CITY OF PORT ANGELES
GRANT NO. G1000051

SHORELINE INVENTORY, CHARACTERIZATION AND ANALYSIS REPORT

for City of Port Angeles' Shoreline: Strait of Juan de Fuca
June 2012

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1 INTRODUCTION

1.1 Background and Purpose

The City of Port Angeles (City) received a grant from the Washington Department of Ecology (Ecology) in 2009 to complete a comprehensive Shoreline Master Program (SMP) update. One of the first steps of the update process is to inventory and characterize the City's shorelines as defined by the state's Shoreline Management Act (SMA) (RCW 90.58). This inventory was conducted in accordance with the Shoreline Master Program Guidelines (Guidelines, Chapter 173-26 WAC) and project Scope of Work promulgated by Ecology, and includes all areas within current city limits as well as the City's Urban Growth Area (UGA). Under these Guidelines, the City must identify and assemble the most current, applicable, accurate and complete scientific and technical information available. This shoreline analysis report describes existing conditions and characterizes ecological functions in the shoreline jurisdiction. This will serve as the baseline against which the impacts of future development actions in the shoreline will be measured. The Guidelines require that the City demonstrate that its updated SMP yields "no net loss" in shoreline ecological functions due to its implementation relative to the baseline (current condition) established in this report.

A list of potential information sources was compiled and an information request letter was distributed to potential interested parties and agencies that may have relevant information. Collected information was supplemented with other resources such as City documents, scientific literature, personal communications, aerial photographs, and internet data.

1.2 Shoreline Jurisdiction

As defined by the Shoreline Management Act of 1971, shorelines include certain waters of the state plus their associated "shorelands." At a minimum, the waterbodies designated as shorelines of the state are streams whose mean annual flow is 20 cubic feet per second (cfs) or greater, lakes whose area is greater than 20 acres, and all marine waters. Shorelands are defined as:

> "those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter…Any county or city may determine that portion of a one-hundred-year-floodplain to be included in its master program as long as such portion includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet therefrom… Any city or county may also include in its master program land necessary for buffers for critical areas (RCW 90.58.030)"

All marine shorelines are included under shoreline jurisdiction. All areas waterward of the extreme low tide are also considered Shorelines of Statewide Significance. Wetlands associated

with the marine shorelines are also included. No other streams, lakes, or wetlands within the City of Port Angeles are considered part of shoreline jurisdiction. A detailed discussion of the entire jurisdiction assessment and determination process can be reviewed in full in Appendix A of this report.

1.3 Study Area

The City of Port Angeles is located in Clallam County, Washington. The north side of the City fronts the Strait of Juan de Fuca, and is surrounding by unincorporated Clallam County to the west, south and east. The City encompasses approximately 13.9 square miles. Of that area, 3.8 square miles are included in the Port Angeles Harbor. An urban growth area to the east of the city boundary is included in the analysis and encompasses approximately 2.8 square miles. The shoreline jurisdiction in Port Angeles includes all the aquatic lands extending north from the city limits on the west and the east boundary of the EUGA to the international boundary located in the Strait of Juan de Fuca.

The study area for this report includes all land currently within the City's proposed shoreline jurisdiction (Appendix A), as well as relevant discussion of the contributing watershed. This includes both the shoreline area within the existing city limits as well as the City's UGA. The total area subject to the City's updated SMP, not including aquatic area, is approximately 363 acres, and encompasses approximately 17.7 miles of marine shoreline.

2 CURRENT REGULATORY FRAMEWORK SUMMARY

2.1 City of Port Angeles

The Shoreline Management Act of 1971 brought about many changes for local jurisdictions, including the City of Port Angeles. The legislative findings and policy intent of the SMA states:

> "There is, therefore, a clear and urgent demand for a planned, rational, and concerted effort, jointly performed by federal, state, and local governments, to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines (RCW 90.58.020)."

While protecting shoreline resources by regulating development, the SMA is also intended to provide balance by encouraging water-dependent or water-oriented uses while also conserving or enhancing shoreline ecological functions and values. SMPs will be based on state guidelines, but should be tailored to the specific conditions and needs of the local community.

The City adopted its first Shoreline Master Program in 1979, and completed a major update in 1993. The SMP is adopted in Port Angeles Municipal Code (PAMC) Chapter 15.08. The City's 1993 SMP organizes shoreline jurisdiction into four environments: Urban Harbor, Urban Shoreline Protection, Aquatic Harbor, and Aquatic Conservancy.

The City's Comprehensive Plan contains several references to its shoreline in goals and policies of the Land Use and Parks and Recreation elements. In particular, development of a master plan for Ediz Hook that "improves public access to shorelines, abates deteriorating structures, and allows for expanded recreational and commercial uses" is desired. The Conservation Element of the Comprehensive Plan also includes the following shoreline goal, policies and objectives for the entire shoreline:

> ***Goal D.*** *To preserve and enhance the City's shoreline, its natural landscape, and flora and fauna and to minimize conflicts with present and planned uses in a manner consistent with the State Shoreline Management Act.*
>
> ***Policies***
>
> 1. *Shoreline areas should be preserved for future generations by restricting or prohibiting development that would interfere with the shoreline ecology or irretrievably damage shoreline resources.*
> 2. *Where possible, riparian vegetation in shoreline areas and on tributary streams, which affect shoreline resources, should be maintained and restored.*
> 3. *Where possible, techniques to rehabilitate degraded shorelines for the purpose of shoreline stabilization and habitat enhancement should be employed.*
> 4. *Where possible, aquatic habitats including shellfish habitat, and important marine vegetation should be preserved and protected.*

5. *Development patterns and densities on lands adjacent to shorelines should be compatible with shoreline uses and resources and reinforce the policies of the Shoreline Management Act and the City's Shoreline Master Program.*
6. *Where possible, urban service facilities located in shoreline areas should utilize common utility corridors.*
7. *Adequate shoreline area for water-oriented commercial and industrial development should be designated based on the Land Use Element.*
8. *Shoreline uses and activities should be located to avoid environmentally sensitive and ecologically valuable areas and to insure the preservation and protection of shoreline natural areas and resources.*
9. *Where possible, utility facilities and rights-of-way should be located outside of the shoreline area.*
10. *Shoreline ecology and resources should be protected when locating utilities in shoreline areas.*

Objective

1. *The City will update its 1995 Shoreline Master Program consistent with the Comprehensive Plan, the Shoreline Management Act, and the Growth Management Act by 2011.*
2. *The City will develop an Ediz Hook master plan that designates land uses, improves public access to shorelines, abates deteriorating structures, and allows for expanded recreational and commercial uses.*

The City's critical areas regulations (PAMC 15.20 and 15.24) were last thoroughly updated in 2004 with some minor amendments in 2008 to be consistent with Growth Management Act requirements for use of "best available science." In those regulations, Port Angeles specified stream buffers of 100 feet for Type 1 and 2 streams (shoreline and fish-bearing waterbodies), 75 feet for Type 3 streams (perennial, non-fish-bearing), and 50 feet for Type 4 streams (seasonal, non-fish-bearing). Marine bluffs have a buffer of 50 feet from the top and toe. Wetland buffers vary between 25 and 300 feet based on wetland classification and intensity of proposed land use, but apply to regulated wetlands only. The current regulations exempt certain Category II, III and IV wetlands when smaller than 2,500, 2,500 and 10,000 square feet, respectively.

Shoreline uses, developments, and activities regulated under the Critical Areas Regulations are also subject to the City's Comprehensive Plan, other regulations in the PAMC, the International Building Code, and various other provisions of City, state and federal laws. Any applicant must comply with all applicable laws prior to commencing any use, development, or activity. The City will ensure consistency between the SMP and other City codes, plans and programs by reviewing each for consistency during periodic updates of the City's Comprehensive Plan as required by State statute.

2.2 State and Federal Regulations

State and federal regulations most pertinent to development in the City's shorelines include the federal Endangered Species Act, the federal Clean Water Act, the state Shoreline Management Act, and the State Hydraulic Code. Other relevant federal laws include the National Environmental Policy Act, Anadromous Fish Conservation Act, Clean Air Act, and the Migratory Bird Treaty Act. State laws which address shoreline issues include the Growth Management Act, State Environmental Policy Act, Watershed Planning Act, Water Resources Act, Salmon

Recovery Act, the Water Quality Protection Act, Federal Emergency Management Act, Coastal Zone management Act, and tribal agreements and case law.

A variety of agencies (e.g., U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Ecology, Washington Department of Fish and Wildlife) are involved in implementing these regulations, but review by these agencies of shoreline development in most cases would be triggered by in- or over-water work, discharges of fill or pollutants into the water, or substantial land clearing. Depending on the nature of the proposed development, state and federal regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. With the comprehensive SMP update, the City will strive to ensure that Port Angeles' SMP regulations are consistent with other State and Federal requirements and explore ways to streamline the shoreline permitting process. A summary of some of the key regulations and agency responsibilities follows.

Section 10: Section 10 of the federal Rivers and Harbors Appropriation Act of 1899 provides the U.S. Army Corps of Engineers (Corps) with authority to regulate activities that may affect navigation of "navigable" waters. The Strait of Juan de Fuca is a designated navigable waterbody. Accordingly, proposals to construct new or modify existing in-water structures (including piers, marinas, bulkheads, breakwaters), to excavate or fill, or to "alter or modify the course, location, condition, or capacity of" marine waters must be reviewed and approved by the Corps.

Section 404: Section 404 of the federal Clean Water Act provides the Corps, under the oversight of the U.S. Environmental Protection Agency, with authority to regulate "discharge of dredged or fill material into waters of the United States, including wetlands" (http://www.epa.gov/owow/wetlands/pdf/ reg_authority_pr.pdf). The extent of the Corps' authority and the definition of fill have been the subject of considerable legal activity. As applicable to the City of Port Angeles' shoreline jurisdiction, however, it generally means that the Corps must review and approve most activities in streams, wetlands, and the Strait. These activities may include wetland fills, stream and wetland restoration, and culvert installation or replacement, among others. Similar to SEPA requirements, the Corps is interested in avoidance, minimization, restoration, and compensation of impacts.

Federal Endangered Species Act (ESA): Section 9 of the ESA prohibits "take" of listed species. Take has been defined in Section 3 as: "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The take prohibitions of the ESA apply to everyone, so any action that results in a take of listed fish or wildlife is strictly prohibited. Per Section 7 of the ESA, activities with potential to affect federally listed or proposed species and that either require federal approval, receive federal funding, or occur on federal land must be reviewed by the National Marine Fisheries Service (NOAA Fisheries) and/or U.S. Fish and Wildlife Service (USFWS) via a process called "consultation." As previously mentioned, a Corps permit under Section 10 of the Rivers and Harbors Appropriation Act is required for projects in the Strait of Juan de Fuca.

Section 401 Water Quality Certification: Section 401 of the federal Clean Water Act allows states to review, condition, and approve or deny certain federal permitted actions that result in discharges to state waters, including wetlands. In Washington, the Department of Ecology is the state agency responsible for conducting that review, with its primary review criteria ensuring that state water quality standards are met. Actions within the Strait, streams or

wetlands within the shoreline zone that require a Section 404 permit (see above) will also need to be reviewed by Ecology.

Hydraulic Code: Chapter 77.55 RCW (the Hydraulic Code) gives the Washington Department of Fish and Wildlife (WDFW) the authority to review, condition, and approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of state waters." As applicable to the City of Port Angeles' shoreline jurisdiction, however, it generally means that WDFW must review and approve most activities in the Strait and any streams passing through shoreline jurisdiction. These activities may include pier and bulkhead repair or construction, stream alteration, and culvert installation or replacement, among others. WDFW can condition projects to avoid, minimize, restore, and compensate adverse impacts.

3 ELEMENTS OF THE SHORELINE INVENTORY & SPECIFIC CONDITIONS

3.1 Introduction

Development of a shoreline inventory is intended to record the existing or baseline conditions upon which the development of shoreline master program provisions will be examined to ensure the adopted regulations provide no net loss of shoreline ecological functions. At a minimum, local jurisdictions shall gather the inventory elements listed in the Guidelines, to the extent information is relevant and readily available. Table 1 lists those relevant inventory elements for which data is available for the City's shoreline. Areas of data gaps are listed in Section 3.3. The table also describes the information collected for each of the required inventory elements. Figures depicting the various inventory pieces listed in Table 1 are provided in Appendix B.

Table 1. Shoreline Inventory Elements and Information Sources.

Inventory Element	Information Gathered	Data Sources	Map Location
Land use patterns	Zoning	City	Maps 4A, B
	Current land use	City, County	Maps 5A, B
Surface water	Lines, discharge points, creeks	City	Maps 6A, B
Sewer	CSO locations, outfalls, lines, septic tanks	City	Maps 7A, B
Soils	Soils, wetland hydric soils	City	Maps 8A, B
Geologic hazards	Coastal slope stability	City, Ecology	Maps 9A-D
	Liquefaction susceptibility, tsunami inundation	City, DNR	Maps 10A-D
Vegetation	Terrestrial vegetation type and land cover	NOAA Coastal Change Analysis Program (C-CAP)	Maps 11A, B
	Kelp distribution	DNR	
Impervious surfaces	General impervious surface from 2001 aerial photo interpretation at 30-m resolution	USGS	Maps 12A, B
Floodplain & wetlands	Wetlands	NWI, City	Maps 13A, B
	Floodplains	FEMA	
WDFW Priority Habitats & Species	Priority fish, priority wildlife, priority habitats	WDFW	Maps 14A(1), 14A(2),14 B(1), 14B(2)
Shoreline modifications & drift cells	Overwater structures	DNR	Maps 15A, B
	Shoreline percent modified	DNR	
	Drift cells	Ecology	
Historic shoreline	Shoreline between 1864 and 2006	City, Wengler Surveying and Mapping	Maps 16A,B
Water quality	303(d)/305(b) waters	Ecology	Maps 17A, B

Inventory Element	Information Gathered	Data Sources	Map Location
impairment and regulated sites	Regulated sites	Ecology	Maps 18A, B
Marine sediment	Responsible Ecology program	Ecology	Maps 19A, B
Public access	Parks, trails	City	Maps 20A, B
	View corridors, shoreline access	Project meetings and other reference documents	
Restoration opportunities	Potential restoration actions	Strait Ecosystem Recovery Network (Strait ERN)	Maps 22A, B
		Project meetings and other reference documents	

3.2 Assessment Unit Conditions

In order to break down the shoreline into manageable units and to help evaluate differences between discrete shoreline areas, the Strait of Juan de Fuca shoreline has been divided into eleven assessment reaches based on a combination of factors, including sediment drift cells, land use and shoreline condition, and exposure as follows and as illustrated on Exhibit 1.

- Reach 1: Landfill. This reach extends east from the western City limits to the eastern edge of the landfill parcel. Off shore kelp beds occur in the waterward portion of this reach.
- Reach 2: Western City. This reach extends east from the eastern edge of the landfill to the western edge of the Nippon industrial site. Off shore kelp beds occur in the waterward portion of this reach.
- Reach 3: Outer Industrial. This reach extends east to the eastern edge of the Nippon industrial development on the north side of Ediz Hook. Off shore kelp beds occur in the waterward portion of this reach.
- Reach 4: Outer Ediz Hook. This reach extends east from the Nippon industrial development on the north side of Ediz Hook, and around the tip of the Hook consistent with a mapped drift cell boundary. Off shore kelp beds occur in the waterward portion of this reach.
- Reach 5: Inner Ediz Hook. This reach extends west along the south side of Ediz Hook to the eastern edge of the Nippon industrial development.
- Reach 6: Inner Industrial. This reach encompasses the Nippon industrial development on the south side of Ediz Hook on Port Angeles Harbor.
- Reach 7: Mill Pond. This reach consists of the old mill pond that is currently connected via a canal to Port Angeles Harbor.
- Reach 8A: Downtown – Tse-whit-zen. This reach is primarily Port-owned property that extends east from the Nippon industrial area to the western edge of Boat Haven marina.
- Reach 8B: Downtown – Marina. This reach consists of the Boat Haven marina and adjacent Port properties.
- Reach 8C: Downtown - Transition. This reach extends from the Boat Haven marina to the west side of the Valley Creek estuary.
- Reach 8D: Downtown – Mixed Use. This reach extends east from the west side of the Valley Creek estuary to the South Vine Street road end.

- Reach 9: Olympic. This reach extends east along the Olympic Discovery Trail and the adjacent wooded bluff. Off shore kelp beds occur in the waterward portion of this reach.
- Reach 10: Ennis Delta. This reach encompasses the properties which formerly housed the Rayonier Mill.
- Reach 11: Eastern City (UGA). This reach extends east from the eastern edge of the Rayonier properties and City limits to the eastern limits of the urban growth area.

Table 2 expands upon the relevant above required inventory elements, providing specific detail and data for each of the assessment units.

Table 2. Summary of Inventory by Assessment Unit.

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
Reach 1 Landfill **1,388 feet** **6.48 acres**	**Zoning Type:** Public building – park: 100% **Existing Land Use:** City owned – closed landfill: 98% No data: 2%	Forest: 20% Palustrine wetland: 3% Grassland: 36% Developed: 4% Scrub-shrub: 18% Unconsolidated shore: 19%	<1%	The data pre-dates the recent armoring. More than 400 feet (~30%) of the reach is armored by seawall.	0	**Wetlands:** City-mapped: 51% NWI marine intertidal: 60% NWI marine subtidal: 1% **Geologically Hazardous Areas:** Modified land (fill): 18% Marine bluff: 69% Ravine: 1% **Priority habitats/species:** cliff/bluffs, abalone, red sea urchin **Streams:** Dry Creek **Floodplain:** 46%
Reach 2 Western City **9,969 feet** **46.18 acres**	**Zoning Type:** Public building – park: 30% Residential, single-family: 62% Residential trailer park: 8% **Existing Land Use:** City owned Cemetery: 6% MF mobile home: 7% Parks and open	Forest: 30% Developed open space: 2% Estuarine wetland: 1% Palustrine wetland: 1% Grassland: 2% Developed: 3% Scrub-shrub: 6% Unconsolidated shore: 54%	<1%	~77% of the reach is armored with rock. The armoring protects the Industrial Waterline.	0	**Wetlands:** City-mapped: 18% NWI marine intertidal: 10% NWI marine subtidal: 4% **Geologically Hazardous Areas:** Modified land (fill): 1% Marine bluff: 66% Ravine: 3% **Priority habitats/species:** cliff/bluffs, bald eagle nest and

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
	space: 2% Single-family: 36% State or County exempt: 27% Undeveloped land: 13% No data: 9%					buffer, abalone, red sea urchin, geoduck offshore **Floodplain:** 28%
Reach 3 **Outer Industrial** **3,863 feet** **16.63 acres**	**Zoning Type:** Industrial, heavy: 94% Public building – park: 5% Residential, single-family: 1% **Existing Land Use:** Resources: 57% State or County exempt: 39% No data: 4%	Bare land: 86% Developed: 10% Unconsolidated shore: 3%	3%	The entire reach is armored with rock.	0	**Wetlands:** NWI marine subtidal: 22% **Geologically Hazardous Areas:** Modified land (fill): 80% **Priority habitats/species:** bald eagle, red sea urchin and abalone. **Floodplain:** 85%
Reach 4 **Outer Ediz Hook** **16,043 feet** **53.33 acres**	**Zoning Type:** Industrial, heavy: 6% Public building – park: 94% **Existing Land Use:** State or County exempt: 34% No data: 66%	Bare land: 54% Grassland: 15% Developed: 30% Unconsolidated shore: 3%	14%	92% of the reach is armored. Large stone rip-rap is maintained by USACOE.	0	**Wetlands:** NWI marine subtidal: 18% **Geologically Hazardous Areas:** Modified land (fill): 50% **Priority habitats/species:** bald eagle, red sea urchin and abalone. **Floodplain:** 100%

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
Reach 5 Inner Ediz Hook **14,972 feet 46.80 acres**	**Zoning Type:** Commercial, arterial: 5% Industrial, heavy: 36% Public building – park: 59% **Existing Land Use:** Exempt or unclassified: 3% Indian exempt: 10% State or County exempt: 31% No data: 56%	Bare land: 54% Grassland: 17% Developed: 29%	29%	~44% of the reach is armored. The Ediz Hook Road is protected from erosion by armoring through most of its length.	5.36 acres	**Wetlands:** NWI marine subtidal: 4% **Geologically Hazardous Areas:** Modified land (fill): 7% **Priority habitats/species:** hardshell clam and abalone, harbor seal, harlequin ducks, and shorebird concentrations **Floodplain:** 99%
Reach 6 Inner Industrial **3,177 feet 10.85 acres**	**Zoning Type:** Industrial, heavy: 100% **Existing Land Use:** Resources: 29% State or County exempt: 52% No data: 19%	Bare land: 64% Grassland: 15% Developed: 21%	21%	~96% of the reach is armored	1.30 acres	**Wetlands:** NWI marine subtidal: 7% **Geologically Hazardous Areas:** Modified land (fill): 90% **Priority habitats/species:** abalone, nesting bald eagle buffer **Floodplain:** 48%
Reach 7 Mill Pond **7,189 feet 30.01 acres**	**Zoning Type:** Industrial, heavy: 59% Public building – park: 38% Residential, single-	Bare land: 40% Forest: 24% Developed open space: 6% Palustrine wetland: 4%	14%	~70% of the reach is armored. Armoring includes stone rip rap and sheet pile.	0.15 acre	**Wetlands:** City-mapped: 33% NWI estuarine subtidal: 3% NWI palustrine: 1% **Geologically Hazardous**

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
	family: 4% **Existing Land Use:** Resources: 75% Single-family: 2% State or County exempt: 22% No data: 1%	Grassland: 4% Developed: 21% Unconsolidated shore: 1%				**Areas:** Modified land (fill): 84% Marine bluff: 15% **Priority habitats/species:** abalone, nesting bald eagle buffer **Floodplain:** 54%
Reach 8A Downtown – Tse-whit-zen **2,689 feet** **12.91 acres**	**Zoning Type:** Industrial, heavy: 100% **Existing Land Use:** State or County exempt: 43% No data: 56%	Bare land: 3% Forest: 4% Developed open space: 2% Grassland: 40% Developed: 50%	28%	The entire reach is armored	1.36 acres	**Wetlands:** NWI marine subtidal: 15% **Geologically Hazardous Areas:** Modified land (fill): 93% **Priority habitats/species:** Offshore shellfish, nesting bald eagle buffer **Floodplain:** 33%
Reach 8B Downtown - Marina **7,281 feet** **20.05 acres**	**Zoning Type:** Industrial, heavy: 76% Public building, park: 24% **Existing Land Use:** State or County exempt: 48% Undeveloped land: 15%	Bare land: 4% Developed open space: 3% Palustrine wetland: 4% Grassland: 6% Developed: 81% Unconsolidated shore: 2%	60%	The entire reach is armored	8.83 acres	**Wetlands:** NWI marine subtidal: 5% **Geologically Hazardous Areas:** Modified land (fill): 92% Marine bluff: 2% **Priority habitats/species:** Offshore shellfish **Floodplain:**

