4. WORK PLAN RATIONALE

The following section outlines the general approach to the remedial investigation. A discussion of data quality objectives and the process used to identify data gaps and approaches to collect the data necessary to fill those gaps is presented in Section 5.1. Each subsequent section provides an overview of data gaps by media type, and the approach to collecting the necessary information in the remedial investigation. Specific sampling locations, analytes, and methods are documented in Volume II.

4.1 DATA QUALITY OBJECTIVES NEEDS

DQOs are qualitative and quantitative statements that specify the characteristics of the data necessary to support decisions and the required quality of the data collected (EPA QA/G4, 2000). Through the development of DQOs, the objectives and methods to be used in the field investigations are clearly defined.

DQOs are specified for each activity associated with the RI/FS and are typically developed through a seven-step process:

- State the problem.
- Identify the decision.
- Identify inputs to the decision.
- Define the study boundaries.
- Develop a decision rule.
- Specify limits on decision errors.
- Optimize the design for obtaining data.

For the data collection activities, these steps are condensed into an interactive, three-stage process including identification of decision types, identification of data uses and needs, and design of a data collection program. These three stages may be further detailed as described in the following sections.

4.1.1 Identification of Decision Types

This stage of the DQO process identifies the project scope and guides the development of the management plans. The key components are the identification of project objectives, major decisions, data users, and available data.

4.1.1.1 Objective and Major Decisions

The objective of this study is to develop an RI report that can be used in an associated FS and risk assessment (RA) to determine the appropriate actions for the former Rayonier Mill Site. The major decisions on actions will control, contain, stabilize, and remediate areas of potential concern at the former Rayonier Mill Site and associated marine and off-site locations. This activity will require the identification of potential areas of concern, associated COPCs, potential receptors, and exposure (migration pathways). These aspects are discussed in detail in other sections of the Work Plan.

4.1.1.2 Data Users

The data users will include both primary and secondary users. Primary users are involved in ongoing site activities and include lead decision makers. Secondary users rely on the data for supporting review and external activities. Primary data users include members of the former Rayonier Mill Site Management Team (SMT) consisting of representatives of Ecology, Rayonier, Inc., and the Tribe, as well as EPA. Secondary users include members of the Rayonier Technical Advisory Group (RTAG), the city of Port Angeles, organized public groups, and the public at large.

4.1.1.3 Evaluation of the Available Data

The SMT has held a series of meetings to discuss and review available data. This effort has culminated in a series of public information meetings and development of briefing papers, which are available for public review. These efforts compiled the previous site data, including the recent ESI EPA conducted. The existing data provide substantial information on the nature and extent of contamination, although there are specific data gaps requiring additional work. An initial site conceptual model has been developed, which provides a preliminary understanding of the possible sources of contamination, potential migration pathways, and the potential receptors. This initial model will be refined as part of the ongoing effort. The existing data, data gaps, and conceptual model are discussed in detail in other sections of this Work Plan.

4.1.2 Identification of Data Uses and Needs

This stage of the DQO process involves identification of data uses and needs, data types, and data quality needs. The elements of this stage are interrelated and undergo refinement as more data become available, and scoping is refined.

4.1.2.1 Data Uses and Needs

The data generated from the field investigations will be used to 1) fill existing data gaps, including the extent of contamination; 2) support a risk assessment (determine risk); 3) prepare the RI report; 4) develop remedial options through a feasibility study; 5) assessment of the potential for sediment recontamination. Data gaps are discussed in detail in other sections. Selected requirements include determination of background levels in soils and groundwater, additional sampling to determine extent of potential contamination in soils and levels in the former log pond area, additional sampling to determine potential levels in biota; a refined site conceptual model, and an ecological and human health risk assessment to evaluate the potential risk posed by the former Rayonier Mill Site to public health and the environment, including the aquatic marine biota.

4.1.2.2 Data Types

Several types of data are required for the investigation: physical parameters (including location information); water quality parameters; sediment quality parameters; sediment toxicity (bioassays); and chemical contaminant distributions in soil, groundwater, sediment, and biota. This will require both field measurements and off-site laboratory analyses. The SAP (Volumes II) and Table 3-1 of the QAPP (Volume III) provide detailed information on the data types and matrices for collection.

4.1.2.3 Data Quality Needs

The necessary level of data quality must be determined when the data uses and types are identified. In general, to support the data uses identified above, one must develop "definitive data" as defined in EPA 540-R-93-071 (EPA, 1993). This level of data quality corresponds to older EPA definitions of DQO Level III and DQO Level IV data quality (EPA 540/G-87/003, EPA, 1987). Field measurements and certain elementary analyses will generally correspond to the EPA definition of "screening data" (EPA, 1993). The data quality requirements are discussed further and presented by matrix in the QAPP (Volume III), including Table 3-1. The data quality needs will also help define the appropriate analytical methods. These are also detailed in the QAPP (see Tables 3-2 to 3-5).

