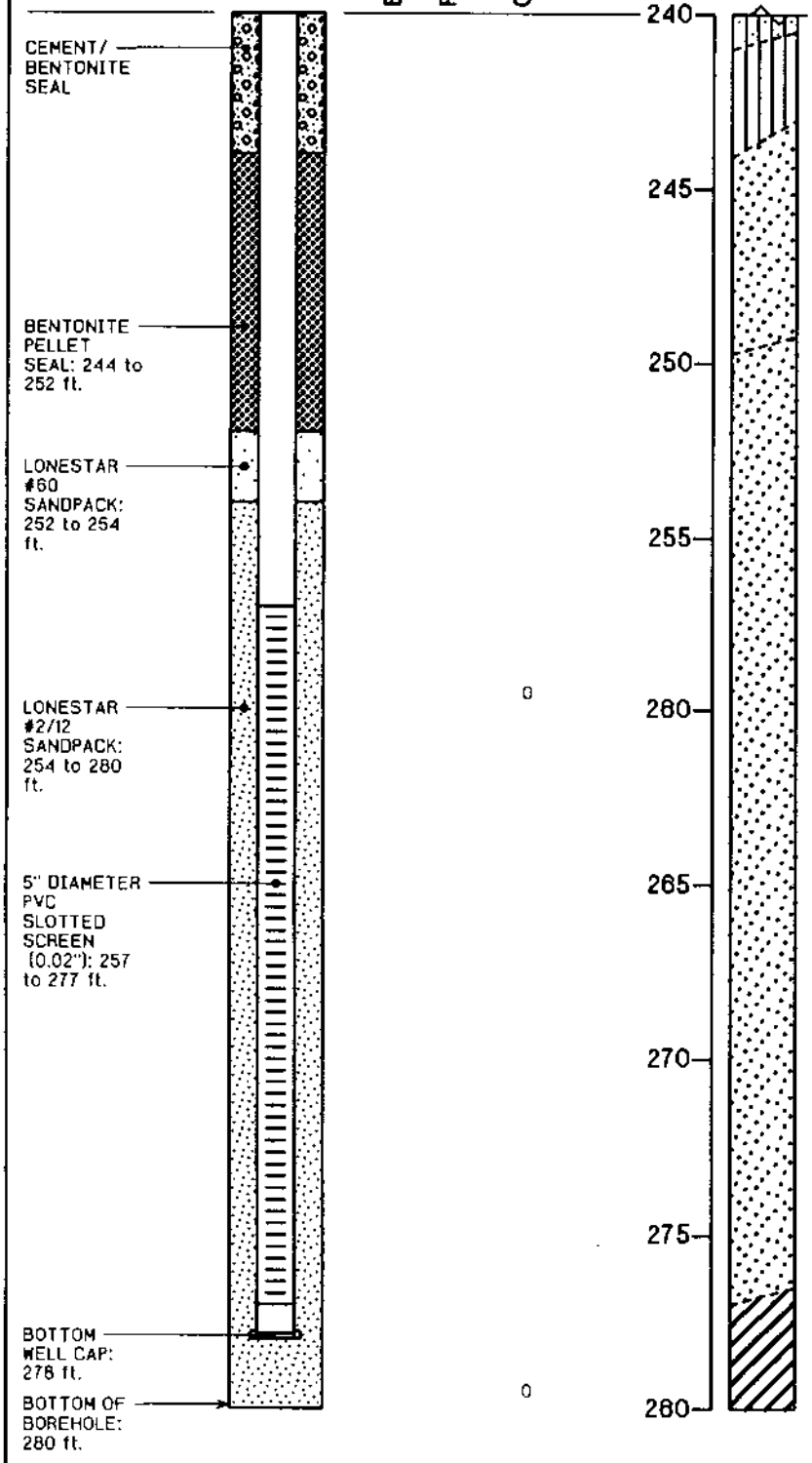
FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-68-180 PLATE
OU 2 Plume Delineation
Investigation Report
Fort Ord, California

1-9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	



Equipment Speedstar Mud Rotary
10"-diameter

Elevation 161.00 ft. GS **Date** 01-28-99

DARK YELLOWISH BROWN SILT WITH SAND (ML) (10YR 4/4) stiff, moist, 85% silt, 15% fine sand

