

**SIXTH FIVE-YEAR REVIEW REPORT FOR
HARBOR ISLAND SUPERFUND SITE
KING COUNTY, WASHINGTON**



Prepared by

U.S. Environmental Protection Agency

Region 10

Seattle, Washington

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Date

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EXECUTIVE SUMMARY

This is the sixth Five-Year Review (FYR) for the Harbor Island Superfund (Site) located in Seattle, King County, Washington. The purpose of this FYR is to review information to determine if the remedies are and will continue to be protective of human health and the environment. The triggering action for this statutory FYR was the signing of the previous FYR on September 16, 2020.

The Site is divided into seven Operable Units (OUs): Soil and Groundwater OU (S&G-OU1), Tank Farms OU (TF-OU2), Lockheed Upland OU (LU-OU3), Lockheed Shipyard Sediment OU (LSS-OU7), West Waterway OU (WW-OU8), Todd/Vigor Shipyard Sediment OU (TSS-OU9), and the East Waterway OU (EW-OU10).

Harbor Island is a 420-acre island located in the Duwamish River delta in Elliott Bay in the City of Seattle, Washington. The man-made island was constructed on the Duwamish River delta with the addition of bulkheads and fill placed in the early 1900s. The Harbor Island Site has evolved from an industrialized upland area into a complex cleanup site involving both the upland area and the offshore sediment. Contaminated media include soils, sediments, and groundwater.

A summary of the FYR conclusions for each of the OUs is presented below.

Soil and Groundwater - OU1

The Soil and Groundwater Operable Unit 01 (S&G-OU1) consists of the upland portion of Harbor Island except for the Tank Farms (OU2) and the Lockheed Upland (OU3). The selected remedy at S&G-OU1 includes excavation of hot spot soils and treatment/disposal of these soils off-site, capping of remaining contaminated soil that exceeds cleanup goals, institutional controls, removal and treatment of floating product on groundwater at Todd/Vigor Shipyard upland property, and implementation of long-term groundwater monitoring.

Portions of the remedy are functioning as intended by the decision documents. Hot spot soils within OU1 have been removed and remaining contaminated soils have been capped. Institutional controls in the form of environmental covenants restricting activities that may otherwise damage caps have been recorded for each of the Harbor Island upland properties. The environmental covenants also prohibit the use of groundwater as drinking water. Annual cap inspections are required to confirm that the cap integrity has not been compromised; however, not all the owners whose properties are subject to the environmental covenants consistently submit cap inspection reports.

Removal of light non-aqueous-phase liquid (LNAPL) was completed at the Todd/Vigor Shipyard upland property and has met the remedial action objective of no measurable LNAPL and/or rebound of LNAPL. In 2020, Vigor submitted the remedial action completion report for the LNAPL recovery system and has completed removal of the pump houses, recovery wells, and all monitoring wells associated with that system, except monitoring well, TD-06A.

Groundwater monitoring is regularly conducted across S&G-OU1 as required in the Record of Decision (ROD) and demonstrates that, although metals are present in groundwater at concentrations above ROD cleanup goals, this contamination is not migrating into the East or West Waterway.

Changes to applicable or relevant and appropriate requirements (ARARs) and toxicity data since remedy selection do not affect the current protectiveness of the remedy because the low permeability cap and institutional controls continue to prevent exposure to soils with contaminant concentrations above the new standards (new standards created since the ROD was signed). There is no exposure to contaminants in site groundwater because

groundwater in S&G-OU1 is non-potable and monitoring indicates that S&G-OU1 contaminants are not reaching the East or West waterway. There are no unacceptable risks associated with any exposure pathways.

The remedy at S&G-OU1 is short-term protective because the cap is in good condition, LNAPL recovery at Todd/Vigor Shipyards upland property is complete, and long-term groundwater monitoring indicates that contaminants are not migrating to the East or West waterway. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Inspect the seawall at Union Pacific Railroad (UPRR) property and conduct a study to verify its integrity.
- Update and enforce the Operation and Maintenance (O&M) plan to ensure cap inspection reports are prepared and promptly provided.

Tank Farms – OU2

The Tank Farms Operable Unit 02 (TF-OU2) is being managed by the Washington State Department of Ecology (Ecology) Toxics Cleanup Program under State of Washington Model Toxic Control Act (MTCA) Cleanup Action Plans (CAPs). There are three tank farms owned and operated by British Petroleum (BP), Kinder Morgan and Shell, respectively. The selected remedy at TF-OU2 includes excavation of lead and arsenic contaminated shallow surface soil and petroleum-hydrocarbons contaminated hot spot soils, and treatment/disposal of these soils off-site; construction and operation of in-situ remedial systems to treat contaminated groundwater and the remaining contaminated soil; utilization of natural attenuation processes; long-term monitoring; and institutional controls.

Portions of the remedy are functioning as intended by the decision documents. Active remediation continues at the BP Plant 1 facility. A groundwater/LNAPL recovery system is located along the shoreline. In general, groundwater monitoring data at BP Plants 1 and 2 show that concentrations of contaminants are decreasing or stable, and most detections of contaminants have been below cleanup levels at their points of compliance within the last five years.

The Kinder Morgan (KM) facility has implemented sulfate land application as a remediation treatment multiple times over the last twelve years. The KM and Shell facilities also use passive free-product recovery at select wells on an as-needed basis. Monitoring wells located along the southwestern edge of the KM property near 13th Ave. S.W. have shown generally stable concentrations of contaminants and no expansion of the groundwater plume over the last five years, indicating that the source area remedial activities are effective.

Shell completed construction of a bio-sparging system within the TX-03A area in May 2017. The system operated until December 2019 and is currently offline for rebound evaluation.

Environmental covenants for BP, KM, and Shell have been recorded to restrict activities at these properties.

Changes to ARARs and toxicity data since remedy selection, do not affect the current protectiveness of the remedy because institutional controls prevent exposure to soils with contamination levels above new standards, and groundwater concentrations above the new standards are being addressed in ongoing remediation areas. There were no unacceptable risks associated with any exposure pathways.

The remedy at TF-OU2 is short-term protective. It currently protects human health and the environment because multiple remediation methods are occurring to treat contaminants, and restrictive covenants ensure there is no exposure to contamination. However, in order for the remedy to be protective in the long-term, the following actions need to be taken:

- Evaluate contaminant concentration trends in Kinder Morgan and Shell area wells to determine efficiency of anaerobic natural attenuation and bio-sparging. Determine if groundwater will meet RAOs in a reasonable timeframe or if other appropriate technologies should be evaluated in the 13th Ave. S.W. and TX 03A areas.
- After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any follow-up CERCLA remedial action is required, and if a decision document is necessary.
- Evaluate the potential for PFAS release.

Lockheed Upland – OU3

The selected remedy at Lockheed Upland Operable Unit 03 (LU-OU3) includes excavation of contaminated hot spot soils and treatment/disposal of these soils off-site, capping of remaining soil contamination exceeding cleanup goals, institutional controls, and implementation of groundwater monitoring for 30 years.

Portions of the remedy are functioning as intended by the decision documents. Groundwater monitoring shows sporadic exceedances of ROD cleanup levels for metals (copper and nickel), tetrachloroethylene (PCE), chrysene, and benzo(b)fluoranthene, as well as sporadic or localized detections of other metals and petroleum hydrocarbons. PCE and metals concentrations above cleanup levels appear to be stable or show a declining trend.

Institutional controls in the form of an environmental covenant are required for the remedy to remain protective; however, there is currently no such covenant recorded for the property. Nonetheless, annual cap inspections show that the integrity of the cap has not been compromised. There have been no changes to ARARs, exposure pathways, and toxicity data since remedy selection that affect the protectiveness of the remedy.

The remedy at LU-OU3 is short-term protective. It currently protects human health and the environment because the cap integrity has been maintained, and groundwater studies indicate that contaminants are not impacting the adjacent West Waterway. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Record environmental covenants for capped areas of the property.

Lockheed Shipyard Sediment – OU7

The selected remedy at Lockheed Sediment Operable Unit 7 (LSS-OU7) included demolition of derelict structures, dredging sediment with contaminant concentrations above the State of Washington Sediment Cleanup Levels, capping of any remaining sediment that exceeds the State Sediment Cleanup Objectives (SCO), and placement of habitat substrate suitable for aquatic life. A thin layer of sand was placed in portions of the Channel Area as enhanced natural recovery.

Monitoring of the cap indicates that the physical integrity of the cap has been maintained, and that sediment deposition from the upstream Duwamish River is occurring in the Slope and Channel Areas. Sediment sampling and analysis indicates that the cap is providing chemical isolation from contaminants moving up through the cap. Newly deposited river sediments in the open channel area have historically had concentrations of polychlorinated biphenyls (PCBs) and mercury that exceed the SMS SCO levels but remain below the SMS cleanup screening levels. During the 2024 only mercury exceeded the SCO level in one sample.

The remedy at the LSS-OU7 is protective of human health and the environment because the physical integrity of the cap has been maintained and groundwater studies indicate that contaminants are not impacting LSS-OU7 sediments.

West Waterway – OU8

The No Action ROD for the West Waterway Operable Unit 8 (WW-OU8) presented the basis for the determination that no CERCLA action was necessary at this OU to protect human health or the environment. WW-OU8 conditions allow for unlimited use and unrestricted exposure. The No Action ROD did not include any requirements for institutional controls and did not require long-term monitoring. Since the U.S. Environmental Protection Agency (EPA) made the decision for no action, there is no necessity for a five-year review and this OU is not being evaluated in this FYR.

Todd Shipyard Sediment – OU9

The selected remedy for Todd Shipyard Sediment Operable Unit 9 (TSS-OU9) included demolition of derelict structures, removal of shipyard wastes and dredging sediment with contaminant concentrations above the State of Washington Sediment Quality Standards. In-water fill was placed to reconstruct excavated slopes, as well as filling subtidal depressions created by the dredging. A sand cap was placed under existing piers that remain in service and where sediments exceeded the State's Sediment Quality Standards.

In May 2011, Todd Shipyard was acquired by Vigor Marine who assumed all CERCLA responsibility for managing the OU. In 2024, as part of the Consent Decree responsibilities, Vigor Marine completed remediation in the southwestern portion of the TSS-OU9, conducting contaminated sediment removal above cleanup levels and a habitat restoration project along the southwestern portion of the TSS-OU9, including Piers 1, 1A, 2P, and the associated Pier 1 shipways. As part of the protected habitat, the capped area is protected from future disturbance in perpetuity with an environmental covenant recorded by Vigor Marine and the Natural Resource Trustees as beneficiaries.

The Operation Management and Monitoring Program (OMMP) requirements for the removal and capping actions included physical integrity monitoring and if needed sediment sampling and chemical analysis. Based on the stability of the sand caps, no additional monitoring was required. Once the remaining piers reach the end of their serviceable life, there may be additional remediation and monitoring requirements.

The remedy at TSS-OU9 is protective of human health and the environment because dredging and capping has been completed to address remaining contaminated sediments underneath piers. The sediment cap integrity is being maintained, reducing concentrations of hazardous substances to levels that have no adverse effects on marine organisms.

East Waterway – OU10

The interim remedy for the East Waterway Operable Unit 10 (EW-OU10) includes dredging, capping, enhanced natural recovery in open water areas, and in-situ remediation under low structures (e.g., docks and piers). This remedy was selected in the East Waterway Interim ROD, signed on May 29, 2024. The remedial objective for the EW-OU10 is to reduce, through active remediation, concentrations of contaminants of concern in sediment greater than remedial action levels. Remedy construction is planned to begin in 2030 and will require at least 10 years to complete. The remedial action for this OU has not yet been initiated, so this OU is not evaluated as part of this FYR.

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	applicable or relevant and appropriate requirements
BP	BP West Coast Products
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cPAH	carcinogenic polycyclic aromatic hydrocarbon
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
EW-OU10	East Waterway Operable Unit 10
FYR	Five-Year Review
HPAH	high molecular weight polycyclic aromatic hydrocarbon
KM	Kinder Morgan Liquid Terminals
LPAH	low molecular weight polycyclic aromatic hydrocarbon
LNAPL	light non-aqueous phase liquid
LSS-OU7	Lockheed Shipyard Sediment Operable Unit 7
LU-OU3	Lockheed Upland Operable Unit 3
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
O&M	Operation and Maintenance
OMMP	Operations, Maintenance and Monitoring Plan
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
Port	Port of Seattle
RAO	Remedial Action Objective
ROD	Record of Decision
S&G-OU1	Soil and Groundwater Operable Unit 1
SCO	Sediment Cleanup Objective
Shell	Shell Oil Products
SMS	Sediment Management Standards
SVE	soil vapor extraction
SQS	Sediment Quality Standard
TF-OU2	Tank Farms Operable Unit 2
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons, diesel range
TPH-G	total petroleum hydrocarbons, gasoline range
TPH-O	total petroleum hydrocarbons, oil range
TSS-OU9	Todd Shipyard Sediment Operable Unit 9
UECA	Uniform Environmental Covenants Act
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
WAC	Washington Administrative Code
WW-OU8	West Waterway Operable Unit 8

1. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan [40 Code of Federal Regulations Section 300.430(f)(4)(ii)] and considering EPA policy.

This is the sixth FYR for the Harbor Island Superfund Site (Site). The triggering action for this statutory review is the completion date of the previous FYR: September 16, 2020. The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

The Site consists of seven operable units (OUs), and five OUs are addressed in this FYR. The West Waterway and East Waterway OUs are not addressed in this FYR because “No Action” was selected as the remedial action decision in the West Waterway Record of Decision (ROD), and although the IROD for East Waterway was issued by EPA in 2024, remedial actions have not yet been initiated for that OU. The following list identifies the seven OUs that comprise the Harbor Island Superfund Site and indicates which OUs are addressed in this FYR report:

OU No.	Name	Included in FYR
01	Soil and Groundwater OU (S&G-OU1)	Yes
02	Tank Farms OU (TF-OU2)	Yes
03	Lockheed Upland OU (LU-OU3)	Yes
07	Lockheed Shipyard Sediment OU (LSS-OU7)	Yes
08	West Waterway OU (WW-OU8)	No – No Action ROD
09	Todd Shipyard Sediment OU (TSS-OU9)	Yes
10	East Waterway OU (EW-OU10)	No – Remedial action not initiated

This FYR was led by Ravi Sanga (EPA Remedial Project Manager). Participants included Amy Baker and Veronica Henzi (US Army Corps of Engineers [USACE] Project Manager), William John (USACE Environmental Engineer), William Gardiner (USACE Risk Assessor), and Ted Repasky (USACE Geologist). Mr. Vance Atkins (Washington State Department of Ecology Hydrogeologist) conducted the five-year review for the Tank Farms OU. The reviews began on 12/13/2024.

1.1. Site Background

Harbor Island is a 420-acre industrial island constructed in the early 1900s at the mouth of the Duwamish River (Figure 1). Historical uses of the Island include ocean and rail transport, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding, and metal plating. Warehouses, laboratories, and offices were also located on the island. Current land uses are primarily shipping container handling and storage, bulk fuel storage, shipbuilding, and marine repair. Federal channels east and west of the island allow deep-draft vessels to berth along piers on both sides of the Site. The groundwater on this man-made island has never been used as a domestic water source and was deemed not suitable for drinking water by EPA and Ecology in the 1993 Soil and Groundwater (S&G-OU1) ROD (EPA 1993).



Figure 1. Harbor Island Site Vicinity Map

The Harbor Island Superfund Site was listed on the National Priorities List on September 8, 1983, due to elevated lead concentrations in soils associated with the former lead smelter operations. The Site is now divided into seven OUs to address the different sources and types of contamination, with three upland OUs and four in-water, sediment OUs (Figure 2).

Subsequent investigations found concentrations of metals, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons in soils above acceptable human health risk levels. In addition, spills and leaks at the petroleum tank farms have created several areas of localized petroleum hydrocarbon contamination in soils in S&G-OU1 and TF-OU2.

General sources of potential contamination to the sediments surrounding Harbor Island were identified as direct discharge of waste, spills, historical disposal practices, atmospheric deposition, groundwater seepage, storm drains, combined sewer overflow systems, and other nonpoint discharges. Sediment contamination of the estuarine environment surrounding Harbor Island may also have resulted from upstream sources.



Figure 2. Harbor Island Superfund Site Operable Units

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Harbor Island		
EPA ID: WAS980722839		
Region: 10	State: WA	City/County: Seattle/King
SITE STATUS		
National Priorities List Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? No	
REVIEW STATUS		
Lead agency: EPA		
Author name: Ravi Sanga		
Author affiliation: EPA Remedial Project Manager		
Review period: 12/13/2024 - 9/16/2025		
Date of inspection: 3/27/2025		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/16/2020		
Due date (five years after triggering action date): 9/16/2025		

2. RESPONSE ACTION SUMMARY

2.1. Basis for Taking Action

A summary of the major contaminants found at the Harbor Island Superfund Site that have been released to the different media in the environment are presented in Table 1.

Table 1. Summary of Harbor Island Superfund Site Contaminants by Media

Soil	Sediments	Groundwater
Arsenic	Arsenic	Arsenic
Antimony	Copper	Cadmium
Cadmium	Lead	Copper
Chromium	Mercury	Lead
Lead	Zinc	Mercury
Mercury	Tributyltin	PAHs
cPAHs	PAHs	PCBs
PCBs	PCBs	Cyanide
TPH-G, TPH-D, BTEX		Trichloroethylene
Trichloroethylene		Tetrachloroethylene (PCE)
Benzene		TPH (TPH-G, TPH-D, TPH-O, BTEX)

Notes:

BTEX = benzene, toluene, ethylbenzene, and xylene

PAHs = polycyclic aromatic hydrocarbons

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

PAHs = polycyclic aromatic hydrocarbons

PCBs = polychlorinated biphenyls

TPH = total petroleum hydrocarbons

TPH-G = total petroleum hydrocarbons, gasoline range

TPH-D = total petroleum hydrocarbons, diesel range

TPH-O = total petroleum hydrocarbons, oil range

Other inorganic contaminants with cleanup goals for groundwater in the 1993 ROD: nickel, silver, thallium, and zinc.

The basis for taking action in the upland OUs is primarily due to human health risks at Harbor Island for people who may incidentally ingest soil or have dermal contact with soil through industrial or commercial exposures. Inhalation was not identified as a significant pathway of exposure to contaminants on Harbor Island. Ecological risks were not evaluated for the upland OUs due to the absence of wildlife habitat areas on Harbor Island.

The basis for taking action in the Lockheed, Todd Shipyard, and East Waterway sediment OUs was human health risks for people eating fish and shellfish from the waterways and direct contact and incidental ingestion of sediments during net fishing and clamming. The most significant human health risk was elevated cancer and non-cancer risk from the ingestion of PCBs in resident fish captured from the waterways. Unacceptable risks were also observed for the benthic community and resident fish. The most significant ecological risks were for PCBs, arsenic, mercury, and tributyltin.

There was no remedial action required for sediments in the West Waterway sediment OU.

2.2. Response Actions and Status of Implementation

The following sections describe that status of remedy implementation for each of the Harbor Island Superfund Site OUs, including the remedy selection, remedy implementation, and any operations, maintenance, and monitoring requirements. No pre-ROD removal actions were conducted in the Harbor Island Superfund Site with the exception of the removal of 273,300 cubic yards of contaminated sediment from the East Waterway OU.

2.2.1. Soil and Groundwater OU1

Remedy Selection

S&G-OU1 includes properties throughout much of Harbor Island supporting many different commercial activities (Figure 2). The ROD for the S&G--OU1 was signed on September 30, 1993, and amended in August 1995 and January 1996. Explanation of Significant Differences (ESDs) were signed in July 1994 and September 2001.

The remedial action objectives (RAOs) are as follows:

- Protect human health from exposure to contaminants in surface soil that pose a combined risk of greater than 1×10^{-5} .
- Protect human health from infrequent exposure to contaminants in the subsurface soil that pose a risk greater than 1×10^{-5} for each contaminant.
- Prevent release of contaminants into the groundwater where they can be transported to the shoreline where marine organisms could be exposed.
- Prevent migration of contaminants to the shoreline where marine organisms could be exposed.
- Protect human health from consuming contaminated marine organisms which pose a risk greater than 1×10^{-6} .

The selected remedial actions for S&G-OU1 identified in the decision documents are:

- Excavate hot spot soils and treat or dispose of off-site. Hot spots are generally defined as soils with total petroleum hydrocarbons (TPH) concentrations greater than 10,000 milligrams per kilogram (mg/kg), PCBs greater than 50 mg/kg, or mixed carcinogens with a total risk greater than 1×10^{-4} . TPH-contaminated soils characterized as non-dangerous waste would be disposed of at a non-hazardous waste landfill. Per the ROD, PCB-contaminated soils and soils with greater than 10^{-4} risk would be sent off-site for treatment (incineration) or disposed-of at a hazardous waste landfill. Cleanup goals for S&G-OU1 are identified in Table 2.
- The 1994 ESD dealt with treatment method clarification and disposal of TPH contaminated soil. The 2001 ESD modified the definition of hot spot cleanup action levels to 20,000 mg/kg in areas extending beneath permanent structures and areas with highly weathered diesel and oil petroleum hydrocarbons.
- Treat TPH hot spots by thermal desorption with condensate collection.
- Place an engineered cap on exposed contaminated soil exceeding cleanup goals. The cap would consist of low permeability material such as asphalt or concrete. New pavement was required to have a minimum thickness of 3 inches and a maximum permeability of 1×10^{-5} centimeters per second (cm/s). Existing asphalt and concrete surfaces that were damaged and located in areas where soils exceed cleanup goals were to be replaced or repaired to prevent infiltration of rainwater.
- Invoke institutional controls to include a requirement for long-term maintenance of new and existing caps, warn future property owners of remaining contamination under capped areas on their properties, and

specify procedures for handling and disposal of excavated contaminated soil from beneath capped areas if future excavation is necessary.

- Remove and treat floating petroleum product (i.e., light non-aqueous phase liquid [LNAPL]) and associated contaminated groundwater at Todd Shipyard (now Vigor Shipyards).
- Implement groundwater monitoring for 30 years, with review of groundwater trends every 5 years to assess the effectiveness of the selected remedy.

The location of S&G-OU1 features and groundwater monitoring wells are shown in Figure 3.

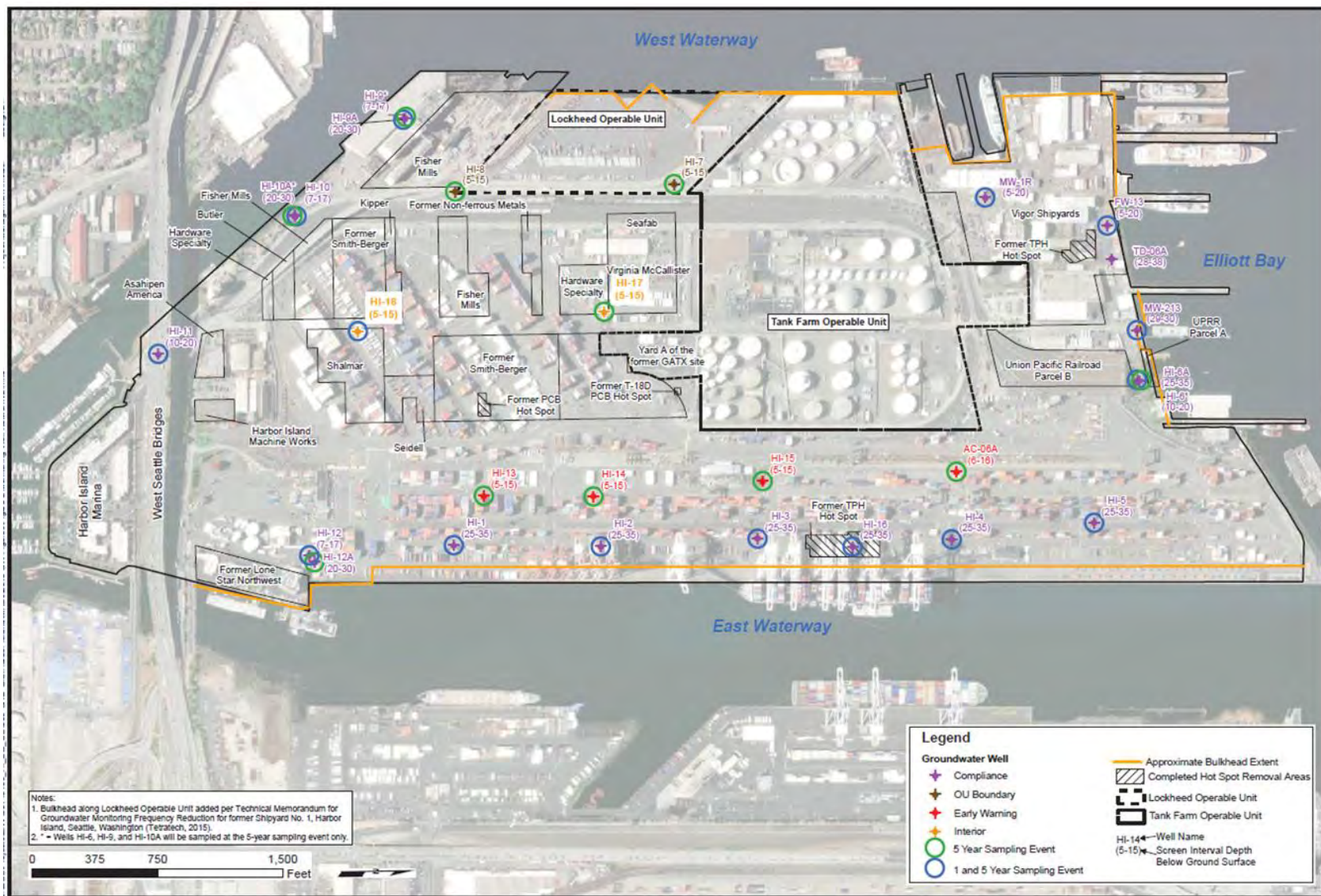


Figure 3. S&G OU1 Site Features and Groundwater Monitoring Locations

Table 2. Cleanup Goals for S&G-OU1 and LU-OU3

Chemical of Concern	Soil-Surface Cleanup Goal (mg/kg)	Soil-Subsurface Cleanup Goal (mg/kg)	Groundwater Cleanup Goal (µg/L)
Lead	1,000 ^a	1,000 ^a	5.8
Arsenic	3.6 to 32.6 ^b	200 ^a	36
Antimony	180 to 677 ^b	-	-
cPAHs	0.1 to 36.5 ^b	20 ^a	-
PCBs	0.18 to 2.99 ^b	-	0.03
TPH-D	-	600 ^a	-
TPH-G	-	400 ^c	-
Cadmium	-	10 ^a	8.0
Chromium	-	5,800 ^a	-
Mercury	-	1.02 ^a	0.025
Benzene	-	1.0 ^c	71
Ethylbenzene	-	200 ^c	-
Toluene	-	100 ^c	-
Xylenes	-	150 ^c	-
Carbon Tetrachloride	-	-	4.48
Trichloroethylene	-	-	42
Tetrachloroethylene	-	-	8.8
Copper	-	-	2.9
Nickel	-	-	7.9
Silver	-	-	1.2
Thallium	-	-	6.3
Zinc	-	-	76.6
Cyanide	-	-	1

Notes:

- Cleanup goals were determined at various locations over the S&G-OU1 and vary based on the number and type of contaminants present. All groundwater levels are based on protection of marine organisms or human health from consumption of organisms.
- Surface soil is defined as soil within the top 6 inches below ground surface. Subsurface soil defined as greater than 6 inches below ground surface.
- Cleanup goal basis:

^a Goals were based on MTCA Method A for soil industrial sites.

^b Based upon achieving a 1×10^{-5} excess cancer risk or hazard index equal to 1.

^c Based on the State of Washington Petroleum-Contaminated Soil Matrix Rating method.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

TPH-D = total petroleum hydrocarbons, diesel range

TPH-G = total petroleum hydrocarbons, gasoline range

Remedy Implementation

To warn future property owners of the remaining contamination, there is a Consent Decree that requires a certified copy of the Consent Decree be recorded by the defendants in the appropriate King County office. Thereafter, each deed, title, or other instrument conveying an interest in a property included in the S&G-OU1 is required to contain a recorded notice that the property is subjected to the Consent Decree (and any lien retained by the United States) and to reference the recorded location of the Consent Decree and any restrictions applicable to the property. The following defendants are required to implement these institutional controls Consent Decree: Port of Seattle (Port), Dutchman LLC, King County, Harbor Island Machine Works, Duwamish Properties LLC, Union Pacific Railroad (UPRR), and Todd Shipyard Corporation.

A “UECA [Uniform Environmental Covenants Act] Covenant for Harbor Island S&G OU Properties Where Soil Capping Is Required” was recorded with King County by Todd Shipyard Corporation on July 28, 2020, and by Harbor Island Machine Works (Paul M. DeFaccio and Dianne L. DeFaccio Irrevocable Trust) on November 14, 2020. UECA-compliant covenants have been recorded for all S&G-OU1 properties.

All hot spot soils with contaminants of concern above acceptable contaminant concentrations have been removed and disposed of off-site. In 2003, the Port finished expanding its cargo container facility (T-18) by acquiring approximately 90 acres within the interior of Harbor Island. Contaminated soils exceeding cleanup goals on the expansion properties were capped. The remaining soil hot spot at Todd Shipyard (in the uplands area) was remediated in 2011.

Todd Shipyard operated an LNAPL recovery system within S&G-OU1 between 1998 and 2018. Several modifications were made to the system following start-up including a vacuum-enhancement system installed in 2001, and installation of additional recovery wells in 2005 and 2009. The LNAPL recovery remedial action effectively removed the free-phase petroleum and prevented dissolved contaminant migration to the shoreline. The system was decommissioned, and equipment was removed, in 2018.

The ROD required semi-annual long-term groundwater monitoring at selected wells across Harbor Island for a period of 30 years. Long-term monitoring began in 2005.

System Operation/Operation and Maintenance

As part of the institutional controls, property owners are required to perform annual cap inspections and maintenance to ensure protection of site workers from dermal contact and reduce infiltration from rainwater. In the last 5 years, a cap inspection was performed annually for properties within this OU, except the cap inspection for 2022 at the UPRR property. Inspections note areas with cracking pavement and plant growth. Damaged pavement was repaired/replaced in needed areas. Cap inspections at the UPRR Parcel A in 2023 and 2024 noted holes and repaired holes in areas near the seawall, potentially indicating a persistent issue for this portion of the cap.

2.2.2. Tank Farms OU2

Remedy Selection

TF-OU2 is comprised of three facilities (Figure 4):

- BP West Coast Products (“BP”; formerly ARCO Bulk Fuel Storage Facility Harbor Island) Plant 1 and Plant 2.
- Kinder Morgan Liquids Terminal, Harbor Island (“KM”; formerly GATX Terminals) Yards A through E.
- Shell Oil Products Seattle Terminal, Harbor Island (“Shell”; formerly Equilon Enterprises) comprised of the Shell Main Terminal and Tank Farm, Shell’s North Tank Farm area (located 300 feet north of Main Tank Farm), and Shell’s Shoreline Manifold area (located 1,200 feet north of Shell’s Main Tank Farm).

Consent Decrees and Cleanup Action Plans (CAPs) were entered and issued respectively in 1999 and 2000. The CAPs are similar to EPA RODs and establish actions associated with the following hazardous substances identified within the TF-OU2:

- Soil: TPH (shallow and subsurface soil), arsenic (shallow soil), and lead (shallow soil).
- Groundwater: Free product/sheen, TPH-G, TPH-D, and TPH-O, benzene, toluene, ethylbenzene, xylenes, cPAHs, and lead.

Cleanup levels for these substances were established in the CAPs for each property within TF-OU2 and were mostly identical to cleanup goals established in the EPA RODs for S&G-OU1 and LU-OU3. The cleanup levels for soil were considered protective of industrial worker exposure. The cleanup levels in groundwater were considered protective of surface water (aquatic organisms in Elliott Bay). The specific cleanup levels for TF-OU2 and the associated constituents are listed in Table 3.

Table 3. Cleanup Levels for TF-OU2 Soil and Groundwater.

Chemical of Concern	Soil-Surface Cleanup Level (mg/kg)	Soil-Subsurface Cleanup Level (mg/kg)	Groundwater Cleanup Level (µg/L)
Arsenic	32.6	-	-
Lead	1,000	-	5.8
Total TPH	10,000	20,000	-
Petroleum Product	-	-	No sheen
Benzene	-	-	71
cPAHs	-	-	0.031
Copper	-	-	2.9
Ethylbenzene	-	-	29
Toluene	-	-	200
TPH-G	-	-	10
TPH-D	-	-	10
TPH-O	-	-	10

Notes:

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

TPH-G = total petroleum hydrocarbons, gasoline range

TPH-D = total petroleum hydrocarbons, diesel range

TPH-O = total petroleum hydrocarbons, oil range



Figure 4. TF-OU2 Tank Farms Facilities

The RAOs are as follows:

- Remove all accessible contaminated soil.
- Achieve groundwater cleanup levels at the shoreline areas and inland property boundaries.

The selected remedial components include:

- Excavate and remove shallow surface soil (6 inches) in areas exceeding 1,000 mg/kg lead and/or 32 mg/kg arsenic.
- Excavate and remove accessible surface and subsurface soil in areas exceeding 10,000 mg/kg total TPH at identified areas adjacent to the shoreline and inland where a large release occurred in 1996. Excavate and remove soil exceeding 20,000 mg/kg total TPH throughout all other inland areas. An overriding consideration regarding excavation of contaminated soils was to avoid any risk to the petroleum storage tanks and pipelines.
- Construct and/or operate in-situ remedial systems to treat contaminated soil and groundwater. The systems include LNAPL/groundwater recovery, air sparging, and soil vapor extraction (SVE) components, and supplemental active free-product recovery by passive methods in specific wells as needed.
- Utilize natural attenuation to reduce contaminant levels in soil and groundwater. This was an inherent part of the remedy for inaccessible contaminated soils left in place to avoid risk to infrastructure.
- Perform long-term groundwater monitoring, examine wells for free product, measure groundwater elevations at wells, and construct seasonal groundwater flow maps. Analyze groundwater samples for contaminants of concern (TPH-G, TPH-D, TPH-O, BTEX, cPAHs, arsenic, and lead). Also analyze for natural attenuation parameters (dissolved oxygen, oxidation reduction potential, carbon dioxide, methane, ferrous iron, nitrate, sulfate, and alkalinity) to evaluate natural attenuation processes.
- Institute restrictive covenants to identify contamination that exists at each property, provide for continued industrial use of the property, prohibit groundwater taken from the property, provide for the safety and notification of on-site workers, prohibit activities that would release or cause exposure to contamination, provide for continuance of remedial actions given property transference, and provide for Ecology access.

Remedy Implementation

Removal of Lead and Arsenic Contaminated Surface Soil

Removal actions for lead and arsenic contaminated soils were complete in 2004.

At the BP facility, no removal of lead or arsenic contaminated surface soil was required. At the KM facility, excavation of near-surface lead and arsenic contaminated soil throughout large areas in the B and C Yards (Appendix B, Figure B-8) was completed April through May 2002. Approximately 11,094 tons of impacted soil was removed and disposed of at the Waste Management Columbia Ridge Landfill and Recycling Facility in Arlington, Oregon. Soil cleanup levels for lead and arsenic were achieved throughout these areas.

At the Shell facility, excavation of near-surface lead and arsenic contaminated soil in areas throughout the main tank farm was completed December 2003 through February 2004. Approximately 2,929 tons of impacted soil were removed and disposed of at the Roosevelt Regional Landfill in Klickitat County, Washington. Soil cleanup levels for lead and arsenic were achieved throughout this area. A small area of lead-contaminated soil near an oil-water separator at the Shell facility was excavated during October 2001; approximately 75 tons of impacted soil was removed. Due to structural constraints, lead levels in some subsurface soil remains above the lead standard in this area, and it was capped with 3 inches of low-permeability asphalt.

