Five-Year Review Report

Third Five-Year Review Report

for

Pacific Sound Resources Superfund Site

City of Seattle

King County, Washington

September 2014

PREPARED BY

United States Army Corps of Engineers

Seattle District

Seattle, Washington

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Date: 9/24/14

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Executive Summary

This is the third five-year review (FYR) for the Pacific Sound Resources (PSR) Superfund Site located in Seattle, Washington. The purpose of this five-year review is to review information to determine if the remedy at the site is, and will continue to be, protective of human health and the environment. The triggering action for this FYR is the signing of the previous FYR, which was signed on September 25, 2009.

The PSR Site occupies approximately 225 acres and is divided into two operable units (OUs): the Upland Unit (UU) and the Marine Sediment Unit (MSU). The UU occupies approximately 25 acres and is located in a mostly industrial portion of West Seattle, adjacent to the Lockheed West Seattle Superfund Site to the northeast, and otherwise surrounded by a moderately dense populated urban residential area. The MSU lies directly north of the UU and occupies roughly 200 acres in Elliott Bay. The MSU is divided into five Remedial Action (RA) subunits (RA1-RA5).

Contamination at the PSR site is associated with former wood treating processes and facilities. Investigation results indicated that releases of wood treating materials occurred throughout the lifetime of the facility (1909-1994). Soil, groundwater, and marine sediments were impacted by these historical operations. The primary sources of contamination to the UU were associated with the wood treating areas, discharge pits, equipment, tanks, and loading areas. The MSU was contaminated primarily through direct disposal of contaminated materials to Elliott Bay. The primary wood preservatives in use at the time of plant closure were creosote, pentachlorophenol (PCP), and chemonite (an inorganic solution of copper, arsenic, and zinc salts). Other preservatives used during historical plant operations include phenol, chromium, boric acid, and fluoride. Based on investigation results, the primary constituents of concern for the UU were determined to be polycyclic aromatic hydrocarbons (PAHs), PCP, dibenzofuran (DBF), and zinc. Light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) remain present in the site subsurface; volumetrically, most non-aqueous phase liquid (NAPL) at the PSR Site is DNAPL.

In August 1994, EPA issued an Administrative Order on Consent (AOC) to the Port of Seattle for upland removal actions. Early actions were completed at the PSR Site to stabilize site conditions, remove sources, address principal threats posed by contaminated soil and groundwater, and allow for redevelopment of the site. Time critical early actions completed in 1995 included demolition of the entire wood treating facility, removal of 4,000 cubic yards of contaminated soil and process sludge, and initial redevelopment of the PSR site as an intermodal rail yard and container terminal.

Between 1996 and 1998, early actions for the UU of the PSR Site completed by the Port of Seattle as Non-Time Critical Removal Actions (NTCRA) included:

- Excavation and disposal of 3,840 tons (approximately 2,400 cubic yards) of process residuals present in soils beneath demolished structures.
- Placement of a 4-inch to 8-inch thick low permeability asphalt cap to (a) isolate and prevent direct human exposure to contaminated soil and (b) minimize the potential for contaminants to migrate from impacted, unsaturated soil to groundwater via stormwater infiltration.

- Installation of a 1,600-foot long by roughly 40 feet below ground surface (bgs) bentonite slurry wall to (a) minimize shallow groundwater and LNAPL flow to Elliott Bay and (b) reduce tidal influence on contaminant movement.
- Installation of a 1,000-foot long by 15-foot deep LNAPL recovery trench on the inland side of the slurry wall to capture and prevent NAPL transport to Elliott Bay as a contingency measure.

On 30 September 1999, EPA issued the Record of Decision (ROD) for the PSR Superfund Site. The ROD described final selected remedies for both the UU and the MSU. The NTCRAs completed at the time of the ROD were determined to be part of the final remedy for the UU. In addition, an Inspection and Maintenance (I&M) program for the UU surface cap, ongoing monitoring of groundwater and collection of NAPL as needed, and institutional controls (ICs) for prohibiting groundwater use and restricting land use were selected as part of the final remedy. For the MSU, the ROD called for placement of a cap over 50 acres of contaminated sediments with the thickness to-be-determined during design (except in intertidal areas where a cap no less than 5-foot thick was required), dredging of approximately 3,500 cubic yards of contaminated sediment to maintain navigational depths and access, removal of unused creosote-treated pilings prior to capping, designation of the entire capped area as a "no-anchor" zone applicable to commercial vessels using the large "whale-tail" type anchors that have the capacity to break through the cap and expose contaminated sediment, and the development of a short- and long-term monitoring or management plan to ensure that the cap is placed as intended and is performing the basic confinement functions.

In 2005, a 3-foot thick containment cap was placed over 58 acres of contaminated sediments in the MSU, except in intertidal areas where a 5-foot thick cap was placed to allow for unrestricted tribal harvest of shellfish as required by tribal treaty rights. Additional actions included dredging of 10,000 cubic yards of contaminated sediment to maintain navigational access, removal of 800 unused creosote-treated pilings, and monitoring of cap performance. Results of post construction cap monitoring indicated that the designed cap thickness was not achieved in RA5. Additional materials were placed in RA5 in 2012.

Overall, the uplands remedy has been successful in preventing current human health exposures. The asphalt cap is inspected annually, and the Port of Seattle recently completed restoration of the cap sealcoat. Institutional controls (ICs) for the UU and MSU have been implemented. EPA has stopped analyzing individual constituents in groundwater in the UU because upland groundwater monitoring is not the best way of evaluating impacts from upland contaminants on Elliot Bay; USACE is currently preparing a revised Operation, Maintenance, and Monitoring Plan (OMMP) specific to the UU that will describe the future monitoring plan. The solid-phase microextraction (SPME) deployment study in 2010 showed that aquatic life was not being exposed to porewater or surface water with contaminants of concern (COCs; not including PCP, which was not measured in the SPME study) above protective levels.

Sampling of the MSU cap in 2014 indicated that no surface sediment exceeded the cleanup levels for any COCs including PCP (though the data is preliminary as of the writing of this review).

The MSU monitoring revealed that additional cap materials placement in RA5 in 2012 resulted in an increased average cap thickness, though the design cap thickness was not achieved. As noted in the

previous FYR, the use of alternate concentration levels (ACLs) and the related assumptions was flawed and the cleanup levels based on them are not protective of surface water and aquatic organisms when compared to likely applicable or relevant and appropriate requirements (ARARs). An analysis of groundwater potability has not been completed, but is required to determine whether drinking water standards are ARARs. PCP toxicity data has changed in the last five years, which may affect protectiveness of the remedy. An analysis is needed in order to determine whether the change in the PCP toxicity values will affect changes to the risk assessment and, therefore, remedy protectiveness. Porewater PCP concentrations were not determined in the SPME study, but PCP concentrations in groundwater exceeded maximum contaminant levels (MCLs) in many shoreline wells during the last five years. At some point in the future, the cleanup level for PCP may need to be addressed in a ROD Amendment. Porewater sampling for PCP should be considered to determine if a revised PCP cleanup level is exceeded.

The remedy at the PSR Site currently protects human health and the environment because there is no exposure to contaminated soil or groundwater, studies have indicated that aquatic life is not expected to be exposed to contaminants in porewater above protective levels, and surface sediments did not exceed cleanup levels for any contaminants in the latest monitoring event. However, in order to be protective in the long-term, ARARs, cleanup levels, and waiver potential for ARARs that cannot be met for groundwater in the UU should be re-evaluated in a ROD Amendment; a potability determination for groundwater in the UU should be considered; and an analysis should be completed to determine whether the change in PCP toxicity values will affect changes to the risk assessment and remedy protectiveness.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Pacific Sound Resources		
EPA ID: WAD009248287		
Region: 10	**State:** WA	**City/County:** Seattle/King

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:** Click here to enter text.
Author name (Federal or State Project Manager): Ravi Sanga
Author affiliation: USEPA Region 10
Review period: June 27, 2013 – September 25, 2014
Date of site inspection: September 20, 2013
Type of review: Statutory
Review number: 3
Triggering action date: 09/25/2009
Due date *(five years after triggering action date)*: 09/25/2014

Five-Year Review Summary Form (continued)

The table below is for the purpose of the summary form and associated data entry and does not replace the two tables required in Section VIII and IX by the FYR guidance. Instead, data entry in this section should match information in Section VII and IX of the FYR report.

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
None				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): Upland Unit	**Issue Category: Remedy Performance**			
	Issue: The ROD's ACLs are not appropriate standards to demonstrate compliance and protectiveness. The use of ACLs and the related assumptions was flawed and the cleanup levels based on them are not protective of surface water and aquatic organisms when compared to likely ARARs. EPA recognizes the inappropriate use of ACLs, but has not formally re-evaluated ARARs and cleanup levels in a ROD Amendment (as previously recommended).			
	Recommendation: Re-evaluate ARARs and cleanup levels. Assess practicability of achieving ARARs and cleanup levels and waiver potential for any ARAR that cannot be met. Make revisions, including ACL elimination, in a ROD Amendment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	09/30/2018
OU(s): Upland Unit	**Issue Category: Monitoring**			
	Issue: Groundwater potability has not been adequately evaluated in the upper or lower aquifer, although the ROD states that prospective future water supplies (potable water) are present in at least part of the site.			
	Recommendation: Based on existing data and new data as necessary, determine (i) whether the formation underlying the contaminated site is a confining layer, (ii) the potability of the groundwater underlying the confining layer beneath this formation, and (iii) whether the upper aquifer is potable. If groundwater is potable, drinking water requirements are relevant and appropriate.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	09/30/2018
OU(s): Marine Sediments Unit	**Issue Category: Monitoring**			
	Issue: Future implementation of remedial actions at the Lockheed West Seattle Superfund Site, which is immediately east of the Pacific Sound Resources Superfund Site, may impact the MSU sediment cap.			
	Recommendation: Sediment traps or other monitoring methods should be employed in the MSU during the implementation of remedial actions at the Lockheed West Seattle Superfund site to assess any potential effects on the MSU sediment cap.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	09/30/2019
OU(s): Upland	**Issue Category: Monitoring**			

Unit	**Issue:** The changes to the UU groundwater monitoring program have not been reflected in a Revised Addendum to the UU OMMP.			
	Recommendation: Complete a Revised Addendum to the UU OMMP.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	09/30/2015
OU(s): Upland Unit	**Issue Category: Monitoring**			
	Issue: The PCP toxicity values changed in the IRIS database which may affect protectiveness with regard to the risk assessment.			
	Recommendation: Complete and analysis to determine whether the change in PCP toxicity values will affect changes to the risk assessment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	09/30/2017

To add additional issues/recommendations here, copy and paste the above table as many times as necessary to document all issues/recommendations identified in the FYR report.

Protectiveness Statement(s)

Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.

Operable Unit:	***Protectiveness Determination:***	***Addendum Due Date (if applicable):***
Upland Unit	Short-term Protective	

Protectiveness Statement:
The remedy at the UU currently protects human health and the environment because the asphalt cap prevents exposure to contaminated soils, there is no exposure to contaminated groundwater due to institutional controls, and the SPME study indicated that aquatic life is not expected to be exposed to contaminants in porewater above protective levels. However, in order for the remedy to be protective in the long term, ARARs, cleanup levels, and waiver potential for ARARs that cannot be met should be re-evaluated in a ROD Amendment, a potability determination for groundwater in the UU should be considered, and an analysis should be completed to determine whether the change in PCP toxicity values will affect changes to the risk assessment.

Operable Unit:	***Protectiveness Determination:***	***Addendum Due Date (if applicable):***
Marine Sediments Unit	Protective	

Protectiveness Statement:
The remedy at the MSU is protective of human health and the environment because cleanup levels were not exceeded in surface sediments during the latest monitoring event.

Sitewide Protectiveness Statement (if applicable)

For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.

Protectiveness Determination:	***Addendum Due Date (if applicable):***
Short-term Protective	

Protectiveness Statement:
The remedy at the PSR Site currently protects human health and the environment because there is no exposure to contaminated soil or groundwater, studies have indicated that aquatic life is not expected to be exposed to contaminants in porewater above protective levels, and surface sediments did not exceed cleanup levels for any contaminants in the latest monitoring event. However, in order to be protective in the long-term, ARARs, cleanup levels, and waiver potential for ARARs that cannot be met for groundwater in the UU should be re-evaluated in a ROD Amendment;, a potability determination for groundwater in the UU should be considered; and an analysis should be completed to determine whether the change in PCP toxicity values will affect changes to the risk assessment and remedy protectiveness.

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List of Abbreviations

ACL	Alternate Concentration Limit
AOC	Administrative Order on Consent
AWQC	Ambient Water Quality Criteria
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSL	Cleanup Screening Level
DBF	Dibenzofuran
DNAPL	Dense non-aqueous phase liquid
EPA	United States Environmental Protection Agency
FYR	Five-Year Review
HPAH	High molecular weight polycyclic aromatic hydrocarbon
IC	Institutional Control
IRIS	Integrated Risk Information System
I&M	Inspection and Maintenance
LNAPL	Light non-aqueous phase liquid
LPAH	Low molecular weight polycyclic aromatic hydrocarbon
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
NCP	National Contingency Plan
NTCRA	Non-Time-Critical Removal Actions

OMMP	Operation, Maintenance, and Monitoring Plan
OU	Operable Unit
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCP	Pentachlorophenol
PPA	Prospective Purchaser Agreement
PSR	Pacific Sound Resources
QAPP	Quality Assurance Project Plan
RCW	Revised Code of Washington
RI/FS	Remedial Investigation/Feasibility Study
RNA	Regulated navigation area
ROD	Record of Decision
SCO	Sediment Cleanup Objective
SMS	Sediment Management Standards
SPME	Solid-phase microextraction
SQS	Sediment Quality Standard
TEQ	Toxicity equivalent
TU	Toxicity unit
USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
WAC	Washington Administrative Code
WQS	Water Quality Standards

1. Introduction

The Pacific Sound Resources (PSR) Superfund Site (EPA ID: WAD009248287) is a former wood treating facility in Seattle, King County, Washington. This is the third Five-Year Review (FYR) for the PSR Site. The triggering action for this FYR is the previous FYR, which was signed on September 25, 2009. The PSR Site is divided into two operable units (OUs): the Upland Unit (UU) and the Marine Sediment Unit (MSU). Both OUs are addressed in this FYR.

1.1. Purpose

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and recommendations to address them.

1.2. Authority

The U.S. Environmental Protection Agency (EPA) prepared this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP). CERCLA §121(c) states:

> *"If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."*

The agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §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."*

EPA Region 10, with the assistance of the United States Army Corps of Engineers (USACE) via an interagency agreement, has conducted a five-year review of the remedial actions implemented at the PSR Superfund Site in Seattle, Washington. This review was conducted from June 2013 through September 2014. This report documents the results of the review.

This is the third five-year review for the PSR Superfund site. The triggering action for this statutory review is the signature date of the second five-year review: 25 September 2009. This review is being conducted because hazardous substances, pollutants, or contaminants on site are at levels above those which would allow for unlimited use and unrestricted exposure.

2. Site Chronology

Table 1 summarizes, in chronological order, the major milestones or notable events for the PSR Superfund Site.