LIGHT OLIVE BROWN WELL GRADED SAND (SW) (2.5Y 5/3) dense, wet, 80% fine to coarse sand, 20% silt

OLIVE GRAY WELL GRADED SAND (SW) (5Y 5/2) dense, wet, 90% fine to coarse sand, 10% silt

@ 255 ft: similar to above

@ 260 ft: similar to above

@ 265 ft: similar to above

@ 270 ft: similar to above

@ 275 ft: similar to above, trace fine gravel

@ 277 ft: Driller notes: decrease in drilling rate
LIGHT OLIVE BROWN SANDY FAT CLAY (CH) (2.5Y 5/4) stiff, moist, 70% clay, 30% fine sand

Bottom of boring at 280 ft.

FTO

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion MW-OU2-68-180
OU 2 Plume Delineation Investigation Report
Fort Ord, California

PLATE **1-9**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
PCB	42481 00123		3/99	

ATTACHMENT E

Responses to Comments on the Draft Quality Assurance Project Plan Addendum No. 1 submitted by the U.S. Environmental Protection Agency (USEPA)

Responses to Comments submitted by the U.S. Environmental Protection Agency (USEPA)[1]

General Comment 1: QAPP Addendum No. 1 proposes the installation of three wells, MW-BW-103-A, MW-BW-102-A, and MW-BW-101-A north of MW-BW-94-AR. Section 5.1.1, Well Installation, on page 7, states "The purpose of these wells is to further delineate OUCTP north of MW-BW-94-AR," but the location of the wells do not appear be sufficiently to the northwest of the plume near the groundwater divide to completely define the extent of contamination. In addition, the groundwater elevation/flow direction in this area are unclear as this information does not appear to be presented on the figure. Please revise the QAPP Addendum No. 1 to include groundwater flow information and to either propose additional wells to the northwest or include a discussion clarifying how the locations of the three new proposed wells will define the extent of contamination.

Response to General Comment 1: *Figure 2 was revised to indicate the groundwater flow direction, updated with Third Quarter 2023 groundwater elevation data, and to show the location of existing monitoring well MW-40-01-A, which provides control to the north of the OUCTP and east of the groundwater divide. These proposed new wells are also intentionally placed in the developed area outside of the Fort Ord Natural Reserve to avoid impacts to sensitive species. The text was revised to include this information.*

Specific Comment 1: Section 2.0, Worksheet #1 and #2: Title and Approval Page, Page 2, and Section 3.0, Worksheet #4. #7, and # 8, Personnel Qualifications and Sign-Off Sheet, Page 5: These sections contain signature spaces for project personnel (e.g., Project Manager, Quality Control Manager, Project Chemists), but are not signed. Please ensure that the final version of the QAPP Addendum No. 1 includes all applicable signatures.

Response to Specific Comment 1: *The Final QAPP Addendum No. 1 will include signatures for all project personnel. Please note it is standard practice for the Fort Ord project that only final versions of documents are signed.*

Specific Comment 2: Section 5.1.2, Well Decommissioning, Page 7: Footnote 2 indicates that video logging of the 10-inch unidentified steel conductor casing indicated that there was no evidence of materials in the pipe that would require testing for hazard determination or would require removal and disposal or treatment prior to the decommissioning of the pipe. Please revise the QAPP Addendum No. 1 to include a more detailed discussion of how this conclusion was drawn, including consideration of historical sampling data associated with the area near and/or within the pipe if available.

Response to Specific Comment 2: *As stated in footnote 2, there was no record of the steel conductor pipe and therefore no historical sampling data from within the pipe. The pipe is located in a remote area with no identified potential sources of contamination that have warranted historical sampling of soil or groundwater in the uppermost A-Aquifer (e.g., see Administrative Record No. BW-1238A). This information was added to the footnote.*

[1] In a letter dated October 3, 2023 (see Administrative Record No. BW-2785S.3). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

Specific Comment 3: Section 5.2.2, Investigation-Derived Waste – Soil, Page 8: This section indicates that the investigation-derived waste (IDW) will be sampled and analyzed for OUCTP groundwater chemicals of concern by USEPA Method 8260D, but does not list the specific analytical parameters. In addition, this section does not recommend sampling the IDW to ensure it meets the Fort Ord Landfills disposal requirements. Please revise this section to specifically list the parameters that will be analyzed using USEPA Method 8260D, and to clarify the Fort Ord Landfills requirements for IDW.

