Operation and Maintenance Manual

McCormick & Baxter Superfund Site

Portland, Oregon

ECSI Site No. 74

Prepared for

Oregon Department of Environmental Quality

April 28, 2023
0202315-000/Task 6

(tables and figures with confidential security information removed.)

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ACRONYMS AND ABBREVIATIONS

ACB	articulated concrete block
ASTM	American Society for Testing and Materials
bml	below the mudline
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm^2	square centimeters
DEQ	Oregon Department of Environmental Quality
DGPS	Differential Global Positioning System
DGT	diffusive gradients in thin film
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DOT	United States Department of Transportation
DSL	Department of State Lands
Dup	duplicate
DTW	depth to water
EDD	Electronic Data Deliverable
Eh	electrical conductance
EPA	United States Environmental Protection Agency
ESC	ESC Lab Sciences
FWDA	Former Waste Disposal Area
GC-MS/MS	Gas Chromatography Tandem Mass Spectrometry
GPS	global positioning system
GSI	GSI Water Solutions, Inc.
HASP	Health and Safety Plan
HEM	hexane extractable material
IA	inter-armoring
IATA	International Air Transport Association
ICP/MS	Inductively Coupled Plasma Mass Spectrometry
ID	identification
IDW	investigation-derived waste
LDPE	low density polyethylene
liters/m^2	liters per square meter
LNAPL	light non-aqueous phase liquid
M&B	McCormick & Baxter
MDL	method detection limits
mg/kg	milligrams per kilogram
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NAD83	North American Datum of 1983
NAD83/91	North American Datum of 1983 – 91 adj
NAPL	non-aqueous phase liquid
NAVD88	North American Vertical Datum 1988
NOAA	National Oceanic and Atmospheric Administration

NTU	nephelometric turbidity unit
O&F	operational and functional
O&M	operation and maintenance
OAR	Oregon Administrative Rules
OC	organophilic clay
ORP	oxidation-reduction potential
OSHA	Occupational Health and Safety Administration
OSU	Oregon State University
PAH	polycyclic aromatic hydrocarbon
PCP	pentachlorophenol
PDA	personal digital assistant
PDMS	polydimethylsiloxane
PE	polyethylene
PPE	personal protective equipment
PRC	performance reference compound
PSD	passive sampling device
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RM	river mile
RNA	Regulated Navigational Area
ROD	Record of Decision
RTK	real-time kinematic
SA	sub-armoring
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SPCS	State Plane Coordinate System
SPME	Solid Phase Microextraction
SSC	State Superfund Contract
SW	surface water
TFA	Tank Farm Area
TOC	total organic carbon
TOIC	top of inner casing
UPRR	Union Pacific Railroad
USCG	United States Coast Guard
USGS	United States Geological Survey

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1.0 INTRODUCTION

The following sections provide Site summary and background information.

1.1 Site Summary

The Oregon Department of Environmental Quality (DEQ) prepared this Operation and Maintenance (O&M) Manual for the remedial actions implemented at the McCormick & Baxter (M&B) Creosoting Company Superfund Site (Site), located in Portland, Multnomah County, Oregon. This O&M Manual is primarily intended for use by the DEQ O&M consultants (Consultants) and their contractors (Subcontractor), while performing site maintenance activities. At the time of this manual update, Haley & Aldrich, Inc. (Haley & Aldrich), and GSI Water Solutions, Inc., are the O&M consultants for the Site.

Section 104I(3) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires the State to assure future maintenance of CERCLA-funded removal and remedial actions. DEQ entered into a State Superfund Contract under which the DEQ assured the O&M of the implemented CERCLA-funded remedial action.

This O&M Manual contains up-to-date, site-wide Record Drawings of the remedial features present at the Site. Record Drawings are included as Appendix A. The O&M Manual specifies the sampling and monitoring procedures, quality assurance and quality control (QA/QC), technical information, and instructions necessary for implementing the O&M activities. The O&M Manual is a living document that will be modified by DEQ to reflect changing monitoring and maintenance needs.

The O&M Plan serves as a companion to this O&M Manual and is included as Appendix B. The O&M Plan defines the administrative, financial, and technical details and requirements for inspecting, monitoring, operating, and maintaining the remedial actions at the Site; it also includes information on maintaining, as appropriate, institutional controls established at the Site pursuant to the Records of Decision jointly issued by the Environmental Protection Agency (EPA) and DEQ.

1.2 Site Background

The Site is located in Portland, Oregon, on the Willamette River at approximately River Mile (RM) 7. The Site encompasses approximately 41 acres of land and an additional 23 acres of capped contaminated river sediments. Currently, the Site is vacant except for a paved parking area, a small shop and storage building, and associated utilities used to support ongoing remedial action operations and maintenance. The upland portion of the Site is fenced.

DEQ implemented a number of removal measures, including plant demolition, sludge and soil removals, and creosote extraction from the shallow and intermediate water-bearing zones. Creosote extraction was discontinued in 2011 based on an evaluation showing that the non-aqueous phase liquid (NAPL) is primarily in a residual state and ongoing manual recovery had reached diminishing returns. Over 6,500 gallons were recovered between 1996 and 2011. Implementation of the soil remedy began in March 1999 with the removal of 33,000 tons of highly contaminated soil and debris.

As a component of the groundwater remedy, a fully-encompassing impermeable subsurface barrier wall was installed around 18 acres of the site in 2003. The subsurface barrier wall contains a large portion of the primary source areas of groundwater contamination and should minimize horizontal seepage of creosote into the Willamette River. In 2004 and 2005, a protective cap was placed over areas of contaminated river sediments posing an unacceptable risk to human health and the environment. The Clean Water Act Water Quality Certification documentation for the sediment cap action is provided as Appendix C. In 2005, a soil cap was placed over the upland portion of the Site with a Resource Conservation and Recovery Act (RCRA)-style impermeable cap over the upland portion of the Site within the barrier wall.

2.0 SITE ACCESS AND VISITOR ENTRY

The following sections provides information on site access, including vehicle entrances and lock combinations and key locations to the various site features. In addition, this section describes measures in place to warn the public of hazards located offshore from the Site. Information in this section corresponds to Sections 19 and 20 of the O&M Plan.

The Site can be accessed from upland roads or from the Willamette River. Perimeter fencing and warning signs restrict access to the upland portion of the Site. Public access to the beach is not restricted; however, DEQ has obtained a permanent easement for the sediment cap from the Department of State Lands (DSL) that prohibits the anchoring and grounding of non-recreational vessels and the use of all motor propelled vessels. A Regulated Navigational Area (RNA) designation for the Site was adopted February 4, 2009 (74 FR 5989). Refer to Appendix D for copies of the permanent easement, navigation restrictions, and other access agreements and easements pertaining to the Site.

2.1 Site Health & Safety Requirements

All personnel visiting the site must abide by applicable health and safety procedures for the Site. Abiding by health and safety protocols is the responsibility of each individual contractor (including Consultant and their subcontractors) that performs work at the Site. Contractors will be responsible for preparing their own health and safety plans as well as performing health and safety briefings (i.e., health and safety “tailgate” meetings) before performing any tasks. Should an incident occur, the contractor will provide any required internal notifications and notify the Consultant who will in turn notify the DEQ Project Manager. For serious injuries, the DEQ will be notified by the Consultant within four hours of occurrence.

The remedies have been completed for the Site, eliminating the potential for exposure from unintrusive surface activities and the need for additional training or certification is not required. Field personnel performing sampling activities or handling potentially contaminated material must be Hazardous Waste

Operations and Emergency Response (HAZWOPER) trained in accordance with Occupational Safety and Health Administration, 29 Code of Federal Regulation, 1910.120, or under the direct supervision of someone who is. Field personnel will have completed a 40-hour initial HAZWOPER training and maintain a current 8-hour refresher training each year thereafter. Medical monitoring is required for HAZWOPER trained personnel and is required to be performed on an annual or biennial basis.

2.2 Upland Site Access

The Site can be entered through an upper gate located on N. Edgewater Road, just off N. Willamette Boulevard. This upper gate is secured with multiple locks (including the railroad's lock) chained together. The Site uses the Metro combination lock. Refer to Table 2.1 for the access combination for the Metro lock (the remaining locks at the gate placed by other entities are keyed). If the combination does not work, call Alison Clements at Metro: (971) 373-1424. To reach the Site, travel down N. Edgewater, cross the railroad tracks, and veer to the left to follow the dirt/gravel road under the railroad bridge. Once past the railroad bridge, the paved site entrance and perimeter fencing is visible.

There is also an alternate entrance accessible from N. Van Houten Place (near the University of Portland). There is a University of Portland gate at the upper end of N. Van Houten Place. The gate is open and is not locked though it does have the ability to be locked in the future. Follow N. Van Houten down the bluff and cross over the railroad tracks. Enter the Site using the gate located approximately 50 feet past the railroad tracks on the right side of the access road. This gate is secured with a combination lock. Follow the gravel road to the northeast corner of the property to access the paved support facility area.

There are a total of eight perimeter gates: four along the shore, one on the west edge and one on the north edge of the property, and the two entrance gates described above. Figure 2.1 shows the location of each perimeter gate and the two possible site entrances. Perimeter gates are secured with combination locks. Refer to Table 2.1 for the combination to the combination locks.

2.3 Railroad Crossings

Accessing the Site through either entrance will require crossing over Union Pacific Railroad (UPRR) tracks. As there are no functional crossing gates, and remote-controlled trains are operated in the area, caution should be used when crossing. As of 2023, Crossing gates have been installed at the N. Van Houten crossing though they are not yet operational. Occasionally, UPRR trains will be parked across the entrance, blocking access. If this occurs, first check the other entrance to ascertain if the train is blocking both vehicle entrances. If only one entrance is blocked, use the other. If both entrances are blocked, call the following number(s):

- Union Pacific RR Block Xing – (800) 848-8715: This number allows you to report a blocked Xing to UPRR headquarters (not local). If possible, have the number of the boxcar blocking the entrance available so UPRR can more quickly identify which train is causing the blockage. They will contact the local train yard operator to have the train moved.

- Union Pacific Critical Call Number – (888) 877-7267: May be useful if the above option does not work. This number is to report unusual or suspicious occurrences, criminal activity, illegal dumping, and environmental incidents and hazards.
- General Union Pacific, Portland – (503) 249-2711
- Bryan Robinson, Manager of Environmental Field Operations for Idaho, Montana, Oregon, and Washington – (308) 535-4456 or (308) 520-5213
- Mike Eliason, Public Affairs Director, Portland, Oregon – (503) 249-3079

In the past, special events attended by elected officials, media, and the community required direct coordination with the UPRR Director of Terminal Operations, Portland, Oregon, to ensure that the crossing is not blocked.

2.4 Accessing Upland Site Features

The following sections outline sign-in, access procedures, and contact information for the Site.

2.4.1 Visitor Sign-In

All visitors to the Site must sign the visitor log located either in the main trailer or outside the trailer (if accessing the trailer is not necessary). Visitors who sign in outside the trailer provide their information on forms stored in a weatherproof box attached to the trailer near the bottom of the stairs. Keeping detailed records of personnel and visitors to the Site aids in tracking activities occurring on Site. An example visitor sign-in sheet is presented in Table 2.2.

2.4.2 Accessing Upland Areas

The location of keys to access the shop, Kubota vehicle, and monitoring wells are described in Table 2.1. The remainder of the upland portion of the Site can be accessed through the two gates located in the southwest corner of the support area; the combination for those gates is the same as all site gates and listed in Table 2.1. When leaving the support area to work in other parts of the Site, always lock the perimeter entrance so unauthorized people cannot enter the Site while the support area is unattended. Signs are posted around the perimeter to warn people of entering the Site. Figure 2.2 is an example of the perimeter warning signs.

The property to the north of the railroad bridge (known as Willamette Cove) is maintained by Metro and public access is restricted as marked due to elevated contaminant concentrations in soil. Remediation is anticipated at the Metro Site and access will likely change after remediation has been completed. It is not the responsibility of the contractor personnel or DEQ employees to confront people/trespassers on the Metro property. If there is an issue on the property, call either the Metro contact listed below in Section 2.4.4, or the police, depending on the situation.

2.4.3 Sediment Cap Access

DEQ placed permanent buoys along the perimeter of the sediment cap to warn boaters of navigational hazards and installed a sign at the top of the bank warning boaters of the rock reef. Table 2.3 lists the coordinates for the five buoys; Figures 2.3 and 2.4 are images of the buoys and sign at the top of the bank, respectively; Figure 2.5 shows the buoy locations. A Local Notice to Mariners was issued on May 5, 2007, warning boaters of the rock reef. The permanent buoys were placed in August 2011. On February 4, 2009, the United States Coast Guard (USCG) published the final rulemaking formally establishing the RNA for the M&B Site sediment cap (docket number USCG-2008-0121). This rule became effective on March 6, 2009. In 2015 and 2022, missing permanent buoys were replaced. The as-built drawing for the buoys is included in Appendix A, Record Drawings.

2.4.4 Contact Information

The following lists the project contacts and phone numbers for key personnel.

- DEQ Project Manager, Sarah Miller – (503) 863-0561,
- Haley & Aldrich Site Manager, Kevin Woodhouse – (971) 808-5178,
- GSI Project Manager, Chris Rhea – (971) 200-8572,
- Metro representative, Alison Clements – (971) 373-1424,
- Police and Fire Emergency – 911,
- Fire Non-Emergency – (503) 823-3700,
- Police Non-Emergency – (503) 823-3333, and
- UPRR Blocked Crossing – (800) 848-8715.

3.0 SOIL CAP AND SEDIMENT CAP SHORELINE INSPECTIONS AND MEETINGS

This section describes soil and sediment cap inspections to be performed at the Site. Inspections are performed quarterly by the DEQ and Consultant. If necessary, a follow-up inspection will be performed jointly by the DEQ, Consultant, and any applicable O&M subcontractors to verify and discuss conditions observed during the initial inspections. Information in this section corresponds to Chapters 7 and 8 of the O&M Plan.

3.1 Soil Cap Inspections

During each inspection, the following should be noted: general site conditions, areas of erosion, condition of storm water conveyance system, condition of the vegetation, and any wildlife. Other observations should be noted as needed. Each area of inspection is described below.

3.1.1 General Site Conditions

During each inspection, note:

- The high and low temperatures of the day;
- Estimated wind speed for the day;

- Estimated precipitation;
- Gate conditions, such as whether they were locked or unlocked when arriving on the Site or if any damage or evidence of tampering has occurred;
- Condition of perimeter fencing, such as holes in fence fabric, gaps between the fencing and ground surface, or evidence of tampering; and
- Any trespassers on the Site.

3.1.2 Erosion

- During each inspection, inspect around each of the five manholes, the headway to the retention pond, eastern edge of the property (property bordering the UPRR tracks), retention pond spillway, and outfall area; and
- Inspect for animal burrows or disturbances.

3.1.3 Storm Water Conveyance System

- During inspections, inspect manholes for debris, flow, erosion, and general condition.
- During significant precipitation, observe if water flows from collection piping into the manholes; if not, this is an indication of the collection piping being blocked with debris.
- Inspect the outfall and note if the amount of flow corresponds correctly to the amount of precipitation (i.e., heavy rains, but no flow).
- Note the estimated flow rate from the outfall and spillway if flow is present.

3.1.4 Vegetation and Irrigation

The City of Portland Bureau of Environmental Services was initially responsible for the Upland Sediment and Soil Cap Vegetation Management Strategy provided. In 2010, Hart Crowser, Inc. (now Haley & Aldrich, Inc.) took over the vegetation management and prepared an updated Vegetation Management Plan provided in Appendix E.

During routine site inspections, the Consultant and DEQ note problems with vegetation (i.e., vegetation not growing, dead trees, blackberries overgrowing). Periodically, the Consultant’s botanist will conduct a site visit to assess the health of the vegetation and whether it meets the intent of the Vegetation Management Plan.

3.1.5 Wildlife

During inspections, make note of any observations of wildlife inhabiting or frequenting the Site. This is often noted from scat or burrows present at the Site.

3.2 Sediment Cap Shoreline Inspections

During each inspection, the following should be noted: general site conditions, presence of sheen or gas ebullition, condition of articulated concrete block (ACB) and riprap armoring, conditions of organophilic clay mats if visible, wildlife, and conditions of warning signs and buoys. Other observations should be noted as needed. Each area of inspection is described below.

3.2.1 General Site Conditions

During each inspection, note:

- High and low temperatures of the day;
- Estimated wind speed for the day;
- Estimated precipitation;
- Gate conditions, such as whether they were locked or unlocked when arriving on site or if there has been damage or evidence of tampering; and
- General condition of cove shoreline, Former Waste Disposal Area (FWDA) shoreline, bulkhead shoreline, and Tank Farm Area (TFA) shoreline.

3.2.2 Sheen and Gas Ebullition

During each inspection, note:

- The presence of sheen including size and form (patches, streaks, or sheets), color, iridescence, blocky or continuous, thickness, specific location, and potential source (coating gas bubbles, from bank, unknown source); and
- The presence of gas ebullition even if no sheen is associated. Note the frequency of ebullition from specific locations (approximate number of bubbles per minute, is it ongoing or intermittent, etc.)

Section 3.3 provides terminology for sheen descriptions.

3.2.3 ACB and Riprap Armoring

During each inspection, note:

- Changes in location of ACB, displaced blocks, vandalism to ACB, and the river level relative to the top of ACB; and
- Changes in location and vandalism to riprap armoring.

3.2.4 Organophilic Clay Mat

During extreme low water times, inspect:

- Areas where organophilic clay mats have been installed and note if edges of mats are visible and whether there are increased gas bubble ebullition along the edges of the mats;
- The condition of the overlying armoring; and
- Evidence of movement.

3.2.5 Wildlife

During inspections, make note of any observations of wildlife inhabiting or frequenting the Site.

3.2.6 Warning Signs and Buoys

During each inspection, note:

- Any damage or vandalism to the bank warning signs; and
- If buoys are still located in the correct location or if they need to be relocated. Figure 2.5 shows the correct location for the five buoys, and Table 2.3 lists the coordinates for the buoys.

3.3 Sheen Terminology

Routine inspections along the shoreline look for signs of cap disturbance, sheens, gas bubbling, animal activity, etc. The descriptions of various sheen appearances have varied widely. This guidance was prepared to provide uniform and consistent terminology for describing observed sheens at the Site.

There are many potential origins of sheen including fuel leaks from boat traffic, organic sheens from rotting organic debris, and creosote sheens from the remaining residual creosote contamination in the sediments and in the upland soils at the Site. It is important to be able to differentiate these sheens.

The following terminology is suggested for describing sheen:

NS = No sheen visible on the sediment or water surface.

BS = bacterial sheen. If the sheen breaks into several fragments/platelets without returning to its original shape when passing a foreign object such as a stick through it, the sheen is a bacterial sheen. This sheen can either be translucent or iridescent. Bacteria sheens can have a rainbow color that is commonly associated with oil sheens seen in parking lots after rainfall. Bacterial sheens will not have a petroleum or creosote odor but may have a rotten egg odor (hydrogen sulfide gas).

SS = slight sheen; light, colorless, dull sheen. Almost translucent in nature. Spread is irregular, not rapid; sheen dissipates rapidly. This sheen can be confused with natural sheen resulting from biological processes. If the sheen cannot clearly be described as a bacterial sheen, but is translucent in nature and dissipates rapidly, it can be described as a slight sheen.

MS = moderate sheen; appears silvery or shimmers, may have slight color. Sometimes called a gray sheen. Spread is irregular to flowing, may be rapid; few areas of no sheen are identified in the area of sheen.

HS = heavy sheen; sheen has a rainbow color, iridescence; spread is rapid, entire water surface in area of sheen is colored by sheen.

In addition to classifying the sheen as described above, the size, location and odor associated with the sheen should be described. Label the size and area where the sheen was identified on a site map. Odors should be described as either: no odor, fuel/petroleum odor, creosote odor, or other odor.

Sheen Volume

Since the thickness of the film is on the order of the wavelength of visible light, the reflection of sunlight off the thin oil film and the resulting colors can give an idea of oil thickness. The following table summarizes the oil thicknesses based on visual color of the sheen.

Color	Thickness (Inches)	Volume (liters/m^2)
Barely visible	0.000002	5 x 10^{-5}
Silver sheen	0.000003	1 X 10^{-4}
First color trace	0.000004	2 X 10^{-4}
Bright colors	0.00001	4 X 10^{-4}

3.4 Site Meetings

During the quarterly site meeting, inspect the Site and discuss observations and corrective actions to be taken. Other items to discuss during the site meeting include budget status; site activities; and ongoing deliverables. After each meeting prepare meeting minutes to be sent to DEQ for review. Address any DEQ comments to the meeting minutes and finalize. Minutes should summarize each topic covered during the meeting, provide a list of action items, identify any persons responsible for the action item, and a time frame for completion. Table 3.1 shows an example format for the meeting minutes.

4.0 SUBSIDENCE MONITORING

In June 2008, subsidence of the soil cap was observed near groundwater monitoring wells EW-1s and MW-23d. An upland site survey confirmed that the ground surface had subsided up to approximately 0.8 feet in a limited area around the wells between the time that the soil cap was installed in 2005 and 2008. Investigation activities was performed and documented in a 2008 Subsidence in Upland Cap Memorandum and additional investigation and corrective actions were performed and documented in a 2010 Additional Subsidence Monitoring Memorandum. The 2010 memo recommended periodic monitoring be performed to evaluate if conditions were stable following implementation of the corrective action and to monitor for additional subsidence. The most recent subsidence monitoring event was performed in 2019 and documented in a 2020 Subsidence Monitoring and Evaluation Technical Memorandum.

The cause of the subsidence was suspected to be caused by aerobic degradation of woody debris based on elevated groundwater temperatures in well EW-1s (40°C) and the large amount of buried woody debris in the area. Decreasing groundwater levels within the barrier wall also may have contributed to the subsidence of the soil cap by opening a larger unsaturated zone to allow compaction. In 2009, EW-1s was sealed to reduce the amount of oxygen reaching the unsaturated zone. After the well was sealed, subsidence ceased. Since 2009, no additional subsidence has been observed. The groundwater temperature dropped to approximately 21 to 23°C and has remained stable since then. Current temperatures in the well are approximately 19 to 20°C. This temperature remains higher than groundwater from surrounding wells (approximately 13°C) indicating that some heat is still being produced in the subsurface near well EW1s. This may be caused by anaerobic degradation, which generates less heat than aerobic degradation.

To verify that the sealing of EW-1s continues to remain successful in preventing further subsidence, periodic monitoring is performed that includes the following tasks.

- Measurement of the relative difference between the inner well casing and outer well monument standpipe casing of well MW-23d;
- Video scoping of the stormwater sewer conveyance lines to look for sags or cracks/breaks in the pipes; and
- Land survey of the vicinity around wells EW-1s and MW-23d and comparison to past survey data.

The following sections provide additional detail on monitoring procedures and past monitoring events. The results of stormwater conveyance line inspections and land surveys performed at 10-year intervals will be documented and presented in a subsidence monitoring memorandum.

4.1 MW-23d Well Casing Measurements

Ground surface subsidence is monitored by measuring the inner PVC casing at well MW-23d relative to the outer steel well monument casing. The inner casing extends to 182 feet bgs and is considered stable. In 2008, field staff noticed that the inner casing for MW-23d extended approximately 4 inches above the outer casing and interfered with the well monument lid closing correctly. In August 2008, the inner casing for MW-23d was trimmed down to approximately 4 inches below the outer casing. The outer casing is representative of the ground surface and if the outer casing (or ground surface) subsides, then the distance between the inner and outer casing decreases. Between November 2008 (first periodic measurement conducted) and 2010, the total distance between the inner and outer casing decreased by approximately 1.35 inches to a total distance of approximately 2.75 inches. Most of the decrease between the inner and outer casing occurred in 2009, with 0.5 inches of decrease occurring between November 2008 and January 2009. Since 2010, the distance has not changed, being measured at approximately 2.75 inches.

The distance between the inner and outer casing is measured quarterly during the quarterly site inspection. Measurements are taken at the black permanent ink mark on the northern side of the inner PVC casing. The end of the tape measure or ruler will be placed on top of the inner casing at the mark and the distance to the top of the outer casing will be measured and recorded in the site inspection summary (Table 3.1).

4.2 Stormwater Conveyance Line Video Inspection

Inspection and video scoping of the stormwater conveyance lines was performed in 2009 and 2019 to evaluate if the subsidence has affected the ability of the stormwater lines to convey water away from the soil cap to the discharge outfall. The 2009 inspection identified two sags in the stormwater line between Manhole B (SDMH-B) and Manhole C (SDMH-C). The first sag was identified at approximately 430 to 480 feet downstream of Manhole B and the second sad was identified at approximately 680 to 730 feet downstream of Manhole B. The 2019 inspection identified the same two sags in the same approximate positions with no indication of additional settling of the lines.

Follow up stormwater conveyance line inspections will be performed at 10-year intervals, or as requested by DEQ, and in conjunction with land survey activities (discussed in the following section). The inspection will be performed by using a waterproof, crawler mounted camera to traverse the length of the stormwater lines. Video captured by the crawler will either be annotated to describe features observed or a written report will be prepared by the video scoping subcontractor to document the inspection. The inspection will record any sags or low points encountered as well as any signs of fatigue or failure of the lines and pay particular attention to the two existing sag areas. The manholes and stormwater conveyance lines are shown on Record Drawing 3 in Appendix A.

4.3 Land Survey

Following the identification of subsidence, a land survey was performed in 2008 to measure the elevation change. The soil cap was surveyed and compared to post-construction, soil cap survey data from 2005. The comparison indicated ground surface subsidence of up to 0.8 feet in areas where wood debris was present. Targeted surveying was then performed through 2009 at select wells and temporary survey hubs installed on the cap to monitor conditions during and after corrective action implementation. The site was surveyed in 2019 to monitor for any additional elevation changes due to subsidence and compared to the 2008 survey data, which was supplemented by more recent 2009 data for select wells. Survey results indicated elevation decreases of 6.72 inches for EW-1s and 2.64 inches for MW 23d between 2009 and 2019.

Topographic land surveys of the upland area are performed at 10-year intervals, and in conjunction with stormwater conveyance line inspections) as part of subsidence monitor for the Site. Surveys will be performed on an approximate 25-foot grid spacing. A tighter grid spacing will be used around wells EW-1s and MW-23d to provide higher resolution as this is the area of greatest subsidence. A grid spacing of 10 feet will be used in a 60 by 60-foot area centered wells EW-1s and MW-23d. In addition to site topography, monitoring wells within the upland area will also be measured and will include elevation measurements of the top of inner casing, top of outer casing, and ground surface next to the well.

Survey data will be measured in North American Datum of 1983, Oregon North State Plane Coordinate System, Zone 3601, international feet, for horizontal coordinates and North American Vertical Datum of 1988 for elevations. Measurements will be collected to the nearest hundredth of a foot for horizontal coordinates and vertical elevations. Survey data will be referenced to National Geodetic Survey monument E718 (PID RD1546) located approximately 300 feet north of the Site.

Survey data collected will be evaluated against the previous survey by loading both data sets into Geographic Information System (GIS) software, generating a raster layer for each survey, and calculating the difference in elevation. The difference in elevation will be plotted on a figure and elevation change bins of 0.5 feet or less will be represented visually as color gradients.

5.0 SURFACE WATER, INTER-ARMORING POREWATER, SUB-ARMORING POREWATER AND CRAYFISH TISSUE SAMPLING

Following construction of the sediment cap in 2004/2005, 5 years of semiannual sampling were performed during the operational and functional (O&F) phase of the Superfund remedial action process. Through the semiannual sampling and additional targeted investigation, as described in the annual O&M reports (E&E, 2007 and 2008; Hart Crowser/GSI, 2009, 2010, and 2011), DEQ and EPA have determined that the sediment remedy is protective as well as operational and functional. Therefore, the sediment remedy is now in the O&M phase of the remedy completion process.

Ten post-cap semiannual surface water, inter-armoring water, and sub-armoring water sampling events were conducted between 2005 and 2010 used an MHE PushPoint sampling tool (a.k.a. “the Henry Sampler”) described in Appendix F. While Appendix F has been retained for potential future use, passive sampling methods (rather than the MHE PushPoint sampling method) were used in 2015 and 2020, and are expected to be used for all future sampling events. As part of the 2020 sampling event, a porewater and crayfish tissue Sampling and Analysis Plan (SAP) was prepared in accordance with Chapter 8 of the O&M Plan (Appendix B) and is included as Appendix G.

The solid phase micro-extraction and diffusive cell membrane technologies used for the 2020 sampling event are detailed in the SAP. Details of the previous passive sampling technologies used during the 2015 sampling event can be found in the 2018 version of this O&M Manual. The SAP contains information that is relevant to all future sampling events; however, specific details such as sampling locations will vary between sampling events. To capture these variations, the sampling memorandums that were prepared for each event (beginning with the 2015 event) are included in Appendix H. Crayfish tissue sampling, when performed, must also be performed in compliance with the Biological Assessment that was prepared by DEQ and EPA prior to implementation of the remedy. The Biological Assessment is included in Appendix I.

6.0 ORGANOPHILIC CLAY SAMPLING AND ANALYSIS PLAN

The following sections describe the sampling procedures for organophilic clay sampling events.

6.1 Introduction

This section describes the investigative techniques used to collect organophilic clay core samples and the testing for samples collected. In general, the purpose of the organophilic clay investigation was to expand the knowledge base on the effectiveness of organophilic clay as a capping material, on the effectiveness of using organophilic clay mats for future cap repair, and to obtain information that will shape the long-term monitoring and maintenance plan for the M&B organophilic clay portion of the sediment cap. Organophilic clay from the sediment cap was sampled in the fall of 2006, 2008, and 2009. A fourth sampling event was conducted in conjunction with the 2015 passive sampling event (see Appendices G and H) in September 2015. The 2015 organophilic clay sampling followed this SAP; and it is likely that future organophilic clay sampling will also follow the methodology and analyses described below.

The purpose of this SAP is to provide the sampling methodology used during the 2015 event and for future sampling events.

The following sections describe the general scope of work, objectives, and methodology used for obtaining organophilic clay cores and repair of the areas disturbed through coring. In addition to field observations of the organophilic clay thickness and nature obtained by logging the cores; three equidistant samples were collected in 2015 from within the granular organophilic clay layer of each core. Generally, the thickness of the organophilic layer is between 9 and 14 inches based on cores collected in 2006. Samples collected were analyzed for PAHs and total organic carbon (TOC).

6.2 Previous Investigations

In 2006, the percent hexane extractable material (percent HEM), permeability, strength, available sorption capacity, PAHs, and water content were measured. The results showed that the granular organophilic clay from the cap retained similar permeability, strength, sorption capacity and percent HEM to fresh organophilic clay indicating that the organophilic clay had not been compromised by reduction in either capacity or permeability. PAHs were analyzed from five intervals in one core. In the 0- to 0.5-inch sampling interval immediately above the native sediment, 40 milligrams per kilogram (mg/kg) pyrene was detected in the granular organophilic cap. Other overlying granular organophilic clay cap sample intervals showed concentrations of PAHs that were either below the method detection limits (MDLs) or only slightly elevated.

In 2008, tests conducted on the organophilic clay from the granular portion of the sediment cap included water content, organic matter content, percent HEM, and PAH concentrations. The organophilic clay showed no evidence of NAPL saturation and the dry HEM of organophilic clay samples were less than six percent and considerably below the capacity of the fresh organophilic clay (50 percent or greater). However, the PAH concentrations were less than 2.3 mg/kg which does not account for the percent HEM measured in the organophilic clay, suggesting that the low HEM was associated with the extractable material from the organophilic clay and not from the migration of NAPL or dissolved PAHs in water into the organophilic clay portion of the sediment cap. This is consistent with the observation of increased biological activity within the footprint of the organophilic clay. There is evidence that this biological activity has led to a significant reduction in organic matter of the organophilic clay used in the sediment cap. Although degradation of the organic matter will ultimately result in a reduced sorption capacity of the organophilic clay, in 2008 (and again in 2009), there was still ample sorption capacity remaining in the organophilic clay. The organic matter content decreased from approximately 24 percent in fresh ET1 organophilic clay to between 13 and 18 percent (four years after emplacement). Measurements from 2009 showed that the percent organic matter had remained stable between 2008 and 2009.

In 2009, the TOC percentage was also approximately 16 percent suggesting that the degradation of the organophilic clay may be stabilizing. The primary purpose of the sampling was to determine whether the organophilic clay continues to degrade losing organic matter content, or whether the degradation has stabilized. The combination of PAHs (the contaminant that would be expected to sorb to the organophilic clay if there is an ongoing source to the sediment cap) combined with measuring the organic matter content will provide the information needed to make the assessment.

6.3 Organophilic Clay Use

Organophilic clay is a bentonite or hectorite clay modified to be hydrophobic and has an affinity for non-soluble organics. Organophilic clay is used in water treatment systems to reduce fouling from oil in downstream components. Because it has an affinity for organic liquids and has been used effectively in water treatment applications, organophilic clay was selected for placement within the sediment cap at site oil seeps. At the Willamette Cove and TFA seeps, a 1-foot-thick layer of granular organophilic clay was placed during sediment cap construction. Organophilic clay reactive core mats “blankets” were placed in other TFA locations and beneath the Burlington Northern Railroad bridge where local ebullition entrained creosote sheen. A test patch of the “blanket” material was placed downstream of the TFA in a bubble path ebullition area that measures approximately 10 feet by 15 feet. The test patch was secured with a section of chain link fence, and then covered by sand and rock armoring. A second blanket was placed in an adjacent bubble path ebullition area in October 2006 during the initial organophilic clay sampling event. This blanket measures approximately 10 feet by 10 feet and is located approximately 15 feet riverward of the first in the TFA. The locations of organophilic clay areas along with other site features are shown on Figure 5.1.

6.4 Objectives/Scope of Work

The objectives of organophilic clay sampling activities include:

- Collect sediment cap cores through the organophilic clay area in Willamette Cove and/or the TFA seeps area to observe, log, and provide samples for laboratory testing; and
- Measure the placed thickness of organophilic clay material in the collected cores.

The scope of work for the organophilic clay sampling includes the collection of sediment cap cores and abandonment of core holes using granular organophilic clay or bentonite chips to plug holes. The articulated concrete block in the area targeted for sampling will be removed to allow for advancing the core through the sediment cap.

Previous coring locations within Willamette Cove are shown on Figure 5.2. Locations selected for core collection will be field located using a hand-held global positioning system (GPS) with pre-loaded background imagery to confirm that the sample locations are within the targeted area.

6.5 Sample Collection Methodology

Collect sediment cap cores using 2-inch diameter polyvinyl chloride (PVC) pipe, saw-cut on one end to provide a pointed cutting tip. After the ACB has been removed, cut the geotextile, and remove the 4 inches of 1-inch minus gravel beneath the geotextile exposing the sand portion of the sediment cap. Drive each core approximately 2.5 to 3 feet below the top of the sand cap. Use a metal slide hammer to drive PVC cores. Once the desired depth has been reached, make two measurements from the top of the PVC. The first measurement is to the top of the sand cap, and the second measurement is inside the pipe to the top of the sample material in the core. The amount of core material (difference between the top of material inside the core and the bottom depth of the core) could also be calculated to help determine how much deeper to drive the core. Mark the outside of the PVC Core at the top of the sand layer with a permanent marker. Next, fill the void space within the upper portion of the PVC pipe with water, and cap to create suction within the sampler, so the sediment core is not lost out the bottom of the sampler during retrieval.

Retrieve cores using a lifting strap and a high lift jack, with the core either capped or duct taped on the end. Hold the core vertically and drill a hole just above the permanent marker line and remove the top cap to release the water to the ground. Then cut the core at the marker line and replace the cap.

Record each core location using a hand-held GPS, and label each core with the boring identification, depth measurements, and top and bottom. Backfill each core hole with either granular organophilic clay or bentonite chips, and cap with a piece of organophilic clay blanket material followed by replacement of the ACB block.

Once a core is retrieved, labeled, water released, cut and capped, transport it to the site shop building to be opened and logged. Lay the core flat and cut the pipe lengthwise, removing approximately one-third of the pipe using a hand-held circular saw, exposing the entire sample core. Log cores for sediment description, including thickness of organophilic clay, and presence of NAPL or discoloration. In the core logs, include the following:

- Organophilic clay sediment contact, location, and nature of contact.
- Creosote should be described within the organophilic clay. Is there a layer? Are there stringers? (These should appear as black organophilic clay).
- Creosote should be logged in sediment. Is the sediment underlying the organophilic clay contaminated with product, sheen – light, moderate, heavy, stringers, etc.?
- Thickness of the granular organophilic clay layer.
- Nature of contact with overlying sand.

Once cores have been logged and the thickness of the organophilic clay layer has been determined, cut three equidistance sections from each end and the center of the organophilic clay interval taking care to NOT include the sand layer or native sediment layer and transfer each section to sampling jars. Clean sample containers will be provided by the analytical laboratory ready for sample collection. Samples will be fully filled, leaving no headspace. A label will be affixed to each sample container and marked with identifying information, including the actual sampling interval, date and time of collection, and unique sample identification as discussed in Section 6.6.1.

6.6 Sample Handling Procedures

The following sections describe handling and documentation procedures for organophilic clay sampling activities.

6.6.1 Sample Identification

Assign each sample a unique ID number describing the sample location. Record the sample number on a waterproof sample label and affix the label to the sample jar. To aid in data management, the field team should use sample location numbers in the format listed below. Each sample ID will consist of abbreviations reflecting the following six components:

1. Site Identification: MB = McCormick & Baxter Site.
2. Sample Matrix: OC = organophilic clay.
3. Sample Year: e.g., 2023.
4. Sample Station Number: e.g., 01 or 02.
5. Sample Start Depth (in inches): e.g., 0 = bottom of granular organophilic clay layer.
6. Sample End Depth (in inches): e.g., 3 = 3 inches above bottom of granular organophilic clay layer.

Note that the last three constituents (station number, start depth, and end depth) should be separated by dashes. For example, MBOC2023-01-0-3 would be used to describe the sampling interval from 0 to 3 inches above the bottom of the observed granular organophilic clay layer.

6.6.2 Chain of Custody Forms

Chain of custody forms should be completed fully by the field technician responsible for sample shipment to the analytical laboratory. At a minimum, the chain of custody forms should include:

- Name and company or organization of person collecting the samples;
- Date samples were collected;
- Type of sample collected (composite or grab);
- Location of sampling station (using the sample ID number described in Section 6.6.1);
- Numbers and types of containers shipped;
- Analysis requested; and
- Signature of the person relinquishing samples to the transporter, with the date and time of transfer noted, and signature of the designated sample custodian at the receiving facility.

In the remarks section of the custody record, note if samples require rapid laboratory turnaround.

The relinquishing individual should record all shipping data (e.g., airbill number, organization, time, and date) on the original custody record, which would be transported with the samples to the laboratory and retained in the laboratory’s file. Original and duplicate custody records with the airbill or delivery note constitute a complete custody record.

6.6.3 Field Logbooks and Data Forms

Field logbooks (or field forms and data forms) are necessary to document daily activities and observations. Documentation should be sufficient to enable participants to accurately and objectively reconstruct project events. Field logbooks should be bound and contain numbered pages. Entries should be made in waterproof ink, dated, and signed. No pages of the bound notebook should be removed for any reason.

If corrections to field notes are necessary, they should be made by drawing a single line through the original entry (so the original entry is still legible) and writing the corrected entry alongside the original entry. The correction should be initialed and dated. Corrected errors may require a footnote explaining the correction.

6.6.4 Photographs

Photographs will be taken to document field activities. Photographs will be taken in landscape orientation and in 16:9 or 16:10 aspect ratio, i.e., widescreen format. Photographs will be documented in the field notebook, downloaded into a photo log file, and kept with the electronic project files.

6.6.5 Custody Procedures

The main objective of chain of custody procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses. A sample is in custody if it is:

- In someone’s physical possession;
- In someone’s view;
- In a locked container; or
- Kept in a secured area restricted to authorized personnel.

6.6.5.1 Field Custody Procedures

Use the following guidance to ensure proper control of samples during fieldwork.

- As few people as possible should handle samples.
- The sample collector is responsible for the care and custody of samples until they are transferred to another person or dispatched properly under chain of custody rules.
- The sample collector should record sample data in the field logbook.
- The field manager should determine whether proper custody procedures were followed during the fieldwork and decide whether additional samples are required.

When transferring custody (i.e., releasing samples to a shipping agent), the following guidelines apply.

- Coolers in which samples are packed should be sealed and accompanied by two chain of custody records. When transferring samples, individuals relinquishing and receiving them must sign, date, and note the time on the chain of custody record. This record documents sample custody transfer.
- Samples should be dispatched to the laboratory for analysis with separate chain of custody records accompanying each shipment. The shipment method, courier name, and other pertinent information should be entered in the chain of custody record.

- All shipments should be accompanied by chain of custody records identifying their contents. The original record should accompany the shipment. The other copies should be distributed appropriately to the site team leader and site manager.
- If sent by common carrier, a bill of lading should be used. Freight bills and bills of lading should be retained as part of the permanent documentation.

6.6.5.2 Laboratory Custody Procedures

A designated sample custodian at the laboratory should accept custody of shipped samples from the carrier and enter preliminary information regarding the package into a package or sample receipt log, including the initials of the person delivering the package and the status of the custody seals on the coolers (i.e., broken versus unbroken). The custodian responsible for sample login should open the package, check the contents, and verify the information on the chain of custody agrees with the samples received. Pertinent information regarding shipment, pickup, and courier should be entered into the chain of custody record. The custodian also should document the relative temperature of the cooler and the general condition of the sample containers. The custodian then should enter the project name and sample identification information into the laboratory’s sample management system.

The custodian responsible for sample login should complete the package or sample receipt log and note any discrepancy or improper preservation. Each sample should be assigned a unique laboratory identification number, and a label should be generated for each container associated with that sample. The labels allow easy tracking of samples within the laboratory every time the samples are taken from or returned to sample management.

Internal custody procedures for transfer of samples within the laboratory should be followed in accordance with the guidelines presented herein. The laboratory should maintain records to clearly document all internal transactions and the ultimate fate (consumption or destruction) of the samples.

6.6.6 Sample Handling, Packaging, and Shipping

The transportation and handling of samples must be accomplished in a manner that not only protects the samples’ integrity but also prevents any detrimental unnecessary exposure to sample handlers because of the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (DOT) in 49 Code of Federal Regulations 171–177 and/or the International Air Transport Association (IATA) Regulations for Dangerous Goods.

6.6.6.1 Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. Follow the subsequent sample packaging requirements:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers.
- Sample bottles may be placed in a plastic bag to minimize leakage in case a bottle breaks during shipment.

- Cool samples by double bagging ice and placing the sealed ice-filled bags around the sample containers. Ice is not to be used as a substitute for packing materials.
- Any remaining space in the sample-shipping container should be filled with inert packing material. Under no circumstances should material such as sawdust, newspaper, or sand be used.
- The custody record must be sealed in a plastic bag and placed in the shipping container. Custody seals must be affixed to the cooler that contains the samples.

6.6.6.2 Shipping Containers

The appropriate shipping container should be determined by DOT or IATA regulations for the anticipated concentrations of suspected contaminants. Because samples at the Site may contain several contaminants, several different packaging schemes may apply. The most stringent packaging scheme should be chosen.

Shipping containers are to be custody-sealed for shipment if samples are being shipped through a commercial shipper. Affix the custody seals so that the container cannot be opened without breaking the seal.

Field personnel should make arrangements for transportation of samples to the laboratory. If samples are being shipped by a third party, field personnel should inform the laboratory of the expected arrival time of the sample shipment and advise the laboratory of time constraints on sample analysis.

6.6.6.3 Shipping Container Labeling

Suggested guidelines for marking and labeling shipping containers are presented below. These guidelines apply when samples are shipped to the laboratory by a third-party shipping company (e.g., Federal Express). In these cases, DOT or IATA regulations should be consulted for appropriate marking and labeling requirements:

- Use abbreviations only where specified.
- The words “This End Up” or “This Side Up” must be printed clearly on the top of the shipping container. Upward-pointing arrows should be placed on the sides of the shipping container.
- After a shipping container is sealed, two chain of custody seals should be placed on the container, one on the front and one on the back. If the shipping container is a drum, one seal should be placed on each side (opposite each other) of the drum. To protect the seals from accidental damage, clear strapping tape should be placed over them.

6.7 Laboratory Analysis

Chemical analysis of the samples will be completed by the DEQ contract laboratory. Submitted samples will be analyzed for the following constituents:

- PAHs by EPA Method 8270D-SIM (low-level detection); and
- TOC by American Society for Testing and Materials (ASTM) F1647-02A (loss of weight on ignition). The lab will report both the percent total organic carbon and percent total organic matter (dry weight)

Laboratory QA/QC will be maintained through the use of standard EPA methods and other accepted methods and standard analytical procedures for the target analytes. Data that falls outside of laboratory QA/QC requirements should be flagged accordingly and noted in the laboratory report.

6.8 Investigation-Derived Waste

Investigation-derived waste (IDW) for sampling activities will include soil cuttings from excess core material, decontamination water, and PPE. Field staff will place soil cuttings and decontamination water in a 55-gallon drum and store onsite for later proper disposal. Used PPE that is minimally contaminated will be placed in the garbage dumpster next to the storage building and disposed of as municipal waste. Grossly contaminated PPE (e.g., chemical coveralls with NAPL product on it) will be placed in a 55-gallon drum and stored onsite for proper disposal. IDW management procedures are detailed in the IDW Management Plan (Appendix J).

6.9 Reporting

The results will be summarized in the Annual Report. Reporting will include organophilic clay core collection methodology, description of creosote distribution, if present, in the sediment cap based on visual observations of the cores, and the TOC and PAH results from the organophilic clay samples.

7.0 SIDE-SCAN SONAR AND HIGH-RESOLUTION MULTIBEAM BATHYMETRY

Additional side-scan and multibeam sonar surveys will be performed approximately every 10 years or following any action that results in a change to the surface of the submerged portion of the sediment cap (e.g., any significant sediment cap repair activities such as the placement of additional rock armor), as well as after extremely high-flow events or at other times deemed necessary by DEQ to assess the condition of the sediment cap.

The side-scan and multibeam sonar surveys will use a side-scan sonar to transmit sound energy to analyze the return signal (echo) bounced off the river bottom or other submerged objects. The transmitted energy shall be formed into a fan shape form, which sweeps the river bottom directly below an emitting and sensing device towed by a vessel through the water a few feet above the river bottom to either side of the river. The strength of the return echo shall be continuously recorded, creating an image of the river bottom where objects protruding from the river bottom create a dark area (strong return), and shadows from these objects create light areas (little or no return). While the surface of the river bottom and submerged objects are normally well depicted, side-scan sonar cannot usually provide depth information. As such, the multibeam sonar survey shall also complete a multibeam sonar survey that will provide fan-shaped coverage of the river bottom similar to side-scan sonar to provide data in the form of depths rather than images. The multibeam sonar shall measure and record the time for the acoustic signal to travel from the transmitter to the river bottom (or other submerged objects) and back to the receiver. The side-scan sonar and multibeam surveys shall be performed in a manner consistent with previous surveys to allow direct comparison of data between survey events. Survey procedures are as follows:

- Prior to field activities provide a drawing showing the track-lines to be used to perform the survey work and the means and frequency to detect debris or bathymetric features within the sediment cap boundary.
- Bathymetric surveying shall be conducted using a real-time kinematic (RTK) DGPS. The RTK-DGPS shall be able to provide horizontal positioning accuracy to within 3 feet and vertical positioning accuracy to within 2 inches.
- Horizontal location observations shall compensate for errors, geodetic corrections, and atmospheric variations. Water surface observations obtained by RTK-DGPS shall be checked against established staff gauges.
- At least five leadline soundings shall be conducted during each survey to confirm that the soundings meet the water depth accuracy requirements established for this project.

The sounding equipment that shall be utilized is as specified below and shall be capable of producing high-resolution, permanent records accurately depicting bottom profiles.

- A single-beam, dual frequency echosounder system shall be used to obtain soundings in water depths ranging from 1 to 10 feet.
- A multi-beam, single frequency echosounder system shall be used to obtain soundings in water depths greater than 10 feet.
- Sounding and survey lines shall be generally perpendicular to the shoreline and shall intersect the baseline at intervals of no greater than 25 feet.
- All bathymetric and verification surveys shall result in a grid spacing of no greater than 5 feet in water deeper than -8 feet NAVD88.
- Verification surveys (i.e., soundings) shall cover intervals of no greater than one foot along the survey grid lines.
- Surveys in shallow water (-8 feet NAVD88 and higher) shall use a survey grid spacing of 25 feet with data points collected every 5 feet along each line at a minimum.
- The survey grid shall extend a minimum of 50 feet beyond the capping area or finished edge, as applicable.
- If multiple surveys are conducted, subsequent surveys shall not deviate more than 20 percent to the left or right from the initial survey grid lines.
- For each survey grid line, indicate in the field notes each line’s location, date and time, tidal information, and river stage.

Topographic surveying methods may also be required to generate bathymetric survey data in shallow water areas and to provide verification of bathymetric survey data.

These activities require the use of a vessel, RTK-DGPS, and sidescan sonar survey and multibeam sonar survey equipment. Subcontractor will be required to provide all appropriate equipment for the sidescan and multibeam sonar survey. An operator (provided by Subcontractor), using RTK-DGPS survey equipment, will navigate to the survey area and complete sweeps of the survey area.

The selected Subcontractor will submit one bathymetry image of the Site sediment cap. Bathymetry image deliverable requirements are as follows:

- Horizontal datum survey: North American Datum of 1983 – 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
- Vertical datum for survey: NAVD88.
- Submit image within 14 calendar days after completion of the field activities for review and approval. Images documenting all survey items shall be provided in both hard copy and electronic formats.
- AutoCAD (.dwg), ASCII text files, shape files (.shp), and associated metadata (.xml) files for the topographic/bathymetric surface generated shall be submitted on a CD or DVD. Submitted files shall contain a listing of all survey points including description, northing, easting, and elevation.
- Electronic files shall be compatible with AutoCAD 2005 or higher. Within AutoCAD, entities and points shall be contained in layers pertinent to the objects being surveyed.
- The AutoCAD file shall have a separate layer for a border and title block. At a minimum, title blocks shall contain the following: name of the Consultant; name of the surveying firm that performed the survey (Subcontractor) and prepared the drawing; the title of the project; the date of preparation; and the subject matter illustrated.
- The hard copy of the Site bathymetry image shall be color-plotted on 24-inch by 36-inch sheets (D-size) using “matchline” techniques (as necessary). Bar scales, north arrow, color-coded legend, and title blocks shall be shown on all drawings.
- A “Notes” layer shall be included. The notes layer shall identify the dates of the survey, control points and benchmarks used, software and equipment information, tidal correction, and any other information that the surveyor deems pertinent.

Differencing images shall be produced to compare the multibeam sonar high-resolution bathymetry to previous multibeam sonar surveys to produce differencing images illustrating deepening or shoaling within the sediment cap boundary. The difference analysis shall be conducted between the new survey and previous bathymetric surveys to determine what changes have occurred in the surface of the river bottom. Up to three differencing images will be produced. Previous bathymetric results will be provided to allow direct comparison of data between survey events. Bathymetric differencing image deliverable requirements are as follows:

- Horizontal datum survey: NAD83/91, SPCS, Oregon North Zone. Units: International Feet.
- Vertical datum for survey: NAVD88.
- Submit differencing images within 21 calendar days after completion of the work for review and approval. Images documenting all survey items shall be provided in both hard copy and electronic formats.

- AutoCAD (.dwg), ASCII text files, shape files (.shp), and associated metadata (.xml) files for all topographic/bathymetric surfaces generated shall be submitted on a CD or DVD. Submitted files shall contain a listing of all survey points including description, northing, easting, and elevation.
- Electronic files shall be compatible with AutoCAD 2005 or higher. Within AutoCAD, entities and points shall be contained in layers pertinent to the objects being surveyed.

8.0 DIVE TEAM INSPECTIONS OF SEDIMENT CAP SUBMERGED AREAS

Diver inspections may be conducted upon review of side-scan sonar and multibeam bathymetric differencing images to investigate potential anomaly areas highlighted in survey images (see previous section) or to assess anomalies identified from shore during site inspections. Past inspections have included both targeted inspections of areas showing a change in elevation, as well as sampling along transects to provide general information regarding the sediment cap armor thickness and condition.

Diver inspection tasks included obtaining cores, mapping sediment cap material boundaries with buoys, measuring the thickness of sand and rock armor layers, examining the condition of sediment cap material interfaces, checking submerged objects to determine their impact on the integrity of the sediment cap, and inspecting apparent shoaling and erosion areas. Dive inspections should be documented using video recordings of observations, as well as notes collected in a field logbook.

These activities require the use of vessels, divers, video recording equipment, a field hydrographer equipped with Hypack® software (or similar) and RTK-DGPS to provide location data during the diver inspections, and underwater breathing and protective equipment to inspect potential anomaly areas at underwater depths up to 45 feet. RTK-DGPS horizontal positioning accuracy must be to within 3 feet and vertical positioning accuracy to within 1.6 inches. An operator using GPS will navigate to predetermined inspection locations.

If deficiencies in the sediment cap are identified in the course of dive inspections, DEQ may initiate corrective action, potentially including addition of sand and/or rock armor.

9.0 GROUNDWATER AND NAPL LEVEL MONITORING

Groundwater level monitoring is conducted both manually and using automated pressure transducers. NAPL levels and thicknesses are monitored in June and October during the low-tide monitoring events. The O&M Plan requires manual water levels be collected semi-annually during low tide conditions. Transducer water levels are collected from select wells continuously in half-hour increments and the data is downloaded semi-annually during the low-tide monitoring events and in January during winter transducer maintenance. The measured groundwater elevations will be used to prepare a shallow groundwater elevation contour map each event that will be included in the annual O&M report. Based on the transducer water levels, plots of groundwater level verses time will be prepared for shallow and deep wells each event and included in the annual O&M report. The following section outlines a procedure for collecting manual groundwater levels and downloading transducer data. Information in this section is further discussed in Chapter 9 of the O&M Plan (Appendix B).

9.1 Manual Groundwater Level Measurement

Manual groundwater level measurements will be performed during the low tide monitoring events, typically in June and October. Tide predictions for the Willamette River can be obtained from the National Oceanic and Atmospheric Administration (NOAA) website for the Morrison Bridge Station, number 9439221, or at the following link:

https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=9439221

Water levels will be measured at all wells over a sampling period that targets the daily low-tide portion of the day. Three field technicians will be used to measure water levels at the 73 wells (see Figure 8.1) in a relatively short timeframe by dividing the wells into three groups (one technician per well group) and measuring the water levels simultaneously. Tables 8.1 through 8.3 illustrate how the wells are currently divided into three groups. A NAPL/water interface probe will be used at wells that have recently shown the potential to contain NAPL. The remaining wells will be measured using an electronic water level probe. Depth to water will be measured from the north side of the top of inner casing (TOIC) at each well. Well construction details and copies of monitoring well logs are provided in Appendix K.

The presence of NAPL will be evaluated when measuring depth to water (DTW) at each well. For water levels measured with an electronic water level probe, the sensor will be lowered until a tone is produced indicating water is present and the DTW will be recorded in the field logbook or data form. Dense non-aqueous phase liquid (DNAPL) will be measured by lowering the electronic water level probe through the water until the tone stops or until the sensor hits bottom. If the tone stops, the sensor has hit DNAPL, and the depth to DNAPL will be recorded in the field logbook or data form; if the sensor hits the bottom of the well, the electronic water level probe will be reeled up and inspected for visual signs of DNAPL that may not have been detected by the instrument. For wells measured with the NAPL/water interface probe, the probe will be lowered until the tone indicates light non-aqueous phase liquid (LNAPL). The NAPL/water interface probe will then be lowered further until the tone indicates water and subsequently lowered further until the tone indicates DNAPL. LNAPL, water, and DNAPL levels will be recorded in the field logbook or data form. The NAPL/water interface probe will be decontaminated between wells using an Alconox®, tap water, and deionized water triple rinse process. The electronic water level indicator will be rinsed with DI water in between wells as it is being used on the wells that have been determined to have either very low or non-detect concentrations of Site constituents through groundwater sampling. Field monitoring results will be recorded on Tables 8.1 through 8.3.

The recorded data will be put into a spreadsheet for incorporation into the annual report. Table 8.4 provides an example of information to be included in the semi-annual spreadsheet. Necessary correction factors for the presence of LNAPL and electronic water level versus NAPL/water interface probes will be included. The spreadsheet will be used to calculate groundwater elevations in the NAVD88 datum based on the DTW readings collected in the field and the TOIC elevation at each well. The following tables and figures will be produced from using the manually measured groundwater elevations:

- Table 8.4 with the depths to water, LNAPL, DNAPL, groundwater and NAPL elevations, and TOIC;
- A groundwater contour map produced from shallow well water levels in NAVD88; and

- Figure 8.2 is an example of a site groundwater contour map. Each well TOIC elevation can be found in Table 8.4.

9.2 Transducer Groundwater Level Measurement

Groundwater levels are monitored using Instrumentation Northwest, Inc. smart sensor automated pressure transducers in select groundwater monitoring wells. The majority of these wells (currently 11) are located along the riverfront portion of the barrier wall. These include the paired shallow and deep wells in the interior/exterior well clusters: MW-36/MW-37 and MW-44/ MW-45. Transducers are also installed in the interior well EW-1s and in the shallow interior/exterior well pair MW-52s/MW-53s along the upland edge of the barrier wall. Data is downloaded each event from the automated pressure transducers using a computer equipped with Aqua4Plus software. Currently, the transducer data are used to produce groundwater-level figures for paired wells to evaluate horizontal and vertical groundwater gradients. The following sections provide information regarding transducer installation, data downloads, and data processing procedures.

9.2.1 Installation of Transducers

Transducers currently in use at the Site were installed in March 2006, June 2015, and February 2016. In 2017, all transducers from 2006 will be replaced with non-vented automated pressure transducers. An automated barometric pressure transducer has been installed at the Site to correct transducer data for barometric pressure. The following procedures are used when installing new transducers or reinstalling transducers after maintenance or factory calibration:

1. Use previous water levels for each well to determine the depth from TOIC at which the transducer should be installed. Place the transducers deep enough in the well that the water level will not drop below the transducer and shallow enough that the maximum pressure of the transducer will not be reached. The maximum pressure (pounds per square inch [psi]) rating and depth placement for each transducer is provided in Table 8.5, updated in January 2016.
2. Use a water level meter tape to measure and mark on the cable housing the depth at which the transducer is to be installed ($\text{Transducer}_{\text{depth}}$). Lower the transducer into the well until the mark on the cable housing is aligned with the TOIC. Secure the transducer with a cable grip to prevent slipping. Marking the cable housing aids in the initial placement of the transducer and identifying if the transducer slips lower in the well while installed.
3. Collect a manual depth to water ($\text{DTW}_{\text{manual}}$) using a water level meter.
4. Using the communication cable, connect the computer to the transducer and run the Aqua4Plus program. Click the "*Sensor Window* icon to connect to the sensor (i.e., transducer) and a pop-up window will appear.
5. From the Configure menu, choose Sensor Clock, and select the Set from System Clock button.
6. From the Configure menu, choose Sensor Description, and name the transducer after the well ID. Click the OK button.

7. From the Options menu, choose Display Units, and confirm that the pressure units are set to Ft H2O (top, left drop down menu).
8. From the Configure menu, choose Field Calibration. Ensure that the Pressure channel is selected and that the Calculate as depth to water box is not checked. Note: transducer cannot be field calibrated if a session is in progress.
   a) For the first point calibration, have the transducer at ground surface to read atmospheric pressure. Type in the barometric pressure reading collected from the onsite barometric transducer in the Ref Ft H2O text box. Click Measure and a pop-up window will appear displaying the pressure readings. Click Accept in the pop-up window.
   b) For the second point calibration, place the transducer in the well. Using the $\mathrm{DTW}_{\mathrm{manual}}$ and $\mathrm{Transducer}_{\mathrm{depth}}$ measurements, calculate the feet of water above the transducer ($\mathrm{Transducer}_{\mathrm{depth}}$ - $\mathrm{DTW}_{\mathrm{manual}}$) and enter this value in the Ref Ft H2O text box. Click Measure and a pop-up window will appear displaying the pressure readings. Click Accept in the pop-up window.
9. Start a session as described in Step 4 of Section 9.2.2. Currently, transducers are programmed to collect data every 15 minutes.

9.2.2 Downloading Transducer Data

Download transducers at the end of each event. When downloading transducers, record the time, well ID, $\mathrm{DTW}_{\mathrm{manual}}$, and transducer depth to water ($\mathrm{DTW}_{\mathrm{transducer}}$) in the field form provided as Table 8.6. As needed, record other information regarding transducers such as if it has slipped in the well, if batteries are low, or if the desiccate needs to be replaced. Follow the subsequent procedure when downloading transducers:

1. Record the current $\mathrm{DTW}_{\mathrm{manual}}$.
2. Using the communication cable, connect the computer to the transducer, and start the Aqua4Plus program. Click the Sensor Window icon to connect to the sensor (i.e., transducer) and a pop-up window will appear.
3. To view real-time data, click the Single to view one record. Record the real-time pressure reading which measures the feet of water above the transducer and the barometric pressure. Using the $\mathrm{DTW}_{\mathrm{manual}}$ and the barometric pressure reading from the onsite barometric pressure transducer, calculate the feet of water and barometric pressure the transducer should be reading; compare against the real-time pressure reading which should be relatively close. If these two differ greatly, it is an indication the transducer has malfunctioned during the recording period or that the transducer has moved vertically within the well.
4. To upload the data, first stop the session in progress by clicking the Stop button. Then, highlight the session and click the Upload Session icon to save the data on the computer. Rename the file if desired, then click the Save button and then the Start button to initiate the uploading of the data from the transducer. Once the upload is complete:
   a. Choose Done and the data will be saved in the .a4d file format.

   b. Choose View to save the data in the .a4d file format and export the data into a .csv file format (Excel compatible). After clicking View, a pop-up window will appear displaying the data. With this window open, click the Export to CSV or Excel File icon.

5. After confirming the data has been saved on the computer, remove the completed session from the transducer by right-clicking on the session and select Erase All Sessions.
6. Reprogram the transducer with a new session. From the Session menu, choose New. Name the session, set the interval of readings (i.e., every 15 minutes), and set the number of records. To ensure that the number of records is large enough to run for the duration between events, confirm the number of days is enough under Phase Duration. In the upper left corner, check the Delayed Start box and set the start time to the next closest half-hour increment. The interval of readings and number of records programming can be saved in a profile and used repeatedly rather than entering new for each transducer. If a profile has been created, access it while in the Session window by choosing Open and opening the desired profile. Select Start once the session setup is complete. Click Start in the main sensor window.

9.2.3 Data Processing

To produce groundwater level figures, river level and precipitation data needs to be downloaded and pressure transducer data needs to be processed. The following procedures need to be performed to produce groundwater level figures such as the example one provided as Figure 8.3:

1. For data collected with absolute pressure transducers, the data needs to be corrected for barometric pressure. Absolute pressure transducers are not vented; therefore, it captures both water level pressure and atmospheric pressure. The absolute pressure transducer data is corrected by subtracting the barometric pressure transducer data to determine the water level pressure. This water level pressure (or feet of water above the transducer) is then converted to groundwater elevation using the TOIC elevation.
2. Data collected with gauged pressure transducer is vented and therefore does not need to be corrected for barometric pressure. The data is feet of water above the transducer and needs to be converted to groundwater elevations using the TOIC elevation.
3. Precipitation data can be obtained from: http://or.water.usgs.gov/non-usgs/bes/astor.rain
4. Willamette River level data at the Morrison Bridge station (USGS 14211720) can be obtained from: http://or.water.usgs.gov/cgi-bin/grapher/graph_setup.pl?basin_id=will&site_id=14211720#step2

Convert river level height from this website (presented in Portland River Datum) to NAVD88 by adding 5.001 feet.

10.0 GROUNDWATER SAP

This section describes the techniques used to sample groundwater from wells at the Site. Groundwater samples will be collected from the monitoring well downgradient of the infiltration pond (monitoring well MW-59s) every five years and select Site-wide wells every 10 years starting in calendar year 2020. The existing Site-well locations are displayed in Figure 9.1.

The following sections describe the specific activities involved in collecting groundwater samples, including sampling methodology, sample analysis, decontamination procedures, QA/QC samples, sample analytical and handling procedures, calibration procedures and frequency, and IDW. This section is further discussed in Section 9 of the O&M Plan.

10.1 Sampling Methodology

Groundwater sampling methods depend on whether NAPL is present in the well that is being sampled. Due to the potential for NAPL migration, the exact number of non-NAPL, DNAPL, and LNAPL wells to sample cannot be specified. Historically, eight wells have contained measurable amounts of LNAPL, and seven wells have contained DNAPL. Prior to collecting a groundwater sample, a NAPL/water interface probe will be used to determine presence and, if applicable, thickness of NAPL as well as the depth to water. Well sampling will be completed in order from least contaminated to most contaminated, to the extent practical, based on historical sampling results. The suggested sampling order is summarized in Table 9.1. This order should be maintained even when only a few wells are sampled. Table 9.2 summarizes the well depth, measuring point, transducer status, monitoring rationale, and whether it was sampled for water quality in 2010 and 2020. The procedures for sampling wells without NAPL, wells with DNAPL, and wells with LNAPL are summarized below. All sampling procedures are in general accordance with EPA's SOP for Low-Stress (Low-Flow)/Minimal Drawdown Ground-Water Sample Collection.

10.1.1 Wells Without NAPL

Groundwater samples will be collected from wells without NAPL using a low-flow submersible pump and disposable polyethylene tubing. The submersible pump will be lowered down the well until the pump intake is located at the screened interval midpoint. A flow-through cell with a water-quality meter will then be attached. A water level will be measured in the well with an electronic water level probe or NAPL/water interface probe prior to purging. Purging will begin at no more than 0.5 liters per minute. The rate may be increased so long as drawdown in the well does not exceed 0.33 feet. During purging, the water-quality meter and flow-through cell will be used to monitor groundwater pH, specific electrical conductance (Eh), temperature, oxidation-reduction potential (ORP), dissolved oxygen (DO) turbidity, and salinity. Water quality parameters including pH, Eh, ORP, DO, salinity, and turbidity will be recorded in intervals every 3 to 5 minutes for the remainder of purging and documented on a Groundwater Sampling Field Form, an example is provided in Table 9.3. After pH, Eh, ORP, DO, salinity, and turbidity have stabilized sample collection will proceed. The water quality parameters are considered to be stable when the change between successive readings is less than the following:

- pH: +/- 0.1 pH units
- Eh: +/- 3% milliSiemens per centimeter (mS/cm)
- ORP: +/- 10 millivolts
- Turbidity: +/- 10 nephelometric turbidity units (NTUs)
- DO: +/- 0.3 milligrams per liter (mg/L)
- Salinity: +/- 10% salinity percent

After parameters have stabilized, the pumping rate will be decreased to minimize volatilization during sample collection. Samples will be collected directly into sample containers from the discharge port prior to the flow through cell and water-quality meter.

If water-quality parameters do not stabilize within 30 minutes of purging, then collect the sample after three to six casing volumes have been purged from the well and make a note on the Groundwater Sampling Field Form.

Samples will be placed on ice in a cooler for transport to the contract laboratory as described in Section 10.5.3. Purge water will be transferred to the 55-gallon steel drums for subsequent off-site disposal. Disposal procedures are described in Section 10.7. Decontaminate sampling equipment and dispose of dedicated tubing. Decontamination procedures are described in Section 10.3.

10.1.2 Wells containing DNAPL

Wells containing DNAPL will be purged and sampled using the same procedures as used for wells that do not contain NAPL (Section 10.1.1), with the exception of pump placement. In DNAPL wells, the pump will be placed a minimum of 4 feet above the top of DNAPL. The depth to the top of DNAPL will be measured using a NAPL/water interface probe. If DNAPL is observed in purge water, purging will be stopped, sampling equipment will be decontaminated as described in Section 10.3, and sufficient time will be given to allow DNAPL in the well to settle. The purging process will be resumed utilizing the submersible pump (as described in Section 10.1.3) until the purge criteria have been successfully met. Sample collection will be completed using the submersible pump once purging is complete, as described in Section 10.1.1.

10.1.3 Wells containing LNAPL

The depth to the top of LNAPL will be measured using a NAPL/water interface probe prior to sampling. If LNAPL is encountered a sealed length of PVC pipe will be lowered into the well to create a pathway through the LNAPL. The PVC pipe will be lowered at least 18 inches below the LNAPL/water interface. Once the pipe is emplaced, the submersible pump will be lowered through the pipe, breaking the seal at the pipe bottom, and the sampling device will be placed at the appropriate depth for purging. Purging and sampling will be conducted as described in Section 10.1.1. If a sheen or LNAPL is observed in purge water, purging will be stopped. The LNAPL and water will be allowed to re-equilibrate in the well, before purging and/or sampling is continued. If LNAPL continues to be observed during purging and drawdown requirements are being satisfied, the sample will be collected because the LNAPL is likely coming from the formation.

10.2 Sample Analysis

The groundwater samples will be submitted to the DEQ laboratory for analysis of the following constituents:

- PAHs and PCP by EPA Method 8270-SIM; and
- Total metals including arsenic, chromium, copper, and zinc by EPA 6020.

Sample containers, preservation requirements, holding times, required MDLs, and QA/QC samples are presented in Table 9.4.

10.3 Decontamination Procedures

Prior to the commencement of purging and sampling activities at each well, decontaminate all sampling equipment which may contact groundwater through a two-step Alconox®/deionized water rinse.

The submersible pump will be decontaminated by submersing it in a bucket of Alconox® solution and operating the pump at the maximum flow rate for no less than 2 minutes. The pump will be transferred to a bucket filled with deionized water and operated again at the maximum flow rate for no less than 1 minute. Tubing will be replaced between sampling of each well.

For wells with LNAPL, the section of pipe acting as a pathway that contacted groundwater or LNAPL will be cut off. PVC pipe and disposable tubing will be disposed of as hazardous waste.

10.4 Quality Assurance / Quality Control Samples

QA/QC samples will be collected to ensure that the project QA objectives are met. QA/QC samples include field duplicates, MS/MSD samples, and rinsate blanks.

Collect and submit one field duplicate sample for every group of 20 samples (or fewer) submitted to the laboratory for analysis.

MS samples reveal information regarding sample preparation and analytical methodology. They can provide information regarding sample homogeneity, the extent of matrix bias, or interference on analyte recovery; they also can indicate the accuracy of the method. Collect and submit one MS/MSD sample for every group of 20 samples (or fewer) submitted to the laboratory for analysis.

Rinsate blanks confirm whether equipment used during sampling (i.e., pump) was sufficiently decontaminated in between samples. Collect one equipment rinsate blanks for every group of 10 samples that uses equipment requiring decontamination. After the pump has been decontaminated, pass deionized water through the pump and into sample containers.

10.5 Sample Analytical and Handling Procedures

This section describes procedures for sample identification and chain of custody that should be used for the field activities. The purpose of these procedures is to ensure the quality of samples is maintained during collection, transportation, storage, and analysis.

Sample analytical requirements are summarized in Tables 9.3. Included are the anticipated analytical parameters, the required analytical MDLs, the required sample containers, the sample preservation methods, the maximum sample holding times, the numbers and types of QA/QC samples required.

10.5.1 Sample Identification and Documentation

Sample documentation for custody purposes includes:

- Sample identification numbers;
- Sample labels;
- Custody seals; and
- Chain of custody records.

Sample identification and documentation are discussed below.

10.5.1.1 Sample Identification

Assign each sample with a unique number describing the sample location. Record the sample number on a sample label, and affix this to the sample jar. Use sample location numbers in the format listed in Table 9.5 to aid in data management. For example, use MW36s-041910 to describe a sample collected from well MW-36s on April 19, 2010. The letters and numerals in the above example represent the following:

- MW = Monitoring Well/EW = Extraction Well/ PW = Production Well;
- 36 = Well number;
- s/i/d = Shallow/Intermediate/Deep well; and
- 041910 = Month, Day, and Year of Collection.

Identify field duplicate samples with a "dup" at the end of the sample name (e.g., MW36s-041810dup in the example above). Identify MS/MSD samples with a "MS/MSD" at the end of the sample name (e.g., MW36s-041910MS/MSD in the example above). Identify rinsate blanks by adding an "R" to the end of the previously sampled well. This is to indicate after which well was sampled the rinsate blank was collected.

10.5.1.2 Sample Labels

Use sample labels to identify samples collected in the field. Place the sample labels on bottles so as not to obscure any QA/QC lot numbers and print sample information legibly. Information on the sample label should be sufficient to enable cross-reference with the project logbook. For chain of custody purposes, subject all QA/QC samples to the same custodial procedures and documentation as site samples.

Fill out the sample labels using waterproof ink, attached them firmly to the sample containers, and protect the labels with clear tape. At a minimum, the sample labels should contain the following information:

- Sample identification;
- Date and time of collection; and
- Client.

Additional information may include:

- pH and preservation;
- Requested analysis; and
- Sampling personnel.

10.5.1.3 Custody Seals

Custody seals are preprinted, adhesive-back seals with security slots designed to break if the seals are disturbed. If samples are to be shipped to the laboratory by a third party, seal sample shipping containers (e.g., coolers, drums, and cardboard boxes, as appropriate) in as many places as necessary to ensure security. Shipping seals will be signed and dated before use. Place clear strapping tape over the seals to ensure they are not broken accidentally during shipment. Upon shipment receipt at the laboratory, the custodian should check (and certify by completing the package receipt log) that seals on shipping containers are intact. Sample deliveries to the laboratory by field personnel do not require the use of custody seals.

10.5.1.4 Chain of Custody Forms

Chain of custody forms should be completed fully by the field technician responsible for sample shipment to the analytical laboratory. At a minimum, the chain of custody forms should include the following information:

- Name and company or organization of person collecting the samples;
- Date samples were collected;
- Type of sample collected (composite or grab);
- Location of sampling station (using the sample code system described in Table 9.5);
- Numbers and types of containers shipped;
- Analysis requested; and
- Signature of the person relinquishing samples to the transporter, with the date and time of transfer noted, and signature of the designated sample custodian at the receiving facility.

If samples require rapid laboratory turnaround, the person completing the chain of custody record should note these or similar requirements in the remarks section of the custody record.

The relinquishing individual should record all shipping data (e.g., airbill number, organization, time, and date) on the original custody record, which should be transported with the samples to the laboratory and be retained in the laboratory’s file. Original and duplicate custody records with the airbill or delivery note constitute a complete custody record.

10.5.1.5 Field Logbooks and Data Forms

Field logbooks (or daily logs) and data forms are necessary to document daily activities and observations. Documentation should be sufficient to enable participants to accurately and objectively reconstruct events that occurred during the project. Keep all daily logs in a bound notebook containing numbered pages. Date, sign, and make all entries in waterproof ink. No pages of the bound notebook should be removed for any reason.

If corrections to field notes are necessary, they should be made by drawing a single line through the original entry (so the original entry is still legible) and writing the corrected entry alongside it. The correction should be initialed and dated. Corrected errors may require a footnote explaining the correction.

10.5.1.6 Photographs

Photographs will be taken as directed by the team leader. The following information concerning photographs should be noted in the project or task logbook:

- Date, time, and location where the photograph was taken;
- Weather conditions;
- Description of photograph;
- Reason(s) the photograph was taken;
- Sequential number of the photograph; and
- Compass direction.

Digital photographs will be downloaded into a photo log file and kept with the project files.

10.5.2 Custody Procedures

The main objective of chain of custody procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses.

A sample is in custody if it is:

- In someone's physical possession;
- In someone's view;
- In a locked container; or
- Kept in a secured area restricted to authorized personnel.

10.5.2.1 Field Custody Procedures

Use the following guidance to ensure proper control of samples during fieldwork:

- As few people as possible should handle samples.
- The sample collector is responsible for the care and custody of samples until they are transferred to another person or dispatched properly under chain of custody rules.
- The sample collector should record sample data in the field logbook.
- The site team leader should determine whether proper custody procedures were followed during the fieldwork and decide whether additional samples are required.

When transferring custody (i.e., releasing samples to a shipping agent), the following guidelines apply.

- The coolers in which the samples are packed should be sealed and accompanied by two chain of custody records. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain of custody record. This record documents sample custody transfer.
- Samples should be dispatched to the laboratory for analysis with separate chain of custody records accompanying each shipment. The shipment method, courier name, and other pertinent information should be entered in the chain of custody record.
- All shipments should be accompanied by chain of custody records identifying their contents. The original record should accompany the shipment. The other copies should be distributed appropriately to the site team leader and site manager.
- If sent by common carrier, a bill of lading should be used. Freight bills and bills of lading should be retained as part of the permanent documentation.

10.5.2.2 Laboratory Custody Procedures

A designated sample custodian at the laboratory should accept custody of the shipped samples from the carrier and enter preliminary information regarding the package into a package or sample receipt log, including the initials of the person delivering the package and the status of the custody seals on the coolers (i.e., broken versus unbroken). The custodian responsible for sample login should open the package, check the contents, and verify the information on the chain of custody agrees with the samples received. Pertinent information regarding shipment, pickup, and courier should be entered into the chain of custody record. The custodian also should document the relative temperature of the cooler and the general condition of the sample containers. The custodian then should enter the project name and sample identification information into the laboratory's sample management system.

The custodian responsible for sample login should complete the package or sample receipt log and note any discrepancy or improper preservation. Each sample should be assigned a unique laboratory identification number, and a label should be generated for each container associated with that sample. The labels allow easy tracking of samples within the laboratory every time the samples are taken from or returned to sample management.

Internal custody procedures for transfer of samples within the laboratory should be followed in accordance with the guidelines presented herein. The laboratory should maintain records to clearly document all internal transactions and the ultimate fate (consumption or destruction) of the samples.

10.5.3 Sample Handling, Packaging, and Shipping

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of the samples but also prevents any detrimental unnecessary exposure to sample handlers because of the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the DOT in 49 Code of Federal Regulations 171–177 and/or the IATA Regulations for Dangerous Goods.

10.5.3.1 Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. Follow the subsequent sample packaging requirements:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers.
- Sample bottles may be placed in a plastic bag to minimize leakage in case a bottle breaks during shipment.
- Cool samples by double bagging ice and placing the sealed ice-filled bags around the sample containers. Ice is not to be used as a substitute for packing materials.
- Any remaining space in the sample-shipping container should be filled with inert packing material. Under no circumstances should material such as sawdust, newspaper, or sand be used.
- The custody record must be sealed in a plastic bag and placed in the shipping container. Custody seals must be affixed to the cooler that contains the samples.

10.5.3.2 Shipping Containers

The appropriate shipping container should be determined by DOT or IATA regulations for the anticipated concentrations of suspected contaminants. Because the samples at the Site may contain several contaminants, several different packaging schemes may apply. The most stringent packaging scheme should be chosen.

Shipping containers are to be custody-sealed for shipment if samples are being shipped by commercial shippers. Affix the custody seals so that the container cannot be opened without breaking the seal.

Field personnel should make arrangements for transportation of samples to the laboratory. If samples are being shipped by a third party, field personnel should inform the laboratory of the expected time of arrival of the sample shipment and to advise the laboratory of any time constraints on sample analysis.

10.5.3.3 Shipping Container Labeling

Suggested guidelines for marking and labeling shipping containers are presented below. These guidelines apply when samples are shipped to the laboratory by a third-party shipping company (e.g., Federal Express). In these cases, DOT or IATA regulations should be consulted for appropriate marking and labeling requirements:

- Use abbreviations only where specified.
- The words This End Up or This Side Up must be printed clearly on the top of the shipping container. Upward-pointing arrows should be placed on the sides of the shipping container.
- After a shipping container is sealed, two chain of custody seals should be placed on the container, one on the front and one on the back. If the shipping container is a drum, one seal should be placed on each side (opposite each other) of the drum. To protect the seals from accidental damage, clear strapping tape should be placed over them.

10.6 Calibration Procedures and Frequency

All instruments will be operated, calibrated, and maintained in accordance with the manufacturer's guidelines and recommendations as well as on criteria set forth in the applicable methodology references during sampling and analysis. Documentation will be kept of all routine and special maintenance and calibration information in an appropriate logbook or reference file and have the information available upon request.

10.7 Investigation-Derived Waste

IDW for the planned field activities is expected to include disposable polyethylene tubing, purge water, decontamination water, and PPE. Place water in 55-gallon drums and store on site for subsequent disposal. Examine disposable sampling equipment and PPE for the presence of NAPL. If no NAPL is observed, discard the item as non-hazardous waste (i.e., in existing wrangler totes). If NAPL is observed, discard items with visible NAPL contamination in on-site hazardous waste totes. An IDW Management Plan to document IDW handling and disposal procedures and is included as Appendix K.

11.0 DATA AND EQUIPMENT MANAGEMENT

This section identifies the types of data generated during O&M activities at the site, how the data are stored, and how they are used. In addition, this section discusses management of equipment used for sampling and monitoring activities. Data are collected by DEQ, their contractor and other subcontractors such as surveyors and divers. A Data Management Plan located in Appendix L was developed in 2022 to aid with collection and storage of data related to historical and future site management activities.

11.1 Soil and Sediment Cap Inspections and Meetings

Data generated as a result of the soil and sediment cap inspections include two observation sheets containing notes from the follow-up meeting, meeting minutes, and visitor sign-in sheets. After performing the site inspections, the O&M subcontractor immediately e-mails the observation sheets to the DEQ contractor for review. The inspection sheets will be used to prepare the agenda for the status meeting. Following the status meeting, copies of the observation sheets containing follow-up notes are again e-mailed to the DEQ contractor and stored in the project files. At the end of the year, the observation sheets are compiled in a PDF and included with the O&M annual report. The visitor sign-in sheets are entered into an electronic site activity log and included with the O&M annual report.

11.2 Surface Water, Inter-armoring Water, Sub-armoring Water Sampling

Data generated from the surface water/inter-armoring/sub-armoring sampling event include water sample analytical data, sample location coordinates, and field observations, (e.g., field water quality parameters, video of the sampling that is conducted by divers, photographs, and Willamette River stage, discharge rate, and velocity).

11.2.1 *Water Sample Analytical Data*

The following handling procedure will be used to ensure figures and tables are properly produced and analytical data are properly stored. The analytical laboratory will comply with the QC procedures mentioned in their SOPs. Laboratory personnel will perform all of the calculations necessary to convert the raw results and present the final surface water and porewater results in their analytical report. Tables will be provided in Microsoft Excel format, so that the Consultant can format and utilize the data to prepare report tables and figures. Excel files of both the raw data and the final water calculations will be kept in DEQ's project files. Tables with analytical results by media will be provided in the Annual reports and/or associated 5-Year Review Report. A statistical analysis of analytical data in the draft tables will be performed that includes number of samples, detection frequency, maximum concentration, sample ID of maximum concentration, mean concentration, data distribution, 95 percent upper confidence limit on the mean concentration, and area-weighted average. Analytical data will be summed in a manner similar to how the EPA handles data summations for work in the Portland Harbor Superfund Site as detailed in Appendix L and the EPA's Program Data Management Plan for the Portland Harbor Superfund site dated 2021. Rules for summations are specified in the Data Management Plan and in general, all detected analyte concentrations and one half the detection limit for non-detect values are used for the summation. Additionally, there are analyte group specific summation rules which are also presented in the Data Management Plan.

The DEQ Contractor maintains electronic tables, GIS figures, and statistical analysis within its current data management system architecture as described in the Data Management Plan. Simple electronic tables, GIS figures, and statistical analyses will be maintained in the DEQ project file. Include hard copies and PDFs of the GIS figures, analytical tables, and statistical analysis summary tables with the Surface Water, Inter-Armoring Water, and Sub-Armoring Water Quality Assessment submitted as part of the O&M annual report.

11.2.2 *Sample Location Coordinates*

Use the following data handling procedure to ensure data are properly included in all necessary documents and properly stored. The personnel responsible for maintenance of the site-wide record drawings should review the data to determine if the information is a remedial feature and should be added to the record drawings. This would only be for features such as repairs to the sediment cap, soil cap, well replacements or alternations, or barrier wall maintenance. Normal monitoring associated with long-term monitoring as either included in the Site database, or electronically available in excel tables.

11.2.3 *Field Observations*

While performing sampling, divers should make a video documenting sample locations, sediment cap conditions in the area, and installation of sampling devices. This video should be delivered to the DEQ contractor, and copies will be made and included with each of the O&M annual reports.

While in the field, document sampling procedures using photographs, and record field water quality parameters (if applicable) in the field logbook or on field forms. This information is included in the O&M

annual report as part of the laboratory results summary tables. This information will be stored in the site files and/or electronically in the Consultant's project files for use as needed.

11.3 Organophilic Clay Sampling

Data generated as a result of OC sampling include analytical data, sample location coordinates, and field observations (e.g., core logs and photographs).

11.3.1 Analytical Data

Chemical analysis of the surface water samples will be completed by the DEQ contract laboratory, currently Pace Analytical National of Mt. Juliet, Tennessee. Laboratory QA/QC will be maintained through the use of standard EPA methods and other accepted methods and standard analytical procedures for the target analytes. Data that falls outside of Laboratory QA/QC requirements should be flagged accordingly and noted in the laboratory report. Laboratory reports will be provided to the Consultant and reviewed for accuracy. Summary tables of the analytical data and copies of the laboratory reports will be provided in the Annual Report. Electronic Data Deliverables (EDDs) will be kept in the project files for future reference.

11.3.2 Sample Location Coordinates

Use the following data handling procedure to ensure data are properly included in all necessary documents and are properly stored. Personnel responsible for maintenance of the site-wide record drawings should review the data to determine if the information is a remedial feature and should be added to the record drawings. In the case of organophilic clay coring, the information would not be a remedial feature and therefore, will be documented in electronic excel tables and included in the O&M Annual Report.

11.3.3 Field Observations

Core logs will be constructed using observations and notes from the field; representative photographs from the sampling event will also be compiled into a photo log. Include the core logs and photo log with hard copies of the core logs in the Organophilic Clay Assessment submitted as part of the O&M annual report. Electronic copies of the core logs and photographs will be stored in the Consultant's project files. Field notebooks will be stored with the project files.

11.4 Side-scan Sonar and High-Resolution Multibeam Bathymetry

Electronic files will be integrated into the GIS and/or AutoCAD files. Images showing changes to the cap surface or features as a result of future construction or corrective action will be incorporated into the record drawing files (described in Section 12).

11.5 Dive Team Inspections of Sediment Cap Submerged Areas

Data gathered from dive team inspections include video images and field notes of observations. Field notebooks will be stored with the project files. Video will be provided on DVDs included with the O&M

annual report. Pertinent data will be summarized in a memo that will be submitted with the O&M annual report.

11.6 Fluid Level Monitoring and NAPL Thickness

Data generated as a result of fluid level monitoring include groundwater levels at each well, depth to LNAPL and/or DNAPL (if present), and transducer readings in half-hour increments. Store field sheets containing the original data in the project files; store the logbook containing transducer field notes with the personal digital assistant (PDA) used to download the transducers. Electronic data will be stored in Microsoft ™ Access.

Use the data to create the surface water elevation table and the groundwater elevation contour figures. The tables and figures listed above will be included as part of the Groundwater Performance Monitoring Assessment submitted with the O&M annual report. The electronic files of the tables and figures will be stored in the Consultant's project files.

Errors or anomalies will be assessed in the groundwater level monitoring data by developing the groundwater contour map and identifying any significant changes in groundwater flow from the previous quarter or water levels that do not correspond to surrounding wells. Vertical gradients will be compared on groundwater contour maps to vertical gradients on the transducer figures to verify that vertical gradients on the two data sources (manual and automated) are consistent.

11.7 Groundwater Sampling

Data generated as a result of the groundwater sampling event include groundwater analytical data, locational information, and field observations (e.g., field water quality parameters and photographs).

11.7.1 Groundwater Analytical Data

The following handling procedure will be used to ensure figures and tables are properly produced and the data are properly stored. Once the laboratory-certified laboratory analytical data and electronic deliverable are received, a QA memorandum evaluating the laboratory data will be prepared. Once the electronic data have been updated with the notes from the QA memorandum, the data will be added to the database and a summary table of the analytical results will be prepared and provided in the Annual Report. Field parameters will also be tabulated for inclusion in report tables. Use the database to produce GIS figures of the arsenic, chromium, PCP, and benzo(a)pyrene.

The QA memorandum, GIS figures, and analytical summary tables will be stored electronically by the Consultant in accordance with the Data Management Plan (Appendix L). Include hard copies and PDFs of the QA memorandum, GIS figures, and analytical summary tables in the Annual Report if sampling was conducted.

11.7.2 Sample Location Coordinates

Groundwater sampling location coordinates of existing wells on the site have already been entered into the record drawings and GIS database. It is not necessary to collect sample location coordinates during groundwater sampling.

11.7.3 Field Observations

Field water quality parameters will be recorded in a field logbook or on field sheets during sampling and include the parameters in the analytical summary table for each well. The field logbook and/or field sheets will be stored in the project files and the analytical summary tables on the projects drive. Field water quality parameter will be added to the Access database.

While in the field, document sampling procedures using photographs. Although this information is not included in the O&M annual report, it should be stored electronically for use as needed.

11.8 Record Drawings

See Section 12 for details pertaining to data management of the record drawings. Record Drawings are included as Appendix A.

11.9 Equipment Management

Multiple pieces of equipment have been purchased for use at the site. Table 10.1 provides a list of equipment at the Site. As new equipment is purchased, record the serial number and description in the appropriate table. If the equipment does not have a serial number, engrave the equipment with “DEQ 18004524011.” Record the equipment if it costs approximately $100 or more.

12.0 RECORD DRAWING MANAGEMENT

This section describes procedures for managing and updating the Site wide Record Drawings (i.e., “Site wide Record Drawings.dwg” AutoCAD file) as new site features are added or existing features are modified, repaired, or removed. Record Drawings are included as Appendix A.

In developing the Site wide Record Drawings, a layer system was utilized within AutoCAD. Unique layers were developed for unique site features/components and were organized using AutoCAD layer tools. For example, Upland Cap components were assigned layer names with the prefix “A_UP_” (e.g., “A_UP_Gas Vents”) and have been organized into a Layer Property Filter called “Upland Cap”. Similarly, Sediment Cap components have prefix “A_SED_” (e.g., “A_SED_Organophilic Clay Mats”) under a Layer Property Filter called “Sediment Cap”. Employing the AutoCAD layering/filtering system allows the user to easily turn on or view only those components desired on individual drawing layouts; likewise, turn off components, as needed.

To maintain an accurate and up-to-date site map, whenever features are added to or removed from the site or when modifications or repairs are made to existing site components, the changes should also be incorporated into the AutoCAD drawing file. Additionally, while making field repairs and inspections, it is important to check the accuracy of the map features and immediately make any necessary changes to the drawing file. Any survey information collected should be reviewed by the personnel responsible for updating the record drawings; they will determine if the information is a remedial feature. If the information is a remedial feature, it should be added to the record drawings, then be passed onto personnel responsible for maintaining the GIS database for addition to that database. If the information is not a remedial feature, it will be passed directly for addition to the database and use as needed.

While working in AutoCAD, all changes should be done only in Model Space (vs. Paper Space) using the existing World User Coordinate System, which is based on the NAD83, Oregon State Plane, North Zone, International Feet. Any elevation data added to the drawing should be referenced to the NAVD88. The AutoCAD operator should make sure the modified or new components are added on the appropriate layer using the established layer filter system and are of matching line type, line width, and color, as necessary. If desired, date information may also be added to the layer name to track when the change was made. For example, new riprap armoring added to the Sediment Cap on September 8, 2006, could be added on layer "A_SED_Riprap_ 09-08-06."

Each time the drawing is modified, the user should save the AutoCAD file under a new name using a date suffix convention (i.e., overwriting the existing file should be avoided). For example, if the drawing file is modified on June 26, 2007, save the drawing as "Site wide Record Drawings_06-26-07.dwg". This naming convention allows the user to maintain a historical record of the site. Note: to avoid an excessive number of drawing files, it is recommended changes made to the site over a specified period of time (i.e., semi-annually) be incorporated into the drawing at approximately the same time.

TABLES

Table 2.2
Example Site Visitation Record
McCormick & Baxter Creosoting Company
Portland, Oregon

SITE VISITOR LOG

VISITORS AND WORKERS MUST CHECK IN AND OUT

Date	Time IN	Time OUT	Name	Name of Company, Agency, or Organization	Comment (Purpose of Visit, etc.)

Table 2.3

Warning Buoy Coordinates

McCormick & Baxter Creosoting Company

Portland, Oregon

		Longitude			Latitude		
Location ID Figure 2.5	Buoy Label	Degree	Minute	Second	Degree	Minute	Second
1	Danger	-122	44	27.9115188	45	34	33.7505887
2	Danger	-122	44	34.6730244	45	34	36.3603940
3	Rocks	-122	44	41.5979124	45	34	39.0343156
4	Danger	-122	44	47.5345212	45	34	43.8265931
5	Rocks	-122	44	53.2295880	45	34	47.1865397
Coordinate projection: GCS_North_American_1983							

Table 3.1
Example Quarterly Site Inspection Meeting Summary
McCormick & Baxter Creosoting Company
Portland, Oregon

McCormick & Baxter Operational & Functional Determination Period Status Meeting Report

Friday 1/22/2016
9:00 A.M.
6900 N. Edgewater Street
Portland, OR 97203

Meeting called by:	Oregon Department of Environmental Quality (DEQ)	Type of Meeting:	Quarterly Progress Meeting
Facilitator:	Sarah Miller	Note Taker:	Phil Cordell
Attendees:	Sarah Miller	Project Officer	DEQ
	Phil Cordell	Site Manager	Hart Crowser
	Erin Hughes	Hydrogeologist	GSI

Site Status Meeting Notes

Site Walk and Inspection

The attendees completed a thorough inspection of the entire site on Friday, January 22, 2015. The next inspection is scheduled for April 2016.

Site Walk – Shoreline

The following items were inspected during both the shoreline site walk and inspection:

- Gravel overlay on ACB.
- Buoy locations.
- Stormwater discharge.
- Willamette River and Willamette Cove shoreline conditions.
- Ebullition from sediment cap.
- Shoreline vegetation repairs.

Gravel from the shoreline enhancement task (completed in October 2012) remains settled in the voids of the ACB armoring. Tidal fluctuations have distributed gravel from the top of the ACB, where it was originally applied, to where it has settled along the toe of the bank. Gravel has not settled into the mid-bank portion of the ACB armoring in areas where the slope is steeper.

The Willamette River at the time of inspection (between 9:00 AM and 11:00 AM) was between 8.10 and 8.43 feet COP (or 13.10 – 13.43 NAVD88). Low tide was at approximately 9:30 AM with a tide of approximately 8.07 feet COP (or 13.07 NAVD88). All buoys were visible.

Discharge from the outfall was estimated at 20-25 gallons per minute. The outfall is in good condition.

Approximately 7 derelict boats anchored within Willamette Cove were observed during the site walk. The river level was relatively high, so the shoreline is relatively clean and free of debris.

No ebullition was observed in the area above the granular organoclay along the Willamette River shoreline, and due to high water levels, we could not directly observe the sediment cap within Willamette Cove.

Wildlife spotted along the shoreline included Canada geese and seagulls.

Table 3.1
Example Quarterly Site Inspection Meeting Summary
McCormick & Baxter Creosoting Company
Portland, Oregon

In December 2015, shoreline repairs were completed in certain areas where soil had eroded from beneath the turf-reinforced matting (TRM) above the ACB. The repairs involved pulling up the TRM, placing new soil, and planting shrubs in areas where erosion was observed. The repairs and planted vegetation appeared to be in good condition.

Site Walk – Upland

The following items were inspected during the upland site walk and inspection:

- Site perimeter and fence, and drainage basin.
- Subsurface drainage (manholes).
- Soil cap (burrows, erosion, etc.).
- EW-1s and MW-23d area of subsidence.

The site perimeter fence was intact, with some areas of burrowing identified (small mammal sized burrows). A few large burrows (~1 foot deep) were observed along the gravel roads.

Stormwater drainage was observed by opening a manhole SDMH-B. This coupled with the discharge from the stormwater outfall indicate that the stormwater drainage system within the RCRA-style soil cap is functioning as designed.

The distance between the inner and outer casing of MW-23d was 2.94 inches, slightly greater than previous measurements, but likely a result of measuring differences (e.g., human error). The reading will be double checked on February 4, 2016.

Various small birds and scat were spotted in the upland portion of the cap. Feathers and scat observed near EW-1s/MW-23d suggest coyote activity at the site.

The job trailer roof was observed to be leaking and Hart Crowser will return to the site and place a tarp over the trailer. The trailers appear to be rapidly deteriorating and planning to remove them should begin.

Action Items:	**Person Responsible**	**Deadline**
■ Continue to Monitor MW-23d inner/outer casing relationship for movement.	Phil Cordell	Quarterly
■ Herbicide application	Phil Cordell	Spring 2016
■ Winter transducer inspection and install 4 new transducers	Phil Cordell	February 2016
■ Fill large burrows along perimeter road	Phil Cordell	February 2016
■ Cover job trailer	Phil Cordell	February 2016

Site Activities / Miscellaneous Field Activities

- Shoreline repairs and irrigation system decommissioning were completed in December 2015.

Table 3.1
Example Quarterly Site Inspection Meeting Summary
McCormick & Baxter Creosoting Company
Portland, Oregon

Deliverables

None submitted.

Action Item:	Person Responsible:	Deadline:
Hart Crowser and GSI will submit Draft 2015 O&M Annual Report.	Phil Cordell/Erin Hughes	February 2016
Hart Crowser and GSI will assist DEQ with the five year review	Phil Cordell/Erin Hughes	Spring 2016
Hart Crowser and GSI will update the O&M Manual	Phil Cordell/Erin Hughes	February 2016

Budget Status: November 2015 through January 2016 were at/or below the anticipated budget.

Meeting Status:

Date / Time	TBD – January 2016	
Location	McCormick & Baxter Facility	Site Office

Table 8.1

Example Site-wide GW Gauging Event - NAPL Team
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	Time	Depth to LNAPL	Depth to water (ft)	Depth to DNAPL	Total Well Depth	Reference Point	Wellhead Observations	Site Area
EW-19s									FWDA
EW-10s									FWDA
MW-Gs									FWDA
MW-20i									FWDA
MW-Ds									FWDA
EW-23s									FWDA
EW-2s									FWDA
EW-15s									FWDA
MW-56s									FWDA
MW-10r									FWDA
MW-22i									CPA
MW-1r									TFA
EW-18s									TFA
EW-8s									TFA
EW-1s									TFA

Name of Data Collector: ______________________

Name of Instrument Used: ______________________

Table 8.2

Example Site-wide GW Gauging Event - Well Cluster Team
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	Time	Depth to water (feet)	Reference Point	Total Well Depth (feet)	LNAPL/ DNAPL ?	Wellhead Observations	Site Area
MW-60d								TFA
MW-36s								Other
MW-36i								Other
MW-36d								Other
MW-37s								Other
MW-37i								Other
MW-37d								Other
MW-38s								Other
MW-38i								Other
MW-38d								Other
MW-39s								Other
MW-39i								Other
MW-39d								Other
MW-40s								Other
MW-40i								Other
MW-40d								Other
MW-41s								Other
MW-41i								Other
MW-41d								Other
MW-42s								Other
MW-42i								Other
MW-42d								Other

Table 8.2
Example Site-wide GW Gauging Event - Well Cluster Team
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	Time	Depth to water (feet)	Reference Point	Total Well Depth (feet)	LNAPL/ DNAPL ?	Wellhead Observations	Site Area
MW-43s								Other
MW-43i								Other
MW-43d								Other
MW-44s								Other
MW-44i								Other
MW-44d								Other
MW-45s								Other
MW-45i								Other
MW-45d								Other
MW-46s								Other
MW-47s								Other
MW-59s								Other
MW-49s								Other
MW-48s								Other

Name of Data Collector: ______________________

Name of Instrument Used: ______________________

Table 8.3
Example Site-wide GW Gauging Event - Upland Team
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	Time	Depth to water (feet)	Reference Point	Total Well Depth (feet)	LNAPL/ DNAPL ?	Wellhead Observations	Site Area
MW-58s								WCA
MW-58i								WCA
MW-58d								WCA
MW-35r								WCA
MW-7 WC								WCA
MW-61s								Other
MW-55s								Other
MW-54s								Other
MW-57s								Other
MW-15s								FWDA
MW-62i								Other
MW-34i								FWDA
MW-17s								FWDA
MW-23d								CPA
MW-50s								Other
MW-51s								Other
PW-2d								Other
MW-Os								Other
PW-1d								Other
MW-53s								Other
MW-52s								Other

Table 8.3

Example Site-wide GW Gauging Event - Upland Team
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	Time	Depth to water (feet)	Reference Point	Total Well Depth (feet)	LNAPL/ DNAPL ?	Wellhead Observations	Site Area
MW-As								Other
MW-32i								Other

Name of Data Collector: ______________________________

Name of Instrument Used: ______________________________

Table 8.4

Example Groundwater and NAPL Elevations
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID[a]	Date	Time	Measuring Point Elevation (ft NAVD88)	Depth to water (ft)	Depth to DNAPL (ft)	LNAPL Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
EW-1s	10/2/2015	11:55	40.1	28.0	38.5	40.1		9.5	12.1
EW-2s	10/2/2015	10:15	42.4	33.8		42.4			8.6
EW-8s	10/2/2015	12:17	40.5	29.0	51.9	40.5		2.9	11.5
EW-10s	10/2/2015	9:35	29.4	20.7	41.6	29.4		1.1	8.7
EW-15s	10/2/2015	10:57	43.0	39.6	48.6	10.1	6.7	Trace	10.0
EW-18s	10/2/2015	12:05	40.7	29.3	42.7	11.5	Trace	2.0	11.5
EW-19s	10/2/2015	9:20	25.9	17.5					8.5
EW-23s	10/2/2015	10:40	37.6	33.8	34.1	9.8	6.0	5.2	9.7
MW-1r	10/2/2015	12:30	37.6	27.9		37.6			9.8
MW-7 WC	10/2/2015	11:12	36.7	26.8					9.9
MW-10r	10/2/2015	11:30	41.9	30.6		11.4	0.2		11.4
MW-15s	10/2/2015	11:46	43.3	32.1					11.2
MW-17s	10/2/2015	12:15	41.3	30.3					11.0
MW-20i	10/2/2015	10:00	41.4	32.5	70.0			4.6	9.0
MW-22i	10/2/2015	11:40	42.3	33.6	51.1			7.8	8.7
MW-23d	10/2/2015	12:34	41.1	32.5					8.6
MW-32i	10/2/2015	13:13	39.3	29.5					9.9
MW-34i	10/2/2015	12:20	32.7	24.4					8.2
MW-35r	10/2/2015	11:07	32.3	23.3					9.0
MW-36d	10/2/2015	9:42	30.5	21.6					8.8
MW-36i	10/2/2015	9:38	30.2	21.3					8.9
MW-36s	10/2/2015	9:35	30.7	20.0					10.8
MW-37d	10/2/2015	9:54	26.1	17.1					9.0
MW-37i	10/2/2015	9:49	25.9	16.9					9.0
MW-37s	10/2/2015	9:46	24.9	16.5					8.4
MW-38d	10/2/2015	10:10	31.8	22.8					9.0
MW-38i	10/2/2015	10:08	32.1	23.5					8.5
MW-38s	10/2/2015	10:03	32.3	22.4					9.9
MW-39d	10/2/2015	10:20	29.8	20.8					9.0
MW-39i	10/2/2015	10:16	30.1	21.1					9.0
MW-39s	10/2/2015	10:13	29.8	21.4					8.4
MW-40d	10/2/2015	10:32	28.7	19.8					8.9
MW-40i	10/2/2015	10:35	28.7	20.2					8.5
MW-40s	10/2/2015	10:39	28.3	18.2					10.1
MW-41d	10/2/2015	10:48	27.4	18.6					8.8
MW-41i	10/2/2015	10:44	27.1	18.2					8.9
MW-41s	10/2/2015	10:41	27.8	19.3					8.5
MW-42d	10/2/2015	11:01	32.2	23.6					8.6
MW-42i	10/2/2015	10:57	32.7	23.9					8.8
MW-42s	10/2/2015	10:54	32.4	21.2					11.2
MW-43d	10/2/2015	11:11	28.3	19.7					8.6
MW-43i	10/2/2015	11:08	30.3	21.6					8.7
MW-43s	10/2/2015	11:05	31.1	22.5					8.5
MW-44d	10/2/2015	11:24	29.6	20.8					8.9
MW-44i	10/2/2015	11:20	29.3	21.0					8.3
MW-44s	10/2/2015	11:17	29.6	18.2					11.4
MW-45d	10/2/2015	11:34	27.9	19.4					8.5
MW-45i	10/2/2015	11:30	28.0	19.4					8.6
MW-45s	10/2/2015	11:27	28.2	19.7					8.4
MW-46s	10/2/2015	11:45	35.5	24.1					11.5
MW-47s	10/2/2015	11:49	35.5	27.0					8.5
MW-48s	10/2/2015	12:35	38.7	26.3					12.3
MW-49s	10/2/2015	12:31	37.6	22.3					15.3
MW-50s	10/2/2015	12:39	39.3	27.0					12.2
MW-51s	10/2/2015	12:41	39.5	24.3					15.3
MW-52s	10/2/2015	13:06	40.7	29.3					11.4
MW-53s	10/2/2015	13:03	40.4	26.0					14.4
MW-54s	10/2/2015	11:34	41.8	30.4					11.4
MW-55s	10/2/2015	11:32	41.0	29.6					11.5

Table 8.4

Example Groundwater and NAPL Elevations
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID[a]	Date	Time	Measuring Point Elevation (ft NAVD88)	Depth to water (ft)	Depth to DNAPL (ft)	LNAPL Elevation (ft NAVD88)	LNAPL Thickness (ft)	DNAPL Thickness (ft)	Groundwater Elevation LNAPL Corrected (ft NAVD88)
MW-56s	10/2/2015	11:13	43.5	33.5		10.4	0.3		10.4
MW-57s	10/2/2015	11:41	42.0	33.1					9.0
MW-58d	10/2/2015	10:42	41.4	32.6					8.8
MW-58i	10/2/2015	10:41	41.0	32.4					8.6
MW-58s	10/2/2015	10:40	41.5	32.9					8.6
MW-59s	10/2/2015	12:21	35.9	23.7					12.3
MW-60d	10/2/2015	9:22	40.1	31.2					8.8
MW-61s	10/2/2015	11:22	43.6	32.4					11.2
MW-62i	10/2/2015	12:11	42.6	34.5					8.1
MW-As	10/2/2015	13:15	39.3	23.4					15.9
MW-Ds	10/2/2015	10:25	42.9	34.3	36.4	8.6	Trace	2.2	8.6
MW-Gs	10/5/2015	16:25	40.2	32.3	42.8	7.9	Trace	1.9	7.9
MW-Os	10/2/2015	12:48	40.9	25.6					15.3
PW-1d	10/2/2015	12:53	44.0	34.2					9.8
PW-2d	10/2/2015	12:46	41.8	31.9					9.9

Notes:

LNAPL specific gravity estimated as 0.981 g/cm^3
*Corrected groundwater elevation = [LNAPL thickness * LNAPL specific gravity] + groundwater elevation*
Measuring point is the north side of the top of inner casing (TOIC) at each well.
DNAPL = dense non-aqueous phase liquid
ft = feet
LNAPL = light non-aqueous phase liquid
NAVD88 = feet North American Datum of 1988

Table 8.5

Depth of Transducer Placement - February 2016
McCormick & Baxter Creosoting Company
Portland, Oregon

Well #	**Transducer Information**			**Installation Information**	
	Serial Number	**Maximum Pressure (psi)**	**Pressure Style**	**Target Depth (feet, TOC)**	**Installed Depth Placement (feet, TOC)**
EW-1s	2338004	30	Gauge	35	35.22
MW-36d	21520002	30	Absolute	35	35.72
MW-36s	21520000	30	Absolute	24	24.72
MW-37d	21438063	50	Absolute	70	70.77
MW-37s	2338022	15	Gauge	35	27.36
MW-44d	2338026	15	Gauge	35	37.10
MW-44s	21542036	30	Absolute	20	22.65
MW-45d	21551041	50	Absolute	65	67.50
MW-45s	21549038	30	Absolute	20	26.60
MW-52s	21549039	30	Absolute	32	37.71
MW-53s	21520001	30	Absolute	35	35.11

Notes:

psi = pounds per square inch
TOC = top of casing

Table 8.6

Example Site-wide GW Gauging Event - Transducer Download
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Date	*Clock Time	Depth to water (feet) Manual	Transducer Time	Depth to water (feet) Transducer	Number of Readings	Comments (battery life, dessicate condition, transducer displacement, etc.)
MW-36s							
MW-36i							
MW-36d							
MW-37s							
MW-37i							
MW-37d							
MW-40s							
MW-41s							
MW-44s							
MW-44i							
MW-44d							
MW-45s							
MW-45i							
MW-45d							
MW-52s							
MW-53s							
EW-1s							
MW-15s							

Notes:
** = Clock time two minutes behind actual time.*

Name of Data Collector: ______________________

Name of Instrument Used: ______________________

Table 9.1
Recommended Well Sampling Order
McCormick & Baxter Creosoting Company
Portland, Oregon

Well	Group	Method	Well type or location
MW-As	1	Sub Pump	Upland background
MW-32i	1	Sub Pump	Upland background
PW-1d	1	Sub Pump	Upland background
MW-Os	1	Sub Pump	Upland background
PW-2d	1	Sub Pump	Upland background
MW-61s	1	Sub Pump	Upland background
MW-7	1	Sub Pump	Upland background
MW-35r	1	Sub Pump	Upland background
MW-55s	2	Sub Pump	Upland outside of barrier wall
MW-53s	2	Sub Pump	Upland outside of barrier wall
MW-51s	2	Sub Pump	Upland outside of barrier wall
MW-49s	2	Sub Pump	Upland outside of barrier wall
MW-47s	2	Sub Pump	Upland outside of barrier wall
MW-59s	2	Sub Pump	Upland outside of barrier wall
MW-58d	2	Sub Pump	Willamette Cove
MW-58i	2	Sub Pump	Willamette Cove
MW-58s	2	Sub Pump	Willamette Cove
MW-46s	3	Sub Pump	inside of barrier wall
MW-48s	3	Sub Pump	inside of barrier wall
MW-50s	3	Sub Pump	inside of barrier wall
MW-52s	3	Sub Pump	inside of barrier wall
MW-54s	3	Sub Pump	inside of barrier wall
MW-57s	3	Sub Pump	inside of barrier wall / near NAPL well
MW-23d	4	Sub Pump	inside of barrier wall well
EW-1s	4	Sub Pump	inside of barrier wall well
MW-10r	4	Sub Pump	inside of barrier wall well
MW-22i	4	Sub Pump	inside of barrier wall well
MW-15s	4	Sub Pump	inside of barrier wall well
EW-19s	4	Sub Pump	inside of barrier wall well
MW-17s	4	Sub Pump	inside of barrier wall well
MW-60d	4	Sub Pump	inside of barrier wall well
MW-62i	4	Sub Pump	inside of barrier wall well
MW-37d	4	Sub Pump	outside of barrier wall well
MW-37i	4	Sub Pump	outside of barrier wall well
MW-37s	4	Sub Pump	outside of barrier wall well
MW-39d	4	Sub Pump	outside of barrier wall well
MW-39i	4	Sub Pump	outside of barrier wall well
MW-39s	4	Sub Pump	outside of barrier wall well
MW-41d	4	Sub Pump	outside of barrier wall well
MW-41i	4	Sub Pump	outside of barrier wall well
MW-41s	4	Sub Pump	outside of barrier wall well
MW-43d	4	Sub Pump	outside of barrier wall well
MW-43i	4	Sub Pump	outside of barrier wall well
MW-43s	4	Sub Pump	outside of barrier wall well
MW-45d	4	Sub Pump	outside of barrier wall well
MW-45i	4	Sub Pump	outside of barrier wall well
MW-45s	4	Sub Pump	outside of barrier wall well
MW-36d	4	Sub Pump	inside of barrier wall well
MW-36i	4	Sub Pump	inside of barrier wall well
MW-36s	4	Sub Pump	inside of barrier wall well
MW-38d	4	Sub Pump	inside of barrier wall well

Table 9.1

Recommended Well Sampling Order
McCormick & Baxter Creosoting Company
Portland, Oregon

Well	Group	Method	Well type or location
MW-38i	4	Sub Pump	inside of barrier wall well
MW-38s	4	Sub Pump	inside of barrier wall well
MW-40d	4	Sub Pump	inside of barrier wall well
MW-40i	4	Sub Pump	inside of barrier wall well
MW-40s	4	Sub Pump	inside of barrier wall well
MW-42d	4	Sub Pump	inside of barrier wall well
MW-42i	4	Sub Pump	inside of barrier wall well
MW-42s	4	Sub Pump	inside of barrier wall well
MW-44d	4	Sub Pump	inside of barrier wall well
MW-44i	4	Sub Pump	inside of barrier wall well
MW-44s	4	Sub Pump	inside of barrier wall well
MW-56s	5	Peristaltic Pump	NAPL containing well
MW-1r	5	Peristaltic Pump	NAPL containing well
MW-Ds	5	Peristaltic Pump	NAPL containing well
MW-20i	5	Peristaltic Pump	NAPL containing well
MW-Gs	5	Peristaltic Pump	NAPL containing well
MW-34i	5	Peristaltic Pump	NAPL containing well
EW-10s	5	Peristaltic Pump	NAPL containing well
EW-15s	5	Peristaltic Pump	NAPL containing well
EW-23s	5	Peristaltic Pump	NAPL containing well
EW-18s	5	Peristaltic Pump	NAPL containing well
EW-8s	5	Peristaltic Pump	NAPL containing well

Notes:

NAPL = non aqueous phase liquid

Table 9.2
Monitoring Well Status and Rationale
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Measuring Point Elevation (ft NAVD88)	Well TD Elevation (ft NAVD88)	Current Transducer	Well Sampled for Water Quality (2010)	Well Sampled for Water Quality (2020)	Monitoring Rationale
EW-10s	29.4	-13.2				Shallow groundwater gradients. Vertical gradients. NAPL migration/mobility.
EW-15s	43.0	-5.6				Shallow groundwater gradients. NAPL migration/mobility.
EW-18s	40.7	-3.9				Shallow groundwater gradients. NAPL migration/mobility.
EW-19s	25.9	-4.2		Yes	Yes	Shallow groundwater gradients. NAPL mobility.
EW-1s	40.1	-6.8	Yes			Subsidence. Shallow groundwater gradients. Vertical gradients. NAPL migration/mobility.
EW-23s	37.6	-1.7				Shallow groundwater gradients. NAPL migration/mobility.
EW-8s	40.5	-14.2				Shallow groundwater gradients. NAPL migration/mobility.
MW-10r	41.9	1.5				Vertical gradients. NAPL migration/mobility.
MW-15s	43.3	5.0	No			Shallow groundwater gradients.
MW-17s	41.3	1.2				Shallow groundwater gradients.
MW-1r	37.6	-14.2				Shallow groundwater gradients. NAPL mobility.
MW-20i	41.4	-33.3				Vertical gradients. NAPL migration/mobility.
MW-22i	42.3	-16.7				Vertical gradients. NAPL migration/mobility.
MW-23d	41.1	-147.3				Subsidence. Vertical gradients.
MW-32i	39.3	-23.2				Upgradient well. Vertical gradients.
MW-34i	32.7	-52.5				Vertical gradients. NAPL migration/mobility.

Table 9.2

Monitoring Well Status and Rationale
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Measuring Point Elevation (ft NAVD88)	Well TD Elevation (ft NAVD88)	Current Transducer	Well Sampled for Water Quality (2010)	Well Sampled for Water Quality (2020)	Monitoring Rationale
MW-35r	32.3			Yes	Yes	NAPL mobility.
MW-36d	30.5	-57.3	Yes			Barrier wall performance. Vertical gradients.
MW-36i	30.2	-23.2	No			Barrier wall performance. Vertical gradients.
MW-36s	30.7	1.7	Yes			Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-37d	26.1	-57.3	Yes	Yes	Yes	Barrier wall performance. Vertical gradients.
MW-37i	25.9	-22.2	No	Yes	Yes	Barrier wall performance. Vertical gradients.
MW-37s	24.9	-4.0	Yes	Yes	Yes	Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-38d	31.8	-56.8				Barrier wall performance. Vertical gradients.
MW-38i	32.1	-21.8				Barrier wall performance. Vertical gradients.
MW-38s	32.3	1.1				Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-39d	29.8	-57.3				Barrier wall performance. Vertical gradients.
MW-39i	30.1	-22.5				Barrier wall performance. Vertical gradients.
MW-39s	29.8	0.1		Yes	Yes	Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-40d	28.7	-58.6				Barrier wall performance. Vertical gradients.
MW-40i	28.7	-22.5				Barrier wall performance. Vertical gradients.
MW-40s	28.3	1.6	No			Barrier wall performance. Shallow groundwater gradients. Vertical gradients.

Table 9.2

Monitoring Well Status and Rationale
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Measuring Point Elevation (ft NAVD88)	Well TD Elevation (ft NAVD88)	Current Transducer	Well Sampled for Water Quality (2010)	Well Sampled for Water Quality (2020)	Monitoring Rationale
MW-41d	27.4	-57.9				Barrier wall performance. Vertical gradients.
MW-41i	27.1	-23.9				Barrier wall performance. Vertical gradients.
MW-41s	27.8	0.4	No	Yes	Yes	Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-42d	32.2	-56.7				Barrier wall performance. Vertical gradients.
MW-42i	32.7	-21.2				Barrier wall performance. Vertical gradients.
MW-42s	32.4	5.4				Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-43d	28.3	-57.5				Barrier wall performance. Vertical gradients.
MW-43i	30.3	-22.4				Barrier wall performance. Vertical gradients.
MW-43s	31.1	4.1				Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-44d	29.6	-57.6	Yes			Barrier wall performance. Vertical gradients.
MW-44i	29.3	-22.7	No			Barrier wall performance. Vertical gradients.
MW-44s	29.6	0.5	Yes			Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-45d	27.9	-58.6	Yes			Barrier wall performance. Vertical gradients.
MW-45i	28.0	-22.6	No			Barrier wall performance. Vertical gradients.
MW-45s	28.2	-0.1	Yes			Barrier wall performance. Shallow groundwater gradients. Vertical gradients.
MW-46s	35.5	3.8				Barrier wall performance. Shallow groundwater gradients.

Table 9.2
Monitoring Well Status and Rationale
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Measuring Point Elevation (ft NAVD88)	Well TD Elevation (ft NAVD88)	Current Transducer	Well Sampled for Water Quality (2010)	Well Sampled for Water Quality (2020)	Monitoring Rationale
MW-47s	35.5	4.4		Yes	Yes	Barrier wall performance. Shallow groundwater gradients.
MW-48s	38.7	2.6				Barrier wall performance. Shallow groundwater gradients.
MW-49s	37.6	1.9				Barrier wall performance. Shallow groundwater gradients.
MW-50s	39.3	3.8				Barrier wall performance. Shallow groundwater gradients.
MW-51s	39.5	4.4				Barrier wall performance. Shallow groundwater gradients.
MW-52s	40.7	-0.3	Yes			Barrier wall performance. Shallow groundwater gradients.
MW-53s	40.4	-0.4	Yes	Yes	Yes	Barrier wall performance. Shallow groundwater gradients.
MW-54s	41.8	5.5				Barrier wall performance. Shallow groundwater gradients.
MW-55s	41.0	5.2		Yes	Yes	Barrier wall performance. Shallow groundwater gradients.
MW-56s	43.5	6.2				Barrier wall performance. Shallow groundwater gradients. NAPL migration/mobility.
MW-57s	42.0	5.9				Barrier wall performance. Shallow groundwater gradients.
MW-58d	41.4					Vertical gradients. NAPL mobility.
MW-58i	41.0					Vertical gradients. NAPL mobility.

Table 9.2
Monitoring Well Status and Rationale
McCormick & Baxter Creosoting Company
Portland, Oregon

Well ID	Measuring Point Elevation (ft NAVD88)	Well TD Elevation (ft NAVD88)	Current Transducer	Well Sampled for Water Quality (2010)	Well Sampled for Water Quality (2020)	Monitoring Rationale
MW-58s	41.5			Yes	Yes	Shallow groundwater gradients. Vertical gradients. NAPL mobility.
MW-59s	35.9			Yes	Yes	Infiltration pond. Shallow groundwater gradients.
MW-60d	40.1	-80.3				Vertical gradients. NAPL migration/mobility.
MW-61s	43.6	2.3				Upgradient well. Shallow groundwater gradients. NAPL mobility.
MW-62i	42.6	-21.3				
MW-7 WC	36.7	-0.3				Shallow groundwater gradients.
MW-As	39.3	9.8				Upgradient well. Shallow groundwater gradients.
MW-Ds	42.9	4.2				Shallow groundwater gradients. NAPL migration/mobility.
MW-Gs	40.2	-4.5				Shallow groundwater gradients. NAPL migration/mobility.
MW-Os	40.9	-4.4				Upgradient well. Shallow groundwater gradients.
PW-1d	44.0	-93.5				Upgradient well.
PW-2d	41.8	-59.0				Upgradient well. Vertical gradients.

Notes:

ft = feet
NAPL = non-aqueous phase liquid
NAVD88 = North American Vertical Datum 1988

Table 9.3
Example Water Quality Parameter Form
McCormick and Baxter Creosoting Company
Portland, Oregon

GROUNDWATER MEASUREMENT DATA SHEET

SITE NAME:______________________ WELL No.:_______________ DATE:_______________

1. FIELD OBSERVATION AND MEASUREMENTS

   a. Field Personnel: ____
   b. Visitors at Site: ____
   c. Type of Well: ____
   d. Well Measurements:
      Depth to Water (DTW):____________________________________
      Measuring Point (circle): Top of casing / Ground surface
      NAPL present? (circle): DNAPL / LNAPL / Both
      Total Depth of Well (TD):____________________________________
      Diameter of Well (circle): 2-inch / 4-inch / 6-inch / 8-inch
      Water Column (TD – DTW):__________________________________
   e. Purging/Sampling Method (circle): Low Flow / 2-inch Grundfos / 12V KVA Pump / Bailer

2. PURGING PARAMETERS

Time	Volume Purged (gal.)	Temp. (F°/°C)	ORP	pH	Cond. (Ms/cm)	Turbidity (NTU)	D.O. (m-g-/L)	Pump Speed	SWL	Description of Water
Final										

3. SAMPLE COLLECTION SUMMARY Sample Time:____________

ANALYSES AND SAMPLE NUMBERS							
Sample	VOC's (8260)	SVOC's (8270)	PCB's (8082)	NWTPH-Gx	NWTPH-Dx	Total Metals	

VOLUME OF WATER IN CASING			
Casing Diameter (inches)	Gallons per foot of Depth	Cubic Feet per Foot of Depth	Liters per Meter of Depth
2	0.163	0.0218	2.024
4	0.653	0.0873	8.11
8	2.611	0.3491	32.43
12	5.81	0.7767	65.97

1 Cubic Foot = 7.48 gallons or 28.32 liters, 1 Gallon = 3.785 liters or 0.1337 cubic feet

Table 9.4
Groundwater Sample Analytical Requirements
McCormick & Baxter Creosoting Company
Portland, Oregon

Analytical Parameters (Method)	Method Detection Limit	Type of Container	Sample Preservation	Technical Holding Time	Quality Control Samples
Groundwater Samples					
PAHs and PCP (EPA Method SW-846 8270M-SIM)	0.05 µg/L to 1 µg/L	(1) 1-liter amber glass bottle with Teflon-lined lid	Ice to 4°C	7 days to extraction, 40 days to analysis	Field duplicates (≤ 5% of total samples), MS/MSD(≤ 5% of total samples), Rinsate blanks (≤ 10% of total samples)
Total Cr, Cu, Zn, and As (EPA 6000/7000 series Methods)	0.121 µg/L to 0.7 µg/L	(1) 250-mL HDPE bottle with Teflon-lined lid	pH <2 HNO_3, Ice to 4°C	6 months	Field duplicates (≤ 5% of total samples), MS/MSD(≤ 5% of total samples), Rinsate blanks (≤ 10% of total samples)

Notes:

µg/L = micrograms per liter
% = percent
≤ = greater than or equal to
As = Arsenic
C= Celsius
Cr= Chromium
Cu= Copper
EPA= United States Environmental Protection Agency
HDPE= High-density polyethylene
HNO_3 = Nitric acid
MDL= Method detection limit.
mL= Milliliters
° C = degrees Celsius
PAHs= Polynuclear aromatic hydrocarbons
PCP= Pentachlorophenol
SIM= Selective ion monitoring
SW-846= EPA, Test Methods for Evaluating Solid Waste, SW-846, third edition, December 1996
Zn= Zinc

Table 9.5

Sample Location and Identification Key - Groundwater Sampling
McCormick & Baxter Creosoting Company
Portland, Oregon

Digits	Description	Code	Code Description
1 and 2	Well Type	MW	Monitoring Well
		EW	Extraction Well
		PW	Production Well
3 and 4	Well Number or Letter	1 through 62	Sequential Number
		A through O	Sequential Letter
5	Well Depth	s i d	Shallow Intermediate Deep
6 and 7	Month	12	December
8 and 9	Day	25	Twenty Fifth
10 and 11	Year	06	2006
Example: MW36i-022106 - Monitoring well MW-36, intermediate depth collected on February 21, 2006.			

Table 10.1
Field Equipment Inventory
McCormick & Baxter Creosoting Company
Portland, Oregon

Item No.	Item	Description	Purpose	Serial Number
Inventory of Record				
1	UTV	Kubota 4WD utility task vehicle **Status/Condition:** Operable	Personnel and equipment transport	--
2	Transducers	11 transducers in wells **Status/Condition:** Numerous broken transducers.	Ongoing water level measurements	(see serial numbers at the bottom of page)
3	Water Level Meter	Ullage Interface Flexi-Dip 100 ft. MMC-2 **Status/Condition:** Good condition, functional, slightly creosote stained tape.	NAPL/water level measurements	3914
4	Vacuum	Ridgid Blower Vac **Status/Condition:** Good condition with a variety of extensions.	Clean shop	05115 C 0987
4	Trash Pump	Goulds Pumps, stainless steel **Status/Condition:** Replaced in March 2016.	Remove water from sump	2452
5	Water Level Meter	Old Red Meter **Status/Condition:** Good condition, functional, need battery.	Water level measurements	DEQ 18004524011
6	Water Level Meter	Heron 200' Dipper-T **Status/Condition:** Good condition, functional.	Water level measurements	12970
Non-Recorded Inventory				
8	Folding Table	(Keep two) 1plastic, 3 large, 2 small vinyl topped **Status/Condition:** Good condition.	Meetings	N/A
9	Folding Chairs	Keep six **Status/Condition:** Good condition.	Meetings	N/A
10	Work Bench in Shop	**Status/Condition:** Good condition**.**	Work space	N/A
11	Storage Boxes	2 Knack Storage Boxes (60"x47"x30") **Status/Condition:** Fair condition.	For storage of other equipment	N/A

Table 10.1

Field Equipment Inventory
McCormick & Baxter Creosoting Company
Portland, Oregon

Item No.	Item	Description	Purpose	Serial Number
12	Misc. Hand Tools	Hammers, screw drivers, wrenches etc. **Status/Condition:** Mostly good condition.	For future use	N/A
13	Post Driver	1 Red Post Driver **Status/Condition:** Good condition (one new and one used).	Sign repairs	N/A
14	Crawfish Traps	11 traps **Status/Condition:** Good condition.	Possible future sampling	N/A
15	Waders and Rubber Boots	11-rubber boot pairs, 3-full leg, 2-chest waders **Status/Condition:** Good condition.	Possible future sampling	N/A
16	Henry Samplers	Henry Samplers **Status/Condition:** Good condition.	Future sampling	N/A
17	Display Boxes	Sediment and soil cap displays **Status/Condition:** Good condition.	Educational Purposes	N/A
18	Sand Pile	20 ft. W x 50 ft.L x 4 ft.H **Status/Condition:** Good condition.	Future Cap repairs	N/A
19	Large Boulder Pile	(4' minus) 10 ft.W x 45 ft.L x 6 ft.H **Status/Condition**: Good condition	Future Cap repairs	N/A
20	Small Boulder Pile	(1' minus) 17 ft.W x 40 ft.L x 3 ft.H **Status/Condition:** Good condition	Future Cap repairs	N/A
21	Large Gravel Pile	(3"minus)17 ft.W x 35 ft.L x 3 ft.H **Status/Condition:** Good condition.	Future Cap repairs	N/A

Table 10.1

Field Equipment Inventory
McCormick & Baxter Creosoting Company
Portland, Oregon

Item No.	Item	Description	Purpose	Serial Number
22	ACB	4 ACB sections, 12.5 individual ACBs **Status/Condition:** Fair Condition	Future ACB repairs	N/A
23	Organoclay Mats	1 roll **Status/Condition:** Deteriorating	Future sediment cap repairs	N/A
24	Concrete Mix	12 bags (80 lbs each) Quikrete **Status/Condition:** Good condition	Possible future use on ACB	N/A

Notes:

N/A = Not available.

Transducers

Serial Numbers	*PSI*
2338004	*30*
21520002	*30*
21520000	*30*
21438063	*50*
2338022	*15*
2338026	*15*
21542036	*30*
21551041	*50*
21549038	*30*
21549039	*30*
21520001	*30*

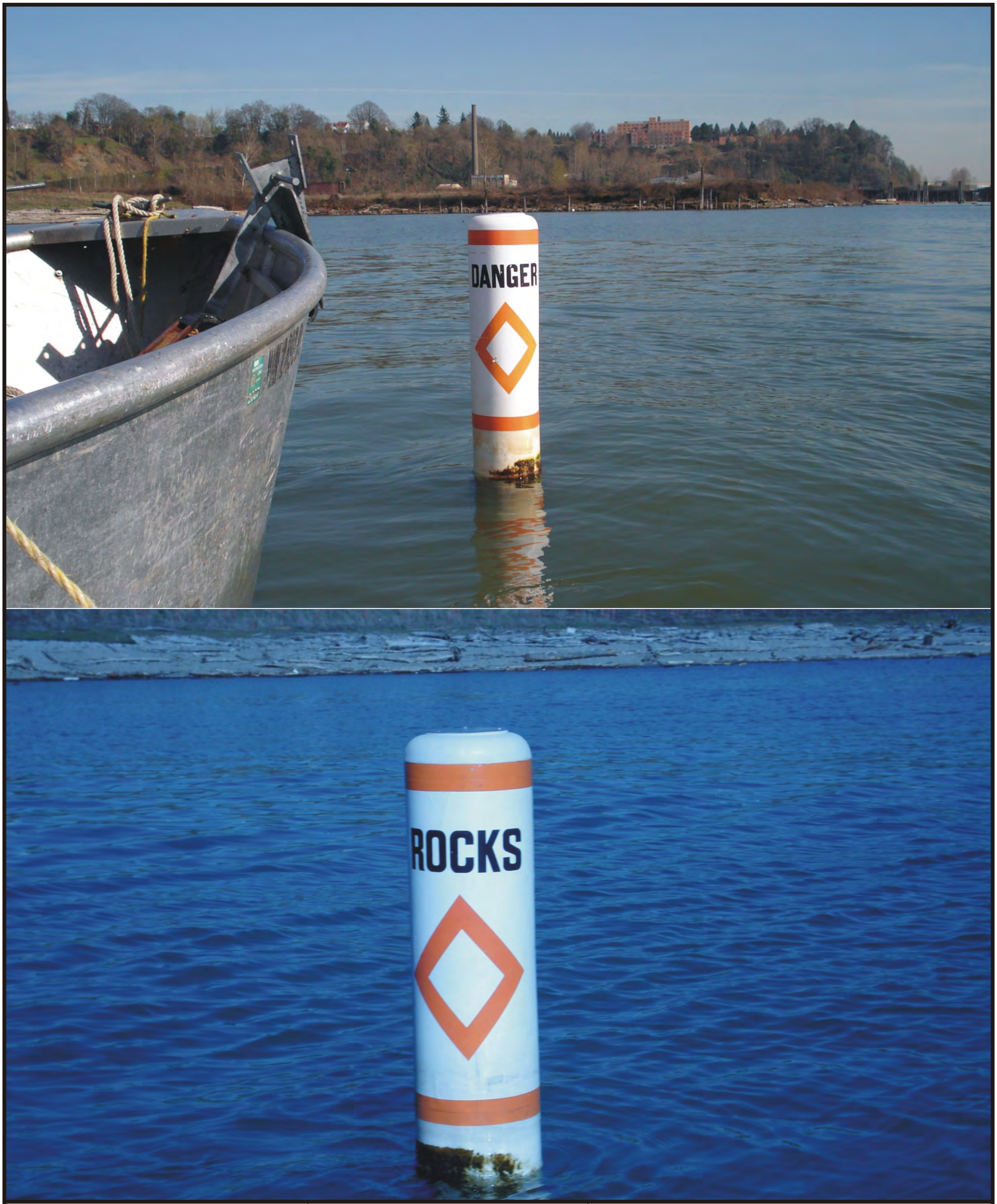
FIGURES

McCORMICK AND BAXTER
CREOSOTING CO.
Portland, Oregon

Figure 2.2

SITE PERIMETER WARNING SIGNS

Date:	Drawn by:	
5-18-07	AES	10:002688OY2806\fig 2.2



McCORMICK AND BAXTER
CREOSOTING CO.
Portland, Oregon

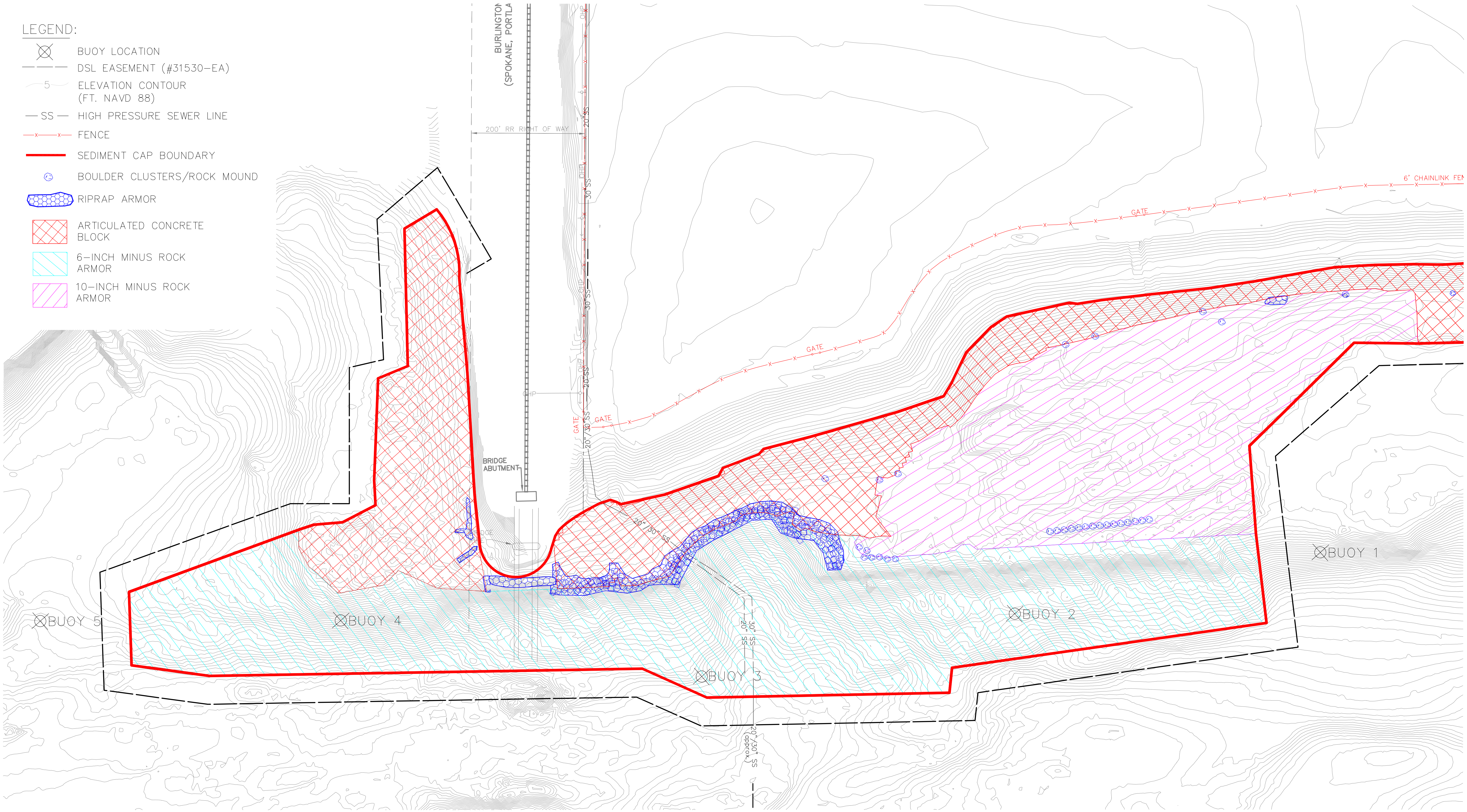
Figure 2.3

IMAGES OF BUOYS CURRENTLY
DEPLOYED AT THE SITE

Date: 5-18-07
Drawn by: AES
10:002688OY2806\fig 2.3

	McCORMICK AND BAXTER CREOSOTING CO. Portland, Oregon	Figure 2.4 IMAGE OF BANK REEF WARNING SIGN

Date: 5-18-07	Drawn by: AES	10:002688OY2806\fig 2.4



SCALE IN FEET: 1"= 80'

0 80 160 240

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

DESIGNED BY:

CHECKED BY:

DRAWN BY: V. RAYNER

APPROVED BY

FIGURE 2.5

BUOY LOCATION MAP

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	05-21-07	Sitewide Record Drawings_Buoy Location Map.dwg

N W E S

0 75 150 300 450 600 750
Feet
Approximate Scale

Map Reference: Orthorectified Photo Image, September 28, 2005 @ 12:30 pm.
River Stage at Time of Photo is 4.93 ft. NAVD at Morrison Street Bridge.

McCormick & Baxter
Creosoting Company

Portland, Oregon

Figure 5.1
LOCATION OF ORGANOCLAY
AND OTHER SITE FEATURES

Date:	GIS:	Job Number:
11/10/2006	avh	002688.OY28.06

P:\Portland\205 - OR DEQ\020-M&B O&M 2014\Figures\Soil_Sed_OM

NOTE: Aerial photo taken on September 22, 2006

McCormick and Baxter Superfund Site
Portland, Oregon

Organophilic Clay Core Sample Locations Collected Through 2009 in Willamette Cove

2/16

HARTCROWSER GSI Water Solutions, Inc.

Figure
5.2

Document Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2015_OM_Manual\Figure5_2_Organophilic_Cores_in_WC_Sampling_Area.mxd

Document Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2015_OM_Manual\Figure8_1_Monitoring_Well_Location_Map.mxd

LEGEND

⊕	Groundwater Monitoring Wells
☐	Groundwater Monitoring Wells with Transducers
🟥	Subsurface Barrier Wall

NOTE:
Aerial photo taken on September 22, 2006.

0 200 400
Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Monitoring Well Location Map

2/16

HARTCROWSER GSI Water Solutions, Inc.

Figure
8.1

LEGEND

⊕	Groundwater Monitoring Wells (Groundwater Elevation)
☐	Groundwater Monitoring Wells with Transducers (Groundwater Elevation)
∼	Groundwater Elevation Contours (dashed where inferred)
∼	Willamette River Level During Sampling Event (8.7 feet)
▭	Subsurface Barrier Wall

NOTES:
1) Elevations shown in NAVD 88.
2) Aerial photo taken on September 22, 2006.
3) Water levels measured between 8:43 and 14:02.
4) Willamette River low tide at 8:00 at 8.7 feet NAVD 88.

0 200 400
Scale in feet

N

McCormick and Baxter Superfund Site
Portland, Oregon

Example Groundwater Contour Map

2/16

HARTCROWSER

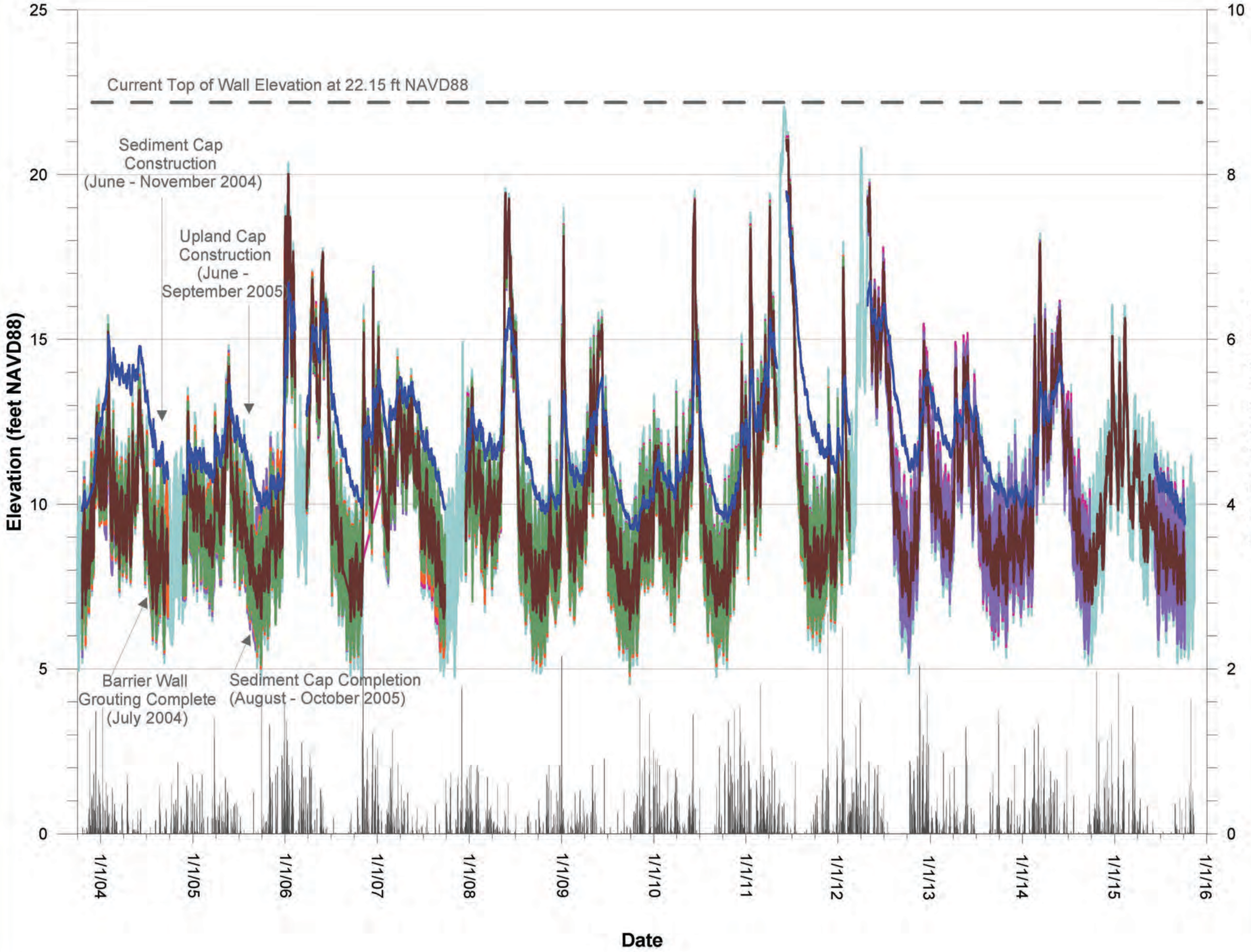
GSI Water Solutions, Inc.

Figure
8.2

Document Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\2015_OM_Manual\Figure8_2_Example_GW_Contour_Map.mxd

Figure 8.3:
Example Groundwater Level Figure

McCormick and Baxter Superfund Site
Portland, OR



LEGEND

- MW-36s (Interior)
- MW-36i (Interior)
- MW-36d (Interior)
- MW-37s (Exterior)
- MW-37i (Exterior)
- MW-37d (Exterior)
- River
- Precipitation

Notes:
MW-36 wells are located inside the barrier wall and MW-37 wells are located outside the barrier wall.

Breaks in transducer data are the result of removal for calibration, removal for well modification, or a transducer that was not collecting accurate pressure readings. Transducers in MW-36i and MW-37i were removed on February 16, 2012.

HARTCROWSER

GSI
Water Solutions, Inc.

FIGURE 9.1

Groundwater Monitoring Well Location Map

McCormick & Baxter Superfund Site
Portland, Oregon

LEGEND

- ⦿ Groundwater Monitoring Well
- ☐ Groundwater Monitoring Well with Transducer
- 🟥 Subsurface Barrier Wall

Date: March 28, 2022
Data Sources: City of Portland Imagery (Summer 2021)

N

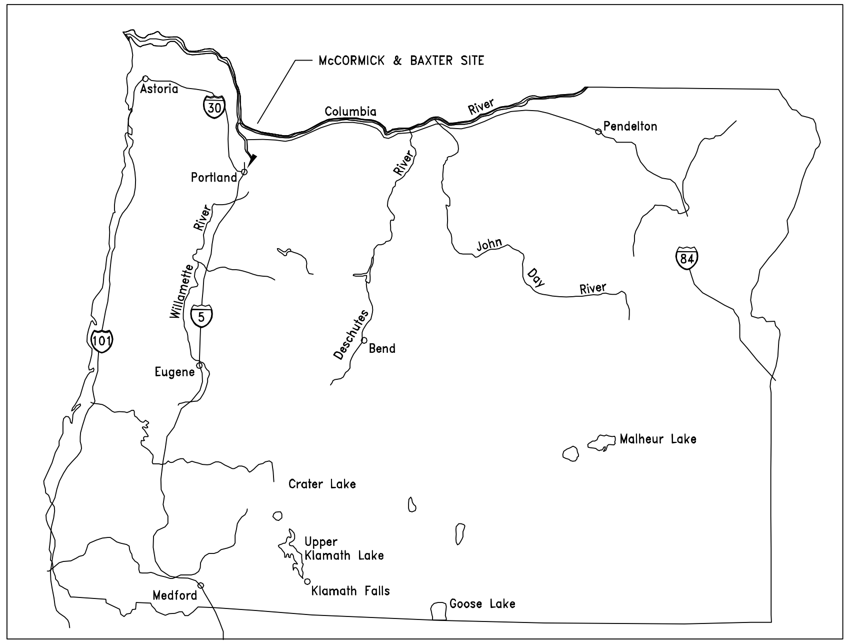
0 100 200 300
Feet

Document Path: \\VMS\GIS_Files\0205_OR_DEQ\Source_Figures\003_003_M_B\2021_Annual_Report\Figure4-1_Monitoring_Well_Location_Map.mxd

APPENDIX A
RECORD DRAWINGS

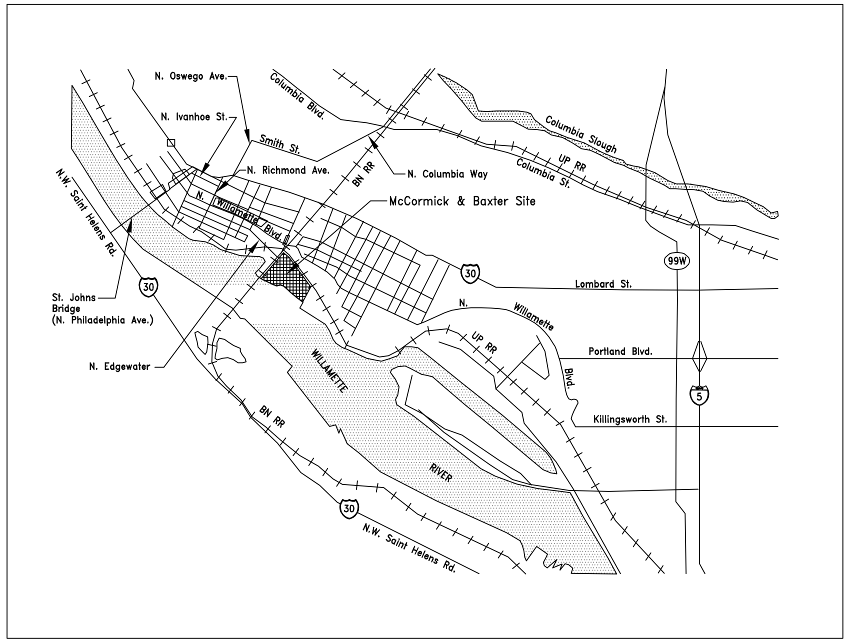
McCORMICK AND BAXTER CREOSOTING CO. SITE
PORTLAND PLANT
Portland, Oregon

SITEWIDE RECORD DRAWING



VICINITY MAP

INDEX OF DRAWINGS



SITE LOCATION MAP

Prepared for:

OREGON DEPARTMENT
OF
ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION
811 SW Sixth Ave.
Portland, Oregon 97204

by:

Ecology and Environment, Inc.
333 SW Fifth Ave.
Portland, Oregon 97204

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

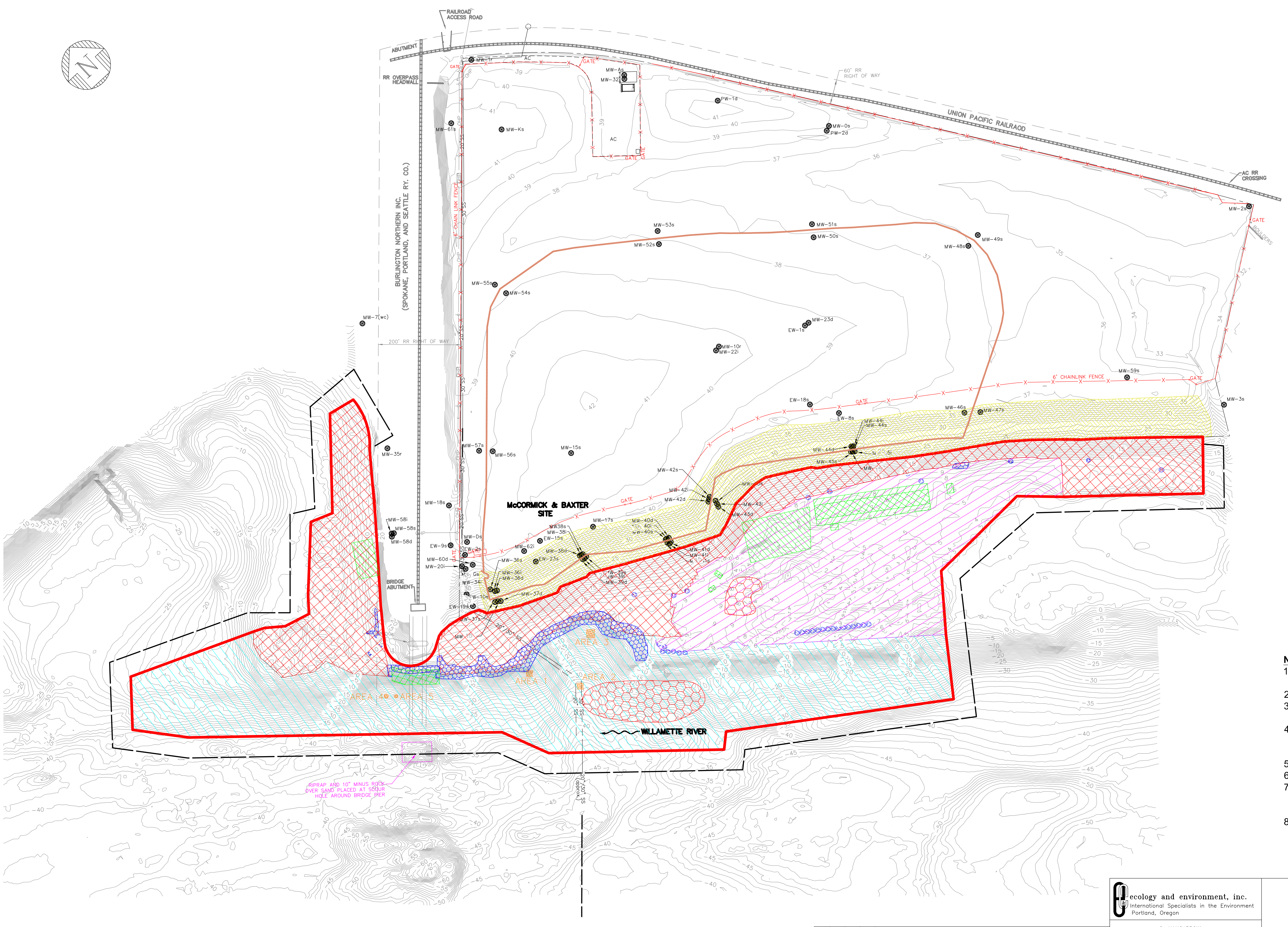
DRAWING 1

TITLE SHEET: SITE LOCATION

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg

CAD ON SEANAS\Engineering Documents\McCORMICK & BAXTER\BASEMAP



SCALE IN FEET: 1"= 120'
0 120 240 360

LEGEND:

— — —	PROPERTY LINE
—— ——	DSL EASEMENT (#31530-EA)
	ELEVATION CONTOUR (FT. NAVD 88)
SS —	HIGH PRESSURE SEWER LINE
STM — —	STORM SEWER
—x—x—	FENCE
- - - -	GRAVEL ACCESS ROAD
——	SUBSURFACE BARRIER WALL
——	SEDIMENT CAP BOUNDARY
○	BOULDER CLUSTERS/ROCK MOUND
⬡	RIPRAP ARMOR
🟩	ORGANOCLAY MAT (DOUBLE LAYER)
🟩	ORGANOCLAY MAT (SINGLE LAYER)
🟩	GRANULAR ORGANOCLAY
🟥	HOT SPOT TREATMENT (THICKENED SAND LAYER)
🟥	ARTICULATED CONCRETE BLOCK
▨	6-INCH MINUS ROCK ARMOR
▨	10-INCH MINUS ROCK ARMOR
🟨	TURF REINFORCEMENT MAT PLACED OVER EARTHEN CAP
🟧	ADDITIONAL 6-INCH MINUS ROCK PLACEMENT AREA

NOTES:

1. Bathymetric and Terrestrial Surveys conducted by David Evans and Associates, Inc. (DEA).
2. Dates of Bathymetric Survey: April 26, 2006 and October 8, 2007.
3. Dates of Terrestrial Survey: November 17, 2004, and January 24, 2006.
4. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone.
5. Units: International Feet.
6. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
7. Contour Interval: One-Foot. Bathymetric contours were derived from a Digital Terrain Model (DTM) based on a 3-foot grid of multibeam data.
8. Additional rock was placed at the 6" minus rock placement areas on June 26, 2007 and June 27, 2007. These areas have not been surveyed, and the contours on this figure do not reflect the additional rock placement.

NO.	DATE	DWN	APP'D	DESCRIPTION
1	6-19-07	CCN	CCN	ISSUED FOR SED CAP REPAIR WORK

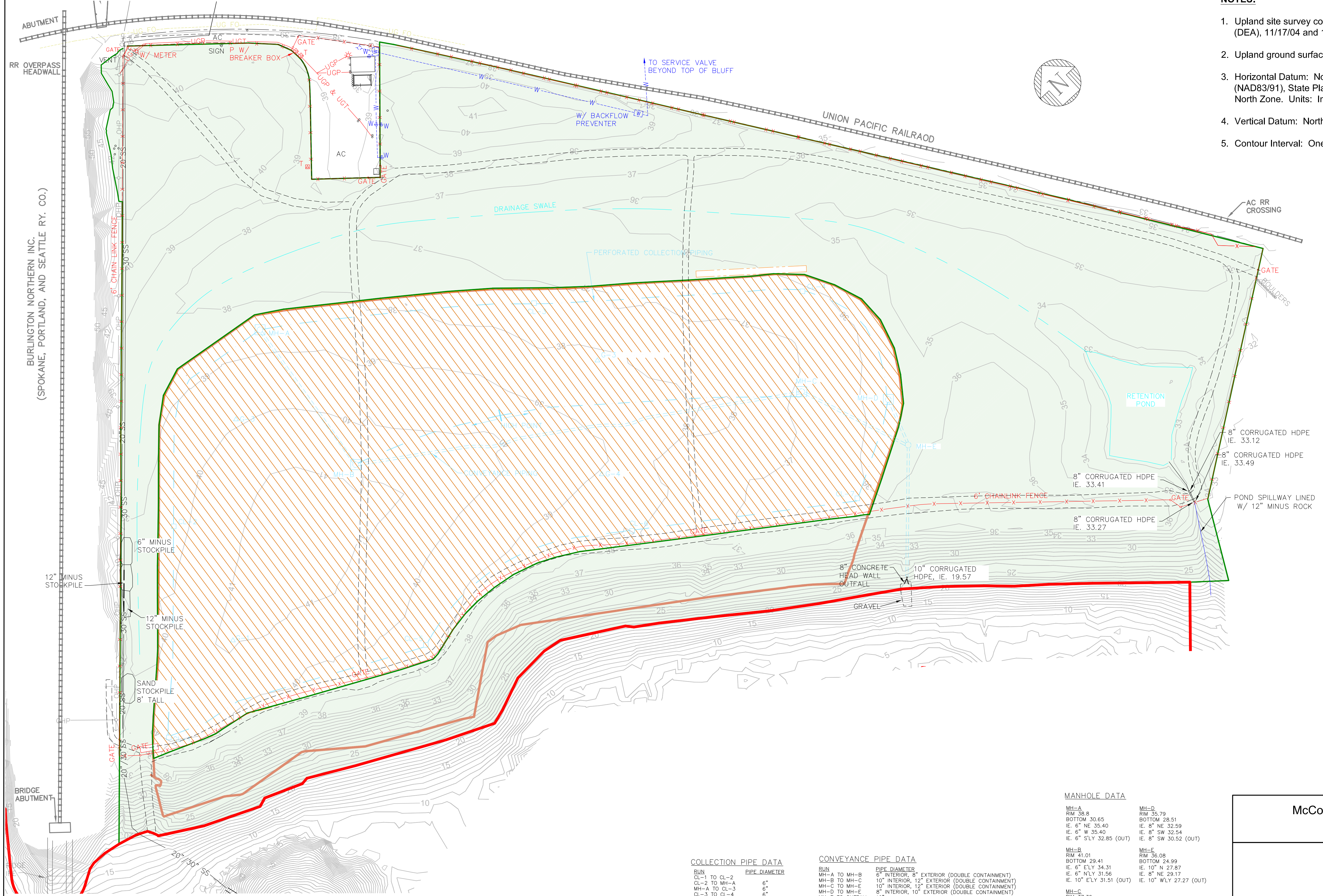
REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 2
SEDIMENT CAP FEATURES
Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	11-30-07	SitewideDrawings_Civil3D.dwg



SCALE IN FEET: 1"= 80'
0 80 160 240

NOTES:

1. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
2. Upland ground surface resurveyed by OTAK, Inc., 9/16/08.
3. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
4. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
5. Contour Interval: One-Foot.

LEGEND:

— – —	PROPERTY LINE
~5~	GROUND SURFACE ELEVATION CONTOUR (FT. NAVD 88)
— SS —	HIGH PRESSURE SEWER
– – STM – –	STORM SEWER
– – W – –	WATER
W	WATER VAULT
⊕	VALVE (AS NOTED)
♉	FIRE HYDRANT
– – UGP – –	UNDERGROUND POWER
– – OPH – –	OVERHEAD POWER
– – UGT – –	UNDERGROUND TELEPHONE
– UG FO –	UNDERGROUND FIBER OPTIC
–x–x–	FENCE
G-1 △	GAS VENT
CL-3 □	CLEAN OUT
◎	MANHOLE
○	RISER
⊠	UTILITY RISER
-○-	UTILITY POLE
======	GRAVEL ACCESS ROAD
—	SUBSURFACE BARRIER WALL
—	SEDIMENT CAP BOUNDARY
▨	IMPERMEABLE CAP
🟩	EARTHEN CAP

COLLECTION PIPE DATA

RUN	PIPE DIAMETER
CL-1 TO CL-2	
CL-2 TO MH-A	6"
MH-A TO CL-3	6"
CL-3 TO CL-4	6"
CL-4 TO MH-D	8"
MH-B TO MH-C	6"
CL-1 TO CL-5	6"
CL-5 TO CL-6	6"
CL-6 TO CL-7	8"
CL-7 TO MH-D	8"

CONVEYANCE PIPE DATA

RUN	PIPE DIAMETER
MH-A TO MH-B	6" INTERIOR, 8" EXTERIOR (DOUBLE CONTAINMENT)
MH-B TO MH-C	10" INTERIOR, 12" EXTERIOR (DOUBLE CONTAINMENT)
MH-C TO MH-E	10" INTERIOR, 12" EXTERIOR (DOUBLE CONTAINMENT)
MH-D TO MH-E	8" INTERIOR, 10" EXTERIOR (DOUBLE CONTAINMENT)
MH-E TO OUTFALL	10"

NOTE: CONVEYANCE PIPE LOCATIONS BASED ON DESIGN PLAN AND FIELD OBSERVATIONS

MANHOLE DATA

MH-A
RIM 38.8
BOTTOM 30.65
IE. 6" NE 35.40
IE. 6" W 35.40
IE. 6" S'LY 32.85 (OUT)

MH-B
RIM 41.01
BOTTOM 29.41
IE. 6" E'LY 34.31
IE. 6" N'LY 31.56
IE. 10" E'LY 31.51 (OUT)

MH-C
RIM 37.36
BOTTOM 27.60
IE. 10" NW 29.61
IE. 6" SW 33.81
IE. 10" SW 29.46 (OUT)

MH-D
RIM 35.79
BOTTOM 28.51
IE. 8" NE 32.59
IE. 8" SW 32.54
IE. 8" SW 30.52 (OUT)

MH-E
RIM 36.08
BOTTOM 24.99
IE. 10" N 27.87
IE. 8" NE 29.17
IE. 10" W'LY 27.27 (OUT)

NOTE: ELEVATIONS IN FT. NAVD 88

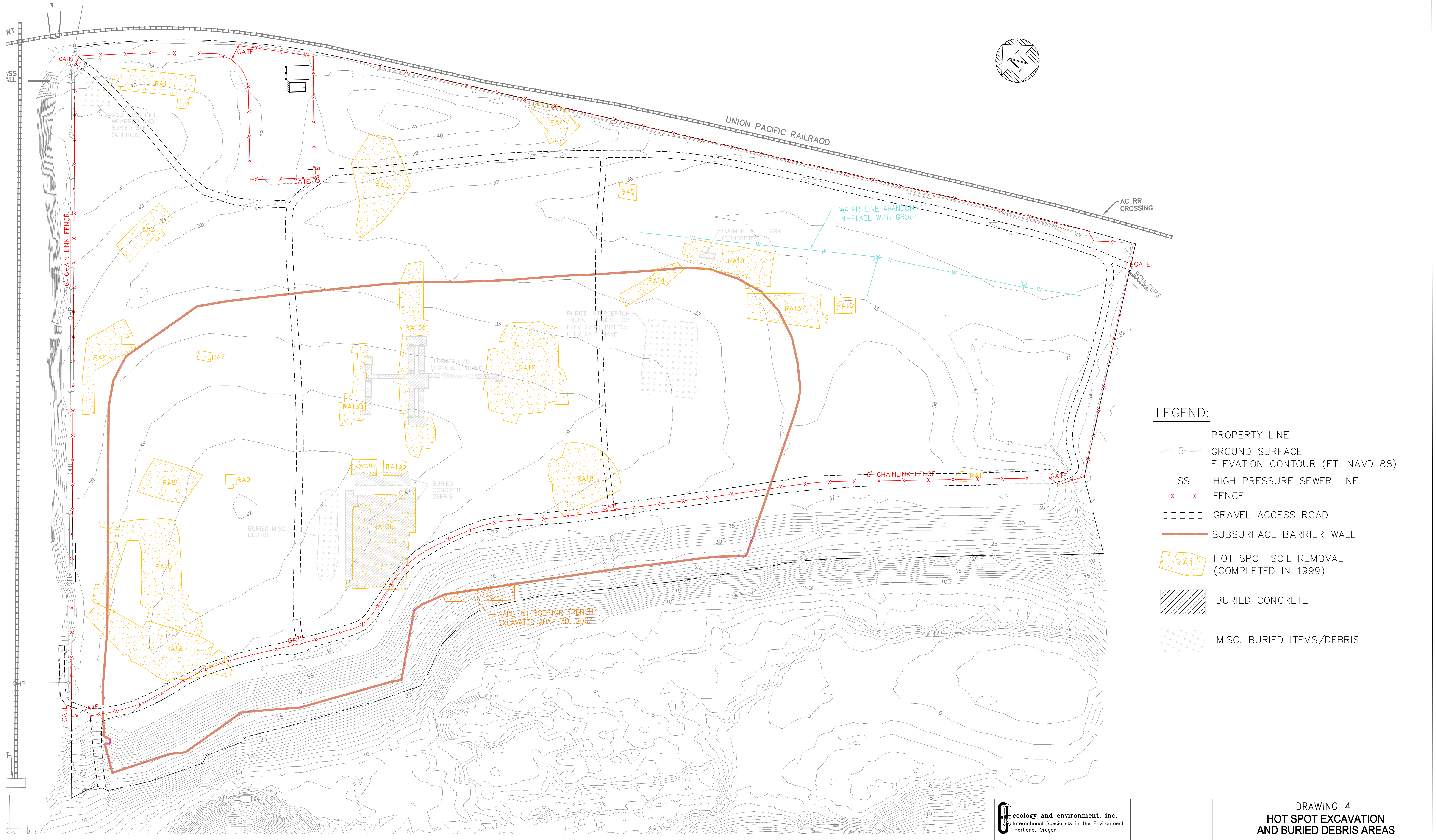
McCormick and Baxter Superfund Site
Portland, Oregon

Upland Cap Features

3/10

HARTCROWSER
GSI Water Solutions, Inc.

