Supplemental Upland Data Collection Work Plan
Volume I of II
Text, Tables and Appendices

For the Upland Portion of the Study Area
Port Angeles Rayonier Mill Site
Port Angeles, Washington

For

Rayonier

July 20, 2010

GeoEngineers

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File No. 0137-015-03

July 20, 2010

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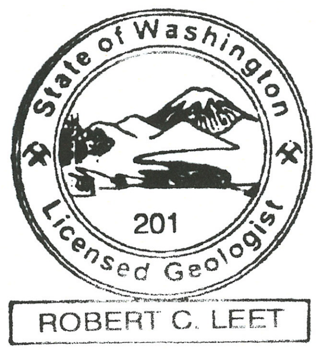

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1.0 INTRODUCTION

1.1 Background and Regulatory Framework

This Supplemental Upland Data Collection Work Plan (Work Plan) has been prepared on behalf of Rayonier, Inc. (Rayonier) for the upland portion of a Study Area within the Port Angeles Rayonier Mill Site (Site). The former mill property, located at 700 North Ennis Street in Port Angeles, Washington, comprises approximately 80 acres on the northern coast of Washington's Olympic Peninsula bordering on the Strait of Juan de Fuca (Figure 1). Until the mill was dismantled in 1997, it operated as a dissolving sulfite pulp mill that produced acetate, specialty paper, fluff, and viscose-grade pulps for industrial use.

A Study Area within the larger Site has been defined to allow cleanup work to be expedited without waiting for the full nature and extent of contamination to be defined. The "Study Area" refers to the former Rayonier Mill property and the adjacent marine environment. The upland portion of the Study Area includes the Rayonier Mill property owned or leased by Rayonier. The Study Area is only a portion of the Site and its boundaries do not reflect the boundaries of the Site/Facility as defined by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (Washington Administrative Code [WAC] Chapter 173-340).

Remedial actions within the Study Area are being conducted under Agreed Order No. DE 6815 (Order) with the Washington State Department of Ecology (Ecology) (Ecology, 2010a). The Order supersedes Agreed Order No. DE 02SWFAPSR-4570 dated July 30, 2002 (Marine Order), and Agreed Order No. DE 04SWFAPSR-6025 dated March 11, 2004 (Upland Order). This Work Plan addresses the upland portion of the Study Area and constitutes Task 1a under Section VII of the Order.

1.2 Purpose and Objectives

Previous investigations have generated a considerable amount of data relating to soil and groundwater quality within the Upland Study Area. However, further work is needed to complete the Upland Remedial Investigation (RI). The purpose of the Upland RI is to collect sufficient Site information to allow a Feasibility Study of cleanup action alternatives to be completed for the Upland Study Area. The purpose of the supplemental upland data collection effort described in this Work Plan is to fully define the nature and extent of contamination in the upland portion of the Study Area. The purpose of fully defining the nature and extent of contamination in the Study Area is to evaluate interim action alternatives for the Study Area as a whole. The objective of the supplemental data collection effort is to fill data gaps identified in Exhibit B of the Order.

1.3 Work Plan Organization

This Work Plan consists of the following sections:

- Section 1: Introduction
- Section 2: Property History and Environmental Setting
- Section 3: Summary of Previous Upland Investigations and Interim Actions

- Section 4: Conceptual Site Model
- Section 5: Nature and Extent of Contamination in Soil and Groundwater
- Section 6: Supplemental Upland Data Collection Field Investigation
- Section 7: Reporting
- Section 8: Schedule
- Section 9: References

2.0 PROPERTY HISTORY AND ENVIRONMENTAL SETTING

The former Rayonier Mill property is in the city of Port Angeles, Clallam County, Washington, along the northern coast of the Olympic Peninsula on the southern shore of Port Angeles Harbor, in the Strait of Juan de Fuca. The mill property comprises approximately 80 acres and is located in the northwest quarter of Section 11, Township 30 North, Range 6 West, at latitude 48° 07' 00" North and longitude 123° 24' 25" West.

The mill property is bounded on the south by a high bluff and gently slopes north toward Port Angeles Harbor. Residential and commercial properties are located to the south of the property. Ennis Creek flows from the Olympic Mountains through the property and discharges into Port Angeles Harbor.

2.1 Property History

2.1.1 Mill Operations

Prior to 1930, a portion of the Rayonier Mill property was occupied by a saw mill. The Rayonier Pulp Mill operated between 1930 and 1997, producing dissolving-grade pulps from wood chips. The mill was owned by Olympic Forest Products from 1930 until 1937, when it merged with Rayonier. Mill ownership shifted to ITT Rayonier, Inc., between 1968 and 1994, after which it returned to Rayonier. Rayonier permanently ceased production at the mill in 1997 and dismantled the mill facilities between 1997 and 1999.

The various process areas used to conduct mill operations are depicted in Figure 2. The former mill operations are described in detail in several previous reports and work plans (Foster Wheeler, 1997; Ecology and Environment [E&E], 1998; Integral and Foster Wheeler, 2004; Integral, 2006). From 1930 to 1972, process wastewater and stormwater generated at the mill were discharged directly into Port Angeles Harbor through five near-shore outfalls distributed along the shoreline between the former log pond area and the mouth of Ennis Creek. The locations of the historical outfalls are shown in Exhibit 1, which is from a 1981 report describing the history of pulp mill effluents in the Port Angeles area (Shea et al., 1981). This figure shows that the locations of the five historical outfalls did not change during their operational life, and the location of the mill property shoreline has not been changed significantly by filling activities since 1930. In 1972, an extensive wastewater and stormwater drainage system and primary wastewater treatment plant were constructed at the mill, and the near-shore outfalls were removed from service. The treatment plant routed all effluent and stormwater to a new outfall, which extends 7,900 feet into the Strait of Juan de Fuca. A secondary wastewater treatment plant was constructed at the mill in 1979.

2.1.2 Cultural Resources

In 1997, as part of mill decommissioning activities, Rayonier contracted Larson Anthropological/ Archaeological Services (LAAS) to conduct a cultural resources assessment of the mill (LAAS, 1997). The assessment consisted of an archival review, tribal consultation, field reconnaissance and preparation of a Cultural Resources Assessment (CRA) Report. The CRA Report provides a detailed description of the environment and cultural background of the Port Angeles Rayonier Mill area. It describes a historical Klallam Indian village on the eastern bank of Ennis Creek that supported a population of hunter-fisher-gatherers prior to Euro-American contact. The Klallam village site was recorded and listed on the Washington Heritage Register, although no archaeological deposits associated with the Rayonier Mill property were recorded.

2.2 Environmental Setting

This section summarizes the topography, geology and hydrogeology, and biological setting of the mill property.

2.2.1 Topography and Surface Water

A significant portion of the mill property rests on historically filled shallows, beach material and the former alluvial fan of Ennis Creek. Surface elevations range from sea level to approximately 75 feet above the National Geodetic Vertical Datum (NGVD) (Harding Lawson Associates [HLA], 1993). The terrain rises to approximately 200, 265 and 150 feet above NGVD within approximately 1 mile southeast, south and southwest of the property, respectively (HLA, 1993). The northern portion of the property is generally flat, with relatively steep bluffs rising rapidly to approximately 75 feet above NGVD immediately to the southeast and southwest (HLA, 1993). Hills farther to the southeast and southwest gradually rise toward the foothills of the Olympic Mountains (HLA, 1993).

The closest surface water bodies are Port Angeles Harbor, which borders the mill property to the north, and White Creek and Ennis Creek, which converge upstream of the property and run through it as Ennis Creek. A steep ravine is formed where Ennis Creek cuts through the bluff in the southern portion of the property. An access road exists along the western side of this ravine, dropping in elevation from approximately 75 feet above NGVD to just above sea level.

2.2.2 Geology

The local geology in the vicinity of the mill property is characterized by Tertiary bedrock overlain by Pleistocene-age sedimentary deposits and recent alluvium. The near-surface geology within the Upland Study Area consists of fill material, alluvium deposited by Ennis Creek, and beach deposits. Vashon Till glacial deposits, consisting of well-graded gravels and cobbles in a matrix of sand, clay and silt, are present along the bluffs to the south of the property. Glacial deposits (till and drift) also are present beneath the beach deposits and shallow fill comprising the Upland Study Area. The depth to bedrock under the property is unknown, but is likely variable in the Port Angeles area based on local isolated outcrops of the Tertiary Twin River Formation (Tabor and Cady, 1978; HLA, 1993).

The mixed beach and fill deposits within the Upland Study Area consist of sand, gravel and cobble-size material reworked by wave action, combined with various materials used for fill. Materials used for fill include sand and gravel, wood waste, ash, and demolition debris (HLA, 1993). During mill decommissioning from 1997 to 1999, crushed concrete rubble was distributed across some areas of the property. In 1999, fill material consisting of gravel, rock, and riprap was imported to reconstruct and prevent further shoreline erosion along the former log pond area beach wall. Materials in many areas of the mill property have likely been modified through grading, dredging, filling, or facility operations, and may vary considerably between locations. The physical characteristics of the fill and native deposits depend on the nature of the materials, and, as a result, are highly variable across the property (HLA, 1993).

During the Upland RI and previous investigations, fill materials generally comprised the majority of the upper soil column encountered in boreholes completed in the Log Yard and Wood Mill areas and the central and northern portions of the Main Process Area. These materials were frequently sands and gravelly sands, although wood debris and crushed limestone also were encountered. In the northwestern portion of the mill property, previous investigations encountered fill consisting of gravel, sand, and silt with fragments of shells, wood, brick, metal, and other debris to depths of 20 to 25 feet below ground surface (bgs). Glacial deposits were encountered under the fill to a depth of 44 feet bgs (see below), the maximum depth explored (Foster Wheeler, 1997).

In general, fill deposits were thinner, and native beach sands (characterized by the presence of poorly graded, uniform materials) tended to be encountered more frequently, in boreholes located closer to the bluffs bordering the property to the south. Similarly, the thickness of fill tended to decrease in boreholes in the vicinity of Ennis Creek, where apparent native sand and silt layers were encountered at relatively shallow depths (roughly 5 feet bgs). Boreholes completed in the eastern portion of the property showed similar patterns, with a 3- to 7-foot-thick layer of gravelly sand fill overlying beach sands. Materials encountered in the Bone Yard, located in the southeastern portion of the property, generally consisted of a gravelly fill layer (roughly 4 feet thick) overlying glacial deposits.

Glacial deposits (Vashon Till, glacially over-ridden outwash, and/or older glacial drift) underlie fill and alluvium across the Upland Study Area. The glacial deposits were encountered in 57 soil borings (Figure 3), at depths ranging from 7.5 to 33 feet bgs (elevations of approximately -22 to +44 feet above mean sea level; note that ground surface elevations in some areas have changed over time as a result of mill decommissioning and interim action construction activities) (Landau, 1990 and 1991; HLA, 1993; CH2M Hill, 1977). The previous borings advanced to the top of the glacial deposits and deeper indicate that the glacial deposits are laterally continuous across the mill property and are at least 10 to 25 feet thick (Landau, 1991; CH2M Hill, 1977). Glacial till deposits at the mill property are described as dense to very dense, silty, gravelly sand with a clay, silt, and fine sand matrix. Older glacial drift deposits are variably described as very dense silty, gravelly, sand and gravelly sand, sandy gravel, and silt.

The permeability of the glacial deposits is likely low given the material's high density and fine-grained matrix. Although the competency of the glacial deposits has not been directly measured (e.g., by performing permeability tests on collected soil samples), the permeability of glacial till is typically several orders of magnitude less than that of unconsolidated sandy soil (Holtz and Kovacs, 1981). Published estimates of the horizontal hydraulic conductivity of Puget Sound glacial till range from 0.014 to 0.12 feet per day (Vaccaro, 1998). As described in Section 6.6.2, an attempt will be made to collect samples of the glacial deposits to confirm low permeability.

2.2.3 Hydrogeology

Groundwater conditions observed during previous investigations indicate the presence of unconfined groundwater in the near-surface fill and alluvial deposits beneath the Upland Study Area. The saturated thickness of the shallow water-bearing zone is variable; the base (generally defined by the top of the glacial till unit) varies from 12 feet bgs to greater than 30 feet bgs (Foster Wheeler, 1997). Groundwater elevations are influenced by tidal fluctuations (E&E, 1998) and, to a lesser extent, by surface water fluctuations in Ennis Creek.

Groundwater monitoring wells at the mill property are screened in the shallow water-bearing zone (fill and alluvium) above the glacial till. The measured depth to groundwater in monitoring wells ranges from approximately 3 to 17 feet bgs (Integral, 2006). Measured groundwater elevations during the winter months are typically 2 to 3 feet higher than in the summer months (Integral, 2006).

Groundwater elevation data indicate that shallow groundwater beneath the mill property flows in a northerly direction toward Port Angeles Harbor, with a locally variable lateral component toward Ennis Creek. During the RI, estimated horizontal hydraulic gradients in the southern portion of the property generally ranged from 0.014 to 0.017, while gradients in the northern portion of the property ranged from 0.002 to 0.009. Estimates of shallow groundwater seepage (interstitial) velocity and discharge to Port Angeles Harbor are presented in the Upland RI Report (Integral, 2006).

Figures 4 and 5 (from the Upland RI Report; Integral, 2006) depict the interpreted potentiometric surface at the property under both low tide and high tide conditions. Previous tidal studies indicate moderate tidal influence on groundwater elevations and hydraulic gradients near the shoreline, but little or no tidal influence in the interior portion of the property.

2.2.4 Biological Setting

The biological setting of the Former Rayonier Pulp Mill is described in detail in the Upland RI Work Plan (Integral and Foster Wheeler, 2004) and summarized in the Upland RI Report (Integral, 2006). These reports identify habitat as well as endangered and threatened species that may be associated with the Upland Study Area.

3.0 SUMMARY OF PREVIOUS UPLAND INVESTIGATIONS AND INTERIM ACTIONS

This section presents a summary of previous investigations and interim actions completed in the Upland Study Area. The two largest studies to date were the Expanded Site Inspection (ESI) conducted in 1997 by the United States Environmental Protection Agency (USEPA) and the Upland RI conducted in 2003 by Rayonier. Samples of soil, groundwater, surface water, freshwater sediment, worm tissue and/or plant tissue were collected from locations across the property during these studies. In addition to these property-wide studies, several investigations focusing on localized areas of the mill property have been completed, most of them initiated prior to the 1997 ESI. Figure 6A shows the Upland RI and ESI sampling locations and the interim action areas. Figure 6B shows the locations of soil samples collected prior to the completion of mill decommissioning in October 1999, and Figure 6C shows the locations of soil samples collected after mill decommissioning. Soil sampling locations that were entirely excavated during subsequent interim actions are not shown on Figures 6B and 6C; however, these figures do show interim action verification sample locations.

3.1 Investigations Initiated Prior to 1997

The ESI conducted by USEPA in 1997 (E&E, 1998) was the first property-wide investigation of the Rayonier Pulp Mill. Prior to the 1997 ESI, several investigations were initiated at the mill property to assess upland soil and groundwater conditions, beginning with an investigation of a hydraulic oil release in the Finishing Room/Ennis Creek area in 1989-1990. The investigations initiated prior to 1997 are summarized below.

3.1.1 Finishing Room/Ennis Creek Hydraulic Oil Release Investigation (1989-1990)

During a USEPA chemical safety audit in May 1989, an oil sheen was discovered in Ennis Creek adjacent to the Finishing Room. The sheen appeared to originate from riprap on the west bank of Ennis Creek. A subsequent investigation conducted by ITT Rayonier in 1989 and 1990 (Landau, 1991) determined that the oil originated from past releases of hydraulic oil from pulp baling presses in the Finishing Room. A free-phase oil plume measuring approximately 160 by 65 feet was identified in shallow soil under the eastern portion of the Finishing Room and extending to Ennis Creek. Polychlorinated biphenyls (PCBs) also were detected in soil under the Finishing Room. ITT Rayonier initially installed absorbent pads/booms and containment structures to collect the oil; Rayonier later installed a free-product recovery system to intercept and collect oil migrating towards Ennis Creek (Foster Wheeler, 1997).

Interim actions completed in the Finishing Room/Ennis Creek area, including the excavation and removal of soil, are summarized in Section 3.4.2.

3.1.2 Investigations at Former Fuel Oil Tank 2 (1989-1997)

Subsurface investigations completed by ITT Rayonier near Fuel Oil Tank 2 prior to demolition of the tank in 1993 consisted of drilling 28 soil borings and installing 13 groundwater monitoring wells (Landau, 1990). The investigations revealed petroleum hydrocarbons in soil and groundwater beneath the tank and in an adjacent pump sump area immediately east of the tank. Free-phase petroleum product accumulated in monitoring wells MW-7 and MW-16 in the pump sump area.

