Final Cleanup Action Plan
West Bay Marina
Olympia, Washington

Prepared by the
Washington State
Department of Ecology

September 25, 2014

CONTENTS

Page

CONTENTS (Continued)

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BMP	best management practice
bgs	below ground surface
CAP	Cleanup Action Plan
COC	constituent of concern
CRZ	critical root zone
CSM	conceptual site model
CUL	cleanup level
CY	cubic yards
DCA	disproportionate cost analysis
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
FFS	focused feasibility study
MSW	municipal solid waste
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
OMC	Olympia Municipal Code
OHWM	ordinary high water mark
pg/g	picograms per gram or parts per trillion
POC	point of compliance
RAO	Remedial Action Objective
RCW	Revised Code of Washington
RI/FS	remedial investigation/feasibility study
SF	square feet
SWPPP	Stormwater Pollution Prevention Plan
TEQ	toxicity equivalency quotient
UST	underground storage tank
WAC	Washington Administrative Code
WBMA	West Bay Marina Associates

EXECUTIVE SUMMARY

This Cleanup Action Plan (CAP) was prepared for cleanup of the area of concern (AOC) identified at the West Bay Marina Site (site) in Olympia, Washington. The cleanup action described in this CAP was selected as the preferred remediation alternative in the focused feasibility study (FFS) performed for the site AOC (Hart Crowser 2014). The cleanup action focuses on remediation of soil at the north end of the site, which contains dioxins/furans in exceedance of regulatory criteria, to eliminate unacceptable risks to human health and the environment posed by the constituents of concern (COCs) to the greatest extent practicable. The cleanup action is limited to this AOC and does not include adjacent properties or the aquatic environment.

The site was first developed as a lumber mill by Buchanan Lumber Company in 1919 (Hart Crowser 2011). Between 1919 and 1966, the site was used for various activities including a sawmill, veneer plant, and stud mill. These timber-related facilities also included a hog fuel burner near the northern property line. It is suspected that operation of the former hog fuel burner may be a potential source of the dioxin/furan contamination detected in near-surface soil at the northern end of the site. Between 1966 and 2002, the site operated as a boatyard and marina. West Bay Marina Associates (WBMA) has owned the West Bay Marina since 1990. In 2002, boat maintenance and repair activities ceased at the site, and it has operated solely as a marina since that time (Anchor 2009a).

The AOC that is the focus of the cleanup action is located at the northern end of the site and is defined as the area of soil containing dioxin/furan toxicity equivalency quotients (TEQs) above the Model Toxics Control Act (MTCA) Method B direct-contact soil cleanup level of 11 picograms per gram (pg/g). The exceedance locations were determined in the remedial investigations conducted in 2010 and 2011 (Anchor 2010, Hart Crowser 2011), which identified four sample locations that exceeded the cleanup level. These sample locations are near the former hog fuel burner.

This CAP describes the preferred cleanup action that was selected for the AOC through the feasibility study evaluation process. In the FFS, six remediation alternatives were developed and evaluated per the criteria specified in the MTCA regulations (Chapter 173-340 WAC), of which Alternative 1a was selected as the preferred cleanup action. The selected remedy consists of the following elements:

- Removal of six trees located within the AOC;

- Excavation of soil containing dioxin/furan TEQs above the Method B cleanup level;
- Off-site disposal of excavated soil at a Subtitle D landfill facility;
- Off-site disposal of clean tree materials at a composting facility and disposal of wood materials containing contaminated soil at a Subtitle D landfill facility;
- Backfilling with clean material and site restoration;
- Institutional controls; and
- Compliance monitoring and maintenance.

Alternative 1a is judged to use permanent solutions to the maximum extent practicable. This alternative may present more short-term risks related to the off-site transport of contaminated soil and potentially more technical challenges during implementation to remove the existing trees in the AOC. However, compared to the other alternatives evaluated in the FFS, Alternative 1a was found to be:

- Equally or more protective;
- Equally or more permanent;
- Equally or more effective over the long term; and
- More administratively implementable.

Cleanup action implementation will be further developed during the remediation design process. Ecology will provide public notice and an opportunity for the public to review and comment on the FFS and this CAP, as required under WAC 173-340-600. The design phase to develop the project plans and specifications to implement the cleanup action would be performed after the public review process has been completed and public comments have been addressed. Implementation would be tentatively scheduled for the 2015 construction season.

DRAFT FINAL CLEANUP ACTION PLAN
WEST BAY MARINA
OLYMPIA, WASHINGTON

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) was prepared to address cleanup of the West Bay Marina Site (site) located in Olympia, Washington (Figure 1). This CAP was prepared for the Washington State Department of Ecology (Ecology) per the requirements of the Model Toxics Control Act (MTCA; Chapter 70.105D RCW) and its implementing regulations (Chapter 173-340 WAC). This work is being completed under Ecology Agreed Order No. DE_5272 between Ecology and West Bay Marina Associates (WBMA).

The work for this CAP follows the previous work conducted by Anchor QEA for WBMA under an existing remedial investigation/feasibility study (RI/FS) Work Plan (Anchor 2009) and investigative work conducted by Hart Crowser in 2011 and 2012 (Hart Crowser 2011 and 2012). Results are presented in the Hart Crowser RI Report dated June 30, 2011, and RI Addendum dated May 31, 2012 (Hart Crowser 2011 and 2012). Hart Crowser subsequently completed a focused feasibility study (FFS) to identify the preferred remedial action for the area of concern identified at the north end of the site (Hart Crowser 2014b).

1.1 Elements of the Cleanup Action Plan

Elements of this CAP address requirements of WAC 173-340-380, which include:

- A description of the planned cleanup action;
- Rationale for selecting the proposed alternative;
- A summary of other cleanup action alternatives evaluated in the FFS;
- Cleanup standards for the contaminants and media of concern;
- A schedule for the planned implementation of the cleanup action plan;
- Description of institutional controls;
- Applicable state and federal laws;
- Preliminary determination of compliance with MTCA remedy selection criteria; and

- Types, levels, and amounts of contaminants remaining on site, and measures to prevent migration and contact.

Design and construction considerations for the proposed alternative will be further developed and evaluated in the Engineering Design Report (EDR) and project design plans and specifications.

1.2 Report Organization

Specific discussion points pertinent to the MTCA criteria are presented in subsequent sections organized as follows:

Section 2.0 Summary of Site Conditions. This section summarizes the historical uses of the property and its current land use. An overview of the results of the RI and other recent investigation work are also included. This information is used to develop the conceptual site model (CSM) also presented in this section.

Section 3.0 Cleanup Requirements. Remedial action objectives and cleanup standards for the site are identified in Section 3.0.

Section 4.0 Selected Remediation Alternative. The planned cleanup action is detailed in Section 4.0. The action includes tree preservation, excavation, off-site disposal, site restoration, and institutional controls.

Section 5.0 Remediation Alternatives Considered and Basis for Selecting the Remedy Selection. The other cleanup alternatives that were evaluated and the evaluation process are summarized in Section 5.0.

Section 6.0 Remediation Alternative Selection and Schedule. The work planned to implement the cleanup action and schedule are outlined in Section 6.0. This work includes preparation of the remedial design documentation, construction plans, and specifications.

Section 7.0 References. Section 7.0 lists references cited in this report.

2.0 SUMMARY OF SITE CONDITIONS

The site is located at 2100 West Bay Drive NW in Olympia, Washington, and is the location of a marina and restaurant. The project location is shown on Figure 1. The site encompasses just over 3 acres of upland, which is predominantly paved and is used for parking and storage.

2.1 Site History

The site was first developed as a lumber mill by Buchanan Lumber Company in 1919 (Hart Crowser 2011). Between 1919 and 1966, the site was used for various facilities including a sawmill, veneer plant, and stud mill. These timber-related facilities also included a hog fuel burner near the northern property line. It is suspected that operation of the former hog fuel burner was a potential source of the dioxin/furan contamination detected in near-surface soil at the northern end of the site. Site features are shown on Figure 2.

The current and assumed future use of the property is as a marina and restaurant facility. Future land use is not expected to change. It is assumed that the area of the remedial action will continue to be used as open space north of the office/supply buildings.

2.2 Summary of Environmental Conditions

Previous upland soil, groundwater, sediment, seep, and stream investigations were conducted at the West Bay Marina site in 1993, 1999, 2009, 2010, 2012, and 2014. These studies are listed below, the details of which are presented in the 2011 RI report and 2012 RI Addendum (Hart Crowser 2011 and 2012) and in Appendix A of the FFS (Hart Crowser 2014).

- Preliminary Environmental Assessment and Soil Remediation (Hart Crowser 1993);
- Underground Storage Tank (UST) Removal Site Assessment (Stemen Environmental 1999a and 1999b);
- 2009/2010 Remedial Investigation (Anchor 2009 and 2010);
- 2011 Remedial Investigation (Hart Crowser 2011); and
- 2014 Stream Assessment (Hart Crowser 2014).