Drawing
3



SCALE IN FEET: 1"= 80'

0 80 160 240

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

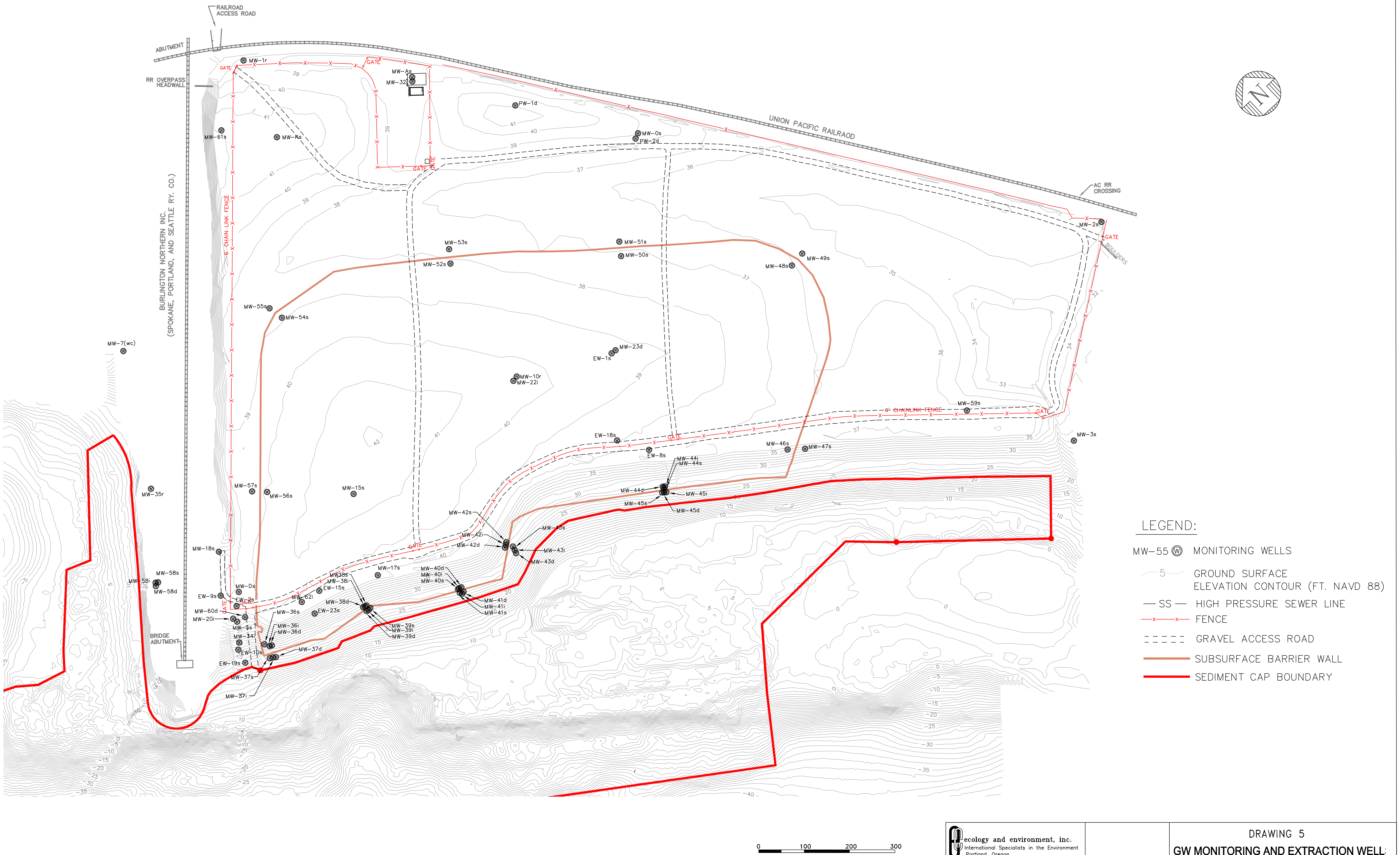
DRAWN BY: C. NANCARROW

APPROVED BY A. WHITMAN

DRAWING 4
HOT SPOT EXCAVATION AND BURIED DEBRIS AREAS

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: C. NANCARROW

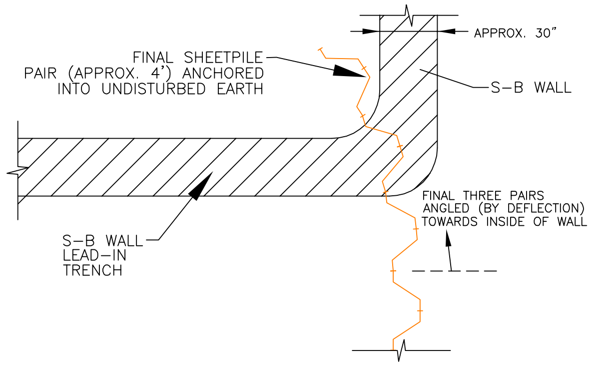
APPROVED BY A. WHITMAN

DRAWING 5

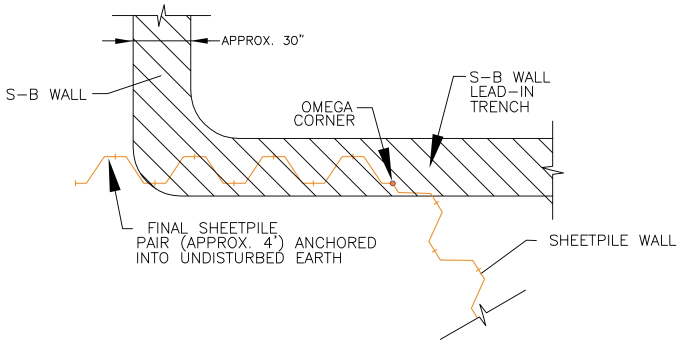
GW MONITORING AND EXTRACTION WELL

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



SHEETPILE TO SLURRY WALL TIE-IN DETAIL
NEAR STATION 1+00
NTS



SHEETPILE TO SLURRY WALL TIE-IN DETAIL
NEAR STATION 15+40
NTS

LEGEND:

- — — — PROPERTY LINE
- 5 GROUND SURFACE ELEVATION CONTOUR (FT. NAVD 88)
- — SS — HIGH PRESSURE SEWER LINE
- —x—x— FENCE
- - - - - GRAVEL ACCESS ROAD
- ━━ SUBSURFACE BARRIER WALL
- 2+00 1+00 BARRIER WALL ALIGNMENT WITH STATIONING

SCALE IN FEET: 1"= 100'
0 100 200 300

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

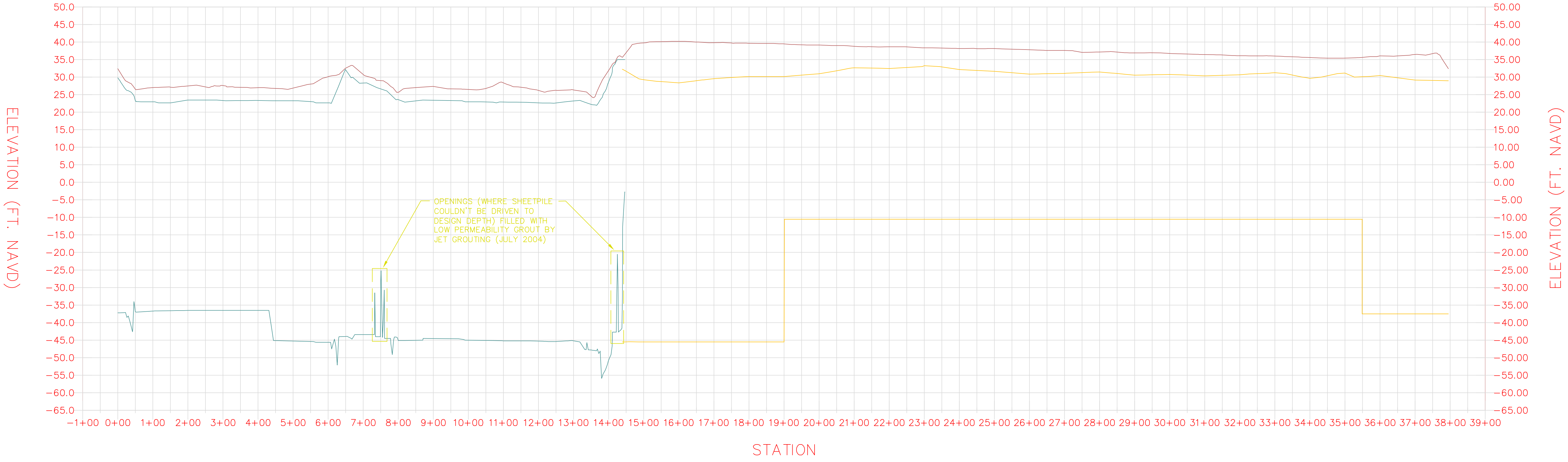
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 6

BARRIER WALL: PLAN

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



HORIZONTAL SCALE IN FEET: 1"= 150'

0 150 300 450

VERTICAL SCALE IN FEET: 1"= 15'
(10X VERTICAL EXAGGERATION)

0 15 30 45

LEGEND:

- EXISTING GROUND
- SOIL-BENTONITE WALL (SLURRY WALL)
- SHEETPILE WALL

NO.	DATE	DWN	APP'D	DESCRIPTION

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International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: C. NANCARROW

APPROVED BY
A. WHITMAN

DRAWING 7

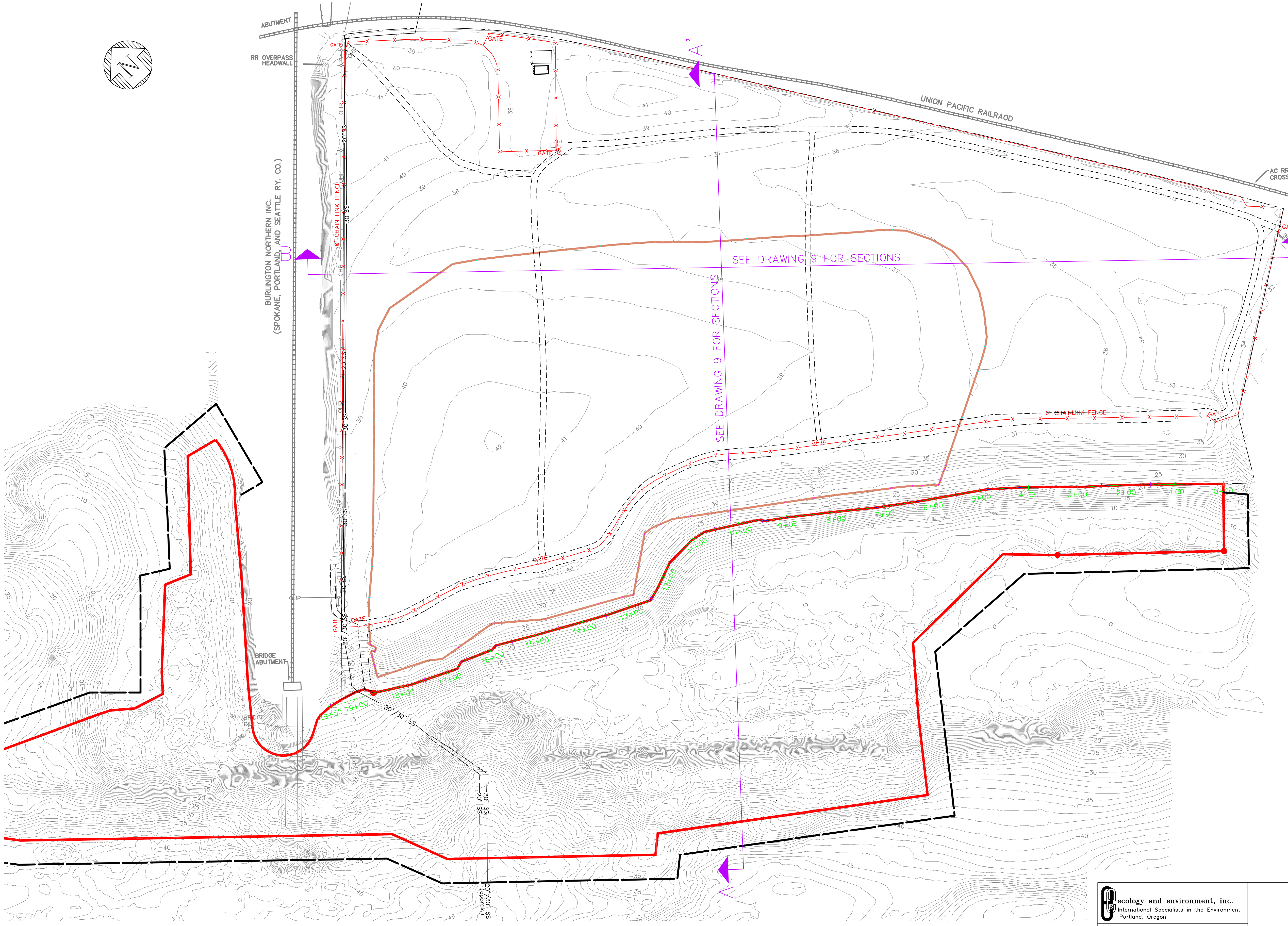
BARRIER WALL: PROFILE

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE
NOTED

01-24-07

SitewideDrawings_Civil3D.dwg



SCALE IN FEET: 1"= 100'

0 100 200 300

LEGEND:

PROPERTY LINE

DSL EASEMENT (#31530-EA)

5 GROUND SURFACE ELEVATION CONTOUR (FT. NAVD 88)

SS HIGH PRESSURE SEWER LINE

OPH OVERHEAD POWER

x FENCE

GRAVEL ACCESS ROAD

SUBSURFACE BARRIER WALL

SEDIMENT CAP BOUNDARY

1+00 0+00 NEW SITE ALIGNMENT WITH STATIONING

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

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International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: C. NANCARROW

APPROVED BY A. WHITMAN

DRAWING 8

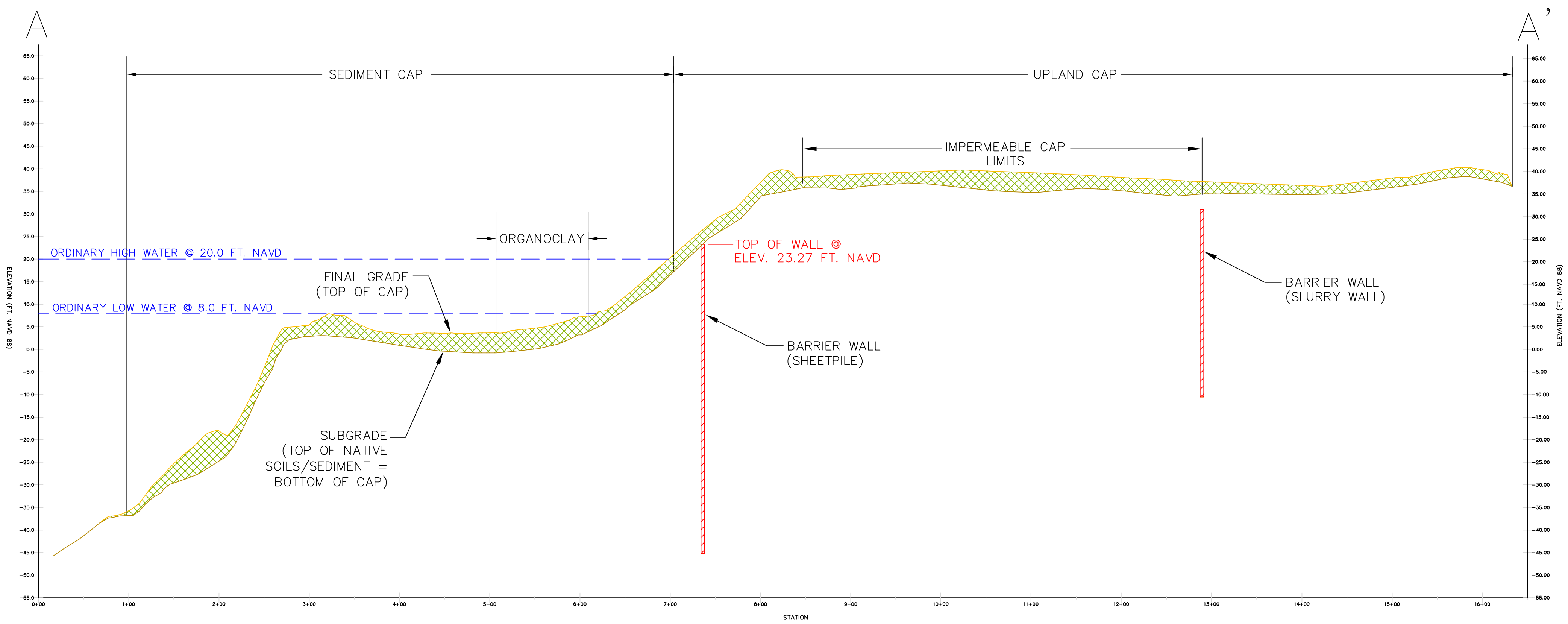
SITE ALIGNMENT

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE NOTED

DATE ISSUED 01-24-07

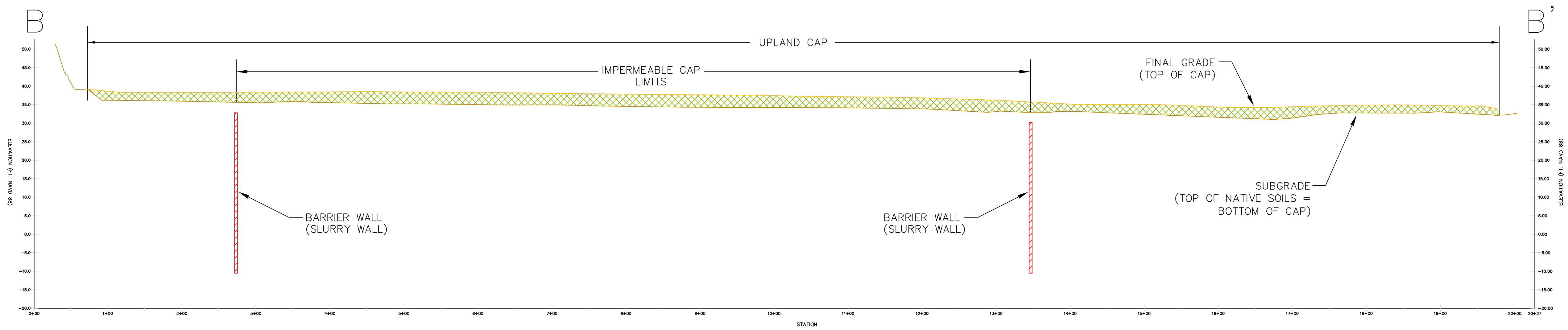
C.A.D. FILE NO. SitewideDrawings_Civil3D.dwg



SECTION A–A'

LEGEND:

- FINAL GRADE (TOP OF CAP)
- SUBGRADE/EXISTING GROUND (NATIVE SOILS/SEDIMENTS = BOTTOM OF CAP)
- ▨ CAP
- ▨ BARRIER WALL



SECTION B–B'

HORIZONTAL SCALE IN FEET: 1"= 80'
0 80 160 240

VERTICAL SCALE IN FEET: 1"= 16'
(5X VERTICAL EXAGGERATION)
0 16 32 48

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

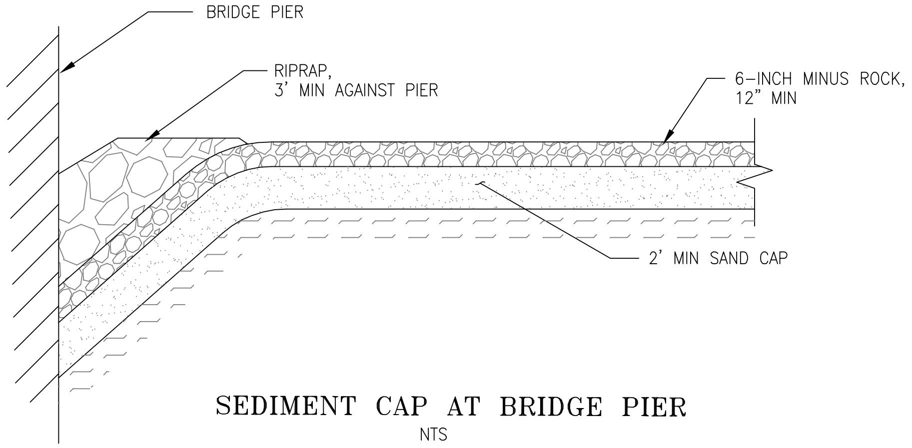
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 9

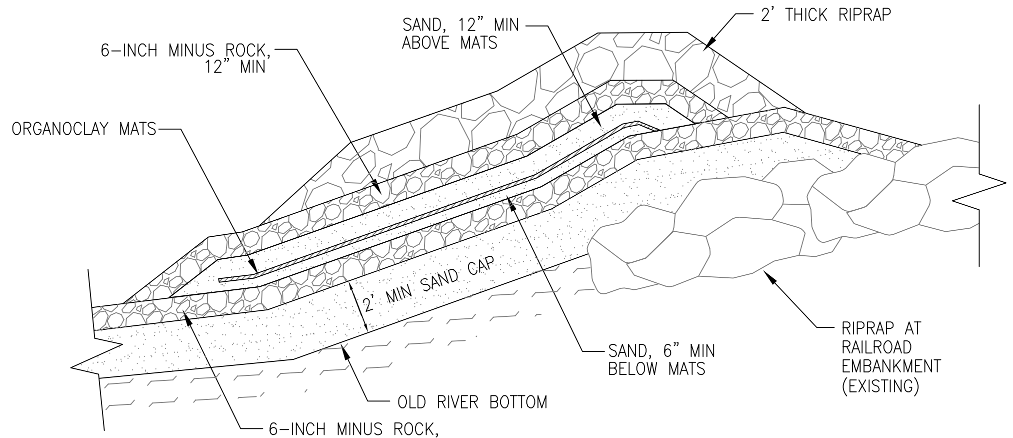
SECTIONS

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

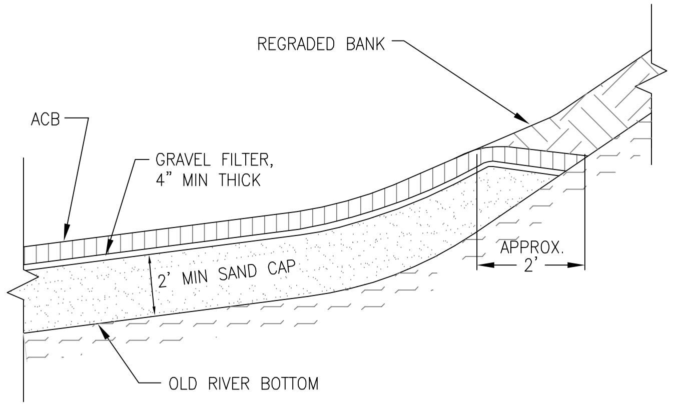
SCALE NOTED
DATE ISSUED 01-24-07
C.A.D. FILE NO. SitewideDrawings_Civil3D.dwg



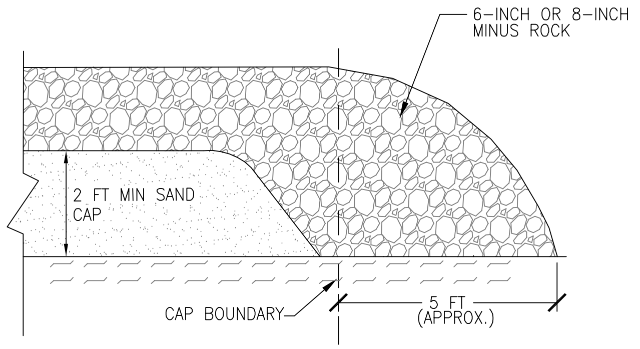
SEDIMENT CAP AT BRIDGE PIER
NTS



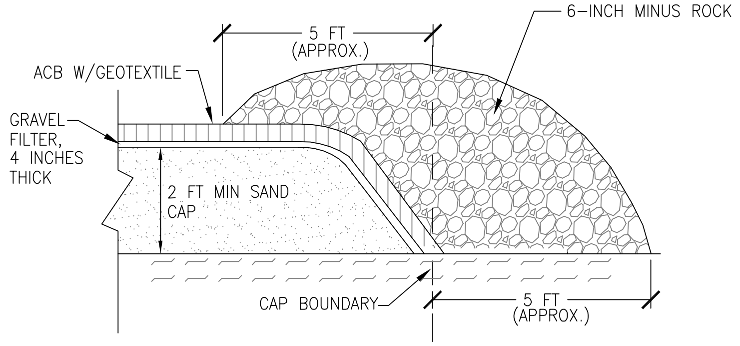
SEDIMENT CAP AT RAILROAD BRIDGE RIPRAP
NTS



ACB/BANK REGRADE INTERFACE
NTS



ROCK EDGE AT CAP BOUNDARY
NTS



ACB EDGE AT CAP BOUNDARY
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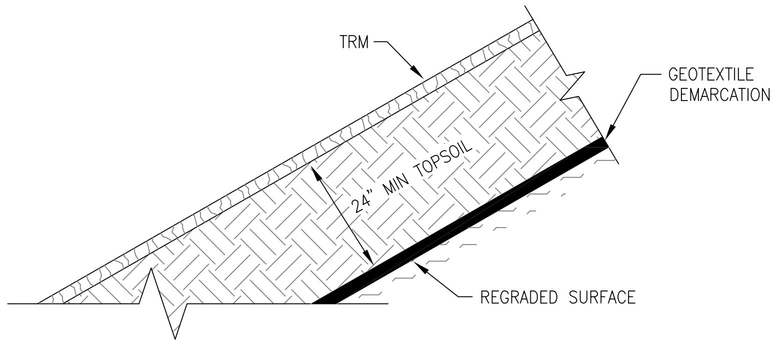
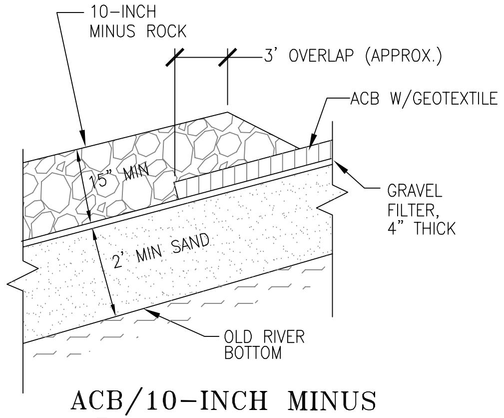
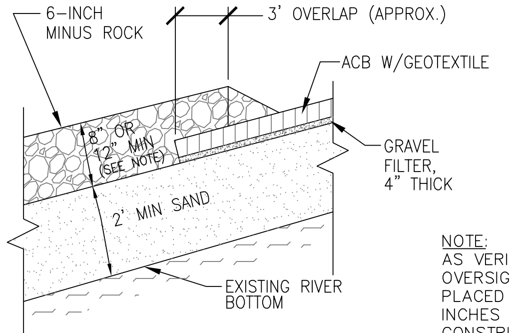


REGRADED BANK TREATMENT
NTS



ACB/10-INCH MINUS ROCK INTERFACE
NTS



ACB/6-INCH MINUS ROCK INTERFACE
NTS

NOTE:
AS VERIFIED THROUGH CONSTRUCTION OVERSIGHT, 6-INCH MINUS ROCK WAS PLACED TO THE DESIGN THICKNESS OF 12 INCHES DURING 2004 SEDIMENT CAP CONSTRUCTION AND 8 INCHES DURING 2005 SEDIMENT CAP CONSTRUCTION.

EDGES AND INTERFACES

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

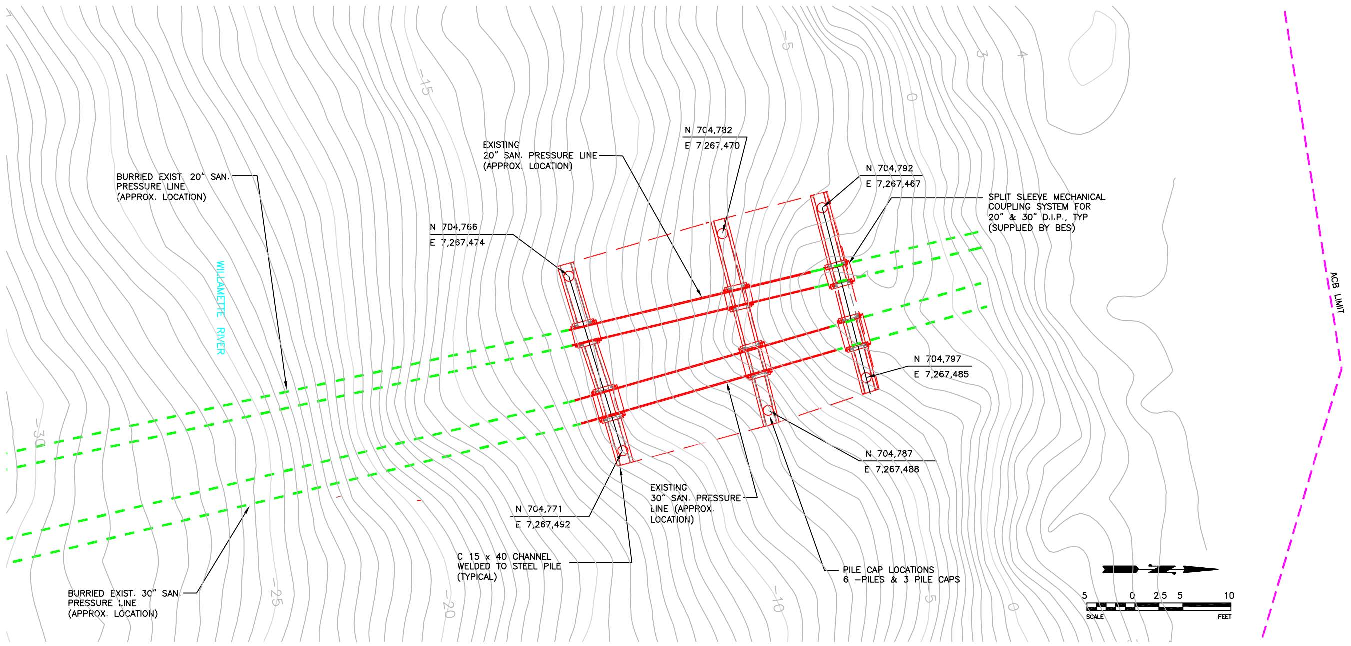
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 10

SEDIMENT CAP DETAILS - SHEET 1

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

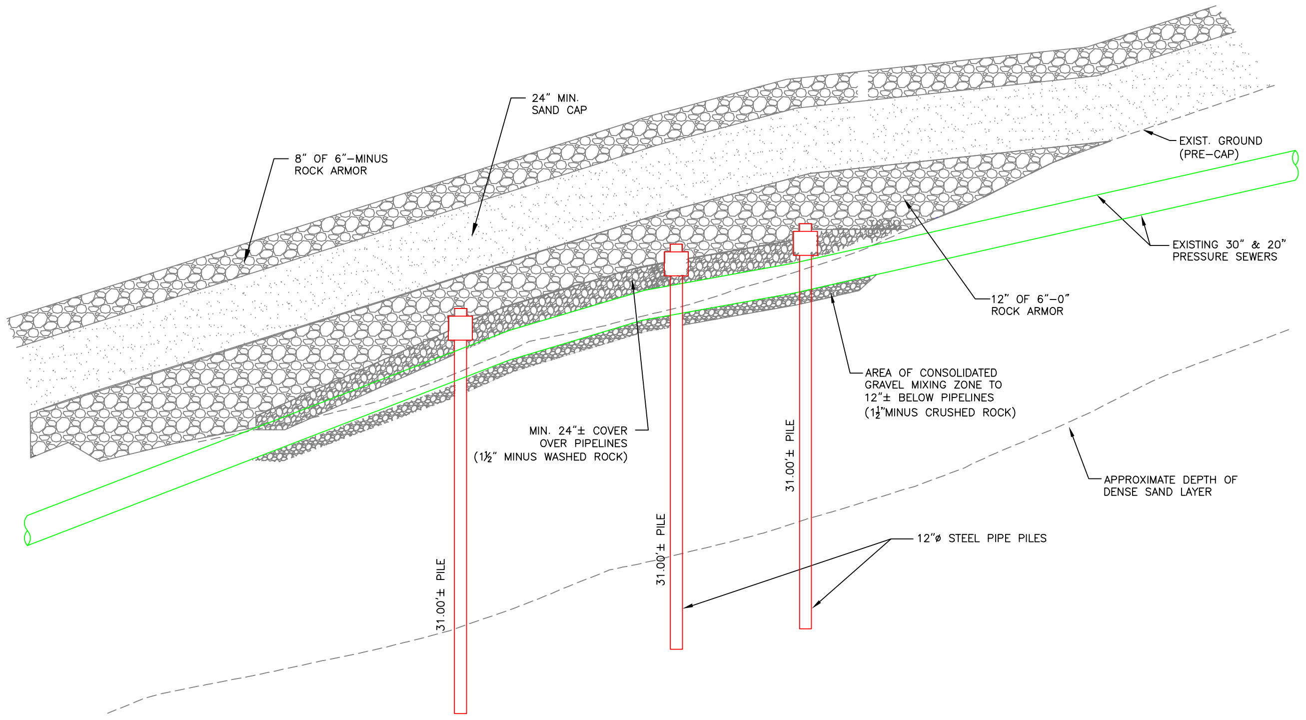
SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



MECHANICAL COUPLING SYSTEM FOR SEWER LINES: PLAN VIEW

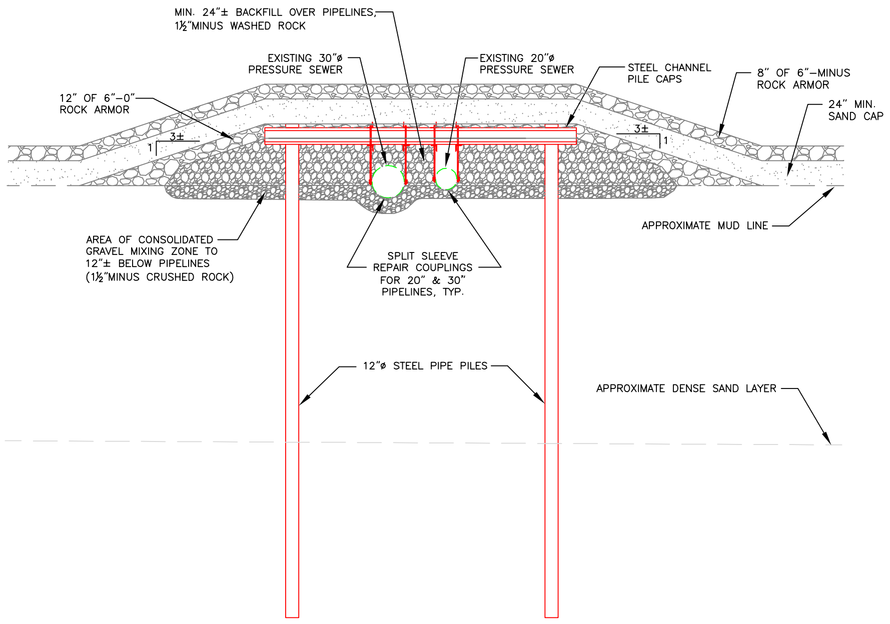
NOTES:

1. DRAWINGS ON THIS SHEET ARE BASED ON RECORD DRAWINGS FROM CITY OF PORTLAND ENVIRONMENTAL SERVICES, FILENAMES "7922C01.DWG", "7922C02.DWG", AND "7922C03.DWG", 05/04/05.
2. FOR MORE DETAILS, SEE "REMEDIAL ACTION CONSTRUCTION SUMMARY REPORT, SEDIMENT CAP COMPLETION (AUGUST 2005 THROUGH OCTOBER 2005)", PREPARED BY ECOLOGY & ENVIRONMENT.
3. VERTICAL DATUM: CITY OF PORTLAND (COP). TO CONVERT TO NAVD88, ADD 2.12 FEET.



MECHANICAL COUPLING SYSTEM FOR SEWER LINES: PROFILE VIEW

NTS



MECHANICAL COUPLING SYSTEM FOR SEWER LINES: SECTION VIEW

NTS

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

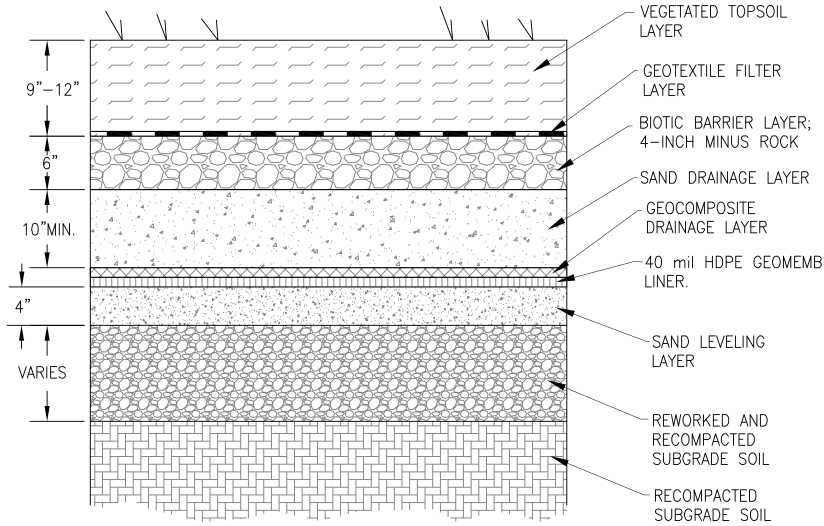
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 11

SEDIMENT CAP DETAILS - SHEET 2

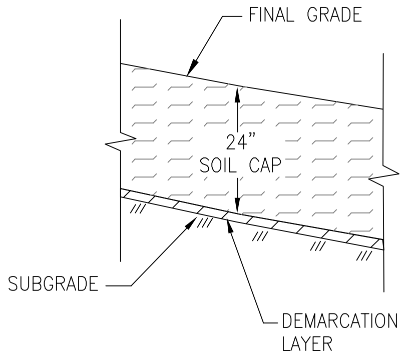
Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE NOTED
DATE ISSUED 01-24-07
C.A.D. FILE NO. SitewideDrawings_Civil3D.dwg



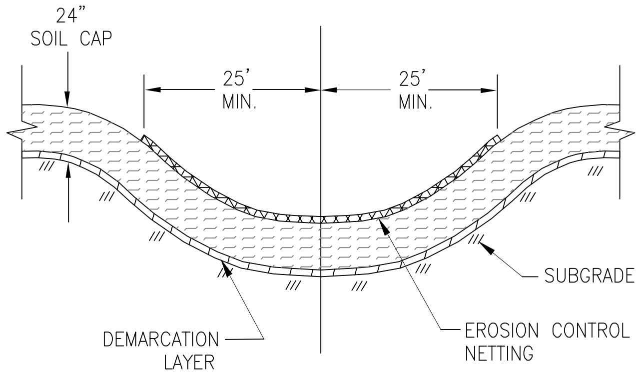
IMPERMEABLE CAP SECTION (TYP.)

NTS



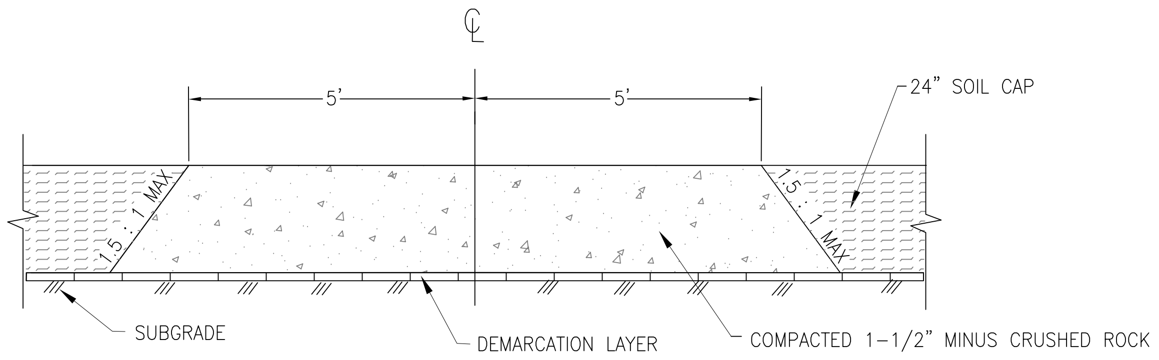
SOIL CAP SECTION (TYP.) OUTSIDE BARRIER WALL

NTS



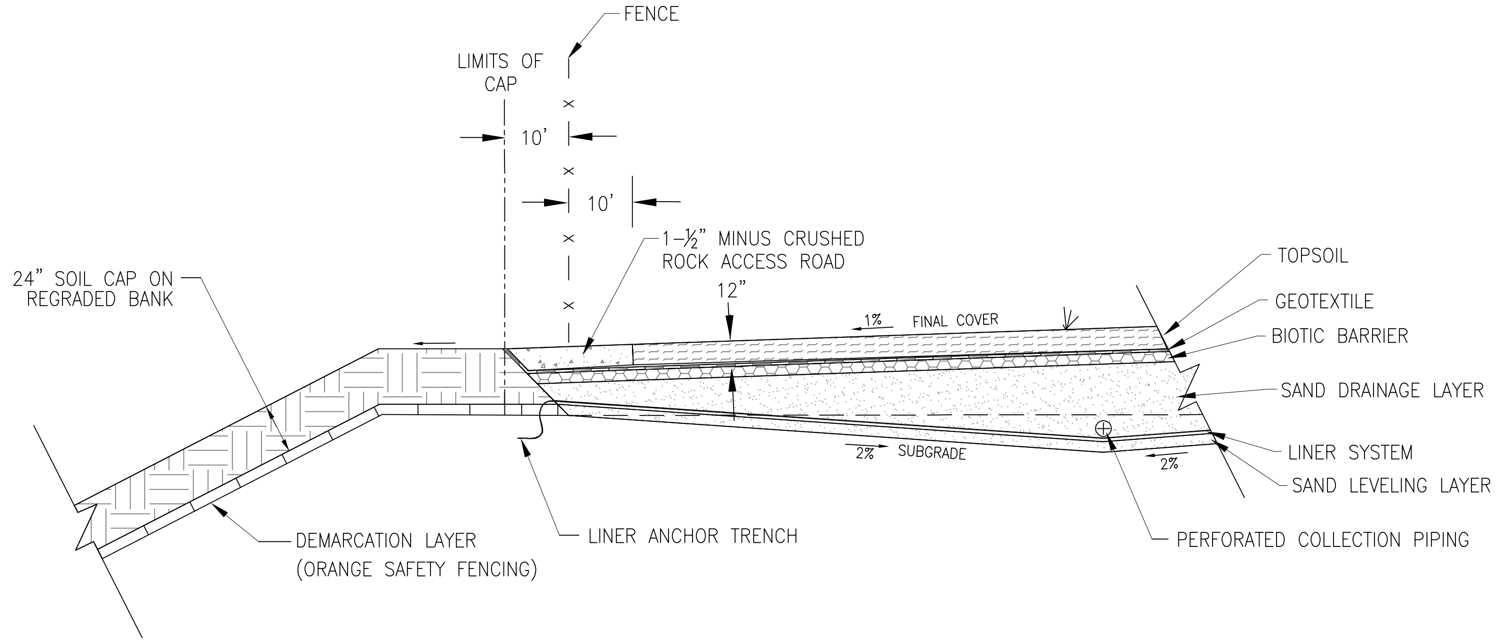
DRAINAGE SWALE

NTS



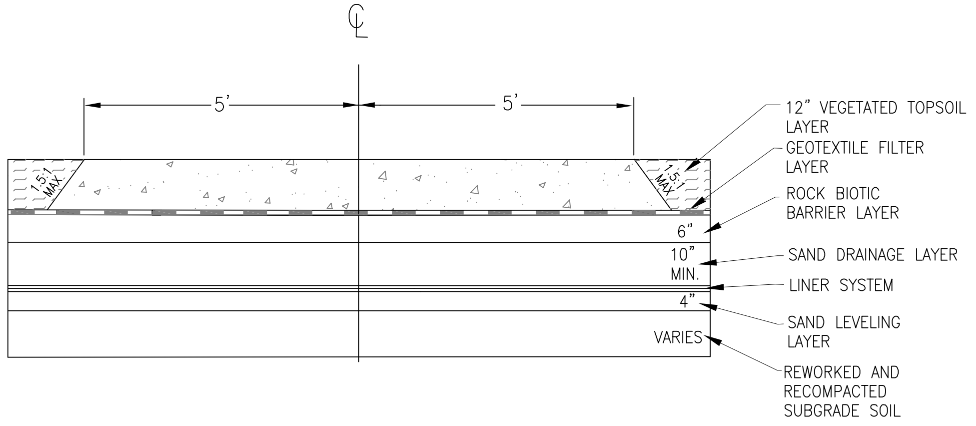
GRAVEL ACCESS ROAD OUTSIDE BARRIER WALL

NTS



IMPERMEBLE CAP TRANSITION TO BANK

NTS



GRAVEL ACCESS ROAD WITHIN BARRIER WALL

NTS

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

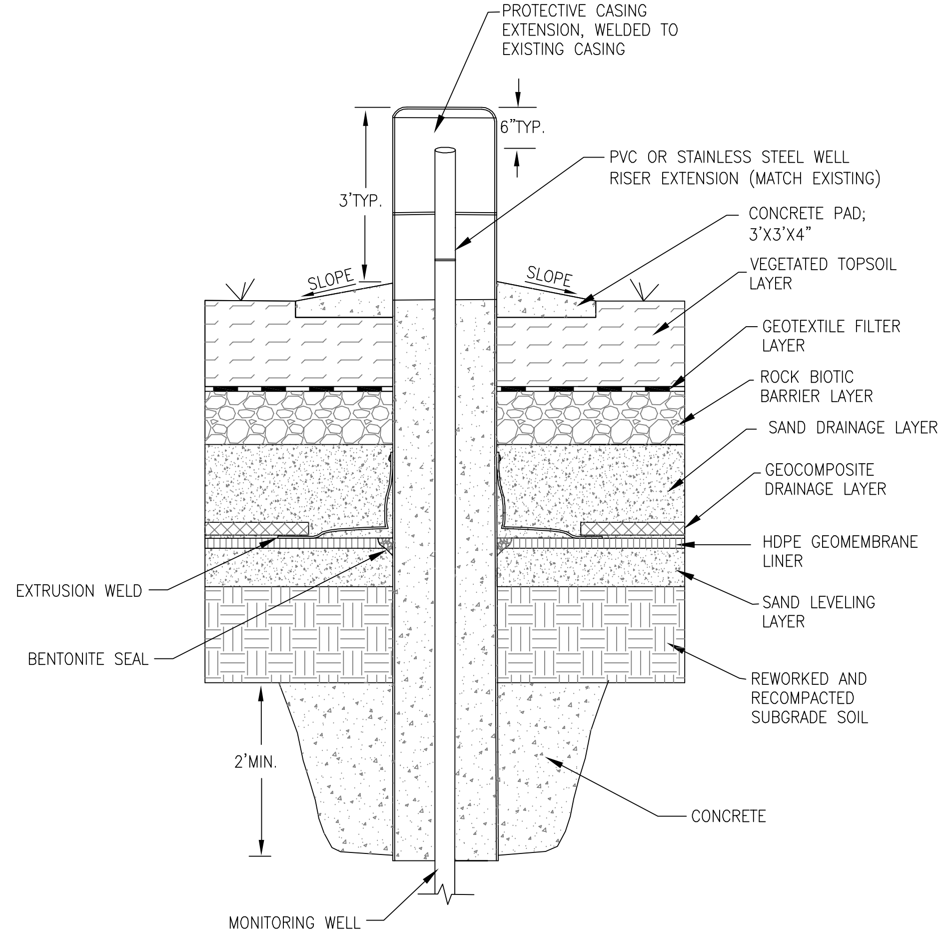
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 12

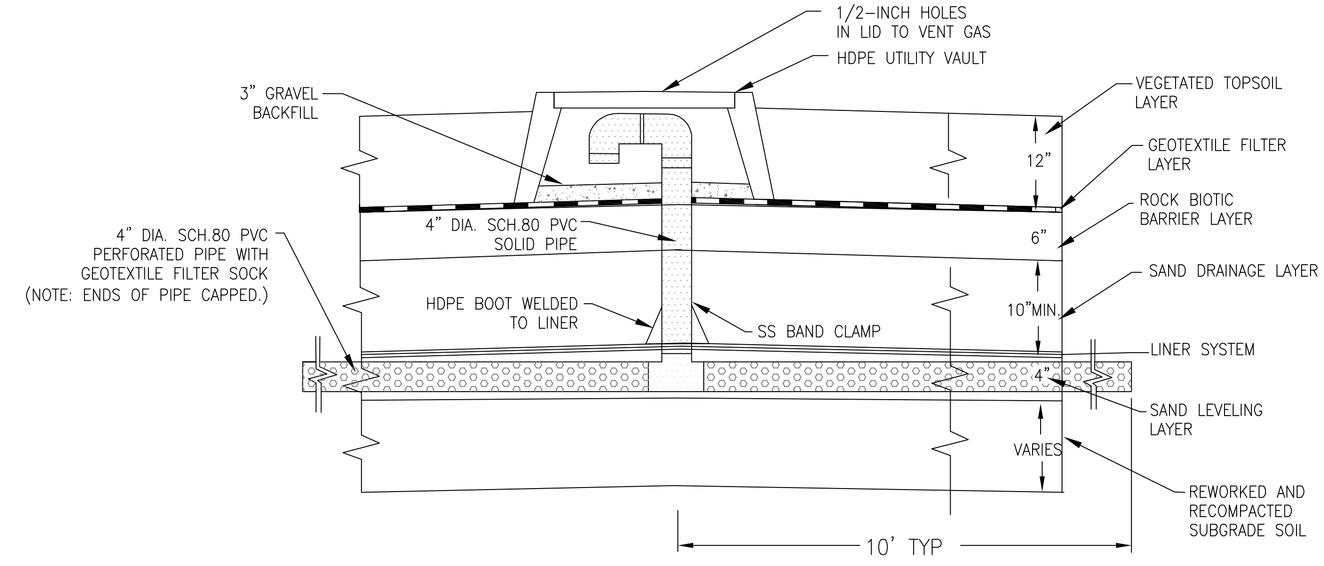
UPLAND CAP DETAILS - SHEET 1

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

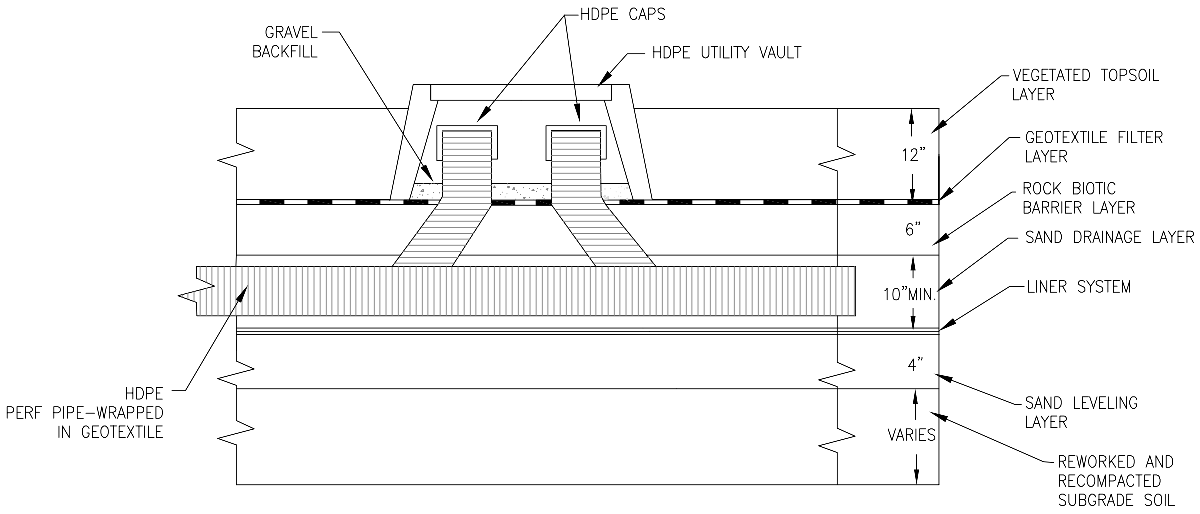
SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



MONITORING WELL
WITHIN IMPERMEABLE CAP
NTS



GAS VENT
NTS



PERFORATED PIPE CLEANOUT
NTS

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

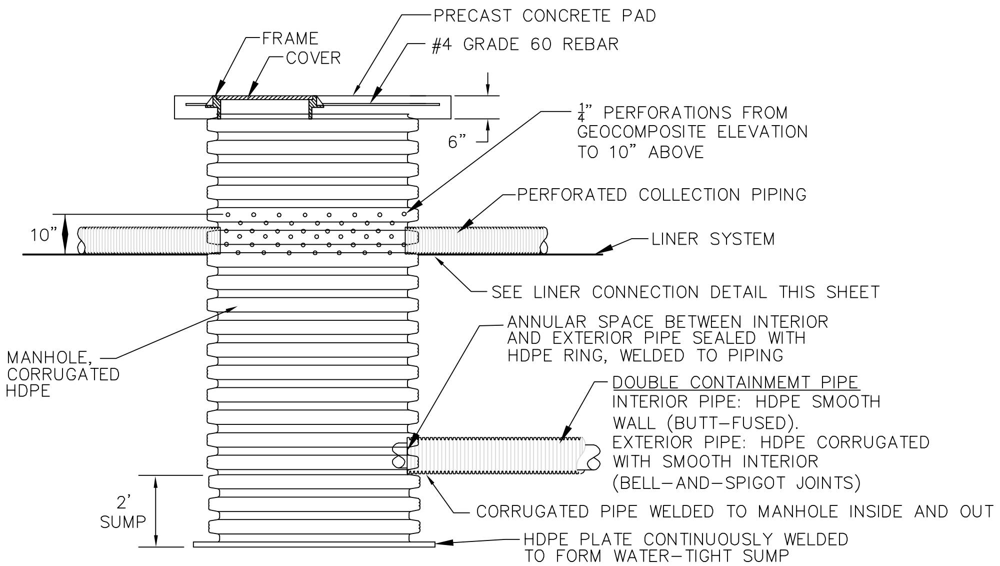
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 13

UPLAND CAP DETAILS - SHEET 2

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



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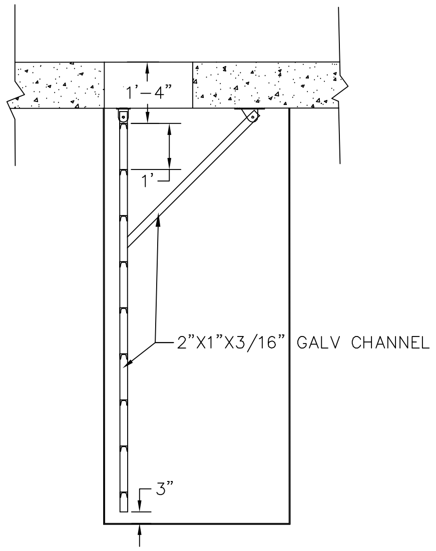

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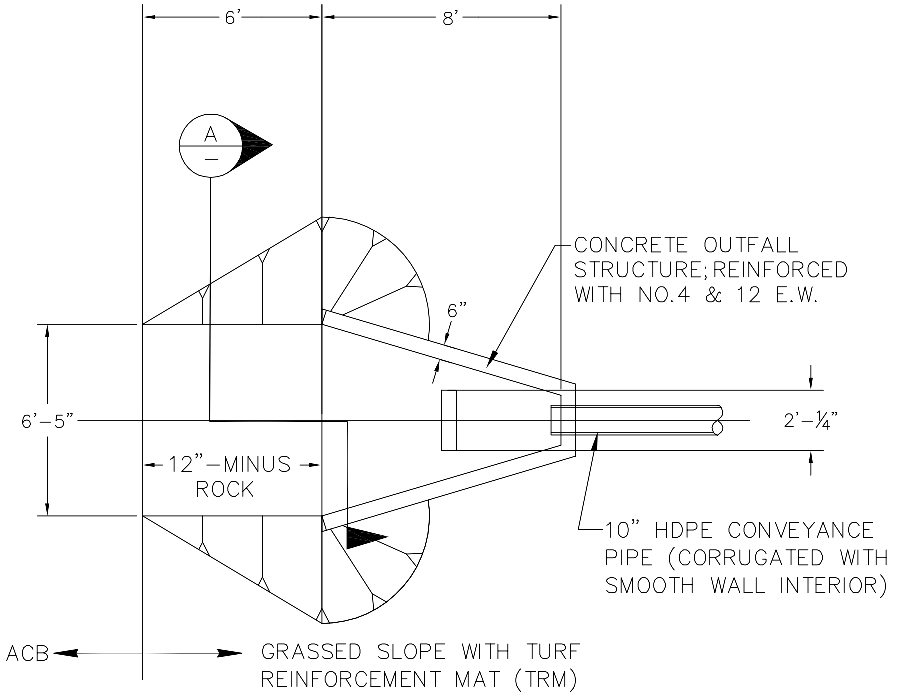

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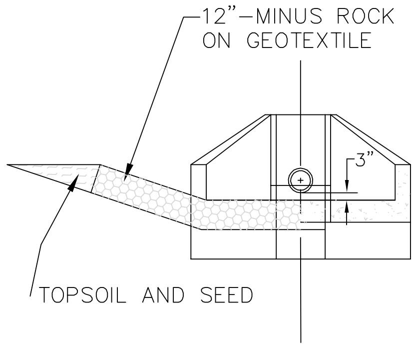

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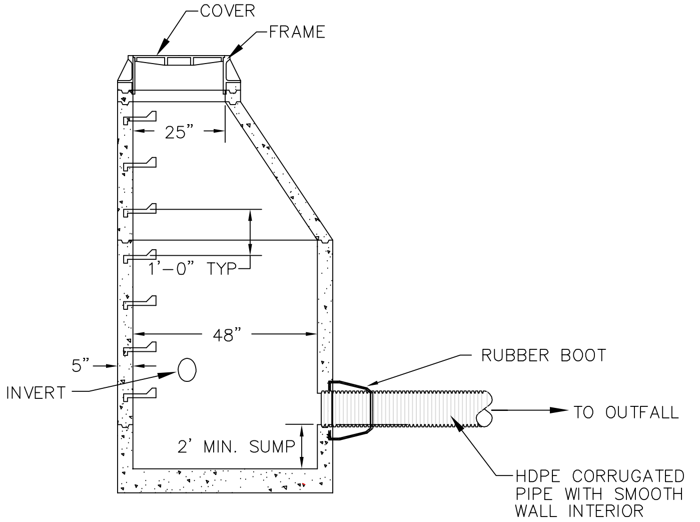

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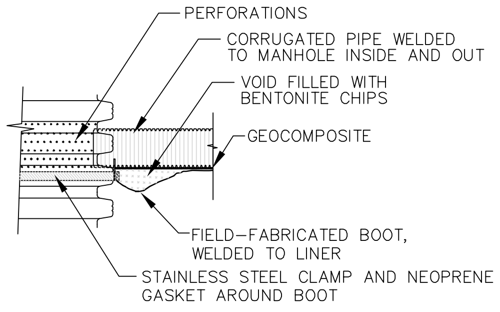

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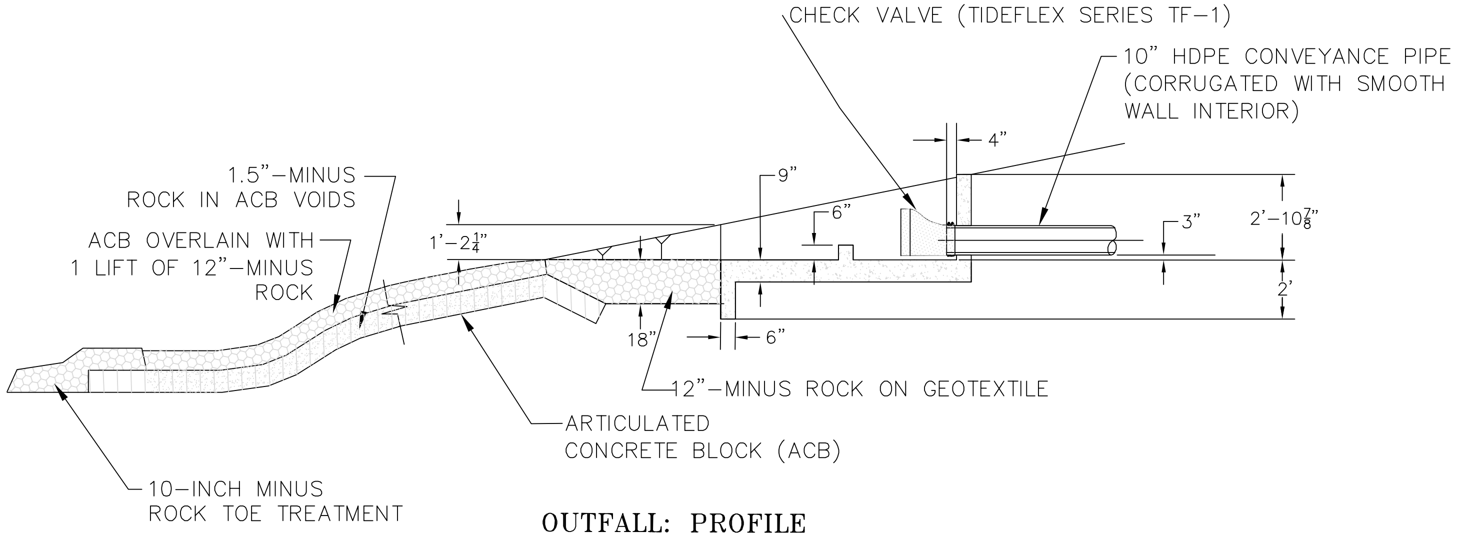


OUTFALL: PROFILE

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

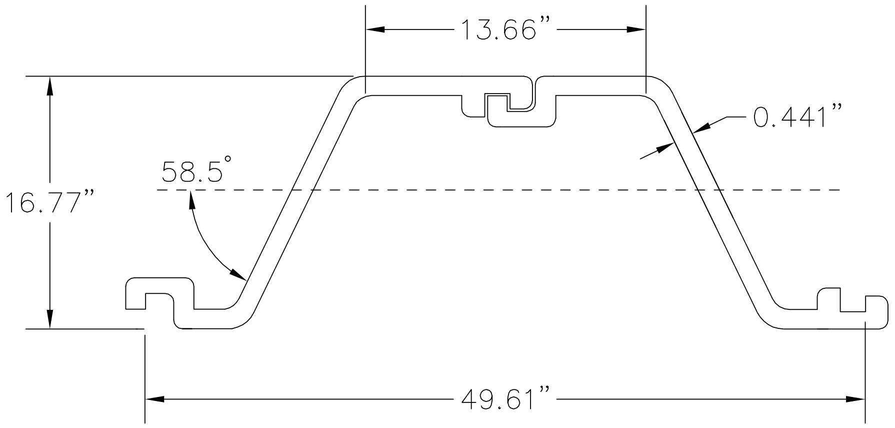
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 14

UPLAND CAP DETAILS - SHEET 3

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	01-24-07	SitewideDrawings_Civil3D.dwg



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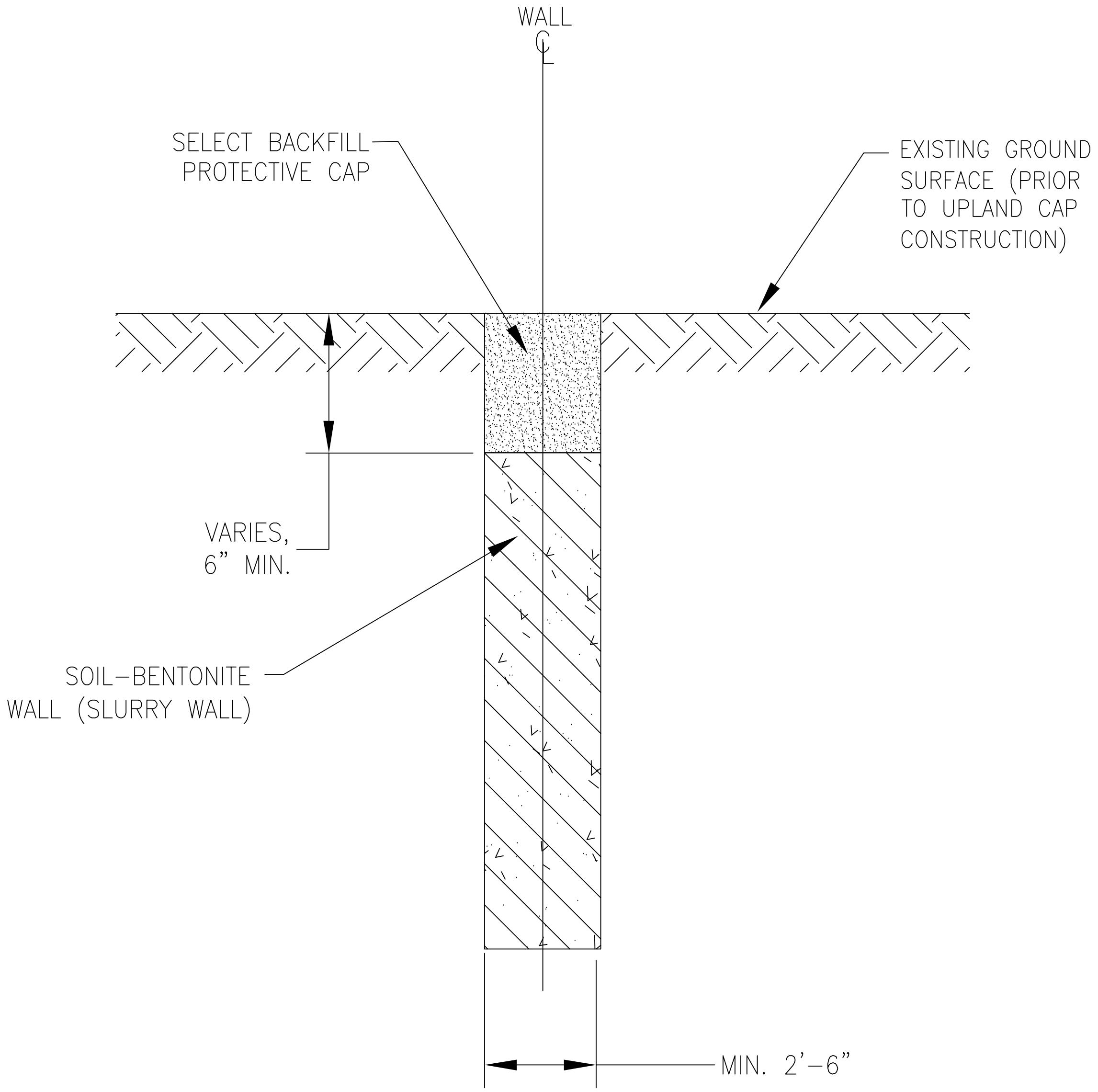

SLURRY WALL SECTION
NTS

NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY A. WHITMAN

DRAWING 15

BARRIER WALL DETAILS

Sitewide Record Drawings
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE NOTED
DATE ISSUED 01–24–07
C.A.D. FILE NO. SitewideDrawings_Civil3D.dwg

APPENDIX B
O&M PLAN

Operation and Maintenance Plan

For

McCormick & Baxter Creosoting Company
Superfund Site
Portland, Multnomah County, Oregon

EPA CERCLIS # ORD009020603
DEQ ECSI # 74

FINAL
March 2014

Prepared by:

Oregon Department of
Environmental Quality (DEQ)

And

U.S. Environmental Protection Agency
Region X

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ACRONYMS

ACB	articulated concrete block
ACL	alternate concentration limit
ACZA	ammoniacal copper zinc arsenate
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
bgs	below ground surface
BNSF	BNSF Railway Co.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPA	central processing area
DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
DNAPL	dense non-aqueous phase liquid
E&E	Ecology & Environment, Inc.
EES	Easement and Equitable Servitude
EPA	U. S. Environmental Protection Agency
ESD	Explanation of Significant Difference
FWDA	former waste disposal area
GSI	GSI Water Solutions, Inc.
IC	institutional control
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
µg/L	microgram per liter
mg/kg	milligram per kilogram
ng/L	nanogram per liter
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NCP	National Oil and Hazardous Substances Contingency Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NPL	National Priorities List
NRWQC	National Recommended Water Quality Criteria
O&F	operational and functional
O&M	operation and maintenance
ODSL	Oregon Division of State Lands
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCP	pentachlorophenol
PPA	Prospective Purchaser Agreement
RAO	remedial action objective
RCM	reactive core mat
RCRA	Resource Conservation and Recovery Act
RNA	Regulated Navigational Area
ROD	Record of Decision
Site	McCormick & Baxter Creosoting Company Superfund Site
SPME	solid phase micro-extraction
SSC	Superfund State Contract
TFA	tank farm area
UPRR	Union Pacific Railroad Co.
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

OPERATION AND MAINTENANCE PLAN
McCORMICK & BAXTER SUPERFUND SITE
PORTLAND, OREGON

1.0 INTRODUCTION AND PURPOSE

The Oregon Department of Environmental Quality (DEQ) has prepared this Operations and Maintenance (O&M) Plan for the remedial actions implemented at the McCormick & Baxter Superfund Site (Site), located in Portland, Multnomah County, Oregon. Preparation of this O&M Plan was supported by DEQ's Contractors, Hart Crowser, Inc. (Hart Crowser) and GSI Water Solutions, Inc. (GSI).

Section 104(c)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires the State to assure all future maintenance of CERCLA-funded removal and remedial actions provided for the expected life of such actions as determined by the President. 42 U.S.C. § 9604(c)(3). The DEQ has entered into a State Superfund Contract (SSC) under which the DEQ has assured the O&M of the implemented CERCLA-funded remedial action.

The purpose of this document is to help ensure the proper transition of O&M responsibility of the Fund-lead remedial action at the McCormick & Baxter Superfund Site from the United States Environmental Protection Agency (EPA) to DEQ, and to ensure adequate O&M for the remedial action. This O&M Plan defines the administrative, financial, and technical details and requirements for inspecting, monitoring, operating, and maintaining the remedial actions at the Site. This plan also includes information on maintaining, as appropriate, institutional controls (ICs) established at the Site pursuant to the Record of Decision (ROD), ROD Amendment, Explanation of Significant Difference, and Five Year Reviews jointly issued by EPA and DEQ, and information regarding additional restrictions to ensure that the Site is protective for the long term.

An O&M Manual has been prepared to serve as a companion to the O&M Plan. The O&M Manual contains up-to-date, site-wide record drawings of the remedial features present at the Site. The O&M Manual specifies the sampling and monitoring procedures, quality assurance and quality control, technical information, and data necessary for implementing the O&M activities. The O&M Manual is a living document that will be periodically modified by DEQ to reflect necessary monitoring and maintenance needs at the Site.

The assumption of O&M activities by DEQ and the nature of those actions are described in CERCLA, 42 U.S.C. § 9601 *et seq*., in EPA regulations titled "The National Oil and Hazardous Substances Pollution Contingency Plan" (NCP), 40 C.F.R. Part 300, and in the following documents:

1. *Operation and Maintenance in the Superfund Program Fact Sheet*, 9200.1-37FS, US. EPA. May 2001;

2. *Superfund State Contract Between EPA and the State of Oregon for Remedial Design and Remedial Action at the McCormick & Baxter Superfund Site* executed on May 22, 1996, as subsequently amended.

This O&M Plan is intended to address the O&M elements described in the EPA Fact Sheet titled *Operation and Maintenance in the Superfund Program*[1], page 7. The general arrangements for the O&M activities for each element of the remedy - soil cap, sediment cap, and subsurface barrier wall - are described in Sections 7, 8, and 9 of this plan. Procedures to conduct the O&M activities for each remedy are contained in the O&M Manual.

This O&M Plan may be modified over time due to changed Site conditions, new guidance, and development of further details concerning O&M at the Site. Modifications to the Plan may be made by mutual agreement between EPA and DEQ.

2.0 DESIGNATION OF THE ORGANIZATIONAL UNIT OF THE GOVERNMENT RESPONSIBLE FOR O&M

DEQ is the State agency responsible to ensure O&M of CERCLA-funded remedial actions will be carried out at the Site. References to “the State” in this plan mean DEQ.

3.0 IDENTIFICATION OF THE AVAILABLE STATE FUNDING MECHANISMS FOR O&M ACTIVITIES

DEQ will conduct O&M activities using funds provided from the DEQ’s Orphan Site Account; to the extent such funds are available. The Orphan Site Account is described in Oregon Revised Statutes 465.381. DEQ will seek funding as necessary and appropriate to conduct O&M activities at the Site.

4.0 SITE BACKGROUND

4.1 Site Description

The McCormick & Baxter Superfund Site includes a former wood-treating facility located on the east bank of the Willamette River in Portland, Oregon (“the McCormick & Baxter Property” which consists of the area owned by the McCormick & Baxter Creosoting Company). The Site encompasses approximately 41 acres of land and an additional 23 acres of contaminated river sediments. The legal address of the McCormick & Baxter Property is 6900 North Edgewater Avenue, Portland, Oregon, and the DEQ’s Environmental Cleanup Site Information (ECSI) number is 74. Figure 1 shows the Site location. Figure 2 shows the current Site layout and features from an aerial photograph. Figure 3 depicts the current Site layout and features on a

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[1] EPA, 2001. *Operation and Maintenance in the Superfund Program*. Prepared by the United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. OSWER 9200.1-37FS. EPA 540-F-01-004. May 2001.

topographic map of the sediment and terrestrial surface elevations. Figure 4 shows the groundwater monitoring well locations at the Site. The upland portion of the Site is on a terrace of imported sand fill (dredged material placed in the early 1900s) within the historic flood plain of the Willamette River. This upland area is generally flat and lies between a 120-foot-high bluff along the northeast border and a 25- to 30-foot-high bank along the Willamette River to the southwest. Currently, the McCormick & Baxter Property is vacant except for a paved parking area, a small shop building, and associated utilities used to support ongoing monitoring of the Site.

A residential area is located above the Site on the adjacent bluff. The 115 acre University of Portland college campus is also located on the bluff, approximately 0.5-mile southeast of the Site. The University of Portland recently purchased the former industrial property (Triangle Park) bordering the Site to the southeast with pending plans for reuse (e.g., athletic fields, and supporting buildings). A BNSF Railway Co. (BNSF) track crosses the northwest portion of the Site, and Union Pacific Railroad (UPRR) track borders the Site to the southeast below the bluff. Beyond the BNSF track, toward the northwest, is a former industrial property managed by Metro (regional government) that is planned to be developed as a public green space (Baltimore Woods). The perimeter of the McCormick & Baxter Property[2] is fenced and posted with warning signs.

4.2 Site History

The McCormick & Baxter Creosoting Company was founded in 1944 to produce treated wood products, including lumber, piling, timbers, and railroad ties during World War II. The wood treating operations continued at the Site until October 1991.

Four retorts were located in the central processing area (CPA) at the Site and were used for various pressure treating processes, which included the use of creosote, pentachlorophenol (PCP), chromium, ammoniacal copper arsenate, ammoniacal copper zinc arsenate (ACZA), and Cellon (PCP in diesel oil, liquid butane, and isopropyl ether). A 750,000-gallon creosote product storage tank was located in a tank farm area (TFA) that included several additional tanks for storing wood-treatment chemicals at the Site.

Between 1945 and 1969, the plant's wastewater from the retorts' oil/water separators, along with boiler blowdown and condenser cooling water were directly discharged to the Willamette River. Three stormwater outfalls were also present along the river. Following plant shutdown, DEQ placed earthen berms around stormwater collection sumps at the Site as an early response action to minimize off-site discharge. The stormwater outfalls were removed as part of the first phase of the soil remedial action conducted in 1999.

Site investigations revealed many releases of wood-treating chemical compounds to soils, groundwater, and sediments as a result of historic Site operations. Contaminants detected include

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[2] More specifically, the fence is located along the legal boundary of the McCormick & Baxter Property, except along the riverfront, where the fence is located along the landward edge of the riparian zone.

polynuclear aromatic hydrocarbons (PAHs, comprising 85 percent of the creosote), PCP, arsenic, chromium, copper, zinc, and dioxins/furans. Three main contaminant sources existed at the Site:

- The former waste disposal area (FWDA), which was located in the western corner of the Site, adjacent to the Willamette River and characterized by a large depression where waste oils, retort sludges, and wastewater were disposed of over a period of several years;
- The CPA, which was located in the center portion of the Site, where retorts, a PCP mixing shed, and ACZA storage areas were formerly located; and
- The TFA, which was located in the south-central portion of the Site, which was the former location of the main tank farm, creosote storage tank, and several other wood treatment process-related tanks or process areas.

Releases from these source areas (particularly in the TFA and FWDA) in the form of insoluble wood-treating contaminants or non-aqueous phase liquids (NAPL) have significantly impacted subsurface soils, groundwater, and riverbed sediment. Remedial investigations identified two large NAPL plumes migrating to the river and impacting surface water and sediments. Subsequent monitoring identified another NAPL plume migrating under the BNSF right-of-way toward Willamette Cove. Remedial actions have been implemented to control these sources (as further described in Section 5.0).

Following remedy construction, on-going monitoring has been conducted and numerous investigations have been performed to evaluate remedy effectiveness. Significant activities and investigations were performed during the period between the *Second Five-Year Review* (2006) and the *Third Five-Year Review* (September 2011), and are summarized in Table 1. These investigations and activities include water quality assessments, subsidence monitoring (inside the barrier wall), bathymetric surveys and diver inspections, ebullition and sheen investigations, organophilic clay cap performance assessments, an evaluation of the articulated concrete block (ACB) unconformities in Willamette Cove, and a dense NAPL (DNAPL) Investigation. These studies are discussed in detail in the *Annual O&M Reports* produced after remedy construction and summarized in the *Third Five-Year Review Report* (September 2011). In general, the routine monitoring and subsequent investigations have shown the Site remedies to be functioning as designed. The *Third Five-Year Review* and *Annual O&M Reports* can be found on the McCormick & Baxter EPA Web site:

http://yosemite.epa.gov/r10/cleanup.nsf/sites/mccormick_baxter

4.3 Regulatory History

The McCormick & Baxter Creosoting Company began environmental investigations of the Site in 1983. DEQ entered into a Stipulated Order with the McCormick & Baxter Creosoting Company in 1987, requiring additional investigation and corrective actions. Corrective actions included the installation and operation of a groundwater extraction and treatment system, construction of drip pads in retort areas, construction of covered storage areas for treated wood, and collection and treatment of stormwater. In December 1988, the McCormick & Baxter Creosoting Company filed for Chapter 11 bankruptcy, and in 1990 DEQ assumed responsibility for completing the investigations and cleanup activities at the Site. In October 1991, the McCormick & Baxter Creosoting Company ceased operations.

DEQ began the Remedial Investigation and Feasibility Study in 1990 and issued a public notice for a proposed cleanup plan in January 1993. DEQ elected not to finalize the proposed plan due to the proposed addition of the Site to the National Priorities List (NPL) by the EPA in June 1993. The Site was added to the NPL on June 1, 1994. DEQ completed a revised Feasibility Study in 1995.

DEQ and EPA entered into a SSC in May 1996. The SSC and its amendments specify the responsibilities of DEQ as the lead agency and EPA as the support agency and also specify the cost sharing allocation between DEQ and EPA.

Additional regulatory background information regarding the McCormick & Baxter Superfund Site can be found in the following documents:

- *Record of Decision*, McCormick & Baxter Creosoting Company Portland Plant, Portland, Oregon, EPA and DEQ, March 1996.
- *Amended Record of Decision*, McCormick & Baxter Creosoting Company Portland Plant, Portland, Oregon, EPA and DEQ, March 1998.
- *First Five-Year Review Report*, McCormick & Baxter Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, September 2001.
- *Explanation of Significant Difference* (OU3 – Final Groundwater), McCormick & Baxter Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, August 2002.
- *Preliminary Close-Out Report*, McCormick & Baxter Superfund Site, Portland, Multnomah County, Oregon, EPA, September 2005.
- *Second Five-Year Review Report*, McCormick & Baxter Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, September 2006.
- *Third Five-Year Review Report*, McCormick & Baxter Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, September 2011.

4.4 Removal Actions

Removal Actions were completed by DEQ under State of Oregon cleanup regulations prior to listing on the NPL and under CERCLA authority between Site listing and issuance of the ROD. A list of these Removal Actions is provided in the document titled *Preliminary Close-Out Report* (EPA, September 2005).

4.5 Remedy Selection and Modifications

In March 1996, EPA and DEQ issued one ROD for the Site to address several different media: contaminated soil, groundwater, stormwater, and Willamette River sediment. The selected remedy required the following media-specific actions to mitigate the threats at the Site:

- Excavation, consolidation and biological treatment/stabilization of the most highly contaminated soils;
- Soil capping;
- Enhancement of the existing groundwater and NAPL extraction and treatment system;
- As a contingency remedy, installation of a vertical subsurface barrier wall in the event mobile NAPL could not be reliably controlled;
- Sediment capping;
- Monitoring; and
- Institutional controls (ICs).

After the ROD was signed, DEQ conducted additional soil sampling to support the remedial design of the upland soil remedy. Sampling results documented more extensive dioxin contaminated soils and accordingly, DEQ and EPA reevaluated the remedy and amended the ROD in March 1998. The 1998 ROD required removal and off-site disposal of shallow soil with concentrations above designated action levels, and capping of remaining contaminated soil on the upland portion of the Site.

In August 2002, EPA and DEQ issued an Explanation of Significant Difference (ESD), explaining the rationale to implement the contingency remedy for installing an impermeable barrier wall to control contaminated groundwater, specified in the 1996 ROD. The ROD contingency stated installation of the barrier wall would be necessary in the event that either:

1. NAPL could not be reliably contained using hydraulic methods; or
2. The barrier wall improves the overall cost-effectiveness of the groundwater remedy.

DEQ and EPA determined NAPL had not been contained using groundwater/NAPL extraction and recovery measures, and concluded hydraulic control of NAPL or groundwater had not been established in either the TFA or the FWDA. In 2003, a fully encompassing, impermeable subsurface barrier wall was constructed in accordance with the ESD.

4.6 Redevelopment Potential

A Site Reuse Assessment was conducted between February 2000 and June 2001 by the City of Portland, Bureau of Planning, under a grant from EPA. In developing reuse recommendations, the City analyzed the Site’s redevelopment potential and engaged stakeholders and the interested public in learning about, proposing, and jointly considering what uses would best fit the Site. The City's findings were presented in a final report dated June 2001 and endorsed by the Portland City Council on July 25, 2001. The City concluded that the Site is best suited for recreational use.

5.0 REMEDY DESCRIPTION AND CONSTRUCTION ACTIVITIES

The Site was divided into three operable units (OUs) to facilitate and manage remedy costs, implementation, and construction. The overall remedy at the Site is designed to function as an integrated containment system for contaminants that are present in each OU. The entire McCormick & Baxter Property at the Site is capped. The combined upland capping extends to the riparian area along the shoreline where it meets the sediment cap and the upland cap extends on to property owned by BNSF Railway, Co. The capping works in conjunction with the barrier wall, as a complementary system, to meet the Site Remedial Action Objectives (RAOs) and prevent contaminated sediments and groundwater from adversely impacting the Willamette River.

5.1 Soil Operable Unit Remedy

The soil remedy is composed of three primary components: removal of highly contaminated soil within 4 feet of the ground surface, capping, and institutional controls.. The RAOs for the soil remedy are:

- Prevent human exposure through direct contact (ingestion, inhalation, or dermal contact) to contaminated surface and near-surface soil that would result in an excess lifetime cancer risk above $1x10^{-6}$ for individual compounds, above $1x10^{-5}$ for additive carcinogenic compounds, or above a Hazard Index of 1 for noncarcinogenic compounds in an industrial land-use scenario; and

- Prevent stormwater runoff containing contaminated soil from reaching the Willamette River.

5.1.1 Soil Removal

Phase I of the soil remedy was conducted from February through May 1999, where the most contaminated soil (above removal action levels) was excavated to 4 feet below ground surface and removed from the Site. Clean sand was imported from an off-site quarry to backfill locations of excavated soils.

Documentation, record drawings, and a detailed summary of the soil removal construction activities are provided in the document titled *Phase 1 Soil Remedial Action Summary Report* (Ecology and Environment (E&E), November 1999).

5.1.2 Upland Soil Cap

Phase II of the soil remedy was conducted between March and September 2005 to cap upland areas where residual soil contamination remained above human health and ecological risk-based protective levels. Documentation, record drawings, and a detailed summary of the upland soil cap construction activities are provided in the document titled *Upland Soil Cap Construction Summary Report* (E&E, May 2006).

Construction activities for the upland soil cap included the following major components:

- Demolition and off-site disposal of existing structures and infrastructure;
- Reinstallation of key support facilities;
- Construction of an impermeable cap within a 15-acre portion of the 18-acre area encompassed by the subsurface barrier wall (see Section 5.3.1); and
- Construction of an earthen soil cap outside of the impermeable cap.

Demolition and removal were conducted in 2005 and included the removal of all remaining structures on the Site. A 15-acre Resource Conservation and Recovery Act (RCRA) design, impermeable cap was constructed within the 18-acre area inside of the barrier wall (note: The 3-acre area within the barrier wall that does not have the RCRA-design cap is the riparian zone that borders the river).

The purpose of the impermeable cap is to minimize infiltration of rainwater into the contaminated areas within the wall. The impermeable cap has a minimum thickness of 29 inches, and includes a subsurface stormwater collection and drainage system. Stormwater infiltrates through the cap's soil, rock and sand layers, and is collected and conveyed by gravity flow to an outfall structure at Willamette River.

A 2-foot earthen cap of imported topsoil was installed over 19 acres of the Site outside of the barrier wall area including a small area within the BNSF right-of-way. An asphalt entrance road and parking area (approx. 1 acre) was also placed over an equivalent 2-foot earthen cap and supporting road base material. An additional 6 acres of earthen cap were installed over the riparian zone during construction of the sediment cap. The purpose of the earthen cap is to prevent direct contact with low-level contamination remaining in the Site soil.

A stormwater management system was constructed to minimize stormwater runoff from the Site to neighboring properties and the Willamette River. This system consists of a swale that conveys stormwater directly to an on-site retention/infiltration pond. Except for the 6-acre riparian zone, the surface of the upland soil cap (including both the earthen and impermeable caps) is constructed with sloped surfaces (approximately 1 percent slope) to direct surface water runoff towards the drainage swale. Rainwater infiltrates into soil and groundwater within the riparian zone, which has a general slope of 25 percent towards the Willamette River.

A 6-foot high, chain-link fence topped with barbed wire was installed with warning signs along the McCormick & Baxter Property perimeter. Along the riverfront, the fence is located 35 feet inland from the top of the bank. Gravel access ways and roads were constructed along the riverfront perimeter and within the interior of the McCormick & Baxter Property to allow monitoring and maintenance of the Site.

Native trees and shrubs were planted throughout the drainage swale and riparian zone in February 2006 to stabilize the soil against stormwater erosion and river flood erosion and to reduce rainwater infiltration by increasing evapotranspiration. A temporary aboveground irrigation system was installed in May 2006 to provide irrigation through 2010. Native grasses were planted on the impermeable cap within the barrier wall. The vegetation is fully established and the irrigation system is no longer needed and will be removed.

5.2 Sediment Operable Unit Remedy

The sediment remedy is composed of two primary components: ICs and a sediment cap. The RAOs for the sediment cap are:

- Prevent humans and aquatic organisms from direct contact with contaminated sediments; and
- Minimize releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state ambient water quality criteria.

The first RAO is designed to prevent human exposure under a recreational scenario from direct contact with contaminated sediments and to prevent exposure of benthic organisms to sediment contamination above known toxicity levels.

The selected sediment remedy consists of capping areas that contain contaminant concentrations above human health and ecological risk-based protective levels or that exhibit significant toxicity to benthic organisms within the upper sediments. Construction of the sediment cap occurred in two separate phases: June through November 2004 and August through October 2005. Documentation, record drawings, and a detailed summary of the sediment cap construction activities are provided in the documents titled *Remedial Action Construction Summary Report Sediment Cap (June 2004 through November 2004)* and *Remedial Action Construction Summary Report Sediment Cap Completion (August 2005 through October 2005)*, both issued by E&E in May 2006. Construction activities in 2004 consisted of the following major components:

- Removal of approximately 1,630 pilings, bulkhead, dock remnants, in-water debris, a derelict barge in Willamette Cove, and other Willamette Cove features;
- Construction of a multi-layer sediment cap using sand, organophilic clay, and armoring;
- Monitoring well abandonment and modification;
- Bank regrading and capping; and

- Disposal and demobilization.

The sediment cap footprint encompasses approximately 22 acres. The cap consists of a 2-foot-thick layer of sand over most of the cap footprint, with a 5-foot thick layer of sand over several more highly contaminated areas. The cap also incorporates organophilic clay to prevent NAPL migration through the cap in specific areas in Willamette Cove and adjacent to the TFA. The organophilic clay was applied in bulk and in the form of Organoclay^{TM} reactive core mats (RCMs). A 6-acre riparian zone was created by regrading the riverbank, placing a demarcation layer, placing and grading 2 feet of imported clean fill (topsoil), placing turf reinforcement mat, hydroseeding with native grasses, and planting native vegetation and trees.

Different types of armoring were used to prevent erosion of the sand and organophilic clay layers of the cap. The type, size, and location of armoring material used to protect the cap depended on the expected hydraulic and physical environments (e.g., currents, wave energy, erosive energies, etc.). ACB mats were installed along the shore and in shallow water where erosive forces due to wave action are greatest. Rock armor was placed within the river, away from the shoreline, and included 6- and 10-inch minus material. Riprap was used in some transition areas between the ACB and rock armoring, and near shore where ACB could not be applied. In addition, boulder clusters were added to provide aquatic habitat diversity and a rock mound was added to lower hydraulic energy within the shallow water embayment area.

5.3 Groundwater Operable Unit Remedy

The groundwater remedy is composed of five components: ICs, a subsurface barrier wall, a multi layer RCRA cap, NAPL recovery, and evaluation of innovative technologies for NAPL recovery. The RAOs for the groundwater remedy are:

- Prevent human exposure to or ingestion of groundwater with contaminant concentrations in excess of federal and state drinking water standards or protective levels;
- Minimize further vertical migration of NAPL to the deep aquifer;
- Minimize precipitation infiltration by installing a RCRA cap, and have most of the precipitation by-pass the flow path through the contamination inside the barrier wall
- Prevent groundwater discharges to the Willamette River that contain dissolved contaminants that would result in contaminant concentrations within the river in excess of background concentrations or in excess of water quality criteria for aquatic organisms;
- Minimize NAPL discharges to the Willamette River beach and adjacent sediment; and
- Remove mobile NAPL to the extent practicable to reduce the continuing source of groundwater contamination and the potential for discharge to Willamette River sediment.

5.3.1 Subsurface Barrier Wall

As required by the ESD, an impermeable subsurface barrier wall was designed and installed to contain much of the upgradient sources of dense NAPL (DNAPL) and light NAPL (LNAPL) in the TFA and FWDA, and to reduce NAPL migration from these areas to the Willamette River. The riverfront segment of the barrier wall is located at approximately 30 feet landward from ordinary high water. The subsurface barrier wall was constructed from April through September 2003, with the exception of eight sheet piles that met refusal before achieving design depth. The resulting gaps were pressure grouted in July 2004. The construction of the barrier wall is documented in the report titled *Remedial Action Construction Summary Report, Combined Sheet Pile and Soil-Bentonite Barrier Wall* (E&E, July 2004).

The barrier wall was constructed to fully encompass 18 acres of NAPL-impacted groundwater, and the main contaminant source areas at the Site. The total length of the wall is 3,792 linear feet, and the depth varies from approximately -25 to -45 feet North American Vertical Datum (NAVD; 45 to 80 feet below ground surface (bgs)) to account for differences in the topography and soil profile at the Site. The depth of -45 feet NAVD is below the depth of the Willamette River adjacent to the Site.

The segment of the wall between the Willamette River and the TFA (approximately 900 linear feet) is keyed into a silt aquitard, and extends to a depth of approximately 70 to 80 feet bgs. The segment of barrier wall between the Willamette River, Willamette Cove, and the FWDA (approximately 1,100 linear feet) is considered a “hanging wall” because deeper soil in this area consists of interbedded sand and silt lenses, and therefore, is not a continuous, competent aquitard. This segment of the wall also extends to a depth of 70 to 80 feet bgs. Although not keyed into an aquitard, the depth of this segment serves to increase the distance, and thereby reduce the potential NAPL movement, between the DNAPL source and the Willamette River. The segment of the wall located upgradient and cross-gradient of the TFA and FWDA (1,800 linear feet) is keyed into the silt aquitard and extends 45 feet bgs.

5.3.2 Creosote Recovery

Creosote (i.e., NAPL) recovery began in 1989 as a Removal Action, and various extraction methods have been attempted to optimize NAPL recovery since that time. The goal of extraction was to remove and deplete NAPL pools to residual levels to minimize or prevent migration into the Willamette River. NAPL recovery continued through July 2011. Approximately 6,500 gallons of NAPL were recovered from the Site between 1989 and 2011, when NAPL extraction was terminated. NAPL recovered from extraction wells was transported to an off-site RCRA Subtitle C facility for treatment and disposal as a listed hazardous waste.

A DNAPL investigation was performed in 2011 to evaluate the nature, extent, and potential pathway(s) of DNAPL routinely observed in monitoring well MW-20i (outside the barrier wall in the FWDA). The *DNAPL Data Gap Investigation* (Hart Crowser/GSI, 2011) concluded that the source of DNAPL to MW-20i is small and localized and does not appear to pose a threat to the Willamette River. Given that this well has been the primary source of DNAPL recovered for the past several years and that no pool of mobile NAPL was encountered during the investigation, DEQ and EPA decided to terminate NAPL recovery in late April 2011 and conducted four subsequent gauging efforts to document the thickness of NAPL in the well to ensure that it is stable. Semiannual NAPL gauging of MW-20i will be evaluated every five years starting in 2015 to ensure there is not an increasing trend relative to the gauging data summarized in the *DNAPL Data Gap Investigation*.

6.0 OPERATIONAL AND FUNCTIONAL CRITERIA, RESULTS, AND MILESTONE DATES FOR DEQ ASSUMPTION OF O&M RESPONSIBILITIES

CERCLA requires the States to assure future maintenance of removal and remedial actions constructed at a site to maintain the effectiveness of those measures. The NCP describes this assurance as follows:

> *40 C.F.R. § 300.435(f) Operation and maintenance. (1) Operation and maintenance (O&M) measures are initiated after the remedy has achieved the RAOs and remediation goals in the ROD, and is determined to be operational and functional, except for ground- or surface-water restoration actions covered under § 300.435(f)(4). A state must provide its assurance to assume responsibility for O&M, including, where appropriate, requirements for maintaining institutional controls, under § 300.510(c).*

Furthermore, the date when the State must assume O&M activities is related to the determination that a removal or remedial action is "operational and functional" (O&F). The NCP provides:

> *40 C.F.R. § 300.435(f)(2) A remedy becomes "operational and functional" [O&F] either one year after construction is complete, or when the remedy is determined concurrently by EPA and the state to be functioning properly and is performing as designed, whichever is earlier. EPA may grant extensions to the one-year period, as appropriate.*

EPA and DEQ conducted a joint final inspection of the McCormick & Baxter Superfund Site soil, groundwater, and sediment remedial actions on September 26, 2005 and determined that the Site had achieved the construction completion milestone. This determination means that all remedial action required by the ROD, the ROD Amendment, and the ESD are complete. This determination was documented in the *Preliminary Close-Out Report* (September 2005). DEQ and EPA completed O&F determinations on the soil and sediment remedies in September 2006 and September 2013, respectively. Table 2 specifies the O&F performance measures developed for the 2007 O&M Plan, and the current status in achieving these measures for each of the remedial actions at the Site.

The *Third Five-Year Review Report* (September 2011) presents a summary of activities and investigations conducted since September 2005 to demonstrate the remedies of groundwater and sediment are functioning properly and performing as designed. The report concludes that the soil, sediment, and groundwater OU remedies are meeting the ROD-defined RAOs, and are currently protective of human health and the environment because the soil and sediment caps, barrier wall, sediment ICs, and engineering controls required by the ROD have been implemented. However, in order for the remedies to be protective of human health and the environment in the long-term, a ROD Amendment that establishes new cleanup goals and points of compliance needs to be completed for the groundwater remedy and the ICs required by the ROD for the soil and groundwater remedies need to be implemented.

The O&F determination for the groundwater remedy has not been completed due to the invalidation of the Alternate Concentration Limit (ACL) cleanup goals for groundwater by EPA in 2006. In the *Second Five-Year Review*, EPA determined that ACLs were not valid as substitutes for EPA's maximum concentration limits (MCLs) in groundwater. As a result of this determination, DEQ and EPA anticipate that amended groundwater cleanup goals for the Site will be established in a ROD Amendment consistent with groundwater cleanup goals for the Portland Harbor Superfund Site ROD, expected in 2016.

7.0 SOIL CAP OPERATION AND MAINTENANCE

7.1 O&M Performance Standards

Contaminated soil removal and construction of an upland soil cap on approximately 41 acres of the Site was completed in September 2005. Institutional controls have not been completed for this portion of the Site.

Soils beneath the soil cap remain contaminated with arsenic, PCP, PAHs, dioxins, and NAPL, thus requiring the need for long-term monitoring and maintenance. The performance standards for the soil cap are:

- Maintain contaminant concentrations in surface soil below the following risk-based cleanup goals, as specified in the ROD (EPA, 1996):
  - Arsenic – 8 milligrams per kilogram (mg/kg)
  - Pentachlorophenol – 50 mg/kg
  - Total Carcinogenic PAHs – 1 mg/kg
  - Dioxins/furans – 0.00004 mg/kg
- Maintain the topsoil layer to within 50 percent of its design specification, by conducting periodic cap inspections to verify that vegetation coverage is preventing erosion
  - Maintain a topsoil thickness of at least 6 inches for the area over impermeable geomembrane cap
  - Maintain a topsoil thickness of at least 12 inches for all areas except over impermeable geomembrane cap

- Minimize infiltration of rainwater within the subsurface barrier wall by maintaining the subsurface stormwater conveyance system.
- Minimize stormwater erosion and ponding outside the barrier wall by maintaining Site grading, surface stormwater conveyance, and native vegetation.
- Maintain native vegetation within the 6-acre riparian zone for compliance with the NMFS Biological Opinion (National Oceanic and Atmospheric Administration [NOAA], 2004).

7.2 O&M Manual

O&M of the soil cap will be conducted as described in the O&M Manual. Monitoring activities for the soil cap (including the riparian zone) include visual inspections of the cap surface, stormwater conveyance system, security fencing, and warning signs. The soil cap is designed to be generally maintenance free, except for maintaining the native vegetation. A long-term Vegetation Management Plan (revised 2010) has been completed for the soil cap. The plan includes semi-annual qualitative inspections and reporting, and is included in the O&M Manual. General routine maintenance will include manual removal of invasive plants and targeted application of herbicides. Non-routine maintenance may include repairs of the fence, replacement of warning signs, repairs of the gravel roads, filling of potential animal burrows, removal of sediments from manholes and replanting of unsuccessful trees and shrubs. The frequency of the planned O&M activities for the soil cap remedy through September 2021 is provided in Table 3.

7.3 Equipment and Material Requirements

Equipment requirements for visual monitoring of the soil cap include a field notebook, a digital camera and a manhole cover lifter. Visual inspections will be documented using photographs and field notes, including:

- Condition of the 41-acre soil cap surface (e.g., erosion, subsidence, well casing alignment/stickup)
- Integrity of storm drainage system (e.g., condition of manholes, catch basins, swale)
- Presence/condition of perimeter fencing and warning signs
- Viability of soil cap vegetation (e.g., native grasses, trees, shrubs)

If visual inspections suggest that the soil cap may be settling or subsiding, an elevation survey may be needed to evaluate the significance of changes in the cap. A video survey of stormwater lines may be needed if the inspections suggest that the integrity of the cap storm drainage system is compromised. Inspections will likely be performed by contractors under oversight of DEQ staff. Site vegetation maintenance equipment for herbicide application will be provided by contractors under oversight of DEQ staff. The irrigation system is no longer necessary and has been decommissioned. Additional, unforeseen vegetation maintenance and irrigation activities will depend on weather conditions (e.g., extremely dry and hot) and other unpredictable variables.

Equipment and material requirements for other repairs will be based on the nature of the work (e.g., fencing, landscaping, drilling, or other general construction). Any substantial repairs, such as those requiring the impermeable cap to be breached or repaired, will be described in detailed work plans prepared before these activities are conducted. The work plans will provide technical specifications and drawings sufficient to assure this work is performed appropriately and by qualified personnel.

Materials needed for potential repairs include: geomembrane, geocomposite, perforated piping, sand, biotic rock (3-inch minus rock), 10-inch minus rock, filter fabric, topsoil, road gravel, and chain link fencing. Sand, 3-, 10-, and 24-inch minus rock, and road gravel are stockpiled on site. Additional materials may be imported to address unforeseen integrity or soil erosion problems. All imported soil will be certified by DEQ to meet the requirements for "clean fill" under Oregon regulations.

8.0 SEDIMENT CAP OPERATION AND MAINTENANCE

8.1 O&M Performance Standards

The sediment remedy consists of a 23-acre cap over contaminated sediments within the Willamette River and ICs. The sediment cap remedy was completed in September 2005 and an easement and equitable servitude (EES) was completed in 2006 to restrict sediment cap use and access. Sediments beneath the sediment cap remain contaminated with arsenic, PCP, PAHs, dioxins and NAPL, thus requiring the need for long-term monitoring and maintenance. The performance standards for the sediment cap are:

- Maintain contaminant concentrations in surface sediments below the following risk-based cleanup goals, as specified in the ROD (EPA, 1996):
    - Arsenic – 12 mg/kg, dry weight
    - Pentachlorophenol – 100 mg/kg, dry weight
    - Total Carcinogenic PAHs – 2 mg/kg, dry weight
    - Dioxins/furans – $8x10^{-5}$ mg/kg, dry weight
    - Protection of benthic organisms based on sediment bioassay tests, resulting in impaired survival and growth (i.e., weight)
- Minimize releases of contaminants from sediment that might result in contamination of the Willamette River in excess of the following federal and state ambient water quality criteria (AWQC):
    - Arsenic (III) – 190 micrograms per liter (µg/l)
    - Chromium (III) – 210 µg/l
    - Copper – 12 µg/l

    - Zinc – 110 µg/l
    - Pentachlorophenol – 13 µg/l
    - Acenaphthene – 520 µg/l
    - Fluoranthene – 54 µg/l
    - Naphthalene – 620 µg/l
    - Total Carcinogenic PAHs – 0.031 µg/l
    - Dioxins/furans – $1.4x10^{-5}$ nanograms per liter (ng/l)
- Maintain armoring layer thicknesses to no less than 50 percent of the design specification throughout the cap. The design specifications are:
    - 6-inch rock armoring – maintain thickness of at least 6 inches
    - 12-inch rock armoring – maintain thickness of at least 7.5 inches
    - 24-inch rock armoring – maintain thickness of at least 12 inches
- Maintain uniformity and continuity of ACB armoring.
- Assess performance of organophilic clay to ensure it is preventing the release of mobile NAPL to the River (potential assessment parameters include sorption capacity, measure of NAPL currently sorbed, and permeability).

The AWQCs listed above are the surface water criteria in effect at the time of the ROD (EPA, 1996) and are the current applicable AWQCs for the sediment cap; since completion of the ROD, additional recommended EPA water quality criteria were published in 2007, and more stringent AWQCs for human health were adopted by DEQ and approved by EPA in 2011. During meetings in August 2007 between stakeholders (DEQ, EPA, NOAA, Warm Springs Tribe, and Yakama Nation), it was agreed that for water sampling data comparison purposes, the five following criteria would be included in analytical results summary tables in the *Annual O&M Reports*:

- Two AWQCs in effect at the time the ROD was issued
    - 1996 criteria for chronic effects to aquatic life
    - 1996 criteria for human health based on fish consumption
- Two 2007 National Recommended Water Quality *Criteria (NRWQCs)*
    - 2007 criteria for chronic effects to aquatic life
    - 2007 criteria for human health (consumption of organisms)
- Current EPA MCLs

Future comparison criteria will include the EPA approved 2011 AWQCs for human health, and other applicable AWQCs at the time of sediment cap water sampling. Attachment A of this plan provides a sampling approach to be conducted in 2015 to evaluate sediment cap protectiveness as part of the fourth Five-Year Review Report, to be completed in 2016.

8.2 O&M Manual

O&M of the sediment cap will be conducted as described in the O&M Manual. Monitoring activities for the sediment cap will include periodic visual inspections of near-shore areas to determine the extent and retention of the sediment cap sand overlay (i.e., biotic layer) and interarmoring habitat gravel, large wood debris accumulating along the shoreline, condition of boulder clusters and rock mound, and deposition of fine-grained substrate from the water column. A multibeam bathymetric survey will be conducted in 2020, and a diver inspection may be conducted if areas of concern are identified from the bathymetry survey. Periodic monitoring activities will include sampling of the water column above the sediment cap, interarmoring water, and may include porewater sampling using passive sampling technology and/or other appropriate sampling methods. Although the sediment cap is designed to be generally maintenance free, unplanned or non-routine maintenance may include: the replacement of warning buoys, placement of additional armoring due to erosion, and placement of additional Organoclay^{TM} RCM if new releases of creosote are discovered. Monitoring and maintenance of the riparian zone is addressed as part of the soil cap. The frequency of the planned O&M activities for the sediment cap remedy through September 2021 is provided in Table 5.

8.3 Equipment and Material Requirements

Equipment requirements for visual inspections of the near-shore sediment cap include a field notebook and a digital camera. Visual inspections will be documented using photographs and field notes.

Equipment requirements for the monitoring of the sediment cap include passive samplers (e.g., solid phase micro-extraction) or other conventional sampling equipment (e.g., Henry samplers), boat services, and survey (e.g., global positioning system) equipment. Divers will be needed to assist with sampling in deep water locations.

The nature of any repairs will determine the equipment and material requirements, and will likely need to be performed by a contractor with expertise in marine construction. Any substantial repairs will be detailed in work plans prepared prior to performing these activities. The work plans will provide technical specifications and drawings sufficient to assure the work is performed appropriately and by qualified personnel.

Materials needed for potential repairs include materials used to construct the sediment cap: sand, organophilic clay, filter gravel (3-inch minus rock), geotextile, ACB, 6-inch minus rock, 10-inch minus rock, 24-inch minus rock, etc. Sand, 3-inch minus rock, 10-inch minus rock, and 24-inch minus rock have been stockpiled on site. Additional materials may be imported as needed for unforeseen repairs. A cement-bentonite grout may also be necessary to fill gaps between the ACB mats. Substantial repairs to the sediment cap are anticipated and have been budgeted for calendar years 2020 and 2040. These major repairs may be conducted sooner, more frequently, or not conducted at all based on bathymetry and diver inspection data, and unanticipated cap disturbing events (e.g., erosion, earthquakes, etc.).

9.0 GROUNDWATER REMEDY OPERATION AND MAINTENANCE

9.1 O&M Performance Standards

The groundwater remedy consists of groundwater monitoring, NAPL recovery, a subsurface barrier wall surrounding approximately 18 acres within the upland soil cap, and ICs. Institutional controls have not been completed to restrict groundwater use beneath the Site, and NAPL recovery was terminated by EPA and DEQ in 2011.

Groundwater both within and outside of the subsurface barrier wall remain contaminated with metals, PCP, PAHs, dioxins, and NAPL. Contaminated groundwater within the barrier wall is contained and is not migrating to the river. Outside the barrier wall, residual product in soils within the FWDA results in elevated concentrations of PCP, PAHs, and NAPL in groundwater. Despite the groundwater contamination in this area, monitoring of downgradient wells, surface water, and the sediment cap (inter-armoring, sub-armoring, and porewater in the organophilic clay) have indicated that the groundwater remedy is performing as designed and that contaminated groundwater is not adversely affecting the river. The performance standards for the subsurface barrier wall and NAPL recovery are:

- Continue to recover NAPL from outside the subsurface barrier wall until recovery rates become minimal, alternate pumping strategies have been examined and/or field tested with poor results, and remaining NAPL does not pose a threat to the Willamette River and its sediments.
- Maintain contaminant concentrations in shallow, downgradient compliance wells (or sediment pore water) below the ACLs set forth in the ROD (EPA, 1996):
    - Arsenic (III) – 1,000 µg/l
    - Chromium (III) – 1,000 µg/l
    - Copper – 1,000 µg/l
    - Zinc – 1,000 µg/l
    - Pentachlorophenol – 5,000 µg/l
    - Total PAHs – 43,000 µg/l
    - Dioxins/furans – 0.2 ng/l

- Minimize the transport of NAPL and communication of groundwater zones across the subsurface barrier wall.
- Minimize further vertical migration of creosote to the deep groundwater aquifer.
- Minimize visible discharge of creosote to the Willamette River.
- Maintain contaminant concentrations in the Willamette River below background concentrations or less than the sediment cap performance standards for surface water.

As discussed in Section 6, in the *Second Five-Year Review*, EPA determined that ACLs were not valid as substitutes for EPA's MCLs in groundwater. As a result of this determination, DEQ and EPA anticipate that amended groundwater cleanup goals for the Site will be established in a ROD Amendment consistent with groundwater cleanup goals for the Portland Harbor Superfund Site ROD, expected in 2016. Once new groundwater cleanup goals are established in a ROD Amendment, the O&M Plan will be revised to reflect the new cleanup goals.

9.2 O&M Manual

O&M of the groundwater remedy will be conducted as described in the O&M Manual. Monitoring activities for the groundwater remedy include groundwater elevation monitoring and groundwater sampling. As described in Section 5, DEQ and EPA terminated NAPL recovery in late April 2011. NAPL gauging will be conducted in conjunction with the semi-annual Site-wide groundwater elevation monitoring events. Groundwater samples will be collected from the monitoring well downgradient of the infiltration pond (monitoring well MW-59s) every 5 years, and select Site-wide wells every ten years starting in calendar year 2020. The frequency of the planned O&M activities for the groundwater remedy through September 2021 is provided in Table 6.

9.3 Equipment and Material Requirements

Equipment requirements for NAPL gauging include an interface probe for determining the thickness of NAPL. Equipment requirements for groundwater include water level indicators, pumps, bailers, and containers. NAPL and groundwater monitoring will likely be performed by contractors under oversight of DEQ staff.

10.0 SUMMARY OF O&M STAFFING NEEDS AND ESTIMATED COSTS

Conservative estimates of staffing needs and costs to conduct specific activities described in this O&M Plan through September 2021 are presented in Table 7.

The total estimated cost (not adjusted for inflation) for implementing the O&M activities described in this O&M Plan through 2021 by DEQ and its contractor is $1,527,500. This estimate includes $200,000 for an anticipated repair to the sediment cap in or before 2020.DEQ staff time for project management, contract management, technical oversight and coordination with EPA is anticipated to range between approximately $25,000 and $90,000 per year dependant on the contractor activity. DEQ staff will consist primarily of the project manager, contract officer, and several technical staff (e.g., hydrogeologist, engineer, and public outreach staff).

Contractor staff will consist primarily of the project manager, hydrogeologists, engineers, field staff, and administrative support.

11.0 CONDITIONS FOR O&M TERMINATION

The soil, sediment, and groundwater remedies at the Site will likely require O&M to be performed indefinitely. Some or all O&M activities may be terminated when DEQ and EPA determine they are no longer necessary to ensure that RAOs are being met.

12.0 REPORTING REQUIREMENTS

O&M reports will be prepared annually by DEQ and its contractors. Copies of the annual O&M reports will be provided to EPA and other project team members, including NOAA and Tribal governments. At least once every five years, DEQ will host a meeting with EPA and the project team to discuss O&M activities of importance conducted since the previous meeting.

The annual O&M reports will be summarized in the *Fourth Five-Year Review Report* that will be prepared by DEQ and EPA. DEQ will host a meeting with EPA, NOAA, and Tribal governments before beginning to draft the report. The *Fourth Five-Year Review Report* will be issued in September 2016. Additional Five-Year Reviews will be required as long as contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.[3]

A copy of the annual O&M reports will be provided to the Oregon Division of State Lands (ODSL) and other members of the project team.

13.0 CONTINGENCY PLAN FOR ABNORMAL OCCURRENCES

As acknowledged by EPA guidance, a remedy may experience problems after construction for a variety of reasons. The responsibility for addressing such problems will depend upon the cause of the problem. DEQ and EPA agree the agencies will cooperate in determining the cause of any such problems and determine the responsibility to address the problem as provided in the SSC.

NAPL recovery may be reinitiated if DEQ and EPA determine that NAPL from the Site poses a threat to the Willamette River and its sediments.

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[3] 40 C.F.R. § 300.430(f)(4)(ii) states: “If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.”

14.0 SAFETY REQUIREMENTS FOR O&M ACTIVITIES

DEQ will continue to require a Site-wide health and safety plan for its staff and contractors pursuant to 29 C.F.R, §1910.120. The health and safety plan will cover those activities potentially resulting in exposure to hazardous substances and other relevant health and safety concerns. Health and safety plans for unplanned maintenance work will be prepared if and when this work is needed.

15.0 SITE USE AND DISPOSITION OF FACILITIES

Currently, the McCormick & Baxter Property is vacant except for a paved parking area, small shop building, two field office trailers, numerous NAPL extraction and groundwater monitoring wells, drum storage facility, and associated utilities used to support ongoing monitoring and maintenance. The perimeter of the Property is posted with warning signs. A fence surrounds 35 acres of the McCormick & Baxter Property, and does not extend into the 6-acre riparian area.

Long term O&M of the soil, sediment, and groundwater remedies likely will be required in perpetuity. DEQ intends to maintain the shop building on-site to support these activities (trailer offices will be decommissioned). Long-term access and land use will be controlled through engineering and ICs, including environmental easements to ensure the integrity and protectiveness of the cap are maintained. Institutional and Engineering Control requirements for the Site are presented in Section 19 of this plan.

Termination of NAPL recovery and changes in the groundwater monitoring program may result in the abandonment of unneeded Site monitoring wells. Upon determination by DEQ that wells are no longer needed, they will be decommissioned in accordance with Oregon Department of Water Resources regulations. Specific plans for decommissioning wells, equipment, and office trailers will be described in the revised O&M Manual.

16.0 MODIFICATIONS TO THE O&M MANUAL

The O&M Manual is a living document which will be modified by DEQ to reflect monitoring and maintenance needs for the Site. The manual will contain up-to-date Site-wide record drawings, specify sampling and monitoring procedures, and included technical and other information necessary for implementing O&M activities. The O&M Manual will also contain a Health and Safety Plan, and the work plan for implementing repairs to the sediment and soil cap remedies.

17.0 PROPERTY OWNERSHIP CHANGE

As presented in Section 19 of this plan, DEQ obtained a permanent easement for the 23 acre sediment cap from the ODSL (Easement # 31530-EA). This easement was recorded in Multnomah County on May 12, 2004 (record # 2004-083416).

In the event of transfer of any part of the Property owned by McCormick & Baxter to a future owner, DEQ will require proprietary ICs be recorded and anticipates that any person who may acquire the Property in the future enter into a Prospective Purchaser Agreement (PPA) with DEQ. The PPA would specify responsibilities to ensure the integrity of the remedial actions and would include an EES to secure institutional controls in accordance with the ROD. Once recorded, those institutional controls run with the land and subsequent owners of the Property. The PPA also may require that the purchaser perform certain O&M activities under DEQ oversight.

18.0 PROPERTY ACCESS

DEQ controls access to the Site, and has access agreements to conduct required O&M activities on adjacent properties - the BNSF right of way, and the Willamette Cove (Metro) - under this plan. These agreements may be amended or extended to cover future maintenance or monitoring, if necessary.

Access to the sediment cap is provided through a permanent easement with DSL. DEQ will likely secure continued access to the Property through an EES with future owners of the Property.

19.0 ENGINEERING AND INSTITUTIONAL CONTROLS

The ROD specifies the following engineering and institutional controls for the soil, groundwater, and sediment remedies:

- Physical restrictions[4] (e.g., fencing), warning signs, and safety measures until completion of the remedies;
- Prohibitions on future uses of the Property that are inconsistent with the level of protectiveness achieved by the cleanup;
- Prohibition on any use of the shallow and intermediate aquifers and prohibition on drinking water use of the deep-water aquifer; and
- Prohibition on the disturbance of sediments.

DEQ currently maintains a perimeter fence and warning signs around the McCormick & Baxter Property to restrict public access. Monitoring wells located outside the fence have locked, steel monuments to prohibit access. These physical Site restrictions will be maintained into the foreseeable future. Public access to the shoreline sediment cap and riparian area riverward of the Property is not restricted. DEQ has obtained a permanent easement for the sediment cap from the DSL. This easement prohibits anchoring and grounding of non-recreational vessels and the use of all motor propelled vessels, and specifies that the sediment cap may be closed to all public uses if DEQ determines that the area poses a threat to public health or the environment. Permanent buoys were installed in August 2011 along the perimeter of the sediment cap warning boaters of

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[4] EPA has since clarified that physical restrictions are considered engineering controls.

navigational hazards. In addition, the Oregon Marine Board established regulations prohibiting anchoring within the easement boundary [Oregon Administrative Rule 250-020-0280(10) - Boat Operations in Multnomah County]:

> *No person shall anchor a boat at approximately River Mile 7 of the Willamette River in Multnomah County described in Dept. of State Lands Easement No. 31530-EA, Exhibit A – Legal Description – Permanent Easement*

A Regulated Navigational Area (RNA) was established by the U.S. Coast Guard (USCG) in water above and adjacent to the sediment cap pursuant to 33 C.F.R. Part 165. On February 4, 2009, the USCG published the final rulemaking formally establishing the RNA (docket number USCG-2008-0121; Attachment 1 to the *Third Five-Year Review Report*). This rule became effective on March 6, 2009. The RNA prohibits anchoring, spudding, dredging, laying cable, dragging, conducting salvage operations, operating commercial vessels of any size, operating recreational vessels greater than 30 feet in length, operating other vessels in excess of "no wake" speed or the minimum speed needed to maintain steerage, or any other activity which could potentially disturb the riverbed in the designated area.

A License or Access Agreement, completed in March 2005 between DEQ and BNSF requires BNSF to notify DEQ in the event planned construction or maintenance activities that could potentially cause damage to the portion of the upland soil cap located in the BNSF right-of-way. The License is a contract between DEQ and BNSF to ensure BNSF's activities are communicated to DEQ, and serve as an institutional control for protection of the soil cap remedy in that location. The License does not contain provisions to restrict groundwater use or to protect groundwater monitoring wells installed in the BNSF right-of-way. DEQ and EPA plan to complete the required IC for groundwater beneath the BNSF property in conjunction with groundwater restrictions for the Site and other adjacent properties.

Site restrictions prohibit development within the 6-acre riparian zone along the riverbank as required by the Endangered Species Act Biological Opinion issued by the National Marine Fisheries Service (NMFS), and limit excavation of Site soils unless authorized by DEQ. Legally recorded ICs have not been implemented for the Site groundwater and soil cap remedies, as required by the ROD. DEQ and EPA plan to complete these ICs in order to achieve long-term remedy protectiveness before the completing the *Fourth Five-Year Review Report* in 2016.

20.0 EPA AND OTHER REGULATORY OVERSIGHT

DEQ will prepare an annual report of O&M activities conducted at the Site for EPA, DSL, NOAA, and Tribal governments. The report will describe Site conditions and O&M activities conducted during the prior calendar year, changed circumstances and any other conditions or O&M related events, and future planned O&M activities. EPA and DEQ will meet within sixty (60) days of receipt of the annual report to discuss findings and follow-up actions. These meetings may be held on a biennial basis as agreed to by DEQ and EPA, and will include participation by NOAA and Tribal governments. DEQ will host a meeting with EPA, NOAA and Tribal governments before beginning to draft the *Fourth Five-Year Review Report*.

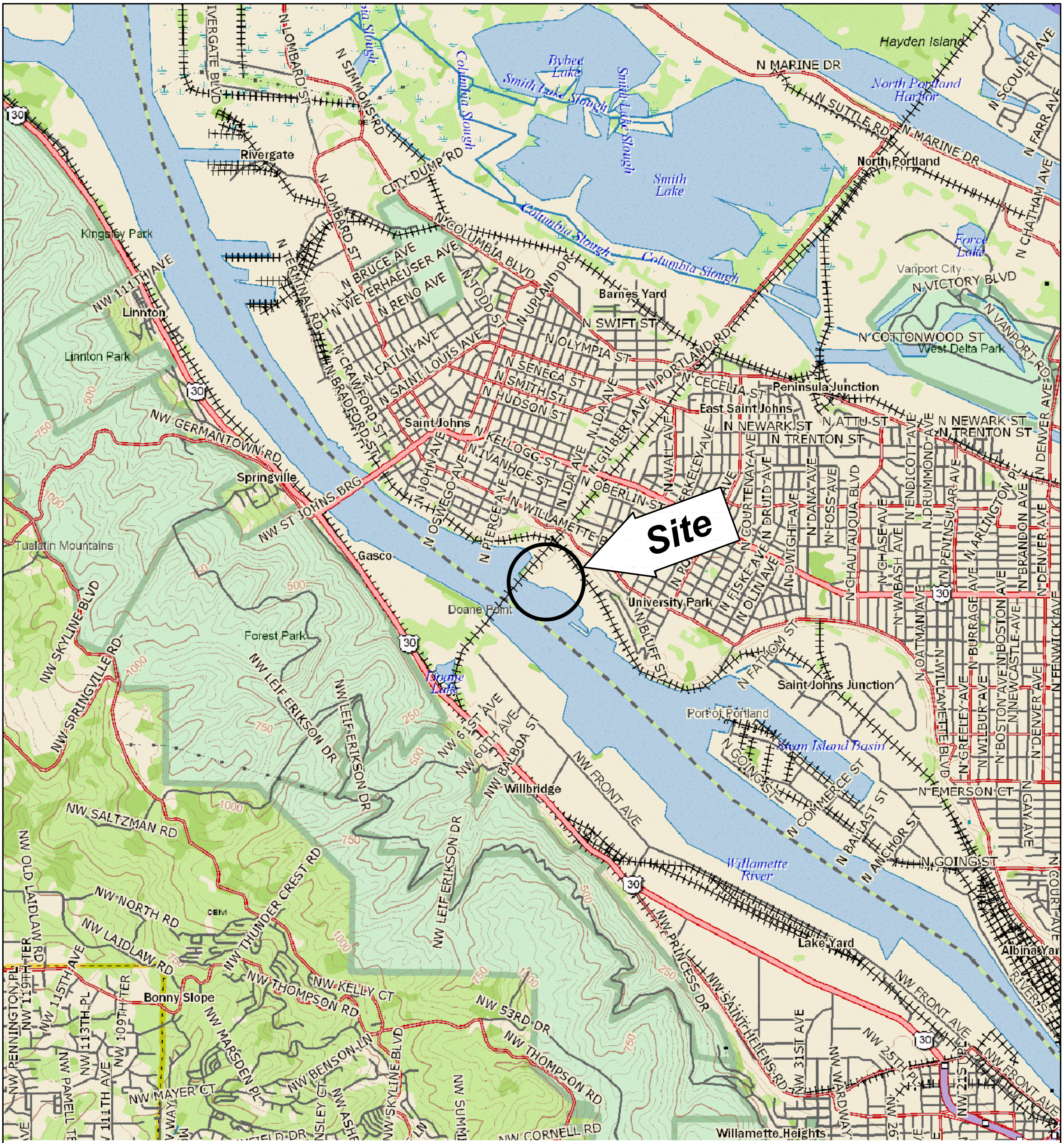
21.0 PERMITS AND OTHER ADMINISTRATIVE REQUIREMENTS

DEQ will be responsible for compliance with all federal, state, and local applicable or relevant and appropriate regulations (ARARs) while conducting O&M activities at the Site. Except for the off-site disposal of hazardous waste, the planned activities presented in the O&M Plan do not require permits or have administrative requirements. However, if repairs to the sediment cap become necessary, a variety of regulations may be ARARs. Several of these potential ARARs are discussed in the *Sediment Cap Basis of Design* report, dated May 2002. Significant ARARs are the Clean Water Act, Sections 401 and 404, and the Endangered Species Action, Section 7.

EPA determined the substantive requirements of the Clean Water Act, Sections 401 and 404, would be met during constructing the sediment cap. Additionally, EPA complied with the Endangered Species Act Section 7 through formal and informal consultation with the U.S. Fish and Wildlife Service (USFWS) and NMFS. As a result of this consultation the NMFS issued a Biological Opinions for construction of the barrier wall and sediment cap.

EPA's substantive requirement determination of the Clean Water Act, Sections 401 and 404, issued in May 2003, will be applied to potential repairs of the sediment cap as long as the scope of these repairs is consistent with the original construction activities.

Compliance with the Endangered Species Act Section 7 will be assured through additional EPA consultations with the FWS and NMFS, which DEQ anticipates will be needed every five years. The Biological Assessment for the first five years of O&M was submitted to the Services in early May 2006, and the NMFS issued its Biological Opinion on October 6, 2006. This consultation addressed planned O&M activities and the most likely potential repair needs of the sediment cap: placement of additional armoring and organophilic clay. If the scope of needed repairs significantly differs from the hypothetical scenarios, additional consultation between the EPA and the Services may be necessary.



N

McCormick and Baxter Superfund Site
6900 N Edgewater Street, Portland, Oregon

Site Location Map

1/13

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GSI Water Solutions, Inc.

Figure

1

Source: DeLorme Topo USA.

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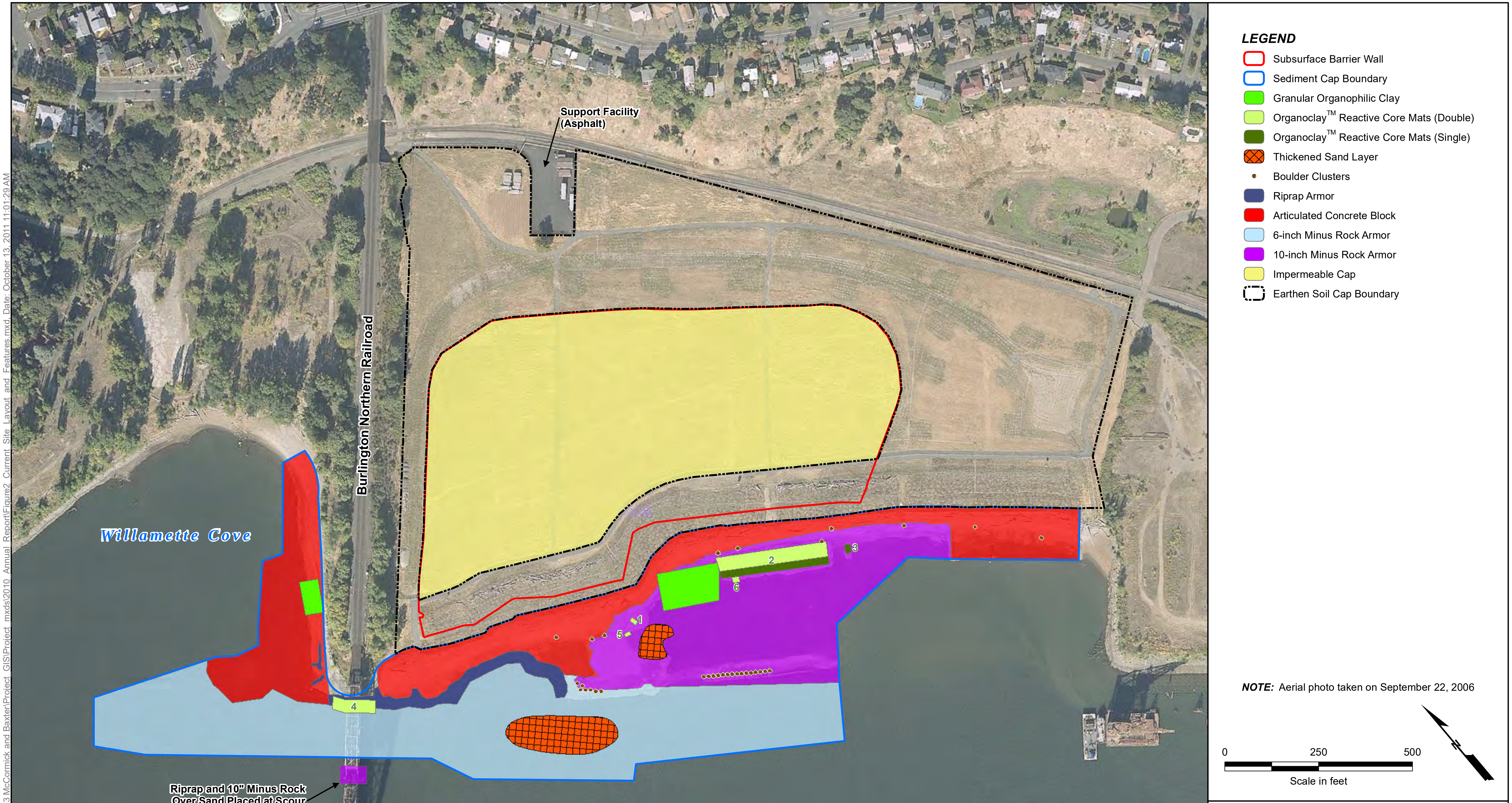

NOTE: Aerial photo taken on September 22, 2006

McCormick & Baxter Superfund Site
Portland, Oregon

Current Site Layout and Features

1/13

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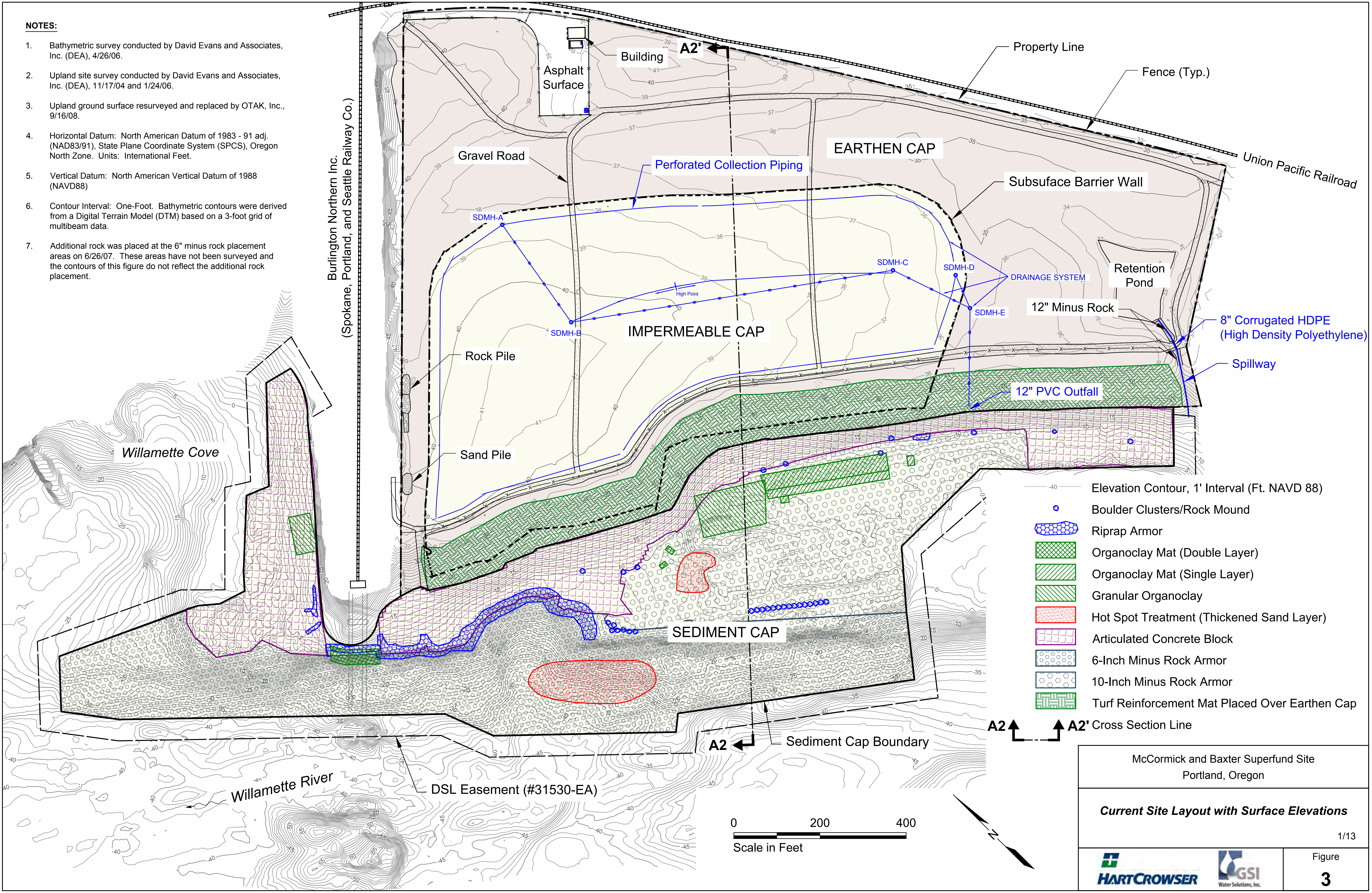
Figure
2

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project GIS\Project mxds\2010 Annual Report\Figure2 Current Site Layout and Features.mxd Date: October 13, 2011 11:01:29 AM

NOTES:

1. Bathymetric survey conducted by David Evans and Associates, Inc. (DEA), 4/26/06.
2. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
3. Upland ground surface resurveyed and replaced by OTAK, Inc., 9/16/08.
4. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
5. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
6. Contour Interval: One-Foot. Bathymetric contours were derived from a Digital Terrain Model (DTM) based on a 3-foot grid of multibeam data.
7. Additional rock was placed at the 6" minus rock placement areas on 6/26/07. These areas have not been surveyed and the contours of this figure do not reflect the additional rock placement.



McCormick and Baxter Superfund Site
Portland, Oregon

Current Site Layout with Surface Elevations

1/13

HARTCROWSER
GSI Water Solutions, Inc.

Figure
3

LEGEND

⊕ Groundwater Monitoring Wells

☐ Groundwater Monitoring Wells with Transducers

⊗ Decommissioned Groundwater Monitoring Wells

🟥 Subsurface Barrier Wall

NOTES:

1) Aerial photo taken on September 22, 2006

2) Wells EW-9s, MW-2s, MW-3s, MW-18s, and MW-Ks were decommissioned between June 30 and August 2, 2012

0 200 400

Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Groundwater Monitoring Well Location Map

1/13

HARTCROWSER GSI Water Solutions, Inc.

Figure
4

File Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project GIS\Project mxds\2012 Annual Report\FigureA-1 Monitoring Well Location Map.mxd

Table 1 - Summary of O&M Activities Between Second and Third Five-Year Reviews (October 2006-September 2011)
O&M Plan
McCormick and Baxter Superfund Site

Activities and Investigations	Dates and Descriptions
October through December 2006	
Soil and sediment cap inspections	Weekly in October; monthly November and December 2006
Sediment cap multibeam bathymetric and side-scan sonar surveys; diver inspections of deep water	October 2006 diver inspection; December 2006 embayment armor probing
Routine and non-routine maintenance and vegetation management	As needed
Surface water/ inter-armoring/ sub-armoring sampling	October 2006
MW-59s sampling	November 2006
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met.
NAPL recovery interior wells	Site-wide wells gauged November 2006
Groundwater elevation monitoring	Site-wide wells gauged November 2006; select wells gauged continuously
Crayfish sampling	October 2006
Organoclay cap performance assessment	October 2006 organoclay core sampling
2007	
Soil and sediment cap inspections	Monthly; additional weekly sediment cap inspections July through October 2007.
Sediment cap multibeam bathymetric and side-scan sonar surveys; diver inspections of deep water	Armoring assessment and repair: Differencing images, June and July 2007 diver inspections, additional rock armor placement, additional organoclay mat placement
Routine and non-routine maintenance and vegetation management	As needed
Surface water/ inter-armoring/ sub-armoring sampling	March and September/October 2007
MW-59s sampling	February and October 2007
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met.
NAPL recovery interior wells	Site-wide wells gauged February, June, September, and December 2007.
Groundwater elevation monitoring	Site-wide wells gauged February, June, September, and December 2007; select wells gauged continuously
Sheen investigation	June 2007 surface water samples; September 2007 surface water and sub-armoring water samples
Organoclay cap performance assessment	Laboratory analysis of organoclay cores collected in 2006
2008	
Soil and sediment cap inspections	Monthly; additional weekly sediment cap inspections July through October 2008.
Habitat enhancement features inspection	October 2008
Routine and non-routine maintenance and vegetation management	As needed
Surface water/ inter-armoring/ sub-armoring sampling	March/April and September 2008
MW-59s sampling	August 2008
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met.
NAPL recovery interior wells	Site-wide wells gauged March, June, September, and December 2008.
Groundwater elevation monitoring	Site-wide wells gauged March, June, September, and December 2008; select wells gauged continuously
Soil cap subsdence monitoring	June and August 2008 monitoring well surveys and comparison to 2005 survey; storm drain inspections, October 2008 install transducers at two shallow wells
Crayfish sampling	September 2008
Ebullition and sheen investigation	July through October 2008 - sheen surveys, sediment cores, sediment sampling, porewater sampling, ebullition monitoring and mapping, flux chamber gas and water sampling

Table 1 - Summary of O&M Activities Since Last 5-Year Review
O&M Plan
McCormick and Baxter Superfund Site

2009	
Soil and sediment cap inspections	Monthly; additional weekly sediment cap inspections July through October 2009.
Habitat enhancement inspection	November 2009
Routine and non-routine maintenance and vegetation management	As needed
Surface/inter-armoring/sub-armoring water sampling	March 2009 by conventional method; October 2009 by conventional method plus colocated SPME sampling at 13 locations
MW-59s sampling	August 2009
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met.
NAPL recovery interior wells	EW-1s gauged weekly starting July 6, 2009, recovery as criterion was met; site-wide wells gauged March, June, September, and December 2009.
Groundwater elevation monitoring	Site-wide wells gauged March, June, September, and December 2009 (December event included 10 additional wells on Triangle Park property); select wells gauged continuously.
Sheen characterization activities	July and August 2009 sheen surveys, August 2009 sheen sampling, laboratory chemical analysis, biological assessment, and sheen simulation
Soil cap subsdence monitoring	March 2009 storm drain inspection, July 2009 vapor and groundwater sampling at EW-1s, April through September 2009 monthly hub surveys Photos of subsidence?
2010	
Soil and sediment cap inspections	January, February, March, June, August, and December 2010; additional sediment cap inspections July through October 2010.
Sediment cap multi-beam bathymetric and side-scan sonar surveys; diver inspections of deep water	June 2010 sediment cap differencing images; October 2010 diver inspection
Routine and non-routine maintenance and vegetation management	As needed
Surface/inter-armoring/sub-armoring water sampling	April 2010 by conventional method; October 2010 by SPME.
MW-59s sampling	October 2010
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met.
NAPL recovery interior wells	EW-1s gauged weekly, recovery as criterion was met; site-wide wells gauged June and October 2010.
Groundwater elevation monitoring	Site-wide wells gauged June and October 2010; select wells gauged continuously.
Groundwater quality assessment	11 wells, Spring 2010.
Willamette Cove ACB inspection	Historical data review, April 2010 porewater sampling, and Fall 2010 sediment coring
January through September 2011	
Soil and sediment cap inspections	Monthly
Routine and non-routine maintenance and vegetation management	As needed
NAPL recovery exterior wells	EW-2s, EW-9s. EW-10s, EW-19s, MW-20i, MW-34i, MW-Ds, MW-Gs gauged weekly, recovery as criterion was met; stopped recovery on April 20, 2011; gauged twice in May and monthly thereafter.
NAPL recovery interior wells	EW-1s gauged weekly starting July 6, 2009, recovery as criterion was met; stopped recovery on April 20, 2011; gauged twice in May and monthly thereafter; site-wide wells gauged June 2011.
Groundwater elevation monitoring	Site-wide wells gauged June 2011; select wells gauged continuously.
DNAPL investigation	March 2011 four investigative borings near MW-20i; excavation around high-pressure sewer lines.

Table 2 - Operational and Functional Performance Measures and Status
O&M Plan
McCormick and Baxter Superfund Site

Remedy	Operational and Functional Performance Measures	Status
Soil Cap	The support facility and soil cap were constructed in accordance with the design.	Achieved
	The paved entrance road and parking area, the shop building, the electrical, telephone and water services, and the security fencing are functioning properly.	Achieved
	A vegetative cover has been established on all parts of the soil cap, including the riparian area.	Achieved
	The temporary irrigation system functioned as intended and native vegetation is adequately established.	Achieved
	Stormwater is properly collected in the geocomposite fabric and perforated piping, and is being conveyed through conveyance piping to an outfall structure.	Achieved
Soil Removal	Highly contaminated soils were excavated and disposed of off-site.	Achieved
Sediment Cap	The sediment cap was constructed in accordance with the design.	Achieved
	The armoring layer is withstanding erosional forces from the river.	Achieved
	All known creosote seeps have been capped with organoclay.	Achieved
	The organoclay caps are effectively preventing creosote migration to the river.	Achieved
Subsurface Barrier Wall	Groundwater flow is substantially retarded across the barrier wall boundary.	Achieved
	Groundwater elevations of the shallow aquifer within the barrier wall have reached a steady-state elevation (following construction of the impermeable soil cap), so to as not threaten to overtop the riverfront segment of the subsurface barrier wall.	Achieved
NAPL Extraction	NAPL extraction is no longer deemed necessary due to minimal recovery rates and mobility that do not pose a threat to the Willamette River and its sediments.	Achieved

Table 3: Soil Cap O&M Activities through 2021
O&M Plan
McCormick and Baxter Superfund Site

O&M Activity	Frequency
Visual Inspections:	
Cap surface	Quarterly
Subsidence near EW-1s	Quarterly
Stormwater conveyance system	Quarterly
Security fencing	Quarterly
Warning signs	Quarterly
Abundance and survival of vegetation	Quarterly
Routine Maintenance and Monitoring:	
Manual removal of invasive plant	Semiannually, if necessary
Targeted application of herbicides	Semiannually, if necessary
Non-Routine Maintenance – such as:	
Repairs of fence	As needed
Replacement of warning signs	As needed
Repairs of gravel roads	As needed
Filling of potential animal burrow into the earthen cap	As needed
Remove sediments from manholes	As needed
Replanting unsuccessful trees and shrubs	As needed

Table 4 - Comparison of Water Quality Criteria
O&M Plan
McCormick and Baxter Superfund Site

			1996 AWQCs[1]		2007 NRWQCs[2]		2011 AWQCs[3]		1996 ROD ACLs	2011 MCLs[4]
Chemical		Units	Aquatic Life (chronic)	Human Health (fish consumption only)	Aquatic Life (chronic)	Human Health (consumption of organism only)	Aquatic Life (chronic)	Human Health (consumption of organism only)		
Total Arsenic		µg/L	0.19		0.15	0.00014	0.15	2.1	1	0.01
Total Chromium		mg/L	0.21		0.074		0.074		1	0.1
Total Copper		mg/L	0.012		0.009		BLM		1	
Total Zinc		µg/L	0.11		0.12	26	0.12	2600	1	
Pentachlorophenol		µg/L	13		15	3	15	0.3	5	0.001
Acenaphthene	L	µg/L	520			990		99		
Acenaphthylene	L	µg/L								
Anthracene	L	µg/L				40000		4000		
Benz[a]anthracene	H, C	µg/L				0.018		0.0018		
Benzo[a]pyrene	H, C	µg/L						0.0018		0.0002
Benzo[b]fluoranthene	H, C	µg/L				0.018		0.0018		
Benzo[g,h,i]perylene	H, C	µg/L				0.018				
Benzo[k]fluoranthene	H	µg/L				0.018		0.0018		
Chrysene	H, C	µg/L				0.018		0.0018		
Dibenzo[a,h]anthracene	H, C	µg/L				0.018		0.0018		
Fluoranthene	H	µg/L		54		140		14		
Fluorene	L	µg/L				5300		530		
Ideno[1,2,3-cd]pyrene	H, C	µg/L				0.018		0.0018		
Naphthalene	L	µg/L	620							
Phenanthrene	L	µg/L								
Pyrene	H	µg/L				4000		400		
Total LPAHs		µg/L								
Total HPAHs		µg/L								
Total cPAHs		µg/L		0.031						
Total PAHs		µg/L							43	

Notes:

[1] The 1996 Record of Decision (ROD) specifies the remedial action objects of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state Ambient Water Quality Criteria (AWQCs).

[2] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html).

[3] Oregon's revised AWQCs for human health approved by EPA on October 17, 2011

[4] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html).

Key:

ACLs = Alternate Concentration Limits
AWQCs = Aquatic Water Quality Criteria
C = Carcinogenic PAH (cPAH)
L = Low Molecular Weight PAH (LPAH)
MCLs = Maximum Contaminant Levels
mg/L = milligrams per liter
NRWQCs = National Recommended Water Quality Criteria
H = High Molecular Weight PAH (HPAH)
µg/L = micrograms per liter

Table 5: Sediment Cap O&M Activities through September 30, 2016
O&M Plan
McCormick and Baxter Superfund Site

O&M Activity	**Frequency**
Visual Inspections (from shore)	
Warning buoys	Quarterly
Cap surface	Quarterly
Habitat quality	Annually
Routine Monitoring:	
Water Column and Interarmoring Water Sampling	Every 5 years (starting in 2015)
Organoclay Cores ***(Need to confirm with Heidi)***	In 2015, then determine frequency
Non-Routine Monitoring – such as:	
Multibeam bathymetric surveys, side-scan sonar survey	Every 10 years, starting in 2020; perform as needed (unforseen natural event)
Diver Inspection	If necessary, will be conducted every 10 years starting in 2020, after bathymetry
Non-Routine Maintenance – such as:	
Replacement of buoys	As needed
Additional armoring placement	Schedule for 2020, and 2040, if needed. After unforseen even, if needed
Additional organoclay capping	As needed
ACB grouting or armoring void space maintenance (habitat gravel)	Every 5 years , or as needed based on site inspections

Table 6: Groundwater O&M Activities through 2021
O&M Plan
McCormick and Baxter Superfund Site

O&M Activity	Frequency
NAPL Monitoring	
Manual gauging of Site wells	Semiannually
Manual extraction from exterior wells	Not recommended
Groundwater Monitoring	
Downloading continuous water level data from transducers	Semiannually
Manual water level measurements from Site wells	Semiannually
Groundwater Sampling	
Site-wide	Every 5 years
Infiltration pond (MW-59s)	Every 5 years
Routine Maintenance of Equipment	
Interface probes, pumps, vehicle, data loggers/transducers, etc.	As needed
Utilities Service	
Water, electric, phone, alarm, solid waste, toilet	Continuous

Table 7: Estimated DEQ and Contractor Costs for O&M Activities Through 2021
O&M Plan
McCormick and Baxter Superfund Site

	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Oregon State Fiscal Year	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21
DEQ Site Management	25,000	45,000	45,000	60,000	60,000	60,000	90,000	60,000
Contractor Upland & Sed Cap Monitoring and Reporting	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
Sed Cap Water and OC Core Sampling		80,000					80,000	
Sediment Cap Sampling Reporting		20,000					20,000	
Five-Year Review Report			25,000					25,000
Barrier Wall Performance Monitoring				15,000	15,000	15,000	15,000	15,000
Barrier Wall Performance Reporting				20,000	20,000	20,000	20,000	20,000
Sed Cap Armoring Inspection							40,000	
Sed Cap Armor Repair							200,000	
Site wide GW Sampling							50,000	
Haz WasterDisposal (Well Development)							7,500	
Annual Total	70,000	190,000	115,000	140,000	140,000	140,000	567,500	165,000
Biennial Total		260,000		255,000		280,000		732,500
Eight-Year Total								1,527,500

APPENDIX C
CLEAN WATER ACT 401 DETERMINATION

CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION

MCCORMICK AND BAXTER CREOSOTING COMPANY
PORTLAND, OREGON
SEDIMENT CAP REMEDIAL ACTION

1. Introduction

This Clean Water Act (CWA) Section 401 Water Quality Certification (WQC) is prepared in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA), for the McCormick & Baxter Creosoting Company Superfund Site in Portland, Oregon. A copy of this WQC will be placed in the Site File.

The action addressed in this WQC is the capping of contaminated sediment in the Willamette River. This action is one of several remedial actions being taken under CERCLA to significantly reduce the potential risk to human health and ecological receptors resulting from exposure to contaminants present in sediment, groundwater, and soils at the project area.

The Oregon Department of Environmental Quality (DEQ) is the lead agency for implementing the remedial actions specified in the Record of Decision (ROD) while funding for remedial design and construction is being provided by U.S. Environmental Protection Agency (EPA). DEQ has contracted with Ecology & Environment, Inc. to provide technical and engineering assistance in implementing the selected remedy. The DEQ also has contracted with the U.S. Army Corp of Engineers (COE) to provide additional technical support, primarily relating to the sediment remedy. It is anticipated that construction oversight will be provided by Ecology & Environment, Inc. who will report directly and on a daily basis to the DEQ project manager. The construction contractor will be under contract to the DEQ.

The McCormick and Baxter site covers approximately 43 acres on land and 17 acres in the river and is located at 6900 Edgewater Street in the City of Portland, Oregon. The McCormick and Baxter site is situated on the northeast bank of the Willamette River (River Mile 7) in an area zoned for heavy industrial use. The site is bordered by railroad tracks on the northeast and northwest, a barge maintenance and dredging facility on the southeast, and an empty lot where a shipyard and cooperage were once located on the northwest. A residential area is located on the northeast side of the site on top of a bluff approximately 120 feet high.

The Willamette River is about 1,500 feet wide along the reach of the project site and flows to the northwest. Channel sounding maps from January 1991 from the COE indicate that a navigational channel is maintained at a width of approximately 600 feet and to a maximum depth of approximately 40 feet below the Columbia River Datum (CRD). The centerline of the navigational channel is approximately 900 feet from the site's shoreline. The CRD is approximately 1.74 feet below the National Geodetic Vertical Datum (NGVD)[1]. The NGVD

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[1] NGVD is approximately equal to MSL.

was used as a control for the site topographic survey. There is a 1,200-foot wide embayment along the southeastern portion of the property, with river depths ranging from +10 to –25 feet NGVD. COE maps indicate that there are steep slopes approximately 150 feet offshore (or 450 feet from the embayment shoreline).

The proposed action is the construction of a sediment cap in the Willamette River that consists of placement of capping and erosion control materials in waters of the United States, as well as any other activities that result in a discharge of dredged or fill materials into waters of the United States. As specified in the ROD, the objectives of this remedial action are to prevent humans and aquatic organisms from coming into direct contact with contaminated sediments and to minimize releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state ambient water quality criteria.

This certification ensures compliance with the substantive requirements of Section 401 of the Federal Clean Water Act (CWA). The EPA has based this evaluation on the State of Oregon's Water Quality Standards (WQSs) including 340-41-026 (1)(a), Antidegradation Policy for Surface Waters. These standards are normally applicable and used by the State of Oregon for Section 401 in the absence of a CERCLA action. EPA's development of this evaluation included coordination with the DEQ.

This reach of the Willamette River is classified as Water Quality Limited under Section 303(d) of the federal CWA for the following parameters: bacteria [fecal coliform (fall-winter-spring)]; toxics: [tissue-mercury (year-round)]; toxics [tissue/sediment- pentachlorophenol, arsenic); temperature (summer); and biological criteria (fish skeletal deformities). In addition, the Oregon Department of Human Services, Office of Public Health, maintains a health advisory for crayfish harvesting within 1,000 feet of the site (see Oregon Sport Fishing Regulations).

This reach of the Willamette River supports salmonid rearing and migration.

The documents used in support of this evaluation include:

a. *Remedial Investigation Report*, McCormick & Baxter Creosoting Company. September 1992.
b. *Record of Decision*, McCormick and Baxter Creosoting Company Portland Plant, Portland, Oregon, March 1996.
c. *Explanation of Significant Difference* (OU3 – Final Groundwater), McCormick and Baxter Creosoting Company Superfund Site, Portland, Multnomah County, Oregon, August 2002.
d. *Sediment Cap Basis of Design*, McCormick & Baxter Creosoting Company, Portland, Oregon, May 2002.
e. *A Cultural Resource Survey of the McCormick & Baxter Superfund (CERCLA) Property, Portland, Oregon,* September 13, 2002.

f. *An Assessment of the Significance of the Western Cooperage Archaeological Site (35MU114), Portland, Oregon,* June 2003.
g. *Draft Technical Plans and Specification, Sediment Cap,* McCormick & Baxter Creosoting Company, Portland, Oregon, January 22, 2003.
h. *Draft Final Monitoring and Maintenance Plan, Sediment Cap,* McCormick & Baxter Creosoting Company, Portland, Oregon, June 19, 2003.
i. *Draft Final Technical Plans and Specification, Sediment Cap,* McCormick & Baxter Creosoting Company, Portland, Oregon, June, 2003.
j. *Biological Assessment Addendum*, McCormick & Baxter Creosoting Company, Portland, Oregon, Draft Final, June 2003.
k. *Substantive Compliance with Section 404 of the Clean Water Act And Section 10 of the Rivers and Harbors Act, Sediment Remedial Action*, McCormick & Baxter Creosoting Company, Portland, Oregon, In-Preparation.

2. Construction Activities.

Construction for the project will consist of the actions listed below. The sequence will consist of the removal of in-water structures and debris along with shoreline structure removal and grading. Cap placement would start with the placement of sand and organophyllic clay in the shallow nearshore areas and working towards deeper water. This would be followed by placement of the erosion control materials (articulated concrete block [ACB] and rock) and other materials (sand and rock) used for habitat enhancement on top of the cap. The riparian vegetation would be planted after all major construction elements have been completed.

Construction Actions

- The removal of approximately 600 pilings for construction of the sediment cap. The area where pilings would be removed covers approximately 27,600 square feet (0.6 acre). The wood pilings would be removed at the sediment surface by snipping at the mudline and would be transported to an off-site disposal facility.
- The removal of dock and bulkhead structures to facilitate grading the project bank to a more natural slope (see paragraph below). The waste wood would be disposed at a suitable disposal facility. Approximately 5,750 square feet of dock support and 900 square feet of bulkhead would be removed. Removal of the structures would occur before sediment capping to provide the final bank configuration against which the sediment cap will abut.
- The grading of the bank upslope from the area of the sediment cap to a maximum slope of 4 feet horizontal to 1 foot vertical (4:1 slope). The slope will incorporate a terrace and would vary in slope from 4:1 to 7:1 to support a varied riparian community. The terrace would vary in width from 12 to 18 feet and in elevation from 17.7 to 19.7 NGVD. The terrace would provide storage for river flows above the approximate 5-year flood event. The terrace (as well as the bank slope) would be planted with riparian vegetation. This will serve as a buffer for storm water from the upland site as well as providing habitat for fish and wildlife.
- After the bank has been graded, 1.5 feet of clean soil fill and 6 inches of topsoil

would be placed to support the riparian plantings. The soil layers would be covered by a turf reinforcement mat to augment the strength of a vegetative root mass.

- The construction of a 25-acre cap below ordinary high water (OHW). It would extend along the shoreline within most of the length of the embayment, along the area of the former creosote dock, under the railroad bridge, and just downstream into Willamette Cove to the north. The cap boundary also includes areas of known NAPL migration (seeps). The seeps would be covered with special material--organophyllic clay that has an affinity to adsorb the associated contaminants. A portion of the NAPL seep in Willamette Cove would be excavated to create a trench that would be backfilled with the organophyllic clay. The excavated materials would be disposed of in an approved upland facility. Approximately 13.5 acres within the cap would be armored with articulated concrete block (8.5 acres) and 10-inch minus rock (5 acres) from a depth of –7 CRD (finished elevation) to approximately OHW. Approximately 11.5 acres of cap would be armored with 6-inch minus rock (a gradation of material from 6-inch diameter size to gravel). The 6-inch minus material will extend from the –7 CRD finished elevation to as deep as –50 CRD. The sediment cap would transition to an upland soil cap at the top of the bank near the shoreline. The sediment cap will extend into the river to the base of the steeply sloped area at approximately the 40-foot depth line and will terminate at least 100 feet from the northeastern edge of the federal navigation channel.
- The removal of approximately 350 remnant pilings from a creosoted treated dock at the upstream end of the McCormick & Baxter site (adjacent to the Triangle property) outside of the cap footprint.
- The placement of 1,300 cubic yards of 2-foot diameter rock in strategic locations along the McCormick and Baxter nearshore environment to serve the purpose of dissipating wave energy and trapping sand in much the same way as do the existing structures or sand bars.
- The placement of 3,000 cubic yards of fine-grained substrate on top of the constructed cap to provide a sand ‘reserve’ within the project area that the currents and waves could rework around the shallows. The intent is to provide a fine-grained veneer on top of the ACB.
- The removal of approximately 100 creosote-treated pilings in Willamette Cove that are being removed solely for habitat mitigation purposes.
- Barge and concrete debris removal in Willamette Cove.

3. Water Quality Standards

The proposed action has been designed to comply with the substantive requirements of the Clean Water Act and to minimize impacts on water quality of the Willamette River during construction activities. To satisfy the State of Oregon’s WQS, actions will be taken to control temporary and long-term runoff impacts (e.g., storm water runoff). Specific actions that will be undertaken to satisfy these requirements include:

- Application of National Pollutant Discharge Elimination System requirements for construction storm water management on all upland construction activities.

- Use of silt fences, silt curtains, and sorbant booms to control turbidity and accidental contaminant releases for in-water work.
- Use of best management practices (BMPs) for construction site maintenance to minimize erosion and to avoid oil and lubricant spills.
- Work restricted to low-water river stages to minimize in-water work.
- Use of placement techniques for capping materials to minimize turbidity and re-suspension of bottom sediments.
- Long-term site monitoring to assure efficacy of remedial activities.

Specific actions that will be undertaken to minimize the generation of turbidity include:

a) Turbidity-Minimizing Actions During In-Water Structure Removal.
The removal of pilings and dolphins will occur over a range of elevations from about +9 to 0[2] CRD for the dock remnant and associated bulkhead and piling removal, –4 to –6 CRD in the vicinity of the Willamette Cove, and from –10 to –30 CRD extending from the railroad bridge upstream, paralleling the harbor line. The wood pilings would be removed at the sediment surface by snipping at the mudline and would be transported to an off-site disposal facility. Sediment fences and booms would be deployed during the removal operations. All large, woody removal debris would be trapped and removed from the water. Pilings that will be removed outside of the areas of contaminated sediments will be pulled, if possible, or cut below the mudline. The same protective operations would apply to all piling removal activities.

The shoreline dock and bulkhead structures would be removed and disposed at a suitable disposal facility. Approximately 230 cubic yards of dock support and bulkhead would be removed. Most of this work will occur during low water and construction storm water controls will be implemented (silt fences, straw bales, biobags). For any work that comes in contact with the water, protective measures described for piling removal will also be applied.

b) Turbidity-Minimizing Actions During Cap Placement.
The cap construction will consist of placing a 2-foot layer of sand, or other readily available clean fill, in addition to armoring. The cap boundary also includes areas of known NAPL migration (seeps). The seeps would be covered with special material--organophyllic clay that has an affinity to adsorb these types of contaminants. A portion of the NAPL seep in Willamette Cove would be excavated to create a trench that would be backfilled with the organophyllic clay. The excavated materials would be disposed of in an approved upland facility. The sand materials will be placed at a controlled rate to minimize re-suspension of contaminated bottom sediments. This may be done by conveyor, clamshell bucket, hose-wash from a barge, or other method to achieve even cap distribution as well as a controlled rate of disposal. Any materials used for the cap

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[2] All elevations are in feet.

will be suitable for in-water disposal, the criteria for which are provided in the technical specifications. These criteria meet and in most cases are more stringent than the criteria specified in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (November 1998) Silt curtains and floating booms will be deployed, as necessary, during placement to maintain the WQS described in Part 4. The organophyllic clay materials will be placed under shallow-water conditions and in such a manner so as to minimize turbidity.

Approximately 6.8 acres within the cap would be armored with ACB from a depth of –7 CRD (finished elevation) to approximately OHW. The ACB would be assemble as cabled mats that would be placed by booms over the sand and clay cap. Protection measures listed for sand placement would also be deployed for ACB placement. Approximately 4.3 acres of the cap would be armored with 10-inch minus rock (a gradation of material from the 10-inch diameter size to gravel. This would also be placed from a depth of –7 CRD to OHW. Approximately 11.5 acres of cap would be armored with 6-inch minus rock (a gradation of material from 6-inch diameter size to gravel). The 6-inch minus material will extend from the –7 CRD finished elevation to as deep as –50 CRD.

All rock would be placed by equipment such as a clamshell bucket to control placement and minimize disturbance to the cap. Protection measures listed for sand placement would also be deployed for rock placement.

Additional habitat enhancement measures, including placement of additional sand and rock on top of the cap, would be placed with the same protection measures listed above.

4. Turbidity Criteria and Monitoring Requirements

The authorized work shall not cause turbidity of the Willamette River to exceed the turbidity criteria listed below at a distance of 100 feet downstream from the turbidity-causing activity.

a) Turbidity criteria are as follows:

- Turbidity shall be no greater than 5 NTU over background turbidity when background is 50 NTU or less; or
- No more than 10% increase in turbidity when background turbidity is more than 50 NTU.

b) Establishing background turbidity:

- Shall be established by collecting seven (7) independent turbidity measures (minimum) during a two-day period prior to the construction activity.
- Mean turbidity values will be used to represent background.

c) Turbidity shall be monitored during active in-water work periods. Monitoring points shall be an undisturbed site (representing background) 100 feet upstream from the turbidity causing activity (i.e., fill or discharge point), and 100 feet downstream from the fill point. In addition, monitoring points at the point of discharge shall be collected at the bottom, midlevel and top of the water column but not closer than within 5 foot intervals.

d) Turbidity shall be measured and recorded at least once every 4 hours during in-water work. On any day in-water work occurs, the first sample will be taken at four hours after the initiation of activity, and once at each four-hour interval thereafter. If the turbidity level is determined to exceed turbidity criteria, work will not proceed until the turbidity level has dropped to an acceptable level or the DEQ gives specific approval to proceed. Additionally, visual monitoring of turbidity will occur at least once every 4 hours during in-water work throughout the construction period.

e) A turbidity meter will be used to monitor turbidity. The meter will be calibrated daily using the factory-recommended calibration procedure. At the end of each day of monitoring, a post calibration procedure will be performed by measuring one of the calibration standards (preferable the standard whose value is closest to the river values). In addition, standards may be measured to check the calibration throughout the day, especially if higher or lower than expected turbidity values occur. All calibration procedures and values will be documented.

f) If, at any time, the monitoring supervisor observes visual turbidity at levels that are estimated to be approaching the turbidity exceedance level, field-testing will be performed. If field-testing indicates the turbidity level is above the turbidity criteria, a second sample will be collected within 30 minutes to verify the results. If both measurements are above the turbidity criteria , the contractor will be required to cease operations responsible for causing the elevated turbidity.

g) BMPs for environmental protection during in-water work will be developed by the contractor for inclusion in the Construction Operations Plan. The BMPs will be evaluated and modified (when applicable) throughout the construction period to assure that WQSs are met. Modifications may include, but are not limited to:

- Check and repair of equipment;
- Decreased rates of capping; and/or
- Deployment of additional sedimentation control devices

5. Additional Measures

a) Deleterious waste materials. Petroleum products, chemicals, fresh cement, riprap grout, or other deleterious waste materials shall not be allowed to enter waters of the State. BMPs shall be employed to prevent discharges of any deleterious materials to surface and ground waters. All foreign materials, refuse, and waste from the area must be removed, including construction debris.

b) If the construction activities cause a water quality problem that results in distressed or dying fish, the operator shall immediately:

- Cease operations;
- Take appropriate corrective measures to prevent further environmental damage;
- Collect fish specimens and water samples; and
- Notify EPA, DEQ, Oregon Department of Fish and Wildlife, and the National Oceanic and Atmospheric Administration Fisheries.

c) Per the technical specifications the contractor will develop a spill prevention, control, and countermeasures (SPCC) plan to address storage, usage, and spill response measures for petroleum and chemical products used at the site. The SPCC plan will be approved by DEQ.

d) Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc, shall be checked regularly for drips or leaks, and shall be maintained in order to prevent spills into State waters.

e) In the event of a discharge of oil, fuel, or other chemicals into State waters, or onto land with a potential to enter State waters, containment and cleanup shall begin immediately and be completed as soon as possible.

f) Spills into State waters, or onto land with a potential to enter State waters, shall be reported immediately to the DEQ Spill Response Team (Northwest Region/Portland: (503) 229-5614.

g) A copy of this certification shall be kept on the job site and readily available for reference by EPA, DEQ personnel, Ecology & Environment, Inc, the contractor, and other appropriate State and local government inspectors.

6. Summary Statement

Based on information contained in the preceding and in supporting documents, EPA does not anticipate any violations of Section 301, 302, 303, 306, and 307 of the Federal CWA, as amended and State of Oregon WQSs, including OAR 340-41-026 (1)(a) Antidegradation Policy for Surface Waters, provided that the conditions which follow are incorporated into the action.

GENERAL NOTIFICATION AND PROVISION OF RECORDS

1. EPA requires prior approval of water quality protective measures prior to any actions taken in the implementation of this project.
2. EPA requires immediate notification upon exceedance or failure to comply with conditions of the Water Quality Certification.
3. Copies of monitoring results will be provided to EPA upon completion of the work. This information will be immediately provided when a violation of WQS has occurred, in the event of a fish kill, or upon failure to comply with other WQS conditions.

4. Water Quality Contact: John Malek, EPA, at (206) 553-1286; email: Malek.John@epamail.epa.gov; Address: 1200 6th Avenue, Seattle, Washington 98101.

APPROVED BY:

______________________________ ______________________

U.S. EPA Date

Cc:
Alan Goodman, EPA Remedial Project Manager
Kevin Parrett, DEQ Project Manager
Tom Melville, DEQ Water Quality

APPENDIX D
INSTITUTIONAL CONTROLS AND ACCESS AGREEMENTS

STAUBACH
A World of Real Estate Knowledge

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APR - 4 2005
DEPT OF ENVIRONMENTAL QUALITY
NORTHWEST REGION

March 31, 2005

Mr. Kevin Parrett
Project Manager, Land Quality Division
Oregon Department of Environmental Quality
2020 SW Fourth Ave, Suite 400
Portland OR 97201-4987

Dear Mr. Parrett:

Enclosed please find one (1) fully executed Agreement for your file. **A copy of the executed Agreement must be available upon request at the job site allowing authorization to do the work.** Please contact Roadmaster Keith Morehead at telephone (360) 418-6324, five (5) days in advance of entry and **BEFORE YOU DIG, CALL 1-800-533-2891.** If you need additional information please contact me at (817) 230-2631.

Sincerely,

Julie Alexander

Julie Alexander
Senior Contract Specialist

Enclosure

cc: RoadMaster
Keith Morehead – 1515 W 39th, Vancouver WA 98660

3017 Lou Menk Drive, Suite 100
Fort Worth, Texas 76131-2800
(817) 230-2600 Fax (817) 306-8129
www.staubach.com

The Staubach Company
provides global coverage through
DTZ Staubach Tie Leung.

04-27010

LICENSE

THIS LICENSE ("License"), made as of the 30th day of March, 2005 ("Effective Date") by and between **THE BURLINGTON NORTHERN AND SANTA FE RAILWAY COMPANY**, a Delaware corporation ("Licensor") and **OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY**, ("Licensee")

NOW THEREFORE, in consideration of the mutual covenants contained herein, the parties agree to the following:

GENERAL

1. Licensor hereby grants Licensee a non-exclusive license, subject to all rights, interests, and estates of third parties, including, without limitation, any leases, licenses, easements, liens or other encumbrances, and upon the terms and conditions set forth below, to use the area of Licensor's right of way shown on the attached Drawing attached hereto, marked Exhibit "A", and made a part hereof, situated at or near Portland, County of Multnomah, State of Oregon, for the purposes specified in Section 3 below.

2. Licensee shall not disturb any improvements of Licensor or interfere with the use of such improvements.

3. Licensee shall use portions of the right of way exclusively as a site for installation of permanent soil cap. Licensee shall not use the right of way for any other purpose whatsoever. Licensee shall not use or store hazardous substances, as defined by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended ("CERCLA") or petroleum or oil as defined by applicable Environmental Laws on the right of way.

4. Any contractors or subcontractors performing work on the right of way, or entering the right of way on behalf of Licensee shall be deemed agents of Licensee for purposes of this License.

TERM

5. This License shall commence on the Effective Date and shall continue indefinitely.

COMPENSATION

6. (a) The Fee for this License has been waived.

   (b) Licensee agrees to reimburse Licensor (within thirty (30) days after receipt of bills therefor) for all costs and expenses incurred by Licensor in connection with Licensee's use of the right of way including but not limited to the furnishing of

Licensor's Flagman ($500.00 per eight hour day, $95.00 per hour thereafter) and any vehicle rental costs incurred. Licensee acknowledges that a twelve-hour day is often required to support an eight-hour work day due to travel, placement, and removal of advance protection signage, safety briefings, and other duties as required.

(c) All invoices are due thirty (30) days after the date of invoice. In the event that Licensee shall fail to pay any monies due to Licensor within thirty (30) days after the invoice date, then Licensee shall pay interest on such unpaid sum from thirty (30) days after its invoice date to the date of payment by Licensee at an annual rate equal to (i) the greater of (a) for the period January 1 through June 30, the prime rate last published in *The Wall Street Journal* in the preceding December plus two and one-half percent (2 ½%), and for the period July 1 through December 31, the prime rate last published in *The Wall Street Journal* in the preceding June plus two and one-half percent (2 ½%), or (b) twelve percent (12%), or (ii) the maximum rate permitted by law, whichever is less.

COMPLIANCE WITH LAWS

7. (a) Licensee shall observe and comply with any and all laws, statutes, regulations, ordinances, orders, covenants or restrictions ("Legal Requirements") relating to the use of the right of way.

(b) Prior to entering the right of way, Licensee shall and shall cause its contractor to comply with all Licensor's applicable safety rules and regulations. Prior to commencing any work on the Premises, Licensee shall complete and shall require its contractor to complete the safety training program at the following Internet Website http://www.contractororientation.com. This training must be completed no more than one year in advance of Licensee's entry on the right of way.

DEFINITION OF COST AND EXPENSE

8. For the purpose of this License, "cost" or "costs" "expense" or "expenses" includes, but is not limited to, actual labor and material costs including all assignable additives, and material and supply costs at current value where used.

RIGHT OF LICENSOR TO USE

9. Licensor excepts and reserves the right, to be exercised by Licensor and any other parties who may obtain written permission or authority from Licensor:

(a) to maintain, renew, use, operate, change, modify and relocate any existing pipe, power, communication lines and appurtenances and other facilities or structures of like character upon, over, under or across the right of way ;

(b) to construct, maintain, renew, use, operate, change, modify and relocate any tracks or additional facilities or structure upon, over, under or across the right of way; or

(c) to use the right of way in any manner as the Licensor deems appropriate, provided Licensor provides reasonable notice to Licensee in the event such activities may cause damage to the soil cap installed by Licensee and proposes mitigation measures..

LICENSEE'S OPERATIONS

10. (a) Licensee shall notify Licensor's Roadmaster at 1515 W 39th, Vancouver WA 98660, telephone (360) 418-6324, at least five (5) business days prior to entering on the right of way and prior to entering the right of way for any subsequent maintenance thereon (if applicable). After completion of use of the right of way for the purpose specified in Section 3, Licensee shall notify Licensor in writing that such use has been completed.

(b) In performing the work described in Section 3, Licensee shall use only public roadways to cross from one side of Licensor's tracks to the other.

11. (a) Under no conditions shall Licensee be permitted to conduct any tests, investigations or any other activity using mechanized equipment and/or machinery, or place or store any mechanized equipment, tools or other materials, within twenty-five (25) feet of the centerline of any railroad track without the express prior permission of Licensor. Licensee shall, at its sole cost and expense, perform all activities on and about the right of way in such a manner as not at any time to be a source of danger to or interference with the existence or use of present or future tracks, roadbed or property of Licensor, or the safe operation and activities of Licensor. If ordered to cease using the Premises at any time by Licensor's personnel due to any hazardous condition, Licensee shall immediately do so. Notwithstanding the foregoing right of Licensor, the parties agree that Licensor has no duty or obligation to monitor Licensee's use of the right of way to determine the safe nature thereof, it being solely Licensee's responsibility to ensure that Licensee's use of the right of way is safe. Neither the exercise nor the failure by Licensor to exercise any rights granted in this Section will alter the liability allocation provided by this License.

(b) Licensee shall, at its sole cost and expense and subject to the supervision of Licensor's Roadmaster, locate, construct and maintain the soil cap in such a manner and of such material that it will not at any time be a source of danger to or interference with the present or future tracks, roadbed and property of Licensor, or the safe operation of its railroad. If at any time Licensee shall, in the judgment of Licensor, fail to perform properly its obligations under this paragraph, Licensor may, at its option, itself perform such work as it deems necessary for the safe operation of its railroad, and in such event Licensee agrees to pay, within fifteen

(15) days after bill shall have been rendered therefore, the cost so incurred by Licensor, but failure on the part of Licensor to perform the obligations of Licensee shall not release Licensee from liability hereunder for loss or damage occasioned thereby.

12. During the construction and any subsequent maintenance performed on the soil cap Licensee shall perform such work in a manner to preclude damage to the property of Licensor, and preclude interference with the operation of its railroad. The construction of the soil cap shall be completed within one (1) year of the Effective Date. Upon completion of the construction of the soil cap and after performing any subsequent maintenance thereon, Licensee shall, at Licensee's own cost and expense, restore Licensor's premises to the extent practicable to their former state as of the Effective Date of this License.

13. If at any time during the term of this License, Licensor shall desire the use of its rail corridor in such a manner as would, in Licensor's reasonable opinion, be interfered with by the soil cap, Licensee shall, at its sole expense, within thirty (30) days after receiving written notice from Licensor to such effect, make such changes in the soil cap as may be necessary to avoid interference with the proposed use of Licensor's rail corridor, including, without limitation, the relocation of the existing or the construction of new soil cap.

14. (a) Prior to Licensee conducting any boring work on or about any portion of the right of way Licensee shall explore the proposed location for such work with hand tools to a depth of at least three (3) feet below the surface of the ground to determine whether pipelines or other structures exist below the surface; <u>provided, however,</u> that in lieu of the foregoing, the Licensee shall have the right to use suitable detection equipment or other generally accepted industry practice (<u>e.g.</u>, consulting with the Underground Services Association) to determine the existence or location of pipelines and other subsurface structures prior to drilling or excavating with mechanized equipment. Upon Licensee's written request, which shall be made thirty (30) business days in advance of Licensee's requested entry on the right of way, Licensor will provide Licensee any information that Licensor's Engineering Department has in its possession concerning the existence and approximate location of Licensor's underground utilities and pipelines on the right of way. Prior to conducting any such boring work, the Licensee will review all such material. Licensor does not warrant the accuracy or completeness of information relating to subsurface conditions and Licensee's operations will be subject at all times to the liability provisions herein.

(b) For all bores greater than 26-inch diameter, and at a depth less than 10.0 feet below bottom of rail, a soil investigation will need to be performed by the Licensee and reviewed by Licensor prior to construction. This study is to determine if granular material is present, and to prevent subsidence during the installation process. If the investigation determines in Licensor's reasonable opinion that granular material is present, Licensor may select a new location for

Licensee's use, or may require Licensee to furnish for Licensor's review and approval, in its sole discretion a remedial plan to deal with the granular material. Once Licensor has approved any such remedial plan in writing, Licensee shall, at its sole cost and expense, carry out the approved plan in accordance with all terms thereof and hereof.

15. Any open hole, boring or well constructed upon the right of way by Licensee shall be safely covered and secured at all times when Licensee is not working in the actual vicinity thereof. Following completion of that portion of the work, all holes or borings constructed on the right of ways by Licensee shall be:

(a) filled in to surrounding ground level with compacted bentonite grout; or

(b) otherwise secured or retired in accordance with any applicable Legal Requirement. No excavated materials may remain on the right of way for more than ten (10) days, but must be properly disposed of by Licensee in accordance with applicable Legal Requirements.

16. Upon completion of Licensee's work on the right of way or upon termination of this License, whichever shall occur first, Licensee shall, at its sole cost and expense:

(a) remove all of its equipment from the right of way ;

(b) report and restore any damage to the right of way arising from, growing out of, or connected with Licensee's use of the Premises;

(c) remedy any unsafe conditions on the right of way created or aggravated by Licensee; and

(d) to the extent practicable, leave the right of way in the condition which existed as of the Effective Date of this License.

17. Licensee's on-site supervision shall retain/maintain a fully-executed copy of this License at all times while on the right of way.

LIABILITY

18. (a) To the extent permitted by Article XI, Section 7, of the Oregon Constitution and by the Oregon Tort Claims Act, Licensee shall and shall cause its contractor to release, indemnify, defend and hold harmless Licensor and Licensor's affiliated companies, partners, successors, assigns, legal employees and agents (collectively, "indemnities") for, from and against any and all claims, liabilities, fines, penalties, costs, damages, losses, liens, causes of action, suits, demands, judgments and expenses (including, without limitation, court costs, attorneys' fees and costs of investigation, removal and remediation and governmental oversight costs) environmental or otherwise (collectively "liabilities") of any nature, kind or

description of any person or entity directly or indirectly arising out of, resulting from or related to (in whole or in part):

(i) This license, including, without limitation, its environmental provisions,

(ii) Any rights or interests granted pursuant to this license,

(iii) Licensee's occupation and use of the premises,

(iv) The environmental condition and status of the right of way caused by or contributed by Licensee, or

(v) Any act or omission of Licensee or Licensee's officers, agents, invitees, employees, or contractors, or anyone directly or indirectly employed by any of them, or anyone they control or exercise control over.

Further, to the fullest extent permitted by law, notwithstanding the limitation in section 19(a), licensee shall and shall cause its contractor to now and forever waive any and all claims, regardless whether based on the strict liability, negligence or otherwise, that railroad is an "owner", "operator", "arranger", or "transporter" with respect to the soil cap for the purposes of CERCLA or other environmental laws. To the extent permitted by Oregon law, Licensee will indemnify, defend and hold the indemnitees harmless from any and all such claims. Licensee further agrees that the use of the right of way as contemplated by this license shall not in any way subject Licensor to claims that Licensor is other than a common carrier for purposes of environmental laws and expressly agrees, to the extent permitted by Oregon law, to indemnify, defend and hold the indemnitees harmless for any and all such claims.

(b) Upon written notice from Licensor, Licensee agrees to assume the defense of any lawsuit or other proceeding brought against any Indemnitee by any entity, relating to any matter covered by this License for which Licensee has an obligation to assume liability for and/or save and hold harmless any Indemnitee. Licensee shall pay all costs incident to such defense, including, but not limited to, attorneys' fees, investigators' fees, litigation and appeal expenses, settlement payments, and amounts paid in satisfaction of judgments.

PERSONAL PROPERTY WAIVER

19. All personal property, including, but not limited to, fixtures, equipment, or related materials upon the right of way will be at the risk of Licensee.

INSURANCE

20. Licensee shall also maintain during the life of this agreement general liability and automobile liability in the amount of $50,000 for property damage, $200,000 per claimant and $500,000 per accident. BNSF Railway shall also be included as an additional indemnitee to the extent permitted by law. Licensee's contractor shall also maintain standard commercial general liability insurance as required of state contractors and shall also provide Railroad Protective liability insurance naming the Railroad as the insured with a combined single limit of $2 million per occurrence with a $4 million aggregate.

ENVIRONMENTAL

21. (a) Licensee shall strictly comply with all federal, state and local environmental laws and regulations in its use of the right of way , including, but not limited to, the Resource Conservation and Recovery Act, as amended (RCRA), the Clean Water Act, the Oil Pollution Act, the Hazardous Materials Transportation Act, CERCLA (collectively referred to as the "Environmental Laws"). Licensee shall not maintain a treatment, storage, transfer or disposal facility, or underground storage tank, as defined by Environmental Laws on the Premises. Licensee shall not release or suffer the release of oil or hazardous substances, as defined by Environmental Laws on or about the right of way.

(b) Licensee shall give Licensor immediate notice to Licensor's Resource Operations Center at (800) 832-5452 of any release of hazardous substances on or from the right of way, violation of Environmental Laws, or inspection or inquiry by governmental authorities charged with enforcing Environmental Laws with respect to Licensee's use of the right of way. Licensee shall use the best efforts to promptly respond to any release on or from the right of way. Licensee also shall give Licensor immediate notice of all measures undertaken on behalf of Licensee to investigate, remediate, respond to other otherwise cure such release or violation.

(c) In the event that Licensor has notice from Licensee or otherwise of a release or violation of Environmental Laws arising in any way which occurred or may occur during the term of this License, Licensee shall take timely measures to investigate, remediate, respond to or otherwise cure such release or violation .

(d) Licensee shall promptly report to Licensor in writing any conditions or activities upon the right of way known to Licensee which create a risk of harm to persons, property or the environment and shall take whatever action is necessary to prevent injury to persons or property arising out of such conditions or activities; provided, however, that Licensee's reporting to Licensor shall not relieve Licensee of any obligation whatsoever imposed on it by this License. Licensee shall promptly respond to Licensor's request for information regarding said conditions or activities.

ALTERATIONS

22. Licensee may not make any alterations of the right of way or permanently affix anything to the right of way or any buildings or other structures adjacent to the right of way other than soil cap without Licensor's prior written consent.

NO WARRANTIES

23. Licensor's duties and warranties are limited to those expressly stated in this license and shall not include any implied duties or implied warranties, now or in the future. No representations or warranties have been made by Licensor other than those contained in this license. Licensee hereby waives any and all warranties, express or implied, with respect to the right of way or which may exist by operation of law or in equity, including, without limitation, any warrant of merchantability, habitability or fitness for a particular purpose.

QUIET ENJOYMENT

24. Licensor does not warrant its title to the property nor undertake to defend Licensee in the peaceable possession or use thereof. No covenant of quiet enjoyment is made.

DEFAULT

25. If default shall be made in any of the covenants or agreements of Licensee contained in this document, or in case of any assignment or transfer of this License by operation of law, Licensor may, at its option, terminate this License by serving five (5) days' notice in writing upon Licensee. Any waiver by Licensor of any default or defaults shall not constitute a waiver of the right to terminate this License for any subsequent default or defaults, nor shall any such waiver in any way affect Licensor's ability to enforce any Section of this License. The remedy set forth in this Section 26 shall be in addition to, and not in limitation of, any other remedies that Licensor may have at law or in equity.

LIENS

26. Licensee shall promptly pay and discharge any and all liens arising out of any construction, alterations or repairs done, suffered or permitted to be done by Licensee on right of way. Licensor is hereby authorized to post any notices or take any other action upon or with respect to the right of way that is or may be permitted by law to prevent the attachment of any such liens provided, however, that failure of Licensor to take any such action shall not relieve Licensee of any obligation or liability under this Section 27 or any other Section of this License.

ASSIGNMENT

27. Neither Licensee, nor the heirs, legal representatives, successors or assigns of Licensee, nor any subsequent assignee, shall assign or transfer this License or any interest herein, without the prior written consent and approval of Licensor, which may be withheld in Licensor's sole discretion.

NOTICES

28. Any notice required or permitted to be given hereunder by one party to the other shall be in writing and the same shall be given and shall be deemed to have been served and given if (i) placed in the United States mail, certified, return receipt requested, or (ii) deposited into the custody of a nationally recognized overnight delivery service, addressed to the party to be notified at the address for such party specified below, or to such other address as the party to be notified may designate by giving the other party no less than thirty (30) days' advance written notice of such change in address.

If to Licensor:
Staubach Global Services – RR, Inc.
3017 Lou Menk Drive, Suite 100
Ft. Worth, TX 76131-2800
Attn: Licenses/Permits

with a copy to:
The Burlington Northern and Santa Fe Railway Company
2500 Lou Menk Dr. – AOB3
Ft. Worth, TX 76131
Attn: Sr. Manager Real Estate

If to Licensee:
Oregon Department of Environmental Quality
2020 SW 4th Ave
Portland, OR 97201

SURVIVAL

29. Neither termination nor expiration will release either party from any liability or obligation under this License, whether of indemnity or otherwise, resulting from any acts, omissions or events happening prior to the date of termination or expiration, or, if later, the date when the right of way is restored to its condition as of the Effective Date.