4.1.3 Design of the Data Collection Program

The intent of this DQO stage is to compile the existing information and requirements, including task-specific DQOs, into a comprehensive program design for data collection. A detailed list of data to be collected includes phase, media, sample type, mass/volume of collected sample, number of samples, location of samples, analytical methods, and QA/QC

samples. In addition, a rationale for sampling and proposed analyses should be included, together with documentation and reporting requirements. Details on the procedures must also be identified. The basic rationale is presented elsewhere in this volume, and is expanded in the associated SAPs (Volume II). The detailed listings of the DQOs and data collection requirements are presented in the QAPP (Volume III), especially in Tables 3-1 through 3-6.

RI data needs generally fall into three major categories:

- Data to define the nature and extent of contamination
- Data to define potential pathways of contaminant migration
- Data to determine whether, or to what extent, threats to human health and the environment exists

4.2 GENERAL APPROACH AND OVERVIEW TO THE WORK PLAN

The following sections discuss, by media, the data that are needed to complete an RI at the former Rayonier Mill Site. The following sections discuss the data gaps and overall approach to the RI for each medium proposed for further sampling.

4.2.1 Marine Sediments

Previous investigations at the former Rayonier Mill Site conducted by EPA (E&E, 1998) and Ecology (SAIC, 1999) have generated a significant volume of data relating to marine sediment quality conditions. These data provide a comprehensive harbor-wide view of sediment quality and identify those areas where wood wastes have accumulated and are affecting bottom-dwelling organisms. These data also provide specific information regarding those areas of the harbor that may have been impacted by past operations at the former Rayonier Mill Site. Together with an understanding of those past operations, these data provide a basis for developing the additional sediment sampling and characterization and wood waste characterization data collection efforts discussed below. The proposed sampling activities and locations will fill specific data gaps to support comprehensive characterization of the COPCs in the sediments and wood wastes potentially associated with the Rayonier operations.

Three main areas in the marine environment at the Rayonier site will require additional investigation based on results from the earlier studies. These areas include the following:

- The area around the deep-water outfall

- The area around the dock
- The log pond area

In addition to these areas, a location within Port Angeles Harbor will be sampled to further evaluate harbor wide conditions. Port Angeles Harbor is an active port facility that supports shipping, ferry transportation, wood products, and pulp and paper industries. Collectively, these industries can produce waste streams containing trace quantities of many, if not all, of the substances of concern that have been identified in sediments in the vicinity of the former Rayonier Mill operations. Because much of Port Angeles Harbor is in an industrial setting, it will be important to establish harbor wide conditions in anticipation of possible site recontamination if active sediment remediation is considered.

The general approach to the marine sediment portion of the RI is to assess the sediment quality in terms of the Washington State SMSs. This includes the initial evaluation of sediment chemistry against the SQS and CSL standards, followed by optional confirmational biological testing, if necessary. This evaluation will be conducted in a phased approach. The existing EPA ESI data have been compared to the SMS to determine which locations near the former Rayonier Mill Site required additional evaluation. If an EPA ESI station does not exceed any SQS values, no further sediment evaluation is necessary. Stations where a chemical SQS is exceeded will be re-sampled, analyzed for chemistry, and confirmed with biological testing, if necessary. Additional station locations will be added to bound the area if the biological testing indicates an exceedance. Surface samples will be collected surrounding the existing areas with exceedances so that the horizontal extent of the areas of concern can be delineated, and any contaminant gradients can be established. Based on the analytical results, the need for a Phase 2 sampling effort beyond the horizontal extent described above or to depth will be evaluated. In areas where EPA collected little or no data (i.e., the log pond, under the dock, and the intertidal zone), additional sediment samples will be collected. These sediments will be analyzed for conventionals (e.g., ammonia, sulfide, total volatile solids [TVS], total organic carbon [TOC]), grain size, the suite of SMS compounds, dioxins and furans, and wood-related constituents (e.g., resin and fatty acids, and guaiacols), as appropriate. Characterization of wood waste impacts will be accomplished through a combination of chemical analyses and biological testing.

Bioassay testing for sediment toxicity will be undertaken following the SMS guidelines at any station where a COPC is above the SQS. As detailed in the SMS guidelines, bioassay

testing should be undertaken to confirm the toxicity of specific samples that exceed the chemical SQS.

The purpose of the sediment toxicity testing is to evaluate the degree and nature of potential surface sediment toxicity to marine organisms resulting from historical activities and releases to the marine area surrounding the former Rayonier Mill Site. The studies will be designed to provide data regarding the acute and chronic effects of sediments on both benthic and epibenthic organisms from the perspective of mortality, growth, and reproduction. The tests are also intended to provide data for evaluation of chemical (i.e., SMS and wood-related breakdown products) versus non-persistent, natural, compound-related (e.g., ammonia, sulfides) toxic effects. The evaluation framework and decision criteria will follow the SMS procedures. The results of the toxicity tests will be used to determine areas that need additional characterization in Phase II and to evaluate the potential toxicity of wood-related breakdown products. These results will be used to evaluate potential impacts due to accumulations of wood debris in sediments.