During a groundwater sampling event in August and September 1997, free-phase petroleum product was observed in monitoring well MW-11 in the pump sump area (Landau, 1998a). Due to the presence of free-phase product, groundwater samples were not collected from well MW-11, but a sample of the petroleum product in the well was collected and analyzed for PCBs. PCBs were not detected in the product sample. Groundwater samples collected from three other wells in the vicinity of Fuel Oil Tank 2 (MW-20, MW-23 and MW-29) in August/September 1997 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, petroleum hydrocarbons, and dissolved priority pollutant metals. None of these constituents was detected above MTCA Method A cleanup levels (WAC 173-340-720).

Interim actions completed in the Fuel Oil Tank 2 area, including the excavation and removal of soil, are summarized in Section 3.4.1.

3.1.3 Quantitative Environmental Survey Program Investigation (1993)

The objective of this 1993 investigation performed by ITT Rayonier (HLA, 1993) was to assess stratigraphic and hydrogeologic conditions at the mill property. It included installing 12 monitoring wells (PZ-1 through PZ-7 and PZ-9 through PZ-13), measuring groundwater and surface water elevations, and assessing tidal influence on groundwater elevations/flow. Samples were not collected for chemical analysis during the study. Unconfined groundwater was encountered at depths of 5 to 15 feet bgs during the study. The groundwater flow direction was determined to be generally northward toward Port Angeles Harbor.

3.1.4 Hog Fuel Pile Investigations (1993 and 2001)

In 1993, ITT Rayonier conducted an investigation to evaluate an area of possible petroleum contamination in the Hog Fuel Pile area. The investigation included digging test pits and sampling soil/wood chip material and groundwater. The samples were analyzed for total petroleum hydrocarbons (TPH). Analytical results indicated that TPH concentrations were only slightly above the MTCA cleanup level of 200 milligrams per kilogram (mg/kg). Due to the apparent limited volume of the contamination (approximately 90 cubic yards [cy], including soil and wood residue), ITT Rayonier chose a natural attenuation remedy for the impacted material.

Rayonier conducted a supplemental investigation of the Hog Fuel Pile area in 2001 to assess the suitability of the material for disposal at the Port Angeles Sanitary Landfill (Landau, 2001a and 2001b). The supplemental investigation consisted of collecting up to 25 samples from 0 to 6 feet bgs and analyzing them for diesel- and heavy oil-range TPH and Toxicity Characteristic Leaching Procedure (TCLP) constituents including VOCs, SVOCs, pesticides, herbicides, and metals.

Interim actions completed in the Hog Fuel Pile area are summarized in Section 3.4.3.

3.1.5 Property-Wide Groundwater Monitoring (1997-1998)

Rayonier first collected samples for chemical analysis from the groundwater monitoring wells installed during the 1993 quantitative environmental survey program investigation (HLA, 1993) in 1997 (Landau, 1997), and again after mill closure in 1998 (Landau, 1998a). Selected monitoring wells in the Fuel Oil Tank 2 area also were sampled in 1998. Rayonier installed two additional monitoring wells (MW-51 and MW-52) in 1998, between the shoreline and the former equipment maintenance facility (MW-51) and near former well PZ-1 (MW-52) (Landau, 1998a).

The groundwater samples were analyzed for VOCs, SVOCs, PCBs, diesel- and heavy oil-range TPH, priority pollutant metals, turbidity, asbestos, and indicator parameters identified in the minimum functional standards for solid waste handling (WAC 173-304-490). Arsenic and chromium were the only constituents that exceeded regulatory screening criteria used in the study (MTCA Method A cleanup levels; WAC 173-340-720). Diesel-range TPH, acenaphthene, fluorene, carbazole, fluoranthene, and naphthalene were detected but did not exceed the screening criteria.

3.2 Expanded Site Inspection (1997)

The USEPA conducted the ESI field investigation in 1997 (E&E, 1998). The ESI included collection of samples from potential upland source (mill process) areas and areas potentially impacted by contaminant migration (Log Yard, Hog Fuel Pile, Bone Yard, soil under facility buildings, Pre-Fab Area/Chlorine Dioxide Generator, Wastewater Treatment Collection System, Ennis Creek, Strait of Juan de Fuca, and nearby homes and businesses). Three hundred and one samples were collected from multiple upland and marine locations, including off-property residences and businesses. Media sampled included soil, groundwater, marine and freshwater sediment, and process wastes.

Thirty-four soil borings were completed during the ESI, and 146 soil samples were collected for analysis (90 surface soil samples and 56 subsurface soil samples). The samples were analyzed for the full suite of priority pollutants (167 chemicals), including VOCs, SVOCs, pesticides, PCBs, polycyclic aromatic hydrocarbons (PAHs), metals, and dioxins/furans. Based on the soil analytical results, USEPA identified 42 constituents that had elevated concentrations with respect to an on-property background location.

Groundwater was sampled at 12 monitoring wells and 7 direct-push boring locations. The groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, diesel- and heavy oil-range TPH, and dissolved priority pollutant metals. Constituents detected at elevated concentrations in groundwater with respect to an on-property background location included arsenic, barium, chromium, copper, lead, manganese, vanadium, zinc, Aroclor-1260, acenaphthene and bis(2-ethylhexyl)phthalate.

3.3 Upland Remedial Investigation (2003)

Rayonier conducted the Upland RI field investigation in 2003 (Integral, 2006). Soil samples were collected in May 2003 from areas where mill operations occurred as well as surrounding areas. Groundwater samples were collected from on-property monitoring wells in June 2003.

A total of 85 soil samples (45 surface samples and 40 subsurface samples) were obtained from 43 locations using drill rigs, backhoes and hand augers. Most of the surface soil samples were obtained from a depth of 0 to 0.25 feet bgs. The subsurface soil samples were obtained from a depth range of 0.25 to 16 feet bgs.

The following constituents were detected in soil at concentrations exceeding the RI screening criteria, which consisted of MTCA Method B cleanup levels protective of human health for unrestricted land uses (i.e., residential/direct contact exposure scenario):

- Arsenic and PAHs in the Bone Yard area.
- Copper in the Chlorine Dioxide Generator and Pre-fab areas.
- PAHs, PCBs and dioxins/furans in the Wood Mill area.
- PAHs, diesel- and heavy oil-range TPH, arsenic, lead and dioxins/furans in the Log Yard area.
- Arsenic, cadmium, total chromium, lead, thallium, vanadium, carcinogenic PAHs (cPAHs), pentachlorophenol, pyrene and dioxins/furans in the Main Process area.

- Dioxins/furans in the eastern portion of the property (east of Ennis Creek).
- Arsenic, lead, heptachlor epoxide, cPAHs and dioxins/furans in off-property residential soil.

Based on the detections exceeding RI screening criteria, the constituents listed above were identified as constituents of potential concern (COPCs) in soil.

Groundwater samples were collected from 20 monitoring wells in June 2003. The following constituents were detected in groundwater at concentrations exceeding the RI screening criteria, which consisted of MTCA Method B cleanup levels protective of marine surface water (aquatic organisms and human consumption of aquatic organisms):

- Conventional parameters: ammonia.
- Metals: arsenic, chromium, copper, nickel, lead and mercury.
- SVOCs: 2,4,6-trichlorophenol and pentachlorophenol.
- cPAHs: benzo(a)anthracene and chrysene.
- Pesticides: 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, alpha-chlordane, dieldrin, endrin and heptachlor.
- PCBs: Aroclor 1260 and total PCBs.

Based on the detections exceeding RI screening criteria, the constituents listed above were identified as COPCs in groundwater. In addition, although aldrin, heptachlor epoxide, and toxaphene were not detected in groundwater samples, they were conservatively identified as groundwater COPCs because the analytical practical quantitation limits (PQLs) for these constituents exceeded the associated RI screening criteria. Concentration distributions of COPCs in groundwater were described in the Upland RI Report as patchy; no groundwater plumes were observed. The areas with the highest concentrations of groundwater COPCs included the former Spent Sulfite Liquor (SSL) Lagoon area and the area immediately east of the dock (Integral, 2006).

3.4 Interim Cleanup Actions

Rayonier has completed several interim cleanup actions at the mill property to reduce risks associated with identified COPCs. Details regarding the interim cleanup actions are presented in the Upland RI Report (Integral, 2006). This section provides a brief summary of the interim actions.

3.4.1 Former Fuel Oil Tank 2 Interim Actions (1990 to 2002)

Interim actions conducted in the Fuel Oil Tank 2 area in 1990 and 1991 consisted of the following (Landau, 1990 and 1991):

- Excavation and thermal-desorption treatment of approximately 1,500 cy of petroleum-contaminated soil.
- Installation of a groundwater extraction system to remove petroleum-contaminated groundwater and convey it to the mill’s wastewater treatment plant.
- Installation of a steam injection and groundwater extraction system to remove petroleum hydrocarbons from the subsurface in an inaccessible area east of the fuel oil tank sump.

In 2002, Rayonier removed approximately 3,042 tons of petroleum-contaminated soil from the area between the previous remedial excavations in the Fuel Oil Tank 2 and Hog Fuel Pile areas (Integral and Foster Wheeler 2003). The excavations were backfilled with concrete rubble and clean soil.

3.4.2 Finishing Room/Ennis Creek Interim Actions (1991 to 2002)

ITT Rayonier began operating an oil recovery system in the Finishing Room/Ennis Creek area in 1991 (Foster Wheeler, 1997). The system included three oil/water extraction wells, and oil/water separator, and an oil storage tank. Extracted groundwater containing dissolved petroleum constituents was conveyed to the mill's wastewater treatment plant. In 1992, Ecology issued an enforcement order that required ITT Rayonier to stop the flow of oil into Ennis Creek and clean up oil-contaminated groundwater and soil. In 1992 and 1993, ITT Rayonier installed a sheet pile containment wall and interceptor trench along the western bank of Ennis Creek (Foster Wheeler, 1997). Extraction pumps in the trench pumped groundwater through an oil/water separator which then conveyed the water to the mill's wastewater treatment plant. The recovered hydraulic oil was transferred to a storage tank for subsequent disposal.

In 1998, Rayonier entered into an agreed order with Ecology for cleanup of contaminated soil and groundwater in the Finishing Room area. The interim action work plan called for removal of contaminated soil exceeding TPH and PCB cleanup levels of 1,000 mg/kg and 10 mg/kg, respectively. Additionally, contaminated soil in the Load Center Transformer Room area (at the southern end of the Finishing Room area) was to be removed to meet the Toxic Substances Control Act (TSCA) cleanup level for PCBs (1 mg/kg).

Rayonier removed approximately 8,300 tons of soil from the Finishing Room and Load Center Transformer Room areas west of Ennis Creek in 1998. Verification soil samples were collected from the excavation limits and analyzed by a mobile laboratory to confirm that cleanup levels were achieved (SECOR, 1999).

An interim action to remove the sheet pile wall and TPH- and PCB-contaminated soil and sediment east of the sheet pile wall was completed in the summer of 2002 (Integral and Foster Wheeler, 2003). A total of 1,248 tons of contaminated soil/sediment was removed from the western bank and streambed of Ennis Creek. In addition to contaminated soil/sediment, the sheet pile wall, two existing concrete pipe supports, four monitoring wells, two extraction sumps, and protective riprap on the western bank of Ennis Creek were removed. Verification samples were collected from the excavation limits. The excavation was backfilled with clean graded material and habitat enhancements were made to the creek bank.

3.4.3 Hog Fuel Pile Interim Action (2001)

Rayonier excavated approximately 2,700 cy of wood residue from the footprint of the former hog fuel pile in 2001. The excavated material was transported to the Port Angeles Sanitary Landfill for disposal. This interim action superseded the 1993 natural attenuation remedy implemented at the northwestern edge of the hog fuel pile. During the 2002 interim action in the Fuel Oil Tank 2 area (see Section 3.4.1), contaminated soil also was excavated from the southwestern corner of the 2001 hog fuel pile excavation (Integral and Foster Wheeler, 2003). The hog fuel pile excavations were backfilled with concrete rubble and clean soil.

3.4.4 *Spent Sulfite Liquor Lagoon Interim Action (2001)*

The SSL Lagoon was located along the shoreline on the eastern portion of the mill property. SSL produced during the pulping process was recovered and recycled as boiler fuel to power the mill's operations. As part of the recovery process, SSL was temporarily pumped to and stored in the SSL Lagoon prior to burning in the recovery boiler.

In 1997, 13 samples were collected from the lagoon's clay liner and berm and from residual material at the bottom of the lagoon (Landau, 1998b). The samples were analyzed for SVOCs, metals and dioxins/furans. Arsenic was detected above the MTCA Method A soil cleanup level (unrestricted land use) in the sample of residual material obtained from the bottom of the lagoon.

The SSL Lagoon was decommissioned in 2001. The clay liner and associated stained soil located above the groundwater table were excavated and transported to Rayonier's Mt. Pleasant Landfill for use as subgrade fill below the synthetic membrane of the final landfill cover (Landau, 2003). The SSL Lagoon excavation was backfilled and compacted with soil from the berm. Excess berm soil also was transported to the Mt. Pleasant Landfill.

3.4.5 *Former Machine Shop Interim Action (2002)*

The machine shop was located inside the engineering building in the western portion of the mill property. When the engineering building was demolished in 1999, oil staining was noted both on the wooden floor of the machine shop and on soil beneath the shop. The wooden flooring was tested for diesel- and heavy oil-range TPH and PCBs in preparation for disposal.

The Machine Shop area interim action was conducted in 2002 (Integral and Foster Wheeler, 2003). The objectives of the action were to remove petroleum-contaminated soil above the groundwater table under the former machine shop and to clean residual petroleum from the surface of the concrete support piers. Approximately 970 tons of soil was removed. Concrete support piers within the excavation footprint were either left in place and cleaned or removed to a staging area for further characterization and possible disposal. The excavation was backfilled with clean concrete rubble.

3.4.6 *Former Fuel Oil Tank 1 and Wood Mill Interim Actions (2006)*

Rayonier removed approximately 7,980 tons of petroleum- and PCB-contaminated soil from the Fuel Oil Tank 1 and Wood Mill areas in 2006 (GeoEngineers, 2006). The excavated soil was transported to the Port Angeles Sanitary Landfill for disposal. Approximately 0.5 cy of contaminated soil was left in place adjacent to a utility pole in the Fuel Oil Tank 1 area because it could not be removed without threatening the structural integrity of the utility pole and potentially exposing the excavation contractor to an electrical safety hazard. Contaminated soil also was left in place in the easternmost portion of the former wood mill excavation; the extent of the residual contamination in this area is uncertain.

3.5 City of Port Angeles – Environmental Investigation (2009)

The design for the City of Port Angeles' combined sewer overflow (CSO) project, which will connect existing City infrastructure to the City's wastewater treatment facility, calls for the installation of new underground piping along with using existing piping located in the Upland Study Area.

Because the proposed pipeline will cross the Fuel Oil Tank 1 interim action area and will parallel several other known areas of contamination, the City conducted an environmental investigation along the proposed alignment in late 2009 (Brown and Caldwell, 2009). Thirteen boreholes were drilled on the mill property to a maximum depth of 50 feet bgs, and permanent piezometers/monitoring wells were installed in six of the boreholes (PA-15, PA-17, PA-19, PA-21, PA-23, and PA-24; Figure 6A).

Based on visual observations and field screening of soil samples using a photoionization detector (detects organic vapors), one soil sample obtained from 7.5 to 9 feet bgs and one groundwater grab sample obtained from 10 feet bgs were submitted for laboratory analysis, both from sample location PA-19. The groundwater sample was collected from the open borehole using a disposable bailer before a monitoring well was installed in the borehole. The soil sample was analyzed for VOCs and metals; the groundwater sample was analyzed for gasoline- and diesel-range TPH, PCBs, and metals. The soil sample did not contain exceedances of VOCs or metals when compared to the soil screening levels described in Section 5.1.1 of this Work Plan. The groundwater sample contained exceedances of diesel-range TPH, cadmium, lead, mercury, selenium, and silver when compared to the groundwater screening levels described in Section 5.1.2. PCBs were not detected in the groundwater sample, but the PQLs exceeded the screening level for total PCBs used in this Work Plan. The investigation concluded that the detected TPH and metals impacts are limited to the smear zone immediately above and below the water table, suggesting that well PA-19 may be within a larger area of groundwater contamination, and is not likely located within a source area (Brown and Caldwell, 2009).