Removal of TPH Contaminated Surface and Subsurface Soil

At all three facilities, all TPH hot spots identified in the original remedial investigation and CAPs have been addressed. A description of the removals is presented below. Impacted soil with concentrations above cleanup levels was removed and transported to appropriate facilities off-site for treatment or disposal. Some subsurface soil with concentrations above applicable standards remains in most of these areas because of the safety constraints imposed on excavating by existing structures (primarily the aboveground tanks).

Construction and Operation of In-Situ Remedial Systems

The following is a summary of the remediation systems that have operated, or are currently operating at TF-OU2:

- BP:
 - An SVE system at the southern boundary of Plant 1 operated from 2008-2014.
 - A free product recovery and vapor extraction system at the bulkhead area of Plant 1 has been operating since 1992. The system was expanded in 2003 as a requirement of the CAP to include greater capacity for free product/groundwater recovery and add vapor extraction and air sparging components and continues to operate at present.
 - A new seawall was installed at BP Plant 1 in 2018 on the northern portion of the border with West Waterway, which now extends down to about -66 feet mean sea level. This is a deeper subsurface barrier to groundwater discharged to surface than before. Ecology is evaluating continued operation of the LNAPL recovery system based on the findings of the hydraulic evaluation of the new seawall.
 - Remedial actions along the Plant 1 waterfront have reduced or removed most of the preexisting soil impacts in the unsaturated zone and no free LNAPL has been detected in the groundwater during the last five years. The current remedial system may have recovered LNAPL to the extent practicable and further operation of the existing groundwater pump and treatment system may be unlikely to provide additional environmental benefit.
- KM:
 - Passive free product recovery is occurring.
 - Sulfate land application continues with application of Epsom salt roughly annually at B, C, and D Yards to enhance biodegradation of petroleum products. The most recent applications were in October 2023 and November 2024.
 - A point-source free product recovery at A and B Yards operated from October 2002 through 2004 when product was no longer observed.
 - An air sparge system consisting of 16 sparge wells at C Yard operated from October 2002 through August 2004 when groundwater cleanup levels had been achieved and maintained.
 - An SVE/air sparge system at A Yard started up in 2006 and operated until 2010.
- Shell:
 - Passive free product recovery is occurring.
 - A free product recovery and vapor extraction system operated in the Shoreline Manifold area of the Shell facility prior to the Consent Decree until 2005 when product was no longer observed and hydrocarbon recovery through vapor extraction declined.
 - A bio-sparging system installed in the Shell terminal, within the TX-03A area operated between 2017 and 2019 and is currently undergoing rebound monitoring.

Natural Attenuation

Monitored natural attenuation is occurring in the 13th Ave. S.W. right of way near the KM and Shell facilities in the SH-04 Area (Figure 5). Select wells are analyzed for indicator parameters to evaluate natural attenuation processes. These included dissolved oxygen, ferrous iron, methane, sulfate, sulfide, and carbon dioxide. Declining contaminant levels in some wells near remaining areas of subsurface TPH contamination provide evidence of natural attenuation.

Groundwater Monitoring

Numerous monitoring wells at the tank farms were in place prior to the Consent Decrees and additional wells were installed afterwards. Monitoring wells throughout the tank farms were regularly examined for free product and/or sampled for the contaminants of concern and natural attenuation parameters. Wells designated for certain monitoring activities are specified in the Groundwater Compliance Monitoring Plan for each facility. Two compliance monitoring wells in the Shoreline Manifold area at the Shell facility and five compliance monitoring wells in Plant 1 at the BP facility are screened in groundwater at depths below the bottom of each bulkhead to monitor possible discharge of contaminants to surface water. Other monitoring wells are screened at the water table.

Institutional Controls

Institutional controls are required in the form of Restrictive Covenants (now called Environmental Covenants) for each facility and are required to be written and recorded 10 days after the signing of each Consent Decree. The restrictive covenants for BP, KM, and Shell were filed with King County on August 15, 2000, August 30, 2000, and October 5, 2000, respectively.

System Operation/Operation and Maintenance

The operation and maintenance (O&M) procedures specific to each system are presented in each facility's O&M manual. General system operations and maintenance activities along with the operating and performance parameters for each system are presented in required quarterly reports.

- At the BP facility, recovery wells have experienced pumping rate reductions in recent years, attributed to biological fouling in the shallow aquifer due to high concentrations of iron and sulfate present in the brackish water along the waterfront. During this five-year period, annual average flow rates ranged from 0.9 gallons per minute (gpm) in 2022 to 0.91 gpm in 2023. The system operated at a maximum annual average flow rate of 11.2 gpm in 2005. Maintenance is performed on the wells and pumps to maintain and improve groundwater capture and to ensure that adequate drawdown is achieved.
- At the KM facility, passive free product recovery using absorbent socks continues and is currently performed at select wells within the A Yard when sheen or product is observed.
- At the Shell facility, there are currently no active recovery systems. Passive free-product recovery (absorbent socks) continues in the Shoreline Manifold area on an as needed basis.

Additional information regarding the TF-OU2 background, physical characteristics, hydrology, and remedy is presented in Appendix B.

- Excavate and treat hot spot soils. Hot spots are defined as soils with TPH concentrations greater than 10,000 mg/kg. The TPH hot spot soil will be treated on-site by a thermal desorption system with an afterburner.
- Contain exposed contaminated soil with contaminant levels exceeding inorganic and organic cleanup goals. Cleanup goals for LU-OU3 are the same as OU1 as shown on Table 2.
- Invoke institutional controls that will warn future property owners of the remaining contamination contained under capped areas on this property, require future owners and operators to maintain these caps, and specify procedures for handling and disposal of excavated contaminated soil from beneath capped areas if future excavation is necessary.
- Monitor groundwater quality semi-annually for 30 years, or until it has been demonstrated that groundwater contaminants will not reach the shoreline in concentrations exceeding cleanup goals. The groundwater data will be reviewed every 5 years to assess the effectiveness of the selected remedy.

Remedy Implementation

A Consent Decree for LU-OU3 was signed on December 8, 1994, and the remedial actions were completed on December 27, 1995. The LU-OU3 soils portion was deleted from the National Priorities List on November 7, 1996.

To warn future property owners of the remaining contamination, the Consent Decree requires that a certified copy of the Consent Decree be recorded in the appropriate King County office. Thereafter, each deed, title, or other instrument conveying an interest in a property included in the LU-OU3 is required to contain a recorded notice that the property is subjected to the Consent Decree (and any lien retained by the United States) and to reference the recorded location of the Consent Decree and any restrictions applicable to the property. Restrictive covenants have not been recorded for the Lockheed Uplands property.

All hot spot soils have been removed and areas with organics and inorganics exceeding soil cleanup goals have been capped.

Semi-annual groundwater monitoring has been conducted since 2005. The objective of the program is to monitor contaminants at and down-gradient of source areas.

System Operation/Operation and Maintenance

As part of the institutional controls, annual cap inspections and cap maintenance are required to ensure protection of on-site workers from dermal contact and reduce infiltration from rainwater. There are five capped areas at LU-OU3 that require annual inspections for cracks, breaches, and the presence of vegetation (Figure 6).

Maintenance was completed in the past 5 years to maintain cap integrity. A summary of the annual inspections is presented in Table 4 below.

Table 4. Summary of Annual Cap Inspections for LU-OU3

Year	Cap Area 1	Cap Area 2	Cap Area 4	Cap Area 5	Cap Area 6
2020	Very Good Condition. Small divots in asphalt but thickness remains over 7 inches.	Good Condition. Small divots in asphalt but thickness remains over 7 inches.	Good Condition. Minor weeds were observed; however, total cap thickness is over 3 feet.	Good Condition.	Good Condition. Weeds observed along western border.
2021	Very Good Condition.	Very Good Condition.	Good Condition. Minor weeds were observed; however, total cap thickness is over 3 feet, weeds unlikely to penetrate cap.	Good Condition.	Good Condition.
2022	Very Good Condition.	Good Condition.	Good Condition.	Good Condition.	Good Condition.
2023	Good Condition.	Good Condition. Small divots on the asphalt surface and minor cracks were observed.	Good Condition. Minor weeds and minor cracks were observed. The total cap thickness in this area is over 3 feet, weeds unlikely to penetrate cap.	Satisfactory Condition. Weeds observed along borders. Minor cracks observed.	Satisfactory Condition. Weeds observed.
2024	Very Good Condition. Small divots in asphalt but thickness remains over 7 inches.	Good Condition. Small divots on the asphalt surface and minor cracks were observed.	Good Condition. Minor weeds observed. The total cap thickness in this area is over 3 feet.	Good Condition.	Good Condition.

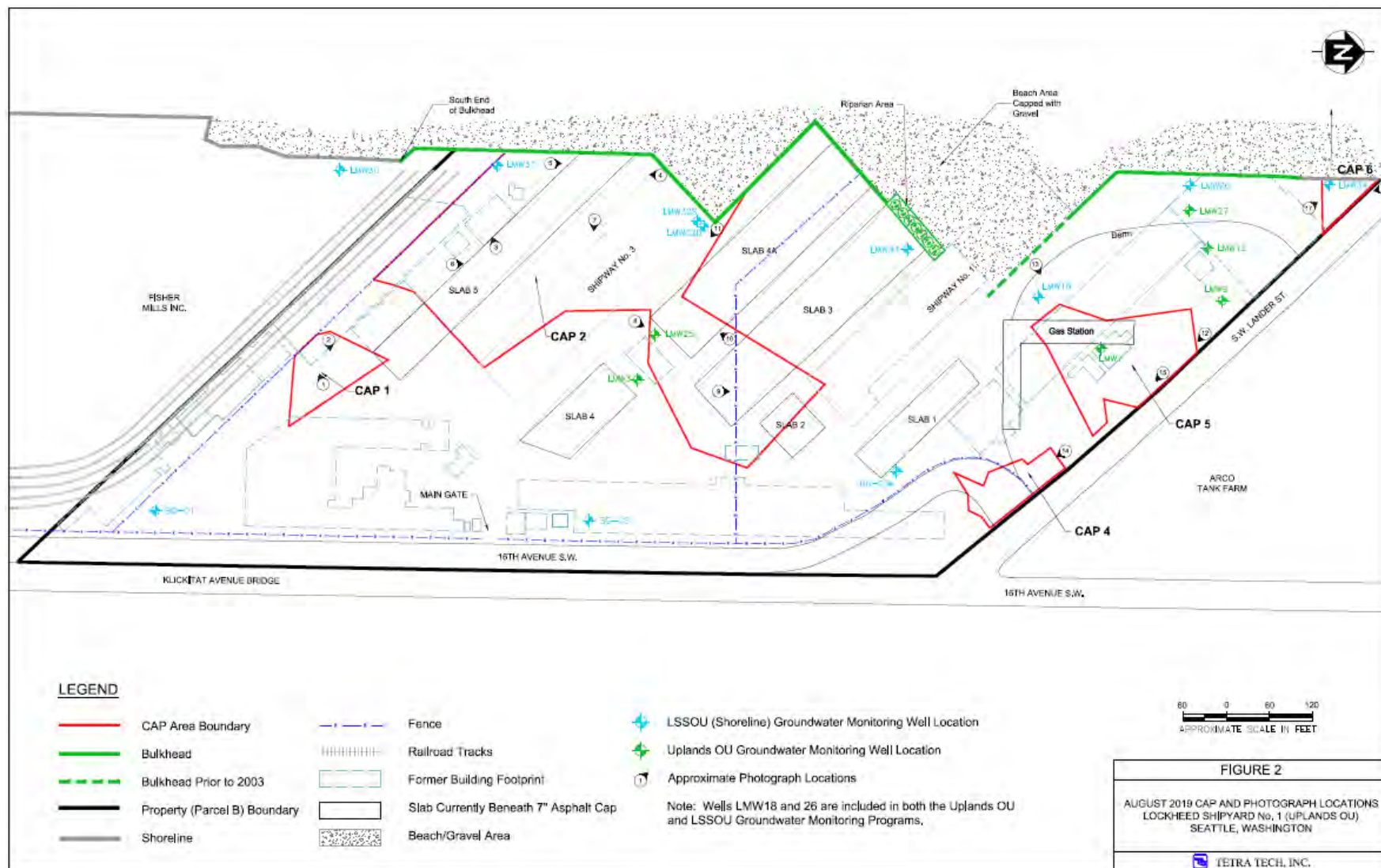


Figure 6. Locations of Asphalt Cap, LU-OU3.

2.2.4. Lockheed Shipyard Sediment OU7

Remedy Selection

The Shipyard Sediments OU ROD, which includes the Lockheed Shipyard and Todd Shipyard sediment areas, was signed by EPA on November 30, 1996. The RAO for the Shipyard Sediment OU was to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms.

The major components of the remedy for the Shipyard Sediment OU include the following:

- All sediment exceeding the State of Washington sediment management standards (SMS) Cleanup Screening Levels (CSLs¹) and all shipyard waste must be dredged and disposed of in an appropriate in-water or upland disposal facility.
- All remaining sediments exceeding the Sediment Quality Standards (SQS¹) of the SMS will be capped with a minimum of 2 feet of clean sediment.
- Dredging and cap design must minimize impacts to habitat and potential recontamination.
- Institution of long-term monitoring and maintenance of the remedy.
- The extent of dredging of contaminated sediments and waste under piers will be determined during remedial design (RD) based on cost, benefit, and technical feasibility.

Subsequent to the Shipyard Sediment ROD, EPA issued three ESDs with the following elements:

- December 27, 1999: Define the Lockheed Shipyard Sediment OU and the Todd Shipyard Sediment OU as separate OUs and provide remedial designs for the Todd Shipyard Sediment OU.
- February 12, 2002: Summarize results of pre-remedial design studies for the Lockheed Shipyard Sediment OU and define dredge and cap remedies for eight different sediment management units within LSS-OU7.

March 7, 2003: Establish Confirmation Numbers to distinguish contamination associated with the LSS-OU7 from that of the West Waterway OU (Table 5); summarize the long-term monitoring, maintenance, and operational parameters; and identify the disposal option for contaminated sediments.

Remedy Implementation

Remedial action at LSS-OU7 was completed in two phases. Phase 1 was completed on March 10, 2004, and Phase 2 was completed on February 4, 2005. The first phase of remedial construction was focused on pier demolition and dredging of contaminated sediments. The second phase consisted of dredging, capping, and habitat enhancement. During this remedial action, 119,064 tons of contaminated sediments were dredged and transported to an approved upland facility for disposal. Capping was implemented using approximately 100,000 cubic yards of capping material including the cap layer, toe buttress riprap, armor riprap, filter layer, armor layer, and fish mix.

¹ The State of Washington Sediment Management Standards includes two regulatory levels for managing sediments in Puget Sound. Cleanup Screening Levels (CSLs) are the level above which minor adverse effects occur in marine organisms and actions may be required. Sediment Quality Standards (SQSs; now referred to as Sediment Cleanup Objectives [SCOs]) corresponds to a level which has no acute or chronic adverse effects on marine organisms and define the cleanup goals for sediments.

Remedial activities were conducted as planned, and cleanup goals were obtained for the first phase of the remedial action (TRC Solutions, 2005). EPA conducted a final inspection on March 7, 2005. The final completed remedy for LSS-OU7 includes the following:

- Removal of all existing pier structures from aquatic areas of the OU and replacement of the existing deteriorated bulkhead to ensure upland soils remain stable.
- Dredging contaminated sediments from the channel and slope areas while maintaining stable slopes and critical habitat elevations.
- Removal of sediment with contaminant levels exceeding SCO criteria in the Open Channel Area, and placement of a 2- to 4-inch-thick enhanced natural recovery layer over any remaining sediments that exceed the SCO criteria.
- Capping of the Slope Area (Figure 7) such that the cap provides chemical and physical isolation of the underlying contaminated sediments and a final cap surface that is compatible with marine organisms.
- Capping of the Beach Area such that the cap will provide chemical and physical isolation of the underlying contaminated sediments and a final cap surface that is compatible with beach habitat.
- Construction of an on-site mitigation area and creation of intertidal habitat with clean soil in the vicinity of Pier 10 to mitigate habitat losses resulting from the partial filling of the South Shipway.
- Limited dredging and enhanced natural remediation of contaminated off-site sediments located adjacent to the OU; and a final substrate surface that is habitat compatible for marine organisms.

System Operation/Operation and Maintenance

The operation, maintenance, and monitoring requirements for the Lockheed Shipyard Sediment OU are laid out in the Site Operation, Maintenance and Monitoring Plan (OMMP) (EPA 2008, 2011, 2025). The goals of the OMMP are to ensure that the remedial actions continue to be protective of public health and the environment. The specific goals are to ensure that:

- The sediment cap continues to isolate toxic concentrations of previously identified contaminants in the underlying sediments from marine biota and other biological receptors.
- The sediment cap and the previously dredged open channel area do not become re-contaminated with contaminants from the underlying sediments or from the uplands adjacent to the LSS-OU7.

Physical integrity monitoring ensures that erosion is not occurring to the extent that would compromise the ability of the cap to physically isolate contaminated sediments from environmental receptors. Topographic and hydrographic surveys were conducted in Years 1 (2003), 3 (2005), 5 (2010), 10 (2015), and 15 (2020). After Year 5, topographic and hydrographic surveys are required once every 5 years per the OMMP.

Sediment quality monitoring is conducted to confirm that toxic concentrations of contaminants are not moving upward to the top of the cap via groundwater or other transport mechanisms. The chemicals of concern and their respective cleanup levels are presented in Table 5. Based on the OMMP, this monitoring included sediment traps and sediment grab samples. However, sediment traps were discontinued in 2008 (EPA 2008) due to heavy ship traffic resulting in the loss of deployed sediment traps. Sediment monitoring is currently conducted biennially.

Groundwater monitoring wells were installed along the bulkhead on the landward side. Groundwater data is analyzed to assess the quality of the groundwater entering the West Waterway from Harbor Island in general. This data is also used to evaluate the potential for contamination of the LSS-OU7 cap from the underlying sediment. Stormwater monitoring was conducted between 2011 and 2021 to determine whether contaminants transported from LU-OU3 via stormwater are impacting sediment quality in LSS-OU7.

Table 5. Cleanup Levels for LSS-OU7 Sediment

Contaminant of Concern	Cleanup Level	Confirmational Number ^a
Arsenic	57 mg/kg	93 mg/kg
Copper	390 mg/kg	390 mg/kg
Lead	450 mg/kg	530 mg/kg
Mercury	0.41 mg/kg	1.34 mg/kg
Zinc	410 mg/kg	960 mg/kg
Total LPAH	370 mg/kg OC (5,200 µg/kg dw)	780 mg/kg OC (13,000 µg/kg dw)
Total HPAH	960 mg/kg OC (12,000 µg/kg dw)	5300 mg/kg OC (69,000 µg/kg dw)
PCB Aroclors	12 mg/kg OC (130 µg/kg dw)	39 mg/kg OC (591 µg/kg dw)

Notes:

a. Sediment within the LSSOU must meet the cleanup level. Sediment associated with other sources outside the LSSOU must meet the confirmational numbers

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

OC = organic carbon

dw = dry weight

LPAH = low molecular weight polycyclic aromatic hydrocarbons

HPAH = high molecular weight polycyclic aromatic hydrocarbons

PCBs = polychlorinated biphenyls

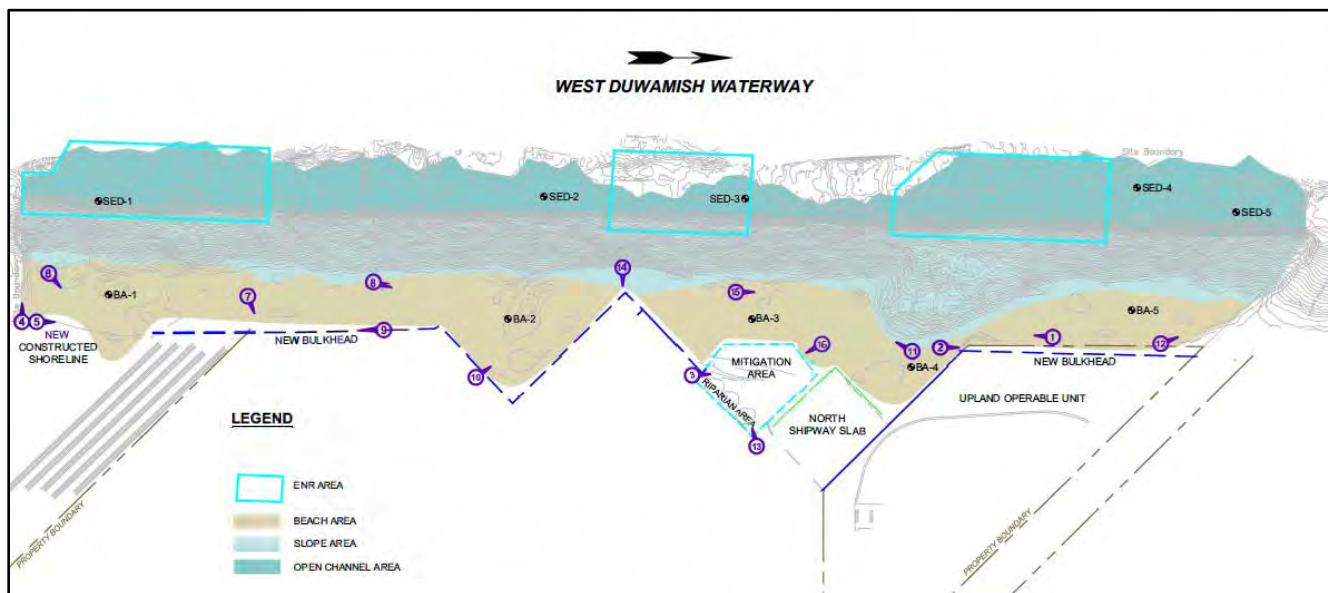


Figure 7. Lockheed Shipyard Sediment-OU7

2.2.5. West Waterway OU8

Remedy Selection

EPA issued a No Action ROD for the WW-OU8 on September 11, 2003. The ROD presents the basis for the determination that no CERCLA action was necessary at this OU to protect human health or the environment. Site conditions allow for unlimited use and unrestricted exposure. The No Action ROD did not include any requirements for institutional controls and did not require long-term monitoring and FYRs are not required for this OU.

2.2.6. Todd Shipyard Sediment OU9

Remedy Selection

The Shipyard Sediments OU ROD, which includes the Todd Shipyard Sediment area, was signed by EPA on November 30, 1996. The RAO for the Shipyard Sediment OU was to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms.

The major components of the selected remedy for the Shipyard Sediment OU includes the following:

- All sediment exceeding the State of Washington SMS Cleanup Screening Levels (CSLs²) and all shipyard waste must be dredged and disposed of in an appropriate in-water or upland disposal facility.
- All remaining sediments exceeding the Sediment Quality Standard (SQS²) of the SMS will be capped with a minimum of 2 feet of clean sediment.
- Dredging and cap design must minimize impacts to habitat and potential recontamination.
- Institution of long-term monitoring and maintenance of the remedy.
- The extent of dredging of contaminated sediments and waste under piers will be determined during RD based on cost, benefit, and technical feasibility.

Subsequent to the ROD, pre-remedial design studies for the TSS-OU9 better defined the nature and extent of contamination within the OU. The results of these studies indicated that certain elements of the ROD needed to be modified. EPA issued an ESD on December 27, 1999, to designate Todd Shipyard sediments as an independent OU identified as the TSS-OU9 and to redefine the boundary of the OU identified in the November 1996 Shipyard Sediment ROD based on additional information gathered during design investigations associated with this OU.

² The State of Washington SMS includes two regulatory levels for managing sediments in Puget Sound. CSLs are the level above which minor adverse effects occur in marine organisms and actions may be required. SQSs (now referred to as SCOs) corresponds to a level which has no acute or chronic adverse effects on marine organisms and define the cleanup goals for sediments.

On April 7, 2003, EPA issued a second ESD. The primary changes documented in this ESD were to:

- Further define the selected remedial action for the under-pier areas.
- Establish Confirmational Numbers characteristic of contamination present in the West Waterway for the purpose of defining the TSS-OU9 boundary.
- Summarize the long-term monitoring, maintenance and operational requirements for TSS-OU9.
- Define “predominantly abrasive blast grit”.
- Identify the disposal option.

The contaminants of concern and cleanup levels for the TSS-OU9 sediments are presented in Table 6.

Table 6. Cleanup Levels for TSS-OU9 Sediment

Contaminant of Concern	Cleanup Level	Confirmational Number ^a
Arsenic	57 mg/kg	93 mg/kg
Copper	390 mg/kg	390 mg/kg
Lead	450 mg/kg	530 mg/kg
Mercury	0.41 mg/kg	1.34 mg/kg
Zinc	410 mg/kg	960 mg/kg
Total LPAH	370 mg/kg OC (5,200 µg/kg dw)	780 mg/kg OC (13,000 µg/kg dw)
Total HPAH	960 mg/kg OC (12,000 µg/kg dw)	5300 mg/kg OC (69,000 µg/kg dw)
PCB Aroclors	12 mg/kg OC (130 µg/kg dw)	39 mg/kg OC (591 µg/kg dw)

Notes:

a. Sediment within the LSSOU must meet the cleanup level. Sediment associated with other sources outside the LSSOU must meet the confirmational numbers

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

OC = organic carbon

LPAH: low molecular weight polycyclic aromatic hydrocarbons

HPAH: high molecular weight polycyclic aromatic hydrocarbons

PCBs: polychlorinated biphenyls

Remedy Implementation

The remedy in TSS-OU9 included the demolition and removal of side-launch shipways and Piers 2 and 4S, as well as dredging and disposal of contaminated sediments above the State of Washington SCO values from the Open Channel sediment management areas (Floyd Snider McCarthy 2007a). In-water water fill was placed to reconstruct excavated slopes, as well as filling subtidal depressions created by the dredging. A clean sand cap was placed under Piers 4N, 5 and 6 that were remaining in place. Following construction, sediment samples were collected from the post-dredge sediment surface for analytical chemistry and toxicity testing. This remediation was conducted between 2004 and 2006, and in 2007 EPA determined that construction for the north and western portion of the TSS-OU9 had been completed in accordance with the remedial design plans and specifications.

An OMMP was developed for OU9, requiring visual surveys of the sand placed under the piers to confirm their stability and, if needed, chemical monitoring (Floyd-Snider McCarthy 2007b). The OMMP required 10 years of monitoring, which was completed in 2017. Based on the post-construction sediment chemistry and 10 years of monitoring, the requirements of the OMMP had been met.

In 2023, Vigor Marine completed remediation on the southwestern shoreline of the OU by removing Piers 1, 1A, 2P, and the Pier 1 shipways and constructing a habitat restoration project along the southwestern portion of the site (

Figure 8, Floyd Snider 2024). Sediments with concentrations exceeding the CSL were dredged from the project area, and an engineered cap placed over sediments with contaminants that exceeded the SCO but were still below the CSL. A 5- to 30-foot layer of fill material was placed in the Pier 1 area, creating a protected habitat bench. As part of the protected habitat, the capped area is protected from future disturbance in perpetuity with an environmental covenant between the Natural Resource Trustees and Vigor, which is a deed restriction on the property. The covenant ensures dedication of the SW Yard Project area as habitat to be maintained in perpetuity. It prohibits any activity that interferes with, damages or disturbs the integrity or maintenance of the habitat area, including any activity that causes the release or exposure to the environment of any hazardous substances. It additionally allows Natural Resource Trustee representatives the right to enter the SW Yard Project area to evaluate and inspect monitoring, operations and maintenance.

System Operation/Operation and Maintenance

Monitoring, as required by the OMMP was completed in 2017 and there is no additional required long-term monitoring for TSS-OU9 provided the sediments remain undisturbed.



Figure 8. Remedial Design for Todd Shipyard Sediment OU, Southwest Piers

2.2.7. East Waterway OU10

Remedy Selection

The East Waterway Interim ROD was signed on May 29, 2024. The RAO for the EW-OU10 is to reduce, through active remediation, concentrations of contaminants of concern in sediment greater than remedial action levels.

The major components of the remedy selected in the interim ROD include the following:

- Dredging 99 acres of contaminated sediment in the open water portions of the EW-OU10, equivalent to approximately 940,000 cubic yards of contaminated sediment removal. This includes 93 acres of dredging without backfill, 2 acres of dredging with backfill to existing contours, and up to 4 acres of dredging and backfilling in the Communication Cable Crossing.
- Capping 7 acres in the two Nearshore Areas, which may require some dredging to accommodate navigation and habitat elevation requirements.
- Placement of approximately 3 acres of a 9-inch enhanced natural recovery layer in the Sill Reach under the Spokane Street, West Seattle, and Railroad Bridges. Access in this area is limited by low-clearance bridges that restrict access by mounted dredges. The enhanced natural recovery design will be optimized, including consideration of an amendment such as activated carbon.
- Placement of in-situ treatment for contaminated sediments on over 12 acres of limited access space in Under-pier Areas.
- Monitored natural recovery in 36 acres, where contaminant concentrations are below the remedial action levels.
- The estimated time for construction is 10 years, assuming a 4.5-month construction window each year.

Remedy Implementation

The EW-OU10 remedial action has not yet been initiated, and this OU is not addressed further in this FYR.

3. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last five-year review (Table 7) as well as the recommendations from the last five-year review and the current status of those recommendations (Table 8).

Table 7. Protectiveness Determinations/Statements from the 2020 FYR

OU	Protectiveness Determination	Protectiveness Statement
S&G-OU1	Short-term Protective	The remedy at the Soil and Groundwater OU1 currently protects human health and the environment because the cap is in good condition, LNAPL is at low enough amounts to no longer be recovered from the groundwater, and long-term groundwater monitoring indicates that contaminants are not migrating to the East and West Waterways. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: • Complete and record environmental covenants for all capped properties. • Complete annual cap inspections and maintenance consistently.
TF-OU2	Short-term Protective	The remedy at the Tank Farms OU2 currently protects human health and the environment because multiple remediation methods are occurring to treat most contaminants, and restrictive covenants help ensure there is no exposure to OU contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: • Evaluate alternatives for remediating contaminants near the southwestern area wells of the Kinder Morgan property and determine if contamination is migrating off site. • After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any follow-up CERCLA remedial action may be necessary to assure protection of human health and the environment.
LU-OU3	Short-term Protective	The remedy at the Lockheed Upland OU3 currently protects human health and the environment because the cap integrity has been maintained, and groundwater studies indicate that contaminants are not impacting the waterway. However, in order for the remedy to be protective in the long-term, the following action need to be taken to ensure protectiveness: • Complete and record environmental covenants for capped areas of the property.
LSS-OU7	Short-term Protective	The remedy at the Lockheed Shipyard Sediment OU7 currently protects human health and the environment because the cap integrity has been maintained, and groundwater studies indicate that contaminants are not impacting the waterway. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: Evaluate new best management practices or investigate sources and opportunities to ensure that stormwater contaminants are not discharging onto the LSS-OU7 cap. • EPA will continue to monitor sediment concentrations and trends for these contaminants in the sediment on the open-channel surface area.
TSS-OU9	Protective	The remedy at the Todd Shipyard Sediment OU9 is protective of human health and the environment. The RAO to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms is being met by the sediment cap integrity being maintained, and dredging and capping is planned as intended by the ROD for remaining contaminated sediments underneath portions of the sediment cap.

Table 8. Status of Recommendations from the 2020 FYR

OU	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
S&G-OU1 LU-OU3	Appropriate restrictive covenants are not in place for all required properties.	Record completed UECA covenants on required properties.	Ongoing	All covenants are in place for OU1. EPA is working on restrictive covenants for OU3.	N/A
S&G-OU1	Cap inspection and maintenance reporting is inconsistent.	Submit reports for all cap areas to EPA on a consistent basis.	Completed	All inspection reports were received with the exception of the 2022 report for UPRR.	6/30/2025
TF-OU2	Groundwater concentrations of site contaminants exceed cleanup levels in western area wells, indicating natural attenuation may not be functioning as intended, and contamination may be migrating off site.	Evaluate alternatives for remediating contaminants in western area wells and determine if contamination is migrating off site.	Ongoing	Monitoring results and statistical reviews demonstrate that the Kinder Morgan plume (as well as Shell) is generally stable. Groundwater monitoring will continue.	N/A
TF-OU2	Current remedial action work is conducted solely by Washington State Department of Ecology. There is currently no CERCLA remedial action decision document for this OU.	After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any follow-up CERCLA remedial action may be necessary.	Ongoing	State-led cleanup actions are not complete.	N/A
LSS-OU7	Zinc and mercury continue to be detected above SCO criteria in solids in stormwater treatment effluent that discharges to the LSS-OU7 cap.	Evaluate new best management practices or investigate sources and opportunities to ensure that stormwater contaminants are not discharging onto the LSS-OU7 cap.	Completed	Mercury has not been detected above the SCO criteria in effluent. Zinc has been observed above the SCO in effluent but is not detected in LSS-OU7 sediments.	3/15/2023

Notes:

SCO = Sediment Cleanup Objective

Table 8 (cont'd). Status of Recommendations from the 2020 FYR

OU	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
LSS-OU7	Fine-grained sediments collected during the most recent sampling event in the open-channel area have mercury and total PCB concentrations greater than their respective SCOs. A general increase in total fines has been observed over the last five years. Evaluations have determined that sediment has deposited on the open-channel surface from sources outside the LSS-OU7.	EPA will continue to monitor sediment concentrations and trends for these contaminants in the sediment on the open-channel surface area.	Completed	Monitoring should be continued according to the OMMP.	8/1/2024
S&G-OU1 TF-OU2 LU-OU3 LSS-OU7 TSS-OU9	No site visit was conducted during the 2020 FYR review period due to COVID-19 travel restrictions.	Conduct a site visit to evaluate current site conditions as soon as possible.	Completed	A site visit was conducted by EPA and USACE as summarized in Section 4.4 and Appendix F.	3/27/2025

4. FIVE-YEAR REVIEW PROCESS

4.1. Community Notification, Involvement & Site Interviews

A public notice was made available by EPA in the West Seattle Blog, the Georgetown Gazette, and the South Seattle Emerald stating that there was a five-year review and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available on the EPA's website <https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=1000949>. A copy of the Public Notice is presented in Appendix D.

4.2. Site Inspection

The inspection of the Site was conducted on March 27, 2025. In attendance were Ravi Sanga, EPA; Bill Gardiner, Kayla Patten, and Ben McKenna of the USACE Seattle District; Vance Atkins, Washington State Department of Ecology; Brick Spangler, Port of Seattle; Mia Grasso, WSP USA in support of UPRR; John Grosevear, Vigor Marine; and Kate Snider, Floyd/Snyder in support of Vigor Marine. The purpose of the inspection was to assess the protectiveness of the various remedies. The Soil and Groundwater (OU1), Tank Farm (OU2), Lockheed Upland and Shipyard Sediment (OU3 and OU7), and Todd Shipyard Sediment (OU9) operable units were inspected.

The site visit to SG-OU1 included Terminal 18, the UPRR parcels, and Vigor Shipyards. Typical operations and maintenance, as well as activities since the last five-year review were discussed with representatives from each area. Cap inspections occur regularly at each property, and appropriate maintenance actions are taken as necessary. The asphalt caps at Terminal 18 and Vigor Shipyards are generally in good condition, though some standing water, plants, and cracks were observed in some areas during the inspection and are functioning as intended. The UPRR Parcel B is a ballast cap and appeared in good condition. The UPRR Parcel A showed damage to the asphalt cap with holes up to a foot deep with exposed soil in locations adjacent to the sheet pile wall. Holes and repaired holes were observed during annual cap inspections in 2023 and 2024. The associated bulkhead for Parcel A should be evaluated from below. At Vigor Shipyard, the LNAPL recovery operations have ceased, and the recovery system has been completely removed.

At TF-OU2, the BP and Shell properties were inspected; however, the Kinder Morgan site was not accessible to the team. At BP, the team observed the new seawall area, existing structures, and areas of institutional controls. Monitoring wells appeared to be accessible and in good condition. Pavement and impervious surfaces in the vicinity of the warehouse, where institutional controls are active, appeared to be in good condition. The team observed pipe outlets labeled for “foam”. Property access is restricted to employees and petroleum transporters. No changes to site use have occurred in the last five years. At Shell, the team observed the area of the 2022 Pump House release and 13th Ave. S.W. Monitoring wells appeared to be accessible and in good condition. Clean soil cap and impervious surfaces appeared to be in good condition. No changes to property use have occurred in the last five years.