SMS sediment biological testing will be performed following the tiered-testing protocols at stations that exceed an SQS and will be concurrent with chemical analyses at selected surface sediment locations in the log pond. These tests will consist of the following:

- Acute 10-d amphipod mortality
- Acute 48-h larval mortality/abnormality
- Chronic 20-d juvenile polychaete mortality and growth

The bioassay framework is designed to incorporate 1) seasonal variability in species availability/sensitivity, 2) varying grain size distributions, 3) potential toxic effects of non-persistent compounds, and 4) potential effects of wood-related chemicals (e.g., resin acids, guaiacols). Additional description of bioassay protocols for each of these tests is provided in Sections 1.3 and 6.2 of the SAP (Volume II).

Data requirements to close existing data gaps related to marine sediment quality are summarized in Table 4-1.

A discussion of each of the existing data gaps relating to marine sediments at the former Rayonier Mill Site and the methodology to be used to obtain the information required to close each data gap are outlined below

Table 4-1. Marine Sediment Data Needs and Planned RI Activity

Existing Data Gap	Remedial Investigation Activity
1.Area around the deep-water outfall: • Determination of sediment quality due to accidental release of PCB-contaminated effluent. • Further evaluation of any SQS sediment exceedance. • Evaluate chemicals with detection limits exceeding criteria.	Activities to close data gaps relating to the accidental release of PCB-contaminated effluent through the deep-water outfall and any SQS exceedances will include the following: • Sampling to be conducted in phases, if necessary. • In Phase I, surface sediment sampling at eight stations located in an elliptical pattern within the main depositional area surrounding the outfall. • Stations positioned to provide worst-case analyses. If exceedances are found, additional samples collected further away from outfall in Phase II sampling event. • Sediment samples to be analyzed for PCBs, PAHs, selected phenolics, selected SVOCs, and conventionals. • Re-sample stations that exceeded any SQS concentrations, if necessary conduct confirmatory biological tests.
2. Areas around the dock: • Confirmation of any SQS exceedances. • Documentation of the nature and extent of sediment contamination (horizontal and vertical); sampling sufficient to show any gradients. • Evaluation of wood-related compound analyses. • Evaluation of historic "sludge beds." • Evaluate the extent of wood debris. • Lack of conventional parameter analyses (e.g., ammonia, sulfides, TOC, grain size). • Lack of PCB congener data for site-specific biota-sediment accumulation factors (BSAFs). • Evaluate chemicals with detection limits exceeding criteria.	Activities to close data gaps relating to the area around the deep-water outfall will include the following: • Sampling to be conducted in phases, if necessary. • In Phase I, surface sediment sampling at 18 stations to confirm EPA ESI SQS exceedances, fill data gaps, and bound potential SMS exceedances. • Analyses to include conventionals, SMS chemicals including PCBs, PAHs, selected SVOCs,dioxins/furans, and conventionals • Vertical characterization of any areas with SMS exceedances (e.g., collect subsurface cores near surface sample exceedance to assist in evaluating potential remedial alternatives).
3. Log pond area: • Data do not exist to assess the nature and extent of COPCs in log pond area; sampling needed to document any contaminant gradients. • Confirmation of any SQS exceedances • Evaluate the nature and extent of wood debris • Evaluate chemical concentrations in the log pond	Activities to close data gaps relating to the area in the log pond will include the following: • Sampling to be conducted at 19 stations throughout log pond area • Resample at locations with SQS exceedance; conduct bioassays, if SQS exceedance found. • Analyses to include conventionals, SMS chemicals, dioxins/furans, and selected SVOCs. • Sediment aliquots archived for potential PCB congener analyses. • Bioassays performed at nine stations where

Existing Data Gap	Remedial Investigation Activity
	wood debris accumulations are known. • Bioassays at other stations if SQS chemical exceedance. Physical characterization of surface and subsurface sediments.
4. Characterization of intertidal sediments within the mill site property boundary needed	Sediment sampling at 5 intertdal areas within the mill boundary (3 in the log pond, 1 around the base of the dock, and 1 in the eastern portion of the site) and analyzed for metals, selected SVOCs, selected phenolics, PAHs, PCBs, dioxins/furans, wood-related compounds, and conventionals.
5. Additional characterization of sediments in Port Angeles harbor	Sediment sampling at 8 locations west of the mill site and analyzed for metals, SVOCs, PAHs, PCBs, dioxins/furans, and conventionals.

4.2.1.1 Area Around the Deep-water Outfall

For the area surrounding the deepwater outfall, previous sediment analytical results (E&E 1998) indicate that, with one exception, COPC concentrations in the sediments are consistently below the SQS. The one exception was at station SD-59, located within 500 feet of the outfall diffuser zone (3-5) where the standard for 4-methylphenol was exceeded.

An accidental release of potentially PCB-contaminated effluent through the outfall post-dates the EPA sampling in 1997. Preliminary effluent depositional modeling indicates the zone of highest rate of solids deposition from the outfall extends roughly 1.1 miles in an east-west direction. The north-south axis is smaller, approximately 1,000 feet, due to the geometry of Port Angeles Harbor, current directions, and bottom slopes. Samples will be collected in this elliptical area surrounding the outfall diffuser field (Figure 4-1). Sedimentation rates beyond this elliptical area would have been significantly lower; hence, the potential for contaminant deposition from the former Rayonier Mill Site would also have been much lower.