4.0 CONCEPTUAL SITE MODEL

A preliminary conceptual site model (CSM) for the Site was presented in the Current Situation/Site Conceptual Model Report (Foster Wheeler, 1997); the CSM was further developed in the Upland RI Work Plan (Integral and Foster Wheeler, 2004). The CSM is a model of the potential contaminant sources, release mechanisms, and transport mechanisms at the Site. The CSM also identifies potential receptors that could be affected by the contamination and the associated exposure pathways. The CSM does not quantify potential risks to human health or the environment posed by Site-related contamination. It is intended to focus remedial actions (site investigations, monitoring, cleanup actions, etc.) on those areas and operations of the Site that may warrant further consideration. This section summarizes the main elements of the CSM for the Upland Study Area; further details regarding the CSM are presented in the Upland RI Work Plan (Integral and Foster Wheeler, 2004).

4.1 Contaminant Sources, Release Mechanisms, and Transport Mechanisms of Potential Concern

Potential primary sources of contamination consist of chemicals or byproducts used or produced by mill processes, such as fuel and hydraulic oils, chemicals used for pulp production, and SSL. Potentially contaminated fill material (e.g., wood residue, ash, demolition debris) may act as a secondary source of contamination.

Potential historical primary release mechanisms for contaminants in the Upland Study Area include direct releases to soil and/or groundwater from materials handling, leaks and spills, and air emissions from fuel combustion in boilers. These releases may have occurred from aboveground tanks, underground tanks, chemical product containers (e.g., drums/totes), process piping such as fuel oil piping, and power plant (boiler) exhaust stacks.

Under present-day conditions, potential contaminant transport mechanisms in the Upland Study Area include:

- Leaching from soil to groundwater;
- Migration in groundwater to surface water;
- Soil erosion caused by surface water runoff and subsequent deposition to soil or sediment; and
- Soil erosion caused by wind (dust) and subsequent deposition to soil or sediment.

4.2 Potential Receptors and Exposure Pathways for Contaminants in Soil and Groundwater

Cross sections depicting subsurface geologic conditions at the mill property are presented in Figures 7, 8, 9A, and 9B. The subsurface conditions illustrated in these cross sections are discussed below in the context of potential receptors and exposure pathways for the contaminants that have been identified in soil and groundwater.

4.2.1 Soil

In general, subsurface geology at the mill property consists of fill material underlain by native beach sands/gravels and glacial deposits. The fill material includes granular fill, construction debris (concrete, bricks, wood, metal, etc.), and wood residue from pulp production. Previous investigations suggest that the contamination detected in the Upland Study Area is generally associated with historical releases or deposition of hazardous substances to the ground surface or shallow subsurface. The glacial deposits (dense glacial till, outwash, and drift) underlying the fill and native beach sands/gravels likely present a barrier to vertical contaminant migration in groundwater due to the expected low permeability of this material (see Section 2.2.2).

Based on previous investigation findings, the potential receptors and exposure pathways for identified soil contamination at the mill property include:

- Direct contact (dermal, incidental ingestion, and/or inhalation) with contaminated soil by visitors, workers, future residents, and/or other property users;
- Direct contact (dermal, incidental ingestion, and/or inhalation) with contaminated soil and/or food-web exposures by terrestrial wildlife;
- Direct contact with contaminated soil by terrestrial plants and soil biota; and
- Contact (via soil leaching and groundwater transport to surface water) with contaminated marine surface water by aquatic organisms, and potential contact by humans through consumption of aquatic organisms.

4.2.2 Groundwater

Unconfined, shallow groundwater occurs in the fill and alluvial deposits beneath the mill property. The shallow water-bearing zone is variable in thickness; the base (generally defined by the top of the glacial deposits) varies from 12 feet bgs to greater than 30 feet bgs (Foster Wheeler, 1997). Monitoring wells at the property are screened in the shallow water-bearing zone. The depth to groundwater in monitoring wells ranges from approximately 2.5 to 17 feet bgs. The inferred groundwater flow direction is generally to the north toward Port Angeles Harbor (Figures 4 and 5).

Based on previous investigation findings, the potential receptors and exposure pathways for identified groundwater contamination at the mill property include:

- Contact (via groundwater transport to surface water) with contaminated marine surface water by aquatic organisms, and potential contact by humans through consumption of aquatic organisms.

In accordance with WAC 173-340-720(2)(d), due to the availability of municipal water and the proximity of the mill property to marine surface water that is not suitable as a domestic water supply, groundwater beneath the property or potentially affected by the property is not a current or reasonable future source of drinking water. Consequently, human ingestion of hazardous substances in groundwater is not a potential exposure pathway at the mill property.

4.3 Summary

Releases of hazardous substances used or generated during historical mill operations have resulted in contamination of soil and shallow groundwater within the Upland Study Area. Soil contamination has been detected at a range of depths between the ground surface and the upper few feet of the saturated zone (i.e., between approximately 0 and 12 feet bgs) in the former operational areas. Interim actions completed in several areas of the mill property from the late 1980s through 2006 have removed a total of approximately 34,000 tons of contaminated soil and wood residue for off-property treatment and/or disposal (see Section 3.4). In addition, liquid-phase hydraulic oil and fuel oil/Bunker C from historical releases in two areas (Finishing Room and Fuel Oil Tank 2 Areas) were recovered and disposed of off-property during previous interim actions in these areas.

Potential receptors that may be exposed to soil contamination remaining at the mill property include humans (e.g., visitors, trespassers, construction workers, future workers, and/or future residents) and terrestrial plants and animals. Soil contaminants also may be transported to the off-shore marine environment via: (1) erosion, or (2) leaching to groundwater and subsequent discharge of affected groundwater to marine surface water, either directly (at the upland/marine interface) or indirectly via Ennis Creek. Potential receptors that may be exposed to contaminants in the marine environment include aquatic organisms and humans (via consumption of aquatic organisms). The supplemental upland data collection field investigation described in Section 6.0 will include activities specifically intended to resolve data gaps related to these contaminant transport and exposure pathways.

The glacial deposits underlying the mixed fill and native beach deposits likely present an effective barrier to vertical groundwater flow and downward migration of contaminants in groundwater (see

Section 2.2.2). Due to the proximity of the mill property to marine surface water, groundwater beneath the property or potentially affected by the property is not a current or reasonable future source of drinking water. Consequently, human ingestion of contaminated groundwater is not a potential exposure pathway. The only transport/exposure pathway of potential concern that exists for groundwater is discharge to the marine environment. The supplemental upland data collection field investigation described in Section 6.0 will include activities specifically intended to resolve data gaps related to this pathway.

5.0 NATURE AND EXTENT OF CONTAMINATION IN SOIL AND GROUNDWATER

Previous investigations conducted at the mill property including the ESI (E&E, 1998), the Upland RI (Integral, 2006), and other studies analyzed soil and groundwater samples for the following potential contaminants:

- VOCs;
- SVOCs including PAHs;
- Gasoline-, diesel-, and heavy oil-range TPH;
- Pesticides;
- PCBs;
- Metals;
- Dioxins/furans; and
- Ammonia (groundwater only).

The historical chemical analytical data from the previous studies provide the basis for the description of the nature and extent of contamination presented in this section. Spreadsheet tables (Microsoft Excel format) of the historical analytical data are provided on a CD-ROM in Appendix E for reference.

The ESI Report (E&E, 1998) compared analytical results for soil and groundwater samples collected in potential source (i.e., process) areas to the results for samples obtained from a soil boring and a monitoring well designated as background locations outside of process areas. Concentrations of detected constituents in potential source areas were designated "significant" or "elevated" if they met the background concentration exceedance criteria specified in the ESI Report.

The Uplands RI Report (Integral, 2006) compared soil analytical results to MTCA Method B cleanup levels protective of human health for an unrestricted land use scenario. Groundwater analytical results were compared to MTCA Method B cleanup levels protective of marine surface water (aquatic organisms and human consumption of aquatic organisms), based on the assumption that groundwater beneath the mill property discharges to Port Angeles Harbor, and the fact that groundwater is not a current or reasonable future source of drinking water (see Section 4.2.2).

During preparation of this Work Plan, previous screening levels used to evaluate Upland Study Area soil and groundwater analytical data were reviewed, and new/updated screening levels were developed as necessary to address the potential receptors and exposure pathways identified in Section 4.0. In particular, soil criteria protective of groundwater as marine surface water, and soil criteria protective of terrestrial plants and animals, were included in the derivation of the updated screening levels. Criteria addressing these potential receptors and pathways were not considered in previous investigations.

The updated screening levels presented in this Work Plan were used to evaluate the existing analytical data and refine the characterization of the nature and extent of contamination in soil and groundwater at the mill property. This section summarizes the derivation of the updated screening levels and identifies COPCs in soil and groundwater based on comparison of the existing data to the updated screening levels.

5.1 Soil and Groundwater Screening Levels

The regulatory criteria used to derive updated screening levels for soil and groundwater are presented in Tables 1 and 2. In general, screening levels were developed for constituents that were previously analyzed in soil and groundwater at the mill property, and that have numeric regulatory criteria (or toxicity data that can be used to calculate protective criteria) listed in Ecology's on-line Cleanup Levels and Risk Calculations (CLARC) database (Ecology, 2010b).

5.1.1 Soil

Regulatory criteria for soil presented in Table 1 include the following:

- MTCA Method B soil cleanup levels (standard formula values for carcinogens and non-carcinogens) protective of human health for unrestricted land use (WAC 173-340-740[3]), obtained from Ecology's CLARC database.
- Soil criteria protective of groundwater as marine surface water were calculated using the MTCA fixed parameter three-phase partitioning model (WAC 173-340-747[3][a]). For each constituent, the protective groundwater concentration used in the calculations was selected as the lowest of the respective marine surface water regulatory criteria presented in Table 2. Default assumptions provided in WAC 173-340-747(4) for unsaturated zone soil were used in the calculations, and model input parameter values were taken directly from Ecology's CLARC database. Where input parameter values were not available in CLARC, they were obtained from Oak Ridge National Laboratory's Risk Assessment Information System (Oak Ridge National Laboratory, 2010).
- As discussed in the RI Work Plan (Integral and Foster Wheeler, 2004), a site-specific terrestrial ecological evaluation (TEE) is required for the Uplands Study Area because there is at least 10 acres of native vegetation within 500 feet of the mill property (WAC 173-340-7491[2][a][iii]). Consistent with WAC 173-340-7493(3), the MTCA Ecological Indicator Soil Concentrations for protection of terrestrial plants and animals (WAC 173-340-900, Table 749-3) were used in developing screening levels. Since the future use of the mill property has not been determined, and may include unrestricted use by terrestrial plants and animals, the lowest of the indicator soil concentrations for protection of plants, soil biota, and wildlife was selected as the TEE criterion for use in deriving soil screening levels.

The MTCA Cleanup Regulation (WAC 173-340-705[6]) specifies that the cleanup level (or screening level) for a given constituent determined using Method B shall not be set at a level below the natural background concentration or analytical PQL, whichever is higher. The preliminary soil screening levels presented in Table 1 were selected as the lowest of the applicable numeric regulatory criteria. The preliminary screening levels were then adjusted as necessary based on Washington state natural background soil metals concentrations (Ecology, 1994) and PQLs to derive the final soil screening levels presented in the last column of Table 1.

The analytical PQLs listed in Table 1 were obtained from Analytical Resources Incorporated of Tukwila, Washington (ARI), and Frontier Analytical Laboratory of El Dorado Hills, California, both of which are Washington-certified laboratories. Discussions with these laboratories regarding the analytical requirements for this project indicate that the listed soil PQLs in Table 1 are the lowest practicably attainable values using conventional/accepted (although not necessarily the most commonly used) analytical methods, without performing extensive custom calibration studies (which may or may not result in lower PQLs) or increasing the probability of unacceptably high matrix interferences. For those analytes listed in Table 1 with PQLs that exceed the lowest applicable numeric regulatory criteria, the laboratories have determined that PQLs below the regulatory criteria cannot be practicably achieved.

5.1.2 Groundwater

As discussed in Section 4.2.2, groundwater beneath the property or potentially affected by the property is not a current or reasonable future source of drinking water. Accordingly, potential risks associated with groundwater at the mill property include:

- Acute and chronic effects to aquatic organisms resulting from exposure to contaminants in groundwater discharging to Port Angeles Harbor. Groundwater discharge to Port Angeles Harbor can occur either directly, via groundwater seepage at the uplands/marine interface, or indirectly, via groundwater discharge to Ennis Creek and subsequent discharge of Ennis Creek to the harbor.
- Human consumption of aquatic organisms exposed to contaminants in groundwater discharging to Port Angeles Harbor.

Based on these potential risks, regulatory criteria for groundwater presented in Table 2 include the following:

- MTCA Method B marine surface water cleanup levels protective of aquatic organisms and human health (WAC 173-340-730[3]), including:
    - Water quality criteria published in the Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A).
    - Water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under Section 304 of the Federal Clean Water Act.
    - Concentrations established under the National Toxics Rule (Code of Federal Regulations [CFR] Title 40, Part 131).

- MTCA standard formula values (for carcinogens and non-carcinogens) protective of human health (consumption of aquatic organisms), obtained from Ecology's CLARC database.

The MTCA Cleanup Regulation (WAC 173-340-705[6]) specifies that the cleanup level (or screening level) for a given constituent determined using Method B shall not be set at a level below the natural background concentration or analytical PQL, whichever is higher. The preliminary groundwater screening levels presented in Table 2 were selected as the lowest of the applicable numeric regulatory criteria. The preliminary screening levels were then adjusted as necessary based on PQLs to derive the final groundwater screening levels presented in the last column of Table 2. (Note: Washington state natural background concentrations for the constituents listed in Table 2 have not been established.)

The analytical PQLs listed in Table 2 were obtained from ARI and Frontier Analytical Laboratory. Discussions with these laboratories regarding the analytical requirements for this project indicate that the listed groundwater PQLs in Table 2 are the lowest practicably attainable values using conventional/accepted (although not necessarily the most commonly used) analytical methods, without performing extensive custom calibration studies (which may or may not result in lower PQLs), collecting unreasonably large sample volumes in the field (e.g., four times the normal volume), or increasing the probability of unacceptably high matrix interferences. For those analytes listed in Table 2 with PQLs that exceed the lowest applicable numeric regulatory criteria, the laboratories have determined that PQLs below the regulatory criteria cannot be practicably achieved.

It should be noted that Ecology's draft vapor intrusion screening levels for groundwater (and soil vapor) contained in *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology, 2009) are relevant regulatory criteria to be considered for areas of the mill property where buildings will be constructed in the future. .Appropriate vapor intrusion assessment and design evaluations will be performed in the future as necessary, once site development plans and the locations of future buildings are better known. As requested by Ecology, a preliminary comparison of existing site groundwater data to Ecology's draft vapor intrusion screening levels for groundwater is presented in Table 3.

5.2 Contaminants of Potential Concern in Soil

Existing soil analytical data from the ESI (E&E, 1998), the Upland RI (Integral, 2006), and other studies completed in the Upland Study Area were compared to the soil screening levels in Table 1. The data evaluation included soil samples collected both prior to and after October 1999 (the month mill decommissioning was completed) that were not subsequently excavated during interim actions. Based on this evaluation, constituents detected at concentrations exceeding the screening levels were designated as confirmed COPCs in soil. Confirmed COPCs are listed in Table 4.

Figures 10A through 17A depict maximum concentrations of analyzed constituents in soil relative to the screening levels shown in the last column of Table 1. As described in Section 5.1.1, these screening levels represent the most stringent of the numeric soil criteria protective of groundwater, human health/direct contact, and terrestrial ecological receptors (adjusted for natural background and PQLs where necessary). The numeric criteria for each of these three exposure pathways of concern are listed in Table 1. Figures 10B through 17B depict maximum concentrations of analyzed constituents in soil relative to screening levels protective of each of the three exposure pathways. These figures are useful for identifying the different COPCs and areas where soil contamination is a concern for potential groundwater impacts, human health, and/or ecological receptors. It should be noted that soil sampling locations that were subsequently excavated as part of interim actions are not shown on Figures 10A/B through 17A/B.

Each pair of figures (10A/B through 17A/B) displays data for a different analyte group (VOCs, SVOCs, cPAHs, etc.). To illustrate differences in contaminant concentrations in shallow/near-surface soil versus deeper soil, soil samples are lumped into two depth categories: shallow samples (0 to 2 feet bgs) and deep samples (> 2 feet bgs). The results are displayed using a "stacked block" symbol centered on each sampling location, with different colors representing the single highest exceedance ratio (ratio of detected analyte concentration to screening level) among all individual analytes and samples within each depth category at a given sampling location.

