CARTY LAKE ENGINEERING DESIGN REPORT

CARTY LAKE REMEDIAL ACTION
111 W DIVISION STREET
RIDGEFIELD, WASHINGTON

Prepared for

PORT OF RIDGEFIELD

RIDGEFIELD, WA

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The material and data in this report were prepared under the supervision and direction of the undersigned.

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ACRONYMS AND ABBREVIATIONS

bml	below mudline
BMP	best management practice
CAP	cleanup action plan
CD	Compatibility Determination
City	City of Ridgefield
CQA	construction quality assurance
COE	U.S. Army Corps of Engineers
CQC	construction quality control
CUL	cleanup level
dioxins	chlorinated dibenzo-p-dioxins and dibenzofurans
DU	decision unit
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
GeoDesign	GeoDesign, Inc.
HAZWOPER	hazardous waste operations and emergency response
IHS	indicator hazardous substance
ISM	incremental sampling methodology
JARPA	Joint Aquatic Resources Permit Application
LRIS	Lake River Industrial Site
MFA	Maul Foster & Alongi, Inc.
MTCA	Model Toxics Control Act
μg/L	micrograms per liter
NEPA	National Environmental Policy Act
ng/kg	nanograms per kilogram
NGVD	National Geodetic Vertical Datum of 1929/1947
NHPA	National Historic Preservation Act
NTU	nephelometric turbidity unit(s)
OHWM	ordinary high-water mark
PCP	pentachlorophenol
PeCDF	pentachlorodibenzofuran
Port	Port of Ridgefield
PQL	practical quantitation limit
PWT	Pacific Wood Treating Co.
REL	remediation level
RI/FS	remedial investigation and feasibility study
RNWR	Ridgefield National Wildlife Refuge
SUP	Special Use Permit
TEQ	toxicity equivalency
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

UWBZ	upper water-bearing zone
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife

1 INTRODUCTION

On behalf of the Port of Ridgefield (the Port), Maul Foster & Alongi, Inc. (MFA) has prepared this draft engineering design report for remediation of sediment in Carty Lake adjacent to the former Pacific Wood Treating Co. (PWT) site in Ridgefield, Washington (see Figures 1-1 and 1-2). This document has been prepared under the authority of Consent Decree No. 13-2-03830-1 (Washington State Department of Ecology [Ecology], 2013b) between the Port and Ecology to satisfy the requirements of the Model Toxics Control Act (MTCA) and sediment management standards.

This report fulfills Ecology's requirement for an engineering design report summarizing the remedial action design as specified in the Ecology-approved remedial investigation and feasibility study (RI/FS) (MFA, 2013b) and as prescribed in the Cleanup Action Plan (CAP) (Ecology, 2013a).

1.1 Site Description and Setting

PWT operated a wood-treating facility from 1964 to 1993 at the Port's approximately 40-acre Lake River Industrial Site (LRIS). PWT filed for bankruptcy in 1993 and abandoned the LRIS. PWT's operations involved pressure-treating wood products with oil-based treatment solutions containing creosote and pentachlorophenol (PCP), and water-based mixtures of copper, chromium, arsenic, and/or zinc. A remedial action has been completed on the uplands portion of the property, consistent with the remedy selected in the CAP. Pathways and sources of contamination to Carty Lake have been removed and an upland cap has been installed.

Carty Lake is a 52-acre, ponded wetland in the Ridgefield National Wildlife Refuge (RNWR) Carty Unit "lowlands" immediately north and west of the LRIS. The Carty Unit is bordered by Lake River to the west, privately owned farmland and natural areas to the north, and Burlington Northern-Santa Fe railroad tracks and the north pole yard of the former PWT facility to the east. During high-water events, Gee Creek and Carty Lake can be hydraulically connected at the lake's northern end. However, during most of the year, Carty Lake has no outlet. Water levels in Carty Lake vary seasonally, and generally are higher during winter and spring and lower during summer and fall. The National Wetlands Inventory has classified the project location as palustrine, emergent, persistent; the inventory subdesignations are seasonally or temporarily flooded and temporary tidal wetland. Approximately 38 acres of adjacent areas of Carty Lake are designated as lacustrine, limnetic, unconsolidated bottom, permanent tidal; and the remaining surrounding areas are designated palustrine emergent wetland. Carty Lake contains Washington State-designated priority palustrine habitat.

Currently, Carty Lake is habitat to aquatic animals, including warm water fish (e.g., introduced carp and largescale sucker), waterbirds such as the great blue heron, and aquatic mammals such as beaver, mink, and nutria. Reed canary grass is prominent in Carty Lake. Along the shoreline, reed canary grass and Himalayan blackberry are prevalent.

1.2 Project Purpose and Need

On September 24, 2001, the Port entered into an agreement with Ecology to conduct an RI/FS at the site. The RI/FS was finalized in July 2013 (MFA, 2013b). The remedial action was selected by Ecology (Ecology, 2013a,b) in accordance with MTCA, Washington Administrative Code (WAC) 173-340-380. The remedy selected by Ecology, and documented in the CAP (Exhibit A of the Consent Decree) (Ecology, 2013b), is based on the final RI/FS report.

The purpose of this remedial action is to address the presence of chlorinated dibenzo-p-dioxins and dibenzofurans (dioxins) above remediation levels (RELs) in the southern portion of Carty Lake. Dioxins were identified as the indicator hazardous substance (IHS) for Carty Lake sediment. Evaluations of human fish consumption scenarios at Carty Lake indicate that a human-health-risk-based number may be below natural background and the practical quantitation limit (PQL). The dioxin cleanup level (CUL) is therefore based on the PQL of 5 nanograms per kilogram (ng/kg) dioxin toxicity equivalency (TEQ) (WAC 173-340-700(6)(d)).

Human activity at Carty Lake is currently minimal. Carty Lake is part of a national wildlife refuge and, as such, is an important resource for ecological receptors. The FS indicated that it was not feasible to achieve the 5 ng/kg dioxin TEQ CUL. Therefore, cleanup is based on RELs established at levels protective of ecological receptors[1]. CULs were not established in the CAP for PCP, arsenic, or chromium, as they are not IHSs, and screening levels. The remedial action identified in the CAP for Carty Lake includes:

- Removal of sediment with concentrations of dioxins above RELs such that the contamination will not be available for potential future exposure or transport. REL exceedances are limited to the south end of the lake which is the subject of this remedial action
- Removal of other contaminants exceeding screening levels (i.e., PCP, arsenic, and chromium)
- Management of low-level residual concentrations of dioxins through the placement of a thin, clean sand cap layer
- Implementation of institutional controls to continue to limit consumption of fish from Carty Lake
- Functional replacement of the bulkhead on the southern end of Carty Lake
- Repair and rehabilitation of the wetland impacted by access, staging, and/or excavation, in consultation with the U.S. Fish and Wildlife Service (USFWS)

Where possible, the design includes elements to reflect a more natural appearance and to provide greater habitat value. The remedy components are described in detail in Section 3.

[1] Concentrations protective of ecological receptors are termed "risk factors" in the CAP.

1.3 Selected Remedial Action

The selected cleanup for Carty Lake involves mechanical sediment excavation paired with the placement of a clean layer of sand to stabilize disturbed sediments and manage residuals generated from the excavation process. The cleanup includes actions above and below OHWM. Drawing C4.0 shows the remedial action area (i.e., the area that will be excavated) and the area in which construction access and staging will be conducted.

The remedy below OHWM consists of removing sediment within the sediment excavation prism via mechanical excavation and placement of an approximately 1-foot-thick, clean sand layer. Additional cleanup components to be conducted below OHW include the following:

- Installation of a temporary isolation barrier to isolate the south end of the lake and to facilitate dewatering of the sediment excavation area.
- Best management practices (BMPs) for water quality will be implemented during work; these will include operational controls, excavation methods, and construction dewatering. Water removed from the construction area will be treated for turbidity and organic compounds if necessary, as described in Section 5, before it is discharged to surface water.
- Excavated material will be disposed of as nonhazardous material waste at a Subtitle D landfill facility.
- Implementation of a long-term institutional control on fish consumption throughout the lake to protect human health.

Additional long-term institutional controls will not be required; however, an updated characterization of sediment conditions may be needed before initiation of any future activities, such as in-water construction or sediment excavation that may result in significant sediment disturbance.

Secondary benefits that will result from the cleanup action components include:

- Restoration of the wetland habitat by removal of nonnative plants and planting of native wetland plant communities in the work area
- Increased wetland quality by leaving a lower, post-removal sediment elevation (deeper water), which is less favorable to invasive plant species (e.g., reed canary grass)

Upland actions will include the following:

- Access improvements, e.g., clearing and grubbing, construction of a permanent access ramp from the Port's property to the Carty Unit, construction of a temporary access road to the northern limits of the Carty Lake excavation prism, and construction of a temporary staging area alongside a portion of the temporary access road
- Construction of an earth and rock embankment to permanently stabilize the soils behind the existing treated-wood bulkhead, which has begun to fail

- Paving of a portion of the Cell 2 hard trail on Port property (work delayed from a previous upland remedial action to provide better construction access for the Carty Lake remedial action)
- Construction of an upland staging and sediment handling area to be used as required for both the Carty Lake and Lake River remedial actions.
- Planting of native transitional and upland plant communities in the work area to control erosion, restore habitat, and meet on-site mitigation objectives

1.4 Nearby Construction Projects

The Port began construction roadway improvements across a portion of the LRIS between Division Street and Mill Street in summer 2014. It is not anticipated that this construction will interface with construction of the sediment remedy in Carty Lake. However, construction of an upland staging and sediment-handling area on the LRIS as part of the Carty Lake Sediment Remedy Project and overland trucking of excavated sediments might interact with roadway construction at Division Street and/or the LRIS access road. The Port has and will continue to coordinate with the roadway improvement contractor to ensure that access is provided for the sediment remedy contractor.

1.5 Permitting, Review, and Substantive Requirements for Sediment Remedial Action

The proposed cleanup action involves coordination among local, state, and federal agencies. Before the proposed work begins, the following notifications or authorizations must be acquired and the regulatory requirements met:

- Approval of the final design—Ecology. Ecology is the lead state agency for the cleanup under MTCA.
- Demonstration of substantive compliance with the Clean Water Act Section 401 Water Quality Certification—Ecology Shoreland and Environmental Assistance Program. A Joint Aquatic Resources Permit Application (JARPA) was provided to Ecology as a first step in the water quality certification process. Ecology reviewed the water quality requirements described in this design document to assess substantive compliance. The proposed work was authorized by the U.S. Army Corps of Engineers (COE) under Nationwide Permit 38 and found to comply with Ecology's Water Quality Certification requirements (see Appendix A).
- National Pollutant Discharge Elimination System Construction Stormwater General Permit—Ecology Water Quality Division. The Port has submitted the application for the construction stormwater general permit to Ecology. This application includes a site-specific stormwater pollution prevention plan (SWPP). Ecology issued Administrative Order #10830 on August 5, 2014; coverage under the construction stormwater general permit was granted on August 11, 2014 (see Appendix A).

- Clean Water Act Section 404 permit and Section 10 of the Rivers and Harbors Act of 1899—COE. The Port submitted a JARPA to the COE for Section 404 and Section 10 authorization on November 12, 2013. The COE requested additional information on December 31, 2013, including a mitigation plan for the proposed loss of up to 0.23 acre of wetland due to bulkhead reinforcement construction and a planting plan for wetland revegetation activities. The Port provided this information on January 30, 2014. Nationwide Permit 38 authorizes work under both Section 404 and Section 10. The COE issued Nationwide Permit 38 (NWS-2013-1209) to the Port on August 19, 2014 (see Appendix A).
- National Environmental Policy Act (NEPA)—USFWS. An environmental assessment of project activities was conducted to meet NEPA requirements. A finding of no significant impact was issued by the USFWS on January 14, 2014 (see Appendix A).
- Endangered Species Act (ESA) consultation—USFWS. The RNWR issued an opinion on February 3, 2014, that the project "may affect, not likely to adversely affect" Columbian white-tailed deer. The project was found to have "no effect" on other threatened and endangered species or on essential fish habitat (see Appendix A). The COE requested concurrence with these determinations from the USFWS (Washington Fish and Wildlife Office) in July 2014. The USFWS provided concurrence on July 30, 2014, concluding informal consultation (see Appendix A). The National Marine Fisheries services declined consultation because the project does not affect endangered fish species under NMFS jurisdiction, as Carty Lake is not typically hydraulically connected to waters with salmon migration routes.
- Demonstration of compliance with Section 106 of the National Historic Preservation Act (NHPA)—USFWS. The USFWS accepted the role of lead agency and engaged the Washington State Department of Archaeology and Historic Preservation (DAHP) and affected Tribes. Consultation with local Tribes was initiated on April 15, 2014. USFWS fulfilled Section 106 compliance responsibilities and made a "No Historic Properties Affected" determination as stated in their June 16, 2014 letter. DAHP concurred with No Adverse Effect determination in their June 12, 2014 letter. As stipulated in the June 16, 2014 letter, USFWS will have a professional archaeologist, one that meets the Secretary of Interior Standards for Historic Preservation, on site to recognize if a buried archaeological site is discovered during construction (see Appendix A).
- Special Use Permit (SUP)—USFWS. Carty Lake is located in the RNWR, and cleanup actions therefore require approval of the USFWS. An SUP enables non-National Wildlife Refuge System entities to engage in activities on a national wildlife refuge. Issuing an SUP is a federal action that triggers the need for the USFWS to address several environmental compliance requirements, including those contained in NEPA, ESA, and Section 106 of the NHPA (see above). Compatibility Determination (CD) requirements must also be met before an SUP can be issued; USFWS issued a CD on February 3, 2014, stating that project activity uses are "compatible." The SUP was issued on July 16, 2014 and is provided in Appendix A.

- Demonstration of substantive compliance with the requirements of the Hydraulic Project Approval process—Washington State Department of Fish and Wildlife (WDFW). The Port, MFA, and Ecology met with WDFW to discuss the design on November 4, 2013, and the Port provided WDFW with the JARPA on November 12, 2013. WDFW provided a letter outlining the requirements of the Hydraulic Project approval process on June 4, 2014; this letter is included in Appendix A.
- Demonstration of substantive compliance with applicable City of Ridgefield (City) code. The Port provided the City with the JARPA on November 12, 2013. The City issued a letter outlining which sections of the City's code would apply as substantive requirements for relevant City permits. On March 31, 2014, the Port submitted for the City's review a narrative response outlining how the project meets these substantive requirements. On May 21, 2014, the City provided a letter to Ecology stating that the cleanup actions will meet the substantive requirements of the City's development regulations and shoreline master program (see Appendix A). The City issued the necessary permits for construction and grading on July 8, 2014 (see Appendix A).
- State Environmental Policy Act—Ecology. Ecology issued a Determination of Nonsignificance for public comment on April 10, 2014 (see Appendix A). No comments were received.

1.5.1 Contractor Work Plan Submittals

Prior to construction, the contractor is required to generate and submit a number of plans detailing its approach to the work and confirming its understanding and incorporation of the permit and project technical requirements. The work plans are subject to review and approval by the Port and Ecology. A list of the work plans, including references to the specification sections that detail their requirements, is provided below:

- Submittal package identification (Section 01 33 00 Submittal Procedures)
- Environmental protection plan (Section 01 57 19 Environmental Protection)
- Corrective action plan for water quality criteria level exceedance (Section 01 57 19 Environmental Protection)
- Site plan layout (Section 02 00 00 Mobilization and Site Preparation)
- Survey work plan (Section 02 14 50 Surveying)
- Structure and debris removal plan. (Section 02 22 40 Demolition)
- Sediment excavation work plan (Section 35 23 15 Sediment Excavation)
- Sediment transportation and disposal work plan (Section 35 23 15 Sediment Excavation)
- Sediment excavation area water handling and dewatering work plan (Section 35 23 15 Sediment Excavation).
- Fill placement work plan (Section 35 42 00 Fill)
- Planting schedule (Section 32 93 00 Planting)

2 EXISTING CONDITIONS

2.1 Topography and Bathymetry

2.1.1 Topography

With the exception of the existing treated-wood bulkhead and associated grade change, the topography of Carty Lake consists of gently rolling terrain with elevations ranging from 7 feet to 34 feet National Geodetic Vertical Datum of 1929/1947 (NGVD) (see Drawing C1.0). The 100-year floodplain elevation of Gee Creek is approximately 23.8 feet at the Burlington Northern-Santa Fe railroad culvert (see Figure 1-2); this portion of Gee Creek, and large portions of the Carty Unit, function as a backwater of the Columbia River during the 100-year flood. The 100-year floodplain elevation of Carty Lake is, therefore, approximately 23.8 feet.

The topography of the LRIS has been modified over the years by fill placement. As part of the RI/FS, aerial photographs taken between 1929 and 2004 were reviewed to determine the fill history of the LRIS. Fill was most recently placed between 1966 and 1972. It appears that the treated-wood bulkhead between LRIS and Carty Lake was constructed concurrently with this fill.

As part of an upland interim action in 2012, Cells 1 and 2 of the LRIS were regraded and capped with a minimum 2 feet of clean soil. Portions of the Cells 2 and 4 hard trail were paved during this interim action.

2.1.2 Bathymetry

A bathymetric and topographic survey of Carty Lake was conducted by Minister-Glaeser in 2013 to inform the remedy design. These contours are provided on Drawing C1.1.

2.2 Stormwater

Stormwater from the Carty Unit drains to Carty Lake. As there is no perennial outlet from Carty Lake, stormwater either infiltrates into the sediment or evaporates. The proposed work will not result in additional stormwater flow either onto the Carty Unit or into Carty Lake.

Stormwater from the LRIS either infiltrates into the ground or discharges to Lake River through five private outfalls and by direct sheet flow. The stormwater system is shown on Figure 2-1. The outfalls are owned by the Port and serve primarily unpaved, soil-capped areas of the LRIS. The Port office building and paved parking area, as well as Division Street and the paved hard trails, are also served by the outfalls. The LRIS has been graded so that stormwater does not discharge directly to Carty Lake.

2.3 Existing Structures and Debris

Existing structures and debris are shown on Drawing C1.1. Aside from the existing treated-wood bulkhead and monitoring wells, there are no structures in the work area. Piles and portions of the existing treated-wood bulkhead that protrude above current topography will be cut down as close to the existing grade as possible (see Drawing C5.0). This will reduce the volume of bulkhead structure left in the embankment and will result in the remaining components of the bulkhead being below the final finished grade. Treated wood is excluded from Dangerous Waste regulations under WAC 173-303-071; therefore, it is eligible for disposal at a municipal solid waste landfill in accordance with WAC 173-351. Treated wood encountered during construction will be disposed of appropriately.

There are existing utilities (wastewater treatment plant outfall line, stormwater lines) on the Port's property that are to be preserved through construction. Nine trees will be removed as part of the work; these, and other trees which will remain, are noted on Drawing C1.1 and elsewhere. In addition, there are four monitoring wells in or near the project location (see Drawing C1.1). Four wells were previously decommissioned as part of this work; remaining wells will be protected in place and adjusted to post-construction grade if necessary.

2.4 Sediment Chemistry and Toxicity

Table 2-1 summarizes chemistry results for all constituents and highlights those exceeding screening criteria, cleanup levels, and remediation levels. Discrete surface and subsurface samples collected throughout the lake during sediment sampling activities in 2010 and 2011 demonstrated that constituents are most elevated in the southern portion of the lake and decrease substantially to the north (see Figures 2-2 and 2-3). REL exceedances occur only in the southern portion of the lake, and this area was therefore identified in the RI/FS (MFA, 2013b) as requiring remedial action. Additional sediment characterization was completed during predesign activities in 2013 to refine the sediment excavation footprint (see Section 3.2). The incremental sampling methodology (ISM) was applied to characterize surface conditions, and discrete samples were collected to further characterize the subsurface (see Figure 2-3), consistent with an Ecology-approved sampling and analysis plan that incorporated input from the USFWS (Mercuri, 2013; MFA, 2013a). See the Carty Lake Predesign Sampling Report (MFA, 2014a) for a description of 2013 predesign environmental field sampling, sample handling and analysis, quality assurance protocols, and laboratory analytical results and interpretation.