At LU-OU3 the asphalt cap is in good condition and is being maintained. The habitat restoration and beach area cap at LSS-OU7 is in good condition.

At TSS-OU9, the newly created habitat appeared stable, protecting the capped material, and functioning as high-quality habitat. The other in-water portions of TSS-OU9 were not observed. A Site Inspection Report, including a discussion and photographs, is presented in Appendix F.

4.3. Interviews

During the Five-Year Review process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date. Interview forms were completed by representatives of the Port of Seattle, Vigor Marine, the Muckleshoot Indian Tribe, and the Suquamish Tribe. An interview form was provided to UPRR, but they did not provide responses. The results of these interviews are summarized below. Copies of the completed interview forms are provided in Appendix G.

Mr. Brick Spangler of the Port of Seattle commented that the remedy is functioning as intended. While the cap is showing some signs of wear in portions of T-18, it remains protective. The Port continues to conduct O&M inspections and maintenance.

Mr. John Rosevear of Vigor Marine commented on the activities related to the Harbor Island groundwater monitoring and Todd Shipyard Sediment Operable Unit. Wells MW-1R and FW-13 were decommissioned in July 2024; TD-06A is the only well remaining and will be monitored on 5-year basis by AECOM. Cap monitoring is being conducted annually. Both the covenant for the capped area and institutional controls were completed in 2020. With the completion of the SW Yard habitat restoration project, the OMMP monitoring is complete and no further monitoring is required. The remedy is functioning as expected and there is a continuous O&M presence at the site.

Mr. Shawn Blocker, representing the Suquamish Tribe, noted that while the Tribe neither supports nor opposes the interim remedy for the East Waterway, there is an expectation that the final remedy is consistent with the Lower Duwamish Waterway ROD. The remedies that are in place are functioning adequately. The Tribe would prefer to be included earlier in the process, particularly for early actions.

4.4. Data Review

Soil and Groundwater OU1

Groundwater sampling for the S&G-OU1 is conducted annually according to the modified groundwater monitoring plan (see Figure 3 for well locations). From the 2024 Annual Groundwater Monitoring and Sixth 5-Year Statistical Review Report, 16 wells were evaluated for concentrations and exceedances. Analyses include total metals (copper, lead, and zinc), and available cyanide. Volatile organic compounds (VOCs), and PCBs were only sampled once in 2024 during the last five-year period. The complete analyte list and ROD-specified cleanup goals are shown in Table 2. However, sampling for each compound was not completed on every well yearly during the past five-years: HI-7 had two sampling events; HI-9 had one event; HI-9A had three events and has since been decommissioned; HI-17 had two events; and MW-01R had three sampling events. There was an insufficient number of sampling events to conduct statistically valid trends analysis (Aziz et al. 2003) .

Exceedances of ROD cleanup goals over the last five years (2020 through 2024) include arsenic, cadmium, copper, lead, nickel, zinc, and available cyanide. The greatest exceedances were at HI-17 and included arsenic, cadmium, copper, lead, nickel, and zinc, which are the same elements that were in exceedance during the last five-year review. The greatest exceedance was copper with a concentration of 600 µg/L and a cleanup goal of 2.9 µg/L. HI-17 is in the center of the site near an old smelter where metals would have been deposited at high concentrations. Although the high concentrations of metals appear to be isolated to the area near HI-17, based on the northern groundwater flow direction, another well north of HI-17 may be useful to determine if the contamination is migrating. More frequent sampling of HI-17 may also be warranted.

Wells with contaminants of concern concentrations detected above the cleanup goal in the last five years were evaluated for trends using the Mann-Kendall nonparametric test (Table 9). Only wells with four or more detections during the last five years were evaluated. All of the Mann-Kendall results had either no trend, stable, or decreasing. Based on these results, it does not appear contaminants are migrating out of the OU boundary. One additional observation of the data is the specific conductivity for well HI-6A at 24,350 microsiemens per centimeter (µS/cm) is almost twice as high as the next highest well. This well is located next to the bulkhead or barrier wall on the north end of the island within UPRR Parcel A. This result might indicate a subsurface breach in the bulkhead that is allowing brackish sea water to mix with the groundwater. This well also showed levels of several metals and cyanide that exceeded ROD cleanup goals.

Additional data review and discussion for S&G-OU1 is presented in Appendix E.

Table 9. Mann-Kendall Trend Analysis (2020-2024) for S&G-OU1

Well	Constituent	Number of Data Points	Min to Max Concentration (µg/L)	Trend Test Result	Confidence Factor
TD-06A	Copper ¹	5	<0.39 to 15.4	No Trend	40.8%
HI-3	Copper ¹	5	<0.28 to 3.03	Stable	59.2%
HI-5	Copper ¹	5	<0.10 to 11.6	No Trend	50.0%
MW-213	Copper ¹	6	0.12 to 6.14	Decreasing ⁴	93.2%
TD-06A	Zinc ²	5	2.0 to 131	No Trend	59.2%
TD-06A	Cyanide ³	4	1.7 to 2.7	Stable	50.0%
HI-2	Cyanide ³	4	1.7 to <2.0	Stable	50.0%
HI-5	Cyanide ³	4	1.9 to <10	No Trend	50.0%
HI-6A	Cyanide ³	4	<2.0 to 4.1	No Trend	62.5%
HI-18	Cyanide ³	5	<2.0 to 2.9	No Trend	59.2%
MW-213	Cyanide ³	5	1.8 to 3.7	Stable	40.8%

Notes:

1. Copper cleanup goal = 2.9 µg/L
2. Zinc cleanup goal = 76.6 µg/L
3. Cyanide cleanup goal = 1 µg/L. The method reporting limit (MRL) for available cyanide (2 µg/L) exceeds the cleanup goal of 1 µg/L. The statistical analysis for cyanide was only evaluated if there was a value within the past 5 years that was not reported as non-detect (MRL = 2 µg/L). Otherwise, values were defaulted to 2 µg/L.
4. Decreasing trend with a confidence factor of 90% to 95%

Tank Farms OU2

The Tank Farms OU is comprised of three primary areas: BP, Kinder Morgan, and Shell. The data collected from each area is evaluated separately in the sections below.

BP

Monitoring wells at BP Plant 1 includes a network of groundwater wells. Performance monitoring at Plant 1 is conducted for TPH-G, TPH-D, TPH-O, benzene, cPAHs, groundwater elevations, and the presence of LNAPL. A total of 15 groundwater monitoring wells at Plant 1 are sampled at varying frequencies (Appendix B, Figure B-5).

Compliance wells AMW-01 through AMW-05 are adjacent to the West Waterway. Each of these wells met cleanup levels, with the exception of AMW-02, which had a single benzene exceedance. All other benzene detections for AMW-02 were either well below the cleanup level or not detected at laboratory reporting limits.

Concentrations in shallow wells were stable indicating that contaminants were not migrating off-site. A summary of results for wells with detections of benzene and TPH is presented in Appendix B, Table B-6 and includes trend analysis results and minimum and maximum contaminant concentrations between 2020 and 2025. Two of the fifteen wells exceeded the TPH-G cleanup level of 1,000 µg/L during the previous five years.

BP has also been conducting periodic monitoring of the ten Plant 1 recovery wells, as well as monitoring well GM-11S, located beneath and adjacent to the Warehouse. As of December 2024, eight of the wells met cleanup levels. Sheens were observed in three wells, but no product has been observed in those wells. Free product has not been observed, and sheens are limited to inconsistent occurrences.

At BP Plant 2, TPH-G concentrations at GM-19S have been below cleanup levels since 2007; benzene concentrations have been below the cleanup level since 2014. The well was removed in 2018. Groundwater monitoring data at BP Plants 1 and 2 show that concentrations of TPH-G and benzene are decreasing or stable.

Hydraulic Study: BP completed a hydraulic study at the Plant 1 in 2021 to evaluate potential changes after the installation of the new seawall in 2018 along the northern half of the waterfront. Twenty-three groundwater monitoring wells and a surface water stilling well were used to document water levels and salinity. The data was compared to data collected prior to wall installation. The results showed that the new seawall does not appear to have altered the groundwater gradient at the site. Groundwater flow at the TF-OU2 is generally west/southwest toward the West Waterway, with tidal effects. Additional analysis associated with the hydraulic study are presented in Appendix B.

King Tide Event: In late December 2022, extremely high tides combined with a storm surge event caused flooding along the BP Plant 1 waterfront (TechSolve, 2023) and temporarily raised the groundwater levels approximately two feet. In February 2023, an area of surficial soil staining and sheen was observed in the northwest corner of the OU near the north end of the sheetpile seawall. The staining was observed on both asphalt and gravel fill behind the seawall. Personnel visually inspected and pressure tested two active distribution lines and excavated a utility vault to assess if existing infrastructure was the cause of the sheen. Any soils associated with the utility excavation that exceeded State standards were disposed of off-site at a licensed facility. Based on the observations, pipeline testing, and analytical results from soil and groundwater samples, the petroleum associated with the surficial staining observed after flooding and high tide events was consistent with residual contamination associated with a historical release at Plant 1, and not a new release. The volume and affected area appear to be limited. No additional staining or sheens have been observed after subsequent king tide events. Additional information is presented in Appendix B.

Kinder Morgan

KM applies sulfate (as Epsom salts) to the soils in the remediation area (B, C and D Yards) on an approximately annual basis. The sulfate enhances anaerobic biological reduction of residual petroleum hydrocarbons in soil and groundwater. The two most recent applications consisted of 15,000 pounds each in October 2023 and November 2024. The application rate is approximately 0.8 pounds per square foot and is mobilized by an irrigation system or rainwater. Applications are normally conducted in the autumn at the beginning of the wet season. The applications are designed to maintain a target sulfate concentration of 900 mg/L.

The data review included annual groundwater monitoring reports from the previous five years and evaluating contaminant trends using the Mann-Kendall trend analysis. The groundwater compliance monitoring program consists of 39 wells sampled annually (Appendix B, Figure B-8), with nineteen of those wells sampled twice a year. Benzene exceeded the cleanup levels in four wells and TPH-G exceeded cleanup level in groundwater from 14 wells. (Appendix B, Table B-7). Monitoring well TMW-B1, located within or near the remedial application area, exhibited a decreasing trend during the 2020-2024 five-year period.

Elevated contaminant concentrations have been observed in both A-28R and MW-23 located outside of the southwestern edge of the property along 13th Ave. S.W., providing evidence for potential offsite migration. The nearest monitoring well, MW-24 downgradient of the A yard, also demonstrated concentrations of TPH-G and benzene in exceedance of the cleanup levels throughout the five-year monitoring period. However, concentrations of dissolved oxygen, methane, and ferrous iron in those wells also indicates that conditions are suitable for enhanced natural attenuation of petroleum.

The dissolved petroleum hydrocarbon contamination along 13th Ave. S.W. is located inland and is limited in extent. Further to the east, along the local downgradient direction of groundwater flow, monitoring wells such as A-23R, A-21, and A-14R (KM wells) and MW-111 (Shell wells, SH-04 area; Figure 5) have been either non-detect or below cleanup levels for these contaminants, indicating that the plume is not expanding and that there is no migration of groundwater contaminants to surface water. However, two wells on the eastern portion of the KM property (KM wells A-23R and A-21) had TPH-G concentrations above the cleanup levels (6,500 µg/l and 1,830 µg/l, respectively) during the second semi-annual sampling event (September 2024). While data from this area may indicate that the plume is not migrating offsite, this most recent data from 2024 suggests that monitoring in this area should continue to better understand the potential for plume expansion or migration.

Shell

Compliance groundwater monitoring is completed semi-annually at about 30 wells (Appendix B, Figure B-10). Samples are analyzed for BTEX, TPH, and natural attenuation parameters. Results above detection limits for the site contaminants of concern were evaluated using the Mann-Kendall trend analysis. The result of the Mann-Kendall and the minimum and maximum concentrations are presented in Table 10.

At the Shoreline Manifold Area, BTEX and PAH concentrations at the two deep compliance monitoring wells (MW-213 and MW-214) have remained below cleanup levels during the period of this five-year review.

Near 13th Ave. S.W., along the southwestern portion of TF-OU2 (Figure 5), contamination remains below cleanup levels. Monitoring well MW-05 contained no sample detections of benzene, and one sample was detected for TPH-G below the cleanup level. Both TPH-G and benzene were detected below cleanup levels in SH-04, and Mann-Kendall trend analysis indicates benzene concentrations are stable, and TPH-G is declining.

Contamination near monitoring well TX-03A declined from 2017 to 2019 during the operation of an air sparging system (Figure 5). Eleven monitoring wells: MW-301 through MW-304, MW-307 through MW-315, and TX-03A were used to monitor the contamination near TX-03A. Groundwater contamination concentrations decreased to below cleanup levels in five of eleven monitoring wells. However, since shutdown of the air sparging system, seven monitoring wells had increasing trends for benzene, and five had increasing trends for TPH-G with concentrations 3 to 4 times the cleanup level of 1,000 µg/L. These wells are located downgradient of TX-03A, and concentrations will likely continue to increase as groundwater migrates through the area.

Spills: There was a fuel spill near the Shoreline Manifold Area after the groundwater remedy was implemented. On October 1, 2020, an estimated 580 gallons of gasoline was released at the Pump House location. Shell and their contractors removed a combined 9,190 gallons of fuel and water during the response. Additional information regarding both spill events is presented in Appendix B.

April 2022 Joint Sampling Shell/Kinder Morgan: Shell and KM conducted a joint gauging/sampling of adjacent monitoring wells within the 13th Ave. S.W. area in April 2022. The water level gauging confirmed a groundwater divide with north/south flow near center of KM's C and D Yards and the southern third of Main Tank Farm.

Selected KM and Shell wells were sampled for petroleum hydrocarbons, BTEX compounds, and total lead. Concentrations of benzene were detected above the cleanup level in KM wells MW-23 and MW-24. The remaining sampled wells during the event did not have concentrations above cleanup levels for the analyzed contaminants (GHD, 2023). Based on the analytical results and groundwater flow measurements, intermingled plume conditions are not likely between the two facilities.

Additional data review and discussion for TF-OU2 is presented in Appendix B.

Table 10. Mann-Kendall Trend Analysis (2020-2024) for TF-OU2, Shell

Well	Constituent	Number of Data Points	Min to Max Concentration (µg/L)	Trend Test Result	Confidence Factor
MW-111	Benzene ¹	11	ND to 53.8	Increasing	97.0%
MW-112A	Benzene ¹	11	1.02 to 4.42	Stable	89.1%
MW-202	Benzene ¹	5	1.32 to 2.78	No trend/stable	88.3%
MW-301	Benzene ¹	20	3.33 to 110	Increasing	98.1%
MW-302	Benzene ¹	20	ND to 112	No trend/stable	80.7%
MW-303	Benzene ¹	20	2.58 to 366	Increasing	99.5%
MW-304	Benzene ¹	20	1.71 to 290	Increasing	98.6%
MW-307	Benzene ¹	20	ND to 160	Decreasing	99.6%
MW-308	Benzene ¹	20	ND to 129	Decreasing ³	93.6%
MW-310	Benzene ¹	20	5.23 to 39.2	Decreasing ³	92.3%
MW-311	Benzene ¹	19	ND to 3.74	Increasing	97.9%
MW-312	Benzene ¹	20	3.92 to 176	Decreasing	>99.9%
MW-314	Benzene ¹	13	ND to 5.84	No trend/stable	81.6%
MW-315	Benzene ¹	20	ND to 69.9	Decreasing	82.1%
SH-04	Benzene ¹	11	2.23 to 11.8	Stable	82.1%
TX-03A	Benzene ¹	19	4.99 to 241	Increasing	>99.9%
MW-111	TPH-G ²	11	89.8 to 490	Stable	53.0%
MW-112A	TPH-G ²	11	976 to 2,340	No trend/stable	67.6%
MW-202	TPH-G ²	10	488 to 3,470	Decreasing	96.4%
MW-301	TPH-G ²	19	114 to 1,690	Increasing	99.9%
MW-302	TPH-G ²	20	198 to 1,260	Stable	84.9%
MW-303	TPH-G ²	20	924 to 4,070	Stable	84.9%
MW-304	TPH-G ²	20	113 to 938	Increasing	>99.9%
MW-307	TPH-G ²	20	ND to 4,060	Stable	48.7%
MW-308	TPH-G ²	20	54.5 to 854	No trend/stable	68.5%
MW-310	TPH-G ²	20	343 to 1,610	Increasing	95.7%
MW-311	TPH-G ²	19	894 to 3,010	Increasing	>99.9%
MW-312	TPH-G ²	19	1230 to 3,610	Increasing ³	93.8%
MW-314	TPH-G ²	13	123 to 634	No trend/stable	68.4%
MW-315	TPH-G ²	20	ND to 4,090	Increasing	97.9%
SH-04	TPH-G ²	11	232 to 1,290	Decreasing	97.0%
TX-03A	TPH-G ²	19	129 to 2,840	Increasing	>99.9%

Notes:

1. Benzene cleanup level = 71 µg/L
 2. TPH-G cleanup level = 1000 µg/L
 3. Increasing or decreasing trend with a confidence factor of 90% to 95%
- ND = non-detect
TPH-G = total petroleum hydrocarbons, gasoline range

Lockheed Uplands OU3

There are 17 groundwater wells on the LU-OU3 property that monitor groundwater for the LU-OU3 remedy and are also used to evaluate potential off-site movement into the adjacent sediments in LSS-OU7 (Figure 9). For the LU-OU3 remedy, eight wells are sampled annually for VOCs and metals, three of which are also sampled semi-annually for PCE-only. For the LSS-OU7 remedy, 11 of these wells are sampled annually for VOCs, metals, and available cyanide, and every five years for VOCs, SVOCs, pesticides, PCBs, petroleum hydrocarbons, metals, and cyanide. Note, two wells are sampled for both OUs. For efficiency, Lockheed manages both efforts under one groundwater monitoring program. Accordingly, for this five-year review, all groundwater data was evaluated together and is presented in this section. Implications of the data for each OU is discussed in each respective section.

Of the 64 VOCs analyzed annually for in the past 5 years, only PCE was detected above the associated LU-OU3 cleanup goal or LSS-OU7 screening level. PCE concentrations were detected in three wells (LMW12, LMW26, and LMW27) with maximum concentration of 20 µg/L, slightly exceeding the LU-OU3 cleanup goal of 8.8 µg/L (and LSS-OU7 screening level of 3.3 µg/L). PCE concentrations during prior five-year review periods (2010 to 2020) were also elevated, relative to the cleanup levels.

For metals, there were sporadic exceedances of the total zinc and total lead cleanup levels; however, there were no exceedances in the dissolved phase. Concentrations for wells and constituents that exceeded cleanup levels during the previous five years (2020-2024) were either stable or had no trend (Table 11).

SVOCs, PCBs, chlorinated pesticides, and petroleum hydrocarbons were sampled from all 17 wells once in the last five years (June 2024). Of the 77 SVOCs analyzed only seven of the wells had SVOC compounds detected, and all reported concentrations were well below their associated LSS-OU7 screening criteria except for well LMW31 which had concentrations of chrysene (0.036 µg/L) and benzo(b)fluoranthene (0.029 µg/L) slightly above the cleanup level (0.018 µg/L for both). For PCBs and chlorinated pesticides, none were detected during the June 2024 sampling event.

For petroleum hydrocarbons, TPH-G, TPH-D, and TPH-O were analyzed. TPH-G was not detected at any of the 17 groundwater wells. TPH-D and TPH-O were detected at low concentrations in 10 of the 17 monitoring wells sampled with a range of 0.25 µg/L to 1 µg/L, all below the LSS-OU7 screening criteria of 500 µg/L.

Arsenic was reported below the cleanup level of 36 µg/L in all 17 of the monitoring wells sampled. However, 14 of the 17 wells showed dissolved concentrations of arsenic above the screening level for human health for consumption of organisms of 0.14 µg/L. The dissolved concentrations ranged from 0.52 µg/L in well BG-02 to 11 µg/L in well LMW32S.

Based on the VOC and metals analysis, the groundwater in LU-OU3 were generally within the cleanup goals, except for sporadic exceedances for PCE, copper, and nickel. Based on the trends analysis, concentrations in LS-OU3 groundwater are stable or decreasing.

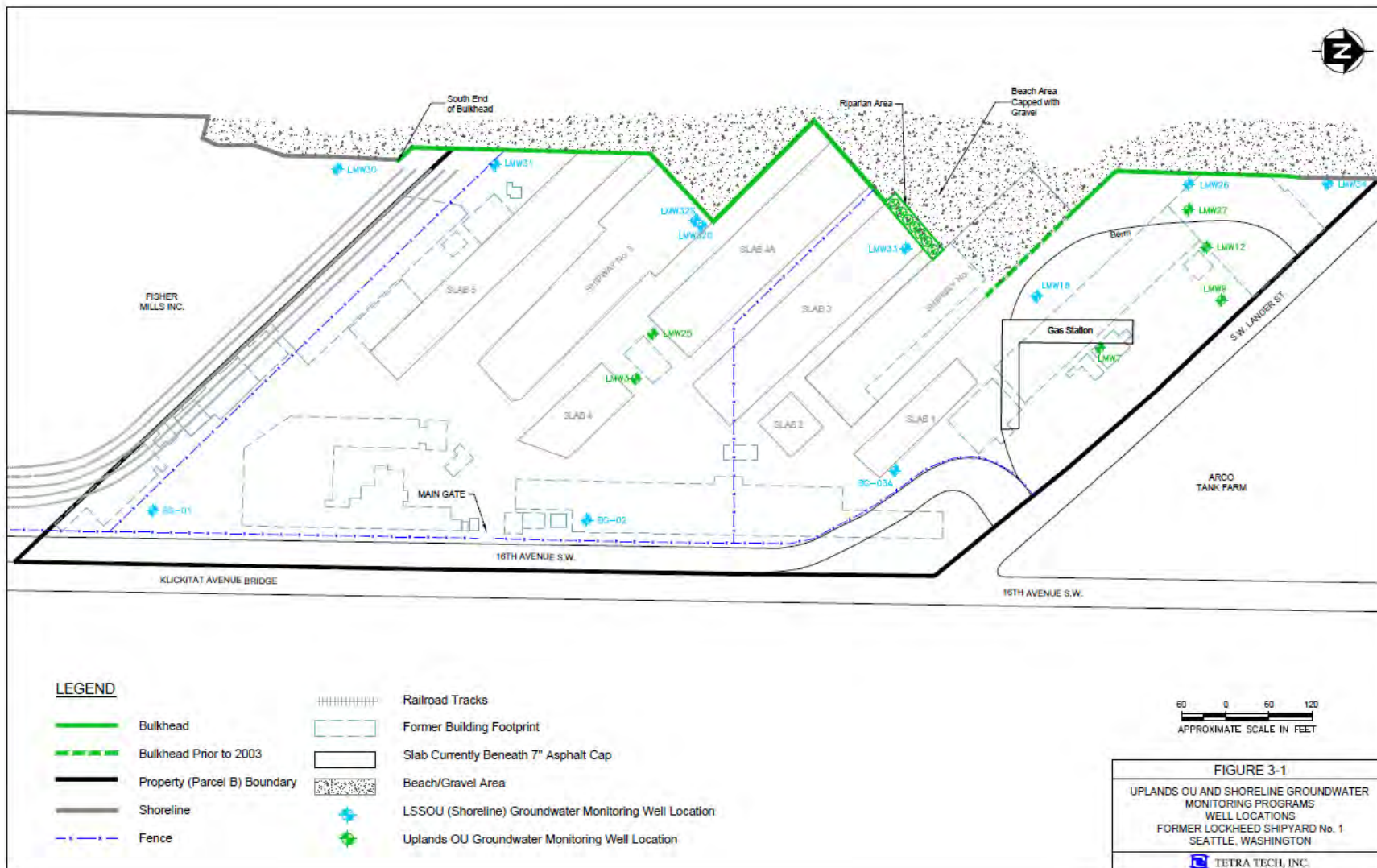


Figure 9. Upland and Shoreline Groundwater Monitoring Stations at LU-OU3

Table 11. Mann-Kendall Trend Analysis (2020-2024) for LU-OU3 and LSS-OU7

Well	Constituent	Number of Data Points	Min to Max ⁴ Concentration (µg/L)	Trend Test Result	Confidence Factor
LMW12	PCE ¹	8	11 to 20	No Trend	68.3%
LMW26	PCE ¹	9	5.8 to 12	Stable	72.8%
LMW27	PCE ¹	8	0.23 to 11	No Trend	80.1%
LMW3	Copper ²	4	ND to 10	Stable	50.0%
LMW9	Copper ²	4	ND to 10	Stable	50.0%
LMW12	Copper ²	4	2.9 to 10	Stable	50.0%
LMW18 ¹	Copper ²	4	2.9 to 10	Stable	72.9%
LMW26 ¹	Copper ²	4	2.3 to 10	Stable	50.0%
LMW27	Copper ²	4	0.82 to 10	Stable	50.0%
LMW30	Copper ²	4	2.9 to 10	Stable	50.0%
LMW31	Copper ²	5	4.5 to 49	No Trend	50.0%
LMW32S	Copper ²	4	ND to 10	Stable	50.0%
LMW32D	Copper ²	4	ND to 10	Stable	50.0%
LMW33	Copper ²	4	1.2 to 10	Stable	50.0%
LMW34	Copper ²	4	1.7 to 10	Stable	50.0%
BG02	Copper ²	4	ND to 10	Stable	50.0%
LMW26	Nickel ³	4	2.4 to 20	Stable	62.5%
LMW30	Nickel ³	4	ND to 20	Stable	83.3%
LMW31	Nickel ³	4	0.56 to 20	No Trend	62.5%
LMW32S	Nickel ³	4	0.62 to 20	No Trend	62.5%
LMW32D	Nickel ³	4	0.13 to 20	No Trend	62.5%
LMW33	Nickel ³	4	8.1 to 20	No Trend	50.0%
LMW34	Nickel ³	4	3.4 to 20	Stable	62.5%
BG02	Nickel ³	4	ND to 20	Stable	83.3%

Notes:

1. PCE cleanup goal = 8.8 µg/L; 2. Copper cleanup goal = 2.9 µg/L; 3. Nickel screening criterion = 8.2 µg/L

4. Maximum concentrations consistently reported for copper (10 µg/L) and nickel (20 µg/L) were 2022 laboratory limits of quantitation (LOQ), and results were U-qualified (non-detects)

ND = non-detect

Lockheed Shipyard Sediment OU7

Monitoring of the LSS-OU7 includes sediment elevation, sediment sampling and chemical analysis, and groundwater monitoring (wells located on LU-OU3 property). Sediment elevation inspections are conducted to evaluate the physical integrity of the Open Channel area and the Beach Area cap (Figure 10) and includes annual visual inspections of the Beach Area cap and elevation surveys of the entire OU every five years. Topographic surveys provide elevations for portions of the sediment surface that are above the tideline. Hydrographic surveys provide elevations for the lower intertidal and subtidal sediment. The most recent elevation survey was conducted in 2020.

Sediment from the nearshore cap and the offshore channel are collected to a sediment depth of 10 centimeters (cm) and submitted for chemical analysis of metals, PCBs, and PAHs. Chemical concentrations are then compared to the project specific cleanup levels (Table 5). A separate sample is collected if a clearly identified top layer of recently deposited material is present. During the period of this five-year review, chemical data was evaluated from sediment sampled in 2020, 2022, and 2024.

A comparison of Open Channel area hydrographic surveys between 2010 and 2020 indicate that elevations have not changed significantly. There appears to be approximately 5 to 8 inches of deposition of river sediments generally occurring across the OU (Figure 10). There was one small area of decreased elevation at the north end of the OU; however, this is an isolated area that was likely due to ship propwash rather than erosion. Elevations in the Beach Area cap indicate that the cap is intact. There was some localized deposition of 2 inches to 3 feet, likely due to episodic tidal and wave influences. Visual inspections of the Beach Area cap confirm the integrity of the beach habitat substrate, as well as the bulkheads and riprap.

Chemical analysis of sediment samples collected from the Beach Area cap indicate contaminants are being isolated by the cap. There were no cleanup level exceedances of metals, PAHs, or PCBs during any of the monitoring events that occurred in the last five years.

Sediments collected from the Open Channel area (which was dredged or had an enhanced natural recovery layer placed) had no detectable levels of arsenic, copper, lead, or zinc. PAHs were detected at concentrations below the cleanup levels. Concentrations of mercury and PCBs exceeded the screening levels in one or more stations over the past three monitoring events showed stable or increasing trends over time (Appendix E). Concentrations of total PCBs were above the cleanup level of 12 mg/kg OC in sediments from 2016 through 2022; however, in the 2024 sampling event, sediment from all five channel stations was below the cleanup level. The sediment grain size analysis and visual observations of surface sediments indicate that there has been deposition of fine-grained sediment on top of the coarser enhanced natural recovery material, suggesting deposition of upriver sediments. The concentrations observed in the Open Channel surface sediments were within the Confirmational Number (Table 5). Considering that the Open Channel stations are not on the LSS-OU7 cap (which ends at the Slope Area) and that the physical characteristics of the sediment samples are similar to more recent deposits, the observed exceedances do not necessarily indicate that remedial dredging missed contamination or that the enhanced natural recovery and shoreward caps have failed. However, the source of the increasing concentrations of PCBs and mercury are not known.

Groundwater sampling is conducted as a joint effort with the adjacent LU-OU3 groundwater sampling as described in the previous section. For the LSS-OU7 remedy, 7 wells are located along the shoreline (LMW-18, LMW-26, LMW-30 through LMW-34) and wells BG-01 through BG-3 located within OU3 (Figure 9). Groundwater samples collected in 2024 showed limited exceedances of screening criteria for PCE, copper and nickel, with concentrations showing no trend or a stable trend over time (Table 11). None of these metals are observed at elevated concentrations in the Beach Area or Channel Area sediments. The sediment quality in LSS-OU7 does not appear to be impacted by the groundwater from OU3.

As part of the T-10 Utility Infrastructure Upgrade Project in 2011, a stormwater treatment system was constructed which discharges onto the LSS-OU7 cap. As part of the best management practices, the Port monitored stormwater solids from 2011 to 2021. Although zinc concentrations in the captured stormwater solids were above the LSS-OU7 sediment screening level (410 mg/kg dw), the concentrations of zinc were below the sediment cleanup levels in the Beach Area or Open Channel surface sediments. The sediment quality in LSS-OU7 does not appear to be impacted by the stormwater from OU3.

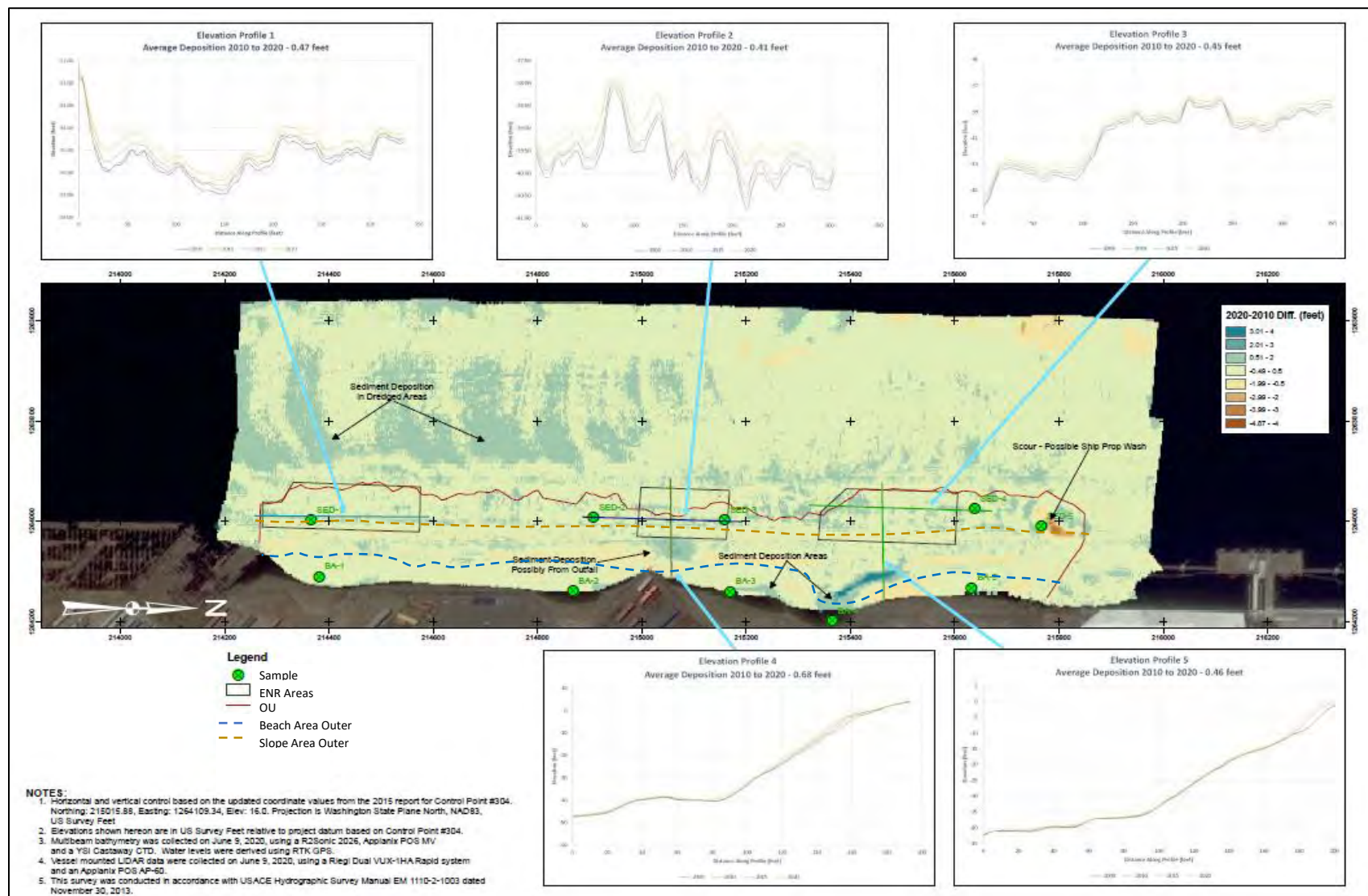


Figure 10. Changes in elevation between 2010 and 2020, LSS-OU7.

Todd Shipyard Sediment OU9

As part of the Southwest Yard habitat restoration project, contaminated sediment was removed from the area between the inner and outer harbor lines at the mouth of the Pier 1 shipway (Figure 11). Post-dredge sediment samples were collected following removal of sediment to confirm completion of dredging prior to placing cap material. Contaminants of concern in the final confirmation samples were below their respective cleanup levels. Two locations with contaminated surface sediments (represented by Stations SC-03 and SC-05) were covered with 12 to 23 feet of fill material followed by a minimum of 4 feet of armoring and habitat substrate. The entire habitat restoration project area was covered with 5 to 30 feet of clean fill material, armoring, and habitat substrate, resulting in a reduction of contaminant concentrations to levels that will have no adverse effect on marine organisms.