Some of the previous soil samples were composited over a relatively large depth interval starting at 0.25 feet bgs, such as 0.25 feet to 3 feet bgs or 0.25 feet to 8 feet bgs. For these samples, if the composite interval end depth was less than or equal to 4 feet bgs, the sample was considered a shallow sample (0 to 2 feet bgs); if the end depth was greater than 4 feet bgs, the sample was considered a deep sample (> 2 feet bgs). A total of 237 samples were categorized as shallow soil samples, of which 101 were obtained from 0 to 0.25 feet bgs, three had composite intervals that extended deeper than 2 feet bgs (to either 3 or 3.5 feet bgs), and 37 were composited over the entire 0 to 2 foot interval. A total of 290 samples were categorized as deep samples, of which 38 were composited over a depth interval from 0.25 feet bgs to depths ranging from 4.5 to 16 feet bgs. The remaining deep samples were discrete or composite samples (2-foot maximum composite interval) obtained from soil between 2 feet and 17 feet bgs.

Figures 10A/B through 17A/B display results for positive detections of the analyzed constituents, as well as non-detect (ND) results for which the PQLs (or calculated total concentrations/toxic equivalent concentrations [TECs] in the case of PCBs, cPAHs, and dioxins/furans) were less than screening levels. ND results for which PQLs (or calculated total concentrations/TECs) exceeded screening levels are not included in Figures 10A/B through 17A/B. Table 5 lists constituents that were not detected above screening levels, but had a significant number of ND results (at least 25 percent of the total number of ND results) for which the PQLs exceeded screening levels. For the purpose of this evaluation, these constituents are designated as unconfirmed COPCs. The results of the data evaluation for the constituents analyzed in soil are discussed below.

It is recognized that construction activities during mill decommissioning from 1997 to 1999 could have potentially affected the distribution and depth of soil contamination. As discussed in Section 2.2.2, crushed concrete rubble was distributed across some areas of the property during mill decommissioning, and fill material consisting of gravel, rock, and riprap was placed along the former log pond area beach wall. However, imported fill material was not placed on the property in other areas. Figures 6B and 6C show the locations of soil samples collected prior to and after the completion of mill decommissioning in October 1999.

5.2.1 Volatile Organic Compounds

Concentrations of VOCs in soil relative to the screening levels listed in Table 1 are shown in Figure 10A. As shown in this figure, VOCs were not detected above screening levels.

Relative to the total number of historical VOC results there were few ND results for which PQLs exceeded screening levels, with one notable exception: all 143 soil results for tetrachloroethene (PCE) were ND, and all had PQLs that exceeded the soil screening level, which is based on protection of groundwater as marine surface water. All 85 groundwater results for PCE were ND (see Section 5.3); of these 85 ND results, 40 had PQLs that were less than the groundwater screening level. Additionally, the highest PCE PQL for any soil sample (0.45 mg/kg) was less than the MTCA Method B soil cleanup level protective of direct human contact (1.9 mg/kg). Due to the elevated PQLs in previous samples relative to the screening level, PCE is considered an unconfirmed COPC in soil (Table 5); other VOCs are not considered COPCs. Additional soil sampling (with PQLs below the screening level for PCE) proposed in this Work Plan at former well location MW-13 (discussed in Section 6.6.2) will determine if VOCs are COPCs in soil.

As discussed in Section 5.3.1, trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA), and/or vinyl chloride have been detected in groundwater in two monitoring wells at concentrations above screening levels. Because these constituents have not been detected in soil (over 120 soil samples were analyzed for these constituents), and more than 83 percent of the ND soil results had PQLs below the screening levels, TCE, 1,2-DCA, and vinyl chloride are not currently considered COPCs in soil. Nevertheless, due to the previous detections in groundwater, these constituents and other VOCs will be further assessed in soil at former well location MW-13 to determine if VOCs are COPCs in soil (see Section 6.6.2).

5.2.2 Semivolatile Organic Compounds (not including cPAHs)

Concentrations of SVOCs in soil relative to the screening levels listed in Table 1 are shown in Figure 11A. As shown in this figure, SVOCs were detected at concentrations exceeding screening levels in the Main Process Area and the Log Yard; the highest exceedances were detected in the vicinity of the Digesters and the Finishing Room. Constituents detected at concentrations exceeding screening levels include pentachlorophenol (PCP) (18 exceedances), bis(2-ethylhexyl)phthalate (2 exceedances), and pyrene (1 exceedance). Three of the four locations where SVOCs exceed screening levels by a factor of 100 or more are PCP exceedances; the fourth location (MS20) is a bis(2-ethylhexyl)phthalate exceedance (Figure 11A). Based on data from three locations where SVOCs were detected above screening levels in shallow soil but not in deeper soil at the same location, and the fact that only two deep soil sampling locations (SR20 and MS20; Figure 11A) had confirmed exceedances of SVOC screening levels, the majority of the SVOC exceedances appear to be concentrated in shallow soil. However, there were a number of locations where SVOCs exceeded screening levels in shallow soil but no deep samples were analyzed, or no SVOCs were detected in the deep samples but the PQLs exceeded screening levels. Section 6.8.2 describes additional sampling that will be performed to further characterize the vertical extent of SVOCs in soil.

The following constituents had a significant number of ND results (i.e., more than 25 percent of the total number of ND results) for which PQLs exceeded screening levels:

- 1,4-Dichlorobenzene
- 2,4,6-Trichlorophenol
- 2,4-Dinitrotoluene
- 3,3'-Dichlorobenzidine
- bis(2-Chloro-1-methylethyl)ether
- bis(2-Chloroethyl)ether
- Hexachloroethane
- n-Nitroso-di-n-propylamine
- n-Nitrosodiphenylamine
- PCP

Except for PCP, there were no positive detections of these constituents above screening levels. Consequently, PCP, bis(2-ethylhexyl)phthalate, and pyrene are the only confirmed COPCs in soil (Table 4). The other SVOCs listed above are considered unconfirmed COPCs (Table 5).

The planned sampling and analysis described in Section 6.0 of this Work Plan will utilize analytical methods for SVOCs (e.g., USEPA Method 8041, USEPA Method 8270-low level/8270-SIM) that have standard PQLs (assuming no matrix interferences or dilutions) equal to or lower than the screening levels listed in Table 1. These PQLs are lower than those used in previous investigations, which likely were standard USEPA Method 8270 PQLs. Some of the elevated PQLs in the previous samples analyzed for SVOCs may have resulted from sample dilutions performed by the laboratory.

5.2.3 Carcinogenic Polycyclic Aromatic Hydrocarbons

Concentrations of total cPAHs (TEC, calculated per WAC 173-340-708[8][e][iii][A]) in soil relative to the screening level listed in Table 1 are shown in Figure 12A. As shown in this figure, cPAHs were detected at concentrations exceeding the screening level in the Main Process Area, the Log Yard, and the areas of the East Roll Storage Warehouse, the Chlorine Dioxide Generator, and the Secondary Wastewater Treatment Plant/Bone Yard. The highest exceedances were detected in the vicinity of the Digesters, the Finishing Room, the Recovery Boiler, and Fuel Oil Tank 2. cPAH exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table.

Eighty-one of the 105 ND results for cPAHs (i.e., samples in which no cPAHs were detected) had total TECs (calculated using one-half the PQLs for individual cPAHs) that exceeded the screening level. Based on the detected screening level exceedances depicted in Figure 12A, cPAHs are confirmed COPCs in soil (Table 4). The SVOC PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of cPAH concentrations below the screening level.

5.2.4 Total Petroleum Hydrocarbons

Concentrations of TPH in soil relative to the screening levels listed in Table 1 are shown in Figure 13A. As shown in this figure, TPH was detected at concentrations exceeding screening levels in the Main Process Area and the Log Yard; the highest exceedances were detected in the vicinity of Fuel

Oil Tank 2, the Hog Fuel Pile, and the Finishing Room. Constituents detected at concentrations exceeding screening levels include heavy oil-range TPH (61 exceedances) and diesel-range TPH (21 exceedances). Both of these TPH constituents were detected at concentrations exceeding screening levels by a factor of 10 or more. TPH exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table.

Although all seven ND results for gasoline-range TPH (out of 13 total results) had PQLs that exceeded the screening level for this constituent, there were no positive detections of gasoline-range TPH above the screening level. Consequently, diesel- and heavy oil-range TPH are the only confirmed COPCs in soil (Table 4). Gasoline-range TPH is considered an unconfirmed COPC (Table 5).

5.2.5 Polychlorinated Biphenyls

Concentrations of total PCBs (sum of seven common Aroclors, calculated per WAC 173-340-708[8][f][iii][A]) in soil relative to the screening level listed in Table 1 are shown in Figure 14A. As shown in this figure, PCBs were detected at concentrations exceeding the screening level in the Main Process Area and the areas of the East Roll Storage Warehouse and the Secondary Wastewater Treatment Plant/Bone Yard. The highest exceedances were detected in the vicinity of the Finishing Room (including the Load Center Transformer Room Area), the Machine Room, the Bleach Plant, the Machine Shop, the Recovery Boiler, and Fuel Oil Tank 1. PCB exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table.

A significant number (i.e., more than 25 percent) of the ND results for PCBs (i.e., samples in which no PCBs were detected) had total concentrations (calculated using one-half the PQLs for individual PCBs) that exceeded the screening level. Based on the detected screening level exceedances depicted in Figure 14A, PCBs are confirmed COPCs in soil (Table 4). The PCB PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of PCB concentrations equal to the screening level.

5.2.6 Pesticides

Concentrations of pesticides in soil relative to the screening levels listed in Table 1 are shown in Figure 15A. As shown in this figure, pesticides were detected at concentrations exceeding screening levels in the Main Process Area, the Log Yard, and the areas of the East Roll Storage Warehouse, the Chlorine Dioxide Generator, and the Secondary Wastewater Treatment Plant/Bone Yard. The highest exceedances were detected in the vicinity of the Digesters, the Finishing Room, the Bleach Plant, the Recovery Boiler, and the Chlorine Dioxide Generator. Constituents detected at concentrations exceeding screening levels in ten or more samples include beta-BHC (25 exceedances), heptachlor epoxide (18 exceedances), endrin ketone (15 exceedances), gamma-chlordane (13 exceedances), 4,4'-DDE (12 exceedances), 4,4'-DDT (12 exceedances), and endosulfan I (10 exceedances). Constituents detected at concentrations exceeding screening levels by a factor of 10 or more include beta-BHC, gamma-BHC (lindane), heptachlor epoxide, hexachlorobenzene, heptachlor, endrin ketone, 4,4'-DDT, aldrin, and 4,4'-DDE. Pesticide exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table.

The majority of pesticide ND results had PQLs that exceeded screening levels. Only four pesticide constituents had no positive detections above screening levels: alpha-BHC, delta-BHC, methoxychlor, and toxaphene. The 131 total results each for delta-BHC and methoxychlor had PQLs that were low enough to rule these constituents out as COPCs in soil. With the exception of alpha-BHC, delta-BHC, methoxychlor, and toxaphene, the previously analyzed pesticides are confirmed COPCs in soil (Table 4); alpha-BHC and toxaphene are considered unconfirmed COPCs (Table 5). The pesticide PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of pesticide concentrations equal to or below the screening levels.

5.2.7 Metals

Concentrations of metals in soil relative to the screening levels listed in Table 1 are shown in Figure 16A. As shown in this figure, metals were detected at concentrations exceeding screening levels throughout the Upland Study Area. The highest exceedances were detected in the vicinity of the Digesters, the Power House, the Hog Fuel Pile, the Machine Room, the Log Yard, and the Pre-Fab Area. Constituents detected at concentrations exceeding screening levels in 25 or more samples include vanadium (181 exceedances), copper (137 exceedances), silver (97 exceedances), mercury (67 exceedances), lead (66 exceedances), zinc (60 exceedances), chromium (46 exceedances), nickel (41 exceedances), and barium (27 exceedances). Constituents detected at concentrations exceeding screening levels by a factor of 10 or more include antimony, arsenic, cadmium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Constituents detected at concentrations exceeding screening levels by a factor of 100 or more include cadmium, copper, lead, silver, and vanadium. Metals exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table.

The following constituents had a significant number of ND results (i.e., more than 25 percent of the total number of ND results) for which PQLs exceeded screening levels:

- Mercury
- Selenium
- Silver
- Thallium

Beryllium is the only metal previously analyzed in soil that was not detected above screening levels (other than aluminum, calcium, iron, magnesium, potassium, and sodium, which are considered common earth crust elements and thus were not included in the analysis of COPCs). All other previously analyzed metals are confirmed COPCs in soil (Table 4). The metals PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of metals concentrations below the screening levels.

5.2.8 Dioxins/Furans

Concentrations of total dioxins/furans (TEC, calculated per WAC 173-340-708[8][d][iii][A]) in soil relative to the screening level listed in Table 1 are shown in Figure 17A. As shown in this figure, dioxins/furans were detected at concentrations exceeding the screening level throughout the Upland Study Area. The highest exceedances were detected in the vicinity of the Digesters, the Power House, the Finishing Room, the Recovery Boiler, and the area between the Recovery Boiler and the Chip Screening Room (location PC20), where the former stack was located. Dioxin/furan exceedances are present in both the upper 2 feet of soil and in deeper soil above the groundwater table. In general, detected dioxin/furan concentrations appear to be higher in shallow soil (≤ 2 feet bgs) than in deep soil (> 2 feet bgs).

There was only one ND result for dioxins/furans (i.e., a sample in which no dioxins/furans were detected), and the total TEC for this sample (calculated using one-half the PQLs for individual dioxin/furan congeners) is less than the screening level. Based on the detected screening level exceedances depicted in Figure 17A, dioxins/furans are confirmed COPCs in soil (Table 4). The dioxin/furan PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of dioxin/furan concentrations below the screening level.

5.3 Contaminants of Potential Concern in Groundwater

Existing groundwater analytical data from the ESI (E&E, 1998), the Upland RI (Integral, 2006), and other studies completed in the Upland Study Area were compared to the groundwater screening levels in Table 2. Based on this evaluation, constituents detected at concentrations exceeding the screening levels were designated as confirmed COPCs in groundwater. Confirmed COPCs are listed in Table 4.

Figures 18 through 26 depict maximum concentrations of analyzed constituents in groundwater relative to screening levels for groundwater sampling events conducted between 1997 and 2003. These figures display results for positive detections of the analyzed constituents, as well as ND results for which the PQLs (or calculated total concentrations/TECs in the case of PCBs, cPAHs, and dioxins/furans) were less than screening levels. ND results for which PQLs (or calculated total concentrations/TECs) exceeded screening levels are not included in Figures 18 through 26. Table 5 lists constituents that were not detected above screening levels, but had a significant number of ND results (at least 25 percent of the total number of ND results) for which the PQLs exceeded screening levels. For the purpose of this evaluation, these constituents are designated as unconfirmed COPCs. The results of the data evaluation for the constituents analyzed in groundwater are discussed below.

5.3.1 Volatile Organic Compounds

Concentrations of VOCs in groundwater relative to the screening levels listed in Table 2 are shown in Figure 18. As shown in this figure, VOCs were not detected above screening levels, with the following exceptions: TCE, 1,2-DCA, and vinyl chloride were detected above screening levels in former monitoring well MW-13, and TCE was detected above the screening level in well PZ-9. Therefore, these three VOCs are considered confirmed COPCs in groundwater pending further sampling (Table 4).

Relative to the total number of historical VOC results there were few ND results for which PQLs exceeded screening levels, with two notable exceptions:

- Acrylonitrile
- PCE

Although there were no positive detections of either acrylonitrile or PCE, these constituents are considered unconfirmed COPCs in groundwater due to the elevated PQLs (Table 5). The planned groundwater sampling and analysis described in this Work Plan (with PQLs below the screening levels for acrylonitrile, PCE, and other VOCs) will verify which VOCs, if any, should be considered confirmed COPCs in groundwater.

5.3.2 Semivolatile Organic Compounds (not including cPAHs)

Concentrations of SVOCs in groundwater relative to the screening levels listed in Table 2 are shown in Figure 19. As shown in this figure, SVOCs were detected at concentrations exceeding screening levels in 11 monitoring wells; the highest exceedances were detected in well MW-23. Constituents detected above screening levels in well MW-23 include 2,4,6-trichlorophenol and PCP. Constituents detected above screening levels in one or more of the other wells with exceedances include bis(2-ethylhexyl)phthalate and PCP.