Two cleanup actions were conducted at the site, which are described in detail in the 2011 RI report (Hart Crowser 2011). In 1993, Hart Crowser performed a cleanup of the soil in the southern ditch, removing the top 3 inches of soil, which contained elevated concentrations of copper. Additionally, approximately 55 tons of petroleum-impacted soil were removed from around an aboveground waste oil storage tank. In 1999, Stemen Environmental removed three USTs from the parking area at the site (Stemen Environmental 1999a). Approximately

675 tons of petroleum-impacted soil, 56 tons of demolition debris, and an unreported volume of oily water were removed from the UST excavation.

2.3 Conceptual Site Model

The CSM is based on the results of historical research and investigations, and the RI report and addendum (Hart Crowser 2011 and 2012). A discussion of the chemicals and media of concern, the fate and transport characteristics of released hazardous substances, and the potential exposure pathways is included in this section. The CSM served as the basis for developing technically feasible cleanup alternatives and selecting a preferred cleanup action for the area of concern (AOC) at the north end of the property, as documented in the FFS (Hart Crowser 2014). The CSM is dynamic and may be refined throughout the cleanup action process as additional information becomes available.

2.3.1 Contaminant Sources and Affected Media

Soil, groundwater, and air are media within the AOC that could potentially be affected by the constituents of concern (COCs) identified at the site. The 2011 RI identified dioxin/furan congeners as COCs for soil in the AOC as a potential exposure risk to human receptors (Hart Crowser 2011). It is suspected that the soil dioxin/furan contamination potentially arose from operation of the former hog fuel burner at the north end of the site. The RI did not find groundwater to be a medium of concern. Based on the chemical and physical properties of the COCs, air is generally not considered a medium of concern. However, dust generated during soil remediation activities in the AOC may present a potential exposure pathway for COCs bound to dust particulates.

2.3.2 Release Mechanisms and Transport Processes

Dioxin/furan compounds can be persistent environmental pollutants that do not readily break down in the subsurface environment. The half-life of dioxins/furans in the subsurface is long, potentially on the order of decades (EPA 2014). Dioxins/furans exhibit low vapor pressure, low water solubility, and strong adsorption to organic matter, which generally ensures their immobility in soil and sediment (ATSDR 1998). Dioxins/furans bound to soil are unlikely to leach into groundwater, but may enter the atmosphere or surface water when the soil particulates to which they are bound are transported by erosion processes, such as wind or surface runoff.

2.3.2 Receptors

Human exposure to dioxin/furans in site soil is considered a risk; however, ecological receptors are not considered to be at risk, according to the results of the terrestrial ecological risk assessment for the site (Hart Crowser 2011). Potential human receptors include marina employees and residents in addition to incidental receptors such as utility workers or site visitors who may be exposed to soil from the AOC.

2.3.3 Summary of Exposure Pathways

For a COC to present a risk to human health and/or the environment, the pathway from the COC to the receptor must be completed. The COC-to-receptor pathways judged to be present at the site are discussed by medium in this section.

Soil

Direct ingestion of or dermal contact with soil containing dioxins/furans is considered a potential exposure pathway. The soil in the area of the four samples (HC-WB-US-001, HC-WB-US-002, WB017, and WB018) with elevated dioxin/furan detections identified in the 2011 RI is not screened or fenced to prevent human access (Hart Crowser 2011). This area is also not covered with a clean vegetated soil cap or an impervious covering such as asphalt or cement. Accordingly, soil containing dioxins/furans in the AOC remains available for potential direct contact or ingestion. It is also susceptible to potential wind- or water-based erosion that could carry COCs to nearby marine sediment, freshwater runoff in the adjacent stream channel drainage, and marine water.

Groundwater

As the RI did not identify groundwater to be a medium of concern, it is not considered an exposure pathway for dioxins/furans.

Air

Air is not considered an exposure pathway from volatilization of dioxins/furans. Generation of airborne dust during cleanup activities or from soil that is not removed or otherwise contained could be a direct-contact exposure pathway.

3.0 CLEANUP REQUIREMENTS

The cleanup requirements include remedial action objectives (RAOs) and preliminary cleanup standards, which were developed to address MTCA regulatory requirements for site cleanup. These requirements address conditions relative to potential human and ecological receptor impacts. Together, the RAOs and cleanup standards provided the framework for evaluating remedial alternatives and for selecting a preferred alternative as summarized in Sections 4.0 and 5.0.

3.1 Remedial Action Objectives

The primary objective for the CAP focuses on substantially eliminating, reducing, and/or controlling unacceptable risks to human health and the environment posed by site COCs to the greatest extent practicable.

3.2 Cleanup Standards

Cleanup standards include cleanup levels (CULs) and points of compliance (POCs) as described in WAC 173-340-700 through WAC 173-340-760. The soil CUL for dioxins/furans is based on human health exposure because the terrestrial ecological risk assessment in the RI demonstrated that residual contamination in site soil was minor or *de minimis* and did not pose an ecological risk to wildlife. For the cleanup action, Ecology has established the MTCA Method B soil CUL of 11 pg/g (picograms per gram or parts per trillion) for dioxins/furans for unrestricted land use. It is assumed that the standard point of compliance will be applied to the cleanup action, which is defined to be throughout the AOC.

3.3 Applicable or Relevant and Appropriate Requirements

Cleanup standards must also incorporate other state and federal regulatory requirements applicable to the cleanup action and/or its location, as appropriate. This section identifies applicable or relevant and appropriate requirements (ARARs) for implementing the remedial action in the West Bay Marina site AOC. The ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of ARARs for the preferred remediation alternative include contaminant-, location-, and action-specific ARARs, which are summarized in Table 1.

In general, only the substantive requirements of ARARs are applied to MTCA cleanup sites being conducted under a legally binding agreement with Ecology (WAC 173-340-710[9][b]). Thus, cleanup actions under a formal agreement with

Ecology are exempt from the administrative and procedural requirements specified in state and federal laws. This exemption also applies to permits or approvals required by local governments.

Contaminant-Specific ARARs. Contaminant-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that are generally recognized by the regulatory agencies as allowable to protect human health and the environment. As noted in Section 3.2, Ecology has established the MTCA Method B soil cleanup level of 11 pg/g for dioxins/furans for the site.

Action-Specific ARARs. Action-specific ARARs are pertinent to particular remediation methods and technologies, and to actions conducted to support cleanup. Action-specific ARARs are requirements that may need to be satisfied during the performance of a specific remedial action because they prescribe how certain activities (e.g., disposal practices, media monitoring programs) must occur.

Location-Specific ARARs. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location. Some examples of special locations include floodplains, wetlands, historic sites, and sensitive ecosystems or habitats.

3.4 Definition of the Area of Concern

The AOC is located at the northern end of the West Bay Marina property and is defined as the area of soil containing dioxin/furan toxicity equivalency quotients (TEQs) above the cleanup level selected for the site (Figure 2). The exceedance locations are based on the results of remedial investigations conducted in 2010 and 2011 (Anchor 2010, Hart Crowser 2011), which identified four sample locations (HC-WB-US-001, HC-WB-US-002, WB017, and WB018) that exceeded the cleanup level. As shown on Figure 2, these sample locations are in the vicinity of the former hog fuel burner.

Specifically, the AOC is limited to the upland area located north of the office/supply buildings at the northern end of the West Bay Marina property but does not extend beyond the property boundary (Figure 2). Assuming that the property boundary extends to the stream channel between West Bay Marina and Dunlap Towing, the northern boundary of the AOC is limited by the channel line and trees located at the edge of the stream. The eastern boundary of the AOC is limited to the top of the slope before it descends to Budd Inlet. It is assumed that the western boundary extends to half the distance between soil sample location HC-WB-US-002 (approximately 19 feet to the west of this sample location), which exceeds the cleanup level, and location HC-WB-US-003, which did not exceed the cleanup level. The cleanup action is limited to this AOC and does not include adjacent properties or the aquatic environment.

The AOC resides in the buffer area of the stream that flows along the northern property boundary. The buffer on the south side of the stream (where the AOC is located) is bounded by a building and gravel driveway; therefore, the buffer is defined as extending from the stream to the existing building and is approximately 17.5 feet wide.

4.0 SELECTED REMEDIATION ALTERNATIVE

The FFS evaluated six alternatives for remediation, of which Alternative 1a was selected as the preferred cleanup action. The selected remedy consists of excavation of soil containing dioxin/furan TEQs above the CUL, off-site disposal, and backfilling and restoration. A conceptual layout of the components of the proposed cleanup action is shown on Figure 3. The components are described in the following sections.

4.1 Excavation of Impacted Soil

Soil will be excavated within the AOC to a depth of 3 feet below ground surface (bgs). Heavy equipment sized to accommodate the constraints and accessibility of the AOC will be used to excavate the soil. Based on the AOC delineation and approximate tree locations, approximately 144 cubic yards (CY) of impacted material (about 215 tons) will be excavated and disposed of in the selected alternative. Excavation and staging of the soil will be conducted using best management practices (BMPs) including sedimentation control and erosion-prevention practices, such as installation of silt fences at the perimeter of the work area and using a stabilized construction entrance and exit. Additionally, dust suppression measures and BMPs (such as wetting soil, etc.) will be implemented during construction activities.

Performance monitoring will be conducted at the limits of excavation to verify that the contaminated material has been removed, which consists of soil sample collection and laboratory analysis for dioxins/furans.

