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LIST OF ABBREVIATIONS AND ACRONYMS

AN	Ammonium Nitrate
ARARs	Applicable or Relevant and Appropriate Requirements
AST	Aboveground Storage Tank
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAP	Cleanup Action Plan
CFR	Code of Federal Regulations
CL	Cleanup Level
CMP	Compliance Monitoring Plan
COPC	Constituent of Potential Concern
DCA	Disproportionate Cost Analysis
DCAP	Draft Cleanup Action Plan
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EDB	Ethylene Dibromide
EDC	1,2-Dichloroethane
IHS	Indicator Hazardous Substance
ft	Feet
ft^2	Square Feet
FS	Feasibility Study
HBU	Highest Beneficial Use
LNAPL	Light Non-Aqueous Phase Liquid
MAP	Monoammonium Phosphate
MNA	Monitored Natural Attenuation
MTBE	Methyl-Tert Butyl Ether
MTCA	Model Toxics Control Act
PCL	Preliminary Cleanup Level
Port	Port of Bellingham
PQL	Practical Quantitation Limit
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
Site	Blaine Marina Inc. Site
TPH-D	Diesel-Range Total Petroleum Hydrocarbons
TPH-G	Gasoline-Range Total Petroleum Hydrocarbons
TPH-O	Oil-Range Total Petroleum Hydrocarbons
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
yd^3	Cubic Yard

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1.0 INTRODUCTION AND SITE BACKGROUND

This draft cleanup action plan (DCAP) describes the cleanup action selected by the Washington State Department of Ecology (Ecology) for the Blaine Marina Inc. Site (Site) in Blaine, Washington (Figure 1). The DCAP is based on a remedial investigation/feasibility study (RI/FS; Landau Associates 2015) prepared in accordance with an Agreed Order between Ecology and the Port of Bellingham (Port), as follows:

Site Name:	Blaine Marina Inc.
Site Location:	214 Sigurdson Avenue, Blaine, Washington
Facility Site Identification No.:	2888
Agreed Order No.:	DE 9000
Effective Date of Order:	May 25, 2012
Parties to the Order:	Port of Bellingham, Washington State Department of Natural Resources
Current Property Owner:	Port of Bellingham, Washington State Department of Natural Resources

1.1 SITE LOCATION AND DESCRIPTION

The Site, registered by Ecology as Facility Site ID No. 2888, is located in Blaine, Washington within Blaine Harbor. Blaine Harbor is at the north end of Drayton Harbor, in the northwest quarter of Section 1, Township 40 North, Range 1 West, Willamette Meridian. Blaine Marina Inc. leased approximately 39,000 square feet (ft^2) of property at 214 Sigurdson Avenue from the Port since the 1950s, until it recently vacated the leasehold in May 2015. Blaine Marina Inc. operated a bulk fuel storage and transfer facility that resulted in the release of petroleum hydrocarbons to soil and groundwater at the Site.

The Site, as described in Agreed Order DE 9000, is defined by the extent of contamination caused by the release of hazardous substances from Blaine Marina Inc. operations, and is not limited to lease area or property area boundaries. The Site includes areas where hazardous substances have been deposited, stored, disposed of, placed, or otherwise have come to be located. The boundaries of the Site based on the RI are shown on Figure 2. With the exception of the vicinity map provided in Figure 1, the plan-view figures in this report are oriented to the northwest. Descriptions of direction in this report are in reference to *map north*, which is toward Marine Drive.

1.2 REGULATORY STATUS

The Site is being cleaned up under the authority of the Model Toxics Control Act (MTCA), Chapter 70.105D of the Revised Code of Washington (RCW), and the MTCA Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC).

The RI/FS report for the Site (Landau Associates 2015) was determined to be final by Ecology in August 2015 (Ecology 2015). The RI/FS evaluated cleanup alternatives and identified a preferred cleanup alternative, which is the basis for the final cleanup action presented in this CAP. As specified in WAC 173-340-380, this CAP:

- Identifies Site cleanup standards
- Describes the selected cleanup action
- Summarizes the rationale for selecting the cleanup alternative for the Site
- Briefly summarizes other cleanup action alternatives evaluated in the RI/FS (Landau Associates 2015)
- Identifies institutional controls required as part of the cleanup action, if applicable
- Identifies applicable state and federal laws
- Provides the schedule for implementation of the cleanup action
- Specifies the types, levels, and amounts of hazardous substances remaining on Site after the cleanup action is implemented, and the measures that will be used to prevent migration of, and contact with, those substances.

1.3 SITE HISTORY AND BACKGROUND

The history of Site development and operations presented in this section is a brief summary of the historical information presented in the RI/FS report (Landau Associates 2015), based on a review of existing environmental reports related to previous Site investigations and a review of historical aerial photographs taken between 1949 and 2011.

Blaine Harbor was originally created in the late 1930s by dredging 2 acres of tideflats to create a small boat harbor. An access road was constructed across the tideflats to access the harbor, and adjacent tidelands were filled to create uplands and provide shore support for the area. In the late 1940s, 4 additional acres were dredged, additional tidelands were filled, and a breakwater, bulkheads, floats, and ramps were constructed. The upland area created at the Site generally consists of dredge fill with timber bulkheads along the shoreline. In some areas, riprap was used instead of, or in conjunction with, the bulkheads to establish the shoreline. An additional 15-acre area of tideflats was dredged and an extension of the breakwater was completed in the mid-1950s (TEC 2001). An aerial photograph from 1956 shows the breakwater was extended farther east and improvements to upland facilities including additional buildings and aboveground storage tanks (ASTs) to support the storage of fuel dispensed at the fuel dock.