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
	No data: 37%					15%
Reach 8C Downtown - Transition **2,344 feet 11.29 acres**	**Zoning Type:** Industrial, heavy: 100% **Existing Land Use:** Manufacturing: 7% State or County exempt: 49% No data: 45%	Developed open space: 2% Grassland: 13% Developed: 86%	61%	Ninety percent of the entire reach is armored. A segment approximately 350 of feet on the west side of the Valley Creek estuary is not armored.	4.44 acres of overwater cover	**Wetlands:** City-mapped: 13% NWI estuarine subtidal: 12% NWI marine subtidal: 3% **Geologically Hazardous Areas:** Modified land (fill): 77% **Priority habitats/species:** Offshore shellfish **Streams:** Tumwater Creek **Floodplain:** 32%
Reach 8D Downtown – Mixed Use **6,313 feet 26.11 acres**	**Zoning Type:** Commercial, arterial: 21% Central business district: 44% Industrial, heavy: 24% Industrial, light: 9% Public building – park: 2% **Existing Land Use:**	Forest: 3% Estuarine wetland: 3% Grassland: 5% Developed: 89%	60%	The entire reach is armored, with the exception of 230 feet segment of Hollywood Beach.	2.81 acres	**Wetlands:** City-mapped: 6% NWI estuarine subtidal: 4% NWI marine intertidal: 2% NWI marine subtidal: 4% **Geologically Hazardous Areas:** Modified land (fill): 90% Marine bluff: 1% **Priority habitats/species:** Offshore shellfish, common

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
	Hotels and motels: 8% Manufacturing: 1% Offices and services: 1% Parking: 1% Retail: 3% State or County exempt: 31% Undeveloped land: 9% Water areas: 4% No data: 43%					loon, eelgrass meadow, waterfowl concentrations **Streams:** Valley Creek and Peabody Creek **Floodplain:** 71%
Reach 9 Olympic **3,084 feet 14.00 acres**	**Zoning Type:** Industrial, heavy: 30% Industrial, light: 2% Public building – park: 50% Residential, single-family: 18% **Existing Land Use:** Duplexes/fourplexes: 1% Single-family: 12% State or County exempt: 16% Undeveloped land: 2% Water areas: 1% No data: 68%	Bare land: 7% Forest: 14% Estuarine wetland: 56% Grassland: 3% Developed: 18% Scrub-shrub: 2%	4%	98% of the reach is armored	.01 acre	**Wetlands:** NWI marine subtidal: 2% **Geologically Hazardous Areas:** Modified land (fill): 19% Marine bluff: 55% Ravine: 3% **Priority habitats/species:** Red sea urchin, offshore shellfish, common loon, eelgrass meadows, harbor seal **Floodplain:** 53%
Reach 10	**Zoning Type:**	Bare land: 5%	53%	61% of the	5.24 acres	**Wetlands:**

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
Rayonier **4,051 feet** **17.65 acres**	Industrial, heavy: 98% Public building – park: 2% **Existing Land Use:** Exempt or unclassified: 29% Undeveloped land: 42% No data: 29%	Developed open space: 1% Estuarine wetland: 2% Grassland: 1% Developed: 85% Unconsolidated shore: 7%		reach is armored		City-mapped: 12% NWI marine intertidal: 4% NWI marine subtidal: 15% NWI palustrine: 5% **Geologically Hazardous Areas:** Modified land (fill): 89% Marine bluff: 1% **Priority habitats/species:** Red sea urchin, harbor seal and seal haulouts, bald eagle nest buffer, and seabird colony. **Streams:** Ennis Creek **Floodplain:** 80%
Reach 11 **Eastern City (UGA)** **11,037 feet** **50.73 acres**	**Zoning Type:** Urban low density: 3% Open space: 97% **Existing Land Use:** Exempt or unclassified: 2% Parks and open space: 1% Resources: 2% Single-family: 24% State or County	Forest: 40% Developed open space: 1% Estuarine wetland: 37% Palustrine wetland: 4% Grassland: 5% Developed: 5% Scrub-shrub: 2% Unconsolidated shore: 6%	2%	79% of the reach is armored	--	**Wetlands:** City-mapped: 6% NWI marine intertidal: 2% NWI marine subtidal: 2% NWI palustrine: 1% **Geologically Hazardous Areas:** Modified land (fill): 30% Marine bluff: 6% Unstable Slope: 10% Unstable – Recent Slide: 4%

Reach # Reach Name Reach Length (ft) Reach Area (acres)	Inventory Elements					
	Land Use Patterns	**Vegetation**	**Impervious Surfaces**	**Shoreline Modification**	**Overwater Cover**	**Critical Areas Present**
	exempt: 47% Undeveloped land: 16% Water areas: 3% No data: 6%					**Priority habitats/species:** Red sea urchin, abalone, bald eagle nests and buffers, urban natural open space, and cliff/bluff habitat. **Streams:** Lees Creek **Floodplain:** 32%

3.3 Data Gaps

Although information was obtained for vegetation and impervious surfaces, the scale and accuracy of the data may not be useful quantitatively in the cumulative impacts analysis. Otherwise, no gaps in information essential to crafting a locally relevant and Shoreline Management Act-compliant Shoreline Master Program were identified.

4 ANALYSIS OF ECOLOGICAL FUNCTIONS AND ECOSYSTEM WIDE PROCESSES

4.1 Geographic and Ecosystem Context (WRIA 18)

The City of Port Angeles is located in Clallam County and contains marine shoreline associated with the Strait of Juan de Fuca and Washington State's Water Resource Inventory Area (WRIA) 18 – Elwha-Dungeness (Exhibit 1).

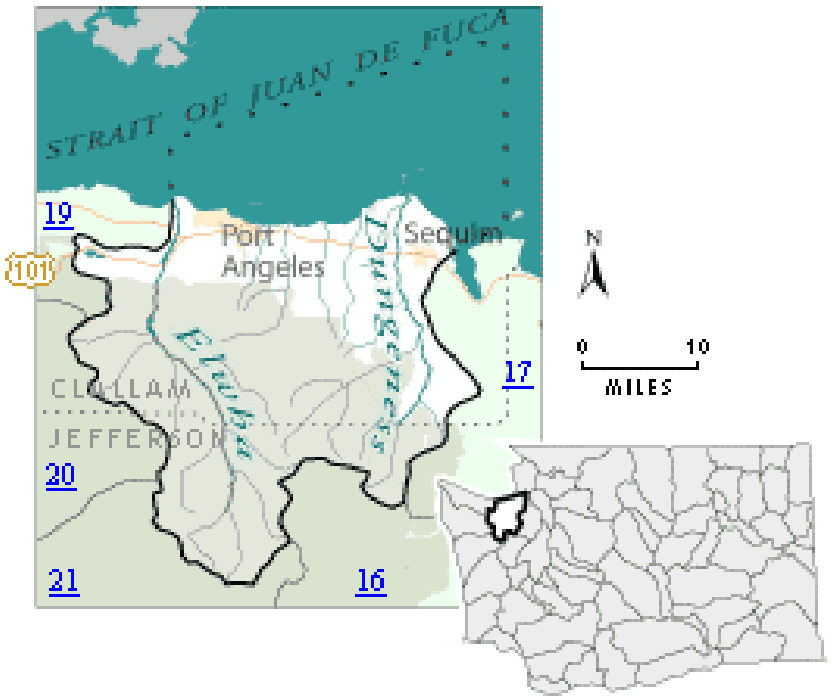

Exhibit 1. City of Port Angeles Setting in WRIA 18 – Elwha-Dungeness (http://www.ecy.wa.gov/apps/watersheds/wriapages/18.html).

Spit/marsh Complexes

The dominant feature of the shoreline area is Ediz Hook, a 3.5-mile-long natural spit that shelters Port Angeles Harbor. A spit is a depositional feature, connected to land at one end, which is formed by longshore (or littoral) drift, the migration of sediment laterally along a shoreline driven by waves approaching predominately at an oblique angle. Ediz Hook represents the terminus of a drift cell that begins near the mouth of the Elwha River to the west, though it might also receive sediments derived from the west of the river along Freshwater Bay. Ediz Hook is a spit formed by the erosion and transport of bluff sediments and the transport of fluvial sediments from the Elwha River located to the west, processes which have occurred over the course of thousands of years since the last continental glaciation. The material forming Ediz Hook consists of sand, gravel and cobbles derived from sediment eroded from bluffs immediately to the west of the spit, and from sediment carried by the Elwha River (USACE 2002).

Two of the longest spit formations in the Puget Sound region occur in the Eastern Strait sub-region, the Dungeness and Ediz Hook, Historically, both spits protected productive estuarine habitats within the lee-side embayments. While the Dungeness Spit complex remains in much the same condition as 150 years ago (not considering changes in eelgrass community and water quality conditions within Dungeness Bay), Ediz Hook has been heavily modified by at least a century of industrial development.

The Ediz Hook habitat complex comprises the spit itself, as well as a tidally-connected lagoon and marsh at its base. The spit partly envelops, and indeed is responsible for the presence of Port Angeles Harbor, a natural deepwater bay that collects drainage from several small streams along its shoreline (see the Port Angeles Harbor complex below).

In August 1862, Ediz Hook was described as "barren, the only growth is a species of Salt grass" (Henry 1862). Gilbert (1900) provided this description of Ediz Hook based on his recollection of the 1892 coast survey: "Ediz Hook is a remarkable spit of gravel and sand and only two or three feet above the highest tides..."

Gilbert described the entire spit as a "Light House reserve". A lighthouse was built near the point of Ediz Hook around 1863-1865 [Sloan 1863, Morse in Nesbit (1885), Johnson 1997]. Gilbert (1900) wrote, that without the reserve, "it is probable that considerable of the business; wharves, etc. might have gone to the base of the spit where the wharves would be shortest and the water the quietest. The best anchorage is up the middle of the Harbor in 12 to 16 fathoms of water".

The tidally accessible lagoon and fringing salt marsh at the base of the spit was shown in the earliest maps of Port Angeles Harbor, including an 1853 U.S. Coast Survey hydrographic map (Alden 1853). The August 1862 GLO survey described the mouth of the sinuous tidal channel connecting to the lagoon as 60 links (40 ft.) wide (Henry 1862). The following year, surveyors described the "soundings" (in the lagoon) as "... sufficiently deep for the accommodation of vessels to anchor in safety."

Changes to the Ediz Hook spit complex are the result of both direct and indirect impacts of human activity during the past 100-150 years. A reduction of fine sediment recruitment to the spit contributed by the Elwha River began with construction of the Elwha dams in 1910 and 1927. In 1929-30, an industrial water pipeline was buried beneath fill along 3.3 miles of shoreline beginning near Dry Creek and extending to the base of Ediz Hook.

Built over several thousands of years by sediments transported from the Elwha River and derived from coastal bluffs that occur between the river and the base of the spit, both sources have been substantially reduced by dams on the Elwha and a buried pipeline and associated armoring along the base of the bluffs.

To contend with the loss of sediment supplied to the spit and consequent erosion, the spit has been heavily armored along the windward side and a road and other structures occupy the length of the spit.

Massive modifications to the connected lagoon and associated tidal marsh at the base of the spit have resulted from a long history of industrial development. The lagoon and associated tidal marsh have been considerably reduced in size from the historical period. The historical tidal lagoon and marsh at the base of the Ediz Hook has been reduced from 27 to 11.4 hectares (Figure 3), and what remains is likely degraded by adjacent industrial activity.

A bulkhead built in the late 1950s (Shaffer et al. 2006) that protects the buried pipeline directly impacts the upper intertidal zone and disrupts natural sediment delivery from high steep bluffs. In combination, the Elwha dams and shoreline armoring have decreased

considerably the sediment supply to the nearshore and deposition to the spit (Shaffer et al. 2006), resulting in beach profile steepening and substrate coarsening of the west side of the spit and corresponding growth at the tip of the spit. Erosion of the west side of the spit has necessitated repeated bank armoring to protect a Coast Guard station. (see Haring 1999 who cites Galster 1978 and US Army Corps of Engineers 1971).

In addition to the massive bank armoring, a road, power lines, and numerous structures extend the length of the spit, reaching the end where a Coast Guard station resides. The leeward side of the spit and inner harbor has historically been used extensively for log storage in preparation for processing at Port Angeles mills (see 1942 air photo). In recent years, the beach along the south shoreline of Ediz Hook, near a documented sand lance spawning beach, has been impacted by oil spills, unpermitted wood removal, and extensive recreational off-road vehicle use (Shaffer 2003).

A restoration project took place in September-October 2003 in an attempt to remedy some of these impacts along 1,500 feet of shoreline. Measures included the removal of 50 creosote piles and railroad debris, a derelict boat ramp, and excavation of 2200 cubic yards of material. The restoration site was then re-graded, hydro-seeded with native grass, and large wood was placed along the shore (Shaffer 2003).

Ediz Hook spit/marsh complex in the sub-region historically showed surface water connectivity with adjacent open waters, however, this connectivity has been impacted since historical times. Though the complex retains a surface connection today, the degree of connectivity has been impaired.

Freshwater inputs at the base of Ediz Hook are derived primarily from seeps in the marine bluff.

The construction of dams on the Elwha River and the installation of bank protection associated with utilities along the base of the bluff just west of Ediz Hook have interrupted the process of sediment delivery to Ediz Hook, resulting in erosion. Beginning as early as 1977, rock protection and beach nourishment activities have occurred on Ediz Hook (Ebbesmeyer et al. 1979) in an ongoing effort to maintain the spit. Dams on the Elwha are being removed at the time of this writing, which have the potential to reduce the need for nourishment.

Ediz Hook protects and creates Port Angeles Harbor, the only deepwater port on the northern shore of the Olympic Peninsula, making this area attractive for industrial activity since the early 1900s. Most of these industrial activities were focused on either wood products (including pulp mills, plywood manufacturing, or whole-log export facilities) or marine uses (shipping, shipbuilding and various types of fishing) (Ecology and Environment 2008).

These industrial activities have had an impact on the habitat in the harbor. Extensive log booms have, over time, deposited a great deal of wood detritus on the harbor floor. Effluent from various mills has been discharged to the harbor (all such effluent is now treated and discharges farther out into the Strait of Juan de Fuca). Fueling storage facilities have leaked, and materials from shipbuilding and ship renovation have been spilled. One study of salmonid habitat found a strong correlation between industrial or former industrial sites and degraded salmonid habitat (Pentec 2001).

Stormwater

The City of Port Angeles Public Works Department maintains 65 miles (105 km) of stormwater mains (separate from the sanitary sewer) and provides collection and treatment of stormwater from residential, commercial, and industrial users. The stormwater infrastructure in the vicinity of the terrestrial portion of the proposed project is near capacity.

The *City of Port Angeles Stormwater Management* Plan (Economic and Engineering Services, Inc. 1996) provides extensive information on then current and planned activities to improve stormwater handling throughout the eleven drainage management areas that are, in the aggregate, roughly equivalent to the WRIA 18W area. Stormwater impacts to Valley Creek are considered severe (Haring 1999). Sixty percent of the watershed is in urban use, with fifty percent of that land in impervious surface (Tetra Tech 1988). Watershed impervious surfaces exceeding three to ten percent have been shown to cause degradation of salmonid habitat (WDFW and WWTIT 1997, as quoted in Haring 1999)."

The City of Port Angeles Public Works Department maintains 65 miles (105 km) of stormwater mains (separate from the sanitary sewer) and provides collection and treatment of stormwater from residential, commercial, and industrial users. The stormwater infrastructure in the vicinity of the terrestrial portion of the proposed project is near capacity.

The City has long been engaged in a combined sewer overflow (CSO) reduction program to eliminate CSOs in the City, and currently only has four remaining CSO outfalls. These outfalls, as of 2009, experienced 30 to 100 events per year, ranging from minutes to days each, and discharging 10 gallons to 12 million gallons per event (City of Port Angeles Public Works and Utilities 2009). To comply with its National Pollutant Discharge Elimination System (NPDES) permit for wastewater, the City must reduce its CSOs so that only an average of one untreated event would occur per year. One element of the City's plan to control the remaining CSOs is the purchase of a 5-million-gallon tank located on the former Rayonier Mill property to provide increased CSO holding capacity, and connect it to the City's wastewater treatment plant (City of Port Angeles Public Works and Utilities no date). Purchase of the tank was completed in 2011. New sewer transmission pipes will be installed into the existing 48" concrete industrial waterline that follows the Port Angeles Harbor shoreline from the downtown area to the holding tank on the former mill property. The project is expected to be completed by February 2014.

Stormwater impacts to Valley Creek are considered severe (Haring 1999). Sixty percent of the watershed is in urban use, with fifty percent of that land in impervious surface (Tetra Tech 1988). Watershed impervious surfaces exceeding three to ten percent have been shown to cause degradation of salmonid habitat (WDFW and WWTIT 1997, as quoted in Haring 1999)."

The Valley Creek estuary has undergone many changes since it discharged to the harbor over an intertidal flat, shortly after passing through the bluffs (Haring 1999). A log pond occupied a large portion of the estuary for over 40 years. Around 1989, K-Ply started using cottonwood, a wood that doesn't float very long, in their manufacturing of plywood. The need for the log pond was eliminated and it became a hindrance to mill operations. Restoring the log pond to somewhat natural conditions became part of K-Ply's mitigation plan for further development and took place in 1998 (Watershed Dynamics, 1993). In 1998, an estuary was constructed with the help of the Soroptomists, the Port of Port Angeles, the City of Port Angeles, and the Lower Elwha Klallam Tribe. The estuary is 1.5 acres and is bordered by the waterfront trail and a wildlife viewing structure.

"Extensive loss and impairment of estuarine habitat has occurred along the Port Angeles shoreline. Much of downtown Port Angeles was filled with upland and nearshore dredge materials in the 1950s *(see* Table *2),* and creeks discharging to the harbor have been channelized and otherwise altered to varying degrees. All presently are lacking in significant estuarine habitat. At least 42 sites in or adjacent to shoreline jurisdiction have reported hazardous substances (see Table 2 of the Shoreline Analysis Report)".

The marine environment has been altered or affected by shoreline modification including port development and shoreline armoring, by toxic contaminants from terrigenous sources, by

dredging and filling, fishing practices, cable and pipeline installation, bridge construction, and vessel operations. These stressors can alter sediment flow within the harbor area, cause diseases in fish and wildlife, and diminish the productive capacity of plant and animal communities.

Marine shipping and oil transport are major activities in the region, where the transboundary corridor is one of the most active shipping areas in the world. The potential for chronic and catastrophic spills or contamination through air pollution plagues some of the most diverse and critical habitats in the region. Federal, state, provincial, and local governments serve as managers of these activities, coordinating scientific and management tasks through a number of forums, for example, the Environmental Coordination Committee.

Port Angeles has been designated as the pilotage station for all vessels en route to U.S. ports from the sea or departing U.S. ports to sea. Vessels desiring a pilot should proceed with caution to a point at least 1.0 mile NNE (1.5 mile NNE if a loaded petroleum tanker) of the east end of Ediz Hook where the pilot will board the vessel. There are two pilot boats, each 22 meters in length with white hulls and red deck houses. The pilot station and pilot boats are equipped with radar and AIS to locate and track vessels. Pilot boats have their own lights to illuminate the pilot ladder, but a standby light should be ready in the event of an emergency.

The waters of Puget Sound and the Strait of Juan de Fuca are environmentally sensitive and a precious environmental and economic resource. Bunkering operations, while routine in many parts of the country, do in fact pose risks different than those normally expected of standard shore to ship refueling operations. Coast Guard Sector Seattle, the State of Washington Department of Ecology and representatives of the petroleum industry have jointly developed guidelines to address those risks and ensure safe bunkering operations in the Puget Sound region.

Port Angeles is located in such a manner that seven stream drainages flow through the city and designated shoreline areas. Morse Creek flows into the Strait of Juan de Fuca just east of the Port Angeles shoreline jurisdiction. All of the urban independent streams originate in the foothills of the Olympic Mountains, a major environmental feature of the area. These small streams result in four small stream-deltas; Tumwater, Valley, Peabody, and Ennis. The streams are perennial, with base flow in most area streams is maintained by springs and seeps. Water quality in the area has been significantly affected by present levels of development and use. Valley Creek is listed as a Category 5 (303d) water body due to fecal coliform and a Category 2 water due to dissolved oxygen and bioassessment. Peabody Creek is listed as Category 5 water for fecal coliform and bioassessment. The Port Angeles Harbor near Hollywood Beach is listed as a Category 5 and Category 2 water due to fecal coliform.

Vegetation along streams reduces bank erosion and diminishes the impacts of flooding. Streamside vegetation filters nutrients and sediment from surface runoff, preventing or slowing their entry into surface or groundwater. Maintenance of stream flows is extremely important, especially during times of low precipitation. Several streams in the watershed have limited fish production because of low flows. Stream corridors within the Port Angeles regional watershed display a wide variety of conditions from densely wooded and undisturbed to heavily impacted.

Estuaries, which include the area from the uppermost limit of tidal influence within the stream to the upper intertidal line on the delta face, provide exceptionally valuable fish habitat (WSCC 1999). Abundant food supply, wide salinity gradients, and diverse habitat make them particularly valuable to salmonid and other anadromous species, providing acclimatization habitat during the transition from fresh and marine water.

Extensive loss and impairment of estuarine habitat has occurred along the Port Angeles shoreline (WSCC 1999). Prior to European settlement in the early 1900s, much of what is now downtown

Port Angeles was low-lying marine waterfront and shallow subtidal area. These areas were filled with upland and nearshore dredge materials through the 1950s. Ennis Creek, which appears to have historically discharged to the harbor over an alluvial fan and a broad intertidal flat, has been channelized by fill associated with the former Rayonier Mill. Peabody Creek presently discharges to a confined intertidal area with less than an acre of fine-grained substrate bounded by heavily armored seawall. Tumwater Creek flows in a narrowly confined channel through an industrial site and discharges directly to the harbor, with a small sandy intertidal flat that is periodically dredged. Lees Creek, in the eastern Urban Growth Area portion of the City's shoreline, and Dry Creek, on the western edge of shoreline jurisdiction, while not as significantly altered as the other streams in the shoreline area, are naturally lacking in estuarine habitat (WSCC 1999).

Valley Creek has also been impacted by development, having been culverted and filled to accommodate waterfront development. In 1998, Valley Creek was the site of an estuary restoration project that created a 1.5-acre opening in the armored Port Angeles Harbor shoreline. While it is unlikely that this project replicates historic conditions, it has likely improved salmonid habitat.

In the late 1980s, the K-Ply plywood mill at the port lost its source of cedar logs due to logging restrictions in the region, and turned to cottonwood. Loggers previously floated the cedar along the shore and into the mill's log pond; after the change, truckers shipped in the cottonwood and unloaded it at a staging area located where Valley Creek's estuary had been filled and culverted years ago, on the other side of the log pond from the mill. Moving the logs around the now useless log pond was costing the mill an extra $150,000 a year. The K-Ply mill and the Port proposed in 1993 to fill the log pond so that the staging area could be relocated there, next to the mill. State regulators insisted on mitigation for loss of the open water habitat of the log pond. Recreating the Valley Creek estuary at the to-be-abandoned staging area provided an obvious opportunity. Excavation to recreate the estuary would also provide much of the necessary fill for the log pond. The mill, the Port, and the Port's engineering consultant Parametrix, Inc. enlisted the help of the City of Port Angeles and local volunteer groups such as the Soroptimist Club (a women's service organization) and Rotary Clubs to design a restoration plan and public park. Public enthusiasm for the project was strong. Local engineering companies NTI and Polaris and the Lindberg local architectural firm donated professional services. Four years of permit negotiations and planning led to construction in late 1997.