4.2 Tree Removal

The selected alternative assumes that the trees within the AOC will be removed as part of the remediation work to allow for complete removal of contaminated soil from the AOC. The trees in this area include two red alders and four larch conifers. We have assumed that each tree would be removed and processed on site using chainsaws and a wood chipper. Stumps would be removed separately by a hydraulic backhoe. Again, BMPs including dust suppression measures would be employed to prevent migration of dust. For the purposes of this CAP, we have assumed that the six trees are each approximately 30 feet tall and the trunks are 12 inches in diameter. Therefore, a total volume of about 5 CY (1.5 tons) of wood material will need to be disposed of. This processed wood material will be hauled and disposed of at a nearby composting facility (Silver Spring Organic, approximately 20 miles from the site). Any wood material containing residual dioxin/furan-impacted soil (such as the root ball of a tree) will be disposed of with the excavated soil at a Subtitle D landfill, as described below.

4.3 Off-Site Disposal

Excavated soil that is contaminated with dioxins/furans will be disposed of in a Subtitle D landfill as non-hazardous waste. The nearest Subtitle D municipal solid waste (MSW) disposal facility that accepts dioxin/furan-contaminated soil is the Roosevelt Regional Landfill, which is located approximately 250 miles from the site. However, contaminated materials will be hauled to a Centralia waste yard (30 miles from the site), loaded onto railcars, and transported to Roosevelt. Approximately 215 tons of impacted material will be excavated and disposed of in the Subtitle D landfill.

Following excavation and verification soil sampling and analysis, the area will be backfilled with clean fill material. Once backfilled with clean material, the area will be restored as described below.

4.4 Site Restoration

Once excavation, verification soil sampling and analysis, and backfilling have been completed, site restoration and slope stabilization will be completed. Additionally, it is assumed that six trees will be planted at the site to compensate for the removal of the six trees within the AOC. This includes implementing temporary and long-term erosion control measures, such as hydroseeding, until the vegetative cover in the AOC is sufficiently established to control erosion. The AOC will be returned to a grade that is similar to current conditions.

4.5 Stormwater Management

The excavation work will be conducted in accordance with the substantive provisions of the National Pollutant Discharge Elimination System (NPDES) requirements for stormwater discharges from construction areas to minimize erosion and to prevent enhanced sediment loading to stream drainages or Budd Inlet. However, since the AOC and work areas associated with the cleanup action would constitute less than 1 acre, a NPDES Construction Surface Water General Permit would not be required. A stormwater pollution prevention plan (SWPPP) that stipulates erosion prevention, slope stabilization, and drainage collection measures will be developed and implemented. The SWPPP will also provide measures to protect the surface waters of Budd Inlet, and must be in place before construction begins.

4.6 Compliance Monitoring

Compliance monitoring will be implemented in accordance with WAC 173-340-410 and includes:

- **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 and other performance standards; and

- **Confirmational Monitoring** to confirm the long-term effectiveness of the cleanup action once performance standards have been obtained.

Protection monitoring elements, including dust monitoring during excavation, will be addressed in the health and safety plan that will be created for the project.

Performance monitoring following soil excavation will begin with topographic surveys or similar grade control measures to verify that the excavation has achieved the desired cut elevation. Soil samples will be collected and analyzed from the base and walls of the excavation to confirm that the target CUL has been achieved, or to document the concentration of COCs that remain on the site. Related monitoring and documentation will include verifying the chemical quality of imported soil used for backfilling, placement to match pre-existing grade, and nominal compaction requirements to be established during the design phase.

Confirmational monitoring is a component of compliance monitoring that is intended to demonstrate the long-term effectiveness of the cleanup action once the CUL or other performance standards have been attained. Specific details for post-construction monitoring will be developed in a long-term monitoring plan after preparing project plans and specifications in the design phase, which will conform to the general requirements of WAC 173-340-410.

4.7 Institutional Controls

As described in the MTCA regulations (WAC 173-340-440), institutional controls are intended to limit or prohibit activities that may interfere with the integrity of a cleanup action that would result in risk of exposure to contaminated soil at the site. These institutional controls may include on-site features (such as fences), educational programs (such as signage and public notices), legal mechanisms (such as land use restrictions, restrictive covenant, zoning designations, and building permit requirements), maintenance requirements for engineered controls (for example, containment caps), and financial assurances.

The aim of the selected remediation alternative is to remove all of the contaminated material within the AOC. Because soil impacted by dioxins/furans will be excavated and removed within the AOC, institutional controls will not be required under the selected alternative. Therefore, it is assumed that an environmental covenant and other institutional controls will not be required under this remedy.

4.8 Permitting and Planning Requirements

Because the AOC is located in the buffer area of a stream, additional permitting and planning requirements will potentially apply to remediation activities in this area. We assume that the stream buffer will be modified during the remediation work, but that no excavation will occur below the ordinary high water mark (OHWM) of the stream; therefore, a US Army Corps of Engineers Clean Water Act permit will not be required. However, the following City permits and planning measures may be required:

- Critical areas review and approval.
- Clearing and grading permit (including a grading plan and a drainage and erosion control plan).
- Once the concept of the design of the remediation has been determined, a pre-application meeting with the City of Olympia would be conducted to determine exactly what permits the City will require and what mitigation measures may be required.

5.0 REMEDIATION ALTERNATIVES CONSIDERED AND BASIS FOR REMEDY SELECTION

Six remediation alternatives were evaluated in the FFS. This section describes the alternatives that were developed and the MTCA criteria used to evaluate the alternatives.

5.1 FFS Alternatives Evaluated

The options evaluated in the FFS specifically included technologies considered to be capable of achieving the remedial action objectives, MTCA cleanup levels, and other regulatory requirements. Six remediation alternatives applicable to impacted media in the AOC were developed from these technologies. The components of the six remediation alternatives are summarized below.

- Alternative 1a included:
  - Excavation of soil containing dioxin/furan TEQs above the CUL;
  - Removal of six trees within the AOC;
  - Off-site disposal of impacted soil and wood waste containing impacted soil at a Subtitle D landfill facility;
  - Off-site disposal of clean wood waste at a composting facility;
  - Backfilling and site restoration; and
  - Compliance monitoring and maintenance.

- Alternative 1b included:
  - Excavation of soil containing dioxin/furan TEQs above the CUL;
  - Removal of six trees within the AOC;
  - Off-site incineration of impacted soil and wood waste containing impacted soil;
  - Off-site disposal of clean wood waste at a composting facility;
  - Backfilling and site restoration; and
  - Compliance monitoring and maintenance.

- Alternative 1c included:
  - Excavation of soil containing dioxin/furan TEQs above the CUL;
  - Tree preservation within the AOC;
  - Off-site disposal of impacted soil at a Subtitle D landfill facility;
  - Backfilling and site restoration;
  - Institutional controls; and
  - Compliance monitoring and maintenance.

- Alternative 1d included:
  - Excavation of soil containing dioxin/furan TEQs above the CUL;
  - Tree preservation within the AOC;
  - Off-site treatment of impacted soil by incineration;
  - Backfilling and site restoration;
  - Institutional controls; and
  - Compliance monitoring and maintenance.

- Alternative 2 included:
  - Capping of the entire surface of the AOC (excluding tree areas) with asphalt pavement;
  - Tree preservation and tree-friendly cover;
  - Institutional controls; and
  - Compliance monitoring and maintenance.

- Alternative 3 included:
  - Excavation of surface soil (top 6 inches) within the AOC (excluding tree areas);
  - Tree preservation and tree-friendly cover;
  - Placement of a continuous demarcation layer over the excavation floor following excavation of the AOC but before capping;
  - Capping of the AOC (except protected tree areas) with asphalt pavement following placement of the demarcation layer;
  - Off-site disposal of impacted soil at a Subtitle D landfill facility;
  - Institutional controls; and
  - Compliance monitoring and maintenance.

5.2 Evaluation Process

Ecology identifies within the MTCA regulations (WAC 173-340-360) the criteria that should be used to evaluate remediation alternatives. The purpose of the evaluation is to identify the relative advantages and disadvantages of each alternative and, thereby, assist in the decision-making process. This process was used in the FFS to identify the preferred alternative.

5.2.1 MTCA Evaluation Criteria

Key guiding requirements for evaluating remediation alternatives and remedial action selection for the site are listed in the MTCA regulations and detailed in the FFS. MTCA criteria consist of threshold requirements and other criteria listed in WAC 173-340-360(2) (Minimum Requirements for Cleanup Actions) as listed in Table 2 and detailed in the FFS (Hart Crowser 2014).

MTCA places preference on permanent solutions to the maximum extent practicable based on a disproportionate cost analysis (DCA). DCA criteria include protectiveness, permanence, effectiveness over the long term, management of short-term risks, technical and administrative implementability, and consideration of public concerns. The benefits of the alternatives considered are balanced against relative costs for implementing each alternative. Preference is also placed on remedies that can be implemented in a shorter time, based on potential environmental risks and effects on current site use and associated site and surrounding area resources. The third criterion, public concerns, is addressed during comment periods for RI/FS documents, remedy selection decision, and subsequent CAP for remedy implementation. Table 3 presents the DCA evaluation from the FFS.