Sampling in the outfall area has been designed to address these data gaps. A sample will be taken at the location of station SD-59 to replicate the earlier sample that showed an elevated concentration of 4-methylphenol. Other points are distributed in a systematic pattern within the sample area. Based on the analytical results, the need for a Phase II sampling effort to characterize a wider area or depth will be evaluated.

Each sample will be analyzed for PCBs as aroclors. Additionally, because PAH concentrations in some sediment samples around the dock exceeded SMS criteria, outfall locations 3, 4, and 5 will be analyzed for PAHs. Enough sediment from each sample location will be archived for PCB congener testing, and additional PAH testing if necessary.

LEGEND

+ SD-45 = EPA ESI SEDIMENT SAMPLE LOCATIONS

● OF-1 = OUTFALL SAMPLES

= DEPTH CONTOUR (3-FT INTERVAL)

■ HS-1 = HARBOR SAMPLES

DATUM
HORIZ: NAD83, WA SPC N. ZONE

FIGURE 4-1

OUTFALL AND HARBOR SEDIMENT SAMPLE LOCATIONS

RAYONIER PORT ANGELES MILL SITE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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DRAWN: KSK		
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Each outfall sample will also be analyzed for selected phenolics because of the previous result at Station SD-59. Aliquots of the samples closest to the diffuser field will be archived for potential analyses for selected resin acid, fatty acid, and guaiacols. Elevated TOCs or phenols would trigger these additional analyses. Enough sample will also be archived for bioassay testing at any station where SQS levels are exceeded.

Dioxin and furan values in samples EPA collected near the outfall were very low or non-detect with TEQ values less than 1 part per trillion (ppt). Consequently, additional dioxin/furan testing is not necessary in the areas already sampled. There is, however, a lack of data to the east of the outfall. Dioxin/furan testing is proposed for the two outfall stations farthest east of the diffuser.

4.2.1.2 Area Around the Rayonier Dock

For the area surrounding the dock near the mill, previous sediment analytical results at 20 stations (E&E, 1998) revealed sediment quality concerns at only four stations (Figure 4-2). Station SD-82, located near historic outfall B and at the shoreline (Figure 4-2), has concentrations of seven PAH constituents that exceed the SQS or CSL. Stations SD-42 and SD-43, east of the dock, exceed the cleanup screening level (CSL) for 4-methlyphenol. Station SD-36, at the north end of the dock, exhibits three exceedances of the SQS for PAH constituents. Sample stations to the west of the deep-water outfall; near historic outfalls A, C, and D; the Ennis Creek delta; and farther from the deep-water outfall area have COPC values below the SQS criteria.

Sampling near the dock and surrounding area will focus on those areas with observed values above SQS and CSL levels. New samples will be taken at each of the four stations with historic exceedances (Figure 4-3). Surface samples will also be collected surrounding those areas so that the horizontal extents of the areas of concern can be delineated, and gradients for COPC can be established. Based on the analytical chemistry results and any biological testing performed, the need for a Phase II sampling effort will be evaluated.

SVOC and PAH compounds were detected at elevated levels, some exceeding the SQS or CSL levels, in several samples near the deep-water outfall and historic outfalls. Each new sample will be analyzed for these compounds. Metals detected in the earlier samples were generally at levels significantly below (less than 50 percent of) SQS levels. However, because of their frequent detection, metals will be among the chemical analytes evaluated in each of the former Rayonier Mill Site dock samples.

Previous sediment sampling did not include the characterization of chemical concentrations under the dock. There is concern that the concentrations of chemicals measured in sediment samples collected near the dock may not be indicative of concentrations in sediments under the dock. Sediment samples will be collected from three locations under the dock and analyzed for PAHs, phenolic compounds, dioxins/furans, and conventional sediment parameters.

Ecology (SAIC, 1999) reported and observed wood debris during the diver survey in scattered areas surrounding thedock. Each of the former Rayonier Mill Site dock samples will be analyzed for selected resin acids, fatty acids, and guaiacols, as well as conventionals (e.g., ammonia and total sulfides). Adequate sample volume will be collected for bioassay testing as necessary.

Pesticides and PCBs were not detected or were detected at levels below the SQS in all of the 20 samples collected from the vicinity of the dock. For those samples closest to the Ennis Creek delta, PCBs remained nondetected or well below (less than 10 percent) the SQS. However, concerns about PCBs associated with the Finishing Room interim action persist. Therefore, PCB analysis will be conducted on selected stations to address this concern.