The project involved removing nearly 400 feet of the seawall along the Port Angeles harbor, excavating a 2.8-acre estuary, filling the log pond with the spoils, removing the lower 490 feet of culvert pipe, and installing habitat enhancement features such as shading logs, beach logs, and root masses. The creek now flows from the shortened culvert in a stream-like but tidally influenced channel for its first 50 feet. It then meanders through the estuary and empties into the strait in a manner that closely resembles the original natural flow. The estuary is largely open water, with some marsh along its banks. Some of the banks are reinforced with rip-rap to prevent erosion from wave action.

The remaining 1.2 acres of the four-acre project surround the estuary in upland areas for the new park. Local volunteer groups are landscaping this area as funds become available. They have routed the Port Angeles waterfront trail around the estuary and installed a viewing tower, and are now raising funds for interpretive signage.

Marine Bluffs

Much of the Port Angeles marine shoreline is characterized by steep marine bluffs. These bluffs are located on the portion of the shoreline west of Ediz Hook and east of the downtown area. Beaches and bluffs provide critical habitat for the region's fish and wildlife. Coastal bluffs are the

primary source of beach sediment along the Puget Sound shore, and their natural erosion is critical for maintaining beaches and spits over the long term. Landward erosion of the bluff is a natural and ongoing process, which has been occurring since the retreat of the last glacier. Bluff retreat rates are highly dependent upon the nature of the substrate and the energy of the environment. In the case of the bluffs between the Elwha River and Port Angeles, the bluff is composed of easily erodible materials, in a high energy environment. Bluff retreat rates for these settings regionally range from about 3 to 18 inches per year. A reasonable approximation for the long term (hundreds of years) rate is about 6 inches per year. Bluff retreat is typically episodic, with no observable change for years or decades punctuated by loss of several to 10 or more feet in one season. (McCormack)

Riparian vegetation growing on coastal bluffs and in the backshore shades the upper beach, provides large wood to the shoreline and contributes organic material to nearshore food webs (Brennan 2007).

Beaches and associated habitats, such as eelgrass beds and salt marshes, serve as the linkage between rivers and the marine environment for migratory species such as salmon, and are important habitat for surf smelt, herring and other forage fishes (Freshy 2006, Mumford 2007, Pentilla 2007). Beaches are habitat for most of Puget Sound's shellfish (Dethier 2006).

Beaches and bluffs are critical for feeding, roosting and, in some cases, nesting of a wide variety of marine and shorebirds (see Buchannan 2006, Eissinger 2007). Rocky shores, common in the northern part of the region, serve as habitats for other species, including kelp and many valued fishes.

Extensive development on coastal bluffs and near beaches in Puget Sound and along the Strait of Juan de Fuca has placed considerable valuable property at risk from erosion and landslides. Low lying coastlines near river or stream estuaries are sensitive to flooding, to ocean erosion from storm waves, and to variation in the amount and type of sediment carried by the rivers or streams. Other stresses in coastal regions presently include loss of wetlands to development or erosion and invasion by exotic (non-native) species, particularly in coastal estuaries.

The Olympic Peninsula is renowned for its extensive conifer stands of Douglas fir, Western red cedar, Sitka spruce, and Western hemlock. The fir, cedar, and spruce are the largest tree species in the watershed. Located within the conifer stands are deciduous trees: red alder, bigleaf and vine maples, willows, and black cottonwoods. They thrive in bottom land environments, particularly alongside streams, but occasionally grow elsewhere. Many locations in the higher elevations and a few locations in the lower elevations of the watershed contain special plants and plant communities. Some plants are listed by Washington State's Natural Heritage Program as sensitive or monitor species. Vegetative cover can reduce pollutant loads, by slowing, detaining, or even absorbing water containing quantities of bacteria, chemicals, sediment, and even heavy metals.

Many different mammals, amphibians, reptiles, birds, and insects use one or more habitats found within the watershed. Marine mammals commonly found near the shoreline include sea and river otters (also in rivers and streams), harbor seals, gray whales, and harbor porpoises. Cavity nesting ducks found in the watershed feed on animal matter in wetlands and require snags and emergent/woody vegetation in swamps. Buffers areas with large trees and woody vegetation for breeding and rearing of their young are beneficial. Many other species of birds either live entirely in the watershed or use it as a resting/feeding area during annual migrations. Many shore birds use the Port Angeles regional watershed shoreline to feed during spring and fall migrations.

Marine Waters

Port Angeles regional watershed provides habitat for a variety of marine and freshwater fishes. The marine shoreline of most of the watershed is fairly steep with large cobble and rock. Nearshore habitats are important nurseries for many kinds of juvenile fish. Many commercially and recreationally important species of shellfish are found immediately offshore of the Port Angeles regional watershed. Dungeness crab, shrimp, sea cucumbers, and red sea urchins are the primary species harvested. Other species found and harvested to a limited extent are octopus, green sea urchins, squid, and pink shrimp. Subtidal commercial concentrations of geoducks and hardshell clams occur in the Strait.

Historically, the Port Angeles Harbor was a site of shellfish harvest by indigenous peoples. Port Angeles Harbor is now classified as prohibited for shellfish harvest by DOH, due to the limited intertidal areas and the nearness of pollution sources in the harbor. Regardless of their commercial harvestability or fitness for human consumption, shellfish serve an important ecological function. They filter pollutants from water, and are a food source for other creatures, such as birds, waterfowl, and marine mammals. Port Angeles Harbor is on the State 303(d) list for water bodies with limited water quality due to levels of dissolved oxygen in water and PCBs in edible fish. Net pens in the harbor are currently utilized for the commercial production of salmon.

The Port Angeles regional watershed has a wealth of wetlands which contribute to the overall health, diversity, and function of the area. Three hundred sixty-six (366) wetlands are mapped in the Port Angeles regional watershed. The estimated acreage of deepwater in the watershed is 633 acres. Wetlands cover about four (4) percent (3,043 acres) and additional hydric soils four (4) percent (2,696 acres) of the total acreage of the watershed. Together, wetlands and additional hydric soils make up eight (8) percent of the watershed. The vast majority of wetlands are classified in the palustrine system.

Common plants in wetland areas include mosses, wire grass, reeds, cattails, rushes, willows, sedges, and many other water-loving plants. According to the Washington Natural Heritage Program, the Olympic Peninsula has the greatest diversity in kinds of wetlands of any place in western Washington, and Peninsula wetlands support more rare plants than any other part of the State.

Groundwater withdrawals for both industrial and domestic use occur in the watershed (Morse Creek, Elwha River). Aquifers are naturally recharged by precipitation falling over a region, and by surface water infiltration. In the Port Angeles watershed, most recharge may be attributed to fractured rock areas in the mountains (especially since precipitation is greater in the higher elevations) and flat areas with gravel or alluvial deposits. Because it is an “invisible” resource, we know little about the quantity of water available for beneficial uses, about the quality of water underground, or how it moves through the watershed. Available groundwater quality information for the watershed is limited to monitoring conducted at active and inactive landfills, and that conducted by public water systems utilizing wells.

Characterizations of the shoreline and beaches in the Eastern Strait sub-region are difficult to find prior to large-scale industrial development that began in earnest during the late 1800s in Port Angeles. The beach from Port Angeles to the bluff was described early in the 1900s as a "narrow sand or pebble beach at low water" (Dibrell 1908).

Even without detailed descriptions of the pre-development shoreline, we are certain that shoreline conditions have been heavily modified in a large segment of the Eastern Strait sub-region. This is

the case from Dry Creek to Morse Creek (see Figure 1), which is nearly entirely armored, most resulting in fill being placed well seaward of the historical high tide line. This shoreline development is associated with industrial, commercial, and transportation activities that had taken shape by WWII. The current shoreline at the former Rayonier site is approximately 200 feet north of the natural shoreline.

Armoring that protects a buried water pipeline that runs from Dry Creek to the base of Ediz Hook, industrial development along the entire shoreline of Port Angeles, and a railroad grade that runs from near Morse Creek to Port Angeles are the major marine shoreline modifications in the region.

In striking contrast, most of Freshwater Bay and the long stretch of shoreline extending from just east of Morse Creek to the Dungeness Spit are considered intact, or at least much less altered compared with the remainder of the Eastern Strait. In many respects these shorelines probably function physically much as they did 150 years ago. Indeed, some have suggested the stretch between Morse and Dungeness Spit as a reference shoreline when comparing it with the modified shoreline occurring just west of Ediz Hook.

4.2 Environmental Contamination Conditions

This section discusses the potential for environmental contamination to be present in and near the Port Angeles Area shoreline. This section identifies sites and measures to limit impacts from environmental contaminants during development.

Environmental contamination may result from a release of hazardous substances. Hazardous substances are materials that present a threat to human health or the environment if released into the environment, and are defined by Washington State Chapter 70.105 RCW and the Model Toxics Control Act regulations (MTCA, Chapter 173-340 WAC). A release may occur when hazardous substances are introduced to media such as soil, surface water, groundwater, and aquatic sediment. A site is defined (Chapter 173-340 WAC) as an "…area where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, placed, or otherwise come to be located". When a release of a hazardous substance is identified, it must be reported to the Washington State Department of Ecology (Ecology) pursuant to the MTCA regulations. Once evaluated, the site is included in one or more of the databases maintained by Ecology (Ecology 2010a).

A second source of marine contamination in Port Angeles Harbor is the result of log storage practices. Several areas of seabed in the Harbor are covered with wood waste. The depth exceeds 3 feet of depth in some areas. No detailed inventory of the extent of wood waste is available.

The existence of wood waste has resulted in the loss of aquatic vegetation and habitat. Several areas of the Harbor floor have been described as "dead zones" or "moonscapes" by local dive enthusiasts.

Remediation of environmental contamination in upland areas may be addressed under MTCA as an independent action or under a legal agreement with Ecology, such as an Agreed Order. In aquatic or marine areas, remediation of sediments may also be addressed independently or under a legal agreement, and sediment remediation activities will be guided by the Ecology's Sediment Management Standards (SMS, Chapter 173-204 WAC). In shoreline areas, both the SMS and MTCA regulations may apply.

Development in marine areas may include in-water activity such as dredging, pile driving, shoreline stabilization, and other activities. The Dredged Material Management Program (DMMP) represents a coordinated inter-agency [U.S. Army Corps of Engineers - Seattle District (USACE); U.S. Environmental Protection Agency - Region 10 (EPA); Ecology, and Washington Department of Natural Resources (DNR)] approach to evaluate conditions at proposed dredge locations and manage disposal of dredged materials. The process includes sampling and analysis to assess potential sediment contamination conditions, review and reporting of results, and preparation of a suitability determination for dredging and in-water disposal site use.

4.2.1 Upland Sites in the Shoreline Zone

Sites that are in or adjacent to the shoreline area identified by Ecology, where hazardous substances have been reported, are shown on Maps 18A-18D. Table 3 provides an inventory of locations in and near the shoreline where a release of hazardous substances has been reported. The locations of the selected sites presented in this section are located both near the shoreline and south to approximately U.S. Highway 101. The information on properties with reported environmental conditions presented in this section was obtained from Ecology databases. The listings were confirmed using an Environmental Data Report for the vicinity of Port Angeles (Ecology 2010a).

Table 3. Sites in or adjacent to shoreline jurisdiction with reported hazardous substances.

Map ID	Site Name	Contaminants/Status	Permit/Ecology Agreed Order (as applicable)
1	Port Angeles Landfill	Solid Waste Landfill, Cell Closure completed, Post-closure monitoring.	CCEHS Solid Waste Post Closure Permit SLW-08-001
2	Daishowa America; Nippon Paper Industries	CSCSL, ICR: confirmed TPH & phenolic release to soil, groundwater, and surface water; with status of "awaiting RA".	
3	Levaque Co Inc Port Angeles Shingle	LUST: TPH release	
4	Unocal #0601	TPH release from former bulk storage facility, refer to Ecology website for additional details.	AO# DE 4086
5	Marine Trades Area (MTA)	TPH release from former bulk storage facility, refer to Ecology website for additional details.	AO# DE 03TCPSR-5738
6	Port Angeles Port	LUST: TPH release	
7	Chevron Bulk Plant 61001372, Pettit Oil Company Port Angeles WHS	CSCSL: TPH release to groundwater, status is "RA in progress"	
8	ITT Peninsula Plywood Corp	LUST: TPH release, reported cleaned up. Formerly and currently Peninsula Plywood.	
9	K-Ply	Hydraulic oil spill. Formerly and currently Peninsula Plywood.	RAO# DE 90S255
10	Tire Town Kolk	LUST: TPH release to soil, status is	

Map ID	Site Name	Contaminants/Status	Permit/Ecology Agreed Order (as applicable)
		"cleanup started"	
11	436 Marine Drive Property	LUST: TPH release to soil	
12	Marine Drive Exxon and Grocery	ICR: TPH release to soil	
13	Fuds Port Angeles AAF	CSCSL: suspected release of TPH, base/neutral/acid organics, metals & cyanide into soil	
14	Jackpot Foodmart 356	LUST, VCP: TPH release to soil and groundwater, NFA date is 3/20/2001	
15	Armory Square	VCP: chemical and medium not reported, NFA date is 1/12/2001	
16	City of Port Angeles, PW Dept	SPILLS: TPH release	
17	AT&T Port Angeles	NFA: chemical and medium not reported, NFA date is 7/26/06	
18	Richard J Nichel	NFA, ICR: TPH release	
19	City Parking Lot – Port Angeles	ICR, NFA: TPH release to soil	
20	Port Angeles Gull 275	TPH release to groundwater and soil	
21	Alpine Realty Jiffy Cleaners Safeway	VCP: chemical and medium not reported	
22	Lincoln Square Apartments	SCS, VCP: chemical and medium not reported	
23	Sadler Mobil	LUST: TPH release	
24	Stoddard Property	LUST: TPH release	
25	Habit Cleaners	LUST: TPH release	
26	Port Angeles City Senior Center	VCP: chemical and medium not reported	
27	Exhaust Shop of Port Angeles	LUST: TPH release to soil, reported cleaned up	
28	Albert Substation	VCP: chemical and medium not reported	
29	Rudy's Automotive Inc.	TPH release to soil, final cleanup report received	
30	Port Angeles Rayonier Mill Site	Former pulp mill, for details on contaminants and medium, refer to Ecology website.	AO# DE 6815
31	FIRST & RACE CAR WASH	LUST: TPH release to soil, final cleanup report received	
32	CHEVRON 90089	LUST: TPH release	
33	OLYMPIC MEDICAL CENTER	SPILLS: chemical and medium not reported	
34	St Marys Texaco	LUST: TPH release	
35	Nebert Brothers Inc.	VCP: chemical and medium not reported	
36	Berts Small Car	LUST: TPH release,	

Map ID	Site Name	Contaminants/Status	Permit/Ecology Agreed Order (as applicable)
	Repair		
37	Truck Town 1921 Hwy 101	SCS, VCP: chemical and medium not reported	
38	Jiffy Lube 793	VCP, LUST: TPH release	
39	Quality 4x4	SCS: chemical and medium not reported	
40	Ediz Hook Drum II	VCP: suspected TPH release to sediment; TPH release to soil and groundwater; TPH "remediated" in soil and groundwater and "RA in Progress"	
41	Ediz Hook Salmon Club	LUST: TPH release	
42	USCG Air Station	ICR: TPH release to groundwater and soil, received interim cleanup reports	

Abbreviations and Ecology Data Base Acronyms:

TPH = Total Petroleum Hydrocarbons
LUST = Leaking Underground Storage Tank
CSCSL = Confirmed and Suspected Contaminated Site List
VCP = Voluntary Cleanup Program
ICR = Independent Cleanup Report
RA = Remedial Action
SPILLS = Ecology sites database
SCS = State Cleanup Site
NFA = No Further Action

Five cleanup sites and one sediment investigation are identified in the Port Angeles shoreline zone that are managed by Ecology using either legal agreements, a landfill permit, or, in the case of the Port Angeles Harbor Sediment Study, managed as an active Ecology-led investigation under the Puget Sound Initiative. Maps 18A-18D show the boundaries of sites listed in Agreed Orders and Solid Waste Permits. Table 1 includes these upland sites, which are, from west to east, the Port Angeles Landfill, the Unocal Bulk Plant, the Marine Trades Area, the K-Ply Mill site, and the Rayonier Mill site. The Ecology Port Angeles Harbor Sediment Study, an on-going investigation of marine sediment conditions, may at some point be connected to a strategy, marine cleanup action(s), and upland source control and clean up actions as summarized below.

4.2.2 Marine Aquatic Conditions

Port Angeles Harbor is one of several Puget Sound bays being targeted for priority cleanup by the Puget Sound Initiative (Ecology 2010b). As part of the cleanup, Ecology has focused on source control, sediment cleanup, and restoration. Various locations in the Harbor are classified as Category 5 (significant impairment that requires development of a Total Maximum Daily Load (TMDL)) for sediment bioassay. Ecology started an investigation of aquatic sediment conditions and will develop a strategy for cleanup of the harbor. The contaminants and deleterious substances in Port Angeles Harbor that Ecology reports may pose a threat to human health and the environment are pilings with creosote, dioxins and furans, polychlorinated biphenyls (PCBs), and wood debris accumulations. These contaminants and deleterious substances can impact aquatic habitat and the quality of fisheries and shellfish.

Map 19 in Appendix B shows locations of environmental samples in the vicinity of Port Angeles Harbor that are being considered by Ecology in conjunction with the Port Angeles Harbor Sediment Study (Ecology 2010b). The evaluation of data from the investigation, determination of cleanup levels, strategy for cleaning up the harbor, and implementation of source control measures have not been completed.

Contaminants may move to the marine environment through several pathways. Some may be deposited directly from past industrial practices and/or spills. Contaminants may be associated with both residential and commercial activities, and some may be associated with permitted industrial outfalls. Stormwater can dissolve and/or transport substances and soil that are exposed during storms, and may flow directly or indirectly to the harbor. Groundwater contamination can move toward and discharge to marine water or sediments directly, or into adjacent creeks that flow to the harbor. Control of the sources of contaminants is an important element of the future harbor cleanup and the health of the shoreline zone and marine environment.

In addition to the sediment contamination, the water column has also been adversely impacted. The waters of Port Angeles Harbor are in various places designated as Category 5 for fecal coliform and dissolved oxygen. Sources of water column contamination include stormwater runoff from the immediately adjacent industries and other basin developments, waterfowl (fecal coliform), combined sewer overflows (CSOs), and faulty septic systems (fecal coliform) outside of the City (Ecology and Environment 2008).

An additional source of impairment is the substantial areas of sunken logs and wood waste on the bottom of the Port Angeles Harbor that were a byproduct of the various wood-based industries (saw mills, pulp and paper mills, and plywood). Intact logs may be present in sediment and may be able to be reused in stream rehabilitation projects if they can be recovered. Concentrations of wood waste are found in the embayment on the west side of the Rayonier properties, along the west and northwest sides of the Harbor, and in front of the Boat Haven marina. Decomposing wood waste has high biological oxygen demand, lowering dissolved oxygen in the area to nearly anoxic levels and potentially releasing hazardous substances during decomposition. The wood waste also essentially forms a blanket over the benthic habitats, making them inhospitable to invertebrates and other aquatic organisms (Ecology and Environment 2008). Finally, the amount of wood debris may present impediments to dredge material disposal based on a high percentage of included wood debris.

4.3 Geology

The surficial geologic units in the vicinity of the City of Port Angeles shoreline were interpreted from the *Geologic Map of the Port Angeles and Ediz Hook 7.5-minute Quadrangles, Clallam County, Washington* (Schasse et al. 2004) and data from shoreline area explorations. The geology of the northern Olympic Peninsula has been shaped by various glacial advances and retreats, as well as by subsequent sedimentation and recent filling and industrial-related land modification of the shoreline. A substantial portion is historical beach along the Port Angeles Harbor that was filled in the past.

General descriptions of the primary geologic units that are identified on the above-referenced geologic map as being present at, or in the vicinity of, the City of Port Angeles shoreline are presented below.

4.3.1 Fill and Modified Land

Much of the City of Port Angeles shoreline is mapped as either fill or modified land that consists of fill material (described as consisting of soil, sediment or other material including demolition rubble) that was locally reworked by excavation and/or redistribution to modify topography or protect the shoreline from erosion. The fill and modified land along the City of Port Angeles shoreline primarily consists of fill associated with historical and recent industrial development and is held in place by shoreline armoring in the form of large stone rip rap.

Armoring modifies the natural transition between terrestrial and aquatic ecosystems. This can affect movement of materials and organisms between systems, reduce the quality of riparian functions, and introduce discontinuities to this narrow ecotone and ecological corridor. Structures also tend to result in alterations to the pattern of natural drainage to the beach.

One measure of the amount of modified land is the amount of shoreline change. Map 16, which was adapted from information obtained from the Port of Port Angeles, shows historical shorelines as development progressed since the late 1800s.

4.3.2 Beach Deposits

Beach deposits are mapped along portions of the City of the Port Angeles shoreline. These deposits are described as generally consisting of sand and cobbles that may include silt, pebbles and boulders.

4.3.3 Mass Wasting and Landslide Deposits

Mass wasting and landslide deposits are mapped along the lower portions of the marine bluffs and ravines that are present along the City of Port Angeles shoreline. These deposits are described as generally consisting of loose boulders, gravel, sand, silt and clay that are generally unsorted but may be locally stratified. These deposits occur at the bases of slopes that are potentially unstable.

Factors Affecting Slides

The occurrence of landslides is governed by numerous factors, though geology, hydrology, and slope steepness are the most significant. Most landslides on Puget Sound occur in response to either heavy precipitation or elevated groundwater conditions (Thorsen, 1987). Different rainfall regimes may lead to different kinds of slides, reflecting the ability of heavy precipitation to saturate shallow soils or of extended wet periods to lead to a rise in regional groundwater levels. During the winter of 1996-1997, two major episodes of landsliding followed heavy rainfall, a majority of which were relatively shallow failures. In contrast, during the winter of 1998-1999, shallow landslides were infrequent, but prolonged wet conditions led to the reactivation of numerous large, deep-seated landslides (Shipman, 2001).

The geology of the bluffs affects the geotechnical properties of the bluff soils, but its most significant impact on stability appears to be stratigraphic and hydrologic. Most landslides in the region occur where permeable sand and gravel units lie directly on top of less permeable silts and clays, allowing a perched water table to develop and soils to become locally saturated (Tubbs, 1974). The most common scenario is where advance outwash overlies proglacial lakebed clay. Groundwater percolates downward in the porous outwash and laterally toward the bluff face along the contact with the finer grained underlying material. When water levels rise, increased pore pressures lead to weakness and failure. Similar geologic conditions exist where glacial sediments overlie bedrock and where recessional outwash is found above impermeable glacial till.

Steeper slopes are generally more prone to failure as gravitational stresses are greater, but variations in rock strength and differences in hydrologic conditions make it difficult to predict landslides based on slope alone. On coastal bluffs, erosion of the toe by wave action ultimately leads to steepening of the slope and the increasing likelihood of failure, but whereas toe erosion is a relatively slow process on most Puget Sound bluffs, landslides typically occur in response to transient increases in groundwater or soil saturation. As a result, wave action and undercutting may set the stage for future slope failures but rarely precipitate landslides. The common practice

of constructing shoreline bulkheads to prevent coastal bluff erosion often overemphasizes the role of waves in determining slope stability

Human-induced Erosion

The third driver of bluff erosion is human-induced erosion, which comes in many forms. Bluff erosion can be exacerbated and initiated by overloading the top of a bluff, cutting into the toe of the slope, grading and removing stabilizing soil, removing dunes and vegetation and, most importantly, adding water (Emery and Kuhn 1982, Shipman 2004).