Business activity has historically been focused in the area along the western end of Blaine Harbor in the industrial area, which comprises all of the upland area shown on Figure 2. A portion of the southwestern end of the harbor includes state-owned lands that are managed by the Port under a Port Management Agreement

with the Washington State Department of Natural Resource (DNR). The Inner Harbor Line shown on Figure 2 defines the boundary between property owned by the Port (east of the Inner Harbor Line), and property that is owned by the state and managed by the Port under the agreement with DNR (west of the Inner Harbor Line).

Most of the infrastructure supporting the commercial activity in the industrial area is from the original construction. In 2001, the Port completed an expansion project at Blaine Harbor that included enlarging the moorage basin and the addition of more than 300 slips. The footprint of the upland industrial area has remained largely unchanged based on review of aerial photographs.

1.3.1 BLAINE MARINA INC. HISTORICAL OPERATIONS

Blaine Marina Inc. was a family-owned retail business, located in the industrial area that sold furniture, appliances, and fuel products. The company leased the property at 214 Sigurdson Avenue from the Port from the mid-1950s until it ceased operations in 2015. The furniture and appliance retailing portion of the business is presumed not to have contributed to releases observed at the Site. Blaine Marina Inc. continuously operated the tank farm at the Site to support the fuel retailing portion of its business from the mid-1950s until operations ceased in May 2015. These fueling operations resulted in the contamination of soil and groundwater at the Site. The tank farm consisted of three 8,500-gallon fuel ASTs that stored diesel and gasoline to support Blaine Marina Inc.'s onsite fueling facility. Reportedly, the ASTs were emptied when Blaine Marina Inc. ceased operations. The ASTs and associated piping remain in place.

A 4,000-gallon, horizontally oriented AST was formerly located at the tank farm. This AST stored home heating oil that was transferred to tanker trucks for offsite delivery. Because the horizontally oriented AST was supported above the ground, surface leaks would have been noticed and likely remedied quickly; it is not considered a likely source of significant contamination at the Site. This horizontally oriented AST is no longer present at the Site, although it is not clear from the review of historical documents when it was removed from service.

Fuel from the three vertically oriented 8,500-gallon ASTs was historically transferred through steel pipes buried underground from the ASTs to the fuel dock. In recent years, the use of the steel pipes was discontinued and fuel was then transferred through flexible hose from the ASTs to the dock. Underneath Sigurdson Avenue, the flexible hose is run inside of the former steel pipe fuel pipelines.

The three 8,500-gallon vertically oriented steel tanks were installed in contact with the ground surface (or more accurately, slightly below ground surface) about 60 years ago, in about 1956. Because the facility stored more than 1,320 gallons, it was subject to the federal requirements for a spill prevention control and countermeasures plan [40 Code of Federal Regulations (CFR) Part 112]. Tank and piping integrity testing are requirements under the applicable federal regulation and Chapter 173-180 WAC. On August 16, 2010, Ecology

personnel visited the Site to evaluate compliance with these requirements and determined that Blaine Marina Inc. had not conducted annual inspections or tests of the pipelines that supplied fuel to the fuel dock. Ecology issued a Notice of Violation (Docket #8900) on December 1, 2011 (Ecology 2011) and Blaine Marina Inc. subsequently completed an inspection of the pipelines. Although the pipelines passed inspection, Blaine Marina Inc. replaced the remaining metallic pipes with non-metallic hose in December 2011 (Blaine Marina Inc. 2012). Blaine Marina Inc. reported that no fuel losses were apparent based on its records of fuel purchases and sales.

1.3.2 CURRENT SITE FEATURES AND USES

Significant surface features at the Site are shown on Figure 2, which includes a dock formerly used for fueling, the Blaine Marina Inc. retail building, smaller storage buildings, and the ASTs and equipment associated with the storage and dispensing of fuel products.

A secondary containment area with concrete walls to contain accidental spills surrounds the ASTs. The secondary containment area is large enough to hold approximately 25,000 gallons of fuel, although because it has a gravel, unlined floor, it is unlikely to have effectively contained any fuel spills. Additionally, the walls of the secondary containment area are constructed of cinder blocks and only some portions of the inner surfaces of the wall have been sealed. The secondary containment may prevent a catastrophic release near the ASTs from immediately flowing over the ground surface and into the surface waters of Blaine Harbor, it is likely that if spilled fuel were not immediately removed from the secondary containment area, it would seep through the walls and/or infiltrate into the subsurface.

Four buildings are currently or were recently located at the Site, as shown on Figure 2:

1. The Blaine Marina Furniture and Appliance Retail building near the center of the Site covers approximately 5,400 ft^2 of area. The western half of the building is single-story, and the eastern half has two stories. Blaine Marina Inc. sold furniture and appliances on the ground level of the building with a public entrance on the south side of the building. This building is just south of the ASTs.
2. The former fuel office building was located on the west side of Sigurdson Avenue and occupied approximately 1,200 ft^2 on the dock adjacent to the fuel dock. The ground surface on the east side of the fuel office building (upland of the bulkhead) contained sinkholes and collapsed pavement that extended horizontally 3 to 4 feet (ft) behind (east of) the bulkhead due to a failing section of bulkhead underlying the eastern side of the building. Under the Agreed Order with Ecology, the Port implemented an interim action in 2012 to repair the failing section of bulkhead, as described in more detail in Section 1.4. The building was deconstructed down to the floor to facilitate implementation of the interim action.
3. An approximately 1,000-ft^2 storage building is located just east of the ASTs and was used by Blaine Marina Inc. for storage.
4. An approximately 1,350-ft^2 storage building is located approximately 50 ft east of the ASTs (10 ft east of the smaller storage building) and was used by Blaine Marina Inc. for storage.