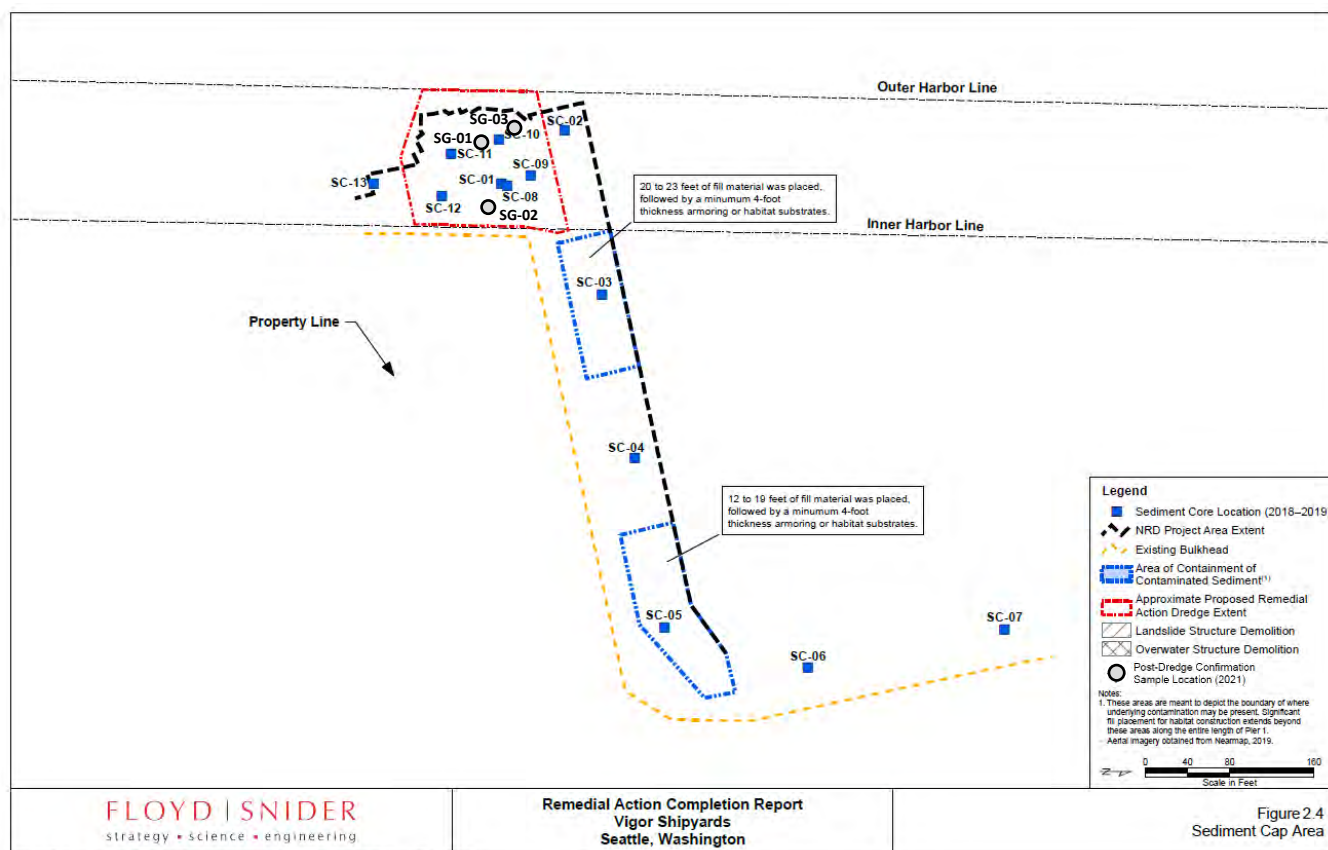


Figure 11. Location of Dredging Area, Confirmation Sample Stations, and Cap Areas.

5. TECHNICAL ASSESSMENT

5.1. QUESTION A: Is the remedy functioning as intended by the decision documents?

Soil and Groundwater OU1

Yes, the remedy is functioning as intended by the decision documents. However, cap inspections at the UPRR Parcel A in 2023 and 2024 noted holes and repaired holes in areas near the seawall, potentially indicating a persistent issue for this portion of the cap. Additionally, the specific conductivity for well HI-6A is almost twice as high as the next highest well. This well is located next to the bulkhead or barrier wall on the north end of the island within UPRR Parcel A, and this result might indicate a subsurface breach in the bulkhead that is allowing brackish sea water to mix with the groundwater. This well also showed levels of several metals and cyanide that exceeded ROD cleanup goals.

Groundwater monitoring is conducted semi-annually. The groundwater data over the last five years (2020 – 2024) showed exceedances of cleanup goals for arsenic, cadmium, copper, lead, nickel, zinc, and available cyanide. Over the last 5 years, wells with these detections have shown either no trend, stable trend, or decreasing trends. This indicates that contaminant concentrations have largely met asymptotic levels throughout most of the OU, and contaminants are not currently migrating out of the OU boundary.

The LNAPL system at Todd Shipyard has ceased operations was removed prior to the previous FYR.

Hot spot soils were removed by 2011. The ROD states that institutional controls are required for seven properties containing environmental caps to provide long-term maintenance of the caps, warn future property owners of remaining contamination, and specify procedures for handling and disposal of excavated contaminated soil. Appropriate institutional controls are in place for all properties at S&G-OU1.

Tank Farms OU2

Yes, the remedy is functioning as intended by the decision documents. Active and passive remediation is occurring at the facilities and contaminant concentrations appear to be generally stable or decreasing. However, increasing contaminant concentrations above cleanup levels at Shell in the TX-03A area indicate that monitored natural attenuation is not an adequate remedy to reduce contaminant concentrations in that area.

BP

A groundwater and LNAPL recovery system is located along the shoreline and was designed to pump shallow groundwater with drawdown extending to the bottom of the LNAPL smear zone, approximately 4 feet in total. Results of operation show that desired drawdown and hydraulic capture/control are being achieved along the waterfront despite reduction in pumping rates from some wells.

At BP Plant 1, groundwater compliance monitoring wells AMW-01 through AMW-05, located along the waterfront, have had concentrations below cleanup levels for TPH-G, TPH-D, and TPH-O for all quarterly groundwater monitoring events since installation. With the exception of well AMW-02, these wells have also been below cleanup levels for benzene. The single exceedance at AMW-02 was anomalously high, but within historic concentrations detected at that well. AMW-02 is currently in compliance, and benzene concentrations have been below its cleanup level since March 2023. Trend evaluations indicate that benzene concentrations at these wells are decreasing.

Kinder Morgan

Most of the contaminant trends in this area of the OU were stable or had no trend. TPH-G was detected above the cleanup level (1000 µg/L) in nine of the 39 wells.

The KM facility has implemented sulfate land application as a remediation system to increase biodegradation with applications on an approximately annual basis. The most recent applications were in October 2023 and November 2024. Passive free-product recovery using absorbent socks is also performed at select wells in the A Yard.

There were no increasing benzene and TPH-G concentration trends in analyzed wells. Monitoring well TMW-B1, located within the remedial application zone, had decreasing trends indicating the remediation is remaining effective.

Contaminant increases at A-28R and MW-23, located along the western edge of the property near 13th Ave. S.W. indicate contamination is not fully attenuating. However, downgradient wells show non-detect concentrations, indicating the contamination is inland and limited in extent. Monitoring well MW-24, also located near 13th Ave. S.W. had TPH-G and benzene concentrations above cleanup levels during all of the monitoring events during the past five years. Groundwater parameters collected from wells near 13th Ave. S.W. including dissolved oxygen, methane, and ferrous iron indicate conditions for natural attenuation is present, but the increasing trends with concentrations above cleanup levels indicates that monitored natural attenuation is not sufficient to reduce concentrations below cleanup levels.

Shell

At the Shoreline Manifold Area, BTEX and PAH concentrations at the two deep compliance monitoring wells have remained below cleanup levels during the previous five years. Near 13th Ave. S.W., along the southeastern portion of the site, contamination mostly remains below cleanup levels.

Contamination near monitoring well TX-03A declined between 2017 and 2019 due to an air sparging system operation. Petroleum and benzene concentrations have increased since the cessation of the system operation. Two of the wells, MW-312 and MW-315, had increasing trends for TPH-G and benzene above cleanup levels. These wells are located down gradient of TX-03A, and concentrations will likely re-equilibrate (stabilize) as the aerated groundwater from the air sparging system returns to an anaerobic condition. The plume extent appears to be generally stable, and contaminant exceedances have not been detected in downgradient monitoring wells.

Restrictive covenants for BP, KM, and Shell were recorded by these parties in accordance with the Consent Decree in 2000. The following limitations were imposed by the restrictive covenant: industrial zoning, groundwater shall not be used for any purpose inconsistent with the remedial action, existing structures shall not be modified to expose contamination, and site workers will be instructed to take precautionary actions to avoid direct contact with contamination.

Lockheed Upland OU3

Yes, the remedy is functioning as intended. Cap integrity has been maintained, and groundwater studies indicate that contaminants are not impacting the waterway.

Most of the contamination detected at the OU are below cleanup goals and none of the wells have increasing trends. The trend results were either stable or had no trend.

The 1994 Lockheed Uplands ROD required institutional controls for the capped areas of the OU. A review of the institutional controls indicates that the Consent Decree was recorded as required; however, there are no restrictive covenants in place mandating the necessary activities and limitations for protection of the asphalt cap.

Annual cap inspections are completed consistently. Maintenance items are completed as necessary to maintain cap integrity.

Lockheed Shipyard Sediment OU7

Yes, the remedy is functioning as intended. The sediment cap is in place and intact. Local upland sources do not appear to be a source to cap recontamination. However, there may be off-site sources that are depositing a fine layer of contaminated sediment in the Open Channel area.

The surface sediments from the Beach Area cap had no exceedances of the cleanup levels. During the most recent sampling in 2024, PCB and mercury concentrations in Open Channel area sediments were below cleanup levels except an isolated mercury concentration in one location that was below the 2003 ESD Confirmational Number.

As part of the T10 Utility Infrastructure Upgrade Project in 2011, a stormwater treatment system was constructed which discharges onto the LSS-OU7 cap. Zinc has been detected at concentrations above sediment cleanup levels in solids collected from traps within the treatment system. The Port implemented best management practices to help mitigate the problem, such as increased sweeping frequency, inspection of tenant's properties, and cleanup of the treatment system. Although zinc concentrations in the captured stormwater solids remains above the LSS-OU7 sediment cleanup level (410 mg/kg dw), zinc has not been observed at concentrations above the cleanup level in the Beach Area or Open Channel surface sediments. The sediment quality in LSS-OU7 does not appear to be impacted by the stormwater from OU3.

Institutional controls were not specified in the 1996 ROD, but the OMMP requires the potentially responsible parties to maintain OU access and required institutional controls including establishing a United States Coast Guard Restricted Navigation Area. This was established on April 10, 2012, as documented in the Federal Register.

Todd Shipyard Sediment OU9

Yes, the remedy is functioning as intended. All sediment above the State of Washington SCO levels has been removed from each of the SMAs, except for sediment under Piers 4N, 5 and 6 where a sand cap is in place. In 2024, Vigor removed Pier 1, 1A, and 2P areas. Two areas with sediment contamination were capped with over 20 feet of sand and habitat mix as part of a NRDA action. An environmental covenant was established between the Natural Resource Trustees and Vigor to maintain the habitat areas and to prevent any activities that might disturb the cap. All institutional controls required per the OMMP have been implemented for this OU.

5.2. 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?

Soil and Groundwater OU1

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used in the decision documents are still valid. Although some of the ARARs and toxicity data have changed, the changes do not affect the protectiveness of the remedy because the intact asphalt cap prevents exposure to contamination.

Changes in Standards: Cleanup goals specified in the ROD, along with changes in the standards, are shown in Appendix C. Cleanup goals for surface (depth less than 0.5 feet) and subsurface soil (depth greater than 0.5 feet) were primarily based on the State of Washington MTCA Method A, which specifies cleanup goals based on a risk of 10^{-6} for individual carcinogens or a hazard quotient of 1.0 for non-carcinogens. In 2001, MTCA amendments reduced the MTCA Method A soil criteria for TPH-G, cadmium, PAHs, arsenic, benzene, ethylbenzene, toluene, and xylenes. However, protectiveness of the remedy remains unchanged since the selected remedy limits exposure to soils through a cap and institutional controls.

Groundwater cleanup goals were based on the protection of marine organisms or human health from consumption of organisms. Since the 1993 ROD, there have been revisions to the standards for marine waters that have decreased groundwater standards for cadmium, thallium, lead, benzene, and trichloroethane. However, these changes do not affect the protectiveness of the remedy in SG-OU1 groundwater because engineered and institutional controls are in place to prevent exposure.

Changes in Toxicity and Other Contaminant Characteristics: EPA's Integrated Risk Information System has a program to update toxicity values used by EPA in risk assessment when newer scientific information becomes available. Risk-based values were used as the basis for cleanup goals for antimony, arsenic, cPAHs, and PCBs in surface soil. The oral slope factors for arsenic, cPAHs, and PCBs have changed since the ROD; however, protectiveness is unchanged since the selected remedy limits the exposure to soils through engineered caps and institutional controls.

Changes in Exposure Pathways: Land use at the OU remains industrial and there are no expected land use changes in the future.

Expected Progress Toward Meeting RAOs: The implemented remedy limits exposure to these soils through a low permeability cap and institutional controls. Additionally, there is no indication that groundwater with contaminant concentrations above cleanup goals are migrating to the shoreline.

Tank Farms OU2

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used in the decision documents are still valid. Although some ARARs have changed, those changes do not affect the protectiveness of the remedy because there is no exposure to groundwater at concentrations above the revised criteria. Additionally, groundwater at this OU was declared non-potable in the EPA ROD and in the Ecology CAPs.

Changes in Standards: Soil cleanup levels for the TF-OU2 are similar to those in the EPA cleanup levels for the S&G-OU1 and LU-OU3, which were established for Harbor Island. The basis for the lead cleanup level (MTCA A) has decreased; however, concentrations of lead have remained below this updated standard.

Groundwater cleanup levels were for "the chronic criteria for protection of aquatic organisms (WAC 173-201A) and Section 304 of the Clean Water Act" and were similar to the EPA cleanup levels for the S&G-OU1 and

LU-OU3. Since the CAPs have been completed, water quality standards for benzene, ethylbenzene, toluene, cPAHs, and lead have decreased. Ethylbenzene and toluene concentrations at TF-OU2 are below the revised standards. Remaining elevated concentrations of benzene and cPAHs are in areas of active and passive remediation. Therefore, based on the reduction in the criteria and recent sampling results, the remedy still remains protective.

Surface water standards are not available for TPH. The CAPs selected groundwater cleanup levels for TPH-G, TPH-D, and TPH-O to be protective of surface water. In 2001, MTCA revisions lowered the MTCA Method A groundwater cleanup levels for TPH-G, TPH-D, and TPH-O. However, these standards do not affect protectiveness, as the selected remedy limits the exposure to these soils through a low permeability cap and institutional controls.

Changes in Exposure Pathways: Exposure assumptions used in the CAPs remain valid. Assumptions included industrial zoning of the OU and the determination that there is no planned future use of the groundwater for drinking purposes.

PFAS were used in fire-fighting foams, as well as in a variety of other industrial applications (e.g., metal plating, textiles, paper and packaging, and food processing). Considering that a number of these activities occurred at Harbor Island and that outlets for “foam” were observed in the Tank Farms OU, there is a potential for PFAS releases at the Harbor Island site.

Expected Progress Toward Meeting RAOs: All accessible contaminated soil was removed. Groundwater contaminant concentrations in the BP area are generally below cleanup levels or showing stable or decreasing trends. The KM data shows that monitored natural attenuation appears to be functioning in groundwater contamination in the KM OU area, and the groundwater contamination plume appears to be stable. However, natural attenuation may not be adequately reducing contaminant concentrations which remain above the cleanup level in areas of passive remediation at the Shell OU area.

Lockheed Upland OU3

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used in the decision documents are still valid. Although some of the ARARs and toxicity data have changed, those changes do not affect the protectiveness of the remedy because there is no exposure to contaminated soil.

Changes in Standards: Cleanup goals for soil are similar to the S&G-OU1: MTCA Method C for industrial soil was applied to the surface soil (depth less than 0.5 foot) and MTCA Method A for subsurface soil (depth greater than 0.5 foot). In 2001, MTCA amendments reduced the MTCA Method A soil criteria for lead, cPAHs, arsenic, benzene, ethylbenzene, toluene, and xylenes. However, the selected remedy limits the exposure to these soils through a low permeability cap and institutional controls.

Groundwater cleanup goals were based on the protection of marine organisms or human health from consumption of organisms. Since the 1994 ROD, there have been revisions to the National Recommended Water Quality Criteria standards for marine waters that have decreased groundwater standards for benzene and lead. Detected concentrations of benzene and lead have been below the revised standard; therefore, this revision does not call into question the protectiveness of the remedy.

Changes in Exposure Pathways: The exposure assumptions used to develop the risk assessment remain valid. Assumptions included industrial worker incidental ingestion and dermal contact with contaminated soil. Capping of the OU has reduced the exposure to the remaining contaminated soils and institutional controls were required

to document the location of remaining soil contamination and procedures for handling and disposal of excavated soil from beneath the capped areas. Land use at the OU remains industrial and there are no expected land use changes in the future.

Expected Progress Toward Meeting RAOs: The selected remedy limits the exposure to these soils through a low-permeability cap. Additionally, there is no indication that groundwater with contaminant concentrations above cleanup goals is discharging to the shoreline.

Lockheed Shipyard Sediment OU7

Yes, the exposure assumptions and toxicity data used at the time of the remedy selection have not changed and are still valid.

Changes in Standards: The remedial action required for the LSS-OU7 was based on the presence of unacceptable risks to benthic organisms. Cleanup levels for the protection of benthic organisms were derived from Ecology regulations for sediment cleanups and have not changed since the ROD.

Changes in Exposure Pathways: There are no expected land use changes in the capped nearshore areas. Institutional controls are in place that prevent disturbance of the cap.

Expected Progress Toward Meeting RAOs: RAOs in the ROD and the subsequent ESDs were to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms. At the LSS-OU7, contaminated sediments were either dredged to native clean sediments or capped. Both remedial actions prevent exposure to humans, fish, shellfish, etc., either by removing the contaminated sediments or capping contaminated sediments remaining in place, and absent deposition of contaminated sediments from outside the remedial action area, should be meeting its RAO to reduce concentrations of hazardous substances for the protection of marine organisms. Based on post-cleanup sediment sampling of the cap and dredged area, all contaminants, except mercury and PCBs, were undetected. Recent sediment concentrations of mercury and PCBs were above the SCO in a few locations.

Todd Shipyard Sediment OU9

Yes, the exposure assumptions and toxicity data used at the time of the remedy selection have not changed and are still valid.

Changes in Standards: The remedial action required for the TSS-OU9 was based on the presence of unacceptable risks to benthic organisms. Cleanup levels for the protection of benthic organisms were derived from Ecology regulations for sediment cleanups and have not changed since the ROD.

Changes in Exposure Pathways: The recent completion of remedial action in the southwest shipyards area has removed contaminated sediment from the channel, Piers 1, 1a, 2P and shipways and covered the dredged surface with 5 to 30 feet of cap and habitat fill material. Contaminant pathways in this area are now removed.

Expected Progress Toward Meeting RAOs: RAOs in the ROD and the subsequent ESDs were to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms. Enhanced natural recovery under the north and northwest piers and dredging and capping have effectively met the RAO. Because the cap remains in place and stable, contaminant exposure to marine organisms is expected to be minimal or non-existent. Applicable areas of the TSS-OU9 have been well colonized by marine life.

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

No other information has come to light that could call into question protectiveness of the remedy.

6. ISSUES/RECOMMENDATIONS

ISSUES AND RECOMMENDATIONS				
Issues and Recommendations Identified in the Five-Year Review				
OU: S&G-OU1	Issue Category: Changed Site Conditions			
	Issue: Damage to the upland cap at UPRR Parcel A and increased conductivity in adjacent groundwater suggest impacts to the seawall integrity. Concentrations of some contaminants are above cleanup levels in well HI-6A.			
	Recommendation: Inspect the UPRR seawall and conduct a study to verify that there is no discharge of contaminated groundwater to Elliott Bay and determine whether adjustments to the remedy or O&M are needed.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA	9/30/2029
OU: S&G-OU1	Issue Category: Operations and Maintenance			
	Issue: Cap inspection and maintenance reporting is inconsistent.			
	Recommendation: Cap inspection reports must be submitted to EPA on a consistent annual basis. Develop notification and tracking system to record property owner, location, frequency, and results of cap inspections, and notify property owners of any deficiencies.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	9/30/2026
OU: TF-OU2	Issue Category: Remedy Performance			
	Issue: Groundwater concentrations of site contaminants exceed cleanup levels in Kinder Morgan and Shell area wells. Contaminant trends are generally stable at Kinder Morgan. Although contaminant concentrations are increasing at Shell, the location of the plume appears stable.			
	Recommendation: Evaluate contaminant concentration trends in Kinder Morgan and Shell area wells to determine efficiency of anaerobic natural attenuation and bio-sparging. If cleanup is not anticipated in a reasonable time frame, consider other appropriate technologies in the 13th Ave. S.W. and TX-03A areas.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	9/14/2035

OU: TF-OU2	Issue Category: Other			
	Issue: Current remedial actions are conducted solely by Washington State Department of Ecology. There is no CERCLA remedial action decision document recorded for this OU.			
	Recommendation: After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any follow-up CERCLA remedial action is necessary.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	9/14/2035
OU: TF-OU2	Issue Category: Operations and Maintenance			
	Issue: Historical land use is consistent with industries that have used per- and polyfluoroalkyl substances (PFAS). Foam nozzles have been observed in the Tank Farm OU.			
	Recommendation: Conduct an evaluation of potential PFAS release.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	9/14/2035
OU: LU-OU3	Issue Category: Institutional Controls			
	Issue: Appropriate restrictive covenants are not in place.			
	Recommendation: Record restrictive covenants on required properties.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	9/13/2030

6.1. OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and may improve management of O&M but do not affect current and/or future protectiveness:

- Develop a Harbor Island Site management plan to facilitate tracking of O&M responsibilities and institutional controls including Site inspection frequencies and responsibilities, ownership, covenants and institutional controls. The Site management plan should be updated annually to adjust to changes at individual properties.
- Update O&M plan to require that the elevation surveys at LSS-OU7 are conducted one year prior to the FYR, so that data can be used to support the FYR.

7. VII. PROTECTIVENESS STATEMENT

PROTECTIVENESS STATEMENTS	
<i>Operable Unit:</i> S&G-OU1	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Soil and Groundwater OU1 currently protects human health and the environment because the cap is in good condition and long-term groundwater monitoring indicates that contaminants are not migrating to the waterways. However, for the remedy to be protective in the long term, the following actions need to be taken to ensure protectiveness: • Inspect the UPRR seawall and conduct a study to verify its integrity, and • Update the O&M plan to ensure cap inspection reports are prepared and promptly provided.	
<i>Operable Unit:</i> TF-OU2	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Tank Farms OU2 currently protects human health and the environment because multiple remediation methods are effectively treating contaminants, and restrictive covenants ensure there is no exposure to site contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: • Evaluate contaminant concentration trends in Kinder Morgan and Shell area wells to determine efficiency of anaerobic natural attenuation and bio-sparging. Determine if groundwater will meet RAOs in a reasonable timeframe or if other appropriate technologies should be evaluated in the 13th Ave. S.W. and TX-03A areas. • After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any follow-up CERCLA remedial action is required, and if a decision document is necessary. • Evaluate the potential for PFAS release.	

<i>Operable Unit:</i> LU-OU3	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Lockheed Upland OU3 currently protects human health and the environment because the cap integrity has been maintained, and groundwater studies indicate that contaminants are not impacting the waterway. However, in order for the remedy to be protective in the long-term, the following action need to be taken to ensure protectiveness: Record environmental covenants for capped areas of the property.	
<i>Operable Unit:</i> LSS-OU7	<i>Protectiveness Determination:</i> Protective
<i>Protectiveness Statement:</i> The remedy at the Lockheed Shipyard Sediment OU7 currently protects human health and the environment because physical integrity of the cap has been maintained, and groundwater studies indicate that contaminants are not impacting LSS-OU7 sediments.	
<i>Operable Unit:</i> TSS-OU9	<i>Protectiveness Determination:</i> Protective
<i>Protectiveness Statement:</i> The remedy at the Todd Shipyard Sediment OU9 is protective of human health and the environment because dredging and capping has been completed to address remaining contaminated sediments underneath piers. The sediment cap integrity is being maintained, reducing concentrations of hazardous substances to levels that have no adverse effects on marine organisms.	

8. VIII. NEXT REVIEW

The next five-year review report for the Harbor Island Superfund Site is required five years from the completion date of this review. September 16, 2030.

Appendix A. List of Documents

- AECOM, 2025. *2024 Annual Groundwater Monitoring Report and Sixth 5-Year Review Report. Harbor Island Superfund Site – Soil and Groundwater Operable Unit*. January 17, 2025.
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Appendix B. Washington State Department of Ecology Tank Farms OU2 FYR Report

The following text was provided by Washington State Department of Ecology (Ecology) for incorporation into the Harbor Island Five Year Review being prepared by the EPA. Ecology manages the Tank Farms Operable Unit (TF-OU2) of the Harbor Island Site and completed a review specific to that operable unit. EPA incorporated Ecology's findings into the main text of this Five-Year Review. The original text (only modified for formatting) is provided below for reference.

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Executive Summary

TF-OU2

The Tank Farms Operable Unit 02 (TF-OU2) is being managed by the Washington State Department of Ecology (Ecology) Toxics Cleanup Program under Model Toxic Control Act (MTCA) Cleanup Action Plans (CAPs). The selected remedy at TF-OU2 included excavation of lead and arsenic contaminated shallow surface soil, and total petroleum hydrocarbons (TPH) contaminated hot spot soils and treatment/disposal of these soils off-Site; construction and operation of in-situ remedial systems to treat contaminated groundwater and the remaining contaminated soil, utilization of natural attenuation processes; long-term monitoring; and ICs.

Portions of the remedy are functioning as intended by the decision documents. Active remediation continues at the BP Plant 1 facility. A groundwater/LNAPL recovery system is located along the shoreline. In general, groundwater monitoring data at BP Plants 1 and 2 show that concentrations of contaminants are decreasing or stable, and most detections of contaminants have been below cleanup levels at their points of compliance within the last five years.

The Kinder Morgan (KM) facility has implemented sulfate land application as a remediation system multiple times over the last twelve years. The KM and Shell facilities also use passive free-product recovery at select wells on an as-needed basis. Monitoring wells located along the southwestern edge of the KM property near 13th Ave. S.W. have shown generally stable concentrations of contaminants over the last five years, indicating that the plume is generally stable and that source area remedial activities are having a positive effect.

Shell completed construction of a bio-sparging system within the TX-03A area in May 2017 and the system operated until December, 2019, and is currently offline for rebound evaluation.

Environmental covenants for BP, KM, and Shell have been recorded to restrict activities at these properties.

Changes to ARARs and toxicity data since remedy selection do not affect the current protectiveness of the remedy because ICs help prevent exposure to soils with contamination levels above the new standards, and contaminants in groundwater detected at concentrations above the new standards are located in remediation areas. There were no changes in exposure pathways.

The remedy at the Tank Farms OU2 currently protects human health and the environment because multiple remediation methods are occurring to treat most contaminants, and restrictive covenants help ensure there is no exposure to site contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness:

- Evaluate the rebound of contaminant concentrations at the Shell TX-03A area and determine if the plume is stable or potentially migrating.
- After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any CERCLA remedial action is required, and if a decision document should be recorded.

1. RESPONSE ACTION SUMMARY

1.1. Tank Farms OU2

Remedy Selection

TF-OU2 is comprised of three facilities (Figure 3):

- BP West Coast Products (formerly ARCO Bulk Fuel Storage Facility Harbor Island). Comprised of Plant 1 and Plant 2.
- KM Liquids Terminal, Harbor Island (formerly GATX Terminals). Comprised of Yards A through E.
- Shell Oil Products Seattle Terminal, Harbor Island (formerly Equilon Enterprises). Comprised of the Shell Main Terminal and Tank Farm, Shell's North Tank Farm area (located 300 feet north of Shell's Main Tank Farm) and Shell's Shoreline Manifold area (located 1,200 feet north of Shell's Main Tank Farm).

Consent Decrees and Cleanup Action Plans (CAPs), which Ecology issues that are similar to EPA RODs, were established with property owners during 1999 and 2000. Indicator hazardous substances identified within the TF-OU2 included:

- Soil: TPH (shallow and subsurface soil), arsenic (shallow soil), and lead (shallow soil).
- Groundwater: Free product/sheen; TPH gasoline, diesel, and oil range; benzene, toluene, ethylbenzene, xylenes, carcinogenic PAHs, and lead.

Cleanup levels for these substances were established in the CAPs for each property within TF-OU2 and were mostly identical to cleanup levels established in the EPA RODs for S&G-OU1 and LU-OU3. The cleanup levels for soil were considered protective of industrial worker exposure. The cleanup levels in groundwater were considered protective of surface water (aquatic organisms in Elliott Bay). The specific cleanup levels for each property within TF-OU2 and the associated constituents are listed in Table 3 below.

Table 3. Cleanup Levels for Tank Farms OU (µg/L (groundwater) & µg/kg (soil))

Medium	Substance	Kinder Morgan	BP	Shell	Source
		Cleanup level			
Surface Soil	Arsenic	32,600			ROD – OU1
	Lead	1,000,000			ROD – OU1
	Total TPH	10,000,000			MTCA A
Subsurface Soil	Total TPH	20,000,000			MTCA A
Groundwater	Product	No sheen			MTCA & Ambient Water Quality
	Benzene	71			WAC 173-201A
	cPAHs	0.031			Clean Water Act Section 304
	Copper	2.9			Clean Water Act Section 304
	Ethylbenzene	29			Clean Water Act Section 304
	Lead	5.8			Clean Water Act Section 304
	Toluene	200			Clean Water Act Section 304
	TPH-gas	10			MTCA A
	TPH-diesel	10			MTCA A
	TPH-oil	10			MTCA A

The objectives of the remedial actions were to remove all accessible contaminated soil and to achieve groundwater cleanup levels at the shoreline areas and inland property boundaries.

The selected remedial components included:

- Excavate and remove shallow surface soil (6 inches) in areas exceeding 1,000 parts per million (ppm) lead and/or 32 ppm arsenic.
- Excavate and remove accessible surface and subsurface soil in areas exceeding 10,000 ppm total TPH at identified areas adjacent to the shoreline and inland where a large release occurred in 1996. Excavate and remove soil exceeding 20,000 ppm total TPH throughout all other inland areas. An overriding consideration regarding excavation of contaminated soils was to avoid any risk to the petroleum storage tanks and pipelines.
- Construct and/or operate *in-situ* remedial systems to treat contaminated soil and groundwater. The systems include free product/groundwater recovery, air sparging, and soil vapor extraction (SVE) components and supplemental active free-product recovery by passive methods in specific wells as needed.
- Utilize natural attenuation processes to reduce contaminant levels in soil and groundwater. This was an inherent part of the remedy for inaccessible contaminated soils left in place to avoid risk to infrastructure.
- Perform long-term groundwater monitoring, examine wells for free product, measure groundwater elevations at wells, and construct seasonal groundwater flow maps. Analyze groundwater samples for contaminants of concern (TPH-G, TPH-D, TPH-O, BTEX, cPAHs, arsenic, lead). Also analyze for natural attenuation parameters (dissolved oxygen [DO], oxidation reduction potential [ORP], carbon dioxide, methane, ferrous iron, nitrate, sulfate, alkalinity) to evaluate natural attenuation processes.

- Institute Restrictive Covenants. The restrictive covenants identified the contamination that existed at each property, provided for the continued industrial use of the property, prohibited groundwater taken from the property, provided for the safety and notification of on-site workers, prohibited activities that would release or cause exposure to contamination, provided for continuance of remedial actions given property transference, and provided for Ecology access.

Remedy Implementation

Removal of Lead-Arsenic Contaminated Surface Soil

Excavation of near-surface lead-arsenic contaminated soil in areas throughout the main tank farm at the Shell facility was completed December 2003 through February 2004. Approximately 2,929 tons of impacted soil were removed and disposed of at the Roosevelt Regional Landfill in Klickitat County, Washington. Soil cleanup standards for lead (1,000 ppm) and arsenic (32 ppm) were achieved throughout this area. A small area of lead-contaminated soil near an oil-water separator at the Shell facility was excavated during October 2001, and approximately 75 tons of impacted soil was removed. Due to structural constraints, lead levels in some subsurface soil remains above the lead standard in this area and it was capped with 3 inches of low-permeability asphalt.

Excavation of near-surface lead-arsenic contaminated soil throughout large areas in B and C Yards at the KM facility was completed April through May 2002. Approximately 11,094 tons of impacted soil was removed and disposed of at the Waste Management Columbia Ridge Landfill and Recycling Facility in Arlington, Oregon. Soil cleanup standards for lead (1,000 ppm) and arsenic (32 ppm) were achieved throughout these areas.

No removal of lead/arsenic contaminated surface soil was required at the BP facility.

Removal of TPH Contaminated Surface and Subsurface Soil

All TPH “hot spots” identified in the original RI work and CAPs have been addressed. A description of the removals is presented below. Numerous discrete areas of TPH-contaminated soil above established cleanup standards were identified throughout all three tank farms. Impacted soil with concentrations above applicable standards was removed in areas and transported to appropriate facilities off-site for treatment or disposal. Some subsurface soil with concentrations above applicable standards remains in most of these areas because of the safety constraints imposed on excavating by existing structures (primarily the aboveground tanks).

Remedial actions along the Plant 1 waterfront have reduced or removed most of the preexisting soil impacts in the unsaturated zone and that no free LNAPL has been detected in the groundwater during the last five years. The current remedial system may have recovered LNAPL to the extent practicable and further operation of the existing groundwater pump and treatment system may be unlikely to provide additional environmental benefit.

A new seawall was installed in 2018 on the border of the OU which now extends down to about -66 feet MSL. This is a deeper subsurface barrier to groundwater discharged to the surface of west waterway than before. Ecology is evaluating continued operation of the LNAPL recovery system based on the findings of the hydraulic evaluation of the new seawall.

Construction and Operation of In-Situ Remedial Systems

A summary of the remediation systems that have operated or are currently operating at TF-OU2 is as follows:

- A free product recovery and vapor extraction system operated at the shoreline in the Shoreline Manifold area of the Shell facility prior to the Consent Decree until 2005 when product was no longer observed and hydrocarbon recovery through vapor extraction declined.
- A point-source free product recovery at the KM facility A and B Yards operated from October 2002 through 2004 when product was no longer observed.

- An air sparge system consisting of 16 sparge wells at the KM facility C Yard operated from October 2002 through August 2004 when groundwater cleanup standards had been achieved and maintained.
- An SVE/air sparge system at the KM facility A Yard started up in 2006 and operated until 2010.
- A free product recovery and vapor extraction system at the bulkhead area of BP Plant 1 has been operating since 1992. The system was expanded in 2003 as a requirement of the CAP to include greater capacity for free product/groundwater recovery and add vapor extraction and air sparging components and continues to operate at present.
- An SVE system at BP Plant 1's southern boundary operated from 2008-2014. In 2018, a partial decommissioning of the SVE System occurred.
- Passive free product recovery is occurring at the KM and Shell facilities.
- Sulfate Land Application continues with application of Epsom salt at KM on a roughly annual basis, which was also implemented in 2013 and 2015, at Yards B, C, and D to enhance biodegradation of petroleum products. The most recent applications were in October, 2023 and November, 2024.
- A bio-sparging system installed in the Shell terminal, within the TX-03A area operated between 2017 and 2019 and is currently undergoing rebound monitoring.

Natural Attenuation

Monitored Natural Attenuation (MNA) has occurred at 13th Ave SW right of way at the SH-04 area by the KM and Shell facilities. Select wells are analyzed for indicator parameters to evaluate natural attenuation processes. These included dissolved oxygen, ferrous iron, methane, sulfate, sulfide, carbon dioxide.

Declining contaminant levels in some wells near remaining areas of subsurface TPH contamination provide evidence that natural attenuation is occurring in these areas.

Groundwater Monitoring

Numerous monitoring wells at the tank farms were in place prior to the Consent Decrees and additional wells were installed afterwards. Monitoring wells throughout the tank farms were regularly examined for free product and/or sampled for the contaminants of concern and natural attenuation parameters. Wells designated for particular monitoring activities are specified in the Groundwater Compliance Monitoring Plan for each facility. Two compliance monitoring wells in the Shoreline Manifold area at the Shell facility and five compliance monitoring wells in Plant 1 at the BP facility are screened in groundwater at depths below the bottom of each bulkhead to monitor possible discharge of contaminants to surface water. Other monitoring wells are screened at the water table.