Sampling results show that elevated metals (at LRIS-CL-02) and PCP (at LRIS-CL-02 and decision units [DUs] 1 and 2) are collocated with dioxin concentrations above the REL (see Table 2-1 and Figure 2-3). Consequently, the remedial action developed for dioxins is expected to address metals and PCP as well. Dioxins are most elevated in surface sediments and the vertical extent of dioxin impacts is limited, with the deepest samples exceeding RELs occurring at 1 to 2 feet below mudline (bml) in the southern portion of the lake (see Figure 2-4). The spatial distribution of impacts is consistent with the conceptual model that shows that the source of impacts is historical discharge and/or surface soil erosion from the upland LRIS (MFA, 2013b).

2.5 Sediment Physical Parameters

During sediment sampling activities, grain size and total organic carbon (TOC) data were collected from surface and some subsurface sediment samples (see Table 2-2). Percent total fines (silt and clay) generally dominated the particle size distribution, ranging from 56 to 93 percent in surface samples, with both an average and median of 75.9 percent. In surface samples, TOC ranged from 1.3 to 5.4 percent. TOC generally decreases with depth (e.g., LRIS-CL-02 at 0.84 percent [2 to 3 feet bml] and LRIS-CL-17 at 0.88 percent [1 to 2 feet bml]).

Geotechnical investigations were conducted in 2013 to further evaluate the physical and mechanical properties in sediments in the southern portion of Carty Lake. These properties influence the sediment excavation and handling processes and inform the ultimate project implementation procedures (PIANC, 2000). Physical properties, including grain size, moisture content, dry density, and Atterberg limits (i.e., liquid and plastic limits), are shown in Table 2-3.

2.6 Carty Lake Setting

Carty Lake features a low-energy, depositional environment. As indicated above, percent fines in Carty Lake are uniformly high, generally over 75 percent fines. Carty Lake's hydraulic exchange with other surface water bodies is limited to unusually high water events. Water fluctuations are generally muted, with increases and decreases occurring gradually because there is no direct connection with other surface water bodies. The ordinary high-water mark (OHWM) in the project area is +12 NGVD. Human access to Carty Lake is limited and boat access is restricted, and thus anthropogenic, high-velocity events are not expected.

During installation of monitoring wells in and near Carty Lake, a confining layer composed of clay that restricts vertical movement of water was identified. Clay was present upland near Carty Lake between approximately 5.6 and 9.0 feet below ground surface, and was most prominent in Carty Lake sediments from the surface to approximately 2.5 feet below ground surface. Based on lithology and head potential, the upper water-bearing zone (UWBZ) does not discharge to Carty Lake, and it is unlikely that Carty Lake significantly discharges to the UWBZ in the lake's southern portion (MFA, 2013b).

2.7 Water-Dependent Site Activities and Expected Vessels

Carty Lake has limited recreational uses (USFWS, 2010), which can include wildlife photography, wildlife observation, environmental education, and fishing. Boating is not allowed. Trails lead to the Gee Creek portion of the Carty Unit for fishing. Carty Lake itself is not currently readily accessible to visitors; the RNWR maintains a mowed seasonal footpath along the north end of the lake, but this path is flooded during high-water periods and is not heavily used. However, the potential exists for the RNWR to work with the Port to develop a loop trail adjacent to Carty Lake for the public to access from the Port property. At the RNWR, fishing is allowed in areas open to the public on the Carty Unit; the Carty Unit receives approximately 260 fishing visits per year, with use distributed among Gee Creek, Duck Lake, Middle Lake, and Carty Lake (USFWS, 2010), suggesting that public-use activities near or in Carty Lake are currently uncommon.

In the future, the USFWS may consider the feasibility of reconnecting Carty Lake either to the Columbia River via Gee Creek or to Lake River through a constructed channel. Of the two options, the Gee Creek connection likely would be more feasible in terms of construction and access for salmonids such as cutthroat trout and coho salmon. The resulting hydrology of the lake could vary considerably, depending on the option selected; however, some changes to the fish, wildlife, and vegetation communities would be expected (USFWS, 2010). Those implementing the reconnection would also need to consider the potential for contaminant migration.

Potential USFWS Carty Lake restoration efforts could promote more robust emergents such as tule, wapato, and cattail. Submergents, such as Eurasian milfoil and reed canary grass, would probably still be prevalent in the seasonally flooded portions of the wetlands; however, mechanical treatments such as disking and mowing would allow the RNWR to improve the coverage of native vegetation. Additional efforts to establish riparian forest and shrub vegetation along Gee Creek and the east side of Carty Lake may be considered. Carty Lake historically contained a large native wapato bed, which is currently confined to small areas of Carty Lake. The Cowlitz Tribe historically incorporated wapato into their diets (USFWS, 2010), and may desire to use Carty Lake for wapato harvest again in the future (MFA, 2013b).

2.8 Biology and Habitat

Carty Lake is a 52-acre, ponded wetland in the RNWR Carty Unit "lowlands." Carty Lake and its adjacent areas provide habitat for a diversity of species; species and habitat are further described below.

2.8.1 Plants

Carty Lake and adjacent land and wetlands in the Carty Unit support a variety of plant species. In permanent nontidal wetlands such as Carty Lake, open water and native submergent vegetation generally cover more than 70 to 75 percent of the wetland basin during peak water elevations, while covering less than 25 percent of native emergent vegetation. Three special-status plant species have been identified as potentially being present in the Carty Unit but not likely to be present in the remedy area: water howellia (*Howellia aquatilus*), Bradshaw's desert parsley (*Lomatium bradshawii*), and Nelson's checker-mallow (*Sidalcea nelsoniana*). Water howellia is often found in shallow water (1 to 2 meters deep) and on the edges of deep ponds that are partially surrounded by deciduous trees. Bradshaw's desert parsley is generally found on seasonally saturated or flooded prairies, adjacent to creeks and small rivers. Bradshaw's desert parsley and Nelson's checker-mallow may have been present historically, and experimental plantings were conducted in 2007 in the RNWR Bachelor Island and River "S" Units (USFWS, 2010).

Permanent wetlands in the RNWR also support stands of persistent emergent vegetation such as cattail and softstem bulrush (MFA, 2003; USFWS, 2010). Oregon white oak woodlands, a state priority-designated habitat, occur directly adjacent to the east and north of Carty Lake. Along the Carty Lake shoreline, nonnative reed canary grass and Himalayan blackberry are abundant (ELS, 2007). Finally, Carty Lake formerly contained a large native wapato bed, which is currently confined to small areas of Carty Lake. Wapato beds are composed of emergent aquatic plants (tubers) in the family *Alismataceae* and are good indicators of suitable red-legged frog breeding habitat, since wapato beds require a similar water depth and hydroperiod (USFWS, 2010).

2.8.2 Shellfish

Because of loss of connection with the Columbia River, Carty Lake is unlikely to be susceptible to invasive shellfish and no longer adequately supports native mussel beds. Crayfish may be present in Carty Lake; however, no native shellfish found in the RNWR are currently listed as special-status species to be considered for conservation and management.

2.8.3 Fish

More than 40 species of fish have been documented in the RNWR and in the waterways that flow in and around it. Fish found in Carty Lake include primarily warm water fish: introduced common carp and largescale sucker. Other fish commonly found in the RNWR where Carty Lake lies include introduced goldfish, longnose dace, brown bullhead, mosquitofish, three-spine stickleback, introduced largemouth bass, introduced black crappie, introduced white crappie, introduced bluegill, and introduced yellow perch. Because Carty Lake does not maintain connectivity with the Columbia River, state listed and federally listed anadromous species are unlikely to use Carty Lake for spawning or rearing habitat (USFWS, 2010). Pacific salmon critical habitat is identified in Gee Creek to the northeast of Carty Lake; coastal cutthroat trout (federally designated as threatened), coho salmon (federally designated as threatened), and Pacific smelt (eulachon) (federally designated as threatened) may occur in Gee Creek, based on surveys conducted in the last ten years (USFWS, 2010). If a Gee Creek connection is constructed in the future, salmonids and eulachon may access Carty Lake.

2.8.4 Reptiles and Amphibians

Carty Lake and the RNWR provide wetland habitat for a variety of reptiles and amphibians. Reptiles and amphibians known to occur in the RNWR include the bullfrog (introduced), western chorus frog, northwestern salamander, long-toed salamander, and western painted turtle. Special-status (species of concern) northern red-legged frog (*Rana aurora*) may occur in Carty Lake (USFWS, 2010).

2.8.5 Birds

Waterfowl representing more than 30 species use the RNWR during winter or as stopover sites during spring and fall migrations. Waterfowl utilize palustrine wetland habitats, such as Carty Lake, on the RNWR. Twelve species of waterfowl are known to breed on the RNWR, and Washington State-designated priority waterfowl habitat occurs in the vicinity of Carty Lake. Wintering species include Canada geese, cackling geese, tundra swan, mallard, American wigeon, gadwall, northern shoveler, northern pintail, and green-winged teal (USFWS, 2010). Special-status sandhill crane may aggregate at Carty Lake (MFA, 2003). The RNWR also attracts significant numbers of diving ducks, such as ring-necked duck, lesser scaup, and bufflehead. Common waterbird species that use RNWR wetlands include coot, pied-billed grebe, double-crested cormorant, great blue heron, great egret, ring-billed gull, California gull, Thayer's gull, and glaucous-winged gull. The riparian and floodplain forests adjacent to Carty Lake host a number of breeding terrestrial species, including commonly seen migrant and resident species such as downy woodpecker, northern flicker, western wood-pewee, Pacific slope flycatcher, tree swallow, common bushtit, Bewick's wren, American robin, Swainson's thrush, cedar waxwing, common yellowthroat, Wilson's warbler, spotted towhee, song sparrow, and black-headed grosbeak. As many as 50 bald eagles have been sighted using riparian trees on or near the RNWR for roosts from December through March, and three pairs are known to nest and breed approximately 1 mile northeast of Carty Lake (MFA, 2013b; USFWS, 2010). Special-status birds that may be present near Carty Lake are summarized in Table 2-4. The RNWR's oak woodlands near Carty Lake provide habitat for oak-associated landbird species that are now rare in western Washington, including the slender-billed white-breasted nuthatch, western scrub jay, and house wren (USFWS, 2010).

2.8.6 Mammals

The special-status Columbian white-tailed deer (*Odocoileus virginianus leucurus*), American beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), mink (*Mustela vison*), and river otter (*Lutra canadensis*) inhabit wetlands such as Carty Lake on the RNWR. Nonnative nutria (*Myocastor coypus*) are commonly observed in Carty Lake. The riparian and floodplain forests surrounding the edges of Carty Lake also provide mammal habitat. The most common large mammal occurring on the RNWR is the mule deer (*Odocoileus hemionus*). Riparian areas provide both forage and cover for this species and other mammals. Omnivores, including coyote (*Canis latrans*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*), are frequently seen on the RNWR. The white oak woodlands adjacent to Carty Lake may provide habitat for special-status western gray squirrel (*Sciurus griseus*), although the presence of this species has not been confirmed (USFWS, 2010).

In December 2012, the USFWS proposed an emergency translocation of rare Columbian white-tailed deer (*Odocoileus virginianus leucurus*) from Julia Butler Hansen Refuge near Cathlamet, Washington, to the RNWR (USFWS, 2012). Columbian white-tailed deer are listed under the federal ESA as an endangered species. Emergency relocation of the deer to the RNWR began in January 2013.

2.8.7 Habitat

Diking and filling, in conjunction with agricultural development, have eliminated most of the natural tidal exchange of water, materials, and organisms between the Columbia River and the adjacent floodplain forests and overflow lakes. Because Carty Lake lacks a consistent connection with the Columbia River system, the lake's functionality has been reduced, particularly with respect to anadromous fish rearing habitat and native mussel beds. As with other permanent, nontidal wetlands on the RNWR, Carty Lake's water quality and aquatic plants have been negatively impacted by introduced carp.

The southern end of Carty Lake is a shallow, open water body with a fringe of emergent wetland. Aquatic plants, including wapato (*Sagittaria latifolia*), occur in the lake, and the fringe wetland is dominated by nonnative, invasive reed canary grass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus armeniacus*). The National Wetlands Inventory classifies much of Carty Lake as a lacustrine, limnetic, unconsolidated bottom, permanently tidal. The southern portion of the lake is classified as palustrine, emergent and persistent; the western side is subdesignated as temporarily or seasonally flooded; and the eastern side is subdesignated as temporary-tidal (see Appendix B).

A wetlands delineation and rating for the southern end of Carty Lake in the project area was conducted in summer 2013 (see Appendix B). Based on the Wetland Rating Form for Western Washington, the lake-fringe wetland was classified as a Category II wetland. The water quality functions had a high score of 24, with the vegetation exceeding 33 feet in width and herbaceous plants covering more than 90 percent of the area. The hydrologic functions scored low, receiving 4 out of the possible 12 for lake-fringe. The wetland scored 25 out of 48 in habitat functions, based on the high species diversity and complex habitat structure. Note that the standard wetland rating system is limited in its application to this site because it does not account for contamination impacts (discussed in Section 2.4).

2.8.8 Mitigation Status

The Carty Lake remedial action is proposed to prevent toxic chemicals from impacting human health, water quality, and fish and wildlife. However, since the remediation requires work in Carty Lake and surrounding wetlands, there will be encroachments into regulated wetlands. Work that will be conducted within the wetland boundary is designed to enhance functions and values relative to existing conditions. Carty Lake and the fringe wetland will be enhanced by the following measures:

- Sediment remediation. The remedial action will remove contaminated sediments from Carty Lake, enhancing benthic habitat quality and water quality.
- Invasive species control. Upon completion of the project, at the request of USFWS, Carty Lake in the remediation area will be at least 6 inches deeper as a measure to inhibit the growth of reed canary grass. This greater depth also increases the volume of water in the lake available for fish habitat.
- Bank enhancement. The proposed bank stabilization elements include replacing an existing wall condition (an abrupt, approximately 15-foot change in grade from the higher-elevation Miller's Landing to the lower-elevation wetlands of the Carty Unit) with more gradual slopes planted with a diverse palette of native plants. This will increase both the area and the quality of transition habitat between the wetland and the surrounding uplands.

The ratio of impacted area relative to the area that will be enhanced, as described above, meets the mitigation ratio of 6:1 specified for rehabilitation activities conducted in Category II wetlands (Table 1a in Ecology, COE, and U.S. Environmental Protection Agency [USEPA], 2006). Rehabilitation is defined as the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural or historical functions [and processes] of a degraded wetland, resulting in a gain in wetland function but not in wetland acres. Excavation activities in Carty Lake are considered rehabilitation, as they involve improving or repairing the performance of processes and functions in an existing, highly degraded wetland, and sediment removal is considered an effective action to address contaminated wetlands (Table H-2 in Ecology, COE, and USEPA, 2006). Native plantings and deepening of the wetland will further enhance wetland functions. Note that restoration (which includes rehabilitation) is generally the most preferred type of wetland compensation and that emphasis is placed on minimizing invasive species (Ecology, COE, and USEPA, 2006).

The COE Section 404 permitting for the remedial action is underway and the COE mitigation evaluation operates under a different framework. The COE has determined that two types of impacts to the wetland will result from the remedial action:

- Short-term, temporary impacts to 1.2 acres[2] of wetland will result from sediment excavation. Sediment removal will result in short-term, temporary construction impacts to benthic populations and vegetation.
- Permanent impacts to up to 0.23 acre[3] of wetland will result from the construction of bank stabilization and remediation elements.

Mitigation sequencing has been incorporated throughout the project's design process, which has been overseen by Ecology. Short-term, temporary impacts will be mitigated by 1.2[4] acres of revegetation and maintenance in the excavation area. In addition, areas surrounding the mitigation area will be revegetated and maintained for five years. The Carty Lake mitigation plan was developed in consultation with the USFWS and COE and addresses mitigation objectives (see Appendix C). The landscape plan is further described in Section 4.5.

Permanent impacts will be mitigated by the purchase of mitigation credits. The bank use plan describing off-site mitigation to compensate for wetland filling is provided as Appendix D.

3 REMEDIAL ACTION

Consistent with the CAP, sediments with dioxin congeners above RELs (based on concentrations protective of ecological receptors) will be removed by implementation of a variable-depth sediment excavation process with immediate (post sediment excavation) placement of a clean sand residuals cap. The remedial action incorporates both water-based and land-based components and has been developed to implement the intended remedial objectives.

3.1 Access Improvements and Staging Area

A permanent gravel access ramp will be constructed from the existing Cell 2 hard trail to the Carty Unit. This ramp, intended to provide access to the Carty Unit for RNWR staff and equipment, has

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[2] The area of temporary impacts is approximate and does not include areas that will be excavated and permanently covered by bank stabilization elements. These permanent impacts will be addressed by mitigation banking.

[3] The acreage includes contingency as described in the JARPA. Permanent impacts may therefore be less.

[4] The area of mitigation planting will be equivalent to the final temporary impact area.

been discussed with the USFWS and is shown in detail on Drawings C6.3.0 and C6.3.1. A temporary haul road and staging area will also be constructed in the Carty Unit as shown on Drawing C2.0.1.

A portion of the existing clean soil cap on the LRIS uplands will be removed and placed in a covered stockpile to allow for construction of the upland staging and sediment-handling area. The excavation and clean soil stockpile are shown on Drawing C3.2. The existing demarcation fabric below the clean soil will be cut away and disposed of. The existing contaminated subgrade will be regraded, and filter fabric and an 8-inch-thick operational layer of crushed rock will be placed on the contaminated subgrade. Construction BMPs, such as stabilized construction entrances and silt fence, will be installed in the upland staging and sediment-handling area as shown on Drawing C2.0.2 and more completely detailed in the Stormwater Pollution Prevention Plan (SWPPP) (MFA 2014b). The contractor will be responsible for maintenance of the stockpile cover.

This upland staging and sediment-handling area will also be used for the subsequent Lake River Sediment Remedy project. At the end of that project, demarcation fabric will be placed on the operational layer and the clean soil cap will be restored and seeded.

3.2 Sediment Excavation

Sediment in the excavation area will be removed to elevations between 1 and 2 feet (approximate, neatline) below the existing sediment surface elevation (mudline) (see Drawing C5.1). The target excavation elevations were developed based on the vertical extent of contamination, as determined by the RI and 2013 predesign sampling results (MFA, 2014a), in addition to allowances for overexcavation and construction logistics. Removing contamination at the selected depths is expected to result in the removal of the most significant mass of dioxins present in Carty Lake. Sample depths that are measured from the mudline have been translated to NGVD elevations to establish the elevation of contamination and for development of the sediment excavation prism. The excavation prism represents approximately 1.3 acres of surface area and a neatline volume of approximately 3,700 cubic yards. Based on the previous analyses, significant undisturbed residuals above RELs are not anticipated below the sediment excavation target. Note that overexcavation volume (i.e., the amount of material that is removed beyond the target neatline surface because of the imprecision of the excavation method and equipment) is not accounted for in the estimates above. The contractor will be limited to 0.25 foot over-excavation. The anticipated maximum excavation volume, including overexcavation, is 4,200 cubic yards.

3.2.1 Sediment Excavation Prism Delineation

REL exceedances occur in the southern portion of Carty Lake, and this area was identified as requiring remedial action (see Section 2.4). The required remedy identified in the CAP targets sediment exceeding RELs (based on concentrations protective of ecological receptors) for removal and subsequent placement of clean sand (MFA, 2013b). See Figure 2-4 for REL exceedances in surface and subsurface sediment.

Excavation areas are shown in Drawing C5.1 and were developed based on sampling results exceeding RELs and the following:

- RI sampling identified the extreme southern portion of Carty Lake as requiring remedial action (see Section 2.4). To generate remedy extents for this area surface and subsurface, sediment data at LRIS-CL-01, -02, and -04 were considered. Elevated concentrations were observed in surface sediment and at 1 to 2 feet bml at LRIS CL-02. Impacts were observed in surface sediment but not in subsurface sediment at LRIS-CL-01 and -04. However, these samples were located in more elevated nearshore areas of Carty Lake that may be less susceptible to contaminant deposition. As a conservative measure and to accommodate a USFWS request to create a leave surface at least 6 inches lower than the pre-excavation conditions, a neatline excavation depth of 2 feet has been selected for this area.