Table 1. Chronology of Site Events

Event	Date
Site developed by J.M. Coleman Company.	1909
Wood treating operations on site.	1909-1994
Site ownership transferred to West Coast Wood Preserving Company (jointly owned by J.M. Coleman Co. and Pacific Creosoting).	1930
Site ownership transferred to Baxter-Wyckoff Company (jointly owned by J.H. Baxter and Mr. Walter Wyckoff).	1959
Site ownership transferred to Wyckoff Company.	1964
Site characterization done under RCRA §3013 Order until the Site was added to the NPL in 1994.	1984
Name changed from Wyckoff Company to Pacific Sound Resources.	1991
Site ownership transferred from Pacific Sound Resources to the Port of Seattle with Prospective Purchaser Agreement (PPA) from EPA.	August 1994
Site added to the NPL.	1994
Consent decree entered between PSR and EPA, creating an environmental trust for funding the cleanup actions.	August 1994
Administrative Order on Consent (AOC) issued by EPA to the Port of Seattle for upland removal actions.	September 1994
Initiated Upland OU Remedial Investigation/Feasibility Study (RI/FS).	1994
Implemented Time Critical Early Actions, including demolition of entire wood treating facility, removal of 4,000 cubic yards of contaminated soil and process sludge, and initial redevelopment of PSR as an intermodal rail yard and container terminal.	1995
Implemented Non-time-critical Early Actions, including installation of slurry wall, installation of light non-aqueous phase liquids (LNAPL) recovery trench, and completion of asphalt cap over layer of clean fill.	1996-1998
Initiated Marine Sediments OU RI/FS.	1996
RI/FS for Upland OU Completed.	November 1998
Inspection and maintenance of surface cap begins.	1998

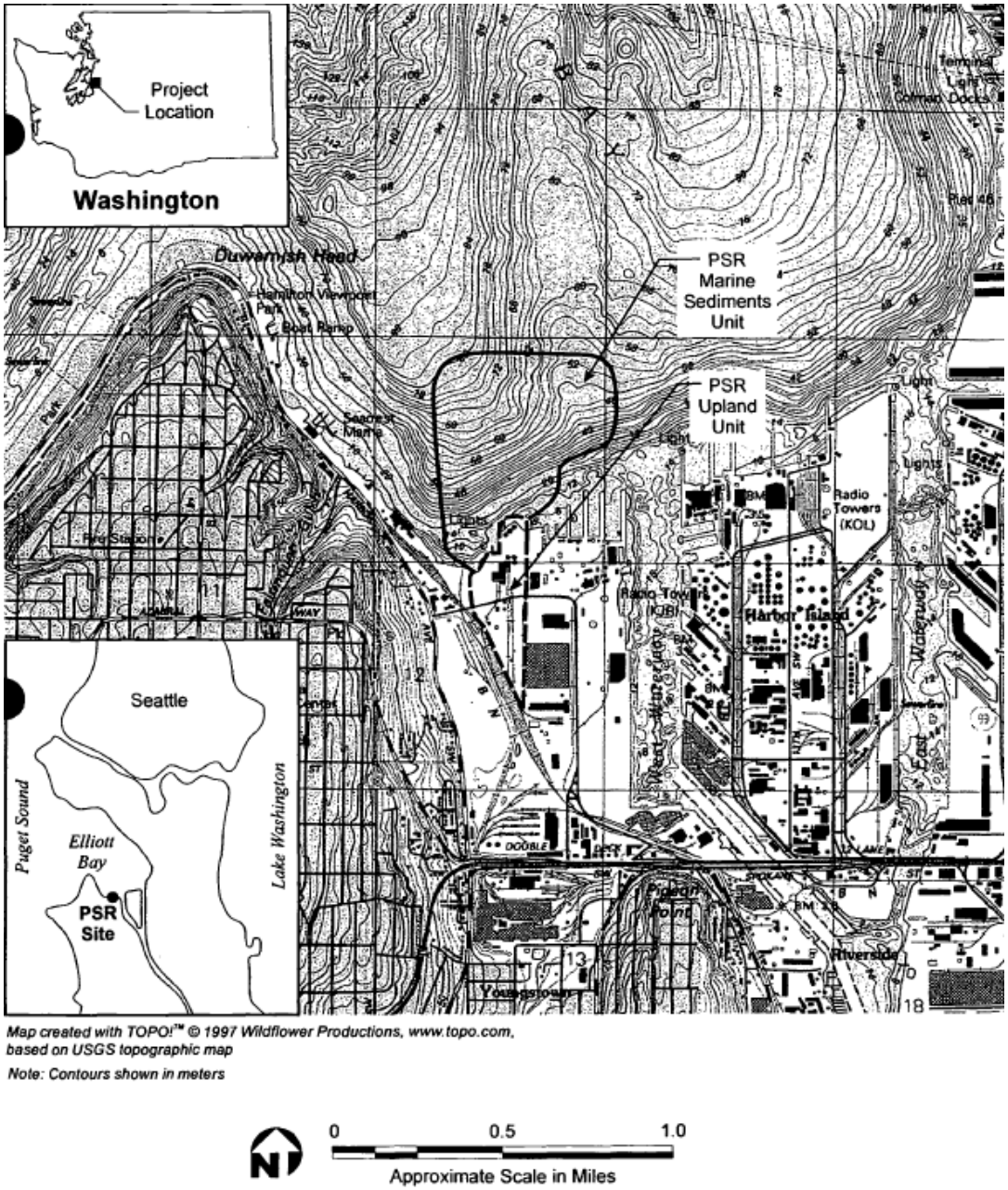
Event	Date
Public comment period for RI/FS reports and Proposed Plan for the PSR Site.	April-May 1999
Record of Decision (ROD) issued stating that the Early Actions for the Upland OU were the final action with additional requirements to ensure the actions remain protective, including (1) inspection and maintenance of the surface cap, (2) conformational monitoring including groundwater sampling and NAPL recovery, (3) institutional controls (ICs) to prohibit groundwater use and restrict land use, and (4) use of alternate concentration limits (ACLs).	September 1999
Assessment of potential damage to slurry wall as a result of the 2001 Nisqually earthquake; wall determined to be functioning effectively.	2001 - 2002
Assessment and repair of damage to monitoring wells as a result of the 2001 Nisqually earthquake.	2001 - 2003
Supplemental AOC issued by EPA to the Port of Seattle for groundwater monitoring of shallow and intermediate monitoring wells to expend remaining funds committed to the site by the Port in the 1994 PPA.	December 2002
Additional monitoring wells were installed to complete the performance or compliance monitoring network.	May 2003
Performance or compliance groundwater monitoring began.	May 2003
Marine Sediments OU cap design completed.	2004
First Five-Year Review completed.	September 2004
Marine Sediments OU cap installed: A 3-foot thick containment cap was placed over 58 acres of contaminated sediments in the MSU, except in intertidal areas where a 5-foot thick cap was placed to allow for unrestricted tribal harvest of shellfish as required by tribal treaty rights. Additional actions included dredging of 10,000 cubic yards of contaminated sediment to maintain navigational access, removal of 800 unused creosote-treated pilings, and monitoring of cap performance.	2005
Preliminary closeout report (PCOR) completed.	September 2005
Long-Term Sediment Monitoring Report approved.	2008
Upland groundwater monitoring program responsibility transferred from Port of Seattle to USACE. Port of Seattle PPA funding obligation completed.	2008
Second Five-Year Review completed.	September 2009
Environmental covenant between the Port of Seattle and EPA signed.	December 2009
Addendum to the Operation, Maintenance, and Monitoring Plan (OMMP) finalized.	March 2010
Solid Phase Microextraction (SPME) deployment study initiated and completed.	2010
Port of Seattle applied new sealcoat to asphalt cap in the UU.	2011-2013
The beach in Jack Block Park opened to public access.	June 2011
Final UU Annual 2010 Groundwater Report finalized.	November 2011

Event	Date
Final SPME Report submitted.	January 2012
Additional cap materials placed in RA5a of the MSU.	2012
US Coast Guard (USCG) established Regulated Navigation Area (RNA) on the portion of Elliot Bay that is subject to PSR cleanup and remediation efforts.	April 2012
Final UU Annual 2011 Groundwater Report finalized.	March 2013
USACE revised the portions of the Addendum to the OMMP pertaining to the MSU.	June 2013
Measurement of COCs in shoreline monitoring wells was discontinued.	September 2014
MSU Long Term Monitoring conducted.	January – April 2014

3. Background

3.1. Physical Characteristics

The PSR Site is a former wood treating facility located on the south shore of Elliott Bay at 2801 S.W. Florida Street, Seattle, Washington (**Figure 3-1**). The Site occupies approximately 225 acres. The UU occupies approximately 25 acres and is located in a mostly industrial portion of West Seattle, adjacent to the Lockheed West Seattle Superfund Site to the northeast, and otherwise surrounded by a fairly densely populated urban residential area. The MSU lies directly north of the UU and occupies roughly 200 acres in Elliott Bay. The MSU is divided into five Remedial Action (RA) subunits (RA1-RA5) as depicted in **Figure 3-2**.



Map created with TOPO!™ © 1997 Wildflower Productions, www.topo.com, based on USGS topographic map

Note: Contours shown in meters

Figure 3-1. Location of Pacific Sound Resources Superfund Site (USACE and URS Group, Inc. 2005)

Figure 3-2. Remedial Action Subunits RA1-RA5 in the Marine Sediments Unit

3.2. Land and Resource Use

The UU south of the inner harbor line of PSR is currently owned by the Port of Seattle and is largely covered with asphalt, which limits habitat for most terrestrial plants and animals found in the Duwamish River/Elliott Bay region. The UU lies adjacent to the West Duwamish Waterway and the

southwest portion of Elliott Bay; these water bodies are a portion of the adjudicated usual and accustomed fishing area of the Muckleshoot and Suquamish Indian Tribes. During early actions, the north portion of the UU, located adjacent to the shoreline, was converted to a public access park (Jack Block Park). Initially, the park included fish advisory signs and fences preventing shoreline access; shoreline access was opened to the public in the summer of 2011. The property to the west is used as a barge transport facility for bulk material. The remaining portion of the UU was completed as part of a larger intermodal terminal, which includes other property adjacent to the PSR Site. The nearest residence is over one-quarter of a mile from the PSR Site.

An environmental covenant (Covenant) between the Port of Seattle and EPA dated 15 December 2009 restricted property use to traditional industrial uses, except for the public shoreline access and public use facilities that are maintained on a portion of the property. No residential use and no other recreational uses are permitted (Appendix B). Therefore, with the exception of Jack Block Park, PSR Site use is anticipated to remain primarily industrial for the foreseeable future.

3.3. History of Contamination

Contamination at the PSR site is associated with former wood treating processes and facilities. Investigation results indicated that releases of wood treating materials occurred throughout the lifetime of the facility (1909-1994). Soil, groundwater, and marine sediments were impacted by these historical operations. The primary sources of contamination to the UU were associated with the treating areas, discharge pits, equipment, tanks, and loading areas. The MSU was contaminated primarily through direct disposal of contaminated materials into Elliott Bay (Weston 1998).

The primary wood preservatives in use at the time of plant closure were creosote, pentachlorophenol (PCP), and chemonite (an inorganic solution of copper, arsenic, and zinc salts). Other preservatives used during historical plant operations include phenol, chromium, boric acid, and fluoride (Science Applications International Corporation, 1990). Based on investigation results, the primary constituents of concern for the UU were determined to be polycyclic aromatic hydrocarbons (PAHs), PCP, dibenzofuran (DBF), and zinc. Light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) remain present in the site subsurface. Volumetrically, most non-aqueous phase liquid (NAPL) at the PSR Site is DNAPL.

The LNAPL followed the flow pathway of the groundwater (i.e., discharged to Elliott Bay). Prior to the placement of the slurry wall, LNAPL was seen as oily seepage at the shoreline of the facility. DNAPL followed the path of least resistance downward, due to gravity; however, the path has a lateral component due to grain size variation. Free-phase NAPL (both light and dense) is mobile and able to flow. Residual NAPL is the material that is left behind after the free-phase NAPL (either light or dense) has moved through (i.e., NAPL caught in the soil pore spaces). NAPL stringers result when the majority of the mass of NAPL had been spent and the remainder continues to "trickle" through the formation. Consequently, in addition to the layers of soil contamination caused by releases to the soil surface both before and after the filling in of the upland area, upland soil borings indicate NAPL contamination as deep as the deepest borings taken (100 feet below ground surface).

3.4. Initial response

Early actions were completed at the PSR Site to stabilize site conditions, remove sources, address principal threats posed by contaminated soil and groundwater, and allow for redevelopment of the site. Time-critical early actions completed in 1995 included demolition of the entire wood treating facility, removal of 4,000 cubic yards of contaminated soil and process sludge, and initial redevelopment of the PSR site as an intermodal rail yard and container terminal.

Between 1996 and 1998, early actions for the UU of the PSR Site completed by the Port of Seattle as Non-Time Critical Removal Actions (NTCRA) included:

- Excavation and disposal of 3,840 tons (approximately 2,400 cubic yards) of process residuals present in soils beneath demolished structures.
- Placement of a 4-inch to 8-inch thick low permeability asphalt cap to (a) isolate and prevent direct human exposure to contaminated soil and (b) minimize the potential for contaminants to migrate from impacted, unsaturated soil to groundwater via stormwater infiltration.
- Installation of a 1,600-foot long by roughly 40 feet below ground surface (bgs) bentonite slurry wall to (a) minimize shallow groundwater and LNAPL flow to Elliott Bay and (b) reduce tidal influence on contaminant movement.
- Installation of a 1,000-foot long by 15-foot deep LNAPL recovery trench on the inland side of the slurry wall to capture and prevent NAPL transport to Elliott Bay as a contingency measure.

3.5. Basis for Taking Remedial Action

Upland Unit

Pre-early action risks were greater than the acceptable risk ranges established by the NCP and the Washington State Model Toxics Control Act (MTCA), and established the need for CERCLA response action. The ROD stated that the early actions eliminated risks to upland receptors, based on exposure to contaminated soil and vapor, because capping the upland area eliminated direct contact exposure with contaminated soil. In addition, the current and long-term use of the upland property as an intermodal rail yard and container storage facility assured that future residential as well as industrial exposures would either not occur or be controlled under an Institutional Control (IC) Plan.

Marine Sediments Unit

The basis for taking action in the MSU resulted from a combination of human health and ecological risk considerations. With respect to human health, the basis for taking action was a result of pre-remedy incremental cancer risks for the Reasonable Maximum Exposure (RME) individual (tribal fisher) that were above the NCP risk range due to both PAHs and polychlorinated biphenyls (PCBs).

With respect to ecological risk, adverse effects were predicted for some sensitive aquatic invertebrate species living in contaminated sediments at PSR. No risks were calculated for clams because of a lack of effects data in the literature. However, clams are exposed to site-related contaminants at levels exceeding the Elliott Bay background concentrations, indicating the possibility that deleterious

impacts could occur to this receptor. No risks were identified for the existing conditions in the MSU to English Sole or its eggs. The Record of Decision (ROD), though, cited research by the National Marine Fisheries Service (Horness et al 1998) that suggested that flatfish (or other fish in direct contact with sediments) at PSR and throughout Elliott Bay may be at risk via impaired growth or reproduction, or via suppressed immune responses. Both PSR and the Elliott Bay PAH background concentrations exceeded this restoration goal. Accordingly, English Sole populations may be at risk throughout Elliott Bay due to non-site related sources.

4. Remedial Actions

4.1. Regulatory actions

In August 1994, EPA issued an Administrative Order on Consent (AOC) to the Port of Seattle for upland removal actions. On 30 September 1999, EPA issued the ROD for the PSR Superfund Site. The ROD described final selected remedies for both the UU and the MSU. In December 2002, EPA issued a Supplemental AOC to the Port of Seattle for groundwater monitoring of shallow and intermediate monitoring wells to expend remaining funds committed to the site by the Port in the 1994 Prospective Purchaser Agreement (PPA).

4.2. Remedial action objectives

The remedial action objectives for the UU were stated in the ROD as follows: "*(1) protection of aquatic life in surface water and sediments from exposure to contaminants of concern above protective levels, and (2) protection of humans from exposure to groundwater containing contaminants of concern above protective levels.*"

The remedial action objectives for the MSU were stated in the ROD as follows: "*(1) minimize human exposure through seafood consumption, and (2) minimize benthic community exposure to site contaminants.*"

4.3. Remedy description

Upland Unit

The NTCRAs completed at the time of the ROD were determined to be the final remedy for the UU. These early actions were demolition of all on-site structures, removal of highly contaminated shallow soil and sludge, focused NAPL collection and disposal, and isolation of remaining contaminated soil and groundwater with a low permeability asphalt cap and a subsurface slurry wall to prevent LNAPL migration to Elliott Bay. In addition, an Inspection and Maintenance (I&M) program for the UU surface cap, ongoing monitoring of groundwater and collection of NAPL as needed, and institutional controls (ICs) for prohibiting groundwater use and restricting land use were selected as part of the final remedy.

Marine Sediments Unit

For the MSU, the ROD called for:

- placement of a cap over 50 acres of contaminated sediments with the thickness to-be-determined during design (except in intertidal areas where a cap no less than 5-foot thick was required);
- dredging of approximately 3,500 cubic yards of contaminated sediment to maintain navigational depths and access;
- removal of unused creosote-treated pilings prior to capping;
- designation of the entire capped area as a "no-anchor" zone applicable to commercial vessels using the large "whale-tail" type anchors that have the capacity to break through the cap and expose contaminated sediment; and
- the development of a short- and long-term monitoring or management plan to ensure that the cap is placed as intended and is performing the basic confinement functions.

4.4. Remedy implementation

Upland Unit

For the UU, the early actions were completed prior to the ROD (see section 3.4).

Marine Sediment Units

In 2005, a 3-foot thick containment cap was placed over 58 acres of contaminated sediments, except in intertidal areas where a 5-foot thick cap was placed to allow for unrestricted tribal harvest of shellfish as required by tribal treaty rights. Additional actions included dredging of 10,000 cubic yards of contaminated sediment to maintain navigational access, removal of 800 unused creosote-treated pilings, and monitoring of cap performance.

4.5. Systems operations/Operations & Maintenance

4.5.1. Systems operations/O&M requirements

The operation, maintenance, and monitoring requirements for the MSU were first established by the Final Operation, Maintenance, and Monitoring Plan (OMMP) in September 2004 (USACE 2004). An Addendum to the OMMP was finalized in September 2010 to include UU (USACE 2010a). USACE submitted a revised addendum to the OMMP for the MSU in June 2013 (USACE 2013a), and is planning to submit a revised addendum to the OMMP for the UU.

Upland Unit

Groundwater monitoring in the upland unit began in May 2003 per the original work plan; **Figure 4-1** shows the layout of site monitoring wells. RETEC, on behalf of the Port of Seattle, collected groundwater monitoring data starting in May 2003 until the responsibility was shifted to USACE in

2008. Groundwater monitoring occurred quarterly from 2003 to 2008, and has been semi-annual since (though three groundwater monitoring events occurred in 2011). Based on the Addendum to the OMMP (USACE 2010a), there were three groundwater monitoring objectives with the overall purpose of evaluating whether the asphalt cap and slurry wall remedy was maintaining protectiveness at the mudline:

1. Determine if groundwater COC concentrations in shoreline wells meet criteria established in the ROD. Groundwater quality will be measured at the shoreline to ensure conditions are protective at the mudline. Shoreline wells are used because direct measurements of water quality at the mudline (the point of compliance) are currently impractical.
2. Evaluate trends in upland groundwater contaminant concentrations and DNAPL recovery volumes to identify changes in site conditions. This component of the plan involves measuring product thickness in the wells and recovering product if significant accumulation is identified. DNAPL thickness monitoring will also provide an early warning should site conditions change unexpectedly.
3. Monitor groundwater elevations inside and near the boundaries of the slurry wall as changes in groundwater elevation and/or flow direction may indicate changes in slurry wall or asphalt cap integrity. These remedial actions were designed to minimize flow of contaminated groundwater and LNAPL to Elliott Bay, and to reduce tidal influence on subsurface contaminant movement.