Common problematic water additions include increased surface water runoff resulting from impervious surfaces, vegetation removal, and poorly designed drainage, lawn watering, and septic tank leach lines.

Surface water volumes often increase and become more concentrated as a result of housing and road development, causing decreased infiltration and interception of water (Montgomery et at. 2000). Concentrated surface water can locally erode bluff crests and saturate soils, which exacerbates slope stability problems and can trigger. Landslides (Shipman 2004).

Runoff flowing down a driveway and rapidly across a lawn (which can absorb little water when wet) as sheet flow to the bluff face is an example of this process. Failed tightlines on a bluff face (constructed out of low strength corrugated pipe) have often contributed to initiating coastal landslides. Overall, more than 70 percent of slope failures that occurred during the heavy rainfall events in Seattle in 1997 were at least partially due to human actions (Shannon and Wilson 2000).

4.3.4 Alluvium

Within the City of Port Angeles shoreline area, alluvium is mapped along both sides of creeks. This unit is described as typically consisting of loose, variably sorted, bedded gravel, sand, silt, clay and peat that was deposited in stream beds and estuaries and on floodplains. Alluvium may also include lacustrine and beach deposits.

4.3.5 Recessional Outwash and Glaciomarine Drift

Recessional outwash and glaciomarine drift are mapped along the higher portions of the bluff along the City of Port Angeles shoreline. Recessional outwash is described as typically consisting of loose, well rounded, generally well sorted, mostly stratified gravel, sand, silt and clay that was deposited by glacial meltwater (as opposed to nonglacial streams). The recessional outwash locally grades up into, or interfingers with, post-glacial alluvium. The glaciomarine drift is described as consisting of pebbly silt and clay with discontinuous layers of silty sand that is weakly stratified to nonstratified.

4.4 Geologic Hazards

Washington's Growth Management Act (GMA) (Chapter 36.70A RCW) requires all cities and counties to identify critical areas within their jurisdictions and formulate development regulations for their protection. Among the critical areas designated by GMA are geologically hazardous areas defined as such because of their potential susceptibility to landsliding, erosion, seismic or other geologic events, or because of their past use (e.g., landfill). These areas may not be suited for development consistent with public health and safety without conducting specific studies during the design and permitting process.

The City of Port Angeles Municipal Code (PAMC) (15.20.030) defines geologically hazardous areas and the City has developed a map of the geologically hazardous areas. In general, before development is allowed in or immediately adjacent to mapped geologically hazardous areas, detailed geotechnical studies must be conducted as part of the permit process to address specific standards relating to site geology and soils, seismic hazards and facility design.

A discussion of potential geologic hazards along the City of Port Angeles shoreline is provided below.

4.4.1 Flooding Hazards

Flooding of lowland areas by storm precipitation runoff, snow melt and/or storm tides, is one of the most common natural hazards. Furthermore, floods throughout the world are historically responsible for the greatest economic losses due to natural hazards. Consequently, the utilization of land located in close proximity to marine shorelines, rivers and creeks must take into consideration the natural geohydrologic principles and geologic processes that are at work in order to limit the potential for economic loss associated with flooding.

Creeks flow north off the flanks of the forested uplands to the shoreline in the Port Angeles vicinity (USGS 1965, photo revised 1985). Existing grades are such that portions of the creeks near the marine shoreline (some designated as within the 100-year floodplain) could flood during extreme storm events or as a result of rain-on-snow events. Depending on future grading activities and storm events, other portions of the City of Port Angeles shoreline could also be vulnerable to flooding.

The long-term effects of climate change on the coastal zones of the Pacific Northwest are likely to be similar and even more serious than those climate impacts already felt in the region. Port Angeles' shoreline armoring generally may be said to have served to protect the City's low lying elevation areas from coastal high water events in the past. An anticipated acceleration of regional sea level rise has been predicted. Expected changes in the frequency and intensity of storms may change both the frequency and magnitude of storm surges.

Beaches and bluffs currently armored are expected to have increased water depths and be subject to greater wave energy, storm run-up, beach loss, and probability of structural damage, requiring construction to repair and improve structures (Bray and Hooke 1997). Soft shore protection strategies are recommended for mitigating sea level rise, as hard protection does not respond to the fundamental problem of diminishing sediment sources (Neumann et al. 2000).

Additional implications of global climate change result from warmer ocean conditions, including more frequent and greater magnitude storm events, increased precipitation, and more frequent and longer lasting El Nina(s). Sea level rise (SLR) due to El Nino often results in increased frequency and magnitude of coastal erosion, increased precipitation and storm surge flood events (Canning 2001). Allen and Komar (2002) have documented a progressive increase in winter wave heights and periods in the Pacific Ocean off the coast of Washington and Oregon over the past 25 years. This suggests that increases in wave energy may also be attributed to global climate change.

Management Implications

In most cases, the impacts of SLR can be mitigated by forward-looking state or local land-use policies. A major obstacle that must be overcome includes improving our integration of

these concepts into Puget Sound socio-economic and environmental context, as well as the accessibility and application of the science by state and local decision-makers who are most able to prepare coastal areas to respond to the threat of sea level rise (Neumann et al. 2000).

4.4.2 Landslide Hazards

Landslide hazard areas may be prone to landslides and/or subsidence that could include movement of soil, fill, rock or other geologic strata. Specific landslide hazard areas may include, but are not limited to, the following.

- Slopes that rise at an inclination of 40 percent or more (typically with a vertical change in elevation of at least 10 feet)
- Slopes that are parallel or subparallel to planes of weakness in subsurface materials
- Marine bluffs along present and historical shorelines of Port Angeles Harbor
- Areas mapped as unstable in the 1978 Coastal Zone Atlas of Washington.

The degree of potential sloughing and sliding varies with the steepness, height groundwater conditions, and potential planes of weakness of the slope. Steeper, higher slopes are more likely to create larger slides, whereas shorter slopes tend to produce smaller surficial sloughs. Slopes that are susceptible to movement under non-earthquake (static) conditions also present a hazard under earthquake (dynamic) loading conditions.

In the vicinity of the City of Port Angeles shoreline, the stability of the bluff along Port Angeles Harbor west of Ennis Creek is mapped in the Coastal Zone Atlas of Washington as intermediate. East of Ennis Creek, and west of Ediz Hook, the bluff is mapped as unstable. These areas of intermediate and unstable slopes generally coincide with the areas mapped as marine bluff and ravine on Maps 9A through 9D. Consequently, a moderate landslide potential that could affect existing development and future redevelopment may exist along the bluffs that are located within the limits of the shoreline area.

4.4.3 Erosion Hazards

Erosion hazard areas are defined as those areas containing soils that may experience severe to very severe erosion from construction activity. The susceptibility to erosion is generally a function of soil type, topography, occurrence of groundwater seepage or surface runoff and the built environment. Certain soil types along the City of Port Angeles shoreline may be susceptible to erosion when disturbed by construction activities, or when exposed to wave and tidal processes, particularly on slopes exceeding 15 percent. This potential erosion hazard primarily applies to the bluff and steeper slope areas (see Maps 9A through 9D).

4.4.4 Seismic Hazards

General

Seismic hazard areas are generally defined as those areas subject to severe risk of earthquake damage as a result of ground shaking, ground rupture, soil liquefaction or tsunamis. Ground shaking can occur far from the earthquake source; ground rupture typically only occurs near the active fault trace; liquefaction requires a certain combination of soil and groundwater conditions at the site; and tsunamis can occur far from a fault rupture or massive landslide in a water basin.

The U.S. Geological Survey (USGS) and other researchers continue to evaluate the presence and potential effects of fault systems in the Pacific Northwest that could affect seismic hazard

assessments. Accordingly, seismic hazard assessments conducted during the design phase of future shoreline improvements should use USGS seismic hazard maps and data that have been updated to reflect potential ground shaking from nearby fault systems.

Ground Shaking and Ground Motion Amplification

The entire Puget Sound and Strait of Juan de Fuca region lies within a seismically active area, and moderate to high levels of ground shaking should be anticipated during the design life of structures constructed along the City of Port Angeles shoreline. Portions of the shoreline are underlain by deposits of relatively soft to loose soils that may amplify earthquake ground motions at various frequencies. Consequently, the near-surface soils along the shoreline could affect the level of earthquake ground shaking felt in the area. In addition, certain soil deposits along the shoreline may be subject to ground motion amplification and subsequent liquefaction during a significant earthquake event.

Ground Rupture

The Puget Sound and Strait of Juan de Fuca region contain numerous fault zones. The Lower Elwha Fault thrust fault, located approximately 1 mile south of Port Angeles, is currently considered the closest reported fault zone (Schasse et al. 2004). However, due to the distance between the City of Port Angeles shoreline and this fault zone, it is unlikely that ground rupture would occur along the shoreline. Therefore, it is anticipated that design against ground surface rupture along the shoreline during a seismic event will not be a significant part of the site-specific seismic design for future improvements.

Liquefaction and Lateral Spreading

When shaken by a significant earthquake, certain soils lose strength and temporarily behave as if they were liquid. This phenomenon is known as liquefaction. The seismically-induced loss of strength can result in loss of bearing capacity for shallow foundations, reduction in vertical and lateral capacities of deep foundations, downdrag forces on deep foundations, ground surface settlement, embankment instability, sand boils, and lateral spreading. Seismically-induced liquefaction typically occurs in loose, saturated, sandy material commonly associated with recent river, lake and beach sedimentation. In addition, seismically-induced liquefaction can occur in areas of loose, saturated fill.

The Washington State Department of Natural Resources (WDNR) Division of Geology and Earth Resources has published liquefaction susceptibility maps for Washington. The results of the WDNR study (Palmer et al. 2004) entitled *Liquefaction Susceptibility Map of Clallam County, Washington* indicate that the filled shoreline areas of Port Angeles have a high liquefaction susceptibility, whereas the remainder of the shoreline has a very low to moderate liquefaction susceptibility (see Maps 10A through 10D).

The depth and extent of potentially liquefiable soil deposits depends on specific soil and groundwater conditions and could be highly variable along the City of Port Angeles shoreline. The actual magnitude and extent of soil liquefaction will depend on many factors, including the duration and intensity of the ground shaking during the seismic event and specific soil and groundwater conditions. At this time, it is anticipated that the filled shoreline area of Port Angeles will be vulnerable to the effects of liquefaction. Therefore, a site-specific liquefaction analysis would need to be conducted during the design process for specific site improvements in order to estimate the expected impact due to soil liquefaction (and lateral spreading) and evaluate potential mitigation measures.

Tsunamis

Tsunamis are earthquake-generated waves that occur in open water bodies. A tsunami can be generated by permanent ground displacements in a water basin caused by a fault rupture (or landsliding). The extent and severity of a tsunami will depend on many factors, including site location and elevation, fault offset, ground motions and tide stage. A tsunami could be generated by a large earthquake in the Pacific Ocean basin.

WDNR's Division of Geology and Earth Resources and the National Oceanic and Atmospheric Administration (NOAA) have published estimates of tsunami inundation in the Port Angeles Harbor area based on a computer model of ground deformations and waves that may be generated by two different scenario earthquakes, both moment magnitude 9.1, on the Cascadia Subduction Zone. The results of the WDNR and NOAA modeling study (Walsh et al. 2002), entitled *Tsunami Inundation Map of the Port Angeles, Washington, Area,* indicate that under Scenario 1A (the worst case scenario), the entire northern portion of Port Angeles shoreline may experience inundation as a result of a tsunami (see Maps 10A through 10D.

It should be noted that the study acknowledges certain limitations, with the largest source of uncertainty being the initial deformation of the earthquake, which is poorly understood. Additionally, the model does not include the influences of changes of tides, and tide stage and tidal currents, all of which can amplify or reduce the impact of a tsunami at a specific site. Thus, the study states, "While the modeling can be a useful tool to guide evacuation planning, it is not of sufficient resolution to be useful for land-use planning."

The dominant wave period of 25 seconds and significant wave height of 3.5 m from the summary plot statistics of Station 46088, New Dungeness, WA were used in a simple swell model. Ediz Hook does shelter the project site (the Port Angeles waterfront) from Pacific Ocean swell. The average swell height of 1.5 m with the average swell period of 10.2 seconds from the summary plot statistics for Station 46088, New Dungeness, WA were also modeled with the same result of having no impact inside Ediz Hook. Therefore, the average and large Pacific Ocean swell do not need to be part of design criteria." (**Coastal Geologic Services' report** on waves and wind conditions affecting Port Angeles, completed as part of research for the Waterfront Transportation Plan:)

4.5 Sea Level Rise

A recent study by the University of Washington Climate Impacts Group and Ecology (University of Washington Climate Impacts Group and Washington Department of Ecology 2008) suggests that on the northwest Olympic Peninsula, very little relative sea level rise during the 21st century will be apparent due to estimated rates of tectonic uplift that currently exceed projected rates of global sea level rise. Therefore, over the next 90 years, the apparent sea level in Port Angeles Harbor may rise by between 0 and several feet over current levels. This study relied on the 2007 IPCC report that are now considered very questionable given that they did not include a contribution to SLR from global ice melt, which is now viewed as a potentially significant contributor to overall rates of global sea level rise.

Sea level rise may prove to have profound implications for stream delta and spit/marsh complexes is the risk to tidal wetland habitat from sea level rise given global climate change projections (see Snover et al. 2005). Habitat complexes that occur immediately adjacent to steep topography or where encroachment from human infrastructure or fill has taken place, would likely be at greater risk of habitat loss through erosion and inundation of wetlands than complexes that are adjacent to relatively flat topography and those relatively free of human encroachment.

Sea level rise could have important implications on coastal erosion and sediment processes that might at least partially offset the erosion or inundation of down-drift spit and marsh features. Therefore, spits and marshes associated with drift cells that are heavily armored by bulkheads, for example, might be particularly vulnerable to erosion under sea-level rise projections (Beamer et al. 2005). Thus, restoration practitioners and long-term planners need to seriously consider the implications of sea-level rise in their development of policies/regulations and restoration strategies and plans.

If the sea level in Port Angeles Harbor rises by several feet over current levels by 2100, lower-lying upland portions along the City of Port Angeles shoreline could be inundated in the future. If such a trend occurs, grades along the shoreline could be raised to mitigate the potential impact of a long-term sea level rise in Port Angeles Harbor.

4.6 Historical and Current Land Use

At the base of the Olympic Mountains, Port Angeles sits on a harbor naturally sheltered by Ediz Hook, a long sand spit jutting into the Strait of Juan de Fuca. The harbor area has been inhabited for over 2,700 years and was home to two major Klallam villages for at least 400 years. Founded by white settlers in 1862 and incorporated in 1890, Port Angeles grew as Clallam County's civic, commercial and industrial center. For most of the twentieth century, Port Angeles was largely dependent on the old growth forests to support lumber, pulp, paper and plywood mills along the waterfront. More recently, tourism to the Olympic National Park and nearby attractions has become an important part of the economy.

Several notable European explorers plied the waters of the Strait of Juan de Fuca during the Seventeenth and Eighteenth centuries. One of these explorers, a Spaniard named Don Francisco Eliza, named the harbor "Puerto de Nuestra de Senora de Los Angelos"; or Port Angeles as it was later shortened. The harbor also appears on English language charts as "False Dungeness" until at least 1853.

From 1800 until about 1850 the area was traversed infrequently by trappers, traders and explorers while the Olympic Peninsula remained the last frontier of America. After 1850, the European settlement of the harbor began slowly causing the regions to be considered the Last Frontier in America. The first white settlers appeared during the early 1850s. According to local historian Paul Martin (1983), they were likely Captain Alexander Sampson who settled in the elbow of Ediz Hook (over the Tse-whit-zen village site and possibly with Klallam Chief Norman's permission) with Rufus Holmes and William Winsor. Martin (1983: 11) also suggests that Angus Johnson may also have been the earliest non-native settler of the harbor according to other sources. Regardless of the earliest, by 1859 a group of men from Port Townsend had staked claims on the beachfront of the harbor and formed the speculative land agency they called the Cherbourg Land Company. Among notable early profiteering schemes centered around Port Angeles' location were moving the Port of Entry from Port Townsend to Port Angeles and getting Port Angeles recognized, by President Lincoln, as the Second National City (technically as a Federal Reserve; Martin 1983: 23).

For the most part, Port Angeles was little more than these schemes of a few entrepreneurs through the middle of the nineteenth century with construction of only a handful of homes, small businesses and the lighthouse on Ediz Hook. But by 1885 the mechanisms that would turn Port Angeles into a Washington city were reinvigorated. Important events included the short-lived, but none-the-less important, establishment of the Puget Sound Cooperative Colony along the Ennis Creek estuary at what is now the former Rayonier Mill, the construction of schools, churches and the opera house in downtown; the 1890 land grab after the Federal Reserve was

opened up for purchases, and the establishment of Port Angeles as the county seat that same year. From this point on, Port Angeles was thrust into the modern age with a focus on waterfront industry including a cannery, a long series of water dependent mill constructions and failures, the raising of the elevation downtown after periods of tidal flooding in 1914, and a period of general industrial success based on the harbor location and access to the old growth forests of the Olympic Peninsula. Of special note to the history of Port Angeles' waterfront in additional to those previously mentioned are the completion of the Milwaukee, St. Paul and Pacific Railroad line on trestles stretching across town in 1914, the establishment of the Port of Port Angeles in 1923 and completion of Port Terminal 1 in 1926, the formation of Olympic National Park in 1938, and the general period of military fear during World War II when the peninsula, and Port Angeles, were on the forefront of preparations for potential attack by the Japanese Navy.

4.6.1 Klallam

Port Angeles Harbor was historically populated by the Klallam People. The Klallam are a part of the larger Central Coast Salish culture group whose traditional territory included the Strait of Juan de Fuca on both the northern shore (including Beecher Bay and Victoria on Vancouver Island) and the southern shore (from the Hoko River to Port Townsend) (Suttles 1990). The Klallam (also *S'Klallam*) are most often described as the groups residing on the northern slope of the Olympic Peninsula from the Hoko River to Discovery Bay. Historic interactions with the United States government lead to the formation of three units of the Klallam residing in three geographically distinct areas including the Lower Elwha Klallam, Jamestown S'Klallam, and Port Gamble S'Klallam Tribes.

The Klallam and their ethnographers generally agree that there were two villages present on Port Angeles Harbor during the ethnographic period and archaeological evidence indicates the harbor shores have been populated off and on for the last 2500 years. One village, "Tcīwī'tsen" or Tse-whit-zen, is located at the base of Ediz Hook and the other, "I'ē'nis," at the mouth of Ennis Creek (Gunther 1927 and Suttles 1990: 456). Both Ediz Hook and Ennis Creek derive their names from "I'e'nis," meaning "good beach." In the mid to late 1800s, I'e'nis had between 200 and 1,500 residents and was fortified with a double stockade. Tse-whit-zen had at least six longhouses, a stockade similar to I'e'nis', and a large cemetery. Into the late 1800s, the cemetery was a prominent feature with canoes hung from trees or built structures and decorated with blankets and other possessions.

Historic maps of the harbor, the drawings and descriptions of early white settlers and explorers, and archaeological research have identified both village locations. A third village, likely a small inter- or sub-tidal camp, is depicted on an 1853 hydrographic map of Port Angeles Harbor prepared by Lt. James Alden and placed near the historic channel of Tumwater Creek. Other ethnographic or archaeological evidence regarding this village is not currently published. Regardless, it is highly likely that the hunter-fisher-gatherer Klallam traversed the entire Port Angeles shoreline as part of their movement between villages and economic resource areas.

4.6.2 Cultural Resources

Archaeological sites in and near Port Angeles and along its harbor have demonstrated well over 5,000 years of occupation of the uplands and at least 2,500 years of occupation in select areas of the shoreline through archaeological contexts. Classic Northwest Coast archaeology is present in Port Angeles at the recently excavated Tse-whit-zen site located at the base of Ediz Hook. The Ennis Creek site at the former Rayonier Mill may also contain archaeologically significant deposits, though to what extent is currently undetermined. Isolated finds of stone tools and other

archaeological artifacts across the waterfront suggest that the entire harbor was once a bustling center for hunter-fisher-gatherers; a story also promoted in the oral traditions of the Klallam.

The City of Port Angeles has conducted an analysis of the probability of areas along the Port Angeles Harbor shoreline to contain archaeologically intact Pre-Contact habitation sites. This analytical process is a part of the stipulations that resulted from the August 14, 2006 Settlement Agreement Among the State of Washington, Lower Elwha Klallam Tribe, City of Port Angeles, and Port of Port Angeles as enacted after the occurrences surrounding construction of a Washington Department of Transportation graving dock at the base of Ediz Hook. Since the acceptance of the Settlement Agreement, the City has treated all areas of the waterfront as high probability areas for archaeological resources until the installation of the City's Archaeological Predictive Model. This Archaeological Predictive Model demonstrates the most up-to-date professional archaeological understanding of shoreline areas denoting high, medium and low probability areas for intact archaeological resources along the waterfront. It is to be consulted for all development purposes and municipal permitting actions within the shoreline area. The Archaeological Predictive Model is accompanied by regulatory conditions for ground disturbing activities within areas designated above the "low" probability level.

The City of Port Angeles recently contracted an architectural study of the downtown business district and a historic district was recommended (Eysaman and Company Architecture 2000). To date, none of the buildings, save for the Naval Elks Lodge and the Federal Building, are listed on the State or National Registers. Other state or nationally registered historic buildings and sites within Port Angeles include St. Andrew's Episcopal Church, the Masonic Lodge, the Joseph Paris House and the Clallam County Courthouse. Along the waterfront, The Puget Sound Cooperative Colony and Klallam Ennis Creek Village Site on the east side of the harbor are listed on the State Register. Also listed are the now removed Ediz Hook Lighthouse and Engine Repair Shop/A-frame on Ediz Hook. The former Chicago, Milwaukee, St. Paul and Pacific Railroad and Seattle and North Coast Railroad (45CA458) are listed on the State Register with important features present in other areas of Clallam County. However, within the City limits the once-raised timber trestle railroad grade has been filled and converted into the Olympic Discovery Trail and exhibits little historical integrity beyond its setting. Additionally, Hollywood Beach downtown is listed on the State Register based on historic accounts of Native American encampments; however, archaeological materials have not been reported there.

All of these cultural resources combine to illustrate the history of Port Angeles and are a remarkable and integral piece of the story of Washington State's maritime heritage. Historic and archaeological resources are non-renewable and careful consideration should be devoted to projects that result in losses of historical association or archaeological information. The City's Archaeological Predictive Model must be consulted for any development issues along the entirety of the waterfront and will identify conditions and regulations for ground disturbing projects that fall under municipal and state regulatory compliance. Historical preservation goals for buildings along the waterfront should also be considered during shoreline permit-able actions.

4.6.3 Recent Land Use

West Harbor Area

The west Harbor Area is described as the shoreline from the Valley Creek Estuary to the base of Ediz Hook (Reach segments 6, 8A, 8B, & 8C). This portion of the harbor shoreline has supported mostly industrial, commercial, and recreational uses over the years. Four major mills—Crown Zellerbach, Merrill & Ring, Fibreboard/Peninsula Plywood, and Rayonier—were

the backbone of Port Angeles' economy for many years. Due to rising freight costs, reduced timber supplies and increased expenses, all but one mill has closed.