Institutional Controls

Institutional Controls were required in the form of Restrictive Covenants (now called Environmental Covenants) for each facility and were required to be written and recorded 10 days after the signing of each Consent Decree. The restrictive covenants for BP, KM, and Shell were filed with King County on August 15, 2000, August 30, 2000, and October 5, 2000, respectively.

System Operation/Operation and Maintenance

The Operation and Maintenance (O&M) procedures specific to each system are presented in O&M manuals prepared for each system. General system operations and maintenance activities along with the operating and performance parameters for each system are presented in required quarterly reports.

BP

Recovery wells have experienced pumping rate reductions in recent years, attributed to biological fouling in the shallow aquifer due to high concentrations of iron and sulfate present in the brackish water along the waterfront. During the previous five years annual average flow rates ranged from 0.9 gpm in 2022 to

0.91 gpm in 2023. The system operated at a maximum annual average flow rate of 11.2 gpm in 2005.

Maintenance is performed on the wells and pumps to maintain and improve groundwater capture and to ensure that adequate drawdown is achieved.

Kinder Morgan

Passive free product recovery using absorbent socks continues and is currently performed at select wells within the A Yard when sheen or product is observed.

Shell

There are currently no active recovery systems at Shell. Passive free-product recovery continues in the Shoreline Manifold area on an as needed basis.

2. Progress Since the Last Review

Table 4. Protectiveness Determinations/Statements from the 2015 FYR

OU #	Protectiveness Determination	Protectiveness Statement
2	Short-term Protective	The remedy at the Tank Farms OU2 currently protects human health and the environment because active remediation or MNA is treating contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: • Evaluate post-shutdown rebound of biosparging remediation at the area near well TX- 03A and implement additional remediation if determined appropriate by Ecology in coordination with EPA. • Evaluate potential for plume migration in 13th Ave SW.

Table 5. Status of Recommendations from the 2015 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
2	Elevated COC concentrations and a lack of decreasing trends indicate that MNA may not be able to reach cleanup levels in the TX-03A area	Evaluate restart of bio-sparging active remediation at the area near well TX-03A and implement additional remediation if determined appropriate by Ecology in coordination with EPA.	Ongoing	A bio-sparging system within the TX-03A area was operated between 2017 and 2019. Post-remediation sample results have increased to greater than CULs.	May 25, 2026
	Evaluate potential plume migration in 13 th Ave SW area.	Evaluate if increasing concentration trends are present in the 13 th Ave SW area.			

3. Five-Year Review Process

3.1. Data Review

Tank Farms OU2 Data Review

BP (SeaPort Midstream Partners)

Performance monitoring at Plant 1 includes groundwater monitoring for TPH-G, TPH-D, TPH-O, benzene, cPAHs, groundwater elevations, and the presence of LNAPL. The groundwater monitoring program at Plant 1 includes 15 wells sampled at varying frequencies (Figure 5). In addition to the annual monitoring a soil and groundwater study (Waterfront Probing Study) was completed in 2019 at Plant 1 to evaluate the extent of contamination remaining from an LNAPL plume, as discussed in the 2020 Periodic Review.

Plant 1 compliance wells (AMW-01 through AMW-05), completed into the marine sediments below the Site, meet standards, both for Site cleanup levels and State MTCA Method A CULs. These wells have met the standards since the prior Periodic Review, with the exception of AMW-02, which had a single benzene exceedance. All other benzene analyses for AMW-02 during that time period were either well below the Site CUL or not detected at laboratory reporting limits. There were no shallow performance wells with increasing contaminant trends, indicating contamination at the site is stable and not migrating off site. Table 6 has a summary of the trend analysis results and maximum and minimum concentrations of contaminants during the previous five years. The most common contaminant above cleanup levels was TPH with two of the fifteen wells exceeding the cleanup level of 1,000 µg/L during the previous five years.

BP has also been conducting periodic performance monitoring of the ten Plant 1 recovery wells, as well as monitoring well GM-11S, located beneath and adjacent to the Warehouse. As of December 2024, eight of the wells met Site cleanup levels. Sheens were observed in three wells, but no product has been observed in those wells. Free product has not been observed at the Site and sheens are limited to inconsistent occurrences.

At BP Plant 2, TPH-G concentrations at GM-19S have been below cleanup levels since 2007 and benzene concentrations were below the cleanup level since 2014. The well was removed from the monitoring program in 2018.

In general, groundwater monitoring data at BP Plants 1 and 2 show that concentrations of TPH-G and benzene are decreasing or stable.

Table 6. Mann-Kendall Trend Analysis (2020-2024), TF-OU2, BP (SeaPort Midstream Partners)

Well	Constituent	# Data Points	Min-Max Concentration (µg/L)	Trend Test Result	Confidence Factor
AMW-02	Benzene ¹	20	0.5 to 200	Decreasing	95.0%
GM-14S	Benzene ¹	20	0.5 to 1900	Increasing	95.0%
MW-3-T9	Benzene ¹	10	0.5 to 17	No Trend	95.0%
GM-14S	TPH-G ²	20	280 to 3000	No Trend	95.0%
GM-24S	TPH-G ²	20	190 to 2300	No Trend	95.0%
GM-15S	TPH-G ²	10	50 to 300	No Trend	95.0%
GM-16S	TPH-G ²	10	50 to 140	No Trend	95.0%
AR-03	TPH-G ²	10	5 to 740	No Trend	95.0%
MW-1-T9	TPH-G ²	10	87 to 480	No Trend	95.0%
MW-2-T9	TPH-G ²	10	56 to 760	No Trend	95.0%
MW-3-T9	TPH-G ²	10	410 to 740	No Trend	95.0%

1. Benzene site specific cleanup level = 71 µg/L

2. TPH-G site specific cleanup level = 1000 µg/L

Hydraulic Evaluation Report:

TechSolve completed a hydraulic study at the Site in 2021 to evaluate potential Site changes after the installation of the new Seawall in 2018 along the northern half of the waterfront. Twenty-three groundwater monitoring wells and a surface water stilling well were incorporated into the study to document water levels and salinity. The data was compared to available data collected during prior studies at the Site. The results showed that although the new seawall has localized impacts at the Site, the seawall does not appear to have altered the groundwater gradient at site. Groundwater flow at the Site is generally west/southwest toward the west waterway, with visible tidal effects.

Localized mounding was observed behind the seawall, as well as limited preferential flow between the ends of the new seawall and existing foundation wall under the warehouse, as well as around the southern wooden bulkhead, south of the warehouse.

Locally attenuated tidal response/surface water mixing was observed in shallow groundwater at the Site. This indicates shallow groundwater is isolated from surface water at the location as compared to deeper groundwater.

Tidal response/surface water mixing is more pronounced in deeper wells at similar locations. Some isolation of deeper groundwater was observed at individual well locations, dependent on depth of pilings. Decreased salinity in the deep waterfront wells indicated reduced mixing.

The most pronounced tidal response was measured at shallow well RW-6. This well is located between the south end of the new seawall and north end of the warehouse foundation, where there is a preferential flow at the gap between structures. Salinity profiles are more pronounced here as well.

The warehouse foundation continues to act as a barrier to shallow groundwater at the Site.

South of the warehouse foundation, groundwater-surface water mixing and tidal response is more pronounced in deeper groundwater vs shallow groundwater. Shallow groundwater has more relative communication to surface water than equivalent wells behind the foundation/ seawall. In this area, a timber bulkhead is the only significant structure limiting flow. Salinity profiles are also more pronounced here as well.

The on-site remediation system was shut down during the performance of the hydraulic evaluation study. An occurrence of sheen/thin product sufficient to require an absorbent sock was observed at remediation well RW-4, located north of the warehouse. This indicates the potential for re-occurrence of product at areas of high TPH soil concentrations. Piezometers installed as part of the hydraulic evaluation have been sampled for four quarters in 2023 and 2024 to assist in evaluation of the status of the on-site groundwater remediation system. Final results of that investigation are pending and will be reviewed as part of Site discussions regarding modification or cessation of groundwater remedial activities.

King Tide Events:

In late December 2022, a king tide combined with a storm surge event caused flooding along the Site waterfront (TechSolve, 2023). The combined effects of the tidal and storm events also temporarily raised the Site groundwater levels approximately two feet. An additional king tide event occurred in January, 2023, although Site flooding did not occur.

In February, 2023, an area of surficial soil staining and sheen was observed in the northwest corner of the Site near the north end of the sheetpile seawall. The staining was observed on both asphalt and gravel fill behind the seawall.

Petroleum analyses indicated that the soil staining was consistent with weathered diesel petroleum, similar to other characterized releases at the site. The petroleum concentrations were below Site-specific soil cleanup levels. Site personnel exposed and pressure tested two active subsurface diesel distribution lines in the vicinity. Both lines passed testing.

A utility vault was excavated approximately twenty feet north of the stained area in June, 2023. Groundwater encountered in the vault excavation displayed a slight sheen. Three soil samples were collected from an associated utility trench sidewalls or base, and one sample was collected from the utility vault excavation. Petroleum concentrations in the utility trench samples were below Site-specific soil cleanup levels. Diesel concentrations from the vault excavation exceeded the Site-specific soil cleanup levels. Soils associated with the utility excavation were disposed of off-Site at a licensed facility. Groundwater was sampled from three nearby monitoring wells (GM-10S, HWM-01-S, and B-007) for four quarters. Analytical results either did not contain detectable concentrations of petroleum hydrocarbons or detected concentrations of petroleum hydrocarbons were below both the Site-specific cleanup level, as well as the MTCA Method A cleanup level.

Based on the Site observations, pipeline testing, and analytical results, the petroleum associated with the surficial staining observed after flooding and king tide events is consistent with residual contamination associated with a historic release at the Site, and not a new release. The volume and affected area appear to be limited. No additional staining or sheens have been observed after subsequent king tide events at the Site.

Kinder Morgan

Kinder Morgan applies sulfate (as Epsom salts) to the Site remediation area (B, C and D Yards) on an approximately annual basis. The salts enhance anaerobic biological oxidation (ABOx) of residual petroleum hydrocarbons in Site soil and groundwater. The two most recent applications consisted of 15,000 pounds each in October 2023 and November 2024. The application rate is approximately 0.8 pounds per square foot. The Kinder Morgan B yard application area partially covered by an irrigation system that is used to dissolve and migrate the sulfate into Site groundwater. This covers approximately the northern two-thirds of the of application area. The

remainder of the application areas rely on precipitation to mobilize the sulfate; therefore applications are normally conducted in the autumn at the beginning of the wet season. The applications are designed to maintain a target sulfate concentration of 900 mg/L at the Site.

Biannual sampling was conducted prior to the most recent application, and groundwater concentrations are representative of conditions during decreasing sulfate concentrations in Site groundwater. Between biannual sampling events, Kinder Morgan gauges representative monitoring wells on a monthly basis to monitor groundwater conductivity and confirm that the conductivity is representative of target sulfate concentrations. Sulfate and other natural attenuation parameters are analyzed during the scheduled biannual sampling events. Groundwater contamination at the KM site has been generally stable to improving during the past five years. The most common contaminants are benzene and gasoline range organics (GRO). GRO was detected above the cleanup level (1000 µg/L) in nine of the 39 wells with a maximum of 17,500 µg/L at MW-24. During the prior five-year review period, fifteen wells exceeded the Site cleanup level.

The data review included reviewing annual groundwater monitoring reports from the previous five years and evaluating contaminant trends using the Mann-Kendall trend analysis. The groundwater compliance monitoring program consists of 39 wells sampled annually (Figure 8). Nineteen of the wells are sampled twice a year and all 39 of the wells are sampled once a year. The Mann-Kendall trend analysis was completed for constituents with more than four detections during the previous five years. Table 7 has the results of the Mann-Kendall analysis. Most of the contaminant trends were stable or had no trend.

There were no significant trends in benzene and GRO concentrations in most of the analyzed wells. Monitoring well TMW-B1, located within or near the remedial application area exhibited a decreasing Mann-Kendall trend during the analyses period.

Elevated contaminant concentrations have been observed in both A-28R and MW-23. As displayed in Figure 8, these two monitoring wells are located along the southwestern edge of the property near 13th Ave. S.W., providing evidence for potential offsite migration. In addition, the proximal monitoring well, MW-24, also demonstrated concentrations of GRO and benzene in exceedance of the cleanup levels throughout the five-year monitoring period. Natural attenuation parameters collected from these wells, including DO, methane and ferrous iron indicate conditions for natural attenuation are present. The dissolved petroleum hydrocarbon contamination along 13th Ave. S.W. is located inland and limited in extent. Further to the east, along the local downgradient direction of groundwater flow, monitoring wells such as A-23R, A-21, and A-14R (Kinder Morgan wells) and MW-111 (Shell wells, SH-04 area) have been either non-detect or below cleanup levels for these contaminants, indicating that there is no expanding plume and no migration of groundwater contaminants to receptors such as surface water. However, KM wells A-23R and A-21 recorded a gasoline exceedance (6,500 ug/l and 1,830 ug/l, respectively) in the second semiannual sampling event (September 2024). These wells should be evaluated along with other Site trends for potential plume expansion or migration.

Table 7. Mann-Kendall Trend Analysis (2020-2024), TF-OU2, Kinder Morgan

Well	Constituent	# Data Points	Min-Max Concentration (µg/L)	Trend Test Result	Confidence Factor
TMW-B1	Benzene ¹	5	5 - 80	Decreasing Trend	95%
TMW-4	Benzene ¹	10	1.2 – 4.3	No Significant trend	95%
TMW-5	Benzene ¹	10	1.6 - 9.2	No Significant trend	95%
MW-19	Benzene ¹	10	1.1 - 18	No Significant trend	95%
MW-23	Benzene ¹	10	36 - 310	No Significant trend	95%
MW-24	Benzene ¹	10	190 - 860	No Significant trend	95%
A-27	Benzene ¹	10	9.4 - 77	No Significant trend	95%
A-28R	Benzene ¹	10	2.9 - 40	No Significant trend	95%
12	Benzene ¹	10	2.1 - 170	No Significant trend	95%
A-5	TPH-G ²	10	260 - 1400	No Significant trend	95%
A-21	TPH-G ²	10	110 - 1800	No Significant trend	95%
A-27	TPH-G ²	10	740 - 2900	No Significant trend	95%
A-28R	TPH-G ²	01	610 - 4100	No Significant trend	95%
12	TPH-G ²	10	520 - 4100	No Significant trend	95%
MW-4	TPH-G ²	5	150 - 220	No Significant trend	95%
MW-6	TPH-G ²	5	210 - 350	No Significant trend	95%
MW-7	TPH-G ²	10	110 - 1900	No Significant trend	95%
MW-9	TPH-G ²	10	110 - 390	No Significant trend	95%
MW-19	TPH-G ²	10	280 - 2100	No Significant trend	95%
MW-21	TPH-G ²	10	120 - 2700	No Significant trend	95%
MW-23	TPH-G ²	10	1300 - 11300	No Significant trend	95%
MW-24	TPH-G ²	10	2200 - 17500	No Significant trend	95%
TMW-B1	TPH-G ²	5	4700 - 10700	No Significant trend	95%
TMW-3	TPH-G ²	10	120 - 560	No Significant trend	95%
TMW-4	TPH-G ²	10	1400 - 4500	No Significant trend	95%
TMW-5	TPH-G ²	10	320 - 1110	No Significant trend	95%
TMW-6	TPH-G ²	10	2200 - 10300	No Significant trend	95%

1. Benzene site specific cleanup level = 71 µg/L

2. TPH-G site specific cleanup level = 1000 µg/L

Shell

Compliance groundwater monitoring is completed semi-annually at about 30 wells (Figure 10). Samples are analyzed for BTEX, TPH and natural attenuation parameters. Results above detection limits for the site COCs were evaluated using the Mann-Kendall trend analysis. The result of the Mann-Kendall and the maximum and minimum concentrations are presented in Table 8.

At the Shoreline Manifold Area, BTEX and PAH concentrations at the two deep compliance monitoring wells (MW-213 and MW-214) have remained below cleanup levels during the previous five years. There was a fuel spill near the Shoreline Manifold Area that occurred after the groundwater remedy was implemented and is not part of the cleanup for the Superfund site. The spill is being mitigated by placing absorbent socks in shallow monitoring wells MW-210 and MW-211. Washington State Department of Ecology is overseeing the cleanup.

Near 13th Ave S.W. along the southwestern portion of the site contamination remains below cleanup levels. Monitoring well MW-05 contained no sample detections of benzene, and one sample was detected for TPH-G below the cleanup level during the previous five years of sampling. Both TPH-G and benzene were detected below cleanup levels in SH-04 and Mann-Kendall trend analysis indicates benzene concentrations are stable and TPH-G is declining.

Contamination near monitoring well TX-03A declined during the 2017 to 2019 operation of an air sparging system. Eleven monitoring wells: MW-301 through MW-304, MW-307 through MW-315, and TX-03A were used to monitor the contamination near TX-03A. Groundwater contamination concentrations had decreased to below cleanup levels in five of eleven of the monitoring wells. Since shutdown of the remediation system, seven of the monitoring wells had increasing trends for benzene and five had increasing trends for TPH-G. These wells are located down gradient of TX-03A and concentrations will likely continue to increase as the remediated groundwater migrates through the area. However the overall plume area appears stable, with the exception of seasonal variation.

Table 8. Mann-Kendall Trend Analysis (2020-2024), TF-OU2, Shell

Well	Constituent	# Data Points	Min-Max Concentration (µg/L)	Trend Test Result	Confidence Factor, %
MW-111	Benzene ¹	11	<0.4-53.8	Increasing	97.0
MW-112A	Benzene ¹	11	1.02-4.42	Stable	89.1
MW-202	Benzene ¹	5	1.32J-2.78	No trend/stable	88.3
MW-301	Benzene ¹	20	3.33- 110	Increasing	98.1
MW-302	Benzene ¹	20	<0.4- 112	No trend/stable	80.7
MW-303	Benzene ¹	20	2.58- 366	Increasing	99.5
MW-304	Benzene ¹	20	1.71- 290	Increasing	98.6
MW-307	Benzene ¹	20	<0.4- 160	Decreasing	99.6
MW-308	Benzene ¹	20	<0.4- 129	Probably decreasing	93.6
MW-310	Benzene ¹	20	5.23-39.2	Probably decreasing	92.3
MW-311	Benzene ¹	19	<0.2-3.74	Increasing	97.9
MW-312	Benzene ¹	20	3.92- 176	Decreasing	>99.9
MW-314	Benzene ¹	13	<0.09-5.84	No trend/stable	81.6
MW-315	Benzene ¹	20	<0.4-69.9	Decreasing	82.1
SH-04	Benzene ¹	11	2.23-11.8	Stable	82.1
TX-03A	Benzene ¹	19	4.99- 241	Increasing	>99.9
MW-111	TPH-G ²	11	89.8J-490	Stable	53.0
MW-112A	TPH-G ²	11	976- 2340	No trend/stable	67.6
MW-202	TPH-G ²	10	488- 3470	Decreasing	96.4
MW-301	TPH-G ²	19	114J- 1690	Increasing	99.9
MW-302	TPH-G ²	20	198- 1260	Stable	84.9
MW-303	TPH-G ²	20	924- 4070	Stable	84.9
MW-304	TPH-G ²	20	113J-938	Increasing	>99.9
MW-307	TPH-G ²	20	<150- 4060J	Stable	48.7
MW-308	TPH-G ²	20	54.5J-854	No trend/stable	68.5
MW-310	TPH-G ²	20	343- 1610	Increasing	95.7
MW-311	TPH-G ²	19	894- 3010	Increasing	>99.9
MW-312	TPH-G ²	19	1230-3610	Probably increasing	93.8
MW-314	TPH-G ²	13	123J-634	No trend/stable	68.4
MW-315	TPH-G ²	20	<150- 4090	Increasing	97.9
SH-04	TPH-G ²	11	232- 1290	Decreasing	97.0
TX-03A	TPH-G ²	19	129J- 2840	Increasing	>99.9

1. Benzene site specific cleanup level = 71 µg/L

2. TPH-G site specific cleanup level = 1000 µg/L

Pump House Gasoline Spill:

On October 1, 2020, an estimated 580 gallons of gasoline was released at the Pump House location. Shell and their contractors removed a combined 9,190 gallons of fuel and water during the response. Shallow soils north and south of the Pump House were removed by excavation, limited by site infrastructure. Approximately 85 cubic yards/136 tons of soil were removed for disposal. Confirmation samples were below the site-specific cleanup

level of 20,000 mg/kg for petroleum. Three monitoring wells were subsequently installed (MW-113, -114, -115) around the Pump House location. A fourth proposed well to be located north/upgradient of the Pump House was deleted due to utility conflicts. Preliminary sampling indicated that petroleum concentrations did not exceed Site cleanup levels. One well located adjacent to the south excavation and generally downgradient of remedial area (MW-113) exceeded Site cleanup levels for Benzene in 2022, and gasoline-range hydrocarbons and benzene in 2023. The wells have been surveyed and added to the sampling schedule.

April 2022 Joint Sampling Shell/Kinder Morgan:

Shell and Kinder Morgan conducted a joint gauging/sampling of adjacent monitoring wells within the 13th Ave SW area in April 2022. The water level gauging confirmed a groundwater divide with north/south flow near center of Kinder Morgan's C and D Yards and the southern third of Main Tank Farm.

Selected Kinder Morgan and Shell wells were sampled for petroleum hydrocarbons, BETX compounds, and total lead. Concentrations of benzene were detected above the Site-specific cleanup level in Kinder Morgan wells MW-23 and MW-24. The remaining sampled wells during the event did not have concentrations above Site-specific cleanup levels for the analyzed contaminants (GHD, 2023). Based on the analytical results and groundwater flow measurements, intermingled plume conditions are not likely between the two Sites.

3.2. Site Inspection

EPA, the Army Corps of Engineers and Ecology conducted a site inspection on March 27, 2025. The BP and Shell sites were inspected, while the Kinder Morgan site was not accessible to the team.

BP current Site conditions were observed, including the new seawall area, existing structures, and areas of institutional controls. Monitoring wells were observed and appeared to be accessible and in good condition. Pavement and impervious surfaces in the vicinity of the warehouse, where institutional controls are active, appeared to be in good condition. Site access is restricted to employees and petroleum transporters. No changes to site use have occurred since the prior Periodic Review.

Shell current Site conditions were observed around the area of the 2022 Pump House release and 13th Ave SW. Monitoring wells were observed and appeared to be accessible and in good condition. Clean soil cap and impervious surfaces appeared to be in good condition. Site access is restricted to employees and petroleum transporters. No changes to site use have occurred since the prior Periodic Review.

4. Technical Assessment

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

Tank Farms - OU2

No, the remedy is not fully functioning as intended. Active and passive remediation is occurring at the facilities and contaminant concentrations appear to be generally stable or decreasing, however, increasing contaminant concentrations at Shell in the TX-03A area indicate that MNA may not be functioning in this area of the site, and contamination above cleanup levels appear to be increasing in the area of the former bio-spargue remedy. The plume appears to be stable. However, the remedy is functioning as intended at the KM and BP areas of this OU.

Remedial Action Performance

BP

A groundwater/LNAPL recovery system is located along the shoreline and was designed to pump shallow groundwater with drawdown extending to the bottom of the LNAPL smear zone, approximately 4 feet in total. Results of operation show that desired drawdown and hydraulic capture/control are being achieved along the waterfront despite reduction in pumping rates from some wells.

At BP Plant 1, groundwater compliance monitoring wells AMW-01 through AMW-05, located along the waterfront, have had concentrations below cleanup levels for TPH-G, TPH-D, and TPH-O for all quarterly groundwater monitoring events since installation. With the exception of well AMW-02, these wells have also been below cleanup levels for benzene. The single exceedance at AMW-02 was anomalously high, but within historic concentrations detected at that well. AMW-02 are currently in compliance; and benzene concentrations have been below its cleanup level since March 2023. Trend evaluations indicate that benzene concentrations at these wells are decreasing.

At Plant 2, TPH-G concentrations at GM-19S have been below cleanup levels since 2007. Also, benzene concentrations at GM-19S were consistently below the cleanup level during the last five years.

Kinder Morgan

Most of the contaminant trends in this area of the Site were stable or had no trend. TPH-G was detected above the cleanup level (1 mg/l) in nine of the 40 wells.

The KM facility has implemented sulfate land application as a remediation system to increase biodegradation with applications on an approximately annual basis. The most recent applications were in October 2023 and November 2024. Passive free-product recovery using absorbent socks is also performed at select wells in the A Yard.

There were no increasing benzene and TPH-G concentration trends in analyzed wells.. Monitoring well TMW-B1, located within the remedial application zone, had decreasing trends indicating the remediation is remaining effective.

Contaminant increases at A-28R and MW-23, located along the western edge of the property near 13th Ave S.W. indicate contamination is not fully attenuating. However, downgradient wells show non-detect concentrations, indicating the contamination is inland and limited in extent. Monitoring well MW-24, also located near 13th Ave S.W. had TPH-G and benzene concentrations above cleanup levels during all of the monitoring events during the past five years. Groundwater parameters collected from wells near 13th Ave S.W. including DO, methane and ferrous iron indicate natural attenuation is occurring, however the concentrations above cleanup levels and increasing trends indicate the MNA is not reducing concentrations of contaminants to below cleanup levels.

Shell

At the Shoreline Manifold Area, BTEX and PAH concentrations at the two deep compliance monitoring wells have remained below cleanup levels during the previous five years. Near 13th Ave S.W., along the southeastern portion of the site, contamination mostly remains below cleanup levels.

Contamination near monitoring well TX-03A declined between 2017 and 2019 due to an air sparging system operation. Petroleum and benzene concentrations have increased since the cessation of the system operation. Two of the wells, MW-312 and MW-315, had increasing trends for TPH-G and benzene above cleanup levels. These wells are located down gradient of TX-03A and concentrations will likely re-equilibrate as the aerated groundwater from the air sparging system returns to an anaerobic condition. The plume extant appears to be generally stable, and contaminant exceedances have not been detected in downgradient monitoring wells.

Implementation of Institutional Controls and Other Measures

Restrictive covenants for BP, KM, and Shell were recorded by these parties in accordance with the Consent Decree in 2000. The following limitations were imposed by the restrictive covenant: industrial zoning, groundwater shall not be used for any purpose inconsistent with the remedial action, existing structures shall not be modified to expose contamination, and site workers will be instructed to take precautionary actions to avoid direct contact with contamination.

4.2. 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?

Tank Farms - OU2

Yes. ARARs that cleanup levels were based on at the time of the remedy selection have changed, however, changes do not affect the protectiveness of the remedy because there is no exposure to groundwater at concentrations above the revised criteria. Additionally, groundwater at this OU was declared non-potable in the EPA ROD and in the Ecology CAPs.

Changes in Standards and TBCs

ARARs cited in the CAPs were reviewed to evaluate changes since they were completed in 1999 and 2000. A summary of the evaluation of each ARAR is presented in Appendix C. The table does not include those ARARs that are no longer pertinent because of completion of the associated work.

Cleanup levels listed in the CAPs along with changes in standards are presented in Appendix C. Soil cleanup levels for the TF-OU2 are similar to those in the EPA cleanup goals for the S&G-OU1 and LU-OU3, which were established unique to Harbor Island. Since the 1993 ROD, the source of the standard (MTCA A) for lead has decreased, and the cleanup goal is now above the standard. Concentrations of lead in groundwater have remained below this updated standard, so therefore this change does not affect protectiveness.

Groundwater cleanup levels were for “the chronic criteria for protection of aquatic organisms (WAC 173- 201A) and Section 304 of the Clean Water Act” and were similar to the EPA cleanup goals for the S&G-OU1 and LU-OU3. Since the CAPs have been completed, NRWQC for benzene, ethylbenzene, toluene, cPAHs, and lead have decreased. Ethylbenzene and toluene concentrations at TF-OU2 are below the revised standards. Remaining elevated concentrations of benzene and cPAHs are in areas of active and passive remediation. Therefore, based on the reduction in NRWQC criteria and recent sampling results, the remedy still remains valid.

Surface water standards are not available for TPH. The CAPs selected groundwater cleanup levels for TPH-G, TPH-D, and TPH-O to be protective of surface water. In 2001, MTCA revisions lowered the MTCA Method A groundwater cleanup levels for TPH-G, TPH-D, and TPH-O. However, these standards do not affect protectiveness, as the selected remedy limits the exposure to these soils through a low permeability cap and ICs.

Changes in Exposure Pathways

Exposure assumptions used in the CAPs remain valid. Assumptions included industrial zoning of the OU and the determination that there is no planned future use of the groundwater for drinking purposes.

Expected Progress Toward Meeting RAOs

Groundwater COC concentrations in the BP area are generally below cleanup levels or showing stable or decreasing trends. The data review done in this FYR shows that MNA appears to be functioning in groundwater contamination in the KM site area, and the groundwater contamination plume appears to be stable. COC concentrations remain above the cleanup level in areas of passive remediation at the Shell site area.

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

No other information has come to light that could call into question the protectiveness of the remedy.

5. Issues/Recommendations

ISSUES AND RECOMMENDATIONS				
Issues and Recommendations Identified in the Five-Year Review				
OU: 2	Issue Category: Remedy Performance			
	Issue: Groundwater concentrations of site contaminants exceed cleanup levels in Kinder Morgan and Shell area wells. Contaminant trends are generally stable at Kinder Morgan. Although contaminant concentrations are increasing at Shell, the plume appears stable.			
	Recommendation: Evaluate contaminant concentration trends in Kinder Morgan and Shell area wells and determine if anaerobic natural attenuation is sufficient in the 13 th Ave S.W. and TX-03A areas.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	Steering Committee	EPA	9/1/2021
OU: TF-OU2	Issue Category: Operations and Maintenance			
	Issue: Current remedial action work is conducted solely by Washington State Department of Ecology. There is currently no CERCLA remedial action decision document recorded for this OU.			
	Recommendation: After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any CERCLA remedial action is required, and if a decision document should be recorded.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	State	EPA	9/1/2021

5.1. Other Findings

N/A

6. Protectiveness Statement

PROTECTIVENESS STATEMENTS	
<i>Operable Unit:</i> TF-OU2	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Tank Farms OU2 currently protects human health and the environment because multiple remediation methods are occurring to treat most contaminants, and restrictive covenants help ensure there is no exposure to site contaminants. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: • Evaluate alternatives for enhancing natural attenuation of contaminants near the southwestern area (13th Ave SW) wells of the Kinder Morgan property. • Evaluate post-remedial rebound at the Shell TX-03 area, and determine if contaminant concentration increases will continue under anaerobic conditions. Assess if bio-sparge remedial system restart is advisable. • After completion of the planned Washington State Department of Ecology remedial action, an evaluation should be conducted to determine if any CERCLA remedial action is required, and if a decision document should be recorded.	