Response to Specific Comment 3: *Section 5.2.2 was revised to specify that the soil IDW will be analyzed for OUCTP A-Aquifer chemicals of concern (COCs) per the Groundwater QAPP Revision 11 (Administrative Record No. BW-2785R) and to note that The Record of Decision, Basewide Remedial Investigation Sites (Administrative Record No. RI-025) in conjunction with the Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit (CAMU), Operable Unit 2 Landfill (Administrative Record No. OU2-523) and the Explanation of Significant Differences, No Further Action for Munitions and Explosives of Concern, Landfill Gas Control, Reuse of Treated Groundwater, Designation of Corrective Action Management Unit (CAMU) Requirements as Applicable or Relevant and Appropriate Requirements (ARARs), Operable Unit 2, Fort Ord Landfills (Administrative Record No. OU2-656) designate CAMU regulations as ARARs for the OU2 Fort Ord Landfills (see Title 22 California Code of Regulations [CCR], Section 6626.552). Such designation generally allows remediation waste, such as the soil IDW expected to be generated during well installation activities, to be placed at the Fort Ord Landfills without triggering certain disposal regulations. Accordingly, no other soil sample analysis is required for IDW disposal.*

Specific Comment 4: Section 6.11.6, Well Decommissioning, Page 20: This section states, "Monitoring wells will be decommissioned in accordance with ASTM D5299 – Standard Practice for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices and Federal, State, and local regulations, though well decommissioning requirements found in Monterey County Code Chapter 15.08 will take precedence over ASTM D5299 and well decommissioning will be consistent with previous practices at the former Fort Ord." However, this section does not reference Standard Operating Procedure (SOP) FSOP-603.01 which is referenced in other sections of the QAPP Addendum No. 1 (e.g., Section 5.1.2, Well Decommissioning). Also, it is unclear if SOP FSOP-603.01 meets the requirements included in Section 6.11.6. In addition, it is unclear how it was determined that the wells would be abandoned in place versus removed (e.g., FSOP-603.01, Section 4.4.3, Removal of Well Materials). Please revise this section to include a discussion that references FSOP-603.01, clarify that the SOP meets the above-referenced requirements and discuss why it is proposed to abandon the wells in place.

Response to Specific Comment 4: *The text was revised per the comment. Section 6.11.6 was edited to include a reference to FSOP-603.01, which meets the requirements of ASTM D5299. The well materials will be abandoned in place as is consistent with previous practices at the former Fort Ord and Monterey County requirements.*

Specific Comment 5: Section 6.12.1, Well Development, Page 21: This section indicates that wells will be developed according to the American Society for Testing and Materials (ASTM) D5521, and that various water quality parameters will be monitored during well development but does not cite the specific equipment that will be used to monitor the groundwater quality. It is noted that a Horiba Multi-

Meter is listed on Worksheet 22. Please revise this section to include a reference to the Horiba Multi-Meter for clarity.

Response to Specific Comment 5: *The text was revised per the comment. Section 6.12.1 was edited to reference the Horiba Multi-Meter and SOP FSOP-603.01 in Appendix A.*

Specific Comment 6: Section 8.0, Worksheet #21: Field SOPs, Page 26: This section indicates that secondary containment will not be required for staged IDW as it will be immediately disposed, but does not clarify why secondary containment is not necessary. It is also unclear what measures will be taken to minimize the potential for cross contamination associated with drilling (e.g., management of cuttings) and sampling. Please revise this section to include a more detailed discussion that clarifies why secondary containment is not needed for staged IDW and what controls (e.g., plastic sheeting) will be utilized as part of the proposed activities to minimize the potential for cross contamination.

Response to Specific Comment 6: *IDW will not be staged; therefore, secondary containment is not required and Section 5.2.1 was revised to delete the sentence regarding a staging area. Drill cuttings will be placed in a soil bin and removed from the well location for immediate disposal at the Fort Ord Landfills before samples are collected from the newly installed wells. There is no potential for cross-contamination. Section 8.0 did not require revision based on this comment.*

ATTACHMENT F

Responses to Comments on the Draft Quality Assurance Project Plan Addendum No. 1 submitted by the California Regional Water Quality Control Board – Central Coast Region (CCRWQCB)

Responses to Comments submitted by the California Regional Water Quality Control Board – Central Coast Region (CCRWQCB)[1]

Comment 1: Figure 2, OUCTP A-Aquifer New Monitoring Locations – Please add the locations and the most recent sampling results for wells MW-40-01-A and MW-BW-93-A to show the carbon tetrachloride concentrations in the northern portion of the OUCTP area in the vicinity of the proposed monitoring well locations.