The following constituents had a significant number of ND results (i.e., more than 25 percent of the total number of ND results) for which PQLs exceeded screening levels:

- 2,4,6-Trichlorophenol
- bis(2-Chloroethyl)ether
- PCP

Although there were no positive detections of bis(2-chloroethyl)ether, this consistuent is considered an unconfirmed COPC in groundwater due to the elevated PQLs (Table 5). PCP, bis(2-ethylhexyl)phthalate, and 2,4,6-trichlorophenol are confirmed COPCs in groundwater (Table 4). The SVOC PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of SVOC concentrations equal to or below the screening levels.

5.3.3 Carcinogenic Polycyclic Aromatic Hydrocarbons

Concentrations of total cPAHs (TEC, calculated per WAC 173-340-708[8][e][iii][A]) in groundwater relative to the screening level listed in Table 2 are shown in Figure 20. As shown in this figure, cPAHs were detected at concentrations exceeding the screening level in one monitoring well: MW-51. cPAHs were detected in groundwater samples obtained from well MW-51 in December 2002 and June 2003; the total TECs for these samples were 0.09 micrograms per liter (ug/L) and 0.02 ug/L, respectively. These concentrations exceed the associated screening level of 0.018 ug/L.

Sixty-five of the 67 ND results for cPAHs (i.e., samples in which no cPAHs were detected) had total TECs (calculated using one-half the PQLs for individual cPAHs) that exceeded the screening level. Based on the detected screening level exceedances depicted in Figure 20, cPAHs are confirmed COPCs in groundwater (Table 4). The SVOC PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of cPAH concentrations below the screening level.

5.3.4 Total Petroleum Hydrocarbons

Concentrations of TPH in groundwater relative to the screening levels listed in Table 2 are shown in Figure 21. As shown in this figure, TPH was detected at concentrations exceeding screening levels at two locations: PZ-9 and PA-19. Diesel-range TPH was detected in a groundwater sample obtained from well PZ-9 in August 1997, at a concentration of 0.84 milligrams per liter (mg/L). This concentration exceeds the associated screening level of 0.5 mg/L. There were no other TPH detections in well PZ-9 that exceeded screening levels. Diesel-range TPH also was detected in a groundwater grab sample obtained from the borehole for well PA-19 in August 2009, at a concentration of 3 mg/L.

Although two ND results for gasoline-range TPH (out of three total results) and 4 of 88 ND results for heavy oil-range TPH (out of 91 total results) had PQLs that exceeded screening levels for these constituents, there were no positive detections of gasoline- or heavy oil-range TPH above screening levels. Consequently, diesel-range TPH is the only confirmed COPC in groundwater (Table 4). Gasoline-range TPH is considered an unconfirmed COPC (Table 5). The TPH PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of TPH concentrations below the screening levels.

5.3.5 Polychlorinated Biphenyls

Concentrations of total PCBs (sum of seven common Aroclors, calculated per WAC 173-340-708[8][f][iii][A]) in groundwater relative to the screening level listed in Table 2 are shown in Figure 22. As shown in this figure, PCBs were detected at concentrations exceeding the screening level in four monitoring wells (MW-51, MW-53, MW-56, and MW-59).

A significant number (i.e., more than 25 percent) of the ND results for PCBs (i.e., samples in which no PCBs were detected) had total concentrations (calculated using one-half the PQLs for individual PCBs) that exceeded the screening level. Based on the detected screening level exceedances depicted in Figure 22, PCBs are confirmed COPCs in groundwater (Table 4). The PCB PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of PCB concentrations equal to the screening level.

5.3.6 Pesticides

Concentrations of pesticides in groundwater relative to the screening levels listed in Table 2 are shown in Figure 23. As shown in this figure, pesticides were detected at concentrations exceeding screening levels in 11 monitoring wells; the highest exceedances were detected in well MW-56. Constituents detected above screening levels in well MW-56 include endrin aldehyde and endrin ketone. Constituents detected above screening levels in one or more of the other wells with exceedances include 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, endrin, endrin ketone, and heptachlor.

The majority of pesticide ND results had PQLs that exceeded screening levels. However, only 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, endrin, endrin aldehyde, endrin ketone, and heptachlor had positive detections above screening levels. Consequently, these are the only confirmed COPCs in groundwater (Table 4). Unconfirmed pesticide COPCs are listed in Table 5. The pesticide PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of pesticide concentrations equal to or below the screening levels.

5.3.7 Metals

Concentrations of metals in groundwater relative to the screening levels listed in Table 2 are shown in Figure 24. As shown in this figure, metals were detected at concentrations exceeding screening levels at the majority of the monitoring well locations. The highest exceedances were detected in wells PZ-3, PZ-4, and MW-51 in the Main Process Area; wells PZ-7, PZ-11, and PZ-12 in the area of the Secondary Wastewater Treatment Plant/Bone Yard; and wells PZ-9, PZ-10, and MW-59 in the area of the Primary Clarifier and SSL Lagoon. Metals exceedances also were detected in the groundwater grab sample obtained from the borehole for PA-19. Constituents detected above screening levels in groundwater include arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and silver.

The following constituents had a significant number of ND results (i.e., more than 25 percent of the total number of ND results) for which PQLs exceeded screening levels:

- Arsenic
- Lead
- Mercury
- Nickel
- Silver
- Thallium

Because arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and silver are the only constituents that have had positive detections above screening levels, they are the only confirmed COPCs in groundwater (Table 4). Thallium is considered an unconfirmed COPC (Table 5). The metals PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of metals concentrations equal to or below the screening levels.

5.3.8 Dioxins/Furans

Concentrations of total dioxins/furans (TEC, calculated per WAC 173-340-708[8][d][iii][A]) in groundwater relative to the screening level listed in Table 2 are shown in Figure 25. Only four groundwater samples (obtained from wells MW-54, MW-55, MW-56, and PZ-9 in February 2001) have been analyzed for dioxins/furans. Dioxins/furans were not detected in three of the samples, but the total TEC in these ND samples (calculated using one-half the PQLs for individual congeners) exceeded the screening level. These three ND results (from wells MW-55, MW-56, and PZ-9) are not included in Figure 25.

As shown in Figure 25, dioxins/furans were detected above the screening level in well MW-54. Consequently, dioxins/furans are a confirmed COPC in groundwater (Table 4). The dioxin/furan PQLs to be used for the sampling and analysis described in this Work Plan will allow detection of dioxin/furan concentrations equal to the screening level.

5.3.9 Ammonia

Concentrations of ammonia (un-ionized) in groundwater relative to the screening level listed in Table 2 are shown in Figure 26. Ammonia was detected in all 103 groundwater samples analyzed for this constituent, and exceeded the associated screening level in 21 samples. Based on the detected screening level exceedances depicted in Figure 26, ammonia is a confirmed COPC in groundwater (Table 4).

6.0 SUPPLEMENTAL UPLAND DATA COLLECTION FIELD INVESTIGATION

This section describes the field investigation that will be conducted to address the data gaps identified in Exhibit B of the Order. It also describes the various data evaluation tasks that were completed during development of the field investigation scope. The data gaps and main elements of the supplemental upland investigation are summarized in Table 6. Data collected during the supplemental investigation will be used to further characterize the contaminant transport pathways and potential risks to human health and the environment identified in the CSM (Section 4.0). The supplemental data also will be used to support the development and evaluation of cleanup action alternatives in the *Interim Action Alternatives Evaluation Report for the Study Area* (Volume III of the Interim Action Report required by the Order).

Specifics regarding sampling locations and depths, field procedures, and analytical methods for the supplemental investigation are presented in the Sampling and Analysis Plan (SAP; Appendix A). Quality control procedures and data quality objectives are discussed in the Quality Assurance Project Plan (QAPP; Appendix B), health and safety procedures are discussed in the Health and Safety Plan (HASP; Appendix C), and archaeological monitoring procedures are discussed in the Archaeological Monitoring Plan (Appendix D).

6.1 General Approach

Groundwater, surface water, and soil sampling will be performed to resolve the data gaps identified in Exhibit B of the Order. The field investigation will be conducted using a phased approach. Five investigation phases are planned; the work to be performed during each phase is outlined in Table 7. Results from each phase of the investigation will inform the scope and locations of additional sampling and analyses to be performed during subsequent phases. The analytical data from each phase will be reviewed by Rayonier and submitted for Ecology review within approximately two to three weeks of receiving the analytical data packages from the laboratory. The scope and schedule of subsequent investigation phases will be reviewed with Ecology before initiating the subsequent phases.

The planned investigation activities outlined in Table 7 are described further in Sections 6.2 through 6.8 below; preliminary proposed exploration/sampling locations are shown in Figure 28. Existing data from the Upland RI (Integral, 2006) and earlier investigations were evaluated as an initial step to resolving several of the Exhibit B data gaps. The methods and results of these data evaluation tasks also are summarized below. It should be noted that Sections 6.2 through 6.8 are organized according to the Exhibit B data gap numbers and the anticipated general chronological sequence of field activities. The section headings are not intended to correlate directly with the investigation phases listed in Table 7.

In general, the laboratory analytical methods to be used during the supplemental investigation will have PQLs that do not exceed the soil and groundwater screening levels (Tables 1 and 2). The analytical laboratories will achieve the lowest sample-specific PQLs consistent with the analytical method and any analytical constraints that may be imposed by the sample matrix, such as matrix interference, elevated analyte concentrations requiring sample dilutions, etc. Target PQLs for the planned analytical methods are presented in the QAPP (Appendix B). See Section 5.1 for additional discussion of PQLs.

6.2 Groundwater Monitoring (Exhibit B Data Gap 10)

Quarterly groundwater monitoring will be initiated during the supplemental investigation, beginning with a baseline sampling event at the existing monitoring wells on the mill property. Construction details for the existing wells are summarized in Table 8. The existing wells will be redeveloped at least 48 hours prior to the baseline monitoring event to ensure effective hydraulic communication between the wells and the shallow water-bearing zone and to allow the water-bearing zone to recover from well development activities. Before the wells are redeveloped or sampled, groundwater levels will be measured and the wells will be checked for the presence of non-aqueous phase liquid (NAPL) using an oil/water interface probe or similar device. Groundwater samples will then be collected from the monitoring wells using low-flow purging and sampling techniques as described in the SAP (Appendix A). Groundwater sampling will be timed with the tidal cycle to minimize the effects of saltwater intrusion (i.e., sampling will be performed at approximately low-tide or the beginning of incoming tide). The groundwater samples collected during the baseline event will be analyzed for the following constituents:

- Field parameters (e.g. salinity and/or conductivity/specific conductance, pH, temperature, dissolved oxygen, redox potential, and turbidity);
- VOCs;
- SVOCs (including cPAHs);
- Gasoline-, diesel-, and heavy oil-range TPH;
- PCBs;
- Pesticides;Metals;
- Dioxins/furans; and
- Ammonia.

Results from the baseline monitoring event and previous (2003 and earlier) groundwater sampling events will be used to develop a groundwater monitoring program for the Upland Study Area. Seasonal trends and tidal fluctuations assessed during previous investigations will be considered in developing the monitoring program. If a particular constituent or analyte group is not detected above PQLs equal to or lower than the groundwater screening levels listed in Table 2 during the baseline monitoring event, and was not detected above PQLs equal to or lower than the Table 2 screening levels during the three most recent historical groundwater sampling events (assuming adequate coverage of seasonal variations), that constituent/analyte group will not be included in the monitoring program.

Groundwater monitoring will be conducted on a quarterly basis for the first year. After the first four quarterly monitoring events are completed (including the baseline event), the monitoring data will be reviewed, and potential modifications to the monitoring frequency and/or list of constituents analyzed during future monitoring events will be discussed with Ecology as appropriate. For example, if a particular constituent or analyte group is not detected above PQLs for four consecutive quarterly monitoring events, Rayonier may propose to Ecology that the constituent/analyte group not be analyzed during future monitoring events.

In addition to providing the baseline data needed to develop a groundwater monitoring program, the results of the baseline groundwater monitoring event will be used (where applicable) to inform and refine the scope of the subsequent investigation activities described below. Table 7 provides a bulleted summary of the anticipated qualitative results and data use for each phase of the investigation (i.e., how the results of each investigation phase will inform subsequent phases).

6.3 Groundwater Seep Survey, Shoreline Monitoring Well Installation, Seep Sampling, and Surface Water Sampling (Exhibit B Data Gap 1)

6.3.1 Groundwater Seep Survey and Shoreline Monitoring Well Installation

Field reconnaissance will be conducted along the intertidal zone adjacent to the mill property during low tide to look for visual evidence of groundwater seeps. The locations and observed characteristics of any seeps identified during the field reconnaissance will be documented in field notes and photographs. To focus the seep survey and facilitate efficient documentation of the associated field activities, the mill property shoreline has been divided into seven "seep survey zones" as shown in Figure 28.

If groundwater seeps are not observed during the field reconnaissance, the spacing of existing groundwater monitoring wells along the shoreline will be reviewed, and additional monitoring wells will be installed if needed to further evaluate the groundwater to surface water pathway. Based on the current spacing between existing monitoring wells, one shoreline location between the Finishing Room Area and well PZ-9 has already been selected for a new monitoring well. This new shoreline monitoring well (MW-63; Figure 28) will be installed regardless of the seep survey results. The new well will be screened to the top of the glacial deposits, and the screen interval will not exceed 20 feet. Soil samples obtained from the well borehole and groundwater samples obtained during the initial (baseline) round of groundwater sampling at this well will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. Well MW-63 will be included in the groundwater monitoring program described in Section 6.2.

6.3.2 Seep Sampling

If groundwater seeps are observed during the field reconnaissance, the locations of the seeps will be compared to potential upland source areas. Potential source areas include areas where soil contaminants exceed screening levels protective of groundwater as marine surface water and areas where groundwater contaminants exceed screening levels protective of marine surface water. At locations where seeps are observed downgradient of potential upland source areas, seep monitoring stations will be established to facilitate collection of pore water samples from intertidal zone sediments. It is anticipated that one seep monitoring station per seep survey zone will be adequate, but adjustments may need to be made following the seep survey.

The seep monitoring stations will consist of temporary, pre-packed well points installed in the upper 3 to 5 feet of intertidal sediments. Up to seven seep monitoring stations will be installed, one in each seep survey zone identified in Figure 28. The initial (baseline) round of pore water samples collected from the seep monitoring stations will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5.

Following the baseline seep monitoring event, three additional quarterly seep monitoring events will be performed in conjunction with the quarterly groundwater monitoring events (groundwater monitoring is discussed in Section 6.2). The pore water samples collected during the quarterly events will be analyzed for those COPCs detected in at least one pore water sample during the baseline event, and any additional COPCs detected above screening levels in soil or groundwater in potential upland source areas. Details of the seep monitoring program will be developed in conjunction with the groundwater monitoring program and submitted for Ecology review and approval.

6.3.3 Surface Water Sampling

Three surface water samples will be collected from Ennis Creek during the same investigation phase (Phase 1) as the seep survey. The surface water samples will be collected downgradient of the Finishing Room Area, just north of the bridge at the mouth of Ennis Creek. The three samples will be obtained from the east bank, west bank, and middle of the creek. Surface water sampling methods are described in the SAP (Appendix A). Surface water sampling will be conducted at low tide to the extent possible to minimize saltwater dilution. The surface water samples will be analyzed for the following constituents:

- Field parameters (e.g. salinity and/or conductivity/specific conductance, pH, temperature, dissolved oxygen, redox potential, and turbidity);
- VOCs;
- SVOCs (including cPAHs);
- Gasoline-, diesel-, and heavy oil-range TPH;
- PCBs;
- Pesticides;Metals;
- Dioxins/furans; and
- Ammonia.

It should be noted that additional surface water samples will be collected from Ennis Creek and White Creek near the southern property boundary during this same phase of sampling, as discussed in Section 6.8.9.

6.4 Former Process Piping Assessment (Exhibit B Data Gap 3)

Information about former mill process piping and tanks (location, construction, and contents) was compiled using the following reference materials:

- Historical Rayonier engineering drawings of mill facilities (paper and electronic [CAD] formats).

- Previously published reports describing mill operations and environmental investigations (including maps and photographs).
- Historical City of Port Angeles engineering drawings showing City-owned sewer lines on the mill property.

In addition, Rayonier interviewed former mill personnel that were responsible for process pipe draining and flushing activities during decommissioning of the mill. Information obtained as a result of this inquiry is presented below.