1.4 INTERIM ACTION

An interim action was conducted in 2012 to repair approximately 60 linear feet of existing timber bulkhead at the Site that was progressively failing. This section of bulkhead is located along the western side of Sigurdson Avenue, and consisted of timber piling and timber lagging, with riprap placed along the toe of the structure. Most of the bulkhead in this area, including the piling and lagging, was damaged. It had shifted and bowed, and the top of the bulkhead was rotated outward toward the water. Repairing this section of bulkhead was deemed critical to preventing the release of contaminated upland soil and groundwater to marine surface water and sediment in Blaine Harbor.

The repair was conducted by installing a sheetpile bulkhead along the damaged section. The repaired section of bulkhead is noted on Figure 2 as "Sheetpile Wall." The repair will ultimately be integrated with broader bulkhead repair and replacement, which will occur during redevelopment of the Blaine Harbor Industrial Area.

1.5 ENVIRONMENTAL INVESTIGATIONS AND CONCLUSIONS

Environmental investigations at the Site were conducted as early as 1990. The Site RI/FS, conducted in 2012, investigated for the presence of the following list of constituents of potential concern (COPCs) based on preliminary information from earlier studies and historical information regarding property usage:

- Gasoline-, diesel-, and oil-range petroleum hydrocarbons (TPH-G, TPH-D, and TPH-O); benzene, toluene, ethylbenzene, and xylenes (BTEX); 1,2-dichloroethane (EDC); ethylene dibromide (EDB); methyl-tert butyl ether (MTBE); naphthalene; and lead in soil
- TPH-G, TPH-D, and TPH-O; BTEX; EDC; EDB; MTBE; naphthalene; total and dissolved lead; and dissolved manganese in groundwater
- TPH-G, TPH-D, and TPH-O; and lead in sediment
- TPH-G, TPH-D, and TPH-O; BTEX; EDC; EDB; MTBE; naphthalene; and total and dissolved lead in surface water
- BTEX; EDC; EDB; and MTBE in soil vapor.

The COPCs that were found to exceed applicable cleanup levels were carried forward in the RI/FS process as indicator hazardous substances (IHS) for the Site. The identified Site IHS and their associated media are TPH-G, TPH-D, benzene, ethylbenzene, xylenes, and total naphthalenes in soil, and TPH-G, TPH-D, benzene, and total naphthalenes in groundwater.

Volatile organic compounds (VOCs) in soil vapor were not carried forward as IHS in the RI/FS based on the low frequency of MTCA Method C soil vapor exceedances, and because the groundwater preliminary cleanup levels (PCLs) were developed to protect the soil vapor pathway. However, so that options for future use of the Site remain flexible, the highest beneficial use (HBU) for the Site is unrestricted land use. Based on

this HBU, a sufficient number of soil vapor samples exceeded the MTCA Method B cleanup levels for benzene and 1,3-butadiene that these VOCs are identified as Site soil vapor IHS.

The Site boundary is shown on Figure 2, and indicates the lateral extent of the IHS as determined during the RI.

2.0 CLEANUP STANDARDS

This section develops Site cleanup standards for IHS detected in affected Site media (soil, groundwater, and soil vapor) at concentrations above screening levels during the RI/FS. Surface water and sediment are not considered media of concern because IHS were not detected at concentrations exceeding the Site screening levels in the samples collected from these media during the RI. Cleanup standards consist of: 1) numerical cleanup levels (CLs) defined by regulatory criteria that are adequately protective of human health and the environment, and 2) the points of compliance at which the CLs must be met.

2.1 NUMERICAL CLEANUP LEVELS

The following sections develop Site CLs for media of concern at the Site.

2.1.1 GROUNDWATER

Based on the potential exposure pathway receptors evaluated in the RI/FS, the HBU for groundwater is considered discharge to surface water (i.e., Blaine Harbor). Based on this HBU, the reasonable maximum exposure (RME) to Site groundwater is the more conservative of 1) uptake by aquatic organisms based on aquatic water quality criteria, 2) ingestion of affected aquatic organisms by humans, 3) uptake of affected marine sediment by benthic organisms, and 4) ingestion of affected benthic organisms by humans. As a result, federal [National Toxics Rule (40 CFR 131.36) and National Recommended Water Quality Criteria (EPA 2006)] and state (MTCA Method B formula values and Chapter 173-201A WAC) surface water criteria based on human consumption of fish, and state sediment quality standards (Chapter 173-204 WAC) were evaluated as potential CLs for Site groundwater.