The mills occupied four general areas of the Port Angeles Harbor waterfront and changed name/ownership several time over their history. The Zellerbach mill is now owned by the Nippon Paper Group, Inc., which occupies the base of Ediz Hook (Reaches 3, 6, & 7) .

Peninsula Plywood started as Crescent Boxboard, became Fibreboard Products Corp. (circa 1926), Pen Ply (1941 -1989) and K-Ply (1989). This mill, situated just west of downtown (Reach 8C) closed in 2011. The Port of Port Angeles currently owns the site and much of the waterfront land between Downtown and Ediz Hook, including the land used by the Boat Haven, Marine Trades areas (terminals 1, and 3) and a large log handling/storage yard.

The area surrounding the mouth of Ennis Creek (Reach 10) was originally developed by the Puget Sound Cooperative Colony. The original mill only operated for a few years. That mill was replaced by the U. S. Spruce Corp. Mill, which became Olympic Forest Products and later ITT Rayonier Mill. Located east of Downtown, the Rayonier site is currently undergoing remediation for cleanup and will be available for future development.

The fourth mill site, located just east of the Nippon site, was most recently occupied by the Merrill & Ring Mill (reach 8A). This site has served a number of uses including ship/barge manufacturing during the second world war.

In 2004, the State Department of Transportation proposed a project to build a graving dock on the former Merrill & Ring site (Reach 8A) at the base of Ediz Hook. The project, located on the former Tse-whit-zen village site, was halted when human remains and artifacts were discovered. A remediation process followed, and balancing the cultural resource considerations and impacts on the local economy has been controversial. The future land use of this site may include a cultural artifacts curation facility.

The U.S. Coast Guard Base is a longstanding major land use, located on the eastern end of Ediz Hook. The stretch of Ediz Hook between the Nippon property and the Coast Guard Base is currently used for recreation purposes. The recreational purposes all focus on the harbor side of the Hook and include a Sail and Paddle Park at the west end, a boat launch ramp, Harborview Park at the east end, and an extension of the Olympic Discovery/Waterfront Trail running the length of the Hook.

Industrial/commercial uses on the hook include the Pilot's facility, an aquaculture (previously American Gold Seafood, now Icicle Seafoods) operation, and a currently vacant structure on the east end of the Hook. Tesoro Petroleum operates a marine fueling operation (including storage tanks and berthing facility for a fuel barge and tug boat) near the base of the Hook. A former log dump structure, known locally as the "A-Frame", was removed in 2008. The YMCA of Clallam County leases a building near the Sail and Paddle Park to house rowing shells.

Land uses located along the southern harbor waterfront include several marine commercial/industrial uses. A major section (Reach 8B) is occupied by the Boat Haven Marina operated by the Port of Port Angeles. The Boat Haven is sheltered inside Port Angeles Harbor and provides easy access to the Strait and to Victoria, BC. Port Angeles Boat Haven is located on 16.1 acres and has moorage space for more than 410 pleasure and commercial boats. This includes 52 boat houses. Slips range from 24 to 50 feet and up to 200 feet broadside. The Boat Haven offers many marine services and is adjacent to local businesses that cater to Boat Haven users. Services at the Boat Haven include moorage, electricity, refueling, and a boat yard with haulout facilities, including a travel lift. Private firms provide boat maintenance; there are 10 to 12 shipwrights working independently at the marina. Local marine services at the Haven include

welding, mechanics, hydraulic services, fiberglass and wood repair, and painting. Additional amenities include charter services, bait shops, and restaurants.

One large boat building operation (Westport Marine) and one large boat repair company (Platypus Marine) occupy a seven acre site immediately east of Tumwater Creek. Directly north of the marine construction/repair site, the Port of Port Angeles operates Terminal 1 for large ship top-side repair and Terminal 3, a materials loading dock.

Directly west of the Boat Haven Marina, the Port of Port Angeles has consolidated its entire log storage operation to an approximately 20 acre site (Reach 8A). This has removed log storage from several other locations on the waterfront. The site also includes a dock and chip loading structure. The chip loader has not been used in years and has been sold to an out of town interest. The structure remains on the shoreline at the writing of this document.

Utilities in this portion of the waterfront include sanitary sewer (pressure mains and gravity lines), water, storm drains, and overhead power. The abandoned industrial waterline branches at the Nippon Paper Mill and extends through this portion of the city. The Olympic Discovery/Waterfront Trail follows city streets on developed sidewalks through downtown to Hill Street. From Hill Street to the end of Ediz Hook, the trail follows Marine Drive along a divided shoulder.

Downtown

The downtown reach is that area extending from the west side of the Peabody Street right-of-way (extended) to Valley Creek centerline on the west. Currently, the Downtown shoreline accommodates the City Pier, a public pier and park with transient moorage; the Feiro Marine Life Center, an aquarium and educational facility; the Hollywood Beach swimming area; the Landing mixed use development; and two ferry terminals. The underutilized Oak Street property on the waterfront between Oak Street and Cherry Street may be redeveloped to offer a park in the Department of Natural Resources-owned and City-leased portion and a park or other uses in the privately owned portion.

Plans for shoreline improvements along the entire downtown waterfront from Hollywood Beach on the east to the Valley Creek Estuary on the west are being developed in the Waterfront and Transportation Improvement Plan. Local approval of the first phase of construction (Coho Ferry Terminal west to Oak Street) was obtained in February 2012. Two existing uses, the Coho Ferry Terminal and the Landing Mall will not be altered by the plan. This plan, titled the Waterfront and Transportation Improvement Plan (WTIP) will result in enhanced public access and shoreline restoration.

Outside of the shoreline jurisdiction, the Downtown features the City's municipal campus, Clallam County building and courthouse, and the Carnegie Library. Community shopping opportunities exist along Lincoln Street, and the Waterfront Trail and a number of parks provide recreation opportunities along the waterfront. In addition, much of the city's multifamily housing is in the downtown area.

"Utilities within the downtown area include sanitary sewer (pressure mains and gravity lines), water, storm drains, and overhead power. The unused Port Angeles Industrial Water line is within the project limits, and major construction using the industrial water line pipe as a carrier for the new pressure sewer lines will occur within the downtown area and east to the former Rayonier site. The existing pressure sewer line will be abandoned when the new system is completed. Storm drain facilities within the downtown include the CSO control structure and discharge piping at the north end of North Oak Street as well as incidental storm drain facilities for runoff from Railroad Avenue and North Oak Street.

Water system distribution mains are located within the Railroad Avenue and North Oak Street rights of way; a main also extends west from North Oak Street in the Department of Natural Resources property to serve Terminal 4. Gravity sanitary sewer collection lines are located with the Railroad Avenue and North Oak Streets rights of way. The gravity sewer line is quite deep (approx 14 feet below ground level) and flow westerly along Railroad Avenue and then southerly along North Oak Street. The line feeds to the City's pump station at the Valley Creek Estuary."

East and West of the Harbor

The area west of Ediz Hook is dominated by single-family residences and undeveloped land. Development is underway in some places, and this area is likely to gain more housing on the bluffs above the shoreline. A cemetery and former landfill at the northwestern edge of the city are other major land uses. There is the potential to redevelop the landfill to support community uses in the future.

East of downtown, a mix of older and newer housing is the primary use, with the Olympic Memorial Center hospital being the only existing commercial use near the waterfront. Only portions of these uses exist within the shoreline jurisdiction. The former Rayonier Mill site is located within this section of the shoreline, however, no land use exists on the site at the writing of this document. In the Urban Growth Area east of the City's boundary, the County has designated most of the land near the shoreline as Rural Character Conservation, which is intended primarily for residential use, but allows some agricultural and commercial uses. Along the shore, this area also includes a portion of the recreational Olympic Discovery Trail, which will eventually extend from Port Townsend to the Pacific Coast. As in other portions of the shoreline, the Olympic Discovery/Waterfront Trail exists on an abandoned railroad grade that is heavily armored for protection against erosional forces of the Strait of Juan de Fuca.

City of Port Angeles Land Use Map

4.7 Analysis of Ecological Functions and Processes

4.7.1 Current Ecological Function and Process Conditions

This analysis of ecological processes and functions provides the context for management of the City of Port Angeles' marine shoreline. This analysis follows Ecology's *Shoreline Master Program Guidelines* (173-26 WAC) and evaluates the functions of the Port Angeles shoreline at a reach scale. Conceptually, ecosystem functions are those aspects of the ecosystem that are beneficial either biologically, economically, or aesthetically. Ecosystem functions are dependent on a number of ecosystem processes, which are influenced or determined by the regime of ecosystem stressors acting on the system. Effectively managing ecosystem stressors is necessary to maintain ecosystem processes that allow the ecosystem to sustain a suite of beneficial functions.

Ecosystem processes, defined as "…the suite of naturally occurring physical and geological processes of erosion, transport, and deposition; and specific chemical processes that shape landforms within a specific shoreline ecosystem and determine both the types of habitat and the associated ecological functions (WAC 173-26-020-12)," are dependent on natural and anthropogenic controlling factors or ecosystem stressors. In a properly functioning ecosystem, the controlling factors occur within the naturally occurring range under which the ecosystem evolved, and the ecosystem in turn provides the suite of naturally occurring functions associated with that ecosystem.

Ecosystem processes can be categorized as geomorphic, chemical, and biological. These processes are interrelated, with each process interacting with the others. Table 4 summarizes the primary ecosystem processes and stressors considered to be relevant to management of the Port Angeles shoreline.

Table 4. Marine Shoreline Processes and Stressors

1. Geomorphic Processes • Bluff erosion • Beach erosion • Sediment transport • Sediment deposition • Sediment stabilization • Flow and movement of water including wave energy and tidal currents • Recruitment, redistribution and reduction of woody debris and other organic material	**Geomorphic Stressors** • Ground clearing • Excavation • Bank alteration • Impervious surfaces • In-water structures • Riparian vegetation removal • Shoreline alterations
2. Chemical Processes • Nutrient cycling • Energy cycling • Toxic substance removal	**Chemical Stressors** • Point source pollution • Non-point source pollution • Impervious surfaces • Riparian vegetation removal • Freshwater inputs

3. Biological Processes	Biological Stressors
• Physical space and conditions for naturally occurring species and life history stages • Access to spawning, rearing, and migration habitat for naturally occurring species • Temperature maintenance • Food production and delivery	• In-water structures • Overwater structures • Riparian vegetation removal • Shoreline alterations • Seafood harvesting • Invasive species

Ecological functions of the City of Port Angeles's shoreline are summarized in Tables 7 through 17. These tables are organized around the functions of marine systems described in Ecology's *Comprehensive Process to Prepare or Amend Shoreline Master Programs* (WAC 173-26-201).

The list includes the evaluation of three major categories of functions:
1) hydrologic; 2) vegetative; and 3) habitat. These are further broken down into the following functions (Table 5) which are in turn used to evaluate reach performance.

Table 5. Marine Shoreline Functions

1. Hydrologic Functions • Transporting and stabilizing sediment • Attenuating wave and tidal energy • Removing excess nutrients and toxic compounds • Recruitment, redistribution and reduction of woody debris and other organic material
2. Vegetative Functions • Maintaining temperature • Removing excessive nutrients and toxic compounds • Attenuating wave energy • Sediment removal and stabilization • Providing woody debris and other organic matter
3. Habitat Functions • Physical space and conditions for life history • Food production and delivery

Assessment of each function is based upon both quantitative data results derived from the GIS inventory information described in Chapter 3 and a qualitative assessment based on aerial photography. As described above, the shoreline has been divided into reaches based on sediment transport drift cells and land use/shoreline condition factors. In the ensuing tables, each reach or group of reaches has been given an overall "rating" for ecological functions based on the available and relevant GIS information and the corresponding quantitative and qualitative evaluation. Rating was completed using a "low" to "high" function scale. The level categories are:

- 1 - Low
- 2 - Low/Moderate
- 3 - Moderate
- 4 - Moderate/High
- 5 - High

Ecosystem functions were scored on a scale of 1 to 5 corresponding to the level categories listed above (i.e. 1 being the lowest level of function and 5 the highest). Similarly, stressors that influence the processes listed in Table 4 were evaluated and scored for each reach. Criteria for scoring are shown in Table 6. The function elements in Table 5 do not always translate directly to the scoring categories in Table 6 because some of the functions needed to be assessed using the inventory information available for this analysis.

The following summary of scores is organized by reach in descending order of function rating (see Maps 21A and B).

Rank		Score
1.	Reach 5: Inner Ediz Hook	3.1
2.	Reach 11: Eastern City (UGA)	3.0
3.	Reach 7: Mill Pond	2.8
4.	Reach 1: Landfill	2.7
5.	Reach 2: Western City	2.6
6.	Reach 9: Olympic	2.5
7.	Reach 10: Rayonier	2.4
8.	Reach 8D: Downtown – Mixed Use	2.3
9.	Reach 8C: Downtown - Transition	2.1
10.	Reach 4: Outer Ediz Hook	2.1
11.	Reach 8A: Downtown – Tse-whit-zen	2.0
12.	Reach 6: Inner Industrial	1.9
13.	Reach 8B: Downtown - Marina	1.7
14.	Reach 3: Outer Industrial	1.7

Table 6. Ecological Function Scoring Criteria.

Functions	Score Criteria				
	1	2	3	4	5
Hydrologic - Sediment					
Erosion	Extensive anthropogenic shoreline erosion (>25%)	Minor anthropogenic shoreline erosion (<25%)	Extensive natural shoreline erosion (>25%)	Minor natural shoreline erosion (<25%)	100% stable shoreline
Interference with sediment transport (barriers to longshore drift)	Significant impediment to sediment transport (e.g. jetty, groin)		Minor impediment to sediment transport		No impediment to sediment transport
Hydrologic - Wave and Tidal Energy					
Interference with natural current patterns	Current blocked or restricted (e.g. at jetty)		Some anthropogenic features that could influence local currents		No alteration of current patterns
Wave and/or tidal attenuation	100% armored shoreline	50-100% armored shoreline	25-50% armored shoreline	0-25% armored shoreline	Natural shoreline
Remove excess nutrients & toxic compounds	303d Category 5 - Impaired, require TMDL	303d Category 5 - Impaired, do not require TMDL	303d Category 2, waters of concern OR suspected sources of water quality concern	303d Category 1, but with some naturally occurring issue	303d Category 1, no problems
Redistribution and cycling of LWD & other organic material	Shoreline segments physically isolated preventing movement of organic inputs		Partial impediment to lateral or vertical movement of organic inputs		Shoreline allows continuous lateral and vertical movement of organic inputs

Functions	Score Criteria				
	1	2	3	4	5
Vegetative					
Shade	No shoreline vegetation	Shoreline vegetated, but <25% of shoreline with overhanging vegetation	25-50% of shoreline with overhanging vegetation	50-75% of shoreline with overhanging vegetation	>75% of shoreline with overhanging vegetation
LWD and other organic recruitment	No shoreline vegetation	Vegetated shoreline, but no riparian trees	<50% Forested shoreline; OR >50% forested, but no evidence for organic recruitment, or a known impediment to organic recruitment	50-75% forested shoreline with evidence of organic recruitment	75-100% Forested shoreline with evidence of organic recruitment
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	0 - 20	20-50	50-100	100-300	>300
Shoreline soil stabilization	No stabilizing shoreline vegetation	0 - 25% stabilizing vegetated shoreline	25 - 75% stabilizing vegetated shoreline	75 - 100% stabilizing vegetated shoreline	100% stabilizing vegetated shoreline
Wave attenuation	Armored shoreline		Natural shoreline with LWD or submerged vegetation		Natural shoreline with plentiful LWD and submerged vegetation to attenuate wave energy.

Functions	Score Criteria				
	1	2	3	4	5
Physical Habitat					
Estuary/Wetland/ Riparian (freshwater) Habitat	No estuary, wetland or riparian habitat	0%-5% estuary/wetland/ riparian habitat	5% - 15% estuary/wetland/ riparian habitat	15%-30% estuary/wetland/ riparian habitat	>30% estuary/wetland/ riparian habitat
Shoreline vegetation	No significant vegetation	Some vegetation, but primarily non-native	Some vegetation, primarily native OR mostly vegetated with non-native species	Mostly vegetated with primarily native vegetation	Fully vegetated with intact and/or restored native vegetation
Direct shoreline alterations	>75% developed/armored	50% - 75% developed/armored	25% - 50% developed/armored	<25% developed/armored	No shoreline alterations
Alteration to shoreline inputs	Severe sediment and water quality disruptions		Severe sediment OR water quality disruptions		Little or no sediment or water quality disruptions
Priority habitats/species - (e.g. forage fish spawning, eelgrass, estuarine)	Impaired habitat, no priority species or habitats mapped	Low potential use by priority species	Potential habitat use by a priority species	Potential use by multiple priority species	Documented priority habitat or use by one or more priority species

4.7.2 Opportunities for Restoration of Ecological Functions and Processes

The assessment of processes and functions for each reach is followed by identification of opportunities and recommendations for protecting existing functions and processes or restoring impaired functions and processes. Ecology's *Shoreline Master Program Guidelines* (173-26 WAC) includes the following definition:

> *"Restore," "Restoration" or "ecological restoration" means the reestablishment or upgrading of impaired ecological shoreline processes or functions. This may be accomplished through measures including but not limited to re-vegetation, removal of intrusive shoreline structures and removal or treatment of toxic materials. Restoration does not imply a requirement for returning the shoreline area to aboriginal or pre-European settlement conditions.*

Another definition of restoration is provided by the National Research Council (1992).

> *"the return of an ecosystem to a close approximation of its condition prior to disturbance...The goal is to emulate a natural, functioning, self regulating system that is integrated with the ecological landscape in which it occurs".*

Consistent with Ecology's definition, use of the word "restore," or any variations, in this document is not intended to encompass actions that re-establish historic conditions. Instead, it encompasses a suite of strategies that can be approximately delineated into four categories: creation (of a new resource), restoration (of a converted or substantially degraded resource), enhancement (of an existing degraded resource), and protection (of an existing high-quality resource).

There is a critical distinction between restoration and mitigation. Mitigation will require applicants whose shoreline proposals will have adverse impacts to complete actions to mitigate those impacts or provide compensation in other ways for losses of ecological function. Degraded wetland buffers are required to be restored under the City's CAO. The City can encourage applicants to implement restoration actions that will improve ecological functions relative to the applicant's pre-project condition. As stated in WAC 173-26-201(2)(c):

> *It is intended that local government, through the master program, along with other regulatory and nonregulatory programs, contribute to restoration by planning for and fostering restoration and that such restoration occur through a combination of public and private programs and actions. Local government should identify restoration opportunities through the shoreline inventory process and authorize, coordinate and facilitate appropriate publicly and privately initiated restoration projects within their master programs. The goal of this effort is master programs which include planning elements that, when implemented, serve to improve the overall condition of habitat and resources within the shoreline area of each city and county."*

The opportunities and recommendations identified below present options for "restoration" that would improve ecological functions. For example, enhancement of riparian vegetation, reductions or modifications to shoreline hardening, minimization of in- and over-water structures, and improvements to fish passage would each increase one or more ecological parameters of the City's shoreline. The City or private property owners could implement these options voluntarily or, depending on specific project details, they could be require measures to mitigate adverse impacts of new shoreline projects.

A preliminary map of restoration opportunities has been prepared (Maps 22A, and 22B), utilizing information from the Strait of Juan de Fuca Ecosystem Recovery Network (Strait ERN), other reference documents, and public input. Where restoration opportunities are site-specific, an identification number has been placed on the map at the site location. However, many of the opportunities are more general, applying to large areas of the shoreline or basin. In those instances, the number is only approximately placed on the map. Where applicable, the reach-specific opportunities identified in Sections 4.7.3 through 4.7.13 refer to the identification number on Maps 22A and 22B.

The projects/programs identified on Figures 22A and 22B, as well as other opportunities identified in this chapter, will be discussed in greater detail in the Shoreline Restoration Plan (see Section 7.2).

4.7.3 Reach 1 - Landfill

Existing Condition

Reach 1 is located at the western edge of the City limits, bounded on the west by Dry Creek (Exhibit 2). As the name implies, this reach is dominated by a closed landfill (now transfer Station), with the portion adjacent to the shoreline a no longer active, and unlined cell. This is a high-bluff shoreline, most of which is nearly vertical, but with the western portion, nearest to Dry Creek, with a more stable slope near the angle of repose. Dry Creek is relatively steep with little fan development and little estuary habitat. According to WDFW, it is used by four priority fish species: chum and coho salmon, coast resident cutthroat trout, and steelhead trout. Trees dominate the shoreline near Dry Creek, but are sparse in the remainder of the reach. A seawall was installed at the toe of the bluff in 2007 (Exhibit 3) to prevent continued erosion of landfill material into the Strait. The seawall extends the entire 620 feet of the landfill beach cell and rises 15 feet above the beach. The seawall is located approximately 100 feet east of the mouth of Dry Creek. As a condition of the approval for the seawall is the annual placement of beach materials to replace the sediment that is no longer provided by the marine bluff.

Dry Creek and the Strait in the area are the subject of ongoing study to identify whether landfill leachate entering the water at two known points is having significant adverse affects on either the stream or the Strait.

Exhibit 2. Reach 1 facing south, prior to seawall construction (Ecology Coastal Atlas, June 2006).

Exhibit 3. Seawall constructed in 2007 at toe of slope (photo taken by Dry Creek Coalition, http://drycreekcommunity.org/index.php/gallery/image_full/262/)

Table 7. Function Summary of Reach 1 - Landfill

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	The steep bluff is naturally an erosion area, except in the area protected by the seawall since 2007. However, it appears that a significant portion of the bluff (near Dry Creek) has failed, and the failure is likely associated with the landfill operations.	1
Interference with sediment transport (barriers to longshore drift)	Sediment transport is significantly impaired in this reach, affected by the lack of historic sediment volume from the Elwha River, the loss of sediment supply from the bluffs now partially protected by the seawall, and presumably an alteration in the rate or type of sediment movement as affected by the interaction of the armoring with the water. However, there are no barriers to movement of sediment along the shoreline. Regular beach nourishment is required as a condition of the seawall.	4
Wave and Tidal Energy		
Interference with natural current patterns	The presence of some shoreline armoring likely influences natural current patterns.	4
Wave and/or tidal attenuation	Shoreline armoring covers approximately 30% of the reach. Armoring is a seawall constructed at the toe of the marine bluff to contain materials in an abandoned landfill cell.	3
Remove excess nutrients & toxic compounds	The presence of an unlined landfill cell in the reach indicates a potential for water quality impairment.	3
Redistribution and cycling of LWD & other organic material	Organic inputs from this reach limited by the existence of bluff armoring and presence of sparsely vegetated steep bluff in non-armored areas. However, Dry Creek is a source of LWD and organic material.	3
Vegetative		
Shade	Less than a quarter of the shoreline has vegetation capable of casting significant shade.	2
LWD and other organic recruitment	Trees are present on less than half of the shoreline.	3
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	While some of the reach has a relatively wide vegetated buffer area, most of the shoreline is limited in shoreline vegetation.	2
Shoreline soil stabilization	Much of the vegetation that does exist in this reach is not in a position to stabilize soil effectively.	2
Wave attenuation	The limited amount of shoreline LWD and	2

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
	vegetation is not in a position to effectively attenuate wave energy.	
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	While Dry Creek does exist in this reach, it is steep and in a narrow gully, with little delta, and provides little estuarine habitat.	2
Shoreline vegetation	Vegetation near Dry Creek appears to be predominately native species, but remainder is vegetated primarily with grasses and a few native or non-native trees.	3
Direct shoreline alterations	Approximately one-third of the reach is armored and the entire reach is impacted directly or indirectly by the landfill.	1
Alteration to shoreline inputs	This reach may provide both sediment and water quality disruptions, but neither is documented.	3
Priority habitats (e.g. forage fish spawning, eelgrass, estuarine)	Documented use by several priority species, including abalone, red sea urchin, chum and coho salmon, cutthroat and steelhead trout. Bluffs are also considered a PHS habitat area.	5
	Average Score	**2.7**

Restoration Opportunities

Restoration opportunities along Reach 1 include:

1. Explore opportunities to further limit influence of landfill on shoreline area, and continue to remove existing landfill debris that is embedded in the beach. (See Map 22B, #26 and #27)
2. Improve vegetation on bluff and at base of bluff with native species.