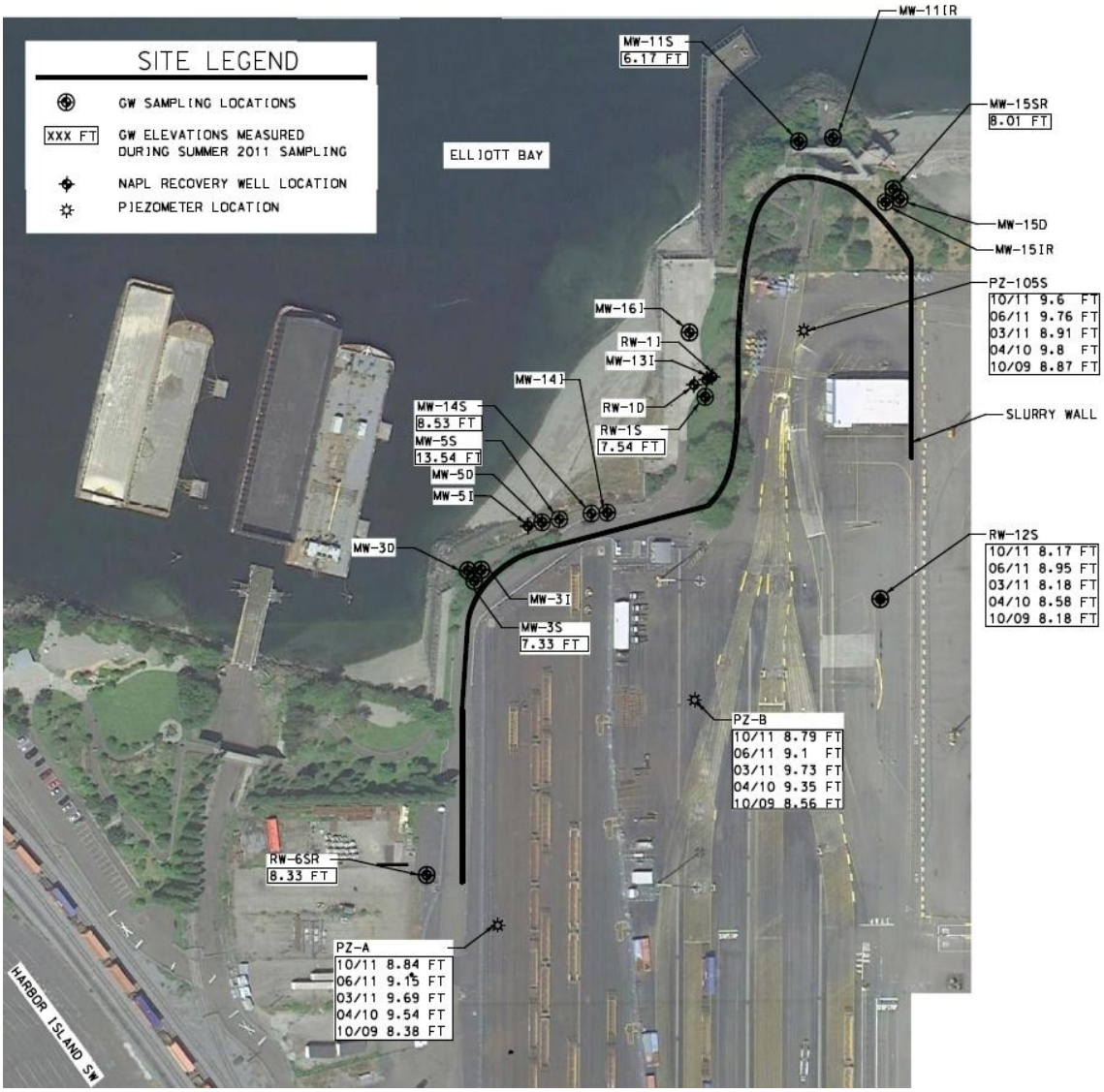


Figure 4-1. Layout of UU Monitoring Wells

During USACE monitoring, groundwater elevations were measured and samples taken from shallow, intermediate, and deep wells outside the slurry wall using low flow techniques and analyzed for PAHs, DBF, 2-methylnapthalene, PCP, and zinc. NAPL thickness monitoring was initiated when strong odors, elevated analytical results, or other signs indicated potential for NAPL accumulation in wells. The USACE submitted field monitoring reports after each sampling event and annual reports showing groundwater monitoring results.

The Port of Seattle, via a contractor, recovered and disposed of DNAPL from wells MW-5I, MW-13I, RW-1I, and RW-1D. DNAPL accumulations were fairly limited and quarterly pumping has been sufficient. The Port also conducted annual inspections of the asphalt cap and made repairs/improvements as necessary.

The OMMP Addendum (USACE 2010a) also called for collecting evidence in the MSU of solute transport from sediments and groundwater to surface water (based on Recommendation 2c from the second FYR). This was completed as described under Issue 2 in Section 5.2.

Marine Sediments Unit

The Revised Addendum to the OMMP (USACE 2013a) was not intended to replace the 2004 MSU OMMP, but instead supplements that latter document by updating operation, maintenance, and monitoring efforts for the MSU that support the determination of remedy effectiveness. The ROD and the MSU OMMP set forth specific performance standards to demonstrate that RAOs are being met by assessing and documenting the efficacy of the remedial actions, and also details the process for contingency monitoring in the event that performance standards are not met. The two specific monitoring objectives identified in the Revised Addendum are as follows:

1. Ensure cap meets sediment cleanup goals as defined in the ROD. Effectiveness of the sediment cap will be based primarily on surface sediments (0-10 cm) being in compliance with sediment cleanup objectives (SCO; formerly termed sediment quality standards [SQS]). The 0-10 cm interval is considered to be the biologically active zone and is therefore the point of compliance for this objective. If chemistry values for a specific COC exceed sediment management standards (SMS) SCO or cleanup screening level (CSL) concentrations, additional testing will be considered as a contingency. Monitoring of the Longfellow Creek outfall will be undertaken under this objective as it was a historical source of contamination to the MSU.

2. Evaluate variations in cap thickness over time. This monitoring objective addresses the need to ensure that the cap is physically stable and remaining in place at a desired thickness. Cap thickness monitoring data is secondary to chemical/biological conditions in the biologically active zone because a cap that is thinner than designed may still effectively prevent chemical exposures to biota.

Monitoring activities for the MSU cap were performed during this FYR period, following the placement of additional materials in RA5a (see section Issue 4 in section 5.2 and Appendix C). Consistent with the Revised Addendum to the OMMP, these activities included:

- Cap Thickness Evaluation
  - Topographic surveys and visual inspections of intertidal areas (RA1)
  - Bathymetric surveys (RAs 1-3 and shallow RA 4) and through-cap coring (RAs 1-3 and 5) of subtidal areas
- Cap Chemistry Evaluation
  - Surface grab samples (RA1)
  - Core samples (RAs 2,3, and 5)

4.5.2. Systems operations/O&M operational summary

Upland Unit

Well Conditions

During USACE's latest round of upland groundwater monitoring in April 2013 (and in previous monitoring rounds), it was noted that vaults for wells RW-6SR, MW-3S, MW-3D, MW-3I, MW-14S, MW-14I, MW-11S, and MW-11IR contained substantial amounts of water upon opening, indicating that the well vaults were not adequately sealed. Many bolts were replaced, and several gaskets were either installed or replaced. Also, well MW-15D, which is behind two locked gates on Port of Seattle property, appears to be damaged. The vault appears displaced, and the monument (the concrete structure around the well vault) appears to have shifted. The well riser protrudes nearly flush with the well cover plate preventing the placement of a plug (cap) on the well riser. The cover plate on the well vault is bolted shut after sampling events, but a plug is not placed on the well riser because it would prevent adequate closure and securing of the well.

The source of the damage was the Nisqually Earthquake that occurred in 2001, and the well was supposedly repaired following the earthquake. MW-15D is still capable of being sampled, though, and further repairs may be unnecessary unless groundwater monitoring is continued at some time in the future. Also, significant drawdown has been observed during purging and sampling of several PSR monitoring wells (e.g., MW-15D, MW-14S, and MW-5S). This significant drawdown may be caused by clogged well screens, which would not be unusual given the approximately 20 year-span since the wells were installed. If, in the future, EPA were to continue groundwater monitoring in the UU, it is recommended that all the monitoring wells be redeveloped to ensure a good connection with the surrounding groundwater that will allow for representative samples and measurements.

Monitoring Objectives for the Upland Unit

In August 2013, EPA in coordination with the USACE re-evaluated the existing monitoring objectives for the UU. EPA determined the first monitoring objective to be no longer viable because (1) site-specific practicality of direct measurement has been demonstrated by the use of SPME technology (see Issue 2 in section 5.2), (2) the impermissible use of Alternate Concentration Limits (ACLs) in the ROD (see Issue 1 in section 5.1), and (3) the difficulty in determining the extent to which DNAPL stringers pose current and potential risk; that is, statistical trend analysis for COCs in shoreline wells may not be indicative of contaminated groundwater effects on the sediment cap. USACE recommended revising the first monitoring objective as follows: "Determine whether upland subsurface contaminants are impacting the MSU sediment cap and increasing exposure."

The recommendation goes on to suggest that this objective could be met by periodic monitoring using field-deployable SPME push-point devices to measure vertical profiles of freely dissolved hydrophobic contaminants (as demonstrated in 2010). In addition to SPMEs, near surface porewater sampling for PCP should be considered because this compound does not adsorb to the SPME (USACE 2009). Dissolved phase porewater concentrations may be used to infer the proximity of a DNAPL source and reveal, in conjunction with data from MSU Long-Term Monitoring, whether dissolved phase DNAPL contaminants have infiltrated the sediment cap.

In regard to the second monitoring objective, monitoring and trend analyses were primarily restricted to monitoring wells outside the slurry wall. However, EPA asserted that the adequacy of this approach for defining impacts on the sediment cap or a potential subsurface source of potable water was undetermined. EPA suggested that a future site-wide groundwater monitoring program may be appropriate should a future determination of groundwater potability be made.

In regard to the third monitoring objective, EPA noted in the Quality Assurance Project Plan (USACE 2011a) that *"Groundwater elevations in five monitoring wells and piezometers (RW-6SR, PZ-A, PZ-B, RW-12S, and PZ-105S) are monitored to evaluate direction of shallow groundwater flow in the vicinity of the slurry wal1. Data from so few wells is likely to be inconclusive regarding groundwater flow direction."* Similarly, analysis of changes in groundwater elevation changes at these stations is also likely to be inconclusive regarding their significance in relation to slurry wall or asphalt cap integrity. EPA recommended that concerns regarding the asphalt cap integrity be addressed through the periodic inspection and maintenance already performed by the Port of Seattle. EPA further recommended that concerns regarding slurry wall integrity, which only seem pertinent following a potentially disruptive event (such as the Nisqually Earthquake of 2001), be addressed by undertaking a tidal efficiency wall performance study after such an event. This type of study was performed in 2002, following the 2001 earthquake, to alleviate concerns about possible seismic disruption of the wall. As a lesser priority, EPA suggested that regular periodic tidal efficiency monitoring could be undertaken by installing and leaving in place an appropriately distributed, nested-piezometer network.

The result of EPA's decision was the cancellation of future groundwater monitoring at the PSR site pursuant to the 2010 OMMP and the development of preliminary plans to conduct another SPME study in the next FYR period. The Port of Seattle will continue to recover DNAPL and should these operations be discontinued by the Port, EPA will continue to monitor the presence and absence of DNAPL.

DNAPL Removal

The Port of Seattle submits quarterly reports, a section of which shows total DNAPL removed and DNAPL removed from wells MW-5I, RW-1D, RW-1I, and MW-13I. As of December 2012, a total of 1,409 gallons of DNAPL have been removed. Roughly 85 gallons from MW-5I, 1,039 gallons from RW-1D, 81 gallons from RW-1I, and 78 gallons from MW-13I have been removed to date. **Error! eference source not found.**shows the results of DNAPL removal from March 2009 through December 2012.

Table 2. DNAPL Volumes Removed by Port of Seattle

Removal Date	MW-5I			RW-1D			RW-1I			MW-13I			DNAPL Removed this event (gal)	DNAPL Removed to Date (gal)
	Liquid Removed (gal)	DNAPL Recovered (gal)	DNAPL Removed to Date (gal)	Liquid Removed (gal)	DNAPL Recovered (gal)	DNAPL Removed to Date (gal)	Liquid Removed (gal)	DNAPL Recovered (gal)	DNAPL Removed to Date (gal)	Liquid Removed (gal)	DNAPL Recovered (gal)	DNAPL Removed to Date (gal)		
3/4/2009	1.75	0.50	80.04	2.20	0.75	1,031.16	1.20	0.20	78.83	2.50	1.10	61.36	2.55	1,377.29
6/29/2009	2.00	0.60	80.64	2.60	0.80	1,031.96	1.60	0.25	79.08	2.75	1.95	63.31	3.60	1,380.89
9/14/2009	2.50	0.50	81.14	1.50	0.40	1,032.36	1.50	0.25	79.33	4.25	2.15	65.46	3.30	1,384.19
12/21/2009	2.50	0.60	81.74	2.80	1.00	1,033.36	2.75	0.30	79.63	4.40	1.25	67.71	3.15	1,388.34
6/17/2010	1.20	0.25	81.99	0.75	0.13	1,033.49	1.60	<0 25	79.88	2.00	0.75	68.46	1.38	1,389.72
10/7/2010	2.50	0.25	82.24	4.25	0.75	1,034.24	2.00	trace	79.88	6.00	1.50	69.96	2.50	1,392.22
2/11/2011	2.00	<0.25	82.49	5.00	<1.0	1,035.24	2.00	<0 25	80.13	5.00	1.25	71.21	2.75	1,394.97
5/26/2011	2.50	<0.25	82.74	5.00	1.00	1,036.24	2.00	trace	80.13	5.00	0.75	71.96	2.00	1,396.97
8/11/2011	2.50	<0.25	82.99	4.00	0.25	1,036.49	2.50	trace	80.13	5.50	0.75	72.71	1.25	1,398.22
12/5/2011	2.50	<0.25	83.24	5.00	0.50	1,036.99	2.50	trace	80.13	6.00	1.50	74.21	2.25	1,400.47
2/7/2012	3.25	<0.25	83.49	4.00	0.66	1,037.65	2.50	<0 25	80.38	6.00	1.50	75.71	2.66	1,403.13
5/7/2012	2.00	0.75	84.24	2.25	0.75	1,038.40	1.00	0.25	80.63	2.50	0.50	76.21	2.25	1,405.38
8/28/2012	1.50	0.25	84.49	1.50	0.25	1,038.65	2.50	0.25	80.88	4.50	0.25	76.46	1.00	1,406.38
12/13/2012	1.50	0.50	84.99	2.00	0.25	1,038.90	2.00	<0 25	81.33	2.00	1.50	77.96	2.50	1,408.88

Marine Sediments Unit

Monitoring activities for the MSU cap were performed from January to April 2014, following the placement of additional materials in RA5a (see Issue 4 in section 5.2 and Appendix C). These activities included cap thickness and cap chemistry evaluations, as described in section 4.5.1. Results of MSU monitoring activities are discussed in section 6.4.

4.5.3. Summary of costs of system operations/O&M effectiveness

Error! Reference source not found. summarizes annual costs for EPA and the Port of Seattle.

Table 3. Annual EPA and Port of Seattle O&M Costs

Year	EPA Annual Costs (FY costs)	Port of Seattle Annual Costs	EPA Activities
2009	$221,600	$18,500	GW sampling; OMMP update
2010	$161,300	$30,600	GW sampling; OMMP update
2011	$295,300	$74,900	GW sampling; SPME
2012	$149,400	$396,900	GW sampling; cap placement
2013	$538,400	not available	GW sampling; OMMP; LTMP development

Port of Seattle costs have increased since 2009 due to necessary cap repairs and the application of a new sealcoat on top of the asphalt cap.

5. Progress Since the Last Five-Year Review

5.1. Protectiveness statements from last review

The protectiveness statement for the UU in the 2009 Second Five-Year Review Report was:

> *"The remedy implemented for the Upland Operable Unit has eliminated current human and ecological terrestrial exposure to site COCs; however, subsurface DNAPL is not fully characterized or remediated, and DNAPL and dissolved contaminants are present in near-shore monitoring wells and may be continuing to move into these wells and beyond. A protectiveness determination of the remedy related to migration of contaminants from the Upland Unit cannot be made until further information is obtained, as recommended in Section 9, Recommendations and Follow-Up Actions. Further information will be obtained by collecting groundwater, sediment and surface water data, characterizing DNAPL in the subsurface, updating the conceptual Site model, and re-evaluating applicable or relevant and appropriate requirements (ARARs), cleanup levels and points of compliance. It is expected these actions will take up to four years to complete, at which time a protectiveness determination will be made. It is likely that some uncertainties will always remain regarding DNAPL location and potential for discharge into sediments and surface water."*

The protectiveness statement for the MSU in the 2009 Second Five-Year Review Report was:

"The sediment cap monitoring has indicated that the MSU remedy is currently performing as designed, based on general attainment of the chemical and biological Sediment Management Standards within the stated scope of the MSU O&M Monitoring Program. However, a protectiveness determination of the remedy at the Marine Sediments Unit cannot be made until further information is obtained, as recommended in Section 9, Recommendations and Follow-Up Actions. Further information will be obtained by collecting groundwater, sediment and surface water data, updating the conceptual Site model, and re-evaluating ARARs, cleanup levels and points of compliance. It is expected that these actions will take up to four years to complete, at which time a protectiveness determination will be made. It is likely that some uncertainties will always remain regarding DNAPL location and potential for discharge into sediments and surface water."