Since TPH-G and TPH-D do not have surface water criteria and because available literature indicates that MTCA Method A groundwater CLs are adequately protective of aquatic organisms, MTCA Method A groundwater CLs were evaluated for these IHS. The groundwater to vapor pathway was also considered for VOCs due to the potential intrusion of soil vapor into Site buildings. The most stringent of the applicable criteria, adjusted to the practical quantitation limit (PQL) or background concentrations, if appropriate, is identified as the Site groundwater CL. Groundwater CLs for the IHS identified for the Site are provided in Table 1.

2.1.2 SOIL

Based on the potential exposure pathways established and receptors discussed in the RI/FS (Landau Associates 2015), the HBU for soil is considered “unrestricted site use.” Although the Site may meet the

criteria for industrial use, ongoing land use planning and future options for Site use may not be compatible with restrictions associated with industrial cleanup standards. Based on a soil HBU of unrestricted site use, the RME for soil is the more conservative of 1) direct ingestion of soil or, 2) impacts to surface water (through the groundwater pathway) and the associated exposures described in the preceding section.

Uptake of constituents in Site soil or groundwater by terrestrial plants and animals is not considered a potential exposure pathway for Site soil. The Site qualifies for an exclusion under WAC 173-340-7491(1)(c)(i) because there is less than 1.5 acres of contiguous undeveloped land within 500 ft of the Site, so a terrestrial ecological evaluation is not required.

Based on an HBU of unrestricted Site use, MTCA Method B standard formula values for direct contact and MTCA contaminant concentrations in soil for surface water protection, calculated using the three-phase partitioning model (equation 747-1), were evaluated as potential CLs for soil. If IHS did not have an associated MTCA Method B screening value, the MTCA Method A CL for unrestricted Site use was identified as the soil CL. MTCA soil criteria for protection of surface water were not applied if the IHS was not detected in groundwater at a concentration above the groundwater CL. The most stringent of the applicable criteria, adjusted for soil background concentrations or the PQL, as appropriate, is identified as the Site soil CLs. CLs for the IHS identified in Site soil are provided in Table 1.

2.1.3 SOIL VAPOR

Similar to Site soil, the HBU for soil vapor is considered "unrestricted site use." The RME for soil vapor is direct inhalation by occupants of Site buildings.

The soil vapor CLs identified in Table 1 were calculated based on the MTCA Method B indoor air CLs and a vapor attenuation factor of 0.03, based on recent guidance from the U.S. Environmental Protection Agency (EPA; 2012) and Ecology (2009). CLs for the IHS identified in Site soil vapor are provided in Table 1.

2.2 POINTS OF COMPLIANCE

The point(s) of compliance under MTCA are the point or points at a site where the CLs must be attained to achieve cleanup standards. The points of compliance at which the CLs must be met are throughout the entire Site for soil [WAC 173-340-740(6)], groundwater [WAC -340-720(8)], and soil vapor [WAC 173-340-750(6)].

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

In accordance with MTCA, cleanup actions conducted under MTCA shall comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as applicable or relevant and appropriate requirements (ARARs).

This section provides a brief overview of potential ARARs for the Site cleanup. The MTCA cleanup regulations (Chapter 173-340 WAC) is considered the governing regulation under which Site cleanup will be conducted, and as such is not considered an ARAR. The primary ARARs that may be applicable to the cleanup action include the following:

- Washington Chemical Contaminants and Water Quality Act and Washington Water Pollution Control Act and the following implementing regulation: Water Quality for Surface Waters (Chapter 173-201A WAC)
- Resource Conservation and Recovery Act (RCRA) and Subtitle C regulations, to the extent that any hazardous wastes are discovered during the cleanup action
- Washington Hazardous Waste Management Act and Dangerous Waste Regulations, to the extent that any dangerous wastes are discovered during the cleanup action
- Washington State Clean Water Act, with respect to water quality criteria for surface water (Blaine Harbor)
- Shoreline Management Act, with respect to construction activities during the cleanup action
- Endangered Species Act, due to the listing of Puget Sound Chinook and the potential listing of coastal/Puget Sound bull trout
- Critical Areas Ordinance of the City of Blaine (Blaine Municipal Land Use Code Chapter 17.82 Critical Areas Management)
- Northwest Clean Air Agency Regulation 300 for point source emissions.

The requirements of MTCA, the Water Quality Standards for Surface Waters, the Sediment Management Standards, and the Clean Water Act were considered in the development of cleanup standards (see Section 2.0). RCRA Subtitle C and Dangerous Waste Regulations are not expected to apply unless dangerous wastes are discovered or generated during implementation of the cleanup action; dangerous wastes are not known to be present at the Site. The Shoreline Management Act may apply during implementation of the selected cleanup action but did not directly influence the evaluation of the cleanup alternatives in the RI/FS.

In accordance with MTCA, the cleanup action will be exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW, and of any laws requiring or authorizing local government permits or approvals. However, the substantive requirements of such permits or approvals (WAC 173-340-520) must be met.

4.0 CLEANUP ACTION SELECTION

Six cleanup action alternatives were evaluated in the Site FS (Landau Associates 2015). This section discusses the cleanup action alternatives evaluated in the FS and provides an overview of the selected cleanup action. The selection of the preferred remedy was based on the procedures specified by MTCA including consideration of remedial action objectives (RAOs), potentially applicable laws, meeting threshold requirements [WAC 173-340-360(2)], being permanent to the maximum extent practicable [WAC 173-340-360(3)(f)], Site restoration timeframe [173-340-360(4)(b)], consideration of public concerns [WAC 173-340-515(4)(d)], and consideration of future land use. Additional details regarding the comparative evaluation of these considerations are provided in the RI/FS report (Landau Associates 2015).