The DCA represents a test to determine whether incremental costs of a given alternative over a lower-cost option exceed the incremental degree of benefit achieved by the higher cost alternative. The most practicable permanent solution is identified as the baseline cleanup action alternative for FS evaluation. The referenced section of MTCA further specifies that, where alternatives are equal in benefits, the least costly alternative will be selected provided that the MTCA threshold and other requirements are met.

5.2.2 Remediation Alternative Evaluation

The ability of each cleanup alternative to meet applicable MTCA criteria was evaluated in Section 7.0 of the FFS and is presented in the attached Table 2.

The remediation alternative that most closely satisfies the threshold criteria and other MTCA requirements discussed in FFS Sections 6.1 and 6.2 is the preferred alternative for the site. Based on the evaluation of alternatives presented in FFS Section 7.0, the preferred remediation alternative is Alternative 1a, which involves excavation of dioxin/furan-impacted soil and off-site disposal in a Subtitle D landfill facility.

Under MTCA, the most practicable permanent solution is to be used as the baseline against which other alternatives are compared. Alternative 1a was the most permanent practicable solution and was used as the baseline for this comparison.

Although Alternatives 1a and 1b are the most permanent, Alternative 1a is judged to use permanent solutions to the maximum extent practicable.

Alternative 1b has significantly higher costs for minimal increase in protectiveness. Based on this large incremental cost difference, and the fact that both alternatives adequately address risks to possible receptors, Alternative 1a is the preferred alternative.

Alternative 1a may present more short-term risks (related to the off-site transport of contaminated soil) and potentially more technical challenges during implementation (to remove the existing trees and stumps within the AOC). However, using the DCA criteria to compare all four alternatives, Alternative 1a was found to be:

- Equally or more protective;
- Equally or more permanent;
- Equally or more effective over the long term; and
- More administratively implementable.

6.0 REMEDIATION ALTERNATIVE SELECTION AND SCHEDULE

Following the above MTCA analysis and DCA, Alternative 1a was identified as the preferred alternative for remedial action, pending public review and agency approval. Alternative 1a addresses protection of human health from the direct-contact exposure pathway. The estimated cost for Alternative 1a, based on the assumptions made in the FFS, is approximately $111,000 (-35 to +50 percent). A detailed cost estimate is presented in Table 4 for the conceptual remediation alternative. Estimated costs will be further refined in the remedial design stage of the cleanup action.

Cleanup action implementation will be further developed in the Engineering Design Report (EDR) and project design documents. Ecology will provide public notice and an opportunity for the public to review and comment on the FFS and this CAP, as required under WAC 173-340-600. The detailed design phase to develop the EDR and project plans and specifications would be performed after the public review process has been completed and public comments have been addressed. Implementation would be tentatively scheduled for the 2015 construction season.

7.0 REFERENCES

Anchor 2009. Letter to Guy Barrett, Site Manager, Toxics Cleanup Program, Washington State Department of Ecology, Re: West Bay Marina Associates

Transfer of Sampling Data and Request for Time Extension. September 25, 2009.

Anchor 2010. Letter to Guy Barrett, Site Manager, Toxics Cleanup Program, Washington State Department of Ecology, Re: West Bay Marina Associates Soil Sample Results. February 5, 2010.

ATSDR 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, GA. December 1998.

EPA 2014. Dioxins, Chemistry and Behavior. Contaminated Site Clean-Up Information. US Environmental Protection Agency. http://www.clu-in.org/contaminantfocus/default.focus/sec/Dioxins/cat/Chemistry_and_Behavior/

Hart Crowser, Inc. 1993. Preliminary Environmental Assessment and Soil Remediation, West Bay Marina, Olympia, Washington. Prepared for West Bay Marina Associates by Hart Crowser, Inc. July 20, 1993.

Hart Crowser 2011. Remedial Investigation, Westbay Marina, 2100 West Bay Drive NW, Olympia, WA. Prepared for the Washington State Department of Ecology by Hart Crowser, Inc. June 30, 2011.

Hart Crowser 2012. Remedial Investigation Addendum, Westbay Marina, 2100 West Bay Drive NW, Olympia, WA. Prepared for the Washington State Department of Ecology by Hart Crowser, Inc. May 31, 2012.

Hart Crowser 2014. Draft Final Focused Feasibility Study. West Bay Marina, 2100 West Bay Drive NW, Olympia, WA. Prepared for the Washington State Department of Ecology by Hart Crowser, Inc. June 20, 2014.

Stemen Environmental 1999a. Tank Removal and Independent Remedial Action Report. Prepared for West Bay Marina Associates by Stemen Environmental, Inc. August 1999.

Stemen Environmental 1999b. Groundwater Monitoring Well Installation and Groundwater Sampling for West Bay Marina. Prepared for Neil Falkenburg, West Bay Marina, by Stemen Environmental, Inc. December 1999.

Table 1 – Applicable or Relevant and Appropriate Requirements

Authority	Resource	Implementing Laws/Regulations	Applicability
Contaminant-Specific ARARs			
State	Soil	Washington State Model Toxics Control Act [RCW 70.105D; Chapter 173-340 WAC]	The Model Toxics Control Act (MTCA) soil cleanup levels are applicable.
Action-Specific ARARs			
Federal/ State	Surface Water	Federal Water Pollution Control Act-- National Pollution Discharge Elimination System [Clean Water Act; 33 USC § 1342, Section 402] and Implementing Regulations Washington State Construction Stormwater General Permit [RCW 90.48]	The NPDES program establishes requirements for point source discharges, including stormwater runoff. These requirements would be applicable for any point source discharge of stormwater during construction or following cleanup.
Federal/ State	Solid Waste	Transportation of Hazardous Materials [49 CFR Parts 105 to 177] [Chapter 446-50 WAC]	Transportation of hazardous waste or materials is required to meet state and federal requirements. This requirement is potentially applicable to alternatives that involve the off-site transport of impacted soil.
Federal	Solid Waste	Resource Conservation and Recovery Act [42 USC § 6901 et seq.], Subtitle D – Managing Municipal and Solid Waste [40 CFR Parts 257 and 258]	Subtitle D of RCRA establishes a framework for management of non-hazardous solid waste. These regulations establish guidelines and criteria from which states develop solid waste regulations. These requirements are applicable to the remediation alternatives that involve off-site disposal of impacted soil.
State	Solid Waste	Washington State Solid Waste Handling Standards [RCW 70.95; Chapter 173-350 WAC]	Washington State Solid Waste Handling Standards apply to facilities and activities that manage solid waste. The regulations set minimum functional performance standards for proper handling and disposal of solid waste; describe responsibilities of various entities; and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure. These requirements are applicable to remediation alternatives that involve off-site disposal of impacted soil.
Federal	Air	Clean Air Act [42 USC § 7401 et seq.; 40 CFR Part 50]	The federal Clean Air Act creates a national framework designed to protect ambient air quality by limiting air emissions.
State	Air	Washington Clean Air Act and Implementing Regulations [Chapter 173-400-040(8) WAC]	These regulations require the owner or operator of a source of fugitive dust to take reasonable precautions to prevent fugitive dust from becoming airborne and to maintain and operate the source to minimize emissions. These regulations are applicable to all alternatives during construction.
State	Remedy Construction	Washington Industrial Safety and Health Act [RCW 49.17; Chapter 296-24 WAC]	Site worker and visitor health and safety requirements established by the Washington Industrial Safety and Health Act (WISHA) are to be met during implementation of the remedial action.
Local	Remedy Construction	Local Ordinances	Appropriate substantive requirements are to be met for implementation of the remedial action.
Location-Specific ARARs			
State	Shorelines and Surface Water	Shoreline Management Act of 1971 [RCW 90.58] and Implementing Regulations	Actions are prohibited within 200 feet of shorelines of statewide significance unless permitted. Remediation alternatives occur within 200 feet of Budd Inlet.
Local	Stream Buffer	Local Ordinance: Olympia Municipal Code, Streams and Important Riparian Areas [OMC 18.32.435]	The OMC requires 150-foot buffers for Type 4 and 5 streams, and 200-foot buffers for Type 3 streams. Remediation alternatives occur within this stream buffer.