The site-wide protectiveness statement for the PSR Superfund Site in the 2009 Second Five-Year Review Report was:

"A protectiveness determination for the overall remedy at the Pacific Sound Resources Superfund Site cannot be made until further information is obtained, as recommended in Section 9, Recommendations and Follow-Up Actions. Further information will be obtained by collecting groundwater, sediment and surface water data, updating the conceptual Site model, and re-evaluating ARARs, cleanup levels and points of compliance. It is expected that these actions will take up to four years to complete."

5.2. Status of recommendations and follow-up actions from last review

Issue 1

Issue 1 from the previous FYR is:

"The ROD's ACLs are not appropriate standards to demonstrate compliance and protectiveness; nonetheless, even very high concentration criteria ACLs have been exceeded in several wells. The use of ACLs and the related assumptions was flawed (see section 4.1.3) and the cleanup levels based on them are not protective of surface water and aquatic organisms when compared to likely ARARs. Potential surface-water ARARs are identified in Table 6 of Section 7.1.2. Presently, maximum contaminant levels (MCLs) and state groundwater cleanup standards are exceeded in Site wells."

The *recommendation* for this issue was:

"Re-evaluate ARARs, cleanup levels and points of compliance, and assess practicability of achieving ARARs, RAOs, cleanup levels, and waiver potential for any ARAR that can't be met. Make revisions, including ACL elimination, in a ROD Amendment."

Recommendation Status:

The ROD stated that, *"based on the groundwater classification at PSR (Class IIb and Class III, i.e., non-potable), the impracticability of restoration, and the impracticability of the site meeting the*

statutory requirements, use of ACLs at PSR is appropriate." This statement contains several inaccuracies. Class IIb aquifers are potential future drinking water sources. Where doubt exists regarding the status of primary drinking water standards (MCLs and non-zero maximum contaminant level goals [MCLGs]) as ARARs, potability should be determined empirically using regulatory criteria rather than aquifer classifications or other designations (see Section 121(d)(2)(B)(i) of CERCLA).

More importantly, ACLs were never intended as a substitute for MCLs. In accordance with Section 121(d)(2)(A)(ii), MCLs and the stricter of federal Ambient Water Quality Criteria (AWQC) or state Water Quality Standards (WQS) must be met or waived where they are relevant and appropriate. If a Technical Impracticability (TI) waiver is invoked for any of these ARARs, it must be documented in a formal waiver pursuant to Section 121(d)(4)(C) of CERCLA. The application of ACLs is limited to applicable requirements (e.g., to groundwater in potable aquifers subject to an anti-degradation rule) where:

1) there are known and projected points of entry of such groundwater into surface water;
2) on the basis of measurements or projections, there is or will be no statistically significant increase of such constituents from such groundwater in such surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream; and
3) the remedial action includes enforceable measures that will preclude human exposure to the contaminated groundwater at any point between the facility boundary and all known or projected points of entry of such groundwater into surface water, then the assume point of human exposure may be at such known and projected points of entry (EPA 2005).

ACL use at PSR was far more expansive and intended for purposes far beyond the scope of Section 121(d)(2)(B)(ii).

Furthermore, the ACLs were derived groundwater concentrations intended to ensure surface water and sediment quality were protected over a long period of groundwater discharge to Elliot Bay. ACLs selected in lieu of an applicable requirement are supposed to measure for the existence of any statistically significant increase in surface water concentrations of groundwater constituents. However, these ACLs merely measured whether some surface water ARARs (which would have to be met in any case) were being met. Essentially, the ROD incorrectly concluded that surface water concentration increases could be characterized as insignificant as long as surface water ARARs were not exceeded. This allowed for extraordinarily lenient ACLs, which in some instances actually exceeded solubility limits and could practicably never be exceeded even if NAPL should be in or advancing towards a monitoring well.

ARARs, RAOs, cleanup levels, and ARAR waiver potential have not yet been formally re-evaluated in a ROD Amendment. ACLs have not been formally eliminated, but it is generally understood that they are not appropriate.

Issue 2

Issue 2 from the previous FYR is:

"Increasing concentrations of dissolved contaminants and newly or increasingly DNAPL contaminated wells indicate possible migration seaward. However, there is no surface water quality monitoring data to assist in determining whether the UU remedy is protective of this medium. DNAPL characterization beneath the site is incomplete or inadequate, additional investigations and monitoring are needed to better define COC sources, extent, depths and architecture, fate and transport. In light of this, it is not possible to determine either current or long-term protectiveness."

The *recommendations* for this issue were:

"(a) Additional DNAPL Characterization to better define COC sources, volume (or mass), extent, depths and architecture, and the extent of flow paths using optical screening tools with push probe insertion, e.g., TarGOST; also measure upwelling flux rates, direct-push fluorimetry, etc.

(b) Collection of near-shore sediment, groundwater, surface water, and transition zone water data to measure any discharge of contaminated groundwater or NAPL.

(c) Additional data collection of sediment and pore water on near-shore cap areas (RA1, RA2a, and RA2b) for suspected subsurface DNAPL (RA4 is not amenable, due to rocky cap materials). Sample down to 55-foot below MLLW off the northern point. SPME locations on Figure 13 for additional pore-water collection. Dissolved phase pore water concentrations could infer the proximity of a DNAPL source and reveal whether dissolved phase COCs from DNAPL can infiltrate the sediment cap.

(d) Update Conceptual Site Model with the new information and additional study results."

Recommendation Status:

The OMMP Addendum (USACE 2010a) called for collecting evidence in the MSU of solute transport from sediments and groundwater to surface water (presumably based on Recommendation 2c from the second FYR). At that time, the methodology for such an evaluation was being developed. A solid-phase microextraction (SPME) field deployment study was completed in 2010; the final report was submitted in January 2012 (Reible and Lu 2012). SPME insertion devices were deployed into the cap and retrieved in twenty-four locations (**Figure 5-1**) to measure contaminants in porewater and three devices were suspended above the cap surface to measure concentrations in surface water. The sixteen priority pollutant PAHs, DBF, and 2-methylnapthalene were analyzed. No NAPL was observed on or near any of the SPME samplers during the study. Results showed 1) no evidence of an upward trend for PAHS through the cap and 2) porewater and surface water concentrations never exceeded ambient water quality standards (**Figure 5-2**); the surface water human health criteria identified in Table A5-1 of the second FYR were used for this analysis because surface water criteria for marine aquatic life are not available for PAHs. The study concluded that porewater PAH concentrations were low and not clearly linked to Site contaminants or migration from upland. Thus, the PSR sediment cap appeared to be functioning as designed. Furthermore, the results of toxicity unit (TU) calculations (EPA 2003) indicated that benthic organisms should be acceptably protected from the adverse effects of PAH mixtures in site sediments (EPA 2011).

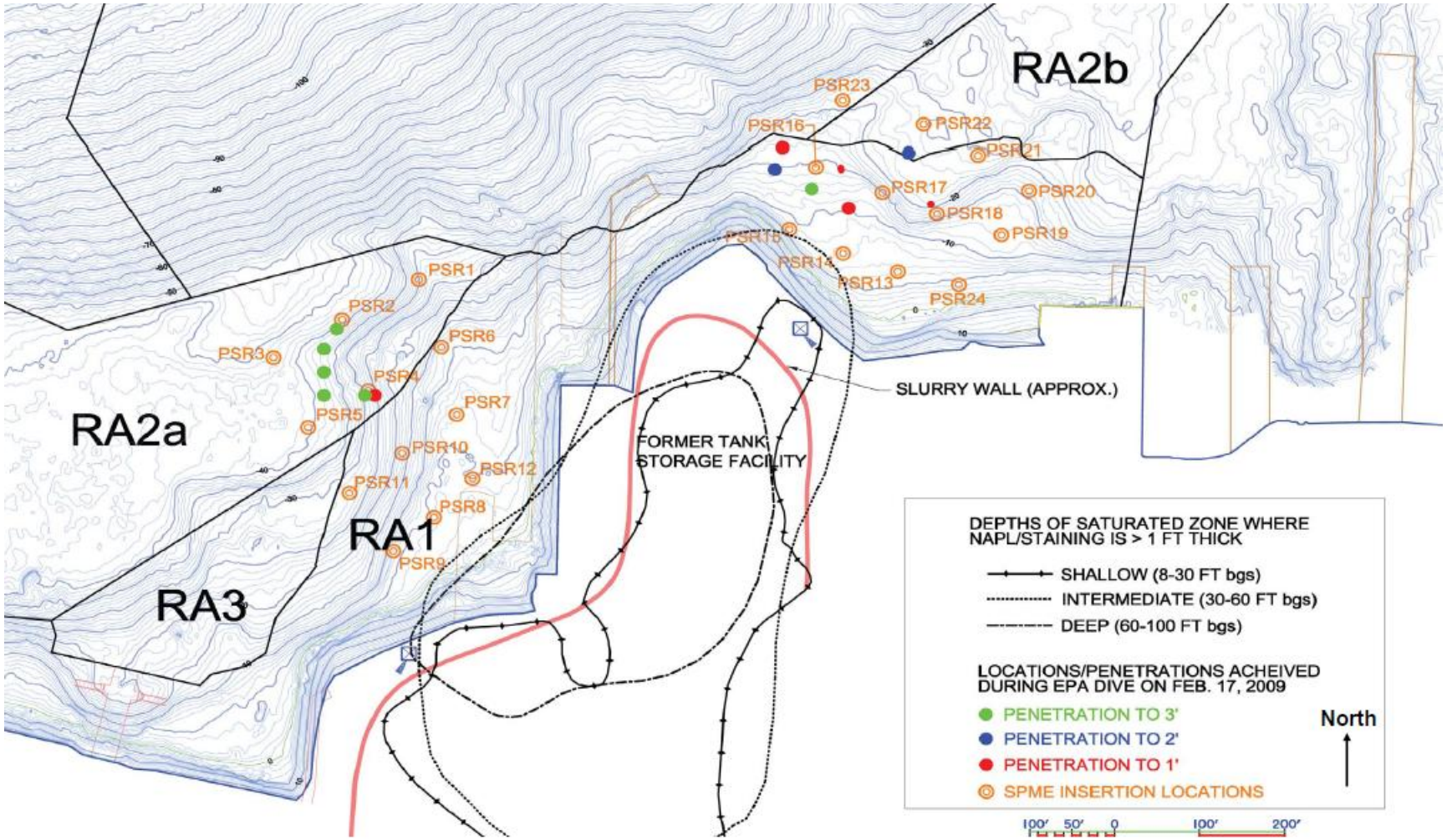


Figure 5-1. SPME Sampling Locations (in orange; USACE 2010b)

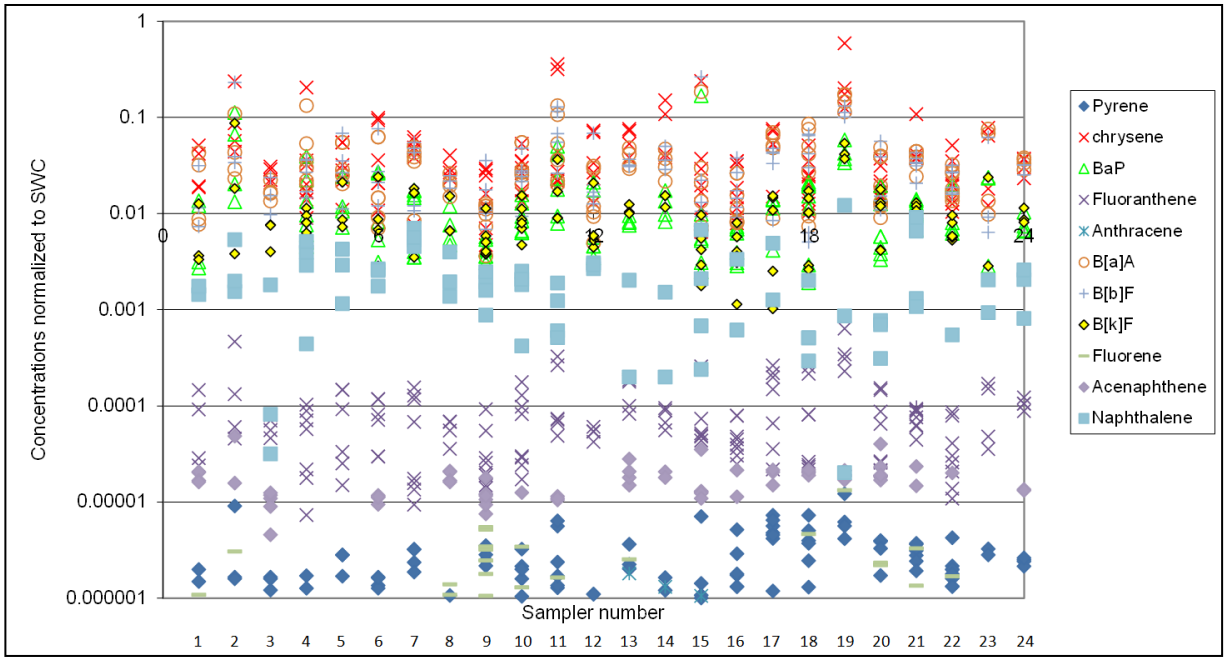


Figure 5-2. Ratio of Measured Concentrations to Surface Water Criteria (Reible and Lu 2012)

<u>Issue 3</u>

Issue 3 from the previous FYR is:

> *"There is a lack of sediment sampling in the near-shore area of RA1, RA2a, and RA3 to verify that uncontrolled contaminants are not reaching sediments at unacceptable concentrations."*

The *recommendation* for this issue was:

> *"Additional data collection of sediment and pore water on near-shore cap areas (RA1, RA2a, and RA2b) for suspected subsurface DNAPL (RA4 is not amenable, due to rocky cap materials). Sample down to 55-feet below MLLW off the northern point. SPME locations on Figure 13 for additional pore-water collection. Dissolved phase pore water concentrations could infer the proximity of a DNAPL source and reveal whether dissolved phase COCs from DNAPL can infiltrate the sediment cap."*

Recommendation Status:

A SPME deployment study was conducted as described under Issue 2. The results of the study indicated that porewater PAH concentrations were low and not clearly linked to Site contaminants or migration from upland and, thus, the PSR sediment cap was functioning as designed.

<u>Issue 4</u>

Issue 4 from the previous FYR is:

> *"Incomplete construction of the isolation cap in RA5."*

The *recommendation* for this issue was:

> *"Add suitable dredged material to the RA5 cap to increase thickness as it becomes available."*

Recommendation Status:

The issue is referring to results of cap thickness measurements in RA5a reported in the 2007 Long Term Monitoring Report (SAIC 2008), which showed that no portion of the cap in RA5a met the minimum cap depth criteria (27 inches) as outlined in the cap design specifications (see section 4.5.2). Material losses during placement were much higher than predicted (USACE 2011b). Roughly 40,000 cubic yards of sandy dredged material from the Swinomish Channel was placed specific locations in RA5a. Because of the uncertainties involved in modeling material losses during placement and capping on a steep side slope, EPA prudently decided to target locations that were identified in previous monitoring events as having very low cap thickness or contamination. Specific details regarding the placement of additional material in 2012 are described in a Memorandum for Record (USACE 2013b), which is provided in Appendix C. Average cap thickness increased as a result of placement of additional capping materials. The results of the 2014 MSU monitoring are described fully in section 6.4.

Issue 5

Issue 5 from the previous FYR is:

> *"A key MSU Institutional Control (US Coast Guard restriction on anchorage) for protecting the cap has not been implemented."*

The *recommendation* for this issue was:

> *"Implement last of ROD ICs, i.e., work with US Coast Guard (USCG) to establish anchorage restrictions to protect MSU Area 6 cap."*

Recommendation Status:

EPA worked with the USCG to establish a permanent regulated navigation area (RNA) on the portion of Elliot Bay that is subject to PSR cleanup and remediation efforts. The RNA prohibits activities that would disturb the seabed, such as anchoring, dragging, trawling, spudding, or other activities that involve disrupting the integrity of the sediment cap that covers the marine sediments. The regulation was posted to the Federal Register on 10 April 2012. The full regulation is given in Appendix D, but can also be found in the online Federal Register at http://www.gpo.gov/fdsys/pkg/FR-2012-04-10/html/2012-8545.htm.

Issue 6

Issue 6 from the previous FYR is:

> *"Groundwater potability was not adequately evaluated in the upper or lower aquifers, although the ROD states that prospective future water supplies (potable water) are present in at least part of the site. Groundwater potability at the site must be determined."*

The *recommendation* for this issue was:

> *"(a) Based on existing data and new data as necessary, determine (i) whether the formation underlying the contaminated site aquifer is a confining layer; (ii) the potability of groundwater underlying the confining layer beneath this formation; and (iii) whether upper aquifer is potable.*
>
> *(b) If groundwater is potable, drinking water requirements are relevant and appropriate."*

Recommendation Status:

Washington Administrative Code (WAC) 173-340-720(1)(c) states: *"Ground water cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of surface water, sediments, soil, or air cleanup standards established under this chapter or other applicable state and federal laws."* Whether PSR groundwater must meet or waive MCLs or MCLGs ultimately depends upon a determination of whether they are relevant and appropriate, which for groundwater is generally based on potability.

In June 1994, the Port of Seattle presented a review of technical and regulatory feasibility of groundwater development for potable water supply. A five-point rationale was presented and discussed, which argued that groundwater was not a potential potable water source. In September 1994, the Washington Department of Ecology (Ecology), Toxics Cleanup Program evaluated the information and determined that the designation of non-potability was appropriate. However, EPA has not accepted Ecology's potability determination for the following reasons.