- DUs 1 and 2 are identified as requiring remedial action, based on elevated ISM surface concentrations and elevated subsurface concentrations at 1 to 2 feet bml (LRIS-CL-16 in DU 1 and LRIS-CL-18 in DU 2). Other discrete 1- to 2-foot-bml subsurface samples in these DUs (LRIS-CL-17 and LRIS-CL-19) did not exceed RELs. Sediment concentrations are below RELs at 2 to 3 feet bml at LRIS-CL-16. A 2- to 3-foot-bml sample is unavailable for LRIS-CL-18;[5] however, concentrations in this interval are expected to be below RELs, based on the following: sediment concentrations are below RELs at 2 to 3 feet bml at LRIS-CL-16, which is closer to the source area than LRIS-CL-18; LRIS-CL-18 is less impacted than LRIS-CL-16 at shallower intervals; and the 2- to 3-foot interval in the lake is composed of dense clays that are low in concentrations as measured at LRIS-CL-02. A neatline excavation depth of 2 feet is selected for this area as a conservative measure and to accommodate a USFWS request to create a leave surface at least 6 inches lower than the pre-excavation conditions.

- DU 4 is identified as requiring remedial action, based on elevated ISM surface concentrations. Discrete 1- to 2-foot-bml subsurface samples in this DU did not exceed RELs; however, a neatline excavation depth of 1.5 feet is selected for this area as a conservative measure and to accommodate a USFWS request to create a leave surface 6 inches lower than the pre-excavation conditions.

- No action was selected for DUs 3 and 5, based on surface concentrations below RELs. These DUs are located in elevated "island" portions of the lake, indicating that contaminant deposition occurred primarily in low-lying areas (e.g., DUs 1 and 2).

3.2.2 Sediment Excavation Method

Sediment excavation is generally defined as removal of sediments that have been partially dewatered in place (USEPA, 2013). Where feasible, the option for excavating contaminated sediment by removing the overlying water can be advantageous and preferable to working in submerged conditions. When sediment excavation techniques are used, sediment is more accessible and is easier to handle, and surface water impacts resulting from construction are limited. This method includes the isolation of the contaminated sediment from the water body before removal; contaminated sediment is then excavated in "dry," not submerged, conditions. The isolation is achieved by adding

[5] Attempts to collect a sample at this depth with a hand-coring device met with refusal because of the dense clay at this elevation.

a hydraulic barrier, such as a sandbag wall, between the main portion of the water body and the area designated for excavation. The work area is subsequently pumped free of most of the water. Isolation and continued pumping are then followed by excavation using land-based equipment such as a track-mounted excavator.

The Carty Lake sediment removal area lends itself to sediment excavation because isolation and dewatering can be conducted with relative ease during the dry season. To isolate the sediment excavation area, a temporary sandbag wall will be placed at the northern end of the excavation area, as shown on Drawing C2.0.1. The exact configuration of the sandbag wall will be informed by the water level at the time of construction. The sandbags will be placed such that hydraulic isolation is substantively achieved. If necessary, a temporary sump will be installed near the sandbag wall to allow for initial dewatering of the sediment excavation area. Water removed from the sediment excavation area will be treated, if necessary, before it is discharged to Carty Lake (see Section 5 for water quality turbidity and treatment requirements). A temporary access route will be required to allow for installation of the sandbag wall and temporary sump; all road surfacing will be removed when the sandbag wall and temporary sump are removed.

Carty Lake excavation will be achieved by the deployment of track-mounted excavators with standard open top buckets from the wetland; given the size of the area to be remedied, it will not be possible to conduct the work from the nearby uplands. Carty Lake surface sediment is known to be composed of soft, silty material and, therefore, the dewatered sediment surface may not have adequate material strength to support the weight of the construction equipment. Excavator track pads, mud mats, or plates likely will be used to distribute the weight of the equipment over the soft sediment when operating in the wetland during construction. The soft sediment will also affect the precision of the removal depths. This condition will require that sediment be removed in a methodical, careful manner that will lower the risk of generating residual contaminated material, or mixing contaminated material with clean substrate. Tracking equipment over excavation areas will be held to the minimum necessary to perform sediment-removal work. Tracking equipment from contaminated sediment (sediment that has not been removed to the neatline elevation) onto finished neatline excavation grade will be prohibited. Sediment excavation and on-site management will be performed in a hygienic manner. On-site haul trucks will be prohibited from spilling or tracking excavated sediment outside the remedy area, or onto areas of the site that have been excavated to a clean condition.

The contractor will submit a survey of the post-excavation grades to the engineer for approval. Engineer approval of the final excavation grades will be required prior to placement of the clean sand layer and embankment fill placement.

3.2.3 Sediment Dewatering

A sediment-handling/dewatering area will be constructed upland on the LRIS to allow for additional moisture conditioning of the material, if required, prior to transport to the landfill. If additional moisture conditioning is required prior to transport to the landfill, excavated sediment will be transported by truck from the remediation area and placed in the sediment-handling/dewatering area. See Section 5 for BMPs and the SWPPP (MFA, 2014b) associated with the transfer of sediments and dewatering. The elimination of free water is desirable, both because it is a regulatory requirement for landfilling solid waste and because the added mass can represent a significant increase to the cost for disposing of sediment. Unless a landfill facility has a waiver, the excavated sediment will have to pass the Paint Filter Liquids Test before transport and disposal at the landfill. In this case, the contractor may mix lime kiln dust into the sediment in the handling/dewatering area to reduce free liquid prior to transport.

Free liquid that drains from sediment in the dewatering area and does not infiltrate will be collected and treated before discharge to a surface water body as described in Section 5.

3.2.4 Sediment Transport and Disposal

If possible, sediment will be loaded onto trucks adjacent to the remedy area for overland transport directly to a disposal facility. Excavated sediment will be staged at the base of the existing wooden bulkhead. An excavator, operating above the wooden bulkhead, will load sediment from the staged pile in the remedy area directly into trucks. The truck loading area will consist of steel plates underlain by a plastic liner. Trucks will be inspected for loose or spilled sediment; trucks will be cleaned of any sediment prior to leaving the loading area. If sediment is noted on the truck tires, the truck will be immediately directed to the above-ground, closed-loop wheel wash; otherwise, the truck will enter the Cell 2 access road via a stabilized construction entrance. Trucks will be lined to prevent water from dripping during transport.

If sediment requires moisture conditioning/amendment prior to disposal, sediment will be loaded into trucks as described above. However, trucks will proceed to the upland staging and sediment handling area. Trucks will dump sediment within a delineated area in the upland staging and sediment handling for conditioning/amendment.

Following amendment, sediment will be loaded onto trucks by the means described above.

This operation will result in significant truck traffic through the town of Ridgefield to I-5; however, impacts to the community will be minimized, as truck traffic will follow established truck routes. As the sediment is not considered hazardous waste, it may be landfilled in any of several subtitle D landfills in the area.

The contractor will use appropriate controls to prevent spillage or loss of sediment during transport, including, at a minimum, using liners in the truck beds as well as covering the loads, which will be verified prior to leaving the site. The contractor has developed a transportation plan identifying haul routes and defining the response plan to ensure that spills will be cleaned up promptly.

3.3 Fill Placement

3.3.1 Clean Sand Layer

To minimize the possibility of mobilizing any generated residuals and to stabilize the disturbed sediment surface when work is complete 2,100 cubic yards of sand will be placed to achieve an approximately 1-foot-thick layer over the excavated surface. Sand will be placed such that the final elevation is approximately 6 inches to 1 foot lower than the initial elevation. The sand cover areas are coincident with sediment removal areas except where the removal area is within the footprint of the embankments, as shown on Drawing C4.0.

3.3.1.1 Placement Method

As this project will be completed in the dry, the 1-foot-thick sand layer will be verified through line and grade approaches using appropriate contractor-developed methods for placement. These may include the use of grade stakes and/or earthwork equipment with real-time kinematics global positioning system capabilities.

Prior to planting, the contractor will submit a survey of the final sand grades, and the engineer will verify the sand thickness and final elevations for consistency with the design grades.

3.3.2 Bulkhead Reinforcement Embankment

A portion of the Port property is separated from the southern portion of Carty Lake by a treated wooden soldier pile and lagging bulkhead. This bulkhead, shown in plan view on Drawing C1.1 and Figure 1-3, is approximately 1,800 feet long and between 7 and 10 feet tall. Portions of this bulkhead have begun to fail, causing some erosion into the RNWR. Failure of the wall could result in release of contamination into Carty Lake.

To stabilize the bank, the remedial construction includes a permanent transition from the grades on the Port property to the RNWR in the form of constructed earthen embankments against the existing southern and eastern walls of the bulkhead. The embankments will functionally replace the existing bulkhead. For construction feasibility, much of the bulkhead structure will remain buried in place.

The embankments will be placed on both RNWR and Port property. They will generally consist of common borrow or structural fill and topsoil fill. The foundation of the embankments will be keyed into the existing grade and placed on filter fabric geotextile to provide strength to the underlying soft sediment and soil that remain following sediment excavation activities. The embankments will be constructed so that the interior will consist of common or structural fill with an outer layer of topsoil approximately 18 inches thick. The topsoil will be seeded and planted with native transitional and upland plants (see Section 4.5). Turf reinforcement mat will be placed on the topsoil to protect against erosion during high-water events, as well as against erosion from stormwater. Turf reinforcement mat will be anchored at the top and bottom of the slope as shown on Drawing C4.1.

During early, informal consultation, the RNWR requested that existing wetlands be preserved as much as practicable. To eliminate the impact of the eastern embankment on the wetland, the eastern embankment will be constructed at a minimum 2.5 H:1V slope from the upper LRIS site down to the RNWR, outside the wetland boundary (see Drawing C4.1 for a typical section through the embankment). For the southern embankment area, a retaining wall structure (to replace the southern wall) was evaluated with RNWR staff in an effort to minimize impact to the wetland; however, the structure was considered impractical because of significant challenges in managing contaminated soil that is contained behind the existing soldier pile wall, as well as because of cost. To minimize the embankment footprint in the area, this portion of the embankment will be constructed at a nominal 2H:1V slope. The section will consist of a structural fill core capable of maintaining stability at that slope, which will be covered with an 18-inch-thick layer of topsoil. The topsoil will be planted with native vegetation (see Section 4.5), as mentioned above. The toe of the slope will be protected from erosion through the addition of a fish mix layer (see Drawing C4.1 for a typical section through the embankment).

The embankments will be vegetated with native plants, which will serve several functions. The embankment vegetation will be composed of both riparian and wetland native plant communities—wetland communities will be planted along the bottom of the embankments, while riparian communities will make up the upper vegetation (see Drawings L1.1 and L1.2 for further detail). The vegetation will provide erosion resistance in the long term by reducing impact energy from raindrops, further slowing the flow of surface water, and retaining soil within the root structure. Once plantings are established, the significant root mass will increase the overall slope stability.

3.3.3 Fill Import and Verification

Samples of sand and other fill materials that contain fines will be provided to the engineer by the contractor for chemical analyses prior to material acceptance and placement. These fill sources will be screened for chemical criteria consistent with Table 3-1 to determine acceptability.

3.4 Cell 2 Hard Trail Paving

A section of the Cell 2 hard trail, a 15-foot-wide asphalt multi-use trail originally intended to be paved during the Cells 1 and 2 interim action work, was left unpaved. As the Carty Lake remediation will require extensive work in this area, this paving was postponed until the conclusion of the Carty Lake remediation. The trail design is shown on Drawings C6.3.0 and C6.3.2.

3.5 Construction BMPs

BMPs associated with working in and near a wetland will be implemented to excavate sediment in a manner that minimizes contaminant release/resuspension, formation of residuals, and the potential for off-site release of contaminants. As mentioned above, excavation of sediment will be completed in an isolated and dewatered condition, using land-based, fixed-arm equipment (excavator). Because of the proximity of the main body of Carty Lake, debris booms and supporting vessels will be required to be on hand and deployed if and when needed.

The sediment-handling and dewatering area will be constructed and managed consistent with all erosion-control practices to prevent erosion from rain, wind, or other natural events.

Transloading of sediments will be performed in a hygienic manner as described in Section 3.2.4.

All equipment will be fueled upland, or where fueling near the wetland is necessary, within a containment vessel. Fueling will be performed in a manner that will not result in a release to the water body.

3.6 Demobilization and Site Restoration

Prior to demobilizing from the site, all equipment will be thoroughly cleaned within the upland staging and sediment handling area. Soil and sediment removed from equipment will be disposed of at the permitted landfill used for sediment disposal. Water generated from equipment cleaning will be allowed to infiltrate within the upland staging and sediment handling area.

Upon approval by the engineer, BMPs; temporary access and haul roads; the temporary equipment staging area; and the temporary isolation barrier will be removed and disposed of by the contractor. When these items have been removed, the disturbed footprints will be seeded with a native grass mix as shown on Drawings L1.1 and L1.2. The access ramp in between the LRIS and Carty Lake lowlands will remain in place for future use by USFWS.

The upland staging and sediment handling area will be left open to facilitate contractor staging and potential onsite upland transload of sediments and water treatment facilities during the Lake River Sediment Remedy Project. Following the completion of that project, demarcation fabric will be placed on the operational surface and the clean soil cap will be restored and seeded. The contractor selected for the Lake River remedy will be responsible for ongoing maintenance of the stockpiled soils until ready to be placed back upon the staging area.

3.7 Engineering and Institutional Controls

A long-term institutional control will be implemented to limit consumption of fish from Carty Lake. Additional long-term institutional controls will not be required; however, an updated characterization of sediment conditions may be needed before initiation of any future activities that may result in significant sediment disturbance, such as in-water construction or dredging.

3.8 Compliance Monitoring

Confirmation sampling will not be conducted upon completion of project activities. The planned post-remedy surface was well characterized before the project design was finalized, and the excavation prism was conservatively designed to remove contaminants (see Section 4.3).

Long-term monitoring will be conducted in order to assess the effectiveness of the remedy. Monitoring for dioxins in the excavation area will be conducted five years after remedy completion. Specifics of the sampling and monitoring will be developed as part of the monitoring plan. Sampling will be conducted in a way that ensures that results are reproducible, to the extent practicable, and that results are representative.

Additional post-remedial sampling could be conducted in consideration of eliminating institutional controls on fishing in the lake, and to evaluate concentration trends. The need for subsequent sampling events will be determined in coordination with Ecology if, after review of year five sampling, there are indications that concentrations have increased.

4 REMEDIAL DESIGN CONSIDERATIONS

4.1 Surveying and Base Map Development

In April 2013, Minister-Glaeser completed a combined topographic survey and bathymetric mapping to construct a master base map of the site. The map includes topography and bathymetry for the areas immediately surrounding the site and is referenced to the NGVD.

The master base map is being used in both Geographic Information Systems and AutoCAD Civil 3D software formats as a basis for all design work. Drawing C1.0, and others, shows the existing topography and bathymetry from the master base map.

4.2 Ordinary High Water

The OHWM of the Carty Lake shoreline was defined during the critical areas delineation (Appendix B) and generally follows the 12-foot elevation contour. The project site was evaluated by Ecological Land Services for the presence and extent of wetlands and the location of the OHWM by observations of topography, changes in vegetation, and evidence of surface and/or subsurface hydrology.

4.3 Sediment Remedy Design

The remedy described in this design report targets sediment exceeding RELs for sediment excavation and provides a clean sand layer. Sediment chemistry was taken into account in the development of the sediment remedy area, shown in plan view on Drawing C4.0.

4.3.1 Post-Remedy Sediment Conditions

Post-excavation (prior to clean sand placement) and post-remedy (after clean sand placement and expected mixing over time) surface concentrations for dioxins were estimated, based on the selected remedial action. The following procedure was followed to estimate remaining surface concentrations:

<u>Post-excavation surface:</u>

- The leave surface was assigned the concentration of the leave interval (the 2- to 3-foot interval for areas designated for a 2-foot excavation depth, or the 1-2' interval for areas designated for a 1.5-foot excavation depth). This method was applied to sample locations CL-02, -16, -22, and 23.

- If the leave interval was unavailable, the leave surface was assigned the concentration of the deepest interval to be removed (e.g., the 1- to 2-foot interval for areas designated for a 2-foot excavation depth). This conservative assumption was applied to locations LRIS-CL-01, -03, -04, -17, -18, and -19. The assigned leave surface concentrations represent the estimated post-excavation concentrations (see Figure 4-1).

Post-remedy surface:

- The projected top 1 foot of the leave surface was assumed to mix fully with the clean sand layer over time; this evaluation is conservative, as full mixing of the sand layer[6] with the leave surface is not expected and concentrations at the point of compliance (0 to 10 centimeters) are therefore likely to remain lower (MFA, 2013b) (see Figure 4-2).

Figures 4-1 and 4-2 show estimated post-excavation and post-remedy surface concentrations as dioxin TEQ and 2,3,4,7,8- pentachlorodibenzofuran (PeCDF), as this congener was the only detected congener that frequently exceeded the REL of 6.5 ng/kg in impacted sediments and was identified as the primary ecological risk driver. All estimated post-excavation and post-remedy concentrations are below RELs, with the exception of 2,3,4,7,8-PeCDF in sample location LRIS-CL-18. This location is not expected to result in unacceptable risk for the following reasons:

- The predicted post-remedy concentration is highly conservative, as the 1-foot-thick sand layer provides a clean surface and is unlikely to be subject to disturbance or bioturbation that would result in significant mixing with sediments below.
- The estimated concentration is based on an interval (1 to 2 feet bml) that will be removed. Assuming the same percent decrease in concentration as observed between its DU surface concentration (47.9 ng/kg) and the 1- to 2-foot-bml interval (15.2 ng/kg), the leave surface is estimated to be 4.82 ng/kg (i.e., below the REL) prior to placement of the clean sand layer.
- Other samples where the 2- to 3-foot interval was obtained (LRIS-CL-02 and LRIS-CL-16) showed significant decreases at the 2- to 3-foot interval compared to the 1- to 2-foot interval.
- Fish and wildlife are not expected to be exposed to discrete areas for extended periods; the average concentration of all leave surface estimates is more representative of typical exposure potential and is well below the REL.

Post-remedy dioxin TEQ concentrations above the CUL of 5 ng/kg will remain in the remedy area; however, concentrations are substantially reduced and are consistent with concentrations observed in other portions of the lake. Metals and PCP are not identified IHSs, based on colocation with dioxins, and will be removed to levels below screening criteria identified in the RI/FS (MFA, 2013b).

[6] In estimating post-remedy concentration of dioxin TEQ, the sand layer is assumed to contain 0.365 dioxin TEQ, based on an evaluation of clean Columbia River sand (MFA, 2013b). Based on analytical results for the same clean sand, 0.156 ng/kg 2,3,4,7,8-PeCDF is assumed for the 2,3,4,7,8-PeCDF mixing evaluation.

4.4 Bulkhead Reinforcement Embankment Design

The embankments are designed to permanently stabilize the soils behind the bulkhead, resist erosion from stormwater and wave action (where applicable), and provide transitional and upland habitat. The embankments replace steep, unstable slopes with moderate, stable, protected slopes.

The design of the embankment follows the geotechnical recommendations that were developed by GeoDesign, Inc. (GeoDesign) (GeoDesign, 2014 and Appendix E). The stability analysis of the proposed embankments showed that the final configuration is stable.

The embankments will include a toe-of-fill keyway composed of granular structural fill to restrain slope thrust and provide slope stability; keyway dimensions are shown on Drawing C4.1. The embankment fill will be placed on a filter fabric geotextile. As described in Section 35 42 00 Fill, the embankment fill will be placed in layers with a maximum uncompacted thickness of 12 inches. The embankment fill will be compacted to at least 95 percent of the maximum dry density as determined by American Association of State Highway and Transportation Officials (AASHTO) T-180.

The surface of the embankments will be covered by an 18-inch-thick topsoil overlay and turf reinforcement mat to accommodate vegetation (see Drawing C4.1). This topsoil overlay will be lightly compacted to allow for plant growth while maintaining soil cohesion.

4.4.1 Embankment Protection Design

The following section presents MFA's design for protection of the bulkhead reinforcement embankments. Both embankments will be subject to erosive forces from stormwater falling on and adjacent to the embankments and from occasional high-water events. Erosion protection for the final embankment slopes will be provided by a turf reinforcement mat and the establishment of a thick, vegetated ground cover by use of a seed mix that has been demonstrated to be effective at the site.