This page is intentionally left blank
for double-sided printing.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Threshold Requirements: WAC 173-340-360(2)(a)						
Protect Human Health and the Environment	Protective. Removal of contaminated material eliminates direct-contact risk to human receptors. Approximately 144 CY of material will be removed under this alternative and disposed offsite at a Subtitle D landfill facility.	Protective. Removal of contaminated material eliminates direct-contact risk to human receptors. Approximately 144 CY of material will be removed under this alternative and incinerated off site.	Protective. Removal of contaminated material eliminates direct-contact risk to human receptors. Approximately 116 CY of material will be removed under this alternative and disposed offsite at a Subtitle D landfill facility.	Protective. Removal of contaminated material eliminates direct-contact risk to human receptors. Approximately 116 CY of material will be removed under this alternative and incinerated off site.	Protective. Capping prevents direct-contact risk to human receptors.	Protective. Removal of contaminated material in the upper 6 inches of soil eliminates direct-contact risk in the area of concern (AOC) and removes approximately 24 CY of impacted soil from the AOC. Following excavation, remaining impacted material in the AOC will be contained in place via capping.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Comply with Cleanup Standards	Complies. Following removal, no contaminated soil exceeding the dioxin/furan cleanup level would remain in the AOC.	Complies. Following removal, no contaminated soil exceeding the dioxin/furan cleanup level would remain in the AOC.	Complies. Following removal, no contaminated soil exceeding the dioxin/furan cleanup level would remain in the AOC, except potentially in protected tree areas.	Complies. Following removal, no contaminated soil exceeding the dioxin/furan cleanup level would remain in the AOC, except potentially in protected tree areas.	Complies. The material left in place above the cleanup level will be contained via capping. Cleanup actions that involve containment can be deemed to meet cleanup standards if requirements set out in WAC 173-340-740(6)(f) are met (see Section 6.2.1).	Complies. The material left in place above the cleanup level will be contained via capping. Cleanup actions that involve containment can be deemed to meet cleanup standards if requirements set out in WAC 173-340-740(6)(f) are met (see Section 6.2.1).
Comply with Applicable State and Federal Laws	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).	Complies. ARARs are judged to be attainable and do not affect the alternative selection process (see Table 1).
Provide for Compliance Monitoring	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.1.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.2.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.3.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.4.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.5.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.2.6.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Other Requirements: WAC 173-340-360(2)(b)						
Use Permanent Solutions to the Maximum Extent Practicable	Uses permanent solutions to the maximum extent practicable, as described in Section 6.2.1 and Table 3.	Uses permanent solutions but is not practicable, as described in Section 6.2.1 and Table 3.	Does not use permanent solutions to the extent provided in Alternatives 1a and 1b, as described in Section 6.2.1 and Table 3. Provides more permanence than Alternatives 2 and 3.	Does not use permanent solutions to the extent provided in Alternatives 1a and 1b, as described in Section 6.2.1 and Table 3. Also not practicable. Provides more permanence than Alternatives 2 and 3.	Does not use permanent solutions to the extent provided in Alternatives 1a and 1b, as described in Section 6.2.1 and Table 3.	Does not use permanent solutions to the extent provided in Alternatives 1a and 1b, as described in Section 6.2.1 and Table 3. Provides more permanence than Alternative 2.
Provide for a Reasonable Restoration Time Frame	Provides a reasonable restoration time frame. The work could be completed within one construction season.	Provides a reasonable restoration time frame. The work could be completed within one construction season.	Provides a reasonable restoration time frame to mitigate direct-contact exposure risk to receptors. However, some contaminated soil may remain contained within the AOC. The work could be completed within one construction season.	Provides a reasonable restoration time frame to mitigate direct-contact exposure risk to receptors. However, some contaminated soil may remain contained within the AOC. The work could be completed within one construction season.	Provides a reasonable restoration time frame to mitigate direct-contact exposure risk to receptors. However, contaminated soil will remain contained within the AOC. The work could be completed within one construction season.	Provides a reasonable restoration time frame to mitigate direct-contact exposure risk to receptors. However, contaminated soil will remain contained within the AOC. The work could be completed within one construction season.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Consider Public Concerns	This criterion will be addressed during the public comment period for the FFS and Draft Cleanup Action Plan.					
Action-Specific Requirements: WAC 173-340-360(2)(c) through (h)						
Groundwater Cleanup Actions, WAC 173-340-360(2)(c)	Not applicable. There are no known dioxin/furan groundwater impacts at the site.					
Cleanup Actions for Soil at Current or Potential Future Residential Areas and for Soil at Schools and Child Care Centers, WAC 173-340-360(2)(d)	Complies. Alternative 1a meets the requirement because soil exceeding the cleanup level will be removed.	Complies. Alternative 1b meets the requirement because soil exceeding the cleanup level will be removed.	Complies. Alternative 1c meets the requirement because soil exceeding the cleanup level will be either removed or contained in place.	Complies. Alternative 1d meets the requirement because soil exceeding the cleanup level will be either removed or contained in place.	Complies. Alternative 2 meets the requirement because soil exceeding the cleanup level will be contained in place.	Complies. Alternative 3 meets the requirement because soil exceeding the cleanup level will be contained in place.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Institutional Controls WAC 173-340-360(2)(e)	Complies. Alternative 1a does not rely primarily on institutional controls and monitoring.	Complies. Alternative 1b does not rely primarily on institutional controls and monitoring.	Complies. Alternative 1c may require institutional controls depending on the amount of contaminated soil remaining in protected tree areas; it does not rely primarily on institutional controls and monitoring.	Complies. Alternative 1d may require institutional controls depending on the amount of contaminated soil remaining in protected tree areas; it does not rely primarily on institutional controls and monitoring.	Complies. Alternative 2 uses institutional controls only to maintain the protectiveness of the cap; it does not rely primarily on institutional controls and monitoring.	Complies. Alternative 3 uses institutional controls only to maintain the protectiveness of the cap; it does not rely primarily on institutional controls and monitoring.
Releases and Migration WAC 173-340-360(2)(f)	Complies. Alternative 1a eliminates releases and migration of chemicals of concern (COCs) from the AOC by excavation and disposal.	Complies. Alternative 1b eliminates releases and migration of COCs from the AOC by excavation and disposal.	Complies. Alternative 1c minimizes releases and migration of COCs through the use of soil excavation to remove contaminated material and capping to contain remaining contaminated material in place.	Complies. Alternative 1d minimizes releases and migration of COCs through the use of soil excavation to remove contaminated material and capping to contain remaining contaminated material in place.	Complies. Alternative 2 contains COCs in place through capping. However, since dioxins/furans are relatively immobile in soil beneath the cap, their migration is not a concern.	Complies. Alternative 3 minimizes releases and migration of COCs through the use of surface soil excavation to remove contaminated material and capping to contain remaining contaminated material in place.
Dilution and Dispersion WAC 173-340-360(2)(g)	Complies. Alternative 1a does not rely on dilution and dispersion.	Complies. Alternative 1b does not rely on dilution and dispersion.	Complies. Alternative 1c does not rely on dilution and dispersion.	Complies. Alternative 1d does not rely on dilution and dispersion.	Complies. Alternative 2 does not rely on dilution and dispersion.	Complies. Alternative 3 does not rely on dilution and dispersion.

Table 2 – Remediation Alternative Evaluation

Selection Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Remediation Levels WAC 173-340-360(2)(h)	Not applicable. The alternatives do not involve remediation levels.					

Evaluation Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, Tree Protection, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, Tree Protection, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Protectiveness	Removal of hazardous substances would eliminate direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternatives 1a and 1b are judged to provide greater protectiveness than the other alternatives because they remove the contaminated material from the AOC.	Removal of hazardous substances would eliminate direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternatives 1a and 1b are judged to provide greater protectiveness than the other alternatives because they remove the contaminated material from the AOC.	Removal of hazardous substances in surface soil and capping would eliminate direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternatives 1c and 1d are considered more protective than Alternatives 2 and 3 but less protective than Alternatives 1a and 1b.	Removal of hazardous substances in surface soil and capping would eliminate direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternatives 1c and 1d are considered more protective than Alternatives 2 and 3 but less protective than Alternatives 1a and 1b.	Capping would prevent direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternative 2 is considered less protective than Alternatives 1a, 1b, 1c, 1d, and 3, since contaminated material will be contained in place in the AOC.	Removal of hazardous substances in surface soil and capping would eliminate direct-contact risk to human receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternative 3 is considered more protective than Alternative 2 but less protective than Alternatives 1a, 1b, 1c, and 1d.
Permanence	Provides reduction in toxicity and volume of contaminants in the AOC. Risk of contaminant mobility would be eliminated by removing the contaminated soil and placing it in an off-site engineered, lined, and monitored landfill facility. For remediation of the areas of concern (AOC), Alternative 1a is considered more permanent than Alternatives 1c, 1d, 2, and 3, and as permanent as Alternative 1b.	Provides reduction in toxicity and volume of contaminants in the AOC. Risk of contaminant mobility would be eliminated by removing the contaminated soil and thermally treating it at a permitted incineration facility to achieve destruction of the contaminants. For remediation of the AOC, Alternative 1b is considered more permanent than Alternatives 1c, 1d, 2, and 3, and as permanent as Alternative 1a.	Provides reduction in toxicity and volume of contaminants in the AOC. Risk of contaminant mobility would be reduced by removing the contaminated soil and placing it in an off-site engineered, lined, and monitored landfill facility. Capping controls the mobility of contaminants remaining in place in the AOC. Long-term monitoring, maintenance, and institutional controls are required to maintain the integrity of the remedial action. For remediation of the AOC, Alternative 1c is considered less permanent than Alternatives 1a and 1b, but more permanent than Alternatives 2 and 3.	Provides reduction in toxicity and volume of contaminants in the AOC. Risk of contaminant mobility would be reduced removing the contaminated soil and thermally treating it at a permitted incineration facility to achieve destruction of the contaminants. Capping controls the mobility of contaminants remaining in place in the AOC. Long-term monitoring, maintenance, and institutional controls are required to maintain the integrity of the remedial action. For remediation of the AOC, Alternative 1d is considered less permanent than Alternatives 1a and 1b, but more permanent than Alternatives 2 and 3.	Capping provides less permanence than the soil removal alternatives but controls mobility of contaminants in the AOC. Long-term monitoring, maintenance, and institutional controls are required to maintain the integrity of the remedial action. Alternative 2 is considered the least permanent of the six alternatives.	Provides some reduction in toxicity and volume of contaminants. Risk of contaminant mobility would be greatly reduced by removing the surface layer of contaminated soil and placing it in an off-site engineered, lined, and monitored landfill facility. Capping controls the mobility of contaminants remaining in place in the AOC. Long-term monitoring, maintenance, and institutional controls are required to maintain the integrity of the remedial action. Alternative 3 is considered less permanent than Alternative 1a and 1b and more permanent than Alternative 2.
Cost	$111,000	$278,000	$106,000	$242,000	$107,000	$112,000
Effectiveness over the Long Term	Removal of contaminated soil from the AOC is very effective over the long term, since direct-contact exposure risk will be eliminated. Subtitle D landfills are proven and expected to be highly effective over the long term. Alternative 1a is	Removal of contaminated soil from the AOC is very effective over the long term, since direct-contact exposure risk will be eliminated. Incineration facilities are highly effective over the long term since contaminant mass will be destroyed.	Alternative 1c is considered more effective over the long term than Alternatives 2 and 3, but less effective than Alternatives 1a and 1b. Subtitle D landfills are proven and expected to be highly effective over the long term. Capping is a	Alternative 1d is considered more effective over the long term than Alternatives 2 and 3, but less effective than Alternatives 1a and 1b. Incineration facilities are highly effective over the long term since contaminant mass will be destroyed.	Capping is a proven technology that is expected to be effective over the long term for containing contaminated material in place. However, long-term effectiveness of the remedy relies on maintenance, monitoring, and institutional controls. Alternative 2 is	Alternative 3 is considered more effective over the long term than Alternative 2, but less effective than Alternatives 1a and 1b. Subtitle D landfills are proven and expected to be highly effective over the long term. Capping is a proven