Piping and former chemical/fuel storage and process tanks identified in the references listed above were overlaid on a base map of the Upland Study Area. Piping systems considered to have the potential to release hazardous substances to the environment were then identified through a process of elimination. The following categories of piping were eliminated from further consideration:

- Known aboveground piping (with the exception of fuel oil piping). The majority of the process piping at the mill was aboveground, including SSL piping. Because these piping systems were regularly inspected and maintained as part of routine mill operations, they are an unlikely source of past releases. Although the pipeline used to transfer fuel oil (Bunker C) from the mill dock to Fuel Oil Tanks 1 and 2 was aboveground, it was retained for further consideration due to: (1) its significance with respect to former mill operations and (2) the documented presence of past fuel oil releases in the area of Fuel Oil Tanks 1 and 2.
- Piping known to have contained only water (e.g., fire suppression and process makeup water piping systems).
- City of Port Angeles sanitary sewer piping.

The piping categories of potential concern that remained after eliminating the above categories include the aboveground fuel oil piping and underground wastewater drain piping. Figure 27 shows the locations of these piping systems and the locations of former tanks.

The former fuel oil pipeline was taken out of service in 1990 (HLA, 1993). There are several groundwater monitoring wells adjacent to and downgradient (shoreward) of this pipeline (Figure 27) that can be used to screen for possible historical releases of petroleum from the fuel oil piping. Accordingly, other than sampling groundwater at these existing monitoring wells, no further data collection is expected to be necessary to evaluate the fuel oil piping unless indicated otherwise by results of further sampling in the area.

The wastewater drain piping system shown in Figure 27 conveyed process effluent streams from various process tanks, sumps, and floor/trench drains in the Main Process Area to the mill's primary and secondary wastewater treatment systems. In the 1970s, wastewater at the mill was segregated into three streams: (1) solids sewer, (2) strong sewer, and (3) uncontaminated sewer (Foster Wheeler, 1997). Effluents that contained more than 0.3 pounds of settleable solids per 1,000 gallons were pumped via the solids sewer force main to the primary clarifier, where the majority of solids were removed by sedimentation. Effluents that contained less than 0.3 pounds of settleable solids per 1,000 gallons were pumped via the strong sewer force main and combined with the primary clarifier effluent. The combined strong sewer and primary clarifier effluent was then pumped to the secondary treatment system. Uncontaminated sewer effluents were combined with the treated effluent from secondary treatment prior to discharge via the deep water outfall that extended approximately 7,900 feet into the Strait of Juan de Fuca (Foster Wheeler, 1997).

Organic pollutants in mill wastewater mainly consisted of dissolved sugars and organic acids (Foster Wheeler, 1997). Rayonier has two active pulp mills in operation in the U.S. – one in Jesup, Georgia and one in Fernandina Beach, Florida. The mill in Fernandina Beach is an analogue to the former Port Angeles mill. Pertinent excerpts of the National Pollutant Discharge Elimination System (NPDES) permit for the Fernandina Beach mill are included in Exhibit 2. Monitoring parameters for the NPDES permit are determined based on characterization data. Based on the information contained in the Fernandina Beach mill NPDES permit, it is unlikely that the Port Angeles mill wastewater contained any of the confirmed soil or groundwater COPCs identified in Section 5.0, with the possible exception of ammonia. Nevertheless, to address Exhibit B Data Gap 3, potential releases from the former wastewater drain piping in the Main Process Area will be assessed by collecting groundwater grab samples at five locations (GWG-1 to GWG-5; Figure 28) in the vicinity of the piping. The groundwater grab samples will be collected using a hollow-stem auger drill rig equipped with a Hydropunch® or similar discrete-depth groundwater sampling device, which is driven ahead of the auger flights into undisturbed soil as the boring is advanced.

Concrete rubble from mill decommissioning activities overlies much of the former wastewater piping system in the Main Process Area, so the groundwater grab samples in this area will be collected along the downgradient (western, northern, and eastern) perimeter of the concrete rubble. The groundwater grab samples will be analyzed for ammonia and additional constituents to be determined based on the results of the baseline groundwater monitoring event described in Section 6.2. The baseline groundwater monitoring results at existing wells MW-51, MW-56, and MW-58 and new wells MW-62 and MW-63 (see Sections 6.3 and 6.5) will supplement the groundwater grab sampling as a means of screening for potential releases from the former wastewater drain piping.

If the groundwater sampling results indicate that releases may have occurred from the wastewater drain piping, one or more targeted test pits or "potholes" will be excavated using a backhoe, excavator, or vactor truck to explore for remaining underground piping that could potentially contain hazardous substances. If piping is discovered, the top of the piping will be carefully opened to allow the pipe contents (if present) to be sampled. Samples of pipe contents will be collected as described in the SAP and analyzed for the constituents detected in groundwater samples collected in the vicinity of the piping. However, based on Rayonier's understanding of the wastewater composition, piping network, and expected groundwater sampling results, it is unlikely that this level of field investigation will be warranted, with the exception of the apparent buried wastewater pipe encountered at sampling location SR23 during the Upland RI (Figure 28). The buried pipe at location SR23 will be exposed and the contents of this pipe will be sampled and analyzed for diesel- and heavy oil-range TPH, SVOCs (including cPAHs), VOCs, PCBs, pesticides, metals, dioxins/furans, and ammonia.

On February 9, 2010, Rayonier interviewed William (Bill) Cassinelli (360-532-0511), who was the Demolition Project Manager for Rayonier when the mill was shut down beginning in 1997. Mr.

Cassinelli was responsible for process pipe draining and flushing activities during decommissioning of the mill and stated during the interview that:

- There were very few chemical lines or underground lines. Most lines were aboveground, and underground lines were mostly in pipe chases. Primary and secondary wastewater drain lines were the main underground lines.
- Fuel lines were restricted to the power house area and were excavated and removed.
- No underground chemical lines were left in place after mill decommissioning.

Following is an excerpt from the Materials Handling Plan for the Port Angeles mill dismantling project dated March 1997, which supports Mr. Cassinelli's statements and Rayonier's assertion that there is negligible underground process piping of concern remaining at the mill property.

> **2. Mill Dismantling**
>
> A. Inspection
>
> The inspection of the mill for the removal of hazardous materials will be conducted in three phases. The first phase is following the last production and includes the normal activities associated with mill shutdown. During this first phase operating departments will assure that all pulp, remaining chemicals, and oil are removed from all of the vessels, piping systems, and equipment. The second phase involves the removal activities of the contractor for items such as lead, asbestos and PCB materials. The third inspection involves a final walk through by the Plant Engineer and the Contractor prior to dismantling of any building or structure. These inspections are described in more detail below.
>
> The phase following the cessation of pulp production will entail careful inspection and verification by mill personnel of each vessel, piping systems, stock storage area, and chemical addition systems. Every area will be inspected by operators first to assure that the production equipment has been properly cleaned and is ready for inspection by the department head and then by the Engineering and Maintenance Department. If the Engineer/Maintenance Department finds that the equipment is not acceptable they will identify the items requiring correction. Only the Engineering/Maintenance Department can give final approval on equipment cleanup and isolation. Tags will be placed on systems to be signed off by the Department Heads and the Maintenance Department. These tags are to remain with the equipment and will not be removed.
>
> The Contractor will be responsible for inspecting each vessel and piping system prior to proceeding with dismantling to assure that they are empty and free of hazardous materials and that all energy and electrical systems have been disconnected. To facilitate this work special tags will be affixed to equipment, tanks and piping systems to indicate that they have been cleaned and are free of all materials. These tags will placed by mill engineering and maintenance personnel qualified on the systems in each production area. Prior to dismantling pipe and tanks in a designated work area, the Contractor's project engineer and a representative of Rayonier's engineering staff shall inspect the pipes and tanks to verify this condition. Such inspections will be documented.
>
> As the Contractor completes various phases of hazardous material removal they will conduct inspections before demobilizing. These inspections will be conducted by the Contractor, their Industrial Hygienist, and Plant Engineering staff to verify that the removal has been thoroughly completed and that all of the contractors equipment has been removed and cleanup performed. Inspections will take place in each vessel undergoing lead abatement and removal and will be documented on appropriate forms. Likewise inspections will take place as various asbestos and PCB removal projects are completed.
>
> The third inspection occurs prior to the dismantling of any building or structure. This will be a final inspection and will be conducted by the Contractor's project engineer, the mill's Plant Engineer, and a qualified person with a Washington certification for asbestos work. The purpose of

the inspection is to perform a final walk through prior to dismantling to verify that all asbestos containing materials or other hazardous materials have been removed. Project specific report forms will be used to document the inspection. An industrial hygienist and environmental engineer will also participate in this inspection to verify that all hazardous materials and conditions have been removed prior to the start of work.

6.5 Assessment of Groundwater Downgradient of Fuel Oil Tanks 1 and 2, Hog Fuel Pile, and Finishing Room Interim Action Areas (Exhibit B Data Gaps 5, 7, and 8)

6.5.1 Fuel Oil Tanks 1 and 2 and Hog Fuel Pile

Two new groundwater monitoring wells (MW-60 and MW-61; Figure 28) will be installed downgradient of the Fuel Oil Tanks 1 and 2 and Hog Fuel Pile Areas. Well MW-60 will be installed south of existing well MW-28, and well MW-61 will be installed near the shoreline between existing wells MW-52 and MW-28. These new wells will provide groundwater data to address Exhibit B Data Gaps 5 and 8.

The new monitoring wells will be screened to the top of the glacial deposits, and the screen interval will not exceed 20 feet. Soil samples obtained from the well boreholes will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. Groundwater samples obtained during the initial (baseline) round of groundwater sampling at these wells will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. Wells MW-60 and MW-61 will be included in the groundwater monitoring program described in Section 6.2.

6.5.2 Finishing Room

One new groundwater monitoring well (MW-62; Figure 28) will be installed between the Finishing Room Area and the shoreline. This new well will provide groundwater data to address Exhibit B Data Gap 7.

The new monitoring well will be screened to the top of the glacial deposits, and the screen interval will not exceed 20 feet. Soil samples obtained from the well borehole will be analyzed for diesel- and heavy oil-range TPH, SVOCs, and PCBs. Groundwater samples obtained during the initial (baseline) round of groundwater sampling at this well will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. Well MW-62 will be included in the groundwater monitoring program described in Section 6.2.

6.6 Assessment of Soil and Groundwater at Former Monitoring Well Locations MW-11 and MW-13 (Exhibit B Data Gaps 6 and 9)

6.6.1 Former Well MW-11

The potential presence of residual petroleum contamination will be investigated at the location of former monitoring well MW-11, immediately east of former Fuel Oil Tank 2 (Figure 28). At least one test pit (TP-7) will be excavated at this location to assess soil conditions in the unsaturated zone and shallow saturated zone immediately below the groundwater table. A minimum of two samples per test pit will be collected; more samples will be obtained if warranted based on observed field conditions. Soil samples obtained from the test pit(s) will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead.

If contaminated soil and/or NAPL are encountered in test pits, up to 100 cy of contaminated material will be removed for subsequent off-property disposal. This is a total quantity not to be exceeded for all test pits completed during the supplemental investigation. If necessary, contaminated media removed for off-property disposal will be temporarily stored on the mill property in lined/covered stockpiles, roll-off boxes, and/or portable liquid storage tanks. Test pits from which contaminated material is removed for disposal will be backfilled with clean fill material.

If petroleum contaminated soil is encountered and removed in the area of former well MW-11, a monitoring well will be installed immediately downgradient of this area to document post-removal groundwater quality. The monitoring well will be screened to the top of the glacial deposits, and the screen interval will not exceed 20 feet. Groundwater samples obtained from this well will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. If petroleum contaminated soil is not encountered, existing wells MW-23, MW-28, and MW-29 will be used to monitor groundwater downgradient of former well MW-11.

6.6.2 Former Well MW-13

The chlorinated VOCs TCE, 1,2-DCA, and vinyl chloride were detected at concentrations ranging from 7.0 to 93 ug/L in groundwater samples obtained from former monitoring well MW-13 in March and July 1991 (Landau, 1991). TCE was detected at a maximum concentration of 7.0 ug/L, which is slightly above the screening level of 6.7 ug/L. 1,2-DCA was detected at a maximum concentration of 93 ug/L, which exceeds the screening level of 37 ug/L. Vinyl chloride was detected at a maximum concentration of 34 ug/L, which exceeds the screening level of 2.4 ug/L. Well MW-13 was located immediately north of former Fuel Oil Tank 2 (Figure 28) and was screened from 6 to 16 feet bgs. The well was installed in September 1990 and was decommissioned in 1993 (Integral, 2006).

The potential presence of dissolved VOCs (including chlorinated compounds) and dense non-aqueous phase liquid (DNAPL; TCE, for example) in groundwater at the location of former well MW-13 will be investigated by advancing a hollow-stem auger soil boring (GWG-6; Figure 28) to a depth of approximately 6 feet below the top of the glacial deposits. The glacial deposits are expected to occur at a depth of approximately 20 to 26 feet bgs based on lithologic logs for nearby borings B-9 and B-14 completed in 1990 (Landau, 1991). Soil and groundwater grab samples will be collected at 5-foot intervals as the boring is advanced. The groundwater samples will be collected using a Hydropunch® or similar discrete-depth groundwater sampling device, which is driven ahead of the augers into undisturbed soil as the boring is advanced. An attempt will be made to collect a soil sample from the glacial deposits for grain-size analysis and permeability testing. In addition, an attempt will be made to collect soil and groundwater samples for VOC analysis from approximately 6 feet below the top of the glacial deposits.

The groundwater samples will be analyzed for VOCs on a rush (2- to 3-day) turnaround basis. The soil samples collected above the glacial deposits will be placed on hold at the analytical laboratory pending receipt and review of the VOC data for the groundwater samples and the soil sample obtained from the glacial deposits (if successfully collected). If VOCs are detected in the groundwater grab samples or the soil sample obtained from the glacial deposits, follow-up VOC analysis may be performed on select shallower soil samples from boring GWG-6 depending on the concentrations detected.

In accordance with the investigation activities outlined in Exhibit B of the Order (Data Gap 9), the competency and lateral continuity of the glacial deposits were evaluated to assess whether the glacial deposits likely act as an aquitard (that is, a laterally continuous, low-permeability hydrogeologic unit that limits vertical groundwater migration). If the glacial deposits act as an aquitard, they would be expected to limit downward migration of any DNAPL that may exist (or may have existed in the past) in the subsurface.

Although the competency of the glacial deposits has not been directly measured (e.g., by performing permeability tests on collected soil samples), the permeability of glacial till is typically several orders of magnitude less than that of unconsolidated sandy soil (Holtz and Kovacs, 1981; Vaccaro, 1998). Previous reports indicate that the glacial deposits beneath the Upland Study Area generally consist of dense to very dense fine sand containing varying quantities of silt, clay, and gravel (Landau, 1991; CH2M Hill, 1977). Previous borings that have been advanced to the top of the glacial deposits and deeper indicate that the glacial deposits are laterally continuous across the mill property and are at least 10 to 25 feet thick (Landau, 1991; CH2M Hill, 1977). An attempt will be made to collect a sample of the glacial deposits for laboratory permeability testing to confirm low permeability (see Appendix A, Section 3.3.1).

The results of the discrete-depth soil and groundwater sampling described above will be reviewed to assess the need for further evaluation of VOCs in groundwater near former well MW-13. The need for further VOC evaluation will be determined through discussion with Ecology after reviewing the supplemental analytical data. If the glacial deposits are encountered at the expected depth (approximately 20 to 26 feet bgs) in boring GWG-6 and chlorinated VOCs are not detected above screening levels, no further investigation of VOCs will be performed. If the glacial deposits are more than 10 feet deeper than expected, or if chlorinated VOCs are detected above screening levels, the need for additional groundwater characterization for VOCs will be discussed with Ecology. If needed, the additional groundwater characterization will consist of conducting further groundwater grab sampling and/or installing and sampling additional groundwater monitoring wells in the vicinity of former well MW-13.

6.7 Delineation of Residual Soil Contamination in Interim Action Areas (Exhibit B Data Gap 4)

As discussed in Section 5.2, the nature and extent of soil contamination in the Upland Study Area was evaluated during preparation of this Work Plan, by comparing the results of previous soil characterization sampling and interim action verification sampling to the screening levels in Table 1. The locations of previous soil samples were plotted on the Upland Study Area base map, and the spatial coverage/completeness of the soil analytical data in those portions of the interim action areas where residual contamination is known to exist was reviewed.