The lower portion of the southern embankment will be also be subject to erosive forces from wind-driven waves in Carty Lake at water levels at or below the OHWM. As motorized boating is not currently allowed or planned for Carty Lake, erosive forces from vessel-generated waves and propeller wash were not considered.

4.4.1.1 Wind-Driven Waves

Carty Lake is a relatively narrow body of water oriented generally north-northwest to south-southeast. By inspection, the longest fetch in Carty Lake is coincident with the longest fetch that would result in waves impacting the southern embankment; this length is approximately 3,000 feet.

MFA used the methodology presented in the Coastal Engineering Manual (COE, 2002), to estimate the significant wind-driven wave height for fetch-limited waves expected at the LRIS. Using the worst-case scenario of the fastest mile wind speed acting over the longest available fetch, the predicted significant wave height is 2.56 feet. However, the water depth in the portion of the remedy area that connects to the main body of Carty Lake is only 2.66 feet (at OHWM level of 12 feet

NGVD). As the predicted significant wave height is greater than one half of the water depth, the significant wave height for the southern embankment is limited to approximately 1.33 feet.

4.4.1.2 Embankment Protection Rounded Rock Sizing

MFA used the Hudson equation for rock, two-layer armored non-overtopped slopes (COE, 2002) to determine the size of fish mix rounded rock required to withstand the design wave of 1.33 feet. At the proposed fish mix rock slope of 3H:1V, and assuming a K_D of 1.2 (for smooth, rounded rocks), the required median rock mass is 29 pounds—equivalent particle size (D_{50}) of approximately 7 inches. The proposed minimum fish mix rock layer thickness is 2 feet, which will ensure ample protection of the lower portion of the embankment. The fish mix will have a D_{100} of 10 inches and a D10 of 1 inch, and will be free of fines.

4.4.2 Slope Settlement Evaluation Design

The addition of embankment fill at thicknesses of up to 10 feet significantly increases mass over the underlying soils and sediments, potentially inducing consolidation and settlement of the newly constructed embankments. GeoDesign also evaluated the settlement potential for the bank fill to ensure that unacceptable conditions would not develop after the placement of the fill. The settlement analysis was based on limited information available in soil borings and well logs and is, therefore, considered preliminary. The analysis indicates that the maximum settlement potential is on the order of 12 to 30 inches at the thickest fill areas (10 feet). This condition will not result in unacceptable differential settlement and will not contribute to an unstable condition in the embankments. It is also anticipated that most of the settlement will occur shortly after the fill is placed; the bid quantity for embankment structural fill will include a contingency for placement of additional material to meet the design line and grades after this primary settlement. This additional volume was anticipated in the JARPA permit volumes. The topsoil overlay and fish mix rock will not be placed until after this initial settlement and any subsequent placement of embankment structural fill.

4.5 Landscaping Plan

Planting and revegetation are vital components of the design for enhancing erosion resistance of the remedy, enhancing and restoring a landscape, and providing a simple and effective way to replenish wildlife habitat. The planting plan has been designed to provide structural habitat, protect scenic views, and meet mitigation objectives (see Section 2.8.8). The plan was developed in consultation with the USFWS and COE. See Drawings L1.0 through L1.3 for an overview of planting areas and species selection. Upon installation some species selection may change based on availability and required quantities. Any alternative plant species selected will be native and appropriate for their environment and location. The monitoring and maintenance plan is provided in Appendix C. The plan was previously provided to the COE and USFWS in support of the remedial action permitting process and has been accepted by those agencies.

The plants specified in the Drawings (L1.0 through L1.3) are intended to provide diversity and will provide cover and habitat in both the short and long terms. Plant selection is based on the plants' location (relationship to the water's elevation) and their tolerance for wet and dry conditions. Culturally significant native plants (i.e., wapato) will be included throughout the wetland work area. The proposed plant list includes a diverse mix of native shrubs, along with variety of native grasses, sedges, rushes, aquatic plants, and groundcovers. Native submerged planting groups will be located in deeper areas of the excavation area, while native emergent plants will be rooted in shallower areas. The scrub-shrub wetland fringe includes a mix of water-tolerant grasses, sedges, rushes, and shrubs. The upland bank areas are to be planted with native, drought-tolerant shrubs and groundcover.

4.6 Construction Methods

The Carty Lake sediment remediation design relies on various construction methods for successful work above and below the OHWM to reduce impacts to the wetlands. These methods are to be implemented in order to prevent overconsolidation of wetland soil and sediment and to prevent the spread and mixing of contaminated sediment during excavation operations. Construction methods include, but will not be limited to the following:

- Use of mats when operating outside the staging area, inside the wetland boundary.
- Use of light ground pressure equipment for sand and topsoil placement and grading.
- Avoiding tracking equipment over areas that have already been excavated.
- Prohibiting the tracking of equipment from contaminated sediment (sediment that has not been removed to the neatline elevation) onto finished neatline excavation grade.
- Avoiding spilling while loading haul trucks and immediately cleaning up any spills that occur.
- Use of lined trucks to transport sediment.

Work below the OHWM relies on the installation of an isolation barrier and dewatering of the work area to complete the work in as dry a condition as possible. Because this work will be completed in an isolated, dewatered condition, turbidity impacts from sediment excavation will not reach the main body of Carty Lake.

4.7 Construction Schedule

Table 4-1 presents the anticipated schedule for construction activities associated with the Carty Lake sediment remediation.

5 WATER QUALITY PLAN

The following information describes the water quality plan for the Carty Lake Remedial Action. The plan has been developed to satisfy the substantive water quality requirements of Clean Water Act Section 401 and the Construction Stormwater Permit. This plan summarizes the proposed remedial activities (e.g., project scope), identifies the selected BMPs, describes BMP implementation, and describes water quality monitoring to be conducted during construction to verify that BMPs are successful.

The contractor has provided several work plans prior to beginning work, detailing implementation of contract and construction techniques. These plans were reviewed for compatibility with requirements of Section 401 and construction stormwater permit water quality protection.

5.1 Construction Scope

The scope of work for this project includes:

- Construction of the RNWR access ramp and staging area
- Construction of the upland (LRIS) dewatering and staging area
- Construction/removal of a temporary (sandbag) barrier
- Dewatering of lake water behind the dam
- Excavation of sediment within the excavation prism
- Dewatering of excavated sediment in the upland handling area
- Placement of an approximately 1-foot-thick, clean sand layer to manage dredging residuals
- Implementation of BMPs to protect water quality during work, including stormwater controls and operational controls
- Treatment and monitoring of stormwater and turbid surface water
- Transport and disposal of dredged material as nonhazardous waste at an approved Subtitle D landfill facility

5.2 Selected BMPs

BMPs are defined in the COE Nationwide Permit as "policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural." The Carty Lake Remedial Action will rely on BMPs that employ structural controls for construction activities below the OHWM, the goal of which is to prevent the occurrence of conditions that lead to the suspension of fine sediment and turbidity within Carty Lake. Further, BMPs for construction activities above OHWM will be implemented as specified in the SWPPP. Discharges to water bodies will be monitored throughout the project to demonstrate compliance with water quality standards.

5.2.1 Carty Lake Work Area BMPs

The following BMPs will be employed during work in the immediate vicinity of Carty Lake. Additional detail is provided in the SWPPP (MFA, 2014b). These controls are intended to significantly reduce or prevent the generation of turbidity and, thus, the release of contaminated sediment.

1) Site Access and Staging

    a. The permanent RNWR access road will be constructed by the placement of fill at the west side of Carty Lake from the LRIS property down to the RNWR (see Drawing C6.0). The construction of the access road has been identified for an area that will minimize the impact to the RNWR and will reduce the drive path of trucks working in the RNWR. The access road alignment and staging area will be cleared of vegetation and covered with a geotextile filter fabric and gravel. The gravel surfacing of the access road and staging area will reduce the potential for entrainment of fine sediment into surface water and will also provide significant dust control.

    b. A temporary access road will be installed to provide access to the work area from the permanent RNWR access road during construction, as shown on Drawing C2.0.1 and elsewhere. A temporary equipment staging area will also be constructed adjacent to this access road. The road alignment will be cleared of vegetation and covered with a geotextile filter fabric and gravel. The equipment staging area will be constructed by clearing vegetation in a proposed location of the RNWR to the west of Carty Lake. The gravel surfacing of the access roads and staging area will reduce the potential for entrainment of fine sediment into surface water and will also provide significant dust control. The temporary access road and associated staging area will be removed at the end of construction activities and the alignment will be restored as part of the Carty Lake vegetation work.

    c. In addition to the access roads, a temporary haul road may be constructed along the existing bulkhead to provide contractor access to the southern end of the work area.

    d. Wattles and filters will be installed at catch basins on the haul route. Catch basin plugs will be kept onsite and be deployed in the event of a spill.

2) Work Area Isolation—Temporary Barrier

    a. A 5-foot-wide and 240-foot-long isolation barrier will be constructed across the southern portion of Carty Lake; see Drawing C2.0.1. The isolation barrier will be constructed of stacked, impermeable sandbags or geotextile tubes filled with sand to facilitate placement and removal of the BMP. An impermeable, 6-millimeter plastic liner will also be incorporated into the isolation barrier to further reduce seepage.

    b. The isolation barrier will reduce the exchange of water between the work area and the rest of Carty Lake, and will allow dewatering of the work area.

3) Carty Lake Dewatering

    a. Water from the south side of the temporary isolation barrier will be pumped to the north side, releasing into the main body of Carty Lake. Turbidity will be monitored.

    b. Lake water with turbidity less than 25 nephelometric turbidity units (NTU) will be pumped directly to the north side without treatment.

c. Water with turbidity exceeding 25 NTU will be pumped to a water treatment/filtration system located in the staging area in the Carty Unit prior to discharge.

d. The treatment system will include storage tanks, a filtration unit (sand filter or bag filter), and an activated carbon vessel. See Section 5.4 for treatment system discharge monitoring.

4) Upland Sediment-Handling Area

a. The clean soil cap in a portion of the upland (LRIS) will be removed in order to provide a sediment-handling area that is directly over contaminated subsoil. The handling area will be lower in elevation than all of the surrounding soil capped area so that surface water flows cannot leave the handling area.

b. The removed clean soil cap will be stockpiled and maintained in a segregated arrangement in order to protect the soil from contamination.

i. The removed soil will be stockpiled on top of plastic sheeting in order to provide a barrier to resist the wicking of soil moisture up into the pile, which could exacerbate the cap re-placement effort after the Lake River Remedial Action.

ii. The removed soil will be covered with plastic sheeting that has been ballasted by sandbags in order to prevent the accumulation of water into the stockpiled soil and to prevent erosion of soil from the stockpile.

c. A silt fence will be installed on the upgradient side of the resulting depression in the upland soil cap to reduce turbidity of surface flows entering the sediment-handling area.

d. A filter fabric geotextile and gravel operating surface will be placed to support equipment operation and prevent excessive mud generation.

e. Construction entrances consisting of a strip of large, angular rock that is approximately 50 feet long will be installed in order to remove mud that may adhere to equipment tracks or tires leaving the sediment-handling area.

f. A wheel wash will be installed at the primary exit location to assist with the removal of mud from equipment tracks or tires that are leaving the sediment-handling area during significantly wet periods.

5) Excavation

a. Excavation will be sequenced from north to south so that equipment does not cross over the remaining sediment surface post removal.

b. Excavated sediments will be placed directly into lined haul trucks for hauling up to the upland sediment dewatering area.

c. Equipment mats will be placed on saturated sediment to support operating equipment. The mats will prevent equipment from sinking into soft sediment and reduce the potential for entrainment of fine sediment into water.

6) Sediment Dewatering

a. Excavated sediment will be dewatered in the dewatering cell in the upland handling area.

b. Bin walls will be lined to contain sediment within the dewatering cell, but the bottom of the cell will remain open to allow the infiltration of water into the upland LRIS site, without contacting the existing clean soil cap.

c. Excess decant water that does not infiltrate will be pumped to the water treatment system.

5.3 Carty Lake Turbidity Monitoring

The intent of monitoring is to ensure that BMPs are effective, and that the turbidity criteria are not exceeded at the point of compliance. Visual turbidity monitoring will be conducted by the Construction Quality Assurance (CQA) engineer to evaluate the effectiveness of the temporary isolation barrier.

Carty Lake is generally stagnant, shallow (2 to 3 feet), and clear. Natural sources of turbidity likely are limited to plankton and sediment resuspended by wind-waves. Because the work area is located at the end of the longest wind fetch in normal wind patterns at the site (from NNW to SSE), there is no applicable background monitoring point that can be used. In addition, the temporary dam will hydraulically isolate the work area from the main body of Carty Lake so that no turbid water will be present that can flow into Carty Lake by way of hydraulic gradient (the hydraulic gradient of the lake/work area dictates that all water will flow from the main body *into* the dewatered work area behind the temporary dam).

In light of this condition, turbidity in Carty Lake will be assessed visually by the engineer. Observations will be made to identify visible plumes of turbidity that emanate from the temporary dam. Observations will be recorded in the daily construction notes every four hours, beginning with the start of work each day.

The CQA engineer will provide a summary of water quality observations in the weekly construction progress reports to the Port and Ecology.

5.4 On-Site Water Treatment System Discharge Monitoring

5.4.1 Carty Lake Remedy Area

Lake water exceeding 25 NTU and stormwater that does not infiltrate in the upland staging, sediment-handling, and water treatment system area will be treated by the contractor-designed, on-site water treatment system and will be discharged to surface water. Effluent from the on-site water treatment system will be sampled from a sampling port downstream of the last treatment unit process. The CQA engineer will monitor effluent on behalf of the Port.

The CQA engineer will monitor the treatment system effluent turbidity at a minimum daily frequency while the system is discharging to surface water. The CQA engineer will perform turbidity analysis with a calibrated turbidity meter on site; the units of measurement will be in NTU. The effluent turbidity benchmark set for this project by Ecology is 25 NTU.

1) Effluent Turbidity Exceedance and Corrective Action:
   a. 0-25 NTU:
      i. No action required.
   b. Greater than 25 NTU:
      i. Notify Ecology project manager within 24 hours and report exceedance.
      ii. The engineer will direct the contractor to immediately take action to stop and contain the exceedance, and to take other steps to prevent further exceedances.
      iii. Document corrective actions in the site log book.
      iv. After the event, the contractor shall assess the adequacy of the treatment system operation and unit process configuration and update or improve those used, to reduce and prevent recurrence of the exceedance.

In addition to turbidity, Ecology has requested treatment system discharge monitoring. For the Section 401 water monitoring, benzo(a)pyrene and PCP will be monitored during the first week of water treatment.

The CQA engineer will collect effluent samples twice during the first week of treatment system operation. Samples will be collected directly into sample containers. During this time, effluent will be contained in two batches on site (one batch for each effluent sample event); discharge to surface water will not be allowed until analytical results are approved by Ecology.

1) Analysis for benzo(a)pyrene will be by USEPA Method 8270. As Ecology has not established freshwater quality criteria for benzo(a)pyrene, if benzo(a)pyrene is detected above the method reporting limit of 1 microgram per liter (μg/L) in the treatment system effluent, the engineer will discuss the analytical results with Ecology. If corrective action is required, the engineer will instruct the contractor to adjust the treatment system operations and/or configuration to reduce the effluent concentration of benzo(a)pyrene.

2) Analysis for PCP will be by USEPA Method 8270. The State freshwater quality criterion for PCP is 13 μg/L. If the concentration of PCP is greater than 13 μg/L, the contractor will adjust the treatment system operations and/or configuration. The effluent will be run through the on-site treatment system again and will be contained on site until effluent analytical results demonstrate compliance with the water quality criteria and the engineer receives approval from Ecology to discharge the batch to surface water.

3) Once the treatment system has demonstrated compliance with the water quality criterion for PCP and removal of benzo(a)pyrene by two consecutive samples, and after approval by Ecology, monitoring for organic contaminants will cease and continuous discharge will be allowed.

If any of the treatment system unit processes selected by the contractor have the potential to affect effluent pH, the CQA engineer will measure the effluent pH with a calibrated pH probe twice during the first week of system operations. The water quality criteria for pH in fresh water is between 6.5 and 8.5. If the effluent pH is outside this range, the engineer will discuss the results with

Ecology and instruct the contractor to adjust the treatment system operations and/or configuration to bring the effluent pH within the water quality range.

5.4.2 Upland Sediment-Handling Area

In the event that stormwater collects within the upland sediment-handling area and does not infiltrate, a second on-site water treatment system will be mobilized to the site. Discharge from this system will be subject to the indicator levels and sampling program established by Administrative Order #10830 (Appendix A). Effluent from this on-site water treatment system will be sampled from a sampling port downstream of the last treatment unit process. The CQA engineer will monitor effluent on behalf of the Port.

All records of water quality monitoring and laboratory results will be kept on site.

6 CONSTRUCTION SITE OPERATIONS

6.1 Health and Safety

All contractors will be required to prepare a health and safety plan that is consistent with the Port's site-specific plan, which is to be prepared by MFA. All employees working at the site will be required to read and sign the contractor's health and safety plans before beginning work at the site. The Port's health and safety plan identifies the site hazards; however, the contractor's plans will provide additional information regarding the hazards associated with specific work activities to be conducted by the contractor.

6.1.1 Site Entry Restrictions

All sediment excavation and handling work areas will be restricted to construction and oversight personnel workers who have received hazardous waste operations and emergency response (HAZWOPER) training. The minimum personal protective equipment for all site activities will be Level D (steel-toed boots, hard hat, safety glasses, hearing protection), although the contractor may require additional protection for specific activities. The contractor will be required to install temporary construction fencing around the sediment-handling area; the area will be secured at the end of each workday to prevent unauthorized access. Signage notifying the public as to which areas of the LRIS are temporarily closed to public access have been placed at the locations identified in Section 6.3.1 by the Port.

Additional measures to keep the public out of the work area may include placement of temporary construction fence around active parts of the work area. Members of the public who encroach upon the work area will receive verbal policing by site workers when within 200 feet of construction equipment.

After the excavation is complete and the sand layer has been placed, soil placement and plantings may be completed by contractor employees with or without HAZWOPER training, as long as they are not disturbing soil below the demarcation layer.

The contractor office and parking area will be restricted to the general public.

6.2 Hours of Operation

Consistent with City noise regulations (Ridgefield Municipal Code 9.14.010), operation of large equipment carrying out remedial activities will generally be limited to the hours of:

- Monday through Friday—7 a.m. to 10 p.m.
- Weekends and holidays—9 a.m. to 6 p.m.

The Port may apply for an exemption to these regulations should 24-hour operations be required to complete the remedy during the dry season.

6.3 Fencing

The site is currently not fenced because the upland remedy has been implemented. A paved shoreline trail and an unpaved trail are currently open to the public. Fencing of the sediment-handling work area will be required because of the impacts associated with excavated sediment. This area will be secured at the end of each day to discourage unauthorized access.

6.3.1 Access Restrictions before Final Remedy Completion

The Port will place signage in the following locations to warn of ongoing construction and to further discourage public access to the work area:

- The Port's boat launch and parking area
- The south terminus of the Miller's Landing waterfront trail
- On Division Street, just west of the Port's driveway
- The north end of Carty Lake

6.4 Security

The site will be secured nightly at the end of construction activities. Security patrols may be conducted by the contractor to limit trespassing, reducing the potential exposure of the public to hazardous situations.

6.5 Transportation Plan

Haul-Route Selection: Site to Freeway: Division Street or Mill Street to 3rd Avenue to Pioneer Street. Pioneer Street to I-5. There may be occasional detours in place on Pioneer Street during construction due to unrelated utility construction. These detours will likely include routing traffic north to the La Center exit on I-5.

Freeway to Landfill:

Wasco County Landfill: I-5S to I205S. I-205S to I-84E. I-84E to US-197S (Exit 87). US-197S to 5 Mile Road. Right (west) on 5 Mile Road to Steele Road—Wasco County Landfill in The Dalles, Oregon. 2250 Steele Road, The Dalles, Oregon.

Hillsboro Landfill: I-5S to I-405S. I-405S to US-26W. US-26W to Waste Management Hillsboro Landfill.

Headquarters Landfill: I-5N to Headquarters Road (Exit 46). Right (east) on Headquarters Road to S Silver Lake Road and Headquarters Landfill.

Other Landfill: As appropriate from I-5.