Evaluation Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, Tree Protection, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, Tree Protection, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Effectiveness over the Long Term (continued)	considered equally effective over the long term for the AOC as Alternative 1b and more effective over the long term than the other alternatives.	Alternative 1b is considered equally effective over the long term for the AOC as Alternative 1a and more effective over the long term than the other alternatives.	proven technology that is expected to be effective over the long term for containing remaining contamination in place in the AOC. However, long-term effectiveness relies on maintenance, monitoring, and institutional controls.	Capping is a proven technology that is expected to be effective over the long term for containing remaining contamination in place in the AOC. However, long-term effectiveness relies on maintenance, monitoring, and institutional controls.	considered the least effective over the long term of the six remediation alternatives.	technology that is expected to be effective over the long term for containing remaining contamination in place in the AOC. However, long-term effectiveness relies on maintenance, monitoring, and institutional controls.
Management of Short-Term Risks	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. However, handling and off-site transport of contaminated soil pose additional short-term risks, such as potential direct-contact exposure risk to the transport personnel and risk of cross-contamination in the event of material loss or spillage during transport. For these reasons, Alternatives 1a and 1b are judged to have equivalent short-term risks, but greater short-term risks than Alternatives 1c, 1d, and 3, which also involves off-site transport of waste material but a lesser quantity. Alternative 2 presents the least short-term risk.	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. However, handling and off-site transport of contaminated soil pose additional short-term risks, such as potential direct-contact exposure risk to the transport personnel and risk of cross-contamination in the event of material loss or spillage during transport. For these reasons, Alternative 1b is judged to have equivalent short-term risks to Alternative 1a, and greater short-term risks than Alternative 3, which also involves off-site transport of waste material but a lesser quantity. Alternative 2 presents the least short-term risk.	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. Alternative 1c includes limited excavation and off-site transport and disposal, which pose additional short-term risks, but to a lesser extent than in Alternatives 1a and 1b and greater extent than Alternative 3. Alternatives 1a and 1b are judged to have greater short-term risks than Alternatives 1c, 1d, and 3. Alternative 2 presents the least short-term risk.	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. Alternative 1d includes limited excavation and off-site transport and disposal, which pose additional short-term risks, but to a lesser extent than in Alternatives 1a and 1b and greater extent than Alternative 3. Alternatives 1a and 1b are judged to have greater short-term risks than Alternatives 1c, 1d, and 3. Alternative 2 presents the least short-term risk.	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. However, in Alternative 2, contaminated soil will be contained in place, and no material will be removed and transported off site. For this reason, Alternative 2 presents the least short-term risk of the six remediation alternatives.	All of the remediation alternatives employ relatively common on-site construction activities with similar short-term risks. Alternative 3 includes limited excavation and off-site transport and disposal, which pose additional short-term risks, but to a lesser extent than in Alternatives 1a and 1b. Alternatives 1a and 1b are judged to have greater short-term risks than Alternatives 1c, 1d, and 3. Alternative 2 presents the least short-term risk.
Technical and Administrative Implementability	The excavation and hauling required for Alternative 1a may be staged to limit disruptions to the local infrastructure to the extent practicable, but some minor amount of business and traffic disruptions are likely to occur. Alternative 1a would have similar disruptions to Alternative 1b, but more disruptions than Alternative 3. Alternative 2 would likely present fewer disruptions during construction.	The excavation and hauling required for Alternative 1b may be staged to limit disruptions to the local infrastructure to the extent practicable, but some minor amount of business and traffic disruptions are likely to occur. Alternative 1b would have similar disruptions to Alternative 1a, but more disruptions than Alternative 3. Alternative 2 would likely present fewer disruptions during construction.	The excavation and hauling required for Alternative 1c may be staged to limit disruptions to the local infrastructure to the extent practicable, but some minor amount of business and traffic disruptions are likely to occur. Alternatives 1c and 1d would likely have more disruptions than the other four alternatives. Alternative 1c would need to	The excavation and hauling required for Alternative 1d may be staged to limit disruptions to the local infrastructure to the extent practicable, but some minor amount of business and traffic disruptions are likely to occur. Alternatives 1c and 1d would likely have more disruptions than the other four alternatives. Alternative 1d would need to	Alternative 2 would likely present fewer disruptions during construction than the other alternatives. Alternative 2 would need to overcome fewer technical obstacles during construction within the AOC, such as having to avoid subsurface impacts to tree roots. Alternative 2 would require obtaining an environmental covenant for the contaminated soil contained beneath the cap. The six alternatives	The excavation and hauling required for Alternative 3 may be staged to limit disruptions to the local infrastructure to the extent practicable, but some minor amount of business and traffic disruptions are likely to occur. Alternative 3 would have fewer disruptions than Alternatives 1a and 1b, but more than Alternative 2. Alternative 3 would need to

Table 3 – Disproportionate Cost Analysis

Evaluation Criteria	Alternative 1a: Excavation and Off-Site Disposal	Alternative 1b: Excavation and Off-Site Incineration	Alternative 1c: Excavation, Off-Site Disposal, Tree Protection, and Institutional Controls	Alternative 1d: Excavation, Off-Site Incineration, Tree Protection, and Institutional Controls	Alternative 2: Capping and Institutional Controls	Alternative 3: Limited Excavation, Capping, and Institutional Controls
Technical and Administrative Implementability (continued)	Alternative 1a would require characterization and acceptance of the contaminated soil waste by the disposal facility. Alternatives 1a and 1b are assumed to remove all of the contaminated soil within the AOC, and therefore an environmental covenant would not be required. The six alternatives are technically implementable, but Alternative 1a may pose greater technical challenges than Alternative 2, which requires less disturbance of the subsurface. Alternative 1a would have similar technical implementability compared to Alternatives 1b and 3. Alternatives 1a and 1b have similar administrative implementability and are judged to be equally administratively implementable as Alternative 2 and more administratively implementable than Alternatives 1c, 1d, and 3.	Alternatives 1b would require characterization and acceptance of the contaminated soil waste by the disposal facility. Alternatives 1a and 1b are assumed to remove all of the contaminated soil within the AOC, and therefore an environmental covenant would not be required. The six alternatives are technically implementable, but Alternative 1b may pose greater technical challenges than Alternative 2, which requires less disturbance of the subsurface. Alternative 1b would have similar technical implementability compared to Alternatives 1a and 3. Alternatives 1a and 1b have similar administrative implementability and are judged to be equally administratively implementable as Alternative 2 and more administratively implementable than Alternatives 1c, 1d, and 3.	overcome greater technical obstacles to avoid tree root impacts when conducting excavation activities within the AOC, in comparison to Alternative 2. Alternative 1c would require characterization and acceptance of the excavated contaminated soil waste by the disposal facility. Alternatives 1c, 1d, 2, and 3 would each require obtaining an environmental covenant for contaminated soil remaining in the AOC. The six alternatives are technically implementable, but Alternatives 1c, 1d, and 3 may pose greater technical challenges than Alternatives 1a, 1b, and 2. Alternatives 1c, 1d, and 3 are judged to be the least administratively implementable of the six alternatives, since they will require off-site waste management and the filing of an environmental covenant.	overcome greater technical obstacles to avoid tree root impacts when conducting excavation activities within the AOC, in comparison to Alternative 2. Alternative 1d would require characterization and acceptance of the excavated contaminated soil waste by the disposal facility. Alternatives 1c, 1d, 2, and 3 would each require obtaining an environmental covenant for the contaminated soil remaining in the AOC. The six alternatives are technically implementable, but Alternatives 1c, 1d, and 3 may pose greater technical challenges than Alternatives 1a, 1b, and 2. Alternatives 1c, 1d, and 3 are judged to be the least administratively implementable of the six alternatives, since they will require off-site waste management and the filing of an environmental covenant.	are technically implementable, but Alternative 2 may be more implementable than the other alternatives since it requires less disturbance of the subsurface and is less constrained by the presence of tree roots. Alternative 2 is judged to be equally administratively implementable as Alternatives 1a and 1b, but more administratively implementable than Alternative 3.	overcome greater technical obstacles to avoid tree root impacts when conducting excavation activities within the AOC, in comparison to Alternative 2. Alternative 3 would require characterization and acceptance of the excavated contaminated soil waste by the disposal facility. Both Alternatives 2 and 3 would require obtaining an environmental covenant for the contaminated soil contained beneath the cap. The six alternatives are technically implementable, but Alternative 3 may pose greater technical challenges than Alternative 2. Alternative 3 is judged to be the least administratively implementable of the four alternatives, since it will require off-site waste management and the filing of an environmental covenant.
Consideration of Public Concerns	This criterion will be addressed during the public comment period for the FFS and CAP.					