4.7.4 Reach 2 – Western City

Existing Condition

Reach 2 extends approximately 2 miles, from the eastern edge of the landfill to the base of Ediz Hook. With the exception of approximately 1,200 feet of shoreline near the western edge, this reach consists of high-bluff shoreline, composed of glacial sands and gravel (Elwha-Dungeness Planning Unit 2005). The remainder of the reach is lower bluff shoreline. Along the base of the bluff, a water line was installed to supply industrial properties at Ediz Hook. Armoring to protect this water line also serves to protect the toe of the bluff from erosion. This armoring encompasses all but the western 800' or so of the reach. The configuration of the water line, armoring and cover for the water line has resulted in a broad pathway along the base of the bluff (see Exhibits 4 and 5).

The eastern portion of this reach is occupied by single family residences located at the top of the marine bluff. A small residential area of manufactured homes also exists in the area. The manufactured home park covers approximately 800 feet of the shoreline and remains as one of the last sub-dividable properties in this reach. The remainder of the bluff top properties have

been subdivided creating 49 single family residential lots. Of those, only 16 remain undeveloped. Those lots meet the minimum lot size allowed by the underlying zone and may not be further subdivided. They also provide adequate area outside of the shoreline jurisdiction to construct homes with little shoreline impacts. Many of these lots have been created during the last decade and therefore supporting infrastructure has been created and/or upgraded to support any anticipated development of these lots.

Exhibit 4. Reach 2 photo of bank armoring and pathway (photo taken by Makers, July 2010).

Exhibit 5. Reach 2 facing south (Ecology Coastal Atlas, June 2006).

Table 8. Function Summary of Reach 2 – Western City

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Most of the shoreline is protected from erosion by the armoring associated with the water line. However, high, nearly vertical bluffs likely still provide periodic and limited sediment supply.	4
Interference with sediment transport (barriers to longshore drift)	Sediment transport is significantly impaired in this reach, affected by the lack of historic sediment volume from the Elwha River, the loss of sediment supply from the bluffs now protected by the water line and armoring, and presumably an alteration in the rate or type of sediment movement as affected by the interaction of the armoring with the water. However, there are no barriers to movement of sediment along the shoreline.	4
Wave and Tidal Energy		
Interference with natural current patterns	Armoring influences local current patterns	3

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Wave and/or tidal attenuation	Approximately 77% of the shoreline is armored	2
Remove excess nutrients & toxic compounds	No known sources of water quality concern, nor is water quality known to be impaired.	5
Redistribution and cycling of LWD & other organic material	Armoring serves as at least a partial impediment to movement of organic inputs.	3
Vegetative		
Shade	Much of the shoreline area has trees to provide shade, though they are sparsely distributed and there is no overhanging vegetation due to the bluff and armoring.	2
LWD and other organic recruitment	Much of the shoreline area has trees, though they are sparse, but recruitment potential is limited by the presence of armoring.	3
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	While a few places along the shoreline have several hundred feet of vegetated width, the reach is dominated by areas with one or two individual trees making up the vegetated buffer. Much of this reach is developed with single family dwellings and the associated nonnative landscape materials and the intent to allow uninhibited views.	1
Shoreline soil stabilization	Vegetation is sparse, and high, nearly vertical banks make what vegetation does exist ineffective at stabilizing shoreline soils.	1
Wave attenuation	No shoreline vegetation	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	No estuary habitat or wetland habitat exists in this reach.	1
Shoreline vegetation	Some sparse vegetation exists along the entire shoreline, and in some places it is well vegetated with native species.	3
Direct shoreline alterations	Well over 75% of the shoreline is armored with large stone rip rap protecting the industrial water line.	1
Alteration to shoreline inputs	Armoring severely impairs sediment input	3
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Documented use by several priority species, including abalone, red sea urchin, bald eagle nest and buffer. Bluffs are also considered a PHS habitat area.	5
	Average Score	**2.6**

Restoration Opportunities

Restoration opportunities in Reach 2 include:

1. Explore opportunities to improve vegetation at the top of the bluff and at the toe of the bluff near the water supply line.
2. Evaluate the feasibility of re-routing the water supply line and removing the bank armoring. Bluff erosion is a key component to providing sediment to the Hook, and should be allowed to occur at a relatively natural pace. However, development at the top of the bluff makes it exceptionally difficult to remove armoring and allow natural erosion to occur. (See Map 22B, #28)
3. Seek ways to mitigate some of the negative impacts of armoring, by including LWD in the armoring or possibly providing beach nourishment along the armored segment to simulate natural sedimentation rates.

4.7.5 Reach 3 – Outer Industrial

Existing Condition

Reach 3 extends three-quarters of a mile along the highly altered, industrial portion of the base of Ediz Hook occupied by Nippon Paper Industries. Virtually the entire reach is armored (Exhibit 6). A small area approximately 650 feet in length remains unarmored and forms a pocket beach. This small beach area is located at the western end of the Nippon Mill site.

Exhibit 6. Central portion of Reach 3 facing south (Ecology Coastal Atlas, June 2006).

Table 9. Function Summary of Reach 3 – Outer Industrial

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Extensive shoreline armoring has been installed to prevent erosion, but erosion continues in this reach.	1
Interference with sediment transport (barriers to longshore drift)	Sediment transport is significantly impaired in this reach, affected by the lack of historic sediment volume from the Elwha River and presumably an alteration in the rate or type of sediment movement as affected by the interaction of the armoring with the water. However, there are no barriers to movement of sediment along the shoreline.	4
Wave and Tidal Energy		
Interference with natural current patterns	Shoreline armoring likely influences local currents	3
Wave and/or tidal attenuation	Very nearly all the shoreline is armored	2
Remove excess nutrients & toxic compounds	Category 5 for Dissolved Oxygen; Category 2 for 1,2,4-Trichlorobensene; Category 2 for Fecal Coliform. No TMDL	2
Redistribution and cycling of LWD & other organic material	Shoreline contains no natural source of LWD or other natural organic material (aside from ground wood products).	1
Vegetative		
Shade	No shoreline vegetation	1
LWD and other organic recruitment	No shoreline vegetation	1
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	No shoreline vegetation	1
Shoreline soil stabilization	No shoreline vegetation	1
Wave attenuation	No shoreline vegetation	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	No estuary habitat. Adjacent to lagoon, but no direct surface water connection.	1
Shoreline vegetation	No shoreline vegetation.	1
Direct shoreline alterations	Virtually entire shoreline is armored and developed.	1
Alteration to shoreline inputs	Severe disruption to sediment and water quality inputs.	1
Priority habitats/species (e.g.	Priority habitat for bald eagle, red sea urchin and abalone.	5

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
forage fish spawning, eelgrass, estuarine)		
	Average Score	**1.7**

Restoration Opportunities

Restoration opportunities in Reach 3 include:

1. Explore opportunities to improve vegetation.
2. Seek ways to mitigate some of the negative impacts of armoring, by including LWD in the armoring or possibly providing beach nourishment along the armored segment to simulate natural sedimentation rates.
3. The placement of LWD along the north shore of Ediz Hook may help retain sediment from the longshore drift following Elwha Dam removal.

4.7.6 Reach 4 – Outer Ediz Hook

Existing Condition

The 3-mile-long Reach consists of the north shore of Ediz Hook facing the open water of the Strait of Juan de Fuca. The Hook is a 90- to 750-foot-wide natural breakwater originally created by sediments from the Elwha River and coastal bluffs in Reaches 1 and 2 and points further west. It protects the Port Angeles Harbor from waves approaching from the north and west. Almost the entire reach is armored with stone, fronted by cobbles, gravels, and patches of sand (Exhibits 7 and 8) (USACE 2002). The beach and armoring collect large woody debris and aquatic vegetation transported by waves. In spite of the revetment, the Hook is at risk due to loss of materials that historically originated from bluff erosion (now limited by armoring), and the Elwha River (sediment supplies trapped above two dams), and the shoreline waterward of the armoring is becoming steeper, potentially eliminating the intertidal habitat. Accordingly, the U.S. Army Corps of Engineers has conducted maintenance work consisting of beach nourishment and relocation of fallen revetment rock back into the structure in two locations – one in this reach and one further west in Reach 3 (USACE 2002). Sediment supplied by the Elwha River is being returned to the system as both dams are being removed at the time of this documents writing.

Exhibit 7. Central portion of Reach 4 facing south (Ecology Coastal Atlas, June 2006).

Exhibit 8. Eastern tip of Reach 4 facing south (Ecology Coastal Atlas, June 2006).

Table 10. Function Summary of Reach 4 – Outer Ediz Hook

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Ediz Spit has been eroded by past human activities, including the construction of the dams on the Elwha River (one now removed with the second removal scheduled for 2013) and armoring along the toe of the feeder bluffs immediately west of the spit. Armoring and nourishment projects have been installed to counteract this erosion.	1
Interference with sediment transport (barriers to longshore drift)	The armoring on the spit interferes with sediment transport, but overall this reach is impaired by other, off-site interruptions in the sediment transport process. However, there are no barriers to movement of sediment along the shoreline.	4
Wave and Tidal Energy		
Interference with natural current patterns	Bank armoring influences local current patterns	3
Wave and/or tidal attenuation	Entire shoreline is armored with the exception of the eastern most 800 feet.	1
Remove excess nutrients & toxic compounds	No known 303(d) or 305(b) impairments.	5
Redistribution and cycling of LWD & other organic material	Armoring and road combine to isolate about half of the reach from organic input. The remaining area is vegetated primarily with grasses.	3
Vegetative		
Shade	No shade-producing vegetation in this reach	1
LWD and other organic recruitment	No potential LWD recruitment on this reach	1
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Most of the area has less than a 20'-width of vegetation.	1
Shoreline soil stabilization	Where vegetation does exist, it is primarily grasses which are less effective at shoreline stabilization than more woody species.	2
Wave attenuation	Entire shoreline is armored with the exception of the eastern most 800 feet.	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	No estuary or wetland habitat.	1
Shoreline vegetation	Much of the reach is lacking in vegetation; where vegetation does exist, it is limited to grasses with a few small shrubs.	2
Direct shoreline	Entire shoreline has been altered: directly with	1

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
alterations	armoring and development, and indirectly via sediment input interruptions.	
Alteration to shoreline inputs	Severe sediment interruption, but water quality is unimpaired.	3
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Priority habitat for red sea urchin and abalone.	5
	Average Score	**2.1**

Restoration Opportunities

Restoration opportunities in Reach 4 include:

1. Explore opportunities to improve vegetation.
2. Seek ways to mitigate some of the negative impacts of armoring, by including LWD in the armoring or continuing and expanding beach nourishment activities conducted by the Corps along the armored segment to simulate natural sedimentation rates. (See Map 22A, #7 and #14)
3. The placement of LWD and finer grain stone along the north shore of Ediz Hook may help retain sediment from the longshore drift following Elwha Dam removal.

4.7.7 Reach 5 – Inner Ediz Hook

Existing Condition

The 2.8-mile-long Reach consists of the south shore of Ediz Hook facing the Port Angeles Harbor. Stretches of the reach are armored, particularly around waterfront Coast Guard facilities, but armoring is not nearly as prevalent as on the north shore. However, this reach has other shoreline modifications, including jetties and numerous over-water structures associated with the Coast Guard Station, the Puget Sound Pilots facility, the YMCA Rowing Club building, a city owned boat launch, and Sail & Paddle Park (Exhibit 9). The beach and armoring collect large woody debris and aquatic vegetation transported by waves (Exhibit 10).

Similar to Outer Ediz Hook, Inner Ediz Hook is also at risk but for different reasons. According to a WDFW memo (Shaffer, 20 October 2003), the south shore has experienced several degrading events since 2001:

> *"… including two oil spills, heavy unpermitted wood removal along the shoreline, and an extremely damaging off road vehicle course that included at least two 'ponds' (approximately 10 'x 20' by 2-3' deep) and long straight away for four wheel drive off roading activities. Water ponding in the ponds and tracks was a significant concern and, left unattended, would have caused this area of the spit to fail and wash away. Runoff from this ponded contaminated water and total loss of vegetative cover was a significant concern to the sand lance spawning beach that is in immediate proximity to this site. The area had been severely degraded and if not restored, a significant portion of the Hook was at risk of being lost…"*

In response to that degradation, WDFW, the Port, the Lower Elwha Klallam Tribe, and the Department of Transportation partnered to restore 1,500 feet of the central portion of the south shore. Restoration actions included removal of old structures and debris, excavation, hydroseeding, and placement of large amounts of wood. The south shore continues to be the subject of restoration proposals, including a recent project by Washington Department of Natural Resources to remove creosote piles and other structures from the inner hook. Additional shoreline restoration at that site is planned for in 2012.

Port Angeles Harbor is unusual in that the majority of shoreline and aquatic parcels are publicly-owned. Major property owners include the City, the Port of Port Angeles, the Washington State DNR, the U.S. federal government, and the Lower Elwha Klallam Tribe. Public agencies lease much of their land, and aquatic areas to others. For example, the DNR leases aquatic property to public and private owners, including the City, the Port, who manage port terminals, log storage and log transfer operations, and lease properties to Port Angeles Landing, LLC who operate the Landing mall, Black Ball Ferry Line and Icicle Seafoods for fish net pens and upland support. In addition, federally-owned property west of the USCG base is leased to the City, who then subleases a portion to Nippon.

Ediz Hook Road extends the entire length of Ediz Hook, running through the center of the Nippon Paper mill site and continuing onto the USCG base at the east end of the hook. This road provides the only access to the USCG base, the Puget Sound Pilots facility, Harbor View Park, Sail and Paddle Park, the YMCA Rowing Club building, and the public boat launch. A small area located approximately 2,500 west of the USCG base is a communications facility 'cell farm' containing antennae towers for a number of public and private users.

Ediz Hook Road also acts as a corridor for water and sewer lines supplying the uses at the east end of the hook. Electric power is supplied in overhead lines. It is a primary concern of the city to ensure that these utilities and structures are maintained in proper working condition. Regular storm events bring heavy wave action from the northeast which cause erosion on the inner Ediz Hook shoreline. These storm events often undercut the road base and threaten the utilities, requiring regular maintenance activities.

Ediz Hook is an important water access area for both local residents and visitors alike. An extension of the Waterfront/Olympic Discovery Trail extends the length of the hook. Two parks and a public boat launch are provided in this reach, and public restrooms exist at both the east and west ends of the hook in association with the parks. Walking, biking, bird watching, kayaking, SCUBA diving, sail boarding, or just being there are activities that attract many visitors to the hook each year. Several areas provide off-street parking, however, some of these areas are informal and would benefit by improvements and organization.

This reach is an important habitat area, including mapped eelgrass beds, sand lance spawning areas, harbor seal haulouts, harlequin ducks, and high shorebird concentrations. A portion of the south shore is identified as a reservation for native birds.

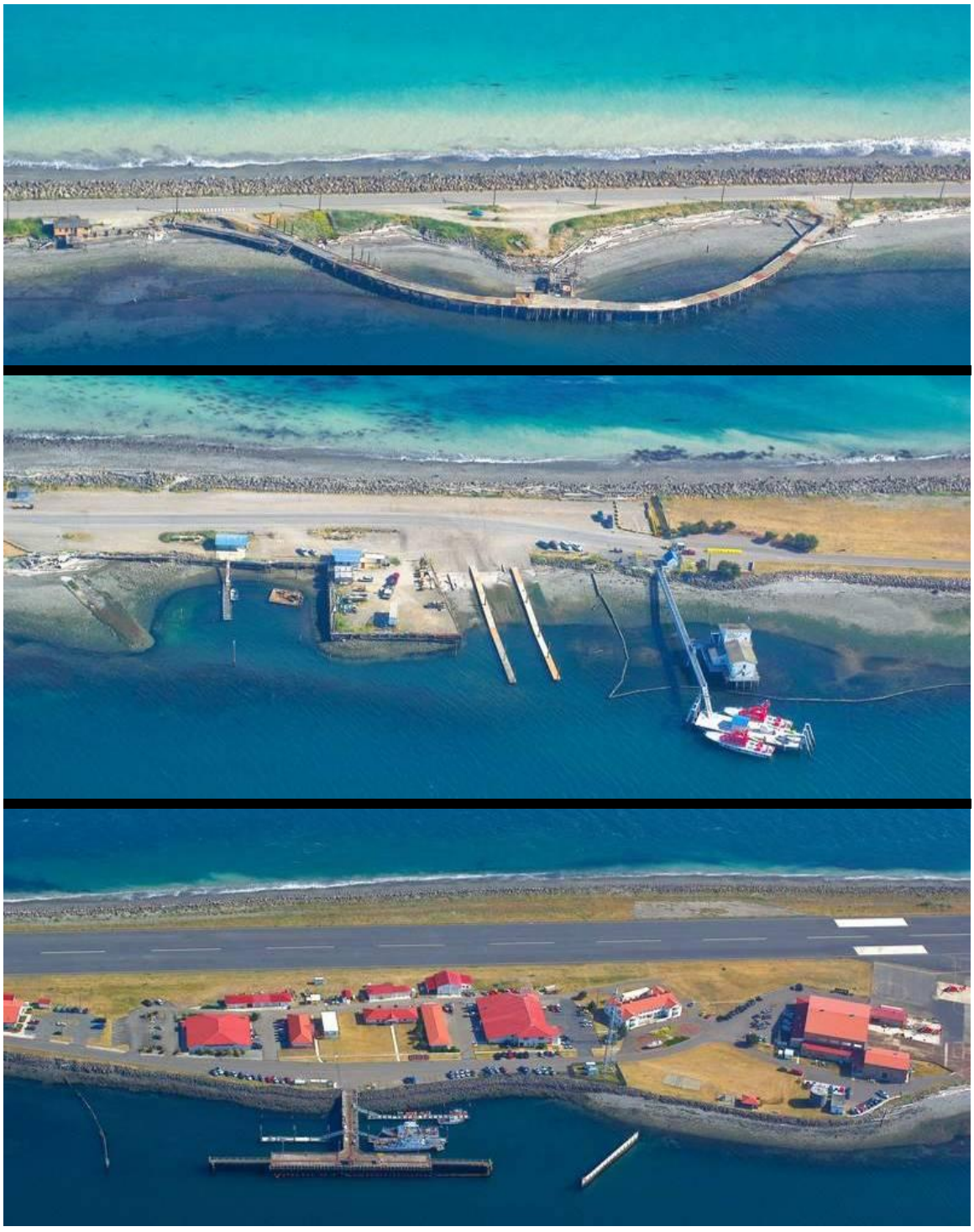

Exhibit 9. Variety of shoreline modifications along Reach 5, all facing north (Ecology Coastal Atlas, June 2006). The structure in the top picture has been removed.

Exhibit 10. Reach 5 photo of unarmored beach and collected large woody debris at the location of the now removed "A-Frame" structure shown in the top photo of Exhibit 9. (photo taken by Makers, July 2010).

Table 11. Function Summary of Reach 5 – Inner Ediz Hook

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	This is naturally a depositional area, but some bank armoring has been placed, indicating some level of erosion.	4
Interference with sediment transport (barriers to longshore drift)	Short jetties likely cause some impediment to sediment transport.	3
Wave and Tidal Energy		
Interference with natural current patterns	Some armoring and jetties in the reach likely influence local currents.	3

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Wave and/or tidal attenuation	Shoreline is largely unarmored, though some armoring exists in the vicinity of the Coast Guard base and around other developments at the east end of the Hook. The Ediz Hook Road is protected with rip rap armoring in several areas where the road is in close proximity to the OHWM.	4
Remove excess nutrients & toxic compounds	No known 303(d) or 305(b) impairments.	5
Redistribution and cycling of LWD & other organic material	Some structures at the Coast Guard base form a partial impediment to transport of LWD and other organic material	3
Vegetative		
Shade	No shade-producing vegetation in this reach	1
LWD and other organic recruitment	No LWD recruitment potential and only minor potential for recruitment of other organic material	2
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	The typical width where vegetation exists is in the range of 30-50 feet, but many places have none. Overall the average is likely near 20'.	2
Shoreline soil stabilization	Where it exists, given the low topography and protected nature of the reach, grasses are likely somewhat effective at stabilizing the shoreline.	3
Wave attenuation	Some armoring near the Coast Guard base, but much of the reach waterfront edge is relatively unaltered and contains some LWD, beach grasses and eel grass for wave attenuation.	3
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	No estuary habitat	1
Shoreline vegetation	Some grassy areas with minor shrubs	2
Direct shoreline alterations	Some shoreline armoring, piers, boat launch, etc.	4
Alteration to shoreline inputs	Neither sediment nor water quality significantly impaired	5
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Priority habitat for hardshell clam and abalone, harbor seal, harlequin ducks, and shorebird concentrations	5
	Average Score	**3.1**

Restoration Opportunities

Restoration opportunities in Reach 5 include:

1. Support as feasible continued efforts of WDFW, the Corps, WDNR and other entities to restore this reach. (See Map 22B, #7)

2. At City facilities, explore restoration of armored areas (removal, beach nourishment, LWD placement), design upgrades to any in- and over-water structures (such as launches, piers, etc), removal of any abandoned structures or debris, and revegetation. (See Map 22B, #7)

4.7.8 Reach 6 – Inner Industrial

Existing Condition

Reach 6 extends 0.6 mile along the west shore of Port Angeles Harbor. This reach is the industrial portion of the Nippon Paper Industries facility that fronts the Harbor rather than the Strait (Reach 3). Virtually the entire reach is armored, except for a small beach area at the south end of the reach (Exhibit 11). This portion of the shoreline is highly altered, resulting from the construction of upland fill areas behind shoreline armoring to create facilities to support industrial uses in the area.

This reach contains the opening to the lagoon area at the base of the hook. This channel, also known as the "Drive Ditch" is armored by sheet pile walls on both sides. A small jetty is located to the south of the channel opening to the harbor, further impacting shoreline functions in the reach. A small portion of the shoreline, approximately 300 feet in length and just south of the lagoon channel is not armored and creates a small pocket beach.

In addition to the Nippon paper mill, a marine fueling facility, including a 'tank farm' and moorage for a fuel barge and tug boat, and a facility for Marine Spill Response Corp are located in this reach.

Exhibit 11. View of Reach 6, facing south-west (Ecology Coastal Atlas, June 2006).