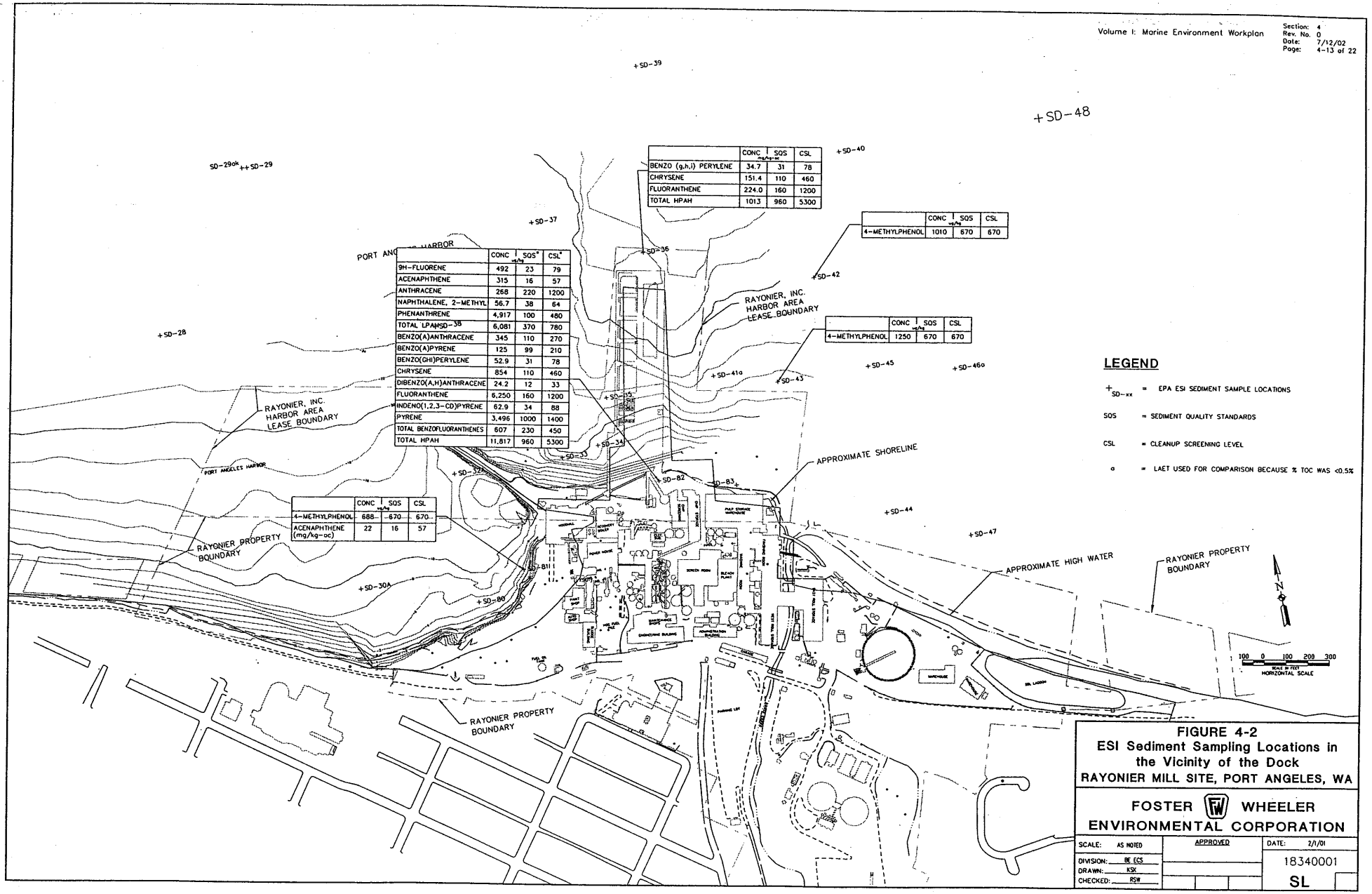
Dioxin and furan values in samples near the dock were low. However, dioxin and furan analysis was not performed on all sediment samples from the dock area (i.e., under and adjacent to the dock). Dioxin and furan analysis will be conducted on selected dock area stations to enhance the spatial coverage.

4.2.1.3 Log Pond Area

Only four samples were collected in the log pond area in the previous sampling effort. Station SD-81, at the shoreline and near historic outfall E (Figure 4-2) exceeded the CSL for 4-methlyphenol and the SQS for acenaphthene. Although all reported values at SD-32 were below SQS levels, no semivolatile or pesticide/PCB data were available. For the remaining two stations, SD 80 near the shoreline and historic outfall E, and SD-30, farther out in the log pond area, the COPC concentrations did not exceed any of the SQS values.

The log pond is also an area with significant wood debris mixed with and resting on sediment. An accumulation of sunken logs also limited sampling efforts by EPA in 1997 (E&E, 1998) and Ecology in 1999 (SAIC). Rayonier undertook a log removal effort in 1999 to provide better access for future sampling efforts.