Response to Comment 1: *Figure 2 was revised per the comment. The groundwater elevation data and carbon tetrachloride (CT) data were also updated to the Third Quarter 2023.*

Comment 2: Table 2 and Figure 4, Monitoring Wells to be Decommissioned – Please confirm whether any of the Sites 2/12 wells proposed for decommissioning would be needed for future Per- and Polyfluoroalkyl Substances investigations in this area. Additionally, please include a note in Table 2 that monitoring well MW-12-07-180 is damaged and has a cracked casing as indicated in the Fourth Quarter 2020 through Third Quarter 2021 Groundwater and Soil Gas Monitoring and Treatment Systems Report.

Response to Comment 2: *The four Site 12 monitoring wells proposed for decommissioning are not expected to be needed for future per- and polyfluoroalkyl substances (PFAS) sampling. Based on the results of the PFAS Site Inspection (Administrative Record No. BW-2942), the apparent distribution of PFAS at Sites 2/12 is similar to the historical maximum extent of the tetrachloroethene (PCE) plume in the Upper 180-Foot Aquifer (Administrative Record No. BW-2927B). MW-12-05-180, -07-180, and -08-180 are outside of this area and MW-12-12-180L is screened in the Lower 180-Foot Aquifer, which is hydraulically separate from the Upper 180-Foot Aquifer at Sites 2/12. Table 2 was revised per the comment.*

[1] In a letter dated October 2, 2023 (see Administrative Record No. BW-2785S.2). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

ATTACHMENT G

Responses to Comments on the Draft Quality Assurance Project Plan Addendum No. 1 submitted by the Fort Ord Community Action Group (FOCAG)

Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)[1]

Comment 1: The FOCAG understands this document is an addendum to the project plan to remedy and monitor the Carbon Tetrachloride Plume(s) near, and emanating from, what's called Operable Unit 2, Sites 2 and 12, i.e., "Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume 1 (and Volume 2)."

The footnote #1, on page 1 of this document (Introduction) identifies the governing document, Volume 1, for which this is an addendum. The governing document is about sampling and analysis of groundwater, soil, soil gas, landfill gas, and per- and polyfluoroalkyl substances. Volume 2 of the governing document pertains to the military munitions response program.

Response to Comment 1: *To clarify, this document (QAPP Addendum No. 1) is an addendum to the Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Revision 11, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2, and 12, and Operable Unit Carbon Tetrachloride Plume (Groundwater QAPP; Administrative Record No. BW-2785T) and the Groundwater QAPP is Appendix A to the Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume 1. As stated in footnote 1, the QAPPs are the governing documents for sampling and analysis (i.e., monitoring) of various types of media (e.g., groundwater and soil).*

Carbon tetrachloride plumes are not emanating from Operable Unit 2 (OU2) or Sites 2 and 12 (2/12). Carbon tetrachloride is not a chemical of concern (COC) for Sites 2/12 and has been detected only intermittently at concentrations below the aquifer cleanup level (ACL) at OU2 for many years (e.g., see Administrative Record No. OU2-738B). Carbon tetrachloride is only present at concentrations greater than the ACL at Operable Unit Carbon Tetrachloride Plume (OUCTP).

Comment 2: This Addendum was received via U.S. mail by the FOCAG on September 20, 2023. Comments are requested by BRAC by September 25, 2023. The FOCAG says five days for review and response is too short. Traditionally it has been 30 days. However, we'll do our best and look forward to receiving the Draft Final.