7. Appendix A: Figures



Figure 1. Harbor Island Site Vicinity Map



Figure 2. Harbor Island Operable Units



Figure 3. TF-OU2 - Tank Farm Facilities



Figure 5. TF-OU2 BP Plant 1 Well Locations

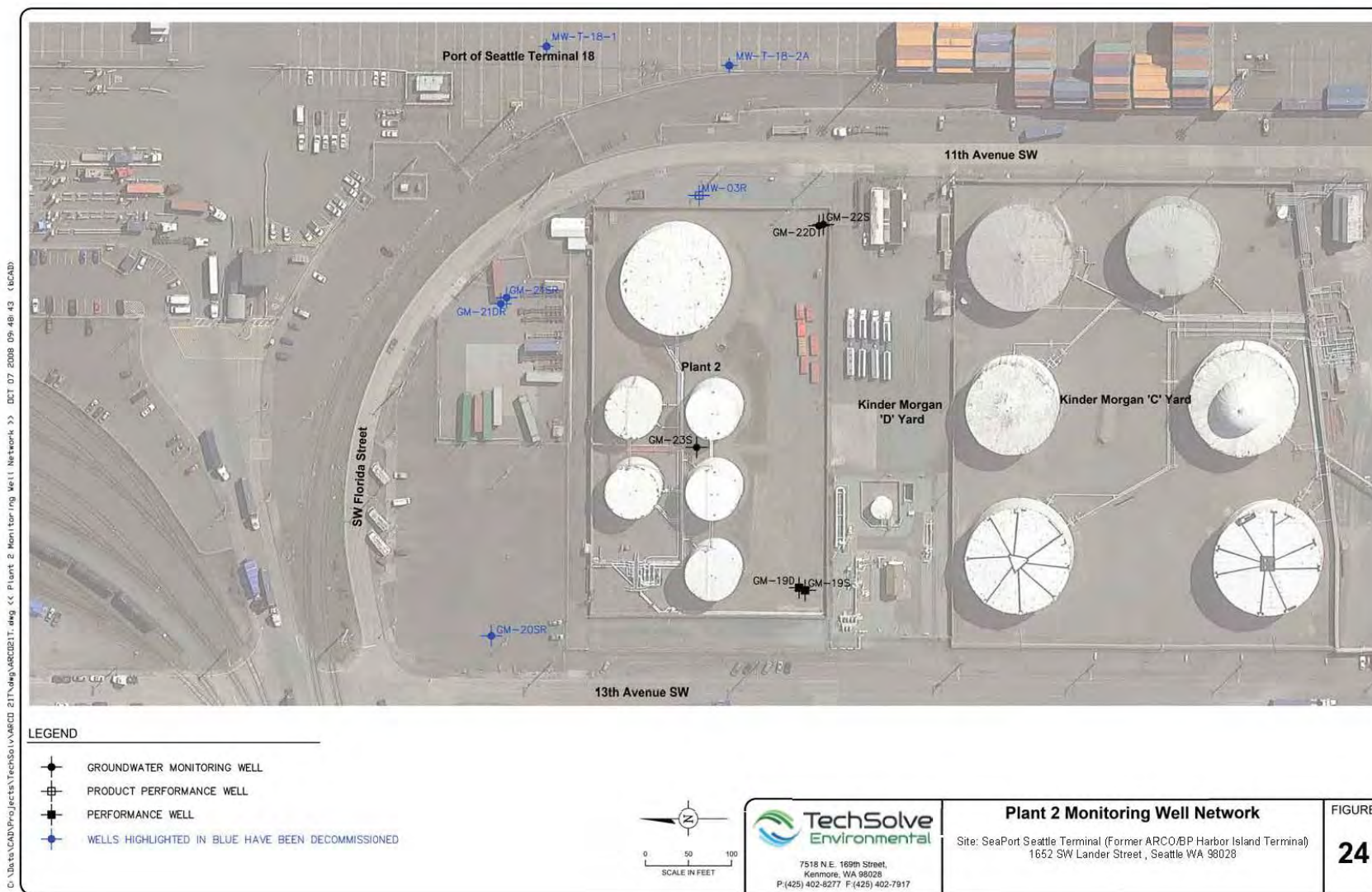


Figure 6. TF-OU2 BP Plant 2 Well Locations

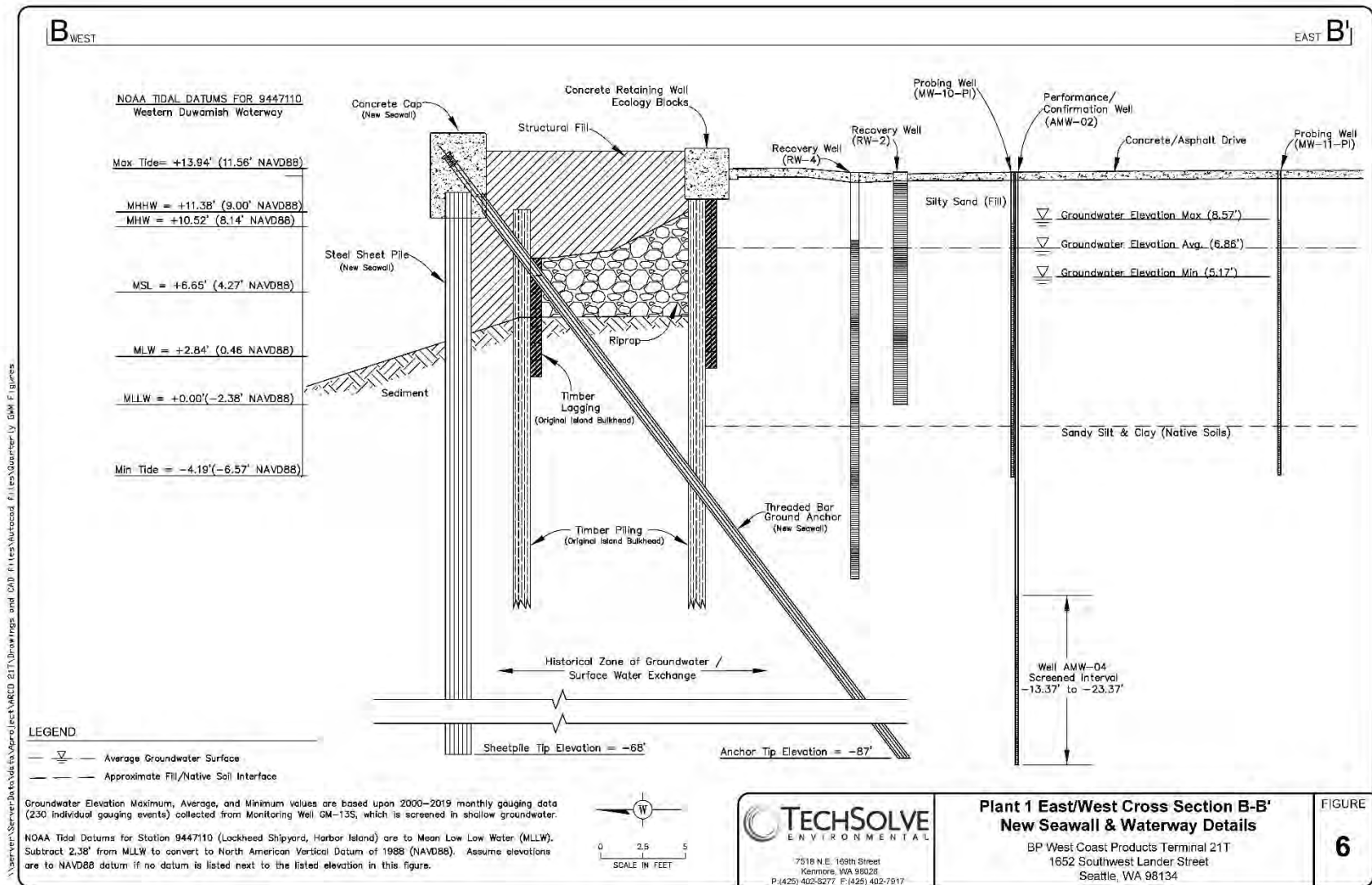


Figure 7. TF-OU2 BP Seawall Construction Cross Section

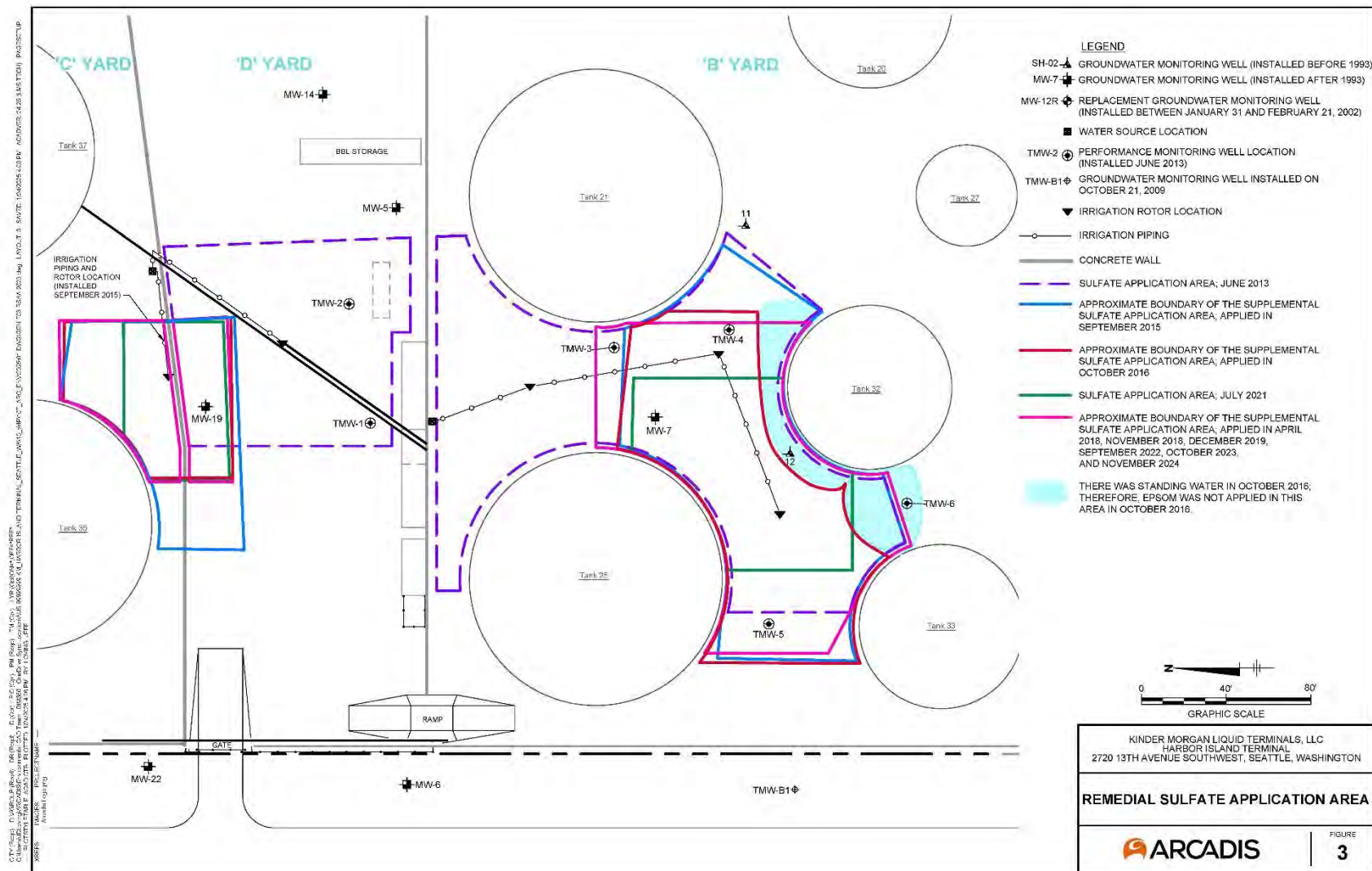


Figure 9 TF= OU 2, Kinder Morgan Remediation Area

8. Appendix B: List of Documents Reviewed

Arcadis, 2022a, Sulfate Application Field Implementation Plan, Kinder Morgan Liquid Terminals, Harbor Island Terminal, dated September 21.

Arcadis, 2022b, 2021 Annual Groundwater Monitoring Report, Kinder Morgan Liquid Terminals, Harbor Island Terminal, Seattle, Washington, dated March 18.

Arcadis, 2023a, 2022 Annual Groundwater Monitoring Report, Kinder Morgan Liquid Terminals, Harbor Island Terminal, Seattle, Washington, dated January.

Arcadis, 2023b, Sulfate Application Field Implementation Plan, Kinder Morgan Liquid Terminals, Harbor Island Terminal, dated October 6.

Arcadis, 2024a, 2023 Annual Groundwater Monitoring Report, Kinder Morgan Liquid Terminals, Harbor Island Terminal, Seattle, Washington, dated January 24

Arcadis, 2024b, Sulfate Application Field Implementation Plan, Kinder Morgan Liquid Terminals, Harbor Island Terminal, dated November 5.

Arcadis, 2025a, 2024 Annual Groundwater Monitoring Report, Kinder Morgan Liquid Terminals, Harbor Island Terminal, Seattle, Washington, dated January 30. Arcadis, 2025b, Statistical Trend Analysis, Kinder Morgan Harbor Island Terminal, dated March 5.

Ecology, 2021, Implementation Memorandum No. 23, Concentrations of Gasoline and Diesel Range Organics Predicted to be Protective of Aquatic Receptors in Surface Waters, Publication No. 19-09-043, dated August.

GHD, 2021a, Interim Action Report, Shell Harbor Island Terminal, dated March 11.

GHD, 2021b, Well Installation Work Plan, Shell Harbor Island Terminal, dated August 31.

GHD, 2022, 2021 Annual Compliance Monitoring Report, Shell Harbor Island Terminal, dated February 15

GHD, 2023, 2022 Annual Compliance Monitoring Report, Shell Harbor Island Terminal, dated February 15.

GHD, 2024, 2023 Annual Compliance Monitoring Report, Shell Harbor Island Terminal, dated February 14.

GHD, 2025, TX-03A Area Contaminant Stability, Shell – Triton West Consent Decree – Harbor Island, dated March 3.

TechSolve Environmental, Inc. 2020, Plant 1 Waterfront Probing Summary Report, Former BP Harbor Island Terminal, dated February 7.

TechSolve Environmental, Inc. 2022a, Hydraulic Evaluation Summary Report, Former BP Harbor Island Terminal, dated February.

TechSolve Environmental, Inc. 2022b, 2021 Annual Site Report, Former BP Harbor Island Terminal, dated April.

TechSolve Environmental, Inc. 2023, 2022 Annual Site Report, Seaport Seattle Terminal, (Former ARCO/BP Harbor Island Terminal), dated April.

TechSolve Environmental, Inc. 2024, 2023 Annual Site Report, Seaport Seattle Terminal, (Former ARCO/BP Harbor Island Terminal), dated April.

TechSolve Environmental, Inc., 2025, Mann-Kendall Summary, dated March 12.

9. Appendix C: ARAR Analysis

Section 121(d)(1)(A) of CERCLA requires that remedial actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). Federal ARARs may include requirements promulgated under any federal environmental laws. State ARARs may only include promulgated, enforceable environmental or facility-siting laws of general application that are more stringent or broader in scope than federal requirements and that are identified by the state in a timely manner. ARARs are identified on a site-specific basis from information about the chemicals at the site, the RAs contemplated, the physical characteristics of the site, and other appropriate factors. ARARs include only substantive, not administrative, requirements and pertain only to onsite activities. There are three general categories of ARARs: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs identified in the selected remedy within the applicable RODs and subsequent ROD Amendments for the groundwater at each OU and considered for this FYR for continued groundwater treatment, are shown in tables below for each OU. Contaminants with cleanup goals that exceed their current MCL are highlighted yellow in the applicable table.

Federal and State laws and regulations other than the chemical-specific ARARs are also described in the tables below for each OU, and if they have been promulgated or changed over the past five years. The tables do not include those ARARs identified from RODs that are no longer pertinent. For example, ARARs related to remedial design and construction are not included in the table if they do not continue into long-term O&M. There have been no revisions to laws or regulations that affect the protectiveness of the remedy for any OU.

Tank Farms – OU2

TF-OU2, ARAR Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Washington Clean Air Act	State – General Regulations for Air Pollution Sources (WAC 173-400, - 460; WA Clean Air Act (RCW 70.94)	Actions that result in major sources of emissions must be designed to meet ambient air quality standards.	None of the revisions to WAC 173-400 affect protectiveness.	Currently operating soil vapor extraction/air sparging systems emissions to air must meet air quality standards.	WAC 173-400: 10/25/2018
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards	State- WPCA – Water Pollution Control (Revised Code of Washington [RCW] 90.48); WPCA-Water Quality Standards for Surface Waters (WAC 173-201A)	Actions must achieve water quality standards for surface waters consistent with public health and protection of fish, shellfish and wildlife.	Protectiveness is not affected.	Remedial actions are specific to the cleanup of site groundwater. The groundwater cleanup goals are surface water standards that are protective of aquatic organisms. Much of RCW 75.20 was recodified to RCW 77.55. All remedial construction has been completed. Should additional remedial construction occur along the shoreline and in the adjacent waters RCW 75.20 would be applicable.	03/25/2020
Washington State Water Resources Act (WRA)	State- WRA – Water Resources Act (RCW 90.54)	Selected remediation methods should promote proper utilization of water resources, public health, economic well-being, and preservation of water's natural resources and aesthetic values.	Protectiveness is not affected.	Remedial actions to clean up site groundwater indirectly achieves surface water goals presented in this ARAR.	None
Washington Shoreline Management	State – Shoreline Management Act of 1971 (RCW 70.95)	The remedial actions will ensure that nearby water resources are protected and wisely managed.	Protectiveness is not affected.	One remediation system is located on the shoreline bulkhead, and will ensure that nearby water resources are protected.	None

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Washington Model Toxics Control Act (MTCA)	State – MTCA (WAC 173-340)	MTCA cleanup regulations provide that cleanup actions must comply with cleanup levels for selected hazardous substances, points of compliance, and ARARs.	Protectiveness is not affected.	Currently operating soil vapor extraction/air sparging systems must meet cleanup levels especially for total petroleum hydrocarbons.	January 2024
Washington Solid Waste Management (SWM)	State – SWM (WAC 173-304) (RCW 70.95)	The remedial actions will follow a comprehensive program for solid waste handling, and solid waste recovery and/or recycling that will prevent land, air, and water pollution.	Protectiveness is not affected.	Solid wastes are potentially generated as part of the remedial actions.	None
Washington Hazardous Waste Management (HWM)	State – HWM (RCW 70.105); Dangerous Waste Regulations (WAC 173-303)	The remedial action will provide for the control and management of hazardous waste that will prevent land, air, and water pollution.	None of the revisions to WAC 173-303 affect protectiveness.	Hazardous wastes are potentially generated as part of the remedial actions.	01/28/2019

TF-OU2, Comparison of Cleanup Goals to Current Standards

Medium	Contaminant	Cleanup Goal per CAP		Current Standards	
		Goal	Basis of Goal	Standard	Source of Standard
Soil-Surface	Lead	1,000 mg/kg	MTCA A	1,000 mg/kg	MTCA A Industrial
	Arsenic	32.6 mg/kg	1 x 10 ⁻⁵ risk	20 mg/kg	MTCA A
Soil-Subsurface	Total TPH (Primary Areas of Concern)	10,000 mg/kg	Protection of Surface Water at Boundary	100 mg/kg (Gasoline) 2,000 mg/kg (Diesel + Oil)	MTCA A
	Total TPH (Secondary Areas of Concern)	20,000 mg/kg	Protection of Surface Water at Boundary		
Groundwater	Benzene	71 µg/L	Protect Organisms	1.6µg/L	State human health
	Ethylbenzene	29,000 µg/L	Protect Organisms	21 µg/L	Implementation Memo 23 (aquatic life)
	Toluene	200,000 µg/L	Protect Organisms	130 µg/L	State & WTR human health
	Carcinogenic PAHs	0.031 µg/L	Protect Organisms	0.000016 µg/L ^a)	TEQ (State & WTR human health)
	Copper	2.9 µg/L	Protect Organisms	3.1 µg/L	State & CWA §304 AL - Marine/Chronic
	Lead	5.8 µg/L	Protect Organisms	8.1 µg/L	State & CWA §304 AL - Marine/Chronic
	TPH (gas)	1,000 µg/L	Protect Groundwater	1,000 µg/L (no detectable benzene)	MTCA A
				800 µg/L (benzene present)	MTCA A
	TPH (diesel)	10,000 µg/L	Protect Groundwater	500 µg/L	MTCA A
	TPH (oil)	10,000 µg/L	Protect Groundwater	500 µg/L	MTCA A

Notes:

Highlight indicates current standard is less than that used in the CAP

MTCA A - Method A Soil Cleanup Levels for Industrial Properties (MTCA Table 745-1)

1 x 10⁻⁵ risk - Total 1 x 10⁻⁵ risk excess cancer risk or Hazard Index equal to 1

CWA §304 AL - Marine/Chronic - Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

TEQ – Toxicity Equivalent

WTR – Washington Toxics Rule

^a The latest MTCA value promulgated in 2024 uses this value as the toxicity equivalent to benzo(a)pyrene

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Storm water Management Program	Federal – Water Programs (40 CFR 122 -124); State – Water Pollution Control (RCW 90.48)	TBC - This describes storm water management objectives that may apply to storm drains at LSS-OU7.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	40 CFR 122: July 2012, December 2012, June 2013, August 2014, September 2014; 40 CFR 124: December 2010, September 2011, January 2013
Puget Sound Estuary Program Protocols	Local – Puget Sound Partnership	TBC - Provides sample collection, laboratory analysis, and QA/QC procedures for sampling and analyzing sediment samples.	Protectiveness is not affected.	A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	None

Appendix C. ARARs Analysis

Section 121(d)(1)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that remedial actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). Federal ARARs may include requirements promulgated under any federal environmental laws. State ARARs may only include promulgated, enforceable environmental or facility siting laws of general application that are more stringent or broader in scope than federal requirements and that are identified by the state in a timely manner. ARARs are identified on a site-specific basis from information about the chemicals at the site, the remedial actions contemplated, the physical characteristics of the site, and other appropriate factors. ARARs include only substantive, not administrative, requirements and pertain only to onsite activities. There are three general categories of ARARs: 1) chemical-specific, 2) location-specific, and 3) action-specific.

Chemical-specific ARARs identified the applicable Records of Decision (RODs) and subsequent ROD Amendments for groundwater and soil at each operable unit (OU) are shown in the tables below for each OU.

Federal and state laws and regulations other than the chemical-specific ARARs are also described in the tables below for each OU, and if they have been promulgated or changed over the past five years. The tables do not include those ARARs identified from RODs that are no longer pertinent. For example, ARARs related to remedial design and construction are not included in the table if they do not continue into long-term operations and maintenance.

There have been no revisions to laws or regulations that affect the protectiveness of the remedy for any OU.

1. Soil & Groundwater – OU1

S&G-OU1 ARARs Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Clean Air Act (CAA)	Federal – CAA, National Ambient Air Quality Standards (42 USC 7401)	Actions that result in major sources of emissions must be designed to meet ambient air quality standards.	Protectiveness is not affected.	LNAPL vacuum-enhancement at Todd Shipyards discharges air, treated by a catalytic oxidizer, to the atmosphere.	August 2022
Washington Clean Air Act	State – General Regulations for Air Pollution Sources (WAC 173-400), WA Clean Air Act (RCW 70.94)				State WAC 173-400: 02/12/2025

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Clean Water Act	Federal – Clean Water Act (33 USC 1251; 40 CFR Part 131)	Standards for protection of marine organisms and human health from ingestion of marine organisms will be achieved through removal of hot spots from both soil and groundwater, capping, and natural biodegradation of remaining low-level organics in the groundwater.	Protectiveness is not affected.	Removal of the floating petroleum product at Todd Shipyards and cap will achieve Clean Water Act standards.	April 2025
Puget Sound Air Pollution Control Agency (PSAPCA)	Local – PSAPCA (Regulations I & III)	Actions that could involve releases of contaminants to air will be performed in compliance with substantive requirements of a permit from PSAPCA.	Protectiveness is not affected.	LNAPL vacuum-enhancement system at Todd Shipyards discharges air, treated by a catalytic oxidizer, to the atmosphere.	Regulation I: 09/26/2019; Regulation III: 12/15/16
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards	State – WPCA-Water Pollution Control (RCW 90.48); WPCA-Water Quality Standards for Surface Waters (WAC 173-201A)	Actions must achieve water quality standards for surface waters consistent with public health and protection of fish, shellfish, and wildlife.	Protectiveness is not affected.	Hot spot removal, cap, and LNAPL removal will achieve water quality standards for protection of marine organisms.	03/25/2020

Notes:

CFR = Code of Federal Regulations
LNAPL = light non-aqueous phase liquid
RCW = Revised Code of Washington
USC = U.S. Code
WAC = Washington Administrative Code

Washington State water rights code (RCW 90.03 and 90.14), Model Toxics Control Act (MTCA) soil cleanup standards (RCW 70.105D and WAC 173-340), and water well construction standards (Water Well Construction Act, WAC 173-160) are unchanged and remain protective.

S&G-OU1 Current and Historical Toxicity Values

Contaminant	Toxicity Value Type	Toxicity Values in 1993 ROD	Source of ROD Toxicity Value	Current Toxicity Criteria	Source of Current Toxicity Criteria
Antimony	RfD _o	4.0x10 ⁻⁴ mg/kg-day	IRIS	4.0x10 ⁻⁴ mg/kg-day	IRIS
Arsenic	RfD _o	3.0x10 ⁻⁴ mg/kg-day	IRIS	3.0x10 ⁻⁴ mg/kg-day	IRIS
Arsenic	SFO	1.8 (mg/kg-day) ⁻¹	IRIS	1.5 (mg/kg-day) ⁻¹	IRIS
cPAHs	SFO	5.8 (mg/kg-day) ⁻¹	EPA ECAO	7.3 (mg/kg-day) ⁻¹	IRIS
PCBs	SFO	7.7 (mg/kg-day) ⁻¹	IRIS	0.07 to 2.0 (mg/kg-day) ⁻¹	IRIS

Notes:

1. **Highlight** indicates current toxicity criteria is more stringent than that used in 1993 ROD.

RfD_o = Oral reference dose

SFO = Oral slope factor

IRIS = EPA's Integrated Risk Information System

EPA ECAO = EPA Environmental Criteria and Assessment Office

S&G-OU1 Comparison of ROD Cleanup Goals to Current Standards

Medium	Contaminant	Cleanup Goal per 1993 ROD	Basis of Cleanup Goal	Current Standard	Source of Current Standard
Soil-Surface	Lead	1,000 mg/kg	MTCA A	250 mg/kg	MTCA A
Soil-Subsurface	Lead	1,000 mg/kg	MTCA A	250 mg/kg	MTCA A
Soil-Subsurface	TPH-D	600 mg/kg	MTCA A	2,000 mg/kg	MTCA A
Soil-Subsurface	TPH-G	400 mg/kg	WA PCS Matrix	100 mg/kg (if no reported benzene present)	MTCA A
Soil-Subsurface	TPH-G	400 mg/kg	WA PCS Matrix	30 mg/kg (if benzene present)	MTCA A
Soil-Subsurface	Cadmium	10 mg/kg	MTCA A	2 mg/kg	MTCA A
Soil-Subsurface	Chromium	500 mg/kg	MTCA A	19 mg/kg (Chromium VI)	MTCA A
Soil-Subsurface	Chromium	500 mg/kg	MTCA A	2,000 mg/kg (Chromium III)	MTCA A
Soil-Subsurface	Mercury	1.0 mg/kg	MTCA A	2 mg/kg	MTCA A
Soil-Subsurface	cPAHs	20 mg/kg	MTCA A	0.1 mg/kg ^a	MTCA A
Soil-Subsurface	Arsenic	200 mg/kg	MTCA A	20 mg/kg	MTCA A
Soil-Subsurface	Benzene	1.0 mg/kg	WA PCS Matrix	0.03 mg/kg	MTCA A
Soil-Subsurface	Ethylbenzene	200 mg/kg	WA PCS Matrix	6 mg/kg	MTCA A
Soil-Subsurface	Toluene	100 mg/kg	WA PCS Matrix	7 mg/kg	MTCA A

Medium	Contaminant	Cleanup Goal per 1993 ROD	Basis of Cleanup Goal	Current Standard	Source of Current Standard
Soil-Subsurface	Xylenes	150 mg/kg	WA PCS Matrix	9 mg/kg	MTCA A
Groundwater	Carbon tetrachloride	4.4 µg/L	Protect Organisms	5 µg/L	CWA §304 HH - Marine Waters
Groundwater	Benzene	71 µg/L	Protect Organisms	16-58 µg/L	CWA §304 HH - Marine Waters
Groundwater	Trichloroethane	42 µg/L	Protect Organisms	8.9 µg/L (1,1,2-trichloroethane)	CWA §304 HH - Marine Waters
Groundwater	Tetrachloroethylene	8.8 µg/L	Protect Organisms	29 µg/L	CWA §304 HH - Marine Waters
Groundwater	PCBs	0.03 µg/L	Protect Organisms	0.03 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Arsenic	36 µg/L	Protect Organisms	36 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Cadmium	8.0 µg/L	Protect Organisms	7.9 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Copper	2.9 µg/L	Protect Organisms	3.1 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Lead	5.8 µg/L	Protect Organisms	5.6 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Mercury	0.025 µg/L	Protect Organisms	0.025 µg/L	173-201A WAC AL - Marine/Chronic
Groundwater	Nickel	7.9 µg/L	Protect Organisms	8.2 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Silver	1.2 µg/L	Protect Organisms	1.9 µg/L	CWA §304 AL - Marine/Acute ^b
Groundwater	Thallium	6.3 µg/L	Protect Organisms	0.47 µg/L	CWA §304 HH - Marine Waters
Groundwater	Zinc	76.6 µg/L	Protect Organisms	81 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Cyanide	1.0 µg/L	Protect Organisms	1.0 µg/L	CWA §304 AL - Marine/Chronic

Notes:

a. The latest MTCA value promulgated uses this value as the toxicity equivalent to benzo(a)pyrene

b. No chronic value available

Highlight indicates current standard is less than the 1993 ROD cleanup goal.

1×10^{-5} risk = total 1×10^{-5} risk excess cancer risk or hazard index equal to 1

173-201A WAC AL - Marine/Chronic = Washington Administrative Code Chapter 173-201A, aquatic life, marine, chronic

CWA §304 AL - Marine/Acute = Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

CWA §304 AL - Marine/Chronic = Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

CWA §304 HH - Marine Waters = Clean Water Act Section 304 National Recommended Water Quality Criteria, Human Health for Marine Waters (consumption of organisms only)

MTCA A = Method A soil cleanup levels for industrial properties (MTCA Table 745-1)

Protect Organisms = Protection of marine organisms or human health from consumptions of organisms

WA PCS Matrix = State of Washington Petroleum-Contaminated Soil Matrix Rating Method

2. Tank Farms – OU2

TF-OU2 ARARs Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Washington Clean Air Act	State – General Regulations for Air Pollution Sources (WAC 173-400, -460; WA Clean Air Act (RCW 70.94)	Actions that result in major sources of emissions must be designed to meet ambient air quality standards.	Protectiveness is not affected.	Soil vapor extraction/air sparging systems emissions to air must meet air quality standards.	WAC 173-400: 02/12/2025
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards	State- WPCA – Water Pollution Control (RCW 90.48); WPCA- Water Quality Standards for Surface Waters (WAC 173-201A)	Actions must achieve water quality standards for surface waters consistent with public health and protection of fish, shellfish and wildlife.	Protectiveness is not affected.	Remedial actions are specific to the cleanup of site groundwater. The groundwater cleanup goals are surface water standards that are protective of aquatic organisms. Much of RCW 75.20 was recodified to RCW 77.55. All remedial construction has been completed. Should additional remedial construction occur along the shoreline and in the adjacent waters RCW 75.20 would be applicable.	03/25/2020
Washington Model Toxics Control Act (MTCA)	State – MTCA (WAC 173-340)	MTCA cleanup regulations provide that cleanup actions must comply with cleanup levels for selected hazardous substances, points of compliance, and ARARs.	Protectiveness is not affected.	Currently operating soil vapor extraction/air sparging systems must meet cleanup levels especially for total petroleum hydrocarbons.	January 2024
Washington Hazardous Waste Management (HWM)	State – HWM (RCW 70.105); Dangerous Waste Regulations (WAC 173-303)	The remedial action will provide for the control and management of hazardous waste that will prevent land, air, and water pollution.	None of the revisions to WAC 173-303 affect protectiveness.	Hazardous wastes are potentially generated as part of the remedial actions.	01/28/2019

Notes:

RCW = Revised Code of Washington

WAC = Washington Administrative Code

Washington State Water Resources Act (RCW 90.54), Shoreline Management Act of 1971 (RCW 70.95), and Solid Waste Management (WAC 173-304 and RCW 70.95) are unchanged and remain protective.

TF-OU2 Comparison of Cleanup Goals to Current Standards

Medium	Contaminant	Cleanup Goal per CAP	Basis of Cleanup Goal	Current Standard	Source of Current Standard
Soil-Surface	Lead	1,000 mg/kg	MTCA A	1,000 mg/kg	MTCA A Industrial
Soil-Surface	Arsenic	32.6 mg/kg	1×10^{-5} risk	20 mg/kg	MTCA A
Soil- Subsurface	Total TPH (primary areas of concern)	10,000 mg/kg	Protection of Surface Water at Boundary	100 mg/kg (Gasoline)	MTCA A
Soil- Subsurface	Total TPH (secondary areas of concern)	20,000 mg/kg	Protection of Surface Water a Boundary	2,000 mg/kg (Diesel + Oil)	MTCA A
Groundwater	Benzene	71 µg/L	Protect Organisms	1.6µg/L	State human health
Groundwater	Ethylbenzene	29,000 µg/L	Protect Organisms	21 µg/L	Implementation Memo 23 (aquatic life)
Groundwater	Toluene	200,000 µg/L	Protect Organisms	130 µg/L	State & WTR human health
Groundwater	cPAHs	0.031 µg/L	Protect Organisms	0.000016 µg/L ^a	TEQ (State & WTR human health)
Groundwater	Copper	2.9 µg/L	Protect Organisms	3.1 µg/L	State & CWA §304 AL - Marine/Chronic
Groundwater	Lead	5.8 µg/L	Protect Organisms	8.1 µg/L	State & CWA §304 AL - Marine/Chronic
Groundwater	TPH-G	1,000 µg/L	Protect Groundwater	1,000 µg/L (if no reported benzene present)	MTCA A
Groundwater	TPH-G	1,000 µg/L	Protect Groundwater	800 µg/L (if benzene present)	MTCA A
Groundwater	TPH-D	10,000 µg/L	Protect Groundwater	500 µg/L	MTCA A
Groundwater	TPH-O	10,000 µg/L	Protect Groundwater	500 µg/L	MTCA A

Notes:

a. The latest MTCA value promulgated in 2024 uses this value as the toxicity equivalent to benzo(a)pyrene

Highlight indicates current standard is less than that used in the CAP

1×10^{-5} risk = Total 1×10^{-5} risk excess cancer risk or hazard index equal to 1 MTCA A - Method A Soil Cleanup Levels for Industrial Properties (MTCA Table 745-1)

CWA §304 AL - Marine/Chronic = Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

TEQ = Toxicity Equivalent

WTR = Washington Toxics Rule

3. Lockheed Upland – OU3

LU-OU3, ARAR Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards	State – WPCA- Water Pollution Control (RCW 90.48); WPCA- Water Quality Standards for Surface Waters (WAC 173-201A)	Actions must achieve water quality standards for surface waters consistent with public health and protection of fish, shellfish and wildlife.	Protectiveness is not affected.	Groundwater is being monitored to assess the effectiveness of the remediation to meet water quality goals.	WAC 173-400: 02/12/2025
Washington Model Toxics Control Act (MTCA)	State – MTCA (WAC 173-340 and RCW 70.105D)	MTCA water cleanup regulations provide that cleanup actions must comply with cleanup levels for selected hazardous substances, points of compliance, and ARARs.	Protectiveness is not affected.	Groundwater is being monitored to assess the effectiveness of the remediation to meet water quality goals.	January 2024
Clean Water Act	Federal – Clean Water Act (33 USC. 1251; 40 CFR Part 131)	Standards for protection of marine organisms and human health from ingestion of marine organisms will be achieved through removal of hot spots from both soil and groundwater, capping, and natural biodegradation of remaining low level organics in the groundwater.	Protectiveness is not affected.	Groundwater is being monitored to assess the effectiveness of the remediation to meet water quality goals.	April 2025

Notes:

CFR = Code of Federal Regulations
 RCW = Revised Code of Washington
 USC = U.S. Code
 WAC = Washington Administrative Code

Washington State water well construction standards (Water Well Construction Act, WAC 173-160) are unchanged and remain protective.

LU-OU3, Comparison of ROD Cleanup Goals to Current Standards

Medium	Contaminant	Cleanup Goal per 1993 ROD	Basis of Cleanup Goal	Current Standard	Source of Current Standard
Soil-Surface	Lead	1,000 mg/kg	MTCA A	250 mg/kg	MTCA A
Soil-Surface	Arsenic	3.60 to 32.6 mg/kg	1 x 10 ⁻⁵ risk	N/A	N/A
Soil-Surface	cPAHs	0.1 to 36.5 mg/kg	1 x 10 ⁻⁵ risk	N/A	N/A
Soil-Subsurface	Lead	1,000 mg/kg	MTCA A	250 mg/kg	MTCA A
Soil-Subsurface	TPH-D	600 mg/kg	WA PCS Matrix	2,000 mg/kg	MTCA A
Soil-Subsurface	cPAHs	20 mg/kg	MTCA A	0.1 mg/kg ^a	MTCA A
Soil-Subsurface	Arsenic	200 mg/kg	MTCA A	20 mg/kg	MTCA A
Soil-Subsurface	Benzene	1.0 mg/kg	WA PCS Matrix	0.03 mg/kg	MTCA A
Soil-Subsurface	Ethylbenzene	200 mg/kg	WA PCS Matrix	6 mg/kg	MTCA A
Soil-Subsurface	Toluene	100 mg/kg	WA PCS Matrix	7 mg/kg	MTCA A
Soil-Subsurface	Xylenes	150 mg/kg	WA PCS Matrix	9 mg/kg	MTCA A
Groundwater	Benzene	71 µg/L	Protect Organisms	16-58 µg/L	CWA §304 HH - Marine Waters
Groundwater	Tetrachloroethylene	8.8 µg/L	Protect Organisms	29 µg/L	CWA §304 HH - Marine Waters
Groundwater	Copper	2.9 µg/L	Protect Organisms	3.1 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Lead	5.8 µg/L	Protect Organisms	5.6 µg/L	CWA §304 AL - Marine/Chronic
Groundwater	Zinc	76.6 µg/L	Protect Organisms	81 µg/L	CWA §304 AL - Marine/Chronic

Notes:

a. The latest MTCA value promulgated uses this value as the toxicity equivalent to benzo(a)pyrene

Highlight indicates current standard is less than the 1993 ROD cleanup goal.

1x10⁻⁵ risk = total 1x10⁻⁵ risk excess cancer risk or hazard index equal to 1

173-201A WAC AL - Marine/Chronic = Washington Administrative Code Chapter 173-201A, aquatic life, marine, chronic
CWA §304 AL - Marine/Acute = Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

CWA §304 AL - Marine/Chronic = Clean Water Act Section 304 National Recommended Water Quality Criteria, aquatic life, marine, chronic

CWA §304 HH - Marine Waters = Clean Water Act Section 304 National Recommended Water Quality Criteria, Human Health for Marine Waters (consumption of organisms only)

MTCA A = Method A soil cleanup levels for industrial properties (MTCA Table 745-1)

Protect Organisms = Protection of marine organisms or human health from consumptions of organisms

WA PCS Matrix = State of Washington Petroleum-Contaminated Soil Matrix Rating Method

4. Lockheed Shipyard Sediments – OU7

LSS-OU7, ARAR Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Clean Water Act	Federal – Clean Water Act (33 USC 1251; 40 CFR 131)	Federal criteria for the protection of marine aquatic life are relevant and appropriate for discharges to surface water during sediment remediation.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	April 2025
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards for Surface Water	State – WPCA-Water Pollution Control (RCW 90.48); WPCA Water Quality Standards for Surface Waters (WAC 173-201A)	Narrative and quantitative limitations for surface water protection are provided in these regulations. Criteria are established for each water classification, including fecal coliform, total dissolved gas, total dissolved oxygen, temperature, pH, and turbidity. During sediment remediation, discharges to marine surface waters will comply with these requirements.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	03/25/2020
Washington State Sediment Management Standards (SMS)	State – Sediment Management Standards (RCW 43.21C, 70.105D, 90.48, 90.52, 90.54, 90.70; WAC 173-204)	Numerical and narrative criteria for chemicals and biological effects are specified for sediment and are applicable to Harbor Island shipyard sediments.	Revisions do not change cleanup values. Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	February 2013
National Pollutant Discharge Elimination System (NPDES) Washington State Discharge Permit Program	Federal – NPDES (40 CFR 122, 125)	Applies to direct discharges to surface water conducted as part of remedial actions. Conditions to authorizing direct discharges to surface water are specified under 40 CFR 122. Criteria and standards for discharges are specified in 40 CFR 125.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the	40 CFR 122: July 2012, December 2012, June 2013, August 2014, September 2014; 40

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
	State – NPDES (WAC 173-216, -220)	The State of Washington has been authorized by the EPA to implement the NPDES permit program.		West Waterway. Stormwater is discharged directly to the West Waterway.	CFR 125: August 2014
Solid Waste Disposal Act	Federal – Solid Waste Disposal (42 USC 3251; 40 CFR 257, 258)	Wastes generated by the remedial action include dredged sediment and sandblast grit, which is separated from dredged sediment. Sandblast grit may be suitable for recycling as feedstock for cement production.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway. Solids are removed from stormwater runoff.	WAC 173-304: 02/12/2025
Washington State Minimum Functional Standards for Solid Waste Handling	State – Solid Waste Handling (WAC 173-304)				
Storm water Management Program	Federal – Water Programs (40 CFR 122 -124) State – Water Pollution Control (RCW 90.48)	TBC - This describes storm water management objectives that may apply to storm drains at LSS-OU7.	Protectiveness is not affected.	No active sediment remediation is occurring. A monitoring program is in place to provide visual inspections, hydrographic and topographic surveys, monitor sediment quality, and the quality of groundwater entering the West Waterway.	40 CFR 122: July 2012, December 2012, June 2013, August 2014, September 2014; 40 CFR 124: December 2010, September 2011, January 2013

Notes:

CFR = Code of Federal Regulations
RCW = Revised Code of Washington
USC = U.S. Code
WAC = Washington Administrative Code

Puget Sound Estuary Program Protocols are unchanged and remain protective.