RECORDATION

30. It is understood and agreed that this License shall not be placed on public record.

APPLICABLE LAW

31. All questions concerning the interpretation or application of provisions of this License shall be decided according to the laws of the State of Oregon.

32.

SEVERABILITY

32. To the maximum extent possible, each provision of this License shall be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this License shall be prohibited by, or held to be invalid under, applicable law, such provision shall be ineffective solely to the extent of such prohibition or invalidity, and this shall not invalidate the remainder of such provision or any other provision of this License.

INTEGRATION

33. This License is the full and complete agreement between Licensor and Licensee with respect to all matters relating to Licensee's use of the right of way and supersedes any and all other agreements between the parties hereto relating to Licensee's use of the right of way as described herein. However, nothing herein is intended to terminate any surviving obligation of Licensee or Licensee's obligation to defend and hold Licensor harmless in any prior written agreement between the parties.

MISCELLANEOUS

34. In the event that Licensee consists of two or more parties, all the covenants and agreements of Licensee herein contained shall be the joint and several covenants and agreements of such parties.

35. The waiver by Licensor of the breach of any provision herein by Licensee shall in no way impair the right of Licensor to enforce that provision for any subsequent breach thereof.

IN WITNESS WHEREOF, this License has been duly executed, in duplicate, by the parties hereto as of the day and year first above written.

BNSF RAILWAY COMPANY - F/K/A

THE BURLINGTON NORTHERN AND SANTA FE RAILWAY COMPANY
P.O. Box 961050
Fort Worth, TX 76161-0050

By: Stephen M. Kuzma

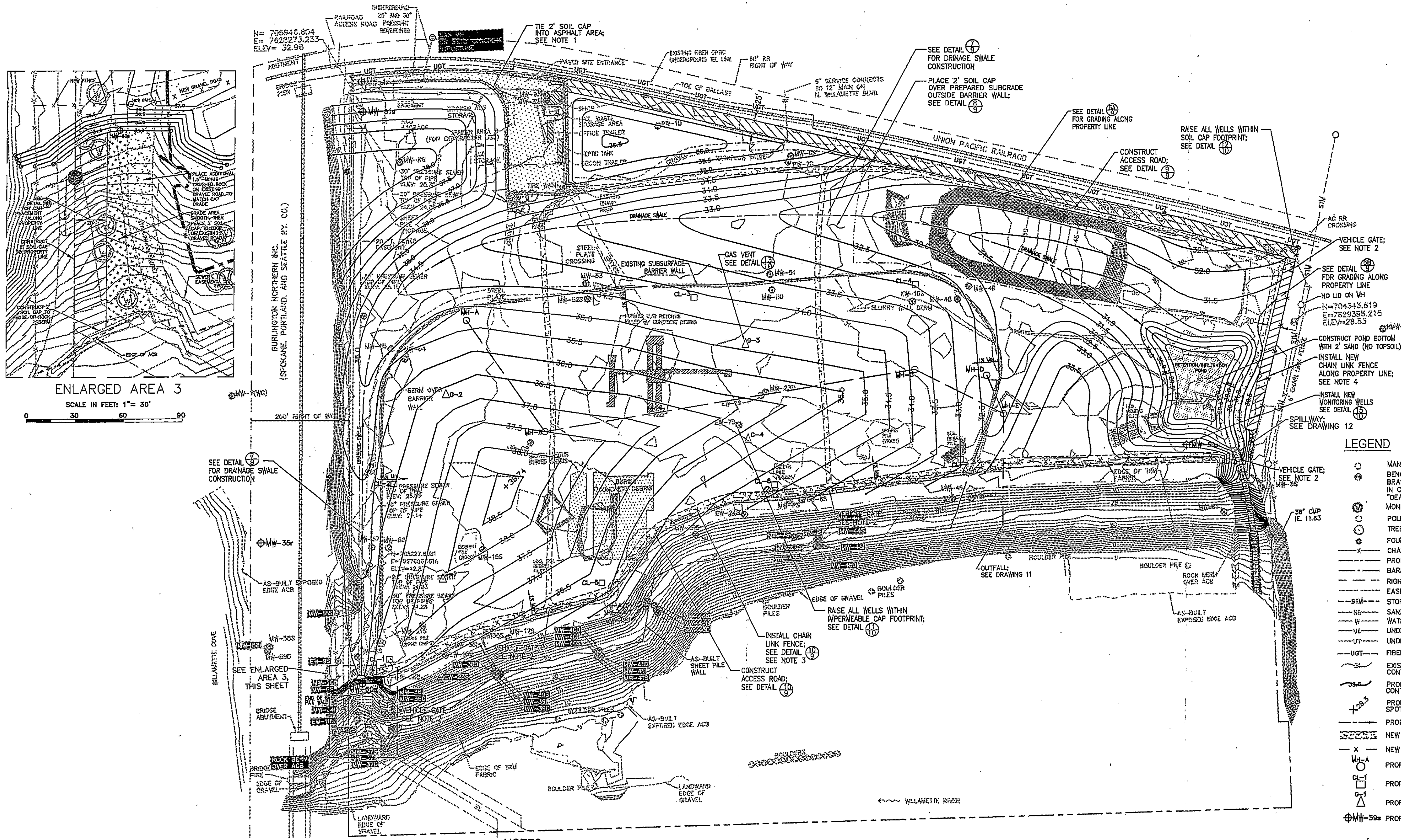
Title: Stephen M. Kuzma
Manager - Land Revenue Management

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
2020 SW 4th Ave
Portland, OR 97201

By: Dick Pede

Title: Division Administrator

Exhibit A



NOTES

1. SITE ENTRANCE AREA WAS RECENTLY RAISED 2 FEET. TIE SOIL CAP INTO NEW ASPHALT.
2. VEHICLE GATES SHALL BE 14' WIDE SWING GATES.
3. ALONG WESTERN (RIVER) EDGE OF PROJECT AREA, USE EXISTING CHAIN-LINK FENCE FABRIC AND ASSOCIATED POSTS, WHERE FEASIBLE.
4. THE EXISTING FENCE ALONG THE SOUTHERN PROPERTY BOUNDARY IS CURRENTLY ENCROACHING ON ADJACENT PROPERTIES. INSTALL NEW CHAIN-LINK FENCE ALONG PROPERTY LINE.

LEGEND

○	MANHOLE
⊕	BENCHMARK 3 1/2' BRASS CAP IN CONCRETE STAMPED: "OEA INC."
⊛	MONITORING WELL
○	POLE
○	TREE
●	FOUND MONUMENT
——x——	CHAIN LINK FENCE LINE
—— - ——	PROPERTY LINE
—— · ——	BARRIER WALL
— —— —	RIGHT-OF-WAY
········	EASEMENT
——STM——	STORM SEWER
——SS——	SANITARY SEWER (HIGH PRESSURE)
——W——	WATER
——UE——	UNDERGROUND ELECTRIC
——UT——	UNDERGROUND TELEPHONE
——UGT——	FIBER OPTIC UNDERGROUND TELEPHONE
~~34~~	EXISTING ELEVATION CONTOUR (FT. NGVD) CONTOUR INTERVAL: 1 FT
~33.5~	PROPOSED FINAL CONTOUR (FT. NGVD) CONTOUR INTERVAL: 0.5 FT
+29.3	PROPOSED FINAL GRADE SPOT ELEVATION (FT. NGVD)
——→	PROPOSED DRAINAGE SWALE
▨	NEW GRAVEL ROAD
— x —	NEW FENCE
MH-A ○	PROPOSED MANHOLE
CL-1 □	PROPOSED CLEANOUT
G-1 △	PROPOSED GAS VENT
⊕MW-59s	PROPOSED MONITORING WELLS

SCALE IN FEET: 1"= 100'
0 100 200 300

NO.	DATE	DWN	APPD	DESCRIPTION

REVISIONS

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: S. STEVENS

APPROVED BY A. WHITMAN

DRAWING 6:
FINAL GRADING PLAN

McCORMICK & BAXTER
CREOSOTING CO.
PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	DRAWING NO.
NOTED	2-25-05	upland cap_final.dwg	6 of 13

AGREEMENT BETWEEN

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

AND

CITY OF PORTLAND

SUPERFUND SITE NAME: McCormick & Baxter Creosoting Co. Superfund Site

SITE ADDRESS: 6900 North Edgewater Avenue, Portland, Oregon

1. The City of Portland, a municipal corporation of the State of Oregon, and the Oregon Department of Environmental Quality (DEQ) hereby agree to conditions to avoid interference with the City sewer right of way described in Attachment A hereto and the sewer easement on the upland McCormick & Baxter property for the purpose of carrying out actions authorized by CERCLA 42 USC 9601 et seq. and ORS 465.200 to 465.455 in accordance with the terms of this Agreement.

2. This Agreement is intended to further the completion of remedial action including but not limited to:

   (a) placement of a sand cap over contaminated sediments within the Willamette River, an organophyllic clay cap over known (contaminated) beach seeps, and placement of rock and concrete armor over the cap; and
   (b) re-grading and re-vegetation of beach and upland areas within portions of the City right of way.

   The remedial action shall be in accordance with the Easement granted to DEQ by the Oregon State Land Board dated April 13, 2004 attached as Attachment A hereto and the following documents on file at DEQ (the "***Remediation Plan***"):

   (a) "Final Technical Plans and Specifications," published by DEQ as Task Order No. 71-03-02, and dated December 2003, as subsequently amended;
   (b) "Record of Decision," published by the United States Environmental Protection Agency and DEQ, dated March 1996; and
   (c) "Sediment Cap Basis of Design, McCormick & Baxter Creosoting Company, Portland, Oregon," prepared for DEQ as Task Order No. 88-97-34, and dated May 2002;

3. All construction material, equipment, tools, and other property taken upon or placed upon property within the City right of way by or at DEQ's direction shall remain DEQ's property and will be removed when DEQ ceases its activities.

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NORTHWEST REGION

4. At least five business days before commencement of construction activities specified in paragraph 2, DEQ shall notify the City contact person in writing, of the intended activities.

5. Except in an emergency involving public health, safety, and welfare or the environment, DEQ shall provide no less than (7) business days' written notice, with written plan of action, before undertaking any removal or remedial actions within the City right of way pursuant to CERCLA and ORS 465.200 et seq.

6. DEQ shall provide the City copies of, at no cost to the City:

   A. Pre-construction plans and specifications;
   B. Post-construction (as-built) drawings;
   C. Monitoring and Maintenance Plan for the sediment cap;
   D. Sampling results and analysis reports of any description that arise from DEQ's remedial activities and
   E. Other non-confidential written reports of any description that arise from DEQ remedial activity unless the record is exempt from disclosure under the Oregon Public Records Law.

7. DEQ shall construct the sediment cap and facilities described herein in a manner that is protective of the City's sewer facilities and that does not interfere with the operation of the City's sewer system. The City's sewer facilities in the easement area described in Attachment A include two parallel force mains of approximately 20" and 30" diameter pipe.

8. DEQ shall develop a Monitoring and Maintenance Plan that provides for future maintenance and repair of the subject sewer forcemains by the City. The plan shall include removal and replacement of the cap components and contaminated sediments in the event that either time critical (i.e., emergency) and non-time critical repairs or maintenance of the sewer forcemains become necessary. This plan shall be developed following construction of the sediment cap. DEQ shall solicit input from the City in developing this plan.

9. Nothing in this Agreement constitutes an admission of liability by the City regarding any release of hazardous substances at or from City Property. Furthermore, any and all defenses to any alleged violations shall be preserved.

10. To the extent permitted by Article XI, Section 7 of the Oregon Constitution and by the Oregon Tort Claims Act, the State of Oregon shall hold harmless and indemnify the City from and against any and all claims arising from acts or omissions related to this Agreement of the State of Oregon or its commissions, agencies, officers, employees, contractors, agents or authorized representatives.

11. When DEQ determines that continued access to the City right of way is not necessary, DEQ or its authorized representative(s) shall remove all tools, equipment and improvements, and shall restore the surface condition of areas disturbed by DEQ's activities, to the maximum extent reasonably possible, to a condition equal to or greater than the condition existing prior to the activities.

12. Nothing herein shall prevent the City from providing for normal or emergency maintenance and repair of City sewer facilities except that, absent emergency conditions, the City shall provide a minimum 48 hours prior notice to DEQ before any City activity that may disturb the sediment cap, and shall work with DEQ to minimize disturbances to the extent possible.

13. The City shall not be liable for damage to the sediment cap or for releases of contaminants as a direct result of sewer maintenance activities within the City right of way so long as the City provides notice to DEQ in accordance with paragraph 10 of this Agreement and conducts such activities according to reasonable engineering standards and practices.

14. DEQ shall provide reasonable notice and opportunity for City comment before altering in any significant manner design or construction activities which have been provided to and reviewed by the City as a precondition to the City's approval of this Agreement.

15. The term of this Agreement is permanent.

16. Contact Person:

For the City: Property Manager
Bureau of Environmental Services
1120 SW Fifth Ave., Room 1000
Portland, OR 97204
FAX: 503.823.6995

For DEQ: Project Manager
McCormick & Baxter
Superfund Site
DEQ Land Quality Division
2020 SW 4th Ave
Portland, OR 97204
FAX: 503.229.6899

17. Signatures:

City of Portland

Dean Marriott
Director, Bureau of Environmental Services

Date: 7/27/04

Department of Environmental Quality:

Dick Pedersen, Administrator
Northwest Region
Oregon Department of Environmental Quality

Date: 8/9/04

APPROVED AS TO FORM

Linda Meng

CITY ATTORNEY

Recorded in MULTNOMAH COUNTY, OREGON
C. Swick, Deputy Clerk
A49 16 ATTDS
Total : 116.00

2004-083416 05/12/2004 01:08:24pm

After recording, return to:
Oregon DEQ
2020 SW 4th Ave. # 400
Portland, OR. 97201
Attn: Liz Waddle

RECEIVED
MAY 2 1 2004
DEPT OF ENVIRONMENTAL QUALITY
NORTHWEST REGION

STATE OF OREGON
Department of State Lands
EASEMENT NO. 31530-EA

The STATE OF OREGON, by and through its Department of State Lands acting under authority of the State Land Board, ***Grantor***, for and in consideration of $ 250.00 and Grantee's undertaking of the obligations incurred herein, hereby grants to ***Grantee***,

NAME of GRANTEE:	ADDRESS:
Oregon Department of Environmental Quality	Land Quality Division 811 SW 6th Avenue Portland, OR 97204

A permanent easement in gross (the "***Permanent Easement***") over, upon, and across all submerged and submersible lands of the State of Oregon lying within the real property situated at approximately River Mile 7 of the Willamette River in Multnomah County, Oregon, more particularly described in Exhibit A attached hereto and as shown on the attached Exhibit C (the "***Easement Parcel***").

The Permanent Easement is intended to further the completion of remedial action authorized under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 USC § 9601 *et seq.*, as amended ("***CERCLA***"). The Easement Parcel shall be used for the following purposes, and no other:

(a) Site preparation, including without limitation debris and piling removal;
(b) Construction, maintenance, operation and replacement of materials consisting of a sand cap placed over contaminated sediments within the Willamette River, an organophyllic clay cap over known contaminated beach seeps, and placement of rock and concrete armor over the cap (a "***Sediment Cap***");
(c) Re-grading and re-vegetation of beach areas encompassed within the Easement Parcel; and
(d) Post-construction sediment sampling to determine cap effectiveness;

all in accordance with the following documents (the "***Remediation Plan***"):

(a) "Final Technical Plans and Specifications," published by Grantee as Task Order No. 71-03-02, and dated December 2003, as subsequently amended;
(b) "Record of Decision," published by the United States Environmental Protection Agency (the "EPA"), dated March 1996; and

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(c) "Sediment Cap Basis of Design, McCormick & Baxter Creosoting Company, Portland, Oregon," prepared for Grantee as Task Order No. 88-97-34, and dated May 2002;

TOGETHER WITH a temporary easement in gross (the "***Construction Easement***") over, upon, and across all submerged and submersible lands of the State of Oregon lying within the real property situated at approximately River Mile 7 of the Willamette River in Multnomah County, Oregon, more particularly described in Exhibit B attached hereto and as shown on the attached Exhibit C (the "***Construction Site***"). The Construction Easement shall be used for the purpose of providing access to the Easement Parcel for Grantee and Grantee's contractors during initial construction of the Sediment Cap, including without limitation site preparation and re-grading and re-vegetation of beach areas encompassed within the Easement Parcel. The Construction Easement shall expire upon the completion of initial construction of the Sediment Cap.

The Permanent Easement and the Construction Easement shall be subject and subordinate to all easements and restrictions of record encumbering the Easement Parcel and the Construction Site and existing as of March 15, 2004, and to all statutory rights of way, including without limitation the following:

(a) A right of way for the purposes of constructing and maintaining a railroad bridge over the Willamette River, granted to Portland & Seattle Railway Company (*Bellinger & Cotton's Annotated Codes and Statutes of Oregon*, § 3336 (1902); *Lord's Oregon Laws*, § 3938 (1909)), and to its successors and assigns, and described as follows: a one hundred foot wide strip, being fifty feet in width on each side of the center line of the road when located and staked out, and as shown on Exhibit C; and

(b) A right of way for the purposes of constructing and maintaining sanitary pressure mains, granted to the City of Portland (ORS 273.761(2) (1973 through 2003) and described as follows: a fifty foot wide strip, being twenty-five feet in width on each side of the sanitary pressure mains, and as shown on Exhibit C.

Grantee shall not, without the prior written approval of Grantor, enter into any agreement, memoranda, or plan that purports to modify in any way the rights retained by Grantor under this Easement or under any right of way, encumbrance, or easement existing at the time of this grant of easement.

TO HAVE AND TO HOLD the same unto Grantee in perpetuity, subject to the following conditions:

1. Use of the Easement Parcel and the Construction Site shall be on a nonexclusive, non-priority basis benefiting Grantee and Grantee's contractors. Grantor retains the right to grant additional easements within the Easement Parcel and the Construction Site subject to the provisions of the administrative rules governing the granting of easements.

2. Grantee shall not, without the prior written approval of Grantor, purport to modify in any way this Easement, including without limitation modifications to:

- (a) The type of use authorized by the Permanent Easement or the Construction Easement;
- (b) The number of authorized developments or uses;
- (c) The size or location of the Easement Parcel or the Construction Site; and
- (d) Allow other persons to use the Easement Parcel or the Construction Site for any purpose not described in the Remediation Plan.

3. The Easement Parcel shall remain open to the public for recreational and other non-proprietary uses, except:

- (a) The Easement Parcel shall be closed to all anchoring;
- (b) The Easement Parcel shall be closed for all purposes to all vessels that are equipped with a propeller or motor of any kind;
- (c) The Easement Parcel shall be closed to all grounding, except that grounding which is incidental to and necessary for launching and landing of recreational vessels; and
- (d) The Easement Parcel shall be closed to all public uses whenever Grantor receives written notice from Grantee that Grantee has determined that site conditions pose a threat to public health or the environment.

The Construction Site shall be closed to all public use until the Construction Easement expires. Grantor may prescribe public use of the Easement Parcel and Construction Site through administrative rulemaking or other action authorized by law.

4. Grantee shall be solely responsible for maintenance of the Sediment Cap and any other structures required to be placed in the Easement Parcel under the Remediation Plan. Notwithstanding the foregoing, Grantor and/or its authorized representative(s) shall have the right to enter into and upon the Easement Parcel and the Construction Site at any time for the purposes of any inspection or at any time for management activities not related to the Sediment Cap or the Remediation Plan.

5. Except as expressly authorized in writing by the Department, Grantee shall not:

- (a) Cut, destroy or remove, or permit to be cut, destroyed or removed any vegetation, beyond that necessary for construction or maintenance of the Sediment Cap; or
- (b) Remove any sediment, sand, gravel or other material from the Easement Parcel or the Construction Site, for any purpose not described in the Remediation Plan including without limitation commercial use or sale, except as expressly authorized in writing by Grantor.

Routine maintenance including vegetation trimming shall be allowed.

6. Subject to the requirements of the Remediation Plan, Grantee shall conduct all its activities within and uses of the Easement Parcel and the Construction Site:

- (a) In a manner that conserves fish and wildlife habitat;
- (b) In a manner that protects water quality;

(c) In a manner that does not contribute to the introduction or spread of noxious weeds or pests; and

(d) During the in-water work windows of the Oregon Department of Fish & Wildlife.

7. Grantee shall:

(a) Inspect the condition of the Easement Parcel and the Construction Site and the developments authorized by these Easements as provided in the Remediation Plan;

(b) Discharge all duties imposed under the Remediation Plan as such duties affect the Easement Parcel or the Construction Site;

(c) Comply with all applicable federal (including without limitation CERCLA), state, and local laws;

(d) Remove all construction debris and unused materials from the Easement Parcel and the Construction Site within fourteen (14) days of completing initial construction of the Sediment Cap;

(e) Provide written reports to Grantor annually on or before April 30 of each year that:

(1) State whether the Sediment Cap is functioning as described in the Remediation Plan;

(2) Summarize all activities undertaken by Grantee in the previous 12-month period that may affect the Easement Parcel or disclose the functioning of the Sediment Cap, including without limitation all sampling, analysis and investigations; and

(3) Summarize information not described in (1) or (2) that is known to Grantee that may affect the Easement Parcel or disclose the functioning of the Sediment Cap, including without limitation accidents, trespasses, sales of adjacent land parcels, rezoning of adjacent land parcels, and acts of nature.

(f) Perform all of the obligations of the State of Oregon that are described in the "Superfund State Contract" between EPA and DEQ for the McCormick & Baxter Site dated May 22, 1996;

(g) As permitted by the local United States Coast Guard District Aids to Navigation Office or other federal or state agency, install and maintain aids to navigation marking the upriver, waterward and downriver boundaries of the Easement Parcel, unless Grantee demonstrates to Grantor that all aids to navigation will damage the Sediment Cap; and

(h) Take all measures reasonably necessary to have notices and warnings describing the closures and restrictions applicable to the Easement Parcel or the navigation hazards posed by the Sediment Cap included in or on books, manuals, nautical charts and other reference sources issued, compiled or published by the National Oceanographic Atmospheric Administration, United States Coast Guard, United States Corp of Engineers, and Oregon Marine Board.

8. To the extent permitted by Section 7 of Article XI of the Oregon Constitution and by the Oregon Tort Claims Act, Grantee shall hold harmless and indemnify Grantor, from all liability

and from all costs and expenses of any kind arising from Grantee's use of the Permanent Easement and the Construction Easement.

9. Grantee shall pay to Grantor the current market value, as determined by Grantor, for any unnecessary and non-approved damages to state-owned lands caused by construction or maintenance of the Sediment Cap or other activities engaged in by Grantee within the Permanent Easement or Construction Easement; provided, this payment obligation does not apply to activities undertaken in compliance with the Remediation Plan.

10. Grantee shall pay all assessments that are levied against any land under the jurisdiction of Grantor if the assessment levied by the assessing entity is at least partially based on the Permanent Easement or Construction Easement.

11. Grantee shall use the Easement Parcel and the Construction Site only in a manner or for such purposes that assure fair and non-discriminatory treatment of all persons without respect to race, creed, color, religion, handicap, disability, age, gender or national origin.

12. The Easements granted by this instrument may not be transferred or assigned in any manner.

13. The Easements granted by this instrument do not convey an estate in fee simple of the lands subject to the Easements. Title to the real property that is the subject of the Easements granted herein shall remain in the State of Oregon.

14. All notices and other communications from Grantee to Grantor regarding this easement shall be addressed to:

Director
Department of State Lands
775 Summer Street NE
Salem, Oregon 97301

15. The individual executing and acknowledging this instrument on behalf of the Department of State Lands represents and warrants that he has authority so to act and that the Easements granted herein have been authorized by the State Land Board.

(The remainder of this page has been intentionally left blank.)

WITNESS the seal of the Department of State Lands affixed this 13th day of April, 2004.

STATE OF OREGON,
acting by and through its Department of State Lands
under authority from the State Land Board

By: Stephen J Purchase
Stephen J. Purchase
As: Assistant Director for Field Operations

STATE OF OREGON)
) ss
County of Marion)

This foregoing instrument was acknowledged before me this 13th day of April, 2004, by Stephen J. Purchase, the Assistant Director for Field Operations of the Department of State Lands.

OFFICIAL SEAL
JENNIFER J VICKERS
NOTARY PUBLIC-OREGON
COMMISSION NO. 346517
MY COMMISSION EXPIRES JUNE 05, 2005

Jennifer J. Vickers
Signature
My commission Expires 6-5, 2004.

J:\AttachmentAwestLAS\EA Easements\31530-EA.DOC

EXHIBIT A

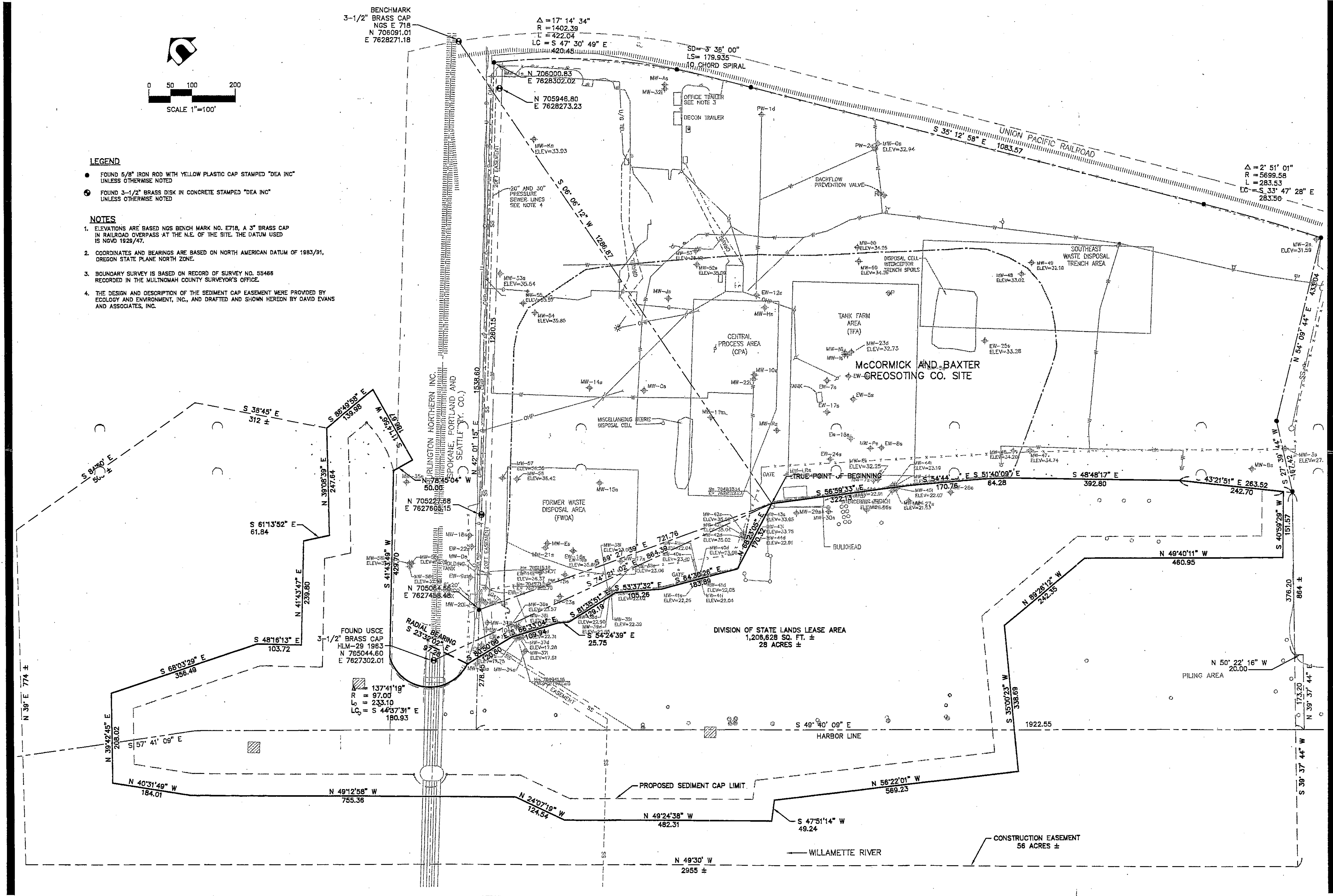
Legal Description – Permanent Easement

All state-owned submerged and submersible lands in the Willamette River fronting tax lots 100, 200 and 300 (Multnomah County tax assessors map 1N 1E 18AB) Willamette Meridian, Multnomah County, Oregon, and more particularly described as follows: The Permanent Easement area for a Sediment Cap located in Sections 7 and 18, Township 1 North, Range 1 East of the Willamette Meridian and Sections 12 and 13, Township 1 North, Range 1 West of the Willamette Meridian, commencing at a benchmark identified as NGS E 718, located on the Burlington Northern Railroad trestle where it crosses the Union Pacific Railroad, and having the State Plane coordinates of Northing 706091.01 and Easting 7628271.18, thence proceeding S 6° 06' 12" W for 1,286.87 feet to a point identified in Exhibit C (Easement for Sediment Cap Drawing 1, produced by Ecology and Environment, Inc. and David Evans and Associates for Oregon Department of Environmental Quality) also identified as N= 704811.43, E= 7628134.36 on the Ecology and Environment Drawing No. 4,"SEDIMENT CAP AND SEEP TREATMENT PLAN", dated12/15/03, this being the True Point of Beginning;
thence S 56° 59' 33" E for 322.13',
thence S 54° 44' 23" E for 170.76',
thence S 51° 40' 09" E for 64.28',
thence S 48° 48' 17" E for 392.80',
thence S 43° 21' 51" E for 242.70',
thence S 40° 59' 29" W for 151.57',
thence N 49° 40' 11" W for 460.95',
thence N 89° 26' 12" W for 242.35',
thence S 35° 00' 23" W for 338.69',
thence N 56° 22' 01" W for 569.23',
thence S 47° 51' 14" W for 49.24',
thence N 49° 24' 38" W for 482.31',
thence N 24° 07' 19" W for 124.54',
thence N 49° 12' 58" W for 755.36',
thence N 40° 31' 49" W for 184.01',
thence N 39° 42' 45" E for 208.02',
thence S 68° 03' 29" E for 356.49',
thence S 48° 16' 13" E for 103.72',
thence N 41° 43' 47" E for 239.80',
thence S 61° 13' 52" E for 61.84',
thence N 39° 08' 39" E for 247.64',
thence S 88° 49' 58" E for 139.98',
thence S 11° 14' 56" W for 186.67',
thence N 78° 45' 04" W for 50',
thence S 41° 43' 49" W for 429.70',
thence to an arc with the following curve elements:
Δ=137°41'19"
R=97.00'
L=233.10'
LC=S 44° 37' 31" E for 180.93',
thence S 80° 50' 06" E for 120.60',
thence S 66° 33' 04" E for 109.94',
thence S 54° 24' 39" E for 25.75',
thence S 81° 35' 51" E for 129',
thence S 53° 37' 32" E for 105.26',
thence S 64° 30' 26" E for 183.89',
thence N 68° 23' 05" E for 170.32' to end at the True Point of Beginning, encompassing 28 acres more or less.

EXHIBIT B

Legal Description – Construction Easement

All state-owned submerged and submersible lands in the Willamette River fronting tax lots 100, 200 and 300 (Multnomah County tax assessors map 1N 1E 18AB) Willamette Meridian, Multnomah County, Oregon, and more particularly described as follows: The Easement area for construction and placement of a Sediment Cap located in Sections 7 and 18, Township 1 North, Range 1 East of the Willamette Meridian and Sections 12 and 13, Township 1 North, Range 1 West of the Willamette Meridian, commencing at a benchmark identified as NGS E 718, located on the Burlington Northern Railroad trestle where it crosses the Union Pacific Railroad, and having the State Plane coordinates of Northing 706091.01 and Easting 7628271.18, thence proceeding S 6° 06' 12" W for 1,286.87 feet to a point identified in Exhibit C (Easement for Sediment Cap Drawing 1, produced by Ecology and Environment, Inc. and David Evans and Associates for Oregon Department of Environmental Quality) also identified as N= 704811.43, E= 7628134.36 on the Ecology and Environment Drawing No. 4,"SEDIMENT CAP AND SEEP TREATMENT PLAN", dated12/15/03, this being the True Point of Beginning;
thence S 56° 59' 33" E for 322.13',
thence S 54° 44' 23" E for 170.76',
thence S 51° 40' 09" E for 64.28',
thence S 48° 48' 17" E for 392.80',
thence S 43° 21" 51" E for 263.52' more or less to intersect the south eastern property boundary,
thence S 39° 37' 44" W along that property boundary towards the center of the Willamette River navigation channel for 864' more or less,
thence N 49° 30' W along the thread of the stream for 2,955 feet, more or less,
thence N 39° E for 774' more or less to intersect the bank of the Willamette River in Willamette Cove,
thence S 84° 50' E for 508' more or less along the bank of Willamette Cove,
thence S 38° 45' E for 312' more or less to a point on the permanent easement as shown in Exhibit C (Easement for Sediment Cap Drawing 1, produced by Ecology and Environment, Inc. and David Evans and Associates for Oregon Department of Environmental Quality),
thence S 88° 49' 58" E for 139.98',
thence S 11° 14' 56" W for 186.67',
thence N 78° 45' 04" W for 50',
thence S 41° 43' 49" W for 429.70',
thence S 44° 29' 25" E for 181.23' this segment being a chord of a circle with a radius of 97' and extending to the west,
thence S 80° 50' 06" E for 120.60',
thence S 66° 33' 04" E for 109.94',
thence S 54° 24' 39" E for 25.75',
thence S 81° 35' 51" E for 129',
thence S 53° 37' 32" E for 105.26',
thence S 64° 30' 26" E for 183.89',
thence N 68° 23' 05" E for 170.32' to end at the True Point of Beginning, and encompassing 50 acres more or less, being the entire area to be covered by the sediment cap with sufficient additional area above the submerged and submersible lands of the State of Oregon to allow for ODEQ and its contractors to complete the construction and placement of the Sediment Cap and complete any additional in water work as required under the 1996 Record of Decision, the March 1998 Amended Record of Decision and the May 2002 Sediment Cap Basis of Design documents.



LEGEND

- ● FOUND 5/8" IRON ROD WITH YELLOW PLASTIC CAP STAMPED "DEA INC" UNLESS OTHERWISE NOTED
- ⊕ FOUND 3-1/2" BRASS DISK IN CONCRETE STAMPED "DEA INC" UNLESS OTHERWISE NOTED

NOTES

1. ELEVATIONS ARE BASED NGS BENCH MARK NO. E718, A 3" BRASS CAP IN RAILROAD OVERPASS AT THE N.E. OF THE SITE. THE DATUM USED IS NGVD 1929/47.
2. COORDINATES AND BEARINGS ARE BASED ON NORTH AMERICAN DATUM OF 1983/91, OREGON STATE PLANE NORTH ZONE.
3. BOUNDARY SURVEY IS BASED ON RECORD OF SURVEY NO. 55466 RECORDED IN THE MULTNOMAH COUNTY SURVEYOR'S OFFICE.
4. THE DESIGN AND DESCRIPTION OF THE SEDIMENT CAP EASEMENT WERE PROVIDED BY ECOLOGY AND ENVIRONMENT, INC., AND DRAFTED AND SHOWN HEREON BY DAVID EVANS AND ASSOCIATES, INC.

RECEIVED
APR 8 2004
DEPT OF ENVIRONMENTAL QUALITY
NORTHWEST REGION

EASEMENT FOR SEDIMENT CAP

McCormick and Baxter
Creosoting Co. Site
PORTLAND, OREGON
WILLAMETTE RIVER

RECEIVED
MAY 2 1 2004
DEPT OF ENVIRO...

DAVID EVANS
AND ASSOCIATES INC.
2100 Southwest River Parkway
Portland Oregon 97201
Phone: 503.223.6663

REGISTERED
PROFESSIONAL
LAND SURVEYOR
OREGON
JULY 25, 1991
PATRICK N. SMITH
2526
RENEWAL 6/30/04

REVISIONS: APPD.

DATE: 4/5/04
DESIGN: E&E
DRAWN: TAS/NST
CHECKED:
REVISION NUMBER: 0

SCALE: 1"=100'

PROJECT NUMBER:
ECEN0015

DRAWING FILE:
ecen15bd.dwg

SHEET NO.
1
OF 1

EXHIBIT C

ACCESS LICENSE AGREEMENT BETWEEN

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY AND

METRO

SITE NAME: McCormick & Baxter Creosoting Co. Superfund Site

SITE ADDRESS: 6900 North Edgewater Ave., Portland, Oregon

1. Metro, a municipal corporation ("the Owner") hereby gives consent for this License to the Oregon Department of Environmental Quality ("DEQ") and its officers, agents, contractors, and authorized representatives to enter the portion of property owned by Metro known as Willamette Cove located at T:1N, R:1W, S:12, Q:SW, St. Johns TL:4 of Block 1, Map 2221, Portland, Oregon as specified on the attached map ("the Property") for the purpose of carrying out actions authorized by CERCLA 42 USC 9601 et seq. and ORS 465.200 to 465.455, in accordance with the terms of this Agreement.

2. This License is granted to enable DEQ to undertake, at DEQ's cost and expense, remedial action or removal activities as those terms are described in CERCLA and ORS 465.200 and OAR 340-122-001 to 340-122-110, pursuant to the March 1996 Record of Decision for the McCormick & Baxter Creosoting Co. (Superfund) site, as amended and updated ("ROD"). The consideration received by Metro for this License is that in carrying out the activities set forth in this License, DEQ shall remediate portions of the Willamette Cove Property to the extent any contamination on the Willamette Cove Property relates to the McCormick & Baxter Creosoting Co. property, as set forth in the ROD.

3. The actions permitted under this License may include any activity consistent with the above referenced ROD and applicable rules and regulations. However, unless DEQ notifies Metro in writing of additional actions required by the ROD, DEQ's actions on the Property shall be limited to those set forth as follows:

    A. Sampling and inspection of soils, surface water, groundwater, sediments and waste materials on or under the Property to the extent such actions are necessary under the ROD;

    B. Construction and removal activities consisting of:

        (a) Construction of a temporary, gated access road across the Willamette Cove property and onto the beach;

        (b) Clearing of brush and a limited number of trees to accommodate construction of the temporary access road;

        (c) Construction of a temporary, fenced equipment storage area;

(d) Placement of a permanent sediment cap composed of sand, gravel, rock, geotextile fabric, and Articulated Concrete Block (ACB) as required by the ROD and applicable statutes and regulations; and

(e) Removal and off-site disposal of the following materials from below the Ordinary High Water Mark (OHW) of the Willamette River within Willamette Cove and located outside of the footprint of the sediment cap: approximately 50 piling dolphins, 300 tons of concrete debris, 85 tons of concrete footings of the former Western Cooperage facility, and an abandoned barge which is stuck in the sediments.

C. Long-term monitoring and maintenance of the sediment caps; and

D. Photographing all portions of the Property and the structures, objects, and materials thereon and thereunder.

4. DEQ shall be responsible for and hereby agrees to perform all activities set forth herein, and DEQ shall obtain any and all approvals and permits necessary for any activities performed. DEQ also agrees to coordinate its activities on the Property with other activities that may be undertaken on the Property by Metro, the Port, and their contractors, including coordinating activities within DEQ and EPA.

5. All construction material, equipment, tools, and other property taken upon or placed upon the Property by or at DEQ's direction remain DEQ's property. DEQ or its authorized representative(s) shall remove all tools, equipment and improvements, and shall restore the surface condition of areas disturbed by DEQ's activities, to the maximum extent reasonably possible, to a condition equal to or greater than the condition existing prior to the activities, when DEQ ceases its activities on the Property or the Agreement terminates, whichever is earlier. Notwithstanding the foregoing, however, DEQ shall remove all materials, equipment, tools, and other items prior to termination of this Agreement if such removal is necessary for Metro to use, investigate, or remediate the Property.

6. At least 72 hours before commencement of construction or other activities specified in Section 3.B on the Subject Property, DEQ and its agents and contractors shall notify Owner in writing, or orally with written confirmation within five business days after oral notification, of the intended activities, stating with specificity the details of said activities.

7. Except in an emergency involving public health, safety, and welfare or the environment, DEQ shall provide no less than (7) business days' written notice, with written plan of action, before undertaking any removal or remedial actions at Property pursuant to ORS 465.200 et seq. or the ROD.

8. DEQ shall provide Owner copies of, at no cost to the Owner:

A. Pre- construction plans and specifications;

B. Post-construction (as-built) drawings;

C. Monitoring and Maintenance Plan for the sediment cap;

D. Sampling results and analysis reports of any description that arise from DEQ's activities at the subject Property; and

E. Other non-confidential written reports of any description that arise from DEQ activity at Subject Property, unless the record is exempt from disclosure under the Oregon Public Records Law.

9. Nothing in this Agreement constitutes an admission of liability by the Owners regarding any release of hazardous substances at or from the Subject Property. Furthermore, any and all defenses to any alleged violations shall be preserved.

10. To the extent permitted by Article XI, Section 7 of the Oregon Constitution and by the Oregon Tort Claims Act, the State of Oregon shall hold harmless and indemnify the Owner from and against any and all claims arising from acts or omissions related to this Agreement of the State of Oregon or its commissions, agencies, officers, employees, contractors, agents or authorized representatives. The Owner shall not be considered a party to any contract made by DEQ or its agents in carrying out activities under this Agreement.

11. Nothing herein shall be construed as authorization by Owner to allow entry or activities on property not owned or controlled by Owner.

12. This License is not intended to be an easement and it conveys no ownership rights or benefits. This License does not run with the land and is not assignable or transferable by DEQ to any other party. If the McCormick & Baxter property is sold, transferred, or acquired to or by a third party, this License shall terminate.

The term of this Agreement is five years from the date of the last signature below, unless earlier terminated as set forth herein. Termination of this Agreement will not relieve DEQ of its obligations under this Agreement, including paragraphs 2-12, which shall survive termination of this Agreement.

Owner: METRO

Name: Jim Desmond
Title: Director
Metro Regional Parks and Greenspaces

Date: 4/27/04

Department of Environmental Quality:

Dick Pedersen, Administrator
Northwest Region
Oregon Department of Environmental Quality

Date: 6/9/04

ACCESS AGREEMENT - ADDENDUM #1

Between

UNION PACIFIC RAILROAD COMPANY

And

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

On January 5, 1999, the Union Pacific Railroad Company (Railroad) gave consent and permission to officers, agents, authorized representatives, employees and contractors of the Oregon Department of Environmental Quality (DEQ) to enter the Railroad's property at the McCormick & Baxter Creosoting Company Site, 6900 N. Edgewater Street, Portland, Oregon for the purpose of undertaking remedial actions relating to contaminant releases at the McCormick and Baxter Superfund Site. An initial phase of the planned remedial action was completed in 1999 and consisted of excavation, offsite disposal and capping of a small area of contaminated soil along the site access road, as described in the 1999 Access Agreement.

Addendum #1 to the Access Agreement addresses the capping of the entire 43 acre site. The cap is not expected to encroach upon the Railroad's right-of-way. However, encroachment may be necessary as a result of unforeseen conditions encountered during construction. Additionally, DEQ intends to conduct a push probe (e.g., Geoprobe™) investigation prior to initiating cap construction. The push probe investigation may encroach within the Railroad's right-of-way.

All conditions of the 1999 Access Agreement remain in effect. **Additionally, Railroad will be named as a beneficiary of the State's self insurance and insurance of the State's contractors. Additionally, Contractors shall be required to maintain standard general liability coverage for State contracts naming Railroad as an additional insured, and to include Railroad Protective coverage naming the Railroad as an insured with a combined single limit of $2 million per occurrence and with a $4 million aggregate. Copies of Certificates of Insurance will be provided to Railroad when contractors are selected.**

DEQ and its Contractors shall comply with all of Railroad's safety rules while on Railroad's Property, including any applicable flagging requirements. As specified in the Access Agreement, at lease 72 hours before commencement of any intended field activity requiring access to the property, DEQ or a designated representative will notify the Railroad's designated representative in writing or verbally (with written confirmation within five business days after a verbal notification) of the intended activities unless notification is waived by the Railroad. Norm Siler (503-872-1979) is the current representative of the Railroad.

The effective date of Addendum #1 shall be the date of DEQ's signature.

UNION PACIFIC RAILROAD COMPANY

By: ____________________

(AUTHORIZED REPRESENTATIVE)

ROBERT C. BYLSMA
Regional Environmental
Counsel

OREGON DEPARTMENT OF
ENVIRONMENTAL QUALITY

Dick Pedersen

Dick Pedersen, Administrator
Northwest Region

APPENDIX E
VEGETATION MANAGEMENT PLAN

HARTCROWSER
www.hartcrowser.com

August 16, 2011

Mr. Scott Manzano
Oregon Department of Environmental Quality
2020 SW Fourth Avenue, Suite 400
Portland, Oregon 97201

Re: Vegetation Management Plan
McCormick and Baxter Superfund Site
Portland, Oregon
15670-02/Task 3

Dear Mr. Manzano:

This Vegetation Management Plan details the scope and methodology for performing long term vegetation performance monitoring and noxious weed control activities at the McCormick and Baxter Superfund Site (Site), Portland, Oregon. The purpose of this document is to present a strategy that meets the project goals for vegetation management for the upland (soil cap) portion of the Site. This Vegetation Management Plan has been prepared for the Oregon Department of Environmental Quality (DEQ) under Task 3 of Task Order 59-08-30.

BACKGROUND

The Site is located at 6900 North Edgewater Avenue, west of North Willamette Boulevard in Portland, Oregon (Figure 1). The Site is located on the Willamette River at approximately River Mile 7, and encompasses approximately 41 acres of land including an 18-acre impermeable cap and an additional 23 acres of capped contaminated riverbed sediments (Figure 2). Currently, the Site is vacant except for a paved parking area, a small shop building, two field office trailers, and associated utilities used to support ongoing remedial action operations and maintenance. The upland cap is managed as five distinct components, corresponding with the goals and objectives for management of hydrology, soils, and wildlife habitat. These components are:

- Entrance Area;
- Impermeable Cap;
- Riparian Area;

8910 SW Gemini Drive
Beaverton, OR 97008-7123
Fax 503.620.6918
Tel 503.620.7284

- Stormwater Retention Pond and Swale; and
- Earthen Cap.

Through an Intergovernmental Agreement (IGA) with the Oregon Department of Environmental Quality (DEQ), the City of Portland, Bureau of Environmental Services (BES) managed vegetation activities at the Site from June 2005 through June 2010. Vegetation management was completed in accordance with the *Upland Sediment and Soil Cap Vegetation Management Strategy* (BES, 2005) and Appendix F of the O&M Manual (Hart Crowser/GSI, 2010). The goal of the bank layback (Riparian Area) and plantings was to create habitat elements such as large wood material, riparian vegetation for food, habitat cover and shelter, and shading (NOAA, 2004). Performance standards used by BES to assess whether the planting goals have been met included the following:

- Bare soil spaces are small and well dispersed;
- Soil movement, such as active rills or gullies and soil deposition around plants or in small basin, is absent or slight and local;
- Plant litter is well distributed and effective in protecting the soil with few or no litter dams present;
- Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site;
- Vegetation structure is resulting in rooting throughout the available soil profile;
- Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation;
- Streambanks have less than 5% exposed soils with margins anchored by deeply-rooted vegetation or coarse-grained alluvial debris; and
- A continuous corridor of shrubs and trees provide shade for the entire streambank.

Following remediation, the upland soil cap and riparian area was planted and an irrigation system was installed by the BES in February 2006. In February 2008, the riparian area was inter-planted with an additional 500 alder trees and irrigation was extended to this portion of the property. The installed plant materials have now completed their fifth growing season. The irrigation system is still in place, but is no longer being used at the Site. Semi-annual noxious weed control activities including herbicide application were conducted by BES from Spring 2006 through Spring 2010. Semi-annual herbicide application was continued using a private subcontractor (Native Ecosystems Northwest) in Fall 2010 and Spring 2011.

Rodents (primarily ground squirrels) that reside at the Site are the likely cause of earlier, targeted damage to the grand fir seedlings (BES, 2010). However, only moderate damage to other plantings has been documented at the Site, and rodent control measures are limited to monitoring.

VEGETATION PERFORMANCE MONITORING

A baseline reconnaissance site visit was conducted on June 10, 2011, by Celina Ambercrombie of Hart Crowser, an ecologist, to confirm the vegetation conditions discussed in the final 2010 BES report. The baseline inspection included visual observation of vegetation planting areas, specie identification (native, non-native, and invasive), growth, density, and general coverage throughout the Site. Photograph documentation of the inspection will be used to evaluate the progress of future vegetation treatments and qualitative observations at the Site.

Semi-annual inspections will be completed by a biologist/ecologist in Spring and Fall of each year to observe vegetation response after each wet (winter) and dry (summer) season. The following qualitative data will be recorded and compared to the June 2010 baseline:

- Observed species in each planting area including native, non-native, and invasive vegetation;
- Growth and vigor;
- General coverage and density;
- Effectiveness of noxious weed control treatments; and
- Photographic documentation of each of the planting areas from vantage points throughout the Site.

After each inspection, the biologist/ecologist will make note of necessary or appropriate management recommendations for the Site. Recommendations that merit a prompt response, e.g., irrigation in response to an unusual dry period, will be discussed with DEQ to determine potential actions. Observations, conclusions, and recommendations will be documented in a report to be included in the annual Operations and Maintenance (O&M) Report for the Site (see below). The presence of observed wildlife on or immediately adjacent to the Site will also be included in the report.

NOXIOUS WEED CONTROL

A preventative approach will continue to be used as part of an ongoing effort to control the spread of noxious weed species at the Site. The scope of work includes completing semi-annual (Spring and Fall) application (spot spraying) of Garlon 3A or Glyphosate herbicide to mitigate thistle, knapweed, scotch broom, sweet clover, black mustard, and other noxious weeds. Figure 3 shows the general area for herbicide application. A Licensed Oregon Pesticide Operator and Applicator subcontractor will follow regulatory and herbicide manufacturer guidelines for proper herbicide use, mixing, storage, and disposal and follow professional guidelines for spray gun calibration (e.g., 3% Glyphosate mix). This is an equivalent approach which was performed successfully by BES for the first five years at the Site.

REPORTING

A Vegetation Performance Monitoring Report will be prepared for inclusion in the annual O&M Report for the Site. The report will include a discussion of the baseline site conditions observed in June 2011 and qualitative site observations described above and recorded during subsequent semi-annual vegetation inspections and noxious weed control activities. Photographs to visually document component-specific vegetation establishment and general site conditions will also be included in the report. The report will be prepared in general accordance with the following outline:

1. Introduction
2. Background
3. Baseline Conditions
4. Semi-Annual Inspections
5. Noxious Weed Control
6. Conclusions and Recommendations
7. Attachments (e.g., photographs)

REFERENCES

BES, 2005. *Upland Sediment and Soil Cap Vegetation Management Strategy, McCormick & Baxter Creosoting Company, Portland, Oregon.* City of Portland, Bureau of Environmental Services. August 2005.

BES, 2010. *Vegetation Management Report (January 2009 through December 2009), McCormick & Baxter Creosoting Company, Portland, Oregon.* City of Portland, Bureau of Environmental Services. January 2010.

Hart Crowser/GSI, 2010. *Revised O&M Manual, McCormick and Baxter Creosoting Company Superfund Site, Portland, Oregon.* April 2010.

NOAA, 2004. *Endangered Species Act - Section 7 Consultation. Biological Opinion & Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation. McCormick and Baxter Creosoting Company Site, Willamette River Remediation Sediment Cap, Multnomah County, Oregon*. National Marine Fisheries Service, Northwest Region. March 2004.

Please feel free to call if you have any questions.

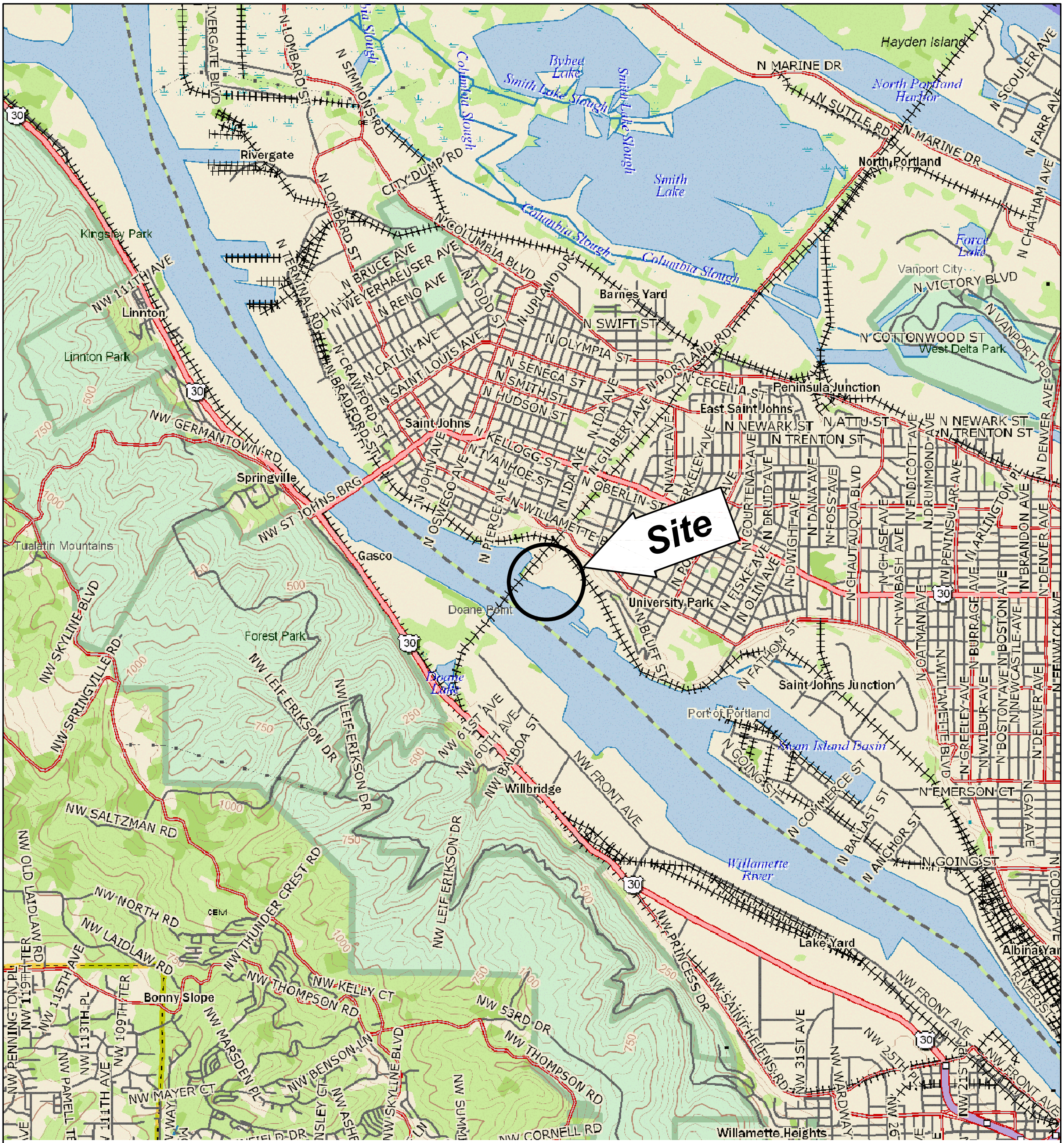
Sincerely,

HART CROWSER, INC.

CELINA AMBERCROMBIE
Ecologist

TIM SKROTZKI, RG, LEED AP
Site Manager

Attachments:
Figure 1 – Site Location Map
Figure 2 – Current Site Layout with Surface Elevations
Figure 3 – Herbicide Application Area



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Scale in Feet

N

McCormick and Baxter Superfund Site
6900 N Edgewater Street, Portland, Oregon

Site Location Map

6/11

HARTCROWSER

GSI Water Solutions, Inc.

Figure
1

Source: DeLorme Topo USA.

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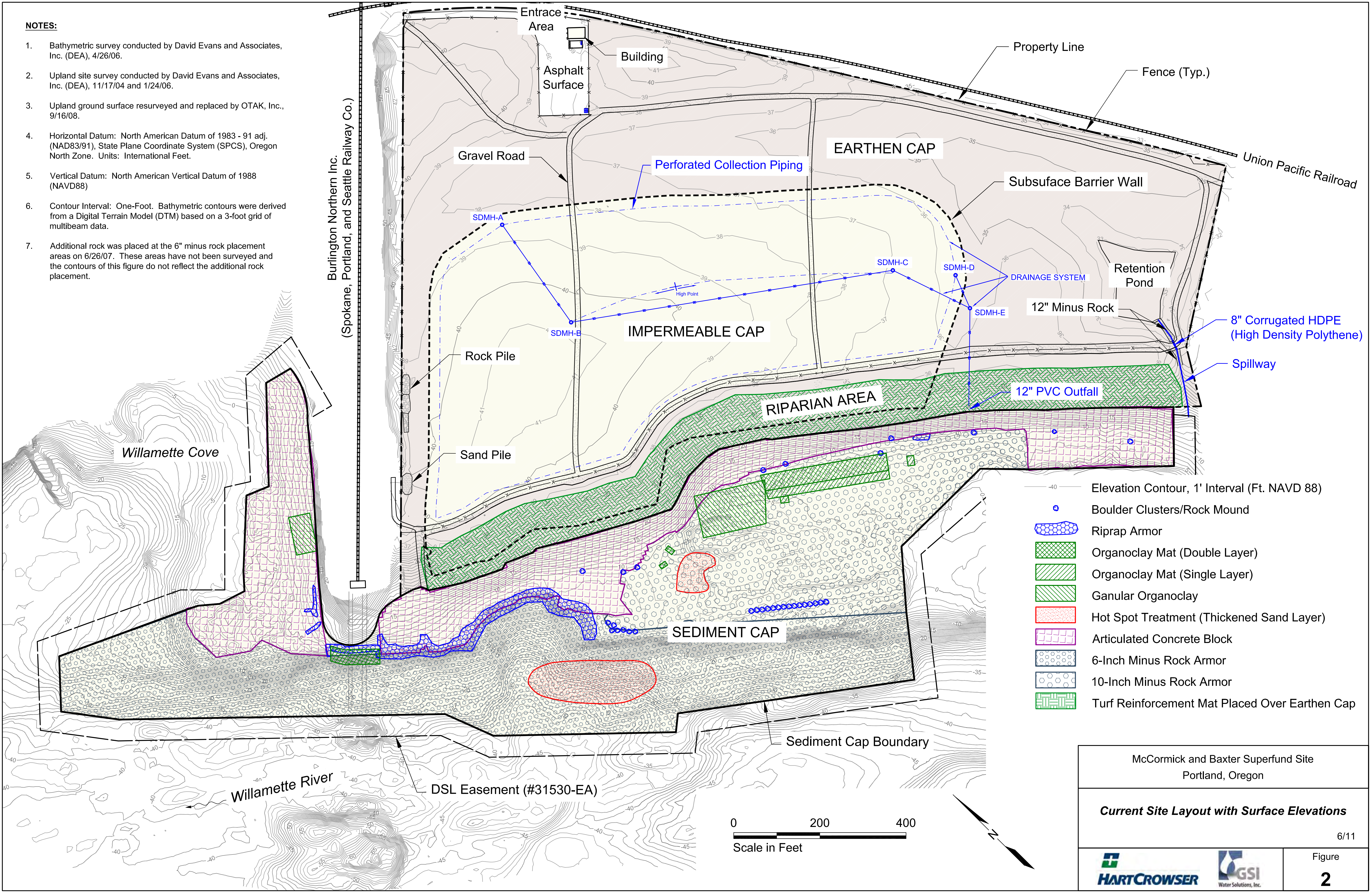
NOTES:

1. Bathymetric survey conducted by David Evans and Associates, Inc. (DEA), 4/26/06.
2. Upland site survey conducted by David Evans and Associates, Inc. (DEA), 11/17/04 and 1/24/06.
3. Upland ground surface resurveyed and replaced by OTAK, Inc., 9/16/08.
4. Horizontal Datum: North American Datum of 1983 - 91 adj. (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone. Units: International Feet.
5. Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
6. Contour Interval: One-Foot. Bathymetric contours were derived from a Digital Terrain Model (DTM) based on a 3-foot grid of multibeam data.
7. Additional rock was placed at the 6" minus rock placement areas on 6/26/07. These areas have not been surveyed and the contours of this figure do not reflect the additional rock placement.



McCormick and Baxter Superfund Site
Portland, Oregon

Current Site Layout with Surface Elevations

6/11

HARTCROWSER

GSI Water Solutions, Inc.

Figure
2

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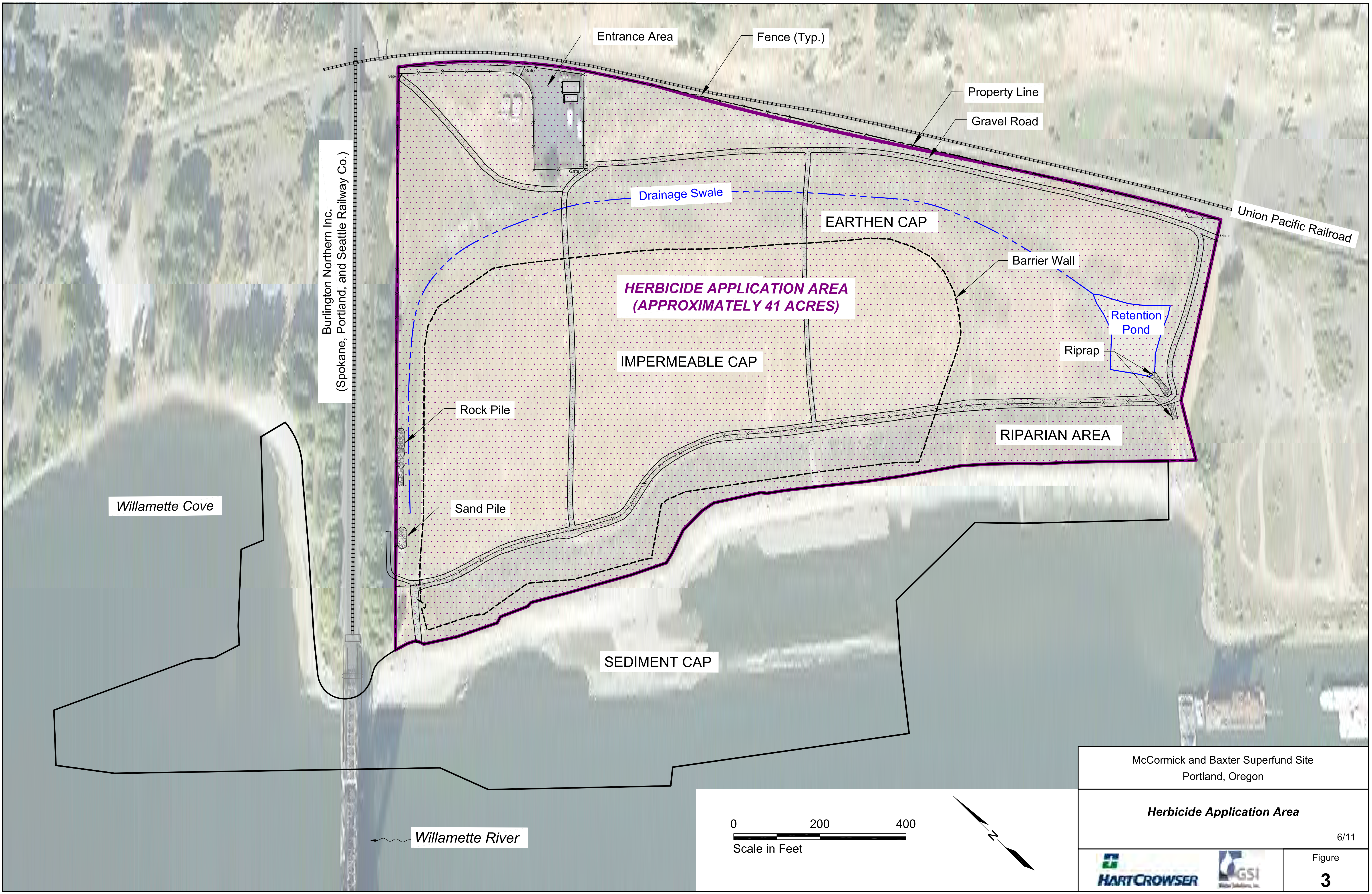

McCormick and Baxter Superfund Site
Portland, Oregon

Herbicide Application Area

6/11

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GSI

Figure
3

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APPENDIX F
PUSHPOINT SAMPLER SPECIFICATIONS

MHE Products PushPoint Sampler (Patent Pending)
Operators Manual and Applications Guide

Ver. 2.00 8/5/01

Models: PP27, PP14, PPX36, PPX72

Introduction

The groundwater/surface water interface (GSI) has been a research interest of mine for the past decade. This transitional zone is usually rich in biomass and may play a predominant role in the bioattenuation of contaminated groundwater entering surface water bodies. Usually these biologic processes have limited effectiveness in attenuating highly contaminated groundwater, leaving a plume of parent contamination and metabolic byproducts that eventually expresses itself in receiving waters - usually classified as non-point sources of pollution because of the uncertainty of the discharge area. Part of the problem in the detection and study of these plumes is that there were no devices on the market for the rapid, discrete collection of pore water samples. Reliance on conventional technology and techniques to perform a detailed investigation required extensive effort and burdensome equipment.

Through several iterations, I have evolved a simple device for collecting pore water samples from beneath surface water bodies or the beach areas surrounding them. Pore-water sampling using the PushPoint becomes a simple and efficient process, generating a wealth of information and very little waste. If one collects groundwater samples in a transect perpendicular to groundwater flow in the suspected area of plume discharge to an open water body, their analysis yields information about the aerial extent of contaminant discharge to the water body. At this point, additional sampling can complement the initial data and provide the information necessary to map the plume expression in both magnitude and aerial distribution. This is becoming increasingly important to regulators as they decide the ecological impacts of discharging contaminant plumes.

Sampling at each location usually takes 5 minutes, allowing a small crew to collect dozens of samples in an afternoon. These samples can be analyzed in the field for real-time information useful in directing field investigations and research. The work that I have conducted at several contamination sites indicates that many groundwater plumes discharge in surface water bodies in 2-3' of water depth - accessible to investigators wearing hip boots or waders. Many plumes, especially Light Non-Aqueous Phase Liquid (LNAPL) plumes can be delineated by collection of samples in very shallow water or from under beaches. My initial experience has shown that Dense Non-Aqueous Phase Liquid (DNAPL) contaminant plumes express themselves in the shallow, near-shore water as well, even though the on-shore depth of the contaminant mass was deep in the aquifer.

Directions

Look at Figure 1.

As you can see, the PushPoint device is a very simple, precisely machined tool consisting of a tubular body fashioned with a screened zone at one end and a sampling port at the other. The bore of the PushPoint body is fitted with a guard-rod that gives structural support to the PushPoint and prevents plugging and deformation of the screened zone during insertion into sediments. The PushPoint is made of 316 stainless steel assuring compatibility with most sampling environments. The screened-zone consists of a series of interlaced machined slots which form a short screened-zone with approximately 20% open area.

Operation of the device is not difficult. One simply holds the device in a manner that squeezes the two handles towards each other to maintain the guard-rod fully inserted in the PushPoint body during the insertion process (as shown in Figure 2). Holding the device in this manner, push the PushPoint into the sediments or beach to the desired depth using a gentle twisting motion. When the desired depth is reached (or you hit refusal, usually at an aquitard) remove the guard-rod from the PushPoint body without disturbing the position of the deployed sampler. Once the guard-rod has been removed from the PushPoint, it SHOULD NOT be reinserted into the device until the bore of the PushPoint has been thoroughly cleansed of all sand, silt, etc.

Attach a syringe or peristaltic pump to the PushPoint sample-port (see Figure 3) and withdraw water at a low-flow sampling rate (50-200 ml/min.). The first 20-50 ml of groundwater will be turbid. This is the "development" water and should be discarded. Once non-turbid aliquots have been withdrawn, representative samples can be collected for on-site and off-site analysis.

Cleaning and Maintenance

I cannot stress how important cleanliness and linearity are to the working life of the instrument. The PushPoint was designed as an indefinitely reusable device; potentially able to be reused hundreds of times. The tolerance between the guard-rod and the bore of the PushPoint is very small. Increases in this tolerance through abrasion and damage may allow silty material into this annular space, eventually jamming the guard-rod into the bore - maybe permanently!

Excess wear and abrasion can also be introduced if the guard-rod is inserted frequently when the PushPoint body is bent. All the small bends should be "undone" prior to reinsertion of guard-rod to avoid scraping the sides of the bore causing burrs. Before reinsertion of the guard-rod into the cleaned PushPoint, the device should be "straight as an arrow". Use caution when straightening the screened-zone, it is somewhat delicate without the guard-rod inside it, and can be broken through repeated bending. Similarly, the guard-rod should be bend-free and clean when inserted into the bore of the device. When a clean and straight PushPoint is assembled, the guard-rod should slide fairly easily through the PushPoint bore and its handle should seat against the sampling port.

Clean the exterior of the guard-rod and PushPoint body and screened-zone with a stiff brush and cleaning solution (soapy water).Cleaning and decontamination of the bore of the instrument is easily accomplished using the cleaning adapter provided. Remove the spray nozzle of a "garden sprayer" filled with cleaning solution. Connect the adapter as shown in Figure 4. Insert the sampling port of the PushPoint to the adapter and squirt ~ 100 ml of pressurized cleaning solution backwards through the sampler and out the screened-zone into a waste receptacle. Gently push the guard rod into the bore of the PushPoint to its end to dislodge any bridged material. Re-rinse the bore with cleaning solution. Follow this with a distilled water and/or methanol rinse. Reinsert the guard-rod and the device is ready to be used again.

In some instances it may be advantageous to force the cleaning solution through the screened-zone and out the sampling port. To do so, gently insert the screened-zone of the PushPoint into the cleaning adapter, making sure not to bend the screened-zone, until the entire screened-zone is within the adapter. The screened-zone is somewhat fragile. To avoid damage, do not bend the screen-zone during insertion into the adapter. Squirt cleaning solution through the sampler to a waste receptacle.

Helpful Hints, Information, and Cautions

- Multiple depths can be sampled in one hole if samples are collected, in order, from deepest to shallowest. Insert the sampler using a twisting motion until you reach refusal. Remove the guard-rod. **Do not push the sampler further into the sediments once the guard-rod has been removed as this may damage the screened-zone and plug the device with sediment**. Once sampling has been completed at this deepest depth, the PushPoint can be partially pulled from the hole to a new sampling elevation. Remember, to prevent screened-zone damage, do not to insert the PushPoint into the sediments without the guard-rod inserted into the PushPoint body. Alternately, multiple holes can be used to collect samples from multiple depths at a particular sampling location. If vertical sampling is performed in one hole, it is recommended that some type be device such as a sampling platform be used to prevent lateral movement and slippage of the PushPoint as sampling is conducted near the top of the hole (see Figure 3). This offsets the leverage of the instrument and reduces hole degeneration. A simple platform would be a plate of steel with a 3/16" dia. hole through its center and would serve the fundamental purpose of maintaining a rigid hole opening . MHE offers a 8" dia., heavy-duty steel sampling platform engineered for the precise sampling depth requirements of field research. If repeated shallow sampling is to be conducted, it may be more convenient to use a shorter sampler (i.e. MHE - PP14").

- If you wish to reuse the PushPoint sampler at a particular sampling location and want to clean the bore quickly while you're there so that the guard-rod may be safely reinserted, you can use a syringe filled with surface water or DI water to backflush the bore several times before reinserting the guard-rod. Use at least 100 ml of water. If you have too much trouble reinserting the guard-rod (i.e. grit), it will be necessary to use the standard cleaning procedures.
- If the screened-zone of the PushPoint becomes plugged while inserted in the sediments due to passage through "something", it is frequently possible to hydraulically/pneumatically shock the screened-zone free of adhering material while it is inserted into the sediments. Attach a large-volume (50 ml) syringe to the sampling port. In a quick motion, pull the syringe plunger most of the way back (creating a vacuum) and then immediately release the plunger - the plunger will slam to a neutral position, sending a shock wave through the bore of the PushPoint and may alleviate the problem.
- The PushPoint can be used as a piezometer to determine the static head of the groundwater and hence, the potential direction of groundwater movement. To do this, a tube is connected to the sample port as shown in Figure 5. A continuous stream of water is established from the syringe (or pump) to the screened-zone by pumping out any air remaining in the PushPoint /tubing. When the tube is disconnected from syringe, the static water level in the tube will represent the static water level at the depth that the screened-zone occupies. In some discharge areas I have found several feet of head differential, and when the tubing is removed, the PushPoint flows like a miniature artesian well.
- It is frequently possible to push the PushPoint through thin lenses of low-permeably material and collect samples from below them and gather valuable geochemical samples. At many of the sites where the PushPoint has been used, sampling from just below a layer of fine sand/silt/clay, one occasionally encounters seemingly large pockets of gas that seem to have coalesced and collected under this less permeable stratum. Analysis of these pockets may provide additional insight to predominant biological processes. It is likely true that the concentration of volatile chemicals in the groundwater has equilibrated with these bubbles which means that their presence in a sampling stream or syringe would not significantly affect the concentration of dissolved volatile organic chemicals (VOC's). In fact, if one assumes that equilibrium conditions exist, the concentration of VOC's in the bubbles is directly related the concentration in the surrounding groundwater. An different condition may exist if the groundwater is supersaturated with bacterial metabolic waste gasses and the negative pressure exerted by the pump (or syringe) initiates degassing of dissolved gasses from the groundwater. In this instance, VOC's would partition from the groundwater to the bubbles as they are formed in the sampling tubing (this is fairly evident if occurring). The consequence of this condition is that part of the dissolved contaminant mass has partitioned into the gas phase and unless the gas-phase is captured, quantified and accounted for, the native VOC concentration of the groundwater is not reflected by analysis of the groundwater alone. If this condition exists, the degassing effect can be minimized by decreasing the sampling rate to a rate more easily yielded by the sampled formation. With experience, it is easy to distinguish which of these conditions (or combination of conditions) exist and to what extent they affect sample quality.
- The internal volume of a PushPoint PP27 is approx. 1.5 ml. A 50 ml syringe full of distilled water, decon water, methanol, etc. will push about 33 volumes through the bore.
- When straightening the screened zone it is sometimes helpful to flush out the bore of the device with a cleaning solution and then insert the guard-rod to the area of the bend in the screened-zone. Gently unbend the portion of the screened-zone nearest the rod and carefully advance the rod to the next bend.

After the rod has been fully inserted into the screened-zone perform the final screened-zone, straightening until the guard-rod slides freely through it.

- If the sampling port of the PushPoint is above the static level of the water body, each time you remove the syringe or pump from the PushPoint sampling port, air will fill the bore of the PushPoint, allowing the water level in the bore to reach its static head. To avoid this plug of air from entering the subsequent syringe, attach a pinch clamp and/or a 3-way valve between the sampling port and the syringe or pump inlet as shown in Figure 7.
- I have conducted dye tests (concentrated uranine dye) by injecting concentrated dye under a perforated 1.5' diameter disk through which the PushPoint was inserted from depths of 3" - 12" into sediments. The goal of these tests was to determine whether or not surface water and dye are drawn into samples collected in near surface sediments (i.e. whether a cone of depression is formed). The results indicated that no surface water is drawn into samples even though sampling was conducted with a peristaltic pump at its maximum rate of 600 ml/min for several minutes.
- I usually couple my field investigations with global positioning system (GPS) identification of the sampling location. If conditions permit, a pin flag can be placed at the sampling location for later location by GPS - I usually use sub-meter grade GPS for this surveying. GPS can then used in the future to relocate previously sampled location even if certain site physical characteristics have changed (eroding shorelines, etc.). If long-term study of a shoreline is planned it will be useful to have an elevation benchmark established on shore that can be used as a reference. The elevation of the sampling locations can then accurately measured. This may be helpful in areas where sediment levels are not stable such as in erosional areas.
- Sampling by syringe has many advantages. This is my preferred field method due to its simplicity and versatility. It is useful to be able to collect several 50 ml syringes full of groundwater, store them on ice and perform the sample transfer to VOA vial, etc. under more controlled conditions. To transfer sample to a VOA vial, place the end of the transfer tube (Figure 8) to the bottom of the VOA vial. Dispense sample into the VOA vial and slowly withdraw the transfer tube from the vial maintaining the mouth of the transfer tube just below the sample surface. When the transfer tube is almost out of the vial, continue to dispense sample and leave an "anti-meniscus" of sample above the rim of the vial. Add several drops of HCl (which will displace a few drops of sample) and cap. If VOC samples are to be collected and/or stored temporarily in a syringe, I recommend 100% polyethylene/polypropylene ("two piece") syringes such as those made by Henke Sass Wolf GMBH (NormJect ®, 50 ml)) configured as shown in Figure 8. From personal experience I have found that small amounts of aromatic compounds (BTEX) can leach from the rubber parts of the rubber-tipped plunger found in common medical syringes. Rubber-tipped plunger syringes have less side-wall resistance and work much smoother than the 100% polyethylene/polypropylene syringes so I use medical syringes for "development" of the PushPoint. Standard medical syringes also work well for collecting samples for non-VOC analysis. I utilize handheld meters for pH, conductivity, redox, DO, etc. One can dispense sample from the syringe into these types of instruments for field measurements. The disposable syringes may be cleaned and reused several times, but because they are a friction fit; prolonged reuse results in scoring of the barrel which eventually causes air leaks.
- The 50 ml, 100% polyethylene/polypropylene "two piece" syringes mentioned above can be purchased directly from MHE, configured with tubing, clamp, and stopper as was the example syringe included with your order, or customized to suit your individual needs. If you would to make your own, the syringes that I am currently using are purchased from National Scientific. The tubing is Tygon 1/4"OD x 1/8" ID. Be sure to use some type of clamp at the tubing mouth to ensure a good seal at the sampler port. The entire syringe assemblies are now available from MHE at a reasonable cost.
- Headspace GC analysis of VOC's can be easily accomplished using 100% polyethylene/polypropylene syringes. Dispense all but 25 ml of the sampled groundwater from the syringe. Refill the syringe to the 50 ml mark with ambient air and then stopper the tubing (and heat the syringe in a water bath if desired) as shown in Figure 9. Shake the syringe assembly to equilibrate the VOC's in the sample with the contained atmosphere. Insert a GC syringe needle through the transfer tube into the sample syringe headspace and withdraw a sample for GC analysis.
- Occasionally a small amount sand and silt is withdrawn into the syringe or pump sampling stream, even after proper "development" of the PushPoint. This may be due to the nature of the geologic formation. This fine material is probably already at equilibrium with the surrounding groundwater and

tests have shown that its presence should not influence analysis of VOC's in the groundwater sample. The sample can be transferred to its shipping container without this silt if the syringe is dispensed in such a manner as to let the solid material settle out in the syringe and not carry over to the shipping vial.

- The PushPoint has been used very successfully for underwater investigations using SCUBA equipment and a series of 100% polyethylene syringes. Once again, GPS equipment was used for location of the position that the divers collected groundwater samples of contaminant plume expression in the lake. Underwater notes (temperature, depth, observations, etc.) can be written directly on the sample syringes if they are pre-prepared with a strip of Scotch Magic Transparent Tape applied down the syringe body and writing is done with a soft pencil.
- The PushPoint may be used to inject nutrients or dyes into the sediments for field trials of biologic or geochemical testing or tracing groundwater paths. Simply insert the PushPoint to the desired depth, and after the guard-rod has been removed, connect a syringe or pump and slowly inject the desired fluid into the sediments, perhaps followed by a small amount of native groundwater to flush the instrument.
- The PushPoint is constructed of 316 stainless steel as mentioned previously. There are two places where the stainless parts are silver soldered together, the handle of the guard-rod and the handle on the PushPoint sampler. If the investigator is collecting samples for metals analysis, the silver solder joint on the guard-rod may impart trace levels metallic residue to the sampling port mouth. This has never caused a problem but the possibility exists. The silver solder that I use is Safety-Silv 45 which contains silver (45%), copper (30%),and zinc (25%). MSDS available upon request. In the unlikely event that these metals cause contamination of samples, MHE can produce specialty guard-rods that are not silver soldered. What can I say, these devices were originally built to sample for VOC's.
- These devices can be dedicated as semi-permanent underwater monitoring devices. If a PushPoint is inserted to the desired depth through a plate (such as the sampling platform mentioned earlier) that can lock the sampler at the correct insertion depth, a vinyl cap can be placed over the mouth of the sampler, and the sampler can be dedicated to that location so that future samples can be withdrawn when desired.
- It has been useful to carry several samplers in "quivers" made of 2" PVC tubing….one tube for (10-15) clean/assembled samplers and one tube for used samplers and their separated guard-rods. This arrangement protects both the investigators and the instruments.
- I have been using a Myron 6P Ultrameter available from www.ColeParmer.com for most of my work. This instrument measures pH, specific conductance, ORP, temperature, and TDS using only a few milliliters of sample and is perfectly suited to samples dispensed by syringe. The instrument is waterproof to 3 m. There will soon be a link on the MHEproducts.com web page.
- I have been using the Chemetrics Vacu-Vial technique (www.Chemtrics.com) in conjunction with PushPoint sampling. I use this for dissolved oxygen and dissolved iron measurements. Many other analytical tests are also available such as nitrate, phenols, etc.. This analytical technique also works very well with samples collected in syringes. The sample is dispensed into a plastic cone until it overflows. The tip of an evacuated ampoule containing the necessary reagents is broken off at the bottom of the cone allowing the vacuum in the ampoule to pull in a aliquot of sample that has not contacted the atmosphere. The ampoule is shaken and is then is then placed as a cuvette into a handheld spectrophotometer. The results are nearly instantaneous and are displayed in ppm. There will soon be a link on the MHEproducts.com web page.

I hope that users will find many useful and innovative uses for this device. If you have other helpful information, uses, and advice concerning these samplers, please write or e-mail suggestions to me for inclusion in future manual revisions. I have finally started a web site: www.MHEproducts.com and have posted pictures, new products, and the latest version of this manual.

Thanks. MHE

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USA

Phn: 989 362 5179
517 393 0948

e-mail: sales@MHEProducts.com

Figure 1

the PushPoint sampler

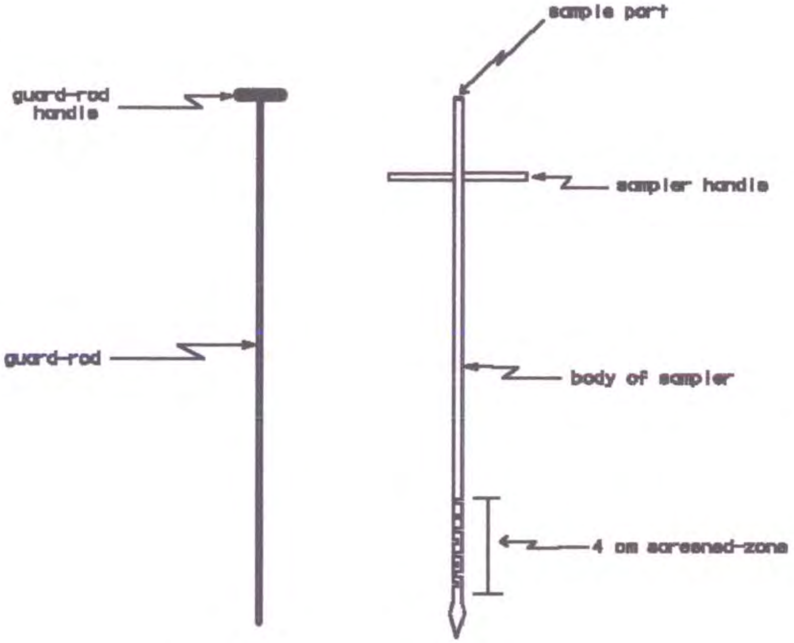


Fig. 1a
disassembled sampler

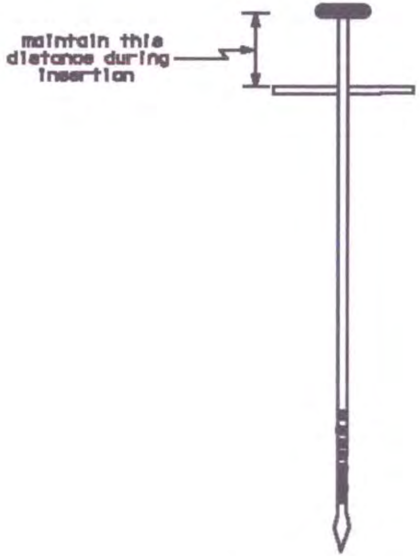
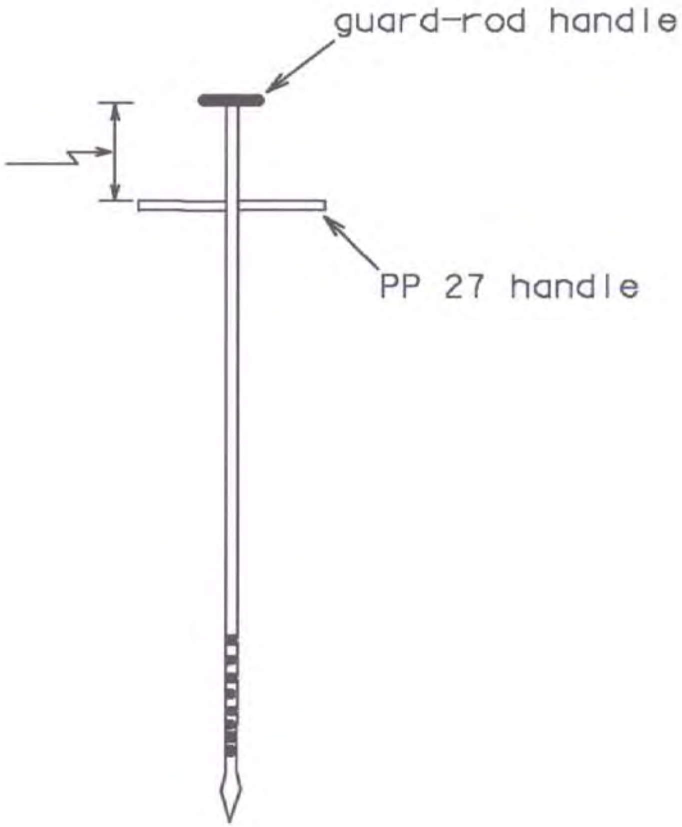


Fig. 1b
assembled sampler

MHE Products.com

Figure 2



grasp instrument firmly
and squeeze two handles
together to maintain
this distance while
inserting into sediments

Figure 3

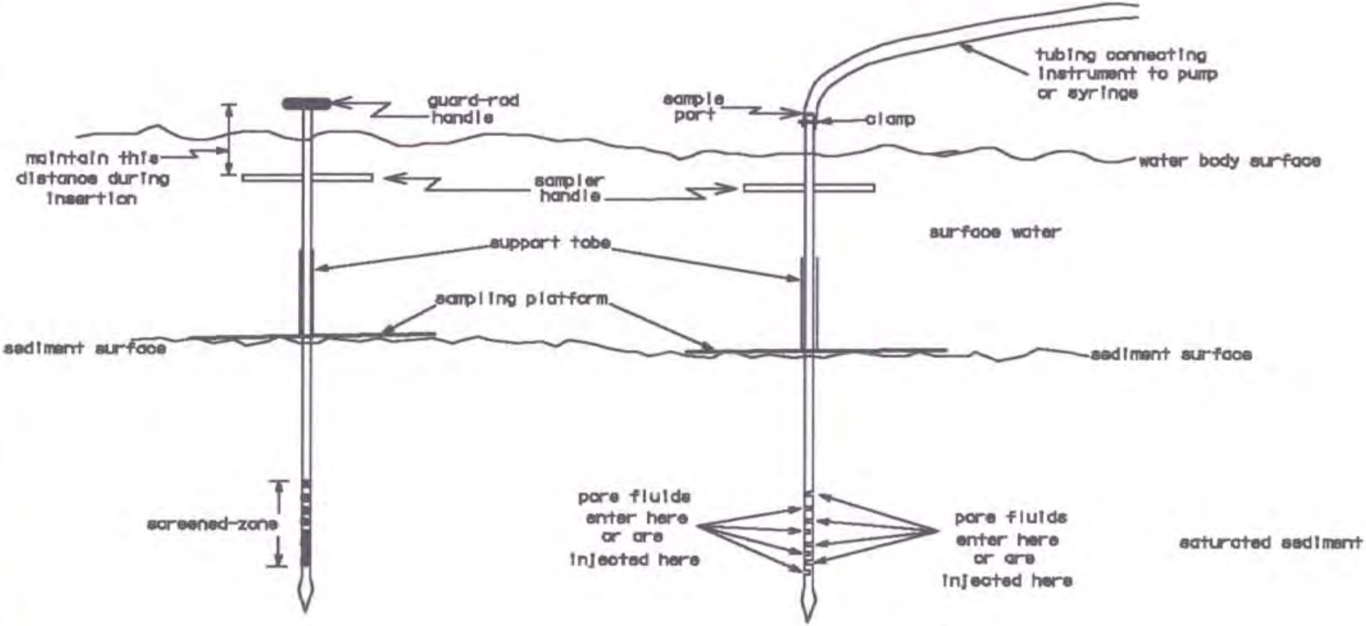


Fig. 3a

configuration when installing in sediments

Fig. 3b

configuration while sampling groundwater

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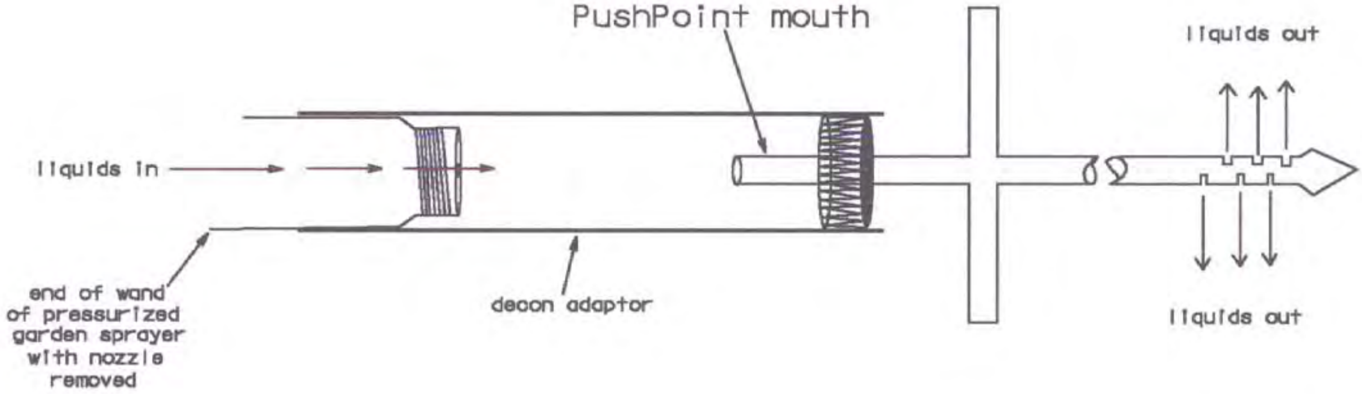
Figure 4

attachment of decon adaptor



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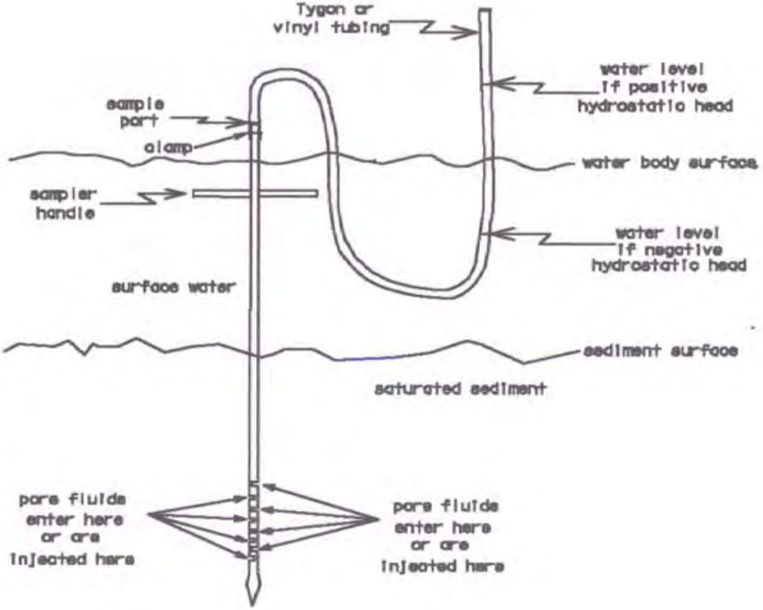

Figure 5

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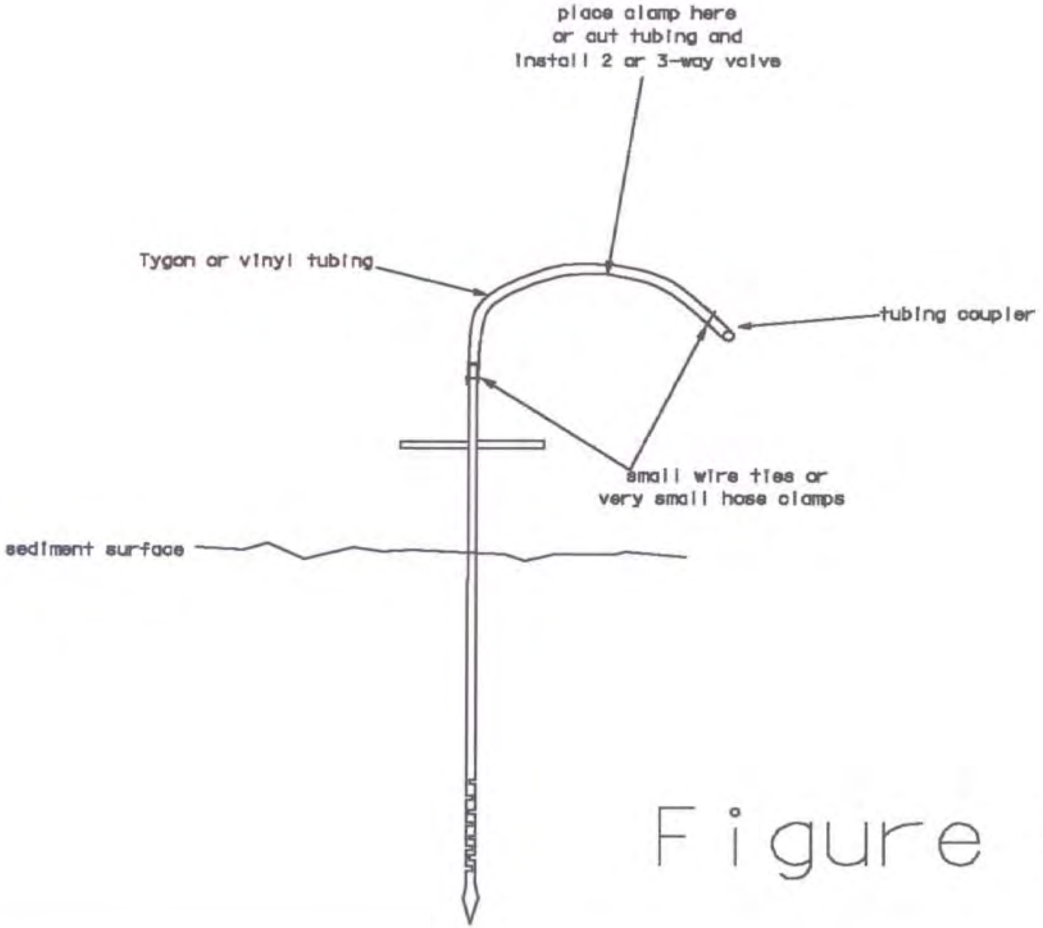

Figure 6

MHE Products.com

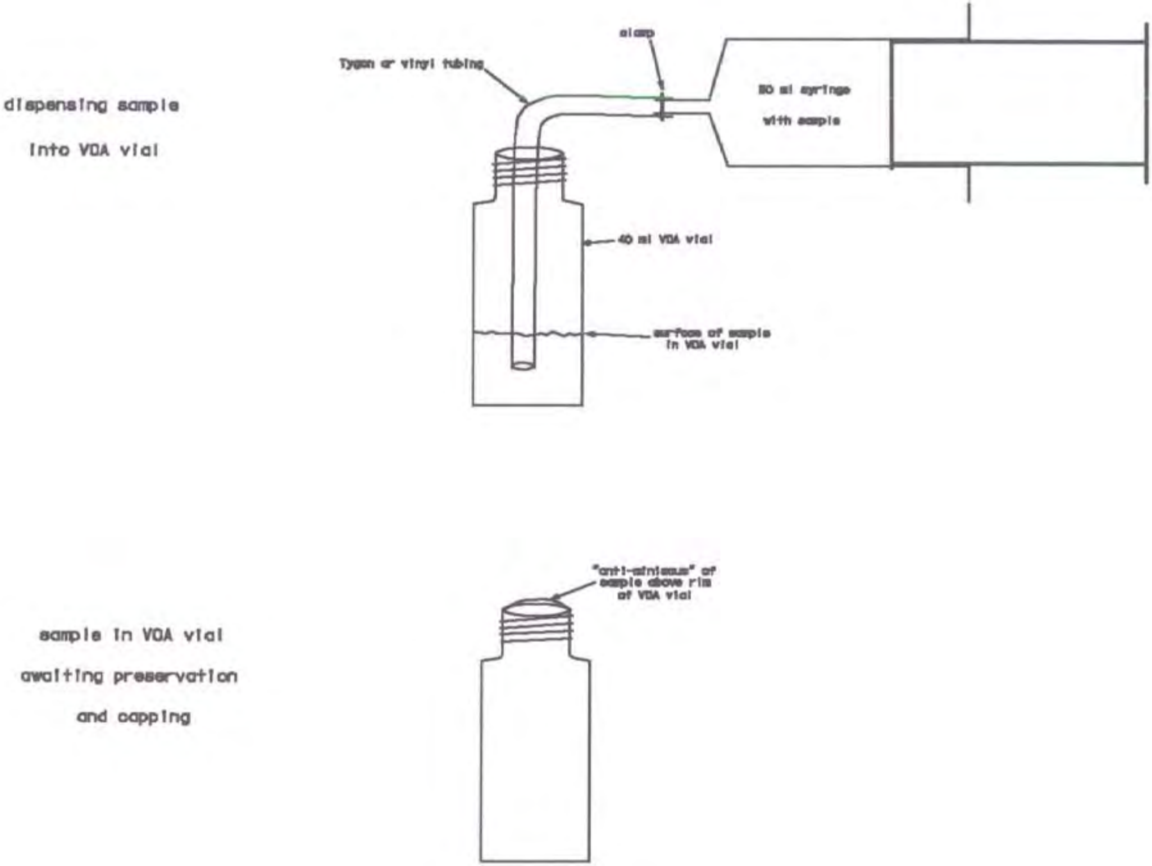

Figure 7

filling VOA vial "headspace free"

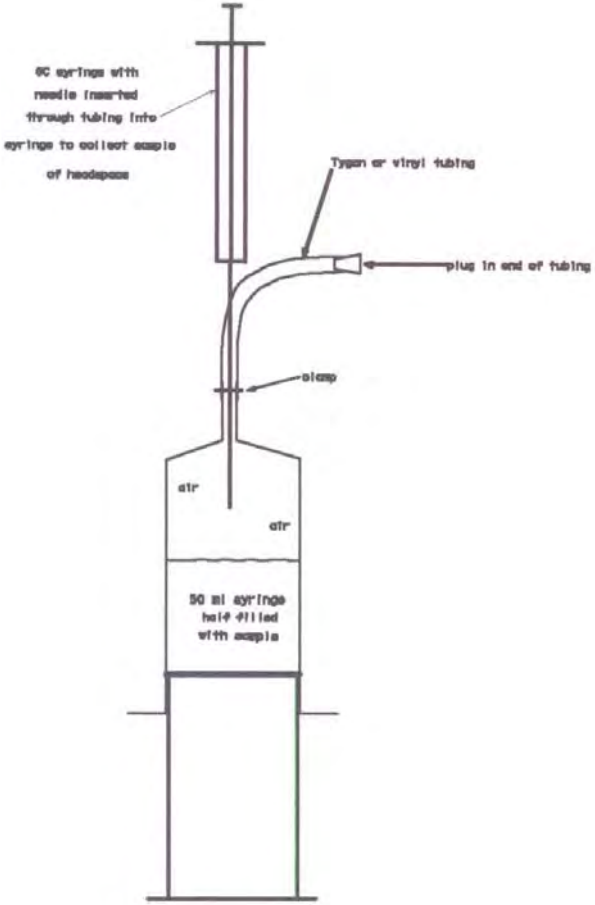

Figure 8

MHE Products, com

http://www-personal.engin.umich.edu/~markhen/insertion.jpg

APPENDIX G
POREWATER AND CRAYFISH
SAMPLING AND ANALYSIS PLAN

Oregon Department of Environmental Quality

McCormick & Baxter Porewater and Crayfish Sampling and Analysis Plan

October 2020

Prepared by:
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Abbreviations and Acronyms

ACB	Articulated concrete block
bml	Below mudline
cm	Centimeter
COC	Constituent of concern
DEQ	Department of Environmental Quality
DGPS	Differential Global Positioning System
DHS	Department of Human Services
EPA	Environmental Protection Agency
ID	Identification
ml	Milliliter
MRL	Method reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
NAD83	North American Datum of 1983
O&M	Operations and Maintenance
PAHs	Polyaromatic hydrocarbons
PCP	Pentachlorophenol
PDMS	Polydimethylsiloxane
PRC	Performance reference compound
PSD	Passive sampling device
RM	River Mile
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SOP	Standard operating procedure
SPME	Solid phase micro extraction
TTU	Texas Tech University
USGS	United States Geological Survey
QA/QC	Quality Assurance/Quality Control

SECTION 1: Surface, Inter-Armor, and Sub-armoring Water Sampling and Analysis Plan

This Sampling and Analysis Plan (SAP) presents the passive sampling techniques that will be used to collect surface, inter-armoring, and sub-armoring water samples at the McCormick & Baxter (M&B) Site in the fall of 2020 as part of the ongoing Operations and Maintenance (O&M) at the Site. These samples will be used to evaluate cap performance at the Site as part of the Five-Year Review process.

1.1 Organization

The surface, inter-armoring, and sub-armoring water SAP is organized as follows:

- Section 1.2: Sampling Approach
- Section 1.3: PSD Preparation, PRC Loading, and Diffusive Cell Tracers
- Section 1.4: Field Deployment and Retrieval Methods
- Section 1.5: Processing of Passive Sampling Devices
- Section 1.6: Sample Identification and Handling Procedures
- Section 1.7: Laboratory Analyses and Quality Assurance
- Section 1.7: Derivation of Water Concentrations from Passive Sampling Devices
- Section 1.9: Comparison to Water Criteria
- Section 1.10: Schedule and Reporting

1.2 Sampling Approach

In 2015 the Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (EPA) elected to use passive sampling methods to characterize surface and porewater at the M&B Site, because the sampling results are thought to more closely represent the biologically available fraction of constituents of concern (COCs). Revised passive sampling methods are being utilized in 2020. These methods will rely on the use of solid phase micro extraction (SPME) fibers coated with a sorbent polydimethylsiloxane (PDMS) polymer media and diffusive membranes covering cells containing reference water. The reference water to be used for this project will be laboratory certified to be free of metals, ions and other COCs. These two passive sampling techniques will be integrated into a passive sampling device (PSD) with discrete sampling intervals for surface, inter-armoring, and sub-armoring water. The samples of surface water and inter-armoring porewater will be used to assess the cap's compliance with the Record of Decision (ROD). Samples from the sub-armoring layer will be used as an early warning indicator to assess the potential for chemical breakthrough.

The PDMS media sorbs polycyclic aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP) present within porewater and surface water such that sorbed concentrations will eventually approach equilibrium with ambient dissolved concentrations. Performance reference compounds (PRCs) will be impregnated onto select PDMS-coated fibers as described in Texas Tech Universities (TTU) Standard Operating Procedures (SOPs) for passive sampling using PDMS-coated SPME fibers provided in Appendix A and summarized in Section 1.3. The PRCs provide information about mass transfer kinetics between the sampled environment and the passive sampler which allows porewater and surface water concentrations to be calculated from the mass of chemical that sorbs to the PDMS even if the PSD is deployed for a shorter period than would be required to reach equilibrium with ambient dissolved concentrations.

The diffusive membrane cells will also be integrated into the PSDs. These cells are sealed with a membrane of a known porosity which only allows dissolved metals to pass through. The reference water[1] inside the diffusive cell accumulates dissolved metals in a controlled manner until it is near equilibrium with ambient concentrations. Additional cells will be spiked with a bromide ion solution to allow for the assessment of water exchange rates in the given sample intervals. Procedures for passive sampling using diffusive membranes are summarized in Section 1.3.

The compliance samples will be collected from 12 representative surface water and inter-armoring porewater sampling locations (A through L) to ensure the cap is functioning as intended in the ROD. Compliance monitoring locations are statistically generated and change during each event, as described in the Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (EPA)-approved technical memorandum, entitled “O&M Sampling Approach for the McCormick & Baxter Sediment Cap” (GSI, 2013). Surface water, inter-armoring, and subarmoring porewater samples will also be collected at four early warning locations (5, 12, 13, and 16). In 2020, Porewater samples will also be collected from the sub-armoring layer at the same 12 locations (A through L) along with four fixed early warning locations (5, 12, 13, and 16) to assess the potential for future contaminant breakthrough site wide. Two additional surface water reference stations (1 and 27) will be sampled to assess background concentrations of COCs in the surface water at the Site. Target compliance, early warning, and background sampling location details are provided in Table 1-1 and are shown in Figure 1-1.

The PSDs will either be deployed by field staff from shore (in shallow water) or by divers at the selected sampling locations (see locations in Table 1-1). The PSD consists of a rigid probe equipped with horizontal channels for the PDMS-coated fibers within each sampling interval, hollow cells for reference water, and a mesh cover to hold and protect the diffusive membranes. PSDs will be advanced approximately 18 inches below mudline (bml) into the sub-armoring layer of the M&B sediment cap. Spacing of the PDMS-coated SPME fiber segments and diffusive cells will ensure that the center of the armoring layer and surface water (approximately 6 inches above the mudline) are characterized. Field deployment is further discussed in Section 1.4. The samplers will then be left in the sediment and overlying water for approximately 42 days and allowed to approach equilibrium. At the time of retrieval, the divers will remove the PSDs and pass them to personnel on the sample vessel for processing and transport to the laboratory. Samples will be processed and analyzed for PAHs, PCP, and metals (see Section 1.7). Results will undergo data quality checks and the PDMS results converted into an associated water concentration (see Section 1.7). Table 1-2 presents the water comparison criteria that will be used to assess cap performance in 2020.

1.3 PSD Preparation, PRC Loading, and Diffusive Cell Tracers

The PSDs and PRC fibers will be prepared at the TTU laboratory before deployment. Figures 1-2a and 1-2b show a PSD similar to those anticipated for the 2020 deployment. The TTU SOP provided in Appendix A describes the procedures for cleaning and drying the PDMS-coated SPME fibers, selecting, and loading PRCs onto the fibers, and fabricating the PSDs before deployment.

All PSDs used on this project will be prepared and fabricated in the same batch to ensure comparability between sample results. In addition, PDMS-coated SPME fibers will be loaded into PSDs with a known concentration of PRC fortification solution. Therefore, tracking time-zero concentrations by PSD is not necessary. The PRCs used on this project will be research grade deuterated compounds including d-Fluoranthene, d-Chrysene, d-Benzo(b)fluoranthene, and d-Dibenzo(a,h)anthracene. PRC loading will be conducted according to the SOP in Appendix A. Actual PRC fortification levels may differ and will be summarized in the Data Report.

The PDMS-coated SPME fibers used for analysis of PAHs and PCP will be approximately 5 centimeters (cm) long. They will be placed into horizontal channels on the PSD during deployment. Each sampling interval will have at least three 5 cm PDMS-coated SPME fibers. Upon retrieval, the fibers will be removed, processed, and submitted for analysis of PAHs and PCP.

Diffusive membrane cells will be used to measure dissolved metals concentrations in water. Each diffusive cell window is approximately 0.6 inches wide, 0.8 inches deep, and 2.0 inches long and will contain 15 milliliters (ml) of reference water. Each cell will be covered with a polysulfone membrane with a porosity of 0.45 µm. The reference water from the diffusive cells will be extracted and submitted for the analysis of the target metals. The results will approximate the dissolved phase concentrations of metals within the sampling interval. Additionally, bromide ion tracers will be used in select diffusive cells to allow estimation of water exchange rates.

1.4 Field Deployment and Retrieval Methods

Loaded PSDs will be deployed by a diver from a sampling vessel in offshore areas (generally greater than 2 feet of water depth). In nearshore areas PSDs may be deployed from land when water is less than 2 feet deep. Health and safety procedures for diving on-site have been developed by the EPA Region 10 Dive Team, who will deploy and retrieve the PSDs in offshore areas. Appendix B contains the EPA Dive Plan for this project.

1.4.1 Field Documentation

Field Documentation will be done using a field log and photos.

1.4.1.1 Logbooks

Field logbooks (or field forms) will be used to document daily activities and observations. Documentation should be sufficient to enable participants to reconstruct project events accurately and objectively. Documentation should include the following at minimum:

- Daily activities
- Types and number of PSDs being deployed and retrieved at each location
- Date and time of PSD deployment
- Issues related to the deployment and retrieval of the PSDs
- Observations of fouling or other impacts to the PSDs
- Any decisions altering the implementation of this SAP

Field logbooks should be bound and contain numbered pages. Entries should be made in waterproof ink, dated, and accompanied by time stamps.

1.4.1.2 Photographs

Photographs will be taken to document all field activities. A white board may be used to annotate field photos. At minimum, photo documentation will cover the following:

- PSD preparation
- PSD deployment (divers are not expected to take photos)
- Field conditions
- General procedures

Photos will be downloaded and kept with the electronic project files for future reference.

1.4.2 Horizontal and Vertical Positioning

Horizontal positioning will be accomplished using a differential global positioning system (DGPS). The sample location coordinates presented in Table 1-1 will be loaded onto the DGPS unit for reference in the field. Once on station, a marker buoy and anchor will be deployed. The line will be pulled taught and a set of coordinates will be collected for future reference. If the station is moved a new set of coordinates will be taken using the same process. This will allow for relocation of the PSDs during retrieval. The horizontal datum for the project is North American Datum of 1983 (NAD83); State Plane Coordinate System; Oregon North Zone; and International Feet. Station accuracy may be affected by satellite positioning and obstructions, such as the Burlington Northern Railroad Bridge and heavy cloud cover.

Mudline elevations at each sampling location will be determined by measuring the water depth with a calibrated fathometer or lead line and subtracting the river elevation. While the DGPS is over the sampling station, depth to the river bottom will be measured. Vertical measurements will be recorded in the field logbook to the nearest 0.1 foot below the water surface along with the date and time. River elevations will be determined from U.S. Geological Survey (USGS) station # 14211720 which records Willamette River stage data every 30-minutes (USGS, 2013). This station is located on the upstream side of the Morrison Bridge (River Mile [RM] 12.8). River stage elevation data reported by USGS are relative to the Portland River Datum at this location. The river stage data are corrected to North American Vertical Datum of 1988 (NAVD88) at approximately RM 7 by adding 5.0 feet to the USGS reading.

1.4.3 Sampling Location Changes

River stage and subsurface obstructions may prevent the deployment of the PSDs at the target sampling locations. If this occurs, the location will be moved no more than 30 feet to an area that is still within the sediment cap footprint. If the deployment of a PSD at the proposed sample location is unsuccessful after two attempts or must be moved more than 30 feet from the initial target, the DEQ project representative will be consulted. Decisions to abandon or relocate sample locations will be recorded in the field logbook along with the coordinates and mudline elevation measurements at any relocated PSD. Additional detail regarding sample location positioning is provided in Section 1.4.4 and should be followed by the dive team and/or field staff during the deployment of the PSDs.

1.4.4 Offshore Positioning

At offshore locations, the dive boat will be positioned over the sampling location. Once on location, an anchoring system and marker will be deployed using the following processes:

- Using estimated water depths field staff will prepare anchor systems for each location. Steel cable will be fixed to an anchor weighing 20 pounds or more. Adjustable rings will be placed on the sections of cable to allow it to be adjusted to actual water depths. Cables will be prepared in a way which minimizes slack but allows fluctuations in water level associated with tidal cycles and river stage changes.
- A support buoy will be attached to a weighted steel cable.
- A top buoy to mark the location will be fixed to the steel cable with a rope. This rope should have sufficient scope to allow for changes in river stage but should be short enough that it will not hinder navigation or become fouled.
- The anchor, cable, and buoys will be lowered onto the sample location.
- Actual coordinates of the sample location will be collected.

A schematic showing the configuration of the PSD anchoring system is provided in Figure 1-3.

1.4.5 Nearshore Positioning

Areas for preparing and processing PSDs on-shore will be set up so that as much of the work can be conducted from the shoreline as possible. At nearshore sampling locations in water less than 2 feet deep, field staff may deploy the PSDs. Positioning will be done using the methods presented in section 1.4.2. Deployment of the PSDs will be conducted during the low-low tide to reduce the likelihood that they will be exposed to the atmosphere. To help ensure that surface water samples remain submerged for the duration of deployment, nearshore sampling locations may be moved up to 30 feet offshore of their proposed locations depending on the existing and projected river stage conditions at the time of deployment. Once on location the field staff will enter the water, assess riverbed conditions, and deploy the PSD anchoring system described in section 1.4.4. This anchoring system may be modified at nearshore locations if it is determined that a top buoy is not warranted.

1.4.6 Field Deployment of PSDs

The PSDs will be prepared in advance of their deployment by TTU. Figures 1-2a and 1-2b present a PSD design like what will be used for this project. Before deployment, the PDMS-coated SPME fibers and PRC-spiked fibers will be inserted into the PSDs as described in Appendix A. Diffusive membrane material and reference water will be used to prepare diffusive cells prior to sampling. Select diffusive cells will be spiked with a bromide ion solution to allow for the assessment of water exchange rates.

Before deployment, field staff will verify the specific PSDs that will be installed at each location, whether a PSD loaded with PRC fibers or bromide ion solution will be deployed, and if a duplicate PSD will be deployed. This information will be communicated to the divers and/or field staff and documented in the field log.

Once positioned on the sampling location divers will descend along the PSD anchoring system cables. At nearshore locations field staff will approach by foot. At each location, field staff or divers will remove enough of the rock armoring and/or articulated concrete block (ACB) to advance the PSD approximately 18 inches bml to allow for placement of the PSDs lowest sampling interval in the sub-armoring layer.

At sampling stations where diver collection is required, the EPA Dive Team will decide whether to lower the PSDs to the diver along a tag line or have the diver descend with the PSD attached to them with a tether. The PSD will be attached to either the diver, tag line, or anchoring system until it is appropriately installed. At nearshore locations, field staff will work in teams to deploy each PSD. Once installed by a diver or field staff the PSD tether will be fixed to the anchoring system using a clip as shown in Figure 1-3.

Deployment procedures for the PSDs include:

- Remove any rock armoring from around the sample location and place it to side.
- Press the PSD into the sediment until the top of the PSD is approximately 12 inches above the mudline. This will position the sampling intervals as intended.
    - If refusal is encountered before the PSD reaches its target depth, gently remove the PSD and inspect it for damage. If the PSD is not damaged, the diver may remove any remaining of rock armor and proceed with a second installation attempt. Alternatively, a slide hammer may be used to advance the PSD to its target depth.
    - If necessary, an alternate sampling location within 30 feet of the proposed location can be used. The personnel will document this change in the field log and by collecting an updated set of coordinates once the PSD has been successfully installed.
- Once the PSD is installed to its target depth, replace rock armoring around the PSD and push into the void and up against the sampler to re-create the ‘armored conditions’. Care should be taken to avoid pressing rock directly onto the diffusive membranes.
- Ensure that the PSD is attached to the anchor line via a steel cable tether and inspect connection (Figure 1-3).

Upon the confirmation that the PSD was properly installed, the diver will return to the boat.

1.4.7 Retrieval of PSDs

Following the deployment period (approximately 42 days), the PSDs will be retrieved. The top buoy should allow for visual relocation of the deployment gear at offshore locations. After the actual sampling location is reoccupied, the installed PSD and anchoring system will be inspected. Any potential impacts that occurred to the PSD during deployment will be documented. The PSD will then be unclipped from the anchor line and carefully removed. The diver will replace any armoring that was removed, carry the PSD to the surface. and pass the PSD to field personnel. If divers are not able to remove the samplers they may be retrieved by pulling them vertically from the boat. The anchoring system will then be removed from the water and broken down for storage.

1.5 Processing of Passive Sampling Devices

Upon arrival at the laboratory, samples will be logged in and refrigerated until extraction. The procedures for processing the PDMS-coated SPME fibers for analysis are described in the TTU SOP in Appendix A. The procedures for processing the diffusive membrane cells are discussed in Section 1.5.2.

1.5.1 Fiber Cleaning, Sampling, and Extraction

PDMS fibers will be removed from the PSD and placed on a foil-covered surface for segmenting. One person will remove the fibers from the PSD and clean them of any biofilms, particulates, and residues using deionized water and a Kimwipe®. After cleaning the fiber will be blotted dry. A second person will handle segments and process each fiber according to the targeted sampling intervals. The segmentation of the fibers should be completed efficiently to minimize chemical loss. Segmented fibers representing the target sampling intervals will be placed into containers with solvent and stored at 4°C until the period of extraction is complete.

1.5.2 Diffusive Cell Sampling and Extraction

Procedures for extracting, processing, and analyzing metals and ion samples collected from diffusive membrane cells [high resolution passive profilers (HRPP)] are provided in Appendix C. In summary, a 4 to 10-mL sample is extracted from the cell via a clean, pretested syringe and 20-gauge stainless steel needle. The sample is filtered through a 0.45 µm syringe filter before being added to a 15-mL polypropylene vial with HNO_3 preservative solution. The samples will then be analyzed for selected metals concentrations via EPA method 200.8.

1.5.3 Quality Assurance and Quality Control Samples

1.5.3.1 Field Duplicate

Field Duplicates will be collected from each target interval and sampling media to evaluate the precision of sampling procedures. Duplicates will be prepared by deploying a replicate PSD or duplicate fibers at three sampling locations. The PDMS-coated SPME fibers and diffusive cells will be processed using the same procedures as a standard sample. The duplicate samples will be analyzed for the complete suite of target COCs. The collection of duplicate samples will be conducted at the sample locations identified in Table 1-3 at a frequency of one duplicate per 20 samples.

1.5.3.2 Field Blank

Field blanks of the PDMS-coated SPME fibers and diffusive cells will be brought into the field to evaluate impacts from ambient contamination. Field blank samples will be opened and exposed to the ambient air during the collection and processing of samples. Field blanks that are sealed during transport will be opened, exposed to the environment, and placed on a work bench as the PSDs are prepared for deployment or retrieval. Once the site samples are processed, the field blanks will be re-sealed, packaged, and transported back to the laboratory for analysis. Field blanks will be collected at a frequency of one field blank per 20 samples.

1.5.3.3 Trip Blank

Trip blanks of the PDMS-coated SPME fibers and diffusive cells will be brought into the field and processed as samples to evaluate impacts from the ambient environment during transport. Trip blanks will remain in sealed containers during transport, sampling, and the return to the laboratory. The trip blanks will not intentionally be exposed to the ambient environment during transport and are intended to represent the impacts from the transport process themselves. Trip blanks will be collected at the frequency of one blank per 20 samples.

1.6 Sampling Identification and Handling Procedures

This section describes procedures for sample identification and chain of custody that should be used for field activities. These procedures ensure sample quality is maintained during collection, transportation, storage, and analysis.

1.6.1 Sample Identification

Each sample will be assigned a unique identification (ID) number describing the specific site location, sample media, depth interval, and date. The identification number will be recorded on a label and fixed to the sample container. Each sample ID will be constructed using the following process:

1. Site Identification: MB = McCormick & Baxter Site
2. Sample Matrix: SW = surface water exposure; IA = inter-armoring water; or SA = sub-armoring water
3. Sample Media: SPME= Solid Phase Micro Extraction fiber or DM = diffusive membrane
4. Sample Month: e.g., 10 = Month of sample retrieval (e.g., October)
5. Sample Year: e.g., 20 = Year of collection (e.g., 2020)
6. Sample Station Number: 01 through 27 will be station numbers consistent with previous sampling events and station letters A through L will be used to denote the statistically derived compliance monitoring locations described in Appendix A.

For example, MBSWSPME1020-01 would be used to describe the surface water exposed PDMS-coated SPME fiber sample collected in October 2020 at station 1. Field duplicates should be designated with a "-Dup" suffix (e.g. MBIADM1020-E-Dup represents a field duplicate collected in the inter-armoring exposed diffusive membrane collected in October 2020 at compliance monitoring station E. Sample IDs for each location, sampling interval, and media are provided in Table 1-3.

1.6.2 Sample Labels

Labels will be used to identify samples collected in the field. Once recovered, the PDMS-coated SPME fibers will be removed from the PSD, processed, placed in laboratory-cleaned glass containers, and labeled. Sample water from the diffusive cells will be removed, placed in laboratory-cleaned containers, and labeled. Each sample label should include the following information:

- Sample identification
- Date and time of collection
- Client

1.6.3 Sample Custody

TTU staff will maintain custody of the samples for the duration of fieldwork, transport, and processing and will follow standard custody procedures to trace the possession and handling of a sample from collection to completion of all required analyses. Chain of custody procedures and forms will be used if necessary.

1.6.4 Sample Handling and Packaging

All samples will be transported between the field and the laboratory by project staff. The shipping of samples or transfer of custody may be needed to facilitate travel. Samples will be bagged and stored on ice in coolers for the duration of the trip to the laboratory. Enough ice should be used to ensure that temperatures remain below 4 ° C. Coolers and sample containers will be packaged to avoid breakage or contamination while in transit. Custody seals will be placed on any cooler that project staff will not physically possess during transit to the laboratory.

1.7 Laboratory Analyses and Quality Assurance and Control Measures

1.7.1 Chemical Analyses

Chemical analyses of the samples will be completed at the laboratory as described in the SOPs provided in Appendices A and C. The specific target analytes and proposed analytical methods for this event include:

- 16 standard PAHs by EPA method 8270
- PCP by EPA method 8270
- Dissolved metals (arsenic, chromium, copper, and zinc) by EPA method 200.8

The analytical schedule for each sample is summarized in Table 1-3. Estimated method detection limits (MDLs) for the final water results are provided in Table 1-4 for organics and Table 1-5 for metals.

1.7.2 Quality Assurance and Quality Control Procedures

Laboratory QA/QC will be maintained by utilizing standard EPA methods and standard analytical procedures for the target analytes. The method-specific and other analytical and laboratory QC procedures and protocols followed are detailed in the laboratory's method-specific SOPs included in Appendices A and C. These procedures incorporate the collection and analysis of the following laboratory QA/QC components:

- Method reporting limit (MRL) checks
- Calibration verification
- Matrix spikes (MS) and matrix spike duplicate (MSD) samples
- Reagent blanks (extraction blanks)
- Calibration check samples
- Laboratory splits

Data that falls outside of Laboratory QA/QC requirements should be flagged accordingly and discussed in the Data Report.

1.8 Derivation of Water Concentrations from Passive Sampling Media

The methods for estimating porewater and surface water concentrations from concentrations measured in PDMS-coated SPME fibers and in the diffusive cells are described in the following sections.

1.8.1 PDMS-Coated SPME Fiber Calculations

The freely dissolved porewater concentrations can be calculated from the accumulated uptake concentrations in the PDMS-coated SPME fibers and the fiber-water partition coefficients as shown in Equation 1.

$$Cw = \frac{C_{PDMS}}{K_{PDMS-W}} = \frac{A * RSF * V_{solvent}}{L_{fiber} * V_{fiber} * K_{PDMS} * f_{ss}}$$

Equation 1. Derivation of Porewater Concentrations from PDMS-Coated SPME Fibers

Cw = Porewater concentration

A = Areas of chromatography peaks

RSF = response factor from calibration curve unique to each organic analyte

$V_{solvent}$ = volume of solvent used to extract fiber

L_{fiber} = length of fiber sample

V_{fiber}= specific volume of fiber

K_{PDMS-W} = fiber-water partition coefficient unique to each organic analyte

f_{ss}= fractional approach to steady state from PRCs

1.8.2 Diffusive cells

The concentrations of dissolved metals collected from the diffusive cells do not need correction. They reflect the flow weighted average dissolved phase concentration of metals during the period of deployment over a given sampling interval. Data collected by spiking select cells with a bromide ion solution may be used to derive water exchange rates over the deployment period.

1.9 Comparison to Water Criteria

Porewater and surface water concentrations calculated from the analyses of PDMS-coated SPME fibers and water from the diffusive cells will be presented in the Data Report and compared to the criteria presented in Table 1-2. The comparison will serve to assess M&B cap performance in relation to updated state criteria and the criteria being used at the adjacent Portland Harbor Superfund Site.

1.10 Schedule and Reporting

A Data Report presenting the results, interpretation, and preliminary conclusions from the sampling event will be prepared and submitted to the DEQ approximately two months after completion of fieldwork. The DEQ will review the preliminary report and provide comments within 30 days of receipt. Comments will be incorporated into a final report within 30 days of their receipt.

SECTION 2: **Crayfish Sampling and Analysis Plan**

The objective of this SAP is to detail the crayfish tissue sampling and analysis protocols that will be used in 2020. These samples will be used to evaluate cap performance at the Site as part of the 5-year review process.

2.1 Organization

The Crayfish SAP is organized as follows:

- Section 2.2: Sampling Approach
- Section 2.3: Field Sampling Methods
- Section 2.4: Crayfish Processing
- Section 2.5: Laboratory Analyses and Quality Assurance and Quality Control Measures
- Section 2.6: Comparison to Tissue Criteria
- Section 2.7: Schedule and Reporting

2.2 Sampling Approach

This section describes the schedule, sampling locations, and targeted crayfish species to ensure that samples of the correct targeted species are collected from the correct timeframe and from the right location. Results from the tissue analysis will be compared to the criteria presented in Table 2-1.

2.2.1 Schedule

Crayfish sampling will be conducted in late summer and fall (August through October) 2020. Two rounds of sampling are proposed to ensure sufficient crayfish samples are collected. The first round of sampling will occur in late August 2020 during the deployment of the PSDs as described in Section 1. The second round of sampling (if needed) will occur during the retrieval of the PSDs in October 2020. Crayfish traps will be deployed overnight at the locations identified in Figure 1-1. These locations are collocated with compliance monitoring locations where water samples are being collected (Section 1).

2.2.2 Locations

Crayfish will be sampled at 5 locations (01 through 05) that are collocated with cap compliance monitoring locations (A, C, D, E, and F), shown on Figure 1-1. The target sample coordinates, anticipated water depth, and collocated compliance monitoring station for each location are provided in Table 2-2.

2.2.3 Target Species

Crayfish species found in western North America are members of the *Astacidae* family. The crayfish species found on the Pacific Coast of the U.S. and British Columbia include the signal crayfish (*Pacifastacus leniusculus*) and shasta crayfish (*Pacifastacus fortis*). Crayfish found in the Willamette and Columbia Rivers are the signal crayfish. Mature signal crayfish are generally 3 to 5 inches (76 to 27 mm) in length and approximately 2 to 4 oz (56 to 113 grams) in weight. This project will target the collection of adult signal crayfish since they represent the endemic species and are of sufficient age to have accumulated COCs if present.

2.2.4 Permits

CERCLA 121(e)(1) and the National Contingency Plan 40 CFR, Section 300.400(e)(1) exempt the requirement for federal, state, or local permits for onsite response actions conducted pursuant to CERCLA. This exemption does not extend to the substantive requirements (EPA, 1992, 1988). Following are the Applicable or Relevant and Appropriate Requirements for crayfish collection.

Endangered Species Act Section 4d

Crayfish collection for McCormick and Baxter typically has no effect on listed salmon and steelhead. Collection occurs once every 5 to 10 years. Previous crayfish collection using similar methods in October 2008 did not entrap any listed salmon or steelhead. To minimize the unintentional catch of listed salmon and steelhead during the collection of crayfish, as described in the SAP, the following conditions will be adhered to:

- Crayfish traps will be deployed at the end of the field day and retrieved the next day as the first field activity; traps will be monitored every 18-24hours, until sufficient tissue mass is collected.

- If other species are inadvertently entrapped in crayfish traps, bycatch will be released into the water column once the traps are brought to the surface. If caught, salmonids and other native fish will be released first. Once all bycatch are removed from the traps, crayfish will be processed.

2.3 Field Sampling Methods

The initial sampling event will consist of one overnight deployment of the crayfish traps; ideally at the time of PSD deployment. If an insufficient number of adult signal crayfish are collected (target of 10 – 11 ounces of crayfish biomass at each location) for the necessary analyses and QA/QC procedures, the traps will be redeployed the following day or during retrieval of the PSDs in October. Crayfish traps will be deployed at the end of the field day and retrieved the next day as the first field activity; traps will be monitored approximately 18-24 hours until sufficient tissue mass is collected.

Crayfish will be collected using baited crayfish traps deployed from a boat at the five locations (01 through 05) collocated with compliance monitoring locations (A, C, D, E, and F) shown on Figure 1-1 and detailed in Table 2-2. Crayfish traps are approximately 1.5 x 2 ft box shape made of plastic mesh material with a metal frame. Trap openings extend almost the full width of the traps (~17inches) and shown on Figure X. Interior Bait traps will use fresh or frozen herring, smelt, or fish heads from local bait shops or fish processing facilities. The bait will be cut into small pieces before being placed in the bait boxes. Bait boxes or other suitable containers (e.g., perforated plastic canister with screw plastic lids) may be used, or bait can be placed directly in the trap (along the entire bottom of the trap). The bait container will be secured inside the trap (i.e., zip-tied) with enough bait to provide continued attraction of crayfish over the duration of the deployment. A sample of the bait will also be analyzed for the COCs identified in Table 2-3 to account for any contamination it may introduce.

Two crayfish traps per location will be deployed to help ensure an adequate sample size is collected. Each composite sample (one per location) must contain at least 10 to 11 oz (300 grams) of total crayfish material. This volume will be confirmed using a scale in the field. Based on this value, the number of crayfish collected for each composite sample will depend on the size of each individual crayfish, but it is anticipated that approximately three to four crayfish per location will be needed. Between 20 and 50 crayfish may be collected for analysis for the entire project. If an insufficient sample size is collected on repeated attempts, tissue analysis may be limited to whole body only, rather than whole body and tail tissue samples. Small fish, , may enter the crayfish trap and become entrapped. Inadvertent animals collected in the trap will be counted, identified. Salmonids and other native fish will be released first into the water column once the traps are brought to the surface. Once all bycatch are removed from the traps, crayfish will be processed.

After the collection of a crayfish sample at a given location, the crayfish will be wrapped together in two layers of aluminum foil, sealed in a clean bag, and frozen with dry ice. A waterproof tag will be placed inside the bag, and a sample label will be attached to the outside of the bag. The tags and labels will include the sample number, date, contents, analyses requested, and samplers' names. As soon as practicable, the samples will be shipped to the laboratory for analysis.

2.3.1 Sample Identification

Each sample will be assigned a unique identification number describing the specific site location, sample media, and date. The identification number will be recorded on a label and fixed to the to the sample container. Each sample ID will be constructed using the following process:

1. Site Identification: MB = McCormick and Baxter Site
2. Sample Matrix: CF - Crayfish
3. Sample Month: e.g., 10 = Month of sample retrieval (e.g., October)
4. Sample Year: e.g., 20 = Year of collection (e.g., 2020)
5. Sample Station Number: 01 through 05 will be station numbers consistent with their collocated compliance monitoring station as described in Table 2-2.

For example, MBCF1020-01 would be used to describe the crayfish tissue sample collected in October 2020 at station 01. Field duplicates will be designated with a "-Dup" suffix (e.g. MBCF1020-02-Dup represents a field duplicate collected in October 2020 at station 02). Sample IDs for each location are provided in Table 2-3.

2.3.2 Sample Labels

Labels will be used to identify samples collected in the field. Once recovered, the crayfish will be wrapped in two layers of tin foil, placed in a sealed bag, and labeled. Each sample label should include the following information:

- Sample identification
- Date and time of collection
- Client

2.4 Crayfish Processing

The laboratory will prepare up to two composite samples for each sampling location where samples of sufficient mass were collected. The primary sample will be of the whole body. If sufficient material exists a secondary composite of tail only material will be created. Tail only processing involves removing the cephalothorax (head and thorax) from the rest of the body and retaining all sample matter to represent the whole-body sample. The tail meat, including the section of intestine passing through the muscle tissue, will be retained for analysis as the tail only sample. Processing of the composite sample for analysis will begin with the homogenization of the entire crayfish body sample in stainless steel grinders, blenders, or homogenizers that have been cooled with dry ice. Processed samples (whole body and potentially tail) will undergo the analyses identified in Section 2.5.1 and in Table 2-3. Additional information about the processing of crayfish samples can be found in the SOP from Pace Laboratories provided in Appendix D

2.5 Laboratory Analyses and Quality Assurance and Quality Control Measures

This section describes chemical analyses and QA/QC procedures. These procedures ensure sample quality is maintained throughout laboratory analysis.

2.5.1 Chemical Analyses

Each composite crayfish sample will be analyzed for:

- 17 2,3,7,8-polychlorinated dibenzo-p dioxins, polychlorinated dibenzofurans, and lipids by EPA Method 1613B
- 16 Standard PAHs by EPA Method 8270
- PCP by EPA Method 8270
- Total metals including arsenic, zinc, chromium, and copper by EPA Method 6020
- Percent lipid content by EPA Method 8290

The analytical schedule for each crayfish sample is summarized in Table 2-3. Method detection limits (MDLs) and method reporting limits (MRLs) are provided in Table 2-4.

2.5.2 Quality Assurance and Quality Control Procedures

A single duplicate whole-body tissue sample will be collected to ensure project QA objectives are met. The duplicate will be taken in the field from a station where enough crayfish are collected. The sample to be used as a duplicate will be designated by field staff and it will contain a similar amount of sample volume, approximately six to eight crayfish. If six to eight crayfish are not collected at any of the sampling locations, the sample with the most crayfish will be split into two with one being designated as the duplicate.

2.6 Comparison to Tissue Criteria

Results from the crayfish tissue analyses will be compared to the criteria presented in Table 2-1. The results of these comparisons will be presented in the Data Report. The comparison will serve to inform managers about how the M&B cap is performing in comparison to updated state tissue criteria and the criteria used at the adjacent Portland Harbor Superfund Site.

2.7 Schedule and Reporting

A Data Report presenting the results, interpretation, and preliminary conclusions from the sampling event will be prepared and submitted to DEQ approximately two months after completion of fieldwork. DEQ will review the preliminary report and provide comments within 30 days of receipt. Comments will be incorporated into a final report within 30 days of their receipt.

SECTION 3: **References**

Hart Crowser/GSI, 2013. O&M Sampling Approach for the McCormick & Baxter Sediment Cap: McCormick & Baxter Superfund Site, Portland, Oregon. Hart Crowser, Inc. and GSI Water Solutions, Inc., 2013.

Tables

Table 1-1
Passive Sampling Locations
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	Sample Location								
	Sample Coordinates (NAD83)[1]				Sample Elevation[2] (ft NAVD88)	Anticipated Water Depth[3] (ft)	Location with ACB	Colocated Crayfish Sampling Location	Access Method (D= Diver S= Shore, B= Boat)
	Northing	Easting	Latitude	Longitude					
Compliance Sampling Locations									
A[5]	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	01	**S**
B	704369.2	7628482.9	45.57687	-122.74050	4.6	2.4	--	--	**D***
C	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	02	**D**
D	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	03	**D**
E	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	04	**D**
F	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	05	**D**
G[6]	705263.6	7627011.2	45.57921	-122.74634	1.1	5.9	Yes	--	**D**
H	705118.3	7626983.2	45.57881	-122.74644	-8.9	15.9	--	--	**D**
I	704565.8	7627624.4	45.57734	-122.74387	-18.6	25.6	--	--	**D**
J	704511.5	7627800.2	45.57721	-122.74318	7.2	-0.2	--	--	**S**
K	704219.7	7628010.5	45.57643	-122.74233	-20.9	27.9	--	--	**D**
L	704335.6	7628390.4	45.57677	-122.74086	4.5	2.5	--	--	**D***
Early Warning Sampling Locations									
5	704576.3	7628007.4	45.57740	-122.74238	1.8	5.2	--	--	**D**
12	705197.2	7627236.8	45.57905	-122.74546	4.9	2.1	Yes	--	**D***
13	705303.9	7627321.8	45.57935	-122.74514	5.4	1.6	Yes	--	**D***
16	704293.9	7627812.9	45.57661	-122.74311	-28.6	35.6	--	--	**D**
Background Sampling Locations									
1 (Upstream)	703730.7	7628583.6	45.57513	-122.74004	-31.5	38.5	--	--	**D**
27 (Downstream)	705647.6	7626360.3	45.58021	-122.74893	-19.3	26.3	--	--	**D**

Notes:

[1] Northing and easting coordinates exist in the following coordinate system: North American Datum of 1983 (NAD83), Oregon State Plane North Zone, International Feet.

[2] Elevations exist in the following coordinate system: North American Vertical Datum of 1988 (NAVD88) in units of feet.

[3] Assumes the Willamette River stage is at an elevation of 7.0 feet NAVD88. Note that sample locations with a negative value are anticipated to be out of water at the time of sampling. The locations will be adjusted to the waters edge when deployed to ensure that the samplers remain submerged throughout the deployment period.

[5] Compliance monitoring location A is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area A will be used. The coordinates for this location are N: 704245.0, E: 7628682.3; Lat: 45.576546, Long: -122.73971

[6] Compliance monitoring location G is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area G will be used. The coordinates for this location are N: 705277.8 E: 7626983.2; Lat: 45.5788109435, Long: -122.746512

*Deployment methodology will depend upon river stage at the time of sampling.

ACB: Articulated concrete block

D/Fs: Dioxin/Furan congeners

PAHs: Polyaromatic hydrocarbons

Table 1-2
Water Comparison Criteria
McCormick & Baxter Creosoting Company
Portland, Oregon

Chemical	1996 AWQCs[1]		DEQ 2011 EPA-Approved AWQCs updated 2019[3]		2015 NRWQCs[2]		2011 MCLs updated 2015[4]	Portland Harbor ROD Table 17[6]
	Aquatic Life (chronic)	Human Health (fish consumption only)	Aquatic Life[5] (chronic)	Human Health (consumption of organism only)	Aquatic Life (chronic)	Human Health (consumption of organism only)	Maximum Contaminant Levels (MCLs)	Surface Water
Metals (mg/L)								
Total Arsenic	0.19	--	0.15	2.1	0.15	0.00014	0.01	0.00018
Total Chromium	0.21	--	0.024	--	0.074	--	0.1	0.1
Total Copper	0.012	--	Note[7]	--	0.0049	--	1.3 [9]	0.00274
Total Zinc	0.11	--	0.036	2600	0.12	26	5 [10]	0.365
Polycyclic Aromatic Hydrocarbons (µg/L)								
Pentachlorophenol	13	--	Note [8]	0.3	15	0.04	1	0.03
Acenaphthene	520	--	--	99	--	90	--	--
Acenaphthylene	--	--	--	--	--	--	--	--
Anthracene	--	--	--	4000	--	400	--	--
Benz[a]anthracene	--	--	--	0.0018	--	0.0013	--	0.0012
Benzo[a]pyrene	--	--	--	0.0018	--	0.00013	0.2	0.00012
Benzo[b]fluoranthene	--	--	--	0.0018	--	0.0013	--	0.0012
Benzo[g,h,i]perylene	--	--	--	--	--		--	--
Benzo[k]fluoranthene	--	--	--	0.0018	--	0.0013	--	0.0013
Chrysene	--	--	--	0.0018	--	0.13	--	0.0013
Dibenzo[a,h]anthracene	--	--	--	0.0018	--	0.00013	--	0.00012
Fluoranthene	--	54	--	14	--	20	--	--
Fluorene	--	--	--	530	--	70	--	--
Ideno[1,2,3-cd]pyrene	--	--	--	0.0018	--	0.0013	--	0.0012
Naphthalene	620	--	--	--	--	--	--	12
Phenanthrene	--	--	--	--	--	--	--	--
Pyrene	--	--	--	400	--	30	--	--
Total LPAHs	--	--	--	--	--	--	--	--
Total HPAHs	--	--	--	--	--	--	--	--
Total cPAHs	--	0.031	--	--	--	--	--	0.0012
Total PAHs	--	--	--	--	--	--	--	--

Notes:

[1] The 1996 Record of Decision (ROD) specifies the remedial action objects of the sediment cap as: 1) preventing human and aquatic organisms from direct contact with contaminated sediment; and 2) minimizing releases of contaminants from sediment that might result in contamination of the Willamette River in excess of Ambient Water Quality Criteria (AWQCs).

[2] National Recommended Water Quality Criteria (NRWQCs) published as of August 15, 2007, are included for comparison (see http://www.epa.gov/waterscience/criteria/wqcriteria.html).

[3] Oregon's revised AWQCs for human health approved by EPA on October 17, 2011

[4] National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs) promulgated as of August 15, 2007, are included for comparison (see http://www.epa.gov/safewater/contaminants/index.html).

[5] Aquatic Water Quality Criteria (AWQCs) published as of 2011, and updated effective 2017, are included for comparison (see ORS 340-041-8033) Oregon default hardness of 25 mg/l used.

[6] Portland Harbor Record of Decision Table 17

[7] Copper criteria is the Biotic Ligand Model and dependent concentration of ions, alkalinity, organic carbon, pH and temperature in water column. Please see Oregon Table 30 Aquatic Life Water Quality Criteria for Toxic Pollutants for procedures.

[8] Pentachlorophenol criteria is pH dependent. Please see Oregon Table 30 Aquatic Life Water Quality Criteria for Toxic Pollutants for procedures. 6.7ug/l corresponds to a pH of 7.0. https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[9] Treatment technique action level

[10] National Secondary Drinking Water Regulation

ACLs = Alternate Concentration Limits
AWQCs = Ambient Water Quality Criteria
NRWQCs = National Recommended Water Quality Criteria
PAH = Polynuclear Aromatic Hydrocarbon
MCLs = Maximum Contaminant Levels

L = Low Molecular Weight PAH (LPAH)
H = High Molecular Weight PAH (HPAH)
C = Carcinogenic PAH (cPAH)
mg/L = milligrams per liter
µg/L = micrograms per liter

Table 1-3
Passive Sampling Sample Identification and Analytical Program
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	**Sampling Interval**	**Sample Media**	**Sample ID**	**Analytes [1]**				
				EPA 8270		**EPA 200.8**		
				PAHs	**PCP**	**As**	**Cr**	**Cu**
Compliance Sampling Locations								
A	Surface Water	SPME	MBSWSPME1020-A	X	X	--	--	--
		DM	MBSWDM1020-A	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-A	X	X	--	--	--
		DM	MBIADM1020-A	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
B	Surface Water	SPME	MBSWSPME1020-B	X	X	--	--	--
		DM	MBSWDM1020-B	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-B	X	X	--	--	--
		DM	MBIADM1020-B	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-B	X	X	--	--	--
		DM	MBSASDM1020-B	--	--	X	X	X
C	Surface Water	SPME	MBSWSPME1020-C	X	X	--	--	--
			MBSWSPME1020-C-Dup	X	X	--	--	--
		DM	MBSWDM1020-C	--	--	X	X	X
			MBSWDM1020-C-Dup	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-C	X	X	--	--	--
			MBIASPME1020-C-Dup	X	X	--	--	--
		DM	MBIADM1020-C	--	--	X	X	X
			MBIADM1020-C-Dup	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-C	X	X	--	--	--
			MBSASPME1020-C-Dup	X	X	--	--	--
		DM	MBSASDM1020-C	--	--	X	X	X
			MBSASDM1020-C-Dup	--	--	X	X	X
D	Surface Water	SPME	MBSWSPME1020-D	X	X	--	--	--
		DM	MBSWDM1020-D	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-D	X	X	--	--	--
		DM	MBIADM1020-D	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
E	Surface Water	SPME	MBSWSPME1020-E	X	X	--	--	--
		DM	MBSWDM1020-E	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-E	X	X	--	--	--
		DM	MBIADM1020-E	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
F	Surface Water	SPME	MBSWSPME1020-F	X	X	--	--	--
		DM	MBSWDM1020-F	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-F	X	X	--	--	--
		DM	MBIADM1020-F	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X

Table 1-3
Passive Sampling Sample Identification and Analytical Program
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	Sampling Interval	Sample Media	Sample ID	Analytes [1]				
				EPA 8270		EPA 200.8		
				PAHs	PCP	As	Cr	Cu
G	Surface Water	SPME	MBSWSPME1020-G	X	X	--	--	--
		DM	MBSWDM1020-G	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-G	X	X	--	--	--
		DM	MBIADM1020-G	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
H	Surface Water	SPME	MBSWSPME1020-H	X	X	--	--	--
		DM	MBSWDM1020-H	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-H	X	X	--	--	--
		DM	MBIADM1020-H	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
I	Surface Water	SPME	MBSWSPME1020-I	X	X	--	--	--
		DM	MBSWDM1020-I	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-I	X	X	--	--	--
		DM	MBIADM1020-I	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
J	Surface Water	SPME	MBSWSPME1020-J	X	X	--	--	--
		DM	MBSWDM1020-J	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-J	X	X	--	--	--
		DM	MBIADM1020-J	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
K	Surface Water	SPME	MBSWSPME1020-K	X	X	--	--	--
		DM	MBSWDM1020-K	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-K	X	X	--	--	--
		DM	MBIADM1020-K	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
L	Surface Water	SPME	MBSWSPME1020-L	X	X	--	--	--
		DM	MBSWDM1020-L	--	--	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-L	X	X	--	--	--
		DM	MBIADM1020-L	--	--	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	X	X	--	--	--
		DM	MBSASDM1020-A	--	--	X	X	X
Early Warning Sampling Locations								
5	Surface Water	SPME	MBSWSPME1020-5	X	X	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-5	X	X	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-5	X	X	--	--	--
12	Surface Water	SPME	MBSWSPME1020-12	X	X	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-12	X	X	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-12	X	X	--	--	--
13	Surface Water	SPME	MBSWSPME1020-13	X	X	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-13	X	X	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-13	X	X	--	--	--
16	Surface Water	SPME	MBSWSPME1020-16	X	X	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-16	X	X	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-16	X	X	--	--	--

Table 1-3
Passive Sampling Sample Identification and Analytical Program
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	**Sampling Interval**	**Sample Media**	**Sample ID**	**Analytes [1]**				
				EPA 8270		**EPA 200.8**		
				PAHs	**PCP**	**As**	**Cr**	**Cu**
Background Sampling Locations								
1 (Upstream)	Surface Water	SPME	MBSWSPME1020-1	X	X	--	--	--
		DM	MBSWDM1020-1	--	--	X	X	X
27 (Downstream)	Surface Water	SPME	MBSWSPME1020-27	X	X	--	--	--
		DM	MBSWDM1020-27	--	--	X	X	X
QA/QC Samples								
Field Blank		SPME	MBSPME1020-FB1	X	X	--	--	--
Field Blank		DM	MBDM1020-FB1	--	--	X	X	X
Field Blank		SPME	MBSPME1020-FB2	X	X	--	--	--
Field Blank		DM	MBDM1020-FB2	--	--	X	X	X
Field Blank		SPME	MBSPME1020-FB3	X	X	--	--	--
Field Blank		DM	MBDM1020-FB3	--	--	X	X	X
Trip Blank		SPME	MBSPME1020-TB1	X	X	--	--	--
Trip Blank		DM	MBDM1020-TB1	--	--	X	X	X
Trip Blank		SPME	MBSPME1020-TB2	X	X	--	--	--
Trip Blank		DM	MBDM1020-TB2	--	--	X	X	X
Trip Blank		SPME	MBSPME1020-TB3	X	X	--	--	--
Trip Blank		DM	MBDM1020-TB3	--	--	X	X	X
			Total Count	**60**	**60**	**47**	**47**	**47**

Notes:

[1] Analytes include the following polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

Italics = Duplicate samples

DM= Diffusive membrane

QA/QC = Quality Assurance/Quality Control

SPME = Solid Phase Micro Extraction

Table 1-4
Partitioning Coefficients and Method Detection Limits for PAHs
McCormick & Baxter Creosoting Company
Portland, Oregon

Compound	log Kow	log Kf	MDL (ng/L)^1
Naphthalene	3.37	2.94	5.42
Fluorene	4.18	3.62	1.13
Acenaphthene	3.92	3.41	1.87
Phenanthrene	4.57	3.95	0.53
Anthracene	4.54	3.93	0.56
Fluoranthene	5.22	4.5	0.15
Pyrene	5.18	4.46	0.16
Chrysene	5.91	5.08	0.04
Benz[a]anthracene	5.86	5.03	0.044
Benzo[b]fluoranthene	5.8	4.98	0.05
Benzo[k]fluoranthene	6	5.15	0.034
Benzo[a]pyrene	6.04	5.18	0.031
Dibenz[a,h]anthracene	6.75	5.78	0.008
Benzo[ghi]perylene	6.5	5.57	0.013
+Indeno[1,2,3-cd]pyrene	6.5	5.57	0.013
Pentachlorophenol	5.12	4.83	0.07

Notes:

MDL = Method detection limit

1: The MDLs presented in this table are for EPA method 8270.

Table 1-5
Method Detection Limits for Metals
McCormick & Baxter Creosoting Company
Portland, Oregon

Target Compound	MDL (ng/L)[1]
Arsenic (As)	100
Chromium (Cr)	80
Copper (Cu)	10
Zinc (Zn)	200

Notes:

MDL = Method detection limit

1: The MDLs presented in this table are for EPA method 200.8.

Table 2-1
Crayfish Tissue Comparison Criteria
McCormick & Baxter Creosoting Company
Portland, Oregon

Analyte	**General Acceptable Tissue Level** [1]	**Acceptable Subsistence Tissue Level**[2]	**Portland Harbor Table 17**	**SEF**[3]
Metals (mg/kg)*				
Arsenic	0.0062	0.00076	0.001	2.7
Chromium III	--	--	--	--
Copper	--	--	--	--
Zinc	--	--	--	--
Polyaromatic Hydrocarbons (mg/kg)*				
Pentachlorophenol	0.078	0.0096	0.0025	0.001
Acenaphthene	--	--	--	--
Fluoranthene	160	20	--	19
Naphthalene	--	--	--	--
Total PAHs	--	--	--	--
cPAH(BaP)eq**	--	--	0.0516	--
Dioxin/Furans (mg/kg)*				
2,3,7,8-TCDD	6.20E-08	7.6E-09	8.0E-09	--
1,2,3,7,8-PeCDD	6.20E-08	7.6E-09	8.0E-09	--
1,2,3,4,7,8-HxCDD	6.20E-07	7.6E-08	--	--
1,2,3,6,7,8-HxCDD	6.20E-07	7.6E-08	--	--
1,2,3,7,8,9-HxCDD	6.20E-07	7.6E-08	--	--
1,2,3,4,6,7,8-HpCDD	6.20E-06	7.6E-07	--	--
OCDD	2.10E-04	2.5E-05	--	--
2,3,7,8-TCDF (bird egg)	6.20E-07	7.6E-08	8.0E-08	--
1,2,3,7,8-PeCDF	2.10E-06	2.5E-07	--	--
2,3,4,7,8-PeCDF	2.10E-07	2.5E-08	3.0E-08	--
1,2,3,4,7,8-HxCDF	6.20E-07	7.6E-08	8.0E-08	--
1,2,3,6,7,8-HxCDF	6.20E-07	7.6E-08	--	--
2,3,4,6,7,8-HxCDF	6.20E-07	7.6E-08	--	--
1,2,3,7,8,9-HxCDF	6.20E-07	7.6E-08	--	--
1,2,3,4,6,7,8-HpCDF	6.20E-06	7.6E-07	--	--
1,2,3,4,7,8,9-HpCDF	6.20E-06	7.6E-07	--	--
OCDF	2.10E-04	2.5E-05	--	--
TCDD, 2,3,7,8-, TEQ	6.2E-08	7.6E-09	--	5.0E-07

Notes:

*wet weight

** Portland Harbor remediation goal.

1: Human Carcinogen values for general/recreation consumption; Table A-3 DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment 2007; updated 2017

2: Human Carcinogen values for subsistence/tribal consumption; Table A-3 DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment 2007; updated 2017

3: USACE: Sediment Evaluation Framework 2018. Tables 8-5 and 8-6.
https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/2548

Table 2-2
Crayfish Sampling Locations
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	Sample Location							
	Sample Coordinates (NAD83) [1]				Sample Elevation [2] (ft NAVD88)	Anticipated Water Depth [3] (ft NAVD88)	Location with ACB	Collocated Compliance Sampling Location
	Northing	Easting	Latitude	Longitude				
Crayfish (CF) Sampling Locations								
01	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	A
02	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	C
03	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	D
04	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	E
05	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	F

Notes:

[1] Northing and easting coordinates exist in the following coordinate system: North American Datum of 1983 (NAD83), Oregon State Plane North Zone, International Feet.

[2] Elevations exist in the following coordinate system: North American Vertical Datum of 1988 (NAVD88) in units of feet.

[3] Assumes the Willamette River stage is at an elevation of 7.0 feet NAVD88. Note that sample locations with a negative value are anticipated to be out of water at the time of sampling. The locations will be adjusted to the waters edge when deployed to ensure that the samplers remain submerged

[4] Analytes include the following dioxin/furan (D/Fs) congeners; polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene,

*Deployment methodology will depend upon river stage at the time of sampling.

ACB: Articulated concrete block

D/Fs: Dioxin/Furan congeners

PAHs: Polyaromatic hydrocarbons

Table 2-3
Crayfish Sample Identification and Analytical Program
McCormick & Baxter Creosoting Company
Portland, Oregon

Sampling Location ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [1,2]							
				EPA 1613	EPA 8270		EPA 6020				EPA 8290
				D/Fs	PAHs	PCP	As	Cr	Cu	Zn	Lipid Content
Crayfish Sampling Locations											
01	Crayfish	Whole Tissue	MBCFGB1020-01	X	X	X	X	X	X	X	X
02	Crayfish	Whole Tissue	MBCFGB1020-02	X	X	X	X	X	X	X	X
03	Crayfish	Whole Tissue	MBCFGB1020-03	X	X	X	X	X	X	X	X
			MBCFGB1020-03-Dup	X	X	X	X	X	X	X	X
04	Crayfish	Whole Tissue	MBCFGB1020-04	X	X	X	X	X	X	X	X
05	Crayfish	Whole Tissue	MBCFGB1020-05	X	X	X	X	X	X	X	X
QA/QC Samples											
Crayfish Bait		--	MBCFGB-20-Bait	X	X	X	X	X	X	X	X

Notes:

[1] Analytes include the following: The 17 2,3,7,8-chlorinated dioxin/furan congeners (D/Fs) used to calculate toxic equivalence (TEQ); The 16 standard polyaromatic hydrocarbons (PAHs) that include acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and four target metals arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

[2] Crayfish samples will be processed as whole tissue samples and analyzed for lipid content in addition to the chemical analyses.

Italics = Duplicate samples

QA/QC = Quality Assurance/Quality Control

Table 2-4
Crayfish Method Detection and Reporting Limits
McCormick & Baxter Creosoting Company
Portland, Oregon

Analyte	Method	Method Detection Limit [1]	Method Reporting Limit
Conventional			
Lipids (%)	1613B	--	--
Metals (mg/kg)			
Arsenic	6020A	0.004	0.1
Chromium		0.004	0.02
Copper		0.012	0.1
Zinc		0.004	0.04
Polyaromatic Hydrocarbons (mg/kg)			
Acenaphthene	8270D	0.000102	0.001
Fluoranthene		0.000064	0.001
Naphthalene		0.000046	0.001
Pentachlorophenol		0.00152	0.02
Total PAHs		0.000024	0.001
cPAH(BaP)eq		0.000072	0.001
Dioxin/Furans (mg/kg)			
2,3,7,8-TCDD	1613B	1.8E-08	--
1,2,3,7,8-PeCDD		4.5E-08	--
1,2,3,4,7,8-HxCDD		4.8E-08	--
1,2,3,6,7,8-HxCDD		3.8E-08	--
1,2,3,7,8,9-HxCDD		5.2E-08	--
1,2,3,4,6,7,8-HpCDD		2.8E-08	--
OCDD		7.2E-08	--
2,3,7,8-TCDF (bird egg)		1.6E-08	--
1,2,3,7,8-PeCDF		3.2E-08	--
2,3,4,7,8-PeCDF		3.1E-08	--
1,2,3,4,7,8-HxCDF		2.4E-08	--
1,2,3,6,7,8-HxCDF		3.1E-08	--
2,3,4,6,7,8-HxCDF		3.0E-08	--
1,2,3,7,8,9-HxCDF		3.1E-08	--
1,2,3,4,6,7,8-HpCDF		5.9E-08	--
1,2,3,4,7,8,9-HpCDF		5.1E-08	--
OCDF		6.4E-08	--
TCDD, 2,3,7,8-, TEQ		7.0E-08	--

Notes:

1: Detection limits for Dioxin/Furan compounds are estimated.

Figures

FIGURE 1-1

Proposed 2020 O&M Sampling Locations

McCormick and Baxter Superfund Site
Portland, Oregon

LEGEND

Proposed O&M Sampling Locations

- ● Compliance Monitoring Sample
- • Alternative Compliance Monitoring Sample
- 🟧 Crayfish Sample
- ◇ Early Warning Sample
- ✚ Background Sample
- ☐ Compliance Monitoring Area

All Other Features

- ▲ MW-37; DGPS Reference Location
- • Boulder Cluster
- ~ Anticipated Willamette River Level (7.0 feet NAVD88)
- ☐ Sediment Cap Boundary
- 🟨 Organoclay Mats (Single)
- 🟩 Organoclay Mats (Double)
- 🟩 Organoclay Granular
- ▨ Articulated Concrete Block (ACB)
- ▦ Hot Spot Treatment (thickened sand layer)
- 🟥 Subsurface Barrier Wall

NOTES

1. Aerial photo taken Summer 2018.
2. The surface water sample at the early warning station will serve as the compliance monitoring point for monitoring area F while the inter-armoring and sub-armoring samples will serve as early warning samples.

Date: July 1, 2020
Data Sources: COP aerial photo

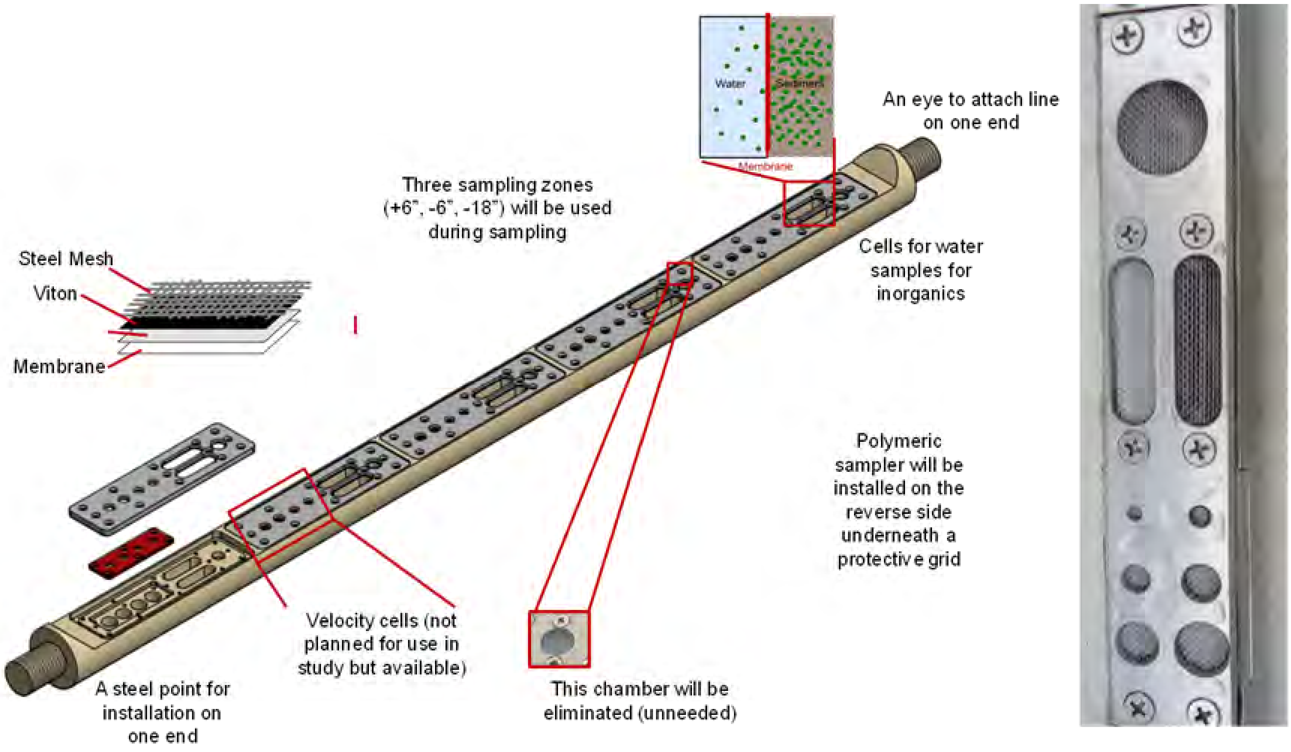
N

0 125 250 375
Feet

HARTCROWSER

GSI Water Solutions, Inc.

Document Path: Y:\0205_OR_DEQ\Source_Figures\028_MB_OM_2018\003_Annual_OM_Report\SAP\Figure1-1_Proposed_OM_Sampling_Locations_elevation_2020.mxd



NOTE
Actual design of proposed sampler showing locations of sampling cells, velocity cells and back of sampler where passive samplers will be placed

SOURCE
Dr. Danny Reibel,Texas Tech University

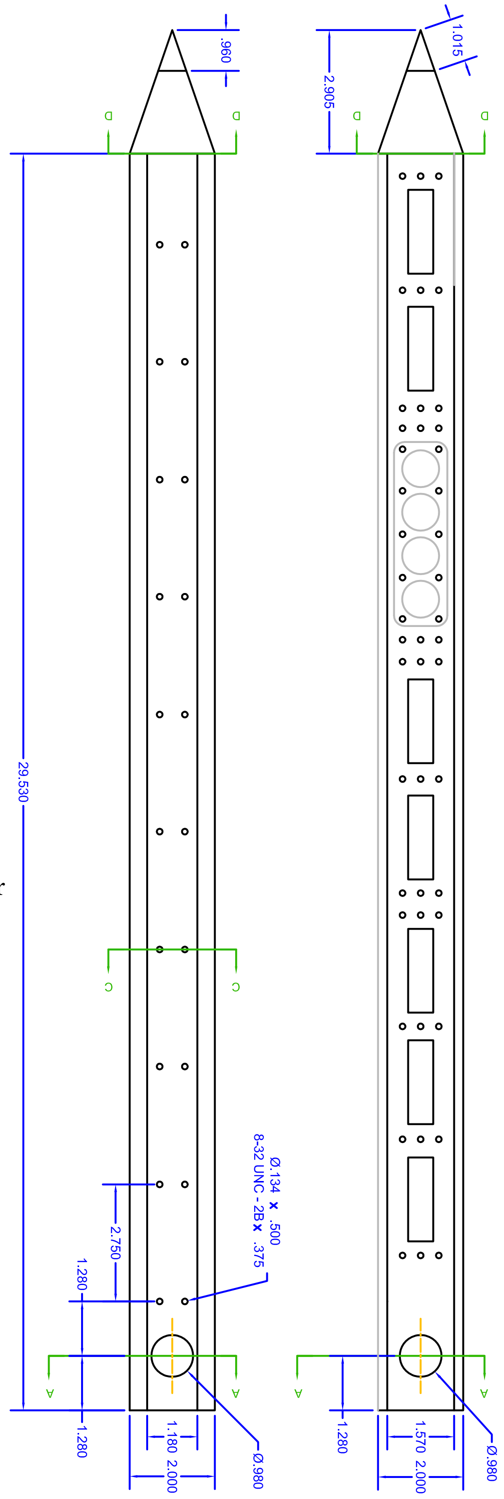
FIGURE 1-2a

Conceptual Passive Sampling Device

McCormick & Baxter 2020
Operations and Maintenance Manual

Into Sediment

PDMS fibers to be
placed under mesh
on back of sampler



Cell for sample 18
inches below mudline

Cells from which
upwelling velocity can
be inferred if desired

Cell for sample 6
inches below mudline

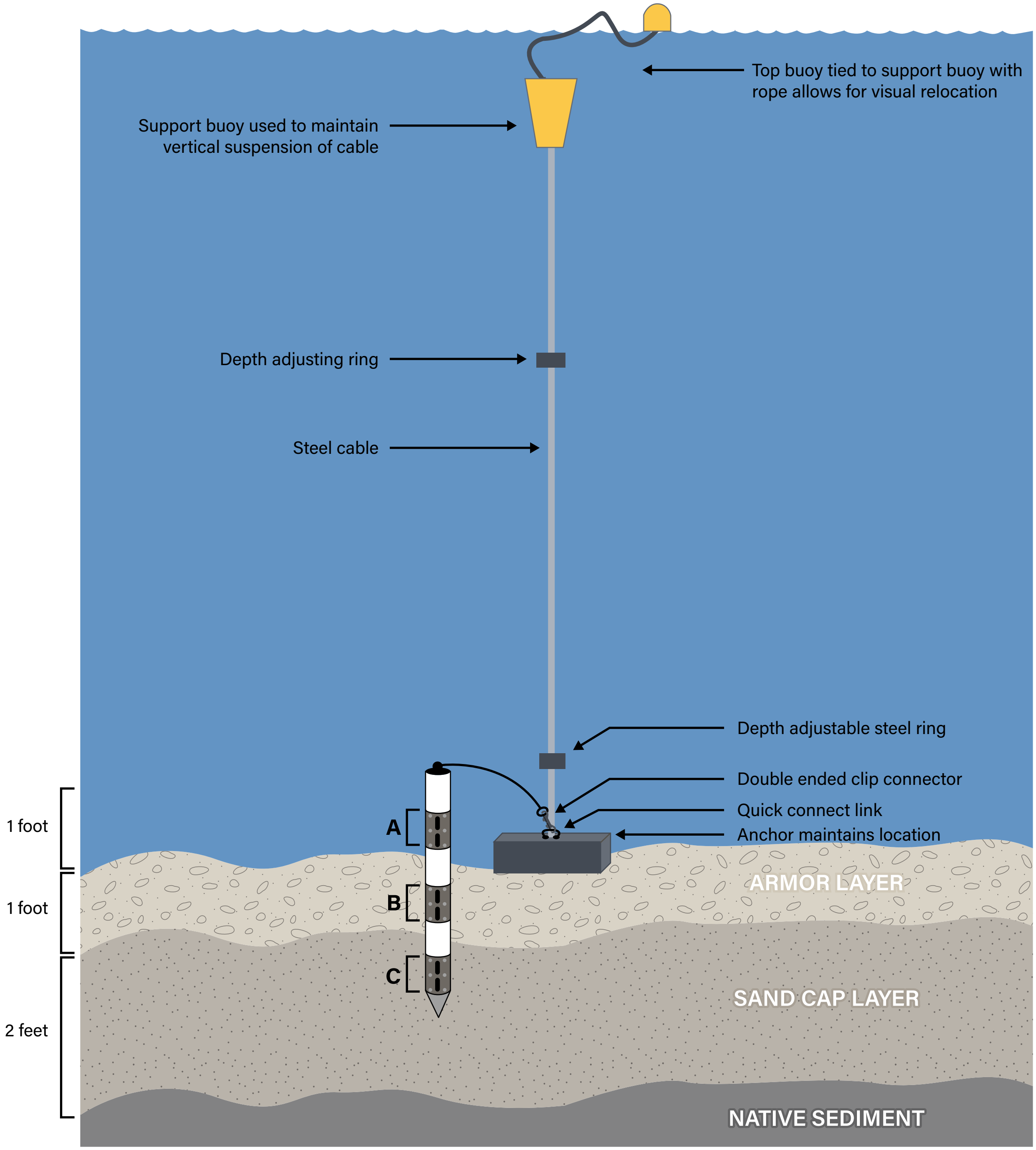
Cell for sample 6
inches above mudline

SOURCE
Dr. Danny Reibel,Texas Tech University

FIGURE 1-2b

Passive Sampling Device Design Plan

McCormick & Baxter 2020
Operations and Maintenance Manual



The Passive Sampling Device (PSD) anchoring system includes a top buoy attached by rope to a support buoy. The support buoy is attached to an adjustable steel cable fixed to an anchor which will rest on the riverbed immediately adjacent to the sampling location. Attached to the anchor will be a tether for connecting the PSD to the anchoring system once it is installed.

A. Surface Water Sample Depth: 12” above mudline
B. Armoring Layer Sample Depth: 6” below mudline (bml)
C. Early Warning Sediment Cap Sample Depth: 18” bml (within the sand cap)

NOT TO SCALE

FIGURE 1-3

Passive Sampling Device Anchoring System

McCormick & Baxter 2020
Operations and Maintenance Manual

GSI Water Solutions, Inc.

Appendix A

Standard Operating Procedure for the Use, Extraction, and Analysis of Solid Phase Microextraction Polydimethylsiloxane Fibers used as a Passive Sampling Technique in Sediment and Surface Waters

1. SCOPE AND APPLICATION

1.1. This method is an operating procedure for measurement of sediment pore water concentrations with solid phase microextraction (SPME) using polydimethylsiloxane (PDMS) as the polymer sorbent.

1.2. The method is applicable to hydrophobic organic contaminants (HOCs) and the focus herein is on polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

1.3. This procedure generates extracts suitable for High Performance Liquid Chromatography (HPLC) and GC-MS analysis for priority and alkyl PAHs (PAH-38) and GC-MS/MS and GC-ECD for PCBs.

1.4. This extraction procedure is applicable to lab or field exposed PDMS fibers.

2. SUMMARY OF METHOD

2.1. The method can be applied *in situ* (field) or *ex-situ* (laboratory) but both approaches entail exposing PDMS fibers to the sediments by direct insertion into the sediment for a period of time followed by extraction and chemical analysis.

2.2. A specific length of PDMS is cleaned by consecutive extraction with dichloromethane, hexane, methanol and ultrapure water.

2.3. Performance reference compounds (PRCs) are loaded onto cleaned PDMS fiber in water-methanol (80:20%) solution.

2.4. A shaker table is required to facilitate well-mixing of the PRC spiking solution and contact with the PDMS fibers.

2.5. The PDMS fibers are kept in the PRC solution until preparation for deployment.

2.6. PDMS fibers are inserted to the sediment or water column and exposed for 21-28 days.

2.7. Upon retrieval from a field location or from laboratory sediment, any adhering material is removed from the PDMS fiber with a lint-free damp tissue before segmentation into appropriate lengths along the PDMS fiber to acquire a concentration depth profile into the sediment or in the water column. The PDMS fibers are extracted with an appropriate solvent (i.e. acetonitrile or hexane) overnight. The PDMS fibers are removed from the extract before analysis via HPLC or GC methods.

3. INTERFERENCES

3.1. In general, the use of PDMS as an extracting phase limits the amount of extraneous compounds from the sample and provides a phase that is easily extracted. This limits the amount of sample cleanup necessary as well as the need for surrogates to test extraction efficiency. However, both may be necessary under some conditions.

3.2. PDMS fibers can become contaminated from the atmosphere and surfaces, and therefore techniques to limit the amount of undesired exposure must be followed.

3.3. Biofilms, adhering sediment, or chemical residues like NAPL residues can be removed by wiping the PDMS fiber with a MiliQ water wetted Kimwipe®

3.4. Method detection limits are related to compound hydrophobicity and therefore the method must be used with caution when analyzing relatively volatile constituents which exhibit greater losses and relatively poor detection limits.

3.5. Sediments that are contaminated with oil or other nonaqueous phase liquid (NAPL) will greatly complicate the interpretation of the results. The NAPL can absorb directly onto the PDMS and will also affect the partitioning into water. Use of the technique in NAPL-contaminated sediments should not be expected to provide quantitation on mobile contaminants

4. APPARATUS AND MATERIALS

4.1. Washing, PRC loading and storage vessel (250 mL, amber/clear glass depending on the analytes of interest) with foil-lined cap. Larger Volumes can be used depending on application.

4.2. Solid phase micro-extraction polydimethylsiloxane fibers – commercially available through suppliers like Polymicro Technologies™ (Molex, Phoenix) and Fiberguide (New Jersey).

4.3. Sampling device/fiber holder –

4.3.1. For *ex situ* use: a septa or mesh bag; Sampling device/fiber holder: a septa or mesh bag; Fibers require neither holder nor protective sheath if used in short lengths in laboratory samples or laboratory slurries although some form of holder (e.g. wire mesh envelope) is useful for locating and retrieving many fibers or smaller fiber sizes (< 500 µm). Their size (< 1 mm diameter) suggests that this can be accomplished with minimal disturbance to the surrounding sediment. Very small fibers may need to be inserted into a septum to aid location and withdrawal.

4.3.2. For *in situ* use: A sheath or holder is typically necessary to both protect the PDMS and to locate the sampler after sediment exposure. Two types of holders have been employed in our laboratory

4.3.2.1. Henry sampler (manufactured by M.H.E. Products) that has been modified. Modifications included 4 mm diameter perforations in the outer sheath, a 2 mm groove in the inner rod of the sampler, and the attachment of a washer that rests at the sediment–water interface during deployments. The groove length of the inner rod dictates the sampling length of the sampler (i.e. 60 or 90 cm). The outer sheath facilitates fiber-porewater contact while protecting the fiber. The inner rod secures the fiber from movement during deployment and retrieval.

        - 4.3.2.2. 30 cm T-bars without the outer sheath attached to a triangle frame (for triplicate measurements, spaced 1 foot apart) can be used for deployment in soft sediments. In this configuration, two 2 mm grooves in the T-rod can accommodate more PDMS for improvement of detection limits especially for monitoring sites after activated carbon addition.
- **4.4.** Extraction vessels – 2 mL amber (for PAHs) or clear glass (for PCBs) autosampler vials.
- **4.5.** 300 µL glass inserts with springs for ultra-low solvent volumes.
- **4.6.** PTFE/Silicone/PTFE screw caps for short-term storage and PTFE lined solid tops for long-term storage.
- **4.7.** Kimwipes®
- **4.8.** Food-grade aluminum foil
- **4.9.** Tweezers
- **4.10.** Single-edge razor
- **4.11.** Ceramic Cutter
- **4.12.** Syringe needle
- **4.13.** Glass tubes
- **4.14.** Shaker table or overhead tumbler

5. **REAGENTS**

- **5.1.** Sodium azide (NaN_3)
- **5.2.** Dichloromethane (methylene chloride, CH_2Cl_2)
- **5.3.** Hexane
- **5.4.** Acetonitrile
- **5.5.** Methanol
- **5.6.** MiliQ Water (Barnstead, GenPure Pro)
- **5.7.** Research grade deuterated or C^{13} labeled compounds as performance reference compounds (PRCs): d-Fluoranthene, d-Chrysene, d-Benzo(b)Fluoranthene, d-Dibenzo(ah)anthracene and C^{13} mix containing PCBs 28/52/101/153/138/180/209 (Ultra Scientific and Cambridge Isotope Laboratories).
- **5.8.** Research grade deuterated or C^{13} labeled compounds as surrogates or internal standards for GC-MS or GC-TQMS analysis: d-acenapthene, d-phenanthrene and d-perylene for PAHs (working standard concentration of 1000 µg/L in hexane) and C^{13} mix containing PCBs 9/118/188 (working standard concentration of 1000 µg/L in hexane).