Truck Haul Schedule: Heavy-truck transportation to and from the site will take place between the hours of 7 a.m. and 6 p.m.

Restricted Routes: Standard truck routes are incorporated into the routes described above. No other route restrictions are anticipated.

Traffic-Control Needs: The need for traffic control will be assessed based on the number of trucks accessing the site. If truck traffic is expected to exceed 20 trucks per day for more than five days, construction signage will be placed to indicate that trucks are entering the roadway. Trucks waiting to be loaded will be managed on site so that they do not block traffic entering or exiting the Port office parking lot or the City wastewater treatment plant. Traffic management will also be provided by site personnel on an as-needed basis.

Accident Prevention and Response: All drivers will be informed of the nature of the materials contained in the loads being hauled. In addition, all loads will require tarping before they leave the site to prevent loss of material during transit. All loads leaving the site will be provided with a nonhazardous-shipping manifest. In the event of an accident or spill, the driver will be instructed to report the incident to an emergency response number listed on the shipping manifest, at which point the appropriate landfill agency will dispatch emergency spill response crews and notify MFA, Ecology, and either the Washington or Oregon Department of Transportation (depending on the spill location).

Decontamination: All trucks will pass through a construction entrance/exit and wheel wash to remove residual contamination from tires before the trucks leave the site and to minimize tracking of mud or sediment onto public roads.

6.6 Public Outreach

Public outreach is addressed through communications with neighboring property owners and the display of project informational signage. An informational flier was developed and sent to neighboring property owners on June 3, 2014. Fliers will also be posted at the Port office, at the RNWR office, and at local establishments such as the hardware store. The informational material was developed in consultation with Ecology.

6.7 Construction Quality Assurance/Quality Control

A construction quality assurance/quality control plan has been prepared and is provided as Appendix F.

The contractor will be responsible for construction quality control (CQC). CQC is a planned system of inspections performed by the construction contractor to directly monitor and control the quality of a construction project. CQC refers to measures taken by the contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project. CQC activities will include surveying, weight tracking for materials delivered and disposed of, any water treatment system operation monitoring and optimization, and other standard CQC techniques to ensure that the project is constructed as designed.

MFA will provide CQA on behalf of the Port. CQA is a planned system of activities that provides the Port and Ecology assurance that a project is constructed as specified in the design. CQA may include inspections, verifications, audits, and evaluations of materials and workmanship as necessary to determine and document construction quality. CQA refers to measures taken by the Port, or its representatives, to assess whether the contractor is complying with the plans and specifications for a project. CQA checks are performed independently of CQC actions; however, CQC and CQA frequently complement each other. CQA activities will include review of the contractor's survey submittals, turbidity monitoring to ensure that the water removed from the excavation area and discharged to Carty Lake is in compliance with the water quality plan, compaction testing of fill, review of disposal documentation, and construction observation and recordkeeping.

6.8 Construction Completion Reporting

Within 90 days following demobilization of construction equipment from the landscape element of the job, MFA will submit a remedial action construction summary report to Ecology. The report will include:

- Photographic documentation and mapping (including surveyed dredge limits) to show the location of the disturbed area(s) and adequate restoration
- Volumes and locations of sediment disposed of off-site and bills of lading or other shipping records
- Topographic survey information recording the final arrangement of the excavation, clean sand, and embankment areas

- Construction verification procedures and results
- Water quality monitoring results for any water discharged to Carty Lake

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

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TABLES

Table 2-1
Sediment Chemical Concentrations
Draft Carty Lake Engineering Design Report
Ridgefield, Washington

				Location ID	LRIS-BKG-04	LRIS-CL-01	LRIS-CL-01	LRIS-CL-02	LRIS-CL-02	LRIS-CL-02	LRIS-CL-03	LRIS-CL-03	LRIS-CL-04	LRIS-CL-04
				Sample ID	LRIS-BKG-04-SS	LRIS-CL-01-SS	LRIS-CL-01-SB-1-2	LRIS-CL-02-SS	LRIS-CL-02-SB-1-2	LRIS-CL-02-SB-2-3	LRIS-CL-03-SS	LRIS-CL-03-SB-1-2	LRIS-CL-04-SS	LRIS-CL-04-SB-1-2
				Sample Date	04/16/2010	04/15/2010	04/15/2010	04/15/2010	04/15/2010	09/01/2011	04/15/2010	04/15/2010	04/15/2010	04/15/2010
				Depth	0-10 cm	0-10 cm	1-2 ft	0-10 cm	1-2 ft	2-3 ft	0-10 cm	1-2 ft	0-10 cm	1-2 ft
Analyte	Units	CUL	REL	Screening Criteria[a]										
Pentachlorophenol	µg/kg	NV	NV	200[b]	13 U	23	NV	**880**	**270 J**	NV	11	NV	**210**	11
Arsenic	mg/kg	NV	NV	14	NV	8.3	NV	**48**	**15**	NV	6.9	NV	10	3.7
Chromium	mg/kg	NV	NV	72	NV	28	NV	**86**	34	NV	27	NV	31	31
Dioxin/Furan TEQ	ng/kg	5	NV	NV	**18**	**140**	**5.5**	**1400**	**130**	2.5	**24**	1.1	**300**	2.1
1,2,3,4,6,7,8,9-OCDF	ng/kg	NV	10000000	NV	44	590	25	2800 J	330	3.5 U	91	3.7 J	790 J	5.5 J
1,2,3,4,6,7,8,9-OCDD	ng/kg	NV	10000000	NV	3,000	38,000	1,700	220000 J	32000 J	280	4800 J	490	64000 J	510
1,2,3,4,6,7,8-HpCDF	ng/kg	NV	250000	NV	41	480	18	6200 J	420	6.2	83	2.9 J	1100 J	6.8
1,2,3,4,6,7,8-HpCDD	ng/kg	NV	310000	NV	510	4,600	190	63000 J	4600 J	39	800	24	12000 J	78
1,2,3,4,7,8,9-HpCDF	ng/kg	NV	250000	NV	2.9	27	1 U	430	23	2.7	3.9 J	0.41 U	48 U	0.39 U
1,2,3,4,7,8-HxCDF	ng/kg	NV	980	NV	6.9	91	2.7 J	**1000**	71	0.93 UJ	12	0.57 U	170	1.4 J
1,2,3,4,7,8-HxCDD	ng/kg	NV	200	NV	7.4	41	1.7 J	**450**	40	0.42 U	8.1	0.61 J	77 J	0.58 J
1,2,3,6,7,8-HxCDF	ng/kg	NV	980	NV	5.2	31	1.2 J	510	31	0.44 U	5.2	0.44 U	82 J	0.54 J
1,2,3,6,7,8-HxCDD	ng/kg	NV	1200	NV	27	250	7.5	350	250	2.3 J	43	1.2 J	540	3.8
1,2,3,7,8,9-HxCDF	ng/kg	NV	980	NV	0.5 U	2.1 J	0.52 J	67 J	3.4 J	0.49 U	0.44 J	0.5 U	24 U	0.29 U
1,2,3,7,8,9-HxCDD	ng/kg	NV	1200	NV	22	71	2 J	810 J	56	4.6 U	16	0.91 J	140 J	1.4 J
1,2,3,7,8-PeCDF	ng/kg	NV	550	NV	3.4	21	1.1 U	320	25	0.8 U	3 J	0.5 U	42 J	0.45 J
1,2,3,7,8-PeCDD	ng/kg	NV	98	NV	3.2	13	0.63 J	**140 J**	11	1.7 U	3.1 J	0.32 U	22 J	0.23 U
2,3,4,6,7,8-HxCDF	ng/kg	NV	980	NV	2.4	24	0.78 J	360	19	0.44 U	4.5	0.38 U	65 J	0.24 U
2,3,4,7,8-PeCDF	ng/kg	NV	6.5	NV	3	**39**	1.7 J	**390 J**	**30**	0.81 U	4.5	0.57 U	**50 J**	0.41 U
2,3,7,8-TCDF	ng/kg	NV	86	NV	1.4	9.4	0.56 J	**120**	13	0.64 U	1.8	0.2 J	18	0.49 J
2,3,7,8-TCDD	ng/kg	NV	3.3	NV	0.23	1.4	0.14 U	**12 U**	0.56 U	0.66 U	0.29 U	0.13 U	**7.1 U**	0.081 U

Table 2-1
Sediment Chemical Concentrations
Draft Carty Lake Engineering Design Report
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				Location ID	LRIS-CL-05	LRIS-CL-05	LRIS-CL-06	LRIS-CL-06	LRIS-CL-07	LRIS-CL-07	LRIS-CL-08	LRIS-CL-09	LRIS-CL-10	LRIS-CL-11
				Sample ID	LRIS-CL-05-SS	LRIS-CL-05-SB-1-2	LRIS-CL-06-SS	LRIS-CL-06-SB-1-2	LRIS-CL-07-SS	LRIS-CL-07-SB-1-2	LRIS-CL-08-SS	LRIS-CL-09-SS	LRIS-CL-10-SS	LRIS-CL-11-SS
				Sample Date	04/15/2010	04/15/2010	04/16/2010	04/15/2010	04/16/2010	04/15/2010	09/01/2011	09/01/2011	09/01/2011	09/01/2011
				Depth	0-10 cm	1-2 ft	0-10 cm	1-2 ft	0-10 cm	1-2 ft	0-10 cm	0-10 cm	0-10 cm	0-10 cm
Analyte	Units	CUL	REL	Screening Criteria[a]										
Pentachlorophenol	µg/kg	NV	NV	200[b]	8.9	NV	15	NV	9.5 U	NV	NV	NV	NV	NV
Arsenic	mg/kg	NV	NV	14	4.3	NV	5.5	NV	5.2	NV	NV	NV	NV	NV
Chromium	mg/kg	NV	NV	72	23	NV	19	NV	17	NV	NV	NV	NV	NV
Dioxin/Furan TEQ	ng/kg	5	NV	NV	1.8	0.74	**22**	0.31	**32**	0.65	**27**	**54**	**15**	**27**
1,2,3,4,6,7,8,9-OCDF	ng/kg	NV	10000000	NV	5.3 J	0.99 U	54 J	0.43 U	110 J	2 U	66	140	45	64
1,2,3,4,6,7,8,9-OCDD	ng/kg	NV	10000000	NV	400	37	5000 J	43	8700 J	130	4800 J	11000 J	2500	3400
1,2,3,4,6,7,8-HpCDF	ng/kg	NV	250000	NV	5.3	0.61 U	51 J	0.49 U	100 J	1.9 J	60	130	35	50
1,2,3,4,6,7,8-HpCDD	ng/kg	NV	310000	NV	62	5	780 J	6.4	1300 J	19	840	2000	400	620
1,2,3,4,7,8,9-HpCDF	ng/kg	NV	250000	NV	0.46 U	0.19 U	4.4 U	0.11 U	5	0.54 U	3 J	5.1 U	1.9 U	4 J
1,2,3,4,7,8-HxCDF	ng/kg	NV	980	NV	0.81 J	0.24 U	6.8	0.067 U	10	0.31 J	8.9	16	5.3	8.5
1,2,3,4,7,8-HxCDD	ng/kg	NV	200	NV	0.78 J	0.16 J	8.5	0.13 J	8.3	0.22 U	12	22	7.2	13
1,2,3,6,7,8-HxCDF	ng/kg	NV	980	NV	0.47 U	0.14 U	5.6	0.064 U	7	0.16 U	7.5	13	5	8.2
1,2,3,6,7,8-HxCDD	ng/kg	NV	1200	NV	3.3	0.35 J	34	0.4 J	55	1 J	41	76	26	46
1,2,3,7,8,9-HxCDF	ng/kg	NV	980	NV	0.28 U	0.18 J	1.4 U	0.069 U	1.6 U	0.15 U	0.54 J	0.81 U	0.39 J	0.47 J
1,2,3,7,8,9-HxCDD	ng/kg	NV	1200	NV	1.6 J	3.1 U	17 J	0.27 J	17 J	0.52 U	30	53	16	28
1,2,3,7,8-PeCDF	ng/kg	NV	550	NV	0.39 U	0.17 U	3 J	0.17 U	4.1	0.16 U	4.3 UJ	6.7 UJ	2.7 UJ	5.3
1,2,3,7,8-PeCDD	ng/kg	NV	98	NV	0.32 U	0.091 U	3.3 J	0.13 U	3.1 J	0.24 U	5.2	8.6	3.3 J	6.7
2,3,4,6,7,8-HxCDF	ng/kg	NV	980	NV	0.35 J	0.12 U	2.9 U	0.061 U	5.2	0.16 U	4.1 J	8	3.1 J	4.9 J
2,3,4,7,8-PeCDF	ng/kg	NV	6.5	NV	0.31 U	0.14 U	2.9 J	0.19 U	3.9 J	0.2 U	4 UJ	6.3 UJ	2.4 UJ	5 UJ
2,3,7,8-TCDF	ng/kg	NV	86	NV	0.33 U	0.47 J	1.4	0.28 U	2.1	0.11 U	3	2.9	0.81 U	2.2
2,3,7,8-TCDD	ng/kg	NV	3.3	NV	0.12 U	0.61 U	0.38 U	0.057 U	0.27 U	0.093 U	0.44 J	0.65 J	0.15 U	0.53 J

				Location ID	LRIS-CL-12	LRIS-CL-13	LRIS-CL-14	LRIS-CL-15	LRIS-CL-16	LRIS-CL-16	LRIS-CL-17	LRIS-CL-17-DUP	LRIS-CL-18	LRIS-CL-19
				Sample ID	LRIS-CL-12-SS	LRIS-CL-13-SS	LRIS-CL-14-SS	LRIS-CL-15-SS	LRIS-CL-16-1.5	LRIS-CL-16-2.5	LRIS-CL-17-1.5	LRIS-CL-17-1.5-DUP	LRIS-CL-18-1.5	LRIS-CL-19-1.5
				Sample Date	09/01/2011	09/01/2011	09/01/2011	09/01/2011	06/26/2013	06/26/2013	06/26/2013	06/26/2013	06/26/2013	06/26/2013
				Depth	0-10 cm	0-10 cm	0-10 cm	0-10 cm	1-2 ft	2-3 ft	1-2 ft	1-2 ft	1-2 ft	1-2 ft
Analyte	Units	CUL	REL	Screening Criteria[a]										
Pentachlorophenol	µg/kg	NV	NV	200[b]	NV	NV	NV	NV	198 U	NV	177 U	165 U	161 U	176 U
Arsenic	mg/kg	NV	NV	14	NV	NV	NV	NV	11.2	NV	2.55	2.16	NV	NV
Chromium	mg/kg	NV	NV	72	NV	NV	NV	NV	34.2	NV	27.7	29.8	NV	NV
Dioxin/Furan TEQ	ng/kg	5	NV	NV	**20**	1.9	**26**	**25**	**320**	**46**	**22**	**19**	**120**	**26**
1,2,3,4,6,7,8,9-OCDF	ng/kg	NV	10000000	NV	51	7.2	65	67	1540	157	78.3	73.2	487	90.3
1,2,3,4,6,7,8,9-OCDD	ng/kg	NV	10000000	NV	2800	330	3400	3500	78200 J	11900 J	7560 J	6480 J	32700 J	6930 J
1,2,3,4,6,7,8-HpCDF	ng/kg	NV	250000	NV	41	5.3	51	51	1180	154	74.7	66.2	397	85
1,2,3,4,6,7,8-HpCDD	ng/kg	NV	310000	NV	490	53	620	620	10800 J	1640 J	840 J	741 J	3960 J	950 J
1,2,3,4,7,8,9-HpCDF	ng/kg	NV	250000	NV	3 U	0.85 UJ	3.7 U	3.4 J	69.6	9.02	3.9 J	3.14 J	22.7	4.72 J
1,2,3,4,7,8-HxCDF	ng/kg	NV	980	NV	6.9	0.99 UJ	8.1	8.6	256	32.8	12.8	10.2	74.4	15.4
1,2,3,4,7,8-HxCDD	ng/kg	NV	200	NV	9.5	0.62 J	13	13	77.3	10.4	4.8 J	4.18 J	30.5	6.51
1,2,3,6,7,8-HxCDF	ng/kg	NV	980	NV	6.3	0.5 U	7.4	7.3	97.7	11.6	5.04	4.34 J	29.6	6.11
1,2,3,6,7,8-HxCDD	ng/kg	NV	1200	NV	32	2.7 J	43	39	600	86.2	39.5	34.1	224	46.4
1,2,3,7,8,9-HxCDF	ng/kg	NV	980	NV	0.51 J	0.08 U	0.41 J	0.42 U	5.33 J	0.935 J	0.406 J	0.337 J	2.18 J	0.459 J
1,2,3,7,8,9-HxCDD	ng/kg	NV	1200	NV	21	2.6 UJ	28	25	204	37.6	13.3	12.9	104	23.1
1,2,3,7,8-PeCDF	ng/kg	NV	550	NV	4.1 UJ	0.24 U	4.4 UJ	4.8 UJ	46.1	5.5	2.25 J	1.94 J	14	2.90 J
1,2,3,7,8-PeCDD	ng/kg	NV	98	NV	5.2	0.35 J	6.2	6.1	23.1	3.1 J	1.43 J	1.32 J	9.31	1.78 J
2,3,4,6,7,8-HxCDF	ng/kg	NV	980	NV	4 J	0.41 J	4.8 J	5.6 J	56	6.77	3.4 J	2.63 J	16.7	3.51 J
2,3,4,7,8-PeCDF	ng/kg	NV	6.5	NV	4 UJ	0.35 J	4.3 UJ	4.5 UJ	**56.3**	6.49	2.72 J	2.17 J	**15.2**	2.97 J
2,3,7,8-TCDF	ng/kg	NV	86	NV	1.8	0.32 U	2.3	2.6 U	23.5	2.71	0.981 J	0.873 J	7.43	1.66
2,3,7,8-TCDD	ng/kg	NV	3.3	NV	0.4 U	0.38 UJ	0.46 J	0.57 J	1.74	0.224 J	0.173 J	0.102 U	0.608 J	0.202 J

Table 2-1
Sediment Chemical Concentrations
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				Location ID	LRIS-CL-22	LRIS-CL-23	LRIS-CL-DU1	LRIS-CL-DU1	LRIS-CL-DU1	LRIS-CL-DU2	LRIS-CL-DU3	LRIS-CL-DU4	LRIS-CL-DU5
				Sample ID	LRIS-CL-22-1.5	LRIS-CL-23-1.5	LRIS-CL-DU1A	LRIS-CL-DU1B	LRIS-CL-DU1C	LRIS-CL-DU2	LRIS-CL-DU3	LRIS-CL-DU4	LRIS-CL-DU5
				Sample Date	06/26/2013	06/26/2013	06/25/2013	06/25/2013	06/25/2013	06/25/2013	06/24/2013	06/25/2013	06/24/2013
				Depth	1-2 ft	1-2 ft	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm
Analyte	Units	CUL	REL	Screening Criteria[a]									
Pentachlorophenol	µg/kg	NV	NV	200[b]	NV	NV	**293**	**331**	**334 J**	**266 J**	104 U	162	104 U
Arsenic	mg/kg	NV	NV	14	NV	NV	12.1	10.1	10.9	9.04	4.53	7.52	4.03
Chromium	mg/kg	NV	NV	72	NV	NV	38.2	35.7	37.2	32.4	19.2	26.5	17.2
Dioxin/Furan TEQ	ng/kg	5	NV	NV	**36**	**24**	**600**	**470**	**350**	**370**	**39**	**270**	**27**
1,2,3,4,6,7,8,9-OCDF	ng/kg	NV	10000000	NV	125	82.7	4050 J	1800 J	1120 J	1370 J	207 J	1610 J	91.6 J
1,2,3,4,6,7,8,9-OCDD	ng/kg	NV	10000000	NV	9290 J	6210 J	161000 J	76500 J	52100 J	95300 J	6860 J	81800 J	6540 J
1,2,3,4,6,7,8-HpCDF	ng/kg	NV	250000	NV	116	79.6	2360	1950	1310	1390	154	1060	96.4
1,2,3,4,6,7,8-HpCDD	ng/kg	NV	310000	NV	1320 J	879 J	22100 J	18900 J	12700 J	14100 J	1150 J	11100 J	1100 J
1,2,3,4,7,8,9-HpCDF	ng/kg	NV	250000	NV	6.53	3.96 J	122	98.9	63.4	70.9	7.73	54.1	4.52
1,2,3,4,7,8-HxCDF	ng/kg	NV	980	NV	22.8	14.6	376	322 U	283 U	218	22.6	160 U	15.3 U
1,2,3,4,7,8-HxCDD	ng/kg	NV	200	NV	9.02	6.34	152	125	88.8	97.8	12	76	7.65
1,2,3,6,7,8-HxCDF	ng/kg	NV	980	NV	8.93	6.03	160	133	117	98.8	9.93	69.5 U	6.6 U
1,2,3,6,7,8-HxCDD	ng/kg	NV	1200	NV	63.5	44.4	1110	982	699	677	83.9	499	56.1
1,2,3,7,8,9-HxCDF	ng/kg	NV	980	NV	0.635 J	0.369 J	12.1 J	9.65 J	8.7 J	6.79 J	0.812 J	4.75 J	0.503 U
1,2,3,7,8,9-HxCDD	ng/kg	NV	1200	NV	32.8	19.6	332	341 U	237 U	243	37.5	186 U	21.6 U
1,2,3,7,8-PeCDF	ng/kg	NV	550	NV	3.84 J	2.62 J	80.7	68	63.8	48	4.28	34.1	3.48
1,2,3,7,8-PeCDD	ng/kg	NV	98	NV	2.65 J	1.85 J	47	38.8	35.8	29.6	3.69	21.4	2.52
2,3,4,6,7,8-HxCDF	ng/kg	NV	980	NV	5.13	3.09 J	91.6	78.5	69.9	56.8	6.5	40	4.07
2,3,4,7,8-PeCDF	ng/kg	NV	6.5	NV	4.21 J	2.93 J	**89.4**	**75.5**	**70.9**	**47.9**	5.38	**36.1**	3.84
2,3,7,8-TCDF	ng/kg	NV	86	NV	2.04	1.36	37.5	31.4	30.7	24	2.26	18.3	2.05
2,3,7,8-TCDD	ng/kg	NV	3.3	NV	0.242 J	0.128 U	2.61	2.09	1.98	1.78	0.291 J	1.48	0.229 J