Table 12. Function Summary of Reach 6 – Inner Industrial

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Armoring of most of the reach precludes natural erosion. Armoring is primarily large stone rip rap.	4
Interference with sediment transport (barriers to longshore drift)	Several large modifications, including apparent fills jutting into the Harbor, likely cause some impediment to sediment transport.	2
Wave and Tidal Energy		
Interference with natural current patterns	Industrial infrastructure likely causes significant interference with natural current patterns	1
Wave and/or tidal attenuation	Shoreline has one small unarmored segment approximately 300 feet in length.	2
Remove excess nutrients & toxic compounds	Category 5 for Dissolved Oxygen; Category 2 for 1,2,4-Trichlorobensene; Category 2 for Fecal Coliform. No TMDL	2
Redistribution and cycling of LWD & other organic material	Shoreline is segmented and artificially irregular in shape, impeding circulation of organic material	1
Vegetative		
Shade	No shade-producing shoreline vegetation	1
LWD and other organic recruitment	No trees at shoreline and only a small segment has any vegetation, primarily grass.	2
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Most areas have no vegetation.	1
Shoreline soil stabilization	Vegetation serves little stabilization function	2
Wave attenuation	Almost entirely armored shoreline, with no significant LWD.	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	Some estuary-type habitat near mouth of the lagoon. The mouth of the lagoon has been altered by sheet pile walls on both sides creating a 15-foot wide channel. No natural delta conditions exist.	2
Shoreline vegetation	Little vegetation near the mouth of the lagoon. Nonnative landscape materials exist on the southeast bank of the drive ditch.	2
Direct shoreline alterations	Most of the shoreline is highly altered.	1
Alteration to shoreline inputs	Sediment and water quality disruptions at site.	1
Priority habitats/species (e.g.	Priority habitat for abalone, and part of a bald eagle buffer	5

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
forage fish spawning, eelgrass, estuarine)		
	Average Score	**1.9**

Restoration Opportunities

Restoration opportunities in Reach 6 include:

1. As opportunities arise, modify existing shoreline structures to incorporate design elements that minimize impact.
2. Protect and enhance the remaining area of unarmored shoreline at the south end of the reach.

4.7.9 Reach 7 – Mill Pond

Existing Condition

Reach 7 is the old Nippon log storage pond (Exhibit 12), that is no longer used for that purpose. The pond was once a natural lagoon (Ecology and Environment 2008). It is connected to Port Angeles Harbor by a narrow, sheet pile lined canal (Exhibit 13). As characterized by Pentec (2001), the pond is shallow with large areas of mud flat utilized by crabs and clams. A bald eagle historically nests in the forested area to the south. The pond is associated with forested wetlands to the southeast.

Current ownership and use surrounding the lagoon limits public access to this reach. Portions of this shoreline are armored with sheet pile or large stone rip rap, while other areas are more natural with little armoring. The entire west side is occupied by the Nippon paper mill and portions of the east side is reserved for parking for Nippon employees or temporary storage of materials, with Marine Drive lying close to the lagoon shoreline. The south side of the lagoon is close to the base of the bluff and is partially fed with fresh water seeping out of the bluff face and collecting in a wetland area at the base of the bluff and running into the lagoon. The industrial water line that once supplied water to the Rayonier mill on the east side of the city is located at the base of the bluff. The industrial waterline in this reach has been abandoned in place and no longer supplies water to Rayonier. The pipe line will be left in place for the possible use as a conduit for new utilities. It could also provide a structure on which an elevated public access walkway might be constructed. Such a walk way could provide access to the western beach areas. Whether public ownership or access is eventually enacted here or not, the pond is an area that is vitally significant from an ecological standpoint, and warrants adequate protection.

Exhibit 12. View of Reach 7, facing south (Ecology Coastal Atlas, June 2006).

Exhibit 13. Aerial photograph of the channel outlet of the Nippon mill pond to Port Angeles Harbor (Google maps).

Table 13. Function Summary of Reach 7 – Mill Pond

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	No appreciable erosion	5
Interference with sediment transport (barriers to longshore drift)	This area is isolated from longshore drift.	NA
Wave and Tidal Energy		
Interference with natural current patterns	The outlet may cause some interference with natural current patterns. In addition to the outlet's armoring, a jetty exists approximately 15 feet to the southeast of the outlet, further interfering with currents.	3
Wave and/or tidal attenuation	This area is not well suited to attenuate wave or tidal energy, but some shoreline armoring exists	3
Remove excess nutrients & toxic compounds	Category 5 with respect to Dissolved Oxygen and Fecal Coliform. No TMDL	2
Redistribution and cycling of LWD & other organic material	Site has been used for log storage, and therefore likely contributes to some organic content in nearby water. However, shoreline alterations likely make input of new material difficult. The area is also not well located for distribution of organic material.	1
Vegetative		
Shade	Some shoreline vegetation along the south bank may provide minor shade	2
LWD and other organic recruitment	Some trees in vegetated buffer area, as well as in the associated wetlands. However, the apparent connection between the pond and the associated wetland does not appear to allow substantial inputs of material into the pond.	3
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Where a vegetated strip exists along the south side of the pond, it is about 200' wide and extends to the top of the marine bluff. However most areas are lacking in shoreline vegetation.	2
Shoreline soil stabilization	The south-west shoreline has some vegetation.	3
Wave attenuation	Wave attenuation occurs primarily at the mouth of the lagoon as waves enter the lagoon.	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	Much of the area functions as marsh/wetland, and the old mill pond is associated with forested wetlands to the southeast.	5
Shoreline vegetation	Shoreline vegetation is sparse to nonexistent along most of the shoreline	2

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Direct shoreline alterations	Most of the shoreline has been altered	2
Alteration to shoreline inputs	Water quality is an identified problem	3
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Identified as abalone habitat, and also within the buffer of nesting bald eagles. An eagle nest is located near the east end of Crown Park on the forested slope.	5
	Average Score	**2.8**

Restoration Opportunities

Pentec (2001) identifies the following opportunities:

1. Improve channel to allow fish passage at all tides. (See Map 22B, #16)
2. Remove wood debris from the deeper areas of the lagoon.
3. Plant saltwater marsh vegetation and native riparian vegetation.

4.7.10 Reaches 8A-8D - Downtown

Existing Condition

Reach 8 consists of four segments, totaling 3.5 miles in length, of largely industrial area that share in common a high degree of upland development or modification, substantial shoreline armoring, extensive over- and in-water structures, and limited shoreline vegetation (Exhibits 14 through 19). However, Reaches 8C and 8D each contain the outfalls of at least one stream. The estuaries/deltas at the ends of these streams present some of the greatest opportunities for shoreline restoration in the City. Valley Creek, (which separates reach 8C and 8D) in particular, has already been the subject of at least two restoration efforts, likely because it can be accommodated by the existing land use at the downstream end.

Upper reaches of Valley Creek are managed by the Washington State Department of Natural Resources. Lands in the middle reaches of Valley Creek south of 8th Street are zoned for single family residential use and managed for low-density development by Clallam County.

The City of Port Angeles manages the majority of the lands within the lower Valley Creek watershed, north of 8th Street. The most recent Port Angeles Zoning Map (2009) indicates three zoning classifications in the lower watershed. The lands immediately adjacent to the stream course extending to the top of the bluffs enclosing Valley Creek are zoned Public Buildings and Parks. Scattered single-family dwellings are included in this zone in some instances. The culverted section of Valley Creek (from Sixth Street to Second Street) is zoned light industrial. This zone includes a mix of uses including single family residences, light industries, the City's food bank and an electric substation. The lowest reach between 2nd Street and Marine Drive where the stream daylights into the harbor is zoned Commercial Arterial. Currently the estuary area is located within the Industrial Heavy zone. From Eighth to Second Street, the eastern upper watershed above the top of the bluff is zoned Residential High-Density.

Habitat Use and Availability

Fish Passage Barriers (Haring 1999) reports significant impediments to fish passage have been constructed in Valley Creek. The 2,062-foot series of box and metal culverts (explained above) were placed at gradients of up to 3.4 percent and contain at least one hydraulic jump. This culvert system almost certainly limits fish access, particularly at low tidal stages. At the Highway 101 crossing (RM 1.2), Valley Creek flows through an eight foot by seven-foot smooth-bottomed culvert, 58 feet long. Baffles were added to the culvert bottom in 2000, potentially opening 4,158 square meters of spawning habitat and 7,725 square meters of rearing habitat (Haring 1999). The Laurel Street culvert, on the East Fork of Valley Creek may also have fish passage problems.

Culverts provide a paradox for migrating salmon: as flows increase, depth conditions improve slowly, while velocity increases dramatically. In other words, at times of low flow, depths are insufficient for fish passage. As flows increase, depths become adequate, but the velocity of the water inhibits fish passage. In culverts, WDFW recommends a minimum depth of one foot and a maximum flow of three feet per second to ensure passage of coho salmon.

In natural channels, Bjorn and Reiser (1991) found that chum, coho, and steelhead cannot migrate with less than a minimum depth of 0.6', and velocities greater than 7.97 fps (McHenry and Odenweller 1998). Average velocity conditions within the culvert system at flows expected during migration exceed these standards. At low flows water depths are insufficient to pass salmon. In order to ensure passage of salmonids, significant changes will be required of the culvert system. Renovation of the reach between 9th Street and the estuary is in the planning stages. A complete plan set for enhancement of the section has been completed. The section from 9th Street to 6th Street will be re-meandered and will include additions of LWD and riparian vegetation. The section between 5th and 6th Streets will be day-lighted, with the remaining culverted section being enhanced for fish passage by the insertion of baffles in the culvert.

According to WDFW, Valley Creek and Tumwater Creek are used by four priority fish species: chum and coho salmon, coast resident cutthroat trout, and steelhead trout. Peabody Creek is reportedly only used by cutthroat and steelhead.

Land Use History

Reach 8A contains the site of the historic Lower Elwha Klallam Tribe village, Tse-whit-zen. More recent history has seen the site used for a variety of industrial uses, including sawmills and boat building during the second world war. Most recently, the State of Washington Department of Transportation purchased the area with the intent of constructing a 'graving yard' for the purpose of building pontoons for floating bridges on state roads. When the remains of the Klallam village were discovered, the project was abandoned and the land was returned to the Tribe after a period of negotiation and an agreement reached between the involved parties. Since that time, the human remains that were disturbed from the site during the state's excavation have been reinterred at the site and the surface returned to the pre-excavation condition. The Tribe is planning for a future development of the site.

Reach 8B contains the Boat Haven Marina. The Boat Haven is an important economic engine for the City, occupying 34.5 acres of the waterfront. The marina, developed in the 1950's includes two boat launches, and slips for 520 boats of varying sizes ranging from 24 to 50 feet and up to 200 feet broadside, an area for upland boat repair, a 70-ton mobile straddle boat hoist, and related marine services including marine supply, charter services, bait and tackle shop, restaurants, showers, waste/trash disposal for tenants, fueling facilities and the Harbor Master's office. Private

firms provide boat maintenance; there are 10 to 12 shipwrights working independently at the marina. The Port of Port Angeles owns and operates the marina and in 2004 created the Port Angeles Boat Haven Master Plan and in 2008 created the Port of Port Angeles Strategic Plan.

The marina is located between two highly industrialized areas on the harbor shoreline. To the west, the Port of Port Angeles has consolidated its log handling operations (reach 8A), and to the east (reach 8C) Westport Marine operates a yacht building operation and Platypus Marine operates a major boat repair facility. The Port of Port Angeles operates terminal 1 conducting topside repair on large ocean going vessels and Terminal 3, where export logs are loaded onto ships. The now vacant K-Ply/PenPly mill is located immediately east of Terminals 1 & 3. The vacant plywood mill has recently closed and the Port has begun the process of demolition with the intent of redeveloping the site for unspecified marine trade uses.

The location of the marina has created issues of access and how the Waterfront/Olympic Discovery Trail and bicycle lanes interact with vehicle access to the marina and other uses in the area. The only waterfront access is along Marine Drive on the south side of the marina, while no direct public access to the water is available throughout the more industrialized portions of the reach. Redevelopment on the plywood mill site may result in better shoreline access, however, conflicts with future uses may preclude shoreline access. Any redevelopment in the area must consider the Waterfront/Olympic Discovery trail and make improvement for the safety and comfort of trail users.

Reach 8C includes the Port terminals, plywood mill site, and marine trades mentioned above. In addition, Tumwater Creek empties into the harbor in this reach. Tumwater Creek watershed is approximately 5.6 square miles (-3600 acres) in size, with headwaters in the lower foothills at the northern boundary of Olympic National Park. The upper portion of the watershed has been modified by past and ongoing forest harvest, resulting in a mosaic of timber ages and altered hydrologic character. The central and lower portions of the stream have been modified by residential, agricultural, road, and commercial/industrial development (Economic and Engineering Services, Inc. 1996).

Tumwater Creek is heavily impacted by urban and industrial development in the lower reaches. Rural development and impacts of stormwater runoff have created serious habitat problems throughout the watershed. Sediment yield from a stormwater related massive gully head-cutting off Black Diamond Road through late 2002 was so great that Tumwater Creek remained highly turbid throughout the winter. Although this had been a long-standing problem, the extent of impact worsened as a result of increased slide and erosion activity in 1997 and again in 2002.

The continuing severity of this problem resulted in an extensive repair and stabilization of the slopes, the drainage, and the associated slide area. This repair was completed in Fall, 2004 and is expected to fully resolve the decades-old slide/sediment problems.

Tumwater Creek, which is adjacent and immediately to the west of Valley Creek, is very similar to Valley Creek. Although the upland subwatersheds of Tumwater Creek are smaller in area than those of Valley Creek, these subwatersheds reach to elevations in excess of 2,200 feet at the crest of the western end of the foothills. The upland subwatershed and the adjacent upper part of the lowland subwatershed show a well integrated drainage network that supports flow in Tumwater Creek. The streamcourse within this lowland subwatershed flows within a broad valley having an open valley floor.

As the streamcourse passes into the lower part of the lowland subwatershed, the valley of Tumwater Creek narrows and becomes more ravine-like. This character is carried into the

somewhat elongate, yet broad, coastal lowland subwatershed. Here, the streamcourse of Tumwater Creek parallels that of Valley Creek (Perry 2001).

Urbanization is very evident within the coastal lowland subwatershed of Tumwater Creek. Virtually the entire subwatershed has been developed, with very little undeveloped area remaining, except within the narrow riparian corridor along the stream. Within the coastal lowland subwatershed areas of the streams, Tumwater Creek does not have a well preserved green-belt corridor protecting the stream. Somewhat above Highway 101, Tumwater Creek lies within a green-belt corridor.

As Tumwater Creek reaches the harbor, it becomes increasingly contained in first an armored channel, then through a culvert under Tumwater Street and Marine Drive before daylighting into a sheet pile lined channel that eventually empties into the harbor with few delta or estuary characteristics. The mouth of Tumwater Creek does offer potential restoration potential, however, its location between two heavily industrialized parcels of land complicates restoration efforts.

Reach 8D is the current downtown of Port Angeles. The western portion of this reach is relatively undeveloped at this writing, however, plans for redevelopment of the entire waterfront of this subreach have been developed with permitting underway. First phase construction is scheduled to begin in 2012 or 2013. Subsequent phases of the plan will create two small beach areas and a new park area between downtown and Valley Creek Estuary park, a reconfiguration of both the Laurel Street and Lincoln Street intersections with Railroad Avenue, and reconfigure the existing shoreline armoring to better facilitate public shoreline access.

The downtown segment includes the Black Ball Ferry company's ferry dock and the adjacent Landing Mall. Both of these structures extend into the harbor on artificial fill behind large stone rip rap. To the east of Lincoln Street (which covers the culverted Peabody Creek) is the City owned City Pier Park. The park includes the city pier, seasonal moorage floats, Hollywood beach, and the Fiero Marine Life Center. This area is a major attraction for local citizens seeking waterfront activities. The park hosts the January 1, Polar Bear Dip, the Arts In Action Sand Sculpture contest, the City's Fourth of July celebration, weekly concerts on the pier during summer months and a wide variety of other activities throughout the year.

A major motel, (the Red Lion Motor Inn) lies directly south of the Hollywood Beach and is within 50 feet of the OHWM. The property occupies approximately 1,000 feet along the shoreline on a 5.9 acre site. This motel hosts a wide variety of activities in their banquet and restaurant areas, and lodges a large number of visitors throughout the year.

Exhibit 14. View of the northern portion of Reach 8A, facing west (Ecology Coastal Atlas, June 2006).

Exhibit 15. View of the southern portion of Reach 8A, facing west (Ecology Coastal Atlas, June 2006). The Port of Port Angeles currently uses this area for log handling operations.

Exhibit 16. View of Reach 8B, facing south (Ecology Coastal Atlas, June 2006).

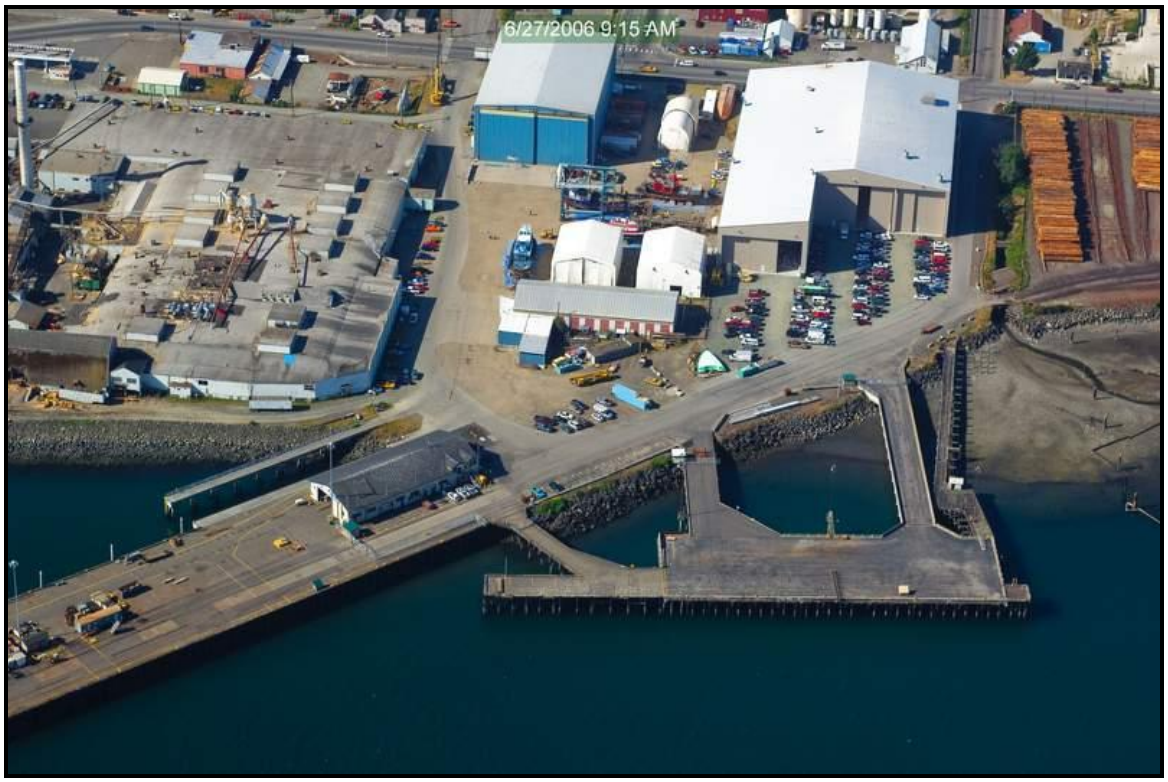

Exhibit 17. View of Reach 8C, facing south (Ecology Coastal Atlas, June 2006). Note the delta of Tumwater Creek on the right side of the photo. Terminal 3 is shown on the lower right and Terminal 1 on the left.

Exhibit 18. View of western portion of Reach 8D, facing south (Ecology Coastal Atlas, June 2006). Note the delta of Valley Creek in the center of the photo.

Exhibit 19. View of eastern portion of Reach 8D, facing south (Ecology Coastal Atlas, June 2006). Note the delta of Peabody Creek in the center of the photo.

Table 14. Function Summary of Reaches 8A-8D – Tse-whit-zen, Marina, Transition and Mixed Use

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	With the exception of the mouth of Valley Creek, the entire shoreline of all four sub-segments is armored. Armoring is primarily large stone rip rap.	A-C = 5 D = 4
Interference with sediment transport (barriers to longshore drift)	Each segment has at least one barrier to longshore drift. Seven docks extend from points of artificial fill. The Boat Haven Marina also impairs long shore drift.	3
Wave and Tidal Energy		
Interference with natural current patterns	All segments have some structures that influence local currents.	3
Wave and/or tidal attenuation	Except for part of segment D, the Valley Creek estuary and Hollywood Beach, all shorelines are armored	A-C = 1 D = 2
Remove excess nutrients & toxic compounds	Category 2 for Fecal Coliform in segments A, B, and D.	A, B, D = 3 C = 5
Redistribution and cycling of LWD & other organic material	Jetties, piers, and other shoreline alteration interfere with the movement of organic debris in all segments	1
Vegetative		
Shade	Virtually no shade-producing vegetation exists in any of the segments	1
LWD and other organic recruitment	Lack of vegetation precludes input of LWD and other organic material	1
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	No vegetated buffer on these reaches.	1
Shoreline soil stabilization	No vegetation to provide stabilization	1
Wave attenuation	No vegetation to provide attenuation	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	Reaches C and D have estuary habitat. Reach C (Tumwater Creek) is a small delta. Reach D (Valley Creek) is the site of an estuarine habitat restoration project.	A, B = 1 C = 2 D = 4
Shoreline vegetation	Shoreline vegetation is severely limited on all reaches, but Reach D has some small native plantings associated with the Valley Creek restoration project.	A-C = 1 D =3
Direct shoreline	All reaches are predominantly altered.	1

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
alterations		
Alteration to shoreline inputs	Reaches A and B are impacted by water quality problems issued from Tumwater Creek, which is a 303(d) listed water for fecal coliform. Reach C, where Tumwater Creek outfalls, is NOT included in the 303(d) listing except for the Creek itself. Reach D receives water from Peabody Creek, also listed for fecal coliform.	3
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Dungeness crab habitat exists just off shore from these reaches, but not at the shoreline. Reach A is part of a bald eagle buffer. Reaches C and D contain priority fish in tributary streams.	A = 5 B = 1 C = 5 D = 5
Average Scores		**A = 2.0** **B = 1.7** **C = 2.1** **D = 2.3**

Restoration Opportunities

Pentec (2001) generally identifies the following opportunities in Reaches 8A-8D:

1. Improve stream/estuarine habitat in the streams entering Port Angeles Harbor, similar to what was recently accomplished on Valley Creek. Actions could include: (See Map 22B, #15, #20, #21)
   - "recontouring to increase the area of shallow water habitat,
   - placement of LWD, and
   - planting of native marsh and riparian vegetation."
2. Improve conditions along armored shorelines where feasible by implementing one or more of the following:
   - "riprap removal,
   - slope cut-back,
   - additions of finer-grained sediments,
   - placement of LWD, and
   - riparian plantings."
3. Establish or reestablish eelgrass beds, including areas of wood accumulation once they have been capped with sand.
4. Clean up and restore Unocal Bulk site. (See Map 22B, #3)
5. Restore Hollywood Beach. (See Map 22B, #9)

Additional restoration opportunities are available at the Oak Street waterfront property, which is currently owned by the City of Port Angeles. (See Map 22B, #13)

Restoration of this entire reach is planned for in the City's Waterfront and Transportation Improvement Plan (WTIP), which is currently in the permit review phase of development.