This page is intentionally left blank for double-sided printing.

Table 4 - Remediation Alternative 1a Estimated Cost Summary

Location: West Bay Marina Olympia, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2013 **Date:** July 2014	**Description:** Alternative 1a involves excavation and off-site disposal of soil containing COCs above the cleanup level at a permitted, engineered, lined, and monitored landfill facility. This cost estimate assumes that the material will be disposed of at a Subtitle D landfill. Following excavation, the AOC will be backfilled to grade with clean fill material. Trees within the AOC will be removed to facilitate complete removal of contaminated soil. It is assumed that an environmental covenant will not be required for this alternative.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Excavation and Disposal					
Mobilization/Demobilization	1	LS	$ 5,000	$ 5,000	Engineer's estimate.
Temp. Erosion & Sedimentation Control Measures	1	LS	$ 3,000	$ 3,000	Engineer's estimate.
Excavation and Loading	144	CY	$ 31	$ 4,394	Hydraulic backhoe, 0.5 CY bucket. 2010 RSMeans 31 23 16.16 6030 and 9024.
Tree and Stump Removal	6	EA	$ 494	$ 2,964	Remove selected trees in AOC using chainsaw and chipper. Stump removal by hydraulic backhoe 2010 RSMeans 31 13 13.20 3050 and 2040.
Waste Transportation and Disposal	215	ton	$ 47	$ 10,121	Roosevelt Regional Landfill, Subtitle D MSW facility. Vendor quote.
Performance Sampling and Analysis	1	LS	$ 9,750	$ 9,750	Analytical cost only, labor assumed to be part of construction management, 1 sample per 100 SF.
Tree and Stump Material Disposal	1	LS	$ 335	$ 335	Haul material and disposal fee for compost facility.
Excavation and Disposal Subtotal				**$ 35,563**	
Restoration and Revegetation					
Backfilling	144	CY	$ 36	$ 5,204	Includes compaction in 12" layers, vibrating plate. 2010 RSMeans 31 23 23.13 1100.
Grading & Seeding	144	SY	$ 3.70	$ 532	Fine grading and seeding, incl. lime, fertilizer & seed, with equipment. 2010 RSMeans 32 91 19.13 1000.
Planting Trees	6	EA	$ 67	$ 402	Planting trees, medium soil, bagged and burlapped, 12"diameter ball, by hand. 2010 RSMeans 32 93 43.10 0600.
Restoration and Revegetation Subtotal				**$ 6,138**	
Contingency	15%	--	--	**$ 6,255**	Scope and bid contingency. Percentage of capital costs.
Permitting					
Pre-Application Meeting with City of Olympia	1	LS	$ 240	$ 240	City of Olympia 2014 land use planning application fees, pre-submission conference.
Critical Areas Review Permit Application	1	LS	$ 2,534	$ 2,534	Thurston County application and review fees.
Clearing and Grading Permit Application	1	LS	$ 500	$ 500	Engineer's estiamte.
Planning Documents	1	LS	$ 9,000	$ 9,000	Drainage/erosion control plans, mitigation planting plan, monitoring plan. Engineer's estiamte.
Permitting Subtotal				**$ 12,274**	

Table 4 - Remediation Alternative 1a Estimated Cost Summary

Location: West Bay Marina, Olympia, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2013 **Date:** July 2014	**Description:** Alternative 1a involves excavation and off-site disposal of soil containing COCs above the cleanup level at a permitted, engineered, lined, and monitored landfill facility. This cost estimate assumes that the material will be disposed of at a Subtitle D landfill. Following excavation, the AOC will be backfilled to grade with clean fill material. Trees within the AOC will be removed to facilitate complete removal of contaminated soil. It is assumed that an environmental covenant will not be required for this alternative.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Professional/Technical Services					
Project Management	10%	--	--	$ 4,796	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial Design	20%	--	--	$ 9,591	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction Management	15%	--	--	$ 7,193	Percentage of capital cost + contingency. EPA 540-R-00-002.
Professional/Technical Services Subtotal				**$ 21,580**	
TOTAL CAPITAL COST				**$ 81,809**	

ANNUAL O&M COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration Monitoring					
Site Inspections	1	YR	$ 500	$ 500	Engineer's estimate.
Site Restoration Monitoring Subtotal				**$ 500**	
Contingency	10%	--	--	**$ 50**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 55	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 55	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 500	$ 500	Engineer's estimate.
Professional/Technical Services Subtotal				**$ 610**	
TOTAL ANNUAL O&M COST				**$ 1,160**	

PERIODIC COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Maintenance					
Site Maintenance	1	YR	$ 1,534	$ 1,534	25% of restoration and revegetation costs, every 2 years.
Contingency	10%	--	--	$ 153	Scope and bid contingency. Percentage of periodic cost.
Project Management	10%	--	--	$ 169	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Site Maintenance Subtotal				**$ 1,857**	
Professional/Technical Services					
5-Year Reviews & Reporting	1	EA	$ 5,000	$ 5,000	Engineer's estimate. Years 5 and 10.
Professional/Technical Services Subtotal				**$ 5,000**	

Table 4 - Remediation Alternative 1a Estimated Cost Summary

Location: West Bay Marina Olympia, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2013 **Date:** July 2014	**Description:** Alternative 1a involves excavation and off-site disposal of soil containing COCs above the cleanup level at a permitted, engineered, lined, and monitored landfill facility. This cost estimate assumes that the material will be disposed of at a Subtitle D landfill. Following excavation, the AOC will be backfilled to grade with clean fill material. Trees within the AOC will be removed to facilitate complete removal of contaminated soil. It is assumed that an environmental covenant will not be required for this alternative.

PRESENT VALUE ANALYSIS

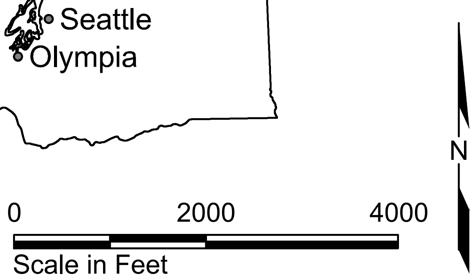
Discount Rate 1.0%
Total Years 10

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 81,809	$ 81,809	1.000	$ 81,809	
Annual O&M	1 - 10	$ 11,600	$ 1,160	9.471	$ 10,987	
Periodic	2	$ 1,857	$ 1,857	0.980	$ 1,820	
Periodic	4	$ 1,857	$ 1,857	0.961	$ 1,784	
Periodic	5	$ 5,000	$ 5,000	0.951	$ 4,757	
Periodic	6	$ 1,857	$ 1,857	0.942	$ 1,749	
Periodic	8	$ 1,857	$ 1,857	0.923	$ 1,715	
Periodic	10	$ 6,857	$ 6,857	0.905	$ 6,207	
		$ 112,693			$ 110,829	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 1A					**$ 110,829**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 10-year discount rate of 1.0 percent (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

This page is intentionally left blank
for double-sided printing.

Source: Base map prepared from DeLorme Topo 7.0, 2007.