WAC 173-340-720(2)(a) states that an aquifer is potable if it *"could be used as a current or future water supply"* (that is, sustain a pumping rate suitable for a water supply), and 173-340-720(2)(b) states that it must have *"sufficiently low salinity."* Neither of these conditions for potability was met in the saline, contaminated shallow groundwater near the PSR shoreline, indicating at least some of the site groundwater may not be drinkable. However, PSR groundwater at greater depths and also more distant from the shoreline requires additional empirical data to determine whether potability criteria are met in these portions of the aquifer. That is, groundwater away from the shoreline may not be naturally contaminated or saline. Additionally, the aquifer away from the shoreline might be able to meet the sustained pumping rate requirement. The June 1994 Port of Seattle evaluation even concedes that domestic wells could be placed adjacent to the project area and meet the sustained pumping requirement without causing saltwater intrusion.

Further, WAC 173-340-720(2)(c) requires a demonstration that contaminants which exceed groundwater quality standards published in WAC 173-200 are unlikely to be transported from a contaminated aquifer to groundwater that is a current or potential future source of drinking water, as defined in 173-340-720(2)(a) or 173-340-720(2)(b). The June 1994 Port of Seattle non-potability designation was not based on such a demonstration. Thus, there are three significant data gaps preventing the evaluation of the WAC 173-340-720(2)(c) requirement: a) whether vertical contaminant transport occurs from the contaminated aquifers to the deeper groundwater beneath the site through the Lawton formation, b) whether the deeper water body is a current or potential future

source of drinking water; and c) whether fresh water in the near-surface aquifers is degraded by site contaminants.

None of these conditions have been documented at this time. . As a result, it is still unknown whether or not drinking water requirements are relevant and appropriate. However, the groundwater is not currently being used as a drinking water source, and the restrictive covenant (refer to section 5.3) prohibits the taking of groundwater from the property for any reason other than remedial sampling and analysis.

Issue 7

Issue 7 from the previous FYR is:

> *"Vapor intrusion into the maintenance building above the UU cap was not evaluated."*

The *recommendation* for this issue was:

> *"Groundwater/soil NAPL to indoor-air assessment for maintenance building with either groundwater data from adjacent wells/ piezometers, or near-slab subsurface data and adjacent wells/piezometers, or near-slab subsurface data."*

Recommendation Status:

EPA evaluated the maintenance building for possible vapor intrusion due to the likely presence of NAPL beneath the building. After a field visit to the site (October 2010), EPA concluded that risk to human health was low due to low exposures (i.e. low exposure durations based on the intermittent, short-term nature of building use), and that further screening would be unnecessary (USACE 2011c). Use of the building has remained constant or decreased since the field visit in October 2010. No further action for vapor intrusion mitigation is needed.

5.3. Status of any other prior issues

The third issue in the first FYR (EPA 2004) indicated that not all of the institutional controls had been implemented, specifically referring to deed restrictions. The recommendation was to record land and groundwater use restrictions against the deed and ensure restrictive covenants are in place. The second FYR (2009) indicated that restrictive covenants for land and groundwater deed use restrictions have been agreed to between the Port of Seattle and EPA and were in the process of being implemented. Approximately three months after the signing of the second FYR, an environmental covenant (Covenant) between the Port of Seattle and EPA dated 15 December 2009 (Appendix B) was signed.

The Covenant:

1) Restricts property use to traditional industrial uses, except for the public shoreline access and public use facilities that are maintained on a portion of the property; no residential use and no other recreational uses are permitted,
2) Prohibits taking groundwater from the Property for any purpose other than remedial sampling and analysis, and

3) Prohibits any activity, without prior written approval from EPA, on the Property that may result in a release or exposure to the environment of contaminated soil that was contained as part of the Remedial Action, or create a new exposure pathway thereto (e.g., drilling or digging through the cap).

6. Five-Year Review Process

6.1. Administrative Components

The team lead for the Pacific Sound Resources Superfund Site Third Five-Year Review is Ravi Sanga, the EPA Remedial Project Manager (RPM). The review team included the following personnel from USACE Seattle District: Marlowe Laubach (Chemical Engineer) and Aaron King (Environmental Engineer). In addition, the project team included Erika Hoffman (EPA, Aquatic Biologist) and Rene Fuentes (EPA, Hydrogeologist). On June 27, 2013, EPA held a scoping meeting (teleconference) with the review team to discuss the Site and items of interest as they related to the protectiveness of the remedy currently in place. A review schedule was established that consisted of the following:

- Community notification and involvement
- Document review
- Data collection and review
- Site inspection
- Local interviews, and
- Five-year review report development and review.

6.2. Community Involvement

A public notice announcing the five-year review for the Site was published in *The Seattle Times* on August 28, 2013. The notice provided a brief background of the Site, explained the reason for the five-year review, and invited the community to submit comments and questions regarding remedy performance via a toll-free phone number or by contacting the RPM directly. A copy of the public notice is provided in Appendix E. No comments were received as a result of the advertisement.

The Five-Year Review report will be made available to the public once it has been finalized. Copies of this document will be placed in the designated public repository: EPA Superfund Records Center, 1200 Sixth Avenue, Seattle, WA 98101. Upon completion of the FYR, a public notice will be placed in *The Seattle Times* and the *West Seattle Herald* to announce the availability of the final FYR report in the document repository.

6.3. Document review

This FYR consisted of a review of relevant, site-related documents including the ROD, monitoring reports, technical memoranda, progress reports, and recent monitoring data. A complete list of the documents reviewed can be found in Appendix A.

6.4. Data Review

Upland Unit

Groundwater monitoring data from May 2003 through October 2012 are provided in Appendix F. Naphthalene concentrations in groundwater and associated contours are plotted in three figures (USACE 2013c) at the end of Appendix F. Sampling had previously not been conducted in wells that contained NAPL, and resulting contours underestimated contamination. NAPL was purged from the wells, and samples were taken to obtain the best estimates for the dissolved phase contamination. Naphthalene is used as an example of what more realistic results would be, and how contouring shows high concentrations outside the wall at multiple depths.

Groundwater in wells near the shoreline has exhibited high concentrations of dissolved contaminants (or free-phase product) over the course of the monitoring events since the last FYR. Table 4 shows the dissolved contaminants that have exceeded either the MTCA Method C, Standard Formula Value for Groundwater or the MCL at least once in wells sampled since the last FYR.

Table 4. Contaminant Exceedences at Sampled Wells since the Previous FYR

	Criterion	
Well	**MTCA Method C, Standard Formula Value**	**MCL**
MW-3D	Benzo(a)pyrene TEQ for cPAHs	--
MW-3I	Benzo(a)pyrene TEQ for cPAHs	--
MW-3S	--	--
MW-5D	2-Methylnaphthalene, Benzo(a)anthracene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-5I	2-Methylnaphthalene, Acenaphthene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	--
MW-5S	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(a)pyrene TEQ for cPAHs	--
MW-11IR	Benzo(a)pyrene TEQ for cPAHs	--
MW-11S	Benzo(a)pyrene TEQ for cPAHs	
MW-13I	2-Methylnaphthalene, Acenaphthene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-14I	2-Methylnaphthalene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Dibenzofuran, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-14S	Benzo(a)anthracene, Benzo(a)pyrene, Dibenzofuran, Fluorene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-15D	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(a)pyrene TEQ for cPAHs	
MW-15IR	2-Methylnaphthalene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-15SR	Benzo(a)pyrene, Benzo(a)pyrene TEQ for cPAHs	PCP
MW-16I	Benzo(a)pyrene TEQ for cPAHs	

Well	Criterion	
	MTCA Method C, Standard Formula Value	**MCL**
RW-1D	2-Methylnaphthalene, Acenaphthene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Dibenzofuran, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	--
RW-1I	2-Methylnaphthalene, Acenaphthene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Dibenzofuran, Fluoranthene, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
RW-1S	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzofuran, Fluorene, lndeno(1,2,3-cd)pyrene, Pyrene, Total Naphthalenes, Benzo(a)pyrene TEQ for cPAHs	PCP
RW-6SR	--	PCP
RW-12S	Benzo(a)pyrene TEQ for cPAHs	--

As noted in section 4.5.2, upland groundwater monitoring has been stopped because it is not the best way of evaluating impacts from upland contaminants on the marine environment in Elliot Bay, which is the overall purpose of the monitoring. This objective could be met by periodic monitoring using field-deployable SPME push-point devices to measure vertical profiles of freely dissolved hydrophobic contaminants (as demonstrated in 2010). In addition to SPMEs, near surface porewater sampling for PCP should be considered because this compound does not adsorb to the SPME. Dissolved phase porewater concentrations may be used to infer the proximity of a DNAPL source and reveal, in conjunction with data from MSU Long-Term Monitoring, whether dissolved phase DNAPL contaminants have infiltrated the sediment cap. Furthermore, pending the resolution of the groundwater potability issue raised by the previous FYR, EPA asserted that the adequacy of groundwater monitoring for defining impacts on a potential subsurface source of potable water was undetermined. EPA suggests that a future site-wide groundwater monitoring program may be appropriate should a future determination of groundwater potability be made.

Results of the SPME study are presented under Issue 2 in section 5.2.

Marine Sediments Unit

Cap Thickness Evaluation

The topographic survey of intertidal areas (RA1) was conducted in February and March 2014 (NetCompliance Environmental Services, 2014a). Visual inspection of the intertidal areas was postponed to April 2014 when the daylight tides would reach -1.5 MLLW, but results were not available at the time of this review. The bathymetric survey of RAs 1, 2a, 2b, 3, shallow 4, 5a, and 5b was performed in January 2014. At the writing of this review, preliminary topographic and bathymetric maps have been constructed (Appendix G), but the data have not been compared to a baseline bathymetry; this comparison is necessary for estimating the cap thickness over the entirety of the capped area, and is expected to be submitted by December 2014.

Fourteen through-cap cores were collected in subtidal areas of RAs 2, 3, and 5 in January 2014 (NetCompliance Environmental Services, 2014b). The core locations (numbered 4 through 17) are shown in **Figure 6-1**. Cap thicknesses were estimated for each core (Table 5).

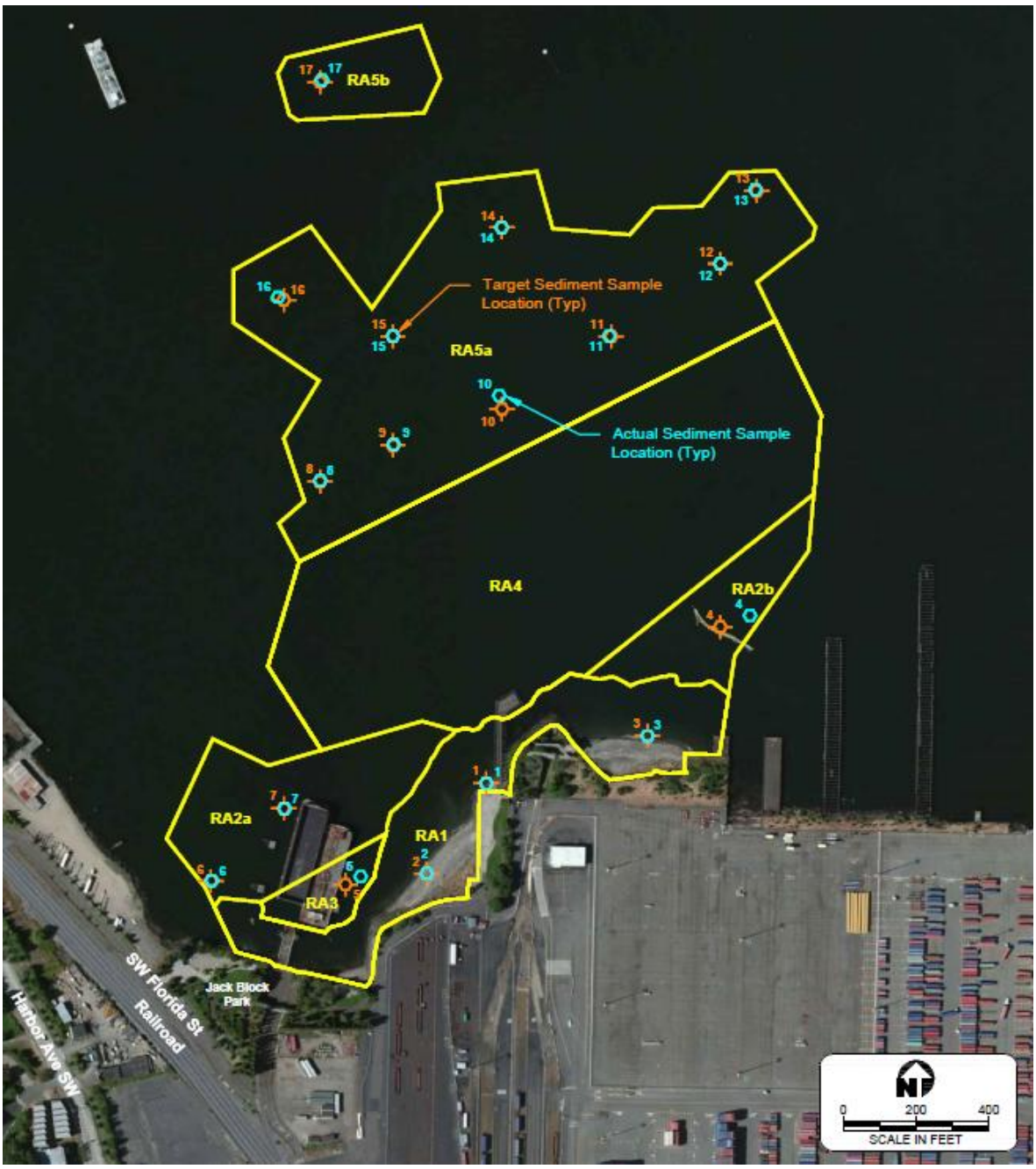


Figure 6-1. Long-Term Monitoring Coring and Sampling Locations (NetCompliance Environmental, 2014b)

Table 5. Summary of Sediment Cores Collected (NetCompliance Environmental, 2014a)

Remedial Area	Sample Location	Recovered/ Penetration (cm/cm)	Recovered/ Penetration (in/in)	Percent Recovery	Estimated Cap Thickness (inches)	Estimated Cap Thickness (cm)
2b	CORE4	99.1/114.3	39/45	87	17	43
3	CORE5	58.4/101.6	23/40	57	9	23
2a	CORE6	81.3/147.3	32/58.5	55	8	21
2a	CORE7	71.1/96.5	28/38	74	10	26
5a	CORE8	133.4/146.1	52.5/57.5	91	10	24
5a	CORE9	105.4/116.8	41.5/46	90	5	12
5a	CORE10	110.5/129.5	43.5/51	85	25	63
5a	CORE11	109.2/120.7	43/47.5	90	14	37
5a	CORE12	102.2/114.3	40.25/45	89	16	41
5a	CORE13	104.1/116.8	41/46	89	12	30
5a	CORE14	109.2/124.5	43/49	88	18	46
5a	CORE15	118.1/147.3	46.5/58	80	14	37
5a	CORE16	101.6/119.4	40/47	85	8	21
5b	CORE17	111.8/149.9	44/59	75	9	23

Based only on coring measurements, average cap thickness in RA5 was 13.1 ± 5.7 inches. This is an increase from the cap thickness reported in the previous FYR, which reported an average cap thickness in RA5 of 9.7 ± 6 inches. However, the minimum design thickness for the cap in RA5 (27 inches) has not been achieved at any of the core locations.

It is possible the estimates of cap thickness are understated because coring measurements do not take into account the percent recovery reflecting compaction (actual core recovery/core penetration). However, it is unlikely that the relatively consolidated fraction representing the cap (i.e., coarse sand) would have significant compaction within the core tube. However, it seems unlikely that the consolidated fraction representing the coarse sand cap would have compacted more than 25 percent within the core tube. If that value is assumed, only CORE10 has met design specifications.

The locations of the core samples in Table 5 do not necessarily line up with core samples from previous MSE Long-Term Monitoring event (SAIC, 2008), but some are fairly close. Table 6 compares the estimated thicknesses in RA5 from the 2007 and 2014 cores that are reasonably close to each other. Cap thickness appears to have increased substantially in some areas, but has decreased in others.

Table 6. Cap Thickness Comparison in RA5

2014 Long-Term Monitoring		2007 Long-Term Monitoring		Change
Sample ID	Estimated Thickness (in)	Sample ID	Estimated Thickness (in)	
CORE8	10	--	--	--
CORE9	5	RA5-04	10.92	Lower
CORE10	25	RA5-05	1.95	Higher
CORE11	14	RA5-10	7.02	Higher
CORE12	16	--	--	--
CORE13	12	RA5-13	3.9	Higher
CORE14	18	--	--	--
CORE15	14	--	--	--
CORE16	8	RA5-07	9.36	Lower
CORE17	9	RA5-14 A	0	Higher

Cap Chemistry Evaluation

Sampling locations for the 2014 sampling event (numbered 1 through 17) are shown in **Figure 6-1**. Three surface sediment (0-10 cm) grab samples (numbered 1 through 3) were collected in RA1. The surface sediments (0-10 cm) in each of the 14 cores (numbered 4 though 17) were submitted for chemical analysis. The underlying core sections were archived. Preliminary analytical results of the surface sediment samples are provided in Appendix H. Note that these results have not been validated as of the writing of this review. For the necessary analytes, values were converted to units consistent with applicable marine sediment criteria where necessary (some of the criteria are normalized to the fraction of organic carbon in the sediment). The results of these calculations are shown in Table 7 and Appendix I, and compared to the applicable cleanup levels (i.e., the SCO [formerly termed SQS] for PCBs and CSLs for all other analytes). The cleanup levels were not exceeded in any samples (Table 7). Mercury, DBF, and acenaphthene exceeded the SCO in CORE8, and DBF exceeded the SCO in CORE14 and its field duplicate, but the CSL is the cleanup level for these compounds.