To address the limited amount of data in the log pond area and to characterize the extent of wood debris and potential wood debris related contaminants, a more extensive set of



	CONC	SQS	CSL
	mg/kg-oc		
BENZO (g,h,i) PERYLENE	34.7	31	78
CHRYSENE	151.4	110	460
FLUORANTHENE	224.0	160	1200
TOTAL HPAH	1013	960	5300

	CONC	SQS	CSL
	mg/kg-oc		
4-METHYLPHENOL	1010	670	670

	CONC	SQS	CSL
	mg/kg-oc		
4-METHYLPHENOL	1250	670	670

	CONC	SQS*	CSL*
	mg/kg-oc		
9H-FLUORENE	492	23	79
ACENAPHTHENE	315	16	57
ANTHRACENE	268	220	1200
NAPHTHALENE, 2-METHYL	56.7	38	64
PHENANTHRENE	4,917	100	480
TOTAL LPAH SD-38	6,081	370	780
BENZO(A)ANTHRACENE	345	110	270
BENZO(A)PYRENE	125	99	210
BENZO(GHI)PERYLENE	52.9	31	78
CHRYSENE	854	110	460
DIBENZO(A,H)ANTHRACENE	24.2	12	33
FLUORANTHENE	6,250	160	1200
INDENO(1,2,3-CD)PYRENE	62.9	34	88
PYRENE	3,496	1000	1400
TOTAL BENZOFLUORANTHENES	607	230	450
TOTAL HPAH	11,817	960	5300

	CONC	SQS	CSL
	mg/kg-oc		
4-METHYLPHENOL	688	670	670
ACENAPHTHENE (mg/kg-oc)	22	16	57

LEGEND

$+_{SD-xx}$ = EPA ESI SEDIMENT SAMPLE LOCATIONS

SQS = SEDIMENT QUALITY STANDARDS

CSL = CLEANUP SCREENING LEVEL

a = LAET USED FOR COMPARISON BECAUSE % TOC WAS <0.5%

FIGURE 4-2
ESI Sediment Sampling Locations in the Vicinity of the Dock
RAYONIER MILL SITE, PORT ANGELES, WA

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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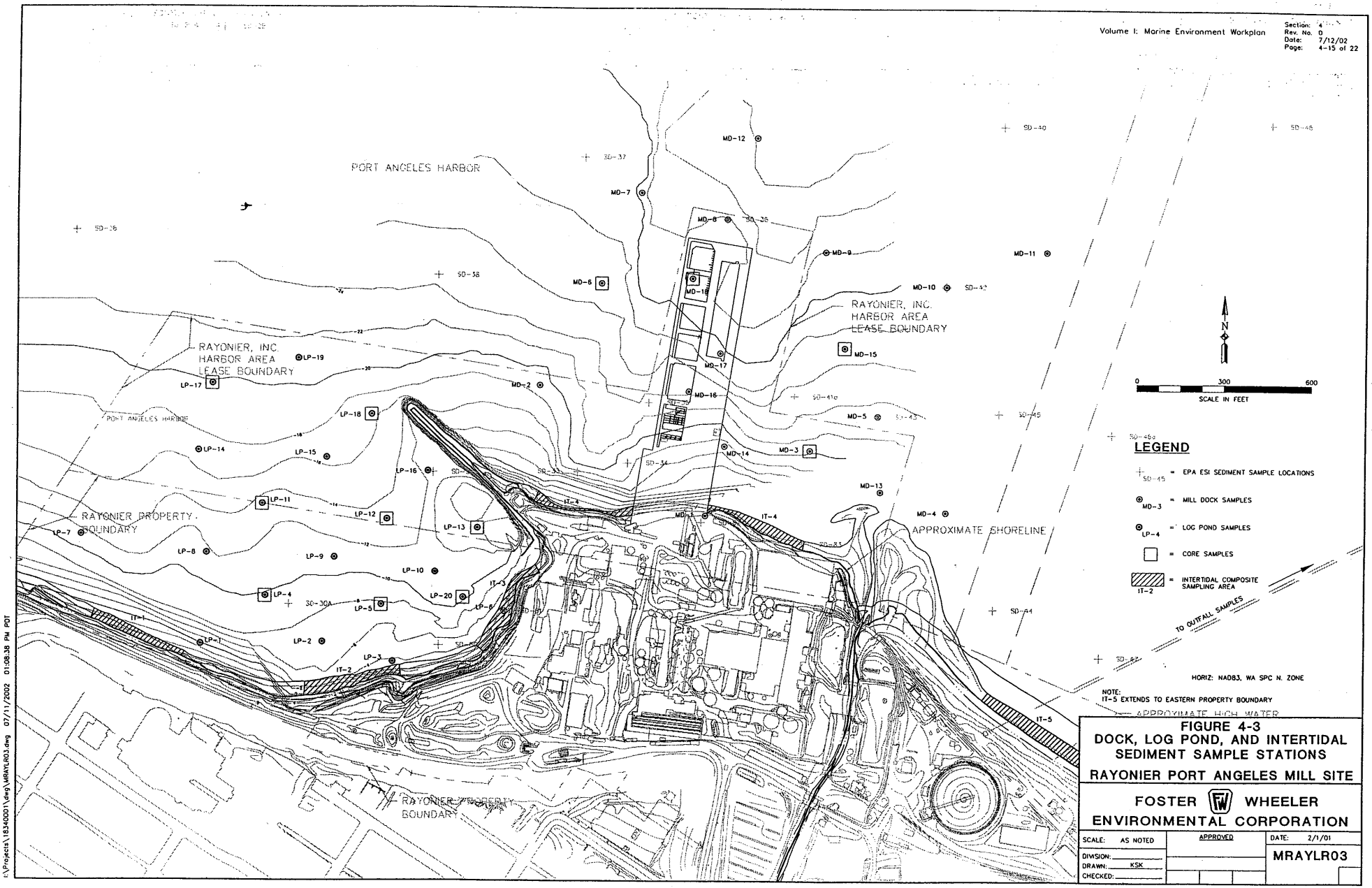