5. Todd Shipyards Sediments – OU9

TSS-OU9, ARAR Evaluation

Requirement	Citation	Description	Effect on Protectiveness	Comments	Amendment Date
Clean Water Act	Federal – Clean Water Act (33 USC 1251; 40 CFR 131);	Federal criteria for the protection of marine aquatic life are relevant and appropriate for discharges to surface water during sediment remediation.	Protectiveness is not affected.	No active sediment remediation is occurring. Only visual monitoring of the cap and the previous dredged channel is occurring.	April 2025
Washington Water Pollution Control Act (WPCA); Washington State Water Quality Standards for Surface Water	State – WPCA-Water Pollution Control (RCW 90.48); WPCA Water Quality Standards for Surface Waters (WAC 173-201A)	Narrative and quantitative limitations for surface water protection are provided in these regulations. Criteria are established for each water classification, including fecal coliform, total dissolved gas, total dissolved oxygen, temperature, pH, and turbidity. During sediment remediation, discharges to marine surface waters will comply with these requirements.	Protectiveness is not affected.	No active sediment remediation is occurring. Only visual monitoring of the cap and the previous dredged channel is occurring.	03/25/2020
Washington State Sediment Management Standards (SMS)	State – Sediment Management Standards (RCW 43.21C, 70.105D, 90.48, 90.52, 90.54, 90.70; WAC 173-204)	Numerical and narrative criteria for chemicals and biological effects are specified for sediment and are applicable to Harbor Island shipyard sediments.	Revisions do not change cleanup values. Protectiveness is not affected.	No active sediment remediation is occurring. Only visual monitoring of the cap and the previous dredged channel is occurring.	February 2013

Appendix D. Press Releases

The following are copies of press releases from local papers and blogs announcing the Five Year Review and soliciting comment.

SOUTH SEATTLE EMERALD™

Ad Proof

Advertiser: U.S. Environmental Protection Agency

Campaign: Public Notice: Harbor Island Cleanup

Ad Size: 300x250

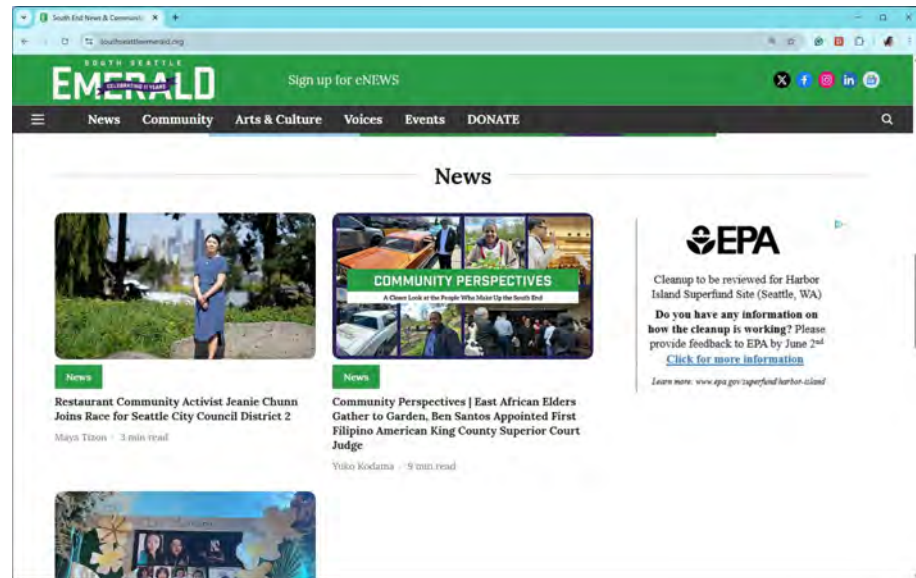
Placement: Sidebar - Middle Rotation

Flight Dates: April 28 – May 6, 2025

Impressions Delivered: 220

Clicks: 5

CTR: 2.27%



Screenshot Date: May 6, 2025



Harbor Island is a 420-acre island located in the Duwamish River and Elliot Bay in Seattle, Washington. Harbor Island was listed as a Superfund Site (a highly contaminated toxic waste site) by the U.S. Environmental Protection Agency in 1983 after discovering that previous commercial and industrial operations contaminated soil, groundwater, and sediment in the adjacent waterways. Polychlorinated biphenyls are the most widespread contaminant of concern in the sediment, but others include arsenic, polycyclic aromatic hydrocarbons, mercury, and dioxins/furans.

The Harbor Island Superfund Site has been divided up into smaller areas (called Operable Units, or OUs) to help organize the cleanup work. There are seven active OUs. Cleanup decisions were made by EPA at six OUs and by the Washington Department of Ecology at the Tank Farm OU.

The EPA is working on the sixth Five-Year Review for the Harbor Island Superfund Site (due in September 2025). A Five-Year Review provides a routine check-up to make sure that the cleanup continues to protect people and the environment. The most recent Five-Year Review (from 2020) showed that the Harbor Island Superfund Site cleanup remains protective of human health and the environment. To ensure the cleanup continues to be protective of human health and the environment, the EPA performs this comprehensive review every five years.

Do you have information on how the cleanup is working? Have you witnessed any damage to the signage or fencing? Do you have other information? If so, the EPA wants to hear from you by **June 2, 2025**. Please contact:

- **Ravi Sanga**, EPA Remedial Project Manager at sanga.ravi@epa.gov or 206-553-4092

For more information about the Harbor Island Superfund Site (including previous Five-Year Review documents), please visit:

- EPA's website: www.epa.gov/superfund/harbor-island

If you need materials in an alternative format or language, please contact EPA Community Involvement Coordinator Laura Knudsen at knudsen.laura@epa.gov or 206-643-4299.

GEORGETOWN COMMUNITY COUNCIL

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GCC is a nonprofit, 501(c)(3) organization seeking to improve the quality of life for all who live, work, and play in Georgetown, Seattle.

[All Posts](#)[Arts & Culture](#)[News](#)[Events](#)[Meet Your Neighbors](#)

Tim Neill · 6 days ago · 2 min read

EPA seeking public review of cleanup for Harbor Island Superfund Site

Updated: 2 days ago

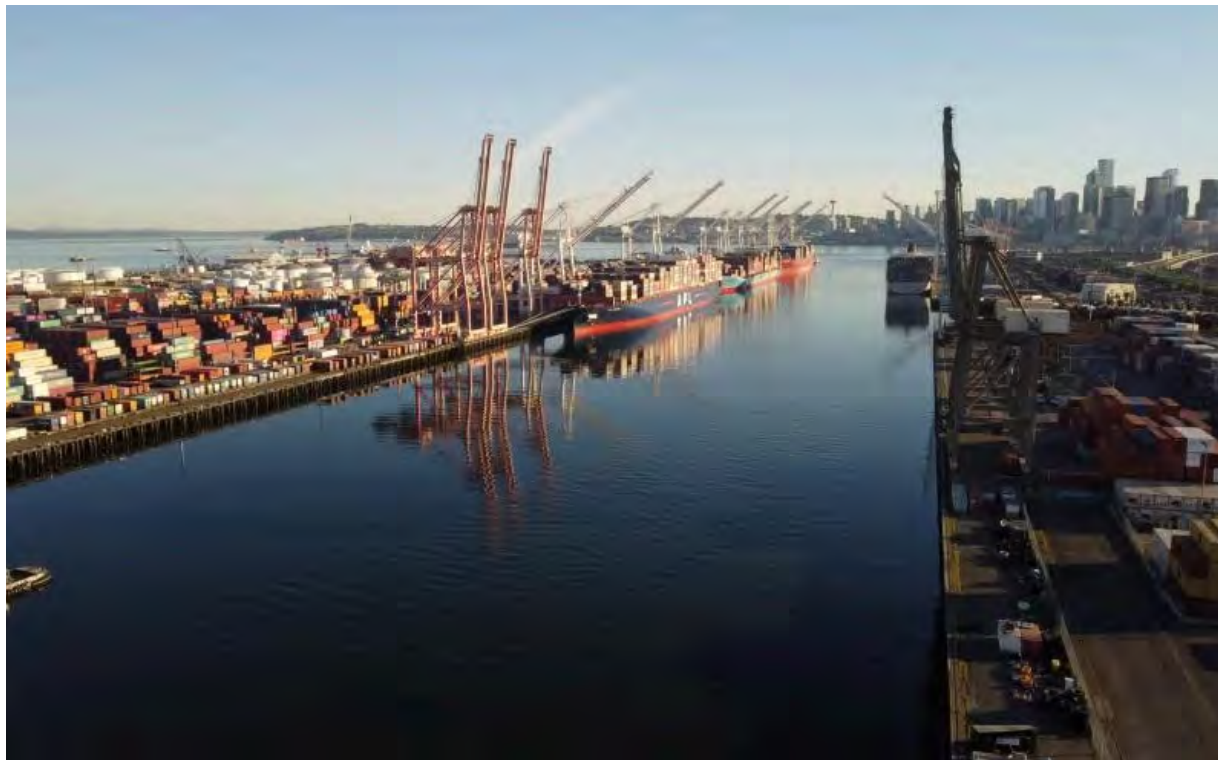
The U.S. Environmental Protection Agency (EPA) is working on its sixth Five-Year Review for the Harbor Island Superfund Site (due in September 2025).

A Five-Year Review provides a routine check-up to make sure that the cleanup continues to protect people and the environment. The most recent Five-Year Review (from 2020) showed that the Harbor Island Superfund Site cleanup remains protective of human health and the environment. To ensure the cleanup continues to be protective of human health and the environment, the EPA performs this comprehensive review every five years.

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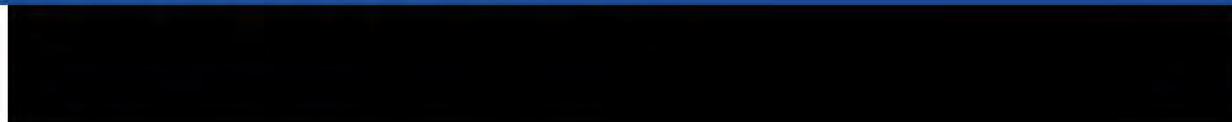
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2025 Georgetown Community Council

Georgetown Community Council is a nonprofit, tax-exempt, 501(c)(3) organization directors@georgetownneighborhood.com



206 293-6302



(Sunday sunset silhouette, photographed by Mike Burns)

ROAD WORK

-Street work for the **Alki Standby Generator Project** could start as soon as today on Beach Drive SW just south of 63rd – [details and map here](#).

-The Admiral Way Bridge's outside lane on the eastbound/southbound side is still closed.

TRANSIT TODAY

Water Taxi – [Regular West Seattle service](#); spring/summer schedule, with later-evening sailings Fridays and Saturdays.

Metro buses – [Regular schedule](#).

Washington State Ferries – Regular service on the Triangle Route, with M/V **Kittitas** and M/V **Cathlamet**, plus [M/V Salish is serving as the "bonus boat"](#). P.S. Next round of community meetings – online, systemwide – have been [announced for later this month](#).

SPOTLIGHT TRAFFIC CAMERAS

High Bridge – Here's the main camera, followed by the Fauntleroy-end camera:



Cleanup to be reviewed for Harbor Island Superfund Site (Seattle, WA)

Do you have any information on how the cleanup is working? Please provide feedback to EPA by June 2nd

[Click for more information](#)

Learn more: www.epa.gov/superfund/harbor-island



Environmental Protection Agency public notice: Harbor Island Superfund Site cleanup review

Public notice for the U.S. Environmental Protection Agency

Cleanup to be reviewed for Harbor Island Superfund Site (Seattle, WA)

Harbor Island is a 420-acre island located in the Duwamish River and Elliot Bay in Seattle, Washington. Harbor Island was listed as a Superfund Site (a highly contaminated toxic waste site) by the U.S. Environmental Protection Agency in 1983 after discovering that previous commercial and industrial operations contaminated soil, groundwater, and sediment in the adjacent waterways. Polychlorinated biphenyls are the most widespread contaminant of concern in the sediment, but others include arsenic, polycyclic aromatic hydrocarbons, mercury, and dioxins/furans.

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Appendix E. Data Review

The following appendix provides a data summary and data analysis for the sixth Harbor Island Superfund Site five-year review for the following operable units:

- Soil and Groundwater Operable Unit 1 (S&G-OU1)
- Lockheed Upland Operable Unit 3 (LU-OU3)
- Lockheed Shipyard Sediments Operable Unit 7 (LSS-OU7)

Operable units that are not included in this appendix are as follows:

- Tank Farms Operable Unit 2: The data review for the was conducted by the State of Washington Department of Ecology and is presented in Appendix B.
- West Waterway Operable Unit 8: No new data that would affect the protectiveness determination was collected during the period of this five year review.
- Todd Shipyard Sediments Operable Unit 9: No new data that would affect the protectiveness determination was collected during the period of this five year review.
- East Waterway Operable Unit 10: The interim ROD was released in 2024, and the remedy has not yet been implemented.

Soil and Groundwater OU1 Data Review

Monitoring for the S&G-OU1 includes groundwater sampling, and cap inspections and maintenance throughout Harbor Island. Groundwater monitoring is conducted annual by the Steering Committee. Cap inspections and maintenance are conducted for different properties within the OU by multiple parties.

Groundwater sampling for the S&G-OU1 is conducted according to the modified groundwater monitoring plan. Data for the previous five-year period is summarized in the 2024 Annual Groundwater Monitoring and Sixth 5-Year Statistical Review Report. A total of 17 wells (see Figure 1 for locations) were evaluated for contaminant concentrations relative to Record of Decision (ROD) cleanup levels and included the following wells:

- HI-1, HI-2, HI-3, HI-4, HI-5, HI-6A, HI-7, HI-9, HI-10, HI-11, HI-12, HI-16, HI-17, HI-18
- MW-01R, MW-213, TD-06A.

Groundwater samples were analyzed annually for total metals (copper, lead, and zinc), and available cyanide. Volatile organic compounds (VOCs) and polychlorinated biphenyls (PCBs) were only sampled once in the last five years, in 2024. The complete list of analytes and associated ROD specified cleanup goals are shown in Table 1.

There were several wells that did not have samples collected each year, limiting the ability to evaluate statistical trends over time (a minimum of four sampling events is required). Wells that did not have samples each year and the number of samples that were available include the following wells:

- HI-7 near the Lockheed Upland (2 sampling events)
- HI-9 near the former Fisher Mills site (1 sampling event)
- HI-9A near the former Fisher Mills site (3 sampling event)
- HI-17 near the former Hardware Specialty site (2 sampling events)
- MW-01R within the current Vigor Shipyard (3 sampling events)

Groundwater concentrations observed in each well are presented in (Table 2). Arsenic, cadmium, copper, lead, nickel, zinc, and available cyanide had concentrations that exceeded the ROD cleanup goals in one or more samples over the last five years (2020 – 2024). The greatest exceedances were observed in samples from Well HI-17 and included arsenic, cadmium, copper, lead, nickel, zinc. These metals also exceeded the cleanup goals during the last five-year review. The greatest exceedance was for copper with a concentration of 600 µg/L and a cleanup level of 2.9 µg/L. HI-17 is located in the interior of Harbor Island and is near an old smelter where metals would have been deposited at high concentrations. The high concentrations of metals appear to be isolated to the area near HI-17. Based on groundwater elevations (Figure 2), groundwater moves southeast from HI-17. Concentrations of metals in wells downgradient of HI-17 (HI-18, HI-12, HI-13) do not have elevated metals concentrations.

Several items of note for the compounds listed in Table 2:

- Arsenic – There were no exceedances of the Cleanup Goal except HI-17 (max: 308 µg/L) in the interior of Harbor Island. There is insufficient data to do a trend analysis for the past 5 years; however, arsenic was elevated in the previous five-year review period.
- Cadmium – There were no exceedances of the Cleanup Goal except HI-17 (max: 188 ug/L). There is insufficient data to do a trend analysis for the past 5 years; however, cadmium was elevated in the previous five-year review period.
- Copper – There were exceedances of the Cleanup Goal in samples collected from Wells TD06A (max: 15.4 µg/L), HI-3 (max: 3.0 µg/L), HI-5 (max: 11.6 µg/L), HI-17 (max: 600 µg/L), and MW-213 (max: 5.1 µg/L). Except for HI-17, trends were stable or decreasing; HI-17 had insufficient data for trends analysis but was elevated in the previous five-year period.
- Lead, Nickel, Zinc – There were no exceedances of the Cleanup Goal in any of the above mentioned wells except HI-17 with maximum values of 28.4 µg/L (lead), 270 ug/L (nickel), and 1,470 µg/L (zinc). Each of these metals were also elevated in the previous five year period.
- Mercury, Silver, Thallium, VOCs, and PCBs – There were no exceedances of the Cleanup Goal in any of the wells for the past 5 years.

Those wells with a detection of a ROD COC concentration above the cleanup goal in the last five years for the constituents sampled annually were evaluated for trends using the Mann-Kendall nonparametric test for trend (Table 9). Only wells with four or more detections during the last five years were evaluated. All of the Mann Kendall results had either no trend, stable, or probably decreasing.

The specific conductivity for well HI-6A at 24,350 µS/cm is almost twice as high as the next highest well. This well is located next to the bulkhead or barrier wall and might indicate a subsurface breach in the bulkhead that is allowing brackish sea water to mix with the groundwater. Although the salinity levels were high, they were not as high as some of the levels noted in the Lockheed Uplands OU3 wells next to the waterway.

Table 1. Analytes for OU1 Groundwater and Cleanup Goals.

Chemical Name	Cleanup Goal for Groundwater (µg/L)
Total Metals	
Arsenic	36
Cadmium	8
Copper	2.9
Lead	5.8
Mercury	0.025
Nickel	7.9
Silver	1.2
Thallium	6.3
Zinc	76.6
Cyanide	
Available Cyanide ^a	1.0
Volatile Organic Compounds	
1,1,1-Trichloroethane	42
1,1,2-Trichloroethane	42
Benzene	71
Carbon Tetrachloride	4.4
Tetrachloroethene	8.8
PCBs	
PCB Aroclor (total)	0.03

Notes:

a: Available cyanide is not included in the ROD. The Steering Committee elected to add it during the second-year monitoring. EPA agreed in February 2011 to replace total cyanide with available cyanide.

Table 2. Summary of Annual Groundwater Concentrations of Metals and Cyanide, OU-1

Well ID	Sample Date	Arsenic Total 36 ug/L	Cadmium Total 8 ug/L	Copper Total 2.9 ug/L	Lead Total 5.8 ug/L	Mercury Total 0.025 ug/L	Nickel Total 7.9 ug/L	Silver Total 1.2 ug/L	Thallium Total 6.3 ug/L	Zinc Total 76.6 ug/L	Cyanide Available 1 ug/L
TD-06A	5/8/2020	NA	NA	3.37	0.324	NA	NA	NA	NA	22.8	<2.0
TD-06A	5/27/2021	NA	NA	13.7	0.66	NA	NA	NA	NA	131	<2.0
TD-06A	12/2/2021	NA	NA	0.65J	0.026J	NA	NA	NA	NA	2.46J	NA
TD-06A	12/2/2021 FD	NA	NA	1.47J	0.067	NA	NA	NA	NA	7.18J	NA
TD-06A	6/14/2022	NA	NA	<0.39	<0.050	NA	NA	NA	NA	2.01	2.7
TD-06A	6/5/2024	<0.06	<0.020	15.4	0.365	0.00158J	0.32	<0.004	<0.008	26.5	1.7J
HI-1	5/9/2020	NA	NA	0.35J	0.489	NA	NA	NA	NA	3.4J	<2.0
HI-1	5/26/2021	NA	NA	0.44	0.173	NA	NA	NA	NA	5.2	<2.0J
HI-1	6/14/2022	NA	NA	<0.15	0.024J	NA	NA	NA	NA	1.0J	<2.0
HI-1	6/4/2024	0.23J	<0.008	0.46J	0.061J	<0.00006	0.48	<0.009	0.010J	1.4J	<2.0
HI-2	5/9/2020	NA	NA	<0.10	<0.050	NA	NA	NA	NA	<0.50	<2.0
HI-2	5/26/2021	NA	NA	0.05J	<0.050	NA	NA	NA	NA	<0.5	<2.0J
HI-2	6/13/2022	NA	NA	<0.10	<0.050	NA	NA	NA	NA	0.31J	1.7J
HI-2	6/4/2024	<0.06	<0.003	<0.10	<0.050	<0.00006	0.38	<0.004	<0.008	0.9	<2.0
HI-3	5/8/2020	NA	NA	1.28J	0.63	NA	NA	NA	NA	10.1	<2.0
HI-3	5/26/2021	NA	NA	3.03	1.44	NA	NA	NA	NA	26.8	<2.0J
HI-3	12/2/2021	NA	NA	1.09	0.668	NA	NA	NA	NA	16.8	NA
HI-3	6/13/2022	NA	NA	<0.28	0.126	NA	NA	NA	NA	5	<2.0
HI-3	6/6/2024	0.20J	0.519	1.37	0.498	<0.00006	1.01	0.013J	<0.009	30.9	<2.0
HI-4	5/8/2020	NA	NA	0.72J	0.401	NA	NA	NA	NA	11.9	NA
HI-4	5/8/2020 FD	NA	NA	1.92J	0.384	NA	NA	NA	NA	11.3	<2.0
HI-4	5/28/2021	NA	NA	2.37	1.02	NA	NA	NA	NA	44.3	<2.0
HI-4	6/14/2022	NA	NA	<0.61	0.104	NA	NA	NA	NA	9.7	<2.0
HI-4	6/4/2024	0.11J	0.392	0.7	0.375	<0.00006	0.18J	<0.009	<0.009	9.7	<2.0

Table 2 (cont'd). Summary of Annual Groundwater Concentrations of Metals and Cyanide, OU-1

Well ID	Sample Date	Arsenic Total 36 ug/L	Cadmium Total 8 ug/L	Copper Total 2.9 ug/L	Lead Total 5.8 ug/L	Mercury Total 0.025 ug/L	Nickel Total 7.9 ug/L	Silver Total 1.2 ug/L	Thallium Total 6.3 ug/L	Zinc Total 76.6 ug/L	Cyanide Available 1 ug/L
HI-5	5/8/2020	NA	NA	<0.10	<0.052	NA	NA	NA	NA	<0.52	1.9J
HI-5	5/26/2021	NA	NA	11.6	1.48	NA	NA	NA	NA	14.8J	<10J
HI-5	12/2/2021	NA	NA	0.07J	<0.050	NA	NA	NA	NA	0.27J	NA
HI-5	6/14/2022	NA	NA	<0.10	<0.050	NA	NA	NA	NA	<0.50	<2.0
HI-5	6/6/2024	0.35J	<0.020	0.7	0.105J	0.00054J	1.47	<0.009	<0.009	1.6J	<2.0
HI-6A	5/7/2020	NA	NA	<0.50	0.193J	NA	NA	NA	NA	<10	<2.0J
HI-6A	5/27/2021	NA	NA	0.55	0.154	NA	NA	NA	NA	1.22J	4.1
HI-6A	6/15/2022	NA	NA	<0.20	0.136	NA	NA	NA	NA	2.69	2.9
HI-6A	6/5/2024	0.15J	<0.003	0.46J	0.107J	<0.00006	0.24	<0.004	<0.008	14.2J	2.1
HI-6A	6/5/2024 FD	0.15J	<0.020	0.38J	0.096J	<0.00006	0.19J	<0.004	<0.008	3.86J	3.3
HI-7	6/5/2023	NA	NA	1.24	0.118	NA	NA	NA	NA	1.7J	2.9
HI-7	6/5/2024	4.5	0.063J	1.27	0.094J	0.00135J	0.79	<0.009	0.038	2.2	<2.0
HI-9 ^a	6/5/2024	0.42J	0.022J	1.44	<0.020	0.00102J	0.82	<0.004	0.013J	0.57	<2.0
HI-9A ^b	5/7/2020	NA	NA	0.38J	0.145J	NA	NA	NA	NA	1.95J	<2.0J
HI-9A ^b	6/24/2021	NA	NA	0.17	0.074J	NA	NA	NA	NA	<2.0	<2.0
HI-9A ^b	6/13/2022	NA	NA	<0.10	<0.050	NA	NA	NA	NA	0.73	<2.0
HI-10	5/7/2020	NA	NA	2.04J	0.028J	NA	NA	NA	NA	<2.0	<2.0
HI-10	6/24/2021	NA	NA	1.36	<0.050	NA	NA	NA	NA	2.95J	<2.0
HI-10	6/13/2022	NA	NA	1.15J	0.046J	NA	NA	NA	NA	1.14	<2.0
HI-10	6/5/2024	0.55	0.035J	1.53	<0.020	0.00079J	1.98	<0.004	0.014J	1.94	<2.0
HI-11	5/7/2020	NA	NA	0.98J	0.152J	NA	NA	NA	NA	<2.0	<2.0
HI-11	5/27/2021	NA	NA	0.6	<0.020	NA	NA	NA	NA	<2.0	<2.0
HI-11	6/15/2022	NA	NA	<1.02	<0.020	NA	NA	NA	NA	0.6J	<2.0
HI-11	6/5/2023	NA	NA	0.24	<0.020	NA	NA	NA	NA	<2.0	<2.0
HI-11	6/5/2024	0.16J	<0.020	0.29J	0.034J	<0.00006	0.61	<0.009	<0.009	2.1	<2.0

Table 2 (cont'd). Summary of Annual Groundwater Concentrations of Metals and Cyanide, OU-1

Well ID	Sample Date	Arsenic Total 36 ug/L	Cadmium Total 8 ug/L	Copper Total 2.9 ug/L	Lead Total 5.8 ug/L	Mercury Total 0.025 ug/L	Nickel Total 7.9 ug/L	Silver Total 1.2 ug/L	Thallium Total 6.3 ug/L	Zinc Total 76.6 ug/L	Cyanide Available 1 ug/L
HI-12	3/9/2020	NA	NA	2.56	0.708	NA	NA	NA	NA	13.2	<2.0
HI-12	5/26/2021	NA	NA	1.96	0.271	NA	NA	NA	NA	11.9	<2.0J
HI-12	6/13/2022	NA	NA	1.87J	0.064	NA	NA	NA	NA	10.3	<2.0
HI-12	6/5/2023	NA	NA	0.05J	NA	NA	NA	NA	NA	NA	NA
HI-12	6/6/2024	0.06J	<0.003	<0.10	<0.020	<0.00006	0.06J	<0.004	<0.008	1.73J	<2.0
HI-12	6/6/2024 FD	0.06J	<0.003	<0.10	<0.020	<0.00006	0.07J	<0.004	<0.008	14.8J	<2.0
HI-16	5/8/2020	NA	NA	<0.10	0.120J	NA	NA	NA	NA	<2.0	<2.0
HI-16	5/26/2021	NA	NA	0.43	0.157J	NA	NA	NA	NA	6.1	<2.0J
HI-16	6/14/2022	NA	NA	<0.17	0.026J	NA	NA	NA	NA	2.5	<2.0
HI-16	6/6/2024	0.15J	<0.008	<0.10	<0.020	<0.00006	0.67	<0.009	<0.009	0.5J	<2.0
HI-17	6/5/2023	NA	NA	488	19.5	NA	NA	NA	NA	1470	<2.0
HI-17	6/5/2024	308	188	600	28.4	0.00332	270	<0.009	0.112	1240	<2.0
HI-18	5/7/2020	NA	NA	0.40J	3.45	NA	NA	NA	NA	<2.0	<2.0
HI-18	5/26/2021	NA	NA	0.29	0.022J	NA	NA	NA	NA	<2.0	<2.0J
HI-18	6/13/2022	NA	NA	<0.25	<0.020	NA	NA	NA	NA	0.6J	<2.0
HI-18	6/5/2023	NA	NA	0.24	0.009J	NA	NA	NA	NA	0.7J	2.9
HI-18	6/5/2024	2.67	<0.020	0.29J	<0.020	0.00051J	7.76	<0.009	<0.009	1.4J	<2.0
MW-01R	5/8/2020	NA	NA	<0.10	0.077J	NA	NA	NA	NA	<2.0	<2.0
MW-01R	5/27/2021	NA	NA	0.12	0.021J	NA	NA	NA	NA	<2.0	<2.0
MW-01R	6/14/2022	NA	NA	<0.31	0.045J	NA	NA	NA	NA	0.5J	<2.0

Table 2 (cont'd). Summary of Annual Groundwater Concentrations of Metals and Cyanide, OU-1

Well ID	Sample Date	Arsenic Total 36 ug/L	Cadmium Total 8 ug/L	Copper Total 2.9 ug/L	Lead Total 5.8 ug/L	Mercury Total 0.025 ug/L	Nickel Total 7.9 ug/L	Silver Total 1.2 ug/L	Thallium Total 6.3 ug/L	Zinc Total 76.6 ug/L	Cyanide Available 1 ug/L
MW-213	5/7/2020	NA	NA	2.22	0.617	NA	NA	NA	NA	4.25J	1.6J
MW-213	5/27/2021	NA	NA	0.12	1.38	NA	NA	NA	NA	14.3	3.6
MW-213	5/27/2021 FD	NA	NA	6.14	1.38	NA	NA	NA	NA	13.6	3.7
MW-213	12/2/2021	NA	NA	5.1	1.13	NA	NA	NA	NA	9.48	NA
MW-213	6/15/2022	NA	NA	<0.97	0.31	NA	NA	NA	NA	28.2	2.3
MW-213	6/15/2022 FD	NA	NA	1.20J	0.35	NA	NA	NA	NA	37.6	2.3
MW-213	6/5/2023	NA	NA	1.39	0.366	NA	NA	NA	NA	9.59	3.3
MW-213	6/5/2023 FD	NA	NA	1.54	0.399	NA	NA	NA	NA	10.7	2.9
MW-213	6/4/2024	<0.06	<0.020	0.28J	0.059J	<0.00006	0.09J	<0.004	<0.008	4.27	1.8J

Notes

a. HI-9 and HI-9A have different screen intervals.

b. HI-9A decommissioned.

Value that are in **bold and highlighted** exceed their respective screening criteria.

< = non-detect

FD = field duplicate

NA = no data available

J = estimated value

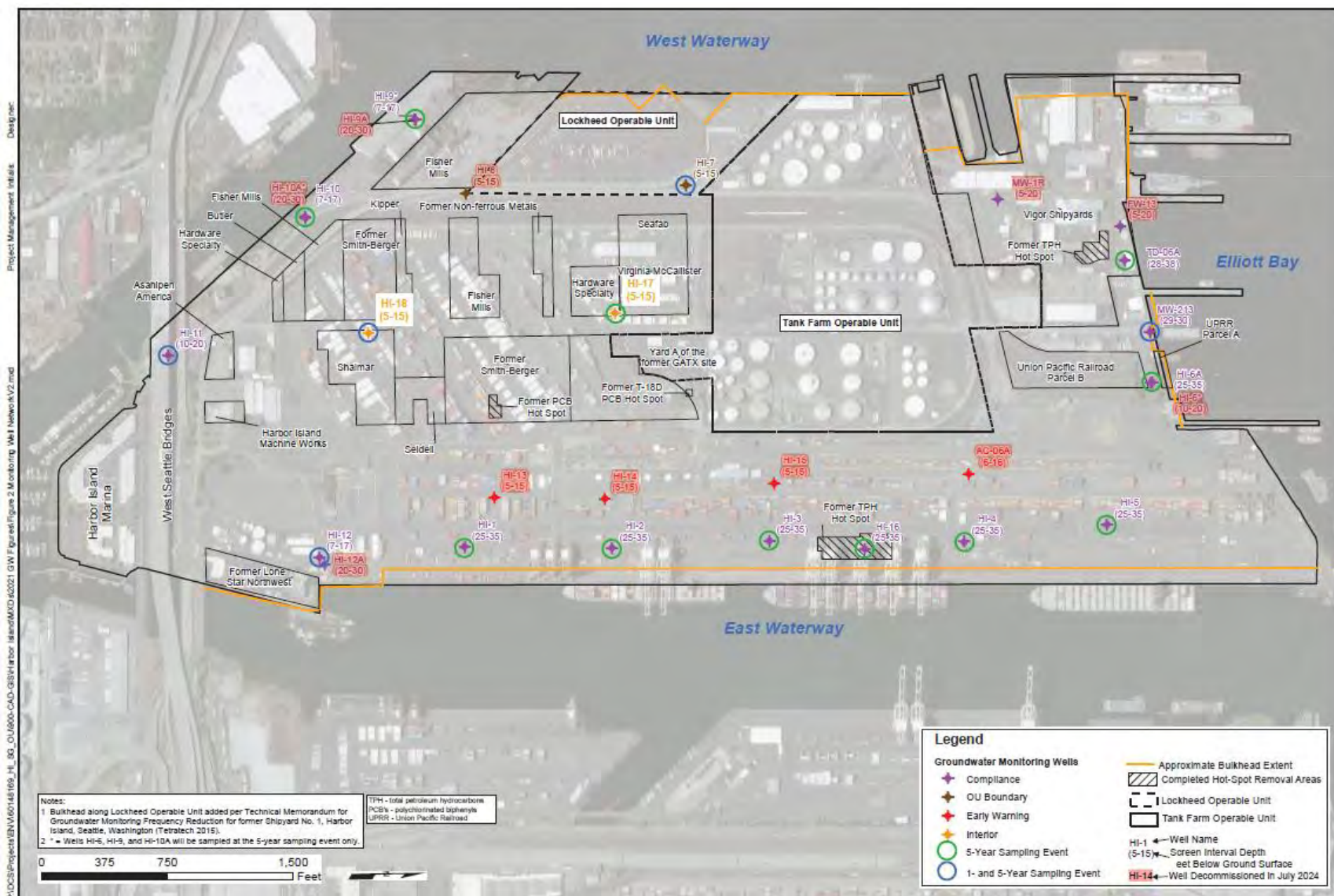


Figure 1. Location of Groundwater Monitoring Wells, S&G-OU1

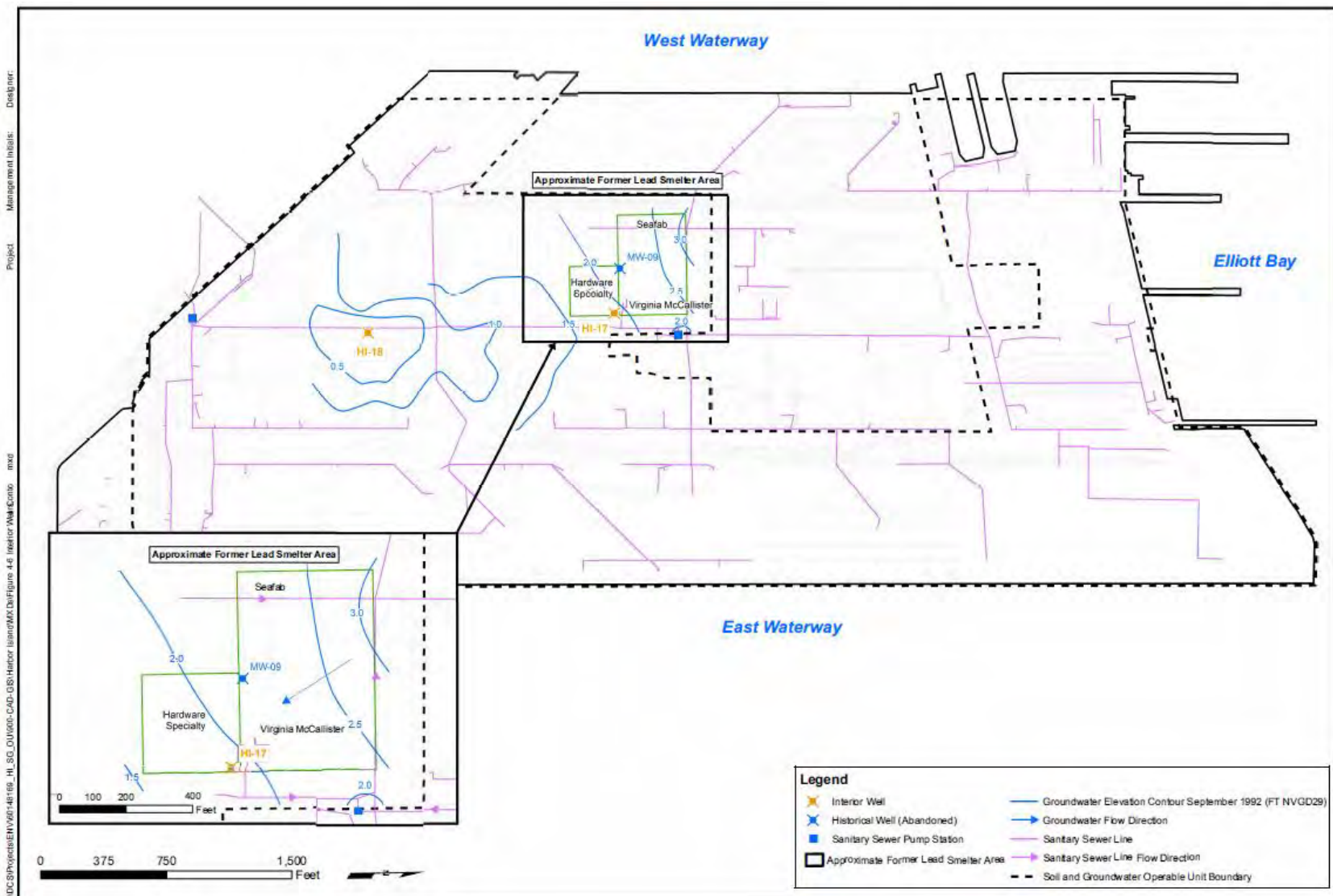


Figure 2. Groundwater Elevations near the Interior Wells HI-17 and HI-18, S&G-OU1.