Table 7. Cap Chemistry Results from 2014 MSU Sampling

Paramter	SCO	CSL	CORE4 Sediment 1/21/2014	CORE5 Sediment 1/22/2014	CORE6 Sediment 1/22/2014	CORE7 Sediment 1/21/2014	CORE8 Sediment 1/22/2014	CORE8 Sediment 1/22/2014	CORE9 Sediment 1/22/2014	CORE10 Sediment 1/23/2014	CORE11 Sediment 1/23/2014	CORE12 Sediment 1/23/2014	CORE13 Sediment 1/23/2014	CORE14 Sediment 1/23/2014	CORE14 Sediment 1/23/2014	FD/CORE14 Sediment 1/23/2014	FD/CORE14 Sediment 1/23/2014	CORE15 Sediment 1/24/2014	CORE15 Sediment 1/24/2014	CORE16 Sediment 1/24/2014	CORE16 Sediment 1/24/2014	CORE17 Sediment 1/24/2014	GRAB1 Sediment 1/29/2014	GRAB2 Sediment 1/29/2014	GRAB3 Sediment 2/12/2014
Conventionals																									
Total Organic Carbon (fraction)	–	–	0.0165	0.015	0.0101	0.0109	0.0162	–	0.0246	0.0202	0.0165	0.00906	0.00757	0.0258	–	0.0223	--	0.0134	–	0.0193	–	0.00865	0.00315	0.00357	0.00216
Metals																									
Arsenic (mg/kg dw)	57	93	4	5	2.96	5	10	–	6	9	6	4	5	7	–	7	--	6	–	12	–	6	4	3.19 J	3
Cadmium (mg/kg dw)	5.1	6.7	0.145 J	0.2	0.2	0.3	0.4	–	0.3	0.4	0.3	0.3	0.2	0.3	–	0.3	--	0.3	–	0.5	–	0.4	0.2	0.2	0.135 J
Chromium (mg/kg dw)	260	270	13.5	14.4	16.8	20.4	30.3	–	24.8	34.7	32.3	25.7	24.9	37.1	–	37.8	--	34.8	–	42	–	21.1	18	15.7	18.7
Copper (mg/kg dw)	390	390	14	20.1	22.7	15.3	33.9	–	15.6	29.5	16.6	11.3	12.3	20.3	–	20.7	--	16.4	–	35.4	–	29.3	12.6	15.8	17.3
Lead (mg/kg dw)	450	530	1.28 J	5	4	4	16	–	3	4	3	1.54 J	2	4	–	4	--	4	–	9	–	9	0.66 J	1 J	1.2 J
Zinc (mg/kg dw)	410	960	23.3	39.2	36.4	45.8	65.8	–	38.5	52.2	39.4	31.2	34.6	44.4	–	46.1	--	39.5	–	67	–	51	31.5	34.1	34.2
Mercury (mg/kg dw)	0.41	0.59	0.02	0.04	0.03	0.03	0.54	–	0.04	0.04	0.04	0.02	0.02	0.04	–	0.05	--	0.05	–	0.16	–	0.09	0.0064 J	0.0013 J	0.0056 J
Semivolatile Organic Compounds																									
Dibenzofuran (mg/kg OC)	15	58	1.15 U	1.27 U	1.88 U	1.65 U	26.54	–	1.42	2.48	4.18	2.10 U	1.32 J	18.99	–	33.63	--	6.72	–	5.70	–	4.74	6.03 U	5.32 U	8.80 U
2-Methylphenol (o-Cresol) (µg/kg dw)	63	63	19 U	19 U	19 U	18 U	19 U	–	20 U	19 U	19 U	19 U	19 U	20 U	–	26	--	20 U	–	19 U	–	19 U	19 U	19 U	19 U
4-Methylphenol (p-Cresol) (µg/kg dw)	670	670	19 U	19 U	19 U	18 U	35	–	24	97	26	19 U	19 U	64	–	170	--	60	–	87	–	19 U	19 U	19 U	19 U
Phenol (µg/kg dw)	420	1,200	41 B	29 B	26 B	30 B	80 B	–	89 B	110 B	46 B	26 B	28 B	180 B	–	140 B	--	48 B	–	190 B	–	32 B	19 U	19 U	19 U
Acenaphthene (mg/kg OC)	16	57	0.29 U	0.35 U	0.27 J	0.42 U	22.22	21.60	1.22	1.63	1.58	1.32	0.53 J	8.53	8.91	9.87	8.97	6.27	6.79	3.99	4.51	6.71	1.52 U	1.34 U	2.18 U
Acenaphthylene (mg/kg OC)	66	66	0.29 U	0.31	0.29 J	0.42	8.02	8.02 J	0.24	0.24	0.52	0.53 U	0.62 U	0.62	0.66	0.81	0.76 J	0.90	0.97 J	1.35	1.55	0.86	1.52 U	1.34 U	2.18 U
Anthracene (mg/kg OC)	220	1,200	0.37	0.73	1.68	0.26	22.84	21.60	1.38	0.99	2.06	1.06	0.57 J	11.24	11.24	9.42	8.52	6.34	6.64	4.72	5.13	3.82	1.52 U	1.34 U	2.18 U
Benzo(a)anthracene (mg/kg OC)	110	270	0.60	1.93	2.87	0.61	16.05	15.43	0.93	1.04	2.24	0.79	0.65	8.91	8.91	5.38	4.93	5.67	6.27	6.74	7.25	5.43	1.52 U	1.34 U	2.18 U
Benzo(a)pyrene (mg/kg OC)	99	210	0.56	2.53	2.97	0.48	80.25 E0	67.90	0.81	0.46	1.94	0.38 J	0.54 J	3.41	3.53	2.15	2.02	2.69	2.91	4.97	5.18	8.79	1.52 U	1.34 U	2.18 U
Benzo(g,h,i)perylene (mg/kg OC)	31	78	0.34	1.93	1.78	0.49	22.22	22.22	0.39	0.24 J	0.91	0.30	0.41	1.09	1.05	0.81	0.85 J	0.90	1.19	1.97	2.23	5.78	1.52 U	1.34 U	2.18 U
Total Benzofluoranthenes (mg/kg OC)	230	450	1.64	6.27	7.23	1.38	160.49 E	148.15	1.83	1.29	4.48	1.10	1.32	8.14	8.53	5.38	4.93	6.87	7.01	11.40	11.40	15.03	2.41	1.34 U	2.18 U
Chrysene (mg/kg OC)	110	460	1.15	3.07	5.74	0.84	34.57 E	35.19	1.10	1.04	4.00	0.85	0.87	7.75	8.14	5.38	4.48	6.04	6.64	5.70	6.74	7.05	1.68	0.76 J	2.18 U
Dibenzo(a,h)anthracene (mg/kg OC)	12	33	0.29 U	0.39	0.39 J	0.42 U	6.17	6.05 J	0.11 J	0.24 U	0.25 J	0.53 U	0.62 U	0.28	0.97 U	0.19 J	1.08 U	0.25 J	1.12 U	0.46	7.25 J	0.83	1.52 U	1.34 U	2.18 U
2,4-Dimethylphenol (µg/kg dw)	29	29	24 U	23 U	23 U	23 U	23 U	–	24 U	24 U	24 U	24 U	24 U	12 J	–	27	--	25 U		24 U	–	24 U	24 U	24 U	23 U
Fluoranthene (mg/kg OC)	160	1,200	1.70	2.13	4.65	1.47	53.09 E	48.77	5.69	5.94	7.88	2.98	2.38	54.26 E0	77.52	49.33 E0	49.33	34.33	35.07	30.57 E	40.41	18.50	3.08	1.12 J	2.18 U
Fluorene (mg/kg OC)	23	79	0.19 J	0.47	0.34 J	0.25 J	20.37	19.75	1.59	2.13	1.88	1.04	0.57 J	11.24	11.63	10.76	10.31	8.21	8.21	4.40	4.82	4.62	1.52 U	1.34 U	2.18 U
Indeno(1,2,3-cd)pyrene (mg/kg OC)	34	88	0.32	1.67	1.58	0.35 J	20.37	20.37	0.35	0.19 J	0.79	0.53	0.62 U	0.97	1.01	0.63	1.08 U	0.90	1.12	1.71	1.97	3.82	1.52 U	1.34 U	2.18 U
2-Methylnaphthalene (mg/kg OC)	38	64	0.30	0.37	4.26 J	1.93	16.05	16.05	0.77	1.19	1.88	0.66	0.74	7.36	8.14	10.31	10.31	7.46	8.21	4.51	5.08	3.12	1.21 B	0.95 B	2.18 U
Naphthalene (mg/kg OC)	99	170	0.55	0.35	0.88	1.01	86.42 E0	92.59	3.37	2.77	5.58	1.66	1.32	42.64 E0	42.64	0.58 E0	0.58	44.03 E	46.27	20.73	23.32	15.03	1.52 U	1.34 U	2.18 U
Pentachlorophenol (µg/kg dw)	360	690	19 U	31	19 U	18 U	20		20 U	19 U	19 U	19 U	19 U	20 U		19 U		20 U		19 U		19 U	19 U	19 U	19 U
Phenanthrene (mg/kg OC)	100	480	0.61	2.13	1.78	1.83	53.09 E	53.09	3.82	5.94	5.64	2.98	1.59	31.78 E	31.78	24.22 E	21.97	21.64	22.39	12.44	13.47	8.90	0.76 J	1.01 J	2.18 U
Pyrene (mg/kg OC)	1,000	1,400	1.27	3.73	3.47	1.74	148.15 E0	493.83	5.28	4.41	8.48	4.08	1.98	46.51 E0	54.26	36.77 E	32.29	29.85	33.58	48.70	56.99	32.37	2.32	0.84 J	2.18 U
Polychlorinated Biphenyls																									
Total PCBs (mg/kg OC)	12	65	– U	0.79	-- U	– U	4.32	–	0.46	– U	– U	1.77	1.85	1.42	– U	--	--	0.59	–	2.07	–	10.87	– U	– U	– U

Notes:

Values highlighted in yellow exceeded the SCO criteria.

mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram
J - Result is an estimated value. A + or - qualifier indicates high or low bias, respectively.
U - Compound was analyzed for but not detected above the reporting limit shown.

B - Inorganis - Reported value is less than the CRDL but > the Reporting Limit
Organics - Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.
E - Organics - Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.
S - Organics - Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte.

6.5. Site Inspection

The site inspection was conducted on Friday, September 20, 2013. Brick Spangler (Port of Seattle, Environmental Program Manager) guided the inspection. Attendees included Ravi Sanga (EPA, Remedial Project Manager), Warren Hansen (Windward Environmental, consultant to Port of Seattle), Marlowe Laubach (USACE, Chemical Engineer), Aaron King (USACE, Environmental Engineer), and Jacob Williams (USACE, Intern). The group met in the morning at Jack Block Park. There, Mr. Spangler described the Port's activities related to the site, and Mr. Sanga described EPA's activities regarding long-term monitoring of the upland and sediment remedies and assessing remedy protectiveness. The group first toured the public access park, including the shoreline which was opened to the public in the summer of 2011. Wells sampled during the most recent sampling event in the UU were located, but were not inspected; evaluation of well conditions was based on USACE field notes during recent sampling events. Mr. Spangler then drove the group onto Port of Seattle property where most of the asphalt cap is located. The Port of Seattle had recently completed applying a new sealcoat to the asphalt cap, but marks delineating the location of the slurry wall had not yet been painted on the surface of the new sealcoat. A few localized depressions in the cap (ruts) appear to have resulted from compression by heavy machinery, but the areas are slated to be repaired soon. Overall, the Port of Seattle seems very proactive in their cap inspection and maintenance program.

The completed Site Inspection Checklist is given in Appendix J. Site inspection photographs are provided after the checklist.

6.6. Institutional Controls

Restrictive covenants for land and groundwater use restrictions were agreed to by the Port of Seattle and EPA and were memorialized on December 15, 2009 (Appendix B). EPA and USCG worked to establish the no-anchor zone over capped areas of the site. A Restricted Navigation Area (RNA) was posted to the Federal Register on April 10, 2012, which prohibits any activities that would disturb the seabed or otherwise disrupt the integrity of the sediment cap that covers the MSU (Appendix D).

6.7. Interviews

Brick Spangler, Environmental Program Manager, Port of Seattle, and Warren Hansen, Port Consultant, Windward Environmental, were interviewed together. The purpose of the interview was to document the perceived status of the PSR Site and any perceived problems or successes with the remedy components implemented to date. In general, the Port felt that the site was easy to maintain and had no concerns. The full interview record is provided in Appendix K.

7. Technical Assessment

7.1. Question A: Is the remedy functioning as intended by the decision documents?

Remedial Action Performance

The SPME study (in 2010) showed that aquatic life was not being exposed to porewater or surface water with COCs above protective levels (except PCP, which remains unknown since it could not, and was not, measured in the SPME study). The asphalt cap is in good condition, and a new sealcoat was recently applied. There is no indication that the slurry wall is not performing as intended. Sampling of the MSU cap in 2014 indicated that no surface sediment exceeded the cleanup levels for any COCs, including PCP (though the data is preliminary as of the writing of this review). Therefore, aquatic life in surface water and sediments are not expected to be exposed to contaminants of concern above protective levels.

System operations/O&M

Due to the questions about the adequacy of the approach for achieving monitoring objectives, EPA has terminated groundwater sampling in the UU. A revised Addendum to the OMMP specific to the UU is being prepared by the USACE that will describe the revised monitoring approach. The asphalt cap is inspected annually and the Port of Seattle completed application of a new sealcoat. Some wells showed significant drawdown during monitoring, perhaps due to clogged well screens. MSU cap monitoring showed that average cap thickness increased as a result of additional material placement. Furthermore, evaluation of cap chemistry showed that no COCs were above cleanup levels.

Cost of System Operations/O&M

EPAs costs for O&M have been rather variable over the last five years, but the variability is understandable considering the scope of the work performed during each year. Port of Seattle costs have increased due to the application of a new sealcoat on the asphalt cap. None of the changes in costs for either USACE or the Port of Seattle over the last five years were unexpected.

Opportunities for Optimization

EPA is no longer monitoring groundwater for individual COCs. This decision was made largely due to upland groundwater monitoring on individual COCs not being the best way of evaluating impacts from upland contaminants on the sediment cap and Elliot Bay, which was the overall purpose of the monitoring. Another SPME study to address porewater will be conducted prior to the next Five-Year Review. There may be an opportunity sometime in the future to optimize or reduce the occurrence of NAPL recovery efforts as well.

Early indicators of potential issues

The cap thickness in RA5 did not meet the minimum requirement following remedy construction. Additional material was placed in RA5 in 2012. Preliminary estimates of cap thickness from the 2014

long-term monitoring event suggest that average cap thickness has increased in RA5, but still does not meet the minimum design thickness of 27 inches. However, monitoring of the MSU cap in 2014 indicated that no surface sediment exceeded the cleanup levels for any COCs (though the data is preliminary as of the writing of this review). The sediment cap will continue to be monitored, and the possibility of adding more capping material will be addressed as needed.

Implementation of Institutional Controls and Other Measures

Restrictive covenants for land and groundwater use were agreed to by the Port of Seattle and EPA and were memorialized on 15 December 2009 (Appendix B). EPA and USCG worked to establish the no-anchor zone over capped areas of the site. A Restricted Navigation Area (RNA) was posted to the Federal Register on 10 April 2012, which prohibits any activities that would disturb the seabed or otherwise disrupt the integrity of the sediment cap that covers the MSU (Appendix D).

Answer to Question A*: The remedy is functioning as intended by the decision documents. Due to institutional controls and remedial actions, human and ecological receptors are not expected to be exposed to contaminants above protective levels. The sediment cap will continue to be monitored, and the possibility of adding more capping material will be addressed as needed.*

7.2. Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in standards and TBCs or Newly Promulgated Standards

The following ARARs in the ROD are relevant to a FYR (those related solely to the construction of the remedy are not included in this list):

Upland Unit

- Washington State Model Toxics Control Act (MTCA) WAC 173-340-720(1)(C) for establishing groundwater cleanup levels.
- MTCA WAC 173-340-440 for ICs.
- MTCA WAC 173-340-730(3) for surface water cleanup standards.
- MTCA WAC 173-340-360(4) for cleanup technologies and restoration timeframes.
- MTCA WAC 173-340-704 through 706 for use of MTCA A and C. Many other MTCA sections could or should have been included, though this citation could be interpreted as a catch-all, given MTCA cross section referencing and the ubiquity in MTCA of these methods. For example, MTCA's Excess Cancer Risk Range, which is more stringent than CERCLA's, is applicable to both OUs.

- As noted in the previous FYR (see Issue 1 in section 5.2), ACLs inappropriately replaced MCLs (and non-zero MCLGs) and any more stringent state groundwater standards per the first bullet above.

Of the ARARs listed above, only the MTCA Method C values (carcinogen and non-carcinogen) for PCP in groundwater (Table 8). The change in the MTCA values reflects an update to the PCP toxicity values in EPA's Integrated Risk Information System (IRIS) database (as discussed later). PCP was not measured in porewater during the SPME study, but groundwater PCP concentrations exceeded the MCL in many shoreline wells. At some point in the future, the cleanup level for PCP may need to be addressed in a ROD Amendment. Porewater sampling for PCP should be considered to determine if a revised PCP cleanup level is exceeded.