Table 1. PRCs and internal standards used for spiking and analysis of PDMS.

Method 8270 and/or 8310		Method 1668	
PRCs	**Internal standard**	**PRC**	**Internal standard**
d-Fluoranthene	**d-acenapthene**	**28**	**9**
d-Chrysene	**d-phenanthrene**	**52**	**118**
d-Benzo(b)Fluoranthene	**d-perylene**	**101**	**188**
d-Dibenzo(ah)anthracene		**153**	
		138	
		180	
		209	

6. HANDLING AND PRESERVATION

6.1. All personnel should wear nitrile or powder-free gloves when handling the sampling devices and the PDMS fiber.

6.2. Clean PDMS should be stored in clean, sealed, glass vessels.

6.3. Solvent rinsed tweezers should be used when handling the PDMS.

6.4. The loaded PDMS fibers should be stored in the PRC solution until further use.

7. PROCEDURE

7.1. PDMS fiber is purchased from Polymicro Technologies™ on a spool with a nominal PDMS coating of 35 µm. Other thickness can be used depending on application. The fiber is cut into desired lengths, for example 5 cm, which can be easily inserted in small vials with sediment. The 5 cm lengths can be easily cut into smaller segments (i.e. 2+2+1 cm) for extraction and processing and may also provide replication and/or contingency in situations when 2 cm lengths are used for analysis and data interpretation. Details on the quantity of fiber per sampling exercise are provided in Appendix 1.

7.2. PDMS washing

7.2.1. The cut PDMS fibers are placed in the 250 ml glass vessel and cleaned by washing consecutively with three solvents i.e. dichloromethane (2x), hexane (2x) and methanol (2x) for 30 minutes each on a shaking table. Care should be taken to avoid PDMS breakage during washing with solvents. Therefore, gentle shaking is recommended or unobstructed movement of the PDMS in the washing vessel. After the methanol solvent wash, the fibers are rinsed with MiliQwater at least three times. The rinsed PDMS fibers are then blotted dry with lint-free tissues.

7.2.2. A portion of the cleaned fibers should be checked for residual contamination by pipetting 1 mL of clean hexane or equivalent solvent down the fiber length, collecting the solvent at the bottom of the PDMS fiber, and analytically checking for contamination. The cleaning process is repeated until any analytes of concern are not detected in the test solvent.

7.2.3. The loaded PDMS fibers should be stored in the PRC solution until further use.

7.3. Loading of PDMS with performance reference compounds:

7.3.1. PRCs should be chosen to assess kinetic dissipation/uptake rates during field deployments. PRCs are loaded onto the PDMS before deployment.

7.3.2. 200 mL of spiking solution (water and 20% methanol) is placed in the glass vessel with cleaned PDMS. Deuterated/C^{13} labeled versions of the analytes of interest (**Table 1)** at working concentration of 2500 ng/ml in methanol or acetone are added to the water-20% methanol solution. Higher concentrations of working standards are available for d-PAHs. The levels of PRCs on PDMS should be similar to the target analytes and can be predetermined by using PDMS-water partition. The total volume of water-methanol solution should result in minimum headspace and ensure effective mixing and transfer of PRCs to PDMS. To avoid losses via volatilization during mixing, the outer side of the caps should be covered with parafilm. Note, after exposure of the loaded PDMS with sediment or overlying water, part of the PRCs will leave the fiber resulting in lower concentrations for analysis. Therefore, one may design the loading calculation in such way that the initial concentration of PRCs in the extract and thus fiber is a factor of 2-3 higher to meet the requirements for detection after PRCs exposure.

7.3.3. The spiking solution with PDMS is agitated (approximately 130 strokes per minute) using a shaker table for a minimum of 8 days with deuterated PAHs and a minimum of three weeks with C^{13} labeled PCBs before using the PRC loaded PDMS. Longer equilibration times may be required for thicker samplers.

7.3.4. The loaded PDMS fibers should be stored in the PRC solution until further use.

7.3.5. PRC loaded PDMS fibers should be used for exposure into sediments and a subset of the simultaneously prepared fibers should be analyzed for initial PRC concentrations in the fibers. At least 6 PRC loaded PDMS fibers should be analyzed for initial PRC concentrations.

7.4. All sampling devices are disassembled and washed with detergent and hot water. Following being washed with detergent and hot water, the sampling devices are sequentially soaked in dichloromethane, hexane, methanol or equivalent solvent based upon analytes of interest, and MiliQ water for at least an hour each. The sampling devices are then dried under the fume hood on clean tissues overnight.

7.4.1. After the process is complete, 3 mL of clean hexane or equivalent solvent is introduced to the inner rod of the sampling device, collected at the bottom of the sampler, and analytically checked for contamination. The cleaning process is repeated until any analytes of concern are not detected in the test solvent.

7.5. Deployment of PDMS in sediment samples

7.5.1. All personnel should wear nitrile or powder-free gloves when handling the sampling devices and the PDMS fiber.

7.5.2. Solvent rinsed tweezers should be used when handling the PDMS.

7.5.3. For *ex situ* deployment: Prior to exposure *ex situ*, all sediment samples (in jars) should be homogenized for 12 hours on a roller-bank. Approximately 22-25 g of wet sediment samples from each sampled location (in triplicate) are weighed into 20 mL amber or clear vials (depending on compounds of interest). The sediment samples should be fully saturated with native water or not exceed 50% dry weight sediment. In case sediment does not appear saturated, a subsample of sediment from original jar should be transferred into a secondary container followed by addition of MiliQ water to ensure saturation and homogenized for 1 hour or a roller-bank.

7.5.4. Sediment samples in 20 mL vials are dosed with sodium azide (NaN_3) to prevent biological activity and homogenized gently with a stainless steel spatula. The addition of NaN_3 should yield a concentration of 100 mg/L in the 20 mL vial.

7.5.5. The loaded PDMS fibers are withdrawn from the PRC solution using clean tweezers, rinsed with MiliQ water and blotted on Kimwipes® to remove any residual methanol.

7.5.6. The loaded PDMS fibers are then inserted into a septa/envelope or placed directly in the 20 ml vials with sediment. Vertical placement is recommended. The vials with sediment and PDMS are closed with an aluminum lined cap and allowed to equilibrate for 21-28 days with gentle shaking on a shaking table at 20ºC.

7.5.7. For *in situ* deployment: the cleaned PDMS fibers are laid into the groove of the sampling device's inner rod and attached with 1 cm or less of waterproof caulk (hydrocarbon free silicon) at both ends of the groove. Care should be taken to avoid any placement of silicon on the active measurement portion of the sampling device or placement of too much silicon so that the cured silicon will hinder insertion or removal of the sampling device's inner rod from its outer sheath. Once the caulk is cured, the sampling device's inner rod is inserted into the outer sheath. The handles of the inner rod and outer sheath are then wrapped together to maintain orientation of the fiber to the screened section of the outer sheath. The sampling devices with PDMS are wrapped in foil and covered with ice for transport.

7.5.8. For *in situ* deployment: before sampling device insertion, buoys are attached via nylon cord to the sampling device to serve as markers for retrieval.

7.5.9. For *in situ* deployment: The sampling devices should be labelled with a waterproof marker on the tape wrapped around the inner rod and outer sheath handles or with an equivalent label that will not be disturbed during deployment.

7.6. Retrieval

7.6.1. All surfaces that the PDMS fiber will come into contact with must be covered with clean food grade aluminum foil.

7.6.2. Hexane or equivalent (other solvents can be selected based upon analytes of interest) rinsed tweezers and ceramic column cutters are used for segmentation of the PDMS fiber.

7.6.3. All laboratory and field personnel must wear nitrile or powder-free gloves when handling the PDMS fiber holder and the PDMS fiber. It is recommended to have two people in the field, one to handle the removal of the PDMS fiber from the holder and cleaning of the PDMS fiber and the other to handle segmentation and extraction. If only one person is available for completing retrieval activities, than the nitrile or latex gloves must be exchanged between the removal/cleaning step and the segmentation/extraction step.

7.6.4. Upon retrieval, the PDMS fiber should be removed from the fiber holder and any biofilms, adhering sediment/particles, or chemical residues should be wiped from its surface using a DI water wetted Kimwipe®. After cleaning, the fiber should be blotted dry prior to segmentation and extraction.

7.6.5. Segmentation of the PDMS fiber should be done as efficiently as possible to minimize volatilization of more volatile analytes of concern.

8. PROCEDURE

8.1. *Ex situ* Retrieval

8.1.1. After 28 d the vials are removed from the shaker table and the PDMS fiber is carefully withdrawn from the sediment. Any adhering sediment, particles, biofilm, or residue is removed from the PDMS fiber using a MiliQ water wetted Kimwipe®. PDMS fibers are then blotted dry before segmentation.

8.1.2. PDMS fibers are segmented using a ceramic column cutter into smaller lengths, for example a 5 cm segment can be cut into 2+2+1 cm lengths.

8.2. Extraction: the 2+2+1 cm fiber segments are then transferred to 2 mL amber vials with glass inserts prefilled with 250 µL of the appropriate solvent depending upon the subsequent analysis. The solvent volume in the insert should be enough for the complete immersion of the PDMS fiber segment. Extraction can also be into a greater volume (e.g. amber vial without insert) if needed, for subsequent processing. The sample can also be reduced in volume by solvent evaporation to concentrate the sample for improvement of detection.

8.2.1. Examples of solvent extract volumes: 250 µL for 5-cm segments of PDMS fiber with a PDMS thickness of greater than or equal to 30 µm and 100 µL for 8 1-cm segments of PDMS fiber with a PDMS thickness of 10 µm

8.2.2. The PDMS fiber segments are left in the solvent overnight and stored at -17°C.

8.2.3. Following overnight extraction vials with inserts containing SPME segments and solvent are sonicated for 1 min.

8.2.4. A portion of the extract should be transferred to a new vial with insert and internal standard (IS) should be added at target concentration before analysis.

8.2.5. Priority pollutant PAHs can be analyzed by EPA Method 8310 or 8270 and PCB congeners by EPA Method 8082/8270 or modified Method 1668.

8.3. *In-situ* retrieval: After removal from the field for in-situ deployments, the sampling device's inner rod is separated from the outer sheath. The PDMS fiber is carefully removed from the inner rod using a single edge razor and any adhering sediment, particles, biofilm, or residue is removed from the PDMS fiber using a MiliQ water wetted Kimwipe®. PDMS fibers are then blotted dry before segmentation. PDMS fibers are segmented using a ceramic column cutter into predetermined lengths at predetermined locations along the PDMS fiber, which correspond to specific depths of interest from the sediment-water interface.

8.4. The SPME PDMS fiber segments are left in the solvent overnight and stored at -17°C. During transportation from a field site, the samples are kept at 4°C until receipt at the laboratory.

8.5. Following overnight extraction vials with inserts containing PDMS segments and solvent are sonicated or vortexed for 1 min (depending on the amount of PDMS in vial or insert).

8.6. If the extracts will be analyzed by another laboratory, the vials will be shipped while maintained at 4°C. The volume of the vials and PRC compounds can be tailored to meet requirements of the receiving laboratory for the analyses planned.

8.7. Priority pollutant PAHs can be analyzed by EPA Method 8310 or 8270 and PCB congeners by EPA Method 8082/8270 or modified Method 1668. Although, these standard methods are more frequently used by research and commercial labs, any method appropriate for the contaminants of concern capable of analyzing a concentrated sample of extract can also be successfully employed.

9. QUALITY CONTROL & METHOD PERFORMANCE

9.1. PRC loading before deployment i.e. @ t=0: 6 samples of loaded PDMS must be collected from different parts of the PDMS fiber, extracted, and analyzed prior to field deployment.

9.2. Blanks

9.2.1. Deployment Blank: For *in situ* deployments, a deployment blank is a sampler that is shipped together with the other samplers to the field, but is shipped back without deployment and processed in the laboratory in the exact same fashion as samplers deployed in the field.

9.2.2. Solvent Blanks: Solvent blanks will be analyzed at the time of filling the vials for shipment i.e. one at the start of filling at one at the end where the same solvent source has been used. If these contain significant levels of contamination, new vials will be filled with a separate source and the process will be repeated. Additional solvent blanks should be shipped with the samples at a frequency of one per 20 samples.

9.2.3. Field Control Samples: For in situ deployments, field control samples are used to track the solvent volume change or contamination during transition if on site processing samplers are needed. The field control samples can be calibration standards or other solutions with known concentrations. The field control samples are treated identically with the other samples. At least five field control samples are needed for each deployment. The average of the concentration change for all compounds and in all field control samples should be within 5% to avoid solvent volume adjustment.

9.3. Chemical Analysis: The QAQC samples for chemical analysis include initial calibration, second source standard checks, and continuous calibration verification checks; all should meet the acceptance criterion set in the analytical methods. A complete set of appropriate guidelines can be found in Table 2.

Table 2. Quality Guidelines for Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (EPA 8310) from DOD QSM Version 4.1.

QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Demonstrate acceptable analyst capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method	QC acceptance criteria published by DoD, if available; otherwise method-specific criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria	NA	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix A. No analysis shall be allowed by analyst until successful demonstration of capability is complete
MDL study	At initial set-up and subsequently once per 12-month period; otherwise quarterly	See 40 CFR 136B. MDL verification checks must produce a signal at least 3 times the instrument's noise level.	Run MDL verification check at higher level and set MDL higher or re-conduct MDL study	NA	Samples cannot be analyzed without a valid MDL.

	MDL verification checks shall be performed				
Minimum five-point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	One of the options below: Option 1: RSD for each analyte ≤ 20%; Option 2: linear least squares regression: r ≥ 0.995; Option 3: non-linear regression: coefficient of determination (COD) r2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.	NA	Problem must be corrected. No samples may be run until ICAL has passed.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. All project analytes within ± 15% of expected value from the ICAL	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Retention time windows are updated per the method.
Second source calibration verification (ICV)	Once after each initial calibration	All project analytes within established retention time windows. Value of second source for all analytes within ± 15% of expected value (ICAL)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL	NA	Problem must be corrected. No samples may be run until calibration has been verified.
Evaluation of relative retention times (RRT)	With each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	NA	

Internal standards verification	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL EICP area within - 50% to + 100% of ICAL midpoint standard	Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS. Flagging criteria are not appropriate for failed standards.	Sample results are not acceptable without a valid IS verification.
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method blank	One per preparatory batch	No analytes detected > ½ RL. and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results	Correct problem, then, If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank.	Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Retention time window position establishment for each analyte	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	NA	
Results reported between MDL and MRL	NA	NA	NA	Apply J-flag to all results between MDL and MRL.	

9. DETERMINATION OF PORE WATER CONCENTRATIONS

The freely-dissolved pore water concentrations can be calculated from the accumulated uptake in the fiber and the fiber-water partition coefficients as shown in the following equation:

$$Cw = \frac{C_{PDMS}}{K_{PDMS-W}} = \frac{A*RSF*V_{solvent}}{L_{fiber}*V_{fiber}*K_{PDMS}*f_{ss}}$$

where:

A = Areas of chromatography peaks
RSF = response factor from calibration curve unique to each HOCs
$V_{solvent}$ = volume of solvent used to extract fiber
L_{fiber} = length of fiber sample
V_{fiber} = specific volume of fiber
K_{PDMS-W} = fiber-water partition coefficient unique to each HOCs
f_{ss}= fractional approach to steady state from PRCs

The fiber-water partition coefficient should correlate with the hydrophobicity of the compound and thus can be correlated with K_{ow} as shown in Ghosh et al. 2014. PRCs will be interpreted employing the methods of Lampert et al. (2015) to determine the fractional approach to steady state, f_{ss}. The fiber-water partition coefficients for dioxins can be extrapolated using the regression parameters for PCBs. Table 2 summarizes typical potential method detection limits by SPME-PDMS for selected PCBs. Expected detection limits for dioxins are provided in Table 3.

Table 3. Method Detection limits (as indicated in porewater) by SPME-PDMS for selected PCB congeners by GC-TQMS. This assumes 150 µL solvent volume and 5 cm of PDMS fiber with 558 µm outside diameter and 497 µm inside diameter.

PCBs	Log KOW[a]	Log Kpdms[b]	MDL pg/L[c]
PCB-18	5.24	4.94528	54.05
PCB-28	5.67	5.35249	21.16
PCB-52	5.84	5.51348	14.61
PCB-66	6.2	5.8544	6.66
PCB-101	6.38	6.02486	4.50
PCB-77	6.35	5.99645	4.80
PCB-118	6.74	6.36578	2.052
PCB-153	6.92	6.53624	1.386
PCB-138	6.83	6.45101	1.687
PCB-187	7.17	6.77299	0.804
PCB-180	7.36	6.95292	0.531
CB-170	7.27	6.86769	0.646
PCB-209	10.54	9.96438	0.001

[a] PCB log KOW values from Hawker and Connell (1988); PAH log KOW values were calculated using the SPARC program (http://archemcalc.com/sparc-web/calc).

[b] Kpdms from Ghosh et al (2014)

[c] MDL using 5 cm of 31 µm PDMS on a 497 µm core and an estimated MDL of 0.08 mg/nL in extract

Table 4. Method Detection limits (as indicated in porewater) by SPME-PDMS for selected dioxins. This assumes 150 µL solvent volume and 5 cm of PDMS fiber with 558 µm outside diameter and 497 µm inside diameter.

Compound	Log Kow (SPARC)[a]	Log Kpdms[b]	MDL pg/L[c]
2-MCDD	227.92	4.32026	227.92
2,3-DiCDD	55.24	4.93581	55.24
2,7/2,8-DiCDD	60.27	4.89793	60.27
2,3,7-TrCDD	14.61	5.51348	14.61
2378-TCDF	3.78	6.10062	3.78
2378-TCDD	3.54	6.12903	3.54
12378-PeCDF	0.839	6.75405	0.839
23478-PeCDF	0.858	6.74458	0.858
12378-PeCDD	0.753	6.8014	0.753
123478-HxCDF	0.175	7.43589	0.175
123678-HxCDF	0.191	7.39801	0.191
234678-HxCDF	0.191	7.39801	0.191
123478-HxCDD	0.147	7.51165	0.147
123678-HxCDD	0.167	7.45483	0.167
123789-HxCDD	0.157	7.48324	0.157
123789-HxCDF	0.175	7.43589	0.175
1234678-HpCDF	0.040	8.07985	0.040
1234678-HpCDD	0.033	8.16508	0.033
1234789-HpCDF	0.039	8.08932	0.039
OCDD	0.007	8.83745	0.007
OCDF	0.008	8.76169	0.008

Dioxin log KOW values were calculated using the SPARC program (http://archemcalc.com/sparc-web/calc).

[b] Kpdms from Ghosh et al (2014)

[c] MDL using 5 cm of 31 µm PDMS on a 497 µm core and instrument detection limit (based upon PCBs) of 0.08

10. REFERENCES

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Appendix B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3123

LABORATORY SERVICES &
APPLIED SCIENCE
DIVISION

DIVE PLAN

From: **Anne Christopher**

Date of Original Request: **4/5/2019 (sent to Sheryl Bilbrey)**

Dive Dates: **Deployment 8/24-28/2020**
Retrieval 10/5-9/2020

Approval

To: Sean Sheldrake, UDO

Copies sent: Michael Szerlog, Dive Unit Manager Sponsor, LSASD
Calvin Terada, Director LSASD

Email approval from sponsoring program office director 4/19/19
Email approval from LSASD office director 6/4/20

Project: McCormick & Baxter Superfund Site
Requesting Office/Point of Contact: Anne Christopher: SEMD; Sarah Miller: Oregon Department of Environmental Quality
Site Account number: T 000DD2 10P9FE00 5-yr Review
Latitude/Longitude: 45.57783, -122.74368

I have read and understand the dive plan and tethered SCUBA / surface supplied diving SOP. **Diver Initials:**

***JUSTIFICATION FOR HAZARDOUS DUTY**
This dive plan conforms to the elements in EPA Order 3100.3A and meets the requirements specified in 5 CFR 550, Subpart I, Appendix A, Underwater Duty and/or Exposure to Hazardous Agents as noted directly below. A hazard pay differential of 25% is warranted. A general "Request for Approval of a Hazard Pay Differential" form is on file with UDO, Deputy UDOs, & RHSO

APPLICABLE EXPECTED HAZARDOUS CONDITIONS *(check all that apply)*
(X) Underwater duty: Diving required in scientific and engineering pursuits, when:
- (X) at a depth of 20 feet or more below the surface; or
- (X) visibility is restricted; or
- (X) in rapidly flowing or cold water; or
- ( ) vertical access to the surface is restricted by ice, rock, or other structure (e.g. entanglements); or
- ( ) testing or working with hardware which presents special hazards (e.g., high voltage equipment or underwater mockup components in an underwater space simulation study). **EXPLAIN**: _________.

Exposure to Hazardous Agents, work with or in proximity to:
- ( ) Toxic chemical materials. Toxic chemical materials when there is a possibility of leakage or spillage.
- ( ) Virulent biologicals. Materials of micro-organic nature which when introduced into the body are likely

to cause serious disease or fatality and for which protective devices do not afford complete protection.

OBJECTIVES AND LOGISTICS

Scientific Objectives: The following dives will be conducted under the OSHA Scientific Diving Exemption, 1910 Subpart T Appendix B. The goal of these scientific dives is to deploy and retrieve passive samplers (SPMEs) to measure concentrations of contaminants of concern (COCs) in surface water, within the armoring of the sediment cap (interarmor) and within the sand layer of the sediment cap (subarmor) in support of the McCormick & Baxter Superfund Site (M&B) 5 Year Review (5YR) due in 2021. The data from the passive samplers will be part of the sediment cap performance monitoring to determine if the remedy is functional and performing as designed (Record of Decision (ROD) criteria) and if the remedy is protective of current Human Health and Ecological Ambient Water Quality Criteria (AWQC).

Alternatives to Diving: For some types of samples such as bottom core samples, these may be taken via boat-based techniques. SPMEs, however, may only be placed by appropriately trained scientific divers. As such, there are no boat based, remotely operated vehicle (ROV), or other alternatives to diving that can place and retrieve these devices to obtain the necessary data for Superfund remedy review.

Value to EPA: Use of the Region 10 Dive Unit will avail scientific expertise to the dive operation in support of Superfund not otherwise available from private contractors. EPA divers bring polluted water diving experience also not available via private contractors.

Scientific Observations/Data collection:

The proposed 2020 Operation & Maintenance (O&M) sampling locations are shown in Figure 1 and consist of 12 compliance monitoring locations in sampling areas A through L, four fixed early-warning locations (at station numbers 5, 12, 13, and 16), fixed upstream and downstream reference locations (stations 1 and 27, respectively), and five crayfish sampling locations (01 through 05). Surface, inter-armoring, and sub-armor water will be sampled using passive techniques at the 12 compliance monitoring locations and 4 early warning stations. The upstream and downstream reference locations will assess background concentrations using passive techniques in surface water only. Crayfish will be sampled at 5 locations collocated with compliance monitoring locations. Field duplicates will be collected adjacent to three compliance monitoring locations (one for each interval) and one crayfish sampling location to evaluate the precision of the sampling procedures. The target sample coordinates, anticipated water depth, and number and type of sample(s) for each location are provided in Table 1. As noted in Table 1, the nearshore samples will be collected by field staff from the shore where water depths are less than approximately 2 feet and by divers in deeper water. All crayfish traps will be deployed by boat. Sample locations may be adjusted in the field based on actual water depths and accessibility. As explained in Table 1, divers will place surface water sampling devices at the upstream and downstream reference locations, and one sampling device for surface water, inter-armoring and sub-armoring sample locations at the compliance monitoring locations and at the early warning stations (see Figures 2 and 3). Table 1 also notes that compliance monitoring locations A and G are located on the articulated concrete block (ACB). If it is too difficult for the diver to insert the passive sampler through the ACB deep enough for the subarmor sample (see Figure 4), then alternate locations have been provided to replace stations A and G. Figure 1 delineates the areas of ACB.

Figure 1. Proposed 2020 sampling locations at McCormick & Baxter

NOTES:
1. Aerial photo taken Summer 2018.
2. The surface water sample at the early warning station will serve as the compliance monitoring point for monitoring area F while the inter-armoring and sub-armoring samples will serve as early warning samples.

Date: April 29, 2020
Data Sources: COP aerial photo

Document Path: Y:\0205_OR_DEQ\Source_Figures\028_MB_OM_2018\003_Annual_OM_Report\Figure1_Proposed_OM_Sampling_Locations_elevation_2020.mxd

Table 1: Sample location, type, number, and analyte group

Table 1
Sample Location, Type, Number, and Analyte Groups

Sampling Location ID	Sample Location								Sampling Interval(s) and Deployment Methodology (S= Shore; D=Diver; B= Boat; -- No Sample)				Field Duplicate Collected?	Analytes [4]						
	Sample Coordinates (NAD83) [1]				Sample Elevation [2] (ft NAVD88)	Anticipated Water Depth [3] (ft NAVD88)	Location with ACB	Colocated Sampling Location	Mudline (ML)	urface Water (S	nter-Armoring (I	ub-Armoring (S								
	Northing	Easting	Latitude	Longitude					At the sediment water interface	6-12 inches above the sediment cap	Centered 6 inches into the armoring layer	Approximately 18 inches below the top of the sediment cap		D/Fs	PAHs	PCP	As	Cr	Cu	Zn
Compliance Sampling Locations																				
A[5]	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	01	--	S	S	S	--	--	3	3	3	3	3	3
B	704369.2	7628482.9	45.57687	-122.74050	4.6	2.4	--	--	--	D*	D*	D*	--	--	3	3	3	3	3	3
C	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	02	--	D	D	D	IA	--	4	4	4	4	4	4
D	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	03	--	D	D	D	--	--	3	3	3	3	3	3
E	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	04	--	D	D	D	SW	--	4	4	4	4	4	4
F	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	05	--	D	D	D	SA	--	4	4	4	4	4	4
G[6]	705263.6	7627011.2	45.57921	-122.74634	1.1	5.9	Yes	--	--	D	D	D	--	--	3	3	3	3	3	3
H	705118.3	7626983.2	45.57881	-122.74644	-8.9	15.9	--	--	--	D	D	D	--	--	3	3	3	3	3	3
I	704565.8	7627624.4	45.57734	-122.74387	-18.6	25.6	--	--	--	D	D	D	--	--	3	3	3	3	3	3
J	704511.5	7627800.2	45.57721	-122.74318	7.2	-0.2	--	--	--	S	S	S	--	--	3	3	3	3	3	3
K	704219.7	7628010.5	45.57643	-122.74233	-20.9	27.9	--	--	--	D	D	D	--	--	3	3	3	3	3	3
L	704335.6	7628390.4	45.57677	-122.74086	4.5	2.5	--	--	--	D*	D*	D*	--	--	3	3	3	3	3	3
Early Warning Sampling Locations																				
5	704576.3	7628007.4	45.57740	-122.74238	1.8	5.2	--	--	--	D	D	D	--	--	3	3	--	--	--	--
12	705197.2	7627236.8	45.57905	-122.74546	4.9	2.1	Yes	--	--	D*	D*	D*	--	--	3	3	--	--	--	--
13	705303.9	7627321.8	45.57935	-122.74514	5.4	1.6	Yes	--	--	D*	D*	D*	--	--	3	3	--	--	--	--
16	704293.9	7627812.9	45.57661	-122.74311	-28.6	35.6	--	--	--	D	D	D	--	--	3	3	--	--	--	--
Background Sampling Locations																				
1 (Upstream)	703730.7	7628583.6	45.57513	-122.74004	-31.5	38.5	--	--	--	B	--	--	--	--	1	1	1	1	1	1
27 (Downstream	705647.6	7626360.3	45.58021	-122.74893	-19.3	26.3	--	--	--	B	--	--	--	--	1	1	1	1	1	1
Crayfish (CF) Sampling Locations																				
01	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	A	B	--	--	--	--	1	1	1	1	1	1	1
02	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	C	B	--	--	--	--	1	1	1	1	1	1	1
03	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	D	B	--	--	--	CF	2	2	2	2	2	2	2
04	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	E	B	--	--	--	--	1	1	1	1	1	1	1
05	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	F	B	--	--	--	--	1	1	1	1	1	1	1
							TOTAL COUNT		B=5; Total=5	D=14; S=2; B=2; Total=18	=14; S=2; Total=	=14; S=2; Total=	4	6	59	59	47	47	47	47
									D=42; S=6; B=7; Total=55											

Notes:

[1] Northing and easting coordinates exist in the following coordinate system: North American Datum of 1983 (NAD83), Oregon State Plane North Zone, International Feet.

[2] Elevations exist in the following coordinate system: North American Vertical Datum of 1988 (NAVD88) in units of feet.

[3] Assumes the Willamette River stage is at an elevation of 7.0 feet NAVD88. Note that sample locations with a negative value are anticipated to be out of water at the time of sampling. The locations will be adjusted to the waters edge when deployed to ensure that the samplers remain submerged throughout the deployment period.

[4] Analytes include the following dioxin/furan (D/Fs) congeners; polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

[5] Compliance monitoring location A is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area A will be used. The coordinates for this location are N: 704245.0, E: 7628682.3; Lat: 45.576546, Long: -122.73971

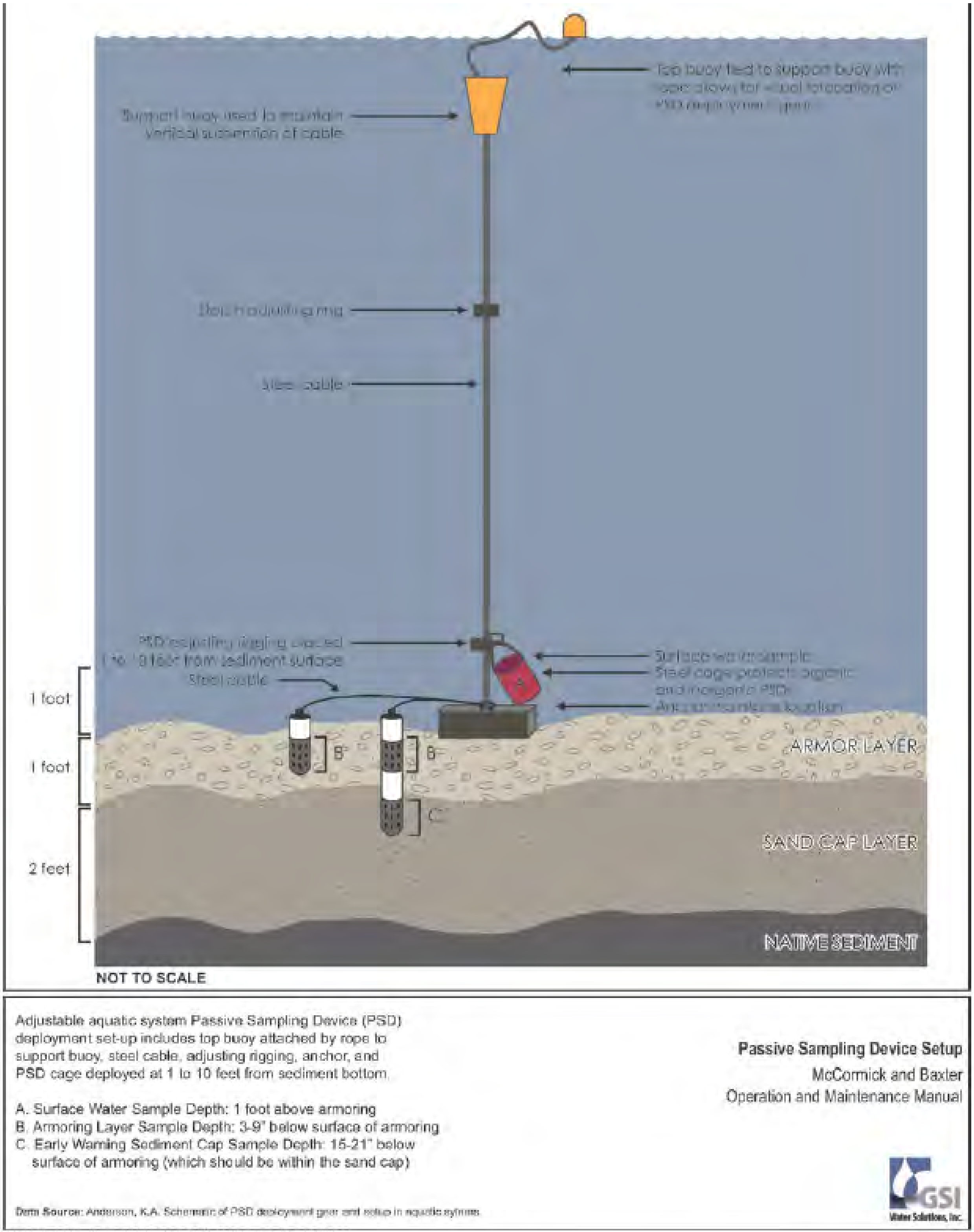
[6] Compliance monitoring location G is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area G will be used. The coordinates for this location are N: 705277.8 E: 7626983.2; Lat: 45.5788109435, Long: -122.746512

*Deployment methodology will depend upon river stage at the time of sampling.

ACB: Articulated concrete block

D/Fs: Dioxin/Furan congeners

PAHs: Polyaromatic hydrocarbons



Adjustable aquatic system Passive Sampling Device (PSD) deployment set-up includes top buoy attached by rope to support buoy, steel cable, adjusting rigging, anchor, and PSD cage deployed at 1 to 10 feet from sediment bottom.

A. Surface Water Sample Depth: 1 foot above armoring
B. Armoring Layer Sample Depth: 3-9" below surface of armoring
C. Early Warning Sediment Cap Sample Depth: 15-21" below surface of armoring (which should be within the sand cap)

Data Source: Anderson, K.A. Schematic of PSD deployment gear and setup in aquatic sytems

Figure 2. Proposed set up for A) Surface Water, B) Inter-Armoring and C) Sub-Armoring samples.

Figure 3: One passive sampling device will include sampling locations for surface water, interarmor and subarmor samples.

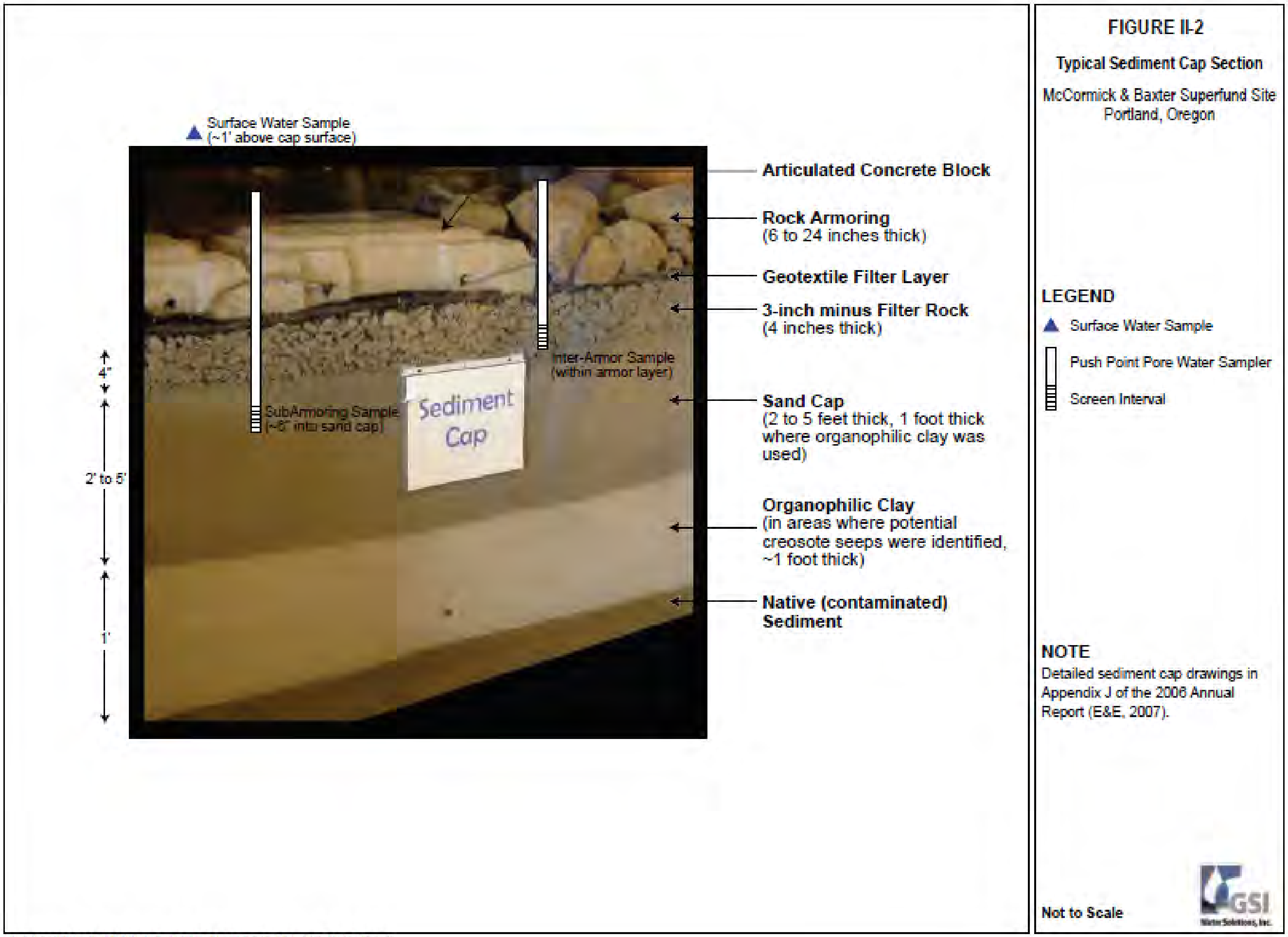


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Figure 4: Sediment cap cross section showing surface water, interarmor, and subarmor sampling locations.

Deployment:

The cap is principally made of two layers, the armoring layer (6-24 in thick) and the sand cap layer (2-5 ft thick) (Figure 4). Depending on the location, the armoring layer may be ACB or gravel (between 6-inch minus and 10-inch minus in size; see Attachment 2). Divers will try to place probes in or through the ACB armoring at compliance monitoring locations A, F, and G, but will use the alternate locations if the ACB is a problem. All other dive sites will have between 6-inch minus and 10-inch minus armoring gravel. The diver will use the slide hammer to pound the sampler through the armoring and into the subarmor sand cap layer. If the diver cannot drive the sampler deep enough through the armoring and into the cap with the slide hammer, then the diver will need to manually excavate some of the armoring prior to placing inter-armoring and sub-armoring sampling devices.

Both the Monitor and Hart Crower's boat will be on site during sample deployment. The Monitor will run all aspects of the dive operation while Hart Crowser's boat will prep the samples, crayfish traps. and marker buoys, and provide support for the divers. It's expected that Hart Crowser's boat will be live boating for most of the operation and the Monitor will be anchored while divers are in the water. The following will be the general procedure for deploying samples.

1. Before dive operations begin, Texas Tech in conjunction with Hart Crower and GSI Water Solutions, Inc. (GSI) will create/provide marker buoys with the passive sampler rigged with a clip to attach to the line or anchor weight (this will also serve to attach the sampler to the diver while descending). They will also provide a slide hammer to drive the sampler into the substrate that can be clipped to the diver's D ring on their harness. Care should be taken avoid excessive slack in the line which could present an entanglement hazard to the diver (see Figure 2).
2. Hart Crowser will set the marker buoys on the site coordinates provided by GSI (3 meter accuracy). Generally, this will be done prior to anchoring the Monitor to ensure correct position of anchor placements. Buoys will be visible at the surface and sufficient slack in the line present for river stage variations.
3. The Boat Operator will set a three-anchor mooring (Danforths preferred) for the dive platform due to the high flow conditions expected on the Willamette River during this time.
4. Divers will descend the marker buoy line, make a note of the substrate and begin placing the listed samplers for the site (see Attachment 3 for photos of the sampling devices; the surface water passive sampler and the combined passive sampler for surface water, interarmor and subarmor).
    a. *Surface Water Samples*. The diver should ensure the surface water sample steel cage is attached to the rigging approximately 12 inches above the sediment surface and adjust accordingly if needed.
    b. *Inter-Armoring Samples*. The diver must manually remove 10-inches of armoring gravel between 6-inch minus and 10-inch minus in size using their hands and/or a hand shovel. The diver will place a probe containing PE and DGT passive sampling devices (PSDs) vertically in the hole and then bury them with the excavated gravel so that the portion of the probe exposed to porewater (i.e., the screened segment) sits between approximately 3 – 9 inches below the surface of the armoring.
    c. *Sub-Armoring Samples*. The diver must manually remove approximately 20 inches of armoring gravel between 6-inch minus and 10-inch minus in size using their hands and/or a hand shovel to a point where they can drive a double probe containing PE and DGT PSDs into the sand layer (see Attachment 3 for photo). The bottom of the probe should be driven with a slide hammer approximately 21-inches below the surface of the armoring such that the bottom 6-inch screened segment will be approximately 15-21 inches deep (measuring the sub-armoring water), the top screened segment will be 3 – 9 inches deep (measuring the inter-armoring water) and the top of the probe will be even with the surface of the armoring. After driving the probe into the sand layer, the diver will bury the rest of the probe with the excavated gravel.

5. Once the sampling device has been placed, the diver will ensure the probes are secure and placed correctly and return to the boat by following their umbilical. The diver should take care not to entangle their umbilical in the marker buoy line or probe lines when returning to the boat.

This process will be repeated for all sampling locations requiring diving. If the sub-armoring probe cannot be driven to the required depth after 45 – 60 minutes of effort, the diver should return to the boat for instructions, additional excavation tools, and/or to potentially move on to another site. All incompleted sites will be revisited based on available time.

Generally, DEQ and EPA would like the following information reported and included in the dive report:

1. sampling station ID;
2. any benthic life seen;
3. bottom description including description of grain size and estimated thickness of rock armoring, (e.g., armoring covered with 2 inches of fine sediment); and
4. water depth. Water depth will be recorded in feet of seawater due to gauge calibration (must be adjusted to feet of freshwater in the dive report).

Retrieval:

Texas Tech designed the marker buoy rigging such that the samples could be retrieved from the surface. Divers will mainly be responsible for securing and replacing the armoring displaced by the sampling probes. Divers may assist in the removal of the samples if GSI cannot retrieve them from the surface.

Both the Monitor and Hart Crowser's boat will be on site during sample retrieval. The Monitor will run all aspects of the dive operation while the Hart Crowser boat will recover and process samples. It's expected that the Hart Crowser boat will be live boating for most of the operation and the Monitor will be anchored while divers are in the water. The following will be the general procedure for securing and replacing the armoring.

1. The Boat Operator will set a three-anchor mooring near the site for the dive platform.

2. Divers will descend the marker buoy line, make a note of the substrate and sample condition. Once on the bottom, the diver will back away from the sample area ensuring they are free of any lines associated with sampling devices. The diver should make note of the distance and bearing to the sample location. Divers must report to surface when they are clear of the sample area.

3. GSI and/or Texas Tech staff will begin removing the samples from the surface. GSI staff should continually communicate to the dive platform about the progress of the sample removal; the diver will be in the water during this time as the sample site cannot be located without the marker buoy.

4. If surface removal is unsuccessful, the diver will assist in removing the samples based on direction from the surface.

5. If surface removal is successful, and once the surface indicates it is clear, the diver will move back to the sampling site and secure/replace the armoring displaced by the sampling probes.

6. Once the armoring is replaced, the diver will ascend their umbilical to the surface and proceed to the next site.

Photo/video shot list:

A GoPro camera should be mounted to the diver's mask so that video can be captured during the dive. The diver should slowly scan the surface of the cap near the sampling location to document the condition of the cap if visibility allows.

Pollution Sources: Possible creosote seepage, PAHs, PCBs, phthalates in sediment nearby. CSO discharges of raw sewage are likely when it rains. There are several NPDES Facilities near the dive site including, Koppers Industries, Inc. (Portland Tar Plant), Wacker Siltronic, Corp., NW Natural Gas Site (Remediation), and Arkema, Inc. (see Figure 5).

PCS NPDES Facilities

Facility Name: ARKEMA INC
Address: 6400 NORTHWEST FRONT AVENUE
City: PORTLAND, OR
EPA Registry ID: 110000487269
EPA Program ID: OR0001597
EPA Program: NPDES
EPA Program Interest: ICIS-NPDES NON-MAJOR

Zoom to

Figure 5. Contaminated Water Dive Planning Tool results.

Dive dress: Diving operations will be conducted using surface supplied nitrox with a 300 foot umbilical and a 70 ft3 bailout bottle. Communications gear will be hard-wired to an AGA full face mask. A single diver will be deployed in the water possibly with an AGA-mounted GoPro camera and Sola lighting system, as requested. Divers must wear disposable gardening gloves over their dry gloves when excavating the armoring. Divers must also wear protective gauntlet gloves over their cuff rings to prevent ripping the upper part of their gloves. All such materials will be disposed of after the dives.

Tender dress: Rubber boots as needed. Gloves required in the exclusion and contaminant reduction zones. See attachment for SARS-CoV-2 protocol.

EGS selection: <u>All surface supply dives will be conducted with 70 cubic foot EGS included in surface supply system.</u>

STANDBY DIVER is in surface supply mode (same mode as primary diver)

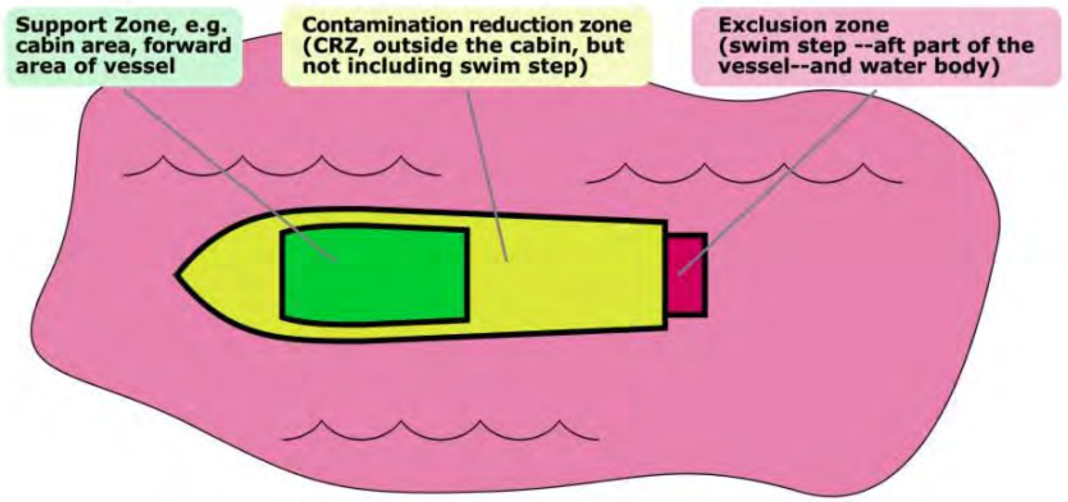
Decontamination Required: Potable water rinse. Citrus cleaning wipes will be on hand should dry suits, boat moorings, or other equipment become contaminated with gross amounts of creosote or other COCs.

Air testing verified with a test within the last 6 months for tank filling against CGA Grade E standards: ____January 8, 2020_________

Potential Hazards and Mitigation:

1. **Boat traffic.** Boat traffic, particularly large container ship and barge traffic, will be the principle physical hazard during this dive operation. Boat traffic will be managed by use of dive flags, boat positioning, and constant monitoring of VHF marine traffic channels (see below). The Monitor's automatic identification system (AIS) will also be used to relay to USCG vessel traffic control and all nearby commercial vessels that dive operations are underway and the Monitor's real time position.
2. **Entanglement with loose lines.** The divemaster will go through hand and body positioning throughout the dive to emphasize ways to keep entanglement prone areas clear of lines (e.g. tank yokes). Boat operators and line handlers will use techniques to ensure the line is taught on the bottom such as weighting each end for deployment (to be retrieved by buoys/lines at the end of the deployment), and pulling tension when releasing the bitter end of the line.
3. **Nitrox Diving:** The Divemaster will brief all divers on signs and symptoms of acute oxygen toxicity using mnemonic VENTID CON (Vision blurring, Ears ringing, Nausea, Tingling, Irritability, Dizziness, Convulsions) The following mitigation procedures will be considered: use of full face masks, light work, minimizing the duration of the exposure, and close diver monitoring for acute oxygen toxicity. Divers will track their dive time via the latest dive tables and/or via dive computers reflecting the exact oxygen percentage being dived. To mitigate exposure, the following measures will be employed: MOD for XXX% oxygen at 1.4 ATA = _______
   MOD FSW= 33 X (PPo2/Fo2-1); e.g. MOD = 33x (1.4/0.32)-1))______
4. **Bounce diving:** The divemaster will minimize the number of ascents and descents to the extent possible. For example, surface supplied diving mode will be considered such that work can be completed without excessive ascent and descent (a virtually unlimited air supply will be provided); all tools needed throughout the dive will be lowered to the diver, carried by the diver, etc.
5. **Overhead hazards.** Divers will not be present in the water when overhead hazards are present.
6. **Contaminants in water:** Divers will be fully encapsulated and use only decon. compatible equipment.
7. **Contaminant tracking on vessel:** Divers will be fully encapsulated and use only decon. compatible equipment. The vessel will be divided into zones, and gross decon conducted on the swim step (ambient water ok to start). This will be followed up at a minimum by a potable water washdown. Equipment that cannot be decontaminated will remain sequestered on the back deck. No eating or drinking will take place outside the cabin. No one without gloves will be in the CRZ or EZ. Gloves will be disposed upon entering the support zone.
8. **Airborne contaminants.** No airborne contaminants are expected other than SARS-COV-2. See attachment for detailed protocols.
9. **Wildlife**. No wildlife expected.
10. **Current**. Current will be managed by line tending (surface supplied diving).
11. **Loading /unloading gear**. Proper lifting techniques; deliberate, attentive lifting and placement. Use assistants. Use back braces as needed.
12. **Travel to site with dive van.** Select confident driver; inspect vehicle for gas/oil/tire pressure/spare tire/ready inflate/jack/safety flares/water/radio; defensive driving techniques; avoid distractions; use seat belts; comply with traffic laws.
13. **Motor in vessel to dive site.** Wear PFD when not in cabin, properly secure gear, minimize set-up tasks while underway, obey boat operator's instructions, stay in cabin/protect hearing, secure cabin door with latch either open or closed; assist boat op in observing boat traffic or other water hazards.
14. **Deploy marker buoys.** Allow prep time, avoid dropping weight/lead ball, stay clear of deploying line; pre-measure and secure a proper length of line (and weight buoy type) for the setting; deploy away from prop/platform considering boat direction, current and wind.
15. **Anchoring/tying up at site.** Avoid entanglement in lines; keep body from pinching between boat and

other objects.



Maximum Expected Water Depth: 35-40
Maximum Expected Water Current: 1 knot
Maximum Expected Horizontal Visibility: 3ft
Weather: Project Divemaster will check weather reports on the day of dive to determine if dive operations may proceed.

Diving Platform: EPA research vessel *Monitor***.** Sample support will be provided by Hart Crowser's boat for both weeks of diving.

Tide and Current Information: Currents will predominantly be downstream. Flow reversal may occur several times daily, depending on river stage.

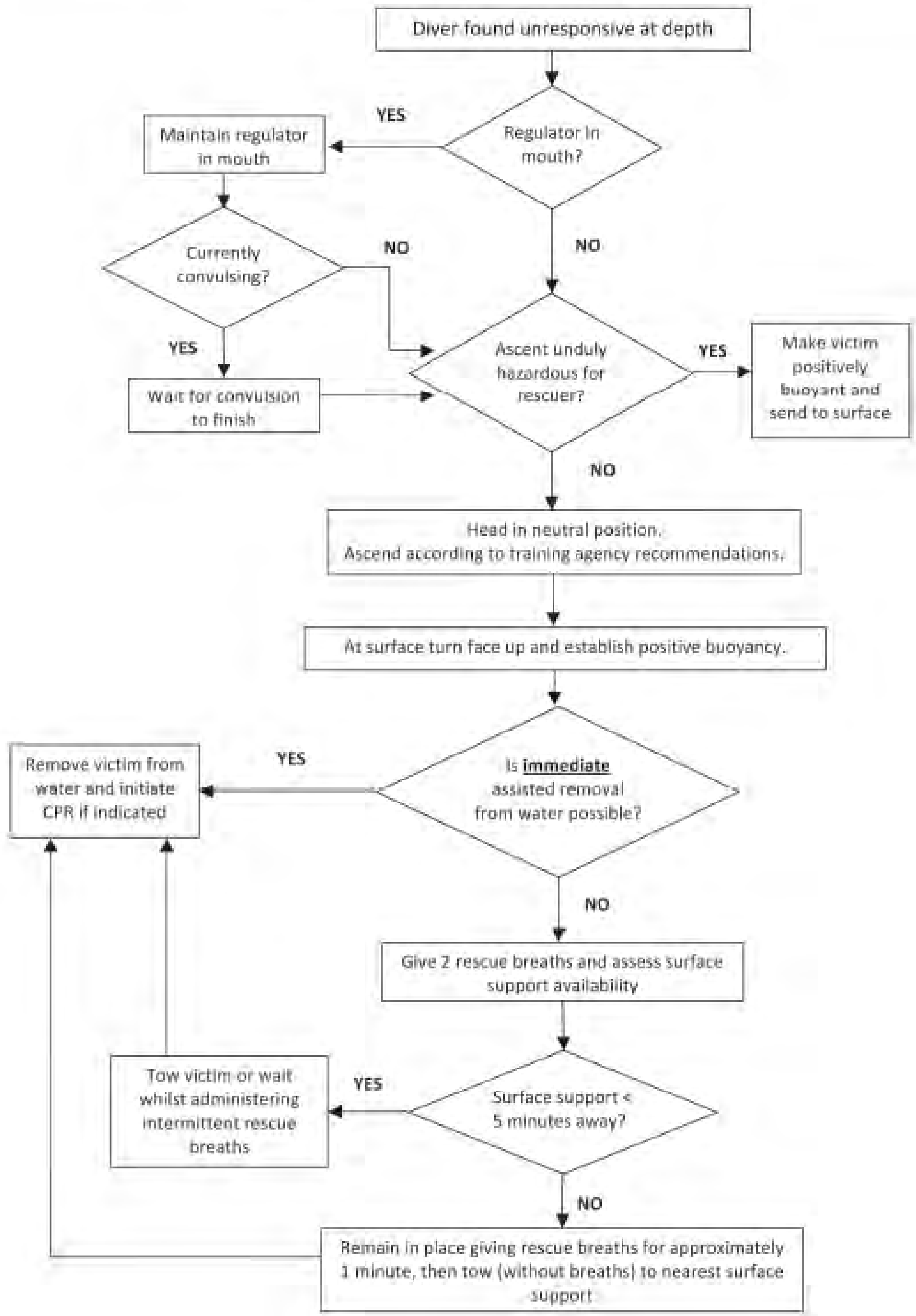
Approximate Dive Site Location and Emergency Egress, Lat/Long : 45.57783, -122.74368

Emergency Egress: Cathedral Park Boat Launch (45.587628, -122.763928)
8676 N Crawford St.
Portland, OR 97203

Figure 6. Egress location in relation to McCormick and Baxter Dive Site.

Method of egress: An incapacitated diver will be lifted onto the vessel as quickly as possible and likely through the use of the backboard on the transom to "slide" the victim onto the deck for treatment (see photo). For surface supply, drop the weight belt and slide the diver up with the harness still on/kit intact.

FIGURE 1 – Rescue breathing protocol



Recommendations for rescue of a submerged unresponsive compressed-gas diver UHM 2012 *S.J. Mitchell 1,2, et. al.*

PERSONNEL
Divemaster: Sean Sheldrake

August 23-28:
Sean Sheldrake - DM/diver/boat operator
Kris Leefers - second DM/diver
Annie Christopher - PI/diver
Brent Richmond - boat operator/diver
TChris Mochon Collura - boat operator/diver
Hunter Young- boat operator trainee
*Brent will be a diver if TChris can’t make it (TChris will know by mid-July if he can make it or not) and Hunter will be the boat operator
*Rachel Stephenson will be 2nd backup diver if TChris plus another diver can’t make it

October 4-9:
Sean Sheldrake - DM/diver/boat operator
TChris Mochon Collura- second DM/boat operator/diver
Annie Christopher - PI/diver
*Chad Schulze - diver
*Adam Baron - diver
*Annie Whitley - backup diver
Hunter Young - boat operator trainee

Boat Logistics:

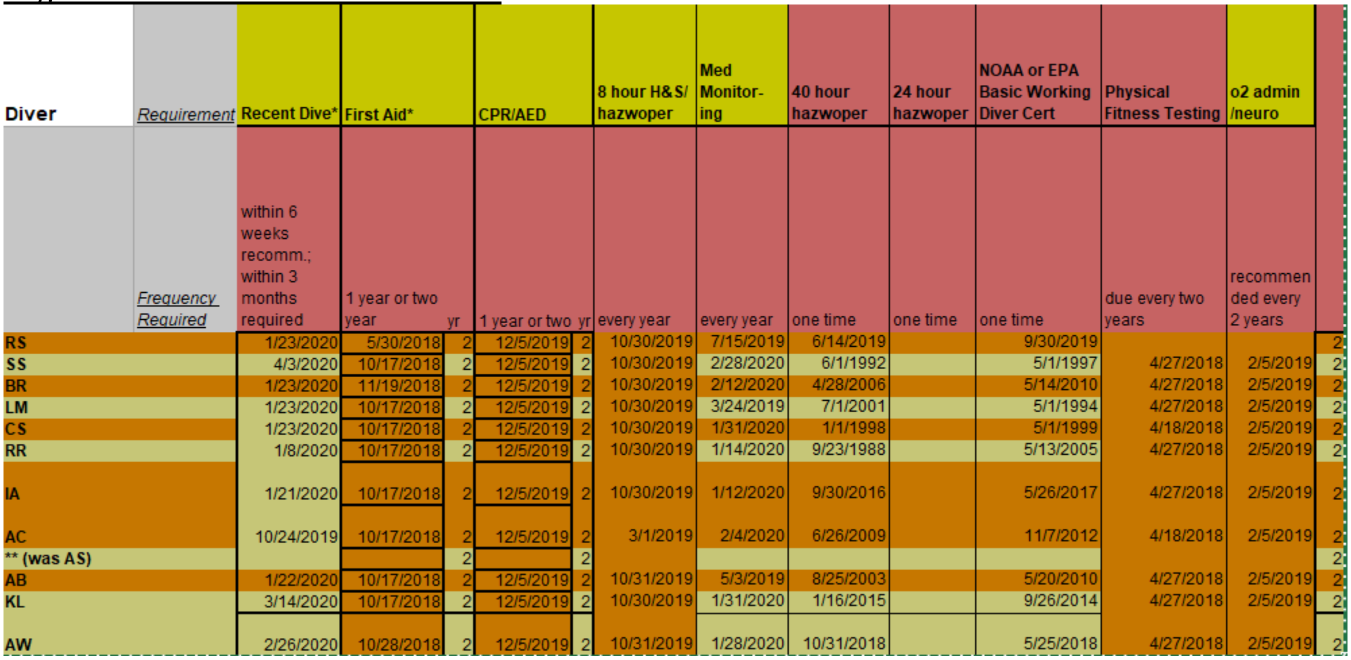
We will be docking the boat at the US Coast Guard Station in Portland. *All divers must bring government ID to access the USCG base.* If the Monitor is not needed by the lab for the month of September, we are going to leave the Monitor on the trailer in the USCG parking lot for September. Brent will trailer the Monitor down to Portland on Sunday, August 23, Brent will drive the boat truck back to Manchester on August 28, and we will leave the Monitor in Portland through September. Then Adam can drive the boat truck from Manchester back to Portland on October 4 and Sean and Chad can come to Portland in the dive van from Seattle. Adam can trailer the boat back to Manchester on October 9 if he is comfortable (Sean or Chad can help if needed) and Sean/Chad can drive the dive van back to Seattle. Brent says 1 tank of gas for the Monitor should cover both weeks of diving.

Diver Training and Proficiency

August 23-28	**Diver 1**	**Diver 2**	**Diver 3**	**Diver 4**	**Backup**
Insert applicable dates for each diver	**SS**	**AC**	**KL**	**TM**	**BR/RS**
Last Dive *within 3 months*	**See table below**	**See table below**	**See table below**	**9 May 2020**	**See attached spreadsheet**
Medical Monitoring *within 12 months*				**16 April 2019 Biennial**	
8 hr. hazwoper *within 12 months*				**19 May 2020**	
First Aid *within 2 years*				**17 Feb 2019**	
CPR/AED *within 2 years*				**17 Feb 2019**	

October 4-9	**Diver 1**	**Diver 2**	**Diver 3**	**Diver 4**	**Diver 5**	**Backup**
Insert applicable dates for each diver	**SS**	**AC**	**CS**	**TM**	**AB**	**AW**
Last Dive *within 3 months*	**See table below**	**See table below**	**See table below**	**9 May 2020**	**See table below**	**See table below**
Medical Monitoring *within 12 months*				**16 April 2019 Biennial**		
8 hr. hazwoper *within 12 months*				**19 May 2020**		
First Aid *within 2 years*				**17 Feb 2019**		
CPR/AED *within 2 years*				**17 Feb 2019**		

Region 10 Dive Unit Certification Table



Diver	*Requirement*	**Recent Dive***	**First Aid***		**CPR/AED**		**8 hour H&S/ hazwoper**	**Med Monitor-ing**	**40 hour hazwoper**	**24 hour hazwoper**	**NOAA or EPA Basic Working Diver Cert**	**Physical Fitness Testing**	**o2 admin /neuro**	
	Frequency Required	within 6 weeks recomm.; within 3 months required	1 year or two year	yr	1 year or two	yr	every year	every year	one time	one time	one time	due every two years	recommended every 2 years	
RS		1/23/2020	5/30/2018	2	12/5/2019	2	10/30/2019	7/15/2019	6/14/2019		9/30/2019			2
SS		4/3/2020	10/17/2018	2	12/5/2019	2	10/30/2019	2/28/2020	6/1/1992		5/1/1997	4/27/2018	2/5/2019	2
BR		1/23/2020	11/19/2018	2	12/5/2019	2	10/30/2019	2/12/2020	4/28/2006		5/14/2010	4/27/2018	2/5/2019	2
LM		1/23/2020	10/17/2018	2	12/5/2019	2	10/30/2019	3/24/2019	7/1/2001		5/1/1994	4/27/2018	2/5/2019	2
CS		1/23/2020	10/17/2018	2	12/5/2019	2	10/30/2019	1/31/2020	1/1/1998		5/1/1999	4/18/2018	2/5/2019	2
RR		1/8/2020	10/17/2018	2	12/5/2019	2	10/30/2019	1/14/2020	9/23/1988		5/13/2005	4/27/2018	2/5/2019	2
IA		1/21/2020	10/17/2018	2	12/5/2019	2	10/30/2019	1/12/2020	9/30/2016		5/26/2017	4/27/2018	2/5/2019	2
AC		10/24/2019	10/17/2018	2	12/5/2019	2	3/1/2019	2/4/2020	6/26/2009		11/7/2012	4/18/2018	2/5/2019	2
**** (was AS)**				2		2								2
AB		1/22/2020	10/17/2018	2	12/5/2019	2	10/31/2019	5/3/2019	8/25/2003		5/20/2010	4/27/2018	2/5/2019	2
KL		3/14/2020	10/17/2018	2	12/5/2019	2	10/30/2019	1/31/2020	1/16/2015		9/26/2014	4/27/2018	2/5/2019	2
AW		2/26/2020	10/28/2018	2	12/5/2019	2	10/31/2019	1/28/2020	10/31/2018		5/25/2018	4/27/2018	2/5/2019	2

LAST DIVE IN SURFACE SUPPLY/TETHERED SCUBA

All divers completed a dive in the same mode in the last 3 months and a rescue drill within the prior year?
N

If "NO", diver(s) to complete safety drill prior to commencement of work diving (list names): **All divers must complete a safety drill for requalification, e.g. doff and don a weight belt and a surface supply specific drill for EGS activation. A rescue drill will also be performed prior to starting dive operations.**

Cox'n: see above
Backup: Hunter Young

Tenders: divers

Others:

Sarah Miller, DEQ (observing)
Danny Reible and grad student(s), Texas Tech (working)
DEQ's contractors (working): Kevin Woodhouse (Hart Crowser), Benjamin Johnson (GSI), Andrew Davidson (GSI)

Access Codes: Codes for Site Access (all gates must be closed and locked immediately after driving thru): Upper Gate Code at Edgewater: 2066 Lower Gate Code: 1776

CONTACT INFORMATION

Contact Information: OEA dive cell phone: 206-369-7500
Sean Sheldrake: 206.225.6528 cell

Vessel Captain cell phone:
Brent: 360-337-9486
TChris: 541-961-3678
Hunter: 614-425-0916

SCHEDULE

Deployment

Dive Briefing and Load Van: scheduled for 8/18/20
Depart EPA office: Sunday, 8/23 at 1300
Brent to leave Manchester with the Monitor: Sunday, 8/23 at 1300

Daily schedule

Meet boat at USCG boat launch: 0800 (6767 N Basin Ave, Portland, OR 97217)
Meet DEQ/Texas Tech/GSI/Hart Crowser at M&B site near railroad bridge: 0830
Dive: 0830-1600
Return to Hotel: 1700
Return to Seattle office: Friday, 8/28

Retrieval

Dive Briefing and Load Van: scheduled for 9/29/20
Depart EPA office: Sunday, 10/4 at 1300
Adam to leave Manchester with the boat truck: Sunday, 10/4 at 1300

Daily schedule

Meet boat at USCG boat launch: 0800 (6767 N Basin Ave, Portland, OR 97217)
Meet DEQ/Texas Tech/GSI/Hart Crowser at M&B site near railroad bridge: 0830
Dive: 0830-1600
Return to Hotel: 1700
Return to Seattle office: Friday, 10/9

PRE/POST DIVE TASKS

Boat Prep

1. Fill boat freshwater tank **daily**, fill cooler for sample gear soaking **daily**
2. 3 anchors and line for anchoring in 40 feet of water and less are needed. **THREE ANCHORS NEEDED FOR HIGH RIVER HIGH FLOW/FLOW REVERSAL TETHER DIVING** NEED TO BE ON THE BOAT.
3. Dive flags and pole
4. Gpx file sent to be loaded on hummingbird plotter on Monitor AND/OR NEW GARMIN 640
5. Surface supplied umbilicals (300 foot), EGS tanks(2), EGS regs (2) loaded, manifold blocks (2) control box loaded & charged; communications box charged and tested; low air alarm checked.
6. Any extra tanks flat on truckbed to avoid injury unloading
7. Slide hammer, shovels, augers or other helpful underwater digging tools.
8. Already confirmed that we can use USCG dock.

Prep. Field equip:

Prep. Dive equip (***day(s) before loading***):

1. Garmin 640 charged/points loaded/BR
2. Vessel GPS chip loaded Garmin 4000/BR
3. Lights- solas, handheld, nite riders, charge/KL
4. Nitrox tanks tested for loading by individual divers using them
5. Video camera (GOPRO)-charge ***set time and date, clear card*** follow prep checklist including clock sync to GPS with photo—NIGHTLY –CHECK VIDEO FOOTAGE, SWITCH TAPES (?), CHECK CONNECTIONS, CHARGE MONITOR, LIGHT PODS, CAMERA/DIVER INITIALS
6. Prep. Surface camera (charge all batteries, ***set time and date, clear card***)/SS
7. Kirby bailout blocks/AGA regs/AGAs connected (match #'s and/or replace labels)/test, leave AGAs on for transit. /KL
8.
9. Verify recall is charged. /BR

Nightly

1. Turn off all pony valves /all divers
2. Charge surface supplied control box /SS
3. CHECK VIDEO FOOTAGE, SWITCH TAPES (?), CHECK CONNECTIONS, CHARGE MONITOR, LIGHT PODS, CAMERA/AC
4. Swap /fill tanks /all divers
5. Charge batteries in diver lights /AC

Post dive

Fill tanks – BR

Equipment Required - See Attachment 1.

SAFETY AND SECURITY NOTIFICATIONS

USCG Notifications (33 USC 1221):
CG Notice Prior to start of dive operations **__Needed? _____Yes _X____No**
Done? Diver Initials_____ Date____________
Advanced notification of USCG for dives near sensitive areas (e.g., port facilities, bridges) or in high traffic lanes/ areas. Call 24hr. Vessel Traffic 206-217-6051 and email sectorseattlewwm@uscg.mil
Advanced notification to USCG 206.217.6002 and email: hlswatch@pacnorwest.uscg.mil
(*For emergency operations with little notice-- you should call the number above for one week ahead **only** for normal operations.* USE THIS NUMBER FOR LESS THAN 24 HOURS NOTICE)

CG Notice to Mariners **Needed? _____Yes __X__ No Done? Diver Initials________ Date_____________**
206-220-7280 **ALL IN CHANNEL OR NEAR CHANNEL DIVES SHALL REQUEST A NTM (SEE NAV CHART)**

CG Notice During Dive Operations **__Needed? _____Yes __X__ No**
Dive Operation start and end :   Call 206.217.6051 and notify USCG of start and end of dive operations. Example script, "*This is the EPA Vessel Monitor, MMSID 338069238; we are commencing dive operations near XXXXXX. Please verify you can see our vessel on your AIS screen.*"   **ALL IN CHANNEL OR NEAR CHANNEL DIVES SHALL NOTIFY USCG AT THE START AND END OF OPS.**

VHF shall monitor 13, 14, 16 for in or near channel dives. AIS will be on with antenna installed for all Monitor dives.   For operating out of a small boat, checkout a handheld VHF from MEL (Brent Richmond) as appropriate.

Washington State Ferries **_Needed? ____Yes X__No Done? Diver Initials___Date__________**
Call Washington State Ferry Operations Center 206-515-3456 for dives in/near ferry lanes

EMERGENCY INFO./DIVE ACCIDENT MANAGEMENT PLAN

Emergency Call in Script (from NOAA 2009 DMT)

"I am an EPA [Divemaster, Dive Medic] and I am calling to report a diving related emergency requiring immediate medical assistance. The victim is a ___ (age) year old (gender) who is ___________(conscious/unconscious), with the following symptoms after diving with compressed gas….(describe pain, dizziness, etc.)

"We have placed the victim in a supine position and have initiated basic first aid. We have also completed a field neurological exam. With the following results….(note any deficits). The victim is on 100% oxygen by mask, and we have rendered the following additional treatment (CPR, fluids, medications, etc.)

Last vital signs are as follows…."

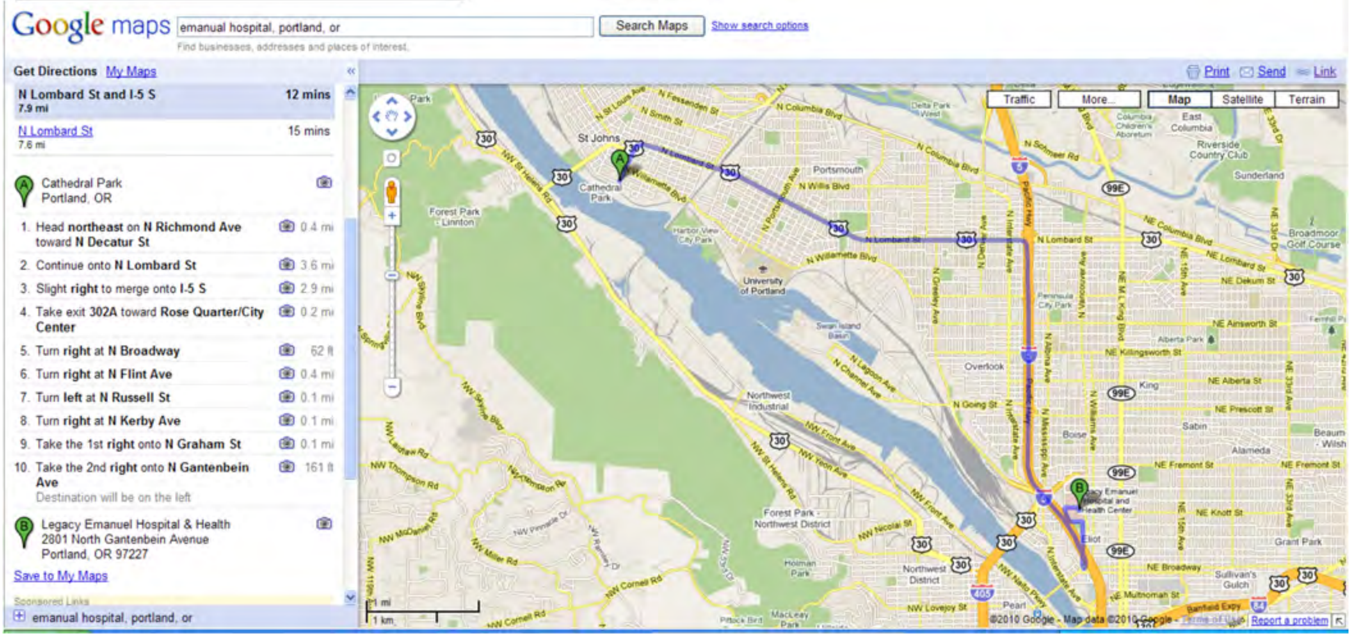
Temp: _______ Pulse:_____ Resp:______ B/P: ______/_______

"We are at the following location….. (location of diver/landmarks) and request immediate medical transport to (receiving facility of choice) via (air/ground) transport."

Note: Do not terminate call...the receiving unit will end the call.

Source of EMERGENCY TRANSPORTATION:
U.S.C.G. for dive accidents. ***Or PICK ONE!*** 911 for all accidents VIA CELL PHONE OR VHF –ONE AS BACKUP, ONE PRIMARY?

Egress Point and Method of Egress: Cathedral Park Boat Launch



N Lombard St and I-5 S — 12 mins
7.9 mi

N Lombard St — 15 mins
7.6 mi

A: Cathedral Park
Portland, OR

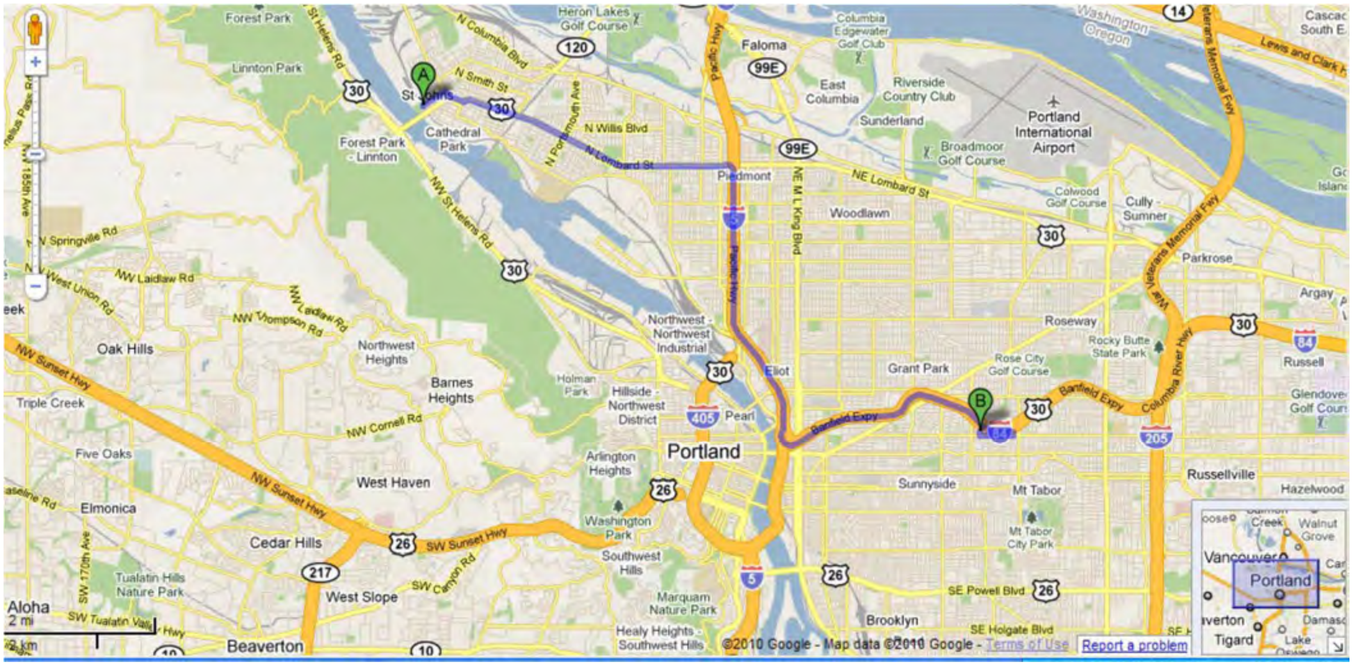
1. Head northeast on N Richmond Ave toward N Decatur St — 0.4 mi
2. Continue onto N Lombard St — 3.6 mi
3. Slight right to merge onto I-5 S — 2.9 mi
4. Take exit 302A toward Rose Quarter/City Center — 0.2 mi
5. Turn right at N Broadway — 62 ft
6. Turn right at N Flint Ave — 0.4 mi
7. Turn left at N Russell St — 0.1 mi
8. Turn right at N Kerby Ave — 0.1 mi
9. Take the 1st right onto N Graham St — 0.1 mi
10. Take the 2nd right onto N Gantenbein Ave — 161 ft
Destination will be on the left

B: Legacy Emanuel Hospital & Health
2801 North Gantenbein Avenue
Portland, OR 97227

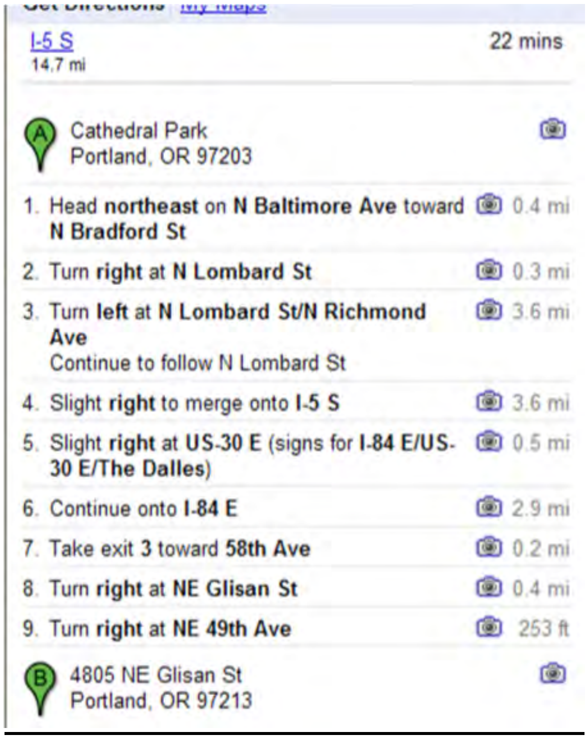
Save to My Maps

emanual hospital, portland, or

Nearest MEDICAL Facility: Legacy Emanuel Hospital & Health – 503-413-2200
Address: 2801 N Gantenbein Ave, Portland, OR 97227



Nearest Hyperbaric Chamber: Providence Portland Medical Center, 4805 N.E. Glisan, Portland, OR 97213. Hyberbaric chamber phone: 503-215-6061.



I-5 S
14.7 mi
22 mins

Cathedral Park
Portland, OR 97203

1. Head **northeast** on **N Baltimore Ave** toward **N Bradford St** 0.4 mi
2. Turn **right** at **N Lombard St** 0.3 mi
3. Turn **left** at **N Lombard St/N Richmond Ave** 3.6 mi
   Continue to follow N Lombard St
4. Slight **right** to merge onto **I-5 S** 3.6 mi
5. Slight **right** at **US-30 E** (signs for **I-84 E/US-30 E/The Dalles**) 0.5 mi
6. Continue onto **I-84 E** 2.9 mi
7. Take exit **3** toward **58th Ave** 0.2 mi
8. Turn **right** at **NE Glisan St** 0.4 mi
9. Turn **right** at **NE 49th Ave** 253 ft

4805 NE Glisan St
Portland, OR 97213

Secondary: Virginia-Mason Medical Center 1202 Terry Ave, Seattle, WA
Hyperbarics Department: (206) 583-6543
24-hour emergency line: (206) 583-6433
(admission is through the Emergency Room on Spring Street)

Diver's Alert Network: For diving emergencies use 1-919-684-9111, for non-emergency diving questions during normal working hours use 1-919-684-2948. **– if EMS isn't expediting transport to the nearest chamber, Divemaster may need to call DAN.**

Notes:

(1) Emergency helicopter transport in Puget Sound is available through the U.S. Coast Guard (Channel 16 or telephone 220-7001 *or *CG* in Seattle).

FOLLOWING INCIDENT; DIVEMASTER TO NOTIFY:

1. Unit Diving Officer, Sean Sheldrake, 206.225.6528 cell
2. Regional SHEMP manager, Grady Maxwell, 206.399.9394 cell,

3. Diving Safety Board Chairman, Mel Parsons, (706) 202-5092
4. Diver supervisor (see blue field emergency form).
5. Dive unit management sponsor, Michael Szerlog 206-849-4821
6. SHEMD contact: Dave Gibson: (202) 497-4486 or Josh Mcdonald (202) 657-3475

Backup Line pull signals (if using tether), Navy Diving Manual, Rev. 5, 2005

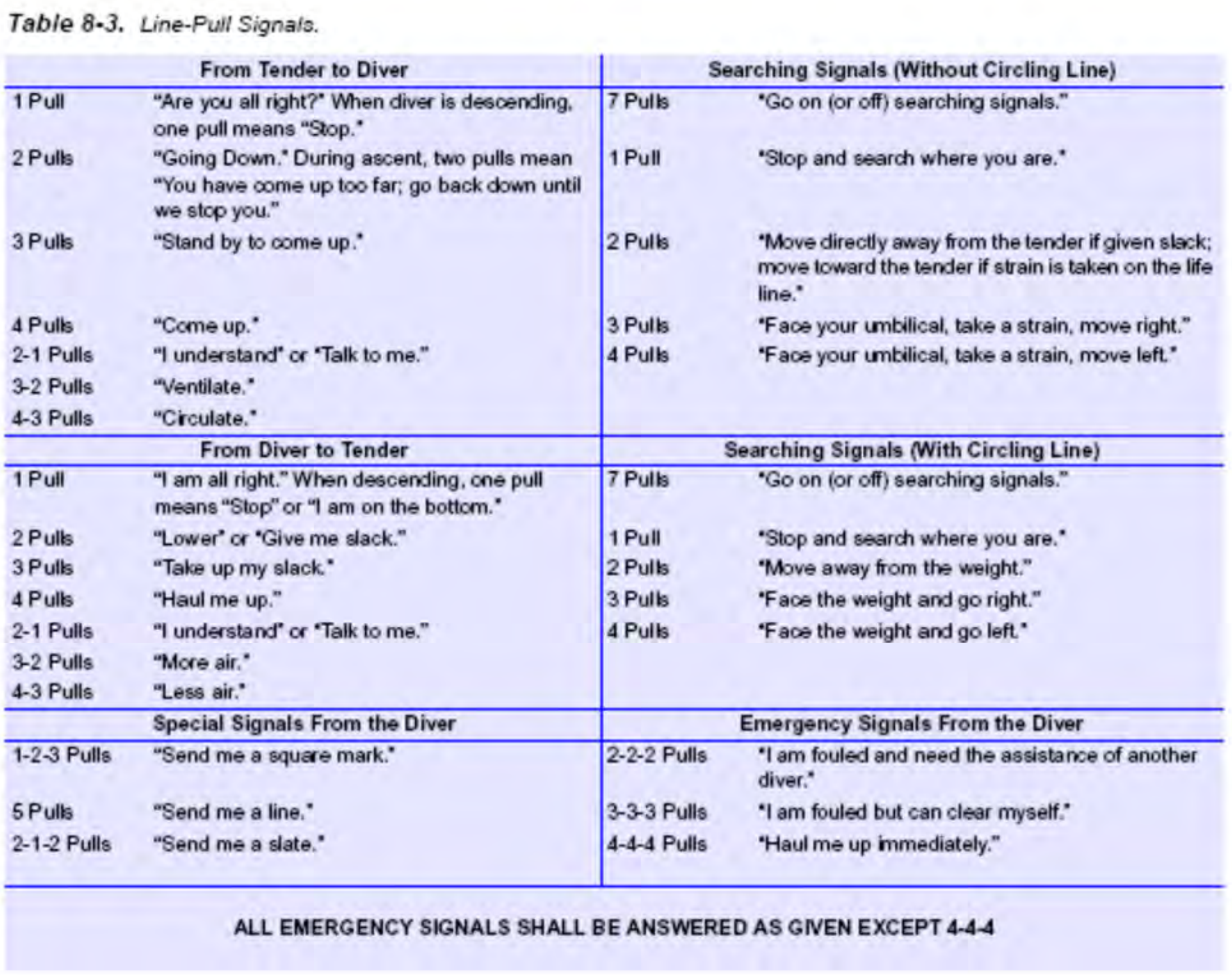


Table 8-3. Line-Pull Signals.

From Tender to Diver		Searching Signals (Without Circling Line)	
1 Pull	"Are you all right?" When diver is descending, one pull means "Stop."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Going Down." During ascent, two pulls mean "You have come up too far; go back down until we stop you."	1 Pull	"Stop and search where you are."
3 Pulls	"Stand by to come up."	2 Pulls	"Move directly away from the tender if given slack; move toward the tender if strain is taken on the life line."
4 Pulls	"Come up."	3 Pulls	"Face your umbilical, take a strain, move right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face your umbilical, take a strain, move left."
3-2 Pulls	"Ventilate."		
4-3 Pulls	"Circulate."		
From Diver to Tender		**Searching Signals (With Circling Line)**	
1 Pull	"I am all right." When descending, one pull means "Stop" or "I am on the bottom."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Lower" or "Give me slack."	1 Pull	"Stop and search where you are."
3 Pulls	"Take up my slack."	2 Pulls	"Move away from the weight."
4 Pulls	"Haul me up."	3 Pulls	"Face the weight and go right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face the weight and go left."
3-2 Pulls	"More air."		
4-3 Pulls	"Less air."		
Special Signals From the Diver		**Emergency Signals From the Diver**	
1-2-3 Pulls	"Send me a square mark."	2-2-2 Pulls	"I am fouled and need the assistance of another diver."
5 Pulls	"Send me a line."	3-3-3 Pulls	"I am fouled but can clear myself."
2-1-2 Pulls	"Send me a slate."	4-4-4 Pulls	"Haul me up immediately."
ALL EMERGENCY SIGNALS SHALL BE ANSWERED AS GIVEN EXCEPT 4-4-4			

NOTE: A high pitch squealing sound on the surface unit indicates the ema2 plug has been unplugged from the AGA mask. Instruct the diver to reconnect these via the DIVER RECALL.

Medical Treatment for a <u>CONSCIOUS</u> Diver (Source: NOAA DMT Course 2007)

- **ABC's**
- **Administer 100% Oxygen**
- **Cut exposure suit open/remove if wet to keep patient dry/warm**
- **Place in position of comfort**
- **Give one (1) aspirin (325 mg) orally***
- **Take vitals every 5 min if unstable; 15 min if stable***
  -Pulse/per min
  -Blood Pressure
  -Respirations/per min
- **Gather dive history info. from buddy***
- **Perform neurological exam ***
- **Contact EMS**
- **Administer 0.5 liters of water orally per hour x 2 hours then reduce to 100-200 ml per hr thereafter**

Note deficiencies on blue card.

Medical Treatment for an <u>UNCONSCIOUS</u> Diver

- **ABC's / Contact EMS**
- **Administer 100% Oxygen**
- **Cut exposure suit open/remove if wet to keep patient dry/warm**
- **Lateral recumbent position (on side)**
- **Take vital signs every 5 min if unstable and every 15 min if stable***
  -Pulse/per min
  -Blood Pressure
  -Respirations/per min
- **Gather dive history info. from dive buddy and/or eye witnesses***
- **Perform neurological exam***

Note deficiencies on blue card.

Diving Injury and First Aid Matrix

CONDITION	CAUSE/EFFECT	SIGNS/SYMPTOMS	FIRST AID
Hypercapnia	Skip Breathing or equipment problems Increased carbon dioxide in body	None, increased depth of respiration,headache, nausea, mental depression, dizziness,air hunger, stupor, unconsciousness	CPR is necessary Administer fresh air or 100% oxygen
Pneumothorax	Overexpansion of lungs by holding breath on ascent Air forced into pleura cavity	Sudden severe chest pain, difficulty breathing, leaning to affected side, shock, cyanosis, shock	Supine position, ABC's 100% oxygen, transport to medical facility. May need recompression therapy.
Carbon Monoxide Poisoning	Breathing air contaminated with carbon monoxide Normally from exhaust fumes compressed into tank	None, clumsiness, dizzy, nausea, weakness, bad judgement, confusion, unnaturally red lips and nail beds	CPR is necessary Administer fresh air or 100% oxygen
Air Embolism	Overexpansion of lungs by holding breath on ascent Air forced into venous circulatory system	Chest pain, shortness of breath, dizzy,convulsions, unconsciousness, motor or sensory deficits, death	Supine position, ABC's, 100% oxygen, transport to recompression chamber, treat for shock
Ruptured Ear Drum	Changing depth without equalizing or a blocked eustachian tube. Allows water to enter middle ear	Pain in ear, vertigo, hearing loss, tinnitus, blood in ear or mouth, water in middle ear	Discontinue diving, put nothing in ears and keep dry. see Ear-Nose-Throat doctor
Decompression Sickness	Too rapid an ascent. Nitrogen comes out of solution and forms bubbles which lodge in tissues and other body parts	Joint pain, tenderness, staggers, weakness, visual problems, extreme fatigue, paralysis, itching skin, paraesthesia, mottling	Supine position on left or right side, ABC's, 100% oxygen, transport to recompression chamber, treat for shock
Hypothermia	Lowered body temperature due to inadequate insulation	Shivering, slurred speech, memory lapses, cyanosis, mental impairment, fumbling hands, decreased pulse and breathing	Rewarm in warm water w/o extremities, handle gently, insulate, hot-packs in vital areas
Hypoxia	Lack of oxygen normally due to inadequate % of oxygen in breathing gas.	Impaired concentration, confusion/judgement, drowsiness, weakness, lessened stamina, cyanosis	ABC's, administer gas supply with adequate % of oxygen
Nitrogen Narcosis	Breathing compression air at depths deeper than 60 fsw . Increased partial pressure of nitrogen in body	Elation, euphoria, impaired judgement, lightheadedness, sense of detachment, increased self-confidence	Reduce partial pressure of nitrogen by ascending

TO BE FILLED OUT FOR PATIENT ASSESSMENT

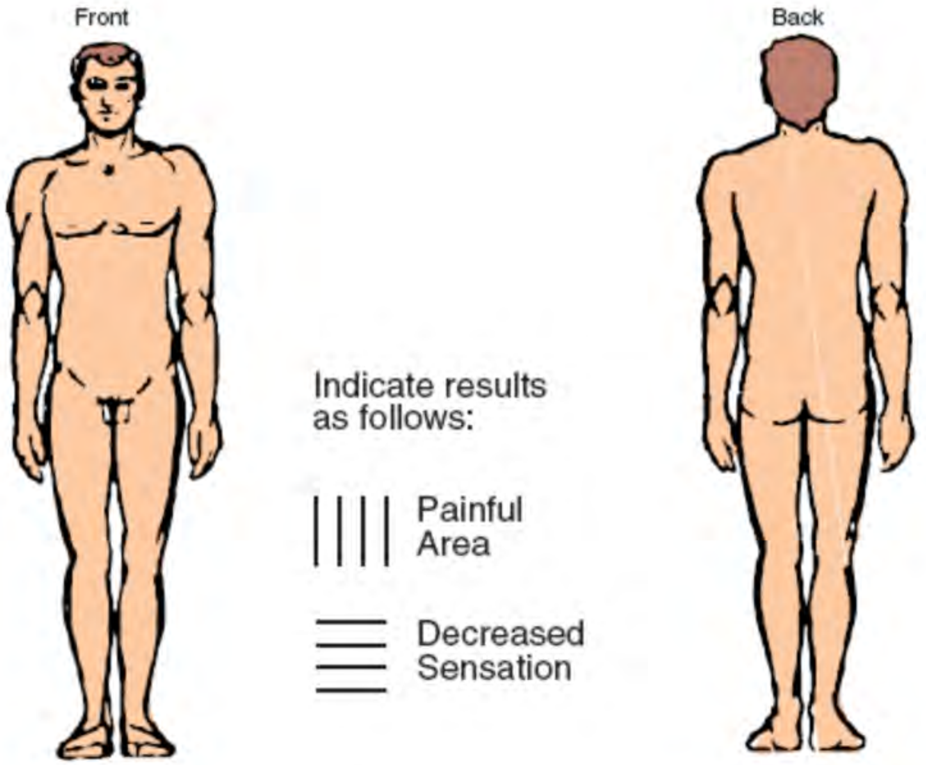
Neurological Examination* (Source: NOAA DMT Course 2009) Page 1 of 2

Note deficiencies on blue card. One person administers, one person checks off items on the list.

MENTAL STATUS/LOC	**STRENGTH**
-Alert to person, place, time	**Upper Body**
-Add a nickel, dime, quarter	-Deltoids
-Count back from 100 by 7’s	-Latissimus
	-Biceps
	-Triceps
VITAL SIGNS	-Forearms
-Pulse/min	-Hands
-Blood Pressure	**Lower Body**
-Respiration/min	-Hips
-Temperature	Flexion
	Extension
COORDINATION	Abduction
-Walk	Adduction
-Heel-to-Toe	-Knees
-Romberg	Flexion
-Finger-to-Nose	Extension
-Heel-Shin Slide	-Ankles
-Rapid Movement	Flexion
	Extension
CRANIAL NERVES	
-Vision/Visual Fields	**REFLEXES**
-Eye movements/pupils (PERRLA)	-Biceps
-Facial sensation/chewing	-Triceps
-Facial expression muscles	-Knees
-Hearing	-Ankles
-Upper mouth/throat sensation (ah)	-Toes (Babinski)
-Gag and voice	
-Shoulder shrug	
-Tongue	
SKIN SENSATION	
Exam performed by:	
Date:	
Time:	

Neurological Exam. page 2/2

Location



Indicate results as follows:

Comments:

History:

Chief complaint:

S - *(Signs and symptoms of current episode)*

O - *Onset (when problem began and what caused it)*

P - *Provocation or palliation (what makes it feel better or worse)*

Q - *Quality (what is the pain like, i.e. crushing, dull, sharp, other)*

R - *Region/radiation (where is the pain, does it move anywhere)*

S - *Severity (rated on a scale of 1 to 10)*

T - *Timing of pain (constant, intermittent, duration)*

A - *Allergies (Rx, foods, insect stings, other substances and what reaction occurred)*

M - *Medications (Rx, OTC, herbs, vitamins)*

P - *Pertinent past history (recent illnesses, injuries, surgeries)*

L - *Last oral intake (including food, liquids, alcohol, drugs)*

E - *Events leading to the injury or illness*

Dive Profile:

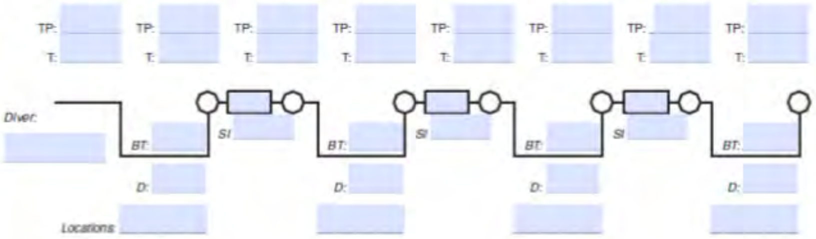
Comments:

Time ***Oxygen*** *Administration* ***Started***

Time ***Oxygen*** *Administration* ***Ended***

Further Description of the Accident:

NOTES: TP = Tank Pressure, T = Clock Time, BT = Bottom Time, D = Maximum Depth, and SI = Surface Interval



Dive History:

Date/time of occurence:

Location:

Breathing gas:

Equipment Used:

Unusual events prior to dive:

If repetitive dives, list all in last 24 hours (list most recent first):

Date	*Number of dive*	*Depth*	*Bottom time*	*Surface interval*	*Breathing gas*

Review of Systems: *(Circle and describe, add other symptoms if present, include negatives)*

a. General- Recent weight change, fever/chills, fatigue, feeling of ill health:

b. HEENT - Headaches, visual/hearing changes, ringing in ears, bleeding, sore throat, hoarseness:

c. Cardiac - Chest pain, palpitations, shortness of breath, orthopnea, edema, history of stroke, hypertension, claudication (angina of the extremities), phlebitis):

d. Pulmonary - Cough, sputum, hemoptysis:

e. Gastrointestinal- Difficulty eating, abdominal pain, nausea/vomiting, ulcers, vomiting blood, jaundice, diarrhea, liver disease:

f. Genitourinary - Dysuria, nocturia, frequency, hematuria, urgency, discharge, incontinence:

g. GYN - Discharge, menstrual history, pregnant?

h. Endocrine - Polyuria, appetite, excess thirst, heat or cold intolerance:

i. Musculoskeletal- Joint pain, stiffness, swelling, weakness:

j. Neurological- Dizziness, loss of consciousness, syncope, numbness, seizure, paresthesias:

k. Skin -itching, rashes, lumps, bruising:

Comments or additional information:

Vital:	Time:	Time	Time	Comments:
LOR				
HR				
RR				
BP				
Skin-CMT				

Name (print)	*Signature*	*Title*	*Date*

Appendix C

Standard Operating Procedure for the Analysis of Inorganic Anions in Water Samples from High Resolution Passive Profilers Using Ion Chromatography

Texas Tech University (TTU)

1. SCOPE AND APPLICATION

1.1. This method is an operating procedure for the analysis of inorganic anions (F^-, Cl^-, NO_2^-, Br^-, NO_3^-, PO_4^{3-}, and SO_4^{2-}) in water samples from High Resolution Passive Profilers (HRPP).

1.2. The method involves the filtration of water samples from the HRPP cells.

1.3. The method includes the preservation of samples at 4 °C.

1.4. The water samples are analyzed for anions following the EPA Method 300.1 *Determination of Inorganic Anions in Drinking Water by Ion Chromatography*.

2. SUMMARY OF METHOD

2.1. A 2 to 5 mL sample is extracted from the HRPP cells with the use of clean, pretested syringes

2.2. The sample is filtered through a 0.45µm capsule filter before being added to the storage vial.

2.3. The vial is stored at 4 °C.

2.4. The sample is analyzed according to EPA Method 300.1.

3. METHOD DETECTION LIMITS, INTERFERENCES AND SAFETY

3.1. The method detection limit (MDL) for all anions should be determined when a new operator begins to use the instrument or whenever, in the judgement of the laboratory, it is necessary to reevaluate the instrument capability. For MDL determination, follow the Title 40 of the Code of Federal Regulations part 136, Appendix B:

3.1.1. Select a spiking level between 2 to 10 times the expected MDL.

3.1.2. Process a minimum of seven spiked samples and seven method blank samples through all the steps of the method. The samples for MDL must be prepared in at least 3 batches on three separate calendar dates and analyzed on three separate calendar dates.

3.1.3. Calculate the sample standard deviation of the anions in the 7 MDL samples. Compute the MDL (based on spiked samples) as follows:

$$\mathrm{MDL} = t_{6,0.99}*S$$

Where $t_{6,0.99}$=3.14 is the Student's t value for a 99% confidence level with 6 degrees of freedom. *S* is the sample standard deviation (n-1).

3.2. Always work accurate and neat, because of safety and quality assurance.

3.3. Always wear a laboratory coat, gloves and safety glasses. Some chemicals are toxic and corrosive.

4. APPARATUS AND MATERIALS

4.1. Syringe and needle for extraction of water sample from HRPP cells — 10 mL Polyproylene or polyethylene.

4.2. Filter capsule — 0.45µm opening.

4.3. Storage vial — 15 ml polypropylene centrifuge tube or equivalent.

4.4. 0.5 mL (or 5 mL) Dionex™ AS-DV Autosampler PolyVials and Caps.

4.5. Dionex™ IonPac™ AG14A Guard Column.

4.6. Dionex™ IonPac™ AS14A IC Column.

4.7. Dionex™ Anion Self-Regenerating Suppressor ASRS 300.

5. REAGENTS and STANDARDS

5.1. All chemicals will be reagent grade or better

5.2. Reagent grade water (purity~18 MΩ.cm).

5.3. Sodium carbonate (Na_2CO_3).

5.4. Sodium bicarbonate ($NaHCO_3$).

5.5. Reagent grade sulfuric acid (H_2SO_4) (95 to 98% w/w, density 1.84 g/cm^3).

5.6. Stock of inorganic anions standard — 300.0 Calibration Standard - 300-CAL-A-125ML from Inorganic Ventures.

5.7. Secondary source of inorganic anions standard for quality control check— QC Standard / Instrument Performance Check - QCP-QCS-5-125ML from Inorganic Ventures.

5.8. Eluent stock solution (0.8M Na_2CO_3/0.1 M $NaHCO_3$) — In a 1 L volumetric flask, add 84.8g of Na_2CO_3, 8.4 g of $NaHCO_3$ and 0.7 L of reagent water. Agitate until all the solids are dissolved. Once there are no suspended particles, dilute with reagent water to a final volume of 1 L.

5.9. Regenerant solution for the suppressor. Pipette 1.4 mL of H_2SO_4 into 1 L of reagent water contained in a 2 L volumetric flask. Dilute with reagent water to a final volume of 2 L. Be careful when handling the sulfuric acid. Never add water directly into the acid.

5.10. Eluent solution (8mM Na_2CO_3/1mM $NaHCO_3$) — Pipette 20 mL of eluent stock solution into a 2 L volumetric flask and dilute with reagent water to a final volume of 2 L.

5.11. Nitrogen — Grade 5.0 (ultra high-purity, GC grade) nitrogen.

6. PREPARATION AND HANDLING

Sample extraction and filtration

6.1. After the HRPP has been retrieved, rinse the surface of the membrane covering the sampling cell.

6.2. Pierce the membrane with a needle and keep the needle inserted. This is going to vent the cell while the solution is being extracted.

6.3. With a separate 10 mL syringe coupled to a needle, pierce the membrane and extract the content of the cell. Do it slowly so you don't bring outer solution into the cell.

6.4. Once the solution is inside the syringe, exchange the needle for the filter capsule and inject the filtered solution into the storage vial.

6.5. The sample must be immediately preserved according to the anions that are going to be analyzed. The guidelines are presented below:

Analyte	**Preservation**	**Holding Time**
Bromide	None required	28 days
Chloride	None required	28 days
Fluoride	None required	28 days
Nitrate	Cool to 4 °C	48 hours
Nitrite	Cool to 4 °C	48 hours
Phosphate	Cool to 4 °C	48 hours
Sulfate	Cool to 4 °C	28 days

Sample preparation for analysis

6.6. Put 0.5 mL (or 5 mL) of sample in the autosampler vial and cap it. Let the sample reach room temperature before analysis.

Analysis

6.7. Analyze the prepared sample in the Dionex™ IC system following the EPA method 300.0.

7. ANALYTICAL CALIBRATION

7.1. The calibration range for each analyte cannot exceed two orders of magnitude.

7.2. There must be at least 3 calibration points per order of magnitude.

7.3. For each calibration point, prepare 20 mL of diluted standard from the stock of inorganic anions standard. These dilutions are the working standards, they should be prepared monthly and must be stored at 4 °C.

7.4. Run at least 2 samples of reagent water before the analysis of the calibration standards. For quality control purpose, the IC system may be flushed overnight with eluent before calibration.

7.5. Run each of the calibration standard solution as a regular sample in the autosampler vials. Begin the analysis with the solution having the lowest concentration and proceed with solutions having higher concentration.

7.6. For each analyte, plot the response of the instrument (peak area) against standard concentration. Typical retentions times are presented below:

Analyte	**Peak number**	**Retention time (min)**
Fluoride	1	2.53
Chloride	2	4.67
Nitrite	3	6.01
Bromide	4	8.21
Nitrate	5	9.84
Phosphate	6	11.98
Sulfate	7	13.49

7.7. After calibration curves have been established, they must be verified before conducting any sample analysis. The verification must be performed by using the secondary source of inorganic anions standard for quality control check (no dilution should be made). The recovery of each analyte should be between 75 and 125 % if its concentration is between the minimum reporting limit (MRL, i.e. the lowest calibration point) and 10xMRL; otherwise, the recovery should be between 85 and 115 %. If this criteria is not met, the calibration must be repeated.

8. DATA ANALYSIS and CALCULATIONS

8.1. Find the peak area corresponding to each analyte. The software Chromeleon™ Chromatography Data System may be helpful.

8.2. Compute sample concentration by comparing sample response with the standard curve. When the calibration curve includes two orders of magnitude, it is advised to split it into two curves, one for the lowest range and the other for the highest.

8.3. No results outside the calibration curve must be reported.

9. QUALITY CONTROL & METHOD PERFORMANCE

9.1. The MDL should be determined (see section 3.1 of this document).

9.2. Chemical Analysis: The quality control (QC) samples for chemical analysis of each anion include initial calibration check standard, second source standard check, continuous calibration verification checks, end calibration check standard, fortified sample and sample duplicate; all should meet the acceptance criteria set in the analytical methods. A complete set of appropriate guidelines can be found in Table 1.

9.2.1. Fortified sample percent recovery:

$$\% R = 100*(C_s-C)/s$$

Where:

C_s = Fortified sample concentration.

C = Sample background concentration.
s = Concentration equivalent of analyte added to sample.

9.2.2. Relative percent difference of duplicate:

$$\% \text{ RPD} = 200*(I_C-D_C)/(I_C+D_C)$$

Where:
I_C = Initial quantitated concentration.
D_C = Duplicate quantitated difference.

Note that the fortified sample can be the sample to be duplicated.

9.3. For every batch of 20 samples there must be at least two reagent blanks, two continuing calibration check standard, two fortified samples and two duplicates. See Table 2 for an analysis sequence in the IC. Note that the fortified samples and the duplicates are considered as samples within the batch.

9.4. There must be at least 5 reference blanks. Reference blanks are generated by sampling one HRPP that is prepared in the same way and at the same time as the deployed samplers. It is brought to the field with deployed samplers but it is not deployed. When the samplers are retrieved, the non-deployed sampler is also sampled identically to the deployed ones using the same needles, syringes, and filters as the rest of the profilers.

9.5. Field blanks: At least five blank samples are to be collected per sampling event. Field blanks are samples of reagent grade water collected using the same type of syringes, needles, filters and vials that are being used for the rest of the samples.

Table 1. Quality Guidelines for total Hg by CVAFS as derived from EPA 1631B method.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
MDL study	At initial set-up and subsequently once per 6-month period. Whenever a new operator begins to use the instrument.	The MDL limit for each anion in reagent water is presented in Table 1A of EPA Method 300.1. However, the MDL for a specific matrix may differ, depending upon the nature of the sample and the specific instrumentation employed.	Run MDL verification check at higher level and set MDL higher or re-conduct MDL study	NA	Samples cannot be analyzed without a valid MDL.
Initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis. Perform a new calibration when the daily initial calibration check standard fails.	Calibration curve with $R^2 \geq 0.99$.	Correct problem then repeat initial calibration.	NA	Problem must be corrected. No samples may be run until ICAL has passed.

Initial calibration check standard / Continuous calibration verification check / End calibration check standard	Prior to batch analysis, after every 10 field samples, and at the end of the analysis sequence.	Peaks within ±5 % of their retention time. Recovery between 75 and 125% for each analyte if its concentration is between MRL and 10xMRL. Otherwise, the recovery must be between 85 to 115%.	Rerun the calibration check and if it fails, reanalyze all samples since the last successful calibration verification. If repeated calibration check fails, repeat the initial calibration.	If calibration check fails and the reanalysis of samples cannot be performed, data must be qualified and explained in the case narrative.	Problem must be corrected. Results may not be reported without a valid CCV.
Second source calibration verification	Once after each initial calibration. Once every day of analysis.	Peaks within ±5 % of their retention time. Recovery between 75 and 125% for each analyte if its concentration is between MRL and 10xMRL. Otherwise, the recovery must be between 85 to 115%.	Rerun the calibration check. If repeated analysis of second source fails, repeat the initial calibration.	NA	Problem must be corrected. No samples can be analyzed until ICAL and second source calibration verification have passed.
Reagent blanks	Two per batch of 20 samples.	No analytes detected with concentration higher than ½ MRL.	Correct problem. Then, if required, prepare and reanalyze method blank and all samples processed with	NA	Problem must be corrected. Results may not be reported without a valid reagent blank.

			the contaminated blank.		
Fortified Sample	Two per every batch of 20 samples.	The recovery must be between 75 and 125 %.	If the recovery falls outside the limits, the fortified sample is reported as “matrix induced bias”.	NA	NA
Duplicate	Two per every batch of 20 samples. The duplicated sample must contain all the analytes.	The relative percent difference (RPD) must be ± 20% if analyte is below 10xMRL; otherwise, RPD must be ± 10%.	If RPD is outside the limits, results of that sample must be identified as “results yielding a poor duplicate analysis RPD”.	NA	If RPD fails with a frequency >20%, it indicates a problem with the instrument or individual technique.

Table 2: Sequence & QA/QC for THg MERX Analysis.

SI No	Sample ID	Description	Preparation	No of samples	QA/QC criteria (EPA 300.1 Criteria)
1	Reagent blank	For analytical system rinse.	Reagent water	2-4	
2	Calibration standards	Solutions prepared from dilutions of stock standard solution. Used to calibrate the instrument response with respect to analytes concentration.	Dilutions of the stock of inorganic anions standard	≥ 5 points	Linear fit $R^2 \geq 0.99$
3	Reagent blank	Used to determine sample/standard carry over, and determine the contribution of reagents.	Reagent water	1	No analytes detected with concentration higher than ½ MRL.
4	Second source calibration verification	Initial calibration verification - used to verify that calibration is accurate.	Run directly the secondary source of inorganic anions standard for quality control check	1	Peaks within ±5 % of retention time. Recovery between 75 and 125% if concentration <10xMRL. Otherwise, recovery between 85 to 115%.
5	Reagent blank	Same as above	Same as above	1	Same as above
6	Unknown samples	Unknown	Run directly or dilute.	8	Values fall within the calibration range
7	Fortified sample	Sample that has been spiked with known concentration of analytes.	Known volume of sample plus known volume of standard.	1	Recovery between 75 and 125 %.
8	Duplicate sample	Rerun one of the unknown samples or the fortified sample.	Same preparation of the sample being duplicated.	1	RPD between ± 20% if concentration below 10xMRL; otherwise, RPD between ± 10%.
9	Reagent blank	Same as above	Same as above	1	Same as above
10	CCV	Solution containing known concentrations of analytes.	Dilution of the stock of inorganic anions standard	1	Recovery between 75 and 125% if concentration <10xMRL. Otherwise, recovery between 85 to 115%.
11	Unknown samples	Unknown	Same as above.	8	Same as above.

12	Fortified sample	Same as above	Same as above	1	Same as above
13	Duplicate sample	Same as above	Same as above	1	Same as above
14	Reagent Blank	Same as above	Same as above	1	Same as above
15	End calibration check standard	Solution containing known concentrations of analytes.	Dilution of the stock of inorganic anions standard	1	Recovery between 75 and 125% if concentration <10xMRL. Otherwise, recovery between 85 to 115%.

After the first batch of 20 samples that follows the instrument calibration, the next batch starts in the point number 5.

10. REFERENCES

Department of Defense (DoD), Department of Energy (DOE). Consolidated Quality Systems Manual (QSM) for Environmental Laboratories Version 5.1 (2017). https://www.denix.osd.mil/edqw/documents/documents/qsm-version-5-1-final/

U.S. Environmental Protection Agency (1999): Method 300.1: Determination of Inorganic Anions in Drinking Water by Ion Chromatography, Revision 1.0.

Standard Operating Procedure for the Analysis of Metals in Water Samples from High Resolution Passive Profilers Using ICP-MS

Texas Tech University (TTU)

1. SCOPE AND APPLICATION

1.1. This method is an operating procedure for the analysis of metal concentrations in water samples from high resolution passive profilers (HRPP).

1.2. The method involves the extraction and filtration of water samples from the HRPP cells.

1.3. The method involves the preservation of the samples with Nitric acid (HNO_3).

1.4. This procedure generates samples that can be analyzed for metals following the EPA Method 220.8: D*etermination of Trace Metals in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry*.

2. SUMMARY OF METHOD

2.1. A 4 to 10 mL sample is extracted from the HRPP cells with the use of clean, pretested syringes and stainless steel needles.

2.2. The sample is filtered through a 0.45µm syringe filter before being added to the storage vial.

2.3. The sample is preserved by addition of HNO_3.

2.4. The sample is then analyzed for selected trace metals according to EPA method 200.8.

3. METHOD DETECTION LIMITS, INTERFERENCES AND SAFETY

3.1. The method detection limit (MDL) for each metal of interest is to be determined prior to analysis based on the method. Method estimated DL for metals of interest are 0.02, 0.04, 0.015, 0.006, and 0.07 ug/l for As, Cr, Pb, V, and Zn, respectively. The MDL should be determined when a new operator begins to use the instrument or whenever, in the judgement of the laboratory, it is necessary to reevaluate the instrument capability and should be established annually. For MDL determination, follow guidelines in EPA 200.8.:

   3.1.1. Select a spiking level between 2 to 5 times the expected MDL.

   3.1.2. Process a minimum of seven spiked samples and seven method blank samples through all the steps of the method. The samples for MDL must be prepared in at least 3 batches on three separate calendar dates and analyzed on three separate calendar dates.

   3.1.3. Calculate the sample standard deviation of the 7 MDL samples. Compute the MDL (based on spiked samples) as follows:

$$\text{MDL} = t_{6,0.99}{*}S$$

Where $t_{6,0.99}$=3.14 is the Student’s t value for a 99% confidence level with 6 degrees of freedom. S is the sample standard deviation (n-1).

3.2. Always work accurately and neat, because of safety and quality assurance.

3.3. Always wear a laboratory coat, gloves and safety glasses; some chemicals are very toxic and corrosive.

3.4. Use a permanent fume hood when working with concentrated acids and powerful oxidants.

4. APPARATUS AND MATERIALS

4.1. Syringe and needle for extraction of water sample from HRPP cells — 10 mL Polyproylene or polyethylene and 20 gauge stainless steel needles.

4.2. Syringe Filter — 0.45μm opening.

4.3. Preservation vials — 15 mL polypropylene centrifuge tubes or equivalent.

5. REAGENTS and STANDARDS

5.1. All chemicals will be reagent grade or better. All acids will be trace metal grade.

5.2. Reagent grade water (purity~18 MΩ.cm).

5.3. Concentrated HNO_3.

5.4. Certified Metal Standards.

5.5. Argon—Grade 5.0 (ultra high-purity, GC grade) argon.

6. PREPARATION AND HANDLING

Sample extraction and filtration

6.1. After the HRPP has been retrieved, rinse the surface of the membrane covering the sampling cell.

6.2. With 10 mL syringe coupled to a needle, pierce the membrane and extract the content of the cell.

6.3. Once the solution is inside the syringe, exchange the needle for the syringe filter and inject the filtered solution into the storage vial.

6.4. The sample must be preserved within 48 hours of collection with either 0.5 % V/V of concentrated HNO_3. One option is to have the storage vial preloaded with the amount of concentrated HNO_3 to reach a concentration 0.5 % V/V.

6.5. Sample preparation for analysis

Analysis

6.6. Analyze the prepared sample in the ICP-MS ELAN DRC-e (Perkin Elmer-SCIEX) following the EPA method 200.8.

7. ANALYTICAL CALIBRATION

7.1. Pre-calibration routine. Allow instrument to warm up for >30 min. Conduct mass calibration and resolution checks using tuning solution. Adjust spectrometer resolution to produce a peak width of approximately 0.75AMU at 5% peak height. Adjust mass calibration if shifted > 0.1amu.

7.2. Instrument stability demonstrated by running tuning solution >5 times with <5% relative standard deviation.

7.3. Add internal standards using either Method A or Method B.

7.4. Calibrate instrument using Calibration Standards A and B and calibration blanks.

7.5. Analyze the standards beginning with the lowest concentration and proceeding to the highest.

7.6. Prepare and analyze a minimum of 3 system blanks and tabulate the peak areas. Calculate the mean peak area for the system blank.

8. QUALITY CONTROL & METHOD PERFORMANCE

8.1. Chemical Analysis: The quality control (QC) samples for chemical analysis include initial calibration, second source standard checks, continuous calibration verification checks, matrix spike and matrix spike duplicates; all should meet the acceptance criterion set in the analytical methods. A complete set of appropriate guidelines can be found in Table 1.

8.1.1. Matrix spike percent recovery:

$$\% R = 100*(A-B)/T$$

Where:

A = Measured amount of metal after spiking.

B = Measured amount of metal before spiking.

T = True concentration of the spike. The spiking level shall be 1-5 times the background concentration.

8.1.2. Relative percent difference of matrix spike duplicates:

$$\% \text{ RPD} = 200*(|D1-D2|)/(\text{D1}+\text{D2})$$

Where:

D1 = concentration of Metal in the matrix spike sample.

D2 = concentration of Metal in the matrix spike duplicate sample.

8.2. For every batch of 10 samples there must be at least one reagent blank, one laboratory fortified blank, one continuing calibration check, and two matrix spikes.

8.3. There must be at least 5 equipment blanks. Equipment blanks are generated by sampling a sHRPP that is prepared in the same way and at the same time as deployed samplers. It is brought to the field with deployed samplers but not deployed. When the samplers are retrieved the non-deployed sampler is also sampled identically to the deployed using the same needles, syringes, filters, and acid as the rest of the profilers.

8.4. Field blanks: At least five blank samples are to be collected per sampling event. Field blanks are samples of reagent grade water collected using the same type of syringes, needles, filters and vials that are being used for the rest of the samples.

Table 1. Quality Guidelines for Metals by EPA 200.8 method.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
MDL study	At initial set-up and subsequently once per 12-month period. Whenever a new operator begins to use the instrument.	< 0.5 µg/L	Run MDL verification check at higher level and set MDL higher or re-conduct MDL study	NA	Samples cannot be analyzed without a valid MDL.
Minimum five-point initial calibration for all analytes (ICAL)	Initial calibration prior to sample analysis	See EAP 200.8 for criteria.	Correct problem then repeat initial calibration.	NA	Problem must be corrected. No samples may be run until ICAL has passed.
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis	Recovery between 85 and 115 % for all analytes.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since	If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples

	sequence.		the last successful calibration verification.		cannot be reanalyzed.
Second source calibration verification (ICV)	Once every two batches.	Recovery between 85 and 115 % for all analytes.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL	NA	Problem must be corrected. No samples may be run until calibration has been verified.
Method blank	One per batch of 10 samples.	The mean result for the two system blanks must be < 2*MDL or 10% of a sample. If not the system is out of control.	Correct problem. Then, if required, prepare and reanalyze method blank and all samples processed with the contaminated blank.	NA	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	One each per every batch of 10 samples.	The recovery must be between 70 and 130 %. The relative percent difference between MS and MSD must be less or equal to 25%.	If results of the MS/MSD are similar and fail the acceptance criteria, the problem is judged to be matrix related, not system related.	NA	The data user should be informed that the result for that analyte in the unfortified sample is suspect due to either the heterogeneous nature of the sample or an uncorrected matrix effect.
Results reported between MDL and MRL	NA	NA	NA	Apply J-flag to all results between MDL and MRL (minimum reporting limit).	

Table 2: Sequence & QA/QC for Metal Analysis.

SI No	Sample ID	Description	Preparation	No of samples	QA/QC criteria (EPA 1631 Criteria)
1	Equipment Blank	Method blank.	Ultra-pure reagent water with 2% V/V concentrated HNO_3 and internal standard.	1	
2	Calibration standards	A solution prepared from the dilution of stock standard solutions. Used to calibrate the instrument response with respect to analytes concentration.	Dilution of stock solutions with 2% V/V concentrated HNO_3 and internal standard.	≥ 5 point	Linear fit $R^2 \geq 0.995$ (or) % RSD of
3	Equipment Blank	Same as above	Same as above	1	
4	ICV/VER	Initial calibration verification - used to verify that a calibration is accurate. The source must be different than that of analyte standards.	Known dilution of stock solution with 2% V/V concentrated HNO_3 and internal standard.	1	85-115% Recovery for all analytes
5	CCV	A solution with a known concentration of analytes prepared from the dilution of stock standard solutions.	Dilution of stock solutions with 2% V/V concentrated HNO_3 and internal standard.	1	85-115% Recovery for all analytes
6	Unknown samples	Unknown	Prepared with 2% V/V concentrated HNO_3 and internal standard.	10	Values fall within the calibration range
7	Matrix Spike	One of the unknown samples that is spiked with a known amount of analytes from the stock standards.	Unknown sample plus spike. Prepared with 2% V/V concentrated HNO_3 and internal standard.	1	Recovery of spike between 70-130 %.
8	Matrix Spike Duplicate	Prepared in the same way as the matrix spike.	Same as matrix spike.	1	Relative percent difference between MS and MSD must be less or equal to 25%.
9	Equipment Blank	Same as above	Same as above	1	

10	CCV	Same as above	Same as above	1	Same as above
11	Unknown samples	Unknown	Same as above	10	Same as above
12	Matrix Spike	Same as above	Same as above	1	Same as above
13	Matrix Spike Duplicate	Same as above	Same as above	1	Same as above

After 20 samples, go to step 3.

9. REFERENCES

Department of Defense (DoD), Department of Energy (DOE). Consolidated Quality Systems Manual (QSM) for Environmental Laboratories Version 5.1 (2017). https://www.denix.osd.mil/edqw/documents/documents/qsm-version-5-1-final/

U.S. Environmental Protection Agency (1994) Method 200.8, Revision 5.4: Determination of trace metals in water and wastes by inductively coupled plasma – Mass Spectrometry.

Appendix D

TISSUE SAMPLE PREPARATION

ALS-KELSO

SOP ID:	MET-TISP	Rev. Number:	11	Effective Date:	2/23/17

Approved By: ______________________ Date: 2/14/17
Department Manager/Technical Director – Jeff Coronado

Approved By: ______________________ Date: 2/14/17
QA Manager – Carl Degner

Approved By: ______________________ Date: 2/14/17
Laboratory Director – Jeff Grindstaff

Issue Date: ___________ Doc Control ID#: ____________ Issued To: ____________

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

ALS-Kelso SOP Annual Review Statement

SOP Code: MET-TISP
Revision: 11

An annual review of the SOP listed was completed on (date): **1-2-19**

☒ The SOP reflects current practices and requires no procedural changes.

Supervisor: L.J.   Date: 1-2-19

☐ Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	**Description of Revision Needed**	**Date Procedure Change Implemented**	**Supervisor Initials** Indicating Approval of Revision

ALS-Kelso SOP Annual Review Statement

SOP Code: MET-TISP

Revision: 11

Attach additional pages or information if necessary

ALS-Kelso SOP Annual Review Statement

SOP Code: MET-TISP
Revision: 11

An annual review of the SOP listed was completed on (date): _____

☐ The SOP reflects current practices and requires no procedural changes.

Supervisor: Date:

☒ Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	**Description of Revision Needed**	**Date Procedure Change Implemented**	**Supervisor Initials** Indicating Approval of Revision
11.2.2.2	Talc free Vinyl gloves remove nitrile.	3-9-17	L.J.
11.2.2.3	Remove A and remove Vinyl glove.	3-9-17	L.J.

TABLE OF CONTENTS

TISSUE SAMPLE PREPARATION

1. SCOPE AND APPLICATION

1.1. This standard operating procedure describes procedures for the initial preparation of tissue samples prior to sample analysis. Customer-specific contracts or statement of works (SOWs) with alternate procedures will take precedence over this SOP.

1.2. This SOP is intended to provide guidance for the preliminary preparation of tissue samples prior to the sample aliquoting and analytical preparation described in individual analytical SOPs. The procedures described in this SOP also apply to compositing and subsampling of tissue samples for analyses to be subcontracted.

2. METHOD SUMMARY

2.1. Tissue samples are inherently heterogeneous requiring special considerations in order to obtain a truly representative sample aliquot for analysis. This SOP provides guidance for handling tissue samples prior to the sample preparation steps described in analytical SOPs. This SOP applies to samples delivered to the lab in whole body form or in the form of pre-dissected tissues.

2.2. The sample handling strategy must consider:

- what analyses are to be performed (metals, organics, or both, and VOC or non-VOC),
- how much sample is available
- are the analyses to be performed on individual samples or composite homogenates,
- are the analyses to be performed on whole body, edible portions or specific organs, and
- are any of the analyses going to be subcontracted which may require subsampling.

2.3. Proper preparation and handling of tissue samples is required to obtain a representative sample, avoid contamination, and to ensure loss of sample and target constituents is minimized.

3. DEFINITIONS

3.1. Sample: The material presented to the laboratory for analysis or testing.

3.2. Sample Aliquot: A representative part or portion of a sample for analysis which is a fraction of the whole sample. See subsampling also.

3.3. Compositing: The process by which sample aliquots from two or more samples are united to form a combined sample which is subsequently analyzed.

3.4. Subsampling: The process by which a representative portion is obtained from a whole sample.

3.5. Service Request: The service request (SR) is a document prepared at the time of sample receipt and summarizes sample analysis and reporting instructions about a customer's sample(s).

3.6. QAPP: Quality Assurance Project Plan document provided by the client specifically written for their project.

3.7. VOC Analyses: Volatile organic compounds (VOC) analyses, including halogenated and aromatic volatile organic compounds and gasoline range organics (GRO) analyses.

3.8. Non-VOC Analyses: Any analysis other than a VOC analysis.

4. INTERFERENCES

4.1. If precautions are not taken, cross-contamination can occur when handling tissue samples in large quantities. Equipment must be thoroughly cleaned as described in this SOP and related SOPs. Also, the SOP describes the use of homogenization and rinsate blanks to monitor any possible contamination.

4.2. For organics samples, polypropylene and polyethylene (plastic) surfaces, implements, and containers are a potential source of adsorption and contamination and should not be used. Gloves should be talc free and of non-contaminating materials.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.1.1. A Cut and Puncture resistant glove should be worn underneath the talc-free, vinyl glove/nitrile glove on the hand opposite the hand being used for cutting.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Refer to the determinative method.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Not applicable to this procedure.

8. APPARATUS AND EQUIPMENT

8.1. Refer to the Procedure section for specific equipment used based on the determinative analysis to be performed. The use of implements and surfaces may vary depending on the analyses to be performed.

8.2. Hobart Food Chopper, or comparable device.

8.3. Tissumizer.

8.4. Waring blender, or similar device.

8.5. Freeze-drier, Labonco or equivalent.

8.6. Glass or PTFE cutting boards.

8.7. Knives and cutting implements – refer to Procedure section.

8.8. Standard laboratory glassware (beakers, scintillation vials, etc.)

8.9. VOA vial – pre-cleaned, 40ml with Teflon-lined cap.

8.10. Pre-cleaned glass jars with PTFE lined lids, various sizes.

8.11. Gloves

8.11.1. Metals Analysis: talc-free, contamination-free vinyl gloves.

8.11.2. Organics Analysis: talc-free, contamination-free nitrile gloves.

8.11.3. Cut and Puncture resistant glove.

8.12. Heavy duty aluminum foil.

9. PREVENTIVE MAINTENANCE

9.1. No specific maintenance steps are needed other than normal cleaning and inspection of apparatus.

9.2. For organics samples, polypropylene and polyethylene (plastic) surfaces, implements, and containers are a potential source of adsorption and contamination and should not be used. Gloves should be talc free and of non-contaminating materials.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. Sample custodians, together with project managers and department supervisors, are responsible for documenting any required sample preparation (including the percent solids or percent lipids determination if required) on the service request. All personnel preparing tissue samples should be familiar with the contents of this document prior to commencing work.

10.3. Tissue sample preparation is to be performed only by lab analysts instructed in the proper handling techniques outlined in this SOP. It is the responsibility of the analyst to perform this procedure to complete all documentation required for data review.

11. PROCEDURE

11.1. Sample Login

11.1.1. Any special sample handling must be noted on the service request and on a label attached to the sample itself. During sample receiving, a sample custodian must follow the procedures described below.

11.1.2. Tissue Samples with Limited Quantity

11.1.2.1. An assessment of the required sample quantity should be made by the project chemist when taking delivery of the sample. This assessment must take into consideration the tests, the required detection limits and the necessary quality assurance samples. If the quantity of sample given to the laboratory is insufficient for the analyses requested, the sample custodian will, along with the project chemist estimate the total amount of sample available. A “LIMITED SAMPLE VOLUME” tag is attached to the sample on which is recorded the estimated sample quantity.

11.1.2.2. In some cases it may be beneficial to perform sample preparations as described in this SOP prior to estimating the sample amount. In this case, the analyst preparing the sample will provide the project chemist with an estimate of the amount available.

11.1.2.3. The project manager must determine if limited sample quantity exists and set the priorities for the analyses and, if possible, estimate the quantity of sample to be *used for each test*. This information is to be documented and placed in the project file and on the service request to communicate to the laboratory staff. For example, 8081 use 10 g; metals use 1g.

11.1.2.4. NOTE. Samples that are quantity limited and require multiple analyses must be identified as soon as possible. Optimally, this should happen during sample login; however, discovery at any time should trigger appropriate actions.

11.2. Sample Homogenization

11.2.1. This section outlines the steps for preparing homogenous samples of whole fish, edible fish (fillets), edible shellfish, worm composite homogenates, eggs, and plant tissues.

11.2.1.1. Samples for Organics Analyses:

11.2.1.1.1. Equipment used for the processing of tissue samples for organics analyses should be stainless steel, anodized aluminum, glass or polytetrafluorethylene (PTFE). Polypropylene and polyethylene (plastic) surfaces, implements, and containers are a potential source of adsorption and contamination and should not be used. Gloves worn should be talc free, nitrile, consisting of contamination free materials. A Cut and Puncture resistant glove should be worn underneath the talc-free, nitrile glove on the opposite hand not being used for cutting. Filleting should be done on glass or PTFE cutting boards that are cleaned properly between samples or on cutting boards that are covered with heavy duty aluminum foil (hexane rinsed) that is changed between samples. Tissue should be handled with pre-cleaned, high quality, corrosion-resistant stainless steel instruments. Fillets or homogenate should be stored in cleaned glass jars of suitable dimensions with PTFE lined lids. If the sample is to be analyzed for VOCs, the homogenization steps should be performed on sample tissue that is partially frozen or chilled. An aliquot of the homogenate should be placed in a clean 40 mL VOA vial and libeled “FOR VOA ANALYSIS ONLY”.

11.2.1.1.2. Prior to handling each sample, utensils, cutting boards and containers should be washed in a detergent hot water solution and rinsed with tap water, hexane, and DI water. Pre-cleaned, certified sample containers may be used without further cleaning. If the sample is to be analyzed for VOCs, methanol is substituted for the rinsing of implements with acetone and the hexane rinsing of the aluminum foil. Exposure to solvent vapors must be minimized.

11.2.2. Samples for Metals Analyses:

11.2.2.1. Equipment used in the processing of samples for metals analyses should be of PTFE, ceramic, polypropylene or polyethylene. Filleting should be performed on PTFE cutting boards which are cleaned after each sample. Knives with titanium or high quality stainless steel blades may be used for tissue resections. Tissue should be stored in glass jars with PTFE lined lids.

11.2.2.2. A Cut and Puncture resistant glove should be worn underneath the talc-free, vinyl or vinyl/nitrile glove on the opposite hand not being used for cutting.

11.2.2.3. Prior to sample handling, utensils, cutting boards and containers should be washed in a detergent hot water solution, rinsed with tap water, 25% HCl (except metal utensils), and DI water. Pre-cleaned, certified sample containers may be used without further cleaning.

11.2.3. Samples for both Metals and Organics Analyses:

11.2.3.1. If the sample is to be prepared for both organics and metals, care must be taken to use equipment and cleaning procedures that are non-contaminating for both. Quartz, ceramic, glass and PTFE are recommended materials for sample processing equipment. Knives with titanium or high quality stainless steel blades may be used for tissue resections. Glass or PTFE cutting boards should be used. If the sample is to be analyzed for VOC's, the homogenization steps should be performed on sample tissue that is partially frozen or chilled. An aliquot of the homogenate should be placed in a clean 40mL VOA vial and labeled "FOR VOA ANALYSIS ONLY".

11.2.3.2.Prior to handling each sample, utensils, cutting boards and containers should be washed in a detergent hot water solution and rinsed with tap water, acetone, methanol, or hexane (as appropriate), and DI water. Pre-cleaned, certified sample containers may be used without further cleaning. Non-metallic surfaces and utensils should also be rinsed with 25% HCl followed by DI water. If the sample is to be analyzed for VOCs, methanol is substituted for the rinsing of implements with acetone. Exposure to solvent vapors must be minimized.

11.2.3.3.A Cut and Puncture resistant glove should be worn underneath the talc-free, vinyl/nitrile glove on the opposite hand not being used for cutting.

11.2.4. Sample Preparation

11.2.4.1.Each tissue sample may be homogenized in the original glass bottle container if there is sufficient space to allow thorough mixing. If homogenization is not achievable in the original container, place the entire sample contents into a clean glass jar. Generally, liquids contained in the container are to be considered part of the sample. If the sample requires size reduction prior to homogenization, chop the sample into the 1-2" chunks using a titanium or stainless steel bladed knife. Large samples may require the use of industrial food processors such as a Hobart Food Chopper, or comparable device. Size-reduced chunks of tissue are thoroughly homogenized to a paste-like consistency using a Tissumizer, Waring blender, or similar device until it reaches a paste-like consistency. Transfer the sample paste to a glass jar for storage and freeze until ready for sample extraction. The new sample container is labeled with the sample I.D., the word "homogenized", initialed, and dated.

11.2.4.2.Whole Fish Tissue

11.2.4.2.1.Samples may be frozen in the field or in the laboratory. While still partially frozen, rinse the fish with DI water to remove extraneous materials and liquids. Cut the fish into appropriate size chunks and mechanically macerate the sample using cutting tools appropriate for the size of the sample and the analysis type. If necessary, process fish tissue chunks through the Hobart Food Chopper. To ensure thorough mixing, divide the ground sample into quarters, mix opposite quarters and then mix halves. Homogenize sample using a Tissumizer or Waring blender until it reaches a paste-like consistency. Transfer the sample paste to a glass jar for storage and freeze until ready for sample extraction. The new sample container is labeled with the sample I.D., the word "homogenized", initialed, and dated.

11.2.4.3.Edible Fish Tissue

11.2.4.3.1. If the client or QAPP indicates that only edible tissue be analyzed, the fish must be filleted. If the sample arrives pre-filleted, the sample tissue may be frozen before processing. If the sample is not yet filleted, the sample should remain chilled until the filleting is completed. Freezing can result in the contamination of edible tissues from the bursting of internal organs. Fish having ruptured internal organs should be noted on the prep benchsheet and the Project Manager consulted. Rinse the fish with DI water to remove extraneous materials and liquids. Remove scales from scaled fish or skin from non-scaled fish. Rinse the fish again prior to filleting. A separate or clean cutting board should be used for filleting. Gloves should be changed between samples. Carefully remove the fillets from the carcass by following the steps outlined in Appendix A. Care should be taken to avoid contaminating fillet with inadvertent puncture of internal organs. Cut the fillet tissue into appropriate size chunks and mechanically macerate the sample using cutting and grinding tools appropriate for the size of the sample and the analysis type. Proper selection of maceration equipment must consider the potential contaminants, sample size/volume and amount of tissue likely to be lost in using the equipment.

Divide the ground sample into quarters, mix opposite quarters and then mix halves. Again homogenize the sample using an appropriate blending mixer. Continue repeating this process until the sample is truly homogenous and no chunks of tissue remain. Freeze sample until ready for extraction.

11.2.4.4. Shellfish Tissue

11.2.4.4.1. Shellfish should be frozen as soon as possible after receipt by the laboratory unless samples can be prepared within 48 hours of sampling. Edible portions of various shellfish are described below and resection described in Appendix B. Thawing of frozen shellfish samples should be kept to a minimum during tissue removal to avoid loss of liquids. Shellfish should be rinsed with DI water prior to tissue removal to dislodge external debris. When multiple organisms constitute a single sample, the edible tissues are collected, composited and homogenized.

11.2.4.5. Bivalve mollusks (oysters, clams, mussels, and scallops).

11.2.4.5.1. Bivalves are typically prepared by severing the adductor muscle, prying open the shell, and removing all of the soft tissue. The soft tissue includes viscera, meat, and body fluids.

11.2.4.6. Crabs

11.2.4.6.1. Edible tissue includes all leg and claw meat, back shell meat and body cavity meat. Internal organs generally are removed. If the crab is soft shelled, the entire crab is used in the sample.

11.2.4.7. Shrimp and Crayfish - Edible tissue includes the tail meat.

11.2.4.8.Lobster - Edible tissue includes the tail and claw meat.

11.2.4.9.Worms

11.2.4.9.1.Samples are typically supplied to the lab in sample jars containing multiple organisms. Liquid and specimens constitute the entire sample and are blended together typically in the sample container. When a worm sample containing dirt particles or significant amounts of water is encountered, the technician should contact the project manager to seek guidance from the client.

11.2.4.10.Eggs

11.2.4.10.1.Avian eggs are typically removed from the shell and blended. Aquatic eggs are blended including the soft shell.

11.2.4.11.Internal Organs Extraction

11.2.4.11.1.Organs such as livers or kidneys must be identified and removed by an experienced sample technician following clear written resection procedures or other guidance provided by the client.

11.2.4.12.Plant Tissue

11.2.4.12.1.Plant tissue should be handled using the size reduction, homogenization and implement cleaning steps as outlined. Where these procedures are inappropriate, specific written procedures or guidance from the client is recommended.

11.2.4.12.2.If drying is requested by the client or is project-specified, a subsample for mercury analysis is taken from the wet sample, and then the plant tissue is dried at 60˚C prior to homogenization.

11.2.4.13.Small Mammals and Rodents

11.2.4.13.1.There are two primary concerns in working with small mammals and rodents: safety and sample homogenization.

11.2.4.13.2.Small mammals are potential carriers of lethal viruses, such as hantavirus and rabies, and bacteria that can be contracted through inhalation or direct contact. Typically, these organisms are excreted in the feces and distributed on the air as the fecal matter dries. During the sample preparation process, tissue is typically freeze-dried in order to calculate a percent solids value and to analyze for metals. As such, it is possible to increase the potential for dispersion of the bacteria or viruses after the sample is homogenized and processed. Prior to processing, all samples should be stored frozen.

11.2.4.13.3.Prior to sample homogenization, instructions should be received from the client regarding the processing of the hide. For organics, it is recommended that the hides be left on the carcass and the entire sample be homogenized. For metals, there is a potential for accumulation in the hair. As a non-digestible portion of the rodent, inclusion of the hair may result in a high bias if the data is to be used in estimating bioaccumulation up the food chain. Skinning may be a preferred alternative when metals are the primary chemicals of concern.

11.2.4.13.4.Homogenization should be done while the carcass is still partially frozen.

11.2.4.13.5.If the hide is to be included in the homogenization, snip the feet from the animal using stainless steel scissors.

11.2.4.13.6.The tail should be removed if it will prevent complete homogenization of the sample (e.g., the tail of a mouse or rat may result in incomplete homogenization and should not be included with the sample). Remove seeds, grasses, and mud from the hide.

11.2.4.13.7.If the hide is to be removed from the carcass, make an incision through the skin on the back of the neck (do not cut into the muscle). In most cases, the hide can be removed by pulling the incision horizontally along the back in one direction, and over the ears, head and snout in the opposite direction. The eyes are usually lost during this procedure. Continue to skin the animal by peeling the hide over the hind legs, off the underside of the animal, and around the front legs. The hide is removed at the hind legs and the snout. Care should be taken not to tear the connective tissue under the hide. Fat should be scraped from the hide when possible and included with the sample. Rinse the skinned carcass with DI water to remove any hair or dirt that has accumulated during the skinning procedure.

11.2.4.13.8.Homogenize the sample using a stainless steel Waring blender. Select a blender cup that is sized in accordance with the amount of sample to be homogenized. That is, small samples should be homogenized using small blender cups. This will improve the overall homogenization and recovery of the sample. Continue to mix the sample into a paste like consistency. Make sure no chunks of muscle, hide, or bone are distributed in the sample. Transfer the sample paste to a glass jar for storage and freeze. The new sample container is labeled “homogenized”, initialed, and dated.

11.2.5. General Provision for Handling Large Sample Mass

11.2.5.1.In some cases, large specimens will be received by the laboratory for homogenization prior to chemical analysis. For the purpose of this SOP, ‘large’ is defined as requiring preliminary size reduction to allow sequential processing of the sample. Sub-samples of the whole specimen should be cut to a size appropriate for the blender, mixer, or grinder that will be used. After each individual fraction is processed, the homogenized material is added to a reservoir large enough to hold all fractions as they accumulate. The reservoir will be constructed of a material suitable for the analytical application as defined. For very large specimens (i.e. >20 pounds), high grade stainless steel containers are used (large bowls or small drums).

11.2.5.2. Blending of the combined fractions to achieve a whole homogenous material is achieved via manual mixing. In general, this is accomplished using a high grade stainless steel paddle or spoon of appropriate size (i.e. relative to the whole homogenate). Very large specimens (i.e. >20 pounds) generally require secondary processing through the grinder, particularly when large amounts of skin, bone, and/or cartilage is present. In these cases, the Hobart grinder is generally used.

11.3. Compositing

11.3.1. Each sample is to be logged in and receive a lab code. Additionally, the sample composite also is assigned a lab code. The compositing process is to be performed by trained staff. It is to be performed in an area free of contamination. It is imperative that the samples are treated in a manner consistent with the requirements of the tests to be performed on the composited sample. Compositing of homogenates should be performed according to this SOP or specific instructions provided by the client.

11.3.2. Documentation (use applicable bench sheet)

The analyst preparing the composite will document

- that homogenization was done before removing an aliquot,
- the quantity of each (field or discrete) sample used for the composite,
- the date and time of compositing, and
- any other pertinent observations.

11.3.3. Tissue Samples with Limited Quantity

11.3.3.1. Samples and sample composites that are quantity limited will be handled by the same procedure.

11.3.4. Compositing Procedure

11.3.4.1. Each tissue sample is first homogenized.

11.3.4.2. An equal weight of sample aliquot from each of the homogenized samples is weighed into a clean glass sample bottle. The amount to be weighed of each sample will depend upon the number of analyses to be performed on the composite and if the quantity of any individual sample is limited.

11.3.4.3. The mixture of the individual sample aliquots is thoroughly homogenized in the glass container. The composite sample bottle is labeled with:

- the name of the composite,
- the lab code of the composite,
- the analyst's initials
- the date of composite preparation
- The composite sample and the remaining (individual, discrete) samples are stored frozen until analysis.

11.3.5. Tissue Samples Requiring VOC Analyses

11.3.5.1. A separate aliquot of the composite homogenate should be placed in 40 mL VOA vial container for later analysis by the VOA department. Each container should be labeled with the lab identifier, date, initials, and “FOR VOA ANALYSIS ONLY”. To minimize losses of volatile constituents, the sample should be kept as cold as possible, the work should be completed as quickly as possible, and the VOA vial filled to the top to minimize head space.

11.4. Sub-sampling

The sample is first thoroughly homogenized. A sample aliquot is removed and placed into a clean glass container of appropriate size and labeled as follows:

- the name of the sample,
- the lab code of the sample,
- “homogenized” written on the label,
- the purpose of the sub-sample (e.g. “dioxin subsample”)
- the analyst’s initials
- the date.

11.5. Freeze-Drying

11.5.1. Depending on project specifications, samples may require freeze-drying. Freeze-drying may be performed on a separate portion of sample to determine % Freeze-Dried Solids, or may be done on the analytical subsample for certain tests. The analyst should obtain direction from the supervisor and/or Project Chemist.

11.5.2. Weigh 5-8 g of sample (wet weight) into a scintillation vial. Freeze the sample for at least 2 hours.

11.5.3. Remove the sample from the freezer and place in the freeze drier for at least 24 hours or longer if necessary for the particular sample matrix.

11.5.4. Record the measurements on the applicable bench sheet.

11.5.5. When freeze drying samples that require PFOA/PFOA, aluminum foil must be placed on the container before putting the lid on, after the freeze drying process and before freezing the sample.

12. QA/QC REQUIREMENTS

12.1. A rinsate blank should be prepared to accompany each batch of tissue samples. The blank is comprised of a collection of DI water rinses of cleaned equipment (knives, cutting boards and mixers/grinders) ***prior*** to the commencement of sample batch preparation. If contamination of the samples is suspected, the rinsate blank is extracted and analyzed for contaminants. The rinsate blank should be labeled with the extraction date and the associated SR numbers and stored at 4° C. In the event that contamination is suspected, the rinsate blank can be analyzed to confirm the presence of contaminants in the tissue preparation process.

12.2. A homogenization blank is prepared to determine if the homogenization equipment was effectively cleaned between samples. Unless a project plan specifies otherwise, the laboratory prepares two homogenization blanks with each shift of sample preparation. One is a 500 mL aliquot for Metals testing and the other is a 1000 mL aliquot for Organics testing. Any requirements other than the labs default procedure must be defined in the project plan and communicated to the laboratory.

12.2.1. Some project quality plans may require homogenization blanks between each sample. Following the blending of a tissue sample decontaminate the Hobart mixer (model HCM62) by following these steps:

- Wash the bowl, blade assembly, and lid with soap and hot water.
- Rinse all parts with deionized water.
- Move to fume hood and hexane rinse all parts.
- Allow excess hexane to evaporate.

12.2.2. Reassemble the mixer and make ready for the next sample.

12.2.3. Fill the bowl with deionized water and turn the mixer on for the approximately average time used for the type of samples being processed.

12.2.4. Aliquot the deionized water to bottles appropriate for the testing being conducted and preserve accordingly. If insufficient sample volume is produced for the required testing, repeat the procedure after the next tissue sample is homogenized.

13. DATA REDUCTION AND REPORTING

13.1. Sample handling documentation must include information about sample homogenization (was it done or not), compositing, and sub-sampling. The established and applicable data be

13.2. nch sheets provide a means for recording this information. Completed bench sheets listing the sample handling information are filed in the project file with the raw data.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision

- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. Refer to determinative methods.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

16.3. This method uses non-halogenated solvents and any waste generated from this solvent must be collected. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

17. TRAINING

17.1. Training outline – Training Plan

17.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst until the supervisor feels the new employee can work independently. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.2. Training is documented following the *ALS-Kelso Training Procedure* (ADM-TRAIN).

17.3. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. This section is not applicable because this procedure is a laboratory developed method.

19. REFERENCES

19.1. Kateman and L. Buydens, *Quality Control in Analytical Chemistry*, Second Edition, John Wiley & Sons, Inc., New York, NY, 1993: Chapter 2 on Sampling and especially sections 2.5 (Sample Quality) and 2.7 (Handling of Samples).

19.2. *Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories;* Volume 1; Fish Sampling and Analysis, 3rd Edition; USEPA Office of Water; EPA 823-B-00-007; Nov 2000.

19.3. *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*; Tetra Tech, Inc.; final report TC-3991-04 Recommended Guidelines for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples Revision April 1996.

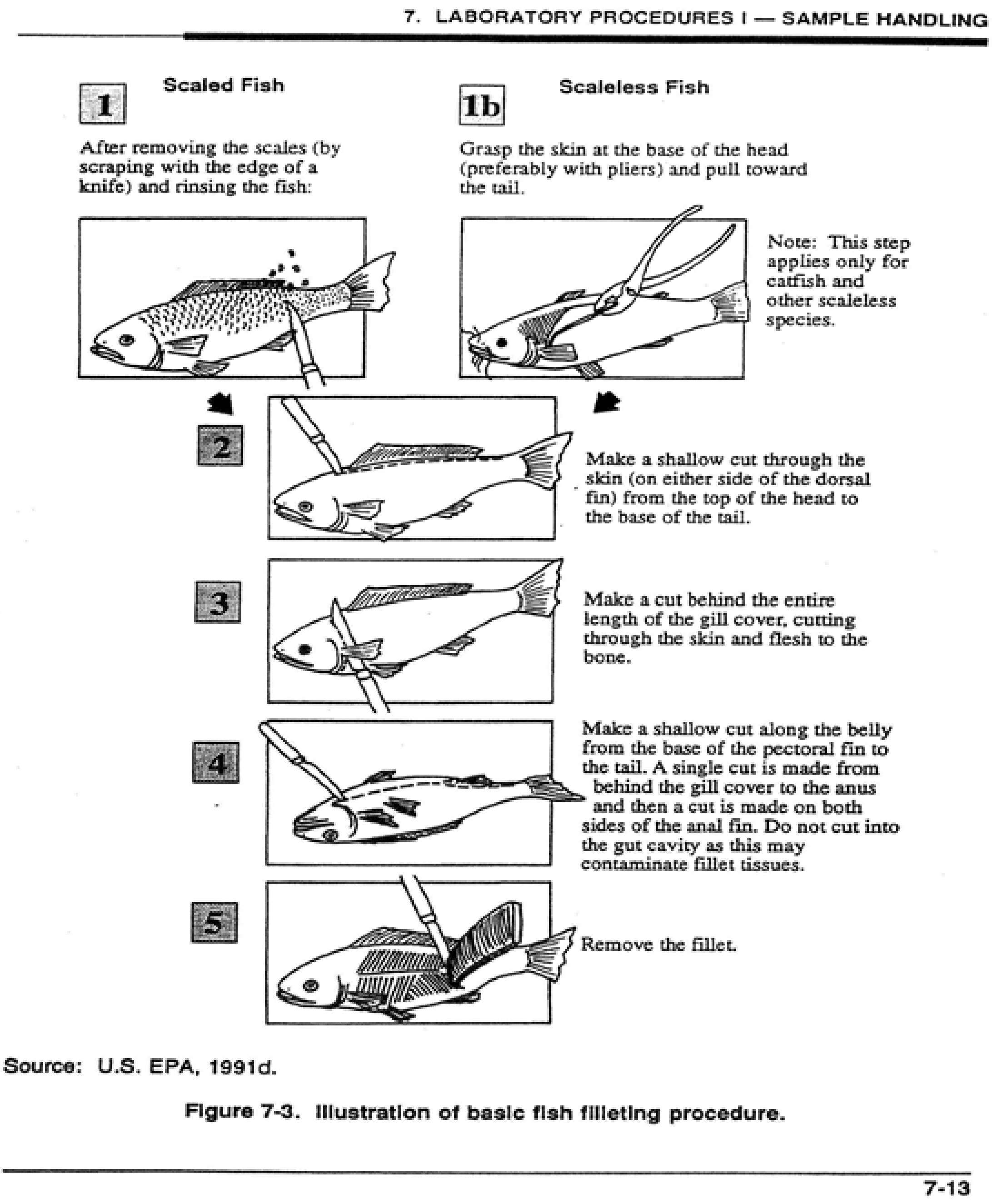
19.4. *PCB's and Mirex In Fish Tissue and Clams* New York State Department of Health Wadsworth Center For Laboratories and Research; Albany, N.Y. 10/6/81

19.5. *Draft Method 1613-Tissue*; Determination of PCDDs and PCDFs in Fish and Other Tissue Using Method 1613; USEPA Office of Water June 1993.

20. CHANGES SINCE THE LAST REVISION

20.1. Various typographical, grammatical, and format revisions.
20.2. Revised to reflect name changes to SDS and Chemical Hygiene Plan.
20.3. Section 5.1: Added use of Cut and Puncture resistant glove into the Safety Section.
20.4. Section 8.11: Added additional glove types to the equipment list.
20.5. Section 11: Inserted the use of Cut and Puncture Resistant gloves throughout the section.

APPENDIX A
Fish Filleting Procedure



1 Scaled Fish

After removing the scales (by scraping with the edge of a knife) and rinsing the fish:

1b Scaleless Fish

Grasp the skin at the base of the head (preferably with pliers) and pull toward the tail.

Note: This step applies only for catfish and other scaleless species.

2 Make a shallow cut through the skin (on either side of the dorsal fin) from the top of the head to the base of the tail.

3 Make a cut behind the entire length of the gill cover, cutting through the skin and flesh to the bone.

4 Make a shallow cut along the belly from the base of the pectoral fin to the tail. A single cut is made from behind the gill cover to the anus and then a cut is made on both sides of the anal fin. Do not cut into the gut cavity as this may contaminate fillet tissues.

5 Remove the fillet.

Source: U.S. EPA, 1991d.

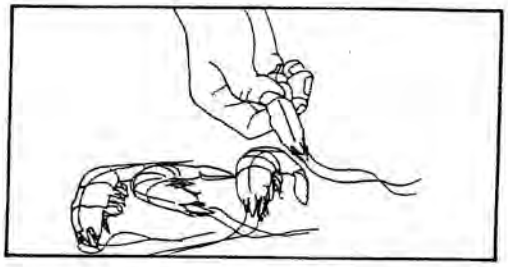
Figure 7-3. Illustration of basic fish filleting procedure.

APPENDIX B
General Procedure for Removing Edible Tissues from Shellfish

Heading, peeling and deveining shrimp

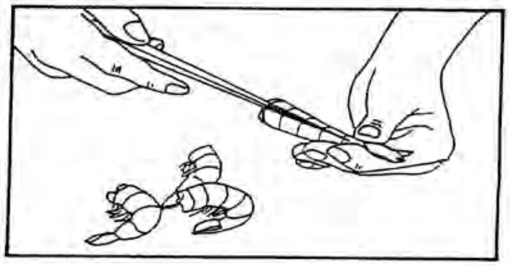
1

To head a shrimp, hold it in one hand. With your thumb behind shrimp head, push head off. Be sure to push just the head off so that you do not lose any meat.



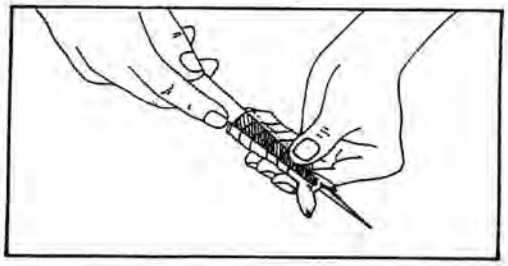
2

If using a deveiner, insert it at head end, just above the vein.



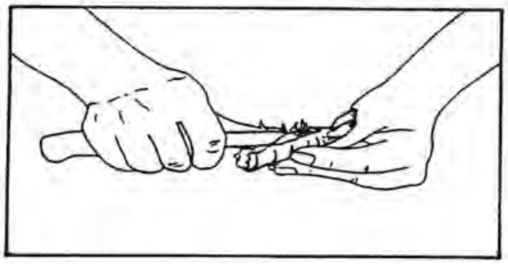
3

Push through shrimp to the tail and split and remove shell. This removes vein at the same time.



4

If you prefer to use a paring knife, shell shrimp with your fingers or knife. Then use knife to gently remove vein.

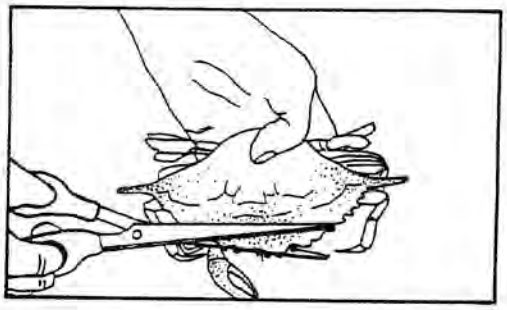


Source: UNC Sea Grant Publication UNC-SG-88-02

Cleaning soft-shell crabs

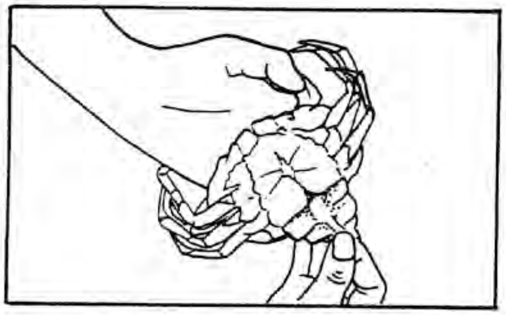
1

Hold crab in one hand and cut across body just behind eyes to remove eyes and mouth.



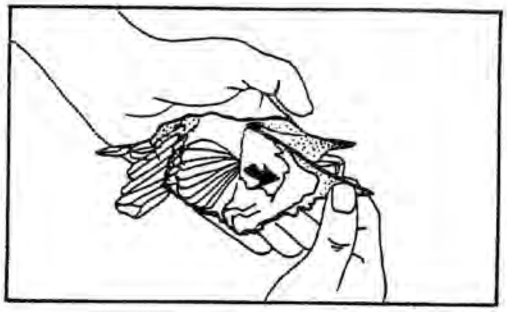
2

Turn crab on its back. Lift and remove apron and vein attached to it.



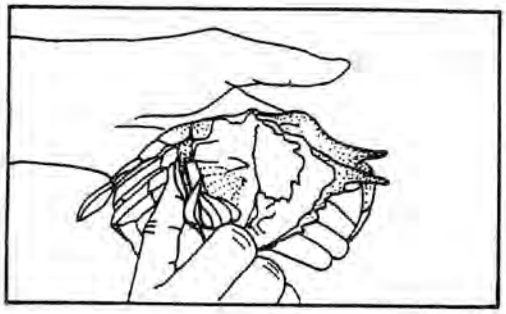
3

Turn crab over and lift one side of top shell.



4

With a small knife, scrape off grayish-feathery gills. Repeat procedure on other side.

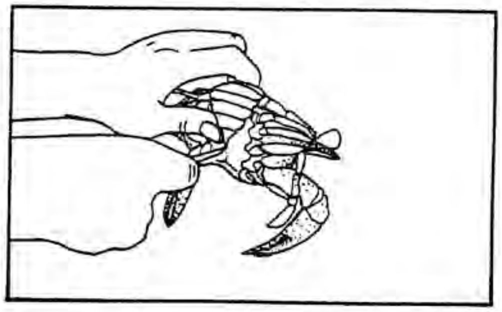


Source: UNC Sea Grant Publication UNC-SG-88-02

Cleaning hard-shell crabs

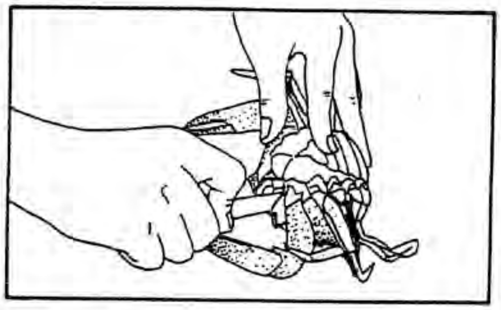
1

Hold crab in one hand. Turn crab over and stab straight down at point of apron with a knife.



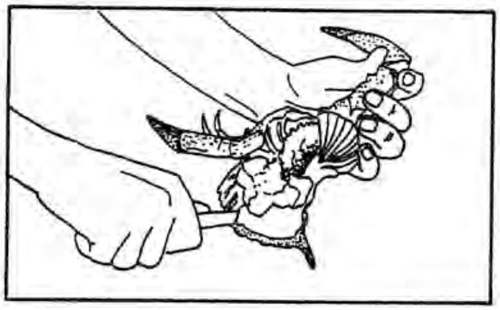
2

Make two cuts from this point to form a V-pattern that will remove mouth.



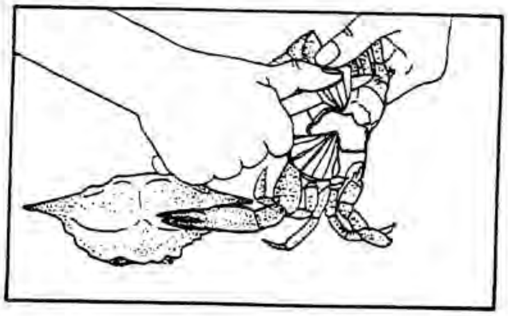
3

Do not remove knife after making second cut. Firmly press crab shell to cutting surface without breaking back shell. With other hand, grasp crab by legs and claws on the side where you are holding knife, and pull up. This should pull crab body free from back shell.



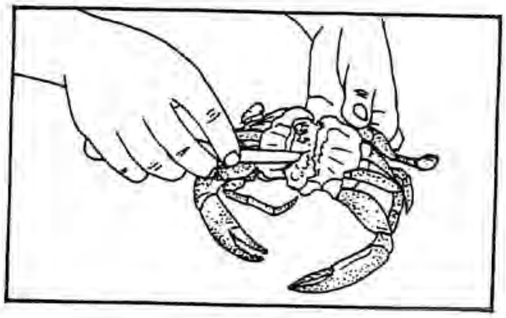
4

Remove gray, feathery gills, which are attached just above legs. Cut and scrape upward to remove gills.



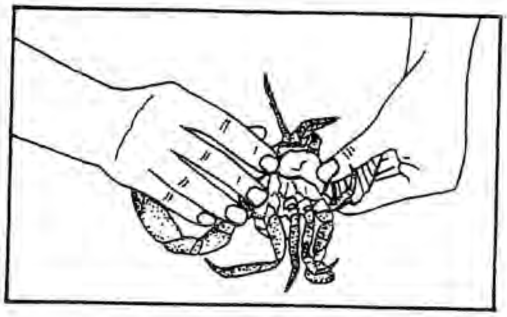
5

Remove all loose material—viscera and eggs—from body cavity.



6

If apron did not come loose with shell, remove it.



Source: UNC Sea Grant Publication UNC-SG-88-02

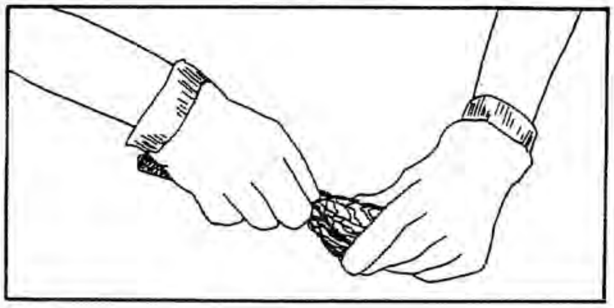
Shucking oysters

1

Oyster shells are especially sharp; be sure to wear gloves to protect your hands. Chip off a small piece of shell from the thin lip of the oyster until there is a small opening.

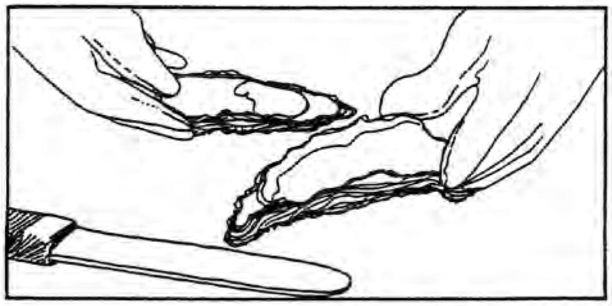
2

Insert knife blade into the opening and cut muscle free from top and bottom shells.



3

Remove oyster meat from the shell.

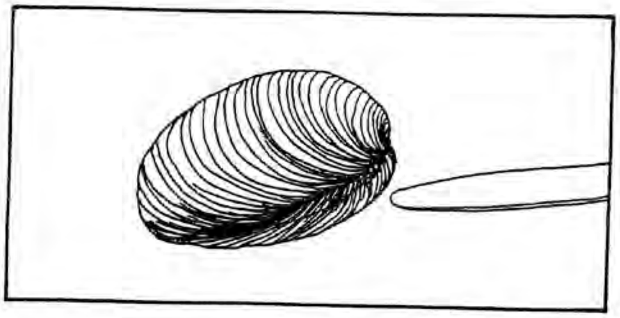


Source: UNC Sea Grant Publication UNC-SG-88-02

Shucking clams

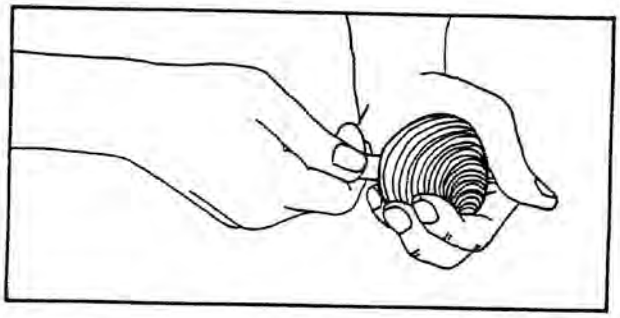
1

In the back of clam near the hinge is a black ligament. Toward the front where ligament ends is a weak spot. Insert your knife at this spot.



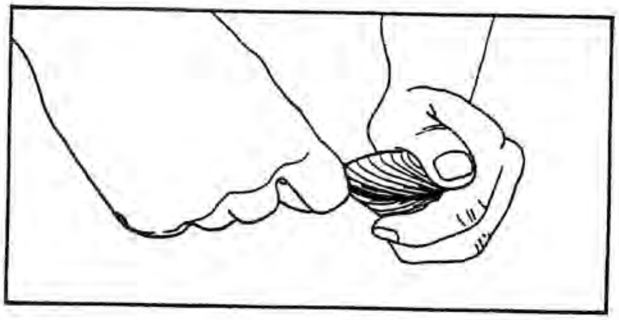
2

Inside are two muscles. Run the knife around the shell to sever both muscles.



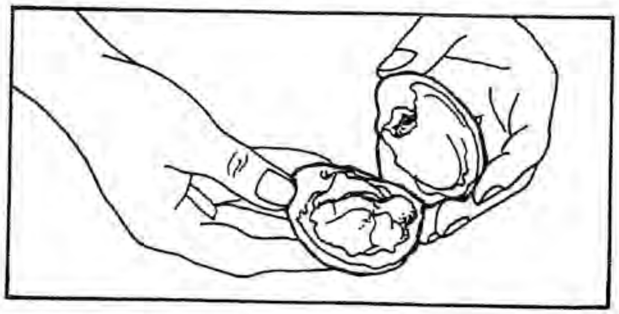
3

Now insert the knife blade into the front of the shell and separate the two shells.



4

Scrape the meat free from the top and bottom shell.



Source: UNC Sea Grant Publication UNC-SG-88-02

APPENDIX H
SEDIMENT CAP SAMPLING APPROACH

Technical Memorandum

To: **Scott Manzano, Oregon Department of Environmental Quality**

From: **Heidi Blischke, RG, GSI Water Solutions, Inc.**
Erin Carroll Hughes, RG, GSI Water Solutions, Inc.

Date: **June 29, 2015**

Re: **2015 O&M Sampling Approach**
McCormick & Baxter Superfund Site, Portland, Oregon

This technical memorandum accompanies the Sampling and Analysis Plan (SAP) presented in Chapter 4 of the Operation and Maintenance (O&M) Manual for the McCormick & Baxter Superfund Site in Portland, Oregon. The SAP provides the passive sample collection, processing, and analytical techniques that apply to the collection of surface water, inter-armoring water, and sub-armoring water throughout the O&M phase of the Superfund process.

Some of the sampling locations are statistically generated and will change during each event, as described in the Oregon Department of Environmental Quality (DEQ)- and U.S. Environmental Protection Agency (EPA)-approved technical memorandum, entitled *O&M Sampling Approach for the McCormick & Baxter Sediment Cap* (GSI, 2013). This technical memorandum provides the target sampling locations and analytical program for the fall 2015 monitoring event and the anticipated schedule for fieldwork and reporting.

The O&M sampling locations are shown in Figure 1 and consist of 12 compliance monitoring stations in sampling areas A through L, 4 early-warning stations (at station numbers 5, 12, 13, and 16), and an upstream and downstream reference location (stations 1 and 27, respectively). Field duplicates will also be collected adjacent to two target sampling locations to evaluate the precision of the sampling procedures. Surface water and inter-armoring water will be sampled at all of the compliance monitoring and early warning stations. The early warning stations will also include a sample from the sub-armoring layer. The upstream and downstream reference stations will assess background concentrations in surface water only. The target sample coordinates, anticipated water depth, and number and type of sample(s) for each location are provided in Table 1. As noted in Table 1, the nearshore samples will be collected by field staff from shore where water depths are less than approximately 2 feet and by divers in deeper water. Note that sample locations will be adjusted in the field based on actual water depths and accessibility.

Table 2 provides the complete list of unique sample identifications and the analytical program for each individual sample. All sampling will be conducted in accordance with the specifications and protocols set forth in the SAP.

The passive samplers are anticipated to be deployed during the week of September 14, 2015, and retrieved during the week of October 5, 2015. Oregon State University (OSU) will prepare a preliminary report, including field and laboratory procedures and interpretations of results and conclusions, and submit it to DEQ by December 15, 2015. DEQ and GSI will review the report and provide comments to OSU within 30 days of receipt.

LEGEND

Proposed O&M Sampling Locations

▭ Compliance Monitoring Area
○ Compliance Monitoring Sample
◆ Early Warning Sample
🟧 Background Sample

Site Features

▭ Subsurface Barrier Wall
▭ Sediment Cap Boundary
🟩 Organoclay Granular
🟩 Organoclay Mats (Double)
🟩 Organoclay Mats (Single)
▨ Hot Spot Treatment (thickened sand layer)
▲ MW-37; DGPS Reference Location
• Boulder Clusters
〰 Anticipated Willamette River Level (7.0 feet NAVD88)

NOTES:

1) Aerial photo taken on September 22, 2006.
2) The surface water sample at the early warning station will serve as the compliance monitoring point for monitoring area F while the inter-armoring and sub-armoring samples will serve as early warning samples.

0 250 500
Scale in feet

McCormick and Baxter Superfund Site
Portland, Oregon

Proposed 2015 O&M Sampling Stations

6/15

HARTCROWSER

GSI Water Solutions, Inc.

Figure
1

Document Path: P:\Portland\205 - OR DEQ\003 - 003 McCormick and Baxter\Project_GIS\Project_mxds\Sampling_Events\2015\Fall2015\Figure1_Proposed_OM_Sampling_Locations.mxd

Table 1
Sample Location, Type, Number, and Analyte Groups

Sampling Station ID	Sample Location						Sampling Interval(s) and Deployment Methodology (S=Field Staff from Shore; D=Diver Deployed; B=Field Staff from Boat; -- No Sample)			Field Duplicate Collected? (SW=Surface Water; IA=Inter-Armoring; -- No Sample)	Analytes [5]					
	Sample Coordinates (NAD83) [2]				Sample Elevation [3] (ft NAVD88)	Anticipated Water Depth [4] (ft NAVD88)	Surface Water	Inter-Armoring	Sub-Armoring							
	Northing	Easting	Latitude	Longitude			6-12 inches above sediment cap	Centered 6 inches into armoring layer	Approximately 18 inches below the top of the sediment cap		PAHs	PCP	As	Cr	Cu	Zn
Compliance Sampling Locations																
A	704239.4	7628772.4	45.57654	-122.73936	7.6	-0.6	**S**	**--**	**--**	**--**	**1**	**1**	**1**	**1**	**1**	**1**
B	704404.0	7628437.2	45.57696	-122.74068	5.2	1.8	**D***	**D***	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
C	704629.5	7628000.4	45.57755	-122.74241	1.2	5.8	**D**	**D**	**--**	**IA**	**3**	**3**	**3**	**3**	**3**	**3**
D	704741.5	7627678.3	45.57783	-122.74368	8.0	-1.0	**S**	**S**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
E	704834.3	7627353.5	45.57806	-122.74496	-2.6	9.6	**D**	**D**	**--**	**SW**	**3**	**3**	**3**	**3**	**3**	**3**
F [1]	705303.9	7627321.8	45.57935	-122.74514	5.0	2.0	**S**	**--**	**--**	**--**	**1**	**1**	**1**	**1**	**1**	**1**
G	705250.3	7626830.9	45.57916	-122.74705	-20.4	27.4	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
H	705037.8	7627077.0	45.57860	-122.74606	-11.2	18.2	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
I	704571.8	7627534.2	45.57735	-122.74423	-32.7	39.7	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
J	704417.0	7627817.3	45.57695	-122.74311	-14.4	21.4	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
K	704246.5	7628053.8	45.57650	-122.74216	-14.8	21.8	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
L	704379.1	7628229.5	45.57688	-122.74149	4.4	2.6	**D**	**D**	**--**	**--**	**2**	**2**	**2**	**2**	**2**	**2**
Early Warning Sampling Locations																
5	704576.3	7628007.4	45.57740	-122.74238	2.7	4.3	**D**	**D**	**D**	**--**	**3**	**3**	**--**	**--**	**--**	**--**
12	705197.2	7627236.8	45.57905	-122.74546	4.7	2.3	**S**	**S**	**S**	**--**	**3**	**3**	**--**	**--**	**--**	**--**
13 [1]	705303.9	7627321.8	45.57935	-122.74514	5.0	2.0	**--**	**S**	**S**	**--**	**2**	**2**	**--**	**--**	**--**	**--**
16	704293.9	7627812.9	45.57661	-122.74311	-29.0	36.0	**D**	**D**	**D**	**--**	**3**	**3**	**--**	**--**	**--**	**--**
Background Sampling Locations																
1 (Upstream)	703730.7	7628583.6	45.57513	-122.74004	-32.0	39.0	**B**	**--**	**--**	**--**	**1**	**1**	**1**	**1**	**1**	**1**
27 (Downstream)	705647.6	7626360.3	45.58021	-122.74893	-19.5	26.5	**B**	**--**	**--**	**--**	**1**	**1**	**1**	**1**	**1**	**1**
						TOTAL COUNT	**D=11; S=4; B=2; Total=17**	**D=11; S=3; Total=14**	**D=2; S=2; Total=4**	**2**	**37**	**37**	**26**	**26**	**26**	**26**
							D=24; S=9; B=2; Total=35									

Notes:

[1] The surface water compliance sampling location in Area F will be co-located with the early warning inter-armoring and sub-armoring samples at sampling location number 13.

[2] Northing and easting coordinates exist in the following coordinate system: North American Datum of 1983 (NAD83), Oregon State Plane North Zone, International Feet.

[3] Elevations exist in the following coordinate system: North American Vertical Datum of 1988 (NAVD88) in units of feet.

[4] Assumes the Willamette River stage is at an elevation of 7.0 feet NAVD88. Note that sample locations with a negative value are anticipated to be out of water at the time of sampling. The locations will be adjusted to the waters edge when deployed to ensure that the samplers remain submerged throughout the deployment period.

[5] Analytes include the following polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

*Deployment methodology will depend upon river stage at the time of sampling.