RAOs define the goals of the cleanup that must be achieved to adequately protect human health and the environment. RAOs must address all affected media, and a cleanup alternative must achieve all RAOs to be considered a viable cleanup action. RAOs can be either action-specific or media-specific.

The following action-specific and media-specific RAOs were identified for the Site:

RAO-1: Remove the fuel storage and dispensing system and recoverable light non-aqueous phase liquid (LNAPL) to eliminate any ongoing sources of contamination, including demolition or removal of adjacent buildings to access LNAPL extent

RAO-2: Prevent human or terrestrial ecological receptors from being exposed to hazardous substances through direct contact with contaminated media (soil and groundwater)

RAO-3: Prevent hazardous substances in soil from leaching to groundwater at concentrations that exceed the groundwater CLs

RAO-4: Prevent hazardous substances in soil from migrating (by erosion) to marine sediment at concentrations that exceed marine sediment CLs

RAO-5: Prevent hazardous substances in groundwater from migrating to surface water and marine sediment at concentrations that exceed the groundwater PCLs

RAO-6: Prevent use of shallow Site groundwater for drinking.

4.1 SUMMARY OF CLEANUP ACTION ALTERNATIVES

This section provides a summary of each alternative. Section 4.2 provides additional detail for the selected alternative. Each alternative considered for application at the Site included the following four common elements that would be implemented regardless of the specific alternative chosen:

- Remove the AST system and adjacent buildings to ensure that the system is not an ongoing source of contamination and to provide access to the source area for implementation of the cleanup action
- Install and maintain a cover containment layer composed of pavement or permeable soil matching existing surface conditions to prevent direct contact with contamination within areas

not subject to contaminated soil excavation and offsite disposal until cleanup standards are achieved

- Conduct monitoring to assess compliance with cleanup standards
- Implement institutional controls to ensure the long-term integrity of the containment system and/or prevent the use of Site groundwater as a drinking water source if soil and groundwater cleanup levels are not met throughout the Site (not applicable for Alternative 6).

The following list summarizes the primary elements of the six remedial alternatives evaluated in the FS:

1. **Remedial Alternative 1:** Limited Source Removal with LNAPL Recovery and Bioremediation
    - Excavation and offsite disposal/treatment of about 1,700 tons of soil in the source area from surface to the groundwater table [an approximate depth of 10 ft below ground surface (BGS)].
    - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads.
    - Extension of the sheetpile bulkhead that was installed as an interim action to the north to reduce near-shore tidal exchange in the affected upland area and extend the residence time for the bioremediation solutions. Sheetpile joints for the new bulkhead extension would be sealed to provide a more complete hydraulic barrier.
    - Implementation of Site-wide bioremediation to achieve groundwater CLs.
    - Conducting monitored natural attenuation (MNA) once cleanup standards are achieved along the shoreline to monitor the continuing decline of contaminant concentrations until Site-wide cleanup is demonstrated.
2. **Remedial Alternative 2:** Source Removal and Bioremediation
    - Excavation and offsite disposal/treatment of about 3,000 tons of soil within the source area from the surface to an approximate depth of 12 ft BGS.
    - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads.
    - Extension of the sheetpile bulkhead that was installed as an interim action to the north to reduce near-shore tidal exchange in the affected upland area and extend the residence time for the bioremediation solutions. Sheetpile joints for the new bulkhead extension would be sealed to provide a more complete hydraulic barrier.
    - Implementation of Site-wide bioremediation to achieve groundwater CLs.
    - Conducting MNA once CLs are achieved along the shoreline to monitor the continuing decline of contaminant concentrations until Site-wide cleanup is demonstrated.
3. **Remedial Alternative 3:** Source Removal, Bioremediation and Soil Flushing with a Downgradient Hydraulic Barrier
    - Excavation and offsite disposal/treatment of the same volume of soil as for Alternative 2.
    - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads.
    - Extension of the sheetpile bulkhead that was installed as an interim action to the north and to the south to reduce near-shore tidal exchange in the affected upland area, extend the

residence time for the soil flushing and bioremediation solutions, and ensure that soil flushing solutions are adequately contained. Sheetpile joints would be sealed for the entire bulkhead system to provide a more complete hydraulic barrier.

- Installation of a soil flushing system along the shoreline, upland of the sheetpile bulkhead, to enhance bioremediation. The western (downgradient) side of the interceptor trench adjacent to the existing sheetpile bulkhead would be lined with a flexible membrane and the joints of the new bulkhead sections would be sealed to provide a downgradient hydraulic barrier along the shoreline.
- Implementation of Site-wide soil flushing/bioremediation to achieve groundwater CLs.
- Conducting MNA once CLs are achieved along the shoreline to monitor the continuing decline of contaminant concentrations until Site-wide cleanup is demonstrated.