Response to Comment 2: *The U.S. Department of the Army appreciates FOCAG's efforts to review and comment on the Draft QAPP Addendum No. 1 given the shortened review time. While it is standard to give 30 days to review and comment on documents related to cleanup of the former Fort Ord under the Comprehensive Environmental Response, Compensation, and Lability Act (CERCLA), the Army requested comments on the Draft QAPP Addendum No. 1 within 14 days because, as noted in the transmittal memorandum, there are two decommissioning locations that require access through the Fort Ord Natural Reserve (FONR) and an expedited review would support completion of activities in the FONR before the start of the wet season on November 1, which is consistent with the requirements of the Reinitiation of Formal Consultation for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (U.S. Fish and Wildlife Service Programmatic Biological Opinion; Administrative Record No. BW-2747A).*

[1] In a letter dated September 24, 2023 (see Administrative Record No. BW-2785S.4). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

It is unclear why the FOCAG did not receive the paper copy of the Draft QAPP Addendum No. 1 until September 20, 2023, as it was sent via U.S. Postal Service Priority Mail from Monterey, California on September 14, 2023 and should have been delivered within one business day. However, the Army did also notify FOCAG via email on September 12, 2023 that the Draft QAPP Addendum was available in the online Fort Ord Administrative Record.

Comment 3: The project task is to install three new A-Aquifer monitoring wells, adjacent to Neeson Road, in the OUCTP area, all approximately 120 feet deep. These three new wells are proposed to be drilled North East of existing monitoring wells.

Response to Comment 3: *Yes, that is correct. Monitoring well installation is one of the project tasks described in QAPP Addendum No. 1, along with monitoring well decommissioning and management of previously decommissioned wells at the former Fort Ord.*

Comment 4: Some of the described well decommissioning activities require access through the Fort Ord Natural Reserve (FONR). It is explained this needs to happen before November 1, 2023, however, rather poorly explained is the need for completion of activities in the FONR by this November 1, 2023 date. Why the late start? Page 9 of this document lists a Baseline Habitat Survey by Denise Duffy and Associates with a deliverable due date of August 2023. The FOCAG asks, where can this completed Habitat Survey be found?

Response to Comment 4: *Section 6.4 of the QAPP Addendum No. 1 specifies that fieldwork in the FONR will be scheduled between June 1 and October 31, which is outside the primary growing season for rare plants and to avoid the flowering periods of special-status species. Accordingly, if work in the FONR is completed prior to November 1, 2023, it is not late. Note that, per the project schedule in Section 5.4, the Baseline Habitat Survey is an activity that occurred in spring 2023 and the deliverable was a habitat checklist that was due in August 2023 (an example habitat checklist is provided in Attachment C). The results of the Baseline Habitat Survey, along with monitoring of work by the Onsite Biologist to ensure habitat conservation measures were implemented, will be summarized in the draft completion report for this project, which is scheduled to be issued in April 2024.*

Comment 5: Page 8 of this document, Section 5. 1.3 Decommissioned Well Management states;

"An inspection of wells that were decommissioned in the FONR and the Fort Ord Dunes State Park between 2014 and 2017 will be conducted ..."

Comment 5a: The FOCAG asks why the Fort Ord Dunes State Park is not identified as being former Fort Ord Site #3 in this document? These are the former Army Infantry training ranges for rifle and pistol practice and are still home to lead bullets, bullet fragments, and lead bullets dust contamination.

Response to Comment 5/5a*: The remedial action for Site 3 is complete and the remedy is protective of human health and the environment (see Administrative Record No. BW-2925). Accordingly, the Army transferred this property to the California Department of Parks and Recreation in 2009 and Fort Ord Dunes State park has been open to the public since then. The area is known as Fort Ord Dunes State Park and identification of this area as "Site 3" in QAPP Addendum No. 1 is not relevant to the current status of the property or the work being conducted, which includes inspecting former well locations and adding cement grout to wells where the grout has settled more than 6 inches.*

Additionally, per the post-remediation health risk assessment (PRHRA) that was performed at Fort Ord Dunes State Park (Appendix B to the Final Remedial Action Confirmation Report and Post-Remediation Risk Assessment Site 3 Remedial Action, Basewide Remedial Investigation Sites [Administrative Record No. SITE3-106A]), Fort Ord Dunes State Park soil is not anticipated to result in adverse health effects via all pathways (ingestion of soil, dermal contact with soil, inhalation of airborne dust) and the property is safe for the intended use as a state park.

Comment 6: Page 13 of this document, Section 6.3 "Air Resources Protection", again does not mention that well decommissioning and inspection activities will be in/on Site #3, Beach Ranges, but does say "that significant dust will not be generated"

Response to Comment 6: *Please see the response to Comment 5/5a. Significant dust will not be generated because no ground-disturbing activities will occur during management of previously decommissioned wells in the Fort Ord Dunes State Park area.*

Comment 6a: The FOCAG asks, what does this mean? What constitutes "significant?" What danger level is breathing amounts of lead dust? Proposition 65 in California requires businesses to alert employees and the public to dangers including lead. Ahtna Global, LLC is a business.