Table 2
Sample Identification and Analytical Program

Sampling Station ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [2]					
				PAHs	PCP	As	Cr	Cu	Zn
Compliance Sampling Locations									
A	Surface Water	PE	MBSWPE1015-A	X	X	--	--	--	--
		DGT	MBSWDGT1015-A	--	--	X	X	X	X
B	Surface Water	PE	MBSWPE1015-B	X	X	--	--	--	--
		DGT	MBSWDGT1015-B	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-B	X	X	--	--	--	--
		DGT	MBIADGT1015-B	--	--	X	X	X	X
C	Surface Water	PE	MBSWPE1015-C	X	X	--	--	--	--
		DGT	MBSWDGT1015-C	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-C	X	X	--	--	--	--
			MBIAPE1015-C-Dup	X	X	--	--	--	--
		DGT	MBIADGT1015-C	--	--	X	X	X	X
			MBIADGT1015-C-Dup	--	--	X	X	X	X
D	Surface Water	PE	MBSWPE1015-D	X	X	--	--	--	--
		DGT	MBSWDGT1015-D	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-D	X	X	--	--	--	--
		DGT	MBIADGT1015-D	--	--	X	X	X	X
E	Surface Water	PE	MBSWPE1015-E	X	X	--	--	--	--
		PE	*MBSWPE1015-E-Dup*	X	X	--	--	--	--
		DGT	MBSWDGT1015-E	--	--	X	X	X	X
		DGT	*MBSWDGT1015-E-Dup*	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-E	X	X	--	--	--	--
		DGT	MBIADGT1015-E	--	--	X	X	X	X
F[1]	Surface Water	PE	MBSWPE1015-F	X	X	--	--	--	--
		DGT	MBSWDGT1015-F	--	--	X	X	X	X
G	Surface Water	PE	MBSWPE1015-G	X	X	--	--	--	--
		DGT	MBSWDGT1015-G	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-G	X	X	--	--	--	--
		DGT	MBIADGT1015-G	--	--	X	X	X	X
H	Surface Water	PE	MBSWPE1015-H	X	X	--	--	--	--
		DGT	MBSWDGT1015-H	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-H	X	X	--	--	--	--
		DGT	MBIADGT1015-H	--	--	X	X	X	X
I	Surface Water	PE	MBSWPE1015-I	X	X	--	--	--	--
		DGT	MBSWDGT1015-I	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-I	X	X	--	--	--	--
		DGT	MBIADGT1015-I	--	--	X	X	X	X
J	Surface Water	PE	MBSWPE1015-J	X	X	--	--	--	--
		DGT	MBSWDGT1015-J	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-J	X	X	--	--	--	--
		DGT	MBIADGT1015-J	--	--	X	X	X	X
K	Surface Water	PE	MBSWPE1015-K	X	X	--	--	--	--
		DGT	MBSWDGT1015-K	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-K	X	X	--	--	--	--
		DGT	MBIADGT1015-K	--	--	X	X	X	X
L	Surface Water	PE	MBSWPE1015-L	X	X	--	--	--	--
		DGT	MBSWDGT1015-L	--	--	X	X	X	X
	Inter-Armoring	PE	MBIAPE1015-L	X	X	--	--	--	--
		DGT	MBIADGT1015-L	--	--	X	X	X	X

Table 2
Sample Identification and Analytical Program

Sampling Station ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [2]					
				PAHs	**PCP**	**As**	**Cr**	**Cu**	**Zn**
Early Warning Sampling Locations									
5	Surface Water	PE	MBSWPE1015-5	X	X	--	--	--	--
	Inter-Armoring	PE	MBIAPE1015-5	X	X	--	--	--	--
	Sub-Armoring	PE	MBSAPE1015-5	X	X	--	--	--	--
12	Surface Water	PE	MBSWPE1015-12	X	X	--	--	--	--
	Inter-Armoring	PE	MBIAPE1015-12	X	X	--	--	--	--
	Sub-Armoring	PE	MBSAPE1015-12	X	X	--	--	--	--
13 [1]	Inter-Armoring	PE	MBIAPE1015-13	X	X	--	--	--	--
	Sub-Armoring	PE	MBSAPE1015-13	X	X	--	--	--	--
16	Surface Water	PE	MBSWPE1015-16	X	X	--	--	--	--
	Inter-Armoring	PE	MBIAPE1015-16	X	X	--	--	--	--
	Sub-Armoring	PE	MBSAPE1015-16	X	X	--	--	--	--
Background Sampling Locations									
1 (Upstream)	Surface Water	PE	MBSWPE1015-1	X	X	--	--	--	--
		DGT	MBSWDGT1015-1	--	--	X	X	X	X
27 (Downstream)	Surface Water	PE	MBSWPE1015-27	X	X	--	--	--	--
		DGT	MBSWDGT1015-27	--	--	X	X	X	X
			Total Count	**37**	**37**	**26**	**26**	**26**	**26**

Notes:

[1] The surface water compliance sampling location in Area F will be co-located with the early warning inter-armoring and sub-armoring samples at sampling location number 13.

[2] Analytes include the following polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

Technical Memorandum

To: **Sarah Miller, Oregon Department of Environmental Quality**

From: **Benjamin Johnson, RG; GSI Water Solutions, Inc.**

Date: **May 4, 2020**

Re: **2020 O&M Sampling Approach**
McCormick & Baxter Superfund Site, Portland, Oregon

This technical memorandum details the 2020 Operations and Maintenance (O&M) sampling approach for the McCormick and Baxter Site. The methods discussed within this memo modifyy the Sampling and Analysis Plans (SAPs) presented in Chapter 6 of the 2009 and Chapter 4 of the 2016 O&M Manuals for the McCormick & Baxter Superfund Site in Portland, Oregon. The 2009 O&M manual Chapter 6 SAP details crayfish sampling protocols (GSI and Hart Crowser, 2009). The 2016 O&M manual Chapter 4 SAP details passive sample collection, processing, and analytical techniques that apply to the collection of surface, inter-armoring, and sub-armoring water throughout the O&M phase of the Superfund process (GSI and Hart Crowser, 2016). The 2020 O&M Manual SAPs will be updated to reflect current sampling decisions and techniques, which differ from those presented in the2009 and 2016 O&M Manuals.

Compliance porewater monitoring sample locations are statistically generated and change during each event, as described in the Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (EPA)-approved technical memorandum, entitled *O&M Sampling Approach for the McCormick & Baxter Sediment Cap* (GSI, 2013). Crayfish sampling locations were selected to be comparable with work completed in 2006 plus one additional location. Crayfish sampling locations from 2006 were adjusted slightly to align with compliance monitoring stations where surface, inter-armoring, and sub-armoring water samples will be collected during 2020 sampling activities. This technical memorandum provides the target sampling locations and analytical program for the fall 2020 monitoring event and the anticipated schedule for fieldwork and reporting.

The proposed 2020 O&M sampling locations are shown in Figure 1 and consist of 12 compliance monitoring locations in sampling areas A through L, four fixed early-warning locations (at station numbers 5, 12, 13, and 16), fixed upstream and downstream reference location (stations 1 and 27, respectively), and five crayfish sampling locations (01 through 05). Surface, inter-armoring, and sub-armor water will be sampled using passive techniques at the 12-compliance monitoring and 4 early warning stations. The upstream and downstream reference locations will assess background concentrations using passive techniques in surface water only. Crayfish will be sampled 5 locations collocated with compliance monitoring locations. Field duplicates will be collected adjacent to three compliance monitoring stations (one for each interval) and one crayfish sampling location to evaluate the precision of the sampling procedures. The target sample coordinates, anticipated water depth, and number and type of sample(s) for each location are provided in Table 1. As noted in Table 1, the nearshore samples will be collected by field staff from the shore where water depths are less than approximately 2 feet and by divers in deeper water. Sample locations may be adjusted in the field based on actual water depths and accessibility.

Table 2 provides the complete list of unique sample identifications and the analytical program for each individual sample. Crayfish specimens will be analyzed for whole tissue analysis. All sampling will be conducted in accordance with the specifications and protocols set forth in the SAPs.

The passive samplers are anticipated to be deployed between August 24th and 28th and retrieved between October 5th and 9th. Crayfish traps will initially be deployed for one night during installation of the passive samplers. If an insufficient number of crayfish are collected for the necessary analyses and QA/QC procedures, the traps will be redeployed the following day or during the retrieval of the passive samplers.

Texas Tech University (TTU) will prepare a preliminary report, including field and laboratory procedures and interpretations of porewater results and conclusions, and submit it to DEQ in December 2020. DEQ, GSI, and Hart Crowser will review the report and provide comments to TTU within 30 days of receipt. Crayfish tissue will be sent to DEQ contract lab.

References

GSI and Hart Crowser, 2009. Operations and Maintenance Manual McCormick and Baxter Creosoting Company Site Portland, Oregon. Prepared for Oregon Department of Environmental Quality by GSI Water Solutions, Inc and Hart Crowser, Inc. May 21, 2009.

GSI and Hart Crowser, 2016. Operations and Maintenance Manual McCormick and Baxter Creosoting Company Site Portland, Oregon. Prepared for Oregon Department of Environmental Quality by GSI Water Solutions, Inc and Hart Crowser, Inc. June 17, 2016.

Table 1 - Sample Location, Type, Number, and Analyte Groups
McCormick & Baxter Superfund Site
Portland, Oregon

Sampling Location ID	Sample Location								Sampling Interval(s) and Deployment Methodology (S= Shore; D=Diver; B= Boat; -- No Sample)				Field Duplicate Collected?	Analytes [4]						
	Sample Coordinates (NAD83) [1]				Sample Elevation [2] (ft NAVD88)	Anticipated Water Depth [3] (ft NAVD88)	Location with ACB	Collocated Sampling Location	Mudline (ML)	Surface Water (SW)	Inter-Armoring (IA)	Sub-Armoring (SA)								
	Northing	Easting	Latitude	Longitude					At the sediment water interface	6-12 inches above the sediment cap	Centered 6 inches into the armoring layer	Approximately 18 inches below the top of the sediment cap		D/Fs	PAHs	PCP	As	Cr	Cu	Zn
Compliance Sampling Locations																				
A[5]	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	01	--	**S**	**S**	**S**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
B	704369.2	7628482.9	45.57687	-122.74050	4.6	2.4	--	--	--	**D***	**D***	**D***	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
C	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	02	--	**D**	**D**	**D**	**IA**	**--**	**4**	**4**	**4**	**4**	**4**	**4**
D	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	03	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
E	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	04	--	**D**	**D**	**D**	**SW**	**--**	**4**	**4**	**4**	**4**	**4**	**4**
F	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	05	--	**D**	**D**	**D**	**SA**	**--**	**4**	**4**	**4**	**4**	**4**	**4**
G[6]	705263.6	7627011.2	45.57921	-122.74634	1.1	5.9	Yes	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
H	705118.3	7626983.2	45.57881	-122.74644	-8.9	15.9	--	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
I	704565.8	7627624.4	45.57734	-122.74387	-18.6	25.6	--	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
J	704511.5	7627800.2	45.57721	-122.74318	7.2	-0.2	--	--	--	**S**	**S**	**S**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
K	704219.7	7628010.5	45.57643	-122.74233	-20.9	27.9	--	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
L	704335.6	7628390.4	45.57677	-122.74086	4.5	2.5	--	--	--	**D***	**D***	**D***	--	**--**	**3**	**3**	**3**	**3**	**3**	**3**
Early Warning Sampling Locations																				
5	704576.3	7628007.4	45.57740	-122.74238	1.8	5.2	--	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**--**	**--**	**--**	**--**
12	705197.2	7627236.8	45.57905	-122.74546	4.9	2.1	Yes	--	--	**D***	**D***	**D***	--	**--**	**3**	**3**	**--**	**--**	**--**	**--**
13	705303.9	7627321.8	45.57935	-122.74514	5.4	1.6	Yes	--	--	**D***	**D***	**D***	--	**--**	**3**	**3**	**--**	**--**	**--**	**--**
16	704293.9	7627812.9	45.57661	-122.74311	-28.6	35.6	--	--	--	**D**	**D**	**D**	--	**--**	**3**	**3**	**--**	**--**	**--**	**--**
Background Sampling Locations																				
1 (Upstream)	703730.7	7628583.6	45.57513	-122.74004	-31.5	38.5	--	--	--	**B**	--	--	--	**--**	**1**	**1**	**1**	**1**	**1**	**1**
27 (Downstream)	705647.6	7626360.3	45.58021	-122.74893	-19.3	26.3	--	--	--	**B**	--	--	--	**--**	**1**	**1**	**1**	**1**	**1**	**1**
Crayfish (CF) Sampling Locations																				
01	704151.8	7628801.0	45.57630	-122.73924	6.1	0.9	Yes	A	**B**	--	--	--	--	**1**	**1**	**1**	**1**	**1**	**1**	**1**
02	704556.6	7628058.5	45.57735	-122.74218	1.8	5.2	--	C	**B**	--	--	--	--	**1**	**1**	**1**	**1**	**1**	**1**	**1**
03	704693.1	7627598.7	45.57769	-122.74399	-17.2	24.2	--	D	**B**	--	--	--	**CF**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
04	704787.3	7627213.2	45.57792	-122.74550	-27.8	34.8	--	E	**B**	--	--	--	--	**1**	**1**	**1**	**1**	**1**	**1**	**1**
05	705220.9	7627179.7	45.57911	-122.74568	0.5	6.5	Yes	F	**B**	--	--	--	--	**1**	**1**	**1**	**1**	**1**	**1**	**1**
						TOTAL COUNT			**B=5; Total=5**	**D=14; S=2; B=2; Total=18**	**D=14; S=2; Total=16**	**D=14; S=2; Total=16**	**4**	**6**	**59**	**59**	**47**	**47**	**47**	**47**
									D=42; S=6; B=7; Total=55											

Notes:

[1] Northing and easting coordinates exist in the following coordinate system: North American Datum of 1983 (NAD83), Oregon State Plane North Zone, International Feet.

[2] Elevations exist in the following coordinate system: North American Vertical Datum of 1988 (NAVD88) in units of feet.

[3] Assumes the Willamette River stage is at an elevation of 7.0 feet NAVD88. Note that sample locations with a negative value are anticipated to be out of water at the time of sampling. The locations will be adjusted to the waters edge when deployed to ensure that the samplers remain submerged throughout the deployment period.

[4] Analytes include the following dioxin/furan (D/Fs) congeners; polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

[5] Compliance monitoring location A is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area A will be used. The coordinates for this location are N: 704245.0, E: 7628682.3; Lat: 45.576546, Long: -122.7397

[6] Compliance monitoring location G is located on ACB. If installation of the passive sampling devices is challenging the nearest location without ACB within area G will be used. The coordinates for this location are N: 705277.8 E: 7626983.2; Lat: 45.5788109435, Long: -122.74651

*Deployment methodology will depend upon river stage at the time of sampling.

ACB: Articulated concrete block

D/Fs: Dioxin/Furan congeners

PAHs: Polyaromatic hydrocarbons

Table 2 - Sample Identification and Analytical Program
McCormick & Baxter Superfund Site
Portland, Oregon

Sampling Location ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [1]						
				D/Fs	PAHs	PCP	As	Cr	Cu	Zn
Compliance Sampling Locations										
A	Surface Water	SPME	MBSWSPME1020-A	--	X	X	--	--	--	--
		DM	MBSWDM1020-A	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-A	--	X	X	--	--	--	--
		DM	MBIADM1020-A	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
B	Surface Water	SPME	MBSWSPME1020-B	--	X	X	--	--	--	--
		DM	MBSWDM1020-B	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-B	--	X	X	--	--	--	--
		DM	MBIADM1020-B	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
C	Surface Water	SPME	MBSWSPME1020-C	--	X	X	--	--	--	--
		DM	MBSWDM1020-C	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-C	--	X	X	--	--	--	--
			MBIASPME1020-C-Dup	--	X	X	--	--	--	--
		DM	MBIADM1020-C	--	--	--	X	X	X	X
			MBIADM1020-C-Dup	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
D	Surface Water	SPME	MBSWSPME1020-D	--	X	X	--	--	--	--
		DM	MBSWDM1020-D	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-D	--	X	X	--	--	--	--
		DM	MBIADM1020-D	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
E	Surface Water	SPME	MBSWSPME1020-E	--	X	X	--	--	--	--
			MBSWSPME1020-E-Dup	--	X	X	--	--	--	--
		DM	MBSWDM1020-E	--	--	--	X	X	X	X
			MBSWDM1020-E-Dup	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-E	--	X	X	--	--	--	--
		DM	MBIADM1020-E	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
F	Surface Water	SPME	MBSWSPME1020-F	--	X	X	--	--	--	--
		DM	MBSWDM1020-F	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-F	--	X	X	--	--	--	--
		DM	MBIADM1020-F	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
			MBSASPME1020-A-Dup	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
			MBSASDM1020-A-Dup	--	--	--	X	X	X	X

Table 2 - Sample Identification and Analytical Program
McCormick & Baxter Superfund Site
Portland, Oregon

Sampling Location ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [1]						
				D/Fs	PAHs	PCP	As	Cr	Cu	Zn
G	Surface Water	SPME	MBSWSPME1020-G	--	X	X	--	--	--	--
		DM	MBSWDM1020-G	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-G	--	X	X	--	--	--	--
		DM	MBIADM1020-G	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
H	Surface Water	SPME	MBSWSPME1020-H	--	X	X	--	--	--	--
		DM	MBSWDM1020-H	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-H	--	X	X	--	--	--	--
		DM	MBIADM1020-H	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
I	Surface Water	SPME	MBSWSPME1020-I	--	X	X	--	--	--	--
		DM	MBSWDM1020-I	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-I	--	X	X	--	--	--	--
		DM	MBIADM1020-I	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
J	Surface Water	SPME	MBSWSPME1020-J	--	X	X	--	--	--	--
		DM	MBSWDM1020-J	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-J	--	X	X	--	--	--	--
		DM	MBIADM1020-J	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
K	Surface Water	SPME	MBSWSPME1020-K	--	X	X	--	--	--	--
		DM	MBSWDM1020-K	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-K	--	X	X	--	--	--	--
		DM	MBIADM1020-K	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
L	Surface Water	SPME	MBSWSPME1020-L	--	X	X	--	--	--	--
		DM	MBSWDM1020-L	--	--	--	X	X	X	X
	Inter-Armoring	SPME	MBIASPME1020-L	--	X	X	--	--	--	--
		DM	MBIADM1020-L	--	--	--	X	X	X	X
	Sub-Armoring	SPME	MBSASPME1020-A	--	X	X	--	--	--	--
		DM	MBSASDM1020-A	--	--	--	X	X	X	X
Early Warning Sampling Locations										
5	Surface Water	SPME	MBSWSPME1020-5	--	X	X	--	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-5	--	X	X	--	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-5	--	X	X	--	--	--	--
12	Surface Water	SPME	MBSWSPME1020-12	--	X	X	--	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-12	--	X	X	--	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-12	--	X	X	--	--	--	--
13	Surface Water	SPME	MBSWSPME1020-13	--	X	X	--	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-13	--	X	X	--	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-13	--	X	X	--	--	--	--
16	Surface Water	SPME	MBSWSPME1020-16	--	X	X	--	--	--	--
	Inter-Armoring	SPME	MBIASPME1020-16	--	X	X	--	--	--	--
	Sub-Armoring	SPME	MBSASPME1020-16	--	X	X	--	--	--	--

Table 2 - Sample Identification and Analytical Program
McCormick & Baxter Superfund Site
Portland, Oregon

Sampling Location ID	Sampling Interval	Sample Media	Unique Sample ID	Analytes [1]						
				D/Fs	PAHs	PCP	As	Cr	Cu	Zn
Background Sampling Locations										
1 (Upstream)	Surface Water	SPME	MBSWSPME1020-1	--	X	X	--	--	--	--
		DM	MBSWDM1020-1	--	--	--	X	X	X	X
27 (Downstream)	Surface Water	SPME	MBSWSPME1020-27	--	X	X	--	--	--	--
		DM	MBSWDM1020-27	--	--	--	X	X	X	X
Crayfish Sampling Locations[2]										
01	Crayfish	Whole Tissue	MBCFGB-20-01	X	X	X	X	X	X	X
02	Crayfish	Whole Tissue	MBCFGB-20-02	X	X	X	X	X	X	X
03	Crayfish	Whole Tissue	MBCFGB-20-03	X	X	X	X	X	X	X
			MBCFGB-20-03-Dup	X	X	X	X	X	X	X
04	Crayfish	Whole Tissue	MBCFGB-20-04	X	X	X	X	X	X	X
05	Crayfish	Whole Tissue	MBCFGB-20-05	X	X	X	X	X	X	X
QA/QC Samples										
Field Blank		SPME	MBSPME1020-FB1	--	X	X	--	--	--	--
Field Blank		DM	MBDM1020-FB1	--	--	--	X	X	X	X
Field Blank		SPME	MBSPME1020-FB2	--	X	X	--	--	--	--
Field Blank		DM	MBDM1020-FB2	--	--	--	X	X	X	X
Field Blank		SPME	MBSPME1020-FB3	--	X	X	--	--	--	--
Field Blank		DM	MBDM1020-FB3	--	--	--	X	X	X	X
Trip Blank		SPME	MBSPME1020-TB1	--	X	X	--	--	--	--
Trip Blank		DM	MBDM1020-TB1	--	--	--	X	X	X	X
Trip Blank		SPME	MBSPME1020-TB2	--	X	X	--	--	--	--
Trip Blank		DM	MBDM1020-TB2	--	--	--	X	X	X	X
Trip Blank		SPME	MBSPME1020-TB3	--	X	X	--	--	--	--
Trip Blank		DM	MBDM1020-TB3	--	--	--	X	X	X	X
Crayfish Bait		--	MBCFGB-20-Bait	X	X	X	X	X	X	X
			Total Count	**7**	**66**	**66**	**54**	**54**	**54**	**54**

Notes:

[1] Analytes include the following dioxin/furan congeners (D/Fs); polyaromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (ghi) perylene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene; pentachlorophenol (PCP); and the following metals: arsenic (As), chromium (Cr), copper (Cu), and zinc (Zn.)

[2] Crayfish samples will processed as whole tissue samples and will also be analyzed for lipid content in addition to the chemical analytes.

Italics = Duplicate samples

DM= Diffusive membrane

QA/QC = Quality Assurance/Quality Control

SPME = Solid Phase Micro Extraction

FIGURE 1

Proposed 2020 O&M Sampling Locations

McCormick and Baxter Superfund Site
Portland, Oregon

LEGEND

Proposed O&M Sampling Locations

- ● Compliance Monitoring Sample
- • Alternative Compliance Monitoring Sample
- 🟧 Crayfish Sample
- ◇ Early Warning Sample
- ☐ Background Sample
- ▭ Compliance Monitoring Area

All Other Features

- ▲ MW-37; DGPS Reference Location
- • Boulder Cluster
- ∼ Anticipated Willamette River Level (7.0 feet NAVD88)
- ☐ Sediment Cap Boundary
- 🟨 Organoclay Mats (Single)
- 🟩 Organoclay Mats (Double)
- 🟩 Organoclay Granular
- ▨ Articulated Concrete Block (ACB)
- ▦ Hot Spot Treatment (thickened sand layer)
- 🟥 Subsurface Barrier Wall

NOTES:

1. Aerial photo taken Summer 2018.
2. The surface water sample at the early warning station will serve as the compliance monitoring point for monitoring area F while the inter-armoring and sub-armoring samples will serve as early warning samples.

Date: April 29, 2020
Data Sources: COP aerial photo

N

0 125 250 375
Feet

HARTCROWSER

GSI Water Solutions, Inc.

Document Path: Y:\0205_OR_DEQ\Source_Figures\028_MB_OM_2018\003_Annual_OM_Report\Figure1_Proposed_OM_Sampling_Locations_elevation_2020.mxd

APPENDIX I
BIOLOGICAL ASSESSMENT

Biological Assessment Addendum

OPERATION & MAINTENANCE OF SOIL CAP, SEDIMENT CAP AND GROUNDWATER REMEDY

MCCORMICK AND BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

May 2006

U.S. ENVIRONMENTAL PROTECTION AGENCY
Oregon State Department of Environmental Quality

TABLE OF CONTENTS

DOCUMENT PURPOSE

This document is the Environmental Protection Agency's (EPA) evaluation of potential effects from a planned Federal action on plant and animal species covered under the Endangered Species Act (ESA). EPA intends this document to demonstrate substantive compliance with ESA pursuant to the requirements of the National Contingency Plan (NCP) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The Federal action addressed in this document is the Operation and Maintenance (O&M) of the soil cap, sediment cap and groundwater remedy at the Federal Superfund site known as the McCormick and Baxter Creosoting Company, Portland, Oregon. This action follows several remedial actions being taken under CERCLA to significantly reduce the potential risk to human health and/or ecological receptors resulting from potential exposure to contaminants present in soils, sediment and groundwater at the project area.

EPA has designated the Oregon Department of Environmental Quality (DEQ) as the lead in implementing the actions contained within the CERCLA Record of Decision (ROD) for the site, although these remain Federal actions.

EPA previously submitted biological assessments for the construction of a subsurface barrier wall, construction of a sediment cap, importing and stockpiling topsoil and construction of an upland soil cap (EPA 2002, 2003, 2004 and 2005).

This evaluation is a continuation of the ongoing consultation between EPA, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) for remediation of the McCormick & Baxter Creosoting Company site.

EPA considers this a living document in that technical studies are on-going and additional studies will be conducted as part of O&M. Furthermore, this document evaluates several hypothetical scenarios for making repairs to the remedy, in particular the sediment cap. Whether these repairs are actually needed and the exact nature of the potential repairs is unknown at this time. If the nature of the repairs substantially deviates from the hypothetical scenarios presented in this report, EPA will perform additional consultation.

1. SUMMARY OF FINDINGS

Remedial actions described in the Environmental Protection Agency's 1996 ROD, issued in conjunction with the Oregon State Department of Environmental Quality, for the McCormick and Baxter Creosoting Company are being taken pursuant to CERCLA. These actions also are considered agency actions under the ESA and are therefore required to substantively comply with the ESA. The EPA determined that this biological assessment is necessary to evaluate potential effects of the proposed remedial activities on federally listed threatened and endangered species.

This biological assessment (BA) addendum is the fifth BA addendum, which evaluates the potential effects on threatened and endangered species from the following activities that comprise the action:

- Soil Cap Monitoring (i.e., inspection of cap surface, inspection of stormwater conveyance system, inspection of security fencing and inspection of warning signs)
- Soil Cap Vegetation Maintenance (i.e., irrigation, mowing open grass areas, manual removal of invasive plants and targeted application of herbicides)[1]
- Soil Cap Unplanned Maintenance (e.g., repairs of fence, replacement of warning signs, repairs of gravel roads, filling of animal burrows and removal of sediments from manholes)
- Sediment Cap Monitoring (i.e., warning buoys, near shore areas, multibeam bathymetric surveys, side-scan sonar surveys and diver inspections of deep water)
- Sediment Cap Sampling (i.e., surface water, pore water, flux chamber, organoclay cores, crayfish, sculpin/clams and possibly lamprey)
- Sediment Cap Unplanned Maintenance (e.g., replacement of buoys, additional armoring placement and additional organoclay capping)
- Groundwater Remedy - NAPL Recovery

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[1] Vegetation maintenance, including the targeted application of herbicides, was addressed in EPA's BA for construction of the sediment cap and in the subsequent Biological Opinion issued by the NMFS (2004). The conclusions of this earlier consultation are carried into the O&M BA in order to provide context and consistency with the other O&M activities.

- Groundwater Monitoring (i.e., downloading continuous water level data loggers, manual water level measurements, NAPL gauging (site-wide), groundwater sampling)

The Federal listed species are:

- Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*)
- Upper Willamette River Chinook Salmon (*Oncorhynchus tshawytscha)*
- Lower Columbia River Steelhead *(Oncorhynchus mykiss)*
- Upper Willamette River Steelhead (*Oncorhynchus mykiss)*
- Columbia River Chum Salmon (*Oncorhynchus keta*)
- Lower Columbia River Coho Salmon (*Oncorhynchus kisutch*)
- Bald Eagle (*Haliaeetus leucocephalus*)
- Golden Paintbrush (*Castilleja levisecta*)
- Water Howellia (*Howellia aquatilis*)
- Bradshaw's Lomatium (*Lomatium bradshawii*)
- Nelson's Checker-Mallow (*Sidalcea nelsoniana*)
- Willamette Daisy (*Erigeron decumbens var. decumbens*)
- Kincaid's Lupine (*Lupinus sulphureus var. kincaidii*)

The Federal proposed species are:

- Oregon Spotted Frog (*Rana pretiosa*).

EPA determined the following effects for each species because of this action.

Listed Species

- Lower Columbia River Chinook Salmon – May affect, likely to adversely affect
- Upper Willamette River Chinook Salmon – May affect, likely to adversely affect
- Lower Columbia River Steelhead – May affect, likely to adversely affect
- Upper Willamette River Steelhead – May affect, likely to adversely affect

- Columbia River Chum Salmon – May affect, likely to adversely affect
- Lower Columbia River Coho Salmon – May affect, likely to adversely affect
- Bald Eagle – No effect
- Golden Paintbrush – No effect
- Water Howellia – No effect
- Bradshaw’s Lomatium – No effect
- Nelson’s Checker-Mallow – No effect
- Willamette Daisy – No effect
- Kincaid’s Lupine – No effect

Federal Proposed Species

- Oregon Spotted Frog – Will not result in jeopardy

2. BACKGROUND INFORMATION ON PROJECT SITE

Site Description

The McCormick & Baxter Creosoting Company site is a former wood treating facility located on the east bank of the Willamette River in Portland, Oregon. The site encompasses approximately 41 acres of land and an additional 23 acres of contaminated river sediments. Figure 1 is a site location map. Figure 2 depicts the current site layout and features on an aerial photograph. Figure 3 depicts the current site layout and features on a topographic map of the sediment and terrestrial surface elevations.

The upland portion is on a terrace of imported sand fill (dredged material placed in the early 1900s) within the historic flood plain of the Willamette River. The upland area is generally flat and lies between a 120 foot high bluff along the northeast border and a 20 foot high bank along the Willamette River to the southwest. Currently the site is vacant except for a paved parking area, small shop building, two field office trailers and associated utilities which are used to support ongoing creosote extraction.

Inactive industrial properties border the site to the south and a residential area is located on the adjacent bluff. A Burlington Northern Santa Fe Railroad track crosses the west portion of the property, and Union Pacific Railroad tracks border the site to the east below the bluff. Beyond the Burlington Northern Santa Fe Railroad tracks, toward the west, is a former industrial property that likely will be developed as a public green space. Additionally, the 92-acre University of Portland college campus is located approximately one half mile east of the McCormick & Baxter Creosoting Company site. The perimeter of the property is fenced and posted with warning signs.

Three hydrostratigraphic units are present at the site: the shallow, intermediate, and deep aquifer zones, which are interconnected to varying degrees depending upon the location within the site. The shallow zone consists of poorly-graded dredge fill sand and wood debris and ranges in thickness from five to greater than 30 feet. In parts of the site, the shallow zone consists mostly of sawdust and wood chips up to 20 to 25 feet thick. The shallow zone acts as an unconfined aquifer that, except within the barrier wall area and close to the bluff away from the river, is in hydraulic connection with the river. Depth to groundwater ranges from approximately 20 to 25 feet below ground surface (bgs). The shallow zone is underlain by a silt aquitard ranging in thickness from zero near the river to greater than 100 feet closer to the bluff.

The intermediate aquifer zone is composed of fine to medium grained alluvial sand and is present below the silt aquitard over most portions of the site. This zone varies in thickness from zero to greater than 50 feet. In the north-central portion of the site, the intermediate zone is approximately 12 feet thick and hydraulically separated from the shallow aquifer. In the south-central portion of the site, the silt aquitard is greater than

100 feet thick and no intermediate aquifer zone is present. Along the beach adjacent to the river, the intermediate zone is up to 50 feet or more thick and is separated from the shallow zone by a discontinuous, thin silt layer.

The deep aquifer zone is present in all portions of the site. The deep zone consists of alluvial sands and is directly connected with the intermediate and shallow zones along the river margin. Near the center of the site, the deep zone is separated from the shallow zone by more than 100 feet of low-permeability silt. Near the bluff, the deep zone is composed of gravel and sands of the Troutdale Formation and Catastrophic Flood Deposits.

Shallow groundwater gradients generally exist from the bluff toward the river. Intermediate and deep zone groundwater surface elevations and gradients have been inferred to flow toward the river in these zones.

The Willamette River is the only surface water body at the site. Near the site, the river is approximately 1,550 feet wide with a typical maximum depth of about 40 to 50 feet below the Columbia River datum. Average flow rates in the river near the site range from 8,300 cubic feet per second (cfs) in summer to 73,000 cfs in winter.

Site History

Much of the McCormick & Baxter Creosoting Company site was created from dredged materials in the early 1900s. At that time, a sawmill operated in the southeast portion of the property. McCormick & Baxter Creosoting Company was founded in 1944 to produce treated wood products, including lumber, piling, timbers, and railroad ties during World War II. The wood treating operations continued until October 1991.

Four retorts were located in the central processing area (CPA) at the site and used for various pressure treating processes which included the use of creosote, pentachlorophenol (PCP), chromium, ammoniacal copper arsenate, ammoniacal copper zinc arsenate and Cellon (PCP in diesel oil, liquid butane and isopropyl ether). Also present at the site were a 750,000 gallon creosote product storage tank and tank farm area (TFA) with several additional tanks for storing wood-treatment chemicals.

From 1950 to 1965 waste oil containing creosote and/or PCP was applied to the site soil for dust suppression in the CPA. Liquid process wastes were reportedly discharged to a low area near the tank farm prior to 1971.

The site included a wastewater discharge outfall that was used to discharge cooling water to the river when the plant was operating. Contact wastewater also was discharged from this outfall in the early years of operation. Three stormwater outfalls were also present along the river. Two of the outfalls were permitted under the National Pollutant Discharge Elimination System (NPDES). Following plant shutdown, DEQ placed earthen berms around stormwater collection sumps at the site as an early response action to minimize off-site discharge. The stormwater outfalls were removed as part of the first phase of the soil remedial action in 1999.

Two major spills have reportedly occurred at the site; a 50,000-gallon creosote release in the tank farm area in approximately 1950 and a large spill of an unspecified volume of creosote from a tank car near the tank farm in 1956.

Sludge from site processes was disposed at an unknown off-site location until 1968. From 1968 to at least 1973 residues from the retorts, oil/water separator, and evaporators were disposed on-site in the former waste disposal area (FWDA) in the western portion of the site. Beginning in 1972 wood preservative sludge was placed in metal containers that were stored on site in the FWDA. After 1978 wood preservative sludge was shipped to Chem-Security System, Inc., a permitted hazardous waste disposal facility near Arlington, Oregon. In 1981 the hazardous waste storage area was secured with a fence and lock and a manifest system was implemented to comply with hazardous waste regulations.

Concrete walls and slabs were built around the ACZA (ammoniacal copper zinc arsenate) process and storage facilities in 1980 to prevent spills from entering the soil. The retorts and retort openings were lined with concrete, but the integrity of the concrete was not verified. The creosote lines and other pipelines passed through a concrete underground walkway that extended from the tank farm to the retort building. In 1985 two feet of soil and sludge were excavated from the tank farm and shipped to a hazardous waste landfill. Visibly contaminated soil remained at the tank farm.

Site investigations have revealed many releases of wood-treating chemical compounds to soils, groundwater and sediments as a result of these operations. Contaminants detected include polynuclear aromatic hydrocarbons (comprising 85% of the creosote), PCP, arsenic, chromium, copper, zinc and dioxins/furans. Three main contaminant sources existed at the site: the FWDA which is located in the western corner of the site adjacent to the Willamette River and was characterized by a large depression where waste oils, retort sludges and wastewater were disposed over a period of several years; the CPA which is located in the center portion of the cite and is where retorts, PCP mixing shed and ACZA storage areas were formerly located; and the TFA which is located in the south-central portion of the site and is the former location of the main tank farm, creosote storage tank and several other wood treatment process-related tanks or process areas. Releases from these source areas, in particular the TFA and FWDA, in the form of insoluble wood-treating contaminants or non-aqueous phase liquids (NAPL) have significantly impacted subsurface soils, groundwater and sediment. Remedial investigations identified two large NAPL plumes that were migrating to the river and impacting surface water and sediments.

Regulatory History

The McCormick & Baxter Creosoting Company began environmental investigations of their property in 1983. Based on those investigations, DEQ entered into a Stipulated

Order with McCormick & Baxter Creosoting Company in 1987 requiring the implementation of corrective actions. Corrective actions included the installation and operation of a groundwater extraction and treatment system, construction of drip pads in retort areas, construction of covered storage areas for treated wood, and collection and treatment of stormwater. In December 1988 the McCormick & Baxter Creosoting Company filed for Chapter 11 bankruptcy, and in 1990 DEQ assumed responsibility for completing the investigations and cleanup activities at the site. In October 1991 the McCormick & Baxter Creosoting Company ceased operations.

DEQ began the Remedial Investigation and Feasibility Study in 1990 and issued a public notice of a proposed cleanup plan in January 1993. DEQ elected not to finalize the proposed remedial actions at the site due to the proposed addition of the site to the National Priorities List (NPL) by EPA in June 1993. The McCormick & Baxter Creosoting Company site was added to the NPL on June 1, 1994. DEQ completed a revised Feasibility Study in 1995.

DEQ and EPA entered into a Superfund State Contract (SSC) in May 1996. The SSC documents the responsibilities of DEQ as the lead agency and EPA as the support agency during the remedial action. Among other items, the SSC specifies cost sharing between DEQ and EPA. The SSC was most recently amended in February 2005.

Additional regulatory background information on the McCormick & Baxter Superfund Site can be found in the following documents:

- *Record of Decision*, McCormick and Baxter Creosoting Company Portland Plant, Portland, Oregon, EPA and DEQ, March 1996.
- *First Five-Year Review Report,* McCormick and Baxter Creosoting Company Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, September 2001.
- *Explanation of Significant Difference* (OU3 – Final Groundwater), McCormick and Baxter Creosoting Company Superfund Site, Portland, Multnomah County, Oregon, EPA and DEQ, August 2002.
- *Preliminary Construction Summary Report*, McCormick and Baxter Creosoting Company Superfund Site, Portland, Multnomah County, Oregon, EPA, September 2005.

Removal Actions

Removal Actions were completed by DEQ under State cleanup rules prior to site listing on the National Priority List (NPL) and under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority between site listing and issuance of the Record of Decision (ROD). These actions included:

- Installation of a fence around the McCormick & Baxter Creosoting Company site to control access.
- Placement of warning buoys along the river and posting of warning signs on the fence.

- Mitigation of potential off-site migration of contaminated airborne particulates through dust control measures such as grass seeding and limitation of site traffic.
- Storm water containment through diversion and collection of storm water in retort sumps.
- Maintenance, sale and transfer of remaining wood-treating chemicals.
- Demolition and off-site disposal of several site structures and materials, including the sale and removal of salvageable equipment and materials from the site.
- Removal of asbestos material from retorts and buildings and recycling or disposal of chemicals stored in the laboratory.
- Disposal of 151 drums of wood-treating process waste.
- Treatment of approximately 400,000 gallons of storm water collected from retort sumps and discharge to the Willamette River.
- Collection and analysis of approximately 650 soil samples to identify the most highly contaminated areas for initial removal actions.
- Excavation and off-site disposal of approximately 377 tons of contaminated soil from three "hot spot" areas.
- Installation of an interceptor trench downgradient of the tank farm area to recover light nonaqueous-phase liquid (LNAPL).
- Dismantling of chemical storage tanks, retorts, and several buildings, and off-site disposal of sludges.
- Installation and monitoring of 21 new wells to further delineate the extent of NAPL contamination.
- Recovery of NAPL from monitoring and extraction wells. Starting in 1989 creosote was purged every week from 5 monitoring wells at the site. Approximately 450 gallons were recovered between July 1989 and November 1991. By February 1995 more extraction wells had been added to the system and approximately 1,800 additional gallons of creosote had been removed.
- Installation of a fully automated pilot-scale wastewater treatment system to separate NAPL and treat groundwater removed through total fluid extraction efforts in the TFA. Wells in the FWDA were used for pure-phase NAPL extraction and were not connected to this treatment system. The treatment system in the FWDA consisted of an oil/water separator, an in-line anthracite/clay filter, two granulated activated carbon units, and a metals treatment unit.
- Modification in 1994 of the fully automated TFA system to a 40 hour per week system. The fully automated system required constant monitoring and temporary shutdown of the extraction system to minimize recovery of groundwater. Field data collected between 1992 and 1994 indicated that weekly pumping yielded as much NAPL as the fully automated system.

Remedy Selection

In March 1996 EPA and DEQ issued one ROD for the site to address several different media: contaminated soil, groundwater, stormwater, and Willamette River sediment. The selected remedy required the following media-specific actions to mitigate the principal threats at the site:

1. Excavation and biological land treatment of the most highly contaminated PAH and PCP contaminated soil, stabilization of the most highly contaminated arsenic-contaminated soil and consolidation and capping of treated soil.
2. Enhancement of the existing groundwater and NAPL extraction and treatment system to remove NAPL and hydraulically control contaminated groundwater in a limited area in the immediate vicinity of the extraction wells.
3. As a contingency remedy, installation of a vertical subsurface barrier wall in the event that mobile NAPL cannot be reliably controlled using hydraulic methods.
4. Sediment capping.
5. Monitoring.
6. Institutional controls.

In March 1998 an amended ROD was issued by EPA and DEQ to change a component of the selected remedial action for contaminated soil. The soil remedy in the original 1996 ROD called for excavation and on-site biological treatment. After the ROD was signed, DEQ initiated additional soil sampling for remedial design. This sampling found that dioxin contamination was more widespread than the previous analyses indicated. Accordingly, DEQ and EPA reevaluated the remedy and subsequently selected an alternative, which called for removal and off-site disposal of shallow soil with concentrations above designated action levels and capping the remaining contaminated soil.

In August 2002 EPA and DEQ issued an "Explanation of Significant Differences" (ESD) explaining the decision to implement the contingency remedy for groundwater as specified in the 1996 ROD. The groundwater remedy selected in the ROD included a contingency for installing an impermeable subsurface barrier wall in the event that either (1) NAPL could not be reliably contained using hydraulic methods or (2) the barrier wall improves the overall cost-effectiveness of the groundwater remedy. DEQ and EPA determined that NAPL had not been contained using groundwater/NAPL extraction and recovery measures, and concluded that hydraulic control of NAPL or groundwater had not been established in either the TFA or the FWDA. To implement the contingency plan, DEQ and EPA selected a fully encompassing, impermeable subsurface barrier wall alignment surrounding the TFA and the FWDA, and a riverfront alignment located along the ordinary high-water mark of the Willamette River.

Remedial Actions

Following is a summary of Remedial Actions implemented by DEQ under CERCLA authority following issuance of the ROD, ROD Amendment, and ESD.

Soil Removal

The purpose of the soil remedy selected in the amended ROD was to eliminate the potential for future human contact with soil less than 4 feet in depth that has contaminant concentrations above removal action levels (*i.e.*, “principal threat” or “hot spot soil”). Action levels for contaminated soils were defined for excavation and off-site disposal for arsenic, pentachlorophenol and total carcinogenic polynuclear aromatic hydrocarbons (cPAHs). These action levels indirectly addressed the removal of dioxins/furans by assuming their presence predominantly in the same areas where elevated concentrations of PCP and PAHs are found in soil.

Soil excavation activities were performed from February through May 1999 and effectively eliminated the presence of the contaminated soils above removal action levels. In several major source areas excavation proceeded to depths of 8 to 10 feet. Approximately 32,604 tons of contaminated soil and debris were excavated and disposed offsite at permitted landfills. A total of 33,128 tons of clean sand was imported from an off-site quarry to back fill the excavation pits.

Documentation, record drawings, and a detailed summary of the soil removal construction activities are provided in *Phase 1 Soil Remedial Action Summary Report* (E & E, 1999).

Upland Soil Cap

The selected soil remedy requires capping upland areas where residual soil contamination remains above human health and ecological risk-based protective levels. Documentation, record drawings, and a detailed summary of the upland soil cap construction activities are provided in *Upland Soil Cap Construction Summary Report* (E & E, 2006).

Construction activities for the upland soil cap were performed between March and September 2005 and included the following major components: demolition and off-site disposal of existing structures and infrastructure; reinstallation of key support facilities; construction of an impermeable cap within a 14.7-acre portion of the subsurface barrier wall (the barrier wall is described under Remedial Actions for the Groundwater Operable Unit); and construction of an earthen soil cap outside of the impermeable cap.

Demolition and removal were conducted from May through June 2005 and included the removal of all remaining structures and disposal of the generated waste in a State-approved disposal facility. All existing water, gas, and electrical utilities were removed or abandoned. Fire hydrants were removed and any associated piping was grouted to prevent preferential flow paths, and water lines were capped. Demolition items were salvaged, scrapped, or disposed of as non-hazardous waste or hazardous waste. Concrete, creosote-contaminated steel and asbestos-containing water pipe was also buried on site. All on-site burial locations were surveyed. Twenty groundwater monitoring wells were abandoned.

Support facility construction was conducted from March to July 2005 and included the reinstallation of a 0.8-acre paved entrance road and parking area; construction of a 25-foot by 40-foot shop building; and reinstallation of electrical, telephone, and water services.

A Resource Conservation and Recovery Act (RCRA) type impermeable cap was constructed over the entire 14.7-acre area inside of the barrier wall, excluding the riparian zone bordering the river. Capping of the riparian zone had been completed in 2004 as part of the sediment cap construction. The purpose of the impermeable cap is to minimize infiltration of rainwater into the contaminated areas within the wall. The impermeable cap is composed of the following materials (listed from bottom to top):

- 8,000 cubic yards of sand used as a leveling layer about 4 inches thick;
- 72,000 square yards of high density polyethylene (HDPE) geomembrane liner;
- 72,000 square yards of a geocomposite plastic ‘fabric’ that allows water to flow laterally;
- 47,000 cubic yards of sand of varying depths to allow for drainage;
- 12,000 cubic yards of 4-inch-minus crushed rock forming a screened biotic barrier layer approximately 6 inches thick;
- 72,000 square yards of geotextile filter fabric;
- 24,000 cubic yards of topsoil placed approximately 9 to 12 inches in depth; and
- 20 species of native grasses to provide a diverse and sustainable herbaceous cover in order to minimize surface erosion.

The impermeable cap has a minimum thickness of 29 inches; however, the thickness varies because of varying subgrade and the final grade of the site. The sand drainage layer increases in depth to create the grades necessary to achieve site drainage. The maximum thickness of the cap is approximately 7 feet, which includes a 4-inch sand leveling layer, a 62-inch sand drainage layer, a 6-inch rock biotic barrier, and 12 inches of topsoil.

The impermeable cap also consists of a subsurface drainage system above the HDPE liner to collect storm water percolating through the upper soil, rock, and sand layers of the cap. Storm water is collected in the geocomposite fabric and perforated piping and conveyed by gravity flow through conveyance piping to an outfall structure which daylights at the Ordinary High Water (OHW) level of the Willamette River (*i.e.*, 19 feet above the National American Vertical Datum [NAVD]).

An earthen soil cap, consisting of a 2-foot layer of imported top soil, was installed over 18.9 acres of the site outside of the barrier wall area excluding the gravel entrance road and parking area. The purpose of this cap is to prevent direct contact with low-level contamination remaining in the soils throughout the rest of the site. The soil layer is underlain with a demarcation layer consisting of orange HDPE safety fencing, to provide a distinction between the clean soil cap and contaminated soil. The earthen soil cap was seeded with native herbaceous vegetation.

A storm water management system was also constructed to minimize storm water runoff from the site to neighboring properties and the Willamette River. This system consists of a swale that conveys storm water directly to an on-site retention/infiltration pond. The surface of the soil cap is constructed with sloped surfaces (approximately 1% slope) to direct surface water runoff towards the drainage swale.

A 6-foot high chain-link fence was also reinstalled along the site perimeter. Along the riverfront the fence is located at the top of the bank, inland of the riparian zone. Gravel access roads were constructed around the perimeter of the site (except along the north side where the drainage swale is located), with spurs that cross the interior area to allow monitoring and maintenance of the site.

Creosote Recovery

Creosote (i.e., NAPL) recovery began in 1989 as a Removal Action. Approximately 450 gallons were recovered between July 1989 and November 1991. By February 1995 more extraction wells had been added to the system and approximately 1,800 additional gallons of NAPL had been removed.

NAPL recovery continued following issuance of the ROD in March 1996. Through March 2004 monthly extraction volumes of NAPL from extraction wells in the TFA and FWDA ranged from 0.4 to 73 gallons, with some periods of no extraction. As of February 2006 slightly more than 6,000 gallons of NAPL have been removed from groundwater.

Since the McCormick & Baxter Creosoting Company facility was shut down in 1991, various extraction methods have been attempted to optimize NAPL recovery. The goal of the extraction was to remove and deplete NAPL pools to residual levels to minimize or prevent migration into the Willamette River. Key NAPL extraction activities are summarized below.

- 1998: The treatment system in the TFA was again modified. Previously, total fluids extracted from three wells were conveyed to the former pilot treatment system and treated by a DAF system. This system required extensive oversight and was expensive to operate (*e.g.*, chemical costs). The system operated 40 hours per week (Monday through Friday) when a technician was on site to perform operation and maintenance activities. To allow for continuous operation and to reduce costs and operator requirements, the system was replaced with one resembling that employed in the FWDA consisting of an oil/water separator, an in-line anthracite/clay filter, two granulated activated carbon units and a metals treatment unit.

- 1999 & 2000: The volume of NAPL extracted by the automated systems was found to be similar to the volume removed via manual extraction using skimmers. In addition, it was determined that manual extraction could be conducted for approximately half the cost of operating the automated systems. Therefore, the FWDA and TFA NAPL extraction systems were shut down in September 2000 and NAPL extraction was continued manually.

- 2004 – Current: Select wells inside and outside the barrier wall are monitored weekly for the presence and thickness of NAPL. NAPL is extracted weekly from interior and exterior wells if the thickness is greater than 0.4 feet. NAPL recovery is continuing until the effectiveness of the barrier wall and sediment cap has been verified.

Subsurface Barrier Wall

As required by the ESD, a fully encompassing, impermeable subsurface barrier wall was designed and installed to meet the remedial action objective of minimizing NAPL discharges to the Willamette River and sediment to protect human health and the environment. The alignment of the wall surrounding the TFA, CPA, the FWDA, and along the riverfront at the OHW of the Willamette River was designed to cut off the upgradient sources of dense non-aqueous phase liquid (DNAPL) and LNAPL in the TFA and FWDA and prevent NAPL migration from these areas to the river.

The majority of the subsurface barrier wall was constructed from April through September 2003 with the exception of eight sheet piles that met refusal before achieving design depth. The resulting gaps were pressure grouted in July 2004. Documentation, record drawings, and a detailed summary of the barrier wall construction activities are provided in *Remedial Action Construction Summary Report, Combined Sheet Pile and Soil-Bentonite Barrier Wall* (E & E, 2004).

The barrier wall was constructed to fully encompass approximately 17.8 acres of NAPL impacted groundwater and the main contaminant source areas at the site, including the TFA and FWDA. The total length of the wall is 3,792 linear feet and the depth varies from approximately 45 feet below ground surface (bgs) to 80 feet bgs to account for differences in the topography and soil profile at the site.

Approximately 1,440 feet of the barrier wall along the bank of the Willamette River were constructed using steel sheet piles. Installation methods involved a panel-driving technique, which consisted of setting and partially driving six to eight sheet pile pairs (a panel).

Approximately 2,355 linear feet of soil-bentonite barrier wall were installed to depths of up to 80 feet bgs to the side and upgradient of the primary contaminant source areas. The excavated trench was held open using a slurry mix of bentonite and water, which was later displaced by the denser soil-bentonite mixture. The mixing operation occurred concurrently with excavation within the wall's perimeter. The soil-bentonite mixture consisted of soil excavated from the trench, slurry from the trench, imported clayey soil, and dry bentonite. The mixing and placement were accomplished by an excavator and bulldozer.

The segment of wall between the Willamette River and the TFA (approximately 900 linear feet) is keyed into a silt aquitard and extends to a depth of approximately 70 to 80 feet bgs. The segment of barrier wall between the Willamette River and Willamette Cove and the FWDA (approximately 1,100 linear feet) is a "hanging wall" because deeper soil in this area consists of interbedded sand and silt lenses with no continuous, competent aquitard to key into. This segment of the wall extends to a depth of 70 to 80 feet bgs. The segment of the wall located upgradient and side gradient of the TFA and FWDA (1,800 linear feet) is keyed into the silt aquitard and has a depth of 45 feet bgs.

Although the barrier wall segment located downgradient of the FWDA does not key into a continuous, competent aquitard, this segment of the wall was extended to such a depth that DNAPL migration toward the river will be substantially retarded.

Review of NAPL Recovery Innovative Technologies

The 1996 ROD required pilot testing to evaluate innovative technologies, such as surfactant flushing, to increase the effectiveness of NAPL removal. This requirement was modified in the 2002 ESD because NAPL accumulations on site (at that time) appeared to be decreasing and there were concerns that, in the absence of containment, the pilot tests could mobilize NAPL and increase discharges to the river.

DEQ, through its contractors, GeoEngineers Inc. and Aquifer Solutions Inc., prepared a technical memorandum that develops and evaluates several innovative technologies and presents a cost-benefit analysis of the most promising innovative technology for enhanced NAPL extraction, the current method of NAPL recovery, and additional capping of potential seeps with Organoclay (capping with Organoclay is discussed under the Sediment Operable Unit). The evaluation of innovative technologies utilizes two general criteria: effectiveness and implementability at the site. The following technologies were developed and evaluated in the report: six-phase soil heating; dual-phase extraction or bioslurping; dynamic underground stripping and hydrous pyrolysis oxidation; in situ flushing; waterflood oil recovery; hydrogen peroxide in situ bioremediation; and membrane filtration system. The cost-benefit analysis considers the cost to construct, operate, and decommission the most promising innovative technology, and these costs associated with the existing system for NAPL recovery; and a scenario where no further NAPL recovery is performed and potential seepage of NAPL is contained by the targeted use of additional Organoclay.

At this time, no additional construction is foreseen. However, as part of the Five Year Review, the results of this or future evaluations will be considered for opportunities to improve the long-term protectiveness or cost efficiencies of the selected remedy.

Sediment Cap

The selected sediment remedy required capping areas that contain contaminant concentrations above human health and ecological risk-based protective levels or that exhibit significant toxicity to biological organisms in the near surface. Documentation, record drawings, and a detailed summary of the sediment cap construction activities are provided in *Remedial Action Construction Summary Report Sediment Cap (June 2004 through November 2004)* (E & E, 2006a) and the *Remedial Action Construction Summary Report Sediment Cap Completion (August 2005 through October 2005)* (E & E, 2006b).

Construction activities during the sediment cap implementation consisted of the following major components: removal of approximately 1,630 pilings, bulkhead and dock remnants, in-water debris, a derelict barge in Willamette Cove, and other Willamette Cove features; construction of a multi-layer sediment cap using sand, organoclay, and armoring; monitoring well abandonment and modification; bank regrading; and disposal and demobilization.

The sediment cap footprint encompasses approximately 23 acres. Its shoreward boundary extends along the shoreline from the south end of the property downstream into Willamette Cove to the north. Its riverward boundary at the furthest offshore location extends into the Willamette River to an approximate elevation of -40 feet NAVD, outside of the limits of the USACE-designated navigational channel, and to 16 feet deep in Willamette Cove. The cap consists of a 2-foot thick layer of sand layer over most of the cap footprint with a 5-foot thick layer of sand over several more highly contaminated areas. Approximately 131,000 tons of sand was placed from July 7 through October 28, 2004.

Within the cap footprint were areas of known NAPL migration (*e.g.*, seep areas). In the Willamette Cove and TFA NAPL seep areas, the cap incorporated 600 tons of organoclay to prevent breakthrough of the NAPL through the cap. Organoclay is bentonite or hectorite clay that has been modified to be hydrophobic and to have an affinity for non-soluble organics.

The sediment cap incorporated different types of armoring to prevent erosion of the sand and organoclay layers. The specific armoring material and where it was installed was dependent on the expected hydraulic and physical environments (*e.g.*, currents, wave energy, erosive energies, etc.). Articulating concrete block (ACB) mats were installed along the shore and in shallow water where erosive forces would be the greatest due to wave action. ACB is individually formed interlocking concrete blocks. Rock armor included 6-inch-minus, 10-inch-minus, and riprap. All shallow water 10-inch-minus and ACB armoring layers were underlain with a woven geotextile fabric and 4-inch thick layer of 3-inch-minus filter rock. This fabric and rock was installed to hinder the migration of the sand through the larger and more porous armoring layer or layers.

ACB installation began on July 7, 2004, and proceeded from the downstream end of the site in the Willamette Cove to the upstream work limits. Installation of ACB mats was allowed only after the subgrade, including sand cap and gravel filter layer, was verified by DEQ’s construction oversight contractor. The ACB installation was completed on October 28, 2004.

The 6-inch-minus rock was basalt and/or andesite. Approximately 23,250 tons of 6-inch-minus cobble were placed over the sand cap and as edge treatment where the 6-inch-minus cobble areas abutted the ACB.

The 10-inch-minus rock used as armoring is also comprised of angular basalt and/or andesite. Approximately 23,300 tons of 10-inch-minus rock was placed in the near-shore embayment.

The riprap material used for construction of the boulder clusters and the rock mound is composed of durable angular boulders less than 3 feet in diameter. Approximately 558 tons of riprap was placed along the shoreline and on an offshore shoal between the embayment and the river at the McCormick & Baxter Creosoting Company site. Each boulder cluster consisted of six to seven boulders.

As a result of the sediment cap construction 18 monitoring wells were abandoned and 36 monitoring wells were modified in accordance with Oregon Water Resources Department (OWRD) requirements (*e.g.,* boreholes were over-drilled and grouted with bentonite).

A 6-acre riparian zone was created by regrading the riverbank, placement of a demarcation layer, placement and grading of two feet of imported clean fill (topsoil), placement of a turf reinforcement mat, and hydroseeding with native grasses.

During initial construction of the sediment cap, two City of Portland pressurized sewer lines were found exposed within the sediment capping area. The City of Portland was informed of the situation, and a no-work zone was established along a 120-foot swath of the sewer lines. These lines were stabilized by the City in July 2005. Construction of the sediment cap was resumed in August 2005 and completed in October 2005 and consisted of the following major components: placement of 8,950 tons of sand, 460 tons of 3-inch-minus filter rock, 1,711 tons of riprap, 2,850 tons of 6-inch-minus rock and 1,240 tons of 10-inch-minus rock. The riprap material was used in place of the ACB to provide stability against wave action along steep portions of the shoreline between elevations of approximately +8 NAVD to -2 NAVD. Construction activities also included the installation of 24,150 square feet of organoclay mats. These mats were placed in three areas along the shoreline: under the Burlington Northern Railway Bridge (6,000 square feet), downstream of the previously organoclay capped TFA seep (150 square feet), and upstream of the previously organoclay capped TFA seep (18,000 square feet). The organoclay mats were covered with sand and rock armoring.

3. DESCRIPTION OF THE PROPOSED ACTION

The proposed action addressed in this BA is the O&M of the soil cap, sediment cap, and groundwater remedy through September 2011. The anticipated O&M activities are discussed in the paragraphs below.

The results of these O&M activities through this five year period will be evaluated as part of the Five-Year Review Report to be issued by the DEQ and EPA in October 2011. The O&M Plan will be updated following this Five-Year Review and subsequent Five-Year Reviews in order to assure the remedies are operated and maintained in a manner that is protective of human health and the environment.

Description, Frequency and Duration of Soil Cap O&M

O&M of the soil cap consists of monitoring, vegetation maintenance, and potential unplanned maintenance. Monitoring activities for the soil cap include visual inspections of the cap surface, stormwater conveyance system, security fencing, and warning signs. The soil cap is designed to be generally maintenance free except for maintaining the native vegetation. Vegetation maintenance will include irrigation of the trees and shrubs (i.e., stormwater swales shrub areas, pond sideslopes shrub areas, natural tree/shrub areas, upper riparian area and lower riparian area) through summer 2008, mowing of open space/grasslands, manual removal of invasive plant throughout the site, and targeted application of herbicides to problem areas throughout the site. Figure 4 provides the locations and sizes of the vegetated areas. Vegetation maintenance, including the targeted application of herbicides, was addressed in EPA’s BA for construction of the sediment cap (EPA 2003) and in the subsequent Biological Opinion issued by the NMFS (2004). The conclusions of this earlier consultation are carried into the O&M BA in order to provide context and consistency with the other O&M activities. For a detailed description of vegetation maintenance see Appendix A of the 2003 BA. Unplanned maintenance work may include repairs of the fence, replacement of warning signs, gravel roads, filling of potential animal burrows dug into the earthen cap, removal of sediments from manholes, and replanting of unsuccessful trees and shrubs.

The frequency of these O&M activities over the first five years of O&M is provided in the following table.

Description and Frequency of Soil Cap O&M Activities through September 30, 2011.

O&M Activity	Frequency
Monitoring: • Inspection of cap surface • Inspection of stormwater	 • Monthly • Monthly

conveyance system • Inspection of security fencing • Inspection of warning signs	• Monthly • Monthly
Vegetation Maintenance: • Irrigation • Mowing open grass areas • Manual removal of invasive plants • Targeted application of herbicides	• Summer 2007 and 2008 • Annually • Annually • Biannually (April and September)
Unplanned Maintenance – such as: • Repairs of fence • Replacement of warning signs • Repairs of gravel roads • Filling of potential animal burrow into the earthen cap • Removal of sediments from manholes	• As needed • As needed • As needed • As needed • As needed

Equipment requirements for monitoring of the soil cap include a site vehicle for inspecting the 41 acre soil cap, perimeter fencing, warning signs and vegetation. Survey equipment, such as GPS, will be needed. Inspections likely will be performed by contractors under oversight of DEQ staff.

Although routine maintenance is not anticipated for the soil cap, unplanned repairs may be needed. The nature of any repairs will determine the equipment and material requirements. These repairs likely could be performed by a contractor with general construction capabilities. Any substantial repairs, such as those requiring the impermeable cap to be breached or repaired, will be detailed in work plan prepared prior to performing this activity. The work plan will provide technical specifications and drawings sufficient to assure that this work is performed appropriately and by qualified personnel.

Materials needed for potential maintenance include those materials used to construct the soil cap: geomembrane, geocomposite, perforated piping, sand, biotic rock (3-inch-minus rock), 10-inch-minus rock, filter fabric, topsoil, fencing, road gravel, etc. Sand, 3-inch-minus rock and 10-inch-minus rock, 24-inch-minus rock and road gravel have been stockpiled on site. If these materials are inappropriate or insufficient for the repair, additional materials will be imported to address minor and routine cap integrity or soil erosion problems. Any imported soil will be certified by DEQ as meeting the requirements for “clean fill” under Oregon regulations.

Description and Duration of Sediment Cap O&M

O&M of the sediment cap consists of monitoring and potential unplanned maintenance.[2] Monitoring activities for the sediment cap include visual inspections of warning buoys and near shore areas, multibeam bathymetric surveys and side scan sonar surveys of deeper areas, and diver inspections of anomalies in areas of concern identified from the bathymetry and sonar surveys. Monitoring activities also include collection of samples from surface water, subarmoring pore water, flux chambers, crayfish, sculpins, clams if available and organoclay cores. Although the sediment cap is designed to be generally maintenance free, unplanned maintenance work may include the replacement of warning buoys, placement of additional armoring due to erosion and placement of additional organoclay if new releases of creosote are discovered or if the existing organoclay become saturated with creosote. Any new organoclay would require armoring.

The frequency of these O&M activities over the first five years of O&M is provided in the following table.

Description and Frequency of Sediment Cap O&M Activities through September 30, 2011	
O&M Activity	**Frequency**
Monitoring	
• Inspections of warning buoys	• Monthly
• Inspections of near shore areas	• Weekly (August - October) otherwise monthly
• Multibeam bathymetric surveys	• Annually through May 2010
• Side-scan sonar surveys	• Annually through May 2010
• Diver inspections of deep water	• Annually through Spring/Summer 2010
Sampling	
• Surface water, pore water, flux chamber	• Biannually (May and September) through 2010
• Crayfish, sculpin, clams, possibly lamprey	• Annually through September 2010
• Organoclay cores	• Performed in September 2010
Unplanned Maintenance – such as:	
• Replacement of buoys	• As needed

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[2] Monitoring and maintenance of the riparian zone is addressed as part of the soil cap.

• Additional armoring placement • Additional organoclay capping	• As needed • As needed

Equipment requirements for monitoring of the sediment cap include sampling tubes and containers, pumps and probes, flux chambers, use of boats and survey equipment such as GPS. Inspections and sampling will likely be performed by contractors under oversight of DEQ staff. Divers will be needed to perform inspections and assist with sampling in deep water locations. Special analytical procedures will be needed to achieve the desired detection limits. Inspections and sampling likely will be performed by contractors under oversight of DEQ staff.

Although routine maintenance is not anticipated for the sediment cap, unplanned repairs may be needed. The nature of any repairs will determine the equipment and material requirements. These repairs likely would need to be performed by a contractor with expertise in marine construction. Any substantial repairs will be detailed in work plan prepared prior to performing this activity. The work plan will provide technical specifications and drawings sufficient to assure that this work is performed appropriately and by qualified personnel.

Materials needed for potential maintenance include those materials used to construct the sediment cap: sand, organoclay, filter gravel (3-inch-minus rock), ACB, 6-inch-minus rock, 10-inch-minus rock, riprap, etc. Sand, 3-inch-minus rock, ACB, 10-inch-minus rock, riprap and road gravel have been stockpiled on site. If these materials are inappropriate or insufficient for the repair, additional materials will be imported. Further discussion of several hypothetical repair scenarios for the sediment cap is provided later in this section.

Description and Duration of GW O&M

O&M of the groundwater remedies consists of NAPL recovery, groundwater elevation monitoring, and groundwater sampling. Figure 5 provides the locations of the groundwater monitoring and extraction wells. Equipment maintenance and maintaining utilities service (electric, water, and telephone) is also covered under the groundwater O&M.

The frequency of these O&M activities over the first five years of O&M is provided in the following table.

Description and Frequency of Groundwater O&M Activities through September 30, 2011	
O&M Activity	**Frequency**

NAPL Recovery[3] • Extraction of Exterior Wells • Extraction of Interior Wells	 • Weekly • Weekly
Groundwater Monitoring • Downloading continuous water level data loggers • Manual water level measurements • NAPL gauging (site-wide)	 • Quarterly • Quarterly • Quarterly
Groundwater Sampling • Site-wide • Infiltration pond	 • Performed in May 2010 • Quarterly through September 2007 – annually through 2010 thereafter
Equipment Maintenance • Interface probes, pumps, vehicle, data loggers/transducers, etc.	 • As needed
Utilities Service • Water, electric, phone, alarm, solid waste, toilet	 • Continuous

Equipment requirements for NAPL gauging and extraction include an interface probe for determining the thickness of NAPL within a well, pumps and bailers for extracting NAPL, a generator and compressor for operating the pumps, a utility vehicle for transporting the equipment and waste products, a shop building for storing the equipment, and a contained storage area for storing the extracted creosote prior to off-site disposal. Equipment requirements for groundwater include water level indicators, pumps, bailers and containers. NAPL extraction and groundwater monitoring will likely be performed by contractors under oversight of DEQ staff.

Hypothetical Repairs to the Sediment Cap

As discussed previously, the soil and sediment caps are designed to be relatively maintenance free and should not require substantial repairs. However, two components of the remedy are more susceptible to damage and are the focus of ongoing monitoring. The armoring layer of the sediment cap is susceptible to damage by wave action, scouring of the armoring by river currents, and gauging of the armoring by submerged

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[3] NAPL extraction termination criteria are met when recovery efficiency reaches a point of diminishing returns in comparison to historical recovery yields and in consideration of recovery cost versus volume.

logs and commercial vessels (anchoring). The chemical isolation layer of the sediment cap is susceptible to damage by unanticipated releases of mobile NAPL from the underlying contaminated sediments or continued seepage of mobile NAPL from upland sources. These releases of NAPL are possible as a result of saturation of the existing organoclay caps or through portions of the sediment cap where organoclay was not utilized.

Repairs to the sediment will need to be performed in a timely manner in the event that the armoring layer becomes damaged or the chemical isolation layer fails to contain NAPL. The following discussion outlines three hypothetical scenarios for performing these repairs:

Additional Armoring Placement

Corrective measures to address damage to the armoring layer would consist of placing additional armoring over the damaged area. If it is determined that the damage resulted from wave action or river currents, the size of the armoring material would be increased. For example, the 10-inch-minus rock within the embayment area would be up-sized to a 24-inch-minus rock (i.e., riprap). The repair would be performed to as small of an area as determined to be susceptible to damage. For evaluation in this BA, it is assumed that the repair area may extend 30 feet along the shoreline and 10 feet away from the shoreline to encompass an area of 300 square feet (see Section 4 for duration discussion). It also is assumed that the existing elevation of the repair area is +8 to -10 feet NAVD. The repair material would consist of:

- 12-inch layer of 6-inch-minus rock or 12-inch-minus rock in elevations deeper than -5 feet NAVD;
- 12-inch layer of 12-inch-minus rock in areas shallower than -5 feet NAVD; or
- 24-inch layer of riprap in exposed or steep sloping areas shallower than -5 NAVD.

Under this scenario, the beachfront or river bottom elevation would rise by approximately 1 to 2 feet, and a total volume of 11 to 22 cubic yards of rock would be added to the beachfront or river bottom. If sizing of the armoring is increased, the sediment structure would change to that of a larger rock size (i.e., riprap instead of 10-inch-minus rock).

Additional Organoclay Capping Along Beachfront

Intermittent releases of NAPL may be discovered along the beachfront in the vicinity of the former NAPL seep areas within Willamette Cover and Willamette River. These releases may coincide with gas ebullition which is more prevalent during the summer and fall when river levels are at annual lows and during the low tide cycles.

Corrective measures to address these releases would consist of the additional placement of organoclay and armoring over existing river bottom elevations of +8 to +2 feet NAVD. The repair area may extend as much as 300 feet along the shoreline and 100 feet away from the shoreline to encompass an area of 300,000 square feet. The repair cap would consist of the following components from bottom to top:

- 6-inch layer of sand placed directly on the river bottom;
- 6-inch layer of organoclay or ½-inch layer of organoclay mats;
- 12-inch layer of sand;
- 4-inch layer of 3-inch-minus filter rock; and
- 12-inch layer of 10-inch-minus rock (protected embayment area) or 9-inch layer of ACB mats (areas exposed to wave action).

Under this scenario, the beachfront elevation would rise by approximately 3 feet, and a total volume of 33,300 cubic yards of rock and sand would be added to the beachfront. No change in sediment structure would occur since the media is currently capped with 10-inch-minus rock or ACB.

Likely construction equipment would consist of an excavator, All-Tracks, dozer, loader, and crane or forklift. Prior to installation of the capping materials, a protective layer of sand would be placed over existing ACB armoring and other sensitive surfaces. Sand would be delivered to the top of bank by truck and then loaded into the All-Tracks using the loader. The All-Tracks would transport the sand to the water and unloaded the sand in the general area where it was to be spread. A dozer would spread the sand to a thickness of approximately 6-inches over the repair area. An excavator would reposition any drift logs or boulder cluster located within the footprint of the repair area.

After the sand is placed, the organoclay would be installed with an excavator. As organoclay is placed, it would be covered with a protective layer of sand. The All-Tracks would transport the sand from the top of the bank to the river, and the dozer would spread the sand to a thickness of approximately 12-inches. After the sand layer is installed, a 4-inch layer of 4-inch-minus rock would be installed atop the sand also utilizing the All-Tracks for transportation and dozer for spreading. If 10-inch-minus rock is used as the final layer, it would be placed in a similar manner to the previous layer. If ACB is used as the final layer, it would be transported by All-Tracks from the top of the bank to the river. A forklift or crane then would be used to place the ACB. Once installation of the organoclay and armoring is complete, access road created from equipment going down the bank would be removed and the vegetation would be replanted with native grasses, shrubs and trees as specified in the vegetation management plan provided in the Biological Assessment for the Sediment Cap (EPA 2003).

Additional Organoclay Capping in Deep Water

Intermittent releases of NAPL also may be discovered in deep water, potentially beneath the Burlington Northern Santa Fe Railway Bridge. Corrective measures to address these releases would consist of the additional placement of organoclay and armoring over existing river bottom elevations of -5 to -35 feet NAVD. The repair area may extend as much as 200 feet along the shoreline and 100 feet away from the shoreline to encompass an area of 200,000 square feet. The repair cap would consist of the following components from bottom to top:

- 6-inch layer of sand placed directly on the river bottom;
- ½-inch layer of organoclay mats;
- 12-inch layer of sand; and
- 12-inch layer of 6-inch-minus rock.

Under this scenario, the river bottom elevation would rise by 2 and ½ feet, and a total volume of 18,500 cubic yards of rock and sand would be added to the river bottom. No change in sediment structure would occur since the media is currently 6-inch-minus rock.

Likely construction equipment would consist of a crane barge, material barge, tug, loader and dive support boat. A crane mounted barge equipped with a clamshell bucket would be used to place the initial layer of sand. The organoclay mats would be placed using a spreader bar attached to the crane. Divers would guide the organoclay mats into the desired location and use sand bags to temporarily secure the mats. The following layers of sand and 6-inch-minus rock would be placed with the clamshell bucket. Upon completion of 6-inch-minus rock placement, the divers would walk the area to ensure appropriate 6-inch-minus rock coverage.

4. DURATION AND TIMING OF THE ACTION

The O&M activities addressed in this document extend through September 30, 2011. These activities would be performed throughout the year over this period as discussed in Section 3. Sampling activities would be performed in the spring, summer and/or fall of each year. Monitoring of the sediment cap surface using multi-beam bathymetry and side-scan sonar would occur in the spring of each year. Diver inspections of the sediment cap would occur in the spring or summer of each year. Any repairs to the sediment cap would be performed between July 1 and October 31 of any given year. These repair would take anywhere between one week and four weeks to complete.

5. DESCRIPTION OF ACTION AREA

An action area is defined by NMFS regulations (50 CFR Part 402) as 'all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved by the action.' The action area for the proposed action includes the entire portion of the Willamette River from RM 8 to the confluence of the Columbia River, including the exposed beach and shoreline areas.

The Willamette River is one of the major rivers in Oregon with a watershed of 12,000 square miles. It is a major tributary to the Columbia River, which it joins approximately 7 miles to the north of the site. The river is tidally influenced at the project site.

The Willamette River is about 1500 feet wide along the reach of the project site and flows to the northwest. Channel sounding maps produced by the U.S. Army Corps of Engineers from January 1991 show a channel width of approximately 600 feet and a maximum depth of approximately 55 to 65 feet below NAVD. There is a 50-foot wide embayment along the south portion of the property, with river depths ranging from 0 to +10 feet NAVD. COE maps indicate that there are steep slopes to the dredged navigational channel approximately 150 feet offshore (or 300 feet from the embayment shoreline).

As described in the US Army Corps' Portland-Vancouver Harbor Information Package (USACE, 2004), maximum monthly stages in the Willamette River at Portland usually occur during the winter (December through February and the spring (March through June). Notable maximum monthly stages of 32.2 feet NAVD in February 1996 and 23.5 feet NAVD in June 1997 indicate the effects that large runoff years on the Columbia River have on stage at Portland. Minimum monthly stages usually occur between July and October. A minimum monthly stage of 6.1 feet NAVD occurred in July of 2001. Normally, August or September is the month when minimum monthly stages are most likely to occur in the Portland Harbor. Tidal effects strongly influence monthly river stages in the Portland Harbor during the summer and fall in which tidal-induced daily stage variations are typically several feet (USACE, 2004). Figure 6 shows a graph of daily average river levels at the Morrison Bridge between 1996 and 2006.

The City of Portland surrounds the action area. Most of the shorelines of the Willamette and the Columbia Rivers are developed as industrial shorelines, although there are areas of greenbelt, residential, and commercial use.

Historic Conditions

European settlement of the Willamette Basin in the early 1800s began a history of substantial changes to the river ecosystem. Although some impacts were the result of naturally occurring events, the principal impacts in the Willamette Basin are from human activities. The most extensive changes in characteristics of the Willamette River occurred as a result of channelization and containment of the main stem (Sedell and

Frogatt 1984). These changes were greatest in the southern half of the river, which historically was a braided system of numerous oxbows, sloughs, ponds, and small side-channels and a broad floodplain with extensive marshlands and riparian gallery forests. Additional habitat loss occurred due to clearing of the extensive riparian forests and draining and filling of wetland habitats (Holland 1994).

Declining anadromous fish stocks in the Willamette Basin and elsewhere in the Pacific Northwest have been attributed to numerous factors, including loss and degradation of freshwater and riparian habitat, introduction of non-native fish species; construction and operation of dams and their effects on habitat, water flows, temperature predation, mortality, and passage; and management of land uses, such as timber harvesting, grazing, and agriculture. Wevers (1994) estimates that approximately 16 million wild salmon and steelhead were produced annually in the Columbia Basin (including the Willamette Basin) 120 years ago. This compares to the approximately 2 million produced today, about 80 percent of which are hatchery fish.

Like the rest of the Willamette River, the action area once supported extensive braided channels, back channels, and marshes. The braided channels and high sediment load were indicative of large seasonal flood events and occasional catastrophic flood events. The low-elevation confluence areas likely supported riparian gallery forests, dominated by black cottonwood (Populus balsimifera), red alder (Alnus rubra) and red maple (Acer macrophylum). These forests would also be indicative of a dynamic, fluctuating river system.

The variability and unregulated river flow resulted in a myriad of conditions and habitat types in the action area. The river likely carried large loads of woody debris and the braided channels provided extensive shallow water habitat with sloping shorelines. The differing bathymetry of the river channel provided pools and backwaters and a variety of water temperature conditions. Adjacent riparian forests and wetlands provided extensive organic detritus and also provided habitat for terrestrial insects, birds and wildlife. During flooding events, the adjacent riparian areas and wetlands also provided feeding and resting areas for migrating fish.

The action area is unique along the Willamette River because it experiences daily tidal fluctuations (lower Willamette River up to Willamette Falls). This allowed for even greater diversity of habitats, including freshwater tidal marshes and forested tidelands in the upper reaches of the flood plain.

There are no estimates of habitat loss for this section of the Willamette. However, the extensive filling for urban and industrial development suggests that most of the area supported wetlands and riparian forests as well as braided channels, back channels, oxbows and other features associated with a dynamic river system.

Current Conditions

The lower Willamette River has been altered to accommodate urban development and a growing shipping industry. Development in the harbor has replaced the natural shoreline with riprap, bulkheads, and other artificial structures, and sand-beach lagoons. Because of navigational dredging by the U.S. Army Corps of Engineers, the river has a steeply sloped, silt and sand bottom.

Several species of anadromous fishes, including Chinook salmon, steelhead, coho salmon, sockeye salmon, American shad, and white sturgeon occur in the area. Both juveniles and adults use the study area as a migratory corridor and as rearing habitat for juveniles. Cutthroat trout are also present, but their abundance is low, particularly in the lower Willamette River (Bennett and Foster 1991, NMFS 1999).

6. EVALUATING PROPOSED ACTIONS

EPA has focused the following discussion on the listed salmonid species because the majority of the work is in migration waters for these species. An expanded discussion for other species of concern is in Section 20 of this document and Section 19 of the June 2002 BA.

Section 5 of the June 2002 BA contains a full discussion on the biological requirements of federally listed or proposed threatened or endangered species. This addendum incorporates by reference the relevant information in the 2002 Biological Assessment. However, since the release of the 2002 BA (EPA 2002), changes have occurred to two of the species that were candidate or proposed for listing at the time of the 2002 submittal; the Southwestern Washington/Columbia River Sea-run Cutthroat Trout and the Lower Columbia River (LCR) / Southwest Washington coho salmon. In June of 2002, the USFWS made a determination that the Southwestern Washington/Columbia River sea-run cutthroat trout did not warrant listing under the ESA. The LCR coho salmon was listed and is discussed in further detail below, as a supplement to the existing information previously provided in the 2002 BA.

On June 28, 2005, the LCR coho salmon was listed as threatened under the ESA (70 CFR §37160). This ESU includes areas within the McCormick and Baxter project area. Critical habitat is not yet proposed for designation in this ESU.

A discussion of the life history for the LCR/Southwest Washington coho salmon ESU in the project area was provided in Section 5.1 of the 2002 subsurface barrier wall BA (EPA 2002). In the 2005 listing, the LCR ESU was identified as a separate ESU and listed as threatened. The listing status of the Southwest Washington coho salmon ESU remains undetermined. The LCR coho salmon ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries, from the mouth of the Columbia River up to the Hood (OR) and Big White Salmon (WA) Rivers, and includes the Willamette River to Willamette Falls, OR, as well as twenty-five artificial propagation programs, including the Eagle Creek National Fish Hatchery on the Clackamas River, a tributary to the Willamette River. The Southwest Washington ESU contains all naturally spawning populations of coho salmon from coastal drainages in southwest Washington between the Columbia River and Point Grenville.

Coho salmon in the LCR ESU that migrate through the project area originate in the Clackamas River. Previous analyses indicated that the Clackamas River coho was a single population (Good et al., 2005) although earlier work did indicate that a remnant native run may exist in the drainage (Cramer and Cramer 1994). More recent analyses by ODFW indicate that there may be two distinct populations; an early run (hatchery origin from LCR outside of the Clackamas River basin) and a late run (native origin) (Good et al., 2005). However, there is continued uncertainty over the population structure for the Columbia River coho salmon. Coho salmon in the Clackamas River is one of only two extant populations in the ESU (70 CFR §37172).

Coho migrate up the Willamette into the Clackamas River from late August through early November with two peaks beginning in mid- to late September and in January/February (Weitkamp et al., 1995). Spawning occurs from September through March, dependent upon the run timing. Clackamas River juveniles have been documented to outmigrate between February and July and peaked in May and June (Cramer and Cramer 1994).

7. BASELINE CONDITIONS IN THE WILLAMETTE RIVER

This section describes habitat pathways and indicators important for salmonids in the riverine ecosystem. Riverine habitat is emphasized because of the potential effects of the proposed action on this type of habitat. For the non-salmonid threatened and endangered species in the action area, the discussion in this document follows a more narrative approach. The complexities of salmonid life histories and estuarine use warranted a more structured approach for the assessment of effects.

EPA based the following description of potential project effects on a set of ecological pathways that may affect listed salmonids by changes in their environment and within the action area (NMFS 1999). EPA considered the ecological pathways of water quality, habitat access, habitat elements, channel condition and dynamics, flow/hydrology, and watershed conditions to describe the existing baseline condition through a set of indicators of these ecological pathways. These indicators reflect essential features of designated critical habitat for salmonids. Although critical habitat has not been designated for coho salmon, many of these features may also be important for the conservation of these species. EPA assessed potential project related changes to the existing baseline conditions using the indicators for each pathway. This allowed EPA to draw conclusions about potential impacts on listed salmonids and their critical habitat. The following is a list of indicators for each of the identified ecological pathways after NMFS (1999). EPA selected these indicators for assessment as they reflected that the action area is primarily a migration area for salmonids. No spawning occurs although there may be some rearing activity in more protected habitats.

Indicators of water quality:

- Temperature
- Sediment/Turbidity
- Water contamination
- Sediment contamination

Indicators of habitat access:

- Physical barriers

Indicators of habitat elements:

- Large woody debris
- Shallow water habitat

Indicators of channel conditions/dynamics and flow/hydrology:

- Streambank condition
- Floodplain connectivity
- Change in peak/baseflows

- Increase in drainage network

Indicators of watershed conditions:
- Disturbance history
- Riparian reserves

Section 6 of the June 2002 Biological Assessment contains a full discussion of the baseline conditions of the Willamette River with respect to these pathways and indicators. This addendum incorporates by reference the information in the 2002 BA.

8. EFFECTS OF THE ACTION

The following sections provide EPA's analysis of the direct and indirect effects of the proposed action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent to the action. These effects are considered along with the environmental baseline and the predicted cumulative effects to determine the overall effects to the species [50 CFR §402.02]. The separate activities making up the proposed action consist of the following:

- Soil Cap Monitoring (i.e., inspection of cap surface, inspection of stormwater conveyance system, inspection of security fencing and inspection of warning signs)
- Soil Cap Vegetation Maintenance (i.e., irrigation, mowing open grass areas, manual removal of invasive plants and targeted application of herbicides)[4]
- Soil Cap Unplanned Maintenance (e.g., repairs of fence, replacement of warning signs, repairs of gravel roads, filling of animal burrows and removal of sediments from manholes)
- Sediment Cap Monitoring (i.e., warning buoys, near shore areas, multibeam bathymetric surveys, side-scan sonar surveys and diver inspections of deep water)
- Sediment Cap Sampling (i.e., surface water, pore water, flux chamber, organoclay cores, crayfish, sculpin/clams and possibly lamprey)
- Sediment Cap Unplanned Maintenance (e.g., replacement of buoys, additional armoring placement and additional organoclay capping)
- Groundwater Remedy - NAPL Recovery
- Groundwater Monitoring (i.e., downloading continuous water level data loggers, manual water level measurements, NAPL gauging (site-wide), groundwater sampling)

EPA determined the effects on the listed, proposed and candidate species by predicting changes in baseline condition for each of the indicators. The EPA's analysis is discussed in the following sections and summarized in Table 1.

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[4] Vegetation maintenance, including the targeted application of herbicides, was addressed in EPA's BA for construction of the sediment cap and in the subsequent Biological Opinion issued by the NMFS (2004). The conclusion of this earlier consultation are carried into the O&M BA in order to provide context and consistency with the other O&M activities.

9. WATER QUALITY HABITAT INDICATORS

9.1 Temperature

Soil Cap Monitoring. There would be no change to water temperature as a result of this activity.

Soil Cap Vegetation Maintenance. There would be no change to water temperature as a result of this activity.

Soil Cap Unplanned Maintenance. There would be no change to water temperature as a result of this activity.

Sediment Cap Monitoring. There would be no change to water temperature as a result of this activity.

Sediment Cap Sampling. There would be no change to water temperature as a result of this activity.

Sediment Cap Unplanned Maintenance. Repairs to the sediment cap may consist of additional armoring placement, additional organoclay capping along the beachfront and additional organoclay capping in deep water. These capping materials would be placed in water or along portions of the shoreline exposed at the time of placement because of low river stage.

As discussed in EPA's Biological Assessment Addendum for the Sediment Cap, very little research has been done on the changes in water temperature from placing fill materials in water (EPA 2003). It is likely that there is some minimal change in ambient water temperature from increased activities (e.g. placement of additional rock) in the water column, but not likely of such a magnitude or duration that would result in any measurable change.

After construction, the site would be shallower in depth than existing conditions. During the summer months, this may result in a localized increase in water temperature for the cap area. This increase in temperature would not likely be measurable throughout the action area, but might result in migrating fish avoiding the project site during the warmest parts of the summer months when high temperatures are of concern throughout the lower Willamette River. As such EPA concludes there may be a localized increase in water temperature from placement of the cap.

Groundwater Remedy - NAPL Recovery. There would be no change to water temperature as a result of this activity.

Groundwater Monitoring. There would be no change to water temperature as a result of this activity.

Effect on Baseline. EPA determined that the action may result in degradation of the baseline conditions for localized water temperature in the action area because the constructed cap would create more shallow nearshore conditions, which may result in localized increases in water temperature during the summer months. These conditions may result in migrating salmonids avoiding the cap area and moving to deeper water, or avoiding the site completely to seek out other shallow water areas in the Lower Willamette River.

9.2 Sedimentation/Turbidity

Soil Cap Monitoring. This activity would have no effect on water sedimentation and/or turbidity.

Soil Cap Vegetation Maintenance. This activity would have no effect on water sedimentation and/or turbidity.

Soil Cap Unplanned Maintenance. This activity would have no effect on water sedimentation and/or turbidity.

Sediment Cap Monitoring. This activity would have no effect on water sedimentation and/or turbidity.

Sediment Cap Sampling. This activity would have no effect on water sedimentation and/or turbidity.

Sediment Cap Unplanned Maintenance. Repairs to the sediment cap may consist of additional armoring placement, additional organoclay capping along the beachfront and additional organoclay capping in deep water. These capping materials would be placed in water or along portions of the shoreline exposed at the time of placement because of low river stage.

These repairs would be performed during the low water and lower velocity periods of the year. The cap materials would consist of sand, organoclay, 6-inch-minus rock, possibly 10-inch-minus rock, ACB and/or riprap. The repair materials would be placed directly on the existing cap surface which primarily consists of rock or ACB armoring.

EPA expects the sand layer to settle out quickly with only localized increases in background turbidity levels. This is typical of coarse-grained capping materials. For example, monitoring of total suspended solids (TSS) during the construction of a

McCormick and Baxter sediment cap in 2004 and 2005 found that turbidity levels dropped to less than 10% above background concentrations at the compliance points located 100 feet downstream of the construction work. This is consistent with EPA's (1994) evaluation of TSS during the construction of a sediment cap in Eagle Harbor (Bainbridge Island, Puget Sound, Washington) which found that conditions returned to background within 30 minutes after a discharge period. EPA also found that turbidity had an expected increase in the areas of on-going sediment placement and that it was greatest at the bottom of the water column and limited in extent to the discharge area. The 2000/2001 cap placement at Eagle Harbor, Washington, which placed a greater amount of sand over a longer period of time than the 1994 cap, experienced some turbidity plumes during placement that were directly tied to movement of strong tidal currents. Monitoring indicated that the periodic plumes lasted between 4 to 6 hours before completely settling out with the majority of the material settling out within a few hours. EPA anticipates a similar experience at McCormick and Baxter where turbidity can be controlled through the methods of placement and that any increases in turbidity are expected to be limited in extent and duration, as was documented during the construction of the sediment cap (EPA 2005a). Furthermore, EPA would ensure that any in-water construction work would limit the generation of TSS pursuant to a Water Quality 401 Certification.

EPA also expects turbidity increases with both the placement of the articulated concrete block, 10-inch-minus rock, and the 6-inch-minus rock. In these cases, there would be some minor increases in turbidity from disturbing the bottom sediments (clean sand and clay) during placement. Some fines in the 10-inch and 6-inch-minus rock may also contribute to turbidity. This is expected to be very minor, in both extent and duration.

EPA concludes that there would be an increase in turbidity during construction. EPA expects this to be limited in extent and duration, and would be timed to occur during low water, low-flow periods of the year, and after times of peak out-migration.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on water sedimentation and/or turbidity.

Groundwater Monitoring. This activity would have no effect on water sedimentation and/or turbidity.

Effect on Baseline. EPA determined that the action would temporarily degrade the baseline conditions for water turbidity in the action area because the cap repairs would increase water turbidity through placement of clean cap materials. However, turbidity impacts are expected to be short in duration and limited in extent.

Impacts from increased turbidity on juvenile and adult salmonids are well documented (Bash et al., 2001). Juvenile salmonids are known to avoid streams that are chronically turbid (Lloyd et al., 1987). Salmonids have also been observed to avoid turbid plumes by traversing non-turbid waters adjacent to the plume (Servizi and Martens 1991). A mean avoidance of 25 % was observed for juvenile coho salmon exposed to a 7,000 mg/L level of suspended sediment and an estimated threshold of avoidance was 37 NTU (Servizi and Martens 1992). (Berg 1982, as cited in Bash et al., 2001) noted that young-of-year coho salmon moved to the substrate after a 60 NTU pulse in a laboratory study.

No adverse impacts to salmon associated with turbidity or other work activities were observed during placement of the sediment cap during the 2004 and 2005 work seasons at the McCormick and Baxter site (EPA 2005).

9.3 Water Contamination

Soil Cap Monitoring. There would be no changes to water contamination as a result of this activity.

Soil Cap Vegetation Maintenance. Vegetation maintenance will require the selective use of herbicides to control invasive species until the riparian community becomes established. This will occur as often as twice a year. The City of Portland's Watershed Revegetation Program recommends using highly targeted applications of chemical controls (herbicide) as a tool against recolonization by invasive species until a healthy native herbaceous plant community can establish. This recommendation is based on the City's experience with evaluating techniques to control invasive vegetation in areas where the city has tried to re-establish native vegetation communities. Their findings show that non-chemical techniques resulted in little success. The proposed herbicides are glyphosate (Roundup®, Roundup Pro®, Rodeo®) with the following surfactants: phosphatidylcholine (LI-700), methylacetic acid and alkyl poloxyethylene ether. Water and WEB oil would be used as carriers.

Herbicides would be applied at the project site where invasive species are hindering or would hinder the establishment of the native plant community. The Vegetation Management Strategy submitted in EPA's Biological Assessment on the Sediment Cap contains the details of application (EPA 2003).

There is little data documenting the effects of the proposed herbicides on aquatic ecosystems and the specific invertebrate prey of listed salmonids. The scientific studies that have been conducted on fish are largely limited to measures of acute mortality – i.e., the concentrations at which short-term exposures to a pesticide will kill fish outright, the standard lethal concentration (LC50). In many cases, actual mortality data may not be appropriate for estimating whether a pesticide will have adverse, non-lethal effects on the essential behavior patterns of salmonids (e.g., feeding, spawning, or migration) (WSDA 2001).

Herbicides can enter water through atmospheric deposition, spray drift, surface water runoff, groundwater contamination and intrusion, and direct application. Although outright mortality from herbicide exposure is not expected at the project site, adverse effects could include reductions in reproductive success, weight loss, physiological effects (endocrine system, blood chemistry, liver function, etc.), and reduction in growth, prey capture ability, and swimming ability, all of which are associated with reduced survival (WSDA 2001).

EPA proposes to apply the herbicide only under highly controlled conditions. However, both herbicides are highly water soluble, which increases their likelihood of being transported off the application site through rain or surface water. Both Roundup® and Rodeo® herbicides degrade relatively quickly, and Rodeo® is approved for in-water applications in Washington State (WSDA 2001). The risk remains, even with strict controls, that herbicides may reach the Willamette River and may result in sublethal direct effects to aquatic organisms, including salmonids. This impact would be temporary and minimal in extent.

Soil Cap Unplanned Maintenance. There would be no changes to water contamination as a result of this activity.

Sediment Cap Monitoring. There would be no changes to water contamination as a result of this activity.

Sediment Cap Sampling. There would be no changes to water contamination as a result of this activity.

Sediment Cap Unplanned Maintenance. Marine-based repairs to the sediment cap may result in minor releases of NAPL to the river. These releases could occur if the “spuds” used to anchor barges are driven through the existing sediment cap and into highly contaminated sediments. Although EPA would require the barge operators to minimize spud locations, complete elimination of spudding cannot be avoided. Repairs to the sediment using land-based equipment would not require use of barges and, therefore, are not expected to result in releases of NAPL to the river.

In order to minimize the impact of any NAPL releases, EPA would require the construction contractor to maintain adsorptive booms for rapid deployment if necessary.

Groundwater Remedy - NAPL Recovery. There would be no changes to water contamination as a result of this activity.

Groundwater Monitoring. There would be no changes to water contamination as a result of this activity.

Effect on Baseline. EPA has determined that the action has a small potential to directly harm fish through NAPL releases and herbicide exposure. Booms can be deployed to adsorb and contain the fraction of light weight NAPL (LNAPL) that floats, the denser fraction (DNAPL) cannot be contained. The potential DNAPL would likely remain on the river bottom within the sediment cap repair area and would be subsequently capped with new capping material (i.e. organoclay). Therefore, a release of DNAPL to the river is unlikely.

Although herbicide applications can be strictly controlled and the potential for harm minimized by timing and application, some risk of direct effect would remain. As such, EPA concludes that this activity could potentially affect listed salmon and steelhead through sublethal effects of direct contaminant exposure during or immediately following application. EPA also concludes that this action would restore the baseline conditions by repairing deficiencies with the existing sediment cap, to minimize additional releases of contaminants from the project area.

9.4 Sediment Contamination

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. Additional capping with organoclay may be performed to prevent releases of NAPL not adequately contained by the existing cap. This activity would improve baseline conditions for sediment contamination. The resulting substrate will no longer be a source of potential contamination to sediment and would serve to isolate contaminated sediment from human exposure and biological uptake.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA concludes that the action would maintain baseline conditions during construction. EPA also concludes that this action would restore the baseline conditions by repairing deficiencies with the existing sediment cap.

10. HABITAT ACCESS INDICATORS

10.1 Physical Barriers

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. Repairs to the sediment cap could increase the bottom elevation by a maximum of approximately 3 feet over potential repair areas of a maximum of 300,000 square feet along the shoreline or a maximum of 200,000 square feet in deeper water. The cap would not be a physical barrier that would preclude migration along the shoreline although more shoreline would be exposed during low water times of the year. This would have minimal effect on baseline conditions.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would degrade baseline conditions for physical barriers because more of the sediment cap would emerge as open beach earlier in the season and more often in low water conditions compared to existing conditions. These conditions would result in migrating salmonids avoiding the shoreline repair area and moving to deeper water.

11. HABITAT ELEMENTS INDICATORS

11.1 Large Woody Debris

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. Repairs to the sediment cap may require the removal of existing large woody debris along the shoreline. The woody debris would be returned to the shoreline after completion of construction. The removal of this material during the construction period would remove the availability of large woody debris as habitat. This activity would temporarily degrade the baseline condition for large woody debris at the project site.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would temporarily degrade baseline conditions because large woody debris would be removed during construction. Any large woody debris removed during potential sediment cap activities would be returned to the original location, thus resulting in a temporary effect.

11.2 Shallow Water Habitat

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. Any repairs to the sediment cap would require the placement of rock armoring or ACB. In most cases the armoring would be identical to the existing armoring. However, the size of the armoring may be increased if erosion of existing armoring is discovered. For examples, the 6-inch-minus rock currently used in water elevations deeper than -2 feet NAVD may be increased to 10-inch-minus rock. Furthermore, repairs to shoreline areas currently armored by ACB may be covered with riprap if these areas are inaccessible by construction vehicles (e.g. crane or forklift). The use of riprap will be avoided as much as possible.

Repairs to the sediment cap could increase the bottom elevation by a maximum of approximately 3 feet over potential repair areas of a maximum of 300,000 square feet along the shoreline or a maximum of 200,000 square feet in deeper water. More of the sediment cap would emerge as open beach earlier in the season and more often in low water conditions than existing conditions.

After project construction, the resulting area may be of a different substrate (possibly riprap) and be at a higher elevation than the existing habitat. As such, this activity would degrade baseline conditions.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would degrade baseline conditions for shallow water habitat because the substrate could change to a larger size of the rock armoring and more of the sediment cap would emerge as open beach earlier in the season and more often in low water conditions than existing conditions.

12. CHANNEL CONDITIONS/DYNAMICS AND FLOW/HYDROLOGY INDICATORS

12.1 Streambank Conditions

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. This activity would have no effect on baseline conditions because it would be constructed below the existing bank.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for streambank conditions.

12.2 Floodplain Connectivity

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. This activity would have no effect on baseline conditions because it would be constructed below the existing bank.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for streambank conditions.

12.3 Change in Peak/Base Flows

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. This activity would have no effect on baseline conditions because it would be constructed below the existing bank.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for streambank conditions.

12.4 Increase in Drainage Network

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. This activity would have no effect on baseline conditions because it would be constructed below the existing bank.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for streambank conditions.

13. WATERSHED CONDITIONS

13.1 Disturbance History

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. Any repairs to the sediment cap would require the use of armoring. However, these materials would be of a similar nature as the existing hardened substrate. As such, this activity would have no effect on baseline conditions.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for disturbance history.

13.2 Riparian Reserves

Soil Cap Monitoring. This activity would have no effect on baseline conditions.

Soil Cap Vegetation Maintenance. This activity would have no effect on baseline conditions.

Soil Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Sediment Cap Monitoring. This activity would have no effect on baseline conditions.

Sediment Cap Sampling. This activity would have no effect on baseline conditions.

Sediment Cap Unplanned Maintenance. This activity would have no effect on baseline conditions.

Groundwater Remedy - NAPL Recovery. This activity would have no effect on baseline conditions.

Groundwater Monitoring. This activity would have no effect on baseline conditions.

Effect on Baseline. EPA determined that the action would have no effect on the baseline for riparian reserves.

14. BENEFICIAL EFFECTS

EPA, through its responsibilities under CERCLA, has concluded that soil, sediment and groundwater at McCormick and Baxter are contaminated with hazardous substances. DEQ on behalf of EPA has constructed the soil and sediment caps and implemented the groundwater remedy, as specified in the ROD, in order to minimize further releases of hazardous substances and prevent unacceptable risks to human health and the environment.

In order to assure the protectiveness of the remedies, DEQ is required to provide long-term O&M of the remedies. There will be significant beneficial effects as a result of this action. Specifically, O&M is necessary to prevent the remedies from failing and resulting in further releases of hazardous substances and unacceptable risks to human health and the environment. The action will reverse the trend of continued degradation of the riverine environment.

There will also be a significant portion of the existing shoreline that will be improved or restored to more natural functions within the nearshore and riparian environment of the project site and Willamette Cove.

15. INTERRELATED AND INTERDEPENDENT EFFECTS

Interdependent actions are those that have no independent utility apart from the action being considered. Interrelated actions are activities that are part of the larger action and depend on the larger action for their justification.

The O&M assures that the soil cap (see 2005 BA), sediment cap (see 2003 BA) and groundwater remedy (see 2002 BA) remain effective and reliable at preventing further releases of hazardous substances and unacceptable risks to human health and the environment.

16. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR part 402.02 as “those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation.” The action area for this project encompasses a significant portion of the Willamette River. This area is currently a disturbed riverine ecosystem altered by previous dredging, backfilling, sewage and industrial discharges, and other anthropogenic activities over the past 100 years. Future Federal actions, including additional clean-up activities, navigational dredging, and activities permitted under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, would be reviewed under separate Section 7 consultation processes and are not considered cumulative effects.

The clean-up activities have the potential to increase public interest in the site for educational purposes, recreational activities, or other shoreline amenities. Activities requiring Federal permits or Federal funding will be subject to Section 7 review.

17. CONCLUSION

The action area has degraded baseline conditions. The proposed action would provide operation and maintenance of the cleanup remedies in order to assure their effectiveness and reliability in preventing further releases of hazardous substances and unacceptable risks to human health and the environment. The action would result in short-term and long-term degradation of several baseline indicators for water quality. The action also would result in long-term degradation of baseline indicators for habitat access and habitat elements. However, the degree of degradation would be minor. The action also would result in improvements to several indicators for water quality.

The action is in support of the overall efforts by EPA to contain a source of soil, sediment, and groundwater contamination thereby resulting in improved baseline conditions for certain aspects of habitat supporting threatened or endangered species.

The conservation measures proposed in Section 19 are intended to lessen the potential impacts of the proposed action.

17.1 Chinook Salmon (Lower Columbia River ESU, Upper Willamette River ESU)

Containment of the source of soil, sediment, and river contamination (NAPL) is the primary purpose of the soil cap, sediment cap, and groundwater remedy. Operation and maintenance of the cleanup remedies will assure their effectiveness and reliability in preventing further releases of hazardous substances and unacceptable risks to human health and the environment. The project's long-term effects will help improve and restore salmon habitat in the Willamette River.

However, EPA acknowledges that the project would result in short-term degradation of baseline conditions for sediment/turbidity and water contamination, if the sediment cap needs repairs, and long-term degradation of baseline conditions for water temperature, physical barriers, and shallow water habitat. There is also potential risk of direct harm through exposure to herbicides or placement of fill. If additional repairs to the cap are necessary, a permanent loss of a small amount of shoreline beach habitat could occur. Given the more recent observations of chinook salmon utilizing beach habitats and the growth increases observed for chinook migrating through the lower river (Friesen 2005), loss of shoreline habitat could have an adverse impact on salmon. It is EPA's determination that the project **may adversely affect Chinook salmon.**

17.2 Steelhead (Lower Columbia River ESU, Upper Willamette River ESU)

Containment of the source of soil, sediment, and river contamination (NAPL) is the primary purpose of the soil cap, sediment cap, and groundwater remedy. Operation and maintenance of the cleanup remedies will assure their effectiveness and reliability in preventing further releases of hazardous substances and unacceptable risks to human health and the environment. The project's long-term effects will help improve and restore salmon habitat in the Willamette River.

However, EPA acknowledges that the project would result in short-term degradation of baseline conditions for sediment/turbidity and water contamination, if the sediment cap needs repairs, and long-term degradation of baseline conditions for water temperature, physical barriers, and shallow water habitat. In addition, there is potential risk of direct harm through exposure to herbicides or placement of fill. It is EPA's determination that the project **may adversely affect steelhead.**

17.3 Columbia River Chum Salmon

Containment of the source of soil, sediment, and river contamination (NAPL) is the primary purpose of the soil cap, sediment cap, and groundwater remedy. Operation and maintenance of the cleanup remedies will assure their effectiveness and reliability in preventing further releases of hazardous substances and unacceptable risks to human health and the environment. The project's long-term effects will help improve and restore salmon habitat in the Willamette River.

However, EPA acknowledges that the project would result in short-term degradation of baseline conditions for sediment/turbidity and water contamination, if the sediment cap needs repairs, and long-term degradation of baseline conditions for water temperature, physical barriers, and shallow water habitat. In addition, there is potential risk of direct harm through exposure to herbicides or placement of fill. It is EPA's determination that the project **may adversely affect chum salmon.**

17.4 Lower Columbia River Coho Salmon

Containment of the source of soil, sediment, and river contamination (NAPL) is the primary purpose of the soil cap, sediment cap, and groundwater remedy. Operation and maintenance of the cleanup remedies will assure their effectiveness and reliability in preventing further releases of hazardous substances and unacceptable risks to human health and the environment. The project's long-term effects will help improve and restore salmon habitat in the Willamette River.

However, EPA acknowledges that the project would result in short-term degradation of baseline conditions for sediment/turbidity and water contamination, if the sediment cap needs repairs, and long-term degradation of baseline conditions for water temperature, physical barriers, and shallow water habitat. In addition, there is potential risk of direct harm through exposure to herbicides or placement of fill. Given the more recent observations of coho salmon utilizing near shore areas and spending relatively long periods of time in the Lower Willamette River (Friesen 2005), permanent loss of shoreline habitat could have an adverse impact on coho salmon. It is EPA's determination that the project **may adversely affect coho salmon.**

18. PROPOSED CRITICAL HABITAT

NOAA Fisheries filed proposed rules in the Federal Register on 20 November 2004 to designate critical habitat areas for a number of populations of salmon and steelhead. The salmon and steelhead populations are listed in the following: (1) Puget Sound Chinook salmon; (2) LCR Chinook salmon; (3) Upper Willamette River Chinook salmon; (4) Upper Columbia River spring-run chinook salmon; (5) Oregon Coast coho salmon; (6) Hood Canal summer-run chum salmon; (7) Columbia River chum salmon; (8) Ozette Lake sockeye salmon; (9) Upper Columbia River steelhead; (10) Snake River Basin steelhead; (11) Middle Columbia River steelhead; (12) LCR steelhead; and (13) Upper Willamette River steelhead. At this time, there is no critical habitat designated for the LCR Coho Salmon.

The proposed designations look at certain factors called "primary constituent elements" (PCEs) that are essential to support one or more of the life stages of salmon. The PCEs consist of the following habitats:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. Freshwater rearing sites with:
    - water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    - water quality and forage supporting juvenile development;
    - natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
4. Estuarine areas free of obstruction and excessive predation with:
    - water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
    - natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels;
    - juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
5. Nearshore marine areas free of obstruction and excessive predation with:
    - water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation;
    - natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The areas of critical habitat proposed in 50 CFR Part 226 for the project area includes the following:

1. Lower Columbia River Chinook Salmon ESU
    - Critical Habitat Lower Willamette Subbasin (Unit 10)
    - Rearing/Migration Corridor (Unit 11)
2. Upper Willamette River Chinook Salmon ESU
    - Rearing/Migration Corridor (Unit 11)
3. Lower Columbia River Steelhead ESU
    - Critical Habitat Lower Willamette Subbasin (Unit 9)
4. Upper Willamette River Steelhead ESU
    - Rearing/Migration Corridor (Unit 8)

The analysis and findings of impacts to proposed critical habitat are contained in Appendix B of this document.

19. CONSERVATION MEASURES

The following conservation measures will reduce or eliminate potential impacts to the listed anadromous fish species.

In-Water Work Window. Repairs to the sediment cap will be completed within the in-water work period July 1 through October 31, and December 1 through January 31. If it becomes necessary to perform repairs during other times, EPA will request approval in writing by biologists from NMFS.

Minimization of Work Area. Construction impacts will be confined to the minimum area necessary to complete the project.

Biological Monitoring. A biological monitoring and reporting program will be developed and employed prior to repairs being made to the sediment cap to ensure measures provided in this Biological Assessment and the ensuing Biological Opinion are effective in minimizing the likelihood of take from permitted activities. In implementing the monitoring and reporting program, an environmental professional will monitor and document on a daily basis the conditions of the shoreline and nearshore area during construction. Furthermore, a qualified biologist will oversee work performed by the environmental professional.

Water Quality Monitoring and Turbidity Standards. The sediment cap repair contractor will be required to adhere to water quality protections and other conditions found in EPA’s Water 401 Quality Certification for Sediment Cap Remedial Action at the McCormick & Baxter Creosoting Company Site (EPA 2004a). These measures are described in the **Water Quality Plan, Pollution and Erosion Control Plan** (see below).

Removal and Isolation of NAPL Sheens. The sediment cap repair contractor will be required provide sorbant booms, pads and other sorbant materials and vacuum pumps to remove and isolate any NAPL sheen resulting from construction activities. Oil absorbent materials will be employed if visible sheens are observed. The booms will remain in place until all oily material and floating debris has been collected and the sheens have dissipated.

Stoppage of Work. If an uncontrolled release of NAPL sheen is observed during sediment cap repairs, the existing protective measures would be reevaluated for efficacy.

If deemed necessary by the environmental professional, work may be stopped until the cause of the event is determined and work can be resumed without additional impacts.

Avoidance and Minimization of Water and Sediment Quality Impacts. All prudent and necessary steps be taken during sediment cap repairs to avoid and minimize potential water and sediment quality impacts. These will include strict contractor performance controls for all shoreline and in-water construction activities.

Composition of Sediment Cap Repair Materials. Sediment cap repair material will not contain detectable levels of organic contaminants and will have background level concentrations of metals. Use of riprap armoring will be avoided to the extent practicable.

Placement of Sediment Cap Repair Materials. Sediment cap repair materials will be placed in a controlled and accurate manner. Armor stone will be placed in a manner that does not disrupt or penetrate the other cap components.

Large Woody Debris. Large Woody Debris within the sediment cap repair area will be moved carefully and returned to its original location after construction.

Heavy Equipment. Land-based heavy equipment use will be restricted as follows.

I. When heavy equipment is required, it will be equipment having the least impact to the existing sediment cap and riverine environment (e.g., minimally-sized, rubber-tired).
II. Heavy equipment will be fueled, maintained and stored as follows.
    a. Place vehicle staging, maintenance, refueling, and fuel storage areas a minimum of 150 feet horizontal distance from the Willamette River. Exceptions may be made for cranes and other very slow-moving equipment; these vehicles may be refueled in place but will have containment measures in place that meet or exceed 100% containment.
    b. All vehicles operated within 150 feet of the Willamette River will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired before the vehicle resumes operation.
    c. When not in use, vehicles will be stored in the vehicle staging area with the exception of cranes and other very slow-moving vehicles.

Pesticide Use. Pesticide use will be limited in type and extent, as described in the proposed action.

Water Quality Plan, Pollution and Erosion Control Plan. Prior to performing repairs to the sediment cap, the construction contractor and/or construction oversight consultant will be required to prepare and carry out a pollution and erosion control plan to prevent increased turbidity. The plan will be made available for inspection on request by NMFS. The pollution and erosion control plan will contain the pertinent elements listed below.

I. The names and address of the party(s) responsible for accomplishment of the water quality and pollution and erosion control plan.
II. Describe methods or best management practices (BMPs) that will be used to minimize turbidity increases as a result of placement of cap materials, or resuspension of river sediment that may have deposited over previously capped areas. Silt curtains and floating booms will be deployed, as necessary, during placement of the cap (including sand, clay, rock and ACB) to maintain the water quality standards described below. All materials will be placed by equipment such as a clamshell bucket to control placement and minimize disturbance to the existing sediment or new cap materials.
III. As specified in EPA's Water Quality 401 Certification, cap materials will be placed in a manner that does not result in exceedance of the following turbidity criteria at a distance of 100 feet downstream from the turbidity-causing activity:
    a. Turbidity shall be no greater than 5 NTU over background turbidity when background is 50 NTU or less; or
    b. No more than 10% increase in turbidity when background turbidity is more than 50 NTU.
    c. Background turbidity shall be established by collecting seven independent turbidity measures, at a minimum, during a two-day period before construction. Mean turbidity values will be used to represent background.
IV. Turbidity will be monitored during active in-water work with a turbidity meter that is calibrated daily (calibration measures must be documented and available for review upon request). Monitoring points will be an undisturbed site 100 feet upstream of the activity and 100 feet downstream from the fill point. In addition, monitoring points at the point of discharge will be collected at the bottom, midlevel, and top of the water column.
V. Turbidity will be measured and recorded at least once every four hours during in-water work. The first sample of the day will be taken four hours after the initiation of the in-water activity, and once at each four-hour interval thereafter. If the turbidity criteria are exceeded, work will not proceed until the turbidity level has dropped to an acceptable level.
VI. Visual monitoring also will occur at least once every four hours during in-water work. If, at any time, the visual turbidity levels are estimated to be approaching the turbidity exceedance level, field-testing will be performed. If field testing confirms turbidity criteria exceedances, then the contractor will cease operations responsible for causing the elevated turbidity.
VII. Daily turbidity measurements will be emailed or faxed to NMFS, including information identifying all sampling locations.
VIII. The BMPs will be evaluated and modified (when applicable) throughout the construction period to assure that the water quality standards are met. BMP modifications may include deployment of addition sediment control devices, if it is determined that there may be difficulty meeting turbidity requirements. If

isolation of in-water work area (see below) is necessary, ESA consultation will be reinitiated to ensure appropriate fish exclusion practices (see below – Capture and Release) are followed.

IX. A description of the hazardous products or materials that will be used, including inventory, storage, handling, and monitoring.
X. A spill containment and control plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures will be available on site, proposed methods for disposal of spilled materials, and employee training for spill containment.

Isolation of In-Water Work Area. If the in-water work area requires isolation in order to maintain the turbidity criteria described above, the work area will be isolated using inflatable bags, sandbags, 10-inch-minus rock, sediment curtains or similar materials. All listed salmonids trapped within the isolation area will be removed and placed in the actively-flowing river using methods described below.

Capture and Release. If the in-water work area requires isolation in order to maintain the turbidity criteria described above, attempts will be made to capture and release fish from the isolated area using trapping, seining, electrofishing or other methods as are prudent to minimize risk of injury.

I. The entire capture and release operation will be conducted or supervised by a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish.
II. Methods of fish capture will primarily involve beach seining and/or electrofishing.
III. Electrofishing will not be performed if water temperatures exceed 18 ^{o}C.
IV. If electrofishing equipment is used to capture fish, the contractor will comply with NOAA Fisheries' electrofishing guidelines (NMFS 2000).
V. ESA-listed fish will be handled with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling.
VI. Fish will be transported in aerated buckets or tanks.
VII. Fish will be released into a safe release site as quickly as possible, and as near as possible to capture sites.
VIII. ESA-listed fish will not be transferred to anyone except NMFS personnel, unless otherwise approved in writing by the NMFS.
IX. All other Federal, state, and local permits necessary to conduct the capture and release activity will be attained.
X. NMFS or its designated representative will be allowed to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.

Construction Monitoring Report. A construction monitoring report describing EPA’s success in meeting the conservation measures will be provided to NMFS within 30 days following the completion of capping repairs. This report will consist of the following information.

I. Project identification.
II. Photographic documentation of environmental conditions at the project site before, during, and after project completion. Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.
III. Isolation of in-water work area, capture and release.
    a. Supervisory fish biologist - name and address.
    b. Methods of work area isolation and take minimization.
    c. Stream conditions before, during, and within one week after completion of work area isolation.
    d. Means of fish capture.
    e. Number of fish captured by species.
    f. Location and condition of all fish released.
    g. Any incidence of observed injury or mortality of listed species.
IV. Narrative that briefly discusses project implementation and consistency with the conservation measures, with special attention to turbidity.

Annual O&M Report. O&M reports will be prepared annually by DEQ and its contractors. A copy of this report will be submitted to NMFS.

Five-Year Vegetation Monitoring Report. As required in NMFS's Biological Opinion for construction of the sediment cap, a five-year monitoring report that addresses planting success of the trees and shrubs planted along the Willamette River will be sent to NOAA Fisheries, Oregon State Habitat Office (NMFS 2004). This report will be issued by December 31, 2011.

Five-Year Review Report. The results of these O&M activities through this five year period will be evaluated as part of the Five-Year Review Report to be issued by the DEQ and EPA in October 2011. The O&M Plan will be updated following this Five-Year Review and subsequent Five-Year Reviews in order to assure the remedies are operated and maintained in a manner that is protective of human health and the environment. Additional protective measures may be implemented as a result of site monitoring and/or the development of new standards. This Five-Year Review Report will be made available to NMFS upon request.

Reporting of Dead, Injured or Sick ESA Species. If a dead, injured, or sick endangered or threatened species specimen is found, initial notification will be made to the National Marine Fishery Service Law Enforcement Office, Vancouver Field Office, 600 Maritime, Suite 130, Vancouver, Washington 98661; telephone: 360-418-4246. Care will be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death.

20. EFFECTS OF THE PROPOSED ACTION ON OTHER LISTED SPECIES

*20.1 Bald Eagle (*Haliaeetus leucocephalus*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. Although bald eagles are within the action area, no bald eagle nests are within 1 mile of the project site. Survival and reproductive success of eagles would be unaffected.

Cumulative, Interrelated or Interdependent Effects. There would be no significant cumulative, interrelated or interdependent effects on this species from the proposed project in conjunction with other projects or actions.

Conservation Methods. None.

Effect Determination. The proposed action will have **no effect** on the bald eagle.

*20.2 Golden Paintbrush (*Castilleja levisecta*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *C. levisecta.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *C. levisecta*

*20.3 Water Howellia (*Howellia aquatilis*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *H. aquatilis.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *Howellia aquatilis.*

*20.4 Bradshaw's lomatium (*Lomatium bradshawii*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *L. bradshawii.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *Lomatium bradshawii.*

*20.5 Nelson's Checker Mallow (*Sidalcea nelsoniana)

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *S. nelsoniana.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *Sidalcia nelsoniana.*

*20.6 Willamette Daisy (*Erigeron decumbens var. decumbens*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *E. decumbens.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *Erigeron decumbens var. decumbens.*

*20.7 Kincaid's Lupine (*Lupinus sulphureus var. kincaidii*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of *L. sulphureus.*

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would have **no effect** on *Lupinus sulphureus var. kincaidii.*

*20.8 Oregon Spotted Frog (*Rana pretiosa*)*

Species and site use information can be found in the June 2002 Biological Assessment.

Analysis of Effects. The actions proposed for the project site would not directly or indirectly affect areas known to support or potentially support individuals or populations of Oregon spotted frog.

Cumulative, Interrelated or Interdependent Effects. There would be no cumulative, interrelated or interdependent effects because of this action.

Conservation Methods. None

Effect Determination. The action would **not result in jeopardy** for Oregon spotted frog.

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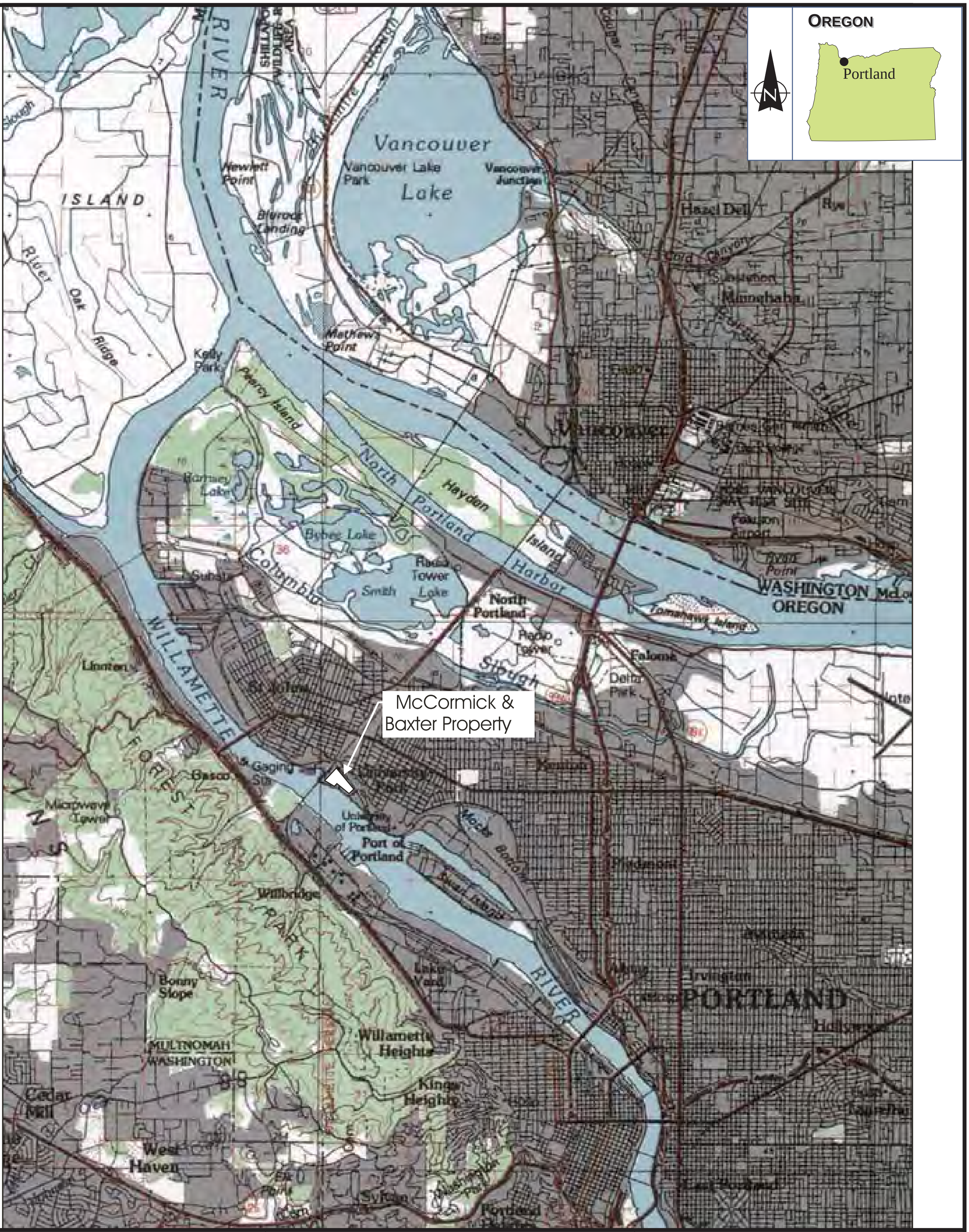
TABLE 1. EXPECTED CHANGES TO BASELINE CONDITIONS

INDICATOR	EFFECTS			
	Improve or Restore	Maintain	Degrade Short Term	Degrade Long Term
WATER QUALITY				
Temperature				X
Sediment/Turbidity		X	X	
Water Contamination	X		X	
Sediment Contamination	X			
HABITAT ACCESS				
Physical Barriers				X
HABITAT ELEMENTS				
LWD		X		
Shallow Water				X
CHANNEL CONDITIONS AND DYNAMICS				
Streambank Condition		X		
Floodplain Connectivity		X		
FLOW/HYDROLOGY				
Change in Peak/Base Flows		X		
Increase in Drainage Network		X		
WATERSHED CONDITIONS				
Disturbance History		X		
Riparian Reserves		X		

FIGURES



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International Specialists in the Environment
Portland, Oregon

McCORMICK & BAXTER
CREOSOTING CO.
Portland, Oregon

Figure 1

SITE LOCATION MAP

Date:
2-21-03

10:001688OY021402\fig 1

N W E S

0 75 150 300 450 600 750
Feet
Approximate Scale

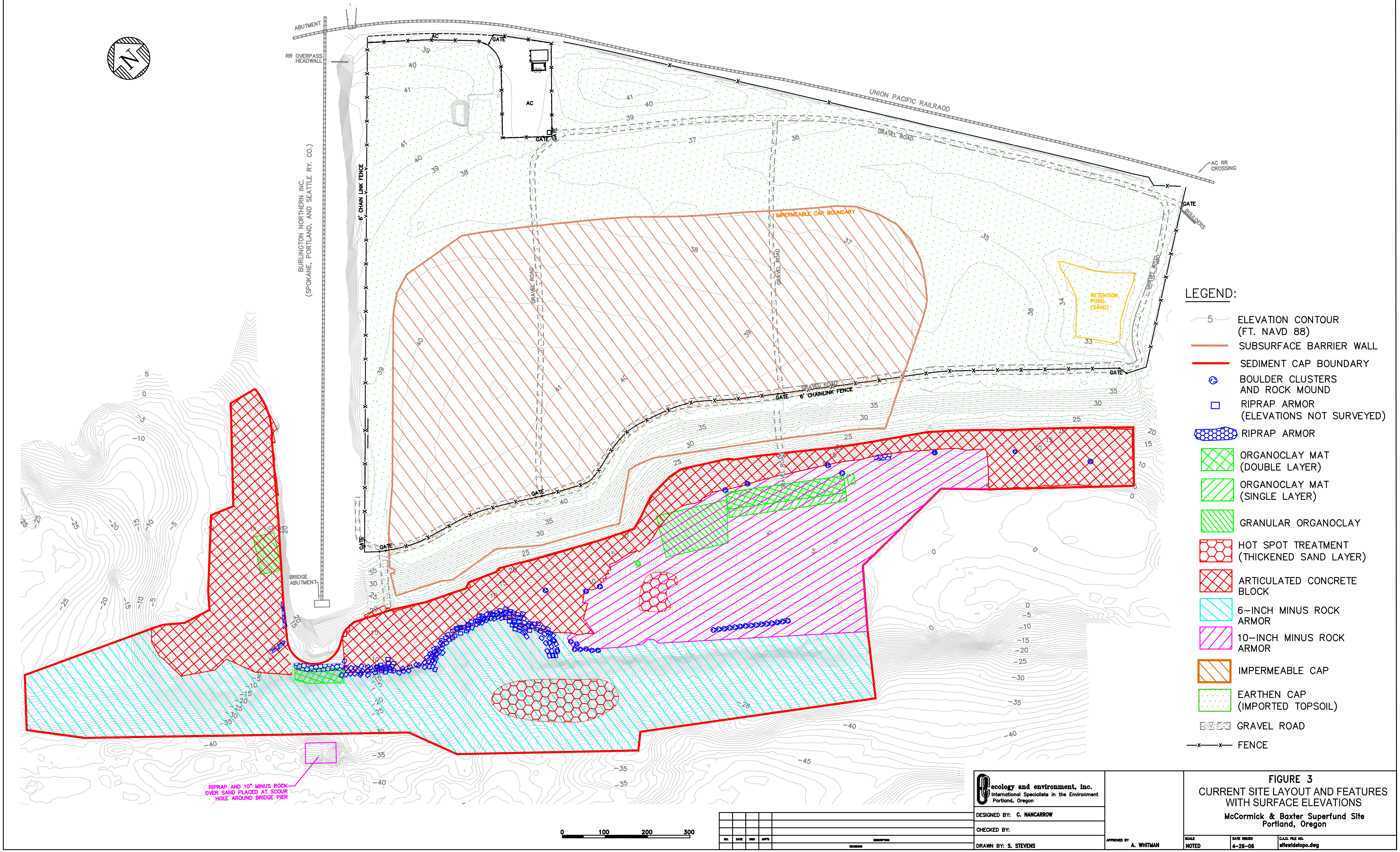
Map Reference: Orthorectified Photo Image, September 28, 2005 @ 12:30 pm.
River Stage at Time of Photo is 1.43 ft. NGVD47 at Morrison Street Bridge.

McCormick & Baxter
Creosoting Company

Portland, Oregon

Figure 2
PROPOSED SITE LAYOUT AND FEATURES

Date:	Drawn by:	Job Number:
3/20/2006	avh	002688.OY25.30.03



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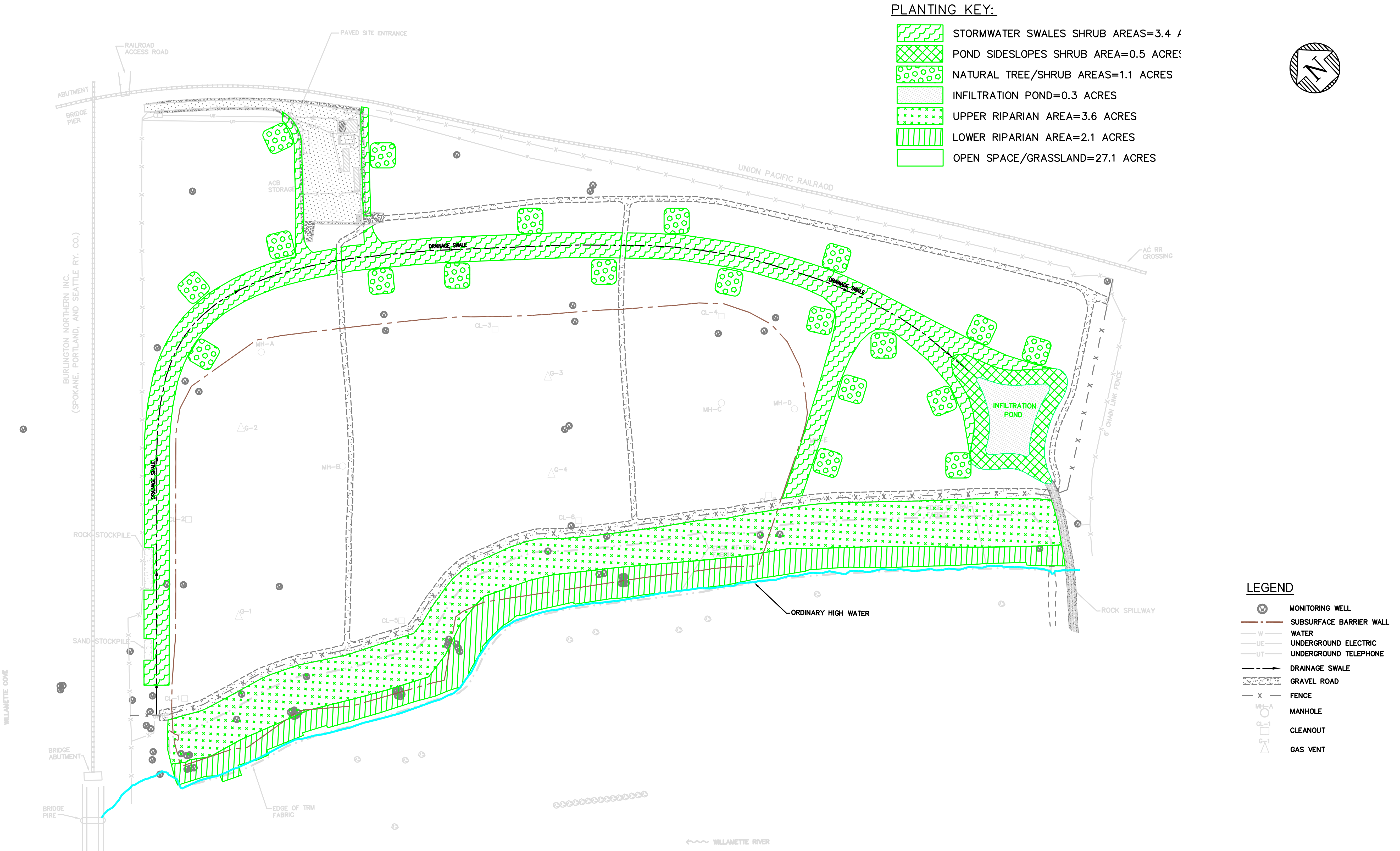
DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: S. STEVENS
APPROVED BY A. WHITMAN

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

FIGURE 3
CURRENT SITE LAYOUT AND FEATURES WITH SURFACE ELEVATIONS
McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	4–26–06	sitewidetopo.dwg



SCALE IN FEET:
0 100 200 300

NO.	DATE	DWN	APP'D	

REVISIONS

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International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

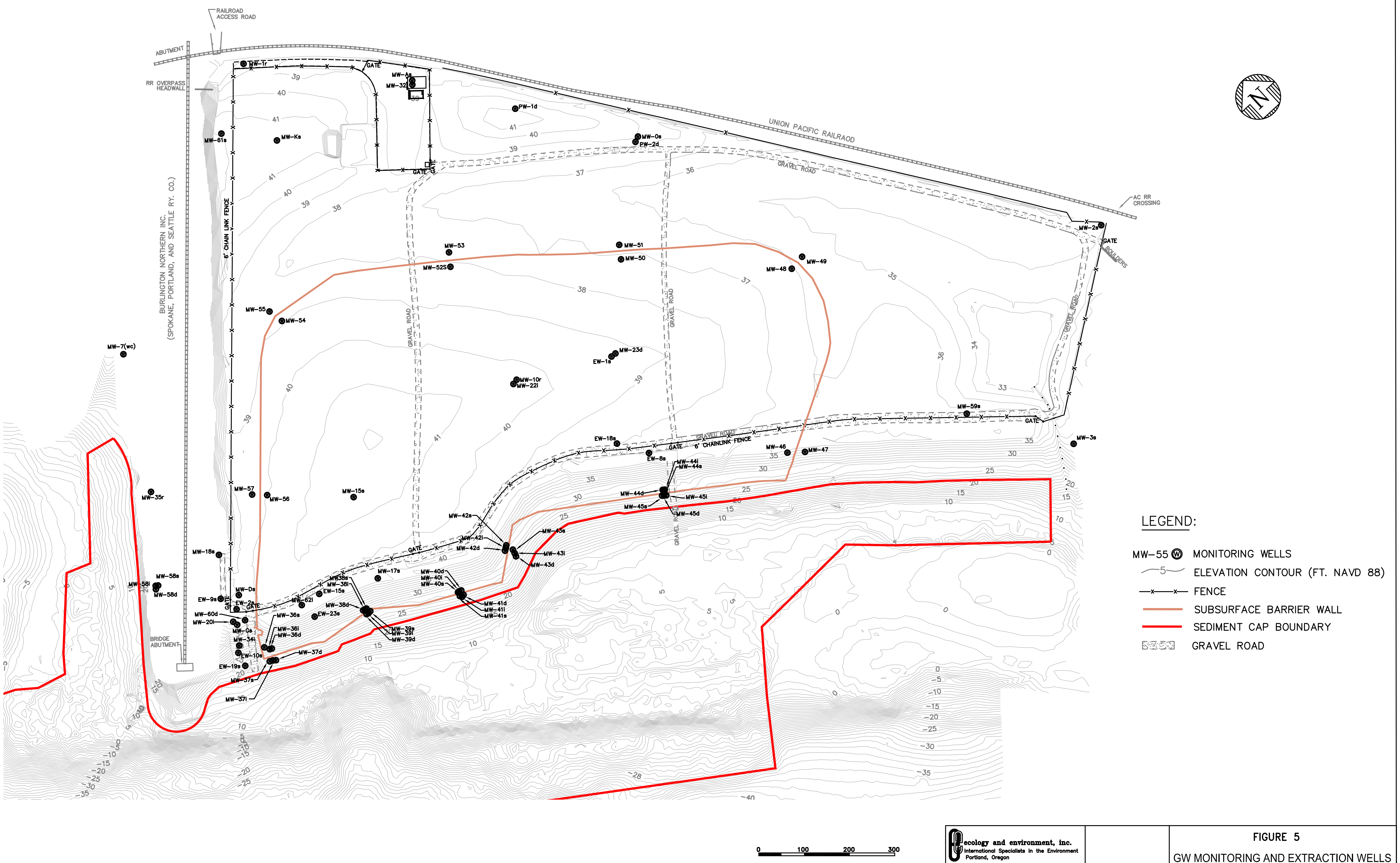
DRAWN BY: C. NANCARROW

APPROVED BY

FIGURE 4
SOIL CAP VEGETATION

McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	4/27/06	UPLAND CAP DESIGN WITH AS BUILTS.DWG



NO.	DATE	DWN	APP'D	DESCRIPTION

REVISIONS

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CHECKED BY:

DRAWN BY: S. STEVENS

APPROVED BY A. WHITMAN

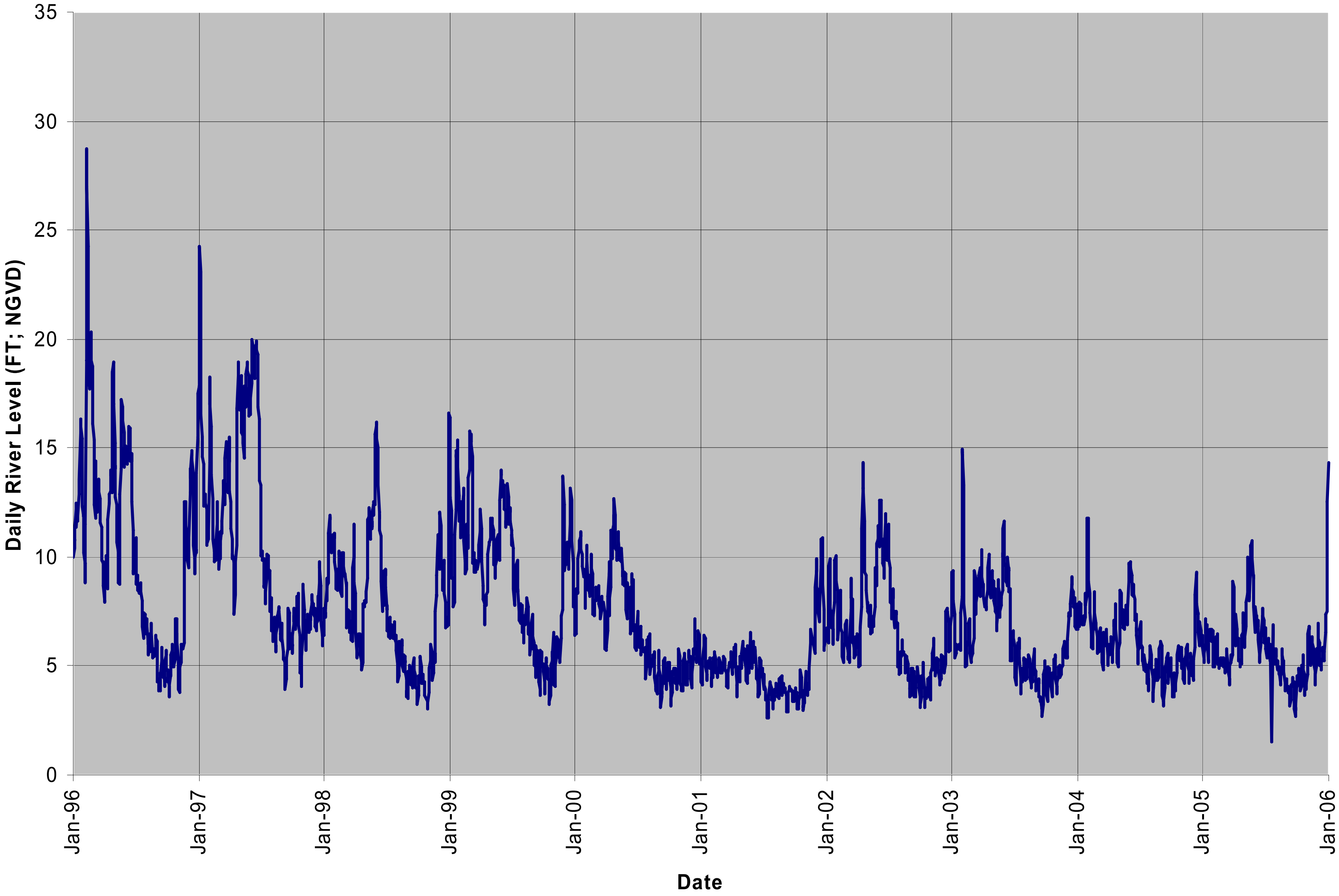
FIGURE 5

GW MONITORING AND EXTRACTION WELLS

McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	4-26-06	sitewidetopo.dwg

Figure 6
River Levels (1996-2005)



Source of Data: Linda Baker (RETEC) email communication with Heidi Blischke (DEQ), January 7, 2006.
Daily average river levels at Morrison Bridge station maintained by USGS. To convert National Geodetic Vertical Datum (NGVD) to NAVD, add 3.5 feet.

APPENDIX A ESSENTIAL FISH HABITAT

The project area has been designated as Essential Fish Habitat (EFH) for various life stages of Chinook and coho salmon, and starry flounder (*Platyichthys stellatus*). The Pacific Fisheries Management Council (PFMC) has designated EFH for federally managed fisheries within the waters of Washington, Oregon, and California. The designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, seaward to the boundary of the U.S. exclusive economic zone (PFMC 1998a, and 1998b). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years) (PFMC 1999).

Detailed descriptions and identifications of EFH for the groundfish species are found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to the Pacific Groundfish Management Plan (PFMC 1998a) and the NOAA Fisheries Essential Fish Habitat for West Coast Groundfish Appendix (Casillas et al 1998). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the potential adverse effects to these species' EFH from the proposed action is based on this information.

EFH Considerations

The *Adverse Nonfishing Impacts and Recommended Conservation Measures* portions of the groundfish and coastal pelagic EFH appendices identify several impacts of filling projects on EFH. Those impacts include: (1) adverse effects on infaunal and bottom dwelling organisms; (2) changes to benthic habitats resulting from erosion, slumping, or lateral displacement of surrounding bottom deposits; (3) elevated turbidity which may impact aquatic vegetation or directly affect fish species; (4) changes to the chemistry and physical characteristics of the receiving water; and (5) loss of habitat function due to burial.

Essential Fish Habitat (EFH) for the Pacific coast salmon fishery is those waters and substrate necessary for salmon production needed to support a long-term sustainable fishery and salmon contributions to a healthy ecosystem. Important features of freshwater EFH for salmon are: (1) substrate composition; (2) water quality; (3) water quantity, depth, and velocity; (4) channel gradient and stability; (5) food; (6) cover and habitat complexity; (7) space; (8) access and passage; and (9) flood plain and habitat connectivity (PFMC 1999).

Effects of Proposed Action

EPA determined that the project would not result in degrading EFH. As such, EPA has determined that the proposed action will not adversely affect the EFH for starry flounder and Pacific salmon species (Chinook and coho salmon).

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APPENDIX B ADDENDUM FOR ESA CONSULTATION ON PROPOSED CRITICAL HABITAT

ADDENDUM FOR ESA CONSULTATION

ASSESSMENT OF IMPACTS TO CRITICAL HABITAT FOR

Lower Columbia River Chinook Salmon

Salmon Critical Habitat - Primary Constituent Elements

From 50 CFR Part 226

The primary constituent elements determined essential to the conservation of Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*) are as follows:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

Existing Conditions: No spawning occurs, or is likely to occur, at the project site.

(2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide some limited rearing functions. The City of Portland noted that juvenile fish were holding in a protected embayment directly downstream of the project site, in the adjacent Willamette Cove. Conditions are similar enough in the near shore adjacent to the project site to assume some holding may occur here.

(3) Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide resting areas for out-migrating juveniles. See (2) above.

(4) Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and

saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near estuarine areas.

(5) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulder and side channels.

Existing Conditions: The project is not located in or near nearshore marine areas.

(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near offshore marine areas.

Effects Analysis: The project will result in only slight modifications to the fresh water environment.

Determination of Effect: The project will not result in the destruction or adverse modification of critical habitat for this ESU.

Conservation Measures: Conservation measures are listed in Section 18 and are pertinent to any modification of critical habitat for this ESU.

ADDENDUM FOR ESA CONSULTATION

ASSESSMENT OF IMPACTS TO CRITICAL HABITAT FOR

Upper Willamette River Chinook Salmon

Salmon Critical Habitat - Primary Constituent Elements

From 50 CFR Part 226

The primary constituent elements determined essential to the conservation of Upper Willamette River Chinook Salmon are as follows:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

Existing Conditions: No spawning occurs, or is likely to occur, at the project site.

(2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide some limited rearing functions. The City of Portland noted that juvenile fish were holding in a protected embayment directly downstream of the project site, in the adjacent Willamette Cove. Conditions are similar enough in the near shore adjacent to the project site to assume some holding may occur here.

(3) Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide resting areas for out-migrating juveniles. See (2) above.

(4) Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near estuarine areas.

(5) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation;

and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulder and side channels.

Existing Conditions: The project is not located in or near nearshore marine areas.

(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near offshore marine areas.

Effects Analysis: The project will result in only slight modifications to the fresh water environment.

Determination of Effect: The project will not result in the destruction or adverse modification of critical habitat for this ESU.

Conservation Measures: Conservation measures are listed in Section 18 and are pertinent to any modification of critical habitat for this ESU.

ADDENDUM FOR ESA CONSULTATION

ASSESSMENT OF IMPACTS TO CRITICAL HABITAT FOR

Lower Columbia River Steelhead

Salmon Critical Habitat - Primary Constituent Elements

From 50 CFR Part 226

The primary constituent elements determined essential to the conservation of Lower Columbia River Steelhead are as follows:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

Existing Conditions: No spawning occurs, or is likely to occur, at the project site.

(2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide some limited rearing functions. The City of Portland noted that juvenile fish were holding in a protected embayment directly downstream of the project site, in the adjacent Willamette Cove. Conditions are similar enough in the near shore adjacent to the project site to assume some holding may occur here.

(3) Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide resting areas for out-migrating juveniles. See (2) above.

(4) Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near estuarine areas.

(5) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation;

and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulder and side channels.
Existing Conditions: The project is not located in or near nearshore marine areas.

(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near offshore marine areas.

Effects Analysis: The project will result in only slight modifications to the fresh water environment.

Determination of Effect: The project will not result in the destruction or adverse modification of critical habitat for this ESU.

Conservation Measures: Conservation measures are listed in Section 18 and are pertinent to any modification of critical habitat for this ESU.

ADDENDUM FOR ESA CONSULTATION
ASSESSMENT OF IMPACTS TO CRITICAL HABITAT FOR
Upper Willamette River Steelhead
Salmon Critical Habitat - Primary Constituent Elements
From 50 CFR Part 226

The primary constituent elements determined essential to the conservation of Upper Willamette River Steelhead are as follows:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

Existing Conditions: No spawning occurs, or is likely to occur, at the project site.

(2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide some limited rearing functions. The City of Portland noted that juvenile fish were holding in a protected embayment directly downstream of the project site, in the adjacent Willamette Cove. Conditions are similar enough in the near shore adjacent to the project site to assume some holding may occur here.

(3) Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Existing Conditions: The project site is adjacent to shallow, near shore areas that may provide resting areas for out-migrating juveniles. See (2) above.

(4) Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near estuarine areas.

(5) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulder and side channels.

Existing Conditions: The project is not located in or near nearshore marine areas.

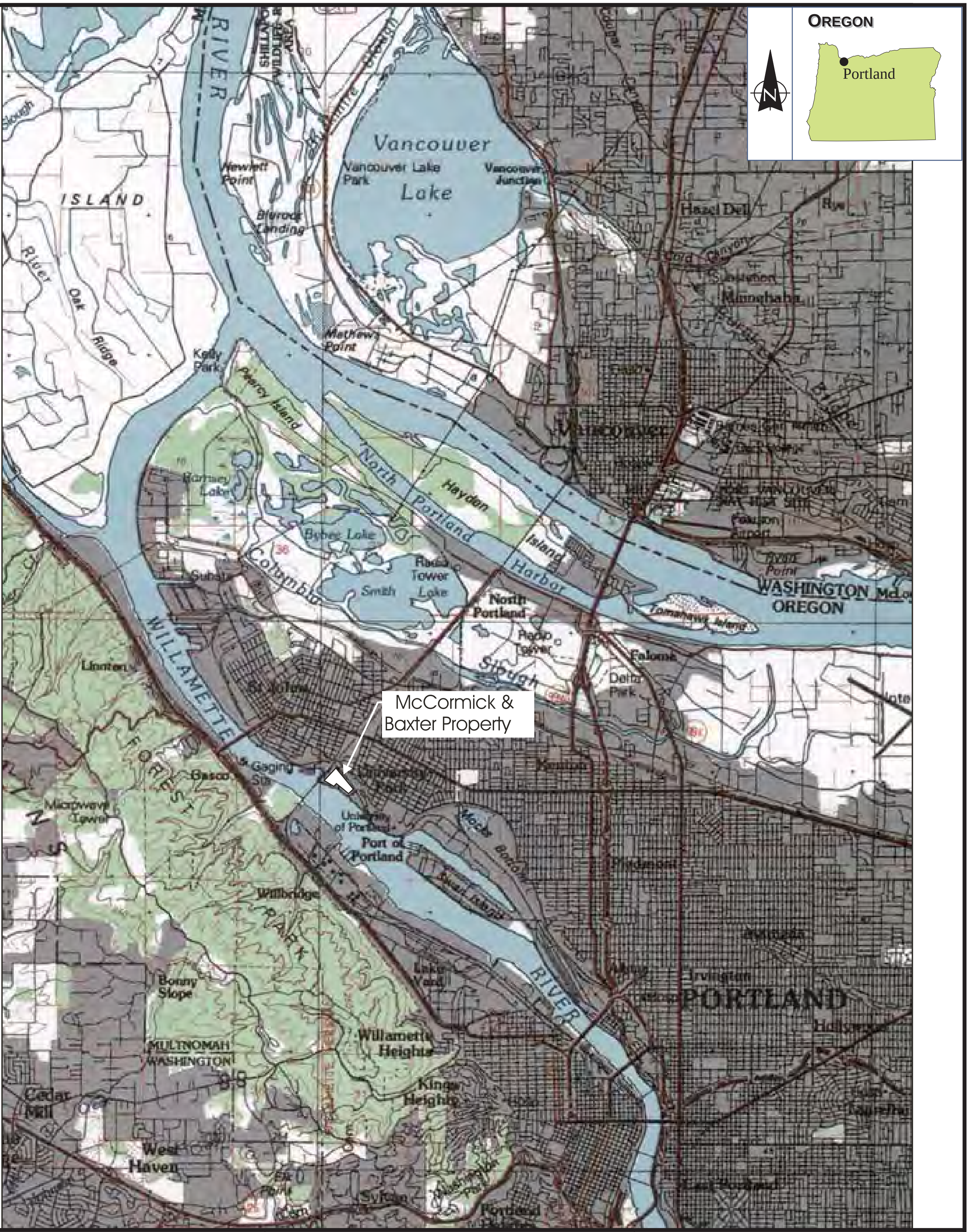
(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Existing Conditions: The project is not located in or near offshore marine areas.

Effects Analysis: The project will result in only slight modifications to the fresh water environment.

Determination of Effect: The project will not result in the destruction or adverse modification of critical habitat for this ESU.

Conservation Measures: Conservation measures are listed in Section 19 and are pertinent to any modification of critical habitat for this ESU.



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International Specialists in the Environment
Portland, Oregon

McCORMICK & BAXTER
CREOSOTING CO.
Portland, Oregon

Figure 1

SITE LOCATION MAP

Date:
2-21-03

10:001688OY021402\fig 1

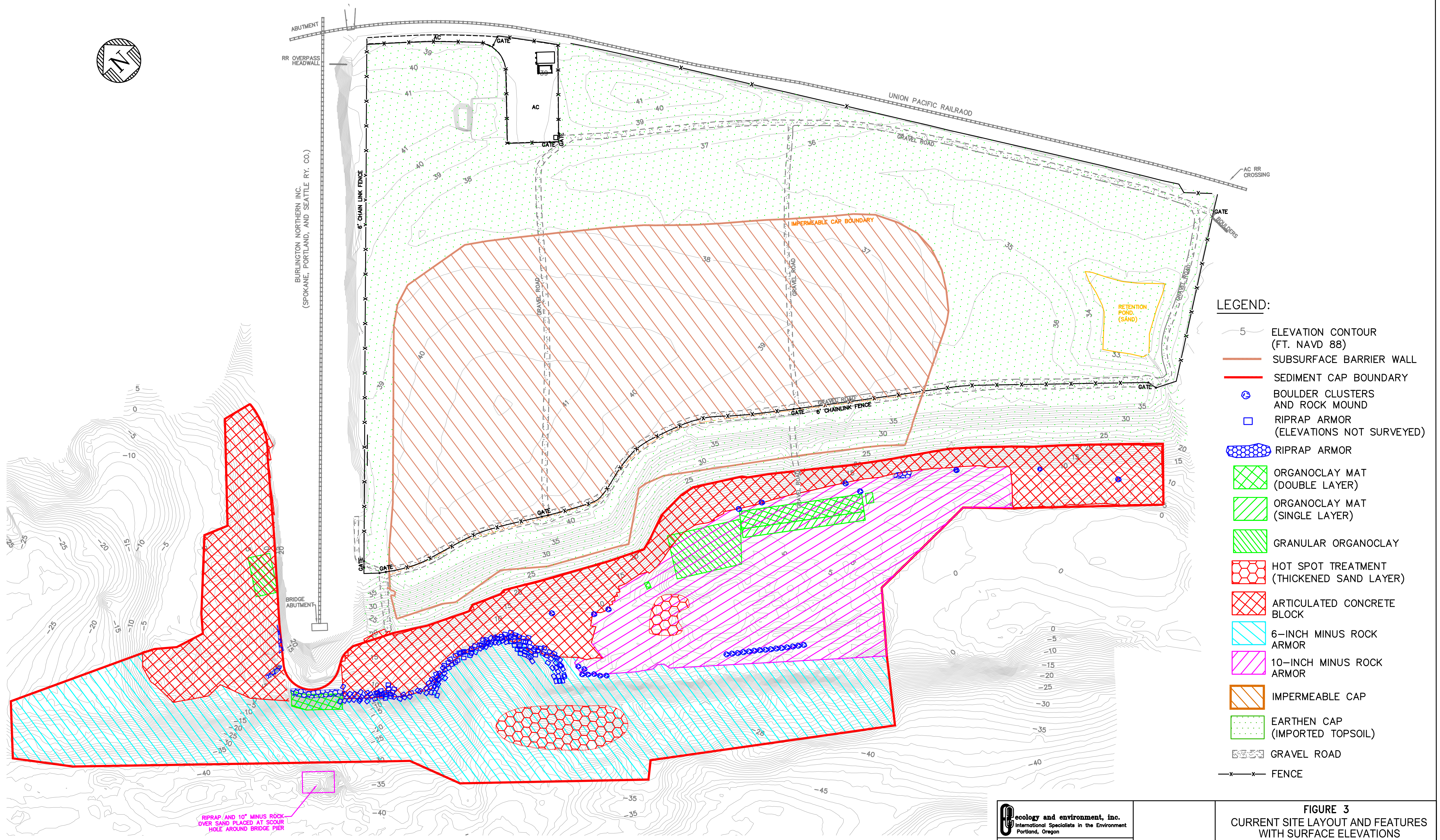
Map Reference: Orthorectified Photo Image, September 28, 2005 @ 12:30 pm.
River Stage at Time of Photo is 1.43 ft. NGVD47 at Morrison Street Bridge.

McCormick & Baxter
Creosoting Company

Portland, Oregon

Figure 2
PROPOSED SITE LAYOUT AND FEATURES

Date:	Drawn by:	Job Number:
3/20/2006	avh	002688.OY25.30.03



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International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW

CHECKED BY:

DRAWN BY: S. STEVENS

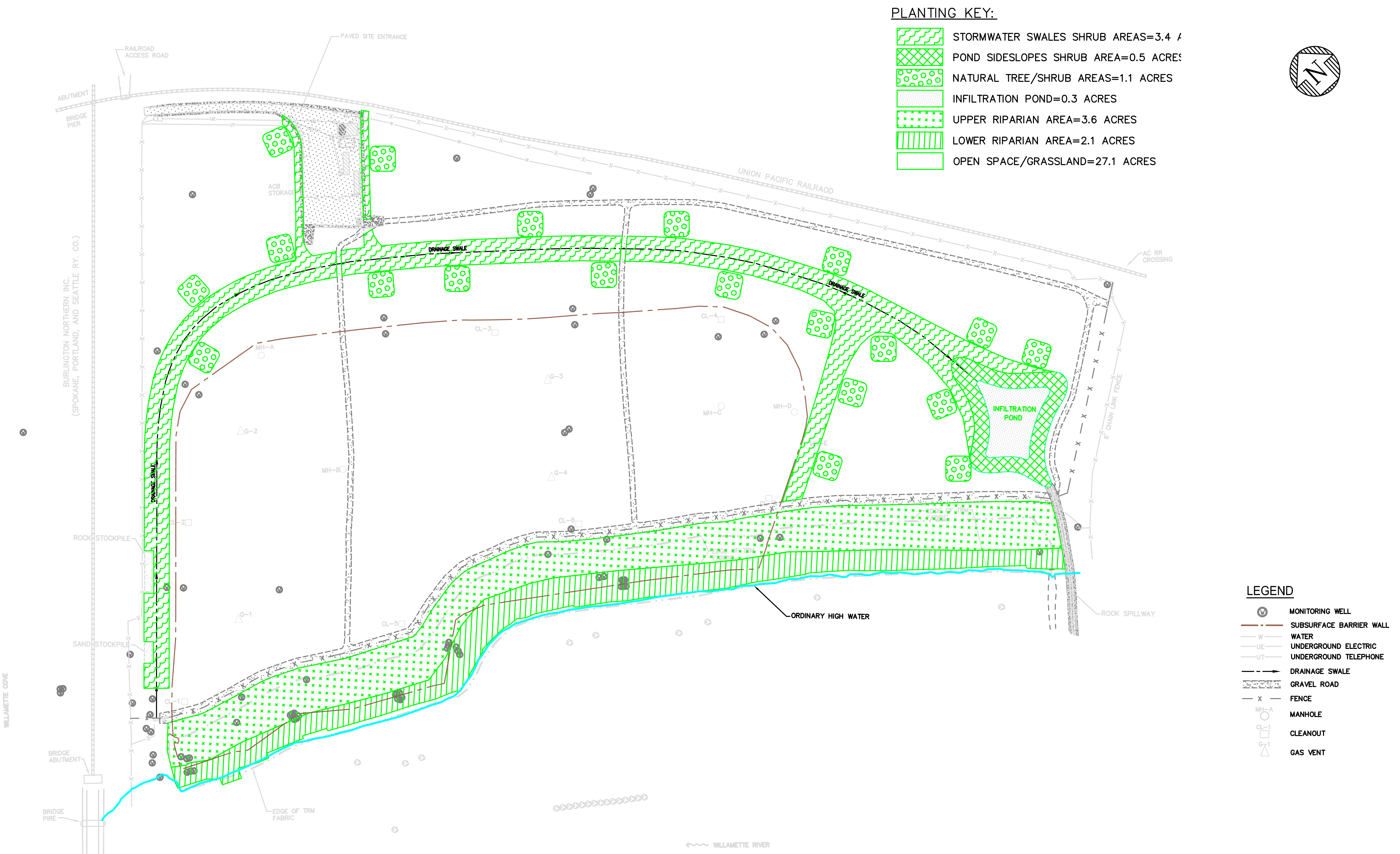
APPROVED BY A. WHITMAN

NO. DATE DWN APP'D DESCRIPTION
REVISIONS

FIGURE 3
CURRENT SITE LAYOUT AND FEATURES WITH SURFACE ELEVATIONS

McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	4–26–06	sitewidetopo.dwg



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Portland, Oregon

NO.	DATE	DWN	APP'D	REVISIONS

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY

FIGURE 4
SOIL CAP VEGETATION

McCormick & Baxter Superfund Site
Portland, Oregon

SCALE
NOTED
DATE ISSUED
4/27/06
C.A.D. FILE NO.
UPLAND CAP DESIGN WITH AS BUILTS.DWG

0 100 200 300

ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: S. STEVENS
APPROVED BY A. WHITMAN

FIGURE 5

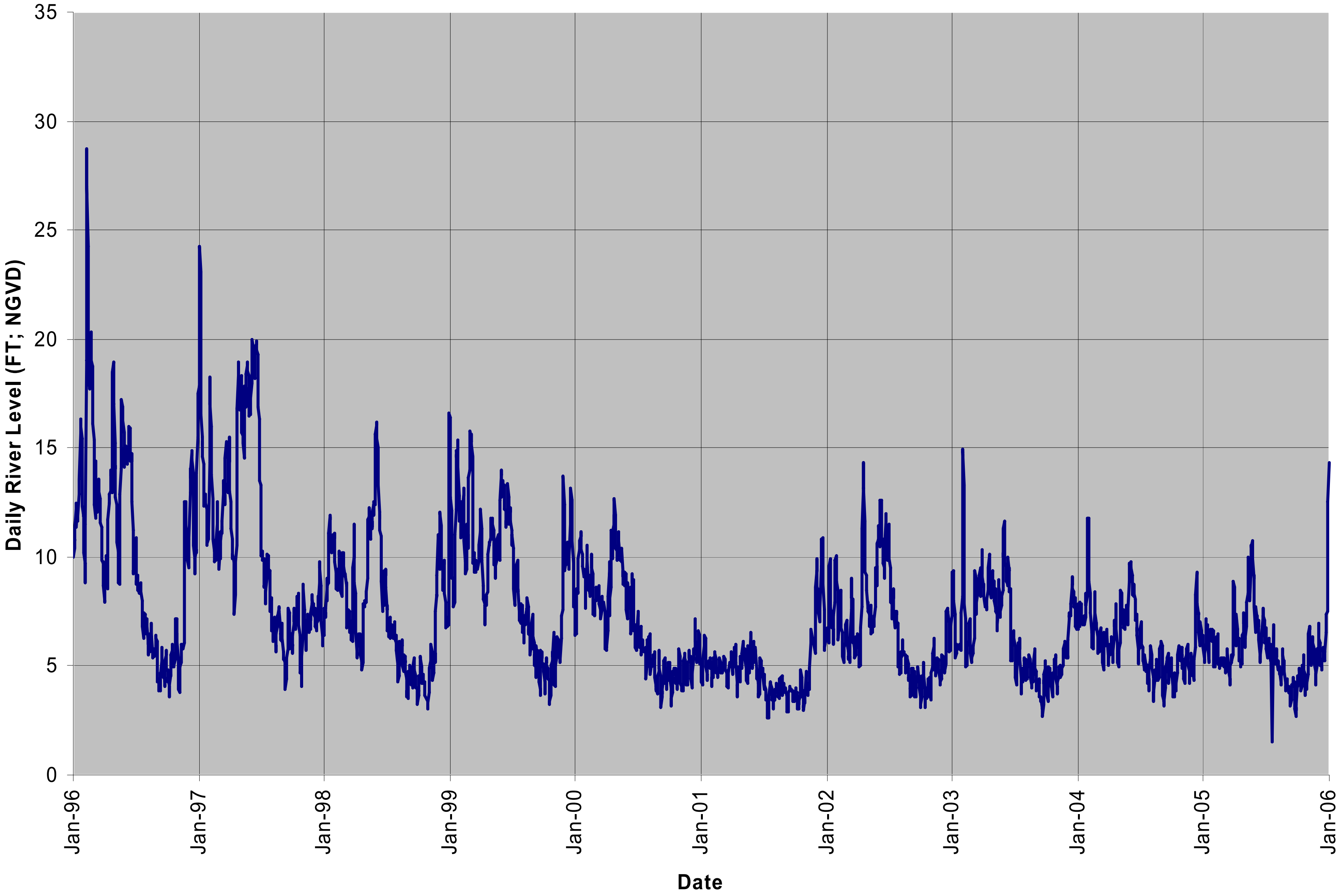
GW MONITORING AND EXTRACTION WELLS

McCormick & Baxter Superfund Site
Portland, Oregon

SCALE	DATE ISSUED	C.A.D. FILE NO.
NOTED	4-26-06	sitewidetopo.dwg

NO.	DATE	DWN	APP'D	DESCRIPTION
				REVISIONS

Figure 6
River Levels (1996-2005)



Source of Data: Linda Baker (RETEC) email communication with Heidi Blischke (DEQ), January 7, 2006.
Daily average river levels at Morrison Bridge station maintained by USGS. To convert National Geodetic Vertical Datum (NGVD) to NAVD, add 3.5 feet.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No.:
2006/02218

October 6, 2006

Ms. Nancy Harney
Superfund Project Manager
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Operation and Maintenance of the Soil Cap, Sediment Cap and Groundwater Remedy, McCormick and Baxter Creosoting Company Superfund Site, Willamette River (HUC 170900120301), Multnomah County, Oregon

Dear Ms. Harney:

The enclosed document contains a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of funding the operation and maintenance of the soil cap, sediment cap, and groundwater remedy at the McCormick and Baxter Creosoting Company, at river mile 7 on the Willamette River, in the City of Portland, Oregon. The site is a Federal Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This action follows several remedial actions being taken under CERCLA to significantly reduce the potential risk to human health and ecological receptors resulting from potential exposure to contaminants present in soils, sediment and groundwater at the project site. The U.S. Environmental Protection Agency (EPA) submitted a biological assessment to address the effect of long-term maintenance and operation of the remedy, and to demonstrate substantive compliance with ESA pursuant to the requirements of the National Contingency Plan under CERCLA. The EPA designated the Oregon Department of Environmental Quality as the lead in implementing the action contained within the CERCLA Record of Decision for the site.

In this Opinion, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), LCR steelhead (*O. mykiss*), LCR coho salmon (*O. kisutch*), Upper Willamette River (UWR) Chinook salmon, and UWR steelhead. Further, NMFS concludes that the action, as proposed, will not result in the destruction or adverse modification of critical habitats designated for the affected species. At this time, critical habitat has not been proposed or designated for LCR coho salmon.

As required by section 7 of the ESA, an incidental take statement prepared by NMFS is provided with this Opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize incidental take associated with this action. It also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and applicant, if any, must comply with to carry out the reasonable and prudent measures. Incidental take from actions by the action agency and applicant that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes four conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These conservation recommendations are a non-identical set of the ESA terms and conditions. Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH conservation recommendations, the EPA must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have questions regarding this consultation, please contact Dr. Nancy Munn in the Willamette Basin Branch of the Oregon State Habitat Office at 503-231-6269.

Sincerely,

Michael R Crouse

D. Robert Lohn
Regional Administrator

Endangered Species Act-Section 7 Consultation
Biological Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Operation and Maintenance of the Soil Cap, Sediment Cap and Groundwater Remedy,
McCormick and Baxter Creosoting Company Superfund Site,
Willamette River (HUC 170900120301),
Multnomah County, Oregon

Lead Action Agency: U.S. Environmental Protection Agency

Consultation
Conducted By: National Marine Fisheries Service
Northwest Region

Date Issued: October 6, 2006

Issued by: Michael R Crouse
D. Robert Lohn
Regional Administrator

NMFS No.: **2006/02218**

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INTRODUCTION

The biological opinion (Opinion) and incidental take statement portions of this consultation were prepared by the National Marine Fisheries Service (NMFS) in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531, *et seq*.), and implementing regulations at 50 CFR 402. With respect to designated critical habitat, the following analysis relied only on the statutory provisions of the ESA, and not on the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02.

The essential fish habitat (EFH) consultation was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801, *et seq*.) and implementing regulations at 50 CFR 600. The administrative record for this consultation is on file at the Oregon State Habitat Office in Portland, Oregon.

Background and Consultation History

On May 22, 2006, NMFS received a request for ESA section 7 consultation and EFH consultation from the U.S. Environmental Protection Agency (EPA) for funding the operation and maintenance of three Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) clean-up remedies implemented at the former McCormick and Baxter Creosoting Company site since 2004. The site is at river mile (RM) 7 on the Willamette River in the City of Portland. EPA proposes to operate and maintain the 34-acre upland soil cap, the 23-acre sediment cap, and groundwater remediation activities through September 2011.

The McCormick and Baxter Creosoting Company operated on the site between 1944 and 1991, treating wood products with creosote, pentachlorophenol, and inorganic preservative solutions containing arsenic, copper, chromium, and zinc. Historically, process wastewaters were discharged directly to the Willamette River, and other process wastes were dumped in several areas of the site. Significant concentrations of wood-treating chemicals were found in soil and groundwater at the site, and in river sediments beside the site. Contaminants detected include polynuclear aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), arsenic, chromium, copper, zinc, and dioxins/furans. The EPA listed the site on the National Priorities List (NPL) in June 1994, which is a Federal Superfund designation under the CERCLA. The EPA designated Oregon Department of Environmental Quality (DEQ) as the lead in implementing the actions contained within the CERCLA Record of Decision (ROD) for the site, although this remains a Federal action with Federal funding.

Various removal activities occurred at the site prior to the NPL listing, including the recovery of nonaqueous-phase liquid (NAPL), disposal of drums of process waste, installation of a wastewater treatment system, and the excavation of approximately 377 tons of contaminated soil. In March 1996, EPA and DEQ issued a ROD for the site to address several different media: contaminated soil, groundwater, stormwater, and Willamette River sediment. In March, 1998, an amended ROD was issued by EPA and DEQ to change a component of the selected remedial action for contaminated soil. In August, 2002, EPA and DEQ issued an "Explanation of Significant Difference" (ESD) explaining the decision to implement the contingency remedy for groundwater as specified in the 1996 ROD. To implement the contingency plan, the agencies selected a fully encompassing, impermeable subsurface barrier wall alignment surrounding the tank farm area and the former waste disposal area, and a riverfront alignment along the ordinary high-water mark of the Willamette River.

The NMFS consulted on three phases of the site remediation. The first phase addressed the construction of the sheet pile wall and the slurry wall around the upland portion of the site to minimize the movement of contaminants toward the Willamette River (August 20, 2004, NMFS No.: 2002/00761). The second phase addressed the construction of a 23-acre sediment cap in the Willamette River (March 15, 2004, NMFS No.: 2003/01440). The third phase addressed the remedy for the upland portion of the site, and included the construction of an upland impermeable soil cap inside the boundaries of the barrier wall, and a permeable, earthen soil cap for areas outside of the barrier wall (March 11, 2005, NMFS No.: 2005/00185). Select wells inside and outside the barrier wall continue to be monitored weekly for the presence and thickness of NAPL. NAPL is extracted weekly from interior and exterior wells if the thickness is greater than 0.4 feet. NAPL recovery will continue until the effectiveness of the barrier wall and sediment cap has been verified.

The proposed action considered in this consultation is the operation and maintenance (O&M)of the soil and sediment cap, vegetation maintenance and potential unplanned maintenance or repairs through 2011.

In the request for consultation, the EPA concluded that the proposed action is “likely to adversely affect” Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook, LCR coho salmon (*O. kisutch*), LCR steelhead (*O. mykiss*), and UWR steelhead. The EPA also concluded that the proposed action may affect critical habitat for four of the above listed salmonids (critical habitat has not been proposed or designated for LCR coho salmon). Finally, the EPA concluded that the proposed project “may adversely affect” EFH for Chinook salmon and coho salmon.

This Opinion is based on the information presented in the request for consultation. The objective of this Opinion is to determine whether funding the proposed action is likely to jeopardize the continued existence of the ESA-listed species listed above, or result in the destruction or adverse modification of designated critical habitat.

Proposed Action

For the purposes of this consultation, the proposed action includes all methods and actions described in the following paragraphs. The project applicant is the DEQ. The DEQ proposes to maintain the soil cap, the sediment cap and the groundwater remedy for 5 years through September 2011. The results of these activities will be evaluated as part of the Five-Year Review Report to be issued by DEQ and EPA in October 2011. The O&M plan will be updated in 2011 and in subsequent five-year reviews to assure the remedies are operated and maintained in a manner that is protective of human health and the environment.

Project Location. The McCormick and Baxter Creosoting Company site is a former wood treating facility on the east bank of the Willamette River in Portland, Oregon. The site encompasses approximately 41 acres of land and an additional 23 acres of contaminated river sediments. The upland portion is on a terrace of imported sand fill (dredged material placed in the early 1900s) within the historic floodplain of the Willamette River. The upland area is generally flat and lies between a 120-foot high bluff along the northeast border and a 20-foot high bank along the Willamette River to the southwest. The site is currently vacant except for a paved parking area, a small shop building, two field office trailers and associated utilities being used to support ongoing creosote extraction. The perimeter of the site is fenced and posted with warning signs.

The Willamette River is the only surface water body at the site. The river is approximately 1,550 feet wide with a typical maximum depth of about 40 to 50 feet below the Columbia River datum. Average flow rates in the river near the site range from 8,300 cubic feet per second (cfs) in summer to 73,000 cfs in the winter.

Three hydrostratigraphic units are present at the site: the shallow, intermediate and deep aquifer zones, which are interconnected to varying degrees depending on the location within the site. The shallow zone is poorly-graded dredge fill sand and wood debris, and ranges in thickness from 5 feet to greater than 30 feet. In parts of the site, the shallow zone consists mostly of sawdust and wood chips up to 20 to 25 feet thick. The shallow zone acts as an unconfined aquifer that, except within the barrier wall areas and close to the bluff, is in hydraulic connection with the river. Depth to groundwater ranges from approximately 20 to 25 feet below ground surface (bgs). The shallow zone is underlain by a silt aquitard ranging in thickness from zero near the river to greater than 100 feet closer to the bluff.

The intermediate aquifer zone is composed of fine to medium-grained alluvial sand and is present below the silt aquitard over most portions of the site. This zone varies in thickness from zero to greater than 50 feet. In the north-central portion of the site, the intermediate zone is approximately 12 feet thick and hydraulically separated from the shallow aquitard. In the south-central portion of the site, the silt aquitard is greater than 100 feet thick and no intermediate aquifer zone is present. Along the beach, the intermediate zone is up to 50 feet or more thick and is separated from the shallow zone by a discontinuous, thin silt layer.

The deep aquifer zone is present in all portions of the site. This zone consists of alluvial sands, and is directly connected with the intermediate and shallow zones along the river margin. Near the center of the site, the deep zone is separated from the shallow zone by more than 100 feet of low-permeability silt. Near the bluff, the deep zone is composed of gravel and sands of the Troutdale Formation and Catastrophic Flood Deposits.

Shallow groundwater gradients generally exist from the bluff toward the river. Intermediate and deep zone groundwater surface elevations and gradients have been inferred to flow toward the river in these zones. This description of flow pathways is important because it describes the primary pathways for contaminants to reach the Willamette River from upland portions of the site.

Project Description. The proposed action consists of a number of elements: (1) O&M of the soil cap; (2) O&M of the sediment cap; (3) groundwater remedy O&M; and (4) hypothetical repairs to the sediment cap. These are described below.

Operation and Maintenance of the Soil Cap. O&M of the soil cap includes monitoring, vegetation maintenance and potential unplanned maintenance. Monitoring activities include visual inspections of the cap surface, stormwater conveyance system, security fencing, and warning signs. The soil cap is designed to be maintenance free except for maintaining the native vegetation. Vegetation maintenance will include irrigation of the trees and shrubs in the stormwater swales and the riparian area through summer 2008, mowing of open space/grasslands, and manual removal of invasive plants throughout the site, and targeted application of herbicides to invasive plants. Vegetation maintenance, including the application of herbicides, was addressed in the 2004 opinion, and is only mentioned here to be inclusive of all maintenance activities. The timing of soil cap maintenance activities are described in Table 1.

Table 1. Description and frequency of soil cap O&M activities through September 30, 2011.