FIGURE 4-3
DOCK, LOG POND, AND INTERTIDAL SEDIMENT SAMPLE STATIONS
RAYONIER PORT ANGELES MILL SITE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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samples will be collected in the log pond area. Stations SD-81 and SD-32 will be sampled again. An additional 17 surface samples, spaced on an approximate 250-foot-grid, will also be collected (Figure 4-3). Based on the analytical chemistry and biological testing results, the need for a Phase II sampling effort to characterize a wider area or depth will be evaluated.

Existing analytical results are limited for this area; therefore, the suite of SMS compounds (e.g., metals, SVOCs, PAHs, and PCBs) will be analyzed for in each sample. Analyses for conventionals and dioxins/furans will be conducted for the samples in this area. No pesticide analyses are proposed due to the limited detection seen in earlier sampling.

Samples were collected during the diver survey and analyzed for TOC. Elevated TOC levels were observed in much of the northern areas of the log pond (Figure 3-6). For these reasons, each of the log pond samples will be analyzed for selected resin acids, fatty acids, and guaiacols, as well as for ammonia, total sulfides, and other conventionals.

Enough sediment sample will be collected for bioassay testing at each location. To quantitatively evaluate the impact of wood debris on the marine environment, bioassay tests will be undertaken at nine sample locations irrespective of analytical results for COPCs. Purged and nonpurged bioassay testing will be conducted to discriminate the effects of non-persistent compounds (e.g., ammonia, sulfides) from the effects of COPCs and chemicals associated with the degradation of wood debris. Bioassay tests will be performed for any sample with COPC concentrations above an SQS level. The need for dual testing at these additional locations will be evaluated based on analytical chemistry results, concentrations of nonpersistent compounds, and other purged and nonpurged testing completed.

4.2.1.4 Intertidal Sampling

Previous sediment sampling in the mill area focused on sampling of subtidal sediments. The characterization of intertidal sediment chemical concentrations is needed to evaluate potential human exposures (e.g., recreational users of the intertidal area). Five sediment samples will be collected from the intertidal zone within the mill boundary to address this concern (Figure 4-3). Each sample will be a composite of five individual grab samples collected from a length of shoreline representative of likely exposure area. Samples will be analyzed for metals, SVOCs, PCBs, dioxins/furans, and conventionals.

4.2.1.5 Harbor Sampling

Harbor samples will be collected from the nearshore area in the southeast section of Port Angeles Harbor (Figure 4-1). These samples will follow the shoreline from the west side of

the Blackball Ferry Dock to the foot of North Albert St., and will extend seaward to the 35-ft bathymetric contour. This area captures much of the urban and industrial influence that could affect sediment quality in the vicinity of the former Rayonier Mill site. These harbor samples include Port Facilities for passenger ferries and cruise ships and an urban marine park. The shoreline is also in the fetch of northwest winds where it can intercept floating wood debris or drift-algae transported by wind-driven surface currents from log rafting and storage facilities along the inner shoreline of Ediz Hook. Preliminary modeling suggests this section of shoreline is located in a farfield area beyond the influence of Rayonier's nearshore outfalls that discharged material prior to the installation of the offshore outfall in 1972 (Foster Wheeler 2001). This sampling location is also representative of the kind of subtidal marine habitat in the vicinity of the former Rayonier Mill site. Qualitative video surveys of the seafloor in both locations show a soft-bottom habitat that is profusely covered by macroalgae nearshore with a gradual transition to relatively uncovered soft-bottom at the 35-ft contour (SAIC 1999). Station locations and sampling methods are described in Volume II (Marine Environment Sampling and Analysis Plan) of the Management Plans.

4.2.2 Marine Biota

Previous studies on marine biota in Port Angeles Harbor have included evaluations of a number of different chemical analytes from various locations. The EPA study in 1998 (E&E, 1998) specifically evaluated marine species in relation to the former Rayonier Mill Site. Samples were collected in the main harbor, near Rayonier's submerged diffuser outfall, and in Dungeness Bay (which was used as a reference site). The primary species collected and analyzed were geoducks and red rock crabs. No samples were taken near the Rayonier dock, nor in the log pond area.

In general, three groups of marine fish or shellfish may be found in the Port Angeles area: 1) highly migratory and transient species such as salmon and trout, 2) less mobile species that may stay in the general vicinity of Port Angeles Harbor over their life span (e.g., crab, flatfish, and shrimp), and 3) less mobile species such as clams and mussels.