West Bay Marina
Olympia, Washington

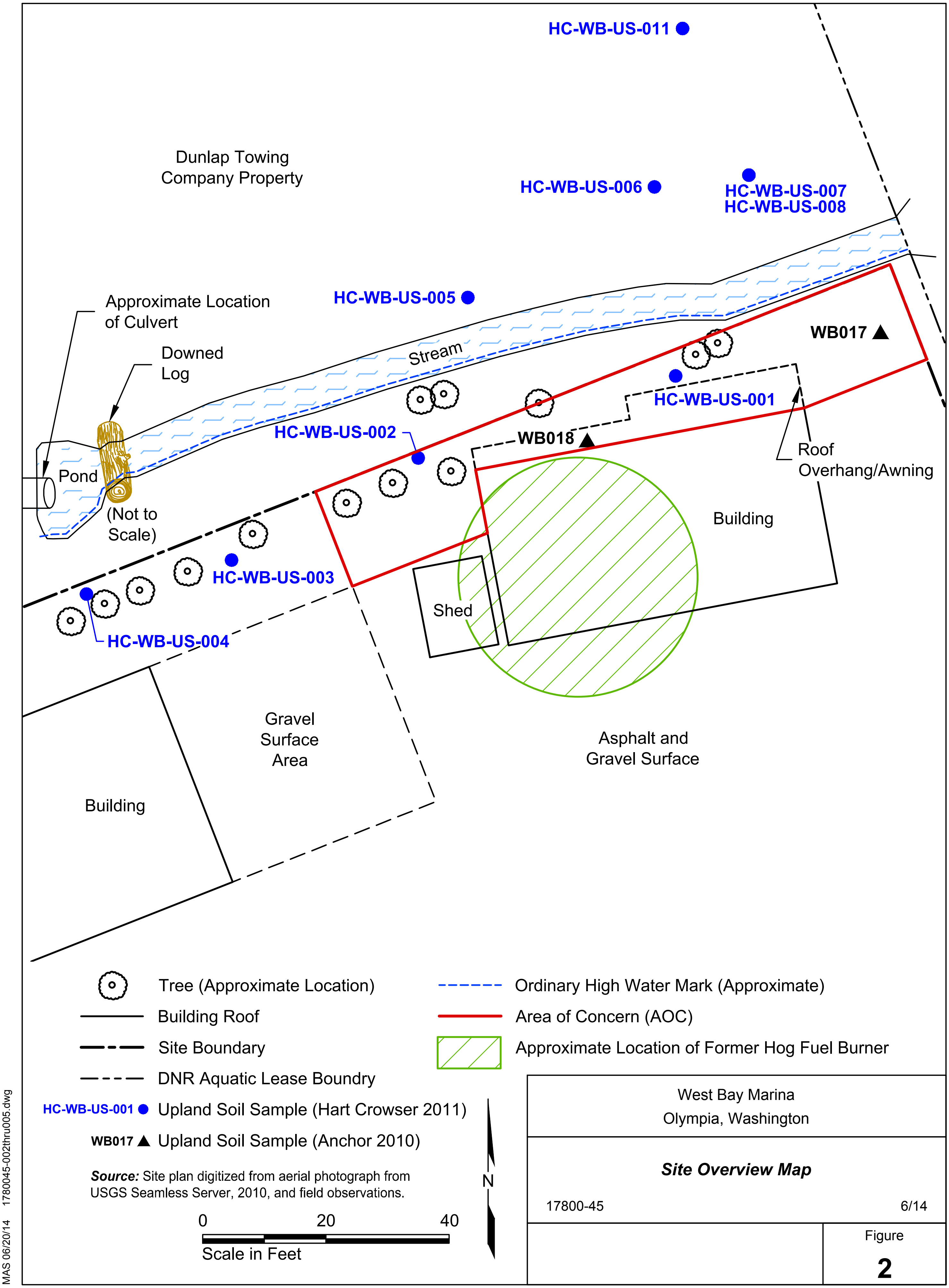
Vicinity Map

17800-45 6/14

Figure
1

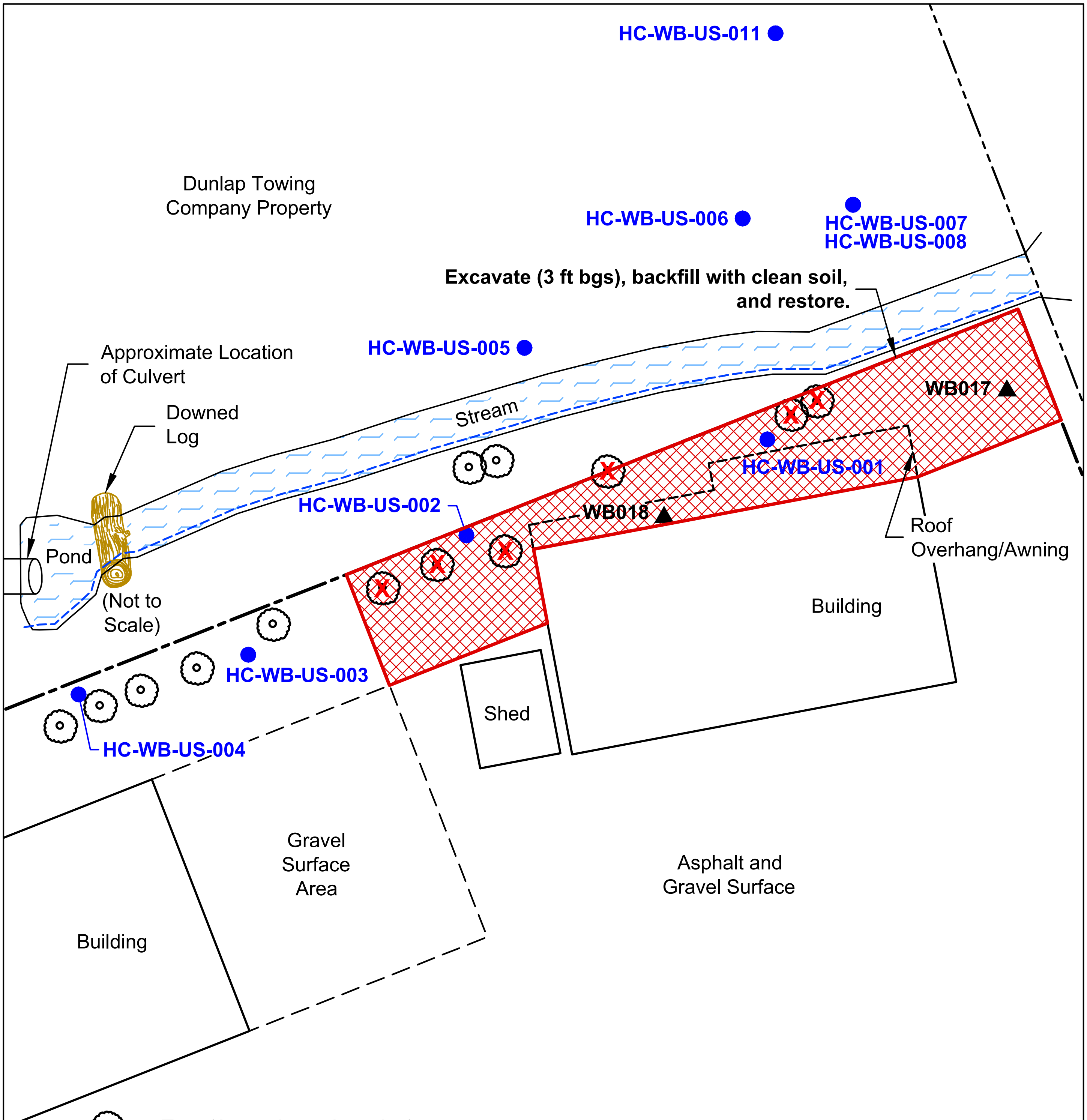
1780045-001.dwg
MAS 06/□/14

This page is intentionally left blank
for double-sided printing.



HC-WB-US-011
Dunlap Towing Company Property
HC-WB-US-006
HC-WB-US-007
HC-WB-US-008
Approximate Location of Culvert
HC-WB-US-005
Downed Log
Stream
WB017
HC-WB-US-001
HC-WB-US-002
WB018
Roof Overhang/Awning
Pond
(Not to Scale)
Building
HC-WB-US-003
Shed
HC-WB-US-004
Gravel Surface Area
Asphalt and Gravel Surface
Building
Tree (Approximate Location)
Building Roof
Site Boundary
DNR Aquatic Lease Boundry
Ordinary High Water Mark (Approximate)
Area of Concern (AOC)
Approximate Location of Former Hog Fuel Burner
HC-WB-US-001 Upland Soil Sample (Hart Crowser 2011)
WB017 Upland Soil Sample (Anchor 2010)
Source: Site plan digitized from aerial photograph from USGS Seamless Server, 2010, and field observations.
0 20 40
Scale in Feet
N
West Bay Marina
Olympia, Washington
Site Overview Map
17800-45
6/14
Figure
2
MAS 06/20/14 1780045-002thru005.dwg

This page is intentionally left blank
for double-sided printing.



Tree (Approximate Location)

X Tree to be Removed

Building Roof

Site Boundary

DNR Aquatic Lease Boundry

HC-WB-US-001 ● Upland Soil Sample (Hart Crowser 2011)

WB017 ▲ Upland Soil Sample (Anchor 2010)

Ordinary High Water Mark (Approximate)

Area of Concern (AOC)

Source: Site plan digitized from aerial photograph from USGS Seamless Server, 2010, and field observations.

0 20 40

Scale in Feet

N

West Bay Marina

Olympia, Washington

Proposed Cleanup Action Conceptual Layout

17800-45 6/14

Figure **3**

MAS 06/20/14 1780045-002thru005.dwg

This page is intentionally left blank
for double-sided printing.