O&M Activity	**Frequency**
Monitoring: • Inspection of cap surface • Inspection of stormwater conveyance system • Inspection of security fencing • Inspection of warning signs	 Monthly Monthly Monthly Monthly
Vegetation Maintenance: • Irrigation • Mowing open grass areas • Manual removal of invasive plants • Targeted application of herbicides	 Summer 2007 and 2008 Annually Annually Biannually (April & September)
Unplanned Maintenance, such as: • Repair of fences • Repair of gravel roads • Filling of animal burrows in earthen cap • Removal of sediments from manholes	 As needed As needed As needed As needed

Although routine maintenance is not anticipated for the soil cap, unplanned repairs may be needed and could include repair of fences, replacement of warning signs, and gravel roads, filling of animal burrows dug into the earthen cap, removal of sediment from manholes, and replanting of unsuccessful trees and shrubs. The nature of the repairs will determine the equipment and material requirements, and would likely be performed by a contractor with general construction capabilities. Any substantial repairs, such as those requiring the impermeable cap to be breached or repaired, will be detailed in a work plan prepared prior to performing this activity. The work plan will provide technical specifications and drawings sufficient to assure that this work is performed appropriately and by qualified personnel. Materials needed for potential maintenance include those materials used to construct the soil cap: geomembrane, geocomposite, perforated piping, sand, biotic rock (3 inch minus rock); 10 inch minus rock, filter fabric, topsoil, fencing, and road gravel. These materials have been stockpiled on site, but if they are inappropriate or insufficient for the repair, additional materials will be imported. Any imported soil will be certified by DEQ as meeting the requirements for "clean fill."

Operation and Maintenance of the Sediment Cap. O&M of the sediment cap consists of monitoring and unscheduled maintenance activities (Table 2). Monitoring activities include visual inspections of warning buoys and near shore areas, multibeam bathymetric surveys and side scan sonar surveys of deeper areas, and diver inspections of anomalies in areas of concern identified from the bathymetry and sonar surveys. Monitoring activities also include the collection of surface water samples, pore water samples from below the armor cap, flux chambers, organoclay cores, and samples of crayfish, sculpins and clams, if available. Unscheduled maintenance work may include the replacement of warning buoys, placement of additional armoring due to erosion and placement of additional organoclay if new releases of creosote are discovered, or if the existing organoclay becomes saturated with creosote. Any new organoclay would require armoring.

Table 2. Description and frequency of sediment cap O&M activities through September 30, 2011.

O&M Activity	**Frequency**
Monitoring:	
• Inspection of warning buoys	Monthly
• Inspection of near shore areas	Weekly (Aug-Oct), otherwise monthly
• Multibeam bathymetric survey	Annually through May 2010
• Side-scan sonar surveys	Annually through May 2010
• Diver inspections of deep water	Annually through spring/summer 2010
Sampling:	
• Surface water, pore water, flux chamber	Biannually (May & Sept) through 2010
• Crayfish, sculpin, clams, lamprey	Annually through September 2010
• Organoclay cores	Performed in September 2010
Unscheduled Maintenance, such as:	
• Replacement of buoys	As needed
• Additional armoring placement	As needed
• Additional organoclay placement	As needed

The nature of any repairs will determine the equipment and material requirements. Materials needed have been stockpiled on site, and if they are inappropriate or insufficient, additional materials will be imported.

The armoring layer of the sediment cap is susceptible to damage by wave action, scouring by river currents, and gouging by submerged logs and vessels (anchoring). The chemical isolation layer of the sediment cap is susceptible to damage by unanticipated releases of mobile NAPL from the underlying contaminated sediments or continued seepage of mobile NAPL from upland sources. These releases of NAPL are possible as a result of saturation of the existing organoclay caps or through portions of the sediment cap where organoclay was not placed. Repairs to the sediment will need to be performed in a timely manner in the event that the armoring layer becomes damaged or the chemical isolation layer fails to contain NAPL. Three types of repairs may be needed:

1. Additional Armor Placement. If it is determined that the damage resulted from wave action or river currents, then the size of the armoring material would be increased. For example, the 10-inch minus rock within the embayment area would be upsized to a 24-inch minus rock (*i.e.*, riprap). The repair would be performed to as small an area as determined to be susceptible to damage. The rock placement would raise the elevation of the river bottom.

2. Additional Organoclay Placement Along Beachfront. Intermittent releases of NAPL may be discovered along the beachfront in the vicinity of the former NAPL seep areas within Willamette Cove and along the Willamette River. These releases may coincide with gas ebullition which is more prevalent during the summer and fall when river levels are at annual lows and during the low tide cycles.

   Corrective measures would consist of the additional placement of organoclay and armoring over the existing river bottom. The repair area may extend as much as 300 feet along the shoreline and 100 feet away from the shoreline to encompass are area of 300,000 square feet. The repair cap would consist of the following components, starting at the lowest elevation:

   - 6-inch layer of sand placed directly on the river bottom;
   - 6-inch layer of organoclay or ½-inch layer of organoclay mats;
   - 12-inch layer of sand;
   - 4-inch layer of 3-inch minus filter rock; and
   - 12-inch layer of 10-inch minus rock in the protected embayment area, or a 9-inch layer articulated concrete block (ACB) mats in areas exposed to wave action.

   This would cause a rise in the elevation of the river bottom associated with the fill, but would not change the type of material present (*i.e.*, size class).

   The equipment needed would include an excavator, all-tracks, dozer, a loader, and a crane or forklift. Prior to installation, a protective layer of sand would be placed over existing ACB armoring and other sensitive areas. Sand would be delivered to the top of bank by truck and then loaded into the All-Tracks using the loader. The All-Tracks would transport the sand to the water and unload. A dozer would spread the sand to a thickness of approximately 6 inches over the repair area. An excavator would reposition any drift logs or boulder cluster within the footprint of the repair area.

   After the sand is placed, the organoclay would be installed with an excavator. The organoclay would be covered with a protective layer of sand. The All-Tracks would transport sand from the top of the bank to the river, and the dozer would spread the sand to a thickness of approximately 12 inches. The 4-inch layer of 4-inch minus rock would be installed on top of the sand using the All-Tracks for transportation and dozer for spreading. If the 10-inch minus rock is used as the final layer, it would be placed in a similar manner. If ACB is used as the final layer, it would be transported by All-Tracks from the top of the bank to the river. A forklift or crane would place the ACB. Once the installation is complete, the access road created from equipment going down the bank would be removed and the vegetation would be replanted with native grasses, trees and shrubs as specified in the vegetation management plan prepared for the 2004 Opinion.

3. Additional Organoclay Placement in Deep Water. Intermittent releases of NAPL may also be discovered in deep water and potentially beneath the Burlington Northern Santa Fe Railway Bridge. Additional placement of organoclay may be needed over the existing river bottom elevations of -5 to -35 feet NAVD. The repair area may extend as much as 200 feet along the shoreline and 100 feet away from the shoreline to encompass an area of 200,000 square feet. The repair cap would consist of the following components from bottom to top:

- 6-inch layer of sand placed directly on the river bottom;
- ½-inch layer of organoclay mats;
- 12-inch layer of sand; and
- 12-inch layer of 6-inch minus rock.

The river bottom elevation would rise by 2.5 feet, but there would be no change in the size class of material at the river bottom. Likely construction equipment would include a crane barge, a material barge, tug, loader and a dive support boat. A crane-mounted barge equipped with a clamshell bucket would be used to place the initial layer of sand. The organoclay mats would be placed using a spreader bar attached to the crane. Divers would guide the organoclay mats into the desired location and use sand bags to temporarily secure the mats. The next layers of sand and rock would be placed with the clamshell bucket.

Operation and Maintenance of the Groundwater Remedy. O&M of the groundwater remedies consists of NAPL recovery, groundwater elevation monitoring, groundwater samplings, and equipment maintenance and maintenance of the utility service (Table 3).

Table 3. Description and frequency of groundwater remedy activities through September 30, 2011.

O&M Activity	**Frequency**
NAPL Recovery:	
• Extraction of exterior wells	Weekly
• Extraction of interior wells	Weekly
Groundwater Monitoring:	
• Downloading continuous water level data loggers	Quarterly
• Manual water level measurements	Quarterly
• NAPL gauging (site-wide)	Quarterly
Groundwater Sampling:	
• Site-wide	Performed in May 2010
• Infiltration pond	Quarterly through Sept 2007, annually through 2010
Equipment and Utility Maintenance:	
• Interface probes, pumps, vehicle, data loggers/transducers, *etc*.	As needed
• Water, electric, phone, alarm, solid waste, toilet	Continuous

Schedule. The O&M activities will extend through September 30, 2011. Sampling activities will be conducted in the spring, summer and/or fall of each year. Monitoring of the sediment cap surface using multi-beam bathymetry and side-scan sonar will occur in the spring of each year. Diver inspections of the sediment cap will occur in the spring or summer of each year. Each repair could take from one to four weeks to complete.

<u>Monitoring and Conservation Measures</u>. The following conservation measures have been incorporated into the project design to reduce potential adverse effects to salmonids and to minimize project effects on other resources.

1. Repairs to the sediment cap will be conducted between July 1 through October 31, and December 1 through January 31, when the fewest number of salmon and steelhead are likely to be present. If it is necessary to perform repairs during other times, EPA will request approval from NMFS.
2. Construction effects will be confined to the minimum area necessary to complete the project.
3. A biological monitoring and reporting program will be developed and employed prior to repairs being made to the sediment cap to ensure conservation measures and terms and conditions from the Opinion are effective in minimizing the likelihood of take from permitted activities. An environmental professional will monitor and document the conditions of the shoreline and nearshore area on a daily basis during construction.

Furthermore, a qualified biologist will oversee work performed by the environmental professional.

4. The sediment cap repair contractor will be required to adhere to water quality protections and other conditions found in EPA's 401 Water Quality Certification for the sediment cap remedial action. Prior to conducting repairs to the sediment cap, the construction contractor and/or the construction oversight consultant will be required to prepare and carry out a pollution and erosion control plan to prevent increased turbidity. The plan will be made available for inspection on request by NMFS. The required elements of the plan are listed in the biological assessment, and include numerical turbidity limits based on background concentrations and a turbidity monitoring plan. The plan also includes hazardous material handling instructions and spill containment procedures.
5. The sediment cap repair contractor will be required to provide sorbant booms, pads and other sorbant materials and vacuum pumps to remove and isolate any NAPL sheen resulting from construction activities. Oil absorbent materials will be used if a sheen is observed. The booms will remain in place until all oil material and floating debris has been collected and the sheen has dissipated.
6. If an uncontrolled release of NAPL sheen is observed during sediment cap repairs, the existing protective measures will be reevaluated for efficacy. If deemed necessary by the environmental professional, work may be stopped until the cause of the event is determined and work can be resumed without additional effects.
7. All prudent and necessary steps will be taken during sediment cap repairs to avoid and minimize potential water and sediment quality effects. These will include strict contractor performance controls for all shoreline and in-water construction activities.
8. Sediment cap repair material will not contain detectable levels of organic contaminants and will have background level concentrations of metals. Use of riprap armoring will be avoided to the extent practicable. Sediment cap repair materials will be placed in a controlled and accurate manner. Armor stone will be placed in a manner that does not disrupt or penetrate the other cap components.
9. Large wood within the sediment cap repair area will be moved carefully and returned to its original location after construction.
10. Land-based heavy equipment will be restricted as follows:
    - When heavy equipment is required, it will be equipment having the least impact to the existing sediment cap and riverine environment (*e.g*., minimally-sized, rubber-tired).
    - Heavy equipment will be fueled, maintained and stored as follows: (a) Place vehicle staging, maintenance, refueling and fuel storage areas a minimum of 150 feet horizontal distance from the Willamette River (exceptions may be made for cranes and other slow-moving equipment, and these vehicles may be refueled in place if they meet or exceed 100% containment); (b) all vehicles operated within 150 feet of the Willamette River will be inspected daily for fluid leaks before leaving the vehicle staging area; and (c) when not in use, vehicles will be stored in the vehicle staging area with the exception of cranes and other very slow-moving vehicles.
11. Pesticide use will be limited in type and extent, as described in the proposed action.
12. If the in-water work area requires isolation to maintain the turbidity criteria, the work area will be isolated using inflatable bags, sandbags, 10-inch minus rock, sediment

curtains, or similar materials. All listed salmonids trapped within the isolation area will be removed and placed in the actively-flowing river using methods described below.

13. If the in-water work area requires isolation, attempts will be made to capture and release fish from the isolated area using trapping, seining, electrofishing, or other methods to minimize the risk of injury. The entire capture and release operation will be conducted or supervised by a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish. Methods of fish capture will primarily involve beach seining and/or electrofishing. Electrofishing will not be performed if water temperatures exceed 18°C. If electrofishing equipment is used to capture fish, the contractor will comply with NMFS electrofishing guidelines (NMFS 2000). ESA-listed fish will be handled with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling. Fish will be transported in aerated buckets or tanks. Fish will be released into a safe release site as quickly as possible, and as near as possible to capture sites. ESA-listed fish will not be transferred to anyone except NMFS personnel, unless otherwise approved in writing by NMFS. The NMFS or its designated representative will be allowed to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.
14. A construction monitoring report describing EPA's success in meeting the conservation measures will be provided to NMFS within 30 days following the completion of cap repairs. The report will identify the project, provide before, during and after photo documentation, and a narrative that briefly discusses project implementation and consistency with the conservation measures, with special attention to turbidity. In addition, annual O&M reports will be prepared by DEQ and submitted to NMFS.

The conservation measures described here and in the consultation initiation package as part of the proposed action are intended to reduce or avoid adverse effects on listed species and their habitats. The NMFS regards these conservation measures as integral components of the proposed action and expects that all proposed project activities will be completed consistent with those measures. We have completed our effects analysis accordingly. Any deviation from these conservation measures will be beyond the scope of this consultation and will not be exempted from the prohibition against take as described in the attached incidental take statement. Further consultation will be required to determine what effect the modified action may have on listed species or designated critical habitats.

Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of this consultation, the action area is all riparian and aquatic habitat within the Willamette River, from RM 8 to the confluence with the Columbia River.

The ESA-listed salmonids described in Table 4 use the action area for adult migration, and juvenile rearing and migration. The action area within the Willamette River is designated critical habitat for steelhead and Chinook salmon (Table 1). The action area is designated EFH for Chinook and coho salmon (PFMC 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for those species.

Table 4. Federal Register Notices for Final Rules that list species, designate critical habitat, or apply protective regulations to species considered in this consultation. Listing status: 'T' means listed as threatened under the ESA; 'D' means that the final listing determination is deferred until December 28, 2005. Critical habitat designated on September 2, 2005 (70 FR 52630) became effective on January 6, 2006.)

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River spring-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon (*O. kisutch*)			
Lower Columbia River	T 6/28/05; 70 FR 37160	Not applicable	6/28/05; 70 FR 37160
Steelhead (*O. mykiss*)			
Lower Columbia River	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

ENDANGERED SPECIES ACT

The ESA establishes a national program to conserve threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. Section 7(b)(4) requires the provision of an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

Biological Opinion

This Opinion presents NMFS' review of the status of each listed species of Pacific salmon and steelhead[1] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected listed species.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of that critical habitat. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used in this Opinion. Instead, this analysis relies

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[1] An 'evolutionarily significant unit' (ESU) of Pacific salmon (Waples 1991) and a 'distinct population segment' (DPS) of steelhead (final steelhead FR notice) are considered to be 'species,' as defined in section 3 of the ESA.

on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that sets forth the substantive protections and procedural aspects of consultation, and on agency guidance for application of the "destruction or adverse modification" standard.[2]

Status of the Species and Critical Habitat

This section defines the biological requirements of each listed species affected by the proposed action, and the status of each designated critical habitat relative to those requirements. Listed species facing a high risk of extinction and critical habitats with degraded conservation value are more vulnerable to the aggregation of effects considered under the environmental baseline, the effects of the proposed action, and cumulative effects.

Status of the Species. The NMFS reviews the condition of the listed species affected by the proposed action using criteria that describe a 'viable salmonid population' (VSP) (McElhany *et al*. 2000). Attributes associated with a VSP include abundance; productivity, spatial structure, and genetic diversity that maintain its capacity to adapt to various environmental conditions and allow it sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced, in turn, by habitat and other environmental conditions.

To be considered viable, with a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over the long term, a species should have the following characteristics. It should contain multiple populations so that a single catastrophic event is less likely to cause the species to become extinct, and so that the species may function as 'metapopulation' as necessary to sustain population-level extinction/recolonization processes. Multiple populations within a species also increase the likelihood that a diversity of phenotypic and genotypic characteristics will be maintained, thus allowing natural evolutionary processes to operate and increase the species' long-term viability. Some of the species' populations should be relatively large and productive to further reduce the risk of extinction in response to a single catastrophic event that affects all populations. If a species consists of only one population, that population must be as large and productive ('resilient') as possible. Some populations in each species should be geographically widespread to reduce the risk that spatially correlated environmental catastrophes will drive the species to extinction. Other populations in the same species should be geographically close to each other to increase connectivity between existing populations and encourage metapopulation function. Populations with diverse life-histories and phenotypes should be maintained in each species to further reduce the risk of correlated environmental catastrophes or changes in environmental conditions that occur too rapidly for an evolutionary response, and to maintain genetic diversity that allows natural evolutionary processes to operate within a species. Finally, evaluations of species status should take into account uncertainty about species-level processes. Our understanding of species-level spatial and temporal processes is limited such that the historical

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[2] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

number and distribution of populations serve as a useful goal in maintaining viability of species that are likely to have been historically self-sustaining (McElhany *et al.* 2000).

Role of Recent Ocean Conditions in Species Status. In the last decade, evidence has shown recurring, decadal-scale patterns of ocean-atmosphere climate variability in the North Pacific Ocean. These oceanic productivity 'regimes' have correlated with salmon abundance in the Pacific Northwest and Alaska. Survival rates in the marine environment are strong determinants of abundance for Pacific salmon and steelhead. However, because the confidence with which ocean-climate regimes can be predicted into the future is limited, the ability to project the future influence of ocean-climate conditions on salmonid productivity is limited. Even under the most optimistic scenario, increases in salmonid abundance might be temporary and could mask a failure to address underlying factors for decline. It is reasonable to assume that salmon populations have persisted over time under healthy freshwater conditions through many such cycles in the past. Less certain is how the populations will fare in periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are degraded (NMFS 2004). Further, no one is sure whether we are about to enter a more favorable period of ocean conditions for Pacific Northwest salmon or, if we are, how long it will last; and even if salmon do experience a long period of better ocean conditions, if we don't address the underlying causes of salmon decline (habitat loss and degradation, hydropower, development, harvest, and hatchery propagation), any "recovery" the salmon experience will be temporary, and the next time ocean conditions decline we could see widespread extinction of salmon populations.

LCR Chinook salmon. The range of this species includes all naturally-spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River. Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, they are subject to large-scale hatchery production, high harvest, and extensive habitat degradation. The Lewis River late fall Chinook population is the healthiest and has a reasonable probability of being self-sustaining. The spring-run populations are largely extirpated as the result of dams which block access to their higher elevation habitat. Abundances largely declined during 1998-2000 and trend indicators for most populations are negative, especially if hatchery fish are assumed to have a reproductive success equivalent to that of natural-origin fish. However, 2001 and 2002 abundance estimates increased for most LCR Chinook populations over the previous few years (*as cited in* Good *et al*. 2005). In 2003, 2,873 fall-run Chinook salmon spawned in the main channel of the Columbia River between RM 113 and RM 143.

Fall Chinook salmon were native to the lower Willamette River and its principal tributary, the Clackamas River. A tule fall-run existed in the lower Clackamas River until the 1930s, when poor water quality conditions below Willamette Falls presented a barrier to returning fall Chinook salmon (Parkhurst *et al*. 1950, Geeson 1972, as cited in Myers *et al*. 2006). Fall Chinook samon probably spawned in the lower reaches of the Clackamas River and other Willamette River tributaries below Willamette Falls (e.g., Johnson Creek, Abernathy Creek) (Myers *et al*. 2006). Fall Chinook salmon from the lower Columbia River hatchery stocks were introduced into the Clackamas River from 1952 to 1981 to reestablish the run. Because there are no data for the hatchery fraction of the Clackmas population, statistics on wild fish population trends and growth rates are not available (Myers *et al*. 2006). Total spawner abundance (hatchery and natural origin fish) ranged from highs near 1,400 fish in the 1960s and 1970s, down to a recent mean of 40 to 50 fish (1998-2001) in the Clackamas River population.

The major factors limiting recovery for LCR Chinook are reduced access to spawning/rearing habitat in tributaries, hatchery impacts, loss of habitat diversity and channel stability in tributaries, excessive sediment in spawning gravel, elevated water temperature in tributaries, and harvest impacts on fall Chinook (NMFS 2005).

Adults from this species pass through the action area from February through November, with peak passage occurring from mid-March through May, and from October through early November (ODFW 2005). The majority of juveniles in this species leave as subyearlings, with downstream movement observed as early as December, with most moving during summer and fall months. Chinook salmon juveniles are likely to be present in the project area during the summer and winter in-water work windows. Because of the lack of structure in the project area and the poor substrate conditions (concrete blocks with some patches of sand on top), fish are unlikely to remain in the project area to feed, and are more likely to continue moving downstream.

UWR spring-run Chinook salmon. The UWR spring-run Chinook salmon species includes native spring-run populations above Willamette Falls and in the Clackamas River, although there are no direct estimates of the abundance of natural-origin spawners. In the past, it included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. The total abundance of adult spring-run Chinook salmon (hatchery-origin plus natural-origin fish) passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but it is an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults).

Until recent years, interpretation of abundance levels has been confounded by a high but uncertain fraction of hatchery-produced fish. The McKenzie River population has shown substantial increase in total abundance in 2001 and 2002, while trends in other natural populations in the species are generally mixed. It is expected that productivity will remain below replacement in the absence of artificial propagation programs. The declines in spring-run Chinook salmon in this species have been attributed to the extensive habitat blockages caused by dam construction, interactions with hatchery fish and harvest (Good *et al*. 2005). Analysis of recent data suggests that the only population that is potentially self-sustaining is the McKenzie River population, perhaps due to increased ocean survival (Good *et al*. 2005).

Chinook salmon generally spawn and rear in mainstem reaches of large river systems such as the Willamette River and the Clackamas River. No Chinook spawning occurs in the project area, but Chinook salmon yearlings and subyearlings rear in the project area as they migrate downstream, and based on recent data from a four-year study sponsored by the City of Portland, Chinook juveniles may spend several weeks or months in the action area as they move downstream (ODFW 2005).

LCR coho salmon. There is limited information on the 21 populations still thought to be in existence because most were considered extirpated, or nearly so, during the low marine survival period of the 1990s (NMFS 2001). There are only two extant populations with appreciable levels of natural production: The Clackamas River and Sandy River. Although adult returns in 2000 and 2001 for the Clackamas and Sandy River populations increased moderately, the recent five-year average of natural-origin spawners for both populations represent less than 1,500 adults per year. Recruitment in the Sandy River population failed in 5 of the last 10 years and has responded poorly to reductions in harvest. With these low numbers of natural-origin returning adults, the Clackamas, and especially Sandy River populations, are in a range where environmental, demographic, and genetic stochasticity can be significant risk factors (Good *et al.* 2005).

The extreme loss of naturally spawning populations, the low abundance of current populations, diminished diversity, and fragmentation and isolation of the remaining naturally-produced fish combine to create considerable risks for this species (Good *et al.* 2005). The lack of naturally-produced spawners is contrasted by the very large number of hatchery-produced adults. The abundance of hatchery coho returning to the lower Columbia River in 2001 and 2002 exceeded one million and 600,000, respectively. Approximately 40% of historical habitat is currently inaccessible, which restricts the number of areas that might support natural productivity, further increasing the vulnerability to environmental variability and catastrophic events (NMFS 2004). In 2003, 196 adult coho salmon spawned in the main channel of the Columbia River between RM 113 and RM 143.

Most adult coho salmon enter the Lower Columbia River from September through December, although there may be some late-run native fish that enter the Clackamas River from late December to march (Cramer and Cramer 1994). Adult generally migrate through the action area from September to March. Juveniles spend about one year in fresh water, with migration to the ocean beginning in April and declining through June. Coho tend to move slowly downstream (4.6 km/day) and are highly associated with nearshore areas, preferably beaches (ODFW 2005). Juvenile coho salmon are generally present in the project are during winter and spring.

LCR steelhead. This species includes all naturally spawning populations of steelhead in streams and tributaries of the Columbia River between, and including, the Cowlitz and Wind Rivers in Washington, along with, and including, the Willamette River and Hood River in Oregon. Excluded are steelhead in the Upper Willamette River basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington (NMFS 2004).

All runs declined from 1980 to 2000, with sharp declines beginning in 1995. Historical counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) probably exceeded 20,000 fish while in the 1990s fish abundance dropped to 1,000 to 2,000 (NMFS 2000). Even more recently, 1997-2002, the average has not been greater than 750 spawners per population.

A number of populations have a substantial fraction of hatchery-origin spawners and probably are sustained largely by hatchery productions. Exceptions are the Kalama, the North Fork Toutle, the South Fork Toutle, and East Fork Lewis winter-run populations, which have few hatchery fish spawning on the natural spawning areas. These populations have relatively low recent mean abundance estimates, with the largest being the Kalama (mean 726 spawners) (Good *et al*. 2005). Long-term trends in spawner abundance are negative for seven of the nine populations for which there are sufficient data, and short-term trends are negative for five of seven populations. Four historical populations have probably been extirpated or nearly extirpated, and only one-half of 23 historical populations currently exhibit appreciable natural productivity.

Concerns for the viability of this species include habitat loss, hatchery steelhead introgression, and harvest pressures. Approximately 18% of historical habitat has been lost due to the construction of dams or other impassable barriers (Good *et al*. 2005). Also of concern is the impact to diversity from the high proportion of hatchery-origin spawners, the disproportionate declines in the summer steelhead life history, and the release of non-native hatchery summer steelhead in the Cowlitz, Toutle, Sandy, Lewis, Elochoman, Kalama, Wind, and Clackamas Rivers (NMFS 2004).

Winter steelhead are native to the Clackamas River basin. Although summer steelhead currently are present and spawn naturally in this system, they originated from releases of Skamania Hatchery summer steelhead stock (Murtagh *et al*. 1992, Chilcote 1997, as cited in Myers *et al*. 2006). The major factors limiting recovery for LCR Steelhead are degraded floodplain and stream channel structure and function, reduced access to spawning/rearing habitat, altered streamflow in tributaries, excessive sediment and elevated water temperatures in tributaries, and hatchery impacts (NMFS 2005).

Juvenile and adult steelhead migrate through the project area, and juveniles are generally present during the winter and spring (ODFW 2005). Downstream movement rates are relatively rapid.

UWR steelhead. The UWR steelhead includes all naturally spawning populations of winter-run steelhead in the Willamette River and its tributaries upstream from Willamette River Falls to, and including, the Calapooia River (NMFS 2004). Over the past several decades, total abundance of natural, late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000 to 20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of the years from 1993 to 1998 was below 4,300 fish, and the run in 1995 was the lowest in 30 years. In 2001 and 2002, the adult returns have significantly increased (exceeding 10,000 total fish) for the species. However, the recent five-year average abundance remains low for the entire species (5,819 adults), and individual populations remain at low abundance. Long-term trends in abundance are negative for all populations in the species, reflecting a decade of consistently low returns during the 1990s. Approximately one-third of the species' historically-accessible spawning habitat is now blocked (Good *et al*. 2005). Notwithstanding the lost spawning habitat, the species continues to be spatially well-distributed, occupying each of the four major subbasins: The Molalla, North Santiam, South Santiam, and Calapooia Rivers. The cessation of the 'early' winter-run hatchery program is considered a positive sign for species diversity risk but there are still concerns that releases of non-native summer steelhead continue (NMFS 2004), no population is naturally self-sustaining (Good *et al.* 2005). All populations are relatively small, with the recent mean abundance of the entire species at less than 6,000.

Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of UWR steelhead. Willamette Falls (RM 26.5) is a known migration barrier. Winter-run steelhead and spring-run Chinook salmon historically occurred above the falls, whereas summer-run steelhead, fall-run Chinook, and coho salmon did not. Detroit and Big Cliff dams cut off access to 335 miles of spawning and rearing habitat in the North Santiam River. In general, habitat in this species has become substantially simplified since the 1800s by removal of large woody debris to increase the river's navigability.

Based on a recent study conducted by ODFW, steelhead tend to move relatively quickly through the lower Willamette River (12.5 km/day) (ODFW 2005). As well, this species was the least associated with nearshore areas, and are generally present during winter and spring.

Status of Critical Habitat. The NMFS reviews the status of critical habitat affected by the proposed action by examining the condition and trends of primary constituent elements (PCEs) throughout the designated area. PCEs consist of the physical and biological elements identified as essential to the conservation of the species in the documents identifying critical habitat (Table 5).

The project reach is within designated critical habitat for LCR Chinook salmon, UWR Chinook salmon, LCR steelhead, and UWR steelhead. The PCEs potentially found at the project site are those associated with freshwater rearing and freshwater migration. The value of designated critical habitat for all species is limited by poor water quality, altered substrate, and lack of floodplain connectivity, and lack of complex habitat to provide forage and cover. The present condition of PCEs within designated areas and the human activities that have affected PCE trends are further described in the environmental baseline.

Table 5. Types of habitats and essential physical and biological features named as PCEs in all salmon and steelhead critical habitat designations.

Habitat	Essential Physical and Biological Features	Species Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover [a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage [b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage [b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). An environmental baseline that does not meet the biological requirements of a listed species may increase the likelihood that adverse effects of the proposed action will result in jeopardy to a listed species or in destruction or adverse modification of a designated critical habitat.

The NMFS describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support all life stages of each listed species within the action area. Each listed species considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that support successful juvenile rearing, and juvenile and adult migration.

The action area is within the lower Willamette River watershed at RM 7. The Willamette River watershed covers approximately 11,500 square miles in northwest Oregon, between the Coast and Cascade mountain ranges. The river travels 187 miles from its headwaters to its mouth at the Columbia River. Most of the rainfall occurs in the fall, winter, and spring, with little rainfall during June, July, and August. The lowest river flow occurs during late summer. The 13 U.S. Army Corps of Engineers dams on tributary systems largely regulate flows in the mainstem Willamette River.

Significant changes have occurred in the watershed since the arrival of Europeans in the 1800s. The watershed was mostly forested land before the arrival of white settlers. Now, about half the basin is still forested. Geomorphically, the river has changed substantially as a result of channelization and containment structures along the mainstem (Sedell and Frogatt 1984). These changes were greatest in the upstream areas which historically was a braided system of oxbows, sloughs, ponds, and small side-channels and a broad floodplain with extensive marshlands and riparian gallery forest. One-third of the basin is used for agriculture, and about 5% is urbanized or is in residential use. The river receives direct inputs from treated municipal wastes and industrial effluents. Nonpoint source input from agricultural, silvicultural, residential, urban and industrial land uses are also significant, especially during rainfall runoff.

Like the rest of the Willamette River, the action area once supported extensive braided channels, backwater areas and marshes. Large seasonal flood events and occasional catastrophic floods defined sediment transport and deposition and the geomorphology of the river. The daily tidal fluctuations of the river in the action area contributed to the health of the marshes and backwater areas. Extensive filling occurred in the project area using material dredged from the river bottom.

The Willamette River is tidally influenced at the project site, although the site is upstream of the salt wedge. At the site, the Willamette River is about 1500 feet wide, and the maximum depth is 55 to 65 feet below North American Vertical Datum (NAVD). The river depth ranges from 0 to +10 NAVD. Corps maps show deep slopes to the dredged navigational channel approximately 150 feet offshore of the site.

The Willamette River, from its mouth to Willamette Falls, is on the 1998 Oregon Department of Environmental Quality (DEQ) 303(d) list as water quality limited for: Temperature (summer), bacteria, biological criteria (fish skeletal deformities), and toxics (mercury in fish tissue). Results from DEQ ambient monitoring data indicate that 68% of the values at RM 7, and 61% of the values at RM 13.2 collected during the summer exceed the temperature standard of 68°F. Sediment conditions in the Willamette River watershed range from excellent in some of the upper tributaries to poor in much of the mainstem of the river (Altman *et al.* 1997). In the lower Willamette River, average turbidity levels tend to be higher in fall and winter. Monthly average turbidity ranges from 4-149 nephelometric turbidity units (NTUs).

In 1997, DEQ and the U.S. Environmental Protection Agency (EPA) took sediment samples within the Portland Harbor. The results of the study indicated that sediments in the harbor, including within the project area, contain concentrations of metals, PCBs, pesticides, herbicides, dioxins/furans, tributyltin (TBT), and polycyclic aromatic hydrocarbons (PAHs) above EPA contaminant guidelines. Cleanup of the contaminated sediments is presently being addressed under the Federal Superfund process. In addition, the skeletal deformities in fish upstream from

Willamette Falls suggest that there may also be chemical contamination upstream from the Portland Harbor area.

Habitat conditions within the lower Willamette River are also highly degraded. The streambanks have been channelized, off-channel areas removed, tributaries put into pipes, and the river disconnected from its floodplain as the lower valley was urbanized. Silt loading to the lower Willamette River has increased over historic levels due to logging, agriculture, road building, and urban and suburban development within the watershed. The river in the vicinity of the project site has a soft bottom, with little or no aquatic vegetation. Limited opportunity exists for large wood recruitment to the lower Willamette River due to the paucity of mature trees along the shoreline, and the lack of relief along the shoreline to catch and hold the material. The banks of the river in the action area are heavily industrialized, with much of the bank hardened with riprap, vertical concrete walls, and docking facilities. Much of the historic off-channel habitat has been lost due to diking and filling of connected channels and wetlands. Columbia Slough, a tributary within the action area, is the closest remaining off-channel habitat. Connections between the slough and the river have been cut off, and dikes have been constructed along much of the slough.

The Willamette River is tidally-influenced within the action area. Both juvenile and adult Chinook salmon, coho salmon, and steelhead use the project area as a migratory corridor and as rearing habitat for juveniles. Chum salmon juveniles may also be present in the lower Willamette River, but are rarely observed as far upstream as the McCormick and Baxter site.

The City of Portland and ODFW have recently completed a four-year study to evaluate relationships between fish communities and waterway development (ODFW 2005). Their data demonstrate that juvenile salmonids are present in the lower Willamette River nearly year-round. The abundance of all juvenile salmonids increased beginning in November, peaked in April, and declined to near zero by July. Some of the larger juveniles may spend extended periods of time in off-channel habitat. Mean migration rates of juvenile salmonids ranged from 2.7 km/day for steelhead to 8.6 km/day for subyearling Chinook salmon. Residence time in the lower Willamette River ranged from 4.9 days for Chinook to 15.8 days for steelhead. Catch rates of juvenile salmonids were significantly higher at sites composed of natural habitat (*e.g.*, beach, rock) and alcoves. Juvenile salmonids tended to move along the east or north bank of the river.

The results of this study demonstrate that the lower Willamette River is more than a simple migration corridor. Juvenile Chinook salmon feed and grow during their outmigration (ODFW 2005), and unaltered nearshore habitats appear to be important to smaller fish. Coho salmon also feed extensively on aquatic invertebrates, are associated with nearshore areas, and spend relatively long periods in the Portland Harbor area. Off-channel habitats are used by juvenile salmonids, and these fish are present for extended periods.

Habitat conditions at the project site were altered by operations at the McCormick and Baxter facility (contaminated sediments and groundwater), and by remedial actions to improve water quality in the river. Articulated concrete block covers approximately 15 acres of the nearshore habitat, and rock and gravel cover another 8 acres. Although EPA added some structure (rocks and wood), the site is relatively homogenous, has an abiotic substrate that limits feeding opportunities.

Finally, designated critical habitat within the action area includes the PCEs of migratory corridors and freshwater rearing. All ESA-listed steelhead and Chinook salmon (ocean-type and stream-type) must pass in the vicinity of the action area twice, once as juveniles en route to the Pacific Ocean and again as adults when they return to spawn. In addition, some juvenile salmonids travel slowly through the action area on their way to the ocean, actively feeding and growing.

Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Effects of the action that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

The proposed action is O&M of the soil cap, sediment cap, and groundwater remedy. Activities associated with the O&M of the soil cap and groundwater remedy are not expected to affect listed salmonids because no in-water work will occur, any sediment disturbance will be isolated to upland areas, and maintenance of facilities such as manholes and the stormwater conveyance will maintain water quality. The use of pesticides for vegetation maintenance was addressed in the 2004 Opinion. Therefore, the effects of O&M of the soil cap and groundwater remedy will not be addressed further.

Project activities for the O&M of the sediment cap will require in-water work. The in-water work period for this reach of the Willamette River is July 1 through October 31, and December 1 through January 31. The O&M activities will extend through September, 2011.

Predicted effects of the action include: (1) Water quality effects from a number of sources including release of NAPL and other contaminants, increased water temperatures, and increased turbidity; (2) effects to the prey base (benthic and planktonic invertebrates); (3) effects to benthic habitat; and (4) direct effects during in-water work.

Water Quality. The proposed action is reasonably certain to cause short-term degradation of water quality in the action area during the in-water work window when work will occur in the active channel. Water quality effects include increased turbidity associated with excavating in the sediments, deposition of new sediment cap material, setting the spuds on the barge, and movement of equipment. Repairs to the sediment cap may result in minor releases of NAPL to the river. These effects will be short-term (days), extending for the period that it takes to complete the repair. The proposed action is reasonably certain to maintain water quality over the long term because the action will repair the portion of the cap that is causing or the source of a contaminant release. Once the repair is complete, water quality will return to baseline conditions. In addition to these short-term effects, water temperatures in near shore habitats may be raised during the summer months because the area may be shallower than the existing condition.

Contaminant Exposure. These releases could occur if the spuds used to anchor barges are driven through the existing sediment cap and into highly contaminated sediments. Booms can be deployed to adsorb and contain the fraction of light weight NAPL (LNAPL) that floats, but the denser fraction (DNAPL) cannot be contained. The DNAPL would likely remain on the river bottom within the sediment cap repair area and would be subsequently capped with new capping material.

Polycyclic aromatic hydrocarbons (PAHs) are the primary component of the NAPL at the site. PAHs cause a variety of deleterious effects, such as cancer, reproductive anomalies, immune dysfunction, and growth and development impairment, to exposed fish (Johnson 2000, Johnson *et al.* 1999, Stehr *et al.* 2000). PAHs attached to sediment particles tend to drop out of the water column within a few hours, where as the dissolved phase contaminants can remain in solution for days, and tend to be more biologically available, and are toxic to juvenile salmonids and their prey base. Although PAHs generally do not generally bioaccumulate in fish or other vertebrates, the metabolites present in food are bioavailable to the consumer (James *et al*. 1991), and PAH-DNA adducts accumulate in the liver of fish chronically exposed to sediment-associated PAHs (Reichert *et a*l. 1998). Moreover, PAHs are capable of causing a variety of deleterious effects in exposed animals. While metabolism serves mainly as a pathway for detoxification for PAH, some of the metabolites that are intermediates in this process possess carcinogenic, mutagenic and cytotoxic activity. Based on recent research with English sole, a variety of effects resulting from PAH exposure include toxicopathic liver lesions, DNA adducts in liver, inhibited gonadal growth, inhibited spawning, reduced egg viability, and reduced growth (Johnson 2000). Releases of contaminants associated with O&M activities would contribute to sublethal effects to salmonids

The short-term degradation in water quality is reasonably certain to affect juvenile salmon rearing nearby, but the long-term effect for both juvenile and adult salmonids will be an improvement in water quality because the purpose of the O&M activities are to find and control ongoing releases of NAPL.

Turbidity. The proposed action will increase turbidity and associated suspended sediments due to the disturbance to the river bed during sediment, rock and concrete placement, during sediment cap excavation and when spud barges are deployed. The turbidity increases associated with the proposed action will be localized (within a few hundred meters on either side of the berth) and short-term (no longer than 4 weeks at a time). Turbidity plumes will be created when the spuds are deployed and retrieved. Barge movement will be minimized, so as to minimize the need to re-deploy the spuds. In all cases, turbidity concentrations will return to background during the night and on days when sediment-disturbing activities are not being conducted. Turbidity plumes will dissipate to background within the action area within a few hours of spud deployment and retrieval. Activities conducted during the winter are more likely to cause elevated turbidity concentration because higher flows tend to carry larger sediment particles, and carry all sediment sizes farther.

The effects of suspended sediment and turbidity on fish, as reported in the literature, range from beneficial to detrimental. Elevated total suspended sediment (TSS) conditions have been reported to enhance cover conditions, reduce piscivorus fish/bird predation rates, and improve survival. Elevated TSS conditions have also been reported to cause physiological stress, reduce growth, and adversely affect survival. Of key importance in considering the detrimental effects of TSS on fish are the frequency and the duration of the exposure, not just the TSS concentration. Turbidity increases associated with the proposed action will be moderate, and lethal concentrations will not occur. The NMFS is reasonably certain that the level of effect will be sublethal, and the type of effects expected are spawning delays, physiological stress and changes in behavior of juveniles migrating through the action area (harm).

Temperature. Repairs to the sediment cap may consist of additional armoring placement, additional organoclay capping along the beachfront, and additional organoclay capping in deep water. After construction, the site will be shallower in depth than the existing condition. During the summer months, this may result in localized increases in water temperature within the cap area. This increase in temperature would likely be measurable throughout the action area, but pockets of warmer water may induce avoidance behavior in juvenile salmonids migrating through the nearshore area of the site. This would most likely occur during the warmest summer months, when high temperatures are already a concern throughout the lower Willamette River.

Effects to Prey Base. Juvenile salmonids feed during their downstream migration in the lower Willamette River. A study looking at diet of juvenile salmonids in the lower Willamette River found that these fish were eating primarily pelagic invertebrates such as *Daphnia* sp. (ODFW 2005). In the same study, ODFW found that sites with riprap have a very high density of invertebrates, whereas beaches have high species diversity and taxa richness.

Short-term releases of contaminants and increases in turbidity are not likely to affect the prey base because the primary prey items are planktonic, and the area would be quickly recolonized from upstream areas. Laboratory studies have shown effects to *Daphnia pulex* after exposure to PAHs (Southworth *et al.* 1978) and effects to *Daphnia magna* after exposure to naphthalene (Whitman and Miller 1982). How these studies relate to the river environment and to invertebrate populations is not clear, and it is unlikely that changes in the pelagic community will be measurable because of flow-induced movements of these animals, and their transient presence in the action area.

Further, an increase in surface area of articulated concrete blocks or riprap would not affect the prey base for juvenile salmonids. Therefore, any releases of sediment and contaminants will be of short duration (days) and are not likely to affect the salmonid prey base. The importance of the site as a rearing area for juvenile salmonids is limited because of the lack of complex habitat, and the disturbance to the benthic community at the site by contaminant exposure likely will not alter feeding opportunities for salmonids in the river.

Therefore, O&M of the sediment cap is not reasonably certain to affect the prey base for juvenile salmonids.

Effects to Physical Habitat. The project site has low value as a feeding and resting area because of the paucity of complex habitat or flow refuge, although portions of Willamette Cove has some potential. Further, the availability of feeding and resting opportunities in the lower Willamette River is very rare because of industrial and urban development. As a consequence, any change in feeding and resting opportunities or quality in this reach becomes more important, despite the low quality of the baseline.

Any repairs to the sediment cap would require the placement of rock armoring or articulated concrete block. In most cases, the armoring would be similar to the existing armoring, although the size of the armoring will likely be increased if erosion of the existing armoring is discovered. Repairs to shoreline areas currently armored by concrete may be covered with riprap if these areas are inaccessible by construction vehicles.

Repairs to the sediment cap could increase the bottom elevation by a maximum of approximately 3 feet over the potential repair area of 300,000 square feet (maximum) along the shoreline or a maximum of 200,000 square feet in deeper water. More of the sediment cap would emerge as open beach earlier in the season, and more often in low water conditions than the existing condition. Because of the contours of the river bottom (gently sloped area and then a steep slope to the dredged navigation channel), the area of shallow water habitat could decrease significantly.

Effects on ESA-Listed Species

Effects to Individual Fish. Direct effects to listed fish are likely to occur during in-water work, during both the summer and winter in-water work windows. Wheeled vehicles, cranes and barges will be operating in the water, and movement of sediment and rock will occur. Any fish migrating through the project site has the potential to be directly affected either by equipment or by sediment or rock. However, more listed salmonids will be actively migrating through and rearing in the action area than during the summer work window (ODFW 2005). Further, higher background turbidity and less visibility render avoidance behaviors less successful. Therefore, if fish do not avoid the project area, they could be injured or killed by equipment. Adult salmonids are effective at moving away from disturbances, so direct effects are not expected for this life stage. However, juveniles are less effective at avoidance behaviors, and some injury and mortality is reasonably certain to occur. The potential for injury and mortality is greater during the winter work window when more fish are present.

Certain aspects of the proposed action are reasonably likely to affect listed salmonids in the action area. Water quality will be degraded during the in-water work period by deployment of spud barges and alterations to the cap. Juvenile Chinook salmon, steelhead, and coho salmon rearing in the action area are reasonably certain to alter essential behaviors (*e.g.*, avoid the area, delay migration), and suffer reduced fitness (*e.g.*, growth) as a result of exposure to contaminants suspended in the water column. Water quality degradation resulting from the proposed action is not likely to kill listed salmonids.

Effects to Fish Populations. The action area provides marginal habitat for rearing and migrating salmonids. The environmental baseline is degraded; water quality is poor and complex habitat required for juvenile resting and feeding is absent. Adult salmonids will be able to avoid the action area. Although individual juvenile fish will be affected and some mortality to this life stage is reasonably certain to occur, no effects on the population VSP characteristics (abundance, spatial structure, diversity and productivity) are likely. The effects are not important at the population scale because such a small proportion of the populations will be affected because the time scale for O&M activities is so short. The primary species using the area are juvenile Chinook and coho salmon and steelhead. Unfortunately, the Columbia Slough provides the only better feeding and resting habitat for these populations in the lower Willamette River system. While the proposed action will contribute to degraded water quality which is a factor limiting the recovery of the populations affected, the short-term nature of the effects (maximum of 4 weeks a year for activities that will cause take) will not be measurable at the population scale. Furthermore, no other limiting factors for the populations [hydrology, access, floodplain connectivity (NMFS 2005)] will be affected by the proposed action. Therefore, project effects are not likely to impede the survival or recovery of the affected populations.

Effects to the Fish Species. Since the proposed action is not likely to affect listed salmonids at the population scale, the proposed action is not likely to affect the listed species. Negative effects to the species presented in the Opinion (responses to increased concentrations of contaminants and turbidity, and disrupted passage) will be short-term and are unlikely to reach a level that will threaten short-term survival or contribute to the long-term risk of extinction for each species. A very small proportion of the total number of salmonids in each species will be affected by the short-term adverse effects of the action on rearing and migratory conditions. Those few fish could be exposed to additional stress caused primarily by reduced water quality, increased turbidity and impaired passage. Any stress experienced by those fish is likely to be brief (maximum of 4 weeks per year) and limited to the project reach and several hundred feet upstream and downstream from the in-water activities. The timing, frequency, intensity, and duration of these adverse effects will be not be felt by enough fish to produce an observable effect on the abundance, distribution, diversity, or productivity of these species.

Effects on Critical Habitat

Designated critical habitat within the action area for the ESA-listed salmonids considered in this Opinion consists of freshwater rearing sites and freshwater migration corridors and their essential physical and biological features as listed below. The effects of the proposed action on these features are summarized as a subset of the habitat-related effects of the action that were discussed more fully above. The water quality effects described will be short-term (maximum of four weeks per year) during in-water work.

Freshwater rearing sites

Water quantity – Project activities are not likely to affect water quantity or flows.

Floodplain connectivity – Floodplain connectivity is very poor in the project reach, and will not be changed by the proposed action.

Water quality – Significant but short-term effects to water quality will occur. Increases in turbidity and contaminants are likely during in-water work, but will dissipate at night and within 24 hours following sediment-disturbing activities. Increases in summer water temperatures in nearshore areas will occur at the reach scale, but effects are not expected to be

Forage – Project activities are unlikely to affect salmonids' forage.
Natural cover – There is no natural cover at the site, so the proposed action will not change the availability of natural cover.

Freshwater migration corridors
Free passage – Passage will be impeded along the east bank of the Willamette River by project activities (equipment movement, barge activity, sediment and rock placement, *etc*.). Project effects are likely to delay migration periodically for a period of hours, and will be limited to the duration of in-water work (maximum of 4 weeks per year).
Water quantity – This will not be changed by the proposed action.
Water quality – Significant, but short-term, increases in turbidity and contaminant concentrations are likely to impair or delay the movement of juvenile salmon through the project reach.
Natural cover – There is no natural cover in the project reach, so this will not be changed by the proposed action.

Information presented in the status and baseline sections, above show that poor conditions for rearing and migration are significant factors for the affected species. The effects of this action will lower the value of water quality and passage in the action area over the short term, but will not affect the conservation value of the action area over the long term. The conservation value of the watershed for the species is already very low and has low potential for improvement, either naturally or through active restoration, because of the industrialized and flow-regulated nature of this portion of the watershed. Although short-term effects are likely, the long-term effect of the proposed action on critical habitat PCEs is likely to be neutral. The current volume of water in the mainstem Willamette River will rapidly dilute contaminants and disperse turbidity to levels indistinguishable from the background. Thus, the proposed action will not appreciably reduce the conservation value of critical habitat.

Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

Between 1990 and 2000, the population of Multnomah County increased by 13.1%, and between 2000 and 2004, the population increased another 1.8%.[3] Thus, NMFS assumes that future private and state actions will continue within the action area, increasing as population density rises. As the human population in the action area continues to grow, demand for agricultural, commercial, or residential development is also likely to grow. Further, the Port of Portland has plans to further develop and maintain Port facilities, and the City of Portland is actively seeking new industrial clients in the port area. The effects of new development caused by that demand

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[3] U.S. Census Bureau, State and County Quickfacts, Multnomah County, http://quickfacts.census.gov/qfd/

are likely to further reduce the conservation value of the habitat within the action area and increase adverse effects on listed species.

Conclusion

After reviewing the status of the affected five listed species and designated critical habitats, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of the affected species and is not likely to destroy or adversely modify designated critical habitats for those species. These conclusions are based on the following considerations:

1. The action area provides marginal habitat for rearing and migrating salmonids because the environmental baseline is degraded, water quality is poor and complex habitat required for juvenile resting and feeding is absent.
2. Adult salmonids will be able to avoid the action area during in-water work.
3. Although individual juvenile fish will be affected and some mortality to this life stage is reasonably certain to occur, the timing, frequency, intensity, and duration of these adverse effects to water quality and passage will be not be felt by enough fish to produce an observable effect on abundance, distribution, diversity, or productivity at the population or species scale.
4. No other limiting factors for the populations (hydrology, access, floodplain connectivity) will be affected by the proposed action.
5. Therefore, project effects are not likely to impede the survival or recovery of the affected populations or species.
6. The effects of this action will lower the value of water quality and passage in the action area over the short term, but will not affect the conservation value of the action area over the long term.

Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) if new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that has an effect to the listed species or designated critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat is designated that may be affected by the identified action (50 CFR 402.16).

To reinitiate consultation, contact the Oregon State Office Habitat Office of NMFS and refer to NMFS No.: 2006/02218.

Incidental Take Statement

Section 9(a) (1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o) (2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Amount or Extent of Take

Activities necessary to complete the proposed activities will take place within and adjacent to the active stream channel of the Willamette River when juvenile and/or adult individuals of LCR Chinook salmon, UWR Chinook salmon, LCR coho salmon, LCR steelhead, and UWR steelhead are likely to be present. The activities will cause temporary increases in turbidity and contaminants, and a long-term increase in water temperature at the reach scale. These minor reductions in water quality are reasonably likely to injure or alter the essential migration behavior of some juvenile fish 100 feet upstream and downstream from the in-water activities.

Take caused by contaminant and turbidity exposure cannot be accurately quantified as a number of fish because the relationship between that exposure and the distribution and abundance of listed salmonids in the action area is imprecise. In such circumstances, NMFS uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance. Here, the best available indicators for extent of take may be duration of inwater activities and the turbidity that will be produced because these are proportional to the level of particulate contaminants, and therefore to the harm that will be caused by this action: (1) In-water activities for a total of 4 weeks per year; and (2) increased turbidity no greater than 10% above background at a distance of 100 feet from the in-water activities.

In the accompanying Opinion, NMFS determined that the amount and extent of incidental take associated with this activity is not likely to result in jeopardy to the species. Moreover, the habitat that will be affected is poor quality because of the existing level of contamination and degree of disturbance, and is not limited at the site-specific or watershed scale.

The duration of in-water activities and injury/death of steelhead, coho and Chinook salmon juveniles are thresholds for reinitiating consultation. Exceeding any of these limits will trigger the reinitiation provisions of this Opinion.

Reasonable and Prudent Measures

Reasonable and prudent measures are nondiscretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o) (2) to apply. The EPA has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if the EPA fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage will lapse.

Full application of conservation measures included as part of the proposed action, together with use of the reasonable and prudent measures and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of listed species due to completion of the proposed action.

The EPA shall:

1. Minimize incidental take from in-water work by modifying permitted activities to reduce the opportunity for fish exposure to turbidity and contaminants and increased water temperatures, and other activities that reduce the value of habitat in the project area.
2. Ensure completion of a monitoring and reporting program to confirm that the terms and conditions in this incidental take statement are effective in avoiding and minimizing incidental take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the EPA and its cooperators, including the permit applicant, must fully comply with conservation measures described as part of the proposed action and the following terms and conditions that implement the reasonable and prudent measures described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead NMFS to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of designated critical habitats.

1. To implement reasonable and prudent measure #1 (reduce exposure to contaminants and turbidity, effects caused by in-water work), the EPA shall:

    a. Deploy an absorptive boom in the water surrounding any activity that disturbs the sediment cap to capture contaminants that may be floating on the water surface as a consequence of all sediment-disturbing activities. The booms must be deployed prior to sediment cap disturbance.

    b. Limit in-water work to the summer in-water work window (July 1 through October 31) to avoid in-water work when higher densities of salmonids are in the project reach.

c. Minimize the amount of riprap added to the nearshore area, by first contacting NMFS prior to rock placement to determine if the placement of rock can be altered to minimize adverse affects to salmonids, and to determine if compensatory actions are necessary.

d. Prepare and carry out an erosion control plan that will be effective in limiting the movement of soil into the water.

e. Conduct work in the dry whenever possible. If water is less than 10 feet deep, use block nets or turbidity curtains to surround the work area, and remove all fish within the enclosure. Minimize the amount of time and movement of equipment in the water.

2. To implement reasonable and prudent measure #2 (monitoring), EPA shall ensure that the applicant completes the following:

   a. Turbidity Monitoring. If more than 2 cubic yards of clean sediment are being added to augment the sediment cap, then EPA will conduct turbidity monitoring two times per day during project activities (beginning at least two hours after project activities begin each day), and limit turbidity increases to 10% above background, as measured 100 feet upstream or downstream from the project activities, depending on the direction of the tide. Quantitative monitoring is required.

   b. Salvage Notice. If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify NMFS Law Enforcement at 1-800-853-1964. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

   c. Report or Memo To File. Within 60 days of project completion, the applicant will submit a report or memo to the NMFS Oregon State Habitat Office with the following information:

      i. Start and end dates for work completed, and number of days with equipment in the water.

      ii. The following data.

         (1) Pollution control. A summary of pollution and erosion control inspections, including any turbidity control failure or releases of any kind into the Columbia River.

         (2) In-water Work. Provide information on the number of days of in-water work. Take photographs of equipment working in water shallower than 10 feet.

         (3) Number, species and size of any salmonids killed in the vicinity of the project.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirement of section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook salmon, and coho salmon.

Based on information provided in the BA and the analysis of effects presented in the ESA portion of this document, NMFS concludes that proposed action will have the following adverse effects on designated EFH:

1. Freshwater rearing habitat will be affected by significant, but short-term adverse effects to water quality. Periodic increases in turbidity and contaminants are likely during in-water work, but will dissipate at night and within 24 hours following sediment disturbing activities.
2. Freshwater migration habitat will be affected by significant, but short-term increases in turbidity and contaminant concentrations that are likely to impair or delay the movement of juvenile salmon through the project reach.

EFH Conservation Recommendations

The NMFS believes that the following four conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. These conservation recommendations are a non-identical set of the ESA Terms and Conditions.

1. Absorptive Boom. The applicant should deploy an absorptive boom in the water to capture contaminants that may be floating on the water surface during any of the following activities: removing or moving sediment in the sediment (not including coring activities), lifting or moving any articulated concrete blocks.
2. Turbidity Control and Monitoring. If more than 2 cubic yards of clean sediment are being added to augment the sediment cap, then the applicant should conduct turbidity monitoring two times per day during project activities (beginning at least 2 hours after project activities begin each day), and limit turbidity increases to 10% above background, as measured 100 feet upstream or downstream from the project activities, depending on the direction of the tide. Quantitative monitoring is required. If the monitoring indicates

that turbidity is greater than 10% above background, then the applicant shall implement conservation measures to ensure this exceedance is not repeated. Conservation measures include working slower and/or deployment of a sediment curtain.

3. Installation of Riprap. If EPA deems it necessary to add riprap to the cap, they shall first contact NMFS to minimize adverse affects to salmonids and to determine if compensatory actions are necessary.
4. Report or Memo To File. Within 60 days of project completion, the applicant will submit an annual report or memo to the NMFS Oregon State Habitat Office with the following information:
    a. Start and end dates for work completed.
    b. The following data:
        i. Pollution control. A summary of pollution and erosion control inspections, including any turbidity control failure or releases of any kind into the Columbia River. Turbidity can be monitored visually.
        ii. In-water Work. Provide information on the number of days of in-water work and describe the activity conducted.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations [50 CFR 600.920(j) (1)]. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects of the activity on EFH. If the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

Supplemental Consultation

The EPA must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(k)].

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users.

This ESA consultation concludes that the proposed operation and maintenance of the clean-up remedy at the McCormick and Baxter site will not jeopardize the affected listed species. Therefore, the EPA can authorize this action in accordance with its authority under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act. The intended users are the EPA and DEQ.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq.*, and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No.:
2006/02218

June 12, 2007

DEPT OF ENVIRONMENTAL QUALITY
RECEIVED
JUN 18 2007
NORTHWEST REGION

Nancy Harney
Project Manager
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101
Attn: ECL-111

Re: Amendment to the October 6, 2006, Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Act Essential Fish Habitat Consultation for the Operation and Maintenance of the Soil Cap, Sediment Cap and Groundwater Remedy at the McCormick and Baxter Creosoting Company Superfund Site, Willamette River (HUC 170900120301), Multnomah County, Oregon

Dear Ms. Harney:

On October 6, 2006, the National Marine Fisheries Service (NMFS) transmitted to the U.S. Environmental Protection Agency (EPA) our biological opinion (Opinion) and essential fish habitat consultation under the Magnuson-Stevens Fishery Conservation and Management Act for the operation and maintenance of the soil cap. sediment cap and groundwater remedy at the McCormick and Baxter Creosoting Company Superfund Site, at river mile 7 on the Willamette River in the Portland Harbor (refer to NMFS No.: 2006/02218). The site is a Federal Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The cleanup remedies were implemented through 2005, and the 2006 Opinion provides for the operation and maintenance of the 34-acre upland soil cap, the 23-acre sediment cap in the Willamette River, and groundwater remediation activities through September 2011. This program is being implemented by the Oregon Department of Environmental Quality (DEQ).

The 2006 Opinion specifies terms and conditions for a variety of planned activities as well as several hypothetical repair scenarios of the sediment cap. Since issuance of the Opinion, DEQ has identified need to place additional rock armoring at three locations over the sediment cap. To accomplish this, DEQ is requesting variances for two terms and conditions specified in the 2006 Opinion.

The NMFS received a request from EPA and DEQ to modify Term and Condition 1(a) of the 2006 Opinion. This Term and Condition requires the use of an absorptive boom in the water surrounding any activity that disturbs the sediment cap to capture contaminants that may be floating on the water as a consequence of sediment-disturbing activities. The booms must be deployed prior to sediment cap disturbance. The EPA states that boom deployment is unnecessary because of the low probability of contaminant release because the volume of rock to be placed is very small. Additionally, boom deployment would be difficult and costly.

The NMFS, at this time, cannot approve the request to modify Term and Condition 1(a). The materials supplied to NMFS with the request for variance did not provide information or data to support the low probability of contaminant release. Therefore, reinitiation of consultation would be required to fully evaluate the effects of non-deployment of the booms.

Secondly, NMFS received a request from EPA and DEQ to modify Term and Condition 1(b) that limits in-water work to the summer in-water work window of July 1 through October 31 to avoid in-water work when high densities of salmonids are expected to be in the project reach. The EPA is requesting that NMFS allow in-water work to begin on June 25, 2007. The EPA and DEQ supplied Oregon Department of Fish and Wildlife data on daily average (2003 through 2006) counts of adult Chinook salmon and steelhead. Fish counts, based on the data supplied, are substantially similar on July 1 and June 25. Therefore, the effect of the action on listed salmonids is identical to the effects described in the Opinion, and the conclusion that the proposed action is not likely to jeopardize the continued existence of the ESA-listed salmonids.

The NMFS concludes that with the change to the in-water work timing, the conclusion and the amount and extent of take in the Opinion are still valid. Further, NMFS concludes that Term and Condition (b) is amended as follows, with double underline indicating added text:

1. To implement Reasonable and Prudent Measure #1 (reduce exposure to contaminants and turbidity, effects caused by in-water work), the EPA shall:
    b. Limit in-water work to the summer in-water work window (July 1 though October 31) to avoid in-water work when higher densities of salmonids are in the project reach. However, a one-time exception will be made in 2007 to allow the DEQ to enter the water beginning June 25th.

So, in final format, Term and Condition 1(b) is amended to read as follows:

1. To implement Reasonable and Prudent Measure #1 (reduce exposure to contaminants and turbidity, effects caused by in-water work), the EPA shall:
    b. Limit in-water work to the summer in-water work window (July 1 though October 31) to avoid in-water work when higher densities of salmonids are in the project reach. However, a one-time exception will be made in 2007 to allow the DEQ to enter the water beginning June 25th.

All other terms and conditions in the 2006 Opinion are unchanged. A copy of this letter will be posted with the Opinion on NMFS' website. If you have any questions regarding this amendment or the Opinion, please contact Dr. Nancy Munn in the Willamette Basin Habitat Branch of the Oregon State Habitat Office at 503-231-6269.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Kevin Parrett, DEQ
John Montgomery and Eric White, Ecology & Environment, Inc.

APPENDIX J
IDW MANAGEMENT PLAN

APPENDIX J
Investigation-Derived Waste Management Plan

This appendix presents the steps that will be utilized by the Oregon Department of Environmental Quality (DEQ) and DEQ's contractors to characterize, manage, and dispose of investigation-derived wastes (IDW) generated during field activities at the former McCormick & Baxter (M&B) Creosoting Company site (the "Site"). IDW generated during the project will be handled in accordance with applicable federal, state, and local regulations. The IDW generated during the field activities is expected to include soil cuttings, purged water, decontamination fluids, personal protective equipment (PPE), disposable sampling equipment, and trash. Waste minimization techniques will be employed where possible to reduce the quantity of IDW generated.

Site Background

The site includes the former M&B wood-treating facility located on the east bank of the Willamette River at 6900 N Edgewater Avenue in Portland, Oregon. The site sits on a terrace of dredge sand fill within the historic flood plain of the Willamette River and encompasses 40.1 acres of land and an additional 23 acres of contaminated river sediments. The University of Portland property borders the site to the southeast which is currently vacant with future plans of sports fields, and a residential area located above the site on the adjacent bluff. A BNSF Railway Company (BNSF) railroad track crosses the northwest portion of the site and Union Pacific Railroad tracks border the site to the southeast below the bluff. The site is currently vacant except for a paved parking area, small shop building, and associated utilities. The perimeter of the M&B property is fenced and posted with warning signs.

The site was created by the placement of dredged material in the early 1900's when a sawmill operated on the southeast portion of the property. M&B Creosoting Company began in 1944 and produced treated wood products, including lumber, piling, timbers, and railroad ties and continued operation until October 1991. Subsequent site investigations identified releases of wood-treating chemical compounds to soil, groundwater, and sediment as a result of these operations. Chemicals of interest (COIs) detected at the site include polycyclic aromatic hydrocarbons (PAHs, comprising 85 percent of the creosote), pentachlorophenol (PCP), arsenic, chromium, copper, zinc, and dioxins/furans. Additionally, remedial investigations identified two large non-aqueous phase liquid (NAPL) plumes migrating west to the river and affecting surface water and sediments. Remedial construction took place between 1996 and 2005 and included construction of a subsurface barrier wall to control NAPL migration from the site to river sediment, a sediment cap in the Willamette River, as well as placement of an upland soil cap.

IDW TYPES

To handle IDW properly, field personnel must determine the types (e.g., soil or decontamination fluids), the characteristics (type and magnitude of COI), and quantities of anticipated wastes. Besides inspection of IDW for contamination (e.g., creosote sheen), analytical results on samples associated with or obtained from the IDW can be used to evaluate containerized wastes. The following types of IDW are generated at the site on an infrequent basis.

Soil and Sediment

In general, subsurface soils and sediment samples collected from beneath the engineered cap are expected to be contaminated with site-related COIs, and should be considered a hazardous waste and properly managed. Material collected from the clean engineered cap may be non-hazardous, pending laboratory analysis.

Groundwater

Groundwater collected during purging and monitoring activities are likely affected by site-related COIs, and should be considered a hazardous waste and properly managed.

Decontamination Fluids

Decontamination fluids are used to clean the sampling equipment between sampling stations. These typically include a non-phosphate detergent (e.g., Alconox®), 10 percent nitric acid, isopropyl alcohol, and deionized water. In some instances, hexane may be used to clean creosote-contaminated equipment. Decontamination fluids should be considered hazardous and properly managed. Small quantities of decontamination fluids may be added to containers of dry soil for off-site shipment and disposal.

Disposable Equipment

Disposable equipment includes plastic bags, plastic bailers, aluminum foil, and plastic bags. Unless grossly contaminated, disposable equipment will be bagged as solid waste at the end of each workday and disposed of as municipal waste. If grossly contaminated, the PPE will be included with other contaminated media for off-site shipment and disposal.

Personal Protective Equipment

PPE IDW that will require disposal includes gloves, Tyvek (if used), and respirator cartridges. Unless grossly contaminated, PPE will be bagged as solid waste at the end of each workday and disposed of as municipal waste. If grossly contaminated, the PPE will be included with other contaminated media for off-site shipment and disposal.

IDW MANAGEMENT

Containerization, Temporary storage, and Labeling

Department of Transportation (DOT)-approved storage containers will be used for the different types of IDW generated at the site. When applicable, IDW will be containerized at the moment of generation in the appropriate storage container and transported to the covered drum storage area located near the entrance of the site.

Each container will be labeled as "Hazardous Waste," preferably with a vinyl pre-printed label, with the following minimum information:

- Generator information, including name, address, city, state, and zip code;
- Composition and physical state of the waste (i.e., soil drill cuttings from EW-20);

- EPA Generator ID Number (ORD089452353);
- Accumulation start date; and
- Contact telephone number and company name.

PPE and disposable equipment will be bagged as solid waste at the end of each workday and disposed of as municipal waste.

IDW determined to be hazardous waste must generally be transported off-site for disposal within 90 days if more than 2,200 pounds (approximately five drums) is generated in a month; if less, than disposal should occur within 180 days. Solid waste (e.g., PPE) should be removed from the site on a daily basis when feasible.

Characterization and Profiling

The majority of waste generated at the site has been previously classified as listed waste (i.e., F032/ F034/F035) based on the historic manufacturing and industrial process used. Listed wastes may further be restricted by Land Disposal Restrictions, based on contaminant concentrations. Unless documented by the DEQ as non-hazardous, all contaminated IDW should be handled, manifested, transported, and disposed of as a listed hazardous material in accordance with local, state, and federal regulations.

To the extent possible, existing waste profiles will be used to facilitate transport and off-site disposal. If profiling is required for a new waste stream, or the profile requires renewal, DEQ or DEQ’s contractor will coordinate with the Treatment, Storage, and Disposal Facility (TSDF) to select the appropriate laboratory methods for the IDW. The laboratory methods will differ depending on the type of IDW, but may include the following types of analysis:

- Leachable Resource Conservation and Recovery Act (RCRA) 8 metals by the Toxicity Characteristic Leaching Procedure per Environmental Protection Agency (EPA) Methods 1311/6200;
- PAHs and PCP by EPA Method 8270-SIM;
- Dioxin and furans by EPA Method 8290; and
- Paint filter test

If sampling is required, a representative sample of the IDW will be collected from the actual container(s) with the IDW. A composite sample may be collected from multiple sample containers with similar characteristics. All sampling will be performed in accordance with previously established sampling, sample handling, and chain of custody protocols for the site.

Off-Site Disposal of IDW

Following final determination of the characteristics of the IDW, off-site disposal of IDW will be arranged in a manner appropriate to its classification. In general, off-site disposal of hazardous waste includes the following activities:

- Procurement of transportation and disposal contractor(s);
- Completion of forms and profiles, as appropriate for each disposal facility;
- Completion of manifests;

- Transportation and disposal of the wastes;
- Documentation of disposal activities; and
- Compilation of disposal certificates from the TSDF.

Approval to accept the IDW will be required from each facility selected to receive IDW and must be obtained prior to shipment of wastes from the site. Should disposal become an issue, alternate disposal and/or contamination reduction will be discussed with the DEQ to determine potential disposal options.

Contractor Procurement and Manifests

Subsequent to TSDF approval, contracting arrangements will be made facilitate off-site transportation and disposal of the IDW. Preparation of manifests and associated forms will be performed by DEQ's contractor. DEQ, as the generator of the hazardous IDW, should sign all manifests when complete. Alternatively, DEQ's contractor may sign the manifest if authorized as an agent in writing. Copies of the manifests and associated forms will be maintained in the project files.

Transportation and Disposal of Wastes

Solid and liquid IDW wastes will be disposed at selected facilities based on the IDW classification. The following TSDF, located nearest the site, is an example of a facility that can accept various classes of IDW:

Chemical Waste Management of the Northwest, Inc.
17629 Cedar Springs Lane
Arlington, OR 97812

Transportation of IDW from the site to the selected TSDF will be performed by the selected disposal facility or by appropriately licensed, hazardous waste transporters.

Reporting

DEQ, as the generator of IDW, will identify the appropriate Hazardous Waste Generator status and report required information to DEQ's Hazardous Waste Program by March 1 of the following year.

APPENDIX K
WELL LOGS AND CONSTRUCTION DETAILS

Table K-1: Well Construction Details
McCormick & Baxter Superfund Site
Portland, Oregon

	Historic Well Construction Details							Historic Elevations							Current Elevation		
Well ID	Date	Northing (NAD 83)	Easting (NAD 83)	Company[1]	Casing Diameter (inches)	Well Casing Material	Well Total Depth (ft bgs)	Original Ground Surface Elevation (NAVD 88)	Original TOC Elevation (NAVD 88)	Original Top of Screen Elevation (NAVD 88)	Original Bottom of Screen Elevation (NAVD 88)	Screen length (ft)	2005 Post-Soil Cap TOC Elevation[2] (NAVD 88)	2009 Survey TOC Elevation[3] (NAVD 88)	2019 Survey TOC Elevation (NAVD 88)	2019 Top of Screen Depth (ft BTOC)	2019 Bottom of Screen Depth (ft BTOC)
EW-1s	10/1/87	704959	7628491	CH2M	4	--	--	34.3	36.3	--	--	--	41.4	40.10	39.54	--	--
EW-2s	10/1/87	705094	7627502	--	4	--	44.3	--	--	--	--	--	--	42.40	42.40	--	--
EW-8s	9/1/92	704745	7628411	PTI	4	SS	49.7	35.7	39.5	7.8	-12.2	20	40.6	40.48	40.55	32.75	52.75
EW-10s	9/21/92	705019	7627441	PTI	4	SS	37.5	24.2	26.4	8.7	-11.3	20	29.5	29.43	29.59	20.89	40.89
EW-15s	11/5/93	704997	7627661	PTI	4	SS	47.3	41.5	40.3	16.4	-3.6	20	43.1	43.01	43.00	26.60	46.60
EW-18s	11/17/93	704808	7628372	PTI	4	SS	40.8	36.5	38.9	18.2	-1.8	20	40.8	40.74	40.79	22.59	42.59
EW-19s	03/94 - 09/98	704988	7627434	--	4	--	--	19.7	22.7	--	--	--	26.1	25.94	25.97	--	--
EW-23s	9/21/98	704967	7627620	E & E, Inc	4	SS	38	36.6	37.7	18.1	-1.9	20	38.6	37.61	37.64	19.54	39.54
MW-1r	6/21/05	705982	7628316	E & E, Inc	4	SS	52.5	38.3	--	--	--	--	38.2	37.63	37.81	--	--
MW-7 WC	--	705680	7627691	--	--	--	--	--	--	--	--	--	36.7	36.69	--	--	--
MW-10r	6/27/05	705060	7628301	E & E, Inc	2	SS	35	--	--	--	--	--	42	41.85	41.85	--	--
MW-15s	2/4/91	705106	7627860	PTI	2	SS	32	36.7	38.3	26.0	6.0	20	43.3	43.25	43.41	17.41	37.41
MW-17s	1/25/91	704937	7627780	PTI	2	SS	35.9	36.8	39.8	22.2	2.2	20	41.4	41.25	41.34	19.14	39.14
MW-20i	1/3/91	705078	7627478	PTI	2	SS	70.7	37.2	37.7	-12.0	-32.0	20	41.6	41.44	41.72	53.72	73.72
MW-22i	6/26/91	705058	7628290	PTI	4	SS	52.8	35.0	37.3	-6.4	-16.4	10	42.4	42.28	42.34	48.74	58.74
MW-23d	7/22/91	704958	7628502	PTI	4	SS	182.2	34.1	36.2	-136.3	-146.3	10	41.7	41.06	40.81	177.11	187.11
MW-32i	12/23/93	705699	7628563	PTI	4	SS	60.3	36.8	36.7	-11.2	-21.2	10	37.4	39.34	39.45	50.65	60.65
MW-34i	12/16/93	705030	7627454	PTI	4	SS	77.2	31.3	27.1	-30.5	-50.5	20	32.8	32.66	32.82	63.32	83.32
MW-35r	6/27/05	705413	7627534	E & E, Inc	2	SS	41.5	32.4	--	--	--	--	32.3	32.27	--	--	--
MW-36d	9/15/03	704977	7627503	E & E, Inc	2	SS	80.5	23.2	25.8	-51.7	-56.7	5	30.5	30.45	30.59	82.29	87.29
MW-36i	9/15/03	704979	7627498	E & E, Inc	2	SS	46.5	23.3	26.0	-17.7	-22.7	5	30.3	30.18	30.30	48.00	53.00
MW-36s	9/15/03	704990	7627492	E & E, Inc	2	SS	22.5	24.2	27.0	17.2	2.2	15	30.8	30.74	30.62	13.42	28.42
MW-37d	9/16/03	704952	7627493	E & E, Inc	2	SS	75.5	18.2	20.7	-51.8	-56.8	5	26.2	26.05	26.19	77.99	82.99
MW-37i	9/16/03	704956	7627487	E & E, Inc	2	SS	40.5	18.3	21.0	-16.7	-21.7	5	26	25.88	26.07	42.77	47.77
MW-37s	9/16/03	704959	7627481	E & E, Inc	2	SS	22.5	18.5	21.2	11.5	-3.5	15	25	24.86	24.98	13.48	28.48
MW-38d	9/15/03	704906	7627709	E & E, Inc	2	SS	80.5	23.7	26.4	-51.3	-56.3	5	31.9	31.84	31.96	83.26	88.26
MW-38i	9/15/03	704905	7627713	E & E, Inc	2	SS	45.5	23.7	26.5	-16.3	-21.3	5	32.2	32.06	32.15	48.45	53.45
MW-38s	9/15/03	704904	7627717	E & E, Inc	2	SS	22.5	23.8	26.5	16.6	1.6	15	32.4	32.31	32.41	15.81	30.81
MW-39d	9/11/03	704895	7627709	E & E, Inc	2	SS	80.5	23.2	26.0	-51.8	-56.8	5	29.9	29.83	29.93	81.73	86.73
MW-39i	9/10/03	704893	7627714	E & E, Inc	2	SS	45.5	23.0	25.8	-17.0	-22.0	5	30.2	30.08	30.18	47.18	52.18
MW-39s	9/10/03	704894	7627720	E & E, Inc	2	SS	22.5	22.6	25.5	15.6	0.6	15	29.9	29.75	29.88	14.28	29.28
MW-40d	9/8/03	704794	7627900	E & E, Inc	2	SS	80.5	23.9	26.5	-51.1	-56.1	5	29	28.67	28.81	79.91	84.91
MW-40i	9/9/03	704796	7627895	E & E, Inc	2	SS	46.5	24.0	26.7	-17.0	-22.0	5	28.5	28.73	28.92	45.92	50.92
MW-40s	9/9/03	704796	7627892	E & E, Inc	2	SS	22.5	24.1	26.9	17.1	2.1	15	28.4	28.33	28.53	11.43	26.43
MW-41d	9/9/03	704784	7627897	E & E, Inc	2	SS	80.5	22.6	25.5	-52.4	-57.4	5	27.5	27.43	27.56	79.96	84.96
MW-41i	9/10/03	704783	7627892	E & E, Inc	2	SS	46.5	22.7	25.5	-18.3	-23.3	5	27.2	27.1	27.22	45.52	50.52
MW-41s	9/10/03	704787	7627890	E & E, Inc	2	SS	22.5	22.9	25.7	15.9	0.9	15	27.5	27.78	27.96	12.06	27.06
MW-42d	9/19/03	704796	7628031	E & E, Inc	2	SS	92.5	35.8	38.5	-51.2	-56.2	5	32.2	32.2	32.26	83.46	88.46
MW-42i	9/19/03	704799	7628036	E & E, Inc	2	SS	57	35.8	38.5	-15.7	-20.7	5	32.7	32.67	32.67	48.37	53.37
MW-42s	9/18/03	704803	7628041	E & E, Inc	2	SS	30.5	35.8	38.5	20.9	5.9	15	32.4	32.37	32.42	11.52	26.52
MW-43d	9/17/03	704770	7628040	E & E, Inc	2	SS	92	34.6	37.0	-51.9	-56.9	5	28.4	28.33	28.57	80.47	85.47
MW-43i	9/17/03	704778	7628042	E & E, Inc	2	SS	57	34.6	37.2	-16.9	-21.9	5	30.4	30.31	30.49	47.39	52.39
MW-43s	9/18/03	704786	7628045	E & E, Inc	2	SS	30.5	34.6	37.4	19.6	4.6	15	31.1	31.05	31.24	11.64	26.64
MW-44d	9/4/03	704664	7628380	E & E, Inc	2	SS	81.5	23.9	26.4	-52.1	-57.1	5	29.4	29.64	29.55	81.65	86.65
MW-44i	9/5/03	704661	7628383	E & E, Inc	2	SS	46.5	23.8	26.6	-17.2	-22.2	5	29.6	29.31	29.47	46.67	51.67

Table K-1: Well Construction Details
McCormick & Baxter Superfund Site
Portland, Oregon

	Historic Well Construction Details							Historic Elevations							Current Elevation		
Well ID	Date	Northing (NAD 83)	Easting (NAD 83)	Company[1]	Casing Diameter (inches)	Well Casing Material	Well Total Depth (ft bgs)	Original Ground Surface Elevation (NAVD 88)	Original TOC Elevation (NAVD 88)	Original Top of Screen Elevation (NAVD 88)	Original Bottom of Screen Elevation (NAVD 88)	Screen length (ft)	2005 Post-Soil Cap TOC Elevation[2] (NAVD 88)	2009 Survey TOC Elevation[3] (NAVD 88)	2019 Survey TOC Elevation (NAVD 88)	2019 Top of Screen Depth (ft BTOC)	2019 Bottom of Screen Depth (ft BTOC)
MW-44s	9/5/03	704660	7628380	E & E, Inc	2	SS	23	23.7	26.5	16.0	1.0	15	29.7	29.57	29.90	13.90	28.90
MW-45d	9/8/03	704653	7628374	E & E, Inc	2	SS	81.5	22.9	25.4	-53.1	-58.1	5	27.9	27.88	28.12	81.22	86.22
MW-45i	9/5/03	704650	7628378	E & E, Inc	2	SS	45.5	22.9	25.5	-17.1	-22.1	5	28.1	27.99	28.05	45.15	50.15
MW-45s	9/8/03	704656	7628370	E & E, Inc	2	SS	23	22.9	25.9	15.4	0.4	15	28.2	28.17	28.20	12.80	27.80
MW-46s	9/10/03	704542	7628640	E & E, Inc	2	SS	31	34.8	37.7	19.3	4.3	15	35.6	35.51	35.51	16.21	31.21
MW-47s	9/10/03	704518	7628670	E & E, Inc	2	SS	31	35.4	38.2	19.9	4.9	15	35.6	35.50	35.56	15.66	30.66
MW-48s	9/10/03	704839	7628917	E & E, Inc	2	SS	31	33.5	36.5	18.1	3.1	15	39	38.68	38.58	20.48	35.48
MW-49s	9/10/03	704843	7628952	E & E, Inc	2	SS	31	32.9	35.6	17.4	2.4	15	37.8	37.55	37.61	20.21	35.21
MW-50s	9/10/03	705105	7628650	E & E, Inc	2	SS	31	34.8	37.7	19.3	4.3	15	39.5	39.25	39.12	19.82	34.82
MW-51s	9/10/03	705132	7628668	E & E, Inc	2	SS	31	35.4	38.2	19.9	4.9	15	39.7	39.53	39.54	19.64	34.64
MW-52s	9/9/03	705343	7628358	E & E, Inc	2	SS	36.1	35.8	38.5	15.2	0.2	15	40.8	40.7	40.70	25.50	40.50
MW-53s	9/9/03	705369	7628377	E & E, Inc	2	SS	36.1	35.7	38.6	15.1	0.1	15	40.6	40.44	40.42	25.32	40.32
MW-54s	9/9/03	705502	7628001	E & E, Inc	2	SS	31	36.5	39.3	21.0	6.0	15	41.9	41.78	41.78	20.78	35.78
MW-55s	9/9/03	705535	7627995	E & E, Inc	2	SS	31	36.2	39.0	20.7	5.7	15	41.1	41.04	41.09	20.39	35.39
MW-56s	9/9/03	705237	7627721	E & E, Inc	2	SS	31	37.1	39.9	21.6	6.6	15	43.5	43.49	43.45	21.85	36.85
MW-57s	9/9/03	705260	7627697	E & E, Inc	2	SS	31	36.9	39.8	21.4	6.4	15	42.1	42.04	42.01	20.61	35.61
MW-58d	10/24/03	705245	7627399	E & E, Inc	2	SS	89.6	41.5	41.4	-43.1	-48.1	5	41.4	41.43	NS	84.53	89.53
MW-58i	10/27/03	705251	7627404	E & E, Inc	2	SS	55	40.8	41.0	-8.7	-13.7	5	41	40.99	NS	49.69	54.69
MW-58s	10/27/03	705248	7627409	E & E, Inc	2	SS	36	41.2	41.5	21.2	6.2	15	41.5	41.51	NS	20.31	35.31
MW-59s	6/23/05	704343	7628993	E & E, Inc	2	PVC	35	34.1	--	19.1	-0.9	20	35.8	35.9	35.85	16.75	36.75
MW-60d	6/29/05	705063	7627500	E & E, Inc	4	SS	115	34.7	--	-45.3	-65.3	20	40.2	40.05	40.18	85.48	105.48
MW-61s	6/22/05	705899	7628177	E & E, Inc	2	SS	36.5	38.8	--	23.8	3.8	20	43.7	43.61	43.65	19.85	39.85
MW-62i	6/23/05	705005	7627616	E & E, Inc	4	SS	61.5	40.2	--	-9.8	-19.8	10	42.7	42.61	42.73	52.53	62.53
MW-As	9/28/83	705707	7628569	AqRes	2	PVC	27	37.0	38.2	14.8	9.8	5	39.3	39.27	39.32	24.52	29.52
MW-Ds	9/28/83	705114	7627527	AqRes	2	PVC	32	37.7	40.4	10.3	5.3	5	43	42.9	43.26	32.96	37.96
MW-Gs	7/10/84	705067	7627481	CH2M	2	GS	39.5	35.4	36.1	17.5	-2.5	20	40.3	40.17	40.27	22.77	42.77
MW-Os	8/1/85	705282	7628858	CH2M	2	GS	41	36.1	38.1	23.6	1.6	22	41	40.93	40.96	17.36	39.36
PW-1d	9/29/45	705509	7628697	RJ Strasser	12	--	130	36.3	39.7	-28.4	-87.4	59	44.1	44.02	44.05	72.45	131.45
PW-2d	2/15/68	705277	7628846	RJ Strasser	12	--	95	35.7	39.3	-35.0	-55.0	20	41.9	41.79	41.83	76.83	96.826

Abbreviations:
BTOC = below top of casing
BGS= Below Ground Surface
ft = feet
GS = galvanized steel
NAD 83 = North American Datum 1983
NAVD 88 = North American Vertical Datum 1988
PVC = polyvinyl chloride
SS = stainless steel
TOC = top of casing
-- = Data not available

Notes:
1. Company with oversite on well installation.
2. Many of the well casings were cut or expanded to account for placement of the upland soil cap in 2005. Value shown reflects the post-cap construction top of casing elevations.
3. The measuring point elevations were re-surveyed by in 2008 due to subsidence observed in the vicinity of EW-1s. Select wells were resurveyed again in 2009 and those elevations are presented in this table.

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ENVIRONMENTAL SERVICES

WELL EW-8

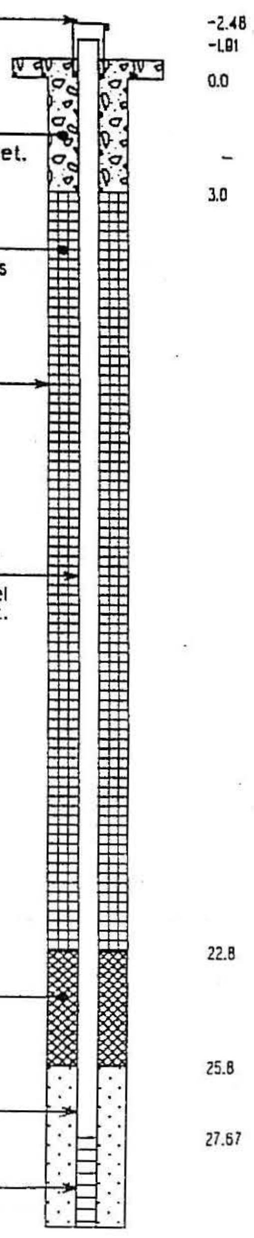
PAGE 1 OF 3

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421614
GEOLOGIST/ENGINEER BEESON, CHASE
DRILLING CONTRACTOR GEOTECH EXPL.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 64.5 FEET
DATE (s) DRILLED 8/31-9/1/92
COORDINATES
WELL CASING ELEVATION
SURFACE PAD ELEVATION
TOTAL WELL CASING LENGTH 52.00 FEET

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
0					SP	Poorly graded SAND, 30% fine sand, 70% medium sand, dark brown, loose to medium dense, dry to wet, no odor or sheen.
5	0	89	4 6 7			transition to moist
10	0	89	5 9 13			
15	0	100	4 12 16			
20	0	100	7 11 17			
25	0	100	5 11 13		∇	Water level at 25.0 feet 8/31/92.
30						

CONSTRUCTION DETAILS



LOCKING WELL COVER
Stickup measured from top of 5-inch-thick concrete pad.

SURFACE SEAL
4 bags concrete 0.0 to 3.0 feet.

ANNULAR SEAL
9x50# bags bentonite grout as slurry 3.0 to 22.8 feet.

BOREHOLE
12-inch O.D. (8-inch I.D.) hollow stem auger 0.0 to 63.0 feet; 2.5-inch O.D. 63.0 to 64.5 feet.

WELL CASING
4-inch diameter stainless steel (type 403) -1.91 to 27.67 feet.

ANNULAR SEAL
3x50# bags medium bentonite chips 22.8 to 25.8 feet.

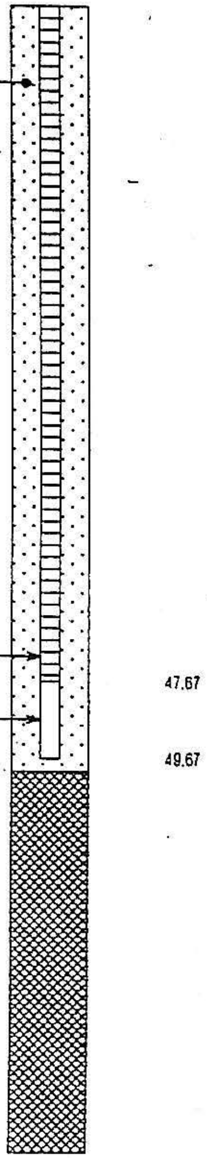
CENTRALIZER
Placed at 27.0 feet.

WELL SCREEN
0.020-inch stainless steel wirewrap 27.67 to 47.67 feet.

WELL EW-8

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
30	8.2	89	5 11 14	SP	color change to very dark gray, light odor and no sheen
35	126	100	4 7 11		strong odor and heavy sheen, saturated with creosote-like liquid
				ML	Sandy SILT, 70% silt, 30% fine sand, very dark gray, moist.
40	25	100	2 2 4		
				SP	Poorly graded SAND, medium sand, very dark gray, light odor, no sheen.
	133	89	4 6 13	ML	SILT, very dark gray, saturated with creosote-like liquid.
				SP	Poorly graded SAND, 80% medium sand, 20% fine sand, very dark gray, occasional 1-inch beds of silt and wood chips, loose, heaving sands, strong odor, moderate sheen.
45	80	100	4 7 11		
	3	33	4 4 7		light odor and sheen
50	4	68	6 6 10		
	42	50	6 6 6		
55	0	100	4 8 9		
	0	44	9 9 9		no odor or sheen
60					

CONSTRUCTION DETAILS



FILTER PACK
31x100# bags 10-20 sand
25.8 to 50.0 feet.

CENTRALIZER
Placed at 47.0 feet.

2-FOOT BOTTOM SUMP

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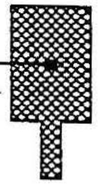
WELL EW-8

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
60					SP		BACKFILL 2x50# bag medium bentonite chips 50.0 to 64.5 feet.
	0	100	4 3 8	■			63.0
65					ML	SILT, slight plasticity, very dark gray, wet, no odor or sheen. Total depth 64.5 feet.	64.5
70							
75							
80							
85							
90							



PTI
ENVIRONMENTAL SERVICES

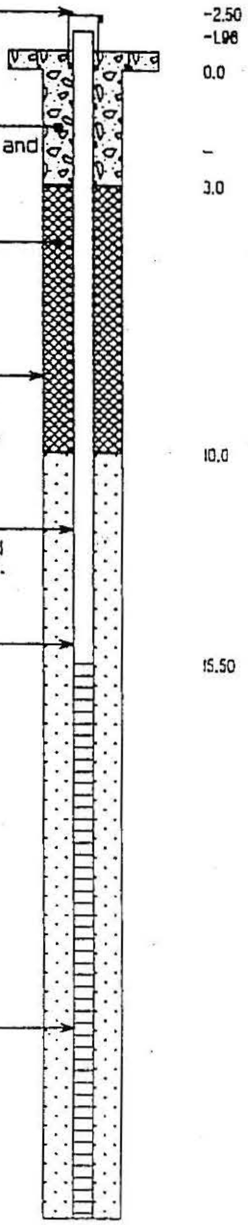
WELL EW-10

PAGE 1 OF 3

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421614
GEOLOGIST/ENGINEER PETERSON, BEESON
DRILLING CONTRACTOR GEOTECH EXPL.
DRILLING METHOD HOLLOW STEM AUGER
DEPTH OF BORING 61.5 FEET
DATE (s) DRILLED 9/21/92
COORDINATES
WELL CASING ELEVATION
SURFACE PAD ELEVATION
TOTAL WELL CASING LENGTH 39.96 FEET

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
0					SP	Poorly graded SAND, 90% fine, 10% medium sand, trace rounded pebbles to 0.5-inch diameter, occasional thin silt beds, dark reddish brown, loose to medium dense, dry to wet, no odor or sheen.
5	0	56	3 3 3			
10	0	56	2 5 6			grain size change to 50% fine and 50% medium sand, color change to very dark gray
15	41	72	7 7 5			color change to black, moist at 15.3 feet with residual creosote-like material, moderate to strong odor
					∇	Water level at 18.5 feet, 9/21/92. heaving sands below 18.5 feet. no odor or sheen
20	26	72	1 2 4			
25	0	50	5 7 9			
30						

CONSTRUCTION DETAILS



LOCKING WELL COVER
Stickup measured from top of 6-inch-thick concrete pad.

SURFACE SEAL
10 bags concrete surface pad and 0.0 to 3.0 feet.

ANNULAR SEAL
5x50# bags medium bentonite chips 3.0 to 10.0 feet.

BOREHOLE
10-inch O.D. hollow stem auger 0.0 to 60.0 feet;
2.5-inch O.D. 60.0 to 61.5 feet.

WELL CASING
4-inch diameter stainless steel (type 403) -1.96 to 15.50 feet.

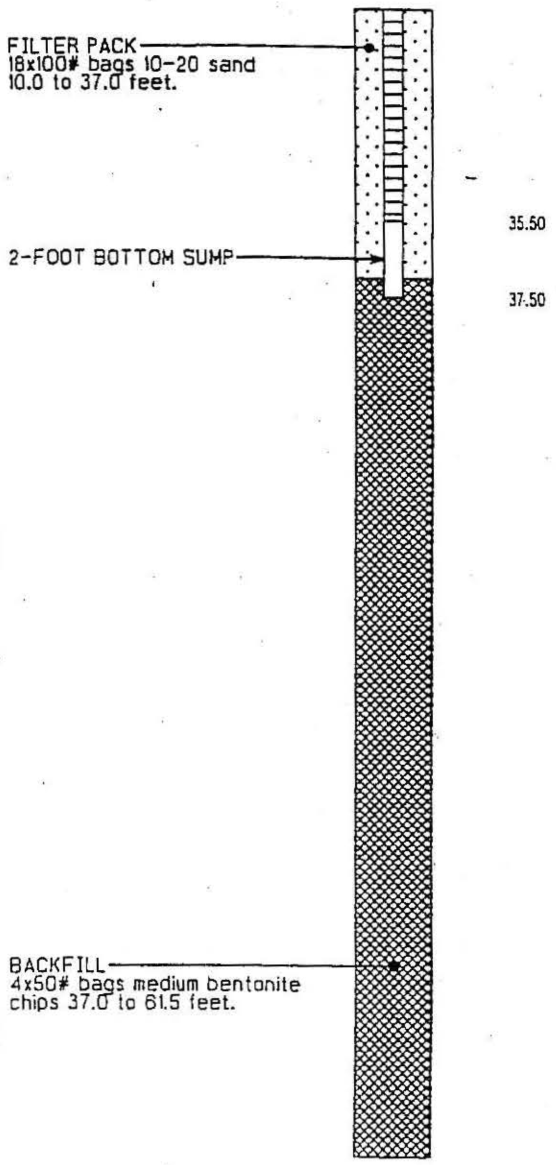
CENTRALIZER
Placed at 15.0 feet.

WELL SCREEN
0.020-inch stainless steel wirewrap 15.50 to 35.50 feet.

WELL EW-10

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
30	22	44	3 4 8		SP	moderate sheen and odor
35	1	0	5 7 13			creosote-like odor, no sheen
40	0	0	10 22 50			grain size change to 20% coarse and 80% medium sand, light odor, no sheen
45	0	0	4 21 28			light odor, no sheen
50	0	44	12 21 28			
55	1	72	13 30 38			
60						

CONSTRUCTION DETAILS



FILTER PACK
18x100# bags 10-20 sand
10.0 to 37.0 feet.

2-FOOT BOTTOM SUMP

BACKFILL
4x50# bags medium bentonite
chips 37.0 to 61.5 feet.

WELL EW-10

DEPTH IN FEET	OVM (ppm)	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
60	1	72	15 32 50	■	SP	Total depth 61.5 feet.	▩ 60.0 61.5
65							
70							
75							
80							
85							
90							

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PTI
ENVIRONMENTAL SERVICES

WELL EW-15

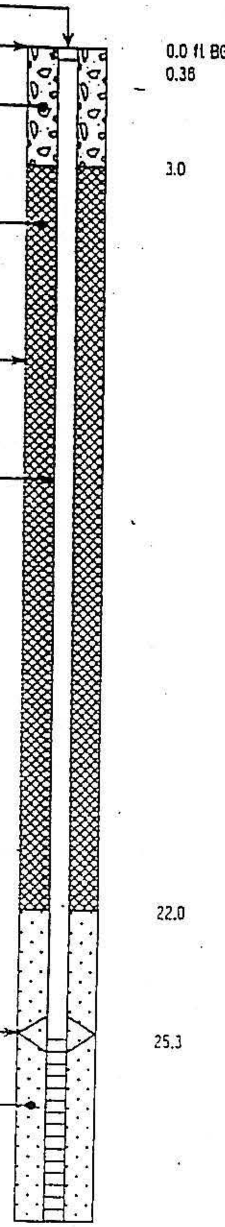
PAGE 1 OF 2

PROJECT MCCORMICK & BAXTER
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C4120304e
GEOLOGIST/ENGINEER A. SOUKUP
DRILLING CONTRACTOR GEOTECH EXPL.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 51.5
DATE (s) DRILLED 11/5/93
COORDINATES 704986.5790N,1425742.9263E
WELL CASING ELEVATION 39.24
SURFACE PAD ELEVATION 39.60
TOTAL WELL CASING LENGTH 46.94 FT

DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BOREHOLE DESCRIPTION
0						
5	O/NS	80	3 5 7			Very dark grayish brown fine to medium SAND.
10	O/NS	50	3 4 6			
15	O/NS	45	4 7 7			color change to dark brown; moist.
20	O/NS	50	3 6 7			occasional subrounded gravel
25	O/NS	70	3 4 5			
30						

CONSTRUCTION DETAILS



LOCKING WELL COVER

FLUSH MOUNT MONUMENT

SURFACE SEAL
Concrete 0.0 to 3.0 ft

ANNULAR SEAL
3/4-in. bentonite chips
3.0 to 22.0 ft

BOREHOLE
8-in. O.D. hollow stem auger
0.0 to 50.0 ft

WELL CASING
4-inch diameter stainless steel
(type 403) 0.4 to 25.3 ft

CENTRALIZER

FILTER PACK
10-20 Colorado silica sand
22.0 to 47.4 ft

WELL EW-15

DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION
30	82/HS	50	2 3 5	▽ SP/SM	Very dark gray fine SAND interbedded with fine SILTY SAND; strong creosote odor; 1-in. layer of wood chips at 30 ft.
	17/SS	60	3 6 8		Very dark gray fine to medium SAND interbedded with fine SILTY SAND; moderate creosote odor. Water level at 31.10 ft on 12/16/93; water encountered at 34.5 ft during drilling.
	74/HS	60	4 4 5		
35	7/SS	65	1 2 3		wet; strong creosote odor. slight creosote odor
	8/SS	10	7 6 7	SP	heaving sands Very dark gray fine SAND; wet; moderate creosote odor and sheen.
	4/NS	50	2 4 3		clean SAND at 38 ft; trace subrounded gravel
40	5/SS	50	2 3 4		occasional gravel
	0/NS	45	4 7 5		
	0/NS	50	2 3 2		Very dark gray medium SAND; occasional very fine silty sand.
45	0/NS	75	1 6 6	SP/SM	interbedded very fine silty sand
	0/NS	10	2 1 3	SP	Very dark gray fine SAND; heaving sands.
50	0/NS	25	1 2 4		Total depth 51.5 ft
55					
					Creosote-like odor and sheen observed in samples from 30 to 41.5 ft; strong odor and heavy sheen from 33 to 34.5 ft.
60					

CONSTRUCTION DETAILS

WELL SCREEN
0.020-in. stainless steel
wirewrap 25.30 to 45.30 ft

FILTER PACK
10-20 Colorado silica sand
22.0 to 47.4 ft

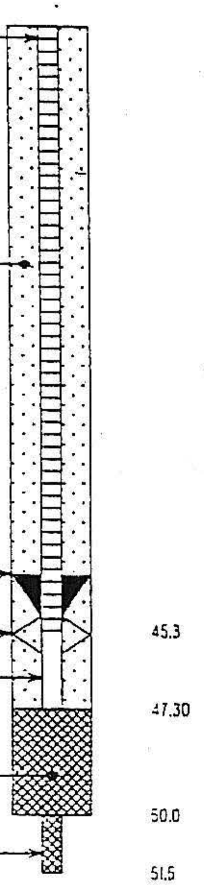
CONE
Customized rubber cone

CENTRALIZER

SUMP
Stainless steel
45.30 to 47.30 ft

BACKFILL
3/4-in. bentonite chips
47.3 to 51.5 ft

Split spoon driven
50.0 to 51.5 ft



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PTI
ENVIRONMENTAL SERVICES

WELL EW-18

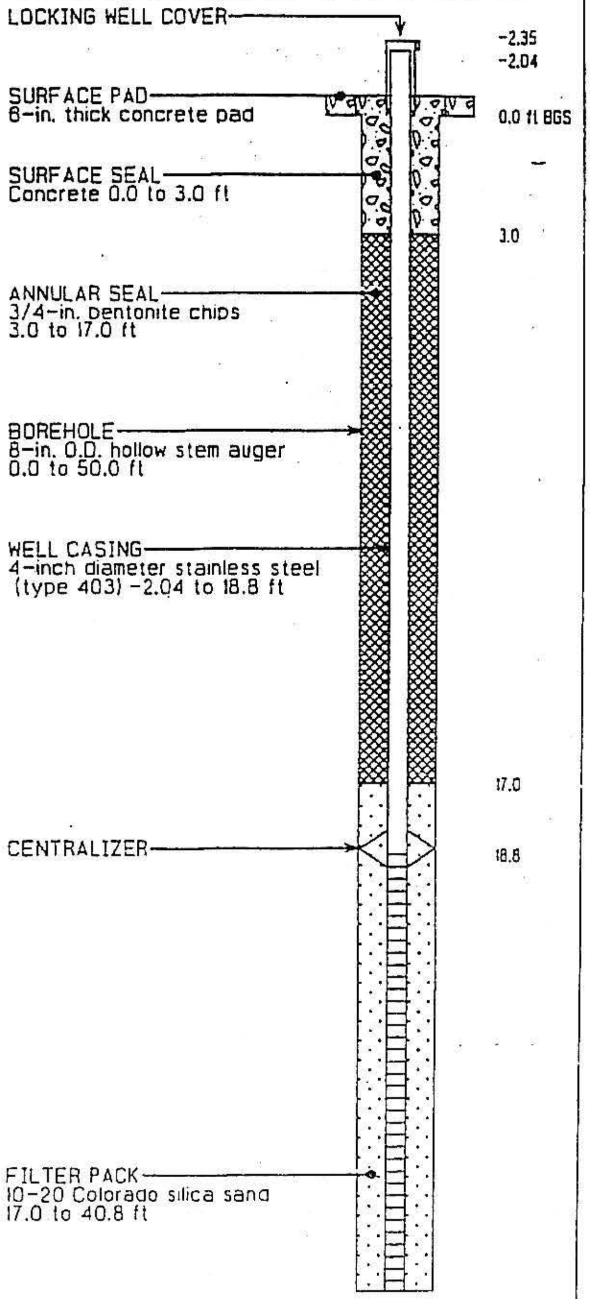
PAGE 1 OF 2

PROJECT MCCORMICK & BAXTER
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C4120304e
GEOLOGIST/ENGINEER A. SOUKUP
DRILLING CONTRACTOR GEOTECH EXPL.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 51.5
DATE (s) DRILLED 11/17/93
COORDINATES 704796.2940N,1426453.8825E
WELL CASING ELEVATION 36.96
SURFACE PAD ELEVATION 34.92
TOTAL WELL CASING LENGTH 42.88 FT

DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION
0					SP	
5	0/NS	50	3 5 8			Very dark gray fine to medium SAND.
10	0/NS	50	4 8 8			
15	0/NS	70	3 6 10			moist
20	0/NS	80	3 8 10			
25	44/HS	70	3 5 7			color change to dark reddish brown; creosote staining at 26.5 ft
	44/HS	60	3 1 5		∇	Water level at 28.75 on 12/15/93 Very dark gray fine to medium SAND; free product in soil.
30						

CONSTRUCTION DETAILS



LOCKING WELL COVER

SURFACE PAD
8-in. thick concrete pad

SURFACE SEAL
Concrete 0.0 to 3.0 ft

ANNULAR SEAL
3/4-in. bentonite chips
3.0 to 17.0 ft

BOREHOLE
8-in. O.D. hollow stem auger
0.0 to 50.0 ft

WELL CASING
4-inch diameter stainless steel
(type 403) -2.04 to 18.8 ft

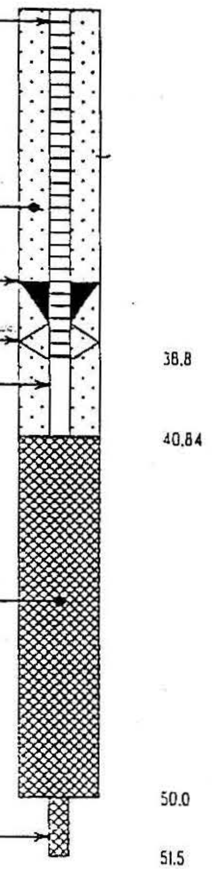
CENTRALIZER

FILTER PACK
10-20 Colorado silica sand
17.0 to 40.8 ft

✓

WELL EW-18

DEPTH IN FEET	OVH/SHEEN	% RECOVERY	BLOWS	LITHOLOGIC DESCRIPTION	BOREHOLE DESCRIPTION	CONSTRUCTION DETAILS
30	18/SS	80	1 3	SP	fine to fine SAND; strong creosote odor.	WELL SCREEN 0.020-in. stainless steel wirewrap 18.84 to 38.84 ft
35	27/HS	100	1 3 2			FILTER PACK 10-20 Colorado silica sand 17.0 to 40.8 ft
	64/HS	40	 2 4			CONE Customized rubber cone
	7/NS	70	2 1 2	ML	SILT with interbedded sand; some clay; occasional wood chips.	CENTRALIZER
40	0/NS	100	1 2 1		no interbedded sand; slightly plastic	SUMP Stainless steel 38.84 to 40.84 ft
45	5/SS	20	1 1 1	SM	Very dark grayish brown silty SAND; fine sand.	BACKFILL 3/4-in. bentonite chips 40.5 to 51.5 ft
50	0/NS	100	2 4 6	SP	Very dark gray fine to medium SAND; trace wood chips. Total depth 51.5 ft	Split spoon driven 50.0 to 51.5 ft
55					Creosote-like odor and sheen observed in samples from 25 ft to 38 ft; heavy sheen observed from 27 to 28.5 ft.	
60						



DRILLING LOG OF WELL NO. EW-23s

Project: McCormick & Baxter

Location: Portland, Oregon

Well Coordinates/Reference System: N 704987.02 / E 7627620.34 / State Plane Coordinates

Date Started/Finished: 9-21-98 / 9-21-98

Drilling Company: Cascade Drilling

Driller/Geologist: / Michael Witnauer

Total Depth of Hole (feet BGS): 40.0

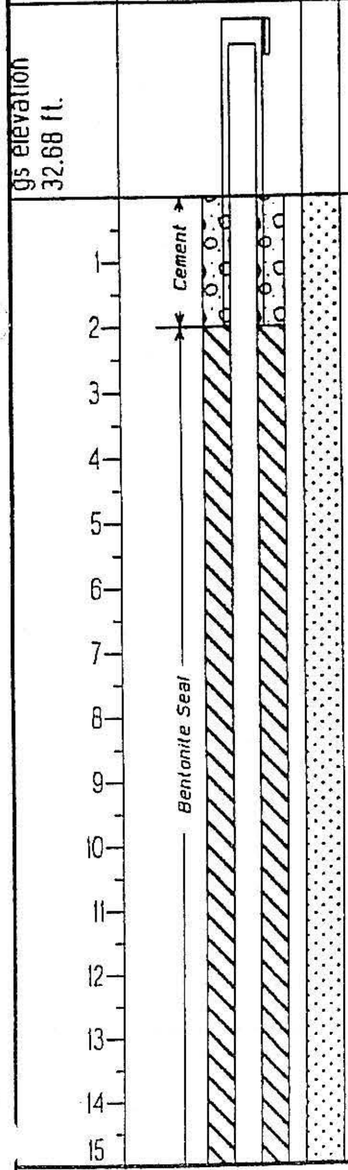
Ground Elevation (feet above MSL): 32.68

Inner casing Stick-Up (feet above GS): 2.34 (35.02)

Groundwater Depth (feet BGS):

At Completion: 28 ▽

On 9/22/98: 28.20 ▼



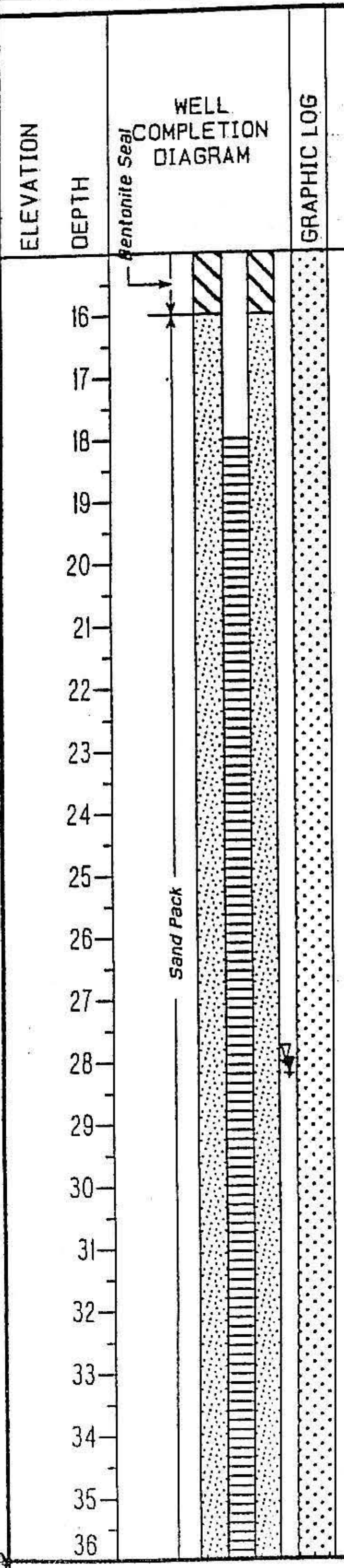
ELEVATION	DEPTH	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION 32.68 2.34 35.02	SAMPLE NUMBER SAMPLE INTERVAL	RUN NUMBER	BLOW COUNT	% RECOVERY	RQD	SAMPLE/HOLE OVA (ppm)	COMMENTS
gs elevation 32.68 ft.				ground surface (gs)							
				SAND brown, fine-to coarse-grained sand with some small gravel in the first five feet that decreases with depth.				NR		NR	Well constructed with 4" diameter, 20' long, .040-slot, stainless steel screen and 20' long, schedule 40 stainless steel riser. sump.

DRILLING LOG OF WELL NO. EW-23s

Page 2 of 3

Project: McCormick & Baxter

Total Depth of Hole (feet BGS): 40.0



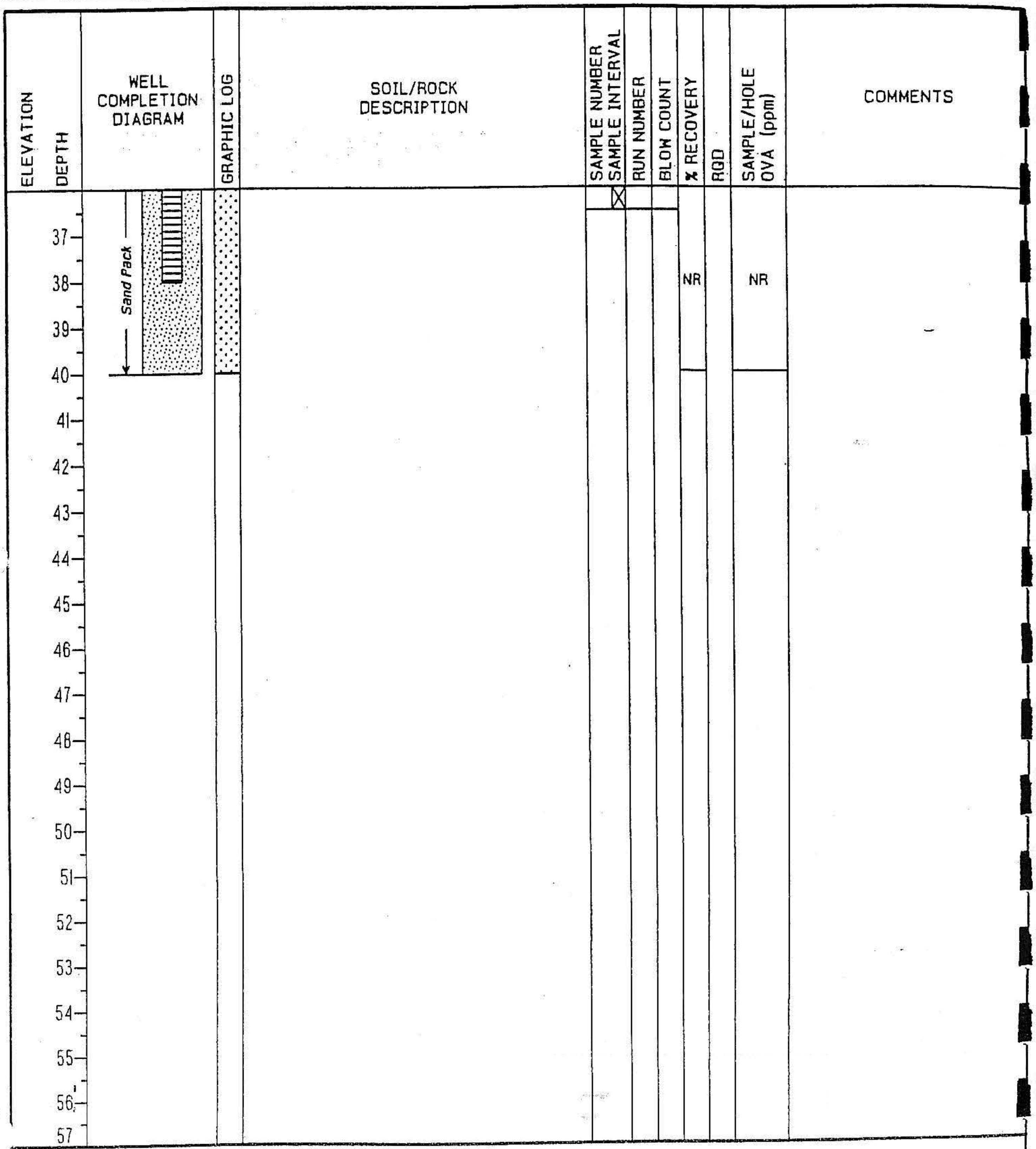
SOIL/ROCK DESCRIPTION	SAMPLE NUMBER SAMPLE INTERVAL	RUN NUMBER	BLOW COUNT	% RECOVERY	RQD	SAMPLE/HOLE OVA (ppm)	COMMENTS
				NR		NR	
SAND black, NAPL saturated, fine-to coarse-grained, strong odor, with some small gravel.	SS 1	SS 1	8 8 10				
SAND brown, fine-to coarse-grained sand with some small gravel, slight odor and no staining.	SS 2	SS 2	1 5 6				

✓

DRILLING LOG OF WELL NO. EW-23s

Project: McCormick & Baxter

Total Depth of Hole (feet BGS): 40.0

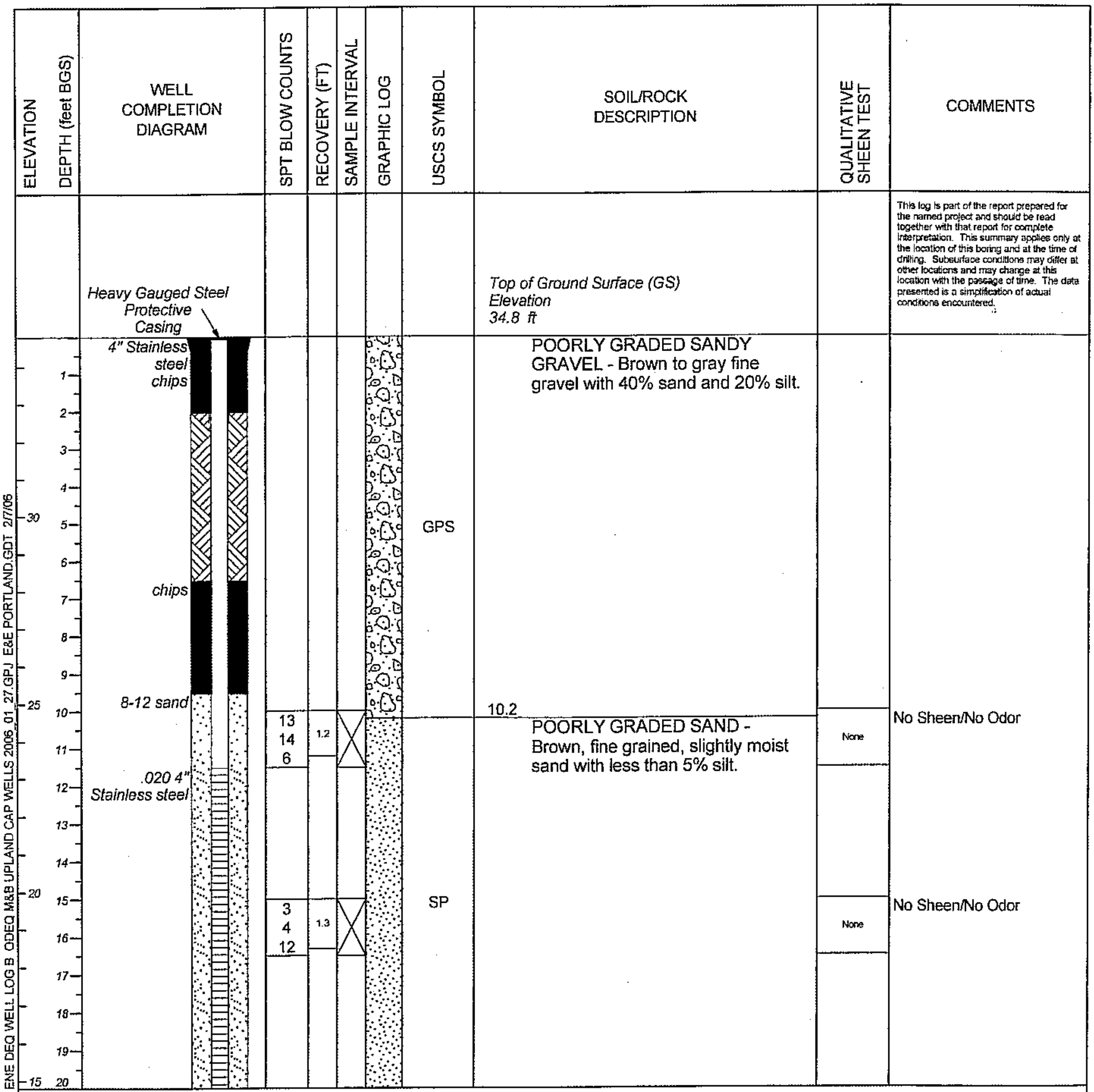


DRILLING LOG OF WELL/BORING NO. MW-1r

DATE DRILLED: 6/21/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: D. Metzger
DRILLING METHOD: Hollow Stem Auger
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 704958.484
EASTING: 7628491.548

PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74

DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery



ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
		Heavy Gauged Steel Protective Casing						*Top of Ground Surface (GS) Elevation 34.8 ft*		This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
		4" Stainless steel chips						POORLY GRADED SANDY GRAVEL - Brown to gray fine gravel with 40% sand and 20% silt.		
	1									
	2									
	3									
	4									
30	5						GPS			
	6									
	7	*chips*								
	8									
	9									
25	10	*8-12 sand*	13 14 6	1.2				10.2 POORLY GRADED SAND - Brown, fine grained, slightly moist sand with less than 5% silt.	None	No Sheen/No Odor
	11									
	12	*.020 4" Stainless steel*								
	13									
	14									
20	15		3 4 12	1.3			SP		None	No Sheen/No Odor
	16									
	17									
	18									
	19									
15	20									

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/7/06

ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
5	20.3		6 50/6	1.0			MLS	Silt no longer present. Now contains up to 5% pebble size gravel. SANDY SILT - Dark brown, moist silt with 15% fine sand.	None	No Sheen/No Odor
0	25.3	▽	14 30 33	1.5			SPG	POORLY GRADED SAND WITH GRAVEL - Black to gray, coarse grained, moist sand with fine gravel, and with 15% silt.	Free Product	Visible NAPL, Heavy Sheen/ Strong Odor
-5	30.0		27 50/3	0.8			SWG	GAP GRADED SAND WITH GRAVEL AND SILT - Brown, wet, fine (20%) and coarse (30%) grained sand with 30% fine gravel and with 20% silt.	None	No Sheen/No Odor
-10	35.0		50/6	0.3			SP	POORLY GRADED SAND - Brown, medium grained, wet sand with 15% silt. One piece of 1-inch gravel in sampler.	None	No Sheen/No Odor
-15	40.0		8 12 22	0.7			GPS	POORLY GRADED SANDY GRAVEL - Black, fine grained, wet gravel with coarse grained sand, and with 10% silt.	Slight Sheen	Slight NAPL sheen observed in pore water/Slight Odor
-20	45.0		15 20 37	1.5			SP	POORLY GRADED SAND - Brown, fine grained, wet sand with less than 5% silt. Color change to black to brown and grain size change to medium	None	No Sheen/No Odor

DRILLING LOG OF WELL/BORING NO. MW-1r

ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	48 49						SP	to coarse sand with <5% silt. POORLY GRADED SAND - Brown, fine grained, wet sand with less than 5% silt. *(continued)* 50.0		
-25	50 51 52		50/6	0.5			GPS	POORLY GRADED GRAVEL WITH SAND - Dark brown, fine grained, wet gravel with coarse grained sand, and with less than 5% silt. 52.5	None	No Sheen/No Odor. Heaving sands at 50-feet BGS, boring terminated.
-30 -35 -40 -45	53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75									

ecology and environment, inc.

PROJECT NAME: McCormick & Baxter Upland Cap
WELL NO.: MW-1r

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ENVIRONMENTAL SERVICES

WELL MW-10s

PAGE 1 OF 2

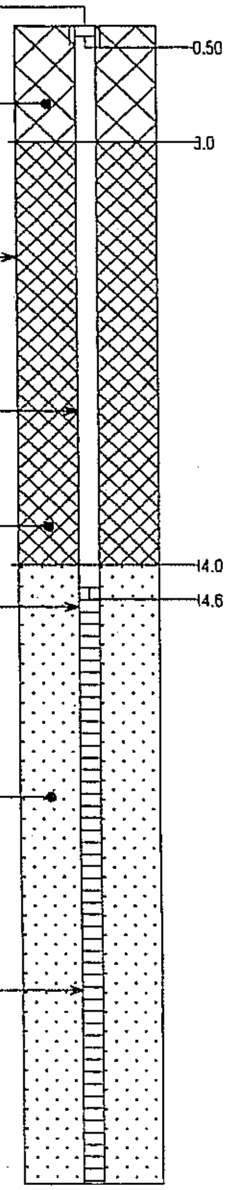
PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER VARNUM & LIVERMORE
DRILLING CONTRACTOR ESD
DRILLING METHOD MOD. HOLLOW STEM AUGER

DEPTH OF BORING 41.7 FEET
DATE (s) DRILLED FEB 11-12, 1990
COORDINATES 705047.595, 1426374.721
WELL CASING ELEVATION 33.65 FEET
SURFACE PAD ELEVATION 34.15 FEET
TOTAL WELL CASING LENGTH 35.10 FEET

DEPTH IN FEET	OVM (ppm)	ENV SAMPLE	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
0	0.0		100		GM	Silty coarse GRAVEL, brown, moist.
	10.0 6.0				SP-SM	Fine to medium SAND with silt and woody material, dark gray, moist.
	4.7		80		ML	SILT with gravel, dark gray, moist, stiff.
10	0.0 0.0	☒ ☒	70		SP-SM	Fine to medium SAND with silt and occasional gravel, dark brown, moist.
20	6.7 55.6 47.2 65.0 420.0 112.0	☒ ☒ ☒ ☒	60 90		SP	Fine to medium SAND, gray, moist to wet. ▼ Water level at 22.21 feet on 3/4/91
30	575.0	☒			SP-SM	Fine SAND with silt with trace organic material, very dark gray, wet.

WELL CONSTRUCTION DETAILS

FLUSH MOUNT WELL COVER



SURFACE SEAL
Concrete 0.0 to 3.0 feet.

BOREHOLE
8-inch diameter 0.0 to 37.7 feet.

WELL CASING
2-inch diameter stainless steel
0.24 to 35.34 feet.

ANNULAR SEAL
2.5x50# bags bentonite
slurry 3.0 to 14.0 feet.

CENTRALIZER
Placed at 15.10 feet.

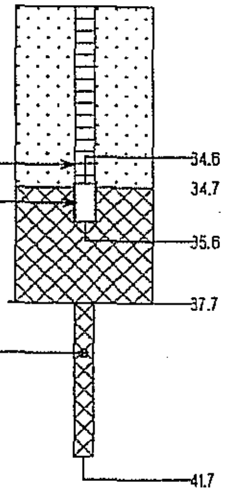
FILTER PACK
10x100# bags 10-20 sand
14.0 to 34.7 feet.

WELL SCREEN
0.020 slot stainless steel
wirewrap 14.60 to 34.60 feet.

WELL MW-10s

DEPTH IN FEET	OVM (ppm)	ENV SAMPLE	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
30					SP-SM	
	480.0	☒		⧗		
					PT	WOOD and native organic material, wet.
	18.0	☒		⧗		
					MH	Clayey SILT with fine sand and trace organic material, very dark gray, wet.
40						
						Total depth 41.7 feet.
						Creosote-like sheen observed in soil samples from 1.0 to 41.7 feet.
50						
60						

WELL CONSTRUCTION DETAILS



CENTRALIZER
Placed at 34.10 feet.
1-FOOT SUMP AND END CAP

BACKFILL
0.5x50# bags medium bentonite chips 34.7 to 41.7 feet.

MULT 78148

STATE OF OREGON
MONITORING WELL REPORT P05-112-116
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

Well I.D. # L75183 ✓
Start Card # ~~176179~~ 176179

(1) OWNER/PROJECT:

WELL NO. MW 105-R
Name McCormick & Baxter Creosting
Address PO Box 3048
City Portland State OR Zip 97205

(2) TYPE OF WORK:

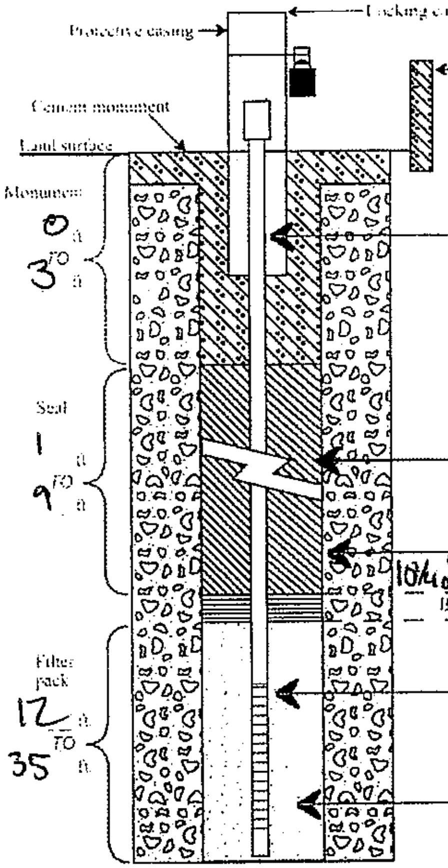
☒ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD:

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☒ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes ☐ No ☒ Depth of completed well 35 ft



Monument 0 ft TO 3 ft

Seal 1 ft TO 9 ft

Filter pack 12 ft TO 35 ft

Casing diameter 2 in
material S.S.
Welded ☐ Threaded ☒ Glued ☐

Liner diameter in
material N/A
Welded ☐ Threaded ☐ Glued ☐

Well seal
Material bent. chips
Amount ~~Grout weight~~ 8 50# bags
Borehole diameter 10¼OD-6¼ID in

Bentonite plug at least 3 ft. thick

Screen material S.S.
interval(s):
From To
From 14' To 34'
Slot size .02 in.

Filter pack
Material Silica
Size 10/20 in.

12' - S.S. Sump

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ pH ______
Temperature of Water 56 °F Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☐ No
By whom? ______
Depth of strata to be analyzed From ______ ft. to ______ ft
Remarks ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location County Multnomah
Township 1 N Range 1 E Section 7
NW ¼ of SW ¼ of above section
Street address of well location 6900 N Edgewater, Portland, OR
Tax lot number of well location 100
ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

20 Ft. below land surface Date 27 June 05
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL
20'	35'	2 GPM	

(9) WELL LOG:

Ground elevation ______

Material	From	To	SWL
Silty Sand	0'		
		35'	

RECEIVED
JUL 25 2005
WATER RESOURCES DEPT
SALEM, OREGON

Date started 27 June 05 Completed 27 June 05

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number 10423
Signed ______ Date 27 June 05

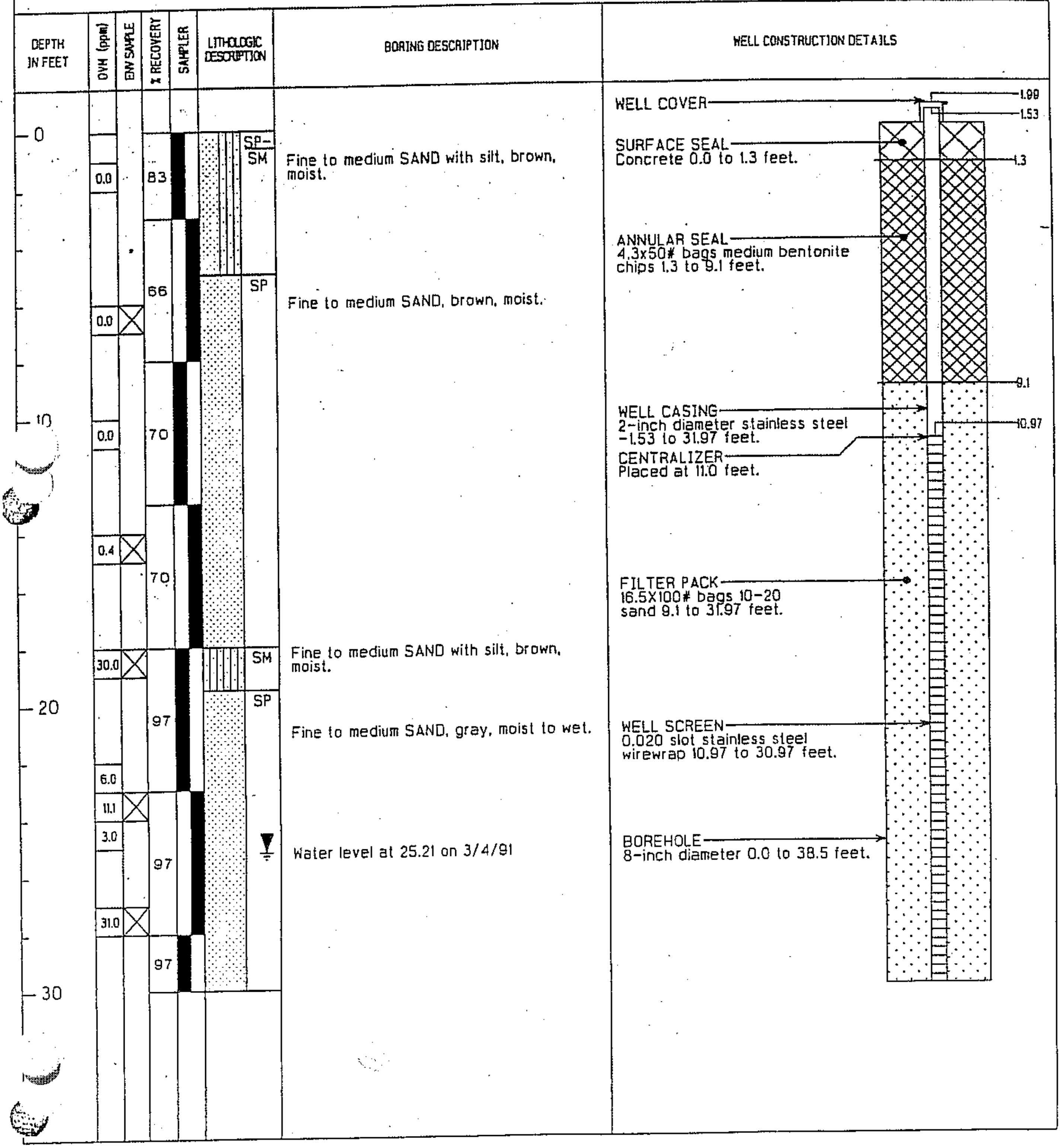
(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10432
Signed ______ Date 7/11/05

PTI
ENVIRONMENTAL SERVICES

WELL MW-15s

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER VARNUM & LIVERMORE
DRILLING CONTRACTOR ESD
DRILLING METHOD MOD. HOLLOW STEM AUGER

DEPTH OF BORING 42.5 FEET
DATE (s) DRILLED FEB 1-4, 1991
COORDINATES 705089.889, 1425937.739
WELL CASING ELEVATION 36.44 FEET
SURFACE PAD ELEVATION 34.91 FEET
TOTAL WELL CASING LENGTH 33.50 FEET



Fine to medium SAND with silt, brown, moist.

Fine to medium SAND, brown, moist.

Fine to medium SAND with silt, brown, moist.

Fine to medium SAND, gray, moist to wet.

Water level at 25.21 on 3/4/91

WELL COVER

SURFACE SEAL
Concrete 0.0 to 1.3 feet.

ANNULAR SEAL
4.3x50# bags medium bentonite chips 1.3 to 9.1 feet.

WELL CASING
2-inch diameter stainless steel -1.53 to 31.97 feet.

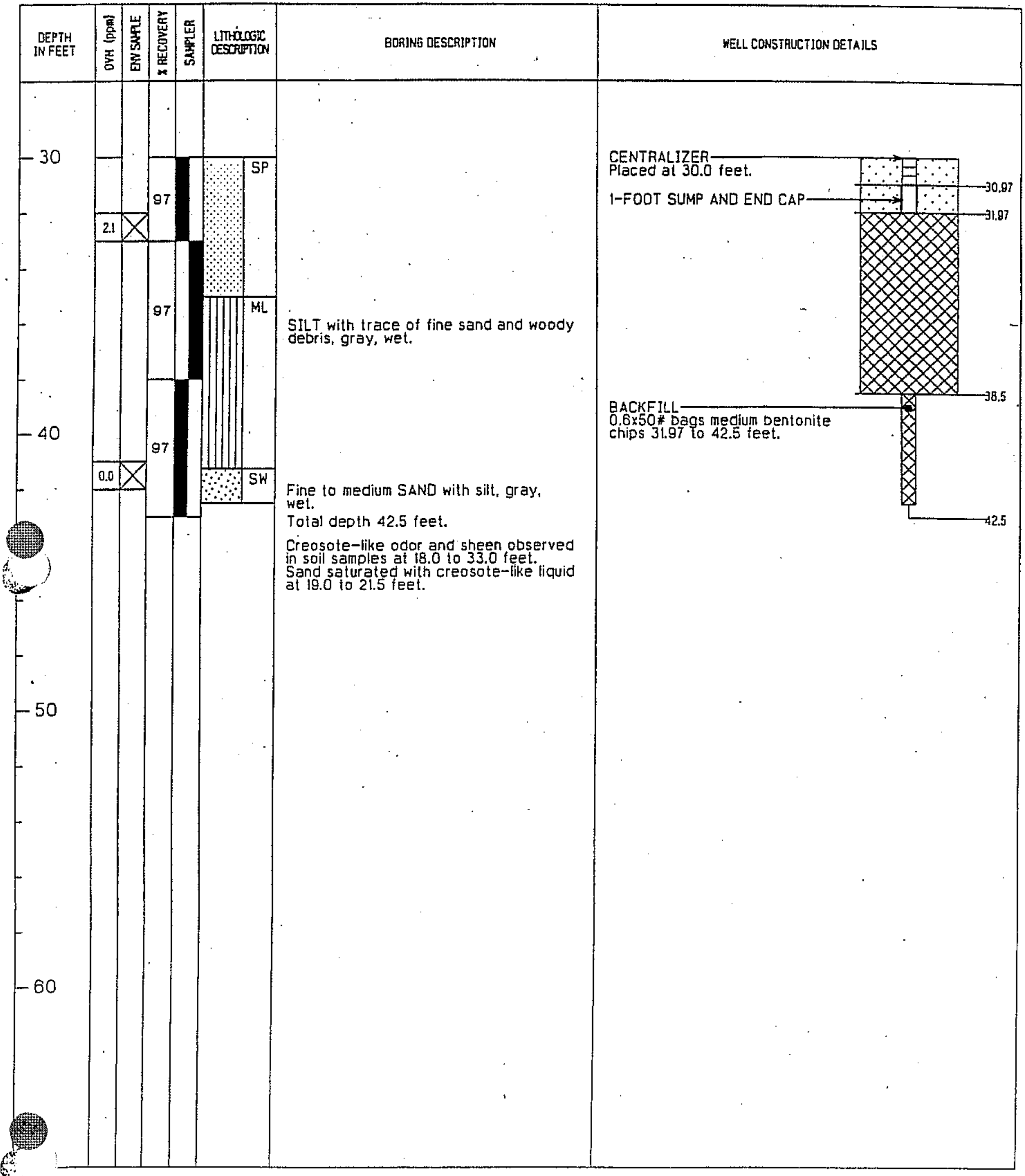
CENTRALIZER
Placed at 11.0 feet.

FILTER PACK
16.5X100# bags 10-20 sand 9.1 to 31.97 feet.

WELL SCREEN
0.020 slot stainless steel wirewrap 10.97 to 30.97 feet.

BOREHOLE
8-inch diameter 0.0 to 38.5 feet.

WELL MW-15s



SILT with trace of fine sand and woody debris, gray, wet.

Fine to medium SAND with silt, gray, wet.

Total depth 42.5 feet.

Creosote-like odor and sheen observed in soil samples at 18.0 to 33.0 feet. Sand saturated with creosote-like liquid at 19.0 to 21.5 feet.

CENTRALIZER
Placed at 30.0 feet.

1-FOOT SUMP AND END CAP

BACKFILL
0.6x50# bags medium bentonite chips 31.97 to 42.5 feet.

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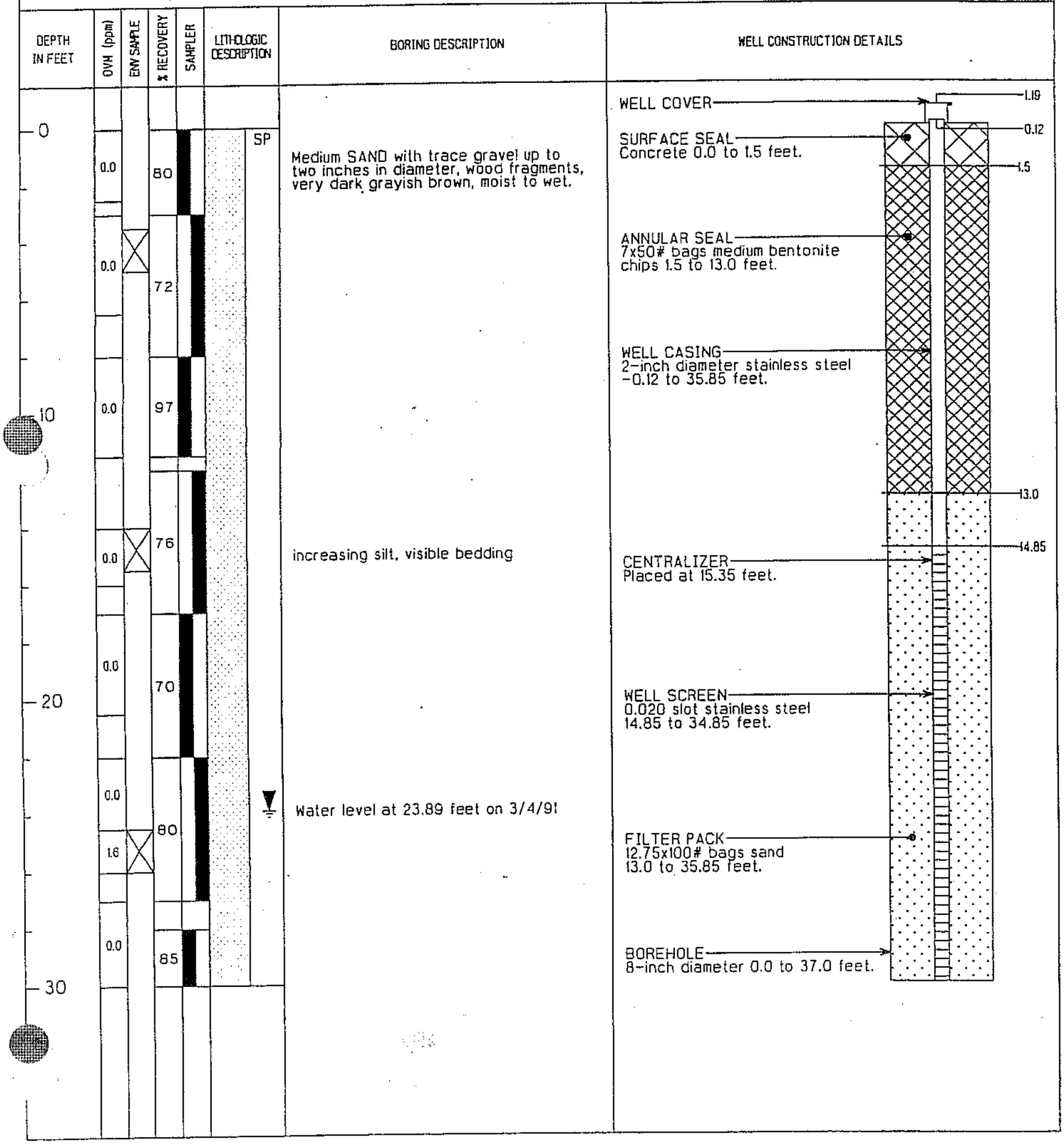
PTI
ENVIRONMENTAL SERVICES

WELL MW-17s

PAGE 1 OF 2

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER LIVERMORE & LOW
DRILLING CONTRACTOR ESD
DRILLING METHOD MOD. HOLLOW STEM AUGER

DEPTH OF BORING 41.0 FEET
DATE (s) DRILLED JAN 24-25, 1991
COORDINATES 704920.429, 1425858.687
WELL CASING ELEVATION 35.10 FEET
SURFACE PAD ELEVATION 34.98 FEET
TOTAL WELL CASING LENGTH 35.97 FEET



BORING DESCRIPTION

Medium SAND with trace gravel up to two inches in diameter, wood fragments, very dark grayish brown, moist to wet.

increasing silt, visible bedding

Water level at 23.89 feet on 3/4/91

WELL CONSTRUCTION DETAILS

WELL COVER

SURFACE SEAL
Concrete 0.0 to 1.5 feet.

ANNULAR SEAL
7x50# bags medium bentonite chips 1.5 to 13.0 feet.

WELL CASING
2-inch diameter stainless steel -0.12 to 35.85 feet.

CENTRALIZER
Placed at 15.35 feet.

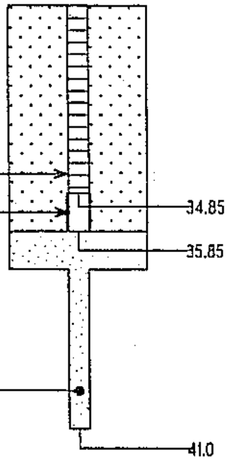
WELL SCREEN
0.020 slot stainless steel 14.85 to 34.85 feet.

FILTER PACK
12.75x100# bags sand 13.0 to 35.85 feet.

BOREHOLE
8-inch diameter 0.0 to 37.0 feet.

WELL MW-17s

DEPTH IN FEET	OVM (ppm)	ENV SAMPLE	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	WELL CONSTRUCTION DETAILS
30	0.0		85	■	SP	heaving sands	
	0.0				SP-SM		CENTRALIZER Placed at 34.35 feet. 1-FOOT SUMP AND END CAP
	0.0			■		Fine SAND with silt and abundant wood debris, very dark gray, wet.	
40				■	ML SP	Interbeds of SILT and fine SAND, 0.05 to 0.40 feet thick, dark gray, wet.	BACKFILL Native materials 35.85 to 41.0 feet.
						Total depth 41.0 feet.	
						Either-like odor observed in soil samples at 24.5 to 26.0 feet and at 39.5 to 41.0 feet.	
50							
60							



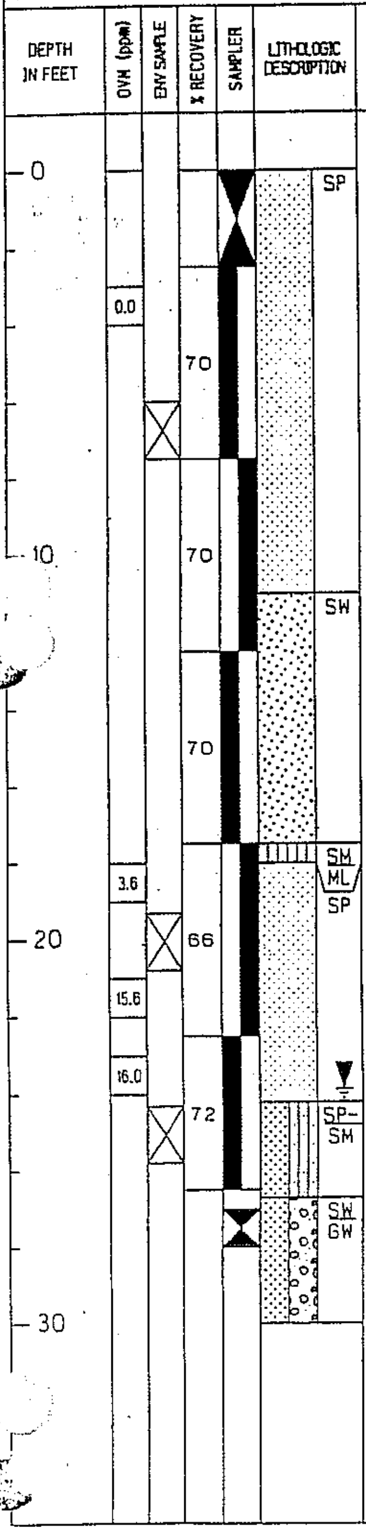
PTI
ENVIRONMENTAL SERVICES

WELL MW-20i

PAGE 1 OF 3

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER LIVERMORE & MCBETH
DRILLING CONTRACTOR ESD
DRILLING METHOD MOD. HOLLOW STEM AUGER

DEPTH OF BORING 88.0 FEET
DATE (s) DRILLED DEC 21, 1990 - JAN 3, 199
COORDINATES 705060.799, 1425556.209
WELL CASING ELEVATION 35.78 FEET
SURFACE PAD ELEVATION 35.54 FEET
TOTAL WELL CASING LENGTH 70.90 FEET



BORING DESCRIPTION

Medium SAND with trace silt and coarse sand, very dark brown, moist.

Medium to coarse SAND, very dark brown.

coarsening with depth, moist 12.50 to 16.0 feet, dry 16.0 to 20.0 feet.

Silty medium SAND grading to SILT, very dark gray.

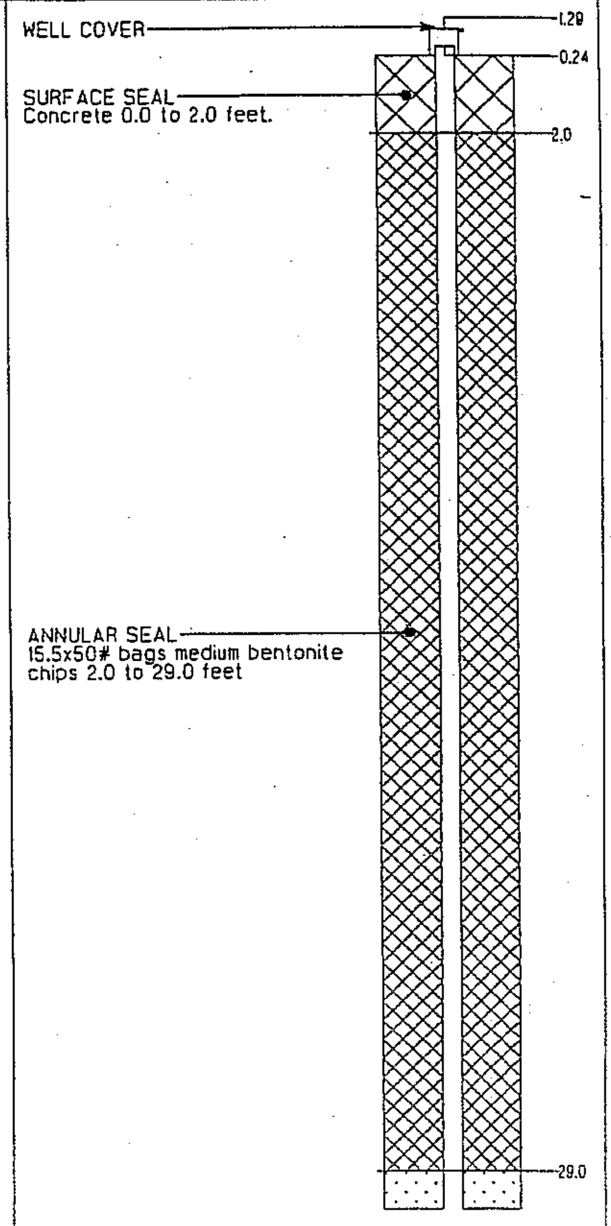
Medium SAND with trace gravel and silt, very dark brown, moist below 20.0 feet.

Water level at 23.87 feet on 3/5/91

Medium SAND with silt and fine gravel, dark to very dark gray, wet.

Medium SAND and coarse GRAVEL, COBBLES, and BOULDERS, very dark gray, wet.
heaving sand below 27.5 feet.

WELL CONSTRUCTION DETAILS

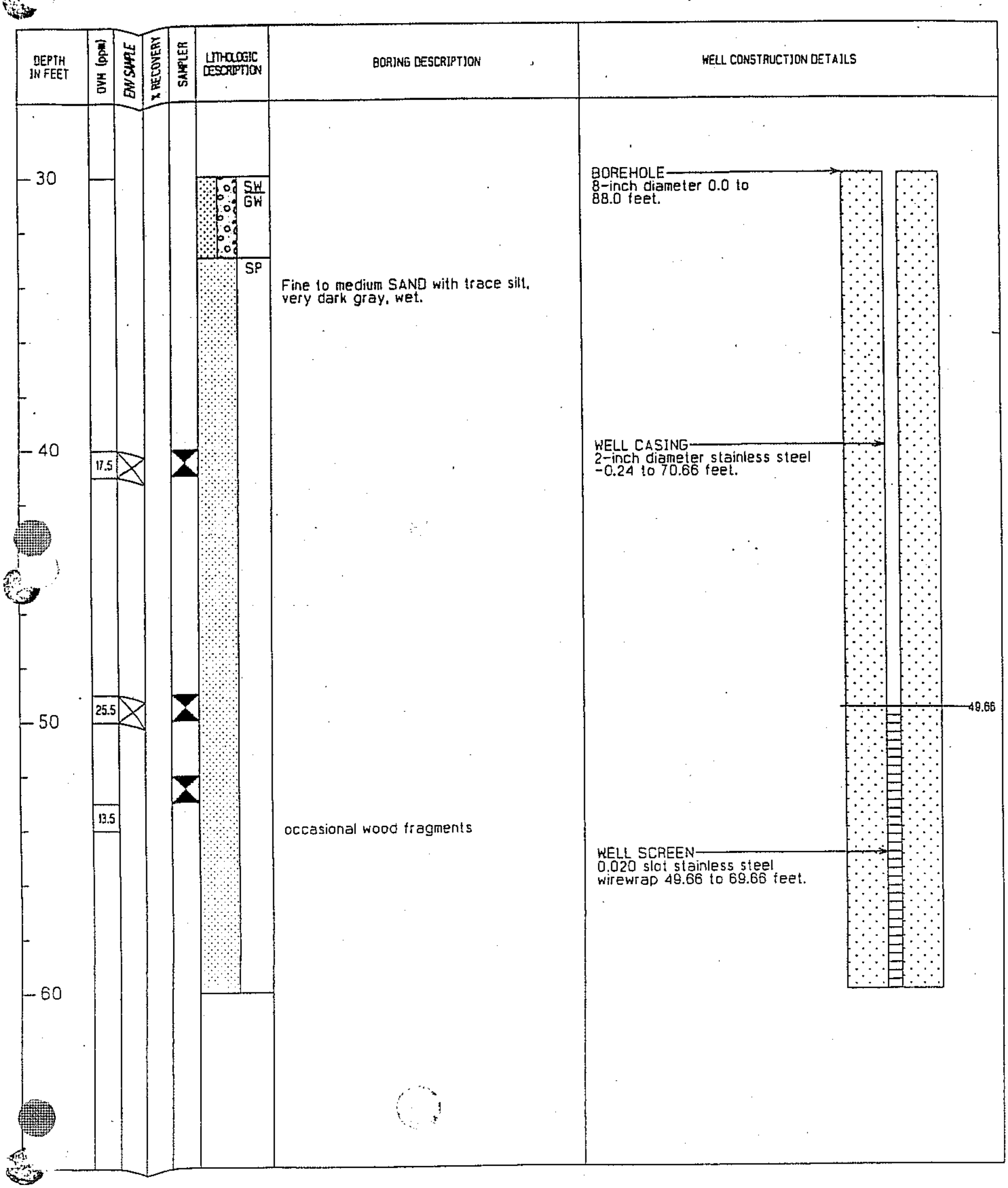


WELL COVER

SURFACE SEAL
Concrete 0.0 to 2.0 feet.

ANNULAR SEAL
15.5x50# bags medium bentonite chips 2.0 to 29.0 feet

WELL MW-20i



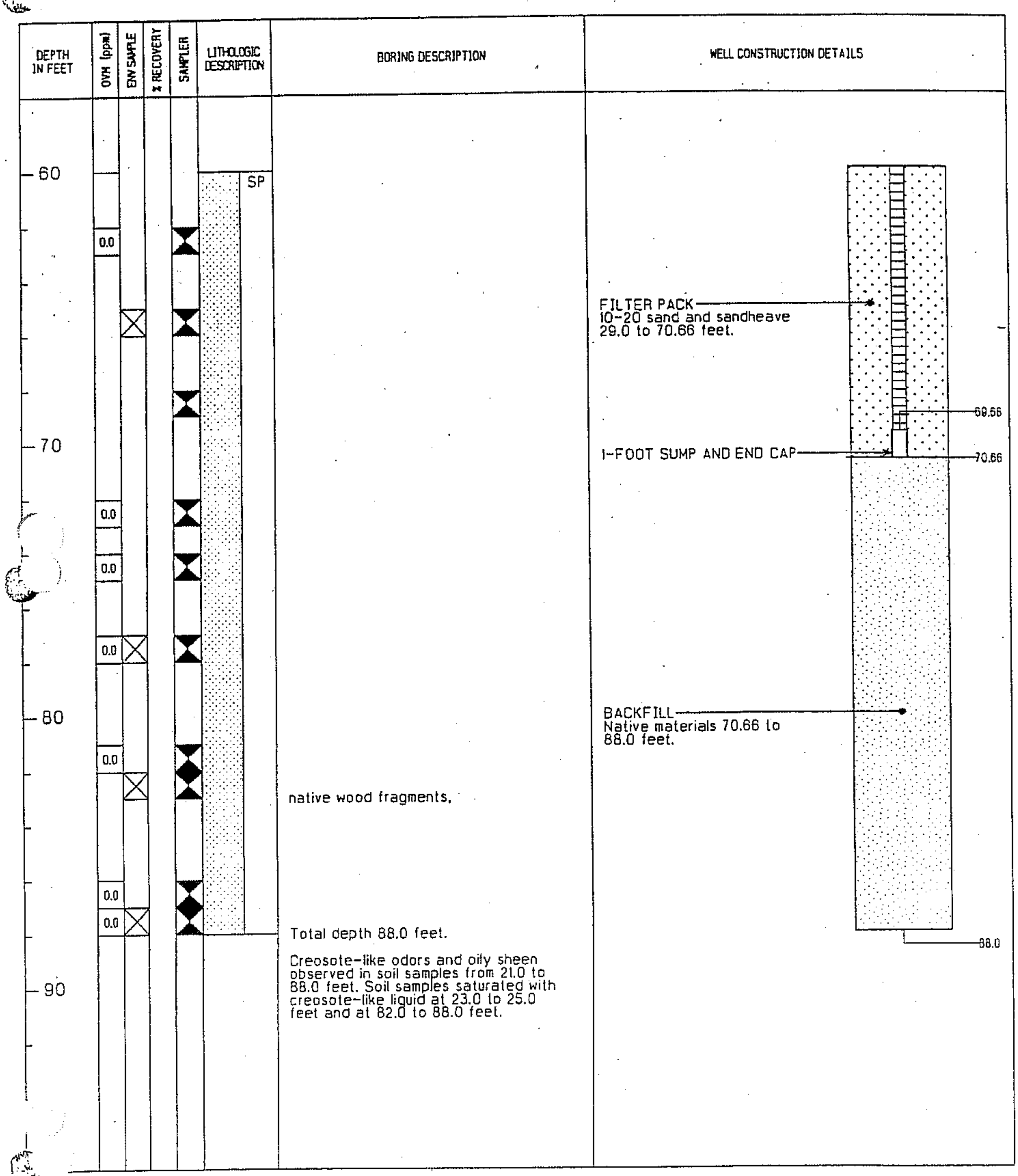
Fine to medium SAND with trace silt, very dark gray, wet.

occasional wood fragments

BOREHOLE
8-inch diameter 0.0 to 88.0 feet.

WELL CASING
2-inch diameter stainless steel -0.24 to 70.66 feet.

WELL SCREEN
0.020 slot stainless steel wirewrap 49.66 to 69.66 feet.



native wood fragments,

Total depth 88.0 feet.

Creosote-like odors and oily sheen observed in soil samples from 21.0 to 88.0 feet. Soil samples saturated with creosote-like liquid at 23.0 to 25.0 feet and at 82.0 to 88.0 feet.

PTI
ENVIRONMENTAL SERVICES

WELL MW-22i

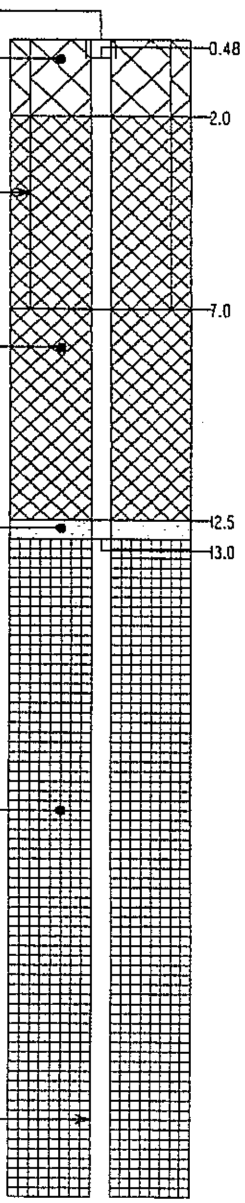
PAGE 1 OF 3

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER D. LOW
DRILLING CONTRACTOR STACO
DRILLING METHOD CABLE TOOL

DEPTH OF BORING 63.5 FEET
DATE (s) DRILLED JUNE 26, 1991
COORDINATES 705046.450, 1426370.950
WELL CASING ELEVATION 33.56 FEET
SURFACE PAD ELEVATION 34.04 FEET
TOTAL WELL CASING LENGTH 52.32 FEET

DEPTH IN FEET	OVM (ppm)	ENV SAMPLE	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
						Log of 0.0 to 32.0 feet is from MW-10s.
0					GM	Silty coarse GRAVEL, brown, moist.
					SP-SM	Fine to medium SAND with silt and woody material, dark gray, moist.
					ML	SILT with gravel, dark gray, moist, stiff.
10					SP-SM	Fine to medium SAND with silt and occasional gravel, dark brown, moist.
20					SP	Fine to medium SAND, gray, moist to wet.
					SP-SM	Fine SAND with silt with trace organic material, very dark gray, wet.
					▼	Water level at 26.87 feet on 7/25/91
30						

WELL CONSTRUCTION DETAILS



FLUSH MOUNT WELL COVER

SURFACE SEAL
Concrete 0.0 to 2.0 feet.

PROTECTIVE CASING
10-inch diameter 0.0 to 7.0 feet.

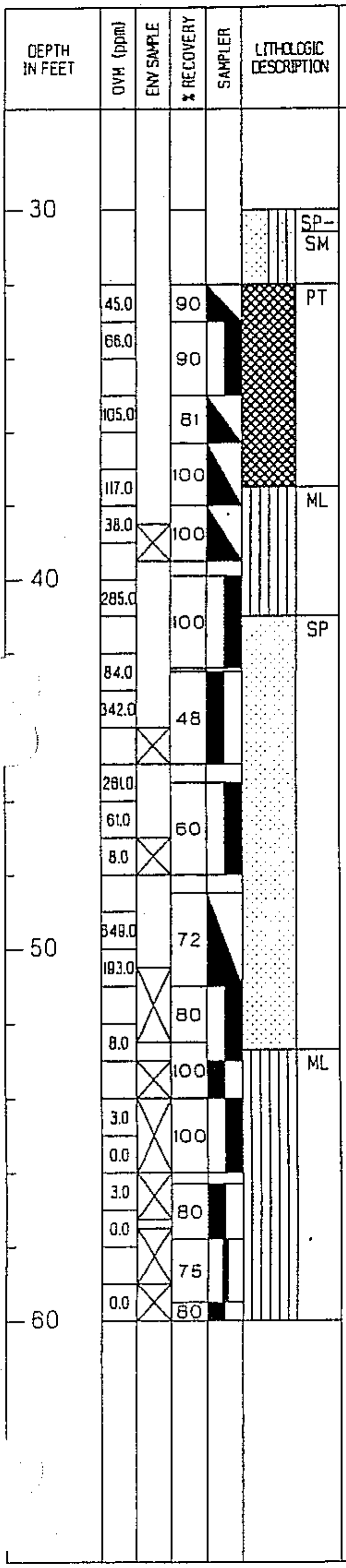
ANNULAR SEAL
Medium bentonite chips 0.0 to 12.5 feet.

Natural formation slough
12.5 to 13.0 feet.

ANNULAR SEAL
Bentonite grout
13.0 to 36.0 feet.

WELL CASING
4-inch diameter stainless steel 0.48 to 52.8 feet.

WELL MW-22i



BORING DESCRIPTION

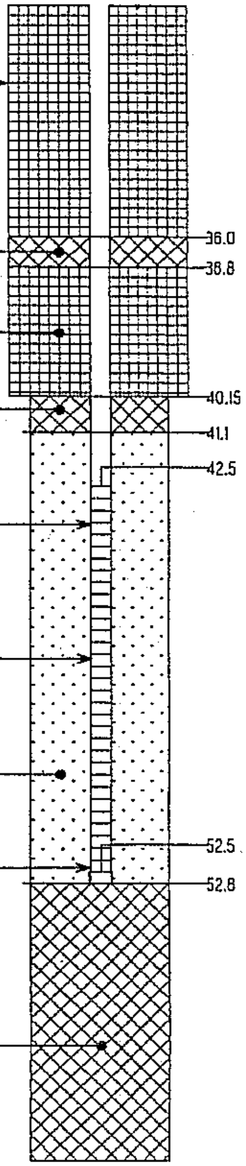
Fine to coarse WOOD debris and medium to fine SAND with silt, dark gray, wet.

SILT with sandy silt and oily wood, very dark gray, wet.

Fine to medium SAND with trace silt, and occasional thin beds of silt and silty sand, dark gray, wet.

Fine sandy SILT with wood chips, very dark gray, wet.

WELL CONSTRUCTION DETAILS



BOREHOLE
12-inch diameter 0.0 to 40.15 feet.
8-inch diameter 40.15 to 61.0 feet.

ANNULAR SEAL
Bentonite pellets 36.0 to 36.8 feet.

ANNULAR SEAL
Grout slough 36.8 to 40.15 feet.

ANNULAR SEAL
Bentonite pellets 40.15 to 41.1 feet.

CENTRALIZER
Placed at 43.0 feet.

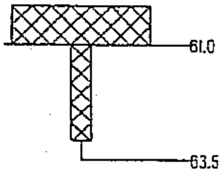
WELL SCREEN
0.020 slot stainless steel wirewrap 42.5 to 52.5 feet.

FILTER PACK
4.75x100# bags 10-20 sand 41.1 to 52.8 feet.

CENTRALIZER
Placed at 52.0 feet.
END CAP

BACKFILL
Medium bentonite chips 52.8 to 63.5 feet.

WELL MW-22i

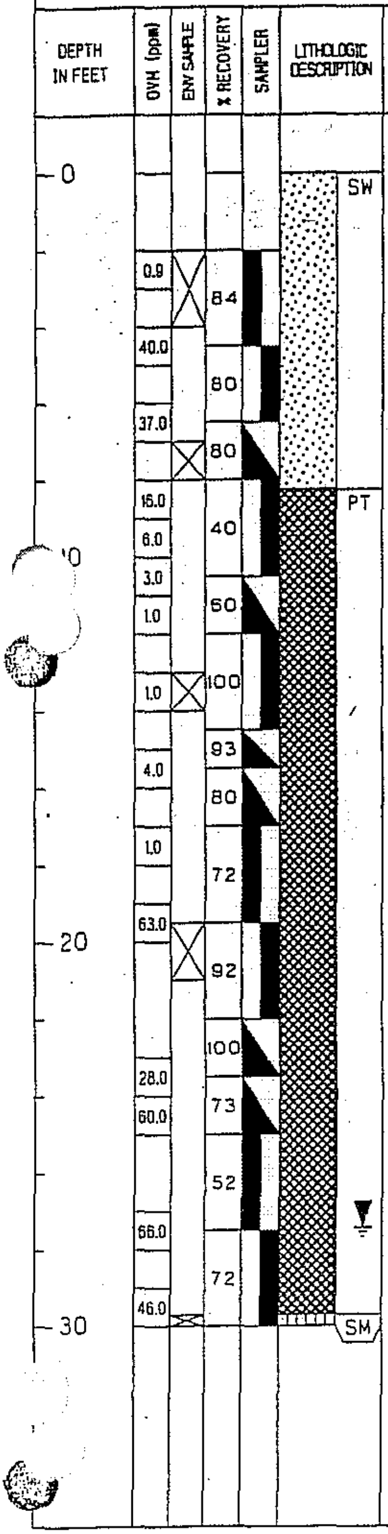
DEPTH IN FEET	OVM (ppm)	ENV SAMPLE	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	WELL CONSTRUCTION DETAILS
60 70 80 90	0.0	☒ ☒	80 92	■ ■	ML	Total depth 63.5 feet. Creosote-like odor and oily sheen observed in soil samples as banded zones from 32.0 to 37.3 feet; sheen and odor observed in soil samples from 32.0 to 55.0 feet.	

PTI
ENVIRONMENTAL SERVICES

WELL MW-23d

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER LIVERMORE & LOW
DRILLING CONTRACTOR STACO
DRILLING METHOD CABLE TOOL

DEPTH OF BORING 182.17 FEET
DATE (s) DRILLED JULY 9-22, 1991
COORDINATES 704946.260, 1426584.640
WELL CASING ELEVATION 34.27 FEET
SURFACE PAD ELEVATION 32.83 FEET
TOTAL WELL CASING LENGTH 183.61 FEET



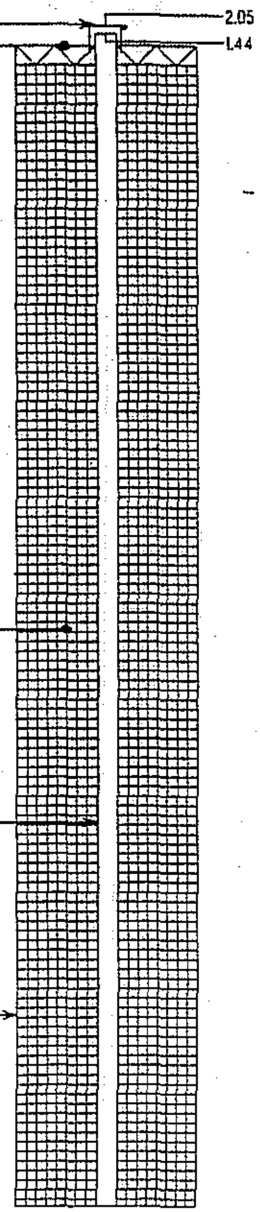
BORING DESCRIPTION

Fine to coarse thinly bedded SAND with trace basaltic gravel, very dark gray to reddish brown, moist.

WOOD chips with minor sand and gravel, dark brown, wet.

Water level at 27.44 feet on 8/27/91

WELL CONSTRUCTION DETAILS



WELL COVER

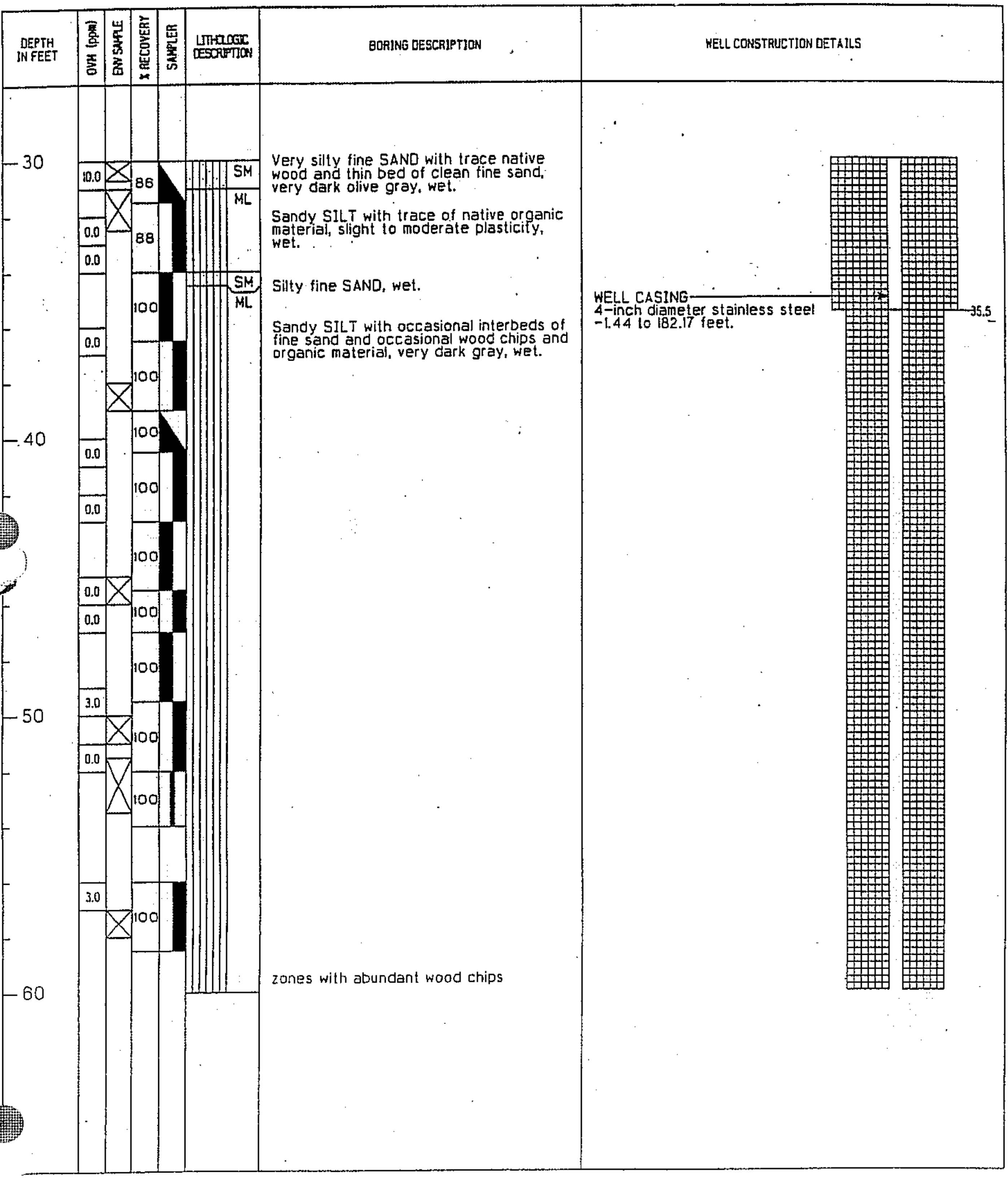
SURFACE SEAL
Concrete pad.

ANNULAR SEAL
Bentonite grout
44X50# bags 0.0 to 162.2 feet.

CENTRALIZER
Placed at 20.0 feet.

BOREHOLE
12-inch diameter 0.0 to 35.5 feet.
8-inch diameter 35.5 to 182.0 feet.

WELL MW-23d



Very silty fine SAND with trace native wood and thin bed of clean fine sand, very dark olive gray, wet.

Sandy SILT with trace of native organic material, slight to moderate plasticity, wet.

Silty fine SAND, wet.