Table 8. Changes in Chemical-Specific Standards for Groundwater

Contaminant	Media	Standard	
Pentachlorophenol	*Groundwater-MTCA Method C, Carcinogen, Standard Formula Value*	Previous	7.3µg/L
		New	2.19 µg/L
Pentachlorophenol	*Groundwater-MTCA Method C, Non-carcinogen, Standard Formula Value*	Previous	1,100 µg/L
		New	175 µg/L

Marine Sediments Unit

- MTCA (WAC 173-340-440) for establishing ICs.
- Federal Water Pollution Control Act (Clean Water Act) (33 USC 1251-1376 and 40 CFR 100-149), and State Water Pollution Control Act (RCW 90.48) and regulations (WAC 173-216 and 220) and Water Resources Act (RCW 90.54) and Water Quality Standards for Surface Water (WAC 173-201A) were cited but inappropriately limited to discharge to marine surface water only during cap placement and sediment dredging.
- Washington State Sediment Management Standards (WAC 173-204).

As part of this FYR, ARARs were reviewed for changes since the last 5 year review. Of those ARARs listed above, WAC 173-204 is the only ARAR with changes in the last five years that is potentially relevant to the remedy. The Washington State Department of Ecology adopted the revised Sediment Management Standards rule on February 22, 2013. The new rule became effective on September 1, 2013. The adopted amendments:

1. Integrate the SMS and MTCA, Chapter 173-340 WAC, cleanup requirements where appropriate.
2. Clarify requirements for protection of human health from sediment contamination.
3. Clarify requirements for protection of higher trophic level species from sediment contamination.

4. Promulgate numerical chemical and biological criteria for freshwater sediment to protect the benthic community,
5. Clarify requirements for coordinating source control and cleanup actions at cleanup sites.

As part of the revised Sediment Management Standards, the SQS term was replaced with Sediment Cleanup Objectives (SCO). However, none of the values changed. The Marine SCO (formerly termed SQS) and CSL (WAC 173-204-562) concentration criteria from the recently updated SMS rule are given below in Table 9. Only the SCO (formerly the SQS) chromium value has changed since the signing of the ROD, but chromium is not a COC for this Site.

Table 9. Marine Sediment Cleanup Objectives and Cleanup Screening Levels

Chemical Parameter	Chemical Criteria	
	Sediment Cleanup Objectives (SCO)	Cleanup Screening Level (CSL)
Arsenic (mg/kg Dry Weight (dw))	57	93
Cadmium (mg/kg dw)	5 1	6.7
Chromium (mg/kg dw)	260	270
Copper (mg/kg dw)	390	390
Lead (mg/kg dw)	450	530
Mercury (mg/kg dw)	0.41	0.59
Silver (mg/kg dw)	6 1	6.1
Zinc (mg/kg dw)	410	960
LPAH (mg/kg Organic Carbon (OC))	370	780
Naphthalene (mg/kg OC)	99	170
Acenapthylene (mg/kg OC)	66	66
Acenaphthene (mg/kg OC)	16	57
Fluorene (mg/kg OC)	23	79
Phenanthrene (mg/kg OC)	100	480
Anthracene (mg/kg OC)	220	1,200
2-Methylnaphthalene (mg/kg OC)	38	64
HPAH (mg/kg OC)	960	5,300
Fluoranthene (mg/kg OC)	160	1,200
Pyrene (mg/kg OC)	1,000	1,400
Benz(a)anthracene (mg/kg OC)	110	270
Chrysene (mg/kg OC)	110	460
Total Benzofluoranthenes (mg/kg OC)	230	450
Benzo(a)pyrene (mg/kg OC)	99	210
Indeno(1,2,3,-c,d)pyrene (mg/kg OC)	34	88
Dibenzo(a,h)anthracene (mg/kg OC)	12	33
Benzo(g,h,i)perylene (mg/kg OC)	31	78
1,2-Dichlorobenzene (mg/kg OC)	2 3	2.3
1,4-Dichlorobenzene (mg/kg OC)	3 1	9
1,2,4-Trichlorobenzene (mg/kg OC)	0.81	1.8
Hexachlorobenzene (mg/kg OC)	0 38	2.3
Dimethyl phthalate (mg/kg OC)	53	53
Diethyl phthalate (mg/kg OC)	61	110
Di-n-butyl phthalate (mg/kg OC)	220	1,700
Butyl benzyl phthalate (mg/kg OC)	4 9	64
Bis (2-ethylhexyl) phthalate (mg/kg OC)	47	78
Di-n-octyl phthalate (mg/kg OC)	58	4,500

Chemical Parameter	Chemical Criteria	
	Sediment Cleanup Objectives (SCO)	Cleanup Screening Level (CSL)
Dibenzofuran (mg/kg OC)	15	58
Hexachlorobutadiene (mg/kg OC)	3.9	6.2
N-Nitrosodiphenylamine (mg/kg OC)	11	11
Total PCBs (mg/kg OC)	12	65
Phenol (µg/kg dw)	420	1,200
2-Methylphenol (µg/kg dw)	63	63
4-Methylphenol (µg/kg dw)	670	670
2,4-Dimethyl phenol (µg/kg dw)	29	29
Pentachlorophenol (µg/kg dw)	360	690
Benzyl Alcohol (µg/kg dw)	57	73
Benzoic Acid (µg/kg dw)	650	650

Notes: The LPAH criterion represents the sum of the following low molecular weight polycyclic aromatic hydrocarbons (LPAHs): naphthalene, acenapthylene, acenaphthene, fluorene, phenanthrene, and anthracene (the LPAH criterion is not the sum of the criteria for the individual compounds as listed). The HPAH criterion represents the sum of the following high molecular weight polycyclic aromatic hydrocarbons (HPAHs): fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene (the HPAH criterion is not the sum of the criteria for the individual compounds as listed). The Total Benzofluoranthenes criterion represents the sum of the concentrations of the b, j, and k isomers.

Expected Progress Towards Meeting RAOs

The SPME study (in 2010) showed that aquatic life was not being exposed to porewater or surface water with COCs above protective levels. Sampling of the MSU cap in 2007 showed only one sample that exceeded the cleanup level (total PCBs concentration of 18.01 mg/kg OC in the duplicate sample in RA5b). Sampling of the MSU cap in 2014 indicated that no surface sediment exceeded the cleanup levels for any COCs (though the data is preliminary as of the writing of this review). Therefore, aquatic life in surface water and sediments are not expected to be exposed to contaminants of concern above protective levels. Likewise, human exposure through seafood consumption and benthic community exposure to site contaminants are expected to be minimal. The Upland Restrictive Covenant (Appendix B) ensures that groundwater cannot be taken from the Site (except for the purpose of environmental sampling). As noted in the previous FYR, the potability of the groundwater in the upper and lower aquifers has not been adequately determined. Currently, though, site groundwater is not utilized for any purpose other than environmental sampling.

Changes in Exposure Pathways

Exposure pathways have not changed since the previous FYR. Potability of the groundwater in the upper and lower aquifers has not been formally reevaluated as recommended in the previous FYR.

Changes in Land Use

The beach in Jack Block Park was opened to public access for recreational use in June 2011. The land use of the remaining site property has not changed.

New Contaminants and/or Contaminant Sources

There are no known new contaminants or contaminant sources. It should be noted, however, that the Lockheed West Seattle Superfund Site is located immediately east of the PSR Site. Sediment traps or

other monitoring methods should be employed in the MSU to determine what, if any, effects implementation of remedial actions at the Lockheed West Seattle Superfund Site have on the MSU sediment cap.

Changes in Toxicity and Other Contaminant Characteristics

The Human Health Risk assessment indicated that excess carcinogenic risks at PSR were associated with PAHs, arsenic, dioxins and furans, and pentachlorophenol. Dioxins and furans were evaluated relative to background concentrations rather than toxicity. EPA's IRIS database was reviewed to determine if toxicity values used by the EPA in risk assessments have been updated. PCP was the only compound in the IRIS database to have toxicity data that was significantly revised in the last five years. The revision occurred on September 30, 2010. The new oral reference dose for PCP is 0.005 mg/kg-day, and the new oral slope factor is 0.4 kg-day/mg. This revision is also reflected in the MTCA C formula values that changed (see Table 8) because those formula values are based, in part, on toxicity values. The change in PCP toxicity may affect protectiveness, but an analysis is needed in order to determine whether the change in toxicity values will affect changes to the risk assessment and, therefore, remedy protectiveness.

Answer to Question B:

The exposure assumptions and RAOs used at the time of remedy selection are still valid.

The cleanup levels chosen for the UU at the time of remedy selection were ACLs, but it has been noted here and in the previous FYR that the use of ACLs was inappropriate. The use of ACLs and the related assumptions was flawed and the cleanup levels based on them are not protective of surface water and aquatic organisms. The cleanup levels chosen for the MSU at the time of remedy selection are still valid.

The toxicity data for PCP has changed in the last five years. The change in PCP toxicity may affect protectiveness, but an analysis is needed in order to determine whethere the change in PCP toxicity values will affect changes to the risk assessment and, therefore, remedy protectiveness. PCP was not measured in porewater during the SPME study, but groundwater PCP concentrations exceeded the MCL in many shoreline wells. At some point in the future, the cleanup level for PCP may need to be addressed in a ROD Amendment. Porewater sampling for PCP should be considered to determine if a revised PCP cleanup level is exceeded, and whether or not groundwater PCP concentrations are affecting the sediment cap and the benthic community.

7.3. Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Natural Disaster Impacts

There are no new impacts to the remedy as a result of natural disasters. The site was assessed for potential damage as a result of the 2001 Nisqually Earthquake. MW-15D is assumed to have been

impacted by the earthquake, but the source of the damage is still uncertain considering damage to monitoring wells was supposedly repaired from 2001-2003 (see Table 1).

Is there any other information that could call into question the protectiveness of the remedy?

Answer to Question C*: There is no other information that has come to light that could call into question the protectiveness of the remedy.*

7.4. Technical Assessment Summary

Overall, the remedy has been successful in protecting human health and the environment.

- ICs for the UU and MSU have been implemented.
- The SPME study (in 2010) concluded that porewater PAH concentrations were low , thus, aquatic life was not being exposed to porewater or surface water with COCs (not including PCP, which was not measured in the SPME study) above protective levels.
- EPA has terminated the groundwater monitoring program in the UU due to questions regarding the adequacy of the approach for achieving the stated monitoring objectives. USACE is preparing a revised addendum to the OMMP specific to the UU that describes the plan (which is briefly outlined in section 4.5.2).
- The asphalt cap is inspected annually, and the Port of Seattle recently completed restoration of the cap sealcoat.
- As noted in the previous FYR, ACLs were inappropriately used. The use of ACLs and the related assumptions was flawed and the cleanup levels based on them are not protective of surface water and aquatic organisms.
- An analysis of groundwater potability has not been completed as recommended in the previous FYR.
- PCP toxicity data has changed in the last five years. The change in PCP toxicity may affect protectiveness, but an analysis is needed in order to determine whethere the change in PCP toxicity values will affect changes to the risk assessment and, therefore, remedy protectiveness. PCP was not measured in porewater during the SPME study, but groundwater PCP concentrations exceeded the MCL in many shoreline wells. At some point in the future, the cleanup level for PCP may need to be addressed in a ROD Amendment. Porewater sampling for PCP should be considered to determine if a revised PCP cleanup level is exceeded, and whether or not groundwater PCP concentrations are affecting the sediment cap and the benthic community.
- Preliminary estimates of cap thickness from the 2014 long-term monitoring event suggest that average cap thickness has increased in RA5, but still does not meet the minimum design thickness. The sediment cap will continue to be monitored, and the possibility of adding more capping material will be addressed as needed.
- Sampling of the MSU cap in 2014 indicated that no surface sediment exceeded the cleanup levels for any COCs (though the data is preliminary as of the writing of this review).

8. Issues

Table 10 summarizes the current issues for the Pacific Sound Resources Site.

Table 10. Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
(1) The ROD's ACLs are not appropriate standards to demonstrate compliance and protectiveness. The use of ACLs and the related assumptions was flawed and the cleanup levels based on them are not protective of surface water and aquatic organisms when compared to likely ARARs. EPA recognizes the inappropriate use of ACLs, but has not formally re-evaluated ARARs and cleanup levels in a ROD Amendment (as previously recommended).	N	Y
(2) Groundwater potability has not been adequately evaluated in the upper or lower aquifer, although the ROD states that prospective future water supplies (potable water) are present in at least part of the site.	N	Y
(3) Future implementation of remedial actions at the Lockheed West Seattle Superfund Site, which is immediately east of the Pacific Sound Resources Superfund Site, may impact the MSU sediment cap.	N	Y
(4) The changes to the UU groundwater monitoring program have not been reflected in a Revised Addendum to the UU OMMP.	N	Y
(5) The PCP toxicity values changed in the IRIS database which may affect protectiveness with regard to the risk assessment.	N	Y

9. Recommendations and Follow-up Actions

Table 11 provides recommendations to address the current issues at the Pacific Sound Resources Site.

Table 11. Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
1	Re-evaluate ARARs and cleanup levels. Assess practicability of achieving ARARs and cleanup levels and waiver potential for any ARAR that cannot be met. Make revisions, including ACL elimination, in a ROD Amendment.	EPA	EPA	09/30/2018	N	Y

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
2	Based on existing data and new data as necessary, determine (i) whether the formation underlying the contaminated site is a confining layer, (ii) the potability of the groundwater underlying the confining layer beneath this formation, and (iii) whether the upper aquifer is potable. If groundwater is potable, drinking water requirements are relevant and appropriate.	EPA	EPA	09/30/2018	N	Y
3	Sediment traps or other monitoring methods should be employed in the MSU during the implementation of remedial actions at the Lockheed West Seattle Superfund site to assess any potential effects on the MSU sediment cap.	EPA	EPA	09/30/2019	N	Y
4	Complete a Revised Addendum to the UU OMMP.	EPA	EPA	09/30/2015	N	Y
5	Complete and analysis to determine whether the change in PCP toxicity values will affect changes to the risk assessment.	EPA	EPA	09/30/2017	N	Y

In addition to the issues and recommendations in Table 10 and Table 11 respectively, an additional issue and recommendation that does not affect protectiveness has been identified. Significant drawdown has been observed during purging and sampling of several PSR monitoring wells (i.e., MW-15D, MW-14S, and MW-5S). This significant drawdown may be caused by clogged well screens which would not be unusual given the approximately 20 year-span since the wells were installed. If, in the future, EPA were to continue groundwater monitoring in the UU, it is recommended that all the monitoring wells be redeveloped to ensure a good connection with the surrounding groundwater that will allow for representative samples and measurements. Furthermore, it is recommended that damaged well MW-15D be repaired or replaced.

10. Protectiveness Statements

Upland Unit

The remedy at the UU currently protects human health and the environment because the asphalt cap prevents exposure to contaminated soils, there is no exposure to contaminated groundwater due to institutional controls, and the SPME study indicated that aquatic life is not expected to be exposed to contaminants in porewater above protective levels. However, in order for the remedy to be protective in the long term, ARARs, cleanup levels, and waiver potential for ARARs that cannot be met should be re-evaluated in a ROD Amendment, a potability determination for groundwater in the UU should be considered, and an analysis should be completed to determine whether the change in PCP toxicity values will affect changes to the risk assessment

Marine Sediments Unit

The remedy at the MSU is protective of human health and the environment because cleanup levels were not exceeded in surface sediments during the latest monitoring event.

Site-wide

The remedy at the PSR Site currently protects human health and the environment because there is no exposure to contaminated soil or groundwater. Studies have indicated that aquatic life is not expected to be exposed to contaminants in porewater above protective levels, and surface sediments did not exceed cleanup levels for any contaminants in the latest monitoring event. However, in order to be protective in the long-term, ARARs, cleanup levels, and waiver potential for ARARs that cannot be met for groundwater in the UU should be re-evaluated in a ROD Amendment; a potability determination for groundwater in the UU should be considered; and an analysis should be completed to determine whether the change in PCP toxicity values will affect changes to the risk assessment and remedy protectiveness.

11. Next Review

The next five-year review for the Pacific Sound Resources Superfund Site is required by September 2019, five years from the signature date of this review.

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Appendix A: List of Documents Reviewed

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List of Documents Reviewed

EPA. 2011. Use of Solid-Phase Microextraction (SPME) to Investigate the Pacific Sound Resources Site Cap. 21st Annual NARPM Training Program. Kansas City, MO. May 16 – 20, 2011. EPA Region 10.

EPA. 2009. Five-Year Review Report, Pacific Sound Resources Superfund Site, Seattle, King County, Washington, First Five-Year Review for the Marine Sediments Unit, Second Five-Year Review for the Upland Unit. EPA Region 10. September 2009.

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EPA. 2005. Memorandum: Use of Alternate Concentration Limits (CLs) in Superfund Cleanups. OSWER 9200.4-39. Office of Solid Waste and Emergency Response. July 2005.

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EPA. 1999. EPA Superfund Record of Decision: Pacific Sound Resources, EPA ID: WAD009248287, OU2, Seattle, WA. September 1999.

Net Compliance Environmental Services, LLC. 2014a. Draft Field Survey Report Marine Sediments Operable Unit Pacific Sound Resources Superfund Site Seattle, Washington. Prepared for USACE Seattle District. April 2014.

Net Compliance Environmental Services, LLC. 2014b. Draft Field Sampling Report Marine Sediments Operable Unit Pacific Sound Resources Superfund Site Seattle, Washington. Prepared for USACE Seattle District. February 2014.

Port of Seattle. 2009. Pacific Sound Resources (PSR) Restrictive Environmental Covenant. Letter correspondence. December 2009.