Based on the review of existing data, it was determined that additional subsurface exploration/sampling is needed to further characterize the extent of residual contamination in all of the interim action areas. This characterization will be accomplished by digging targeted test pits at or beyond the limits of the previous soil removal areas in the Fuel Oil Tanks 1 and 2, Hog Fuel Pile, Wood Mill, and Machine Shop Areas, and by sampling soil and groundwater at proposed new monitoring wells MW-60 and MW-61 downgradient of Fuel Oil Tanks 1 and 2, and MW-62 downgradient of the Finishing Room Area. The test pits will be excavated using a backhoe or excavator. In areas where residual contamination appears to be limited in extent and readily accessible (e.g., near the base of the utility pole at the eastern end of the Fuel Oil Tank 1 soil removal area; GeoEngineers, 2006), contaminated soil and/or NAPL will be removed and either temporarily stored on the mill property in covered/lined stockpiles, roll-off boxes, and/or portable liquid storage tanks, or transported directly to an off-property, permitted disposal facility. The total quantity of contaminated material that may be removed for disposal during the supplemental investigation will not exceed 100 cy.

Depending on field screening and/or soil sampling results, further groundwater characterization may be completed to assess the extent of local groundwater impacts. If needed, further groundwater characterization will be accomplished by installing and sampling additional "infill" monitoring wells (i.e., in addition to the new wells discussed in Sections 6.3 and 6.5; see "Phase 4" in Table 6). The planned sampling and analysis of groundwater at the existing wells and new wells MW-60 through MW-63 may be sufficient to complete the groundwater characterization. The need for additional infill wells will be determined through discussion with Ecology after evaluating data from preceding phases of the investigation. If needed, the infill monitoring wells will be screened to the top of the glacial deposits, and the screen interval will not exceed 20 feet. Soil sampling and analyses performed at infill well locations will depend on the well locations and previous sampling done in the vicinity. Groundwater samples obtained during the initial (baseline) round of groundwater sampling at the infill wells will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. The infill wells (if installed) will be included in the groundwater monitoring program described in Section 6.2.

6.7.1 Finishing Room Area

As discussed in Section 6.5.2, one new monitoring well (MW-62; Figure 28) will be installed and sampled downgradient of the Finishing Room Area to further characterize the extent of the residual soil contamination identified in soil verification samples collected at the northern limits of the interim action excavation west of Ennis Creek. Soil samples obtained from the well borehole will be analyzed for diesel- and heavy oil-range TPH, SVOCs, and PCBs; groundwater samples from well MW-62 will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. Soil samples will not be analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) because the anticipated petroleum source product in this area is hydraulic oil, and BTEX constituents have not been detected in previous soil samples at concentrations above PQLs that are less than the respective screening levels. The soil sampling results will be used to estimate the volume of residual TPH- and PCB-contaminated soil remaining near the western foot of the bridge over Ennis Creek.

6.7.2 Fuel Oil Tank 1

As discussed in Section 6.5.1, two new monitoring wells (MW-60 and MW-61; Figure 28) will be installed and sampled downgradient of the Fuel Oil Tanks 1 and 2 and Hog Fuel Pile areas to assess the potential presence of residual soil and groundwater contamination downgradient of these areas. Soil samples obtained from the well boreholes will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead; groundwater samples from wells MW-60 and MW-61 will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. In addition, at least one test pit (TP-8; Figure 28) will be completed at the location of the residual soil contamination remaining near the base of the utility pole in the Fuel Oil Tank 1 area (GeoEngineers, 2006). A minimum of two samples per test pit will be collected; more samples will be obtained if warranted based on observed field conditions. Soil samples obtained from the test pit(s) will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. Soil samples will not be analyzed for BTEX because the anticipated petroleum source product in this area is Bunker C, and BTEX constituents have not been detected in previous soil samples at concentrations above PQLs that are less than the respective screening levels.

6.7.3 Fuel Oil Tank 2 and Hog Fuel Pile

As discussed in Section 6.5.1, two new monitoring wells (MW-60 and MW-61; Figure 28) will be installed and sampled downgradient of the Fuel Oil Tanks 1 and 2 and Hog Fuel Pile areas to assess the potential presence of residual soil and groundwater contamination downgradient of these areas. Soil samples obtained from the well boreholes will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead; groundwater samples from wells MW-60 and MW-61 will be analyzed for the confirmed and unconfirmed soil and groundwater COPCs listed in Tables 4 and 5. In addition, at least nine test pits (TP-4 through TP-6, TP-11 through TP-13, and TP-15 through TP-17; Figure 28) will be completed beyond and/or within the limits of the 1993, 2001, and 2002 interim action excavations. A minimum of two samples per test pit will be collected; more samples will be obtained if warranted based on observed field conditions. Soil samples obtained from the test pits will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. Soil samples will not be analyzed for BTEX because the anticipated petroleum source product in this area is Bunker C, and BTEX constituents have not been detected in previous soil samples at concentrations above PQLs that are less than the respective screening levels.

6.7.4 Wood Mill

At least three test pits (TP-1 through TP-3; Figure 28) will be completed beyond the limits of the 2006 interim action excavation. A minimum of two samples per test pit will be collected; more samples will be obtained if warranted based on observed field conditions. Soil samples obtained from the test pits will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. Soil samples will not be analyzed for BTEX because the anticipated petroleum source product in this area is Bunker C, and BTEX constituents have not been detected in previous soil samples at concentrations above PQLs that are less than the respective screening levels.

6.7.5 Machine Shop

At least three test pits (TP-9, TP-10, and TP-14; Figure 28) will be completed beyond the limits of the 2002 interim action excavation. A minimum of two samples per test pit will be collected; more samples will be obtained if warranted based on observed field conditions. Soil samples obtained from the test pits will be analyzed for diesel- and heavy oil-range TPH, SVOCs, PCBs, and lead. Soil samples will not be analyzed for BTEX because BTEX constituents have not been detected in previous soil samples at concentrations above PQLs that are less than the respective screening levels.

6.8 Evaluation of Potential Soil-to-Groundwater Source Areas (Exhibit B Data Gap 2)

Potential on-property, soil-to-groundwater source areas (i.e., areas where contaminants in soil could potentially leach to groundwater at concentrations exceeding groundwater screening levels) were evaluated during preparation of this Work Plan. The evaluation focused on areas of the mill property where COPC concentrations in soil and/or groundwater exceed the screening levels presented in Tables 1 and 2 (as depicted in Figures 10A/B through 26), and included a review of previous soil sampling depths in areas where COPC concentrations exceed screening levels. The results of this evaluation are summarized in Sections 6.8.1 through 6.8.8 below; the sections are organized according to analyte group.

The review of previous soil sampling depths indicated that there are some areas of the mill property where COPCs were detected in soil at concentrations exceeding screening levels by an order of magnitude or more, but details regarding the vertical extent of the contamination are not well defined, either due to sparse sampling of deeper soil, PQLs that exceeded screening levels in deeper samples with no detections, or the fact that many of the subsurface soil samples were composited over a depth interval extending from 0.25 feet bgs down to the water table. To address this data gap, nine supplemental soil borings (SSB-1 through SSB-9; Figure 28) will be completed to evaluate the vertical extent of contamination in select areas where one or more COPCs were detected at concentrations at least an order of magnitude higher than screening levels. In addition, discrete soil samples will be collected from multiple depths at all of the proposed monitoring well locations in the former mill operations areas, and at three of the proposed groundwater grab sampling locations (GWG-1, GWG-4, and GWG-5) near the central portion of the Main Process Area. Soil samples from all borings will be obtained at depths of 2 feet and 5 feet bgs, and then at 5-foot intervals down to the top of the glacial deposits.

In addition to potential soil-to-groundwater source areas, the spatial coverage of the existing groundwater monitoring well network was evaluated within and downgradient of potential source areas to assess whether additional monitoring wells may be needed. As discussed in Section 5.1.2, groundwater screening levels for the Upland Study Area are based on protection of marine surface water. Accordingly, the spatial coverage of the existing monitoring well network was evaluated based on the potential discharge of groundwater to marine surface water.

Based on the review of the existing monitoring wells, as discussed in Section 6.3, one shoreline location between the Finishing Room Area and existing well PZ-9 was selected for a new monitoring well (MW-63; Figure 28). This new monitoring well will be installed during Phase 2 of the investigation, along with the new monitoring wells to be installed downgradient of the Fuel Oil Tanks 1 and 2, Hog Fuel Pile, and Finishing Room Areas (see Table 7 and Section 6.5). If further work is needed to characterize potential soil-to-groundwater source areas, additional soil sampling will be conducted, and/or additional "infill" monitoring wells will be installed and sampled as necessary, during Phases 3 and 4 of the investigation. The additional soil and groundwater samples will be analyzed for COPCs previously detected in soil and baseline groundwater samples collected in the vicinity of the areas requiring further characterization.

6.8.1 Volatile Organic Compounds

VOCs were not detected above groundwater screening levels in monitoring wells located across the mill property, with the exception of former well MW-13, which had several historical exceedances of TCE, 1,2-DCA, and vinyl chloride, and well PZ-9, which had one historical exceedance of TCE (Figure 18). These VOCs are considered confirmed COPCs in groundwater in the vicinity of the historical exceedances.

VOCs were not detected in soil at concentrations above screening levels (Figure 10A). VOCs were analyzed in both shallow (≤ 2 feet bgs) and deep (> 2 feet bgs) soil above the groundwater table across much of the property, except near the Finishing Room and Machine Room Areas, where only shallow soil samples were obtained. As discussed in Section 5.2.1, PCE is considered an unconfirmed COPC in soil due to elevated PQLs in previous samples relative to the screening level; other VOCs (including TCE, 1,2-DCA, and vinyl chloride) are not considered COPCs in soil. Nevertheless, due to the previous detections of TCE, 1,2-DCA, and vinyl chloride in groundwater, these constituents and other VOCs will be further assessed in soil at former well location MW-13 to determine if VOCs are COPCs in soil (see Section 6.6.2).

6.8.2 Semivolatile Organic Compounds (not including cPAHs)

SVOC concentrations detected in groundwater exceeded screening levels in 11 monitoring wells (Figure 19). The highest exceedance was a PCP detection (83 ug/L) reported in well MW-23 in 2002. The majority of the SVOC exceedances in groundwater were bis(2-ethylhexyl)phthalate exceedances; other exceedances include PCP in MW-23 and MW-56, and 2,4,6-trichlorophenol in MW-23. SVOC concentrations detected in soil exceeded screening levels in the Main Process Area, the Log Yard (one location), and near the Finishing Room Area (Figure 11A). The majority of the SVOC exceedances in soil were PCP exceedances; other exceedances include bis(2-ethylhexyl)phthalate at two locations (including a detection of 1,800 mg/kg at location MS20), and pyrene at one location. Several of the monitoring wells with groundwater exceedances are downgradient of areas where soil exceedances were detected (for example, wells MW-51, MW-56, and MW-58). However, the primary constituent that exceeded in groundwater was bis(2-ethylhexyl)phthalate, whereas the primary constituent that exceeded in soil was PCP.

Shallow and deep soil samples were collected above the groundwater table throughout most of the areas of potential concern. Exceptions include the central portion of the Main Process Area (near the digesters, Screen Room, Bleach Plant, and Machine Room) and the Finishing Room, where the majority of the samples were shallow. Based on data from three locations where SVOCs were detected above screening levels in shallow soil but not in deeper soil at the same location, and the fact that only two deep soil sampling locations had confirmed exceedances of SVOC screening levels (SR20 and MS20; Figure 11A), the majority of the SVOC exceedances appear to be concentrated in shallow soil. However, there were a number of locations where SVOCs exceeded screening levels in shallow soil but no deep samples were analyzed, or no SVOCs were detected in the deep samples but the PQLs exceeded screening levels. To further define the vertical extent of SVOCs in soil, discrete soil samples will be collected and analyzed for SVOCs from monitoring well borings MW-60 through MW-63, soil borings SSB-1, SSB-2, SSB-3, and SSB-7, and groundwater grab sampling location GWG-5 (Figure 28).

In areas where SVOC concentrations in deep soil have not been previously characterized and monitoring wells do not exist (i.e., central portion of Main Process Area, downgradient of the Finishing Room), additional soil and groundwater characterization is needed to evaluate the soil to groundwater pathway. As discussed in Section 6.4, groundwater grab sampling will be performed to assess potential hazardous substance releases from former wastewater drain piping near the central portion of the Main Process Area (Figure 28; locations GWG-1 through GWG-5). Additionally, the four new monitoring wells to be installed downgradient of the Chlorine Dioxide Generator, Fuel Oil Tanks 1 and 2, Hog Fuel Pile, and Finishing Room (proposed wells MW-60 through MW-63; see Figure 28 and Sections 6.3 and 6.5) will provide for further characterization of SVOC concentrations in soil and groundwater in these areas. The need to further characterize the extent of SVOCs in soil will be assessed based on the results of the soil and groundwater sampling described above and the baseline groundwater sampling event (Section 6.2).

6.8.3 Carcinogenic Polycyclic Aromatic Hydrocarbons

cPAHs were detected at concentrations exceeding the screening level in shallow and/or deep soil in many areas of the mill property (Figure 12A). The highest exceedances were detected in shallow soil in the Main Process Area. In contrast, cPAH concentrations in groundwater exceeded the screening level in only one monitoring well (MW-51, located downgradient of the Main Process Area; Figure 20). This suggests that the cPAHs identified in property soil do not readily leach to groundwater. It should be noted that the soil screening level for cPAHs is based on protection of human health via direct contact, not protection of groundwater as marine surface water (the concentration protective of human health is lower than the concentration protective of groundwater).

The four new monitoring wells to be installed downgradient of the Chlorine Dioxide Generator, Fuel Oil Tanks 1 and 2, Hog Fuel Pile, and Finishing Room (proposed wells MW-60 through MW-63; see Figure 28 and Sections 6.3 and 6.5) will provide for further characterization of cPAH concentrations in soil and groundwater in these areas. Additionally, the collection and analysis of discrete soil samples for SVOCs at soil borings SSB-1, SSB-2, SSB-3, and SSB-7 and groundwater grab sampling location GWG-5 (see Figure 28 and Section 6.8.2) will further define the vertical extent of cPAHs in soil. The need to further characterize the extent of cPAHs in soil will be assessed based on the results of the soil and groundwater sampling described above, the baseline groundwater sampling event (Section 6.2), and the groundwater sampling to be performed in the vicinity of the former wastewater drain piping (Section 6.4).

6.8.4 Total Petroleum Hydrocarbons

Diesel-range TPH was detected in groundwater at concentrations exceeding the screening level of 0.5 mg/L in two samples obtained from existing well locations PZ-9 and PA-19 (Figure 21):

- A groundwater sample obtained from well PZ-9 on August 27, 1997 had a diesel-range TPH concentration of 0.84 mg/L.
- A groundwater grab sample obtained from the borehole for well PA-19 on August 21, 2009 had a diesel-range TPH concentration of 3 mg/L.

In addition, free-phase petroleum product (NAPL) was observed in former monitoring well MW-11 (immediately east of former Fuel Oil Tank 2) in 1997 as discussed in Section 3.1.2.

Soil was not tested for TPH in the vicinity of wells PZ-9 or PA-19. However, diesel- and heavy oil-range TPH exceedances are present in shallow and deep soil above the groundwater table in the previous interim action areas (Fuel Oil Tank 2/Hog Fuel Pile, Fuel Oil Tank 1, Wood Mill, Finishing Room, and Machine Shop Areas; Figure 13A). It should be noted that the soil screening level for diesel- and heavy oil-range TPH is based on protection of terrestrial plants and animals, not protection of groundwater as marine surface water (the concentration protective of terrestrial plants and animals is lower than the concentration protective of groundwater).

Because diesel-range TPH and metals were recently detected above screening levels in groundwater at City of Port Angeles CSO exploration location PA-19, additional soil and groundwater samples will be collected at three groundwater grab sampling locations in this area (GWG-7 through GWG-9; Figure 28) to evaluate the extent of the TPH (and metals) contamination.

The extent of residual TPH contamination in the interim action areas will be further assessed as part of the investigation activities to address Exhibit B Data Gap 4 (Section 6.7), and the potential presence of residual TPH contamination at the former location of well MW-11 will be investigated as discussed in Section 6.6.1. In addition to this work, the vertical extent of TPH in soil will be assessed by collecting and analyzing discrete soil samples from monitoring well borings MW-60 through MW-63, soil borings SSB-2 and SSB-7, and groundwater grab sampling location GWG-4 (Figure 28). Groundwater samples obtained from wells PZ-9, PA-19, and other monitoring wells will be analyzed for TPH during the baseline and subsequent groundwater monitoring events (Section 6.2). The need to further characterize the extent of TPH in soil will be assessed based on the soil and groundwater sampling described above.