4. **Remedial Alternative 4:** Expanded Source Removal, Bioremediation Along Shoreline
   - Excavation and offsite disposal/treatment of all contaminated soil within Site boundaries east of the Sigurdson Avenue surface to an approximate depth of 12 ft BGS, totaling about 8,000 tons.
   - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads.
   - Extension of the sheetpile bulkhead that was installed as an interim action to the north to reduce near-shore tidal exchange in the affected upland area and extend the residence time for the bioremediation solutions. Sheetpile joints in the new bulkhead section would be sealed to provide a more complete hydraulic barrier.
   - Implementation of bioremediation in the area beneath Sigurdson Avenue to achieve groundwater CLs.
   - Conducting MNA once cleanup standards are achieved along the shoreline to monitor the continuing decline of contaminant concentrations until Site-wide cleanup is demonstrated.
5. **Remedial Alternative 5:** Expanded Source Removal, Soil Flushing with Downgradient Hydraulic Barrier
   - Excavation and offsite disposal/treatment of all contaminated soil within Site boundaries east of the Sigurdson Avenue surface to an approximate depth of 12 ft BGS, similar to Alternative 4.
   - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads.
   - Extension of the sheetpile bulkhead that was installed as an interim action to the north and to the south to reduce near-shore tidal exchange in the affected upland area, extend the residence time for the soil flushing and bioremediation solutions, and ensure that soil flushing solutions are adequately contained. Sheetpile joints would be sealed for the entire bulkhead system to provide a more complete hydraulic barrier.
   - Installation of a soil flushing system along the shoreline, upland of the sheetpile bulkhead, to enhance bioremediation. The western (downgradient) side of the interceptor trench adjacent to the existing sheetpile bulkhead would be lined with a flexible membrane and the joints of the new bulkhead sections would be sealed to provide a downgradient hydraulic barrier along the shoreline.

- Implementation of soil flushing/bioremediation in the area beneath Sigurdson Avenue to achieve groundwater CLs.
- Conducting MNA along the shoreline once cleanup standards are achieved to monitor the continuing decline of contaminant concentrations until Site-wide cleanup is demonstrated.

6. **Remedial Alternative 6:** Mass Excavation and Monitored Natural Attenuation
   - Excavation and off-site disposal/treatment of all contaminated soil and LNAPL within Site boundaries, totaling about 15,000 tons.
   - LNAPL recovery from the open excavation using a vactor truck and/or sorbent pads
   - Extension of the sheetpile bulkhead installed as an interim action approximately 60 feet to the north to minimize marine water intrusion and provide shoreline stability during the excavation activities
   - Because this alternative involves full removal of contaminated soil throughout the Site, the pavement cap and institutional controls common to Alternatives 1 through 5 are not required.

4.2 RATIONALE FOR SELECTING THE PREFERRED CLEANUP ACTION

The six cleanup alternatives listed above were developed and evaluated with respect to their ability to achieve compliance with MTCA cleanup requirements. Alternative 2 was identified as the preferred alternative in the FS and is the selected cleanup action for the Site. The rationale for the selection is summarized in this section and presented in detail in the RI/FS report (Landau Associates 2015).

The evaluation for selecting a cleanup action under MTCA requires developing a reasonable number of alternatives for cleanup, each meeting threshold criteria [WAC 173-340-360(2)(a)] including the ability to protect human health and the environment, comply with cleanup standards, comply with state and federal laws, and provide for compliance monitoring. Compliance with these requirements under MTCA is presumed by definition to be protective of human health and the environment and in compliance with applicable state and federal laws once cleanup standards have been met. The alternatives were further evaluated for their ability to satisfy these threshold criteria within a reasonable timeframe [WAC 173-340-360(2)(b)(ii) and WAC 173-340-360(4)] and achieve the RAOs identified for the Site. All six alternatives were determined to meet these requirements.

MTCA provides for the costs and benefits associated with alternatives to be evaluated through a disproportionate cost analysis (DCA), which compares the relative environmental benefits of each alternative to the most permanent alternative. Costs are disproportionate to benefits if the incremental cost of the most permanent alternative exceeds the incremental degree of benefits achieved over the lower cost alternative [WAC 173-340-360(3)(e)(i)]. Alternatives that exhibit disproportionate costs are considered "impracticable," and that alternative is eliminated from further consideration. The six evaluation criteria for the DCA are:

- Protectiveness
- Permanence
- Long-term effectiveness
- Short-term risk management
- Implementability
- Considerations of public concerns.

Based on the results of the DCA, Alternative 2 was determined to be permanent to the maximum extent practicable. The selected cleanup action complies with the provisions of WAC 173-340-360. It will be protective of human health and the environment, comply with cleanup standards and applicable state and federal laws, provide for compliance monitoring, and establish restrictive covenants if needed. Institutional controls will be implemented as needed to provide notification regarding the presence of residual contaminated soil and groundwater, regulate the disturbance/management/use of that soil/groundwater and the cleanup action components, and provide for long-term monitoring and stewardship of the cleanup action until the Site achieves soil, groundwater, and soil vapor cleanup standards. The selected cleanup action is considered to use permanent solutions to the maximum extent practicable, and will provide restoration in a reasonable timeframe. It is not anticipated that a restrictive covenant will be needed, provided soil and groundwater cleanup standards are achieved within a reasonable restoration timeframe.

4.3 DESCRIPTION OF THE SELECTED CLEANUP ACTION

The selected cleanup action (Alternative 2) consists of the following elements; subsequent sections describe how the cleanup action will be implemented to achieve cleanup standards and meet the RAOs for the Site. Figure 3 provides a conceptual summary of the primary elements of the cleanup action.