Lockheed Uplands and Shoreline OU3 Data Review

Groundwater sampling for LU-OU3 is conducted annually at 5 wells in the impacted area and 4 wells downgradient. Groundwater sampling is also conducted in support of the LSS-OU7 monitoring program to evaluate the potential for contaminant migration from the uplands to the sediments. The location of the Upland and Shoreline monitoring wells is presented in Figure 3. Results for both programs will be presented in the following section.

Groundwater samples from the monitoring wells are analyzed annually for VOCs, a limited suite of metals, and cyanide. Once each 5-year period, the shoreline groundwater samples are analyzed for a full suite of contaminants including VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, total petroleum hydrocarbons, limited metals, and available cyanide.

Table 3 includes the minimum and maximum concentration for constituents that exceeded cleanup goals during the previous five years (2020-2024). Of the sixty-four VOCs analyzed for in the past 5 years, only tetrachloroethylene (PCE) was detected above the associated screening level. PCE concentrations slightly exceeded the associated screening level of 8.8 µg/L in wells LMW12, LMW26, and LMW27. The highest value was 20 µg/L during 6/2/2022 and 10/10/2023.

Seventy-seven SVOCs were analyzed at each of the 17 monitoring wells. Only 7 of the wells had SVOC compounds detected, and all reported concentrations were well below their associated screening criteria except for well LMW31 on 6/4/24 had very slightly elevated levels of chrysene (0.036 µg/L) and benzo(b)fluoranthene (0.029 µg/L) elevated above the screening levels (0.018 µg/L for both).

No PCBs were detected in any of the 17 groundwater monitoring wells during the June 2024 sampling event. None of the chlorinated pesticides were observed at concentrations above screening levels. TPH-gasoline range (TPH-G) was not detected at any of the groundwater wells. TPH-diesel range (TPH-D) and -oil range (TPH-O) were detected at low concentrations in the 10 of the 17 monitoring wells sampled with a range of 0.25 µg/L to 1 µg/L, all below the screening criteria of 500 µg/L.

Of the metals, only dissolved arsenic, dissolved copper, and dissolved nickel were observed above screening values. Total arsenic was reported below the associated saltwater criterion continuous concentrations (CCC) of 36 µg/L in all 17 of the monitoring wells sampled. However, 14 of the 17 wells showed dissolved concentrations of arsenic above the screening level for human health for consumption of organisms of 0.14 µg/L. The dissolved concentrations ranged from 0.52 µg/L in well BG-02 to 11 µg/L in well LMW32S. Dissolved copper and nickel were observed above the screening values in one monitoring well (LMW-31 and LMW-33, respectively) and were only slightly elevated in groundwater samples.

Trends in groundwater concentrations were evaluated for those wells with a detection of a contaminant above the cleanup goal and with at least 4 data points in the last five years (Table 3). All of the trends were either stable or had no trend. It should be noted that during this five-year review, the dissolved component of zinc, with a screening level of 76.6 ug/L, did not generate any exceedances in the analyzed wells compared to past evaluations. The total zinc data did however indicate exceedance in three wells. Similarly lead did not have any exceedances in the dissolved phase. However, one well, LMW31, showed exceedance above the screening level of 5.8 ug/L in total lead on two occasions.

Table 3. Mann-Kendall Trend Analysis (2020-2024), LU-OU3 Upland and Shoreline Monitoring Wells

Well	Constituent	Number of Data Points	Min and Max (µg/L)	Trend Test Result	Confidence Factor
LMW12	PCE ²	8	11 to 20	No Trend	68.3%
LMW26 ¹	PCE ²	9	5.8 to 12	Stable	72.8%
LMW27	PCE ²	8	0.23 to 11	No Trend	80.1%
LMW3	Copper ³	4	<2.0 to 10	Stable	50.0%
LMW9	Copper ³	4	<2.0 to 10	Stable	50.0%
LMW12	Copper ³	4	2.9 to 10	Stable	50.0%
LMW18 ¹	Copper ³	4	2.9 to 10	Stable	72.9%
LMW26 ¹	Copper ³	4	2.3 to 10	Stable	50.0%
LMW27	Copper ³	4	0.82 to 10	Stable	50.0%
LMW30	Copper ³	4	2.9 to 10	Stable	50.0%
LMW31	Copper ³	5	4.5 to 49	No Trend	50.0%
LMW32S	Copper ³	4	<2.0 to 10	Stable	50.0%
LMW32D	Copper ³	4	<2.0 to 10	Stable	50.0%
LMW33	Copper ³	4	1.2 to 10	Stable	50.0%
LMW34	Copper ³	4	1.7 to 10	Stable	50.0%
BG02	Copper ³	4	<2.0 to 10	Stable	50.0%
LMW26	Nickel	4	2.4 to 20	Stable	62.5%
LMW30	Nickel	4	<4 to 20	Stable	83.3%
LMW31	Nickel	4	0.56 to 20	No Trend	62.5%
LMW32S	Nickel	4	0.62 to 20	No Trend	62.5%
LMW32D	Nickel	4	0.13 to 20	No Trend	62.5%
LMW33	Nickel	4	8.1 to 20	No Trend	50.0%
LMW34	Nickel	4	3.4 to 20	Stable	62.5%
BG02	Nickel	4	<4.0 to 20	Stable	83.3%

Notes:

1. LMW18 and LMW26 are sampled as part of both the Uplands OU and the LSSOU groundwater monitoring program

2. PCE ROD cleanup goal = 8.8 µg/L

3. Copper ROD cleanup goal = 2.9 µg/L

4. Nickel ROD cleanup goal = 8.2 µg/L

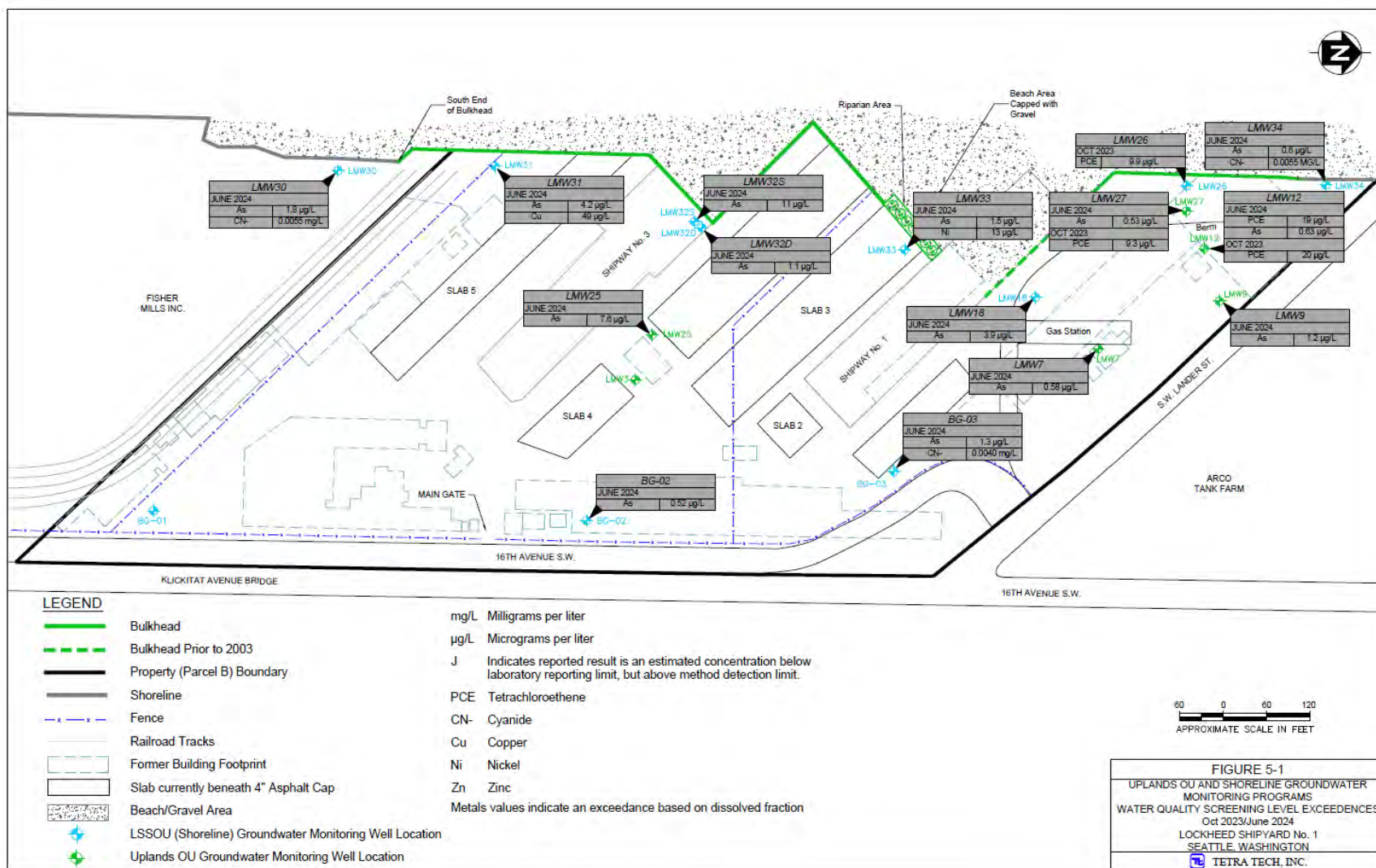


Figure 3. Location of Groundwater Monitoring Stations, LU-OU3

Lockheed Shipyard Sediments OU7 Data Review

Monitoring of LSS-OU7 included cap inspection, sediment sampling, and groundwater monitoring. The cap inspection includes an annual visual inspection and topographic inspection every five years for the on-land portion and hydrographic survey every five years for the in-water portion of the cap. The sediment sampling is completed every two years for metals, PCBs, and polycyclic aromatic hydrocarbons (PAHs).

According to the monitoring plan, sediment samples are to be collected at depths of 0-10 centimeters (cm) and if a clearly identified top layer of deposited material is present, this material will be sampled and submitted for analyses separately. Grab samples were collected from an un-capped portion of the Open Channel Area using a power Van Veen grab sampler. The sample locations are depicted on Figure 4 as SED-01 through SED-05. The actual sample station locations were at or within close proximity to the target coordinates for each location.

Each of the samples was analyzed for grain size and total organic carbon (TOC), five metals (arsenic, copper, mercury, lead, and zinc), low-molecular-weight PAHs (LPAHs), high-molecular-weight PAHs (HPAHs), and PCBs.

Grab samples were collected from the Beach Area using decontaminated stainless-steel bowls and spoons. Sediment samples in the Beach Area were collected from the top 10 cm of the surface, as specified in the monitoring plan. The geographic coordinates of the sample locations are depicted on Figure 4 as BA-1 through BA-5.

Five metals were analyzed in each of the samples collected from the five Beach Area sampling locations in the Beach Area. Analytical results indicate no exceedances above the criteria. Five samples collected from the Beach Area were analyzed for LPAHs, HPAHs, PCBs with no reported criterion exceedances.

The Mann-Kendall trend analysis was completed for the metals arsenic, copper, mercury, lead and zinc as well as for total PCBs. Mercury was the only metal with values above detection limits, exceeded screening levels during the previous five years (Table 4), and had at least four data points. PCBs were also exceeding screening level values; however, they are in SED-1 to SED-5 sampling stations and are not located on the LSSOU cap, and therefore exceedances do not indicate cap failure. None of the sediment samples exceeded the screening values for arsenic, copper, lead, or zinc. Each of these metals showed either no trend over the five-year period or had a stable or probably decreasing trend.

Table 4. Mann-Kendall Trend Analysis (2020-2024), Sediment, LSS-OU7

Sample	Constituent	Number of Data Points	Min and Max (µg/L)	Trend Test Result	Confidence Factor
SED-1	Mercury	11	0.02 to 0.425	No Trend	85.9%
SED-2	Mercury	12	0.24 to 0.81	No Trend	72.7%
SED-3	Mercury	10	0.181 to 0.79	Stable	56.9%
SED-4	Mercury	11	0.12 to 0.495	No Trend	82.1%
SED-5	Mercury	10	0.03 to 0.704	Increasing ^a	99.8%
SED-1	Total PCBs	11	1.7 to 37.01	Increasing	98.0%
SED-2	Total PCBs	12	1.5 to 20.04	Increasing	98.4%
SED-3	Total PCBs	11	1.4 to 14.06	Stable	89.1%
SED-4	Total PCBs	11	0.093 to 14.76	Stable	67.6%
SED-5	Total PCBs	8	0.062 to 15.38	Probably Increasing ^b	91.1%

a: Increasing denotes an increasing trend that is statistically significant with a >95% probability.

b: Probably increasing denotes an increasing trend that is statistically significant with a 90% to 95% probability.

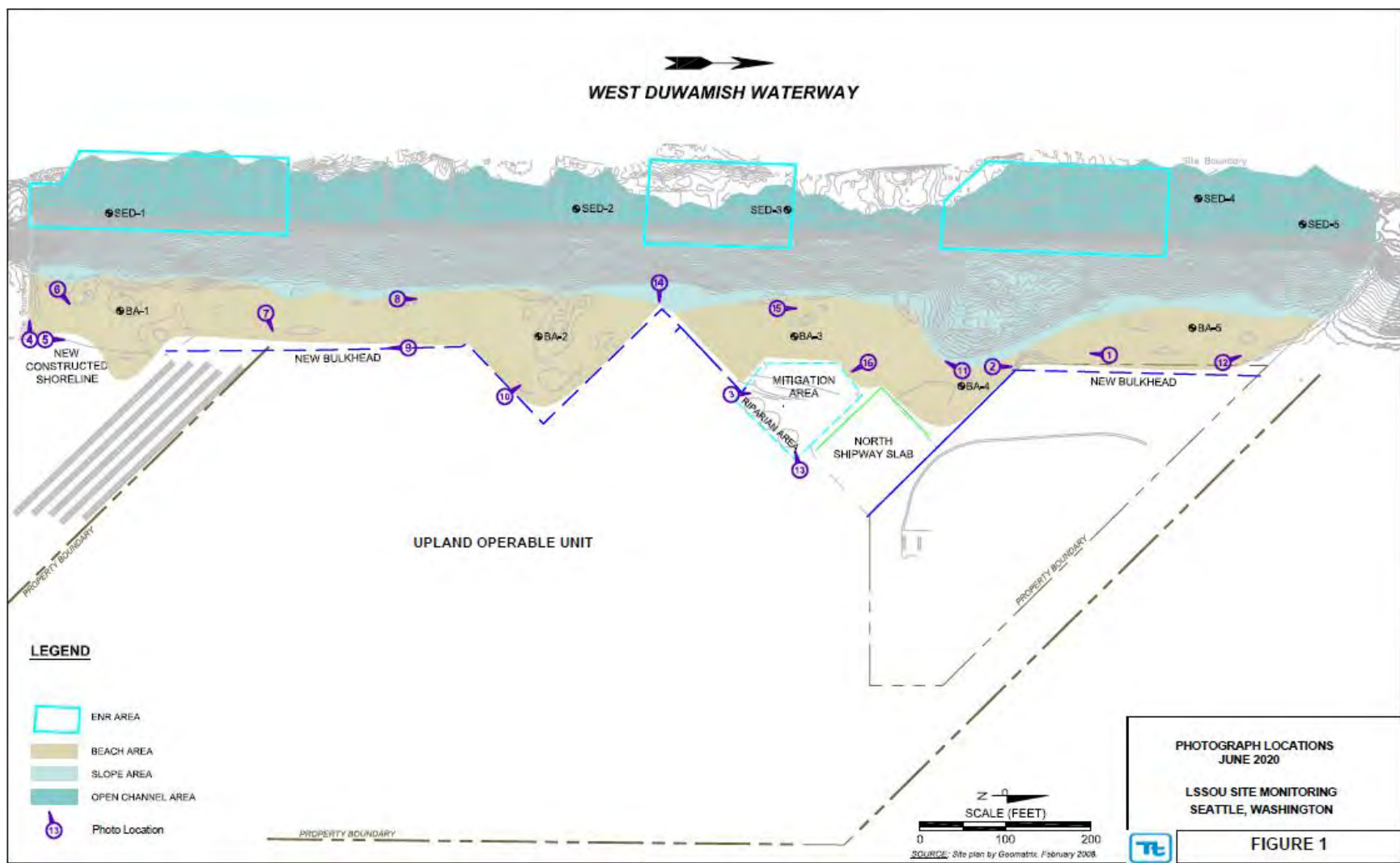


Figure 4. Location of Sediment Monitoring Stations, LSS-OU7

Appendix F. Site Inspection Report

Harbor Island Superfund Site, Seattle, King County, Washington

1. Introduction

- a. Date of Visit: March 27, 2025
- b. Location: Seattle, Washington
- c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.
- d. Participants:

Ravi Sanga	EPA, Remedial Project Manager	(206) 553-4092
Bill Gardiner	USACE, Risk Assessor	(206) 764-3322
Kayla Patten	USACE, Environmental Engineer	(206) 316-3855
Ben McKenna	USACE, Geologist	(206) 764-3803
Vance Atkins	Ecology, Project Manager	(425) 324-1438
Brick Spangler	Port of Seattle, Environmental Project Manager	
Mia Grasso	WSP USA, Environmental Engineer	(315) 401-7303
Kate Snider	Floyd/Snider, Project Manager	(206) 292-2078

2. Summary

A site visit to the Harbor Island Superfund Site was conducted on 27 March 2025. The Soil and Groundwater Unit (OU1) and Lockheed operable units (OU3 and OU7) were inspected along with the Tank Farm Operable Unit, Union Pacific Railroad (UPRR) parcels and Vigor Shipyards. Typical operations and maintenance, as well as activities since the last five-year review, were discussed with representatives from each area. Cap inspections occur regularly at each OU, and appropriate maintenance actions are taken as necessary. Though some standing water, plants, and cracks were observed in some areas during the inspection, the caps are generally in good condition and functioning as intended. The Tank Farm Operable Unit was inspected, and personnel were on hand to provide information to the inspection team. The UPRR Parcel B is a ballast cap and appeared in good condition. The UPRR Parcel A showed damage to the concrete cap with holes up to a foot deep with exposed soil. The associated bulkhead for Parcel A appeared in good condition. LNAPL recovery operations have ceased at the Vigor Shipyard, which is part of OU1. The LNAPL recovery and treatment system has been completely removed. The remaining cap at the shipyard appeared well-maintained and in good condition. The habitat bench on the West Waterway appeared stable and a highly functioning habitat.

3. Discussion

USACE personnel met on site outside the Lockheed Uplands at 11:00. USACE personnel were joined by EPA, Ecology and Port of Seattle personnel shortly after. The weather was partly cloudy and cool with intermittent light rain. After health and safety briefings the inspection team toured OU3. The parcel is currently used as a staging area for various shipping vehicles and equipment. The cap showed some minor cracking but also showed repair efforts to fix and seal the cracks. The Port of Seattle representative discussed the robust repair program that continues to maintain the cap integrity. Several monitoring wells were observed, and it was noted that the protective traffic bollards at one well showed evidence of a collision, however the wellhead itself was undamaged. This detail indicated the necessity of the bollards for protection of the wells. The seawall on the West Waterway showed evidence of normal rust but appeared intact. The team noted several gouges in the cap that were likely caused by staging container boxes but did not penetrate the cover and will be addressed by the Port. Overall, the cap appeared in good condition and continues to perform its function. The Port of Seattle representative discussed a potential land use change for the parcel to include container loading/unloading to rail lines adjacent to the site. This land use change may require the installation of heavy equipment which could affect the integrity of the cap. Minor ponding was observed but was not a concern due to rain in the previous 24 hours.

The intertidal habitat area for OU7 adjacent to the upland area was inspected by the team and what was observable of the habitat appeared to have sufficient cover of cobble and gravels. The riparian area above the beach showed healthy native vegetation, although some invasive butterfly bushes (*Buddleja davidii*) were dominating one area. A significant amount of trash was present at the location.

The team next inspected the cap for the Soil and Groundwater OU (Terminal 18). This area is operated by the Northwest Seaport Alliance (NWSA) and is the main area for the Port's marine cargo operations. Again, ponding was observed but likely due to recent precipitation. The northern portion of the cap appeared in good condition with minor cracking observed. An area in the central portion that is used as a passenger vehicle parking lot showed significant depressions, cracks and ponding. Several pond areas were noted to be nearly 3 inches deep with cracks at the bottom. This ponding associated with cracks could potentially lead to infiltration and facilitate groundwater movement. These areas were discussed with EPA, the Port and the representative from the NWSA who indicated that the condition of the pavement was not up to the standards they would like to see. The representative from the Port indicated that there will likely be some repaving of the cap in the future. Multiple locations were observed where the containers have created depressions in the pavement. The depressions are generally shallow and did not show evidence of cracking. The southern portion of the unit was noted to have significant ponding and cracking present in one area around a rail line that ran SW-NE. Depressions were observed from container staging with minor ponding. Overall, the cap in the southern portion appeared in good condition.

After inspecting Terminal 18 the team drove over to the Tank Farm Operable Unit and met with the staff of the BP-Arco facility. The team was briefed on recent remedial operations and the proceeded out to the newly constructed seawall section north of the marine transfer lines. The new seawall appeared in excellent condition and the representative for BP-Arco indicated that there are discussions about doing the same for the seawall south of the transfer lines but would require extensive measures to protect the existing building situated on the seawall. The extraction system at the site is fully functional and appeared in good condition.

Next the team drove to the Shell Tank Farm facility and met with representatives for Shell. The inspection team did not walk the facility but participated in a briefing for EPA and Ecology from the Shell representatives. The discussion included details on recent remedial actions and remedial options in regard to recent elevated groundwater concentrations in the central portion of the site.

Next the team met with a representative from UPRR and proceeded to inspect the UPRR Parcel B. This area is comprised of multiple rail lines that largely serve as staging/storage for railcars. At the time of the inspection the rail lines were mostly empty and allowed the team to walk the entirety of the area. The cap for this parcel consists of a ballast type cap. The distribution of the ballast appeared to be even with no bare spots and the overall condition appeared to be good.

The team next inspected UPRR Parcel A at the northern end of the island. This parcel consists of a small, paved area adjacent to the bulkhead with a rail loading dock and is operated by Alaska Freight. The bulkhead itself appeared to be in good condition when viewed from above. The concrete capped areas on the east and west of the rail ramp showed evidence of cracking and significant holes (Photos 15 and 16). The holes were several inches in diameter and ranged from several inches to approximately 1 foot deep with exposed soil observed. Representatives from Alaska Freight noted that they have repeatedly repaired holes that have developed along the northern edge of the parcel. Multiple patches of concrete repairs were documented in the inspection [and site inspections conducted in 2023 and 2024 years have shown holes appearing and being repaired]. The adjacent parcel which includes a habitat/park appeared in good condition.

The final area of inspection was the Vigor Shipyards (formerly Todd Shipyards) on the northwestern corner of the island. The parcel is operated by Vigor and consists of extensive boat maintenance and repair operations. The remedy at the Shipyards consisted of an LNAPL removal system and capping. The LNAPL recovery and treatment systems were dismantled and removed in 2017 leaving only the capped area. The team inspected the capped area, and it appeared in good condition and sealed well. The recently constructed habitat bench off the western side of the island was visually inspected from the shoreline. The representative for Vigor discussed the habitats construction, bathymetry and successes since it was finalized. The habitat appears to be a stable, highly functioning project.

After viewing the Vigor Shipyards, the inspection was concluded. All participants were off site by 4:30pm

4. Actions

USACE will incorporate information obtained from the site visit into the Five-Year Review Report.

5. Photos



Photo 1. Lockheed Upland Cap with Repaired Cracks



Photo 2. Lockheed Upland Monitoring Well LMW-32D with Damaged Bollard



Photo 3. Lockheed Upland Ponding



Photo 4. Lockheed Upland Gouges on Cap



Photo 5. Lockheed Sediments Beach Habitat Area with Seawall



Photo 6. Terminal 18 Northern Area Pavement Cracks with Repairs



Photo 7. Terminal 18 Central Area Ponding with Cracking



Photo 8. Terminal 18 Central Area Cap Damage from Containers



Photo 9. Terminal 18 Southern Area Ponding Along Rail Lines



Photo 10. BP-Arco Facility New Seawall



Photo 11. BP-Arco Facility Historic Seawall, Transfer Lines and Warehouse



Photo 12. BP-Arco Facility Extraction System Wells



Photo 13. UPRR Parcel B Ballast Cap



Photo 14. UPRR Parcel A East Seawall



Photo 15. UPRR Parcel A Hole on Eastern End



Photo 16. UPRR Parcel A Holes on Western End

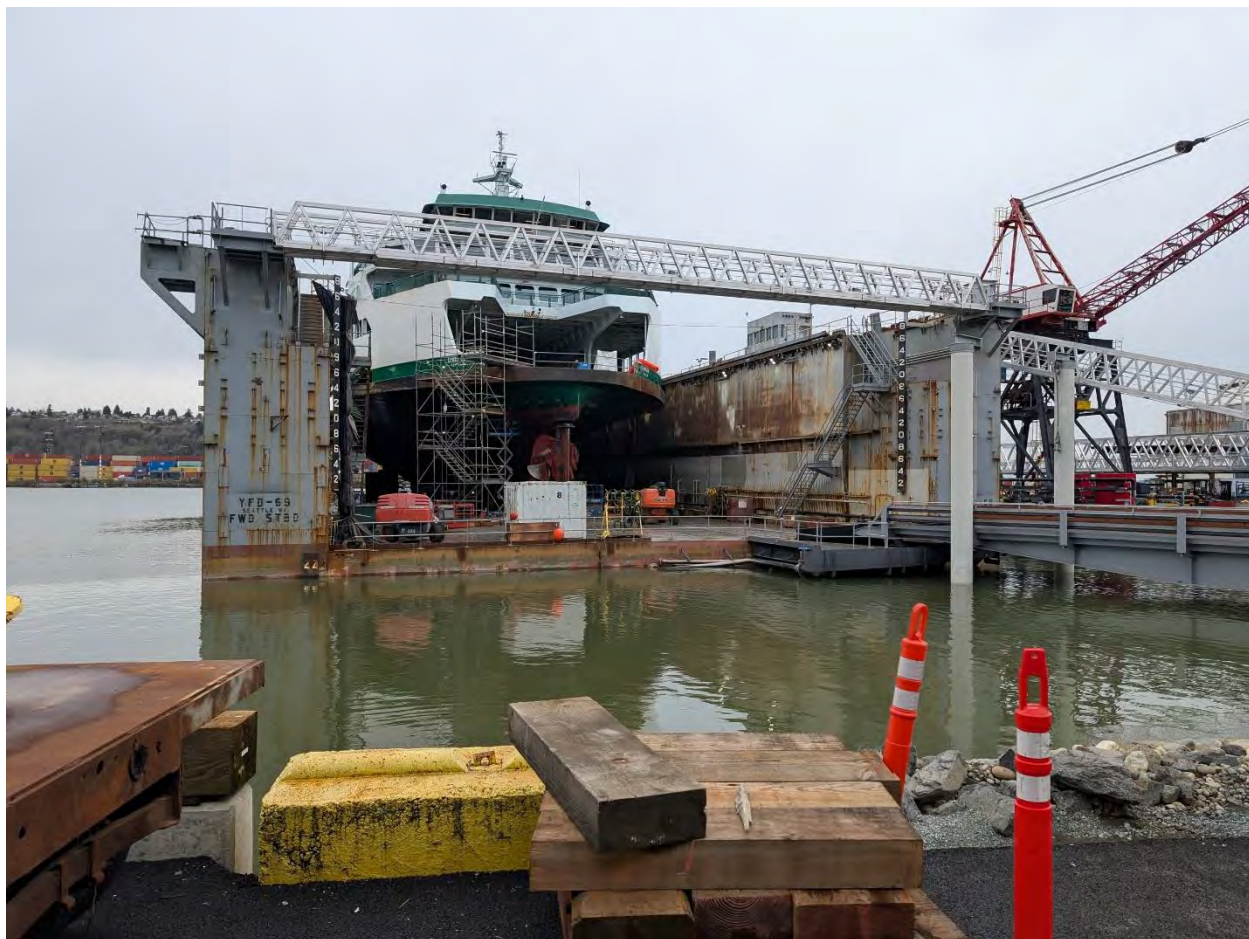


Photo 17. Vigor Shipyards New Drydock

Appendix G. Interview Responses

The following are interview responses provided by the interviewees. Original text is provided; they have only been edited for formatting.

Harbor Island Five Year Review – Interview Form

Interviewee: Brick Spangler

Interviewer: _____

Date: 4-14-2024

1) What is your overall impression of the project?

I feel the selected remedies are still protective.

2) Is the remedy functioning as expected? How well is the remedy performing?

Yes, based on my understanding of the design.

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

Regarding the environmental cap, the monitoring shows wearing of the cap material but still functions as intended. As far as the groundwater concentration, it's my understanding that, in general, contaminants concentration are decreasing or stable.

4) Is there a continuous 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.

Regarding monitoring of the env caps at T18, the caps are inspected annually, with inspection reports provided to EPA. For T10, inspections are also conducted annually with reporting going to EPA, however this responsibility is Lockheed Martin's (previous owners) responsibility.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

My understanding is that the GW monitoring program for the S&GW OU has been recently revised and will require approval from EPA.

6) Have there been unexpected O&M difficulties (e.g., parts replacement, unexpected treatment system shutdown, unanticipated costs associated with O&M, etc.) or costs at the site in the last five years? If so, please give details.

Not that I'm aware of.

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

As described in question 5, the sampling revision has reduced sampling oversight costs.

8) Have there been any modifications to the remedy in the last five years? If so, please give details.

Not that I'm aware of.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No

10) Do you have any comments, suggestions, or recommendations regarding the project?

No

Harbor Island Five Year Review – Interview Form

Interviewee: John Rosevear

Interviewer: _____

Date: _____

1) What is your overall impression of the project?

S&G OU

- Activities only per Harbor Island GW monitoring (AECOM lead for PRP Group)
 - o MW-1R and FW-13 decommissioned in July 2024, as reported in AECOM 2024 annual report
 - o TD-06A is the only well remaining – will be monitored on 5-year basis by AECOM
- Cap monitoring
 - o Annual cap monitoring reports have been submitted to EPA
 - o 2020 Covenant finalized for capped area

TSSOU

- Institutional controls complete per 2020 5-year review
- Pier 1, 1A and Shipways area final cleanup as part of SW Yard Project – approved completion report
- Deed restrictions including the DNR Lease terms still protect under pier sediments at Piers 3, 4, 5, 6. Under pier covered areas are stable and colonized with productive marine biota
- OMMP monitoring complete and no further monitoring required per 2020 5-year review

2) Is the remedy functioning as expected? How well is the remedy performing?

Yes. Both the S&GOU remedial actions and the TSSOU are performing as expected

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

4) Is there a continuous 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.

Yes, Vigor Shipyards staff provide a continuous O&M presence. Vigor Shipyard staff implement all required BMPs, institutional controls and inspections. Required OMMP activities for the TSSOU are complete. S&GOU cap maintenance and inspection is performed annually, with cap inspection reports submitted annually to EPA.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

No

6) Have there been unexpected O&M difficulties (e.g., parts replacement, unexpected treatment system shutdown, unanticipated costs associated with O&M, etc.) or costs at the site in the last five years? If so, please give details.

No

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

No

8) Have there been any modifications to the remedy in the last five years? If so, please give details.

No

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No

10) Do you have any comments, suggestions, or recommendations regarding the project?

No

Harbor Island Five Year Review – Interview Form

Interviewee: Shawn Blocker

Interviewer: _____

Date: 5/12/2025

1) What is your overall impression of the project?

Progressing. The majority of the upland areas and previously remediated areas have adequate controls. The Tribe is neither opposed or supportive of the current actions at East Waterway, Slip 36, and T-25, since all of the proposed removal activities are interim actions, which the Tribe is not supportive of. The Tribe expects that the final remediations will be consistent with the Lower Duwamish Waterway ROD establishing a final cleanup level of 2 ppb for PCB's, or at a supportive asymptotic concentrations' representative of natural background levels.

2) How have you been involved with the project and informed of progress at the Site?

Yes

3) Do you feel informed about the site's activities and progress?

Mostly. The change in policy to no longer sharing draft decision documents affects the Tribes' ability to be involved in the decision-making process. Some activities at East Waterway, Slip 36, and T-25 are not shared with the Tribe prior to sharing with the general public, which negatively impacts timely decision making for the Tribe.

4) Are you aware of the different operable units and the remedies that have been implemented in the different areas?

Yes.

5) Is the remedy functioning as expected? How well is the remedy performing?

Yes and adequately.

6) Are you aware of any community concerns/stakeholder concerns regarding the site? If so, please give details.

See the above concerns detailed in #1 and #3.

7) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

Failure to abide by Washington State Sediment Management Standards negatively impacts the remedy decisions at this site.

8) Do you have any comments, suggestions, or recommendations regarding the project?

See #1, #3, and #7.



Photo 18. Vigor Shipyards Cap



Photo 19. Vigor Shipyards Habitat Restoration Bench