Response to Comment 6a: *The term "significant" is used to describe conditions that could result in the need for additional site controls to prevent a potential impact to human health. Such controls include elimination of the hazard, which has been accomplished through remedial action, engineering or administrative controls, and personal protective equipment.*

The Occupational Safety and Health Standards provide exposure limits for lead. These standards may be found in the Code of Federal Regulations 1910.1025:

https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1025

The areas where work is to be conducted are not managed by Ahtna Global, LLC (Ahtna) or the Army. Fort Ord Dunes State Park is managed by the California Department of Parks and Recreation. Work performed by Ahtna is conducted per the Accident Prevention Plan, which was prepared in accordance with the U.S. Army Corps of Engineers (USACE) EM 385-1-1 Safety and Health Requirements Manual, to mitigate health risks while work is being performed. Ahtna has notified its employees of the health risks associated with lead via the APP, as referenced in QAPP Addendum No. 1.

Comment 7: Page 13 of this document. Section 6.4 "Land Resources Protection" states that fieldwork within the FONR will be coordinated, by a host of job descriptions, but also says the University of California manages the area.

Response to Comment 7: *That is correct. As stated in the text, "Fieldwork within the FONR will be coordinated with the USACE Technical Lead, Onsite Biologist, Fort Ord Base Realignment and Closure (BRAC) Office Biologist, and the University of California, which manages the area, to minimize impact to natural resources and ongoing research projects." The Army transferred the property that includes the FONR to the University of California in 1997. Several entities are involved because, even though the area is a reserve owned and managed by the University of California, the Army must still meet its conservation obligations under the Installation-Wide Multispecies Habitat Management Plan (HMP; Administrative Record No. BW-1787) and the Programmatic Biological Opinion.*

Comment 7a: the FOCAG asks, WHO in the University of California, among its many campus locations, is responsible for managing this area?

Secondly, please identify the other persons (with job titles) who are responsible for this Land Resources Protection. Will nearby CSUMB be involved?

Will someone from DTSC be involved?

The specific area(s) from FONR to non-FONR are not made clear, other than stating well decommissioning will be occurring in the FONR and the Fort Ord Dunes State Park.

The FOCAG again asks why this area is not identified as Site #3, the former Fort Ord lnfantry Beach Training Ranges?

Response to Comment 7a: *The FONR is managed by the University of California, Santa Cruz. For more information, please visit https://fortordreserve.ucsc.edu/*

As stated in QAPP Addendum No. 1, Ahtna will also coordinate fieldwork within the FONR with the USACE Technical Lead, Onsite Biologist, and BRAC Office Biologist. The Army will ensure appropriate personnel are involved in the project to meet its obligations under the HMP and the Programmatic Biological Opinion. California State University Monterey Bay has no responsibilities with respect to the FONR and will not be involved.

The California Department of Toxic Substances Control (DTSC) is a support agency for the Fort Ord cleanup project and has reviewed QAPP Addendum No. 1. Otherwise, DTSC has no responsibility for land resource protection.

The FONR and Fort Ord Dunes State Park boundaries, along with the locations of wells that are the subject of QAPP Addendum No. 1, are clearly defined on Figures 1, 4, 5, and 6. Figure 2 was revised to add the FONR boundary.

As stated in the response to Comment 5/5a, it is not relevant to QAPP Addendum No. 1 to refer to Fort Ord Dunes State Park as Site 3.

Comment 8: Page 15 of this document, Section 6.8 HMP Species Protection describes field activities to include drilling and well installation (FOCAG asks that these be numerically identified as three new wells in a new location), well development and surveying, well decommissioning, decommissioned well management, and groundwater monitoring (FOCAG asks that these be numerically identified as nine wells being decommissioned here).

Response to Comment 8: *The text was not revised per the comment. Section 6.8 describes HMP Species Protection. Specific information about wells being installed or decommissioned is provided in applicable sections of the text, tables, and figures.*

Comment 9: Figure 6 of this document shows a very poor overhead locational photo for 33 previously decommissioned Operable Unit 1 wells. The FOCAG asks, Will these 33 decommissioned wells again be inspected?