Analysis of tissues from highly migratory species would not provide useful information because the source could not be determined if any COPCs were found in their tissues and such organisms are typically pelagic in nature and receive less exposure than benthic organisms which have more contact with the sediment-water interface. The less mobile species such as crab, flatfish, and shrimp would, on the average, likely remain in the Port

Angeles area for a longer time. Therefore, if COPCs were found in their tissues, the source would be more apparent that with the highly mobile species.

Finally, less mobile organisms such as clams and mussels would provide even more definition of any sources of COPCs if they were found in the tissues of these organisms. Overall, however, the less mobile organisms alone may not provide definitive answers as to the source of COPCs because tidal exchanges and water movement in the marine system results in a non-static environment. Therefore, even less mobile organisms may be exposed to varying levels of constituents in the water column. To provide information about sources of COPCs and their potential uptake by marine biota, the tissue data will have to be compared to sediment data to determine any potential pathways.

For these reasons, RI sampling activities will not include collection of tissue samples from highly mobile species. Sampling of the less mobile species such as crabs, flatfish, and shrimp will be conducted as part of the RI. Because their range is greater than the less mobile species, however, a larger sampling area will be used. This will include Port Angeles Harbor from the inner harbor to a line between the tip of Ediz Hook to the mouth of Morse Creek. The reference locations will be Dungeness Spit and Freshwater Bay.

Less mobile organisms (clams) will be sampled from specific locations in proximity to the former Rayonier Mill Site. These locations will include the following:

- Area around the deep-water outfall
- Log pond area
- Area around the dock
- Reference areas

Sampling of less mobile marine biota in these areas will provide information on COPCs from very specific locations near the project site. The sampling in these areas will also provide comparisons to information and data collected for the sediment evaluations.

Although the approach described in this section assumes distributions of marine biota based on past studies in the Port Angeles area, distributions may be different. Some of the target species may not be present, or their availability may be limited and dispersed at specific sites. For example, although butter, manilla, and littleneck clams are a target species at all sampling locations, their population in the log pond area may be at or near zero due to the type of habitat (e.g., the habitat present is not used by this species) or to other natural or human-related factors. Therefore, the composite sample for these clams, if present, may

have to be collected from the general log pond area and not from one specific small location (e.g., a specific 1-meter-square quadrant). However, the emphasis in the field investigations will be to minimize the collection area to be as close to the suspected source(s) as possible consistent with each of the four sampling sites to the smallest area possible, but with the intent of collecting enough organisms for chemical analysis at each location.

Samples of tissues from all locations will be analyzed for metals, selected SVOCs, selected pesticides, PAHs, dioxins/furans, and PCBs. The reasons for this broad analysis include the following: 1) specific locations will be sampled in relation to the former Rayonier Mill Site and 2) little or no data on COPCs were collected at specific locations (e.g., log pond). Table 3-1 in the Sampling and Analysis Plan contains a detailed breakdown of the sampling design.

Data requirements to close existing data gaps related to marine biota are summarized in Table 4-2.

Table 4-2. Marine Biota Data Needs and Planned RI Activity

Existing Data Gap	**Remedial Investigation Activity**
Log Pond: • Current data do not exist to assess the nature and extent of COPCs in sessile marine biota from the log pond area; sampling is needed to document any COPCs. • Data on tissue concentrations are needed at this location to compare to sediment sampling results and for use in ecological and human health risk assessments.	Activities to close data gaps relating to the area in the log pond will include the following: • If available, collection of clams to determine tissue levels of COPCs. • Collection of crabs, flatfish, and shrimp to determine tissue levels of COPCs associated with the Port Angeles Harbor Mill.
Rayonier Dock: • Current specific data do not exist to assess the nature and extent of COPCs in sessile marine biota from locations immediately adjacent to the Rayonier dock; sampling is needed to document any COPCs. • Data on tissue concentrations are needed at this location to compare to sediment sampling results and for use in ecological and human health risk assessments.	Activities to close data gaps relating to the area in the Rayonier dock will include the following: • If available, collection of clams to determine tissue levels of COPCs. • Collection of crabs, flatfish, and shrimp to determine tissue levels of COPCs associated with the Port Angeles Mill.
Area around deep-water outfall: • Although specific data have been collected in this area in the past, current data are needed for comparison to the log pond area and the Rayonier dock. • Must determine if any accumulation has occurred from the accidental release of PCB-contaminated effluent.	Activities to close data gaps relating to the area around the deep water outfall will include the following: • If available, collection of clams to determine tissue levels of COPCs. • Collection of crabs, flatfish, and shrimp to determine tissue levels of COPCs associated with the Port Angeles Mill.
Reference site: • Current specific data have not been collected in	Sampling in Freshwater Bay and Dungeness Spit areas to close data gaps relating to the area in the

Existing Data Gap	Remedial Investigation Activity
this area in the past; sampling is needed for comparison to the Port Angeles Harbor area and to specific sites such as the log pond, outfall, and the Rayonier dock sampling locations.	Rayonier site which will include the following: • Collection of clams, flatfish, crabs, and shrimp to determine tissue levels of COPCs.