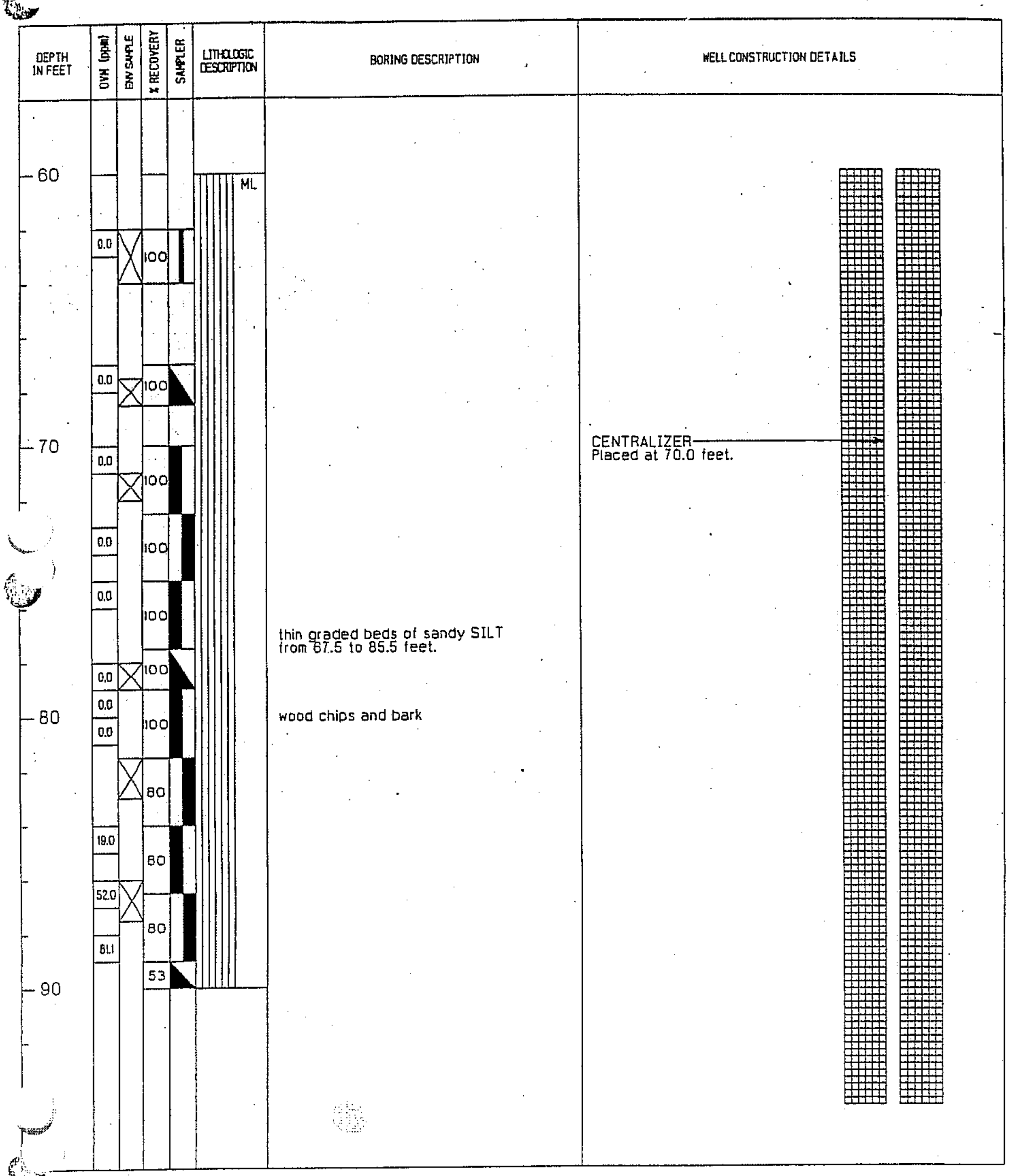
Sandy SILT with occasional interbeds of fine sand and occasional wood chips and organic material, very dark gray, wet.

zones with abundant wood chips

WELL CASING
4-inch diameter stainless steel
-1.44 to 182.17 feet.

WELL MW-23d

51

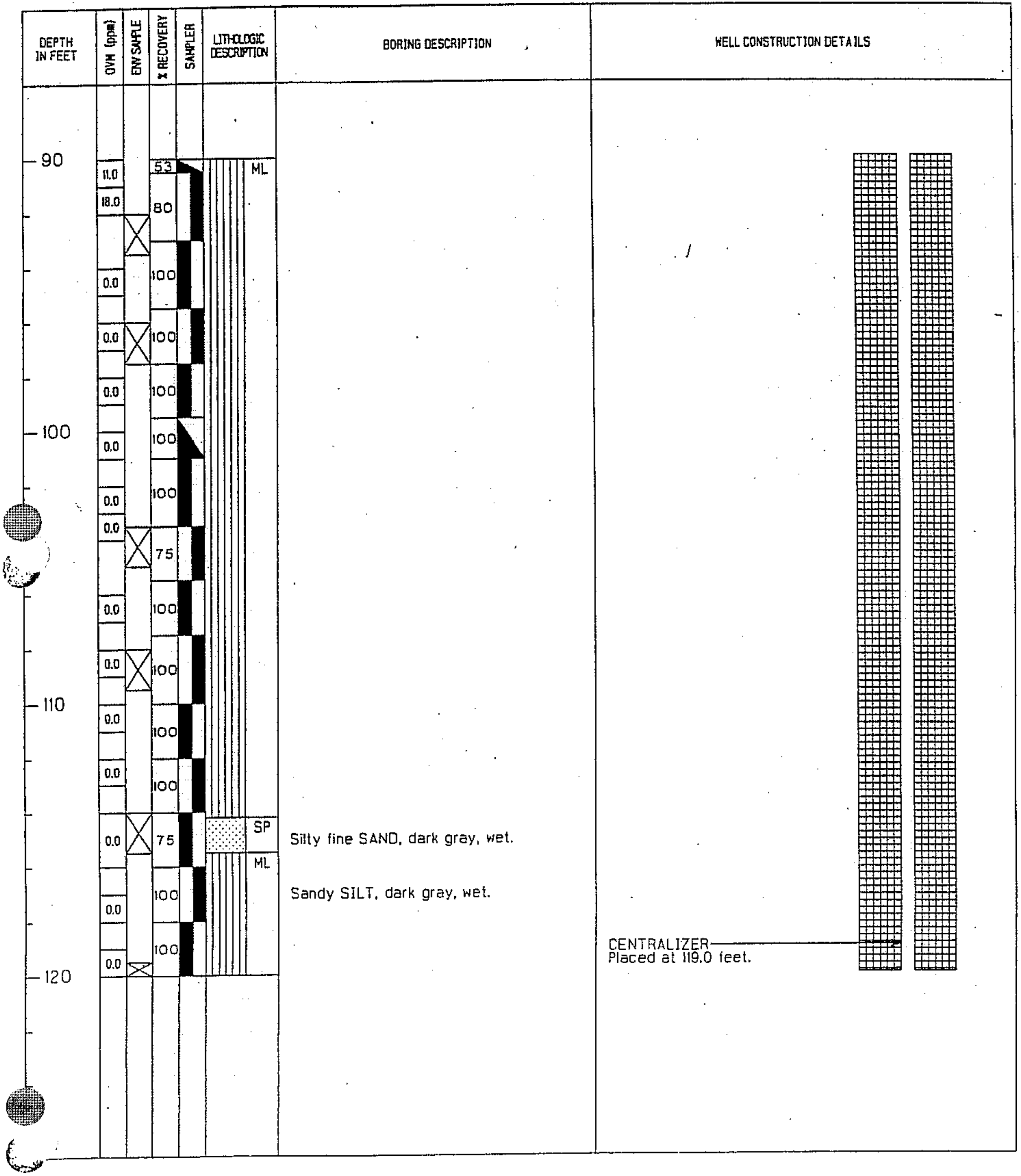


CENTRALIZER
Placed at 70.0 feet.

thin graded beds of sandy SILT from 67.5 to 85.5 feet.

wood chips and bark

WELL MW-23d

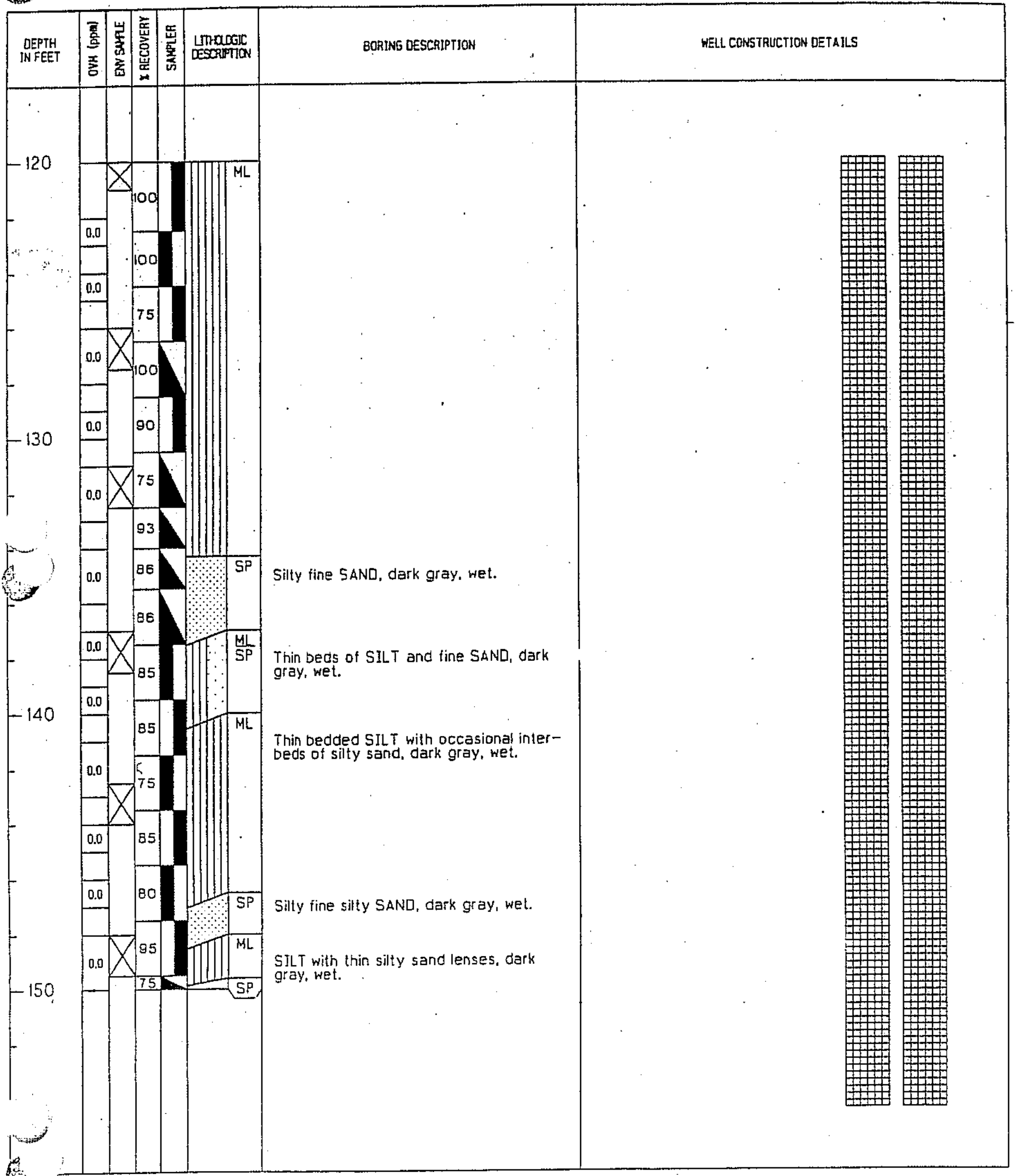


Silty fine SAND, dark gray, wet.

Sandy SILT, dark gray, wet.

CENTRALIZER
Placed at 119.0 feet.

WELL MW-23d



Silty fine SAND, dark gray, wet.

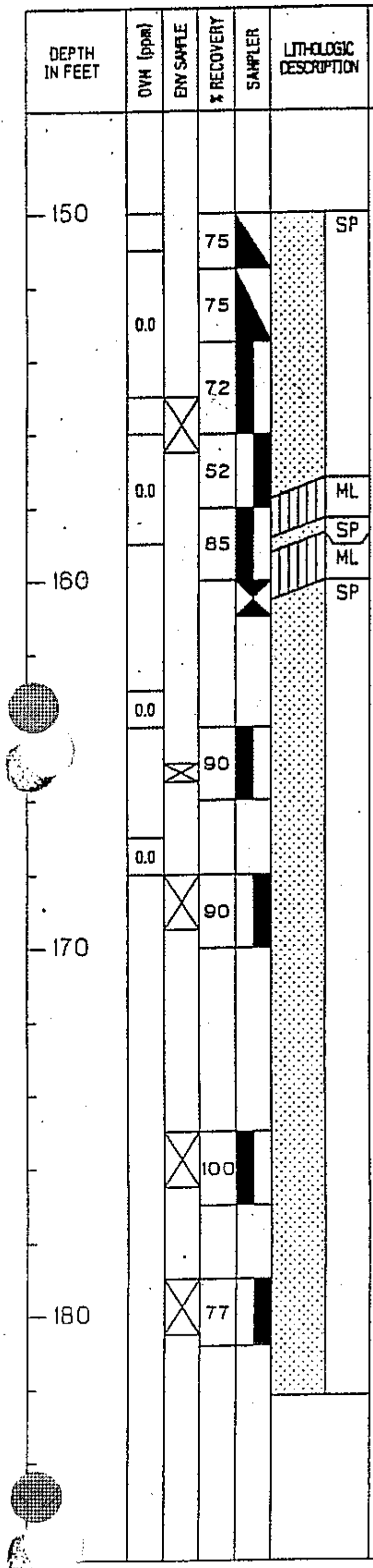
Thin beds of SILT and fine SAND, dark gray, wet.

Thin bedded SILT with occasional interbeds of silty sand, dark gray, wet.

Silty fine silty SAND, dark gray, wet.

SILT with thin silty sand lenses, dark gray, wet.

WELL MW-23d



BORING DESCRIPTION

Fine SAND with trace silt, very dark gray, wet.

SILT, dark gray, wet.
SAND, dark gray, wet.
SILT, dark gray, wet.

Fine to medium SAND, very dark gray, wet.

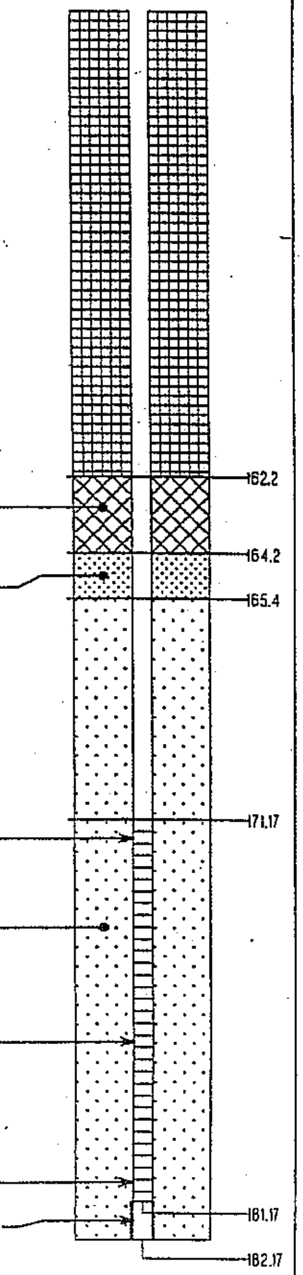
water in borehole

palagonite-like alteration, quartzite clast, light olive gray

Total depth 182.17 feet.

Creosote-like odor and oily sheen observed in soil samples from 1.0 to 32.0 feet. Banded zones of creosote-like material from 2.0 to 8.0 feet. Creosote-like liquid observed in soil samples at 25.0 feet.

WELL CONSTRUCTION DETAILS



ANNULAR SEAL
Medium bentonite pellets
1X5-gallon bucket
162.2 to 164.2 feet.

FILTER PACK
20-40 sand
164.2 to 165.4 feet.

CENTRALIZER
Placed at 171.67 feet.

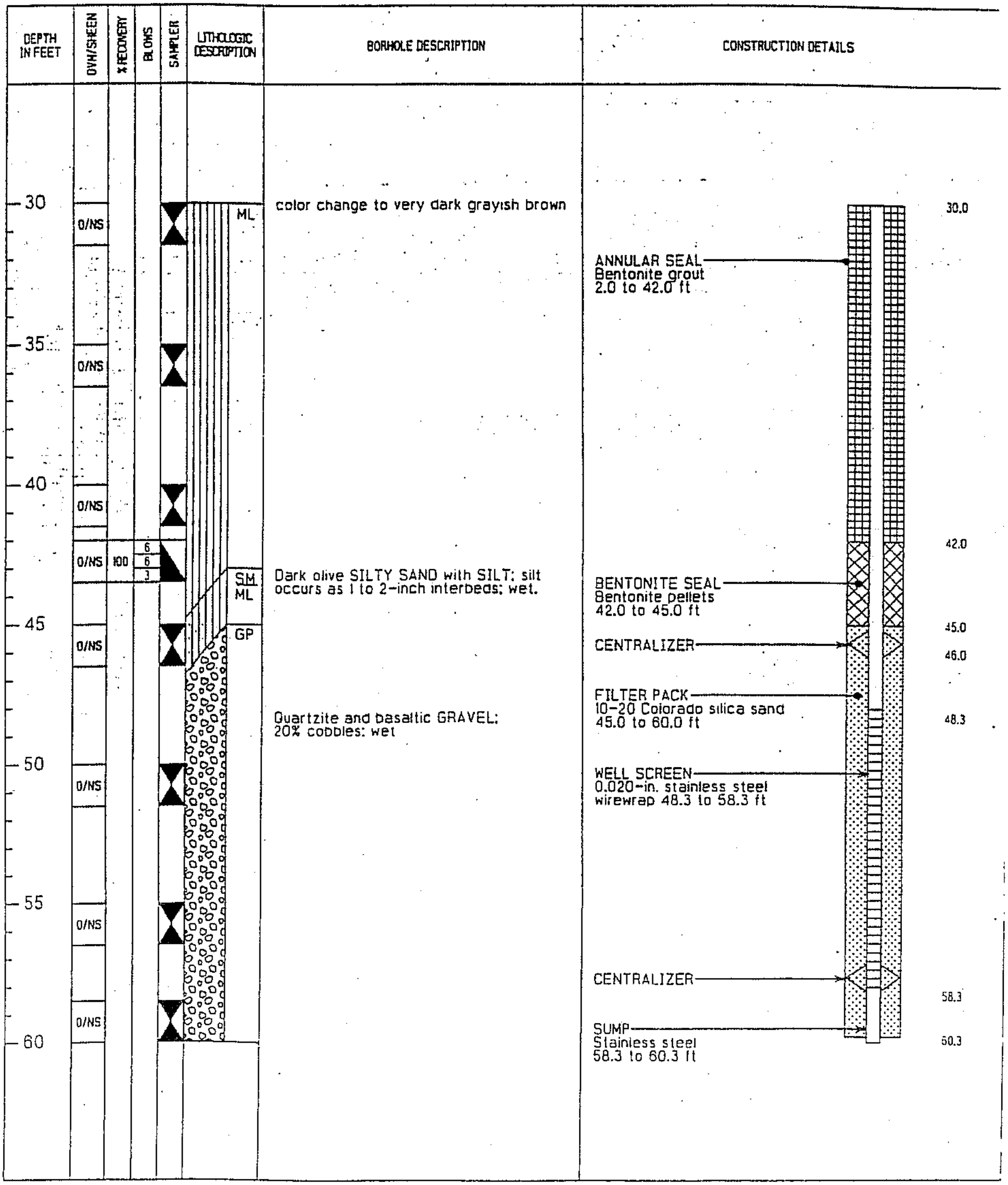
FILTER PACK
1x100# bags 10-20 sand
165.4 to 182.17 feet.

WELL SCREEN
0.020 slot stainless steel
171.17 to 181.17 feet.

CENTRALIZER
Placed at 180.67 feet.

1-FOOT SUMP AND END CAP

WELL MW-32



color change to very dark grayish brown

Dark olive SILTY SAND with SILT; silt occurs as 1 to 2-inch interbeds; wet.

Quartzite and basaltic GRAVEL; 20% cobbles; wet

ANNULAR SEAL
Bentonite grout
2.0 to 42.0 ft

BENTONITE SEAL
Bentonite pellets
42.0 to 45.0 ft

CENTRALIZER

FILTER PACK
10–20 Colorado silica sand
45.0 to 60.0 ft

WELL SCREEN
0.020-in. stainless steel
wirewrap 48.3 to 58.3 ft

CENTRALIZER

SUMP
Stainless steel
58.3 to 60.3 ft

PTI
ENVIRONMENTAL SERVICES

WELL MW-34

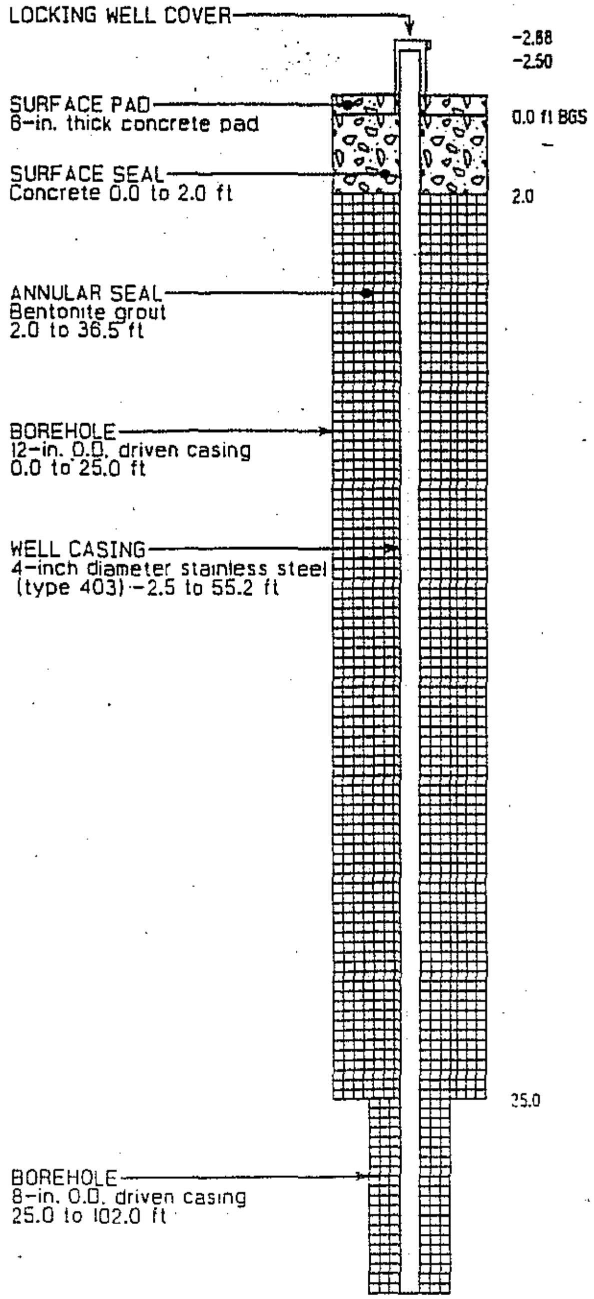
✓
PAGE 1 OF 4

PROJECT MCCORMICK & BAXTER
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C4120306
GEOLOGIST/ENGINEER A. SOUKUP
DRILLING CONTRACTOR STACO WELL SERVICES
DRILLING METHOD CABLE TOOL

DEPTH OF BORING 102.0
DATE (s) DRILLED Dec. 7-16, 1993
COORDINATES 705019.2985N,1425535.0753E
WELL CASING ELEVATION 25.15
SURFACE PAD ELEVATION 22.65
TOTAL WELL CASING LENGTH 79.70

DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION
0					SP	
5	0/NS	5	2 1 1 2			Fine to medium SAND
	0/NS	0	2 2 2 1			
10	1/NS	50	2 2 4 4			sheen on sampler
	0/SS	100				
15	75/HS	50	3 3 6 12		SP SM	Very dark gray fine to medium SAND interbedded with silty sand; trace wood chips; 10% subrounded gravel.
	0/NS	100	2 6 12 29			
20	20/SS	90	2 3 4 6		SP	no gravel or silt; trace wood chips.
		70	4 6 10 11			
25	2/SS	50	3 5 5 8			Very dark gray fine SAND with 10 to 20% silty sand; heaving conditions.
		100	3 5 8 10			
30						

CONSTRUCTION DETAILS



LOCKING WELL COVER

SURFACE PAD
6-in. thick concrete pad

SURFACE SEAL
Concrete 0.0 to 2.0 ft

ANNULAR SEAL
Bentonite grout
2.0 to 36.5 ft

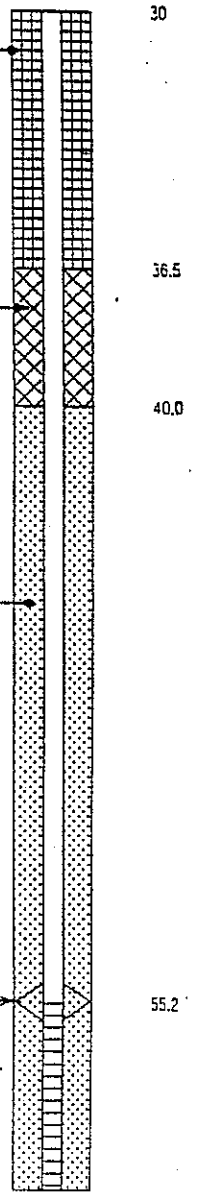
BOREHOLE
12-in. O.D. driven casing
0.0 to 25.0 ft

WELL CASING
4-inch diameter stainless steel
(type 403) -2.5 to 55.2 ft

BOREHOLE
8-in. O.D. driven casing
25.0 to 102.0 ft

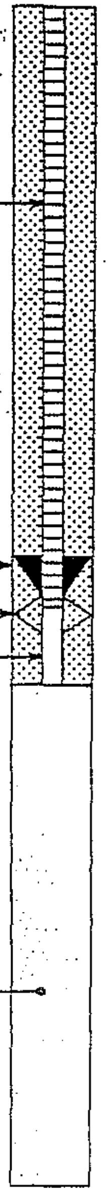
WELL MW-34

DEPTH IN FEET	OVH/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION	CONSTRUCTION DETAILS
30	0/NS	50	4 1 3 5	◣	SP	Very dark gray fine to medium SAND.	BOREHOLE 8-in. O.D. driven casing 25.0 to 102.0 ft
35	0/NS	50	6 6 4 5	◣			
							BENTONITE SEAL Bentonite pellets 36.5 to 40.0 ft
40	0/NS	80	2 3 4 8	◣		15% coarse sand	
45	0/NS	60	1 1 2 3	◣			FILTER PACK 10-20 Colorado silica sand 40.0 to 77.2 ft
50	0/NS	65	4 4 4 8	◣		medium SAND; 5% silt	
55	0/NS	60	1 3 5 10	◣		heaving conditions	CENTRALIZER
60					SP SM		



WELL MW-34

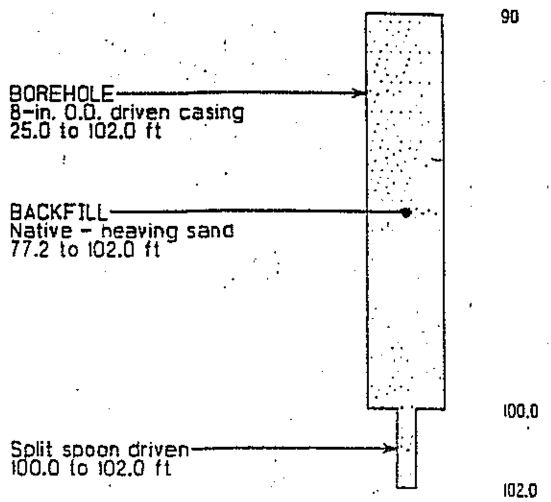
DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION	CONSTRUCTION DETAILS
60	O/NS	50	2 3 5 7		SP SM	Very dark gray fine to medium SAND; 10% silt; heaving conditions.	60
65	O/NS	60	2 2 4 9		SP	no silt; little or no heaving sand	WELL SCREEN 0.020-in. stainless steel wirewrap 55.2 to 75.2 ft
70	1/NS	65	2 3 4 11				
75	1/NS	50	4 3 9 12			trace silt	CONE Customized rubber cone CENTRALIZER 75.2 SUMP Stainless steel 75.2 to 77.2 ft 77.20
80	O/NS	5				heaving conditions	
85	O/NS	50	5 3 3 4				BACKFILL Native - heaving sand 77.2 to 102.0 ft
90							



WELL MW-34

DEPTH IN FEET	OVM/SHEEN	% RECOVERY	BLOWS	SAMPLER	LITHOLOGIC DESCRIPTION	BORHOLE DESCRIPTION
90	0/NS	15			SP	occasional silt; heaving conditions
95	0/NS	5	2 1 1 2			
100	0/NS	45	1 2 3 3			
						Total depth 102 ft
105						
						Creosote-like odor and sheen observed in samples from 11.5 to 27 ft; heavy sheen observed from 15 to 17 ft.
110						
115						
120						

CONSTRUCTION DETAILS



BOREHOLE
8-in. O.D. driven casing
25.0 to 102.0 ft

BACKFILL
Native - heaving sand
77.2 to 102.0 ft

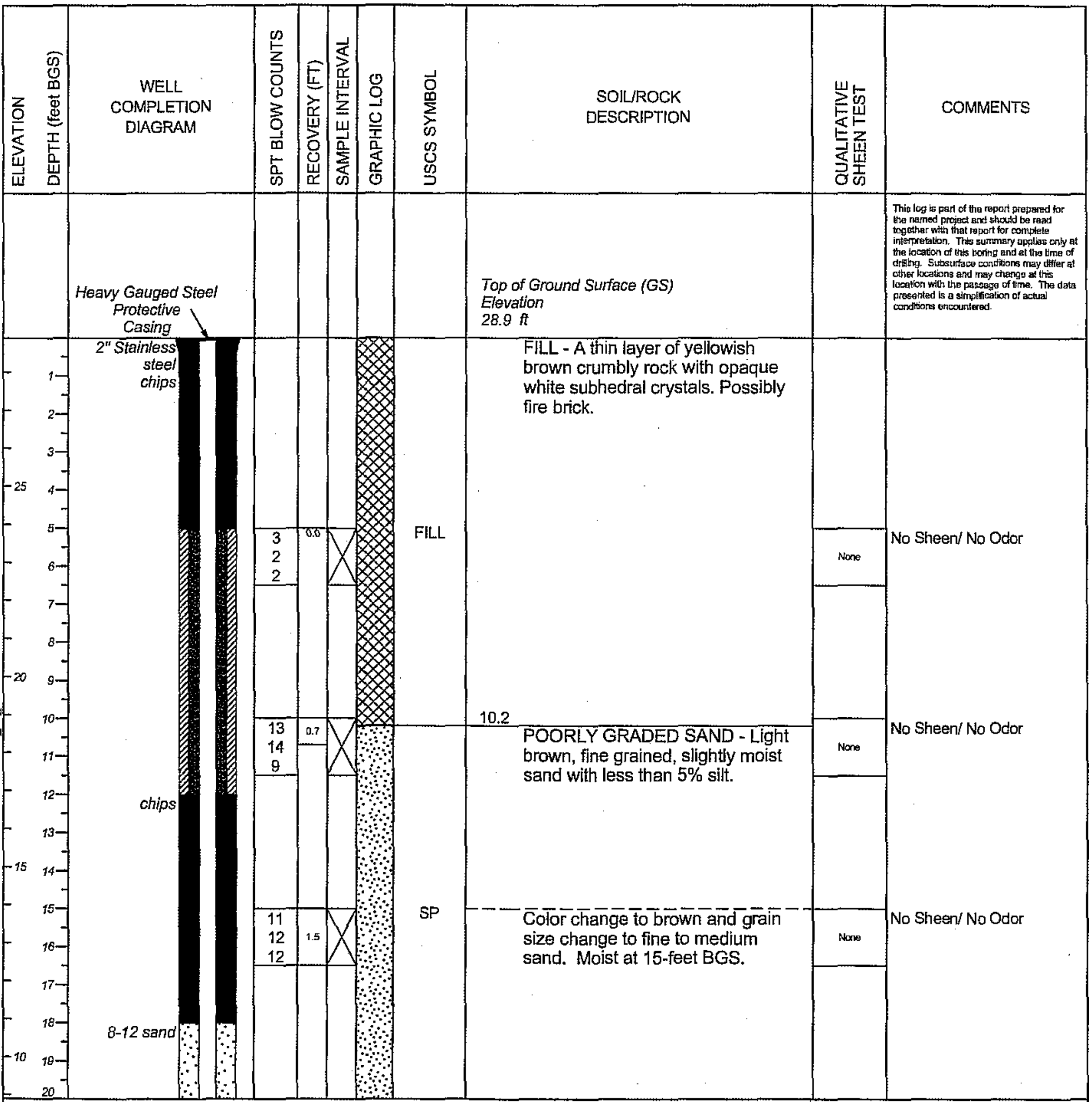
Split spoon driven
100.0 to 102.0 ft

DRILLING LOG OF WELL/BORING NO. MW-35r

DATE DRILLED: 6/27/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: D. Metzger
DRILLING METHOD: Hollow Stem Auger
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 705412.72
EASTING: 7627534.092

PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74

DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery



DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	Heavy Gauged Steel Protective Casing					*Top of Ground Surface (GS) Elevation 28.9 ft*		This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
0	*2" Stainless steel* *chips*					FILL - A thin layer of yellowish brown crumbly rock with opaque white subhedral crystals. Possibly fire brick.		
5		3 2 2	0.0	☒	FILL		None	No Sheen/ No Odor
10.2		13 14 9	0.7	☒		POORLY GRADED SAND - Light brown, fine grained, slightly moist sand with less than 5% silt.	None	No Sheen/ No Odor
12	*chips*							
15		11 12 12	1.5	☒	SP	Color change to brown and grain size change to fine to medium sand. Moist at 15-feet BGS.	None	No Sheen/ No Odor
18	*8-12 sand*							

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/9/06

DRILLING LOG OF WELL/BORING NO. MW-35r

ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	21	*.020 slot 2"* *Stainless steel* ▽	10 12 14	1.5	☒			POORLY GRADED SAND - Light brown, fine grained, slightly moist sand with less than 5% silt. *(continued)* Wet at 21-feet BGS.	None	No Sheen/ No Odor
	22									
	23									
5	24									
	25		3 9 13	1.5	☒			Grain size change to fine sand with 10% silt, and less than 5% fine gravel (up to 1/2 inch).	None	No Sheen/ No Odor
	26									
	27									
	28									
0	29									
	30		5 5 10	1.5	☒		SP	Color change to dark brown and grain size change to fine to medium sand with less than 5% silt.	None	No Sheen/ No Odor
	31									
	32									
	33									
-5	34									
	35		8 10 15	1.5	☒				None	No Sheen/ No Odor
	36									
	37									
	38									
-10	39									
	40		10 12 Heave	1.5	☒				None	No Sheen/ No Odor
	41							41.5		
	42									
	43									
-15	44									
	45									
	46									
	47									

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/9/06

DRILLING LOG OF WELL/BORING NO. MW-36d

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished:

Northing/Easting: 704977.016/7627503.043

Start Card Well Number: L56138

Drill Method:

Total Depth of Hole (feet BGS): 81

Ground Elevation (feet above NGVD): 19.8[illegible]

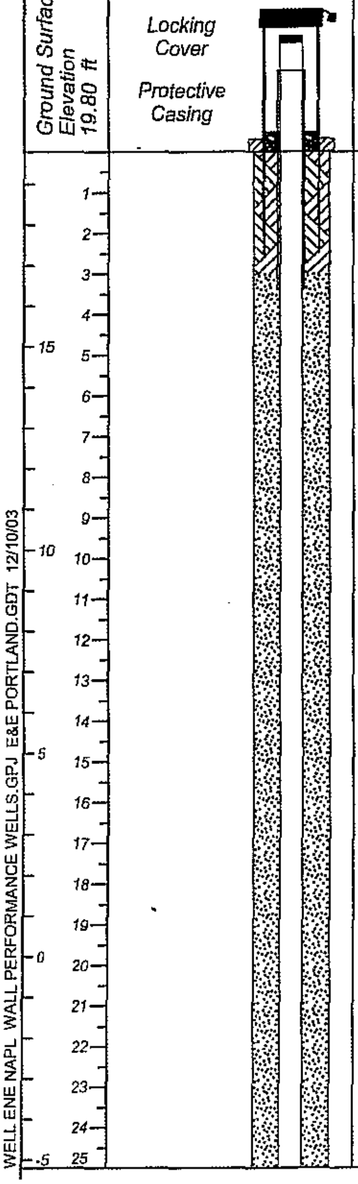
Inner Casing Elevation (TOC): 22.31

Groundwater Elevation (feet NGVD):

Geologist:

Drilling Contractor:

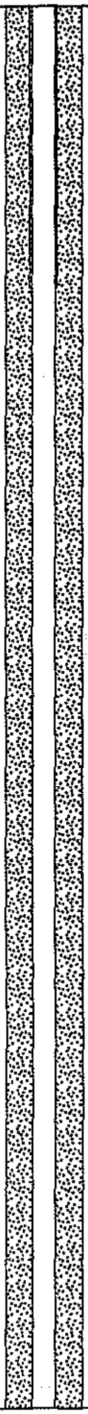
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 19.80 ft		*Locking Cover* *Protective Casing*		*ground surface (gs)*				



DRILLING LOG OF WELL/BORING NO. MW-36d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81

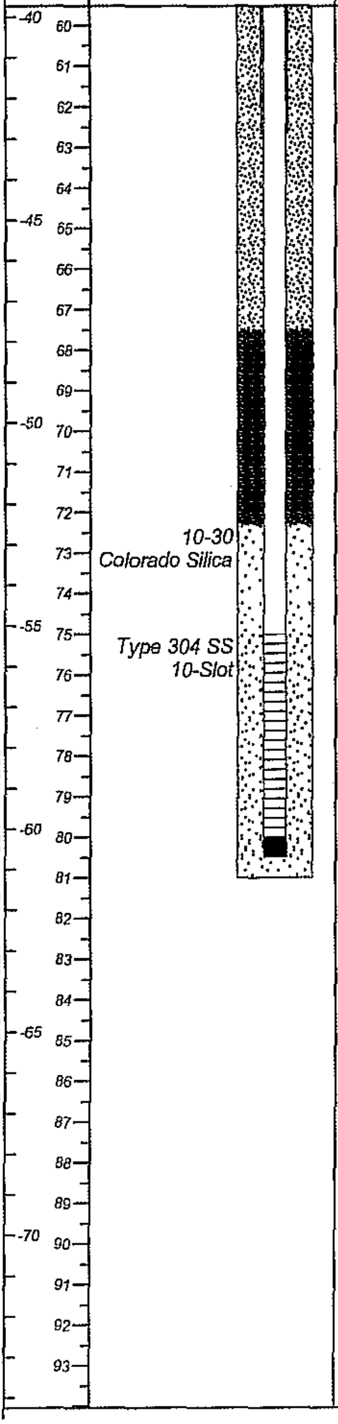
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
	27							
	28							
	29							
-10	30							
	31							
	32							
	33							
	34							
-15	35							
	36							
	37							
	38							
	39							
-20	40							
	41							
	42							
	43							
	44							
-25	45							
	46							
	47							
	48							
	49							
-30	50							
	51							
	52							
	53							
	54							
-35	55							
	56							
	57							
	58							
	59							

DRILLING LOG OF WELL/BORING NO. MW-36d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-36i

Page 1 of 2

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished:

Northing/Easting: 704979.211/7627498.46

Start Card Well Number: L56139

Drill Method:

Total Depth of Hole (feet BGS): 46.5

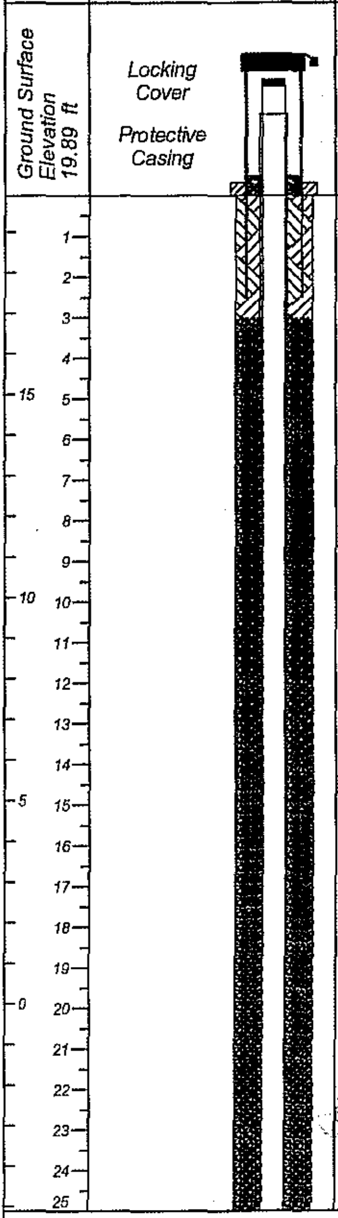
Ground Elevation (feet above NGVD): 19.89

Inner Casing Elevation (TOC): 22.59

Groundwater Elevation (feet NGVD):

Geologist:

Drilling Contractor:



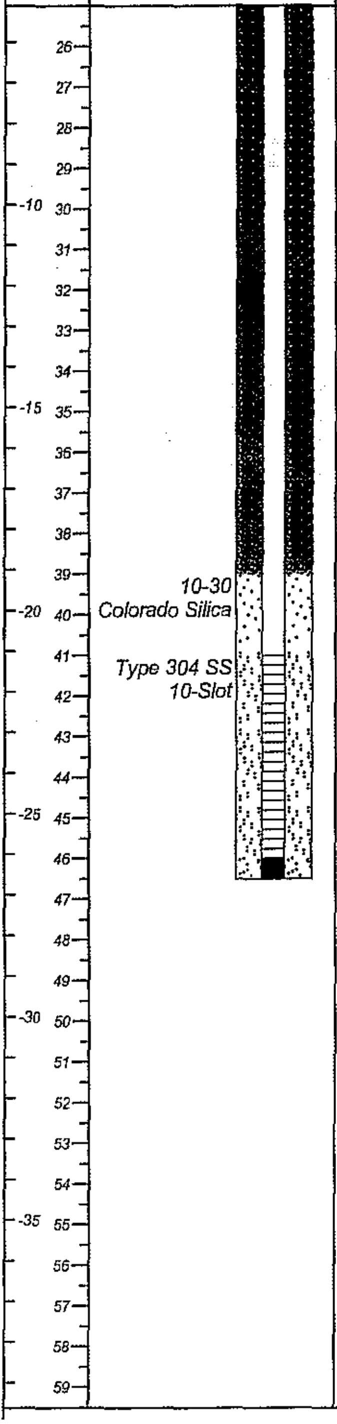
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 19.89 ft				ground surface (gs)				
								No lithology recorded for MW-36i. See log for MW-36d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-36i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 46.5

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



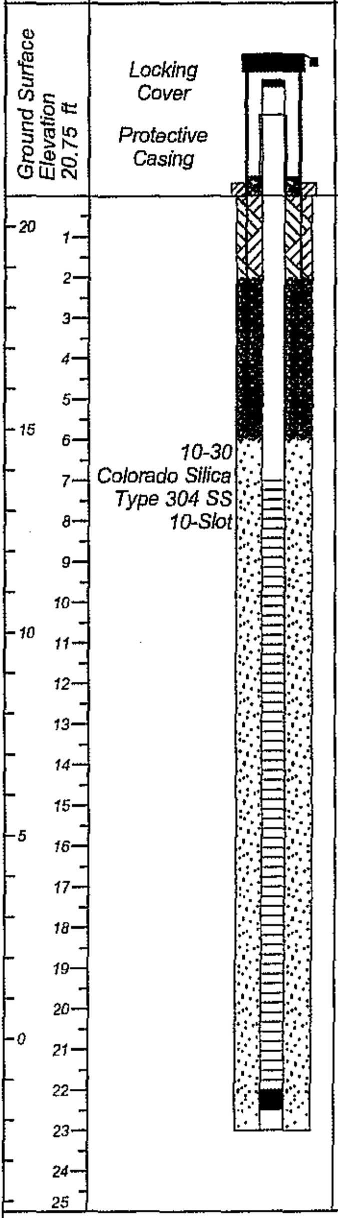
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-36s

Page 1 of 1

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished:
Northing/Easting: 704989.884/7627492.441
Start Card Well Number: L56140
Drill Method:

Total Depth of Hole (feet BGS): 23
Ground Elevation (feet above NGVD): 20.75
Inner Casing Elevation (TOC): 23.57
Groundwater Elevation (feet NGVD):
Geologist:
Drilling Contractor:

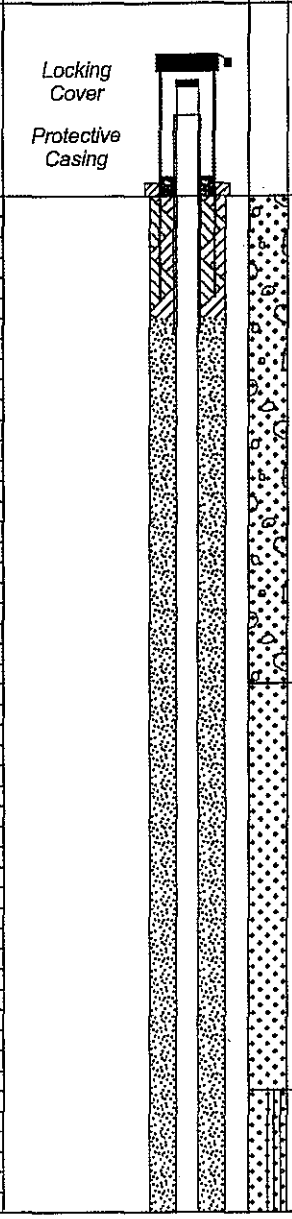


ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				
								No lithology recorded for MW-36s. See log for MW-36d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-37d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/16/2003
Northing/Easting: 704952.319/7627493.366
Start Card Well Number: L58477
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 76
Ground Elevation (feet above NGVD): 14.74
Inner Casing Elevation (TOC): 17.28
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

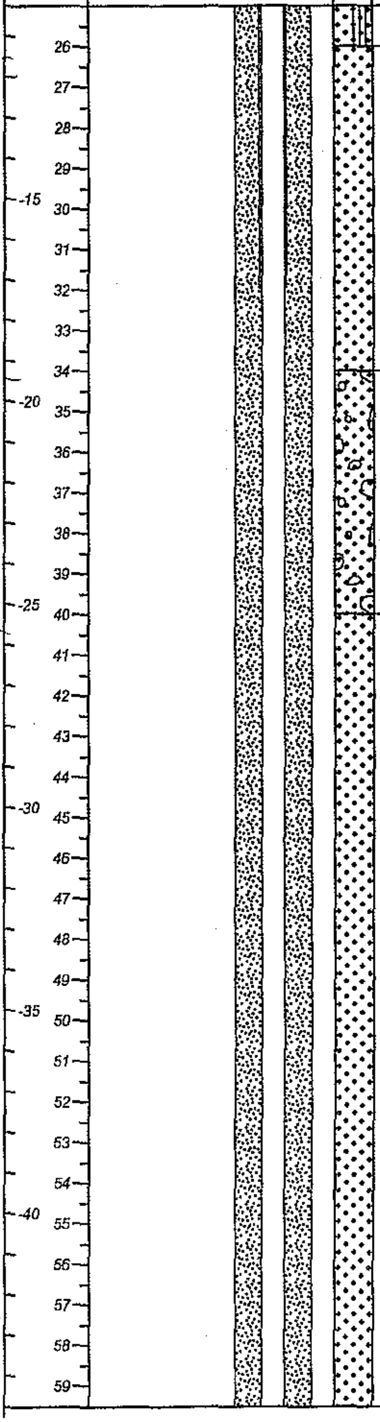


ELEVATION	DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 14.74 ft		ground surface (gs)				
	0	WELL GRADED GRAVELLY SAND - Black tan and gray, fine to coarse grained, subrounded to subangular sand with 20-30% fine gravel.				Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
10	5		✋	None		
5	10					
	12.0	WELL GRADED SAND - Black tan and gray, fine to coarse grained, subangular to subrounded sand with little fine gravel.				
0	15		✋	None	9:11:00 AM	
-5	20					
	22.0		✋			
-10	25				9:26:00	

DRILLING LOG OF WELL/BORING NO. MW-37d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 76



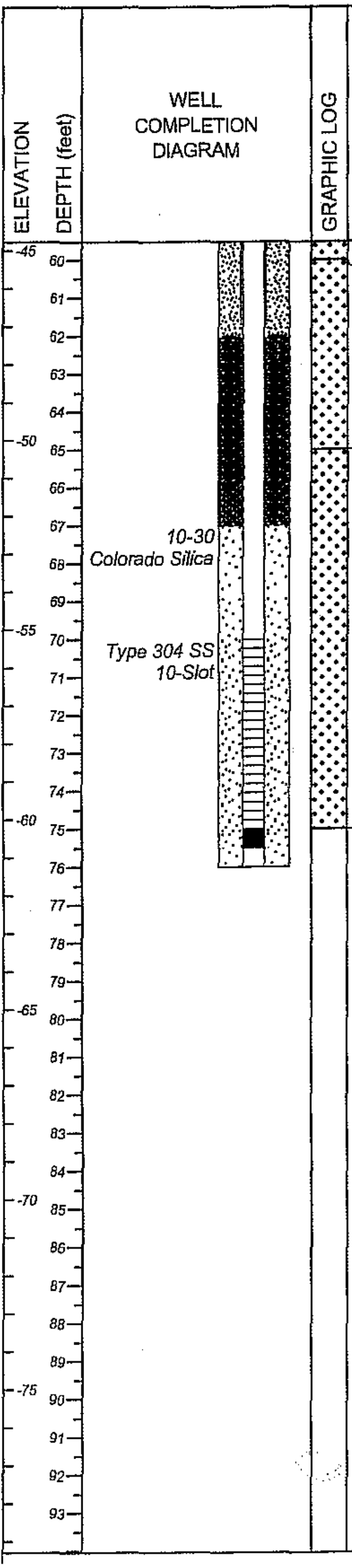
DEPTH (feet)	SOIL/ROCK DESCRIPTION	NAPL	Time	COMMENTS
26.0	WELL GRADED SAND WITH SILT - Dark gray, soft, sandy (30-40%) silt in lenses interbedded with fine to coarse grained sand. Sandy silt lenses are 2"-6" thick each, according to driller's observations. *(continued)*	None	AM	
	WELL GRADED SAND - Black tan and gray, fine to coarse grained sand with trace fine gravel.			
34.0	WELL GRADED GRAVELLY SAND - Black tan and gray (with occassional pink), fine to coarse grained, subrounded to subangular sand with 15-25% fine to medium grained gravel.	None	9:35:00 AM	
40.0	WELL GRADED SAND - Black and tan, very-fine to coarse grained, dense sand with occassional thin lenses of black very fine sand. Trace fine gravel present.	None	9:44:00 AM	Driller reports dense sand begins at 40-feet BGS.
		None	9:55:00 AM	

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-37d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 76



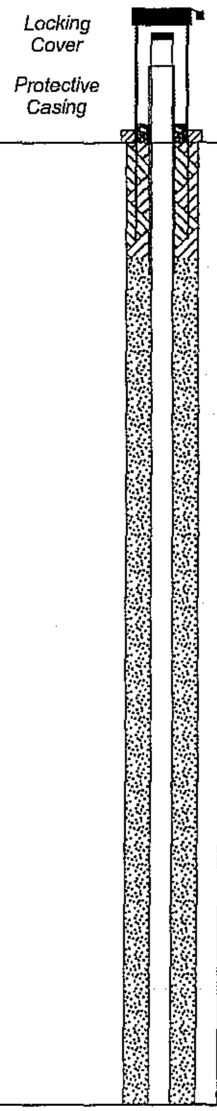
SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0 WELL GRADED SAND - Black with tan green and white, very dense, very-fine to coarse grained, subrounded to subangular, very dense sand. Some sand grains are elongated.				Driller reports very dense sand begins a 60-feet BGS.
65.0 WELL GRADED SAND - Black with tan green and white, very dense, very-fine to coarse grained, subrounded to subangular, dense sand. Some sand grains are elongated.	✋	None	10:16:00 AM	Driller reports that sand returns to dens at 65-feet BGS.
	✋	None	10:26:00 AM	
75.0				

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-37i

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/16/2003
Northing/Easting: 704955.69/7627487.27
Start Card Well Number: L58478
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 41
Ground Elevation (feet above NGVD): 14.83
Inner Casing Elevation (TOC): 17.51
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

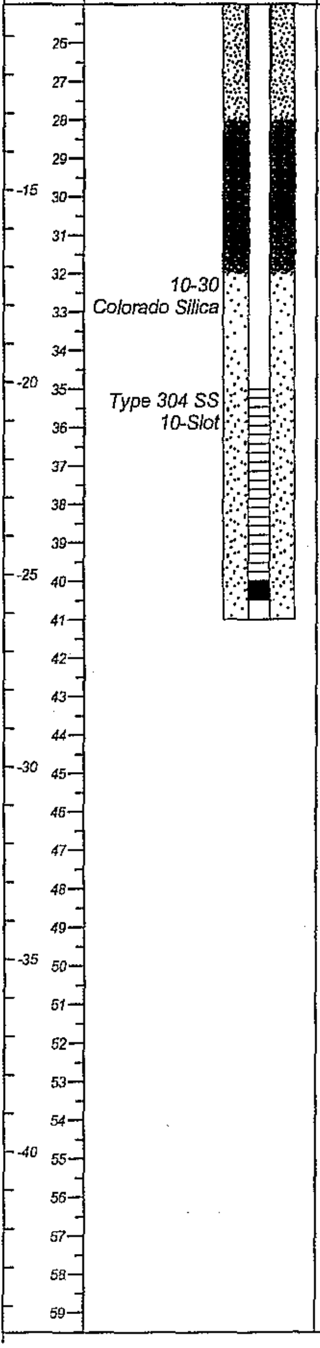
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 14.83 ft				*ground surface (gs)*				
10 5 0 -5 -10	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25							No lithology recorded for MW-37i. See log for MW-37d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-37i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 41

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS

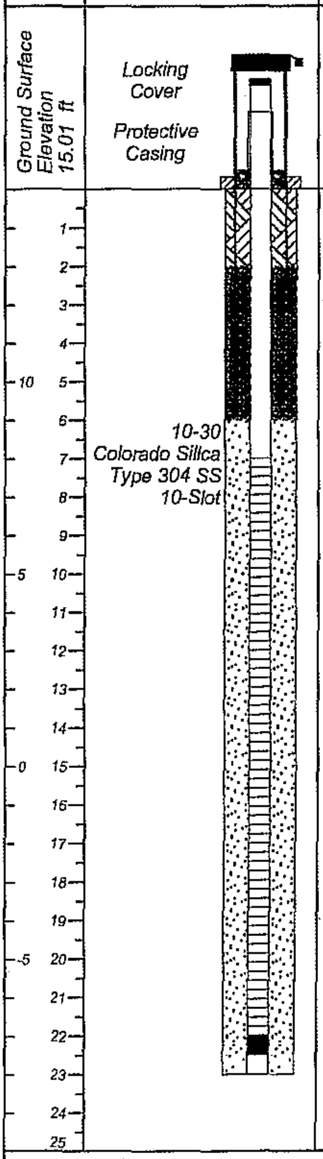


WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-37s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/16/2003
Northing/Easting: 704958.97/7627480.654
Start Card Well Number: L58479
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23
Ground Elevation (feet above NGVD): 15.01
Inner Casing Elevation (TOC): 17.75
Groundwater Elevation (feet NGVD): ______
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations



ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				
								No lithology recorded for MW-37s. See log for MW-37d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-38d

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/15/2003

Northing/Easting: 704905.626/7627709.401

Start Card Well Number: L56134

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 81

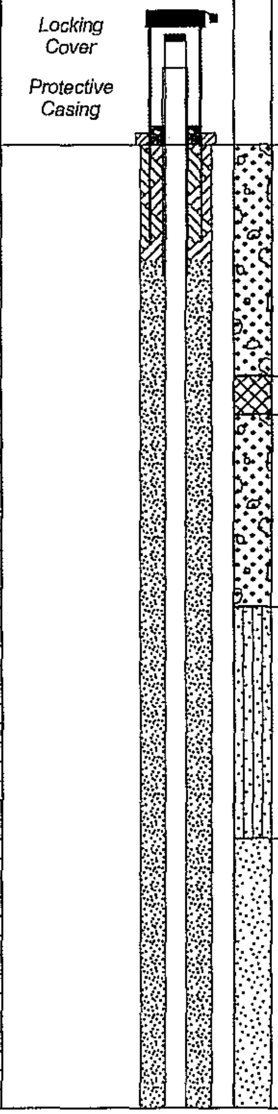
Ground Elevation (feet above NGVD): 20.25

Inner Casing Elevation (TOC): 22.90

Groundwater Elevation (feet NGVD):

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations

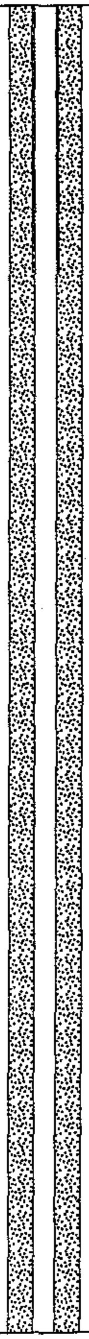


ELEVATION	DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.25 ft		ground surface (gs)				
20		WELL GRADED GRAVELLY SAND - Multicolored (tan, gray, green, white), fine to coarse grained, rounded to angular sand with 15-30% fine gravel.				Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
15	5		✋	None	9:03:00 AM	
	6.0	FILL (DEBRIS) - Tough, wood debris.				Wood debris struck at 6-feet BGS. Mu lost due to excessive chatter. Debris drilled through after mud tub was resealed.
	7.0	WELL GRADED GRAVELLY SAND - Multicolored (tan, gray, black, white, green), fine to coarse grained, rounded to angular sand with 15-30% fine gravel.				
10	10					
	12.0	SANDY SILT - Dark gray, medium stiff silt with 10-20% fine sand.				
5	15		✋	None	9:15:00 AM	
	18.0	POORLY GRADED SAND - Tan and black, fine to medium grained sand with some coarse sand, and 10% fine to medium grained, subangular to subrounded gravel.				
0	20					
	22		✋			
	25				9:22:00	

DRILLING LOG OF WELL/BORING NO. MW-38d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81



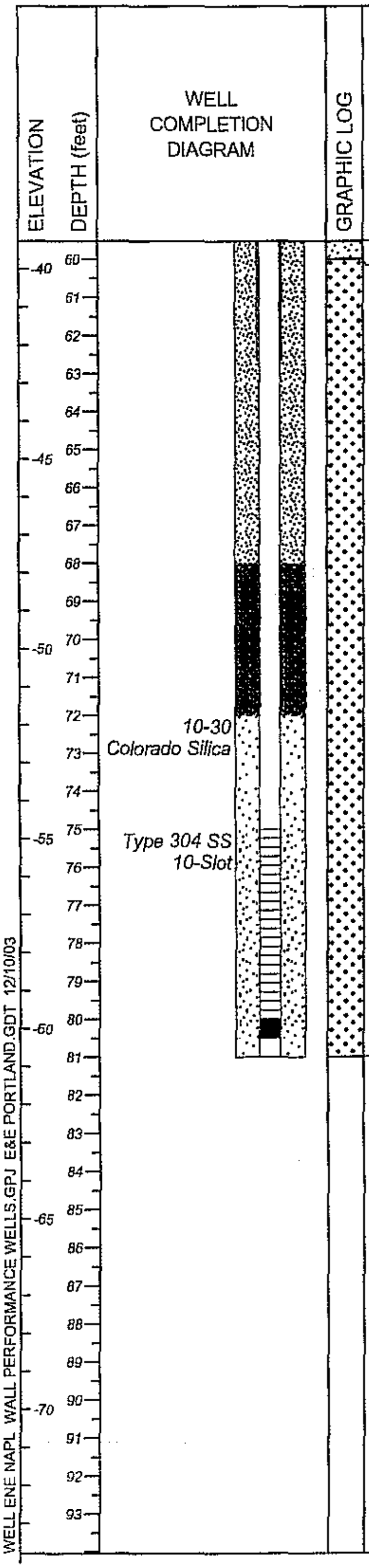
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
-5	26 27 28 29			POORLY GRADED SAND - Tan and black, fine to medium grained sand with some coarse sand, and 10% fine to medium grained, subangular to subrounded gravel. *(continued)*	✋	None	AM	
-10 -15	30 31 32 33 34 35 36 37 38 39			30.0 POORLY GRADED SAND - Black with some tan, fine to medium grained, subrounded, mafic sand. Tan grains appear to be feldspar. Trace fine gravel.	✋	None	9:30:00 AM	
-20 -25	40 41 42 43 44 45 46 47 48 49			40.0 POORLY GRADED SAND - Black with little white and tan, fine to medium grained, rounded to subrounded, mafic sand with little quartz and feldspar.	✋	None	9:36:00 AM	
-30 -35	50 51 52 53 54 55 56 57 58 59			50.0 POORLY GRADED SAND - Black with little tan and white, fine to medium grained, subrounded mafic sand with little quartz and feldspar. Some coarse angular sand present.	✋	None	9:46:00 AM	

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-38d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81



DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	WELL GRADED SAND - Black with little tan and white, very-fine to medium grained, subrounded to rounded sand. 20-40% of medium grains are angular.				
65		✋	None	9:54:00 AM	
75		✋	None	10:06:00 AM	
80		✋	None	10:07:00 AM	
81.0					

DRILLING LOG OF WELL/BORING NO. MW-38i

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/15/2003

Northing/Easting: 704904.954/7627713.538

Start Card Well Number: L56133

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 46

Ground Elevation (feet above NGVD): 20.24

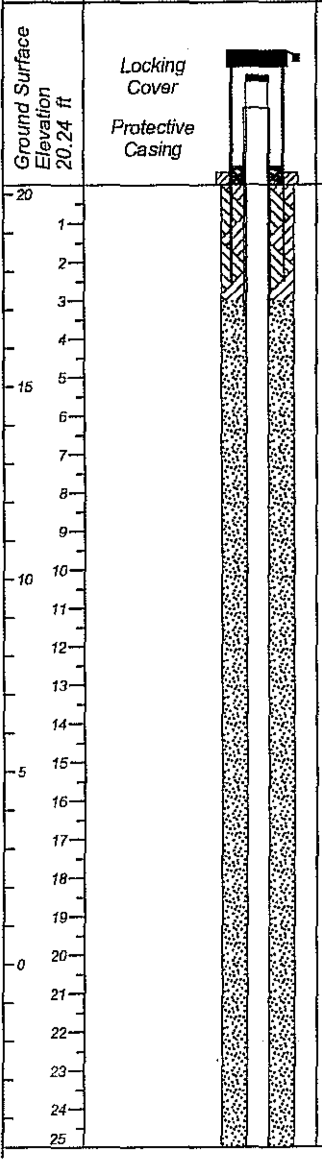
Inner Casing Elevation (TOC): 23.06

Groundwater Elevation (feet NGVD):

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.24 ft				*ground surface (gs)*				
								No lithology recorded for MW-38i. See log for MW-38d for detailed lithology.



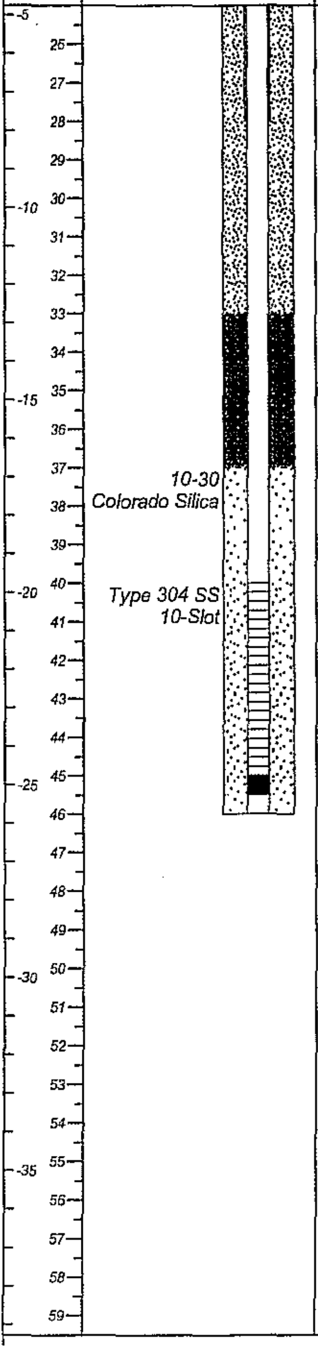
DRILLING LOG OF WELL/BORING NO. MW-38i

Page 2 of 2

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 46

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



DRILLING LOG OF WELL/BORING NO. MW-38s

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/15/2003

Northing/Easting: 704904.038/7627717.811

Start Card Well Number: L56132

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23

Ground Elevation (feet above NGVD): 20.11

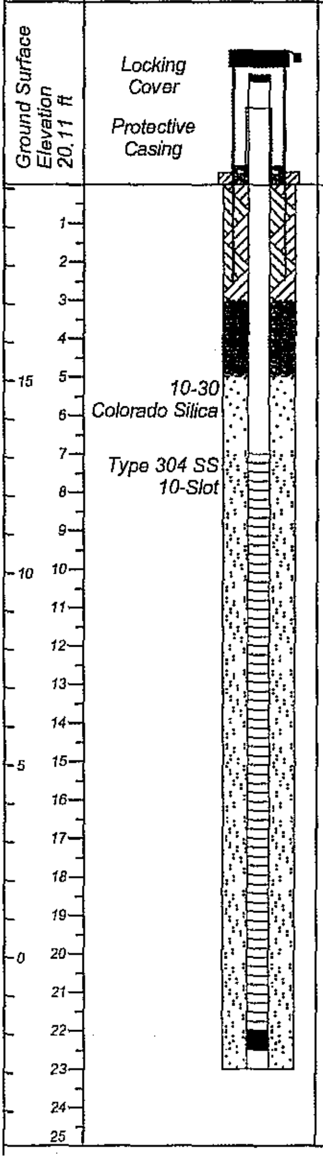
Inner Casing Elevation (TOC): 23.06

Groundwater Elevation (feet NGVD): ______

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.11 ft				*ground surface (gs)*				
								No lithology recorded for MW-38s. Se log for MW-38d for detailed lithology.



PROJECT NAME: Barrier Wall Performance Monitoring Well Networ

WELL NO.: MW-38

ecology and environment, inc.

DRILLING LOG OF WELL/BORING NO. MW-39d

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/11/2003

Northing/Easting: 704894.066/7627708.693

Start Card Well Number: L56137

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 81

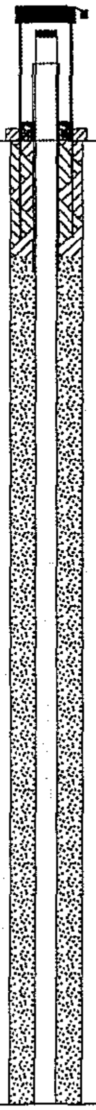
Ground Elevation (feet above NGVD): 19.78

Inner Casing Elevation (TOC): 22.55

Groundwater Elevation (feet NGVD):

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 19.78 ft		*Locking Cover* *Protective Casing* 		*ground surface (gs)*				
	1							Unable to determine moisture content soil because no SPT samples were scheduled to be collected.
	2							
	3							
	4							
15	5							
	6							
	7							
	8							
	9							
10	10							
	11							
	12							
	13							
	14							
5	15							
	16							
	17							
	18							
	19							
0	20							
	21							
	22							
	23							
	24							
-5	25							

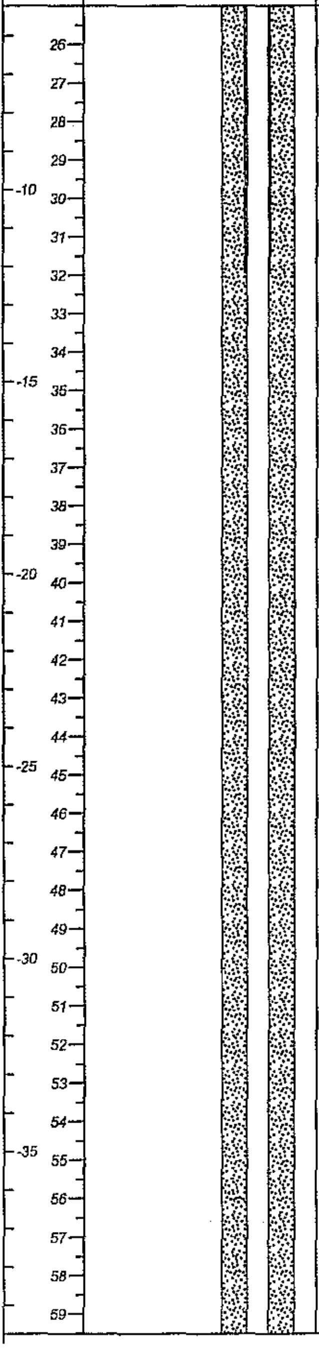
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-39d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



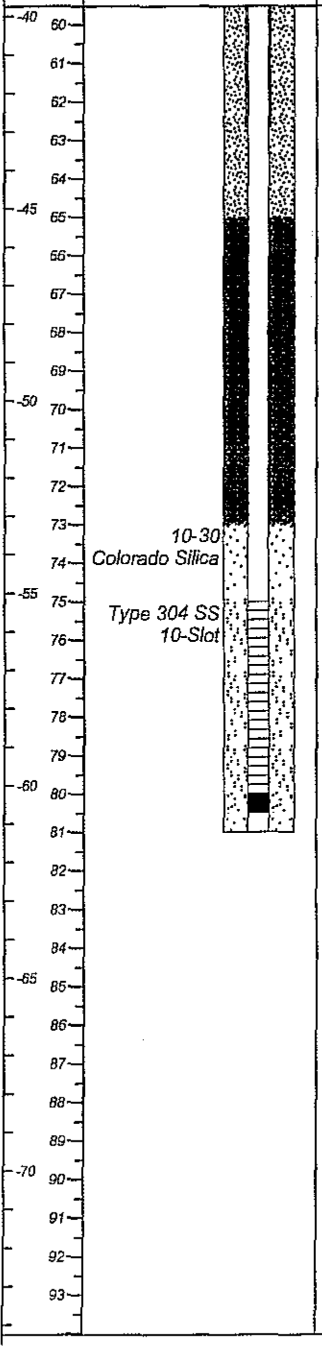
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-39d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



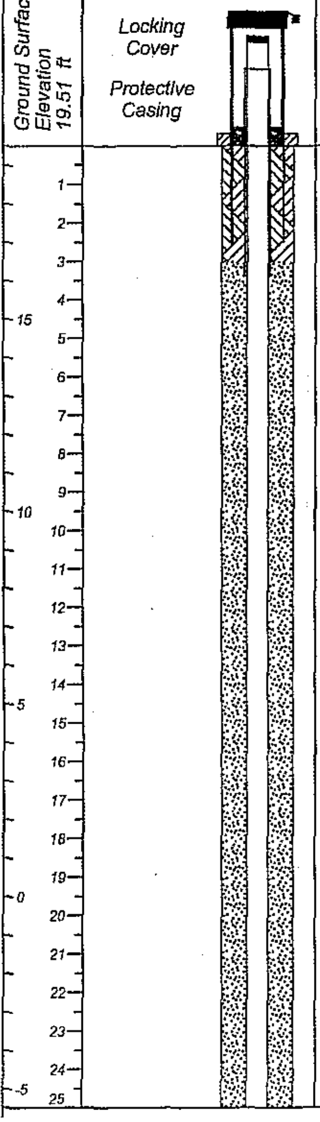
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-39i

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 704893.133/7627713.977
Start Card Well Number: L56136
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 46
Ground Elevation (feet above NGVD): 19.51
Inner Casing Elevation (TOC): 22.39
Groundwater Elevation (feet NGVD):
Geologist: M. Ochsner
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 19.51 ft		*Locking Cover* *Protective Casing*		*ground surface (gs)*				
								No lithology recorded for MW-39i. See log for MW-39d for detailed lithology.



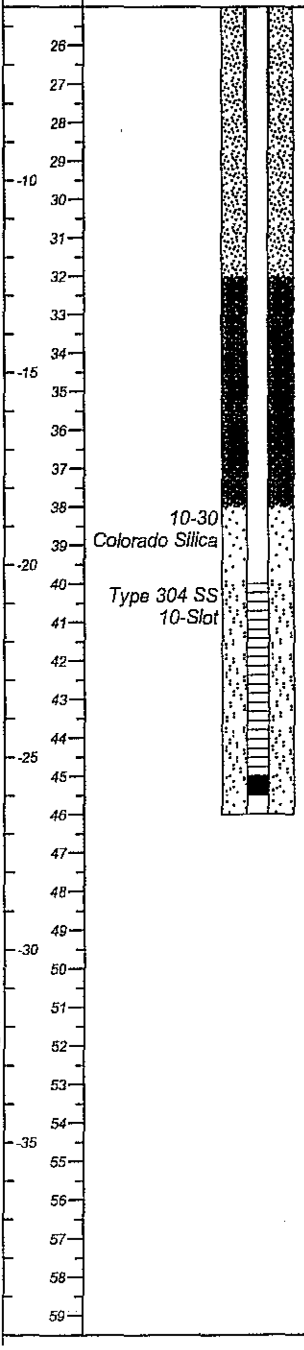
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-39i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 46

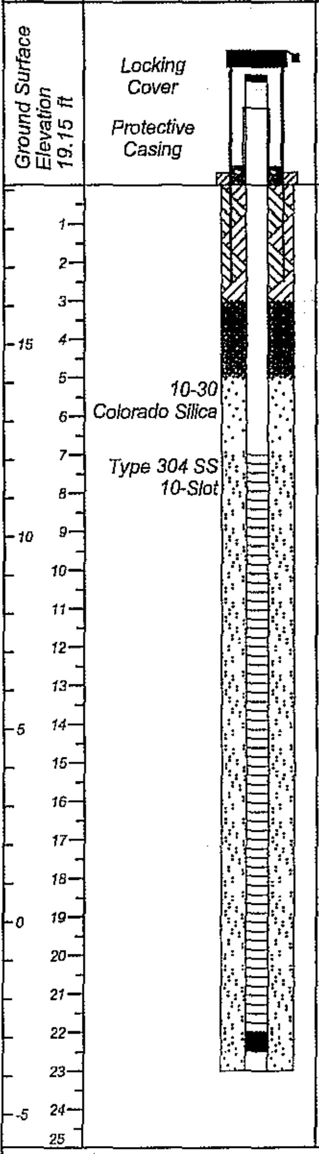
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



DRILLING LOG OF WELL/BORING NO. MW-39s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 704893.985/7627720.016
Start Card Well Number: L56135
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23
Ground Elevation (feet above NGVD): 19.15
Inner Casing Elevation (TOC): 22.02
Groundwater Elevation (feet NGVD):
Geologist: M. Ochsner
Drilling Contractor: Geo-Tech Explorations

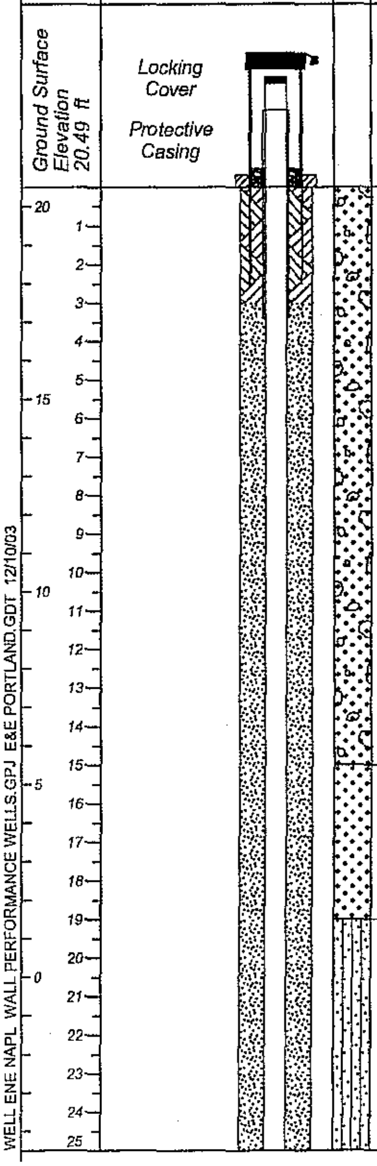
ELEVATION / DEPTH (feet) / WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
		ground surface (gs)				No lithology recorded for MW-39s. See log for MW-39d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-40d

Page 1 of 3

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/8/2003
Northing/Easting: 704794.469/7627900.482
Start Card Well Number: L58627
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 81
Ground Elevation (feet above NGVD): 20.49
Inner Casing Elevation (TOC): 23.08
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

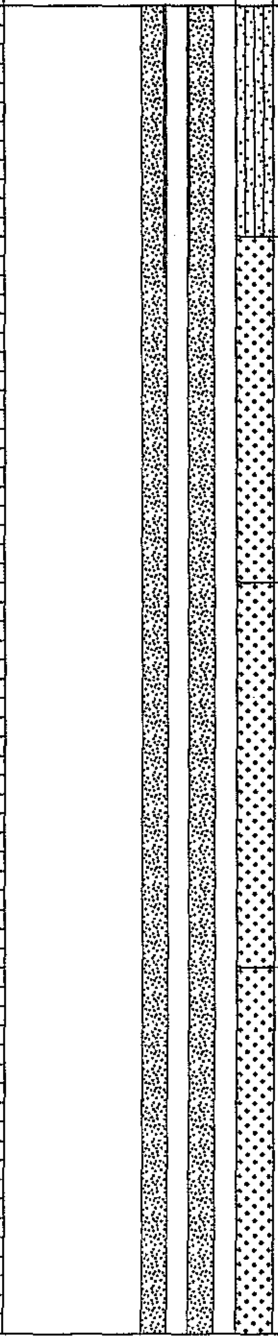


DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
	WELL GRADED GRAVELLY SAND - Black and tan, fine to coarse grained, subangular sand with fine gravel. Sand is mafic with feldspar and trace quartz.				Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
		✋	None	1:04:00 PM	
15.0	WELL GRADED SAND - Black and brown, fine to very coarse grained sand with little gravel and few small gray silt nodules. Some wood fragments at 17-feet BGS.	✋	None	1:14:00 PM	Driller reports easier drilling at 15-feet t 16-feet BGS.
19.0	SANDY SILT - Dark gray, medium stiff silt with 20-40% fine sand.				Driller reports silt contact at 19-feet BGS.
		✋		1:19:00	

DRILLING LOG OF WELL/BORING NO. MW-40d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81

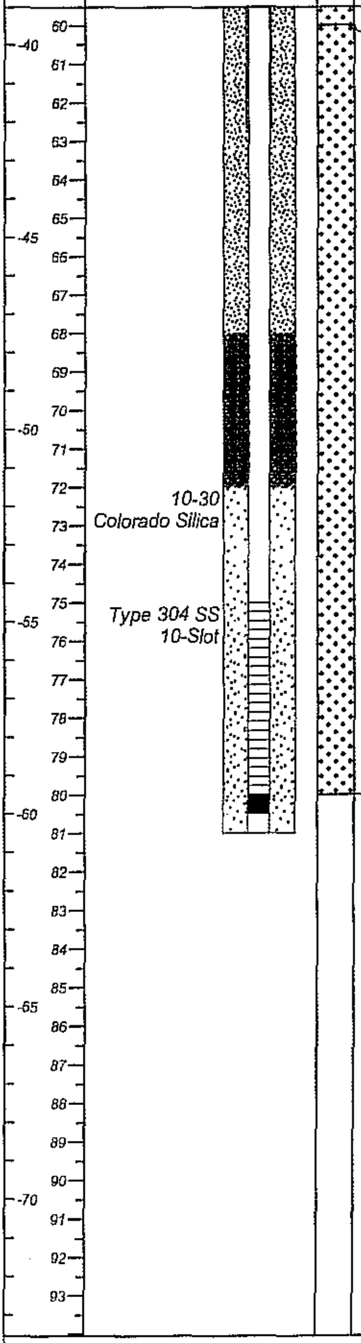


ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
-5 -10	26 27 28 29 30 31			SANDY SILT - Dark gray, medium stiff silt with 20-40% fine sand. *(continued)*	✋	None	PM	
-15	32 33 34 35 36 37 38 39 40			31.0 WELL GRADED SAND - Black with brown, fine to very coarse, subangular to subrounded sand. Sand is mafic with feldspar and trace quartz. Grains are spheroid to irregular.	✋	None	1:27:00 PM	Driller reports end of silt at 31-feet BGS
-20 -25	41 42 43 44 45 46 47 48 49 50			40.0 WELL GRADED SAND - Black with brown, red, trace white, angular to subrounded, fine to coarse grained sand with few nodules of gray silt. No NAPL odor.	✋	None	1:33:00 PM	Most of mud lost at 49-feet BGS. Mud remixed to continue drilling.
-30 -35	51 52 53 54 55 56 57 58 59			50.0 WELL GRADED SAND - Black with brown, subangular to subrounded, fine to coarse grained sand. Sand is mafic with feldspar and trace quartz, mostly spheroidal. Light creosote NAPL odor, no sheen.	✋	Odor	1:48:00 PM	Creosote NAPL odor in breathing zone.

DRILLING LOG OF WELL/BORING NO. MW-40d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81



Depth	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	WELL GRADED SAND - Black with brown, mostly subrounded, fine to coarse grained sand with few silt nodules. Sand is mafic with feldspar and little quartz. Some flattening of grains toward 80-feet BGS. No odor, no sheen.				
			None	2:00:00 PM	Occassional creosote NAPL odor in breathing zone.
			None	2:17:00 PM	
80.0					

DRILLING LOG OF WELL/BORING NO. MW-40i

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/9/2003

Northing/Easting: 704796.408/7627895.603

Start Card Well Number: L58628

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 47

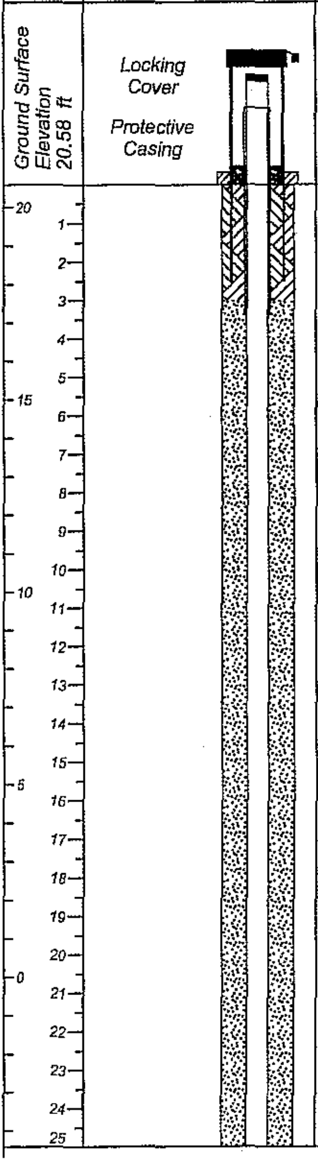
Ground Elevation (feet above NGVD): 20.58

Inner Casing Elevation (TOC): 23.24

Groundwater Elevation (feet NGVD):

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations



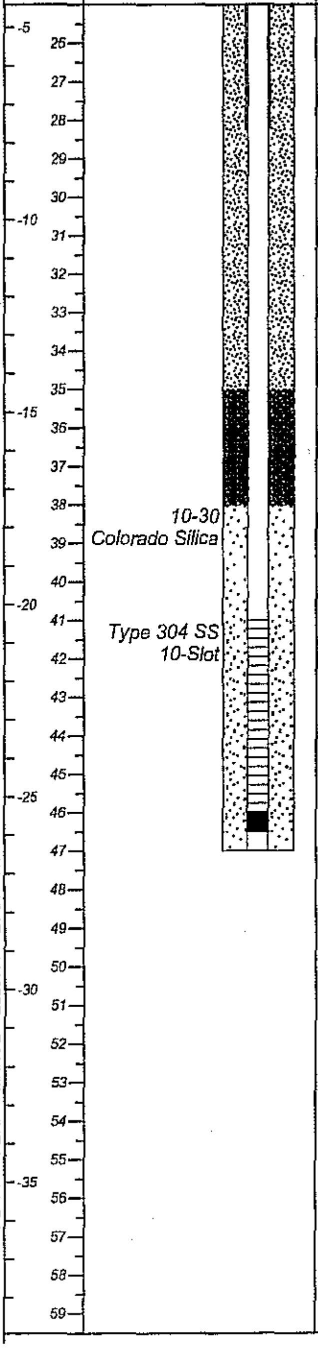
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.58 ft				ground surface (gs)				
								No lithology recorded for MW-40i. See log for MW-40d for detailed lithology.

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-40i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 47

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
								

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-40s

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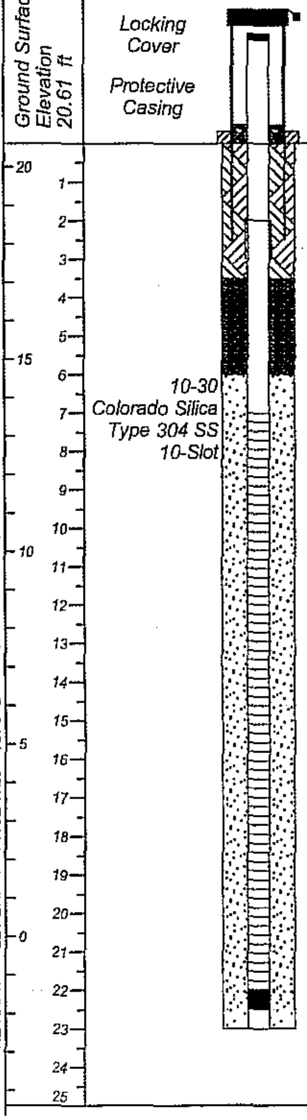
Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 704796.098/7627892.214
Start Card Well Number: L58629
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23
Ground Elevation (feet above NGVD): 20.61
Inner Casing Elevation (TOC): 23.40
Groundwater Elevation (feet NGVD): ______
Geologist: M. Ochsner
Drilling Contractor: Geo-Tech Explorations

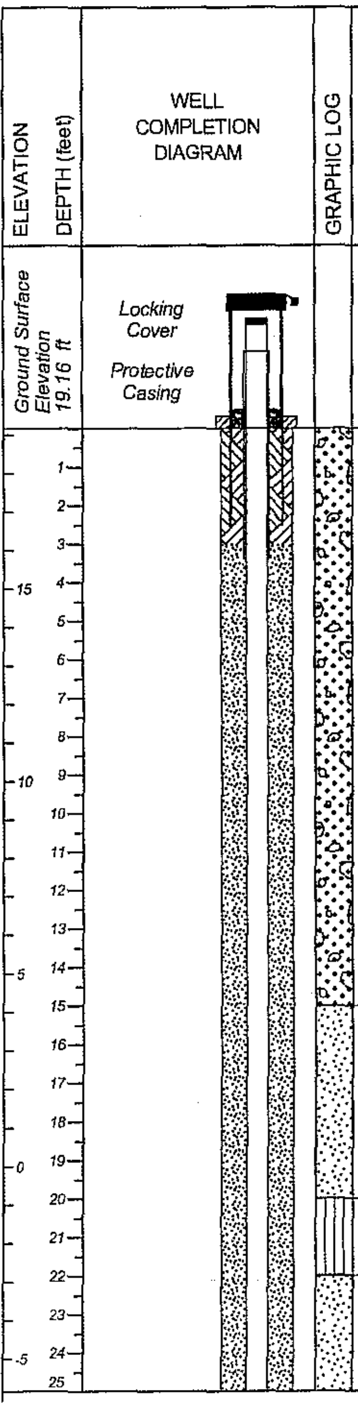
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.61 ft				*ground surface (gs)*				
								No lithology recorded for MW-40s. See log for MW-40d for detailed lithology.

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-41d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 704783.807/7627897.67
Start Card Well Number: L58630
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 81
Ground Elevation (feet above NGVD): 19.16
Inner Casing Elevation (TOC): 22.05
Groundwater Elevation (feet NGVD):
Geologist: M. Ochsner
Drilling Contractor: Geo-Tech Explorations



DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
	WELL GRADED GRAVELLY SAND - Brown, fine to medium grained sand with fine to medium grained, subrounded gravel.	✋	None	1:15:00 PM	Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
15.0	POORLY GRADED SAND - Brown, very moist, feldspar and quartz sand with occassional fine to medium, rounded gravel. Slightly weathered.	✋	None	1:25:00 PM	
20.0	SILT - Brown-gray to olive-gray, medium stiff silt with 10-12% very fine sand.				
22.0	POORLY GRADED SAND - Gray, medium dense sand with 10-12% silts or clays.	✋			
				1:40:00	

DRILLING LOG OF WELL/BORING NO. MW-41d

Project: Barrier Wall Performance Monitoring Well Network

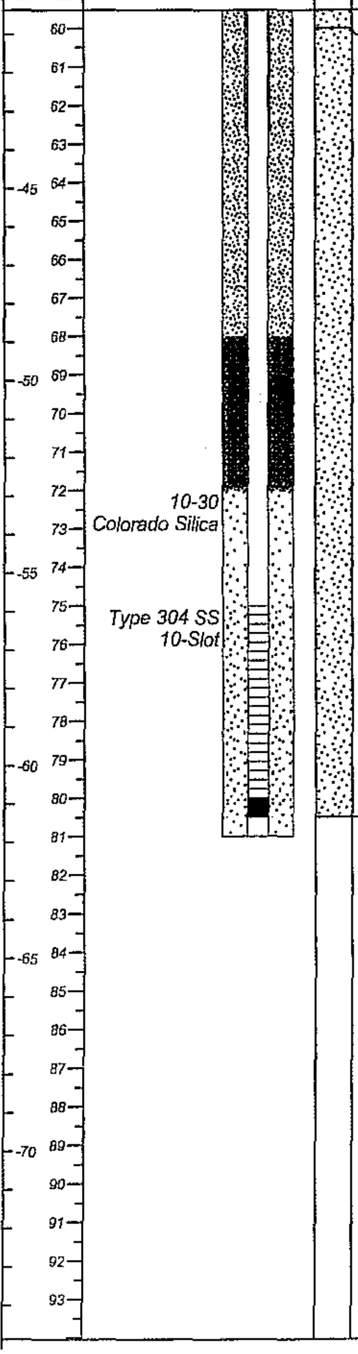
Total Depth of Hole (feet BGS): 81

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG		SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
-10	26 27 28 29 30				POORLY GRADED SAND - Gray, medium dense sand with 10-12% silts or clays. *(continued)*	✋	None	PM	
-15 -20	31 32 33 34 35 36 37 38 39					✋	None	1:55:00 PM	
-25	40 41 42 43 44 45 46 47 48 49			40.0	POORLY GRADED SAND - Gray to dark gray, medium dense sand with little or no fines. No odor, no sheen.	✋	None	2:30:00 PM	
-30 -35 -40	50 51 52 53 54 55 56 57 58 59			50.0	POORLY GRADED SAND - Black, fine to medium grained, subangular, slightly weathered sand with little or no fines. Slight hydrocarbon odor, no sheen.	✋	Odor	2:35:00 PM	

DRILLING LOG OF WELL/BORING NO. MW-41d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 81



DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	POORLY GRADED SAND - Black, fine to medium grained, subangular, slightly weathered sand with little or no fines. No odor, no sheen.				
65		✋	None	2:40:00 PM	
75		✋	None	2:50:00 PM	
80.5					

DRILLING LOG OF WELL/BORING NO. MW-41i

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/10/2003

Northing/Easting: 704782.945/7627892.498

Start Card Well Number: L58631

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 47

Ground Elevation (feet above NGVD): 19.20

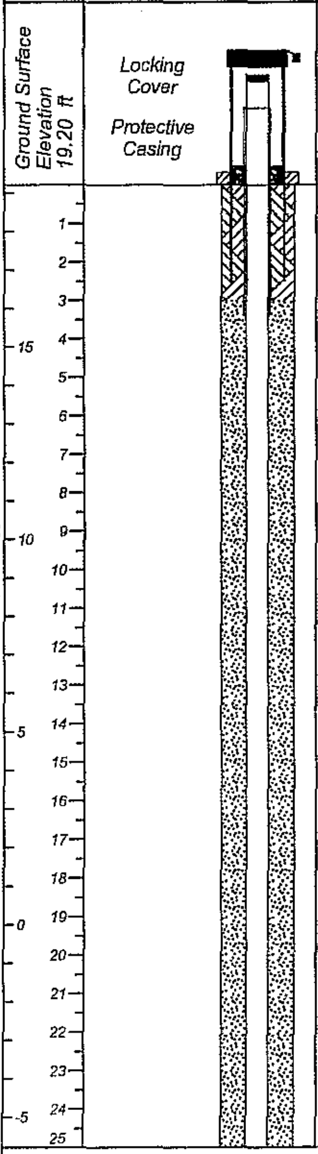
Inner Casing Elevation (TOC): 22.04

Groundwater Elevation (feet NGVD):

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 19.20 ft		Locking Cover Protective Casing		ground surface (gs)				
								No lithology recorded for MW-41i. See log for MW-41d for detailed lithology.

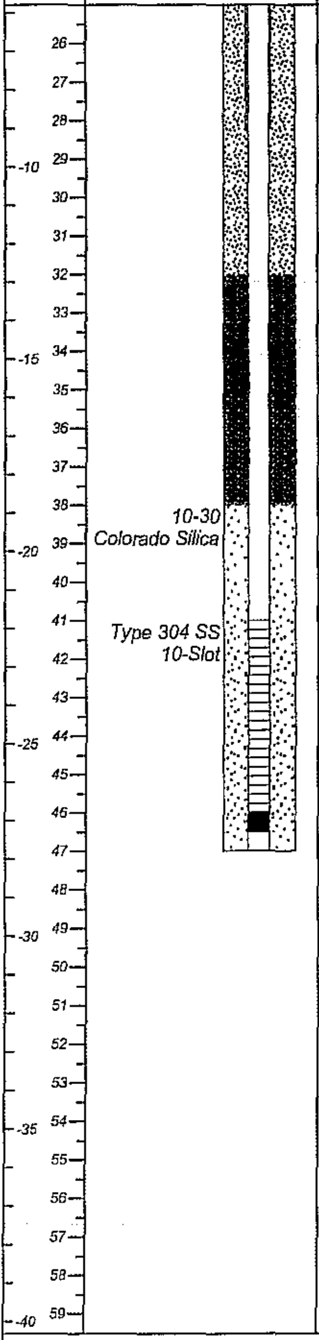


DRILLING LOG OF WELL/BORING NO. MW-41i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 47

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



DRILLING LOG OF WELL/BORING NO. MW-41s

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Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/10/2003

Northing/Easting: 704787.492/7627889.996

Start Card Well Number: L56131

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23

Ground Elevation (feet above NGVD): 19.44

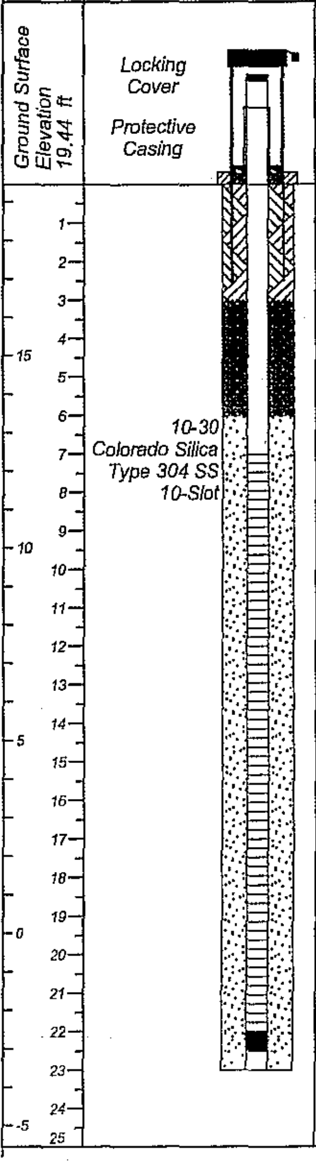
Inner Casing Elevation (TOC): 22.26

Groundwater Elevation (feet NGVD): ______

Geologist: M. Ochsner

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded for MW-41s. See log for MW-41d for detailed lithology.



PROJECT NAME: Barrier Wall Performance Monitoring Well Network

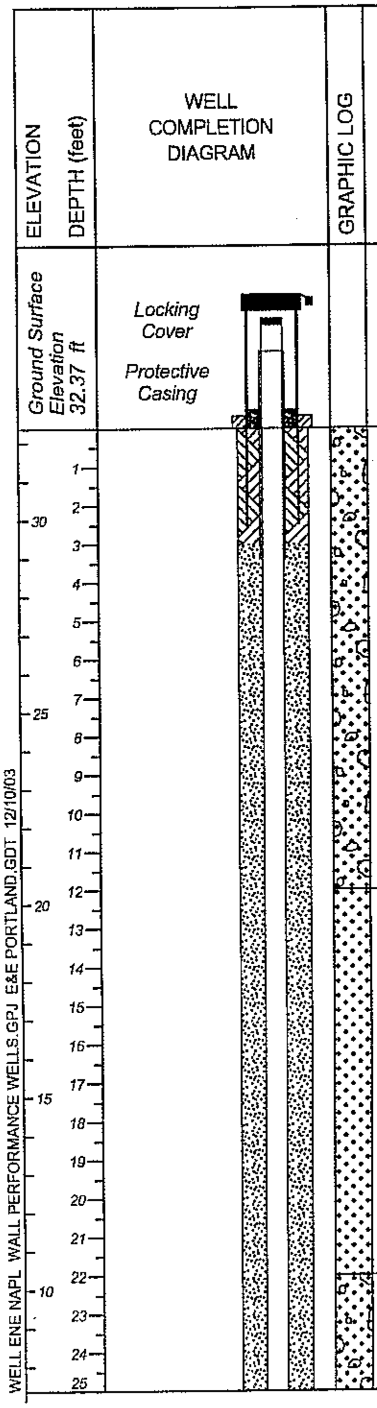
WELL NO.: MW-41s

ecology and environment, inc.

DRILLING LOG OF WELL/BORING NO. MW-42d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/19/2003
Northing/Easting: 704796.482/7628030.834
Start Card Well Number: L56126
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 93
Ground Elevation (feet above NGVD): 32.37
Inner Casing Elevation (TOC): 35.02
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

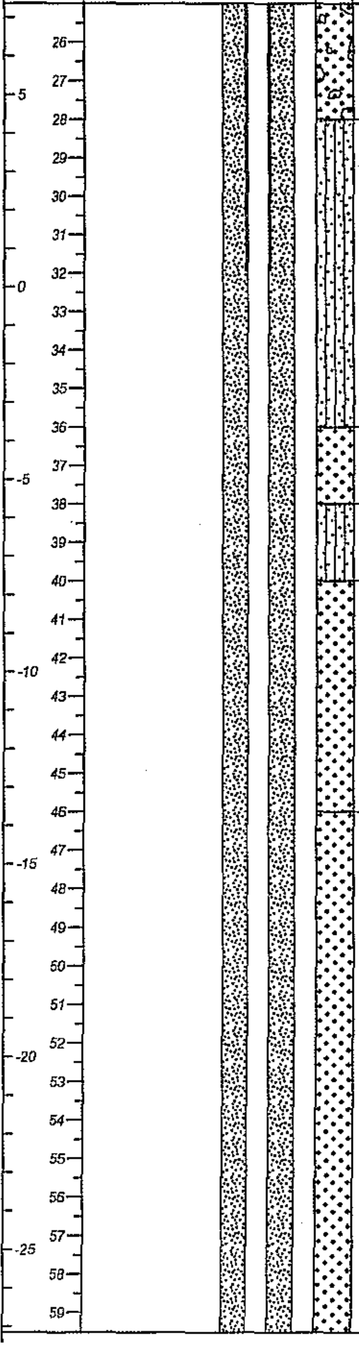


DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
	WELL GRADED GRAVELLY SAND - Black with tan and clear, fine to very coarse grained, subangular to subrounded sand with 10-20% fine gravel.	✋	None	9:59:00 AM	Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
12.0	WELL GRADED SAND - Black with tan, fine to coarse grained, subangular to subrounded, mostly mafic (with some feldspar and trace quartz) sand with some (10%) fine gravel.	✋	None	10:10:00 AM	
22.0		✋		10:20:00	

DRILLING LOG OF WELL/BORING NO. MW-42d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 93



Depth	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	WELL GRADED GRAVELLY SAND - Black with some tan, fine to coarse grained, gravelly (10-20%, fine to medium, subangular), subrounded to subangular sand. Mostly mafic with some feldspar. *(continued)*	✋	Odor	AM	
28.0	SANDY SILT - Dark gray, medium soft, sandy (20-30%, fine grained) silt. Faint NAPL odor, no sheen. Some wood fragments.	✋	Odor	10:30:00 AM	
36.0	WELL GRADED SAND - Black with little tan, fine to coarse grained, subangular sand with little (5-10%) fine gravel.				
38.0	SANDY SILT - Dark gray, medium soft, sandy (20-30%, fine grained) silt.				
40.0	WELL GRADED SAND - Black with little tan and trace clear, medium dense, fine to coarse grained, rounded to subangular sand with trace (less than 5%) fine gravel.	✋	None	10:41:00 AM	Driller reports sand density is medium-dense at 40-feet BGS.
46.0	WELL GRADED SAND - Black with tan, dense, fine to coarse grained, mostly subangular sand with trace fine gravel.				Driller reports sand density increase at 46-feet BGS.
		✋	None	10:53:00 AM	

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-42d

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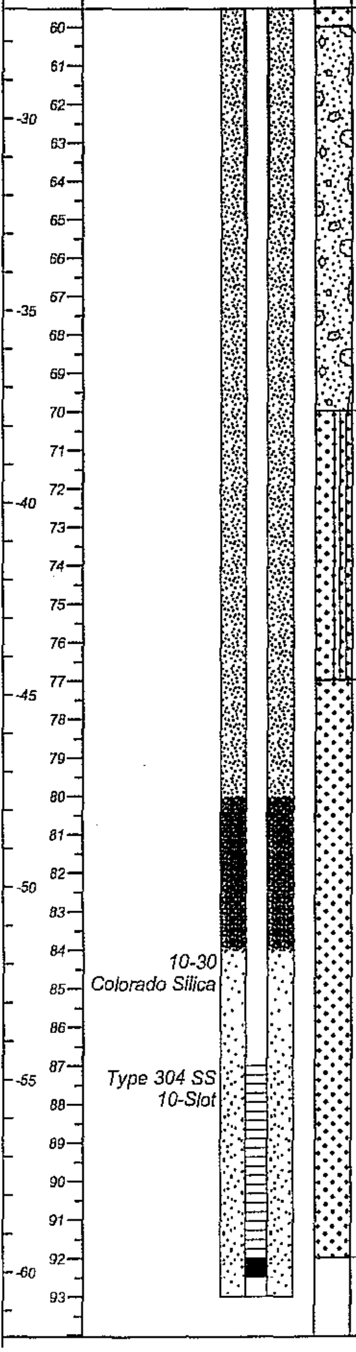
Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 93

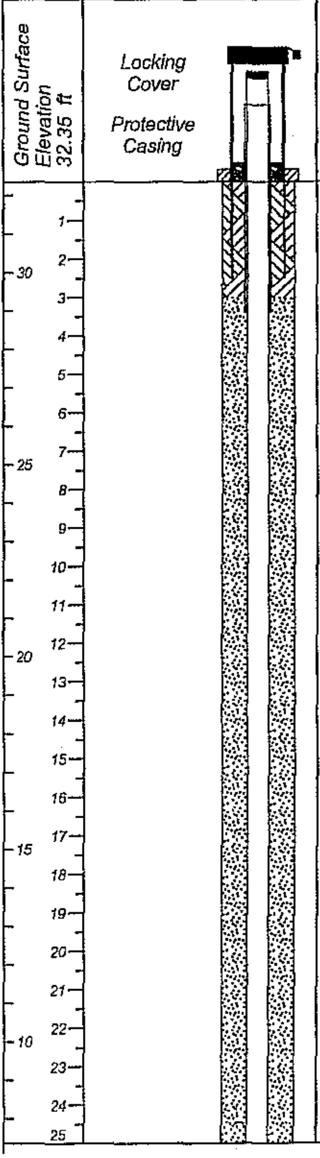


Depth	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	POORLY GRADED GRAVELLY SAND - Black with tan, dense, medium to coarse grained, subrounded to subangular sand with 10-15% fine gravel and some (less than 10%) fine sand.	✋	None	12:15:00 PM	
70.0	WELL GRADED SAND WITH SILT - Black with little tan and little clear, medium dense, fine to coarse grained, mostly subrounded sand with trace (less than 5%) gravel and some (10-15%) tan silt nodules (0.25" dia.).	✋	None	12:25:00 PM	
77.0	WELL GRADED SAND - Black with tan and little clear, dense, fine to coarse grained, subrounded to subangular sand with trace fine pebbles and few (5-10%) nodules of tan silt (0.25" dia.). Some rounded grains present.	✋	None	12:33:00 PM	
		✋	None	12:38:00 PM	
92.0					

DRILLING LOG OF WELL/BORING NO. MW-42i

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/19/2003
Northing/Easting: 704799.132/7628035.467
Start Card Well Number: L58481
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 57.5
Ground Elevation (feet above NGVD): 32.35
Inner Casing Elevation (TOC): 35.04
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

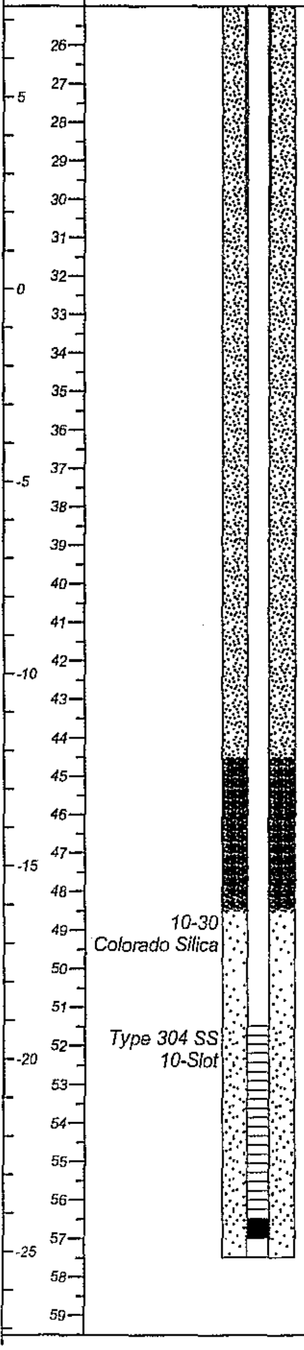
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				
								No lithology recorded for MW-42i. See log for MW-42d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-42i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 57.5

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



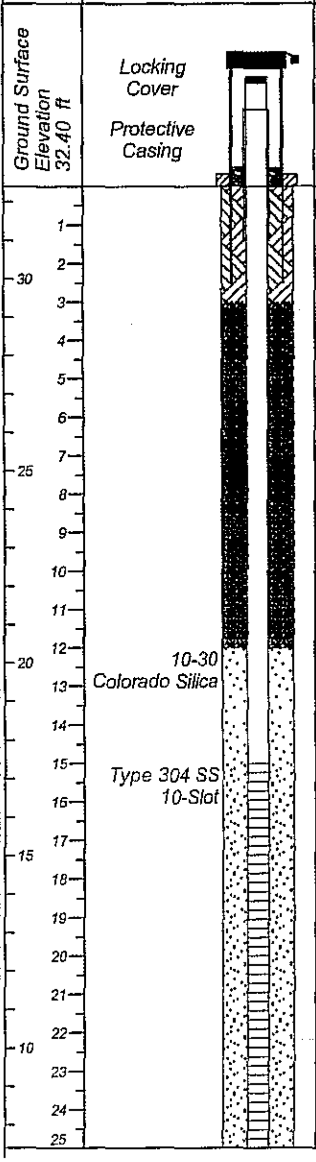
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-42s

Page 1 of 2

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/18/2003
Northing/Easting: 704802.548/7628040.244
Start Card Well Number: L58480
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 32.40
Inner Casing Elevation (TOC): 35.02
Groundwater Elevation (feet NGVD): ______
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded for MW-42s. See log for MW-42d for detailed lithology.

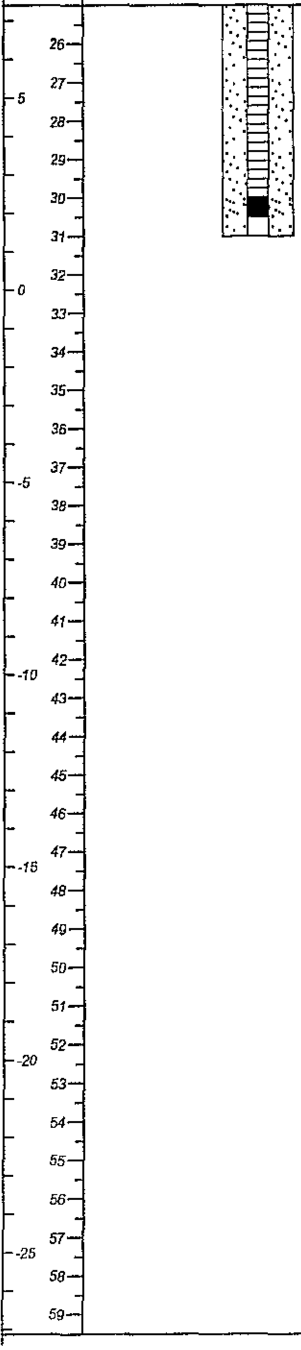
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-42s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS

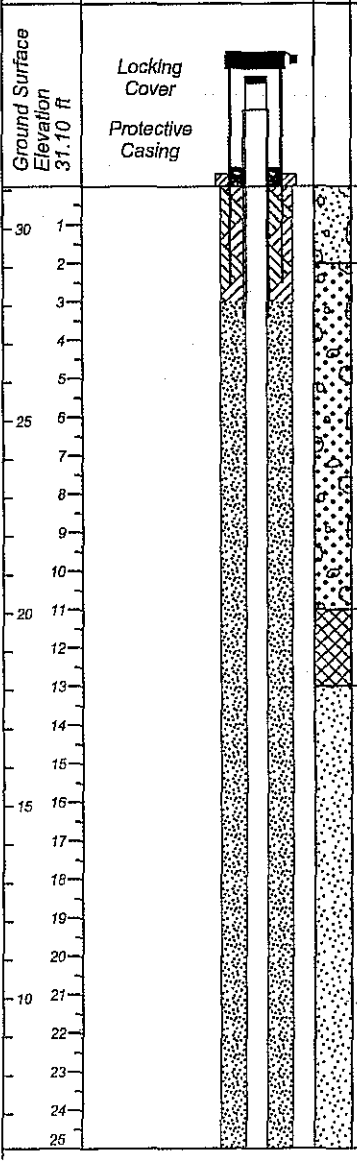


DRILLING LOG OF WELL/BORING NO. MW-43d

Page 1 of 3

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/17/2003
Northing/Easting: 704770.577/7628040.565
Start Card Well Number: L56129
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 92
Ground Elevation (feet above NGVD): 31.10
Inner Casing Elevation (TOC): 33.58
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations



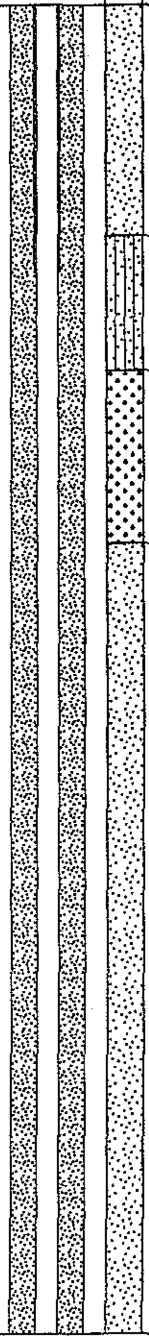
DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
0–2.0	POORLY GRADED GRAVELLY SAND - Black and tan, rounded to subangular, medium to very coarse grained sand with 30-45% fine to medium gravel.	✋	None	9:24:00 AM	Unable to determine moisture content c soil because no SPT samples were scheduled to be collected. Difficult drilling at 0 to 2 feet BGS.
2.0–11.0	WELL GRADED GRAVELLY SAND - Black and tan, fine to very coarse, subangular to rounded, loose, mostly mafic (some feldspar, little quartz) sand with 10-20% fine gravel. Wood fragments encountered from 9-feet to 11-feet BGS.	✋	None	9:37:00 AM	
11.0–13.0	FILL (DEBRIS) - Buried log or wood debris ~~saturated~~ [illegible] with creosote. Strong NAPL odor and sheen.		[illegible]		Difficult drilling due to buried debris.
13.0–	POORLY GRADED SAND - Black and tan, fine to medium grained sand with some (10%) coarse sand and little (5-10%) fine pebbles. Strong NAPL odor (possibly recirculated).	✋	Sheen	10:07:00 AM	
22–		✋			

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-43d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 92

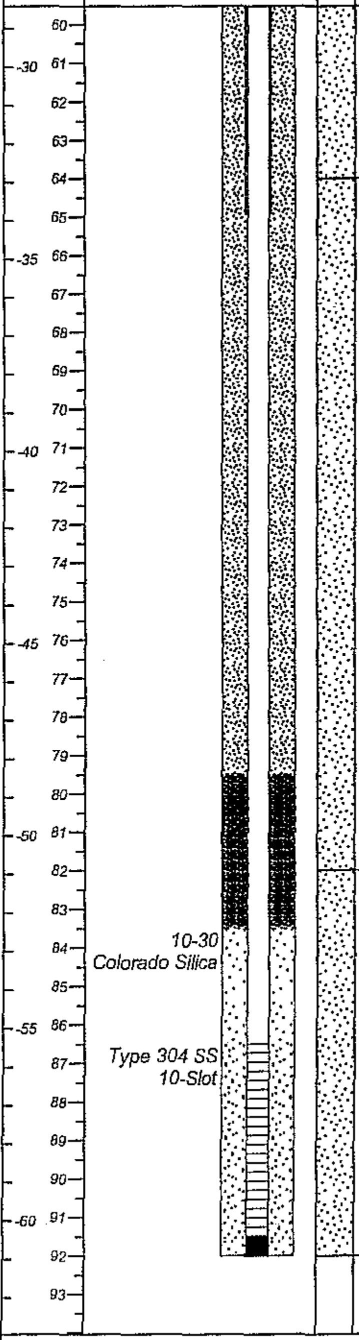


ELEVATION	DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
5	26–30	POORLY GRADED SAND - Black and tan, fine to medium grained sand with some (10%) coarse sand and little (5-10%) fine pebbles. Strong NAPL odor (possibly recirculated). *(continued)*	✋	See addendum ~~Odor~~	10:34:00 AM	
0	31.0	SANDY SILT - Dark gray, soft to medium soft silt with 20-35% fine sand. NAPL odor (possibly recirculated).				Driller reports encountering silt at 31-feet BGS.
-5	34.5	WELL GRADED SAND - Black, fine to coarse grained sand with few small silt nodules (0.25" to 0.50").	✋	~~Odor~~	10:46:00 AM	Driller reports end of silt at 34.5-feet BGS.
-10	39.0	POORLY GRADED SAND - Black, fine to medium grained, dense sand with few sub-rounded coarse sand grains.				Driller reports sand density increase at 39-feet BGS.
-15	47		✋	~~Odor~~	11:03:00 AM	
-20	51					
-25	57		✋	~~Odor~~	11:10:00 AM	
	59					

DRILLING LOG OF WELL/BORING NO. MW-43d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 92



DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	POORLY GRADED SAND - Black, fine to medium grained, dense sand with few sub-rounded coarse sand grains. *(continued)*	✋			
64.0	POORLY GRADED SAND - Mostly black, very fine to medium grained, medium dense sand with some (10%) fine gravel.	✋	Odor	11:28:00 AM	Driller reports sand density decrease at 64-feet BGS.
		✋	Odor	11:35:00 AM	
82.0	POORLY GRADED SAND - Mostly black, very-fine to medium grained, dense sand with some (10%) coarse sand and little (5%) fine gravel.	✋	Odor	11:50:00 AM	Driller reports sand density increase at 82-feet BGS.
		✋	Odor	11:55:00 AM	
92.0					

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

Addendum to MW-43d

NAPL information should read:

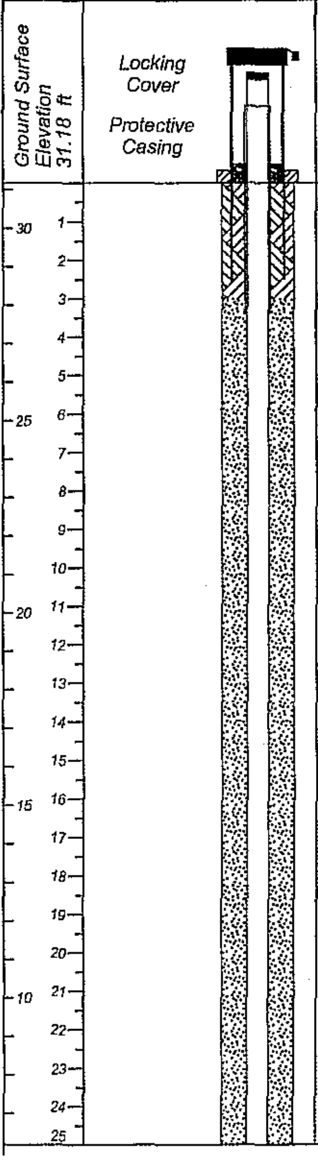
11-13' bgs	Heavy Sheen/ Strong Odor
13-22' bgs	Odor

No other NAPL present on this borelog.

DRILLING LOG OF WELL/BORING NO. MW-43i

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/17/2003
Northing/Easting: 704777.96/7628042.689
Start Card Well Number: L56128
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 57.5
Ground Elevation (feet above NGVD): 31.18
Inner Casing Elevation (TOC): 33.75
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

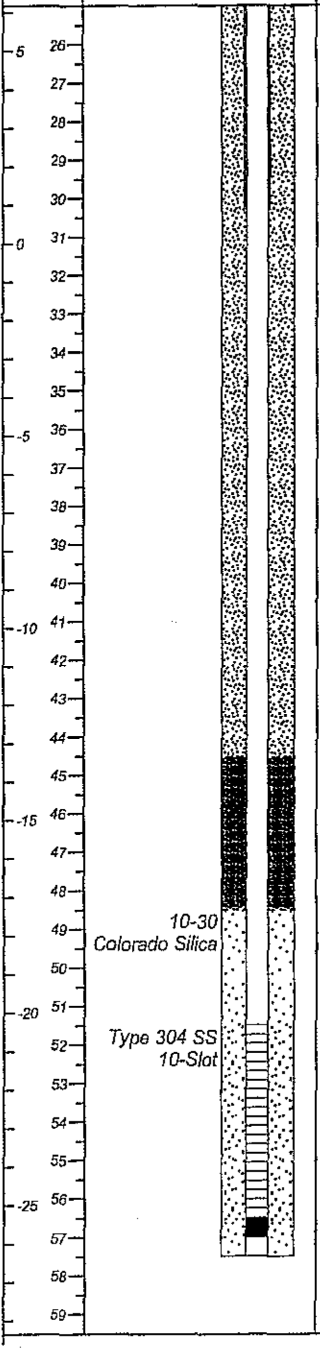
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 31.18 ft				ground surface (gs)				No lithology recorded for MW-43i. See log for MW-43d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-43i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 57.5

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS

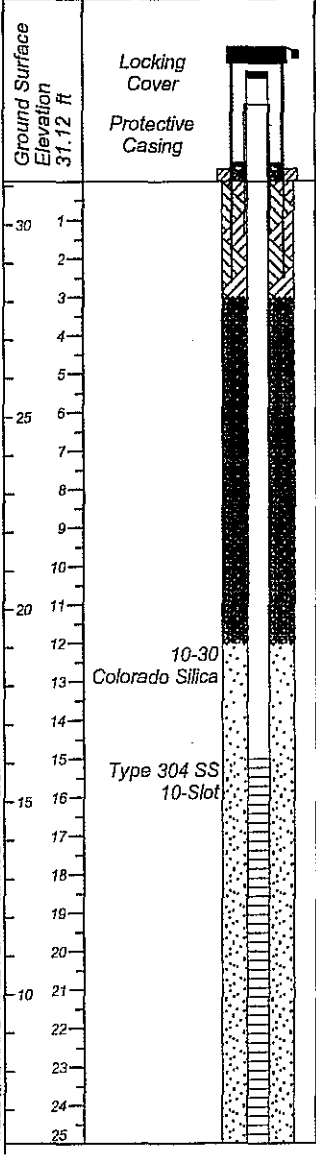


WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-43s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/18/2003
Northing/Easting: 704786.13/7628044.717
Start Card Well Number: L56127
Drill Method: Mud-Rotary

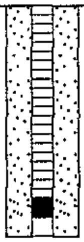
Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 31.12
Inner Casing Elevation (TOC): 33.95
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 31.12 ft				ground surface (gs)				
								No lithology recorded for MW-43s. See log for MW-43d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-43s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

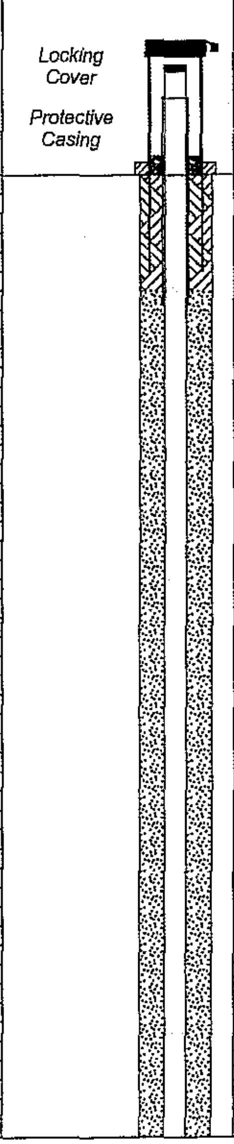
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
5	26							
	27							
	28							
	29							
	30							
0	31							
	32							
	33							
	34							
	35							
-5	36							
	37							
	38							
	39							
	40							
-10	41							
	42							
	43							
	44							
	45							
-15	46							
	47							
	48							
	49							
	50							
-20	51							
	52							
	53							
	54							
	55							
-25	56							
	57							
	58							
	59							

DRILLING LOG OF WELL/BORING NO. MW-44d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/4/2003
Northing/Easting: 704664.358/7628379.82
Start Card Well Number: L58623
Drill Method: HSA / Mud-Rotary

Total Depth of Hole (feet BGS): 82
Ground Elevation (feet above NGVD): 20.46
Inner Casing Elevation (TOC): 22.91
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

WELL COMPLETION DIAGRAM



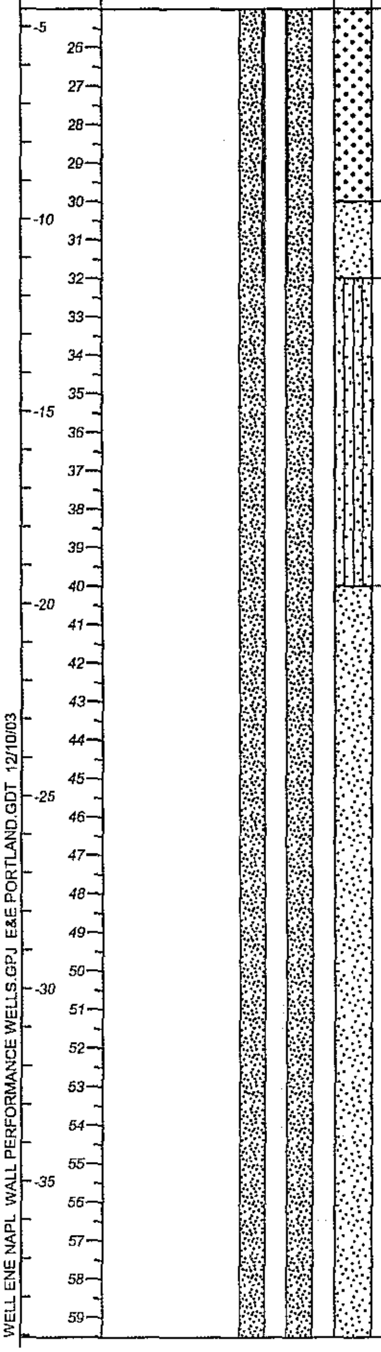
GRAPHIC LOG

ELEVATION	DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.46 ft		*ground surface (gs)*				
20	1 2 3 4 5	POORLY GRADED SAND - Brown, very-fine to fine (with few medium) grained, subrounded, dry sand with trace silt. Sand composition is mafic with feldspar and some quartz.		None	9:15:00 AM	Unable to determine moisture content c soil because no SPT samples were scheduled to be collected. Drilling with wood plug installed inside bottom auger.
15	6 7 8 9 10			None	9:30:00 AM	
10	11 12 13 14 15	10.0 POORLY GRADED SAND - Dark-brown, very-fine to fine (with few medium) grained, moist sand with occassional fine pebbles and trace silt. Sand is mafic with feldspar and occassional quartz.		None	9:40:00 AM	
5	16 17 18 19 20			None	9:45:00 AM	Driller reports high auger-turning resistance after encountering saturated sands.
0	21 22 23 24 25	20.0 WELL GRADED SAND - Black and brown, very-fine to medium grained, wet sand with trace silt. Sand is mafic with feldspar.		None	9:50:00 AM	

DRILLING LOG OF WELL/BORING NO. MW-44d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 82

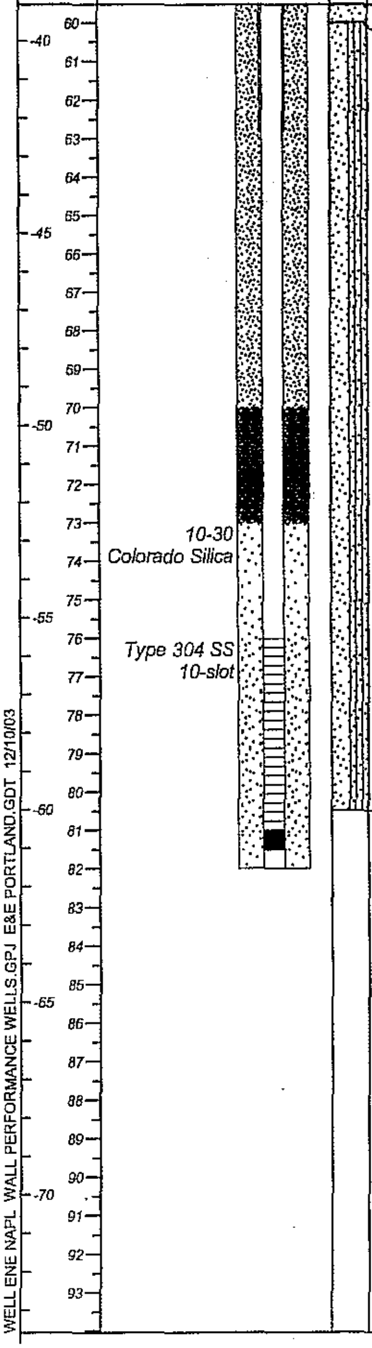


Depth	SOIL/ROCK DESCRIPTION	NAPL	Time	COMMENTS
	WELL GRADED SAND - Black and brown, very-fine to medium grained, wet sand with trace silt. Sand is mafic with feldspar. *(continued)*	Odor	9:55:00 AM	Sand at depth is undergoing liquefactio while augers are turning; cuttings volume is greatly reduced.
30.0	POORLY GRADED SAND - Black and brown, fine to medium grained, subangular to subrounded, wet sand. Sand is mafic with feldspar. Free product as sheen is visible.	Sheen	10:15:00 AM	Free product appears to have collected on top of silt lenses.
32.0	SANDY SILT (INTERBEDDED) - Thick lenses (4" to 12") of silt interbedded with sands or silty sands (determined by drill pressure and RPMs).	Odor	10:30:00 AM	Drill RPM's increase and decrease intermittently from 32-feet to 40-feet BGS, indicating interbedded silts and sands.
40.0	POORLY GRADED SAND - Black, very-fine to fine grained, mafic sand. Some medium grained, red and black sand is present.	None	10:15:00 AM	DEQ authorizes change of drilling method to mud-rotary after drillers determine that track-rig lacks sufficient power to safely continue augering to intended depths. Mud-rotary proceeds through emplaced augers set at 40-feet BGS.
		None	10:22:00 AM	

DRILLING LOG OF WELL/BORING NO. MW-44d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 82



SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	✋			
POORLY GRADED SAND WITH SILT - Black, very-fine to fine grained (with few medium, trace coarse), wet, mafic sand with dark gray silt occurring in sporadic, thin lenses (silt determined from strained drill fluid).	✋	None	10:28:00 AM	
	✋	None	10:35:00 AM	
80.5	✋	None	10:36:00 AM	

DRILLING LOG OF WELL/BORING NO. MW-44i

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/5/2003

Northing/Easting: 704661.179/7628383.818

Start Card Well Number: L58621

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 47

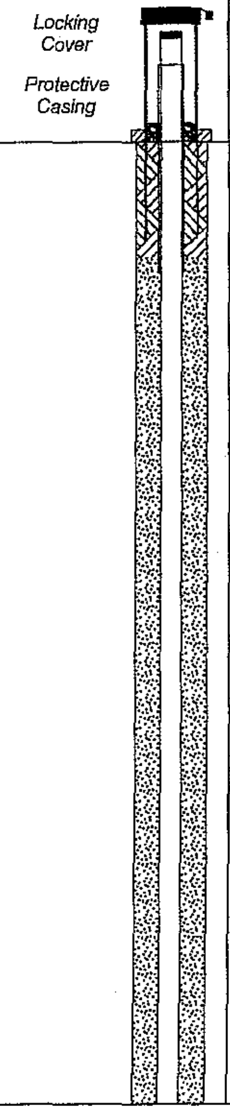
Ground Elevation (feet above NGVD): 20.36

Inner Casing Elevation (TOC): 23.19

Groundwater Elevation (feet NGVD):

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.36 ft				*ground surface (gs)*				
20 15 10 5 0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25							No lithology recorded for MW-44i. See log for MW-44d for detailed lithology.

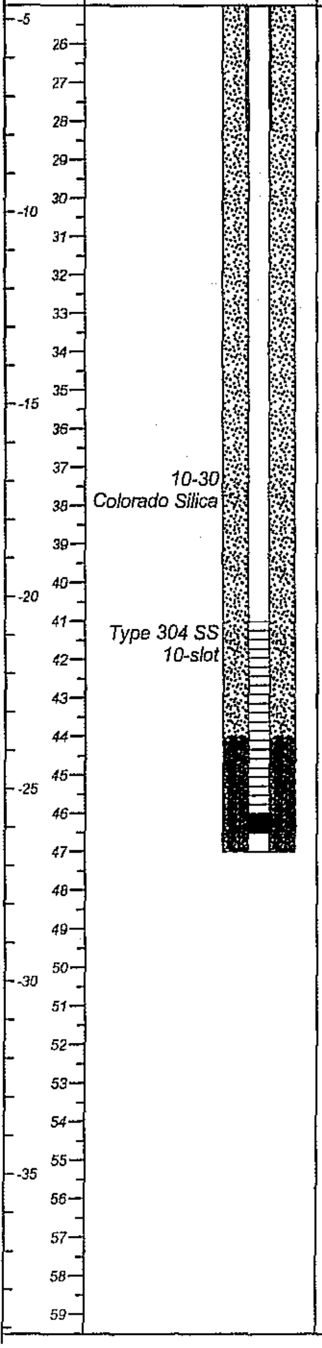
DRILLING LOG OF WELL/BORING NO. MW-44i

Page 2 of 2

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 47

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-44s

Page 1 of 1

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/5/2003

Northing/Easting: 704660.285/7628379.988

Start Card Well Number: L58622

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23.5

Ground Elevation (feet above NGVD): 20.09

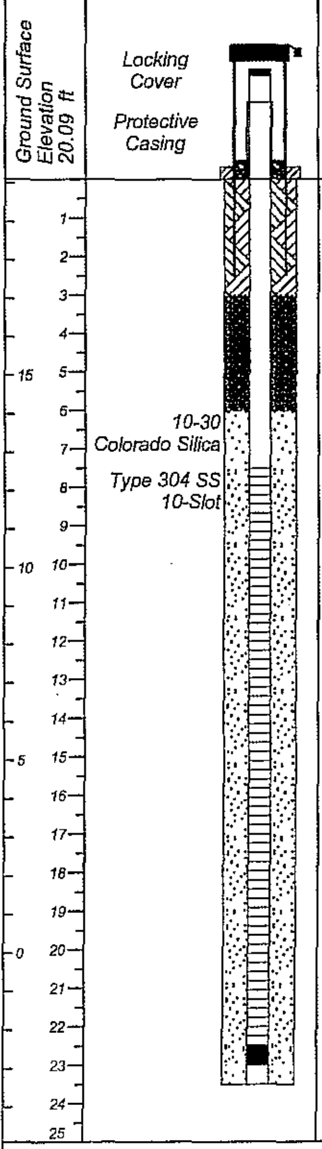
Inner Casing Elevation (TOC): 23.11

Groundwater Elevation (feet NGVD): ______

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 20.09 ft				ground surface (gs)				
								No lithology recorded for MW-44s. Se log for MW-44d for detailed lithology.



WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

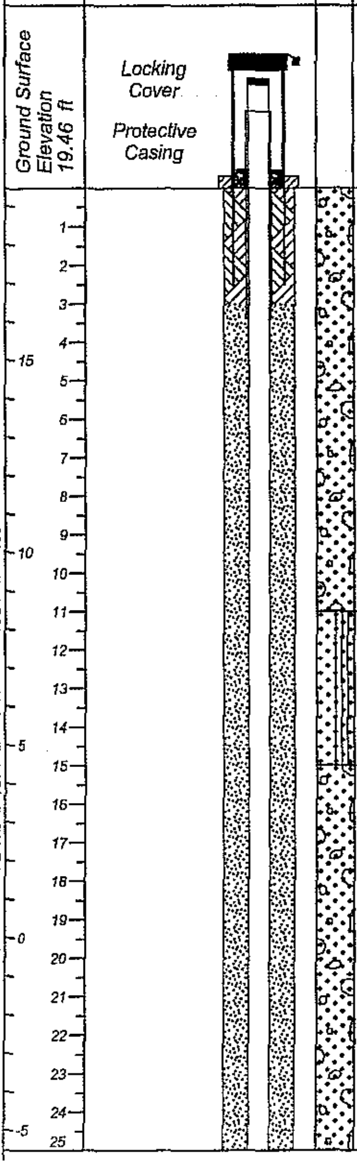
PROJECT NAME: Barrier Wall Performance Monitoring Well Networ
WELL NO.: MW-44

ecology and environment, inc.

DRILLING LOG OF WELL/BORING NO. MW-45d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/8/2003
Northing/Easting: 704652.689/7628373.821
Start Card Well Number: L58625
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 82
Ground Elevation (feet above NGVD): 19.46
Inner Casing Elevation (TOC): 21.93
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

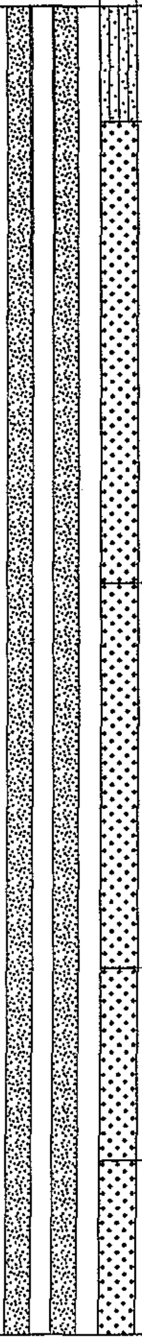


DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
	WELL GRADED GRAVELLY SAND - Brown and black, fine to coarse grained, subangular to subrounded, gravelly (fine to medium) sand. Small quantities of silt occurs as small nodules. Sand and gravel is composed of feldspar and mafics.	✋	None	7:58:00 AM	Unable to determine moisture content c soil because no SPT samples were scheduled to be collected.
11.0	WELL GRADED SILTY SAND - Brown and black, fine to coarse grained, gravelly sand interbedded with thin lenses of silt (bedding nature determined from driller's comments). Creosote NAPL odor is present; no sheen.	✋	Odor	8:18:00 AM	Discontinuous, interbedded, thin silt lenses reported by driller.
15.0	WELL GRADED GRAVELLY SAND - Brown and black, very-fine to coarse grained, gravelly (20-30%, fine) sand with little silt. Creosote NAPL odor; no sheen. Occassional wood fragments present.				
		✋			
25.0				8:26:00	

DRILLING LOG OF WELL/BORING NO. MW-45d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 82

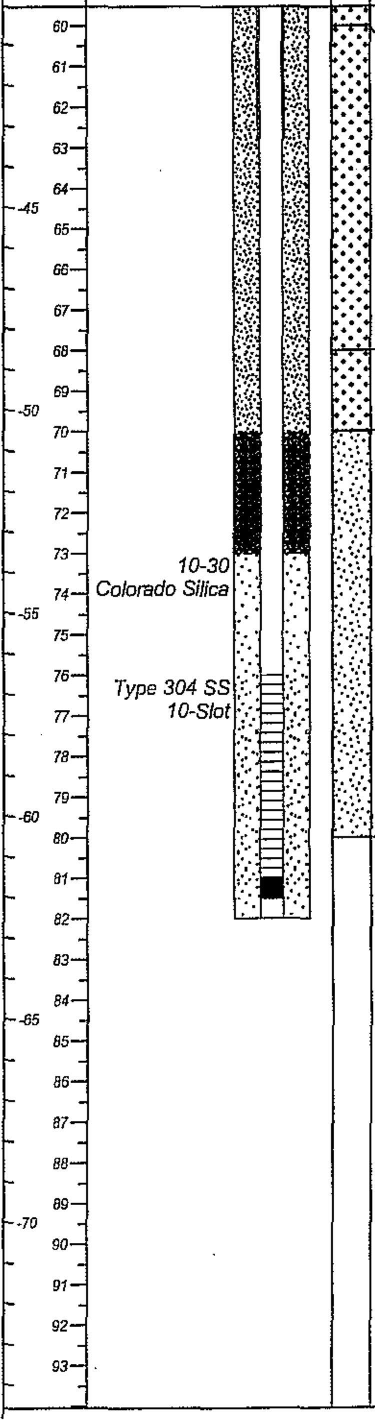


ELEVATION	DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26–28.0	SANDY SILT - Dark gray, medium stiff silt with fine sand and fine gravel. Wood fragments are abundant. Creosote NAPL odor; no sheen.	✋	Odor	AM	Driller reports silt contact at 25-feet BGS.
-10	28.0	WELL GRADED SAND - Mostly black with brown, very-fine to medium grained, subangular, mafic sand with little silt and trace coarse sand and fine gravel. Very light NAPL odor, possibly recirculated.				Driller reports end of silt at 28-feet BGS
	31–33			See addendum Reind		No new wood fragments believed to occur past 30-feet BGS; wood fragments are observed recirculating in drill mud.
-15	35		✋	Odor	8:35:00 AM	
-20	40.0	WELL GRADED SAND - Mostly black with little tan, red brown, and white, very-fine to medium grained, subangular, mafic sand with little coarse sand and little silt. No odor, no sheen.		NONE		
-25	45		✋	~~Odor~~	8:45:00 AM	
-30	50.0	WELL GRADED SAND - Black with some brown and red, subangular to angular, very-fine to medium grained, mafic sand with some coarse sand and some fine to medium gravel.				
-35	55.0	WELL GRADED SAND - Black with some brown, subrounded to subangular, very-fine to medium grained, mafic sand with few small silt nodules. No coarse sand or gravel. Sand grains are mostly spheroidal.	✋	None	8:55:00 AM	

DRILLING LOG OF WELL/BORING NO. MW-45d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 82



DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	WELL GRADED SAND - Black with some brown, subangular to angular, very-fine to coarse, mafic sand with trace silt. Sand grains are mostly elongate.	✋	None	9:08:00 AM	
68.0	WELL GRADED SAND - Black with some brown and little white, subangular to angular, very-fine to medium grained, mafic (with some feldspar and possible quartz) sand with some silt nodules and little coarse sand. Many sand grains are elongate.				
70.0	POORLY GRADED SAND - Black with some brown, fine to medium grained, subrounded, mafic (with some feldspar) sand with occassional coarse sand and small silt nodules. Grains are mostly spheroid to ovoid. Silt nodules increase toward 80-feet BGS, and some quartz is observed at 77-feet to 80-feet BGS. Possible wood fragments also occur from 77-feet to 80-feet BGS.	✋	None	9:21:00 AM	
80.0					

Addendum to MW-45d

NAPL Odor should be recorded as re-circulated from 30-40' bgs . No odor is present from 40 to 50' bgs.

DRILLING LOG OF WELL/BORING NO. MW-45i

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/5/2003

Northing/Easting: 704649.933/7628377.885

Start Card Well Number: L58624

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 46

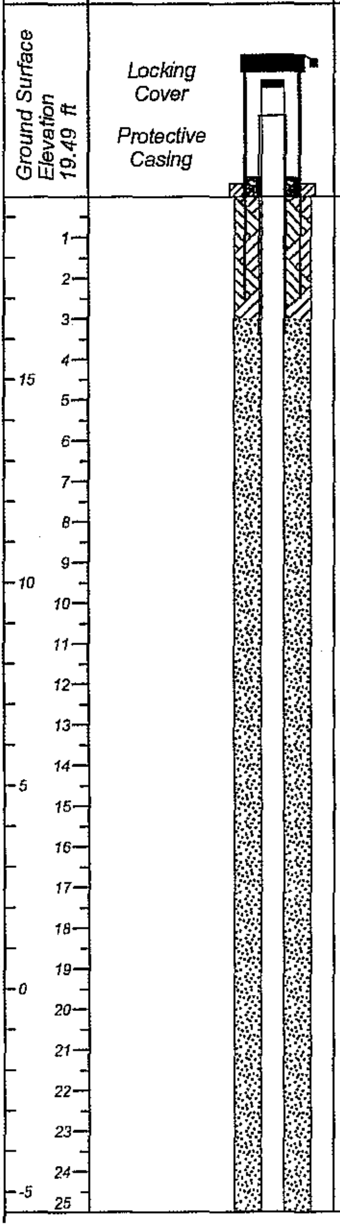
Ground Elevation (feet above NGVD): 19.49

Inner Casing Elevation (TOC): 22.07

Groundwater Elevation (feet NGVD):

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations



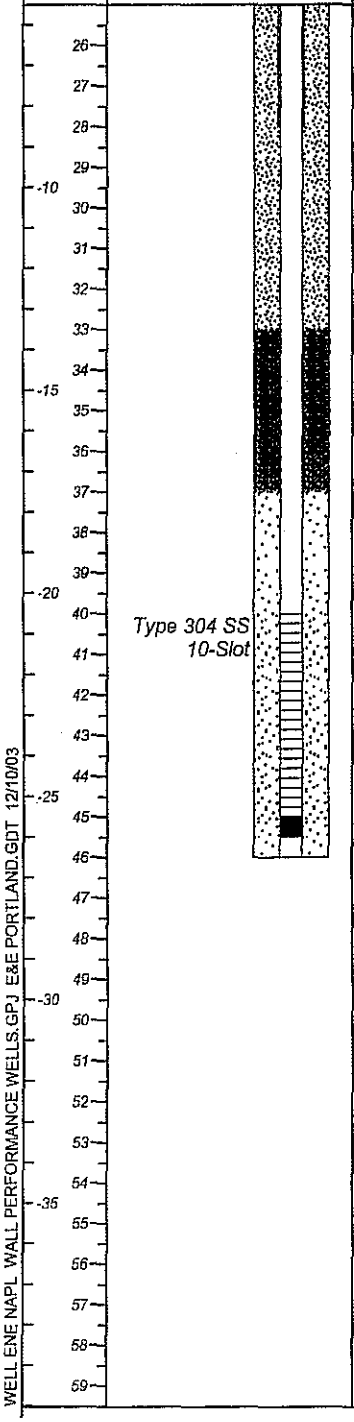
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				
								No lithology recorded for MW-45i. See log for MW-45d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-45i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 46

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



DRILLING LOG OF WELL/BORING NO. MW-45s

Page 1 of 1

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/8/2003

Northing/Easting: 704655.525/7628370.297

Start Card Well Number: L58626

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 23.5

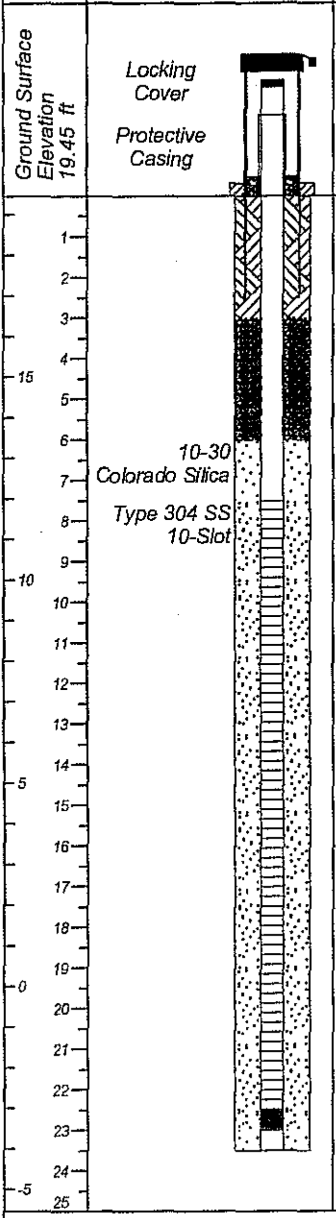
Ground Elevation (feet above NGVD): 19.45

Inner Casing Elevation (TOC): 22.43

Groundwater Elevation (feet NGVD):

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded for MW-45s. Se log for MW-45d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-46s

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/10/2003

Northing/Easting: 704542.097/7628639.864

Start Card Well Number: L58647

Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31

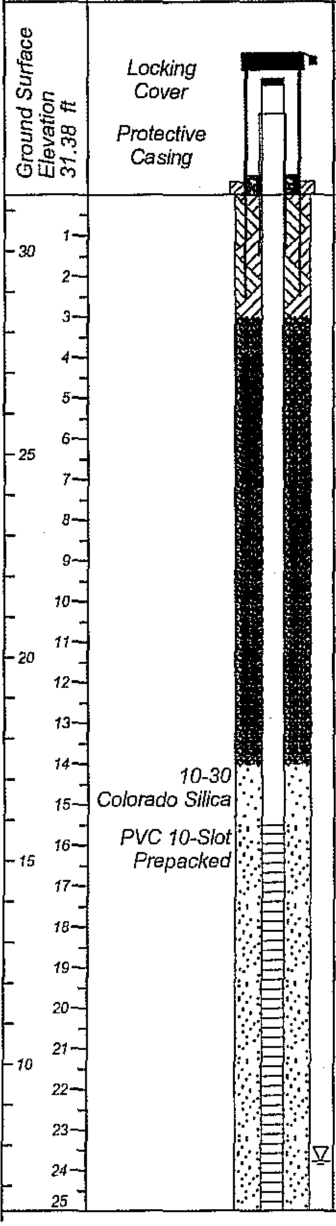
Ground Elevation (feet above NGVD): 31.3

Inner Casing Elevation (TOC): 34.20

Groundwater Elevation (feet NGVD):

Geologist: E. Murphy

Drilling Contractor: Geo-Tech Explorations

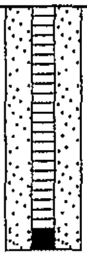


GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
					No lithology recorded. Pre-packed wells were installed using direct-push, and no cuttings or samples were available identification or analysis.

DRILLING LOG OF WELL/BORING NO. MW-46s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
5	26							
	27							
	28							
	29							
	30							
0	31							
	32							
	33							
	34							
	35							
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-20	51							
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WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-47s

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/10/2003

Northing/Easting: 704517.51/7628669.968

Start Card Well Number: L58646

Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31

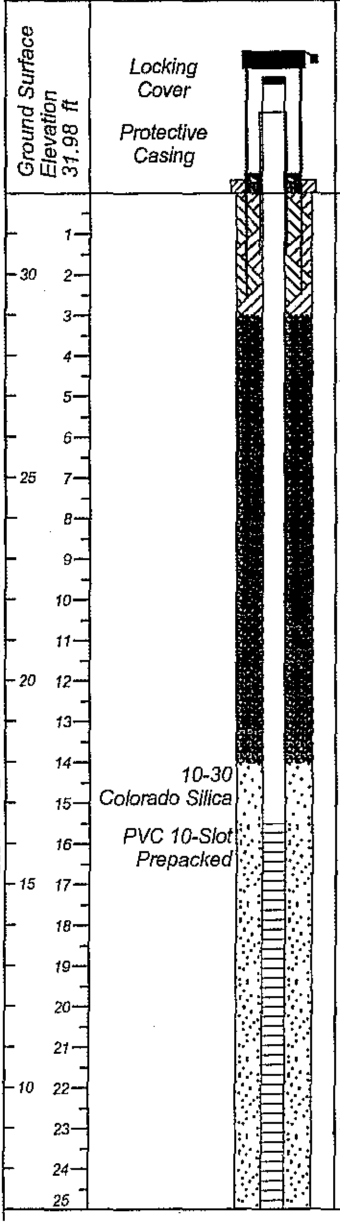
Ground Elevation (feet above NGVD): 31.9

Inner Casing Elevation (TOC): 34.74

Groundwater Elevation (feet NGVD): ______

Geologist: E. Murphy

Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were available identification or analysis.

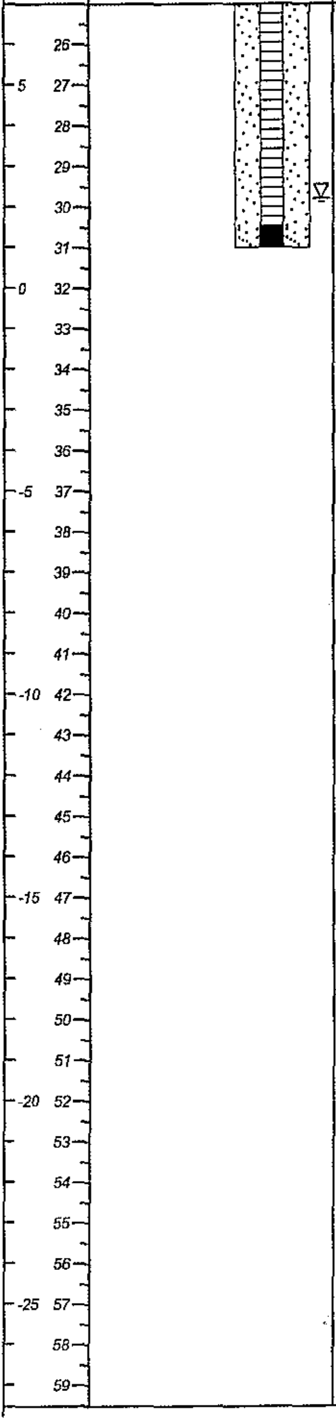
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-47s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



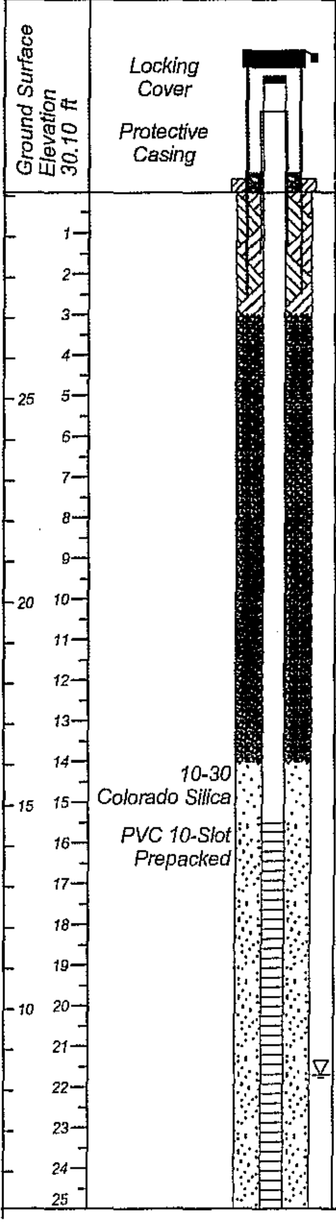
DRILLING LOG OF WELL/BORING NO. MW-48s

Page 1 of 2

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 704838.758/7628917.141
Start Card Well Number: L58645
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 30.1
Inner Casing Elevation (TOC): 33.02
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

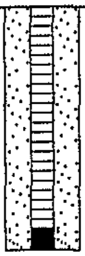
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 30.10 ft				ground surface (gs)				
								No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were available identification or analysis.



DRILLING LOG OF WELL/BORING NO. MW-48s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31



ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
	27							
	28							
	29							
0	30							
	31							
	32							
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	34							
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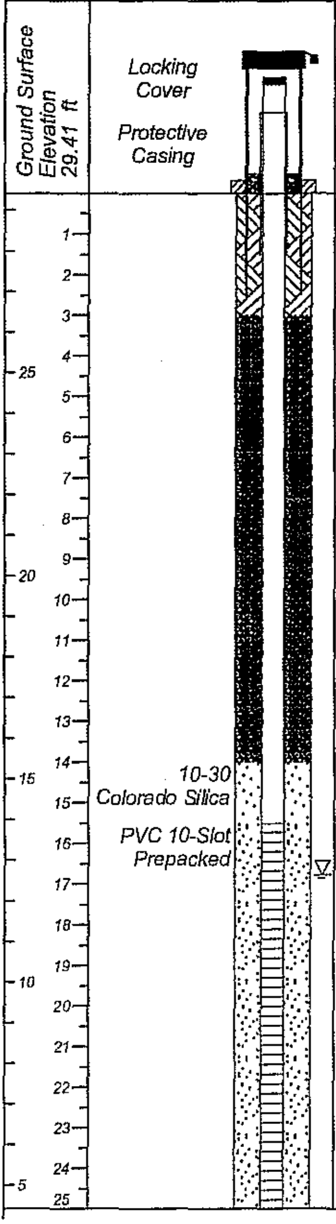
DRILLING LOG OF WELL/BORING NO. MW-49s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 704843.225/7628951.805
Start Card Well Number: L58644
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 29.41
Inner Casing Elevation (TOC): 32.19
Groundwater Elevation (feet NGVD): ______
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded. Pre-packed wells were installed using direct-push, and no cuttings or samples were available identification or analysis.

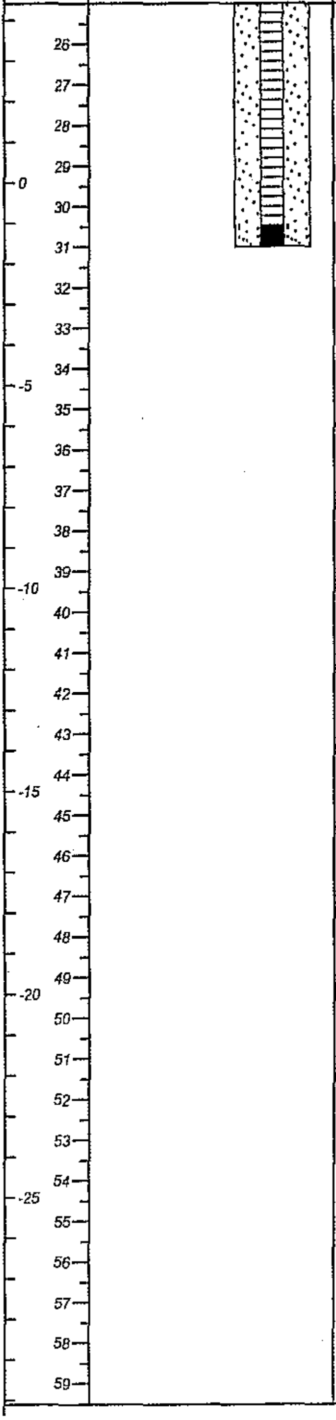
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-49s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS

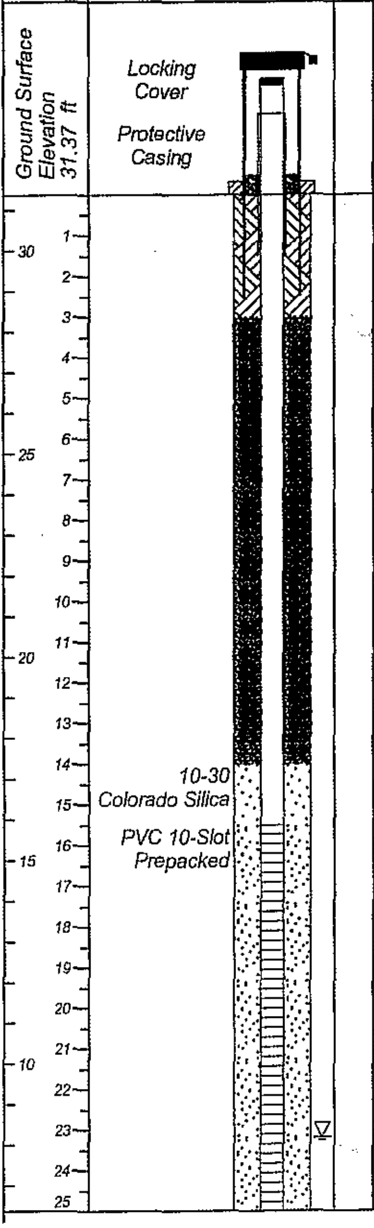


WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-50s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 705105.047/7628649.892
Start Card Well Number: L58643
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 31.3
Inner Casing Elevation (TOC): 34.26
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

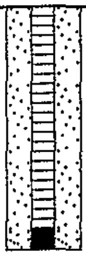


ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				
								No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were availabl identification or analysis.

DRILLING LOG OF WELL/BORING NO. MW-50s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
5	26							
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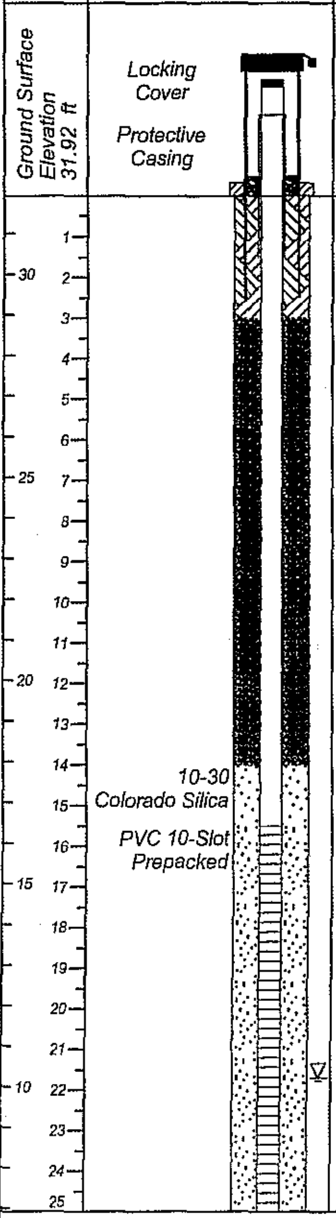
DRILLING LOG OF WELL/BORING NO. MW-51s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/10/2003
Northing/Easting: 705131.528/7628668.22
Start Card Well Number: L58642
Drill Method: Push-Probe

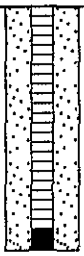
Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 31.92
Inner Casing Elevation (TOC): 34.77
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

ELEVATION / DEPTH (feet) / WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
		ground surface (gs)				No lithology recorded. Pre-packed wells were installed using direct-push, and n cuttings or samples were availab identification or analysis.

DRILLING LOG OF WELL/BORING NO. MW-51s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
5	27							
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	29							
	30							
	31							
0	32							
	33							
	34							
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	36							
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-20	52							
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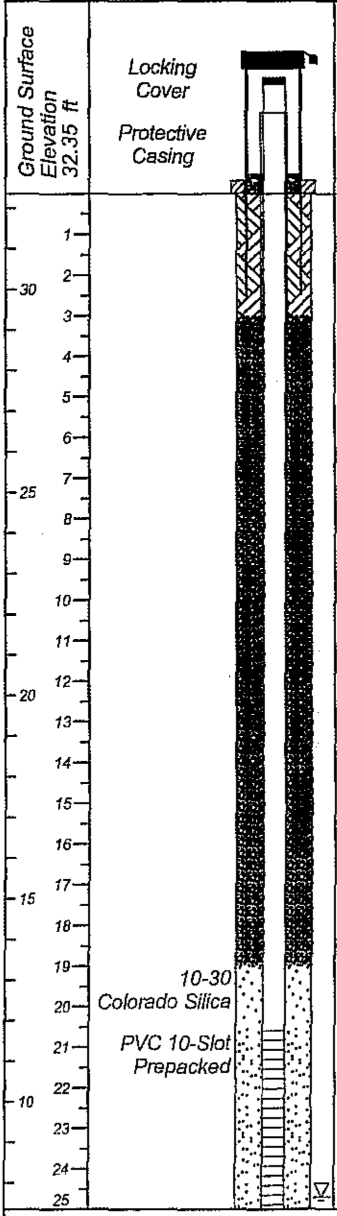
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-52s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 705343.434/7628357.971
Start Card Well Number: L58641
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 36.1
Ground Elevation (feet above NGVD): 32.3
Inner Casing Elevation (TOC): 35.09
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 32.35 ft				ground surface (gs)				
								No lithology recorded. Pre-packed wells were installed using direct-push, and no cuttings or samples were available identification or analysis.

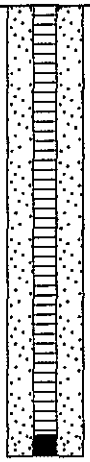


WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-52s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 36.1

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
5 0 -5 -10 -15 -20 -25	26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59							

DRILLING LOG OF WELL/BORING NO. MW-53s

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/9/2003

Northing/Easting: 705369.341/7628376.822

Start Card Well Number: L58640

Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 36.1

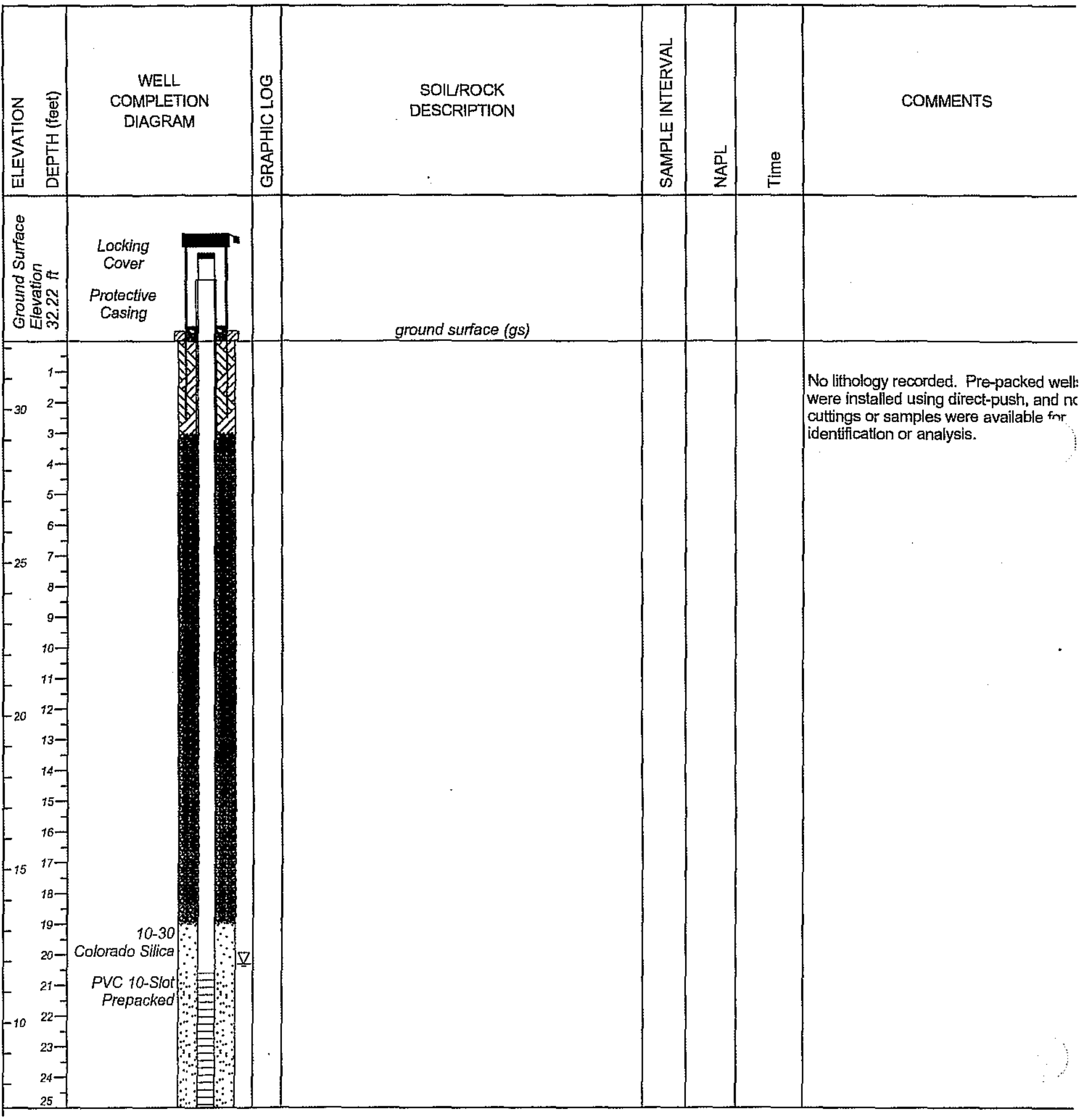
Ground Elevation (feet above NGVD): 32..

Inner Casing Elevation (TOC): 35.12

Groundwater Elevation (feet NGVD): ______

Geologist: E. Murphy

Drilling Contractor: Geo-Tech Explorations

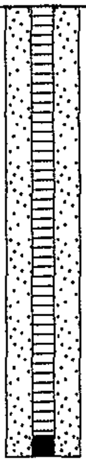


No lithology recorded. Pre-packed well: were installed using direct-push, and nc cuttings or samples were available for identification or analysis.

DRILLING LOG OF WELL/BORING NO. MW-53s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 36.1



ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
5	27							
	28							
	29							
	30							
	31							
0	32							
	33							
	34							
	35							
	36							
-5	37							
	38							
	39							
	40							
	41							
-10	42							
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	49							
	50							
	51							
-20	52							
	53							
	54							
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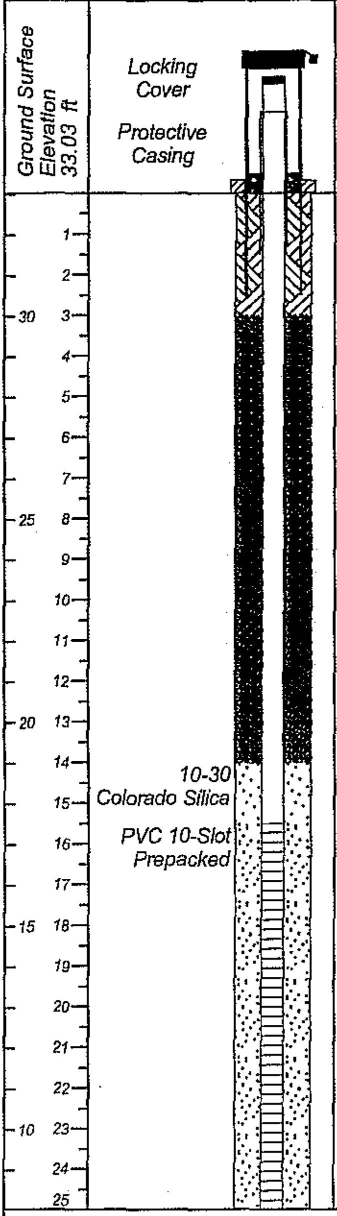
	56							
-25	57							
	58							
	59							

DRILLING LOG OF WELL/BORING NO. MW-54s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 705501.599/7628001.022
Start Card Well Number: L58639
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 33.
Inner Casing Elevation (TOC): 35.85
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

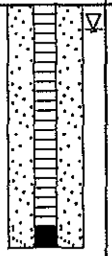
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
				ground surface (gs)				No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were availab identification or analysis.

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-54s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31



ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
	27							
5	28							
	29							
	30							
	31							
	32							
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	34							
	35							
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-15	48							
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-25	58							
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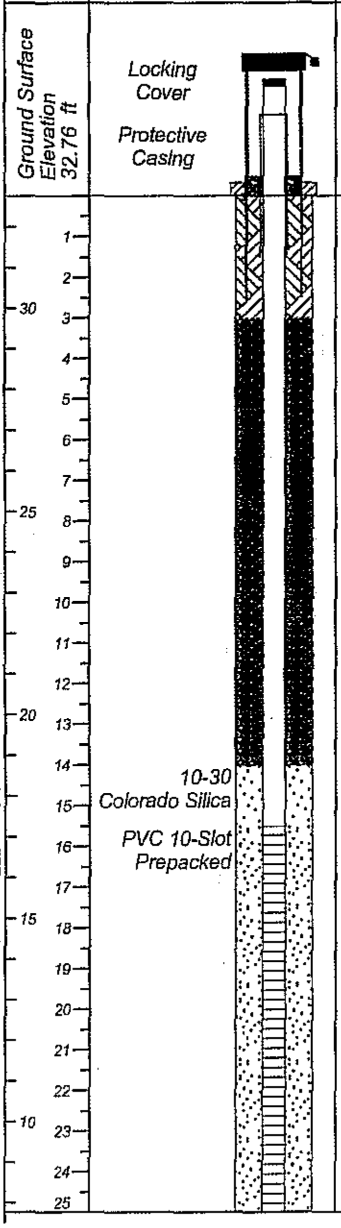
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

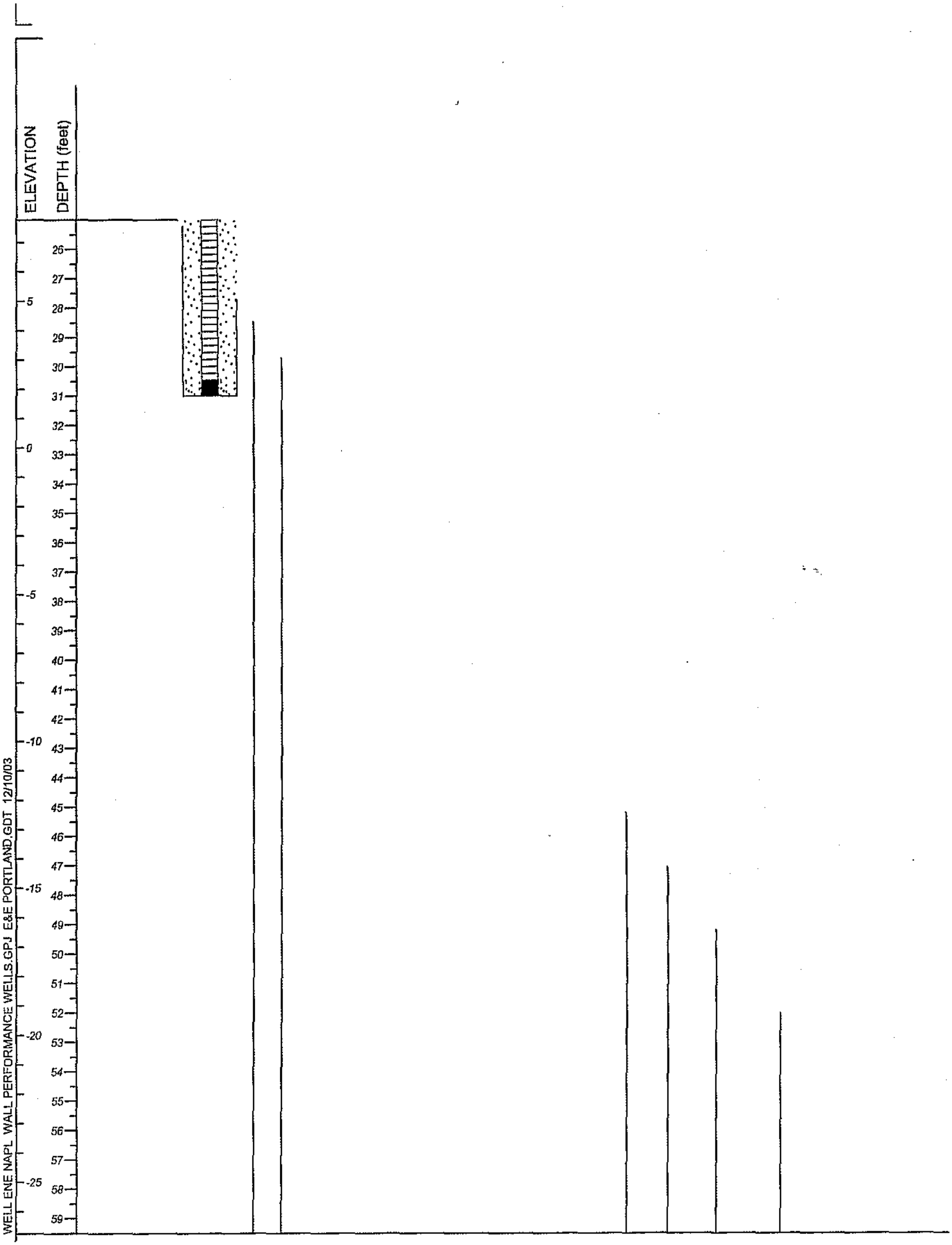
DRILLING LOG OF WELL/BORING NO. MW-55s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 705535.335/7627994.521
Start Card Well Number: L58638
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 32.
Inner Casing Elevation (TOC): 35.57
Groundwater Elevation (feet NGVD): ______
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 32.76 ft				ground surface (gs)				
								No lithology recorded. Pre-packed well: were installed using direct-push, and nc cuttings or samples were availab identification or analysis.





WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

PROJECT NAME: Barrier Wall Performance Monitoring Well Ne

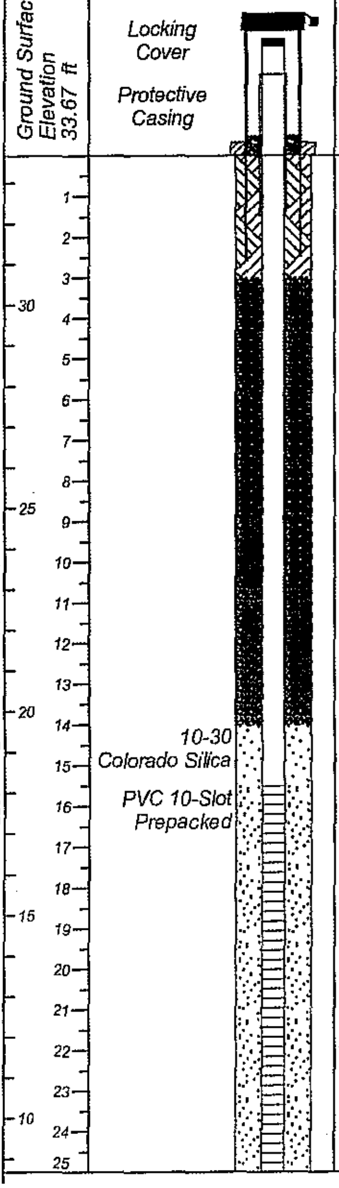
WELL NO.: MW-

DRILLING LOG OF WELL/BORING NO. MW-56s

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 9/9/2003
Northing/Easting: 705236.663/7627720.628
Start Card Well Number: L58637
Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31
Ground Elevation (feet above NGVD): 33.6
Inner Casing Elevation (TOC): 36.42
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

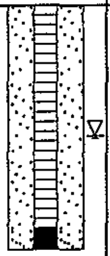
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
Ground Surface Elevation 33.67 ft				ground surface (gs)				
								No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were availab identification or analysis.