Response to Comment 9: *The background image provided on Figure 6 is not poor quality; it is intentionally set at 40 percent transparency so that the data presented on the figure are not obscured*

and will be apparent to the reader. The purpose of the background imagery is to give the reader a frame of reference with respect to the locations of other features on the map. If the transparency of the image is set to less than 40 percent, important map features would not be clearly visible on the figure.

Please note that there are also limitations to map resolution when viewing paper copies; however, viewing the maps and figures in portable document format (PDF) on a computer will allow the reader to zoom in on or zoom out from specific map features at potentially higher resolutions. PDF versions of Fort Ord documents are available in the online Administrative Record at www.fortordcleanup.com and on the compact discs typically included with paper copies of the documents.

There are no plans to inspect the previously decommissioned wells again after the work described in QAPP Addendum No. 1 is accomplished.

Comment 10: Figure 5 of this document shows a very poor overhead locational photo for 20 previously decommissioned wells and identifies them as being in the now Fort Ord Dunes State Park. It fails to tell the reader this was formerly Fort Ord Site #3, the Army's Infantry rifle training ranges.

Response to Comment 10: *The background image provided on Figure 5 is not poor quality. Please see the response to Comment 9. As stated in responses to previous comments, identification of this area as "Site 3" in QAPP Addendum No. 1 is not relevant to the current status of the property or the work being conducted there.*

Comment 11: Figure 4 of this document shows a very poor overhead locational photo for 9 Monitoring Wells to be decommissioned, all East of State Highway 1. The FOCAG notes that two of these wells are adjacent to a new residential housing subdivision area, one is near the relocated unlined landfill, known as a CAMU, several are in the commercial retail public shopping center area, and two are in the Fort Ord Natural Reserve South-East.

The FOCAG notes again that Site #3, the former Army Rifle Training Beach Ranges is not identified.

Response to Comment 11: *The background image provided on Figure 4 is not poor quality. Please see the response to Comment 9. For clarification, the OU2 Landfills (composed of Areas A through F) were active from 1955 to 1987 and were used for residential and on-base waste disposal typical of municipal landfills during that time. Area A was the portion of the landfill that was relocated; it was consolidated in already existing Areas B through F. It is a mischaracterization to state that the OU2 Landfills are unlined, as the remedy included construction of an engineered cover system that prevents infiltration of precipitation through waste materials remaining in the Landfills. To clarify, the OU2 Landfills are not formally designated as a Corrective Action Management Unit (CAMU); however, CAMU regulations (California Code of Regulations Title 22) are applicable or relevant and appropriate requirements for the OU2 Landfills (see Administrative Record No. OU2-656).*

As stated in responses to previous comments, identification of this area as "Site 3" in QAPP Addendum No. 1 is not relevant to the current status of the property or the work being conducted there.

Comment 12:[2] Table 3. "Previous Decommissioned Wells Inspection Details identifies and lists 20 wells decommissioned in year 2014. This was nine years ago. The dates of inspection, the depth of grout settlement, the accessibility safety risk, and the top 20 priority list are all 'TBD" to be determined.

Response to Comment 12: *Table 3 lists 29 wells (not 20) that were decommissioned in 2014. The values for date of inspection, the depth of grout settlement, the accessibility safety risk, and the top 20 priority wells are all listed as "TBD" (to be determined) because inspecting the wells for these parameters is one of the tasks to be completed under QAPP Addendum No. 1.*

Comment 12a: The FOCAG asks; Are there records of these decommissioned wells being inspected in the past nine years?

Table 3 also identifies and lists an additional 16 wells that were previously decommissioned in year 2017. Again, date of inspection, depth of grout, accessibility safety risk and top 20 priority list are all listed as TBD, To Be determined.

Response to Comment 12a: *This is the first formal inspection that is to be conducted on the previously decommissioned wells.*

Table 3 lists 24 wells (not 16) that were decommissioned in 2017. The values for date of inspection, the depth of grout settlement, the accessibility safety risk, and the top 20 priority wells are all listed as "TBD" because inspecting the wells for these parameters is one of the tasks to be completed under QAPP Addendum No. 1.

Comment 12b: The FOCAG asks; Were these 36 wells that were decommissioned in years 2014 and year 2017 ever tested for per- and polyfluoroalkyl substances?

It is a health and safety risk. Where are these records?