4.3.1 SITE PREPARATIONS AND SOURCE REMOVAL

The AST and fueling system will be decommissioned, demolished, and disposed of off Site to eliminate their potential to act as a future source of contamination. Buildings and slabs at the Site will be demolished and disposed of off Site or removed/relocated to provide access to the source area for excavation and removal of contaminated soil and LNAPL. Approximately 3,000 tons of heavily contaminated soil from within the lateral limits of free-phase LNAPL will be excavated and either treated or disposed of off Site. LNAPL will be recovered from the open excavation using sorbent materials or a vactor truck, as needed.

4.3.2 CONTAINMENT AND INSTITUTIONAL CONTROLS

After source removal is complete, a temporary containment system will be installed and maintained to prevent human contact with contaminated soil left in place until the Site cleanup action is complete. The temporary containment system will be a combination of soil and pavement, so that existing surface permeability characteristics are restored. In areas where pavement is removed to conduct the source removal excavation, a pavement surface will be re-installed. In limited areas of the Site where the surface is currently composed of gravel or other permeable materials, permeable soil will be used to restore the surface.

It is anticipated that the cleanup action will achieve the cleanup standards and that institutional controls will not be required following completion of the cleanup action. If the cleanup action requires more time than currently estimated, institutional controls, potentially including a restrictive covenant, will be implemented to ensure that the integrity of the capping system and other cleanup equipment is maintained to prevent contact with contaminated media, protect the integrity of the cleanup action, and prevent the use of Site groundwater as a drinking water source until the Site cleanup standards are achieved.

4.3.3 SHEETPILE BULKHEAD

The sheetpile bulkhead that was installed as an interim action will be extended to the north to reduce near-shore tidal exchange in the affected upland area and extend the residence time for the bioremediation solutions. The joints of the new sheetpile bulkhead will be sealed to provide a more complete hydraulic barrier.

4.3.4 BIOREMEDIATION AND MONITORED NATURAL ATTENUATION

A bioremediation program will be implemented after the source removal to reduce concentrations of IHS until groundwater cleanup standards are achieved. To optimize the efficacy of bioremediation in a naturally reducing environment, nitrate will be used as an electron acceptor to stimulate anaerobic degradation, and will be introduced to the subsurface by an extensive system of infiltration trenches, as shown in the conceptual layout on Figure 3. Implemented after the source removal is complete, bioremediation is anticipated to achieve cleanup standards within 4 years of the first injection. The cleanup action also includes implementing MNA after bioremediation to address any residual concentrations of petroleum hydrocarbons exceeding cleanup standards, if needed.

4.3.5 COMPLIANCE MONITORING

Compliance monitoring is a required element of any MTCA cleanup action. Compliance monitoring will be conducted in accordance with WAC 173-340-410 to confirm that cleanup standards have been achieved and to confirm the long-term effectiveness of cleanup actions at the Site. Detailed requirements will be described in a compliance monitoring plan (CMP), which will be prepared during the remedial design. The CMP will specify the location, duration, and frequency of monitoring and the rationale for the termination of monitoring.

The three types of compliance monitoring to be conducted are:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during the construction period of the cleanup action
- **Performance Monitoring** to confirm that the cleanup action has attained cleanup standards or other performance standards
- **Confirmation Monitoring** to confirm the long-term effectiveness of the cleanup action once cleanup standards and performance standards have been attained.

4.4 CLEANUP ACTION IMPLEMENTATION

This section provides a summary of the final cleanup action implementation. Specific details of the cleanup action will be provided in an Engineering Design Report.

4.4.1 SITE PREPARATIONS AND SOURCE REMOVAL

Site preparations will include decommissioning and removal of the AST and fuel dispensing system so it is not an ongoing source of contamination. Additionally, the buildings that are adjacent to the ASTs will be demolished or removed/relocated to allow access to conduct source removal. The intent of these activities is to remove the potential source of ongoing contamination and to provide access for removal of most of the existing contamination (LNAPL and heavily contaminated soil).

After removing the AST, fuel dispensing system, and adjacent structures, source removal will be conducted by excavating the heavily contaminated soil from within the approximate lateral extent of free-phase LNAPL in the source area, as shown on Figure 3. Excavation will extend from the ground surface to approximately 12 ft BGS and will total approximately 2,000 cubic yards (3,000 tons) of soil. A pre-remedial design investigation will be conducted to confirm the limits of heavily contaminated soil and LNAPL. Considering that only trace levels of contamination were encountered below 12 ft BGS, excavation to this depth will remove most of the contaminant mass from the source area. LNAPL will be recovered from the open excavation using a vactor truck and/or sorbent pads to skim LNAPL from the exposed groundwater

table. Source removal is being conducted so that bioremediation can effectively address the remaining residual contamination.

4.4.2 SURFACE CONTAINMENT SYSTEM, SHEETPILE BULKHEAD, AND INSTITUTIONAL CONTROLS

After source removal activities are complete, the surface will be capped by installing asphalt pavement or permeable soil over areas of excavation and other areas of the Site, as needed. The new and existing surface will be maintained to prevent potential human exposure to contaminated soil during the timeframe that bioremediation and MNA are implemented. The extended sheetpile bulkhead will reduce near-shore tidal exchange in the affected upland area and will extend the residence time for the bioremediation solutions. The joints of the new sheetpile bulkhead will be sealed to provide a more complete hydraulic barrier.