DRILLING LOG OF WELL/BORING NO. MW-56s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	26							
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-25	59							

WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-57s

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 9/9/2003

Northing/Easting: 705259.709/7627696.744

Start Card Well Number: L58636

Drill Method: Push-Probe

Total Depth of Hole (feet BGS): 31

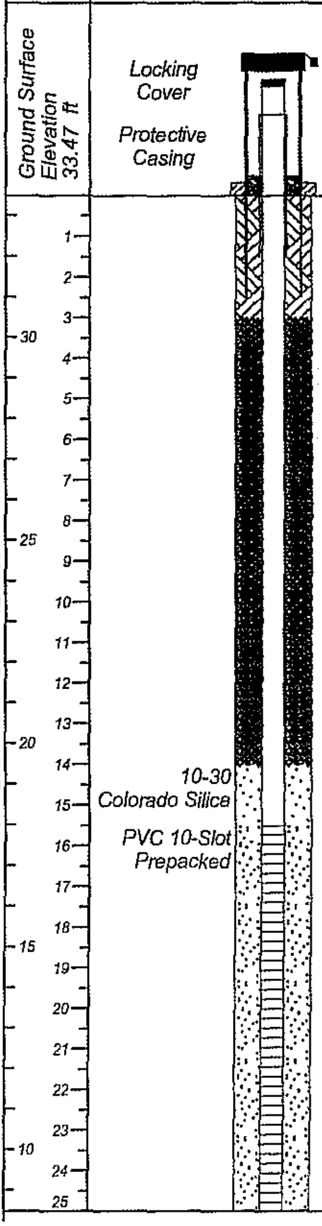
Ground Elevation (feet above NGVD): 33.4

Inner Casing Elevation (TOC): 36.36

Groundwater Elevation (feet NGVD):

Geologist: E. Murphy

Drilling Contractor: Geo-Tech Explorations

ELEVATION / DEPTH (feet) / WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
		ground surface (gs)				No lithology recorded. Pre-packed well were installed using direct-push, and n cuttings or samples were availab identification or analysis.

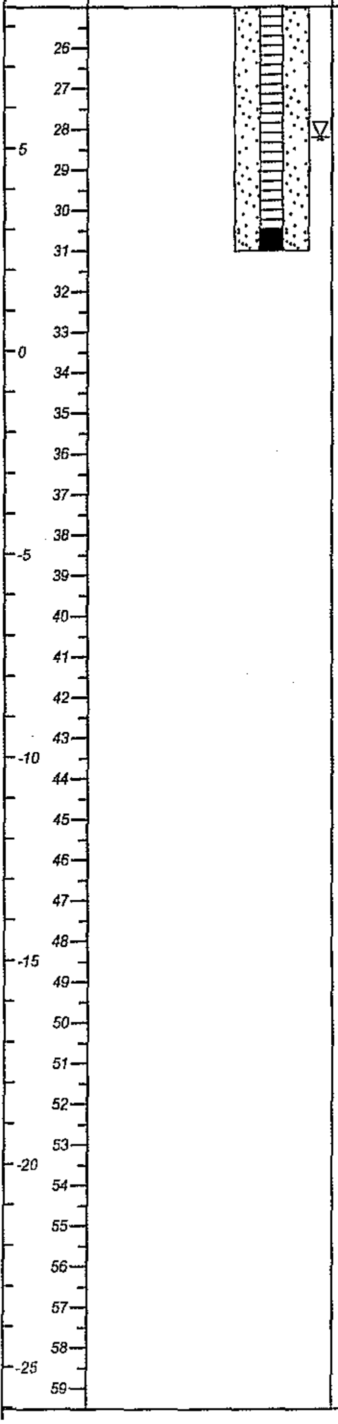
WELL ENE NAPL WALL PERFORMANCE WELLS.GPJ E&E PORTLAND.GDT 12/10/03

DRILLING LOG OF WELL/BORING NO. MW-57s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 31

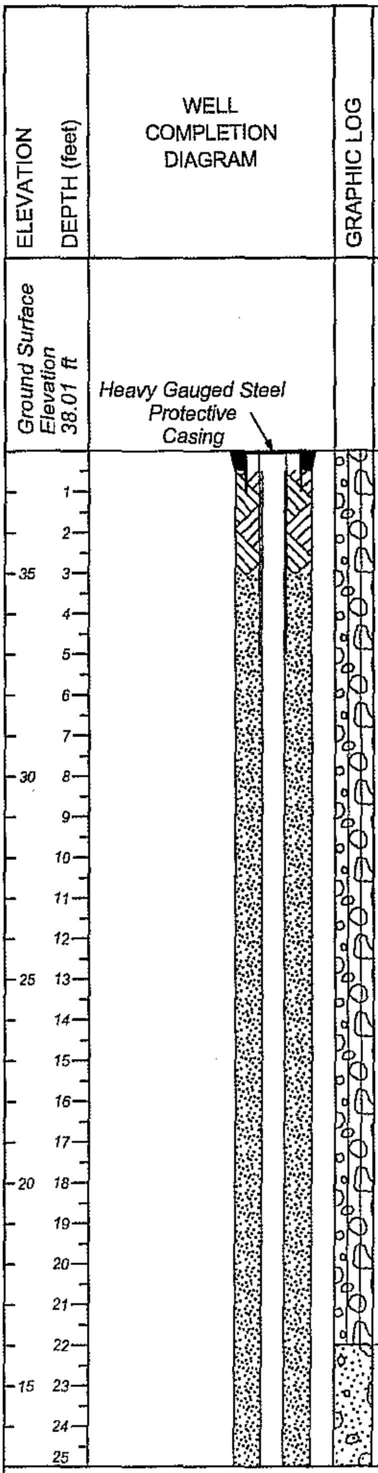
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS



DRILLING LOG OF WELL/BORING NO. MW-58d

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 10/24/2003
Northing/Easting: 705245.089/7627399.581
Start Card Well Number:
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 90.1
Ground Elevation (feet above NGVD): 38.
Inner Casing Elevation (TOC): 37.98
Groundwater Elevation (feet NGVD):
Geologist: E. Murphy
Drilling Contractor: Geo-Tech Explorations

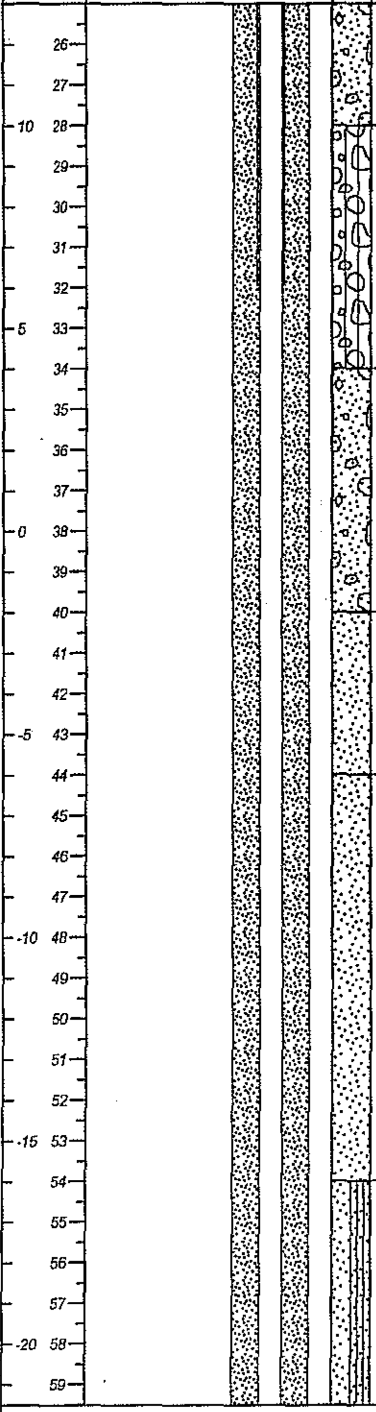


SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
ground surface (gs)				
SILTY GRAVEL - Gray angular to subangular gravel with black, organic silt.	✋	None	10:20:00 AM	
	✋	None	10:26:00 AM	
	✋	None	10:31:00 AM	Lost drilling fluid at 7-feet BGS.
	✋	None	10:38:00 AM	
	✋	None	11:00:00 AM	
22.0	✋	None	12:20:00 PM	
POORLY GRADED GRAVELLY SAND (WITH SILT) - Multi-colored rounded to angular gravel with silt and black and tan coarse sand.	✋			

DRILLING LOG OF WELL/BORING NO. MW-58d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 90.1

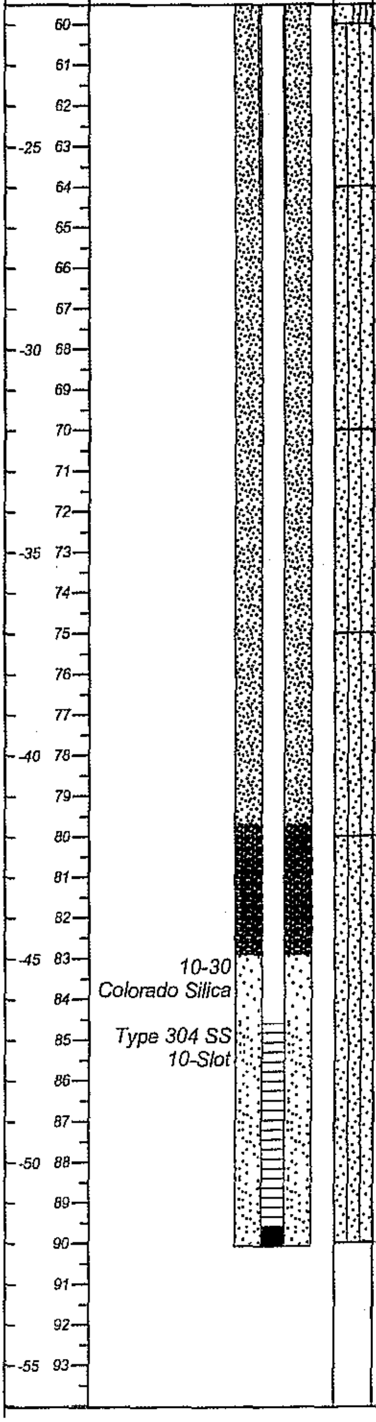


	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
28.0	POORLY GRADED GRAVELLY SAND (WITH SILT) - Multi-colored rounded to angular gravel with silt and black and tan coarse sand. *(continued)*				
34.0	SILTY GRAVEL - Silty (15%), rounded to angular gravel with black and tan coarse sand and trace clay nodules.	✋	None	12:47:00 PM	Driller believes water table encountered at 28-feet BGS.
40.0	POORLY GRADED GRAVELLY SAND - Multicolored, rounded to angular coarse sand with fine gravel.	✋	None	1:01:00 PM	
44.0	POORLY GRADED SAND - Multicolored coarse sand with little fine, rounded to angular gravel.				
54.0	POORLY GRADED SAND - Multicolored, coarse to medium, angular to subangular sand with little fines.	✋	None	1:10:00 PM	
	POORLY GRADED SAND WITH SILT - Black and tan, angular to subangular, fine grained sand with 20% silt.	✋	None	1:13:00 PM	

DRILLING LOG OF WELL/BORING NO. MW-58d

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 90.1



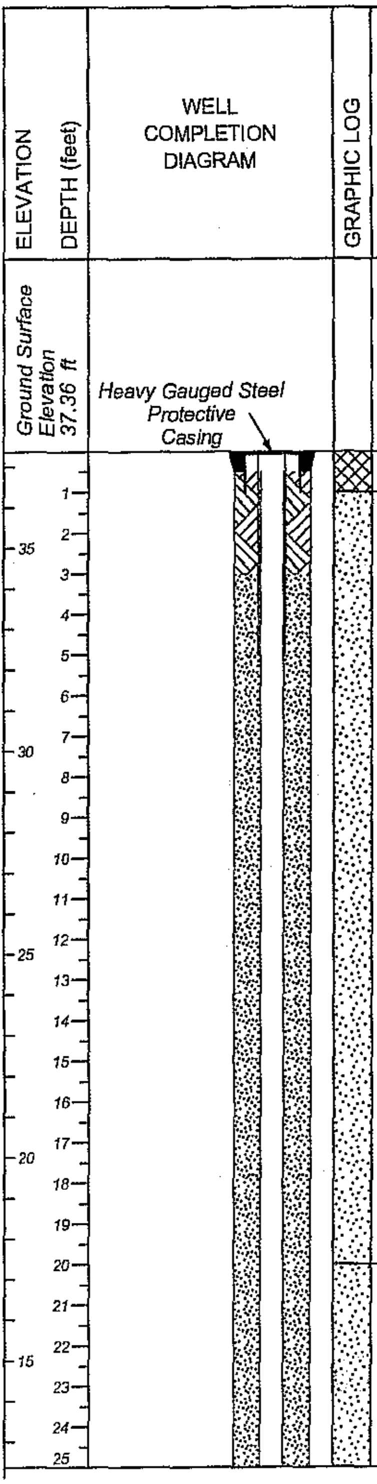
DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
60.0	SILTY SAND - Black, fine to coarse grained, angular to subangular sand with silt. Occassional wood fragments present.	✋	None	1:19:00 PM	
64.0	SILTY SAND - Multicolored coarse and black very-fine sand with silt and occassional wood fragments.	✋	None	1:23:00 PM	
70.0	SILTY SAND - Black, coarse and very-fine sand with silt.	✋	None	1:40:00 PM	
75.0	SILTY SAND - Black, very-fine to medium sand with silt.				
80.0	SILTY SAND - Black, very-fine sand with silt.	✋	None	2:00:00 PM	
90.0					

DRILLING LOG OF WELL/BORING NO. MW-58i

Page 1 of 2

Project: Barrier Wall Performance Monitoring Well Network
Location: McCormick and Baxter Superfund Site, Portland, Oregon
Date Finished: 10/27/2003
Northing/Easting: 705251.066/7627404.297
Start Card Well Number:
Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 55.5
Ground Elevation (feet above NGVD): 37.36
Inner Casing Elevation (TOC): 37.54
Groundwater Elevation (feet NGVD):
Geologist: R. Whitchurch
Drilling Contractor: Geo-Tech Explorations

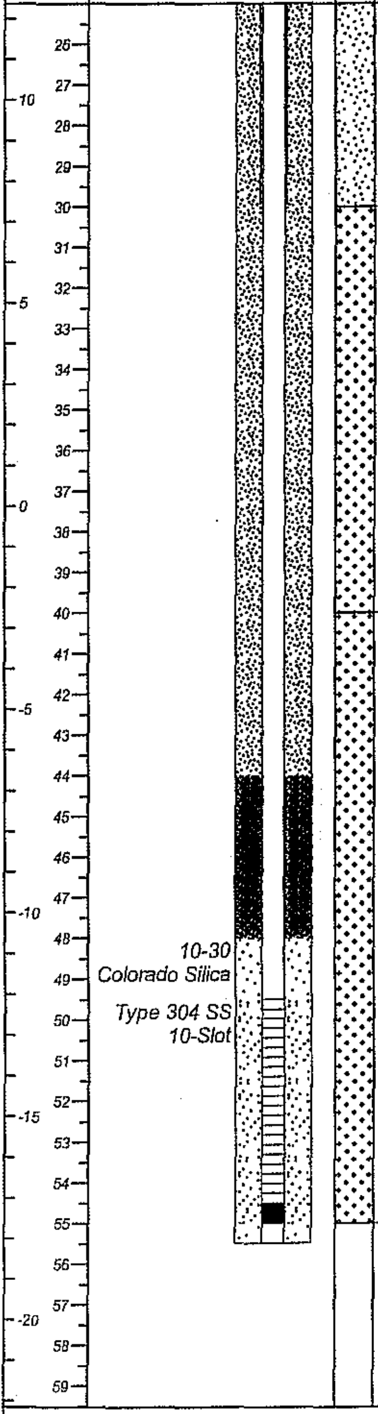


DEPTH (feet)	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
	ground surface (gs)				
1.0	FILL - Crushed gravel road surface.				
	POORLY GRADED SAND - Brown, loose, very-fine to fine grained, dry, fill sand.				Augers (6.25" ID) placed from surface t 20-feet BGS to prevent mud loss through porous sands.
		✋	None	9:45:00 AM	
20.0	POORLY GRADED SAND - (Cuttings obscured by excess drill mud) Dense sand reported by driller.				Augers socketed into bentonite plug.
		✋			
					Mud lost at 23-feet BGS. Second bentonite plug installed.
				10:40:00	

DRILLING LOG OF WELL/BORING NO. MW-58i

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 55.5



SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
POORLY GRADED SAND - (Cuttings obscured by excess drill mud) Dense sand reported by driller. *(continued)*	✋	Odor	AM	Some mud lost at 29-feet BGS.
30.0 WELL GRADED SAND - Black, very-fine to medium grained, angular, dense sand. Some obscurement due to recirculating bentonite chips.	✋	Odor	11:12:00 AM	
40.0 WELL GRADED SAND - Black, very-fine to coarse grained, angular to subangular, dense sand.	✋	Odor	11:22:00 AM	
	✋	Odor	11:33:00 AM	
55.0				

DRILLING LOG OF WELL/BORING NO. MW-58s

Page 1 of 2

Project: Barrier Wall Performance Monitoring Well Network

Location: McCormick and Baxter Superfund Site, Portland, Oregon

Date Finished: 10/27/2003

Northing/Easting: 705247.952/7627408.813

Start Card Well Number:

Drill Method: Mud-Rotary

Total Depth of Hole (feet BGS): 36

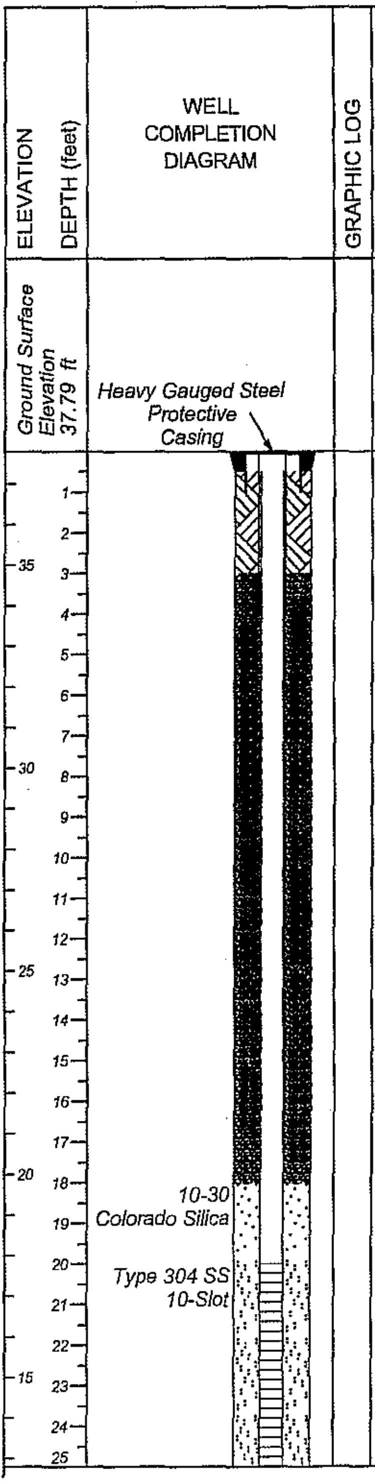
Ground Elevation (feet above NGVD): 37.79

Inner Casing Elevation (TOC): 38.06

Groundwater Elevation (feet NGVD):

Geologist: R. Whitchurch

Drilling Contractor: Geo-Tech Explorations



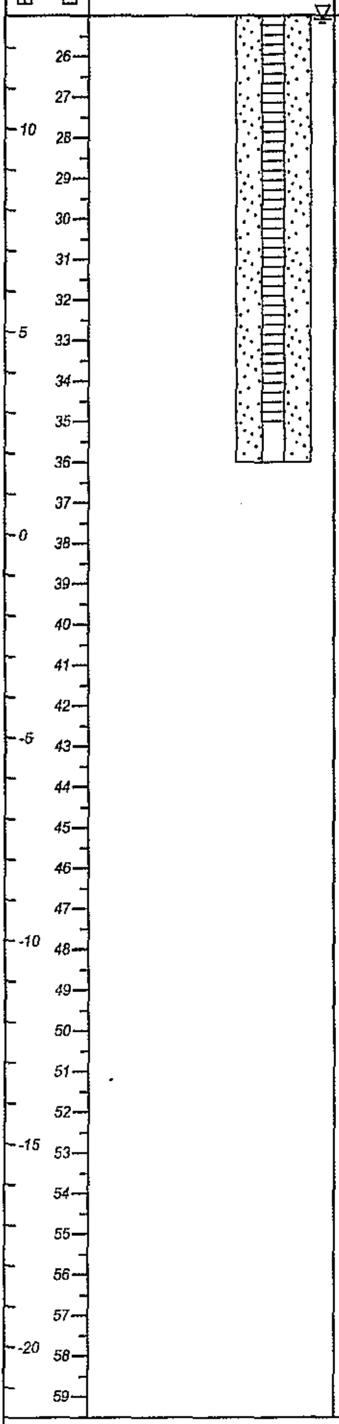
SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS
ground surface (gs)				
				No lithology recorded for MW-58s. See log for MW-58d for detailed lithology.

DRILLING LOG OF WELL/BORING NO. MW-58s

Project: Barrier Wall Performance Monitoring Well Network

Total Depth of Hole (feet BGS): 36

ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	NAPL	Time	COMMENTS

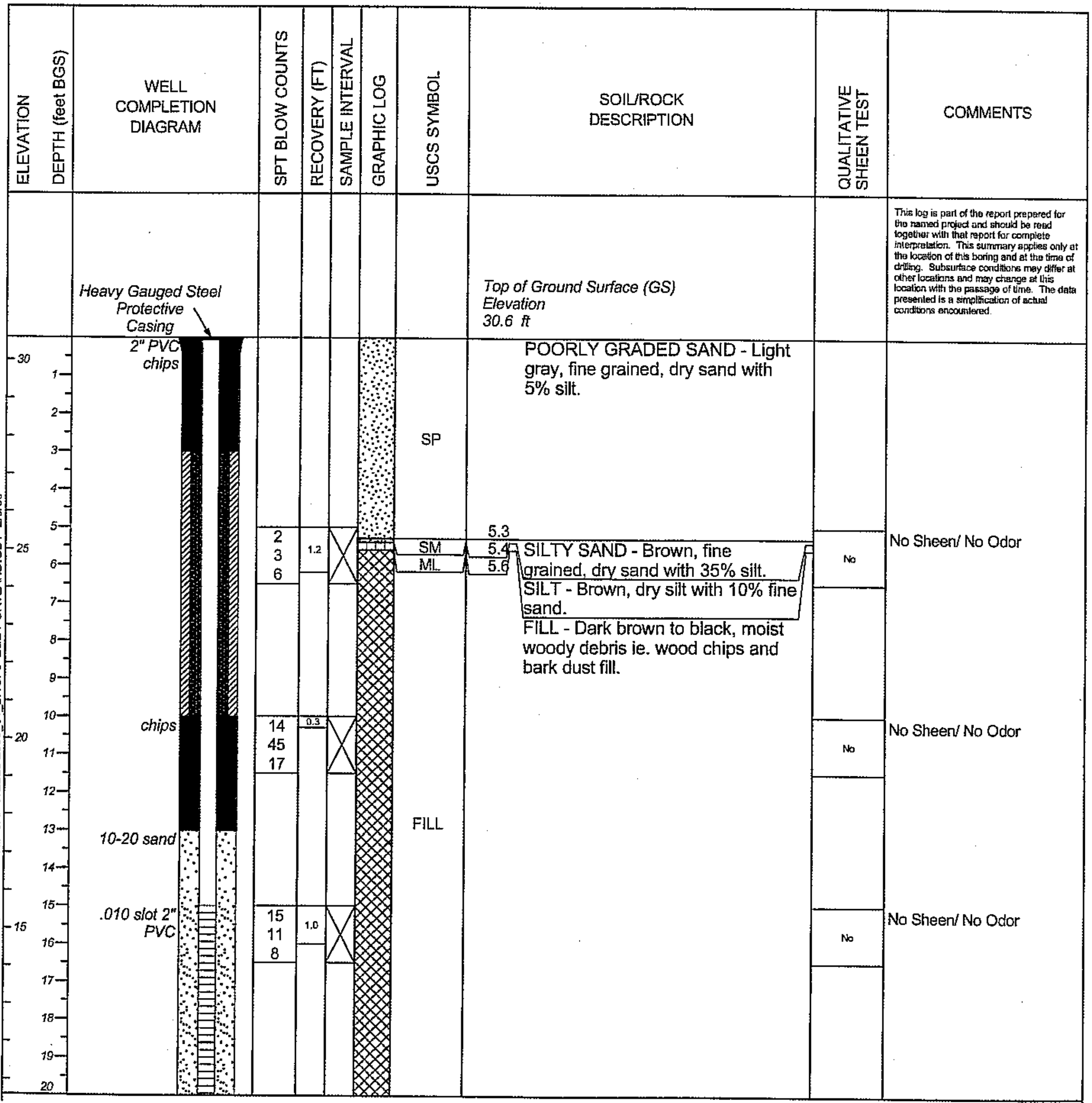


DRILLING LOG OF WELL/BORING NO. MW-59s

Page 1 of 2

DATE DRILLED: 6/23/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: D. Metzger
DRILLING METHOD: Hollow Stem Auger
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 704342.789
EASTING: 7628992.789

PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74
DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery



This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Top of Ground Surface (GS) Elevation 30.6 ft

POORLY GRADED SAND - Light gray, fine grained, dry sand with 5% silt.

SILTY SAND - Brown, fine grained, dry sand with 35% silt.

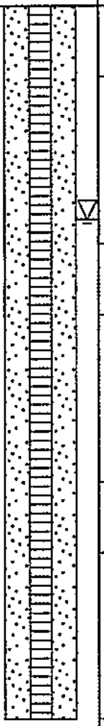
SILT - Brown, dry silt with 10% fine sand.

FILL - Dark brown to black, moist woody debris ie. wood chips and bark dust fill.

SPT BLOW COUNTS	RECOVERY (FT)	QUALITATIVE SHEEN TEST	COMMENTS
2 3 6	1.2	No	No Sheen/ No Odor
14 45 17	0.3	No	No Sheen/ No Odor
15 11 8	1.0	No	No Sheen/ No Odor

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/9/06

DRILLING LOG OF WELL/BORING NO. MW-59s



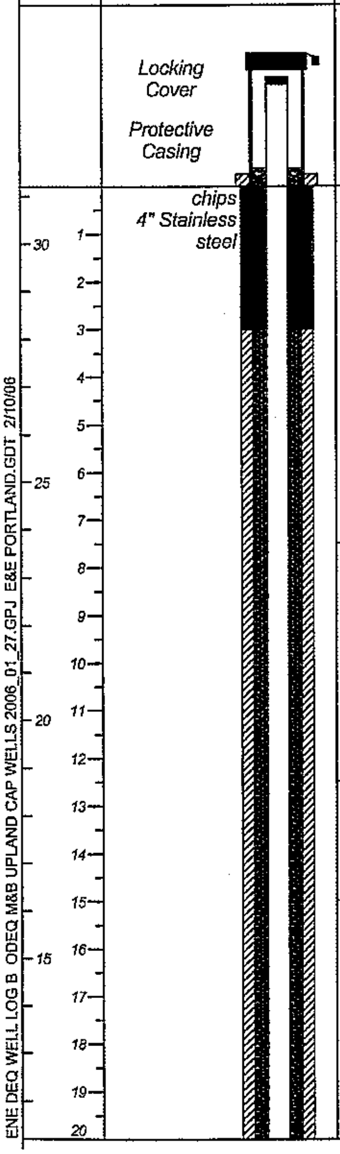
ELEVATION	DEPTH (feet BGS)	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
10	21	5 7 7	0.3	☒	▩		FILL - Dark brown to black, moist woody debris ie. wood chips and bark dust fill. *(continued)*	No	No Sheen/ No Odor
	22				▩				
	23				▩				
	24				▩				
	25	9 13 13	0.4	☒	▩	FILL	Wet at 25-feet BGS.	No	No Sheen/ No Odor
5	26				▩				
	27				▩				
	28				▩				
	29				▩				
	30	10 5 6	0.7	☒	▩		30.5		No Sheen/ No Odor
0	31				▥		SILT - Brown, wet silt with less than 5% fine sand.	No	
	32				▥				
	33				▥	ML			
	34				▥				
	35	3 4 5	0.2	☒	▩	FILL	35.0 35.2 FILL - Dark brown to black, wet woody debris ie. wood chips and bark dust fill.	No	No Sheen/ No Odor
-5	36								
	37								
	38								
	39								
	40								
-10	41								
	42								
	43								
	44								
	45								
-15	46								
	47								

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/9/06

DRILLING LOG OF WELL/BORING NO. MW-60d

DATE DRILLED: 6/29/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: Rodney
DRILLING METHOD: Rotary Sonic
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 705063.029
EASTING: 7627500.354

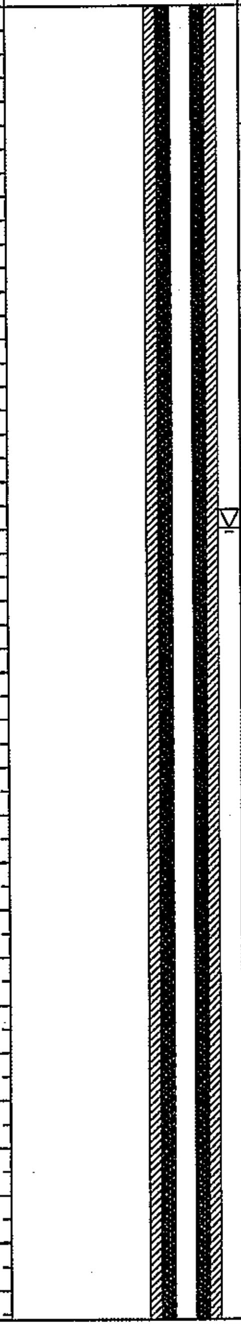
PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74
DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery



This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

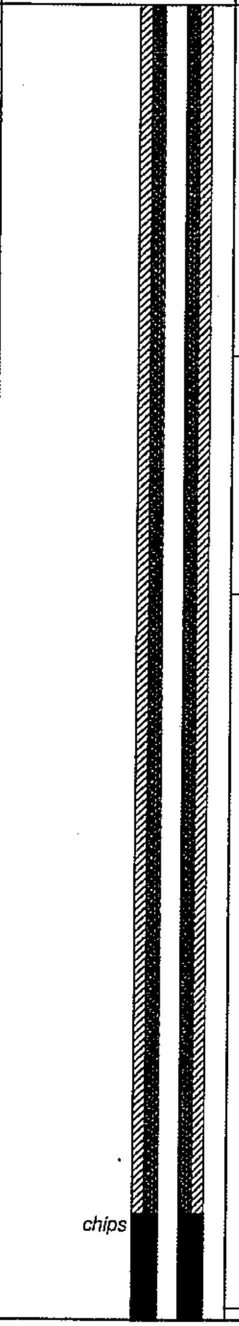
Top of Ground Surface (GS)
Elevation
31.2 ft

SPT BLOW COUNTS	RECOVERY (FT)	USCS SYMBOL	DEPTH	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
NM	5.0	GP-GM		POORLY GRADED GRAVEL WITH SILT - Brown, coarse, moist gravel with 20% silt, and with 10% fine sand.	None	No Sheen/ No Odor
		SPG	2.0	POORLY GRADED GRAVELLY SAND - Dark brown, moist sand with 25% coarse gravel, and with 5% silt.		
		SP	4.0	POORLY GRADED SAND - Brown, fine grained, moist sand with 5% coarse gravel, and with 5% silt.		
NM	5.0	SPG	7.5		None	No Sheen/ No Odor
		SM	8.0	POORLY GRADED GRAVELLY SAND - Brown, medium grained, dry sand with 30% fine gravel.		
		MLS	9.0	SILTY SAND WITH GRAVEL - Brown, moist sand with 20% coarse gravel, and with 20% silt.		
		SP	11.0	SANDY SILT - Brown, moist silt with 40% fine sand.		
				POORLY GRADED SAND - Brown, fine grained, moist sand with 5% silt.		
				Change in silt content to 30%. NAPL odor and sheen.		Slight Sheen/ Some Odor
				Change in silt content to 5%.		
			18.0	Color change to dark gray.		
NM	7.5	ML	18.5	SILT - Dark gray, moist silt with approximately 5% fine sand. Strong NAPL odor and heavy sheen.	Slight Sheen	
		SP				

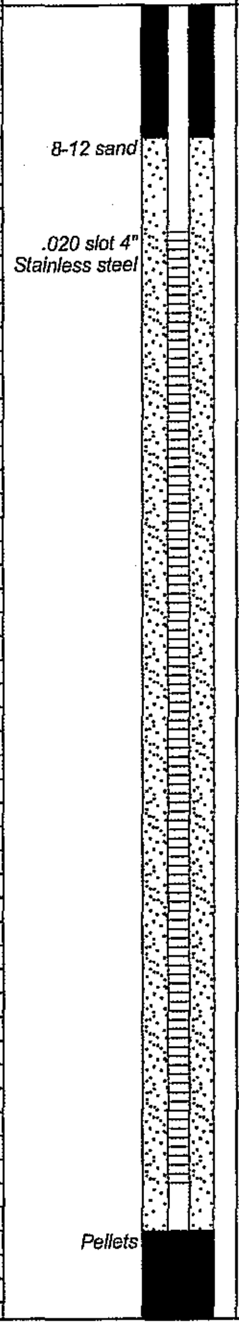


ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
10	21							POORLY GRADED SAND - Dark gray, fine grained, moist sand with woody debris at top and 15% rounded coarse gravel near the sample bottom. NAPL odor and sheen. *(continued)*		
	22						SP			Heavy Sheen/ Strong Odor
	23									
	24									
	25							25.0 SILTY SAND - Brown, fine grained, moist sand with silt. Silt content increases with depth from 5% to 20%. Wet at 31-feet BGS. Slight NAPL odor.		
5	26									
	27			10						
	28		NM				SP-SM		Heavy Sheen	
	29									
	30									
0	31	▽								
	32							32.0 SANDY SILT - Dark brown, wet silt with 25% fine sand, and with 5% rounded, fine gravel. Slight NAPL sheen.		
	33						MLS			
	34									
	35							35.0 POORLY GRADED SAND WITH SILT - Dark gray to black, very fine grained, wet sand with intercolated 2-4" silt beds. Slight NAPL odor.		Slight Sheen/ Slight Odor
-5	36									
	37						SP-SM			
	38									
	39									
	40							40.0 POORLY GRADED SAND - Dark gray, very fine to fine grained, wet sand with less than 10% silt. Slight NAPL odor to 45-feet BGS.		
-10	41									
	42									
	43									
	44						SP			
	45		NM	20					Slight Sheen	
-15	46									
	47									

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/10/06



ELEVATION	DEPTH (feet BGS)	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	48						POORLY GRADED SAND - Dark gray, very fine to fine grained, wet sand with less than 10% silt. Slight NAPL odor to 45-feet BGS. *(continued)*		
	49								
	50								
-20	51								
	52								
	53								
	54								
	55						Grain size change to very fine to fine sand, and increasing silt with depth up to 20%. Slight NAPL odor only at 57-feet BGS.		No Sheen/ Slight Odor
-25	56								
	57	NM	5					None	
	58								
	59								
	60						Color change to dark gray to black, and decrease in silt to 10% or less. Wood chips at 60-feet BGS.		No Sheen/ Slight Odor
-30	61					SP			
	62								
	63								
	64								
	65								
-35	66								
	67	NM	15					None	
	68								
	69								
	70								
-40	71								
	72								
	73								
	74								
	75								



ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
-45	76							POORLY GRADED SAND - Dark gray, very fine to fine grained, wet sand with less than 10% silt. Slight NAPL odor to 45-feet BGS. *(continued)*		No Sheen/ Slight Odor
	77									
	78	8-12 sand								
	79									
	80	.020 slot 4" Stainless steel								
-50	81									
	82									
	83									
	84									
	85		NM	20					None	
-55	86									
	87									
	88									
	89						SP			
	90									
-60	91									
	92									
	93									
	94									
	95									No Sheen/ Slight Odor
-65	96									
	97									
	98									
	99									
	100		NM	10					None	
-70	101	Pellets								
	102									

DRILLING LOG OF WELL/BORING NO. MW-60d

ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	103							POORLY GRADED SAND - Dark gray, very fine to fine grained, wet sand with less than 10% silt. Slight NAPL odor to 45-feet BGS. *(continued)*		
	104									
	105									No Sheen/ Very Slight Odor
-75	106									
	107									
	108									
	109						SP			
	110		NM	10					None	
-80	111									
	112									
	113									
	114									
	115							115.0		
-85	116									
	117									
	118									
	119									
	120									
-90	121									
	122									
	123									
	124									
	125									
-95	126									
	127									
	128									
	129									
	130									

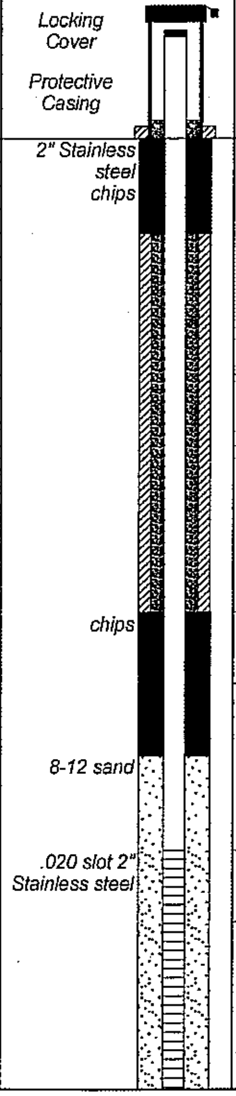
DRILLING LOG OF WELL/BORING NO. MW-61s

Page 1 of 2

DATE DRILLED: 6/22/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: D. Metzger
DRILLING METHOD: Hollow Stem Auger
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 705899.348
EASTING: 7628176.608

PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74
DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery

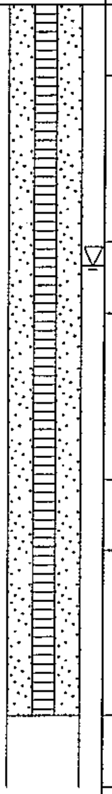
WELL COMPLETION DIAGRAM



ELEVATION	DEPTH (feet BGS)	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
							Top of Ground Surface (GS) Elevation 35.3 ft		This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
35	0						POORLY GRADED SAND - Brown, fine grained, dry sand with <5% silt, poorly graded.		
	1								
	2								
	3								
	4								
30	5	7 11 4	1.3	☒				None	No Sheen/No Odor
	6								
	7								
	8								
	9								
25	10	8 7 5	1.5	☒		SP	Color change to brown to gray.	None	No Sheen/No Odor
	11								
	12								
	13								
	14								
20	15	6 7 10	1.5	☒			Color change to brown, and grain size change to fine to medium grained, angular sand. Moist at 15-feet BGS.	None	No Sheen/No Odor
	16								
	17								
	18								
	19								
	20								

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/7/06

DRILLING LOG OF WELL/BORING NO. MW-61s



ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
5	21 22 23 24 25		7 11 16	1.5	☒	▨	SP	POORLY GRADED SAND - Brown, fine grained, dry sand with <5% silt, poorly graded. *(continued)* Grain size change to fine sand.	None	No Sheen/No Odor
0	26 27 28 29 30	▽	8 7 7	1.5	☒	▨	SM	25.5 SILTY SAND - Brown-black, fine to medium grained sand with 20% silt. Wet at 26-feet BGS.	None	No Sheen/No Odor
-5	31 32 33 34 35		3 4 9	1.3	☒	▨	SP	30.0 POORLY GRADED SAND - Brown-black, fine grained, wet sand.	None	No Sheen/No Odor
	36		20 11 9	1.5	☒	▨		36.5	None	No Sheen/No Odor
-10 -15	37 38 39 40 41 42 43 44 45 46 47									

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/7/06

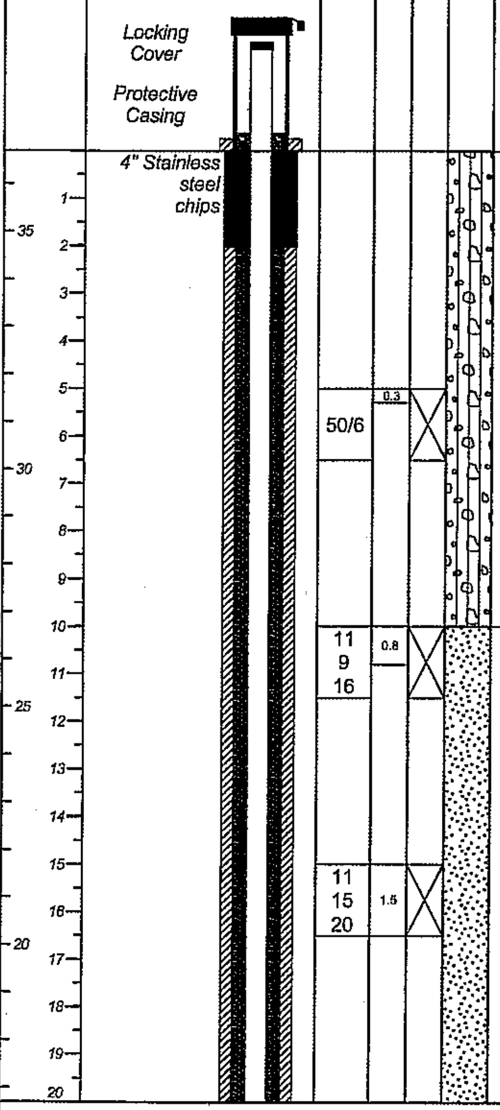
ecology and environment, inc.

PROJECT NAME: McCormick & Baxter Upland Cap
WELL NO.: MW-61s

DRILLING LOG OF WELL/BORING NO. MW-62i

DATE DRILLED: 6/23/2005
LOGGED BY: B. Ciecko
CHECKED BY: G. Lukert
DRILLING CONTRACTOR: Cascade Drilling Inc.
DRILLED BY: D. Metzger
DRILLING METHOD: Hollow Stem Auger
VERTICAL DATUM: NGVD 29/47 (feet)
COORDINATE REFERENCE SYSTEM: NAD83 SPCS Oregon North Zone (Intl feet)
NORTHING: 705004.733
EASTING: 7627616.004

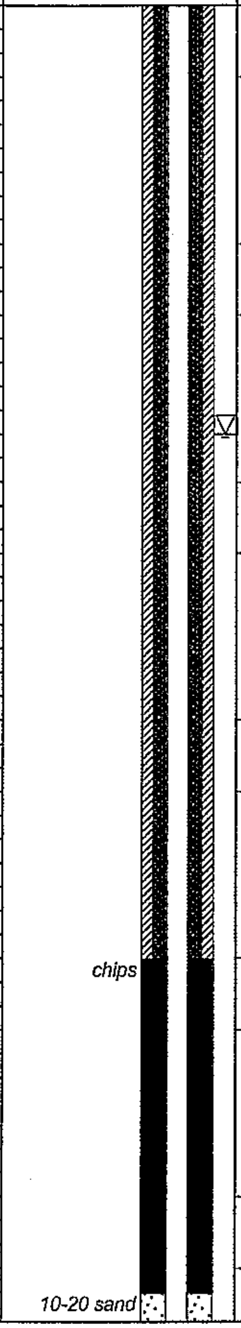
PROJECT NAME: McCormick & Baxter Upland Cap
PROJECT LOCATION: 6900 N. Edgewater St. Portland, OR
DEQ ECSI SITE ID #: 74
DEQ PROJECT MGR: Kevin Parrett
TASK ORDER #: 71-03-21
E & E PROJECT #: 002688.OY21.14.04
E & E PROJ MGR: John Montgomery



ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
								Top of Ground Surface (GS) Elevation 36.7 ft		This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.
							MLG	GRAVELLY SILT - Light brown, dry silt with 15% angular, medium gravel and less than 5% fine sand.		
	5		50/6	0.3	☒				None	No Sheen/ No Odor
	10		11 9 16	0.8	☒			10.0 POORLY GRADED SAND - Light brown, medium to fine grained, moist sand with less than 5%silt. Very slight NAPL sheen.	Slight Sheen	Slight Sheen/ No Odor
	15		11 15 20	1.5	☒		SP	Color change to brown.	Slight Sheen	Slight Sheen/ No Odor

DRILLING LOG OF WELL/BORING NO. MW-62i

Page 2 of 3

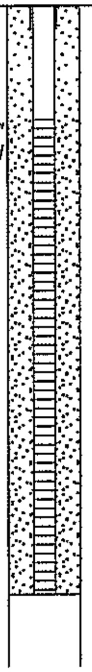


ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
15	21		11 21 25	1.5	☒		SP	POORLY GRADED SAND - Light brown, medium to fine grained, moist sand with less than 5%silt. Very slight NAPL sheen. *(continued)* Grain size change to fine sand. No further NAPL sheen observed.	None	No Sheen/ No Odor
10	25.3 – 25.5		10 17 20	1.5	☒		SM	SILTY SAND - Brown, very fine grained, moist sand with 30% silt. Very slight NAPL sheen.	Slight Sheen	Slight Sheen/ No Odor
	27						SP	POORLY GRADED SAND - Brown, fine grained, moist sand with 5% silt.		
	29	▽						Wet at 29-feet BGS. No further NAPL sheen observed; slight NAPL odor.		
5	30		11 22 25	1.5	☒			Color change to dark gray to black, and grain size change to fine to medium sand.	None	No Sheen/ Some Odor
0	35		6 11 20	1.5	☒		SP	Color change to dark gray, and grain size change to fine sand.	None	No Sheen/ Slight Odor
-5	40	chips	8 7 11	1.5	☒			Change in silt content to less than 5%.	None	No Sheen/ Slight Odor
-10	45		8 12 22	1.5	☒				None	No Sheen/ Slight Odor
	47	10-20 sand								

ENE DEQ WELL LOG B ODEQ M&B UPLAND CAP WELLS 2006_01_27.GPJ E&E PORTLAND.GDT 2/10/06

DRILLING LOG OF WELL/BORING NO. MW-62i

ELEVATION	DEPTH (feet BGS)	WELL COMPLETION DIAGRAM	SPT BLOW COUNTS	RECOVERY (FT)	SAMPLE INTERVAL	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK DESCRIPTION	QUALITATIVE SHEEN TEST	COMMENTS
	48							POORLY GRADED SAND - Brown, fine grained, moist sand with 5% silt. *(continued)*		
	50	*.020 slot 4" Stainless steel*	4 6 7	1.5	☒				None	No Sheen/ Slight Odor
-15	52									
	55		6 12 15	1.5	☒		SP		Slight Sheen	Slight Sheen/ Slight Odor
-20	57									
	60		6 50/5	1.5	☒			Grain size change to fine sand. Sand is heaving.	None	No Sheen/ Slight Odor
	61.5									
-25	62									
-30	67									
-35	72									
	75									



PROJECT NAME: McCormick & Baxter Upland Cap
WELL NO.: MW-62i

ecology and environment, inc.

WELL CONSTRUCTION DATA
McCormick & Baxter Creosoting Co.
Portland Plant

	MW-A	MW-B	MW-C	MW-D
Date Drilled	9/27/83	9/27/83	9/27-28/83	9/28/83
Boring Diameter	7"	7"	7"	7"
Boring Depth	29'	29'	25'	32'
Casing Depth	27'	23'	24'	32'
Casing Diameter	2"	2"	2"	2"
Casing Material	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Perforated Interval	22'-27'	18'-23'	19'-24'	27'-32'
Perforation Thickness	0.02"	0.02"	0.02"	0.02"
Filter Pack Material	1 mm sand	1 mm sand	1 mm sand	1 mm sand
Filter Pack Interval	22'-29'	16'-29'	18'-25'	25'-32'
Annular Seal Depth	10'	16'	4'	15'
Annual Seal Material	Bentonite slurry with 5 sacks cement per yard			

Source: Aqua Resources, Inc.

✓

MW-A SUMMARY BORING
McCormick & Baxter Creosoting Co.
Portland Plant

Depth Below Surface (ft)	Lithologic Description	Soil Classification
0	Brown medium sand; some 1/4-inch gravel	SP
5	Brown medium sand; no gravel	SP
10	Brown medium sand; no gravel	SP
15	Brown medium sand; no gravel; moist at 18 feet	SP
20	Gray-black medium sand	SP
20.5	Gray-black sandy silt with some organics	
23	Black clayey silt on augers	
25	Gray-black medium sand; some lenses/streaks of brown medium sand and gray-black silty fine sand; some organics	SP

Source: Aqua Resources, Inc.

✓

MW-B SUMMARY BORING
McCormick & Baxter Creosoting Co.
Portland Plant

Depth Below Surface (ft)	Lithologic Description	Soil Classification
0	Medium gray-black sand, earth odor	SP
5	Medium gray sand with gravel to 1/2 inch	SP
	Gravelly medium brown sand with 1/4-inch gravel; earthy odor	
10	Gravelly black medium sand	SP
15	Brown medium sand; no gravel	SP
20	Organics—bark and wood chips	PT
25	Organics—bark and wood	PT
25	Clayey silt with organics (bark and wood)	OL

Source: Aqua Resources, Inc.

✓

MW-C SUMMARY BORING
McCormick & Baxter Creosoting Co.
Portland Plant

Depth Below Surface (ft)	Lithologic Description	Soil Classification
0	Brown fine-medium sand	SP
5	Brown fine-medium sand	SP
10	Brown fine-medium sand, moist	SP
15	Brown and black, medium coarse sand; bottom 8 inches saturated (water)	SP
20	Medium sand, saturated	SP

Source: Aqua Resources, Inc.

✓

MW-D SUMMARY BORING
McCormick & Baxter Creosoting Co.
Portland Plant

Depth Below Surface (ft)	Lithologic Description	Soil Classification
0		SP
5	Brown medium sand--dry	SP
10	Brown medium sand--dry, very loose	SP
15	Brown, gray, and white medium sand--dry, very uniform	SP
18	Auger cuttings--medium sand with oily sheen, strong creosote odor	SP
20	Brown, gray, and white medium sand--moist, some creosote odor	SP
25	Brown, medium sand--oily sheen, strong creosote odor	SP
30	Medium sand--saturated with black oil, strong creosote odor	SP

Source: Aqua Resources, Inc.

✓

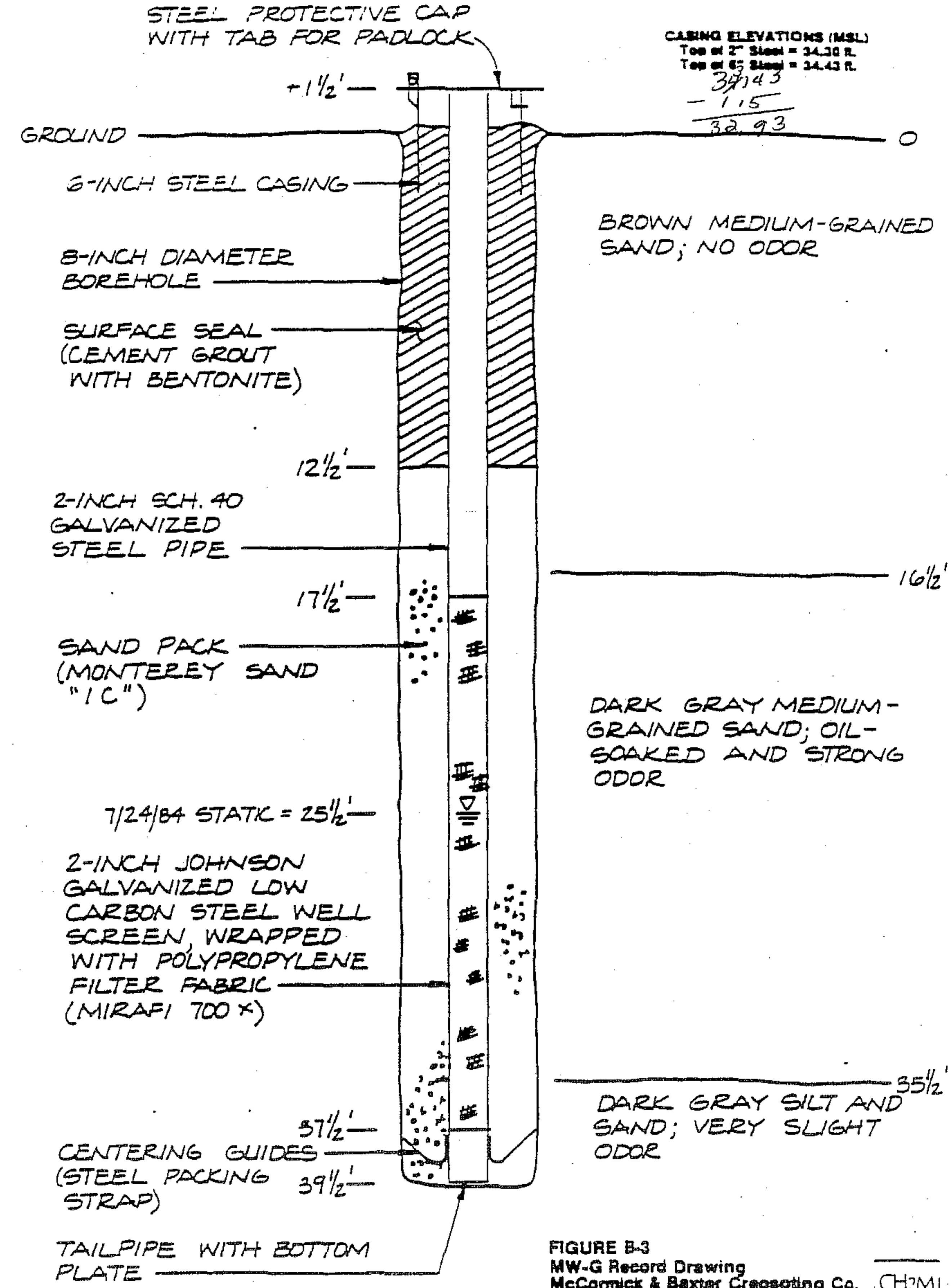


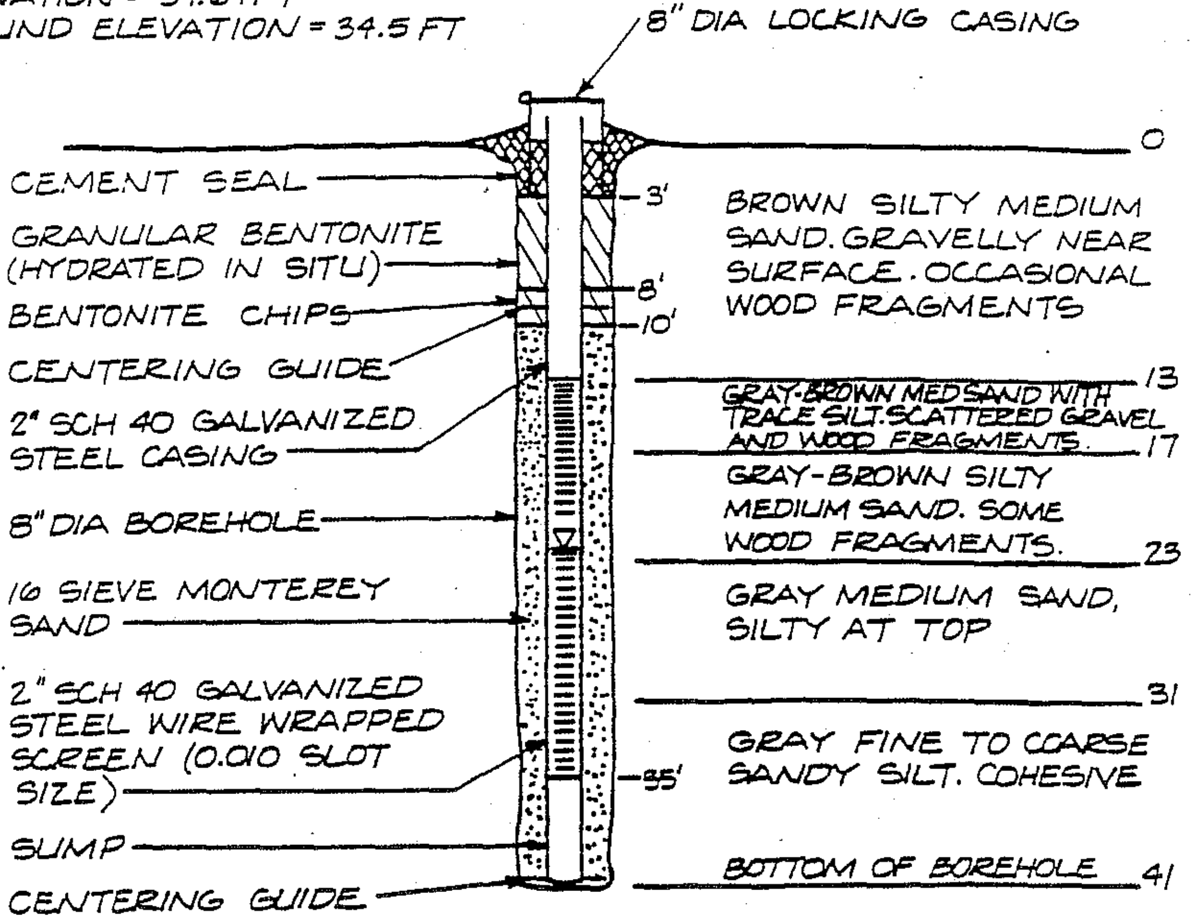
FIGURE B-3
MW-G Record Drawing
McCormick & Baxter Creosoting Co.
Portland, Oregon

CH2M HILL

P17774.A0

✓

TOP OF 2-INCH STEEL CASING
ELEVATION = 34.64 FT
GROUND ELEVATION = 34.5 FT



DEPTH TO WATER = 22.52 FT
8/1/85

FIGURE A-2
MW-O RECORD DRAWING
McCormick & Baxter
Creosoting Company
Portland, Oregon

CH2M HILL

97

PW-1d 6a

STATE ENGINEER
Salem, Oregon

Well Record

STATE WELL NO. 1N/1-7N
COUNTY Multnomah
APPLICATION NO. GR-42

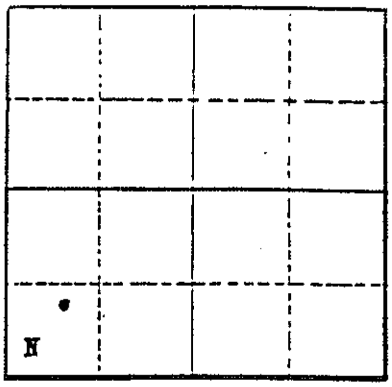
OWNER: McCormick & Baxter Creosoting Co. MAILING ADDRESS: P. O. Box 3344

LOCATION OF WELL: Owner's No. .... CITY AND STATE: Portland, Oregon

SW ¼ SW ¼ Sec. 7 T. 1 ~~S.~~ N. R. 1 ~~W.~~ E., W.M.

Bearing and distance from section or subdivision corner North 13° 38.6' West 4215.6 feet to NW Corner, Section 7.

Altitude at well 20 feet



TYPE OF WELL: Drilled Date Constructed Sept. 1945

Depth drilled 130 feet Depth cased 130 feet

Section 7

CASING RECORD:

12-inch casing set from 0 to 130 feet

FINISH:

casing perforated from 65 to 124 feet
size of perforations not known

AQUIFERS:

sand, gravel, and clay

WATER LEVEL:

23 feet

PUMPING EQUIPMENT: Type Lane Bowler Deep Well Turbine Pump H.P. ....
Capacity 750 G.P.M.

WELL TESTS:

Drawdown 0 ft. after .... hours 1200 G.P.M.

Drawdown 8 ft. after .... hours 1300 G.P.M.

USE OF WATER Industrial Temp. .... °F. ...., 19........
SOURCE OF INFORMATION GR-4121
DRILLER or DIGGER R. J. Strasser Drilling Co. Portland, Oregon
ADDITIONAL DATA:
Log x Water Level Measurements .... Chemical Analysis .... Aquifer Test ....

REMARKS:

dredged sand	12 to 118	cemented gravel	13 to 12
silt, clay and very fine sand	48 to 70	gravel with a little water	5 to
coarse sand with water	24 to 46	cemented gravel	7 to 0
gravel with clay binder	21 to 25		

✓

STATE ENGINEER
Salem, Oregon

State Well No. 1N/1-7N1
County MULTNOMAH
Application No.

Well Log

PW-1d

Owner: McCormick & Baxter Co. Owner's No.

Driller: R. J. Strasser Drilling Co. Date Drilled 1945

CHARACTER OF MATERIAL	(Feet below land surface)		Thickness (feet)
	From	To	
Artificial fill:			
"Dredged sand"	0	12	12
Younger alluvium:			
Silt, clay, and very fine sand	12	60	48
Sand, coarse, water-bearing	60	84	24
Gravel and clay	84	105	21
Troutdale Formation:			
Gravel, cemented	105	118	13
Gravel, water-bearing	118	123	5
Gravel, cemented	123	130	7

V PW-2

The original and first copy
of this report are to be
filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date
of well completion.

WATER WELL REPORT

STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
16 1968
STATE ENGINEER
SALEM, OREGON

G-4242

State Well No. 1N/1-7 N

State Permit No.

(1) OWNER:

Name McCORMICK AND BAXTER Co

Address 6900 N. EDGEWATER ROAD
PORTLAND OREGON

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☒ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) CASING INSTALLED:

Threaded ☐ Welded ☒

12" Diam. from 0 ft. to 71 ft. Gage .330
12" Diam. from 91 ft. to 95 ft. Gage .330
" Diam. from ft. to ft. Gage

(6) PERFORATIONS:

Perforated? ☐ Yes ☒ No.

Type of perforator used

Size of perforations in. by in.

perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS:

Well screen installed? ☒ Yes ☐ No

Manufacturer's Name EDWARD E. JOHNSON

Type ARMCO IRON Model No.

Diam. 12 Slot size 100 Set from 71 ft. to 91 ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.

Static level 25 ft. below land surface Date 2/1/68

Artesian pressure lbs. per square inch Date

(9) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? STRASSER

Yield: 1030 gal./min. with 18 ft. drawdown after 6 hrs.
" " " "
" " " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water 54° Was a chemical analysis made? ☐ Yes ☒ No

(10) CONSTRUCTION:

Well seal—Material used CEMENT

Depth of seal 23 FEET ft.

Diameter of well bore to bottom of seal 20 in.

Were any loose strata cemented off? ☐ Yes ☒ No Depth

Was a drive shoe used? ☒ Yes ☐ No

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? depth of strata

Method of sealing strata off

Was well gravel packed? ☒ Yes ☐ No Size of gravel: 1/4-1/8

Gravel placed from 55 ft. to 95 ft.

(11) LOCATION OF WELL:

County Multnomah Driller's well number 4569

SW ¼ SW ¼ Section 7 T. 1N R. 1E W.M.

Bearing and distance from section or subdivision corner

(12) WELL LOG:

Diameter of well below casing

Depth drilled 95 ft. Depth of completed well 95 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
FILL SAND	0	12	
SAND AND GRAVEL	12	23	
SAND AND SILT	23	65	
FINE SAND	65	70	
COARSE SAND	70	95	

Work started JAN 18 1968 Completed FEB 6 1968

Date well drilling machine moved off of well FEB 7 1968

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] Don Johnson (Drilling Machine Operator) Date FEB 15, 1968

Drilling Machine Operator's License No. 57

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME RJ STRASSER DRILLING Co
(Person, firm or corporation) (Type or print)

Address 8110 SE SUNSET LANE PORTLAND ORE

[Signed] Robert L. Strasser
(Water Well Contractor)

Contractor's License No. 10 Date FEB 15, 1968

(USE ADDITIONAL SHEETS IF NECESSARY)

APPENDIX L
DATA MANAGEMENT PLAN

Oregon Department of Environmental Quality

Final Data Management Plan

McCormick & Baxter Superfund Site

January 13, 2022

Prepared by:
GSI Water Solutions, Inc.
55 SW Yamhill St., Suite 300, Portland, OR, 97204

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Contents

Tables

Figures

Appendices

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Abbreviations and Acronyms

2-D	two-dimensional
3-D	three-dimensional
Collector app	Esri's ArcGIS Collector application
CSDGM	Content Standard for Digital Geospatial Metadata
D/F	dioxin and furan
DEQ	Oregon Department of Environmental Quality
DL	detection limit
DM	Data Manager
DMP	Data Management Plan
DMS	data management system
DQO	data quality objective
EDD	electronic data deliverable
EDL	estimated detection limit
EPA	U.S. Environmental Protection Agency
EPSG	European Petroleum Survey Group
ETL	extract, transform, and load
FGDC	Federal Geographic Data Committee
GIS	geographic information system
Geotech	Geotech Computer Systems, Inc.
GNSS	global navigation satellite system
GPS	global positioning system
GSI	GSI Water Solutions, Inc.
HPAHs	high-molecular weight polycyclic aromatic hydrocarbons
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
LCS	laboratory control spike
LPAHs	low-molecular weight polycyclic aromatic hydrocarbons
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
O&M	operations and maintenance

OCDF	octachlorodibenzofuran
OCDD	octachlorodibenzo-p-dioxin
ORGN	Oregon Real-Time GNSS Network
PAH	polycyclic aromatic hydrocarbon
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
PEF	potency equivalency factor
Project Area	McCormick & Baxter Superfund Site
QA	quality assurance
QC	quality control
RDMS	relational database management system
RPD	relative percent difference
RTK	real-time kinematic
SAC	Sample and Analysis Coordinator
SAP	sampling and analysis plan
SOP	standard operating procedure
SQL	Structured Query Language
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TIFF	tagged image file format
T-SQL	Transect-Structured Query Language

SECTION 1: **Introduction**

This Final Data Management Plan (DMP) for the McCormick & Baxter Superfund Site (Project Area) was developed to aid the Oregon Department of Environmental Quality (DEQ) with the collection and storage of data related to historical and future site management activities. This section is an introduction to the DMP and explains the DMP's objectives, data quality objectives, applicable guidance, and data management roles and responsibilities.

1.1 Objective

The purpose of this DMP is to develop a data management system (DMS) to aid in the integration of historical environmental chemistry data along with new environmental chemistry data specific to the Project Area. This DMP defines data handling procedures and processes to ensure that the scientific data integrated, collected, and derived from the Project Area are managed in a manner that meets the data quality objectives (DQOs) outlined in this document. Data managed in accordance with this DMP represent measurements of the chemical and physical properties of multiple environmental media. Detailed descriptions of the sample media, locations, and analytical requirements for sampling are presented in the applicable operations and maintenance (O&M) Manuals and sampling and analysis plans (SAPs) developed for work done in the Project Area.

This DMP also ensures the data are well documented and reliably stored to support future uses and long-term preservation. The DMP addresses requirements associated with all aspects of the project data life cycle for all project identification information, environmental sampling data, and associated geospatial data (Figure 1). Planning for data management at the onset of future project activities will help mitigate risk throughout the data life cycle. This DMP will be revisited during the onset of future projects to ensure data treatments are consistent with the objectives. If revisions to the DMP are necessary, they will be documented using the revision history tracking table (Table 1).

1.2 Data Quality Objectives

The DQOs for work performed in the Project Area have varied over time. This DMP was developed to implement procedures that will ensure the integration of historical data that are of known and acceptable quality and collection of data in the future. The laboratory quality assurance/quality control (QA/QC) procedures for work performed in the Project Area are consistent with procedures applied in the applicable O&M Manuals and SAPs. Specific DQOs for this DMP are as follows:

- **Define Specific Data QA/QC Procedures:** The applicable O&M Manual or SAP and this DMP present a set of QA/QC procedures for the data as well as derivative data products to help ensure that project data are of sufficient quality to meet current and future project objectives. The essential components of data quality addressed in this DMP are presented in Table 2.
- **Define Data Delivery and Transmission Processes:** Project data must be made accessible to internal parties and delivered to DEQ promptly while meeting other components of data quality shown in Table 2.
- **Provide Clear and Available Data Documentation:** Internal and external understanding of the project data requires documentation that is developed according to industry standards and compliant with requirements in the O&M Manuals, SAPs, and regulatory guidance documents.

- **Design and Implement a Data Management System:** Achieving the above DQOs requires designing and implementing a DMS for the storage, analysis, and dissemination of data. The data repository is designed to achieve the essential objectives related to data integrity. Data integrity refers to the processes and procedures that provide for the maintenance, accuracy, and consistency of data over the entire life cycle of the data. The essential components of data integrity are shown in Table 3.

1.3 Applicable Guidance

The applicable guidance for the development of this DMP include the following:

- Historical documents, including O&M Manuals and SAPs
- Project Area-specific data needs
- The DEQ's *Assurance Policy for the Environmental Cleanup Programs* (DEQ, 2015).
- Harmonization with the U.S. Environmental Protection Agency's (EPA's) *Program Data Management Plan: Portland Harbor Remedial Design Investigation* (EPA, 2021)
- The 2005 World Health Organization's *Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds* (WHO, 2005)

1.4 Data Management Roles and Responsibilities

The specific roles and responsibilities that will fulfil the DMS tasks outlined above are summarized below and shown on Figure 2:

- **Task Order Manager:** The Task Order Manager is responsible for administering the DMP, developing budgets associated with the DMP, and tracking progress towards the objectives of the DMP.
- **Sample and Analysis Coordinator (SAC):** The SAC is responsible for coordinating with field sampling and analytical laboratory programs. They serve as a field QA/QC officer and maintain copies of field documentation and laboratory chain-of-custody forms.
- **Analytical Chemistry Quality Assurance Manager:** The Analytical Chemistry QA Manager tracks progress of analytical programs, resolves questions or concerns from the analytical laboratory, validates data using appropriate QA/QC processes, and communicates issues to the project team.
- **Data Manager (DM):** The DM will coordinate directly with the project team, including the SAC, Analytical Chemistry QA Manager, and analytical laboratories. The DM will ensure field data entries are correct and complete, verify the satisfactory electronic transfer of validated data, maintain the integrity of the database, and oversee all data queries and reporting.
- **Geospatial Data Manager:** The Geospatial Data Manager will coordinate directly with the project team, including the SAC, Analytical Chemistry QA Manager, and DM to ensure proper application of geospatial information in the project database.
- **Laboratory Project Manager:** The Laboratory Project Manager is responsible for overseeing the QA/QC activities in the laboratory and ensuring the quality of the data for this project. They are responsible for maintaining appropriate records, reviewing and addressing non-conformities, preparing corrective action reports, and ensuring that appropriate QA/QC practices are adhered to.
- **Specialty Laboratory Manager:** Same roles and responsibilities as the Laboratory Project Manager.

SECTION 2: **Data Management System Architecture**

This section presents the architecture of the DMS.

2.1 Project Software and Hardware

The DMS is composed of a set of integrated software and hardware technologies that are listed in Table 4. Metadata associated with data deliverables will detail all changes made to software and hardware used as the project progresses. The software and hardware shown in Table 3 are widely used and can support multiple data uses while facilitating the transfer of project data to a wide range of technologies as required.

2.2 Data Management System Architecture

This project integrates the software listed in Table 4 to produce a DMS, as shown in Figure 3. This integrated approach results in secure management of data throughout its life cycle and will facilitate ready access and use of project data by scientists, engineers, geographic information system (GIS) professionals, and data analysts. Data can be provided to project stakeholders through end-user tools, including, but not limited to, ArcGIS Online, R programming language, Microsoft Power BI, and Microsoft Access. The open-source nature of the project data model also allows for a full backup file of the Microsoft Structured Query Language (SQL) Server database to be completed nightly. These backup files are retained for 90 days.

SECTION 3: **Tabular Data Management**

This section describes the relational database management system used to store project tabular data. Most data associated with this project consist of tabular data related to the collection and analysis of environmental samples. Consequently, this section describes the relational database management system and the open-source Enviro Data database model used for this project. Additionally, this section presents standards for database nomenclature, field data, and electronic data deliverables (EDDs). This project also involves the integration of historical data. Consequently, this section details procedures and workflows associated with historical data integration.

3.1 Relational Database Management System

This project will use Microsoft SQL Server 2017 as the relational database management system (RDMS) to serve as the master data repository for all analytical chemistry sample information. This sample information includes locations, results, field measurements, and associated ancillary and descriptive information documented using formal metadata.

3.1.1 Enviro Data Database Model

The data storage structure for the project analytical chemistry data will follow the industry-standard data model found in the Enviro Data version 8 software package (Geotech, 2019a). This data model represents years of continuous refinement based on the assessment of environmental data management at numerous sites, involving millions of records. The Enviro Data data model has a normalized design to reduce data redundancy while storing site characterization, physical characteristics, and operational data. The Enviro Data version 8 data model is extensive and can facilitate storing a wide variety of information including geologic units, lithology, and field observations.

The Enviro Data data model has more than 40 tables with more than 6,000 data fields. This project will use a smaller subset of related tables, as shown in Figure 4. There are also many lookup tables associated with the essential data tables shown in Figure 4. For example, as shown in Figure 4, the ***Parameters*** table stores additional information about the coded values used in the ***Analyses*** table regarding analytes of interest. The ***Parameters*** table reduces data redundancy by using coded values such as primary keys to store full analyte names, as numeric integers, and other information about analytes or ***Parameters***.

The Enviro Data data model also contains reference tables, which are primarily used by the program to perform maintenance, analytical, or other program-specific functions. For example, there is a set of tables that can store information about regulatory limits or cleanup levels that are not directly related to any specific data tables. within Enviro Data, graphical, and tabular displays of data can be developed and compared with regulatory limits to quickly determine where exceedances occur, if desired. Utility tables include ***ActivityLog***, which stores information about data management processes, and ***Documents***, which records information about project-related documents.

3.1.2 Database Nomenclature

This project follows database nomenclature used in the Enviro Data data model as fully described in Geotech Computer Systems, Inc. (Geotech) 2019a and 2019b. Values used for Enviro Data database lookup tables will facilitate consistent nomenclature for sample locations, analytes, analytical methods, field measurements, sample matrices, and other project-specific information.

Stations will have a unique identifier, either (1) assigned by this project for new sample locations as described in the applicable O&M Manual or SAP or (2) created following protocols used in previous efforts for historical data. Each sample will have a unique identifier following the protocols described in Sections 4.4, 5.6, and 9.5 of the 2018 O&M Manual (GSI and Hart Crowser, 2018), for new *Sample* locations or conform to historical *Sample* names (no sample names will be modified to conform to new naming conventions). Enviro Data import tools as shown in Figure 5 have automated techniques to check for consistent *Station* and *Sample* names, as well as other data quality checks described in the sections below.

All final stand-alone files, databases, data sets, or other documents will adhere to a project-specific naming convention for final deliverables. The file naming convention will be determined at the onset of the project.

3.1.3 Field Data Standards

Staff will record field information on waterproof field forms shown in the most recent O&M Manual (GSI and Hart Crowser, 2018) or SAP, mobile data collection systems with electronic versions of these forms, or both. Staff may use Esri's ArcGIS Collector application (Collector app) or a similar product as the platform for electronic data collection. Electronic data collection will support the use of standardized picklist values, specific attribute data types, default values, and required fields to aid in automated data quality control. However, environmental conditions may preclude the use of electronic systems and warrant the need for hard copy forms to record tabular information.[1] Hard copy forms will be entered manually into the database using Enviro Data data entry forms by field staff who collected the data using the associated quality control procedures described below. Electronic field data can be transferred automatically to the project Enviro Data SQL Server, facilitating the use of automated quality control on the field data using existing Enviro Data tools as described below. The project may require the collection of additional information beyond that required in the field forms found in the O&M Manual or SAP. The creation of electronic and hard copy field forms will occur as required for the project.

3.1.4 Laboratory Electronic Data Deliverable Standards

The Enviro Data *Data Transfer Standard* (Geotech, 2019a) is the foundation of the EDD format used for this project and specified in Appendix A. The project EDD format detailed in Appendix A contains specifications for location, sample, and result data to be followed by project laboratories. Red titled columns are essential data fields and black titled columns are optional data fields. The project EDDs are used by the DM to load data to the project SQL Server database using standard attribute names, values, and codes. Enviro Data contains tools to automate the import of the data and check for conformance to lookup table values, as shown in Figure 5. However, custom import Transact-Structured Query Language (T-SQL) scripts may also be required to load project data into the SQL Server database.

3.2 Integrating Historical Data

There have been extensive environmental sampling activities conducted across the Project Area since the mid-1990s. Sampling efforts were generally performed by DEQ consultants and subject to QA/QC review during data generation. Historical sampling efforts are described in annual and Five-Year Review reports. The integration of historical analytical chemistry data from the Project Area into the Enviro Data database will be necessary for evaluations of remedy performance and long-term monitoring. This section details the integration of historical data into the project Enviro Data SQL Server database.

Historical data is currently stored in report tables on the GSI Water Solutions, Inc. (GSI) and Hart Crowser, Inc. servers. These tables are saved in various formats, including Excel and PDF versions of the annual report. Historical datasets will be prioritized for database entry based on long-term monitoring evaluation goals and accessibility. Data manipulations using Excel PowerQuery and Adobe Acrobat will be used to

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[1] All coordinate locations will be recorded electronically using a global positioning system (GPS) and in the field log.

extract the data from these files, normalize the data formatting, and then load the data into the database using an Enviro Data import format.

3.3 Tabular Data Quality Assurance

The assurance of quality related to project tabular analytic chemistry data will occur through performing a series of QC procedures, as detailed in the relevant O&M Manual or SAP. QC procedures will be performed on the historical data, as described in Section 3.2, as well as new data from field data collection, laboratories, third-party validators, and other data collection events.

3.3.1 Historical Data Quality Control Procedures

Table 5 will be updated to list the specific QC procedures conducted on historical data loaded to the database to ensure that the data met the DQOs. Future endeavors will include compiling historical data and conducting the QA/QC procedures described below. The data may be available in an Access database, stand-alone Excel tables, or historical documents. End users of historical data will evaluate their use for project-specific purposes. This could result in certain data in the database not being used for certain project activities. All users of the project database will indicate data exclusions and the reason(s) for these exclusions. The measures that may be used to assess historical data include:

- A QA/QC check will be performed on historical data incorporated into the database after it is entered to ensure it is complete and accurate.
- Results of the QA/QC check will be stored in the database as fields, which may include:
    - Use approval
    - Assessment of completeness
    - Status and QA/QC level of each historical and newly collected data point if available
    - 10 percent check
    - Qualifier review

3.3.2 Field Data Quality Control Procedures

Project field staff will scan hard copy field forms and enter information into the project Enviro Data SQL Server database using Enviro Data data entry forms. During these data assessment and transcription activities, the field staff will track sample completion, using a custom data set. Quality control of incoming field data will be facilitated through Enviro Data data entry forms and batch loading tools that check for consistent sample names, standard attribute values, and other aspects of database integrity. QC review will be conducted on 100 percent of data entered by the manual data entry to identify any typographical errors. The QC procedures for loading field data to the project database are shown in Table 6.

SECTION 4: **Geospatial Data Management**

This section describes the management of geospatial data, including geodetic standards and the systems used to manage spatial data, as well as the quality measures employed to ensure geospatial data integrity and accuracy.

4.1 Geodetic Specifications and Data Quality

The geodetic specifications identified in this section are intended to standardize the positional accuracy and alignment of mapped data collection locations. These underlying standards define project data positional reference on the Earth for proper mapping, visualization, analysis, calculations, and reporting.

4.1.1 Vertical Datum

A vertical datum is a surface of zero elevation to which heights at various locations on the Earth are referenced (NGS, 2019). The current vertical datum for the contiguous United States is the North American Vertical Datum of 1988 (NAVD 88), which will serve as the standard vertical datum for this project. Most data collected for the project are two-dimensional (2-D) in nature, represented by horizontal coordinates. Subsurface samples add a vertical, or three-dimensional (3-D), component to specific data. The NAVD 88 vertical datum is used to map 3-D elevations. Existing elevational data sets such as topography and bathymetry also use NAVD 88 for reference heights. Historical elevation data may use the National Geodetic Vertical Datum of 1929 (NGVD 29). Any data referenced to NGVD 29 will be converted to NAVD 88 using the National Geodetic Survey's Coordinate Conversion and Transformation Tool to compute the modeled difference in orthometric heights between the NGVD 29 and NAVD 88 datums. The project will use units of international feet for storage of vertical measurements and coordinates.

4.1.2 Horizontal Datum

A horizontal datum is a specified coordinate system for a collection of positions on the surface of the Earth (NGS, 2019). The current horizontal datum for the United States is the North American Datum of 1983 (2011), referred to as NAD 83 (2011). NAD 83 (2011) will serve as the standard horizontal datum for this project. The project will use units of international feet for the storage of horizontal measurements and coordinates.

4.1.3 Coordinate System

The State Plane Oregon North coordinate system is a regional standard and the coordinate system of record for most ancillary geospatial data used by this project. Map and data deliverables will use the State Plane Oregon North coordinate system and the following projection parameters for the horizontal coordinate system:

- NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl
- WKID: 6559 Authority: European Petroleum Survey Group (EPSG)
- Geographic Coordinate System: GCS_NAD_1983_2011
- Datum: D_NAD_1983_2011

The following projection parameters are for the vertical coordinate system:

- NAVD_1988
- WKID: 5703 Authority: EPSG
- Vertical Datum: North_American_Vertical_Datum_1988

4.1.4 Data Precision

Geospatial precision in this document refers to the resolution, variation, and repeatability of spatial measurements or derivations. Precision for vector data sets is of primary concern for this project, as this project will create and derive new vector data sets. Raster data used for the project will primarily consist of historical data with preexisting precision requirements. The precision requirements for new project geospatial data are as follows:

- Storing, managing, and editing of vector data will occur using ArcGIS or other appropriate editing tools. Shapefiles and geodatabases can be used to store geospatial data.
- Storing of numerical data will occur using double precision with a minimum of eight decimal digits unless otherwise noted.
- Storing of vector data will occur in shapefiles or feature classes with only one geometry type.
- Collecting sample location information will be conducted using a high-precision GPS unit.
- Storing, managing, and editing of raster data will occur in ArcGIS geodatabases or uncompressed tagged image file formats (TIFF) or geoTIFF files, with an associated Microsoft Word file.
- Scanning of hard copy maps to create a raster data set will use a minimum scanning resolution of 250 dots per inch.

4.1.5 Data Accuracy

Geospatial data accuracy in this document refers to the degree to which information in geospatial data sets corresponds to real-world conditions or locations. Accuracy, as applies to geospatial data, can refer to both horizontal and vertical measurements. Historical data were mapped with sub-meter and sub-foot GPS equipment. Collection of GPS data in the future will also use sub-meter or sub-foot grade GPS equipment and real-time differential corrections.

During the integration of new and historical geospatial data, checks for consistent coordinate projections and spatial extents will be made.

4.2 Geospatial Data Quality Assurance

GIS staff or the DM and technical subject matter experts will perform periodic quality checks to assure that staff develop, format, and store geospatial data to meet the project’s analytical and reporting goals.

SECTION 5: **Unstructured Data Management**

Unstructured data is information that does not have an established data model or lacks a pre-defined structure or organization. Examples of unstructured data produced throughout the history of the Project Area include project reports, memos, correspondences, maps, videos, audio files, presentations, web pages, and other documents. This unstructured data are recorded and managed as noted below:

- **Reports and Memos:** Microsoft Word will be used to develop project reports and memos. Figures, graphs, maps, and other associated media will be created using software listed in Table 4.
- **Presentations:** Project presentations will be created using Microsoft PowerPoint.
- **Maps and Figures:** Digital, interactive, hard copy, and static maps will be used to depict geospatial information for the project. ArcGIS will be the primary GIS platform used for the creation of maps. GSI uses standard mapping templates and defined cartographic elements to maintain consistency in all mapping deliverables.
- **Email Correspondence:** Emails can be archived in Outlook or as stand-alone files if the project requires it. All laboratory deliverables sent via email will be archived in Outlook and attachments (lab reports, EDD files) will be downloaded and saved to the project server files.
- **Other Unstructured Data:** A spatially referenced picture library may be developed if project needs support it.

These unstructured project data will be hosted on a SharePoint site or accessible to the DEQ via other software tools (Table 7). Access will be controlled through the issuance of a username and password (Table 8).

SECTION 6: **Data Documentation**

Documentation of spatial and tabular data will be essential to the long-term use of the project data. Additionally, EPA (2008) requires documentation of project data as per the Federal Geographic Data Committee (FGDC) *Content Standard for Digital Geospatial Metadata* (CSDGM) (1998). This section details the formats, specifications, and tools involved in the documentation of project data.

6.1 Tabular Data Metadata

Documentation of tabular data stored in the project Enviro Data SQL Server database occurs via several internal methods within the database as well as methods external to the database. Each table and field used in the project database has descriptive information documented in the project EDD format shown in Appendix A. Furthermore, project-specific lookup tables exist in the database to document standard values and codes used for various data fields within the database. Activities conducted to load and transform data within the project database are also documented internally in the ***ActivityLog*** table. Enviro Data tools have a data entry form, as shown in Figure 6, which reminds data managers to record data entry or update activity after each operation.

6.2 Unstructured Data Metadata

Unstructured data such as reports do not always have or require associated metadata documents, as the information contained within reports and other unstructured data is typically self-explanatory. Nonetheless, Enviro Data supports directly recording and linking documents to various samples, stations, sample plans, or other project-specific documents. The Enviro Data form used to record information about project documents or unstructured data is shown in Figure 7. Additionally, unstructured data will be linked to other structured metadata documents as appropriate using the *Citation* and *Lineage* metadata elements shown in Table 9.

SECTION 7: **Geospatial and Tabular Data Integration**

This section describes the tools, standards, and workflows associated with the integration of project tabular and geospatial data. Project analytical chemistry data will be stored in an Enviro Data SQL Server database as described in the previous sections. The tabular data contains geospatial components, including the horizontal location of the station and vertical placement within the respective media. Integrating tabular analytical chemistry data with other geospatial data will facilitate visualization, quality control, and analysis of the data by multiple groups and specialists. The integration of tabular analytical data with other project geospatial data will involve a set of extract, transform, and load (ETL) operations to reduce the data to pertinent information while transforming and loading data to formats capable of being integrated with other data.

This section details standards for transforming tabular data into geospatial formats. Additionally, the project may require the integration of data from external sources, requiring assurance on the quality of these external data integrations. Consequently, this section details standards for integrating external data sources. Finally, workflows implemented for performing ETL and other data integration operations are detailed.

7.1 Integration Tools

GIS will serve as a primary tool for project data integration and analysis. The primary GIS platform for the project will be ArcGIS—both desktop and cloud-based systems. The ArcGIS platform supports many Open Geospatial Consortium standards to help make data more available and capable of being integrated as described below. Additionally, the use of a SQL Server database to store tabular data will facilitate directly connecting to the project repository of tabular data via various ArcGIS tools through the development of custom query layers. These query layers will contain preset extractions of project data, facilitating consistent use and analysis of the project data. Enviro Data also facilitates the creation of standard exports of the data to formats like Microsoft Excel; these standard exports will be used as practical to meet project needs.

7.2 Integration Standards

The project efforts need to ensure that integrated data sources are accurate, timely, and reliable. Additionally, spatiotemporal data integration requires consistent spatial and temporal extents, resolutions, coordinate projections, and data quality. Finally, all data integrations need to use data sources that are not restricted, requiring appropriate documentation of data privacy. The standards described above for tabular, geospatial, and unstructured data will aid in ensuring consistency in project data integrations. ArcGIS Online also supports several Open Geospatial Consortium specifications, including Web Feature Services, Web Map Services, and Web Map Tile Service. Consequently, the use of ArcGIS Online to deliver geospatial data will facilitate the use of the data in compliant applications outside of the ArcGIS platform.

7.3 Integration Workflows

GSI will run ETL operations to integrate tabular and geospatial data as new data are added to the project database. All ETL operations will include the unique identifier for each station location and sample in the export. In addition, laboratory sample delivery group numbers will be transferred when ETL operations are performed and custom query layers will be created to facilitate direct access to tabular data within GIS environments. Figure 8 details the ETL workflow for tabular and geospatial data.

7.4 Data Integration Quality Assurance

Table 10 details the quality assurance and control checks of ETL operations designed to integrate tabular analytical chemistry data containing coordinate information with other project geospatial data.

7.5 Data Integration Visualization, Reporting, and Analytics

Other software tools listed in Table 4 will facilitate consistent data integrations. For example, the use of the R programming language for custom visualizations and statistical summaries will facilitate the consistent presentation of integrated project data. R can combine with mapping capabilities in ArcGIS Online and possesses other data analytics capabilities. The combined use of project software tools such as R and ArcGIS Online by project members will also aid in quality control of the project data as multiple individuals will examine the data in similar manners. This integrated approach provides numerous opportunities to identify data quality or data integrity errors. Project data quality and data integrity forms will facilitate reporting of data quality or data integrity errors within ArcGIS Online. Appendix B presents examples of data visualizations prepared previously or that may be used to support the project.

SECTION 8: **Field Data Collection Equipment**

This section discusses the use of data collection equipment in the field and sets field data collection standards for the Project Area.

8.1 Global Positioning System

Field data collection will be aided with use of high-accuracy GPS. Sample locations and ancillary data collection locations may be captured using an Eos Positioning Systems, Inc. Arrow Gold real-time kinematic (RTK) global navigation satellite system (GNSS) paired with an iPad tablet. Locational positions will be recorded using data collection software, such as the Collector app on an iPad. iPad or cell phones will connect to the Arrow Gold through a Bluetooth pairing. The Arrow Gold can obtain 1- to 10-centimeter-level accuracy using RTK positioning. If the Arrow Gold unit is not available, other GPS units with similar capabilities may be used.

Work in the Project Area will capture real-time position corrections by connecting to the Oregon Real-Time GNSS Network (ORGN), which is publicly available and maintained by the Oregon Department of Transportation. All GPS locations mapped in the field will automatically be populated with metadata attributes to document their positional accuracy. If onsite or nearby features—such as buildings, bridges, or ships—obstruct the GPS or ORGN satellite signal, the Arrow Gold can use the Wide Area Augmentation System to obtain sub-meter real-time positional accuracy. Additionally, the Arrow Gold is designed with SafeRTK that enables the device to maintain RTK-level accuracy for up to 20 minutes while waiting for a reconnection to the ORGN network service.

8.2 Mobile Data Collection Devices

One system that can be used in the Project Area for electronic field data collection consists of the Collector app. The Collector app has been configured to support the collection of field data following the Enviro Data standards and can be configured further as project needs require.

Additionally, the Collector app facilitates recording of images associated with each data collection point as well as information regarding that image. The Collector app can also be linked to the RTK GPS device. Additional configurations of the Collector app can be conducted to facilitate various data collection workflows for this project.

SECTION 9: **Post-field Data Collection and Laboratory Workflows**

The data collection and laboratory workflows are presented in this section.

9.1 Chain-of-Custody Tracking

A digital copy of the chain of custody will be reviewed by the DM at the end of each sampling day and compared to O&M Manual requirements. Any deviations will be discussed with the project team and errors will be reconciled with the laboratory by the DM. The chain of custody will then be archived in the server files and entered into the laboratory data tracking sheet until the laboratory sends an applicable work order number confirming that the samples were received and requested for the applicable analyses.

9.2 Laboratory Data Quality Assurance/Quality Control

Laboratory QA/QC will be maintained through the use of standard EPA and other accepted methods and standard analytical procedures for the target analytes. These procedures incorporate the collection and analysis of the following laboratory QA/QC components:

- Internal QC samples
- Laboratory blank spikes
- Method reporting limit (MRL) checks
- Surrogate spikes
- Method blanks
- Calibration check samples
- Matrix spike (MS) and matrix spike duplicates (MSD) samples
- Laboratory replicates
- Dioxin and furan (D/F)-specific components (e.g., Initial Precision and Recovery, isomer-specificity standards, labeled compound and cleanup standard recoveries, ion abundance ratios, Estimated Maximum Possible Concentrations) as specified in EPA Method 1613, Rev. B.

Performance-based control limits established by the laboratory and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification during data validation.

9.2.1 Instrument/Equipment Testing, Inspection, and Maintenance

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by each laboratory in accordance with the requirements identified in the laboratory QA manuals, analytical laboratory standard operating procedures (SOPs), and manufacturer instructions. Laboratory facilities are designed to meet specific operating conditions and are maintained in a condition to ensure that acceptable operating conditions are met. Instruments will only be used for sample analysis if they demonstrate the capability of achieving the required accuracy and compliance with relevant instrument specifications. Only authorized personnel will operate analytical instrumentation and testing equipment. Instrument maintenance and repair will be documented in maintenance logs or record books.

9.2.2 Instrument/Equipment Calibration and Frequency

All applicable laboratory instruments used will be properly calibrated and the calibration will be verified with appropriate check standards and calibration blanks for each parameter before beginning each analysis. Instrument calibration procedures and schedules will conform to analytical protocol requirements and descriptions will be provided in the laboratories' QA manuals and applicable SOPs.

Calibration standards will be obtained from either the EPA repository or a commercial vendor, and the laboratory will maintain traceability to the National Institute of Standards and Technology. Stock standards will be used to make intermediate standards and calibration standards. Special attention will be given to expiration dating, proper labeling, proper refrigeration, and prevention of contamination. Documentation relating to the receipt, mixing, and use of standards will be recorded in a laboratory logbook. All calibration and spiking standards will be checked against standards from another source.

9.2.3 Inspection/Acceptance of Supplies and Consumables

The quality of supplies and consumables used during sample collection and laboratory analyses can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and QC purposes.

During sample collection, solvents of appropriate and documented purity will be used for decontamination. Solvent containers will be dated and initialed when they are opened. The quality of laboratory water used for decontamination will be documented at the laboratory that provides that water. Cleaned and documented sample containers will be provided by the laboratories. All containers will be visually inspected prior to use, and any suspect containers will not be used and will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the laboratories are provided in the laboratory SOPs and QA manuals.

All supplies will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be retained by GSI (i.e., for supplies used in the field) or the laboratories.

9.3 Data Validation and Usability

All data generated in the field and at the laboratories will be verified and validated according to methods and protocols outlined in this section. Data quality and usability will be evaluated, and a discussion will be included in a Data Validation Review Memorandum that will be an attachment to the Field Sampling and Data Report.

9.3.1 Data Verification and Validation Methods

Validation and reporting of data quality will follow method-specific and laboratory-established QC requirements, as applicable, and the guidelines that may be applicable to the analytical methods used in the following documents:

- Internal QC samples
- Method-specific and laboratory-established QC requirements, as applicable
- The DEQ *Quality Assurance Policy for the Environmental Cleanup Programs* (DEQ, 2015)
- *Guidance on Environmental Data Verification and Validation* (EPA, 2002)
- *National Functional Guidelines for High Resolution Superfund Methods Data Review* (EPA, 2016)
- *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2017a)
- *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA, 2017b)

The Chemistry QA Manager will coordinate with the contract laboratories during sample analysis and delivery of analytical results. The Chemistry QA Manager will perform an abbreviated data validation review (Stage 2B) (EPA, 2009) on 90 percent of all results reported for all analyses completed. Ten percent of all results reported for all analyses completed will undergo a comprehensive (100 percent) review (Stage 4) (EPA, 2009) of the applicable QC measurement data to document the performance of the laboratory analyses and to determine the usability of the data toward meeting project objectives. For the abbreviated data validation review of all data reported for all analyses completed, the following laboratory deliverables (if present) will be reviewed:

- Case narratives discussing analytical problems (if any) and procedures.
- Chain-of-custody documentation to verify completeness of the data set.
- Laboratory summary result forms to verify that analytical holding times were met.
- Results for applicable method blanks, trip blanks, and equipment rinsate blanks will be evaluated to determine whether an analyte reported as detected in any sample was the result of possible contamination introduced at the laboratory or during field sampling.
- Results for applicable surrogate compound, laboratory control spike (LCS) (i.e., blank spike), duplicate LCS, MS, and MSD recoveries to assess analytical accuracy.
- Results for applicable laboratory duplicate sample, duplicate LCS, and MSD analyses to assess analytical precision.
- Results for all other method-specific QC measurements.
- Review of laboratory summaries of analytical results.
- Results for the field split sample(s) to provide additional information.

To complete the 100 percent data validation review on 10 percent of all data reported for all analyses completed, the following items will be reviewed in addition to the items listed above:

- Results for applicable instrument tuning, initial calibrations, and continuing calibration (verification) results to assess instrument performance.
- Results for applicable internal performance to ensure that instrument sensitivity and response were stable during the analysis of the samples.
- Results for applicable method-specific QC measurements (e.g., dual-column confirmation results for the PCB analyses) to assess potential matrix interference effects.
- Results for applicable QC measurements required for the analysis of D/F congeners.

- A review of instrument printouts (e.g., chromatograms, mass spectra, and quantification reports) to assess the validity of analyte identification as either detected or undetected.
- Verifying quantification of sample results and applicable QC measurement (e.g., instrument calibrations; surrogate, MS/MSD, and LCS recoveries; and other applicable information for accuracy and precision) results by recalculation.

If significant systemic QC problems are discovered using this approach, the Chemistry QA Manager will consult with the Laboratory Project Manager and the Field Investigation Project Manager to determine whether full data validation is warranted for additional samples. To accommodate the potential for additional data validation, the laboratory will provide a full electronic data package for all samples.

9.3.2 Data Quality and Usability

The overall quality objective for field data collection efforts related to Project Area O&M is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality. The laboratory QA/QC procedures listed in Section 9.2 document the precision and accuracy of the measurements and provide a basis from which to assess the representativeness, completeness, comparability, and overall quality of the environmental data.

Performance-based control limits established by the laboratory and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification. Laboratory-reported control limits for surrogate compounds, LCSs and LCS duplicates, and MS/MSDs will be used for data validation.

For methods without guidelines for data validation (such as conventional analyses, physical testing, petroleum hydrocarbons), the Chemistry QA Manager will use applicable data validation requirements specified in the National Functional Guidelines (EPA, 2017a and 2017b) that are pertinent to the method. The applicable QC measurement data reported will be reviewed and qualification of the data will be completed, as necessary, based on method-specific and laboratory-established control limits.

Results for field splits will be evaluated against a control limit of 50 relative percent difference (RPD). Data will not be qualified as estimated if this control limit is exceeded, but RPD results will be tabulated, and any exceedances will be discussed in the applicable site characterization summary report for each sampling event. Equipment rinsate blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the applicable EPA guidance documents for data review (EPA, 2002, 2016, 2017a, and 2017b).

Analytical data that do not meet established control limits for applicable QC measurements will be qualified as estimated (J) by the laboratory or during the data validation. Results that are reported as detected at a concentration above the MDL or estimated detection limit (EDL), but below the MRL, also will be qualified as estimated (J). Data qualified as estimated (J) may be considered usable and may be of good quality, yet have a degree of uncertainty (i.e., may be less precise or less accurate than unqualified data). J-qualified data may be used in conjunction with non-qualified data when making remedial decisions. Analytical data that are reported as undetected (U) by the laboratory or that are restated as undetected (U) during data validation, are acceptable and are usable. Data will be rejected if control limits for acceptance of data are not met, as described in EPA guidance documents (2002, 2016, 2017b, and 2017c). Any data that were rejected (R) during data validation will not be used for any purpose.

Completeness will be calculated as the ratio of usable data (i.e., unqualified data and U-, J-, or N-qualified data) to generated data, expressed as a percentage. Completeness will be calculated for each suite of analytes for each sample type and sampling event. A completeness criterion of 100 percent is targeted for this project, both in terms of the number of planned samples compared with the number of samples actually collected, and in terms of the number of rejected compared with non-rejected analytical results. Given the unpredictable nature of issues that may arise during field work, samples may not be collected successfully from all locations. Any significant deviations from the proposed sampling locations will be documented in the Field Sampling and Data Report. If analytical results are rejected (R) during data validation, a completeness criterion of 95 percent may be acceptable.

The findings of the data validation review will be presented in a Data Validation Review Memorandum that will be appended to future reports on field data collection efforts. Final qualified (as necessary) laboratory results will be transmitted in electronic format to the DM for data management, further evaluation, and reporting. Data collected previously as part of work in the Project Area may not be validated in the same manner.

9.4 Loading Laboratory Electronic Data Deliverables to the Database

The use of standardized EDDs will facilitate the automated loading of laboratory results to the project Enviro Data SQL Server database. Additionally, the Enviro Data data loading (EDD) form (Appendix A) will perform automated checks of EDDs for conformance with valid values, data types, required fields, and other measures of data quality and integrity. Table 11 details the QC processes used to assess data loaded to the database. Figure 9 details the data collection, processing, and error resolution workflow. GSI will document all data loading operations via the ***ActivityLog*** table.

9.5 Analyte Summations

Analyte summations will occur through the creation of custom T-SQL scripts. These T-SQL scripts will be tested for proper calculation of analyte summations. These tests will compare analyte summations against manual calculations for randomly selected attributes.

Data will be summed in a manner similar to how the EPA handles data summations for work in the Portland Harbor Superfund Site as detailed in the *Program Data Management Plan* (EPA, 2021).

The general rules for summation are as follows:

- Calculated totals are the sum of all detected concentrations and non-detected results for analytes detected at least once. Non-detected results are included at one-half the detection limit.
- If no analytes are detected but are anticipated in the Project Area, the highest non-detect result value is used for the summation.
- If parent and field duplicate samples are both detect, they will be averaged before use in a summation. If both samples are non-detect, the lowest method detection limit can be used. If the results are mixed, the detected results will be used in the summation.

9.5.1 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of hydrocarbons containing two or more benzene rings. This group will be calculated in two separate groups to address both human health and ecological risk screening.

The first group of PAHs are considered carcinogenic and summed separately to address human health concerns. Toxicity of individual members of this group varies, and normalization is required before summation. Concentrations of seven individual PAHs are multiplied by their respective potency equivalency factors (PEFs) (EPA, 2021) (Table 12) and then summed using the general rules for summation. The resulting value obtained represents the benzo(a)pyrene (B(a)P) toxicity equivalent (TEQ) for solid matrix types. The following PAHs are used in B(a)P TEQ calculation:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-c,d)pyrene

The second group of PAHs address impacts to ecological receptors. These include the 17 EPA listed PAHs; the concentrations are summed in two groups: low- and high-molecular weight PAHs (LPAHs and HPAHs) (EPA, 2021). Total PAHs are calculated as the sum of LPAHs and HPAHs. The following PAHs are summed using the general rules for summation:

- LPAHs are calculated as the sum of the following PAHs:
    - 2-Methylnaphthalene
    - Acenaphthene
    - Acenaphthylene
    - Anthracene
    - Fluorene
    - Naphthalene
    - Phenanthrene
- HPAHs are calculated as the sum of the following PAHs:
    - Fluoranthene
    - Pyrene
    - Benzo(a)anthracene
    - Chrysene
    - Benzo(b)fluoranthene
    - Benzo(k)fluoranthene
    - Benzo(a)pyrene
    - Indeno(1,2,3-c,d)pyrene
    - Dibenzo(a,h)anthracene
    - Benzo(g,h,i)perylene

9.5.2 Chlorinated Dioxins and Furans

A subset of D/F chemicals (2,3,7,8-substituted congeners) are assessed for possible human health and ecological impacts. The toxicity of individual members of this group varies, and normalization is required before summation. Toxicity equivalency factors (TEFs) (Table 12) are used for this normalization. Concentrations detected in a single sample are multiplied by their respective TEF. If one or more of these congeners are not detected, the non-detected congener with the highest detection limit (DL) is identified and the DL is multiplied by the appropriate TEF. The sum of resulting toxicity-normalized congener concentrations for the sample is then reported as the tetrachlorodibenzo-p-dioxin (TCDD) TEQ. The following D/F congener concentrations are used in the TCDD TEQ calculation:

- 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)
- 1,2,3,4,7,8,9-HpCDF
- 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)
- 1,2,3,6,7,8-HxCDF
- 1,2,3,7,8,9-HxCDF
- 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)
- 2,3,4,6,7,8-HxCDF
- 2,3,4,7,8-PeCDF
- 2,3,7,8-Tetrachlorodibenzofura (TCDF)
- Octachlorodibenzofuran (OCDF)
- 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)
- 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)
- 1,2,3,6,7,8-HxCDD
- 1,2,3,7,8,9-HxCDD
- 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)
- 2,3,7,8-TCDD
- Octachlorodibenzo-p-dioxin (OCDD)

SECTION 10: **References**

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Tables

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Table 1. Revision History Tracking Table

Date	Revising Author	Reason for Revision	Revisions Made

Table 2. Components of Data Quality

Component	Description	Indicators
Completeness	An indication of the comprehensiveness of a data set, particularly in context of the intended use of the data	▪ Missing samples ▪ An impartial analysis of analytes
Uniqueness	A discrete measure identifying any duplication in the data set	▪ Duplicate stations ▪ Duplicate records for analytes
Timeliness	A measure indicating whether the data set is up-to-date and timely, given the intended purpose	▪ Date of samples ▪ Date of analysis
Validity	A set of measures to determine the validity of the data for the intended purpose	▪ Data Type ▪ Data Range ▪ Incorrect Values
Accuracy	A measure detailing the conformance of the data to the to the actual site conditions.	▪ global positioning system (GPS) data ▪ Laboratory analyses
Consistency	A set of measures describing the usability of the data set	▪ Field blanks that are not contaminated

Table 3. Components of Data Integrity

Component	Description	Sub-Components
Physical Integrity	Physical integrity handles collecting and maintaining the data correctly as well as disseminating the correct data to appropriate audiences.	▪ **Traceable:** The origin of the data in terms of who collected or observed the data should be precise. ▪ **Understandable:** The provided data should be capable of being understood, with lineage and the structure of the data documented with clear descriptions. ▪ **Accessible:** Upon delivery to the system, the data should be accessible and ready to use for the intended purpose. ▪ **Safeguarded:** Upon delivery to the system, the data should be in a format that will have the highest utility for future use, be stored in multiple locations, and have appropriate security.
Logical Integrity	Logical integrity deals with the correctness of the data. It includes concepts of relational database integrity and the integrity of the data as it relates to real-world conditions or other measurements.	▪ **Entity Integrity:** A component of relational database design used to ensure unique records (i.e., no two rows can be the same) within a table by defining a primary key with a unique identifier. ▪ **Referential Integrity:** A component of relational database design concerned with relationships between tables to ensure that related tables do not have conditions in which a foreign key value has no matching primary key values (i.e., orphaned records). This type of integrity can help ensure modeled relationships are consistent with real-world conditions (e.g., each sample location has analytical results) and prevent accidental deletion of data. ▪ **Domain Integrity:** A component of relational database design concerned with valid values for a particular attribute. Valid values must conform to the specified data type, applicable constraints, and value lists. ▪ **Business Integrity:** A component of relational database design concerned with applying specific business or scientific rules to the data. This is typically achieved by having certain operations in the database “trigger” operations or changes to the data. For example, loading new data to a database could trigger a procedure to run extract, transform, and load (ETL) operations for updating file geodatabases.

Table 4. Data Management System Hardware and Software

Software/Hardware	Description	Project Purpose
Environmental System Research Institute ArcGIS Advanced with Spatial Analyst (10.6.1)	geographic information system (GIS) desktop software	Quality control procedures, mapping geospatial analysis, and data management.
ArcGIS Online	Cloud-based GIS	Field data collection, quality control procedures, mapping, data dissemination.
Global Positioning System (GPS)	Geo 7X with Zephyr Model 2 GNSS antenna. RTK GPS Unit (to be determined)	Collects spatial information for project sampling locations.
Esri ArcGIS Collector application	Mobile-based application for storing field data	Records field photos and associated information.
iPad	Mobile collection device	Houses the Esri ArcGIS Collector application.
Enviro Data Version 8 A 1.73	Environmental data management system	Facilitates the use of an industry-standard data model while providing automated quality control and analysis procedures for the project.
Microsoft SQL Server 2017	Enterprise relational database management system	Facilitates the storage of large amounts of data for the project.
Microsoft Power BI	Business information and analytics software	Facilitates data analysis and development of project data dashboards.
R	Programming language used to manage, summarize, and visualize data	Creates consistent data visualizations and statistical assessments.
SharePoint Server	Cloud-based document sharing	Facilitates the sharing of project documents and data.
Microsoft Access	Relational database software	Facilitates the sharing of subsets of the project data.
Microsoft Office suite of products	Spreadsheet and word processing software	Facilitates development of project reports, memos, graphs, and figures.

Table 5. Historical Analytical Chemistry Data Imported into the Project Database

Data Source	Data Import Summary	Quality Control Measures
To be populated in the future	To be populated in the future	To be populated in the future

Table 6. Quality Control Procedures for Integrating Field Data into the Project Database

Quality Control Procedure	Method
Spatial Location Checks	Visual examination of field-recorded spatial locations
Station Name Checks	Implementation of custom queries and the Enviro Data Import Wizard to ensure Stations have consistent names
Sample Name Checks	Implementation of custom queries and Enviro Data Import Wizard to ensure Samples have consistent names
Field Image Checks	Implementation of custom queries to check for appropriate images for Samples
Valid Value and Lookup Table Checks	Implementation of domains in electronic field data collection applications, custom queries, and Enviro Data Import Wizard to check for valid values
Check to ensure that required fields with blank values have appropriate default values	Implementation of custom queries and the Enviro Data Import Wizard

Table 7. Software and Hardware Systems Used for Managing Unstructured Data

Software	Description	Purpose
NTFS	New Technology File System developed by Microsoft as the default file system	Store project data not stored in the SQL Server or project file geodatabases.
SharePoint	A secure, cloud-based document sharing system	Manage and share project documents.
GSI File Sharing	A secure, cloud-based document and data-sharing system	Share larger files that cannot be stored on the SharePoint site.

Table 8. Information for Accessing the Project SharePoint Site

SharePoint Web Address	**https://haleyaldrich.sharepoint.com/sites/McCormickandBaxter**
Username	email address used on Microsoft Office 365
Password	Microsoft Office 365 password

Table 9. Required Metadata Elements

FGDC CSDGM Element	Description (FGDC, 1998)
Citation	The recommended reference to be used for the data set
Abstract	A brief narrative summary of the data set
Purpose	A summary describing the intentions for which the data set was developed
Time Period of Content and Current Reference	The period(s) for which the data set corresponds to the specified reference
Status	The state of and maintenance information for the data set
Spatial Domain	The geographic areal domain of the data set as a description and using geographic coordinates
Keywords (Theme, Place, Stratum, Temporal)	Words or phrases summarizing a pertinent aspect of the data set. Theme keywords represent the subject covered by the data set (e.g., analytical chemistry). Place keywords describe geographic locations characterized by the data set. Stratum keywords describe layered, vertical locations characterized by the data set. Temporal keywords describe time period(s) characterized by the data set.
Access Constraints	Restrictions and legal prerequisites for accessing the data set. Constraints should include any access constraints applied to assure the protection of privacy or intellectual property and any unusual restrictions or limitations on obtaining the data set.
Use Constraints	Restrictions for using the data set. Restrictions include constraints applied to assure the protection of privacy or intellectual property, and any unusual restrictions or limitations on using the data set.
Point of Contact	Contact information for an individual or organization that is knowledgeable about the data set
Data Set Credit	Recognition of those who contributed to the data set
Security Information	Handling restrictions imposed on the data set due to national security, privacy, or other concerns
Cross Reference	Information about other, related data sets that are likely to be of interest
Quantitative Attribute Accuracy Assessment	An assessment of the accuracy of the identification of entities and the assignment of attribute values in the data set

FGDC CSDGM Element	Description (FGDC, 1998)
Logical Consistency Report	A description of the degree of exactness of relationships in the data set. The report shall detail the tests performed and the results of the tests.
Completeness Report	Information about omissions, selection criteria, generalization, definitions used, and other rules used to derive the data set.
Horizontal Positional Accuracy Assessment	An assessment of the accuracy of the horizontal positions of the spatial objects
Vertical Positional Accuracy Assessment	An assessment of the accuracy of the vertical positions of the spatial objects
Lineage	Information about the events, parameters, and source data that constructed the data set as well as information about the responsible parties
Spatial Data Organization Information	The mechanism used to represent spatial information in the data set
Spatial Reference Information	The description of the reference for, and the means to encode, coordinates in the data set
Entity and Attribute Information	Details about the information content of the data set, including the entity types, their attributes, and the domains from which attribute values may be assigned
Distribution Information	Information about the distributor of and options for obtaining the data set

Notes

CSDGM = Content Standard for Digital Geospatial Metadata

FGDC = Federal Geographic Data Committee

Table 10. Testing of Extract, Transform, and Load Operations for Tabular and Spatial Data

Type of Test	Description
Source to Target Testing	This testing is conducted to ensure that the transformed data values conform to expected data values.
Data Completeness Testing	This testing is conducted to ensure that a complete set of data is extracted, transformed, and loaded from the project SQL Server database to other database formats (e.g., file geodatabases).
Data Type Testing	This testing is conducted to ensure that data type, lengths, and indexes or constraints are transformed correctly.
Data Accuracy Testing	This testing is conducted to ensure that data are accurately transformed.
Incremental Extract, Transform, and Load (ETL) Testing	This testing is conducted as new data are loaded to the system and ETL operations run. This testing verifies that inserts and updates are being processed correctly.

Table 11. Quality Control Procedures Run on Lab Data after Loading to the Project Enviro Data SQL Server Database

Quality Control Procedure	Description
Data Valid Value and Lookup Checks	Ensures consistent formatting of coded values in the historical database compared with lookup values in Enviro Data and Scribe data model.
Duplicate Sample Checks	Checks to ensure that there are no duplicate samples.
Duplicate Result Checks	Checks to ensure that there are no duplicate results.
Data Validation Checks	Checks to ensure that all integrated data are validated and all validated and unvalidated data are coded appropriately.
Analyte Summation Checks	Checks to ensure that all summed analytical results are flagged as not validated.

Table 12. Analyte Summations and Toxicity Equivalent Factors

Name	Analytic Method	CAS RN	Analyte	PEF/TEF	Rules for Summation:		
					U = 1/2	Calculated Name	If all ND
Carcinogenic PAHs	8270/8270D	56-55-3	Benz(a)anthracene	0.1	Detects: Simple sum ND: 1/2 the DL Sum together	GSI Total cPAHs (U=1/2) 2020	Use the HIGHEST DL
		50-32-8	Benzo(a)pyrene	1			
		205-99-2	Benzo(b)fluoranthene	0.1			
		207-08-9	Benzo(k)fluoranthene	0.01			
		218-01-9	Chrysene	0.001			
		53-70-3	Dibenz(a,h)anthracene	1			
		193-39-5	Indeno(1,2,3-c,d)pyrene	0.1			
High Molecular Weight PAHs (HPAHs)	8270/8270D	56-55-3	Benz(a)anthracene	N/A	Detects: Simple sum ND: Use 1/2 the DL Sum together	GSI Total HPAHs (U=1/2) 2020	Use the HIGHEST DL
		50-32-8	Benzo(a)pyrene	N/A			
		205-99-2	Benzo(b)fluoranthene	N/A			
		191-24-2	Benzo(g,h,i)perylene	N/A			
		207-08-9	Benzo(k)fluoranthene	N/A			
		218-01-9	Chrysene	N/A			
		53-70-3	Dibenz(a,h)anthracene	N/A			
		206-44-0	Fluoranthene	N/A			
		193-39-5	Indeno(1,2,3-cd)pyrene	N/A			
		129-00-0	Pyrene	N/A			

Name	Analytic Method	CAS RN	Analyte	PEF/TEF	Rules for Summation:		
					U = 1/2	Calculated Name	If all ND
Low Molecular Weight PAHs (LPAHs)	8270/8270D	91-57-6	2-Methylnaphthalene	N/A	Detects: Simple sum ND: Use 1/2 the DL Sum together	GSI Total LPAHs (U=1/2) 2020	Use the HIGHEST DL
		83-32-9	Acenaphthene	N/A			
		208-96-8	Acenaphthylene	N/A			
		120-12-7	Anthracene	N/A			
		86-73-7	Fluorene	N/A			
		91-20-3	Naphthalene	N/A			
		85-01-8	Phenanthrene	N/A			
Total PAHs	8270/8270D	-	GSI Total HPAHs (#) 2020	N/A	Simple sum (where LPAHs/HPAHs (ND = 1/2))	GSI Total PAHs (U=1/2) 2020	Use the HIGHEST DL
		-	GSI Total LPAHs (#) 2020	N/A			

Name	Analytic Method	CAS RN	Analyte	PEF/TEF	Rules for Summation:		
					U = 1/2	Calculated Name	If all ND
Total Dioxins (TEQ)	1613B	67562-39-4	1,2,3,4,6,7,8-HpCDF	0.01	Detects: Multiply by TEF ND: use 1/2 DL, multiply by TEF Sum together	GSI Total Dioxin TEQ (U=1/2) 2020	Use the HIGHEST DL
		55673-89-7	1,2,3,4,7,8,9-HpCDF	0.01			
		70648-26-9	1,2,3,4,7,8-HxCDF	0.1			
		57117-44-9	1,2,3,6,7,8-HxCDF	0.1			
		72918-21-9	1,2,3,7,8,9-HxCDF	0.1			
		57117-41-6	1,2,3,7,8-PeCDF	0.03			
		60851-34-5	2,3,4,6,7,8-HxCDF	0.1			
		57117-31-4	2,3,4,7,8-PeCDF	0.3			
		51207-31-9	2,3,7,8-TCDF	0.1			
		39001-02-0	OCDF	0.0003			
		35822-46-9	1,2,3,4,6,7,8-HpCDD	0.01			
		39227-28-6	1,2,3,4,7,8-HxCDD	0.1			
		57653-85-7	1,2,3,6,7,8-HxCDD	0.1			
		19408-74-3	1,2,3,7,8,9-HxCDD	0.1			
		40321-76-4	1,2,3,7,8-PeCDD	1			
		1746-01-6	2,3,7,8-TCDD	1			
		3268-87-9	OCDD	0.0003			

Notes

CAS RN = Chemical Abstract Services Registry Number
GSI = GSI Water Solutions, Inc.
HPAHs = high-molecular weight polycyclic aromatic hydrocarbons
HpCDD = heptachlorodibenzo-p-dioxin
HpCDF = heptachlorodibenzofuran
HxCDD hexachlorodibenzo-p-dioxin
HxCDF = hexachlorodibenzofuran
LPAHs = low-molecular weight polycyclic aromatic hydrocarbons
N/A = not applicable
ND = nondetect
OCDD = octachlorodibenzo-p-dioxin
OCDF= octachlorodibenzofuran
PAHs = polycyclic aromatic hydrocarbons
PeCDD = pentachlorodibenzo-p-dioxin
PeCDF = pentachlorodibenzofuran
PEF = potency equivalency factor
TCDD = tetrachlorodibenzo-p-dioxin
TCDF = tetrachlorodibenzofuran
TEF = toxicity equivalency factor
TEQ = toxicity equivalent
U = Analyte not detected

Figures

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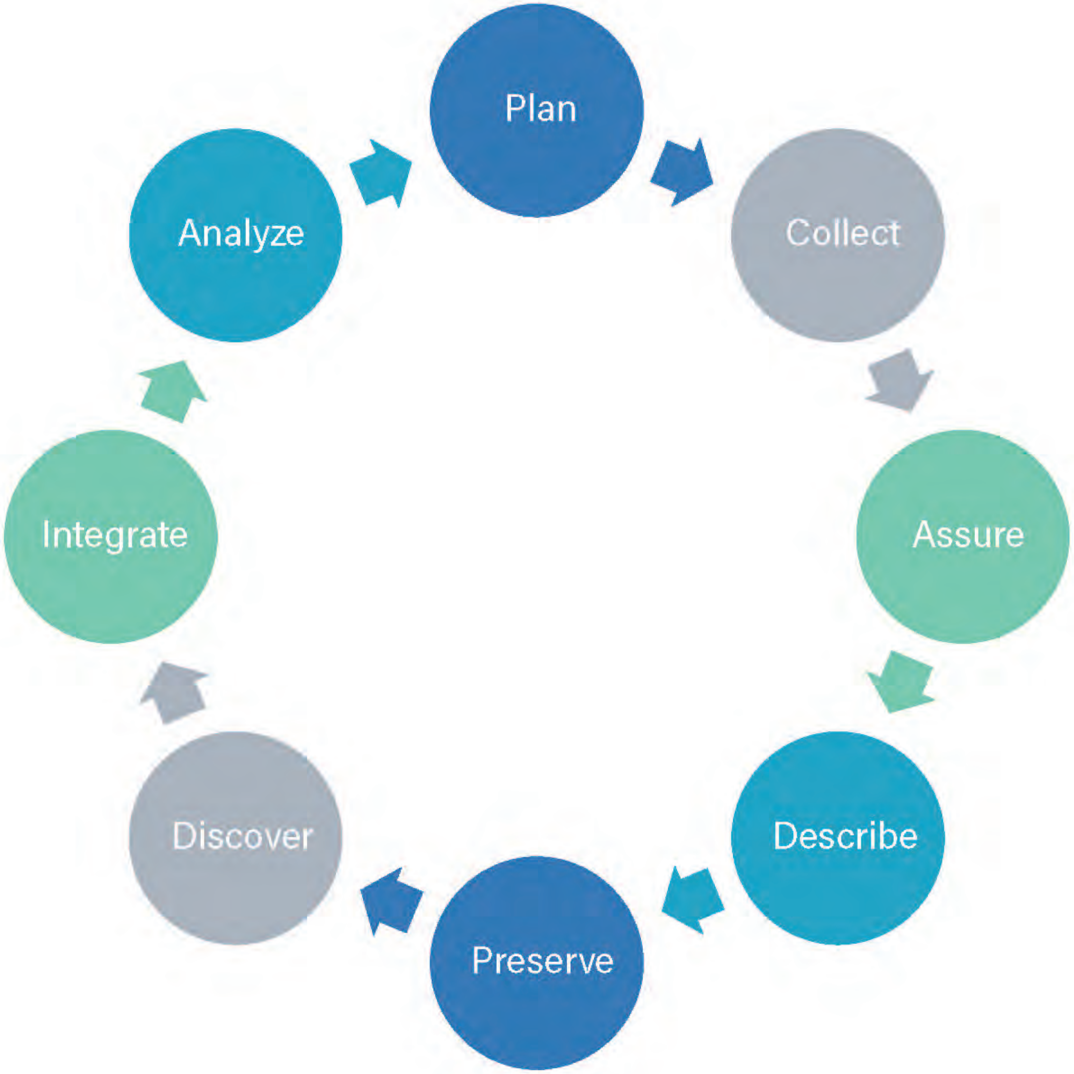
Figure 1. The Data Life Cycle



Plan
- Annual O&M Monitoring

Collect
- Surface/Subsurface Soil Sampling
- Surface/Subsurface Sediment Sampling
- Groundwater, Porewater
- Surface Water Sampling
- Biota Sampling

Assure
- Field, Lab, and Office Data Quality Control

Describe
- Metadata for Spatial and Tabular

Preserve
- Maintaining Data Integrity and Recovery Models

Discover
- Searchable Data though ArcGIS Online

Integrate
- PowerBI, GIS, and Other Tools

Analyze
- Integrated Data Analysis

Figure 2. McCormick & Baxter Superfund Site Data Management Organizational Chart

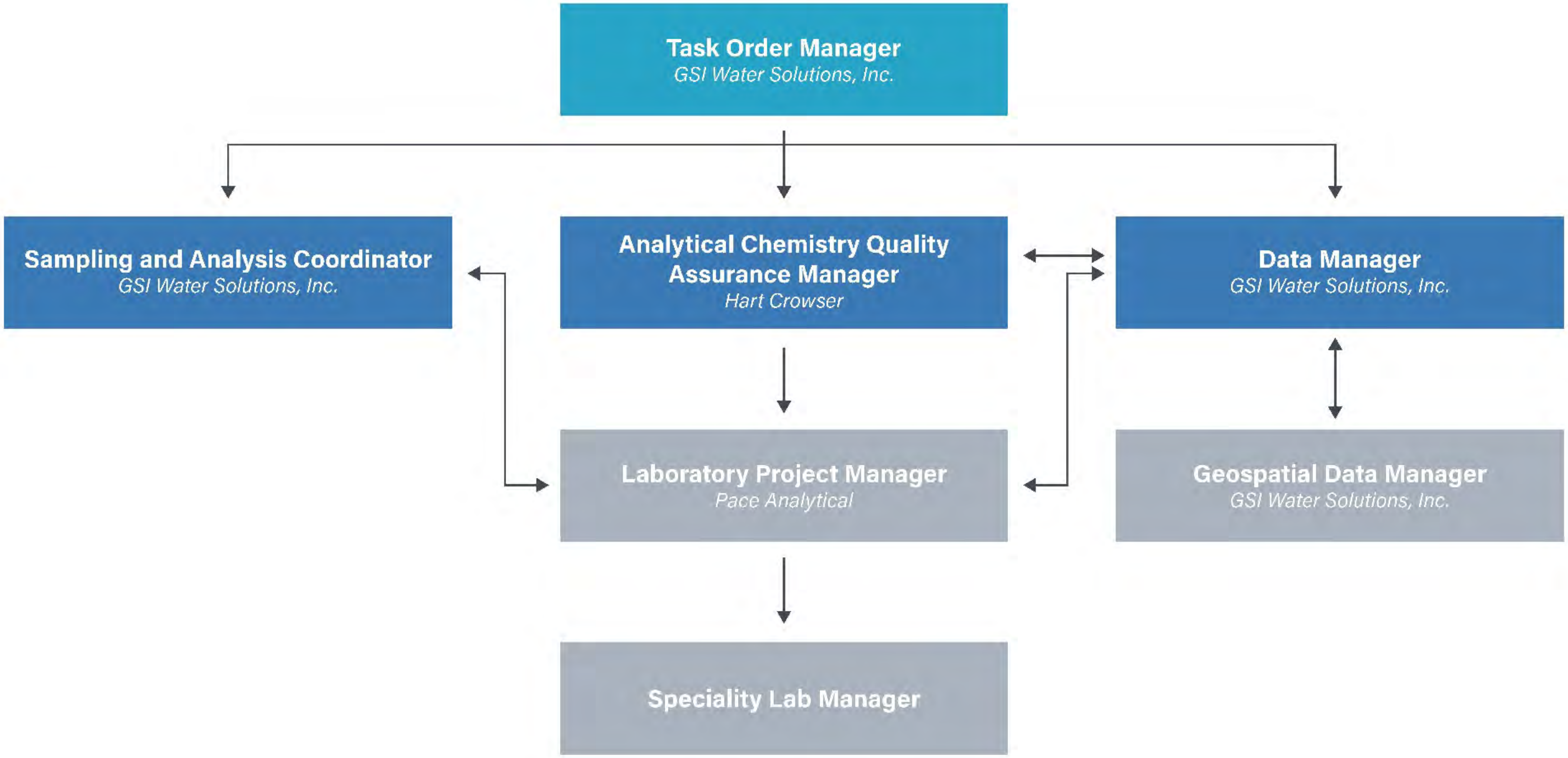


Figure 3. GSI Water Solutions, Inc. System Architecture for Integrated Data Management of Environmental Chemistry Data

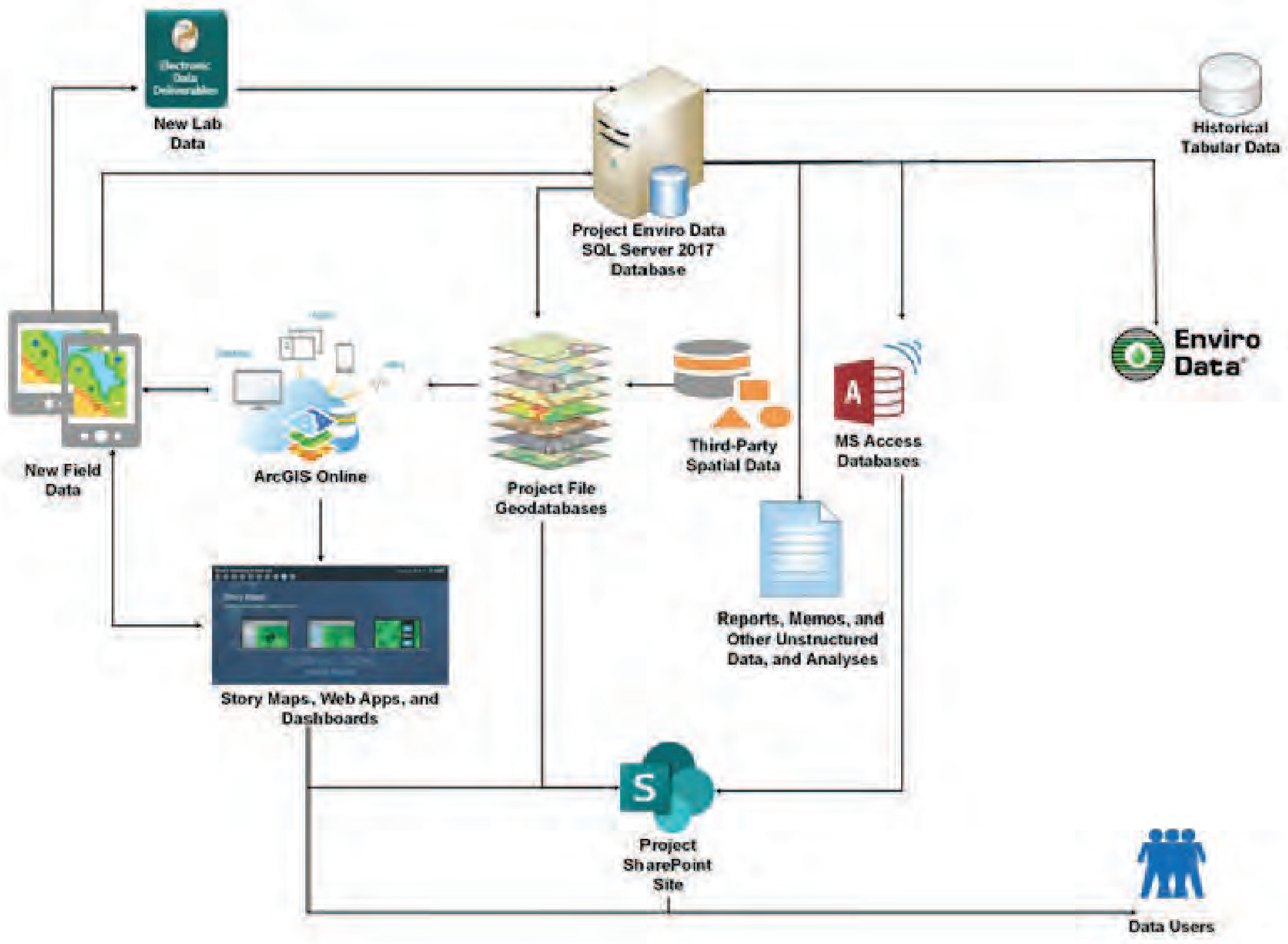


Figure 4. Simplified Entity-Relationship Diagram for Project Enviro Data SQL Server Database

Source: *Data Transfer Standard. Enviro Data Version 8*. Geotech Computer Systems, Inc. Centennial, CO. October, 2019.

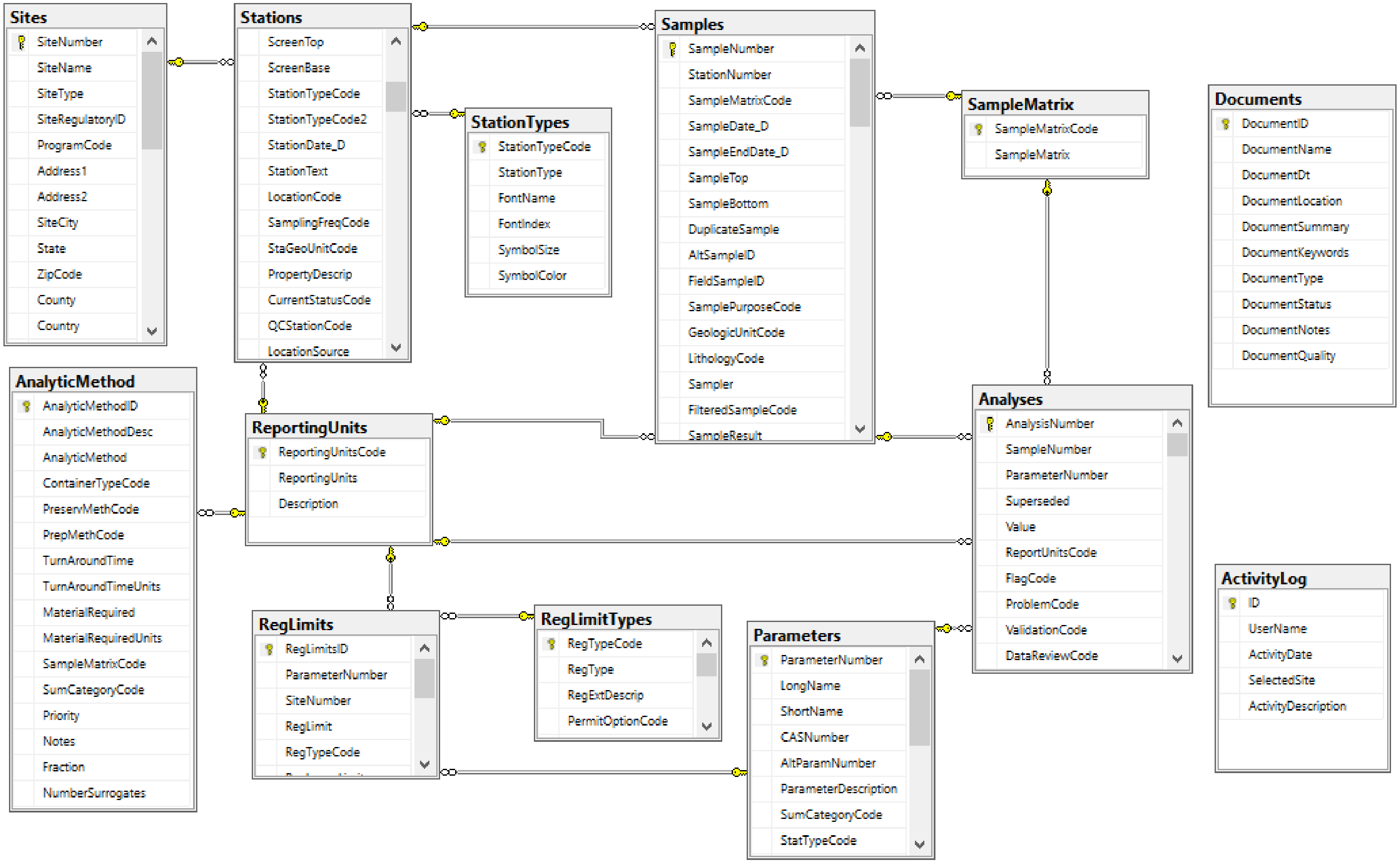
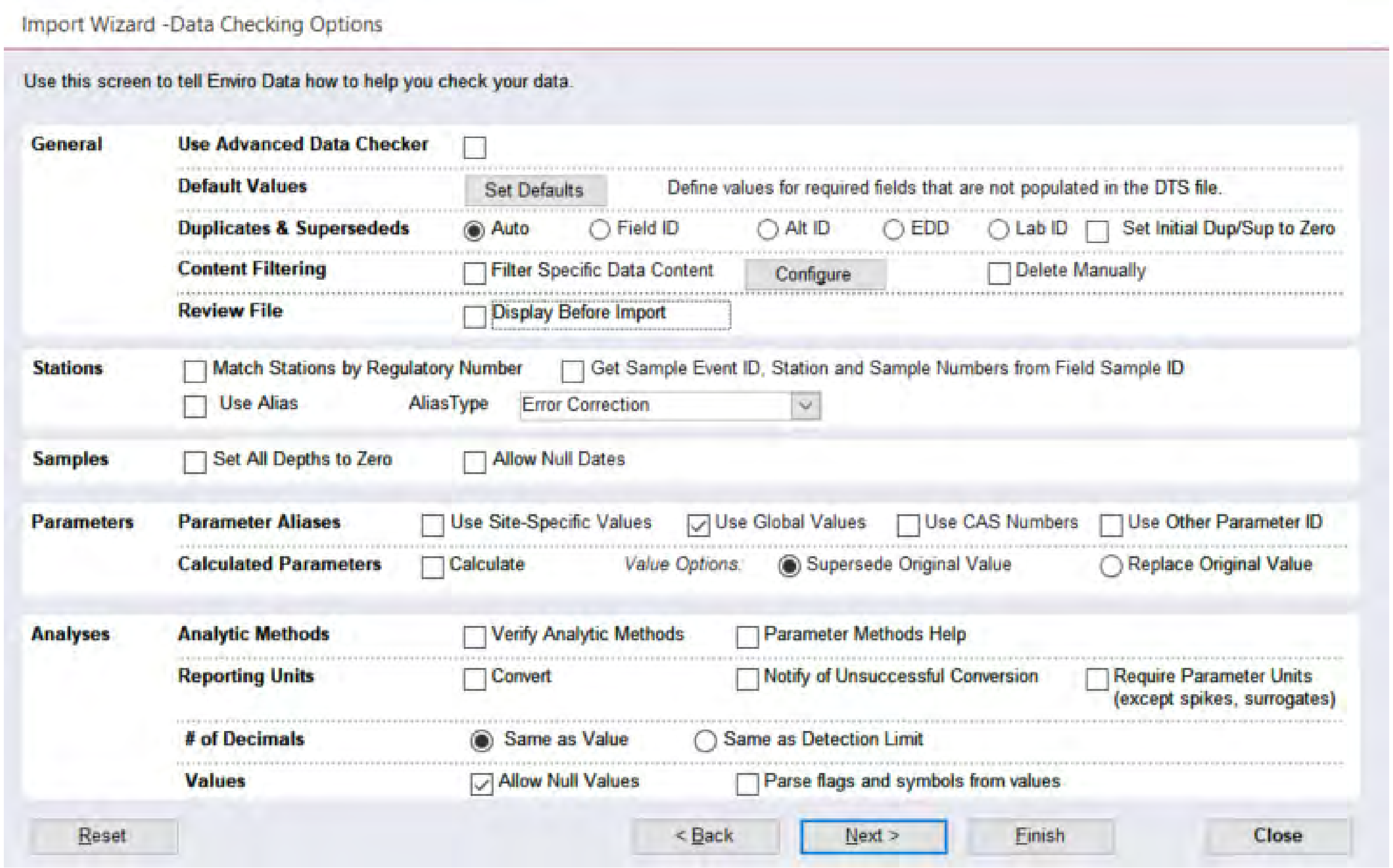


Figure 5. Enviro Data Quality Control Data Checking Form for Loading Field and Laboratory Data to Database

Source: *Data Transfer Standard. Enviro Data Version 8*. Geotech Computer Systems, Inc. Centennial, CO. October 2019.



Import Wizard -Data Checking Options

Use this screen to tell Enviro Data how to help you check your data.

General
- **Use Advanced Data Checker** ☐
- **Default Values** Set Defaults — Define values for required fields that are not populated in the DTS file.
- **Duplicates & Supersededs** ● Auto ○ Field ID ○ Alt ID ○ EDD ○ Lab ID ☐ Set Initial Dup/Sup to Zero
- **Content Filtering** ☐ Filter Specific Data Content — Configure — ☐ Delete Manually
- **Review File** ☐ Display Before Import

Stations
- ☐ Match Stations by Regulatory Number ☐ Get Sample Event ID, Station and Sample Numbers from Field Sample ID
- ☐ Use Alias — AliasType: Error Correction

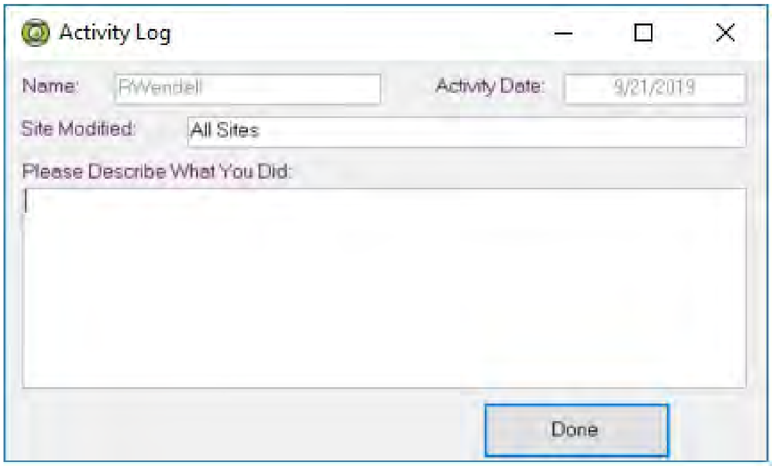
Samples
- ☐ Set All Depths to Zero ☐ Allow Null Dates

Parameters
- **Parameter Aliases** ☐ Use Site-Specific Values ☑ Use Global Values ☐ Use CAS Numbers ☐ Use Other Parameter ID
- **Calculated Parameters** ☐ Calculate — *Value Options:* ● Supersede Original Value ○ Replace Original Value

Analyses
- **Analytic Methods** ☐ Verify Analytic Methods ☐ Parameter Methods Help
- **Reporting Units** ☐ Convert ☐ Notify of Unsuccessful Conversion ☐ Require Parameter Units (except spikes, surrogates)
- **# of Decimals** ● Same as Value ○ Same as Detection Limit
- **Values** ☑ Allow Null Values ☐ Parse flags and symbols from values

Figure 6. Enviro Data Activity Log Data Entry Form

Source: *Data Transfer Standard. Enviro Data Version 8*. Geotech Computer Systems, Inc. Centennial, CO. October 2019.



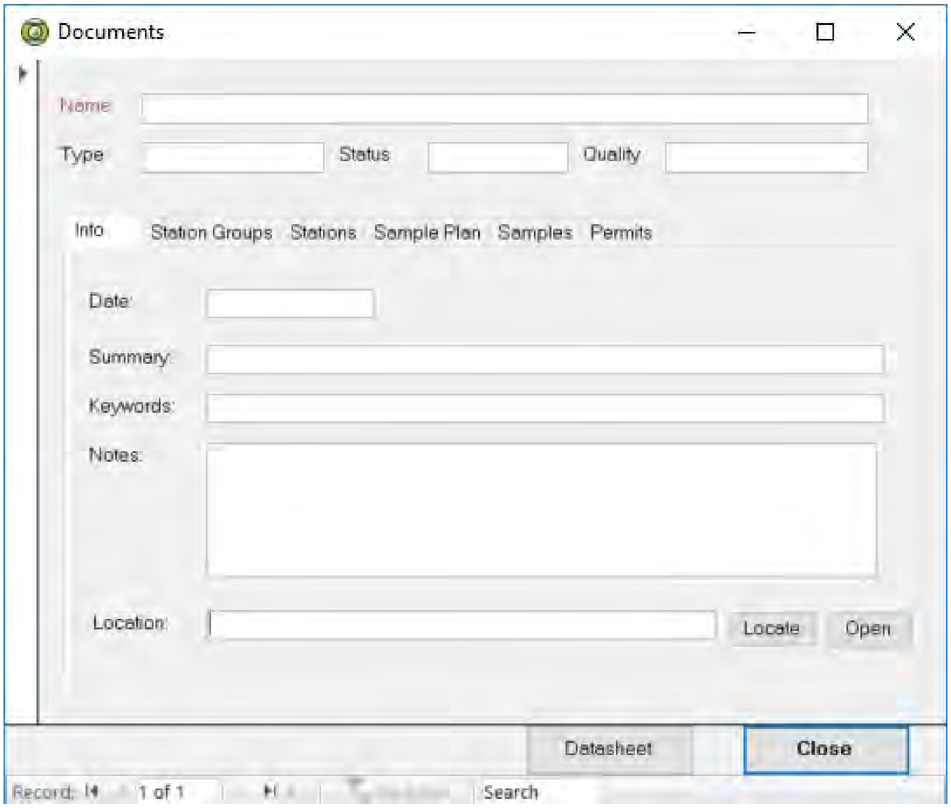
Name: RWendell

Activity Date: 9/21/2019

Site Modified: All Sites

Figure 7. Enviro Data Documents Data Entry Form

Source: *Data Transfer Standard. Enviro Data Version 8*. Geotech Computer Systems, Inc. Centennial, CO. October 2019.



Record: 1 of 1

Figure 8. Overview of Extract, Transform, and Load Operations for Integrating Tabular and Geospatial Data

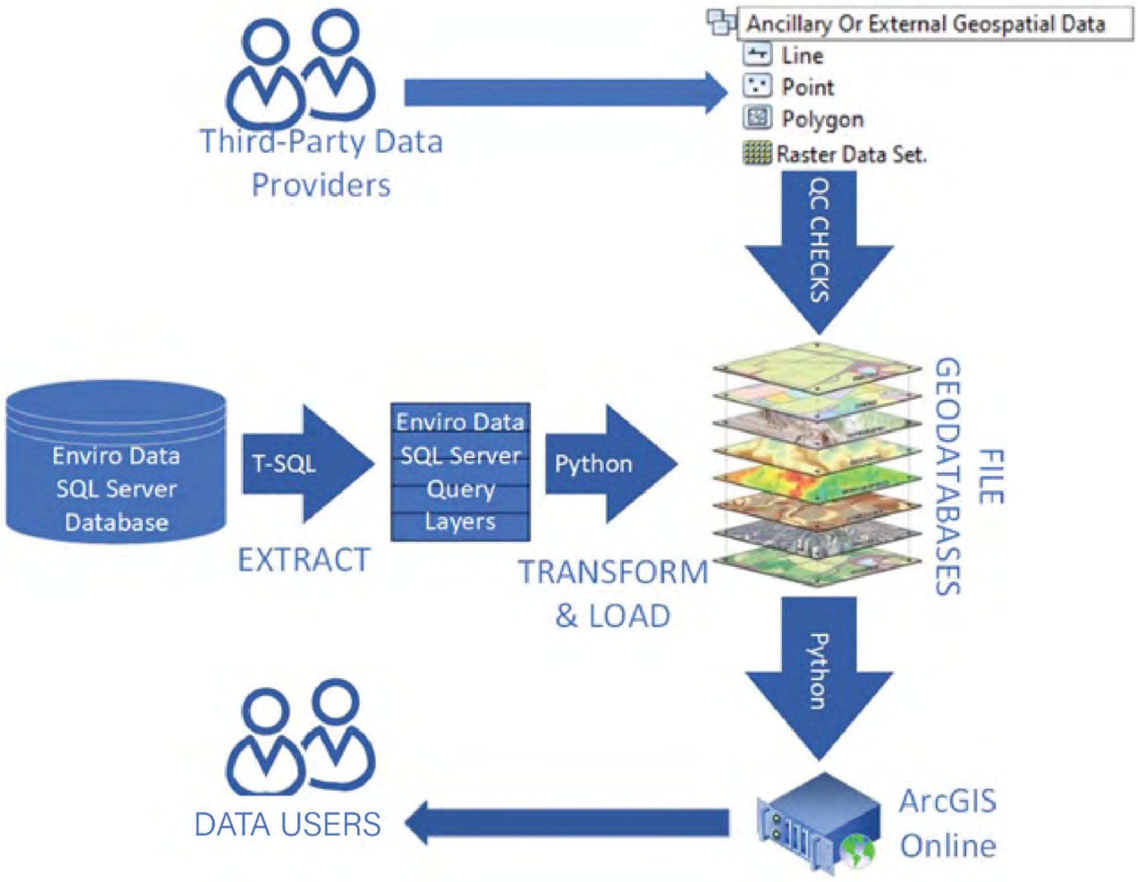
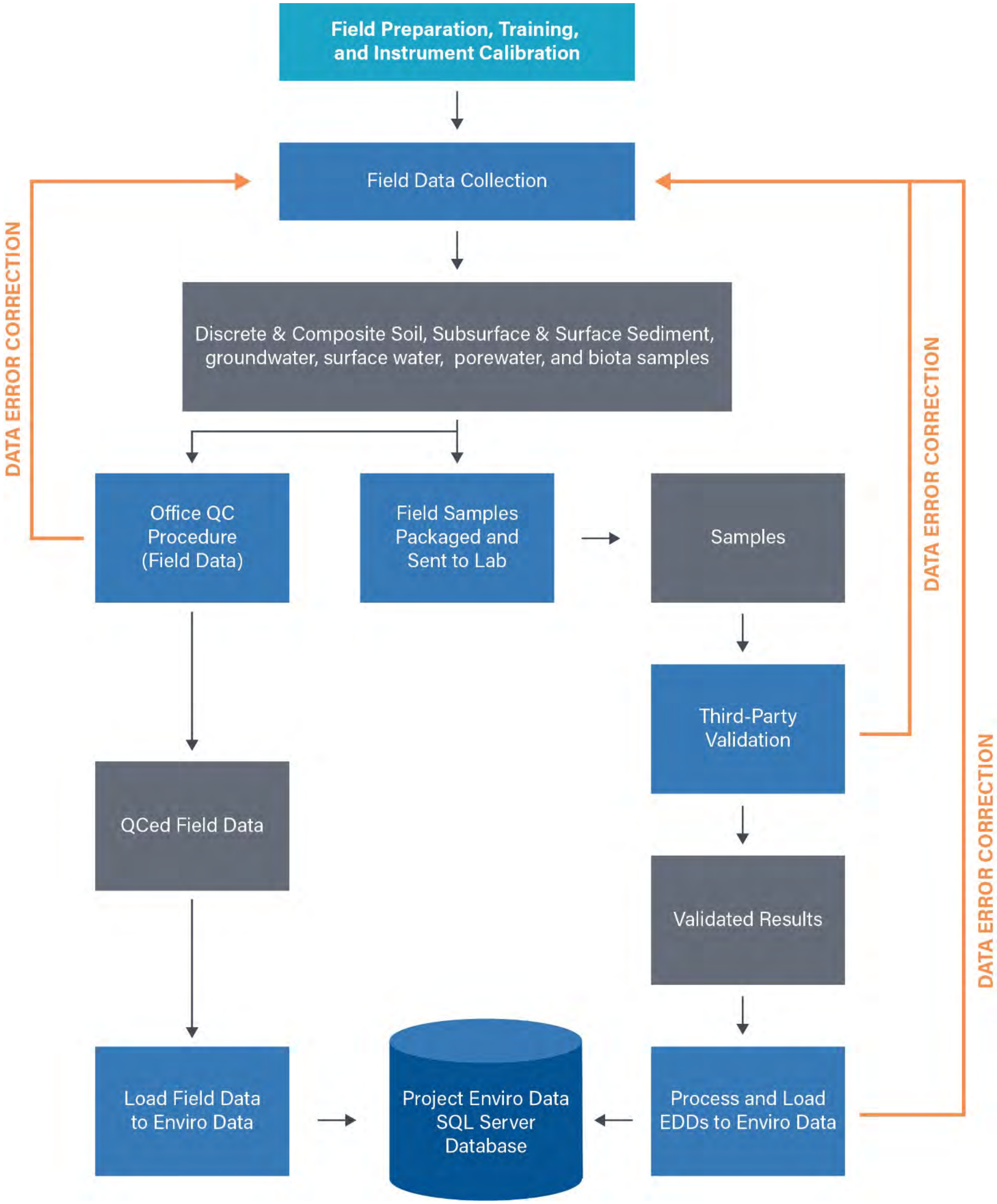


Figure 9. Data Collection and Processing Workflows



Appendices

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APPENDIX A

Electronic Data Deliverables Format

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SiteName	StationName	SampleDate_D	SampleTypeCode	SampleMatrix	SampleTop	SampleBottom	DepthUnits	Duplicate	FieldSampleID	AltSampleID	CoolerID	Sampler	Description	SampleMethodCode

Notes:

- Red text indicates a required field.
- Black text indicates an optional field.

LogCode	COCNumber	DeliveryGroup	AmbientBlankLot	EquipmentBlankLot	TripBlankLot	FilteredSample	QCSequenceID	QCSampleCode	TaskNumber	PrimarySample	SampleResult	Container	NumContainers

CoolerTemp	FieldEquip	GeologicUnitCode	LithologyCode	Odor	Preservation	PumpFault	Purged	QAPlanNumber	SampConcentration	SampleCollProc	SampleEventName	SampleEventID	SamplePurposeCode

SampleSource	Witness	ParameterName	CASNumber	AltParamNumber	StoretCode	Superseded	AnalyticMethod	TaxonSerial	GenderCode	LifeStageCode	TissueTypeCode	Value	ReportingUnits	FlagCode

ProblemCode	ValidationCode	DetectedResult	Detect	LimitType	Detect2	LimitType2	Detect3	LimitType3	SpikeAmount	RetentionTime	Error	DilutionFactor	Basis	FilteredAnalysis	LeachMethod	PrepMethod

PreparationLot	ReportableResult	AnalDate_D	ExtractDate_D	LabReportDate_D	LabRecvDate_D	Lab	LabComments	AnalysisLabID	AnalyticalBatch	ValueCode	RunCode	QCAnalysisCode	AnalysisGroup

AnalysisLocationCode	BatchTypeCode	Cleanup	DetectorMode	DetectorType	ExpectedValue	Extracted	HandlingBatch	HandlingType	InstrumentCalibBy	InstrumentCalibDate_D	InstrumentManufacturer

InstrumentModel	InstrumentNum	LabMatrixCode	LabPrepDate_D	LabReportNum	LabSampleID	LeachateBatch	LeachDate_D	MethodBatch	NumberDecimals	PercentRecovery	PrepBatch	PreserveIntact

RunBatch	StatTypeCode	StdRefMaterial	SubContractLab	ValidationComments	Validator	ValueTypeCode	WeightVolume	WeightVolUnits	Detect4	LimitType4	Detect5	LimitType5	UpperControlLimit

LowerControlLimit	RejectionControlLimit	RPDLimit	APDLimit	CatResult	AnalysesTaxonSerial	AnalysesLifeStageCode	BlankFlagCode	FinalValue	FinalQualifier	SampleEndDate	SampleStatusCode

Sample_CX	Sample_CY	Sample_CZ	StationReach

APPENDIX B

Data Visualization Examples

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Appendix B – Data Visualization Examples

Example 1 – Box and whisker plots

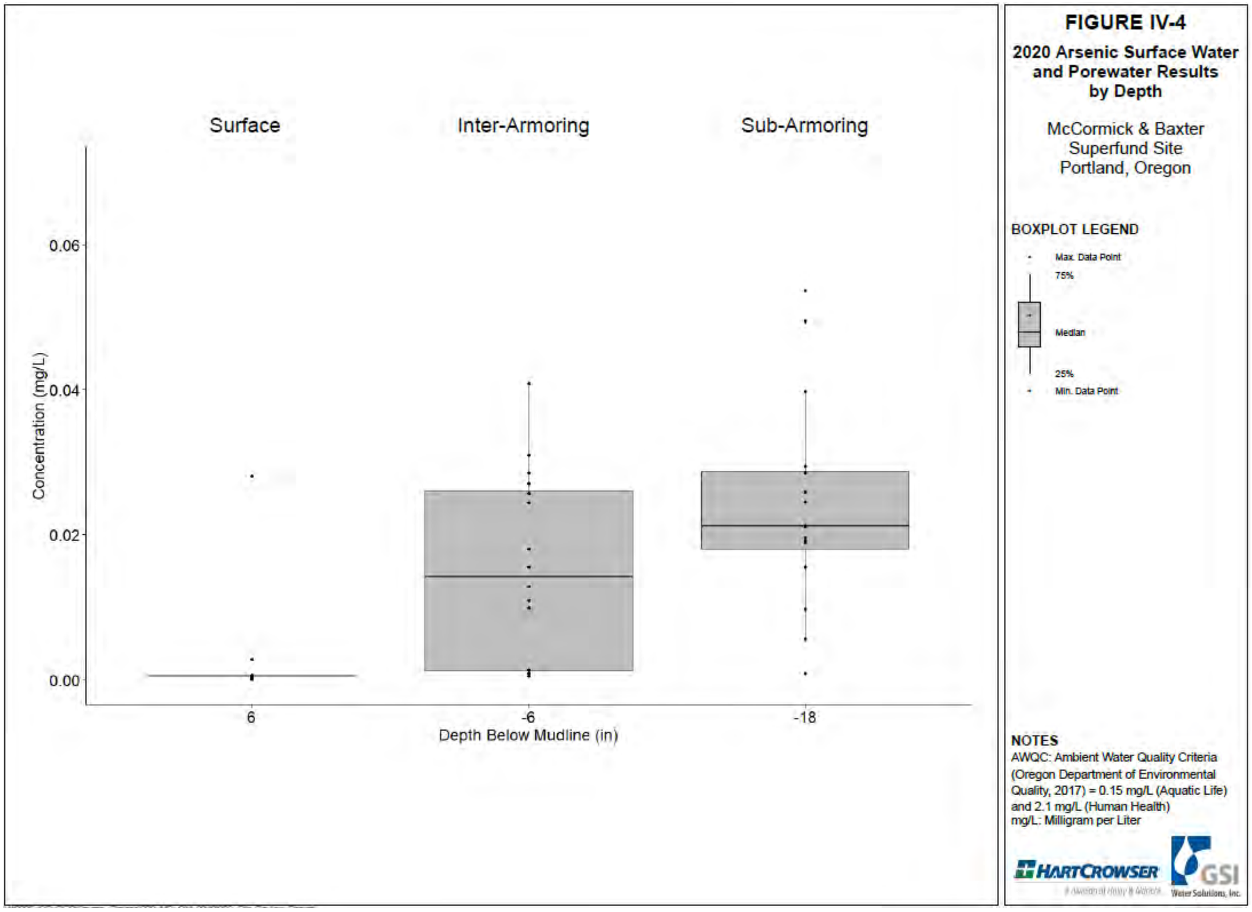


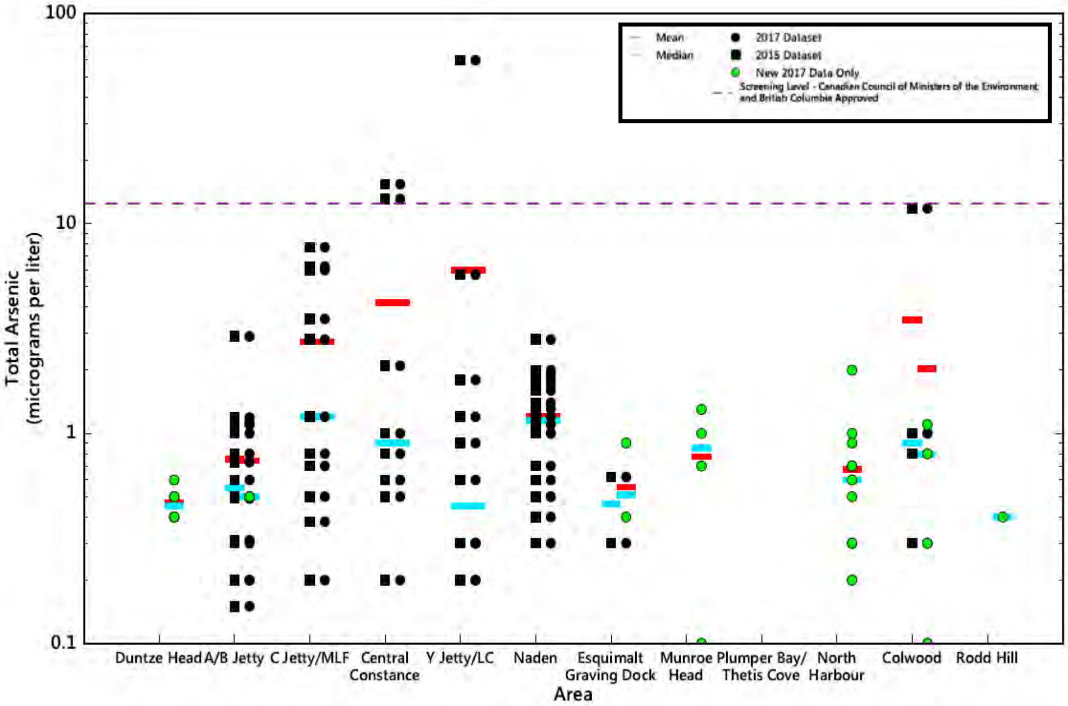
FIGURE IV-4

2020 Arsenic Surface Water and Porewater Results by Depth

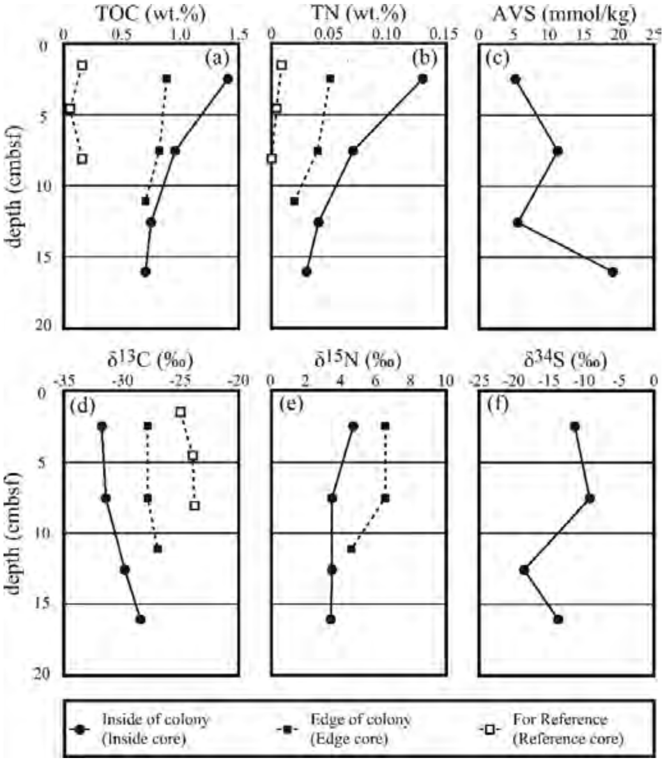
McCormick & Baxter Superfund Site
Portland, Oregon

NOTES
AWQC: Ambient Water Quality Criteria (Oregon Department of Environmental Quality, 2017) = 0.15 mg/L (Aquatic Life) and 2.1 mg/L (Human Health)
mg/L: Milligram per Liter

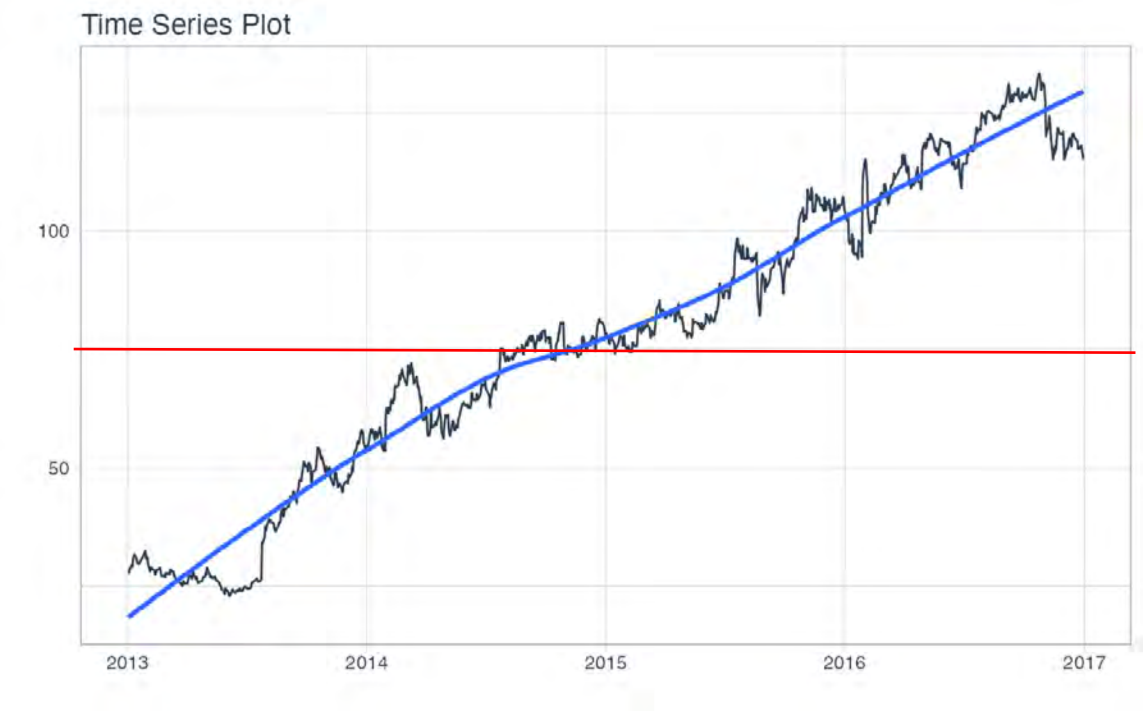
Example 2 – Dot plot with summary statistics

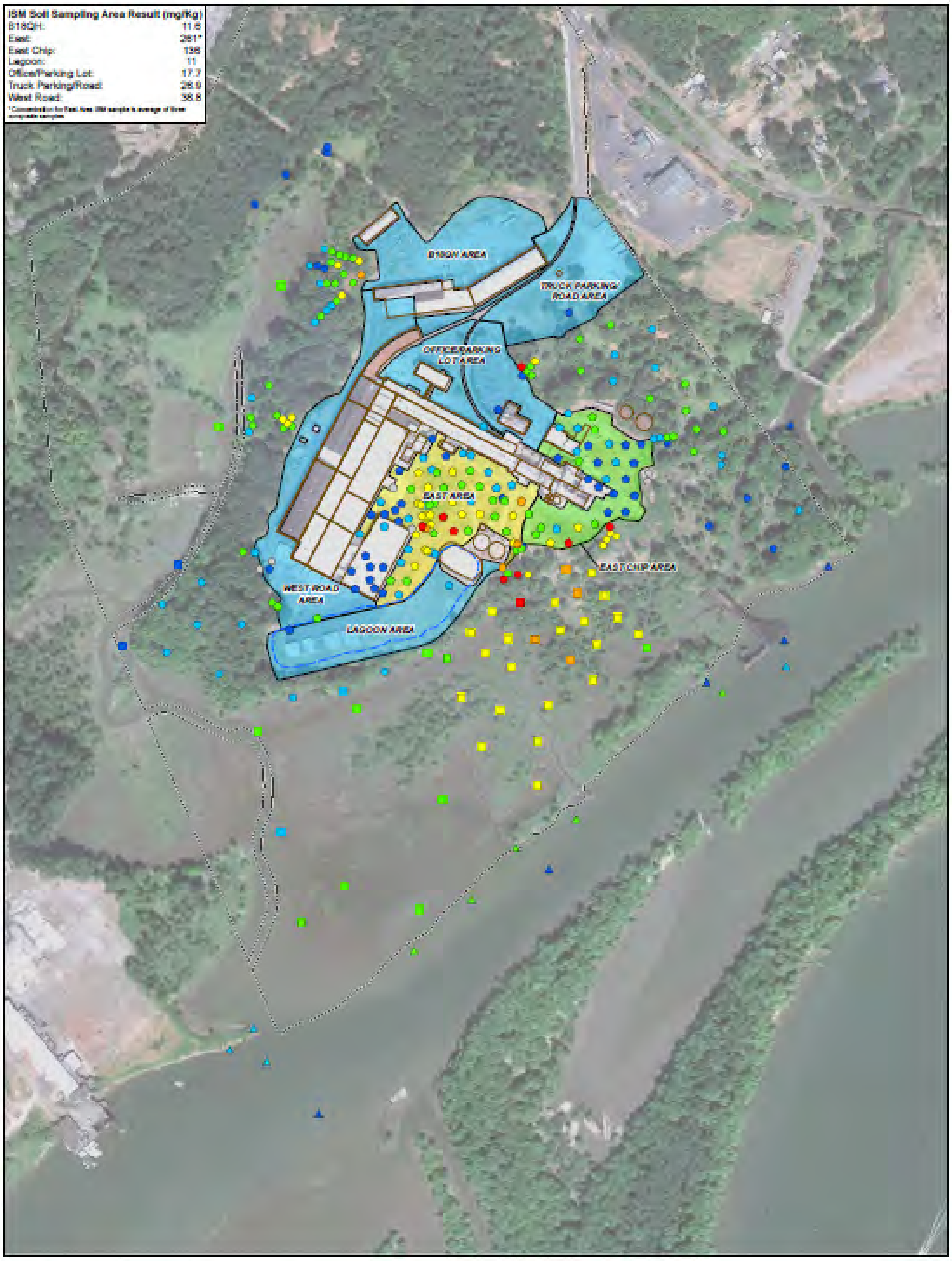


Example 3 – Vertical chemical profile



Example 4 - Time series plot





ISM Soil Sampling Area Result (mg/Kg)	
B18QH:	11.8
East:	261*
East Chip:	138
Lagoon:	11
Office/Parking Lot:	17.7
Truck Parking/Road:	26.9
West Road:	38.8

* Concentration for East Area ISM sample is average of three composite samples

LEGEND

Arsenic Concentrations (mg/Kg dw)

- 🟥 >1,094 (>95th percentile)
- 🟧 >628.4 and <=1,094 (90th - 95th percentile)
- 🟨 >218.5 and <=628.4 (75th - 90th percentile)
- 🟩 >41 and <=218.5 (50th - 75th percentile)
- 🟦 >10.875 and <=41 (25th - 50th percentile)
- 🟦 <=10.875 (<=25th percentile)
- ⬜ Non Detect

Surface Soil Samples (0 to 1 ft sample depth)

- ⬢ Upland
- ● Terrestrial Lowland
- ■ Aquatic Lowland
- ▲ Aquatic In-Water

All Other Features

- ☐ Property Boundary (Based on Ordinary Low Water)
- ☐ ISM Soil Sampling Area (fill color corresponds to the ISM sample concentration)
- ☐ Former Lagoon
- ☐ Buildings

MAP NOTES:
Date: February 28, 2014
Data Sources: MFA, Air photo taken on August 15, 2012 by Google Earth

N

0 175 350 525
Feet

FIGURE 1

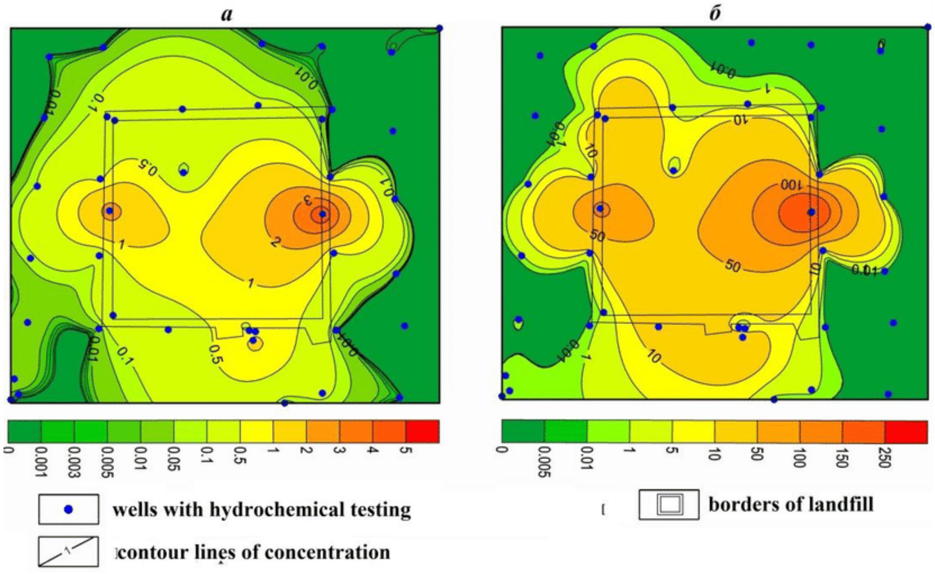
Percentile Distribution of Arsenic Concentrations in Surface (0 to 1 ft) Soil Samples

Combined Remedial Investigation
St. Helens Fiberboard Plant
St. Helens, Oregon

GSI Water Solutions, Inc.

Document Path: P:\Portland\380-Armstrong\St_Helens\Project_GIS\Project_mxds\Combined_RI\Figure1_Surface_Soils_Arsenic.mxd

Example 6 – Isoconcentration Map



Example 7 – Cumulative Distribution Plot

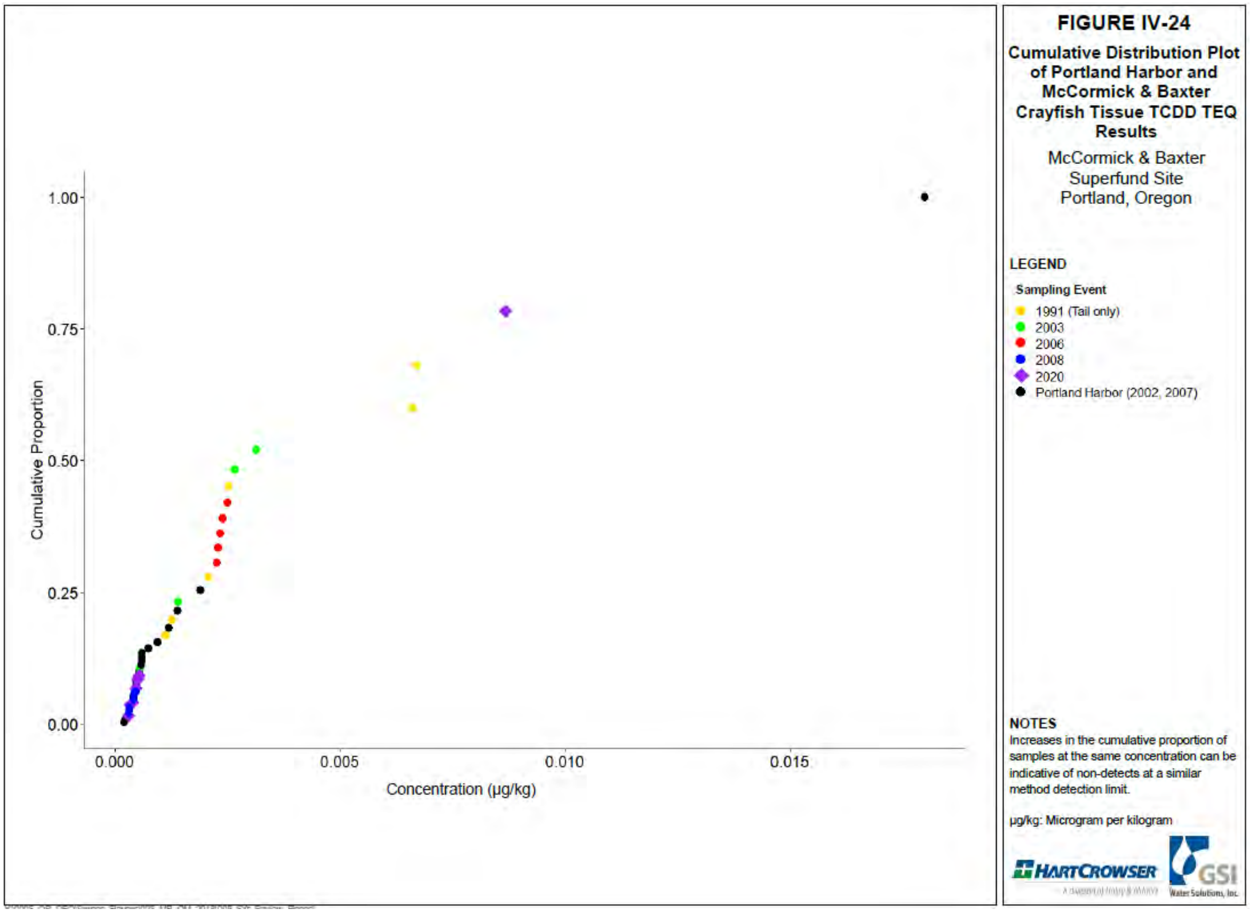


FIGURE IV-24

Cumulative Distribution Plot of Portland Harbor and McCormick & Baxter Crayfish Tissue TCDD TEQ Results

McCormick & Baxter
Superfund Site
Portland, Oregon

NOTES

Increases in the cumulative proportion of samples at the same concentration can be indicative of non-detects at a similar method detection limit.

µg/kg: Microgram per kilogram