Response to Comment 12b: *In 2014, per- and polyfluoroalkyl substances (PFAS) were not chemicals of interest at the former Fort Ord. Accordingly, none of the wells that were decommissioned in 2014 were tested for PFAS. However, seven of the 24 wells decommissioned in 2017 were tested for PFAS (MW-OU1-26-A, EW-OU1-52-A, EW-OU1-53-A, IW-OU1-02-A, PZ-OU1-49-A1, PZ-OU1-10-A1, and MW-OU1-88-A) and the results are reported in the Final Remedial Action Completion Report / Technical Memorandum Operable Unit 1 Attainment Monitoring Results Sampling Events #1 through #4 (Administrative Record No. OU1-623A)*

Comment 12c: What specific documents in the Fort Ord Administrative Record contain the records for Carbon Tetrachloride testing in these 36 decommissioned wells?

Response to Comment 12c: *All decommissioned wells (53 total) were either associated with Operable Unit 1 or Sites 2/12. Carbon tetrachloride is not identified as a COC for these sites in the associated Records of Decision (RODs) for those two sites (Administrative Record Nos. RI-025 and OU1-362). However, there are some analytical results for carbon tetrachloride associated with 26 of the 53 wells (reported for samples collected from 1992 to 2013), but carbon tetrachloride was not detected in any of these samples. Documents containing these data can be found at Administrative Record Nos. BW-0823,*

[2] Comments 12, 12a, 12b, and 12c were identified as Comments 11, 11a, 11b, and 11c, respectively, in the letter dated September 24, 2023 (see Administrative Record No. BW-2785S.4).

BW-0825, BW-1378, BW-1376, BW-1390, BW-1653, BW-1953E, BW-2027F, BW-2064, BW-2086P, BW-2165B, BW-2218H, BW-2277, BW-2333C, BW-2395D, BW-2432F, BW-2460D, BW-2492C, BW-2533A, BW-2573A, and BW-2626A.

ATTACHMENT H

Responses to Comments on the Draft Final Quality Assurance Project Plan Addendum No. 1 submitted by the FOCAG

Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)[1]

Comment 1: Reference Figure 2 in this document, dated 10/10/2023. The FOCAG suggests a better quality photo that includes;

1) A broader view as these three new proposed wells are ever closer to the Salinas Valley
2) The location of the Marina Coast Water Wells locations
3) Identifying information on the photo such as Reservation Road
4) MW-BW-101-A, 102-A and 103-A should be identified on this photo/map as being the "THREE NEW WELLS". We suggest arrows, so readers can readily place their location.

Response to Comment 1: *The background image provided on Figure 2 is intentionally set at 40 percent transparency so that the data presented on the figure are not obscured and will be apparent to the reader. The purpose of the background imagery is to give the reader a frame of reference with respect to the locations of other features on the map. If the transparency of the image is set to less than 40 percent, important map features would not be clearly visible on the figure.*

Please note that there are also limitations to map resolution when viewing paper copies; however, viewing the maps and figures in portable document format (PDF) on a computer will allow the reader to zoom in on or zoom out from specific map features at potentially higher resolutions. PDF versions of Fort Ord documents are available in the online Administrative Record at www.fortordcleanup.com and on the compact discs typically included with paper copies of the documents.

1) *A broader view is already provided on Figure 1. The locations of the three new monitoring wells are no closer to the Salinas Valley than many other monitoring wells at the former Fort Ord (e.g., see Administrative Record No. OUCTP-0111). A broader view on Figure 2 would make it more difficult to see the new well locations and other relevant features, such as the carbon tetrachloride plume and groundwater elevation contours, which is the intent of the figure.*
2) *The inclusion of the Marina Coast Water District (MCWD) supply wells on Figure 2 is not appropriate as they are not relevant to the work being conducted. Figure 2 specifically relates to the installation of A-Aquifer monitoring wells. The MCWD supply wells are screened in deeper aquifers and there is no pathway from the A-Aquifer to these deeper aquifers in the part of the Operable Unit Carbon Tetrachloride Plume where the new monitoring wells are being installed.*
3) *Reservation Road and Imjin Road were labeled on Figure 2 per the comment.*
4) *The Figure 2 legend already includes symbology for the new monitoring wells and the symbols are distinctly colored to differentiate them from existing wells:*

[1] In a letter dated November 9, 2023 (see Administrative Record No. BW-2785U.4). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.