If the restoration timeframe is longer than estimated, institutional controls will be implemented to provide the following protections until the Site is restored:

- Require maintenance of the Site's pavement and gravel cap
- Prevent the use of Site groundwater for drinking water
- Ensure the proper management of excavated soil or groundwater and appropriate worker safety associated with any future intrusive activities through implementation of a soil and groundwater management plan until cleanup standards are achieved in accordance with WAC 173-340-440.

4.4.3 BIOREMEDIATION AND MONITORED NATURAL ATTENUATION

Bioremediation will be implemented by injecting anaerobic biostimulants such as ammonium nitrate and monoammonium phosphate into to the subsurface (specific chemicals/volumes/concentrations will be determined in remedial design). These reagents will act as electron acceptors to stimulate growth of microbes naturally present in the soil that, if stimulated, will increase the rate at which they degrade petroleum hydrocarbons. While the effects of bioremediation will be more pronounced in groundwater, it is expected to also speed the cleanup of the saturated soil and the intermittently unsaturated soil within the smear zone.

It is anticipated that a series of up to 12 injection events will be conducted over the course of up to 4 years. During this time, compliance monitoring will be conducted and the resulting data used to optimize the bioremediation effort. Based on the concentrations of contaminants and remedial agents detected in monitoring wells spread throughout the Site, the subsequent injection formulations (volumes and biostimulant solution concentrations) and injection locations may be adjusted to maximize bioremediation rates throughout the Site. It is expected that groundwater contamination will be suppressed to below CLs

throughout the bioremediation program, and that less biostimulant solution will be required over time, until CLs are maintained without additional injection. As a result, protection of surface water (identified as the most likely pathway for potential contaminant exposure) will be provided early on in the cleanup process.

The cleanup action also provides for a period of MNA to be conducted after completing the bioremediation program, if needed as a final polishing step to allow for IHS concentrations to reduce to below cleanup standards. It is the intent of the cleanup action to use active cleanup measures to minimize the restoration timeframe to the greatest degree practicable. MNA would be applied only after the removal and bioremediation efforts have successfully reduced the concentrations of contaminants to the degree that the restoration timeframe through MNA would be considered reasonable in accordance with this plan and MTCA guidelines. If the evaluation of monitoring data indicates additional active remedial action is required to achieve cleanup standards within a reasonable restoration timeframe, further bioremediation or hotspot removal through excavation could be implemented prior to the use of MNA to achieve cleanup standards.

4.4.4 COMPLIANCE MONITORING

Compliance monitoring will consist of protection monitoring during source removal, performance monitoring following remedial excavation, and groundwater and cap integrity confirmation monitoring.

Protection monitoring will include measures to prevent exposure of workers and the public to hazardous materials during source removal and will be provided through appropriate health and safety protocols outlined under a site-specific health and safety plan. Performance monitoring of the source removal activities will be accomplished by collecting soil samples from the excavation floor and sidewalls to document conditions remaining in place.

Confirmation monitoring will consist of groundwater sampling to monitor the progress of bioremediation and MNA, and routine monitoring of the pavement cap integrity. The scope, schedule, and procedures for compliance monitoring will be presented in a compliance monitoring plan developed in the Engineering Design Report prepared as part of the remedial design for the cleanup action.

4.5 HAZARDOUS SUBSTANCES TO REMAIN IN-PLACE

The extent of contamination was determined during the RI based on conservative interpretations of boring logs and Site analytical data. Based on the estimated areal extent and thickness of impacted soil, the total volume of TPH-G- and VOC-impacted soil is 10,000 cubic yards (yd^3). The remedial excavation and associated LNAPL recovery is expected to remove approximately 2,000 yd^3 (3,000 tons) of highly contaminated soil and LNAPL representing approximately 70 percent of the total Site contamination by

mass. Contaminated soil remaining outside the zone of excavation is generally present in the "smear zone" near the groundwater table within a vertical interval extending from approximately 8 to 12 ft BGS. This remaining contaminated soil will be treated along with groundwater during the bioremediation phase such that no contamination exceeding the CLs is planned to be left in place following completion of the cleanup action.

4.6 RESTORATION TIMEFRAME AND CLEANUP ACTION SCHEDULE

The restoration timeframe for implementing the cleanup action presented in this CAP is expected to require between 5 and 8 years. Implementing the cleanup action includes the following design and remedial activities:

Design Activities

- Conducting a pre-remedial design investigation to provide additional data required to prepare the EDR and detailed construction plans and specifications
- Preparing the EDR
- Preparing detailed construction plans and specifications

Remedial Activities

- Site preparations and source removal
- Temporary containment system and sheetpile bulkhead
- Bioremediation and MNA
- Compliance monitoring.

Design activities will be initiated in 2016 and are anticipated to be complete by June 2017 to support remedial activities commencing during the summer construction season in 2017. The actual start date for remedial activities and thus overall restoration timeframe may be affected by the availability of project funding. Based on the estimated restoration timeframe and project schedule, it is estimated the Site will achieve compliance with cleanup standards between 2022 and 2025.

5.0 COMPATIBILITY WITH SITE REDEVELOPMENT

Implementation of the cleanup action will be coordinated with the long-term redevelopment strategy for the Site. Specific redevelopment plans for the Site and vicinity are currently being developed by the Port. Site use could involve the construction of a new marine fueling facility, development as part of a commercial boatyard, expansion of fish processing operations, or other marine-based commercial or light industrial activities. Regardless of its specific use, the use will remain consistent with current zoning and the existing master plan.

6.0 REFERENCES

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