NOTES:
Bold indicates values that exceed screening levels, cleanup levels, or remediation levels (for dioxins, if values were non-detects ["U" or "UJ"], half the reported concentration was used for comparison).
cm = centimeter(s).
CUL = cleanup level.
dup = duplicate sample.
ft = feet.
HpCDD = heptachlorodibenzo-p-dioxin.
HpCDF = heptachlorodibenzofuran.
HxCDD = hexachlorodibenzo-p-dioxin.
HxCDF = hexachlorodibenzofuran.
J = estimated value.
mg/kg = milligrams per kilogram.
μg/kg = micrograms per kilogram.
ng/kg = nanograms per kilogram (parts per trillion).
NV = no value.
OCDD = octachlorodibenzo-p-dioxin.
OCDF = octachlorodibenzofuran.
PeCDD = pentachlorodibenzo-p-dioxin.
PeCDF = pentachlorodibenzofuran.
REL = remediation level (based on ecological CULs).
TCDD = tetrachlorodibenzo-p-dioxin.
TCDF = tetrachlorodibenzofuran.
TEQ = toxicity equivalent. Non-detects are calculated as 1/2 the estimated detection limit.
U = Compound analyzed, but not detected above detection limit.
[a]Screening criteria described in MFA (2013).
[b]U.S. Fish and Wildlife Service screening criteria.

Table 2-2
Sediment Grain Size and Total Organic Carbon
Draft Carty Lake Engineering Design Report
Ridgefield, Washington

Location ID	LRIS-BKG-04	LRIS-CL-01	LRIS-CL-02	LRIS-CL-02	LRIS-CL-02	LRIS-CL-03	LRIS-CL-04	LRIS-CL-04	LRIS-CL-05	LRIS-CL-06
Sample ID	LRIS-BKG-04-SS	LRIS-CL-01-SS	LRIS-CL-02-SS	LRIS-CL-02-SB-1-2	LRIS-CL-02-SB-2-3	LRIS-CL-03-SS	LRIS-CL-04-SS	LRIS-CL-04-SB-1-2	LRIS-CL-05-SS	LRIS-CL-06-SS
Sample Date	04/16/2010	04/15/2010	04/15/2010	04/15/2010	09/01/2011	04/15/2010	04/15/2010	04/15/2010	04/15/2010	04/15/2010
Sample Depth	0-10 cm	0-10 cm	0-10 cm	1-2 ft	2-3 ft	0-10 cm	0-10 cm	1-2 ft	0-10 cm	0-10 cm
Conventional Parameters										
Total organic carbon (%)	3.2	4.5	5.4	2.8	0.84	3.6	4.9	1.4	1.3	2.4
Grain Size (%)										
Clay	20	34	43	34	38.8	29	22	32	25	20
Gravel	0	0	0	0	0	0	0	0	0	0
Sand, Coarse	0	0	0	0	0	0	0	0	0	0
Sand, Fine	23	14	4.6	8 J	3.1	25	18	5.5	14	24
Sand, Medium	1.2	0.9	1.6	1.6	0.9	1	2	0.7	1.8	1.8
Sand, Very Fine	7.7	6	1.3	2.8 J	NV	8.3	5.4	2.4	5.5	4.8
Silt	48	44	50	53	57.2	36	53	59	54	50
Total Clay	20	34	43	34	38.8	29	22	32	25	20
Total Fines (silt + clay)	68	78	93	87	96	65	75	91	79	70
Total Gravel	0	0	0	0	0	0	0	0	0	0
Total Sand	31.9	20.9	7.5	12.4	4	34.3	25.4	8.6	21.3	30.6
Total Silt	48	44	50	53	57.2	36	53	59	54	50
Total Grain Size	99.9	98.9	100.5	99.4	100	99.3	100.4	99.6	100.3	100.6

Location ID	LRIS-CL-07	LRIS-CL-08	LRIS-CL-09	LRIS-CL-10	LRIS-CL-11	LRIS-CL-12	LRIS-CL-13	LRIS-CL-14	LRIS-CL-15	LRIS-CL-16
Sample ID	LRIS-CL-07-SS	LRIS-CL-08-SS	LRIS-CL-09-SS	LRIS-CL-10-SS	LRIS-CL-11-SS	LRIS-CL-12-SS	LRIS-CL-13-SS	LRIS-CL-14-SS	LRIS-CL-15-SS	LRIS-CL-16-1.5
Sample Date	04/15/2010	09/01/2011	09/01/2011	09/01/2011	09/01/2011	09/01/2011	09/01/2011	09/01/2011	09/01/2011	06/26/2013
Sample Depth	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	1-2 ft
Conventional Parameters										
Total organic carbon (%)	1.7	2.1	3.2	1.5	2.6	2.1	1.3	2.8	3.5	1.6
Grain Size (%)										
Clay	23	8.7	17.5	8.1	14.2	12.5	21.2	11.5	17.8	NV
Gravel	0	0	0	0	0	0	0	0	0	NV
Sand, Coarse	0	0	0	0	0	0	0	0	0	NV
Sand, Fine	36	16.4	8.5	21.6	22.8	27.8	11.9	19.6	26.6	NV
Sand, Medium	1	0.6	0.4	8	0.4	0.2	0.4	0.6	4	NV
Sand, Very Fine	6.2	NV	NV	NV	NV	NV	NV	NV	NV	NV
Silt	33	74.3	73.6	62.3	62.6	59.5	66.5	68.3	51.6	NV
Total Clay	23	8.7	17.5	8.1	14.2	12.5	21.2	11.5	17.8	NV
Total Fines (silt + clay)	56	83	91.1	70.4	76.8	72	87.7	79.8	69.4	NV
Total Gravel	0	0	0	0	0	0	0	0	0	NV
Total Sand	43.2	17	8.9	29.6	23.2	28	12.3	20.2	30.6	NV
Total Silt	33	74.3	73.6	62.3	62.6	59.5	66.5	68.3	51.6	NV
Total Grain Size	99.2	100	100	100	100	100	100	100	100	NV

Location ID	LRIS-CL-17	LRIS-CL-17-DUP	LRIS-CL-DU1	LRIS-CL-DU1	LRIS-CL-DU1	LRIS-CL-DU2	LRIS-CL-DU3	LRIS-CL-DU4	LRIS-CL-DU5	LRIS-CL-126
Sample ID	LRIS-CL-17-1.5	LRIS-CL-17-1.5-DUP	LRIS-CL-DU1A	LRIS-CL-DU1B	LRIS-CL-DU1C	LRIS-CL-DU2	LRIS-CL-DU3	LRIS-CL-DU4	LRIS-CL-DU5	CL-126
Sample Date	06/26/2013	06/26/2013	06/25/2013	06/25/2013	06/25/2013	06/25/2013	06/24/2013	06/25/2013	06/24/2013	06/26/2013
Sample Depth	1-2 ft	1-2 ft	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-0.5 ft
Conventional Parameters										
Total organic carbon (%)	0.88	0.61	2.7	2.7	2.5	2.2	2.1	2.7	2.0	NV
Grain Size (%)										
Clay	NV	NV	NV	NV	NV	NV	NV	NV	NV	42.0
Gravel	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.0
Sand, Coarse	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.0
Sand, Fine	NV	NV	NV	NV	NV	NV	NV	NV	NV	3.0
Sand, Medium	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.0
Sand, Very Fine	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.0
Silt	NV	NV	NV	NV	NV	NV	NV	NV	NV	55.0
Total Clay	NV	NV	NV	NV	NV	NV	NV	NV	NV	42.0
Total Fines (silt + clay)	NV	NV	NV	NV	NV	NV	NV	NV	NV	97.0
Total Gravel	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.0
Total Sand	NV	NV	NV	NV	NV	NV	NV	NV	NV	3.0
Total Silt	NV	NV	NV	NV	NV	NV	NV	NV	NV	55.0
Total Grain Size	NV	NV	NV	NV	NV	NV	NV	NV	NV	100.0

NOTES:
cm = centimeter(s).
ft = feet.
J = estimated value.
NV = no value.

Table 2-3
Physical Parameters
Draft Carty Lake Engineering Design Report
Ridgefield, Washington

Sample ID	CL-126			
Location ID	LRIS-CL-126			
Sample Date	06/26/2013			
Sample Analysis Depth	0.5 ft	1 ft	1.375 ft	1.5 ft
Physical Parameters				
Total solids (%)	nv	nv	nv	68.3
Moisture Content (%)	56	56	41.5	49.8
Dry Density (pcf)	nv	65.5	81	nv
Atterberg Limits				
Liquid Limit (%)	96	nv	nv	nv
Liquidity Index (%)	0.2	nv	nv	nv
Plastic Limit (%)	44	nv	nv	nv
Plasticity Index (%)	51	nv	nv	nv
Permeability Coefficient (cm/s)				
Gradient = 2	nv	nv	3.85×10^{-6}	nv
Gradient = 5			9.58×10^{-7}	
Gradient =10			5.76×10^{-7}	

NOTES:
% = percent.
cm/s = centimeters per second.
ft = feet.
nv = no value.
pcf = pounds per cubic foot.

Table 2-4
Special-Status Birds That May Occur or That May Have Occurred in Vicinity of Carty Lake
Draft Carty Lake Engineering Design Report
Ridgefield, Washington

Species	Federal	Washington State	Current Occurrence on Ridgefield National Wildlife Refuge
American white pelican		E	Infrequently seen Jan.-July; wintering and migrant birds; nonbreeding subadults.
Bald eagle	SC	S	Thirty to 50 eagles winter on or near the RNWR; six pairs nest on or near the RNWR.
Caspian tern		M	Infrequent observations.
Common loon		S	Rare, fall/winter/spring.
Golden eagle		C	Rare.
Lewis's woodpecker		C	Rare, fall/winter/spring.
Loggerhead shrike	SC	C	Rare, spring.
Long-billed curlew		M	Rare.
Northern goshawk	SC	C	Rare.
Olive-sided flycatcher	SC		Occasional seasonal migrant, spring/summer/fall.
Oregon vesper sparrow	SC	C	Rare, spring/fall.
Peregrine falcon, American	SC	S	Occasional observations, all seasons; displaced birds reared on RNWR.
Pileated woodpecker		C	Resident and nests on RNWR.
Purple martin		C	Uncommon, spring/summer/fall. Breeding; 15 pairs nest on RNWR.
Rufous hummingbird	SC		Nests on RNWR.
Sandhill crane, Canadian (*G. c. rowani*)		E	The RNWR and Sauvie Island, Oregon, are significant migration and wintering areas. Fall roost averages 1,700 birds; winter population 700-800. Occasionally seen in summer. Unconfirmed breeding record from Bachelor Island, late 1970s.
Short-billed dowitcher	SC		Rare.
Slender-billed white-breasted nuthatch	SC	C	Resident, nests on RNWR. Mainly confined to Vancouver vicinity, especially the RNWR.
Streaked horned lark	C	E	Rare, fall.
Vaux's swift		C	Seasonal migrant; uncommon summer/fall; occasional winter.
Western bluebird		M	Rare, spring.
Western grebe		C	Occasional, fall/winter/spring.
Willow flycatcher (*ssp. brewsteri*)	SC		Uncommon spring/summer/fall. Breeds on RNWR.

Key to Codes: C = Candidate, E = Endangered, M = Monitored, S = Sensitive, SC = Species of Concern. Source: Adapted from USFWS (2010); USFW (2008). (http://www.fws.gov/migratorybirds); WDFW (www.wdfw.wa.gov),

Table 3-1
Imported Fill Screening Criteria
Draft Carty Lake Engineering Design Report
Ridgefield, WA

Analyte	SMS Freshwater Cleanup Screening Levels (SCO)	Cleanup Level[a]	Ecological Screening Level[b]	Ecology Soils Background Criteria[c]	Selected Screening Criteria
Conventionals (mg/kg)					
Total Organic Carbon	NA	--	--	--	NA
Total Metals (mg/kg)					
Arsenic	14	--	--	5.81	5.81
Cadmium	2.1	--	--	0.93	0.93
Chromium	72	--	--	--	72
Copper	400	--	--	--	400
Lead	360	--	--	24.02	24.02
Mercury	0.66	--	--	0.04	0.04
Nickel	26	--	--	--	26
Selenium	11	--	--	--	11
Silver	0.57	--	--	--	0.57
Zinc	3200	--	--	--	3200
Organochlorine Pesticides (ug/kg)					
4,4'-DDD	310	--	--	--	310
4,4'-DDE	100	--	--	--	100
4,4'-DDT	21	--	--	--	21
Carbazole	900	--	--	--	900
Dieldrin	4.9	--	--	--	4.9
Endrin ketone	8.5	--	--	--	8.5
Beta-Hexachlorocyclohexane	7.2	--	--	--	7.2
Dioxins (ng/kg)					
Dioxin TEQ[d]	NV	5	--	--	5
1,2,3,4,6,7,8,9-OCDF	NV	10000000	--	--	10000000
1,2,3,4,6,7,8,9-OCDD	NV	10000000	--	--	10000000
1,2,3,4,6,7,8-HpCDF	NV	250000	--	--	250000
1,2,3,4,6,7,8-HpCDD	NV	310000	--	--	310000
1,2,3,4,7,8,9-HpCDF	NV	250000	--	--	250000
1,2,3,4,7,8-HxCDF	NV	980	--	--	980
1,2,3,4,7,8-HxCDD	NV	200	--	--	200
1,2,3,6,7,8-HxCDF	NV	980	--	--	980
1,2,3,6,7,8-HxCDD	NV	1200	--	--	1200
1,2,3,7,8,9-HxCDF	NV	980	--	--	980
1,2,3,7,8,9-HxCDD	NV	1200	--	--	1200
1,2,3,7,8-PeCDF	NV	550	--	--	550
1,2,3,7,8-PeCDD	NV	98	--	--	98
2,3,4,6,7,8-HxCDF	NV	980	--	--	980
2,3,4,7,8-PeCDF	NV	6.5	--	--	6.5
2,3,7,8-TCDF	NV	86	--	--	86
2,3,7,8-TCDD	NV	3.3	--	--	3.3
PCBs (ug/kg)					
Total PCB Aroclors	110	--	--	5	5

Table 3-1
Imported Fill Screening Criteria
Draft Carty Lake Engineering Design Report
Ridgefield, WA

PAHs (ug/kg)					
Total PAHs	17000	--	--	--	17000
SVOCs (ug/kg)					
Di-n-butylphthalate	380	--	--	--	380
Bis(2-ethylhexyl)phthalate	500	--	--	--	500
Di-n-octyl phthalate	39	--	--	--	39
Phenol	120	--	--	--	120
4-Methylphenol	260	--	--	--	260
Pentachlorophenol (PCP)	1200	--	200	--	200
Benzoic acid	2900	--	--	--	2900
Dibenzofuran	200	--	--	--	200
NWTPH-Dx (mg/kg)					
Diesel	340	--	--	--	340
Residual Range	3600	--	--	--	3600

Notes:

CUL = cleanup level; derivation described in former PWT site remedial investigation and feasibility study.

mg/kg = milligrams per kilogram (parts per million).

NA = not applicable

ng/kg = nanograms per kilogram (parts per trillion).

NWTPH = Northwest Total Petroleum Hydrocarbon analytical methods.

PAHs = polycyclic aromatic hydrocarbons.

PCBs =polychlorinated biphenyls.

SCO = sediment cleanup objective.

SLV = screening level value; derivation described in former PWT site remedial investigation and feasibility study.

SMS = Sediment Management Standards.

SVOC = Semivolatile Organic Compound.

TEQ =toxicity equivalence.

ug/kg = micrograms per kilogram (parts per billion).

[a]The remediation level (REL) is shown for dioxin congeners; a CUL was not established for dioxin congeners.

[b]U.S. Fish and Wildlife Service screening criteria.

[c]Criteria shown only for bioaccumulative metals of concern and PCBs; PCB level is based on typical reporting limit.

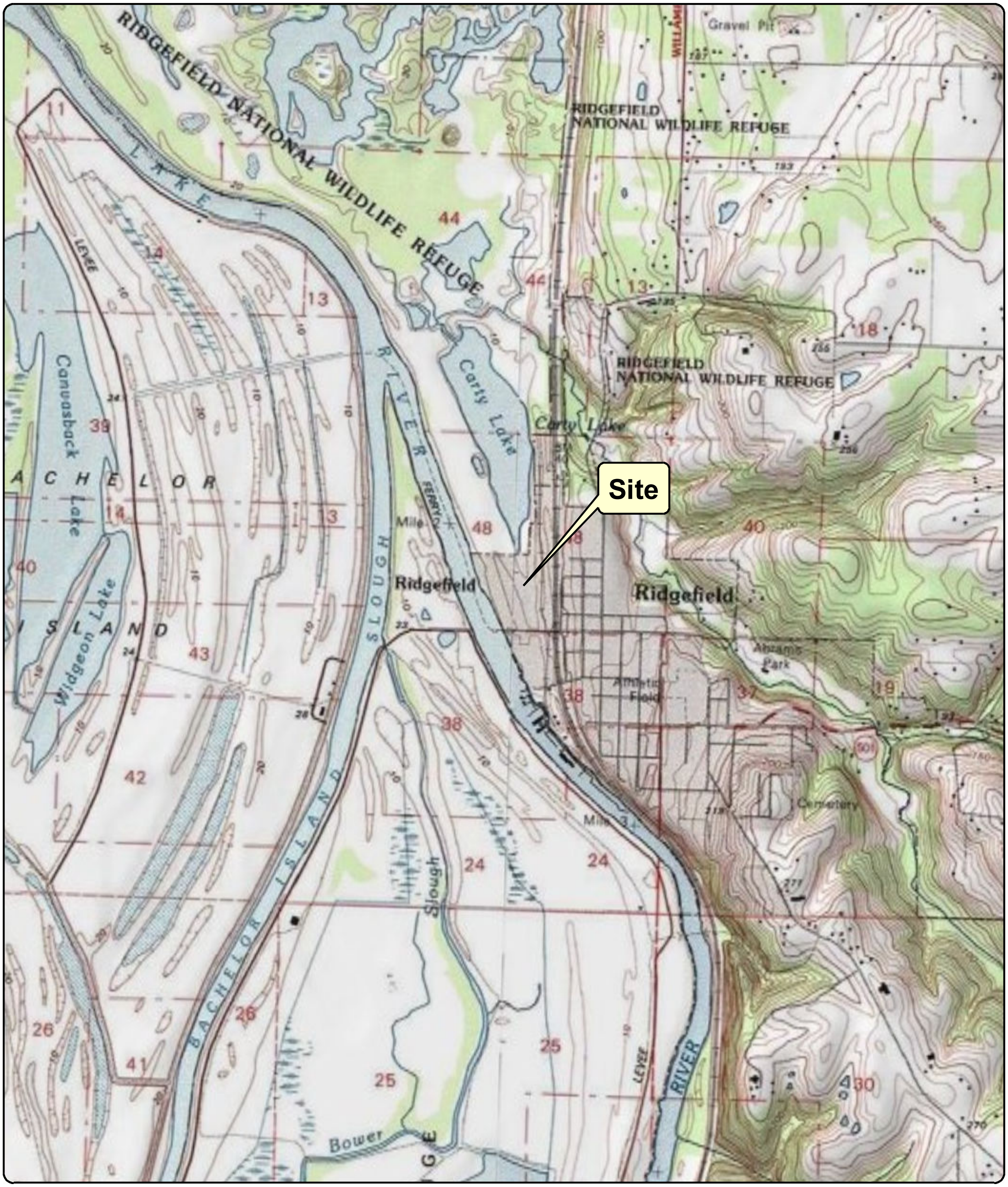
[d]To be calculated in accordance with MFA dioxin TEQ calculation memorandum (MFA, 2012).