Port of Seattle. 2009-2013. Pacific Sound Resources Superfund Site, West Seattle, WA, AOC# 10-94-0213, Progress Reports – First Quarter 2009 through Fourth Quarter 2012.

Reible, D. and Lu, X. 2012. Solid-Phase Microextraction Field Deployment and Analysis, Pacific Sound Resources. January 2012.

SAIC (Science Applications International Corporation). 2008. 2007 Long Term Monitoring, Pacific Sound Resources Superfund Site, Seattle, Washington. August 2008.

USACE. 2013a. Revised Addendum to the Operation, Maintenance, and Monitoring Plan Pacific Sound Resources Superfund Site Marine Sediments. Prepared by USACE Seattle District. June 2013.

USACE. 2013b. Memorandum for Record, Pacific Sound Resources (PSR) Superfund Site Marine Sediment Unit RA5 Cap Placement Monitoring. April 2013.

USACE. 2013c. Annual 2011 Upland Groundwater Remedy Groundwater Monitoring Report Pacific Sound Resources Superfund Site Seattle, Washington. Prepared by USACE Seattle District. March 2013.

USACE. 2011a. Quality Assurance Project Plan Revision 3 – Final Pacific Sound Resources Superfund Site. Prepared by USACE Seattle District. June 2011.

USACE. 2011b. Memorandum for Record, PSR Superfund Site Numerical Modeling of Dredge Material Cap Placement. July 2011.

USACE. 2011c. PSR Vapor Intrusion – Desktop Exercise Review and Completion. E-mail Correspondence. July 2011.

USACE. 2011d. Annual 2010 Upland Groundwater Remedy Groundwater Monitoring Report Pacific Sound Resources Superfund Site Seattle, Washington. Prepared by USACE Seattle District. November 2011.

USACE. 2010a. Addendum to the Operation, Maintenance, and Monitoring Plan Pacific Sound Resources Superfund Site Marine Sediments and Upland Groundwater Units. Prepared by USACE Seattle District. March 2010.

USACE. 2010b. Solid Phase Microextraction Field Deployment and Analysis Work Plan Pacific Sound Resources Superfund Site Seattle, WA. Prepared by USACE Seattle District. September 2010.

USACE. 2010c. Technical Memorandum, PSR Model Input Recommendations for Vapor Intrusion Desktop Exercise for the Intermodal Yard (IY) Maintenance Building, Upland Unit, Port of Seattle, Terminal 5. December 2010.

USACE. 2009. Draft Memorandum Proposed Porewater Sampling in the Marine Sediments Unit of Pacific Sound Resources Superfund Site, Seattle, Washington. USACE Seattle District. February 2009.

USACE. 2004. Final Operation, Maintenance, and Monitoring Plan Pacific Sound Resources Superfund Site Marine Sediments Unit. Prepared by USACE Seattle District. September 2004.

USACE and URS Group, Inc. 2005. Draft Remedial Action Report, Pacific Sound Resources Superfund Site, Marine Sediments Unit, Seattle, Washington. September 2005.

Weston (Roy F. Weston, Inc.). 1998. Remedial Investigation Report Pacific Sound Resources Marine Sediments Unit Seattle, Washington. April 1998.

Appendix B: Environmental Covenant

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Environmental Covenant

Appendix C: RA5a Cap Placement Monitoring Memorandum for Record

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RA5a Cap Placement Monitoring Memorandum for Record

Appendix D: Regulated Navigation Area

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Regulated Navigation Area

Appendix E: Copy of Public Notice

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Copy of Public Notice

Appendix F: Upland Unit Groundwater Monitoring Data

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Upland Unit Groundwater Monitoring Data

Appendix G: Preliminary Bathymetric and Topographic Surveys of Marine Sediments Unit

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Preliminary Bathymetric and Topographic Surveys of Marine Sediments Unit

Appendix H: Preliminary Marine Sediments Unit Long-Term Monitoring Data

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Preliminary Marine Sediments Unit Long-Term Monitoring Data

Appendix I: Preliminary Marine Sediments Unit Long-Term Monitoring Data Compared to Marine Sediment Criteria

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Preliminary Marine Sediments Unit Long-Term Monitoring Data Compared to Marine Sediment Criteria

Appendix J: Site Inspection Checklist and Photographs

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Site Inspection Checklist and Photographs

I. SITE INFORMATION	
Site name: Pacific Sound Resources	**Date of inspection:** 9/20/2013
Location: Seattle, Washington	**EPA ID:**WAD009248287
Agency, office, or company leading the five-year review: USACE/EPA	**Weather/temperature:** Clear, sunny, warm

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ☒ Groundwater containment
- ☒ Vertical barrier walls
- ☒ Other: *Groundwater monitoring, cap monitoring, NAPL removal from monitoring wells*

Remarks: None

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Brick Spangler (Name) Environmental Program Manager (Title) 9/20/2013 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone
   Problems, suggestions; ☒ Report attached; Appendix H shows the interview record
2. **O&M staff** Warren Hansen (Name) Consultant for Port of Seattle (Title) 9/20/2013 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone
   Problems, suggestions; ☒ Report attached; Partner at Windward Environmental, LLC; Appendix H shows the interview record

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☐ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☐ Readily available	☒ Up to date	☐ N/A
☒ Maintenance logs	☐ Readily available	☒ Up to date	☐ N/A

Remarks: The documents are not located on site. EPA has up to date copies of all documents.

2. ☐ **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☐ N/A
   ☐ **Contingency plan/emergency response plan** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks:
3. **O&M and OSHA Training Records** ☐ Readily available ☒ Up to date ☐ N/A
   Remarks EPA has up to date copies of all O&M Records. There are no personnel continuously on site solely for the purpose of operating/maintaining the remedy.

4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
	☒ Other permits Industrial Stormwater	☐ Readily available	☒ Up to date	☐ N/A
	Remarks: Port of Seattle tenants are responsible for stormwater collection, treatment, and O&M under Industrial Stormwater Permits under the authority of the Washington Department of Ecology. There have been no known violations.			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: None			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: None			
7.	**Groundwater Monitoring Records**	☐ Readily available	☒ Up to date	☐ N/A
	Remarks: EPA and USACE have up to date groundwater monitoring records.			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: None			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: There is no discharge of air or water associated with this remedy.			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: This is a passive remedy that does not require daily on-site personnel for the purpose of remedy maintenance.			
	IV. O&M COSTS			
1.	**O&M Organization**			
	☐ State in-house	☐ Contractor for State		
	☐ PRP in-house	☐ Contractor for PRP		
	☐ Federal Facility in-house	☒ Contractor for Federal Facility		
	☒ Other Port of Seattle			
	USACE is EPA's contractor for UU groundwater monitoring and long-term monitoring of the MSU cap. The Port of Seattle is responsible for checking for the presence of and collecting NAPL from specific wells and inspecting and repairing the upland cap.			
2.	**O&M Cost Records**			
	☒ Readily available	☒ Up to date		
	☒ Funding mechanism/agreement in place			
	Original O&M cost estimate_____	☐ Breakdown attached		
	Please see Table 2 in Section 4.5.3 in the text for Annual O&M Costs			
3.	**Unanticipated or Unusually High O&M Costs During Review Period**			
	Describe costs and reasons: A new sealcoat was applied to the cap, but this was not an unexpected cost.			
	V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A			
A. Fencing				
1.	**Fencing damaged**	☐ Location shown on site map	☒ Gates secured	☒ N/A
	Remarks: Fencing is in good condition. Beach was opened to the public in the summer of 2011.			

B. Other Access Restrictions	
1.	**Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks: Signs are posted and legible. EPA requested that the Port install an additional sign in Jack Block Park describing the work done at the site.
C. Institutional Controls (ICs)	
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) _____ Frequency _____ Responsible party/agency _____ Contact _____ _____ _____ _____ Name Title Date Phone no. Reporting is up-to-date ☐ Yes ☐ No ☐ N/A Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A Violations have been reported ☐ Yes ☒ No ☐ N/A Other problems or suggestions: None ☐ Report attached
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks: None
D. General	
1.	**Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident Remarks: None
2.	**Land use changes on site** ☒ N/A Remarks: None
3.	**Land use changes off site** ☒ N/A Remarks: None
VI. GENERAL SITE CONDITIONS	
A. Roads ☒ Applicable ☐ N/A	
1.	**Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A Remarks: None
B. Other Site Conditions	
	Remarks: The Port of Seattle finished applying a new sealcoat to the area capped with asphalt, but had not yet marked the location of the slurry wall on top of the new sealcoat. Top pick container handlers have compressed the cap near the intermodal yard building causing ruts. The tenant is slated to repair the damage soon and the Port of Seattle will oversee the effort.
VII. LANDFILL COVERS ☐ Applicable ☒ N/A	
VIII. VERTICAL BARRIER WALLS ☒ Applicable ☐ N/A	

1.	**Settlement** ☐ Location shown on site map ☒ Settlement not evident Areal extent_____ Depth_____ Remarks: None
2.	**Performance Monitoring** ☒ Performance not monitored Remarks: None
	IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines	☐ Applicable ☒ N/A
B. Surface Water Collection Structures, Pumps, and Pipelines	☐ Applicable ☒ N/A
C. Treatment System	☐ Applicable ☒ N/A
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining
D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition ☒All required wells located ☒Needs Maintenance ☐N/A Remarks: No wells were opened during the site visit; field notes were relied upon to determine the condition of the wells. Many well vaults contain water when opening for routine sampling. Groundwater sampling is unlikely to occur in the future though, because it does not satisfy the purpose of the stated monitoring objectives.
	X. OTHER REMEDIES ☐ Applicable ☒ N/A
	XI. OVERALL OBSERVATIONS
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The remedy appears to be effective because the SPME study indicated that porewater PAH concentrations were low and not clearly linked to Site contaminants or migration from upland. The cap in RA5, though, was found not to be constructed as intended. Additional cap material was applied in 2012 and a monitoring event is scheduled for the near future.
B.	**Adequacy of O&M**

	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. There were no issues identified related to the Port of Seattle's implementation and scope of O&M procedures. USACE groundwater monitoring has been canceled because the monitoring did not meet the overall objective (evaluating whether the asphalt cap and slurry wall remedy was maintaining protectiveness at the mudline) outlined in the OMMP Addendum. Instead, another SPME study will be completed prior to the next Five-Year Review. In the future, the Port of Seattle may be asked to check for presence/absence of and remove NAPL in additional wells.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. The results of long term monitoring of the sediment cap in RA5 indicated that the cap was not built to specifications (see section 4.5.2). In 2012, additional material was placed in RA5. A monitoring event is scheduled to confirm that the cap meets the required specifications (the monitoring had not occurred at the time of the site inspection).
D.Opportunities for Optimization	
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. There may be opportunity sometime in the future to optimize or reduce the occurrence of NAPL recovery efforts. As mentioned in B., groundwater sampling has been canceled and another SPME study will be conducted prior to the next Five-Year Review.

Photograph Log

Photo 1. Beach view looking east

Photo 2. Beach view looking west

Photo 3. Beach view looking north-east

Photo 4. Looking north from elevated walkway in Jack Block Park

Photo 5. Looking north east from elevated walkway in Jack Block Park

Photo 6. View of flip plane from elevated walkway in Jack Block Park

Photo 7. View of flip plane from elevated walkway in Jack Block Park

Photo 8. View of eastern beach and Lockheed West Seattle from elevated walkway in Jack Block Park

Photo 9. MW-11S

Photo 10. MW-11IR

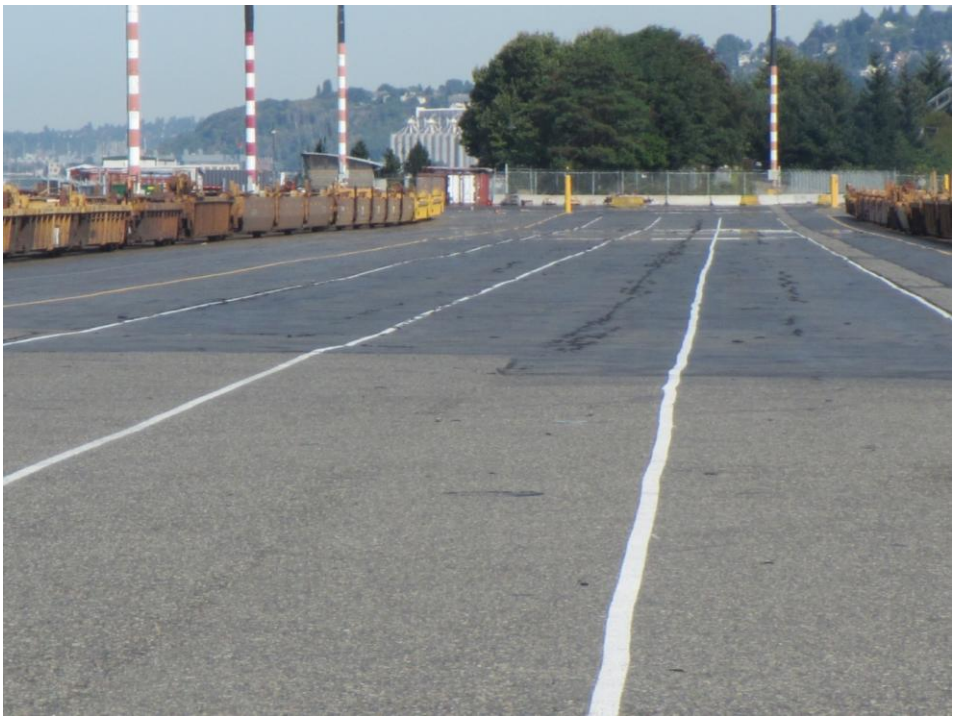

Photo 11. Southern edge of cap

Photo 12. Break room/storage building located on top of cap

Photo 13. Break room/storage building located on top of cap

Photo 14. Break room/storage building located on top of cap

Photo 15. View looking towards the south

Photo 16. Flip lane area of the cap

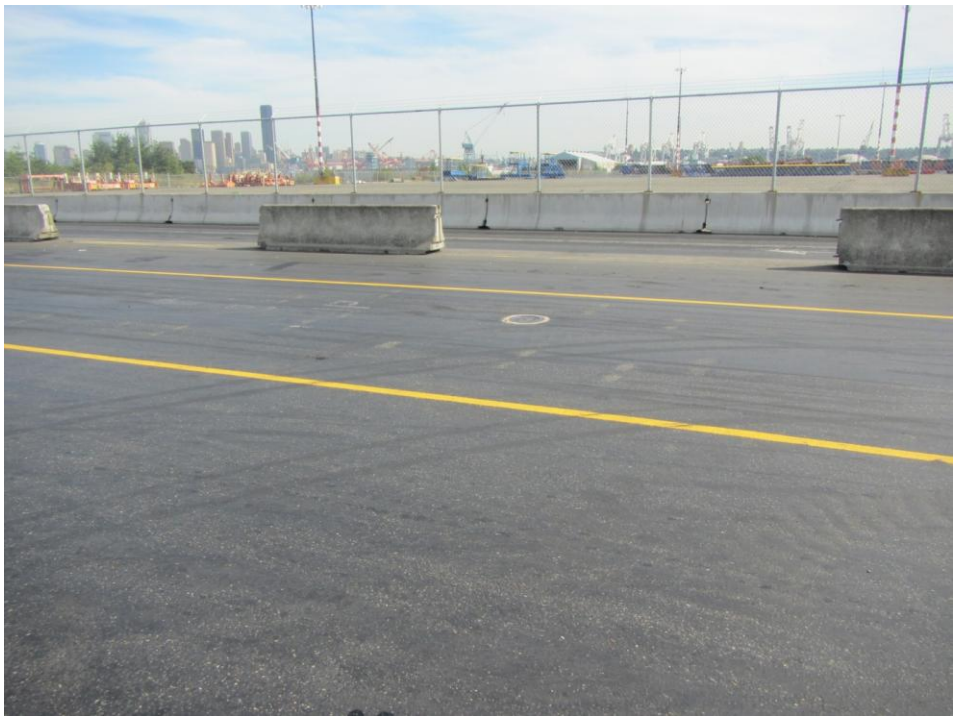

Photo 17. Flip area of the cap and RW-12S

Photo 18. Ruts in the flip lane area

Photo 19. Ruts in the flip lane area

Appendix K: Interview Record

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Interview Record

Interviewee and date interview conducted: Brick Spangler (Environmental Program Manager, Port of Seattle, 206-787-3193) and Warren Hansen (Windward Environmental, Port of Seattle consultant, 206-378-1364) on September 20, 2013 at Jack Block Park.

Interviewers: Marlowe Laubach and Aaron King (USACE, Seattle District)

Q1. What is your overall impression of the project? (general sentiment)

A1. This project is an easy site to maintain; institutional and environmental controls are simple. We have a very cooperative tenant which makes the site easy to maintain. No concerns from the Port.

Q2. Is the remedy functioning as expected? How well is the remedy performing?

A2. Yes. There are no issues of exposures.

Q3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

A3. NAPL is at least steady or decreasing.

Q4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

A4. The tenant representative is on-site who is aware of maintenance needs related to the Site. If there is an issue that would affect the Site, then he lets the Port know. Park maintenance visits the park twice a quarter. Port Police are there [at the park] nightly who would notice unusual activity (e.g. fireworks.)

Q5. Have there been any significant changes in O&M maintenance, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

A5. The only change is a reduction in reporting. O&M work continues as requested.

Q6. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

A6. No unexpected difficulties. The seal coat [for the cap] was an increase in normal O&M costs. However, the

seal coat had normal wear expectancy.

Q7. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

A7. No [opportunities] to date. Maybe in the future the NAPL recovery could be optimized or reduced.

Q8. Do you have any comments, suggestions, or recommendations regarding the project?

A8. None.