6.8.5 Polychlorinated Biphenyls

PCBs have been detected above the groundwater screening level in two monitoring wells (MW-56 and MW-59; Figure 23). PCBs were detected in soil at concentrations exceeding the screening level at several locations upgradient of well MW-56 (Figure 14A). Soil in the vicinity of well MW-59 and in the central portion of the Main Process Area has not been analyzed for PCBs. Existing monitoring wells are located adjacent to or downgradient of the detected PCB exceedances in soil, with the exception of the Finishing Room and East Roll Storage areas. Groundwater and soil downgradient of these areas will be characterized by installing two new monitoring wells (proposed wells MW-62 and MW-63 shown on Figure 28; see Sections 6.3 and 6.5).

PCB exceedances are present in both shallow and deep soil above the groundwater table. PCBs were not analyzed in deep soil in areas west of Ennis Creek (including the Bleach Plant, Machine Room, and Screen Room areas) where PCB exceedances are present in shallow soil. PCBs also have not been analyzed in soil in the vicinity of monitoring well MW-59. The vertical extent of PCBs in soil will be assessed by collecting and analyzing discrete soil samples from soil borings SSB-1, SSB-2, SSB-4, SSB-5, SSB-6, and SSB-7 and groundwater grab sampling locations GWG-4 and GWG-5 (Figure 28). The need to further characterize the extent of PCBs in soil will be assessed based on the results of the soil and groundwater sampling described above, the baseline groundwater sampling event (Section 6.2), and the groundwater sampling to be performed in the vicinity of the former wastewater drain piping (Section 6.4). If further soil sampling is needed to characterize potential soil-to-groundwater source areas, it will be accomplished by digging targeted test pits during Phase 3 of the field investigation (Table 7).

6.8.6 Pesticides

Pesticide concentrations exceeded groundwater screening levels in 11 monitoring wells (Figure 22), with the highest exceedances detected at well MW-56. Pesticide concentrations exceeding soil screening levels were detected in both shallow and deep soil above the groundwater table adjacent to and upgradient of monitoring wells (Figure 15A). Existing monitoring wells are located adjacent to or downgradient of the detected pesticide exceedances in soil, with the exception of the Finishing Room, East Roll Storage, and Chlorine Dioxide Generator areas. Groundwater downgradient of these areas will be characterized by installing two new monitoring wells (proposed wells MW-62 and MW-63 shown on Figure 28; see Sections 6.3 and 6.5).

Pesticides were not analyzed in deep soil (> 2 feet bgs) in areas west of Ennis Creek (including the Bleach Plant, Machine Room, and Screen Room areas) where pesticide exceedances are present in shallow soil. The vertical extent of pesticides in soil will be assessed by collecting and analyzing discrete soil samples from soil borings SSB-1, SSB-2, SSB-6, and SSB-7 and groundwater grab sampling locations GWG-4 and GWG-5 (Figure 28). The need to further characterize the extent of pesticides in soil will be assessed based on the results of the soil and groundwater sampling described above, the baseline groundwater sampling event (Section 6.2), and the groundwater sampling to be performed in the vicinity of the former wastewater drain piping (Section 6.4). If further soil sampling is needed to characterize potential soil-to-groundwater source areas, it will be accomplished by digging targeted test pits during Phase 3 of the field investigation (Table 7).

6.8.7 Metals

Metals including arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and/or silver have been detected above screening levels in groundwater at a number of locations across the mill property (Figure 24). The highest exceedances in monitoring wells were detected in well PZ-9. Metals concentrations exceeding soil screening levels were detected in both shallow and deep soil above the groundwater table adjacent to and upgradient of monitoring wells (Figure 16A). Existing monitoring wells are located adjacent to or downgradient of the detected metals exceedances in soil, with the exception of the Finishing Room, East Roll Storage, Chlorine Dioxide Generator, and Log Yard areas. Groundwater downgradient of these areas will be characterized by installing three new monitoring wells (proposed wells MW-61, MW-62, and MW-63 shown on Figure 28; see Sections 6.3 and 6.5).

Because metals and diesel-range TPH were recently detected above screening levels in groundwater at City of Port Angeles CSO exploration location PA-19, additional soil and groundwater samples will be collected at three groundwater grab sampling locations in this area (GWG-7 through GWG-9; Figure 28) to evaluate the extent of the metals (and TPH) contamination.

Metals were not analyzed in deep soil in areas west of Ennis Creek (including the Bleach Plant, Machine Room, and Screen Room areas) where metals exceedances are present in shallow soil. The vertical extent of metals in soil will be assessed by collecting and analyzing discrete soil samples from soil borings SSB-1, SSB-2, SSB-4, SSB-7, SSB-8, and SSB-9 and groundwater grab sampling location GWG-5 (Figure 28). The need to further characterize the extent of metals in soil will be assessed based on the results of the soil and groundwater sampling described above, the baseline groundwater sampling event (Section 6.2), and the groundwater sampling to be performed in the vicinity of the former wastewater drain piping (Section 6.4). If further soil sampling is needed to characterize potential soil-to-groundwater source areas, it will be accomplished by digging targeted test pits during Phase 3 of the field investigation (Table 7).

6.8.8 Dioxins/Furans

Dioxins/furans were analyzed in groundwater samples obtained from four monitoring wells (MW-54, MW-55, MW-56 and PZ-9) in February 2001. As discussed in Section 5.3.8, dioxins/furans are considered unconfirmed COPCs in groundwater based on the February 2001 sampling results

(Figure 25). Dioxin/furan concentrations exceeding soil screening levels were detected across much of the Upland Study Area (Figure 17A), in both shallow and deep soil above the groundwater table. The highest concentrations in soil were detected in the central portion of the Main Process Area.

Groundwater within and downgradient (north) of the central portion of the Main Process Area has not been analyzed for dioxins/furans. Groundwater samples obtained in this area during the baseline groundwater sampling event (Section 6.2) and the groundwater sampling to be performed in the vicinity of the former wastewater drain piping (Section 6.4) will be analyzed for dioxins/furans. The vertical extent of dioxins/furans in soil will be assessed by collecting and analyzing discrete soil samples from soil borings SSB-1 and SSB-7 and groundwater grab sampling location GWG-1 (Figure 28). The need to further characterize the extent of dioxins/furans in soil will be assessed based on the results of the soil and groundwater sampling described above. If further soil sampling is needed to characterize potential soil-to-groundwater source areas, it will be accomplished by digging targeted test pits during Phase 3 of the field investigation (Table 7).

6.8.9 Potential Upgradient Sources

In addition to collecting supplemental soil and groundwater data to evaluate potential on-property sources of groundwater contamination, the supplemental upland data collection effort will also investigate potential contributions to groundwater contamination from possible upgradient, off-property sources. One such possible upgradient source is the golf course located at 800 South Lindberg Road (Peninsula Golf Course), approximately 1,500 feet south-southeast of the southern boundary of the mill property. Historical U.S. Geological Survey topographic maps indicate that a golf course has existed at this location since at least 1941. Because pesticides may have been used at this golf course in the past, up to four new upgradient monitoring wells will be installed on mill property to assess potential on-property migration of pesticides (or other COPCs) in groundwater from the golf course or other possible off-property sources. Preliminary proposed upgradient monitoring well locations are shown in Figure 28. Soil and groundwater samples obtained from these upgradient wells will be analyzed for constituents to be determined based on the results of the baseline groundwater monitoring event (Phase 1; see Section 6.2).

In order to evaluate whether contaminants may be migrating onto the mill property from off-property sources via surface water flow in Ennis Creek or White Creek, two surface water samples (SW-4 and SW-5; Figure 28) will be collected upstream of the confluence of these creeks and analyzed for all COPCs. Surface water sampling is proposed rather than installing and sampling a new a groundwater monitoring well adjacent to White Creek (upgradient of the confluence with Ennis Creek) because the area where these creeks meet is not readily accessible by a drill rig.

6.9 Permits

The supplemental upland data collection field investigation is being performed pursuant to MTCA under the terms of the Order. Accordingly, the supplemental investigation meets the permit exemption criteria of MTCA (WAC 173-340-710[9]), obviating the need to follow the procedural requirements of certain State and local laws that might otherwise apply to the work. Although State and local permits are not required, the supplemental investigation must comply with the substantive requirements of applicable State and local laws. In addition, the permit exemption provisions of MTCA do not apply to Federal permit requirements. Federal permits and substantive requirements of State/local laws applicable to the supplemental upland data collection field investigation are discussed below.

6.9.1 Archaeological and Historical Preservation

The National Historic Preservation Act (Section 106) will be applicable if any materials of archaeological interest are discovered during the planned exploration activities (borings and test pits). As discussed in Section 2.1.2, Rayonier completed a cultural resources assessment of the mill in 1997 to evaluate whether the impending mill decommissioning activities could affect cultural artifacts or archaeological remains that might be present in the subsurface. The findings of the assessment are presented in the CRA Report (LAAS, 1997). The CRA Report describes an historical Klallam Indian village on the eastern bank of Ennis Creek. The Klallam village site was recorded and listed on the Washington Heritage Register.

The subsurface explorations described in this Work Plan will be monitored and managed in accordance with the archaeological monitoring plan contained in Appendix D.

6.9.2 Monitoring Well Installation

The new groundwater monitoring wells will be installed by a Washington-licensed driller in accordance with the requirements of the Washington State well construction standards (*Minimum Standards for Construction and Maintenance of Wells;* WAC 173-160). These standards require that Ecology be notified of the intent to begin monitoring well construction (i.e., Start Card submittal) at least 72 hours before starting work (WAC 173-160-151).

6.9.3 Seep Monitoring Station Installation

The groundwater seep monitoring stations will be installed manually to an approximate depth of 5 feet bgs in the beach/intertidal zone in general accordance with Washington State well construction standards (*Minimum Standards for Construction and Maintenance of Wells;* WAC 173-160). A well variance will be required from Ecology because the proposed construction of the seep monitoring stations differs slightly from a standard groundwater monitoring well (i.e., no bollards will be placed around the aboveground protective casing, and a bentonite annular seal will not be installed).

Because the seep monitoring stations will be placed below the Mean Higher High Water (MHHW) level within the Strait of Juan de Fuca, which is a navigable water of the United States, the installation activities are regulated under Section 10 of the Federal Rivers and Harbors Act. Consequently, installation of the seep monitoring stations will require a U.S. Army Corps of Engineers Section 10 Nationwide Permit 5 (Scientific Measurement Devices). Other entities that may have requirements pertaining to the seep monitoring station installation work include the City of Port Angeles (State Environmental Policy Act, Shoreline Management Act, and State Growth Management Act review); the Washington Department of Fish and Wildlife (Hydraulic Project Approval review); the Washington Department of Natural Resources (Aquatic Lands Right-of-Entry Permit); and Ecology's Shorelands Division. Additionally, the Lower Elwha Klallam Tribe may want to review and provide input on the planned work. These entities will be consulted, and any necessary requirements will be addressed, prior to the start of the seep monitoring installation work.

6.9.4 *Investigation-Derived Waste Management*

The Washington State Dangerous Waste Regulations (WAC 173-303) will apply to Washington-defined dangerous waste, if generated during the supplemental investigation. Rayonier is not aware of any contaminated media at the Site that would designate as a listed dangerous waste if removed for disposal. Besides listed dangerous waste, the Dangerous Waste Regulations define two types of dangerous waste based on dangerous waste "criteria" (WAC 173-303-100): "toxic" dangerous waste and "persistent" dangerous waste. WAC 173-303-100(5) and WAC 173-303-100(6) describe procedures for evaluating solid wastes for the toxicity and persistence criteria. The Dangerous Waste Regulations also require that a solid waste be evaluated for the toxicity "characteristic" if the waste contains one or more constituents included on the Toxicity Characteristic (TC) List (WAC 173-303-090[8]). A solid waste (such as contaminated soil) has the potential to designate as a Washington dangerous waste if it contains concentrations of TC List constituents greater than 20 times[1] the concentrations established in WAC 173-303-090(8). If the waste satisfies the "20-times rule," representative samples of the waste need be analyzed by the Toxicity Characteristic Leaching Procedure (TCLP). The results of the TCLP analysis are then compared directly to the TC List regulatory concentrations to determine whether the solid waste designates as a dangerous waste.

In addition to the Washington State Dangerous Waste Regulations, the Federal Toxic Substances Control Act (TSCA) regulations pertaining to PCBs (40 CFR 761) will apply to investigation-derived waste (IDW) containing PCBs, if generated during the supplemental upland data collection field investigation. IDW generated during the supplemental investigation will be characterized based on appropriate sampling and analysis and applicable criteria in the Washington State Dangerous Waste Regulations and Federal TSCA PCB regulations. If IDW is designated as Washington dangerous waste and/or TSCA waste based on the waste characterization, it will be managed in accordance with applicable provisions of these regulations.

7.0 REPORTING

Following review and validation of the data generated during the supplemental upland data collection field investigation, Rayonier will prepare a *Draft Supplemental Upland Data Collection Technical Memorandum* presenting the results of the investigation for Ecology review and comment. The Technical Memorandum will describe the work conducted to collect the supplemental upland data, including a summary of the sampling design, sampling methods, and sampling results. As specified in the Order, the supplemental upland data presented in the Technical Memorandum will be integrated into the *Interim Action Report Volume I: Upland Data Summary Report for the Study Area*. The presentation of the supplemental data in the Interim Action Report Volume I will incorporate Ecology comments on the *Draft Supplemental Upland Data Collection Technical Memorandum*.

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[1] This is referred to as the "20-times rule" and is described in a September 21, 1992 EPA letter titled "Calculation of TCLP Concentrations from Total Concentrations". This reference is available at http://yosemite.epa.gov/osw/rcra.nsf/ea6e50dc6214725285256bf00063269d/95e9e57b91ea2e9f8525670f006c0acd!OpenDocument

The supplemental upland sampling data will be submitted to Ecology in both printed and electronic forms. Electronic data will be submitted via Ecology's Environmental Information Management (EIM) system as provided in WAC 173-340-840(5).

8.0 SCHEDULE

The proposed schedule for the supplemental upland data collection program is shown below. This schedule will be revised as necessary based on field conditions, results of sampling and analytical testing completed during each phase of the investigation, and discussions with Ecology and other stakeholders.

Phase 1 of the field investigation (baseline groundwater sampling, seep survey, surface water sampling) is expected to begin in August or September 2010, with the remaining phases being successively carried out over the following four to five months. The four- to five-month investigation timeframe is based on a four-week allowance for laboratory analytical testing and preliminary quality control review of the data generated during each investigation phase, plus a two-week allowance to summarize and review the results from each phase with Ecology. Interim data summary submittals (technical memoranda) consisting of brief text, figures, and tables, and data review discussions with Ecology, are anticipated in approximately October 2010, November 2010, January 2011, and February 2011. A Draft Groundwater Monitoring Plan will be submitted to Ecology prior to the second quarterly groundwater and seep monitoring event, which is anticipated to occur in November or December 2010. The field investigation is expected to be completed by February 2011, with submittal of the *Draft Supplemental Upland Data Collection Technical Memorandum* to Ecology anticipated in April or May 2011.

Milestone	Target Completion Date
Agency-Review Draft Supplemental Upland Data Collection Work Plan	Within 45 calendar days of effective date of Order
Draft Final Supplemental Upland Data Collection Work Plan	Within 60 calendar days of receipt of comments from Ecology on Agency-Review Draft Work Plan
Final Supplemental Upland Data Collection Work Plan	Within 20 calendar days of receipt of comments from Ecology on Draft Final Work Plan
Supplemental Upland Data Collection Field Investigation	Following Ecology Approval of Final Work Plan (August or September 2010 to February 2011 anticipated)
Phase 1 Interim Data Summary Submittal	October 2010
Phase 2 Interim Data Summary Submittal	November 2010
Phase 3 Interim Data Summary Submittal	January 2011
Phase 4 Interim Data Summary Submittal	February 2011
Draft Groundwater Monitoring Plan	Prior to the second quarterly groundwater and seep monitoring event (anticipated to occur in November or December 2010)

Milestone	Target Completion Date
Draft Supplemental Upland Data Collection Technical Memorandum	Within 60 calendar days of receipt of final validated data from the analytical laboratory (April or May 2011 anticipated)

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