Table 4-1
Anticipated Construction Schedule
Carty Lake Engineering Design Report
Ridgefield, Washington

Item	Schedule
Final Design, Permitting, and Preconstruction	August 2013 through July 2014
Site Preparation and Erosion Control	August 2014
Upland Sediment Handling Area Construction	August 2014
Sediment Excavation	August 2014 - September 2014
Clearing and Grubbing along Bulkhead	September 2014
Bulkhead Reinforcement Embankment	September 2014
Planting	October 2014 through June 2015

NOTE:
OHW = ordinary high water.

FIGURES



Source: Topographic Quadrangle obtained from ArcGIS Online Services/NGS-USGS TOPO! US Geological Survey (1999)
7.5-minute topographic quadrangle: Ridgefield
Address: Lake River Industrial Site
111 W. Division Street, Ridgefield, WA 98642
Section: 24 Township: 4N Range: 1W Of Willamette Meridian

Figure 1-1
Site Location

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

0 1,000 2,000
Feet

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Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Sediment Remedy\Fig1-1_Site Location.mxd Print Date: 8/8/2014 Approved By: J. King Produced By: D. Coe/ W. Coffey Project: 9003.01.20

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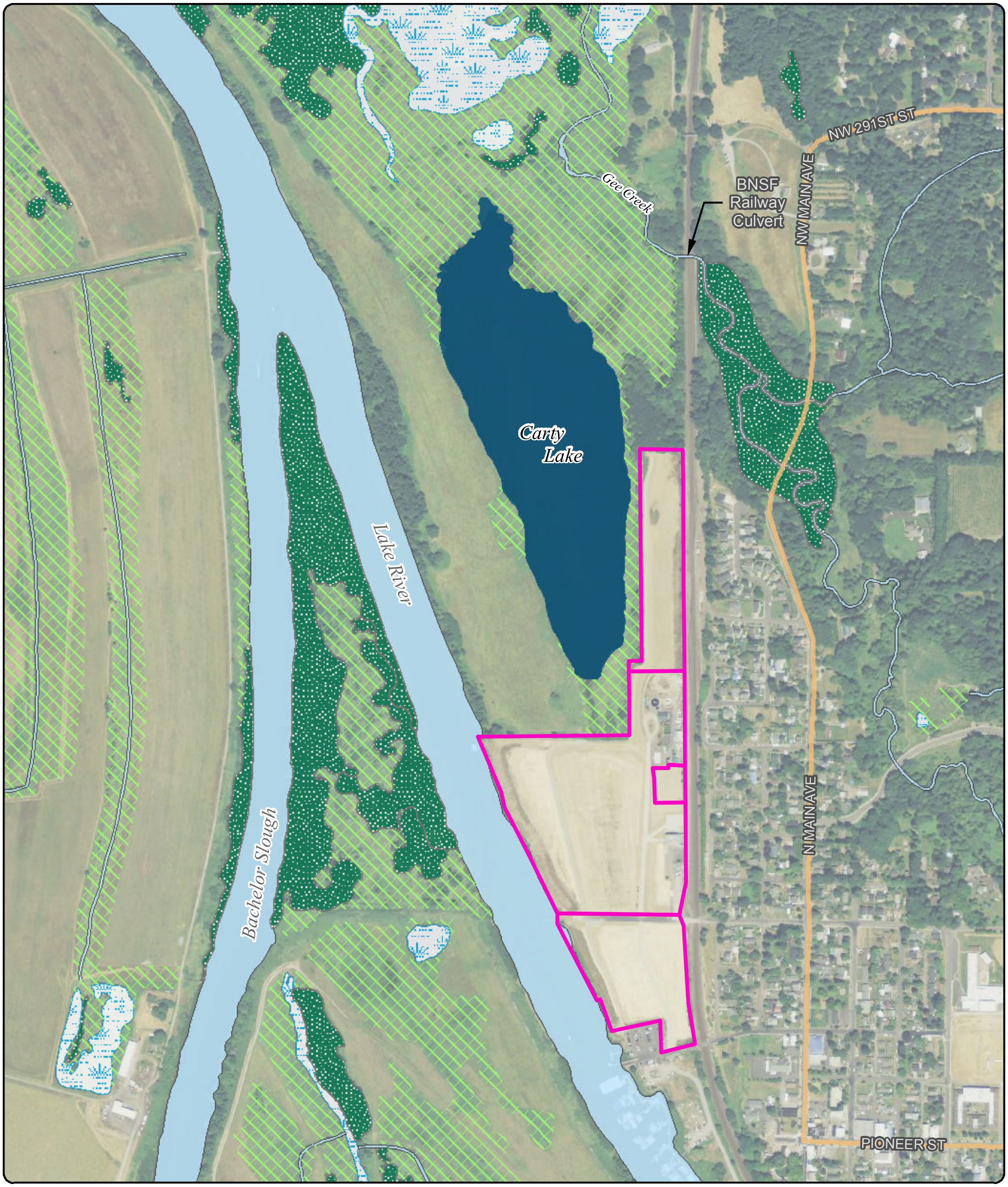
Print Date: 8/8/2014

Approved By: P.Wiescher

Produced By: jschane

Project: 9003.01.40



Source: Aerial photograph and shaded relief obtained from ESRI, Inc. ArcGIS Online.

Notes:
1. Wetlands Delineation obtained from the U.S. Fish and Wildlife Service, National Wetlands Inventory.

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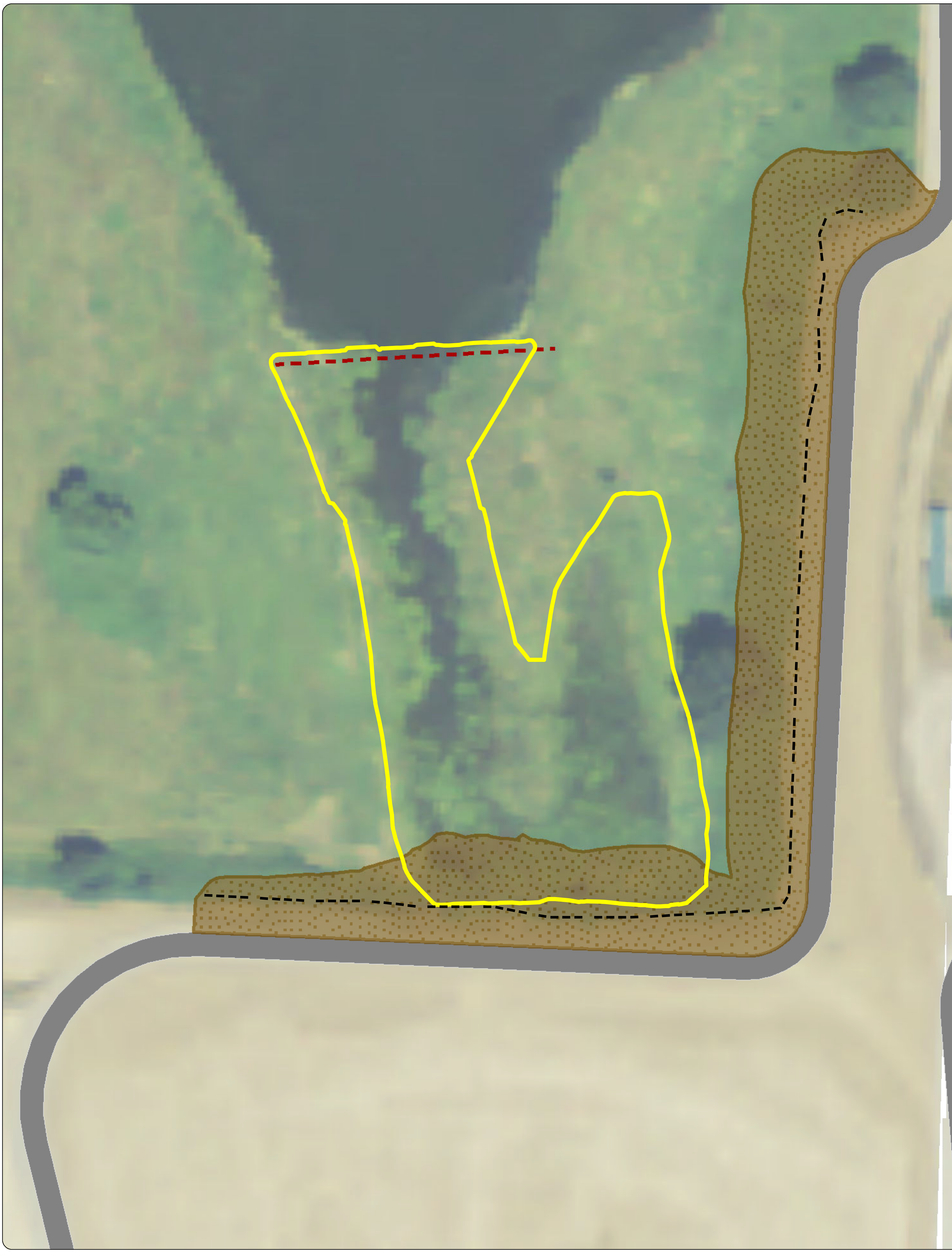
Legend

- POR Cell Boundaries
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Figure 1-2
Carty Lake Setting

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

0 500 1,000
Feet



Source: Aerial photograph (2013) obtained from the National Agriculture Imagery Program (NAIP).

Figure 1-3
Project Location

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

Legend

- Excavation Boundary
- Fill Placement
- Road/Trail
- Retaining Wall
- Former Berm (Approximate)

0 30 60
Feet

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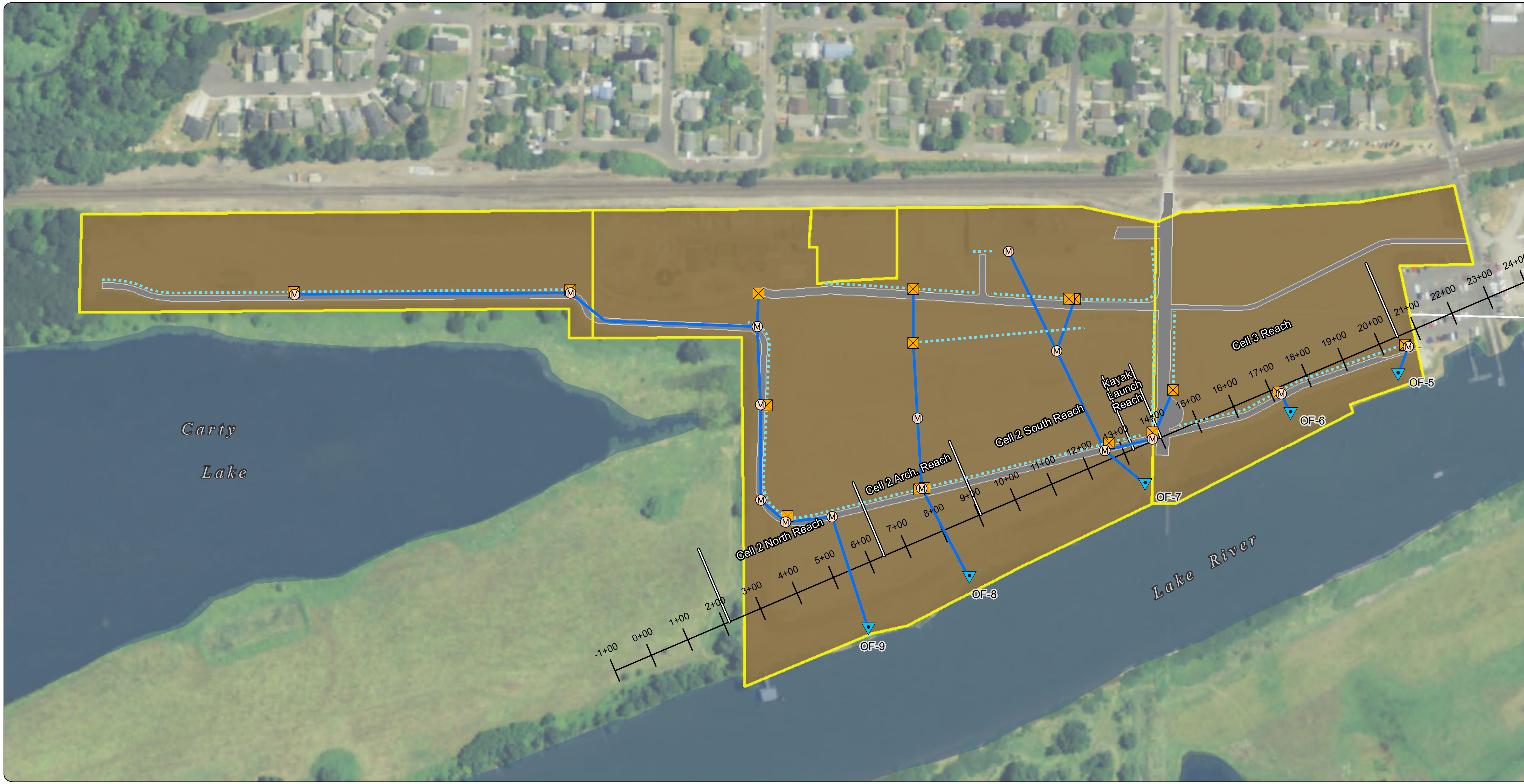
Approved By: P. Wiescher
Produced By: jschane
Project: 9003.01.40



Source: Aerial photograph (2013) obtained from the National Agriculture Imagery Program (NAIP).

Legend

- Manhole
- Catch Basin
- Outfall
- Ditch
- Stormline
- Roads
- Lake & River
- Cell Boundaries

Figure 2-1
Current Stormwater System

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

0 125 250
Feet

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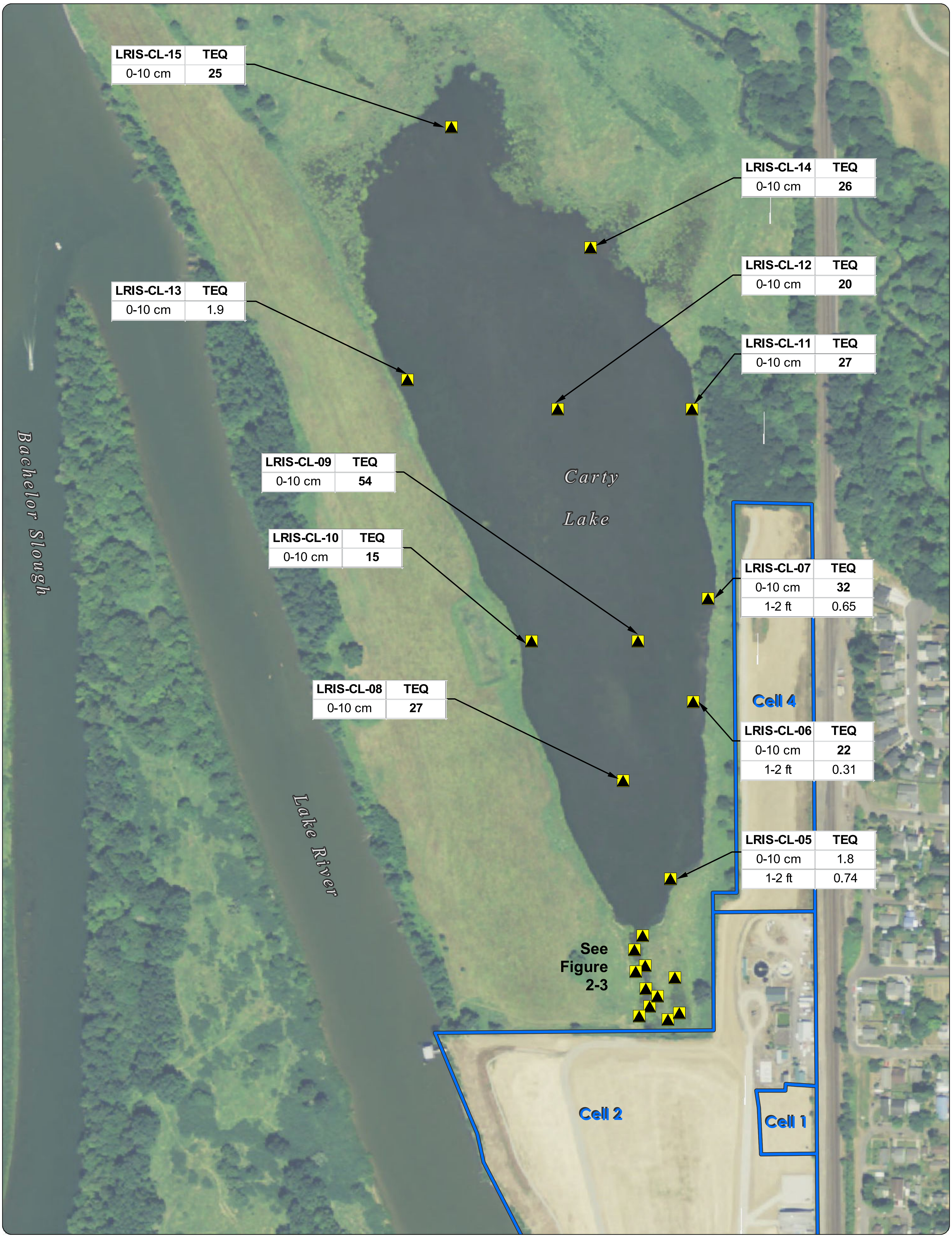
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Sediment Remedy\Fig2-1_Current Stormwater System.mxd
Print Date: 8/8/2014
Approved By: A. Hughes
Produced By: jschane
Project: 9003.01.40



Source: Aerial photograph (2013) obtained from the National Agriculture Imagery Program (NAIP).

Notes:
1. **Bold** value exceeds screening criteria.
2. TEQ = Toxicity Equivalent
3. TEQ measured in ng/kg (nanograms per kilogram)

Legend

- Sediment Sample Location
- Cell Boundaries

Figure 2-2
Carty Lake
Dioxin TEQ Concentrations

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

0 150 300
Feet

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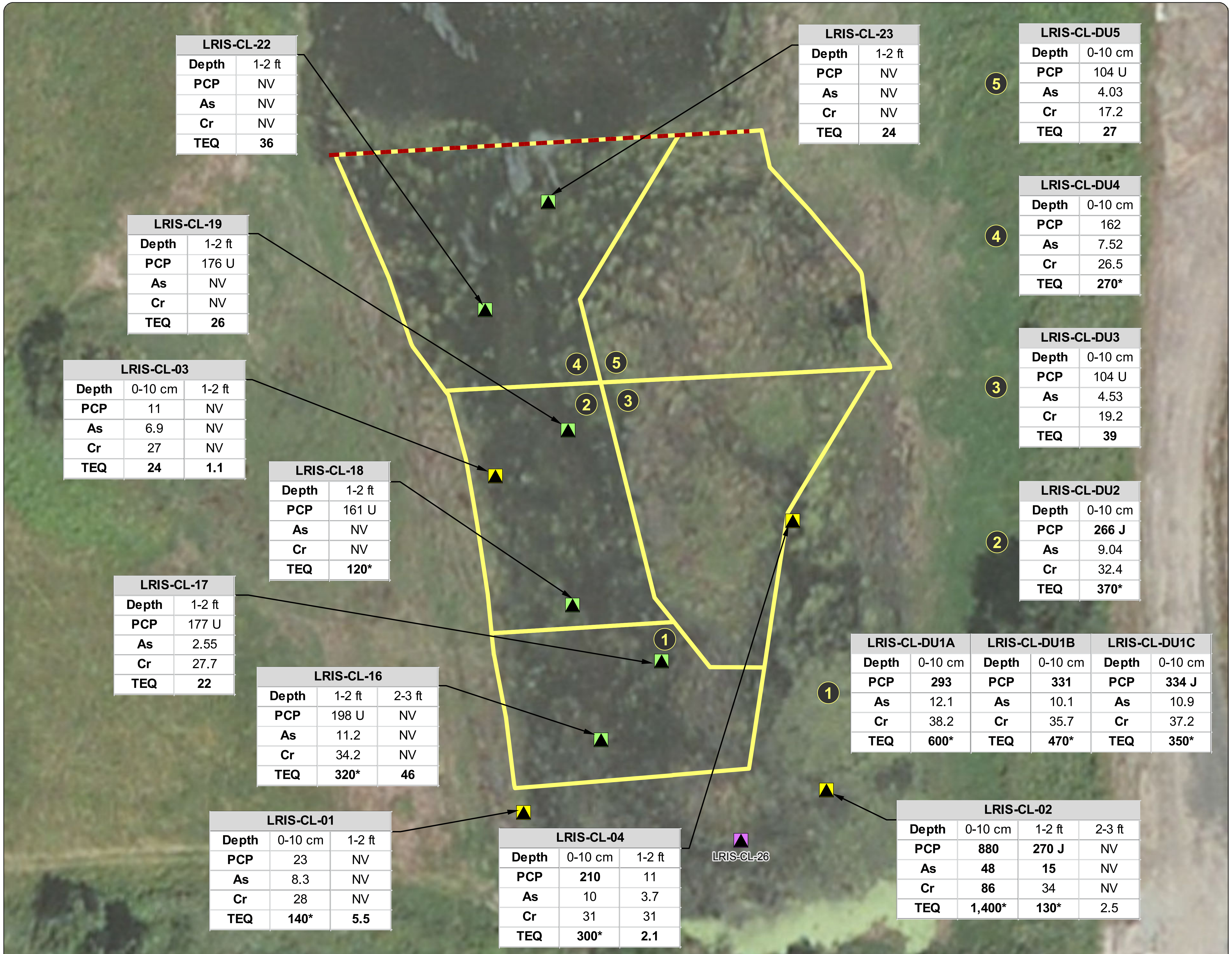
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Sediment Remedy\Fig2-2_Carty Lake Dioxin TEQ Concentrations.mxd

Print Date: 8/8/2014 Approved By: M. Novak Produced By: C.Mikes Project: 9003.01.40/05

Figure 2-3
Carty Lake
Dioxin TEQ Concentrations and Exceedances of Screening Level Values

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington



LRIS-CL-22	
Depth	1-2 ft
PCP	NV
As	NV
Cr	NV
TEQ	**36**

LRIS-CL-23	
Depth	1-2 ft
PCP	NV
As	NV
Cr	NV
TEQ	**24**

LRIS-CL-DU5	
Depth	0-10 cm
PCP	104 U
As	4.03
Cr	17.2
TEQ	**27**

LRIS-CL-19	
Depth	1-2 ft
PCP	176 U
As	NV
Cr	NV
TEQ	**26**

LRIS-CL-DU4	
Depth	0-10 cm
PCP	162
As	7.52
Cr	26.5
TEQ	**270***

LRIS-CL-03		
Depth	0-10 cm	1-2 ft
PCP	11	NV
As	6.9	NV
Cr	27	NV
TEQ	**24**	**1.1**

LRIS-CL-DU3	
Depth	0-10 cm
PCP	104 U
As	4.53
Cr	19.2
TEQ	**39**

LRIS-CL-18	
Depth	1-2 ft
PCP	161 U
As	NV
Cr	NV
TEQ	**120***

LRIS-CL-DU2	
Depth	0-10 cm
PCP	**266 J**
As	9.04
Cr	32.4
TEQ	**370***

LRIS-CL-17	
Depth	1-2 ft
PCP	177 U
As	2.55
Cr	27.7
TEQ	**22**

LRIS-CL-DU1A		LRIS-CL-DU1B		LRIS-CL-DU1C	
Depth	0-10 cm	**Depth**	0-10 cm	**Depth**	0-10 cm
PCP	**293**	**PCP**	**331**	**PCP**	**334 J**
As	12.1	**As**	10.1	**As**	10.9
Cr	38.2	**Cr**	35.7	**Cr**	37.2
TEQ	**600***	**TEQ**	**470***	**TEQ**	**350***

LRIS-CL-16		
Depth	1-2 ft	2-3 ft
PCP	198 U	NV
As	11.2	NV
Cr	34.2	NV
TEQ	**320***	**46**

LRIS-CL-01		
Depth	0-10 cm	1-2 ft
PCP	23	NV
As	8.3	NV
Cr	28	NV
TEQ	**140***	**5.5**

LRIS-CL-04		
Depth	0-10 cm	1-2 ft
PCP	**210**	11
As	10	3.7
Cr	31	31
TEQ	**300***	**2.1**

LRIS-CL-02			
Depth	0-10 cm	1-2 ft	2-3 ft
PCP	**880**	**270 J**	NV
As	**48**	**15**	NV
Cr	**86**	34	NV
TEQ	**1,400***	**130***	2.5

Legend

Sediment Samples

- 2013 Sample
- 2013 Sample (Physical Only)
- 2010/2011 Sample
- Decision Unit (2013 Sample)
- Former Berm (Approximate)

Notes:
1. **Bold** value exceeds screening criteria.
2. As = Arsenic
3. Cr = Chromium
4. J = estimated value
5. NV = no value
6. PCP = Pentachlorophenol
7. TEQ = Toxicity Equivalent
8. TEQ measured in ng/kg (nanograms per kilogram)
   PCP in ug/kg (micrograms per kilogram)
   As and Cr in mg/kg (milligrams per kilogram)
9. U = non-detection

*Indicates exceedance of dioxin congener remediation level. See Figure 2-4 for dioxin congener exceedances.

0 20 40
Feet

Source: Aerial photograph (2010) obtained from Esri ArcGIS Online.

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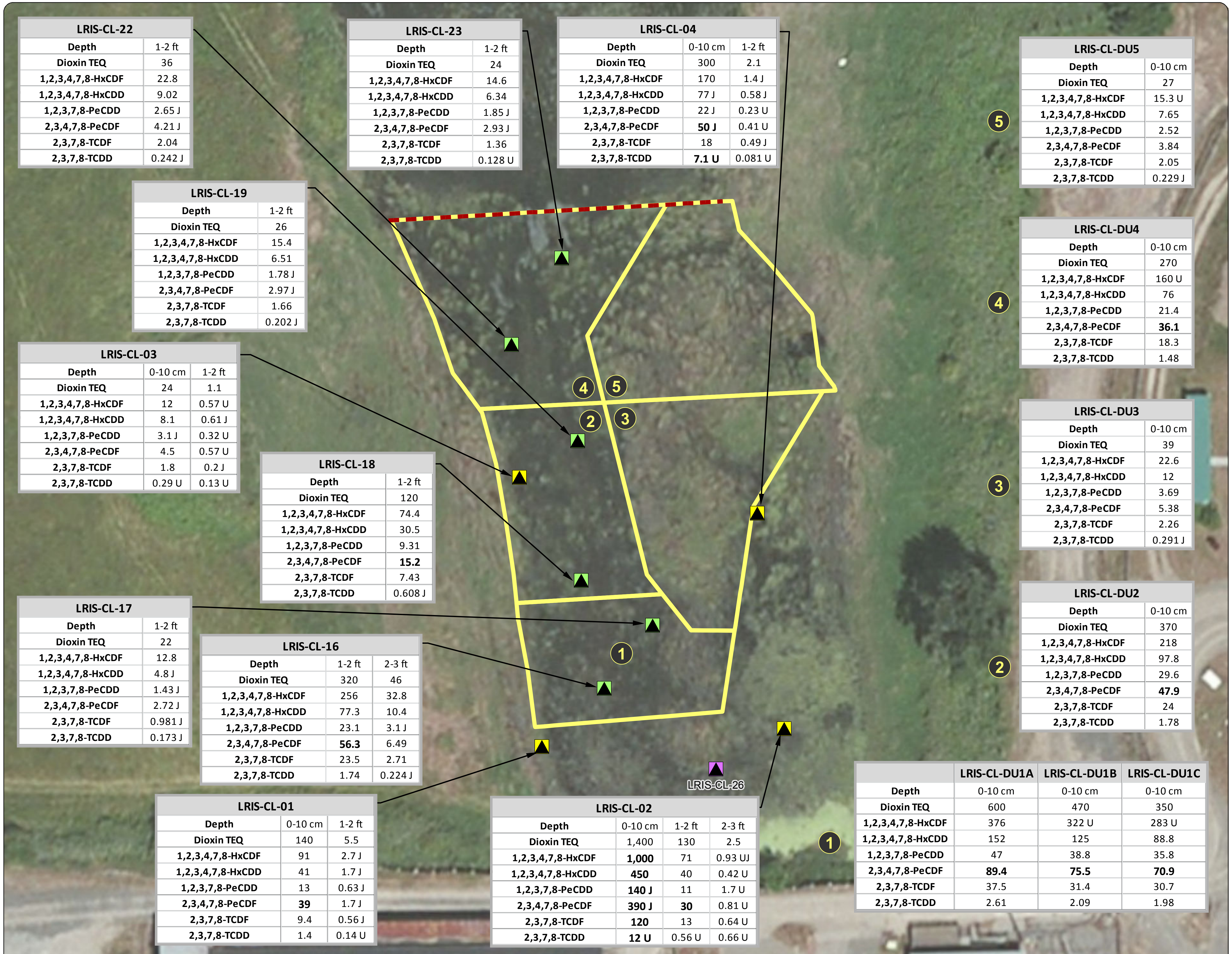
Print Date: 8/8/2014
Approved By: P. Wescher
Produced By: jschane
Project: 9003.01.40

Figure 2-4
Carty Lake
Dioxin TEQ and Congeners Exceedances of Remediation Levels

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington



LRIS-CL-22

Depth	1-2 ft
Dioxin TEQ	36
1,2,3,4,7,8-HxCDF	22.8
1,2,3,4,7,8-HxCDD	9.02
1,2,3,7,8-PeCDD	2.65 J
2,3,4,7,8-PeCDF	4.21 J
2,3,7,8-TCDF	2.04
2,3,7,8-TCDD	0.242 J

LRIS-CL-23

Depth	1-2 ft
Dioxin TEQ	24
1,2,3,4,7,8-HxCDF	14.6
1,2,3,4,7,8-HxCDD	6.34
1,2,3,7,8-PeCDD	1.85 J
2,3,4,7,8-PeCDF	2.93 J
2,3,7,8-TCDF	1.36
2,3,7,8-TCDD	0.128 U

LRIS-CL-04

Depth	0-10 cm	1-2 ft
Dioxin TEQ	300	2.1
1,2,3,4,7,8-HxCDF	170	1.4 J
1,2,3,4,7,8-HxCDD	77 J	0.58 J
1,2,3,7,8-PeCDD	22 J	0.23 U
2,3,4,7,8-PeCDF	**50 J**	0.41 U
2,3,7,8-TCDF	18	0.49 J
2,3,7,8-TCDD	**7.1 U**	0.081 U

LRIS-CL-DU5

Depth	0-10 cm
Dioxin TEQ	27
1,2,3,4,7,8-HxCDF	15.3 U
1,2,3,4,7,8-HxCDD	7.65
1,2,3,7,8-PeCDD	2.52
2,3,4,7,8-PeCDF	3.84
2,3,7,8-TCDF	2.05
2,3,7,8-TCDD	0.229 J

LRIS-CL-19

Depth	1-2 ft
Dioxin TEQ	26
1,2,3,4,7,8-HxCDF	15.4
1,2,3,4,7,8-HxCDD	6.51
1,2,3,7,8-PeCDD	1.78 J
2,3,4,7,8-PeCDF	2.97 J
2,3,7,8-TCDF	1.66
2,3,7,8-TCDD	0.202 J

LRIS-CL-DU4

Depth	0-10 cm
Dioxin TEQ	270
1,2,3,4,7,8-HxCDF	160 U
1,2,3,4,7,8-HxCDD	76
1,2,3,7,8-PeCDD	21.4
2,3,4,7,8-PeCDF	**36.1**
2,3,7,8-TCDF	18.3
2,3,7,8-TCDD	1.48

LRIS-CL-03

Depth	0-10 cm	1-2 ft
Dioxin TEQ	24	1.1
1,2,3,4,7,8-HxCDF	12	0.57 U
1,2,3,4,7,8-HxCDD	8.1	0.61 J
1,2,3,7,8-PeCDD	3.1 J	0.32 U
2,3,4,7,8-PeCDF	4.5	0.57 U
2,3,7,8-TCDF	1.8	0.2 J
2,3,7,8-TCDD	0.29 U	0.13 U

LRIS-CL-DU3

Depth	0-10 cm
Dioxin TEQ	39
1,2,3,4,7,8-HxCDF	22.6
1,2,3,4,7,8-HxCDD	12
1,2,3,7,8-PeCDD	3.69
2,3,4,7,8-PeCDF	5.38
2,3,7,8-TCDF	2.26
2,3,7,8-TCDD	0.291 J

LRIS-CL-18

Depth	1-2 ft
Dioxin TEQ	120
1,2,3,4,7,8-HxCDF	74.4
1,2,3,4,7,8-HxCDD	30.5
1,2,3,7,8-PeCDD	9.31
2,3,4,7,8-PeCDF	**15.2**
2,3,7,8-TCDF	7.43
2,3,7,8-TCDD	0.608 J

LRIS-CL-17

Depth	1-2 ft
Dioxin TEQ	22
1,2,3,4,7,8-HxCDF	12.8
1,2,3,4,7,8-HxCDD	4.8 J
1,2,3,7,8-PeCDD	1.43 J
2,3,4,7,8-PeCDF	2.72 J
2,3,7,8-TCDF	0.981 J
2,3,7,8-TCDD	0.173 J

LRIS-CL-16

Depth	1-2 ft	2-3 ft
Dioxin TEQ	320	46
1,2,3,4,7,8-HxCDF	256	32.8
1,2,3,4,7,8-HxCDD	77.3	10.4
1,2,3,7,8-PeCDD	23.1	3.1 J
2,3,4,7,8-PeCDF	**56.3**	6.49
2,3,7,8-TCDF	23.5	2.71
2,3,7,8-TCDD	1.74	0.224 J

LRIS-CL-DU2

Depth	0-10 cm
Dioxin TEQ	370
1,2,3,4,7,8-HxCDF	218
1,2,3,4,7,8-HxCDD	97.8
1,2,3,7,8-PeCDD	29.6
2,3,4,7,8-PeCDF	**47.9**
2,3,7,8-TCDF	24
2,3,7,8-TCDD	1.78

LRIS-CL-01

Depth	0-10 cm	1-2 ft
Dioxin TEQ	140	5.5
1,2,3,4,7,8-HxCDF	91	2.7 J
1,2,3,4,7,8-HxCDD	41	1.7 J
1,2,3,7,8-PeCDD	13	0.63 J
2,3,4,7,8-PeCDF	**39**	1.7 J
2,3,7,8-TCDF	9.4	0.56 J
2,3,7,8-TCDD	1.4	0.14 U

LRIS-CL-02

Depth	0-10 cm	1-2 ft	2-3 ft
Dioxin TEQ	1,400	130	2.5
1,2,3,4,7,8-HxCDF	**1,000**	71	0.93 UJ
1,2,3,4,7,8-HxCDD	**450**	40	0.42 U
1,2,3,7,8-PeCDD	**140 J**	11	1.7 U
2,3,4,7,8-PeCDF	**390 J**	**30**	0.81 U
2,3,7,8-TCDF	**120**	13	0.64 U
2,3,7,8-TCDD	**12 U**	0.56 U	0.66 U

	LRIS-CL-DU1A	LRIS-CL-DU1B	LRIS-CL-DU1C
Depth	0-10 cm	0-10 cm	0-10 cm
Dioxin TEQ	600	470	350
1,2,3,4,7,8-HxCDF	376	322 U	283 U
1,2,3,4,7,8-HxCDD	152	125	88.8
1,2,3,7,8-PeCDD	47	38.8	35.8
2,3,4,7,8-PeCDF	**89.4**	**75.5**	**70.9**
2,3,7,8-TCDF	37.5	31.4	30.7
2,3,7,8-TCDD	2.61	2.09	1.98

Legend

Sediment Samples

- 2013 Sample
- 2013 Sample (Physical Only)
- 2010/2011 Sample
- Decision Unit (2013 Sample)
- Former Berm (Approximate)

Notes:
1. **Bold** value exceeds remediation level.
2. J = estimated value.
3. U = non-detect.
4. TEQ = Toxicity Equivalent.

0 25 50
Feet

Source: Aerial photograph (2010) obtained from Esri ArcGIS Online.

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Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Sediment Remedy\Fig2-4_Carty Lake Dioxin TEQ and Congeners Exceedances of Remediation Levels.mxd
Print Date: 8/8/2014
Approved By: P. Wiescher
Produced By: jschane
Project: 9003.01.40/06

Figure 4-1
Post Excavation Surface Sediment

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

Legend

- Sediment Sample Location
- Decision Unit
- Extent of Excavation
- Former Berm (Approximate)

Notes:
1. **Bold** value exceeds remediation level.
2. TEQ = Toxicity Equivalent
3. PeCDF = 2,3,4,7,8-Pentachlorodibenzofuran
4. TEQ and 2,3,4,7,8-PeCDF measured in ng/kg (nanograms per kilogram)
5. Conditions shown prior to clean sand placement.

0 20 40
Feet

Source: Aerial photograph (insert date) obtained from Esri ArcGIS Online

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Project: 9003.01.40 Produced By: jschane Approved By: P. Wescher Print Date: 8/8/2014 Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Sediment Remedy\Fig4-1_Post Excavation Surface Sediment.mxd

Figure 4-2
Modeled Post Remedy Surface Sediment Concentrations

Carty Lake Remedial Action
Port of Ridgefield
Ridgefield, Washington

Legend

- Sediment Sample Location
- Decision Unit
- Extent of Excavation
- Former Berm (Approximate)

* The modeled concentration marginally exceeds the remediation level of 6.5 ng/kg. This estimated concentration is based on a number of conservative assumptions and is not expected to result in unacceptable risk for a variety of reasons discussed in the text of the report.

Notes:
1. **Bold** value exceeds remediation level.
2. TEQ = Toxicity Equivalent
3. PeCDF = 2,3,4,7,8-Pentachlorodibenzofuran
4. TEQ and 2,3,4,7,8-PeCDF measured in ng/kg (nanograms per kilogram)
5. Final conditions assume 100% mixing with clean sand layer.

0 20 40
Feet

Source: Aerial photograph (insert date) obtained from Esri ArcGIS Online

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Print Date: 8/8/2014
Approved By: P. Wiescher
Produced By: jschane
Project: 9003.01.40

FINAL DESIGN SPECIFICATIONS

FINAL DESIGN DRAWINGS

APPENDIX A
PERMITTING AND SUBSTANTIVE REQUIREMENTS DOCUMENTATION

APPENDIX B
WETLAND DELINEATION

APPENDIX C

CARTY LAKE MITIGATION PLAN

APPENDIX D

CARTY LAKE BANK USE PLAN

APPENDIX E

LETTER REPORT RE: GEOTECHNICAL ENGINEERING SERVICES MILLER'S LANDING ON THE RIDGEFIELD WATERFRONT BY GEODESIGN, INC.

APPENDIX F

CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE CARTY LAKE SEDIMENT REMEDY PROJECT.