4.7.11 Reach 9 – Olympic (Francis Street Reach)

Existing Condition

Reach 9 extends approximately 0.6 mile, from the eastern edge of the highly developed Downtown area to the western edge of the former Rayonier Mill site. The reach is entirely armored, with the Waterfront/Olympic Discovery Trail running along the one time railroad grade just landward of the armored shoreline (Exhibit 20). Except for the Francis Street Park, the reach is generally forested on the bluff above of the trail, with a few residential developments at the outer fringe of shoreline jurisdiction. The residential development is all located at the top of the marine bluff with only small setbacks from the bluff top. This reach also includes the Olympic Medical Center Hospital, also located at the top of the bluff.

Exhibit 20. View of Reach 9, facing south (Ecology Coastal Atlas, June 2006). Francis Street Park is shown in the left portion of the picture.

Table 15. Function Summary of Reach 9 – Olympic (Francis Street Reach)

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Entire shoreline is armored. Armor material is large stone rip rap.	5

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Interference with sediment transport (barriers to longshore drift)	Sediment transport is presumably altered in the rate or type of sediment movement as affected by the interaction of the armoring with the water. However, there are no barriers to movement of sediment along the shoreline, other than a storm sewer outfall pipe that extends from Francis Street Park and acts as a groin.	4
Wave and Tidal Energy		
Interference with natural current patterns	Armoring may interfere with local currents somewhat.	3
Wave and/or tidal attenuation	Entire shoreline armored.	1
Remove excess nutrients & toxic compounds	Category 5 for fecal coliform and sediment bioassay; no TMDL.	2
Redistribution and cycling of LWD & other organic material	Armoring may interfere somewhat with vertical movement of organic input. Vegetation is set back from the shore by the armoring and a trail, but is likely close enough to allow some input to the water. Small slides from the marine bluff onto the trail are cleared by deposition onto the waterside of the shoreline armoring.	3
Vegetative		
Shade	Shoreline well-vegetated with trees, but they are set back some from the shore.	1
LWD and other organic recruitment	Nearby vegetation provides an opportunity for recruitment, but is limited by the trail and armoring. LWD is deposited waterward of the trail as slides occur.	3
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Moderately wide buffer, but separated from the shoreline by a paved trail.	3
Shoreline soil stabilization	Vegetation, while abundant, is separated from the shoreline and plays no role in shoreline stabilization	2
Wave attenuation	Shoreline armored	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	No estuary or wetland habitat	1
Shoreline vegetation	Mostly vegetated with what appears to be primarily native species upland of the trail. Some nonnative tree species have been planted as memorials on the waterside of the trail. Many of these memorial trees are not robust and show signs of the harsh shoreline conditions.	4
Direct shoreline alterations	Shoreline armored	1

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Alteration to shoreline inputs	Significant water quality and sediment quality problems	1
Priority habitats/species (e.g. forage fish spawning, eelgrass, estuarine)	Priority habitat for red sea urchin in eastern portion of reach. Also eelgrass meadow and common loon.	5
	Average Score	**2.5**

Restoration Opportunities

Pentec (2001) generally identifies the following opportunities in Reach 9:

1. Improve conditions along armored shorelines where feasible by implementing one or more of the following:
    - "riprap removal,
    - slope cut-back,
    - additions of finer-grained sediments,
    - placement of LWD, and
    - riparian plantings."

2. Establish or reestablish eelgrass beds, including over areas of wood accumulation once they have been capped with sand.

4.7.12 Reach 10 - Rayonier

Existing Condition

Reach 10 comprises the upland Rayonier properties which contained an operating sawmill and associated facilities until 1997. After the upland facilities were dismantled in 1999, Rayonier, Inc. and the Washington Department of Ecology began working together to identify and cleanup contaminants on the site under the Washington Model Toxics Control Act (BergerABAM 2010). Some of the contaminants requiring cleanup include: dioxins, furans, total petroleum hydrocarbons, carcinogenic polynuclear aromatic hydrocarbons, PCBs, metals, and others (BergerABAM 2010). The site remains highly altered, with areas of shoreline armoring, a breakwater/jetty, significant overwater cover, impervious surfaces, and very sparse shoreline vegetation (Exhibits 21 through 23). Detailed information about the Rayonier properties investigations, including areas outside of shoreline jurisdiction, can be found at http://paharborworks.org/Final%20Due%20Diligence6_10_10/duediligenceindex.html.

Ennis Creek (Exhibit 22) is an important tributary of the Harbor in this reach, containing four priority fish species: chum and coho salmon, coast resident cutthroat trout, and steelhead trout (WDFW 2010). The riparian area in the nearshore 100 feet of Ennis Creek is mostly unvegetated except for recent plantings of willow, red alder, and blue wildrye (BergerABAM 2010). Upstream, the riparian area "consists of a 5- to 10-foot-wide band of red alder and few understory shrubs" (BergerABAM 2010).

The floodplain of Ennis Creek is moderately confined by urban development (Haring 1999). The lower portion of Ennis Creek is constrained to the east by the City of Port Angeles wastewater treatment plant (Haring 1999).

Development along the stream corridor has led to the management or removal of some riparian vegetation. These activities in turn may result in the destabilization of streambanks and increased streambank erosion.

Mature deciduous trees have replaced the historic coniferous vegetation along parts of the stream. The deciduous riparian zone provides less and lower quality large woody debris to the stream and alters the streamside canopy (Goin personal communication 2002). In addition, livestock access to the corridor has trampled streambanks, increased streambank erosion, and increased the likelihood of animal wastes and associated pollutants in the aquatic environment (Economic and Engineering Services, Inc. 1996).

Ennis Creek is a significant drainage to salt water, entering the Straits at the eastern end of Port Angeles Harbor (Haring 1999). With a length of 8.65 miles, it is the smallest snowfed stream on the Olympic Peninsula, draining approximately 10.5 square miles (Walton 1983, Haring 1999, Port Angeles Stormwater Management Plan 1996). The southernmost headwaters of Ennis Creek exceed a level of 6,000 feet (Tetra Tech 1988, Haring 1999). From its highest elevations along Klahane Ridge, the valley wall drops abruptly more than 2,200 feet to its first step in the valley floor, at an elevation of about 4,150 feet (Perry 2001).

Lake Dawn, created some time in the early 20th century, lies at approximately 2,000 feet in the uplands subwatershed. Ennis Creek is generally steep and is confined within much of its length by valley side slopes (Haring 1999). Both Ennis Creek and White Creek, its major tributary, pass through forested parcels, agricultural and pasture lands, commercial, and residential communities (Economic and Engineering Services, Inc. 1996).

The 4.35 mile long White Creek enters Ennis Creek at RM 0.3, is heavily degraded from urbanization, and has little production potential due to extensive culverting and impassable culverts (Haring 1999). The floodplain immediately downstream from the confluence of White and Ennis creeks is channelized and fully constrained by dikes, armored banks, culverts, the Rayonier Mill parking lot, and several bridges associated with the mill (Haring 1999).

The mill was dismantled by 2001 is continuing to be rehabilitated, with a completion date still unspecified. Future use of the reclaimed site, especially the new use, if any, of the floodplain area will have a major impact on the long term health of the watershed and on the prospects for successful habitat and fisheries restoration. As mentioned earlier, portions of the site have recently been purchased by the City to facilitate remediation of the CSO issue. That project will remove one of the bridges crossing Ennis Creek and will replace that bridge with one designed to provide adequate floodway functions. The project will also change the course of the Waterfront/Olympic Discovery Trail.

Major Subwatersheds

A comprehensive overview of watershed conditions completed by the Bureau of Reclamation (Perry 2001) defines five unnamed subwatersheds within the Ennis Creek drainage area. Perry calculated that the largest contributor to flow is the highland subwatershed covering the southern third of Ennis Creek. This area is defined by a steep glacial valley flanked by alpine and subalpine mountain ridges.

A second upland subwatershed includes a small highland region with a well-integrated drainage network. The lowland and coastal lowland subwatersheds together constitute slightly less than one third of the watershed drainage. White Creek represents two subwatersheds of the Ennis Creek watershed including upland and lowland areas. Flow is primarily developed in the small upland subwatershed area and much larger lowland subwatershed area, amounting to less than one-third of the Ennis Creek watershed.

The lower channel and estuary have been significantly altered. It is thought that Ennis Creek historically emerged from the bluff over an alluvial fan discharge into Port Angeles Harbor. There is no evidence that Ennis Creek flow lost an open connection to marine waters, even during summer low flows. Historic photographs would indicate that Ennis Creek discharged directly to the harbor over a broad intertidal flat (Freudenthal, as quoted by Haring 1999).

Randy Johnson of the Washington Department of Fish and Wildlife (personal communication 2001) suggests that the mill site has completely consumed the natural estuary of Ennis Creek. He references historic photographs to show that estuary conditions included about eight acres of salt marsh, with thirteen acres of sand and gravel flats. These twenty-one acres of intertidal flats associated with Ennis Creek were filled and covered over by the mill. Buildings built on pilings covered areas that were not filled. On the east bank where a building was removed, a portion of the former salt marsh, is now exposed but prolific with pilings. Fill material prevents stream and tidal flow from entering this area.

The Rayonier Mill also extended into the subtidal area. Seaward of the intertidal area, the mill covered about five acres of subtidal flats. Seaward of the mill itself, the industrial pier covers another five acres. The development of the mill site has limited the natural mixing of salt and fresh water from Ennis Creek, altering hydrology and habitat.

Rayonier, Inc. has recently applied for permits to repair 800 creosote treated pilings and 300 fender pilings of the existing 5,000 pilings supporting its industrial pier, located at 700 North Ennis Street. The City of Port Angeles approved the associated Shoreline Substantial Development Permit No. SMA 01-05 (City of Port Angeles 2001). The Washington Department of Fish and Wildlife denied Rayonier's hydraulics permit due to Rayonier's failure to mitigate for the negative impacts of actions (Johnson personal communication 2002).

The following excerpt from the Ennis Creek Watershed Characterization (Costello 2002) described the historic estuary condition and subsequent impacts:

> *"... estuary conditions included about eight acres of salt marsh, with thirteen acres of sand and gravel flats. These twenty-one acres of intertidal flats associated with Ennis Creek were filled and covered over by the mill. Areas that were not filled were covered by buildings built on pilings. On the east bank where a building has been removed, a portion of the former salt marsh, is now exposed but prolific with pilings. Fill material prevents stream and tidal flow from entering this area."*

As part of the Rayonier cleanup, restoration of Ennis Creek and the former Ennis Creek estuary is anticipated in a partnership between Rayonier, Inc. and the Lower Elwha Klallam tribe (Costello 2002). Conceptual plans have been developed, and include removal of the jetty and dock, and other remaining impervious surfaces and structures.

East of Ennis Creek is a stretch of gravel beach that is not armored. Although there is no substantial shoreline vegetation, the beach has collected abundant woody debris and has some grass and shrub vegetation landward.

Exhibit 21. View of Reach 10, facing south (Ecology Coastal Atlas, June 2006).

Exhibit 22. View of the central portion of Reach 10, facing south (Ecology Coastal Atlas, June 2006). Note the Ennis Creek delta and stream corridor.

Exhibit 23. View of the eastern portion of Reach 10 east of Ennis Creek, facing south (Ecology Coastal Atlas, June 2006).

Table 16. Function Summary of Reach 10 - Rayonier

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	A good portion of the shoreline is armored; unarmored parts show little evidence of erosion.	4
Interference with sediment transport (barriers to longshore drift)	A breakwater or jetty on the western portion of the reach likely interferes with longshore drift patterns, though this only impacts a relatively small drift cell.	3
Wave and Tidal Energy		
Interference with natural current patterns	Armoring, breakwater and pier interfere with natural current patterns on the western portion of the reach.	3
Wave and/or tidal attenuation	Approximately half the shoreline is armored.	2
Remove excess nutrients & toxic compounds	Category 5 for sediment bioassay; no TMDL	2
Redistribution and cycling of LWD & other organic material	Western shoreline is segmented. Eastern shoreline is not.	3
Vegetative		
Shade	No shade-producing shoreline vegetation.	1
LWD and other organic recruitment	No potential for LWD recruitment other than what may pass down Ennis Creek. Some potential for other organic recruitment.	2
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Buffer in eastern portion is nearly 300 feet wide, but very sparsely vegetated. Remainder of site has no functional vegetated buffer.	2
Shoreline soil stabilization	Vegetation at shoreline is not a significant contributor to stabilization.	2
Wave attenuation	Primarily armored shoreline	1
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	Significant delta at mouth of Ennis Creek.	3
Shoreline vegetation	Sparse vegetation, where present.	2
Direct shoreline alterations	Entire reach is a former industrial site, and had been developed.	1
Alteration to shoreline inputs	Severe sediment quality issues in portions. The pier at the site creates approximately 4 acres of overwater shaded area.	3
Priority habitats (e.g. forage fish spawning, eelgrass, estuarine)	Priority habitat for red sea urchin. Also harbor seal and seal haulouts, bald eagle nest buffer, and seabird colony.	5
	Average Score	**2.4**

Restoration Opportunities

Restoration is currently in the planning and/or implementation stages by Rayonier, Inc. and the Lower Elwha Klallam tribe, including elements related to contaminant cleanup, structure/modification removal (dock and jetty), and Ennis Creek/estuary restoration. (See Map 22B, #2, #22, #23)

4.7.13 Reach 11 – Eastern City (UGA)

Existing Condition

Reach 11 extends approximately 2.1 miles, from the eastern City limits near the edge of the Rayonier properties east to the boundary of the City's urban growth area. The Waterfront/Olympic Discovery Trail continues along the water's edge the length of the reach, protected by large rock armoring (Exhibit 24). Upland of the trail, the often steep bluffs are covered with what appears to be native forest. This native forest is recent succession growth following earlier logging operations and is comprised primarily of red alder and big leaf maple trees with some Douglas firs interspersed. Tree removal for view enhancement is a popular activity for bluff top residents throughout the eastern reaches of the Port Angeles area. Lees Creek, which segments the eastern reach, contains four priority fish species: chum and coho salmon, coast resident cutthroat trout, and steelhead trout (WDFW 2010).

The Lee's Creek neighborhood is located within the narrow confines of the area between Highway 101 and the Strait. The neighborhood has a distinctly low density, rural residential character with most residences located north of Myrtle Street. The average density is less than two units per acre due to large areas being in wetlands. It is unlikely that densities higher than two units per acre could be supported north of Columbia Street due to the number of developed parcels and the constrained nature of much of the remaining land.

The neighborhood has several large wetlands which must be protected and retained in order to control the volume of stormwater which is currently being generated from commercial development near Highway 101. A 20-acre wetland site on Brook Avenue was recently purchased by a neighborhood landowner in order to protect this area in its natural state. In addition, drainage ditches in the fields west of Brook Avenue and on Bay Street and Larch Avenue must be regularly maintained as they tend to become blocked and cause road damage in high rainfall events.

The appearance of the commercial area near Highway 101 concerns neighborhood residents. They support efforts to upgrade the appearance of Highway 101 with street trees, landscaping and new neighborhood scale businesses along the neighborhood commercial corridor. Providing for a mix of moderate density residential in the neighborhood commercial areas would enhance the trend already apparent in this neighborhood. While the commercial businesses on Highway 101 provide needed neighborhood services, the neighborhood would like to retain its essentially residential character by ensuring that commercial development does not encroach north of an east/west line extending from either end of Myrtle Street The Lee's Creek neighborhood does not want to develop like the hospital area in Port Angeles and see commercial businesses force residential dwelling from the neighborhood (see land use section for goal addressing commercial development in Lee's Creek).

The steep-sided creek ravines and creek bottom lands of Lee's Creek as well as the marine bluffs on the Strait should be protected for public safety, maintenance of water quality and as linear wildlife corridors through the neighborhood. These areas when left in a natural state stabilize the geologically unstable ravine and bluff environments, filter out sediments before they reach

streams and shorelines and provide critical habitat for eagles, falcons, and other birds utilizing trees for perch or nesting. Allowing transfer of development rights from these areas and providing open space tax benefits to owners will further the protection of these critical areas.

Stormwater runoff is causing considerable bluff-front gully erosion and deposition. Controlling the scale of commercial development in urban neighborhood commercial land use designations located on Highway 101 should limit the impacts of stormwater on adjacent residential developments to the north. When developments are reviewed, maintenance of natural water control in the form of wetlands should be a prime concern along with ensuring on-site retention and slow release of stormwater from urban development.

Exhibit 24. View of west-central portion of Reach 11 including the Lees Creek outfall and estuary, facing south (Ecology Coastal Atlas, June 2006).

Table 17. Function Summary of Reach 11 – Eastern City (UGA)

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Hydrologic		
Sediment		
Erosion	Bank armored to protect trail at base of bluff. No significant erosion	5

Shoreline Functions within Reach	Alterations and Assessment of Functions	Shoreline Function Score
Interference with sediment transport (barriers to longshore drift)	Sediment transport is presumably altered in the rate or type of sediment movement as affected by the interaction of the armoring with the water. However, there are no barriers to movement of sediment along the shoreline.	4
Wave and Tidal Energy		
Interference with natural current patterns	Armoring may produce minor influence on natural current patterns	3
Wave and/or tidal attenuation	Much, but not all, of shoreline is armored	2
Remove excess nutrients & toxic compounds	Lees Creek is Category 2 for fecal coliform, and Category 5 for dissolved oxygen. No listings in the marine waters.	3
Redistribution and cycling of LWD & other organic material	Armor and trail may interfere somewhat with natural cycling of organic inputs	3
Vegetative		
Shade	Shoreline well-vegetated with trees, but they are set back some from the shore.	3
LWD and other organic recruitment	Nearby vegetation provides an opportunity for recruitment, but is limited by the trail and armoring.	3
Width (feet) of vegetated buffer to remove nutrients, fine sediment, and toxic substances.	Wide buffer, but separated from the shoreline by a paved trail and bank armoring	3
Shoreline soil stabilization	Vegetation, while abundant, is separated from the shoreline and plays no role in shoreline stabilization	2
Wave attenuation	Shoreline mostly armored, but unarmored portions have abundant LWD.	2
Habitat		
Estuary/wetland/ riparian (freshwater) habitat	Small estuary formed at mouth of Lees Creek	2
Shoreline vegetation	Mostly vegetated with native species	4
Direct shoreline alterations	Armoring along trail through most of reach	1
Alteration to shoreline inputs	Lees Creek is a known water quality issue	3
Priority habitats (e.g. forage fish spawning, eelgrass, estuarine)	Priority habitat for red sea urchin, bald eagle nests and buffers, urban natural open space, and cliff/bluff habitat.	5
	Average Score	**2.9**

Restoration Opportunities

Restoration opportunities in Reach 11 include:

1. Seek ways to mitigate some of the negative impacts of armoring, by including LWD in the armoring or possibly providing beach nourishment along the armored segment to simulate natural sedimentation rates.
2. Implement Lees Creek watershed restoration. (See Map 22B, #25)

5 LAND USE ANALYSIS AND IMPLICATIONS

Introduction

The City of Port Angeles has an estimated population of 19,080 people (2010 census), with associated municipal wastewater and stormwater infrastructure to support the local community. Historically and currently, the Harbor has received discharges from combined sewer overflows, the City of Port Angeles wastewater outfall, septic systems in various stages of disrepair outside the city limits, and non point source runoff from stormwater (CPAPWD 2006, CCMRC 2001). The Harbor also receives direct surface water discharge from the six freshwater creeks in the area, all of which have varying degrees of residential and commercial land-use influences.

Five of the creeks are listed as impaired in terms of water quality and biological quality by the Clallam County Stream Keepers (CCDCD 2004). Shellfish harvesting and fishing historically have been important commercial and subsistence activities in the Harbor, particularly for the Lower Elwha Klallam Tribe (LEKT), who are subsistence-level consumers of shellfish (ATSDR 2000a, Ecology 2008a). Harbor fisheries have been impacted due to environmental quality issues (Beaverson 1998, Clallam County Marine resources Interactive Workshop 2001). Anthropogenic impacts from various sources including wastewater pollution, industrial-based contaminants, and stormwater runoff may have contributed to apparent declines in shellfish and fish populations, as well as to the closure of historic shellfish tracts for commercial harvesting (Beaverson 1998; Clallam County Marine Resources Interactive Workshop 2001).

Land use patterns are an important consideration in SMP analysis because such analysis can identify opportunities for "preferred uses," especially water-dependent, water-related and water-enjoyment uses. Land uses adjacent to the water are also a determinant in assigning environment designations to specific sections of the shoreline. Additionally, an analysis of land use conditions is necessary to determine potential land use changes and their effect on shorelines with respect to SMA objectives. Finally, the existing land uses and proposed environment designation boundaries and provisions must be mutually consistent with the City's comprehensive plan.

Businesses which provide regional services have been grouped at convenient locations at major intersections within the urban growth area and conform to visually pleasing landscape and building design standards. These regional service center sites have been identified both within the City of Port Angeles and within the unincorporated urban growth area. Developers seeking to build a regional business facility are directed to these community approved sites. All neighborhood and regional business centers are linked by an efficient local transit system. Tribal business centers have also grown to become major employers within Clallam County.

Most new manufacturing and industrial concerns are located at the expanded Airport Industrial Park. A major push to provide infrastructure and prebuilt manufacturing sites combined with a major marketing effort in the mid-1990's proved fruitful with several small to mid-size manufacturers relocating to Clallam County. These industries, along with local industries that were encouraged to grow with local support, now supply jobs and have replaced jobs lost in other manufacturing sectors. The Airport Industrial Park has maintained a campus-like appearance which provides an attractive site to relocate a business.

Port activity has also increased markedly in the last 20 years. Cruise ships and high speed passenger ferries now regularly stop in Port Angeles with visitors connecting to various points of interest in the County. Many value-added wood products, other manufactured products and

specialty food products are being shipped from plants in the County to the Pacific Rim Nations. The Port has become a major marine repair and oil spill response center.

The urban area of Port Angeles provides a mixture of employment, residential, commercial, cultural and recreational opportunities. Peninsula College is now offering advanced four-year degrees in some program areas. Much of the new development and redevelopment which occurred after 1995 took place within the existing urban center of Port Angeles where infrastructure was in place or could be easily extended. Today, there is still ample room for development within that original urban growth area. The City of Port Angeles recently extended a sewer main line through the urban growth area and new developments in the area will be required to hook into the city sewer system. The Clallam County Public Utility District supplies water and electricity to the urban growth area and Clallam County Sheriffs provide police protection. Fire protection is provided by the mostly volunteer Clallam County Fire District #2.

Port Angeles is linked to all other urban growth areas in the County by an efficient transit system. Many hybrid and electric cars now are used for local trips. The airport has become the center for commuter, visitor and freight shipment with convenient connections to transit, ferry and freight haulers.

Further, as noted previously, the Strait of Juan de Fuca shoreline waterward of extreme low tide is a Shoreline of Statewide Significance. As such, RCW 90.58.020 establishes a specific order for use preferences as follows:

1. Recognize and protect the statewide interest over local interest;
2. Preserve the natural character of the shoreline;
3. Result in long term over short term benefit;
4. Protect the resources and ecology of the shoreline;
5. Increase public access to publicly owned areas of the shorelines;
6. Increase recreational opportunities for the public in the shoreline;
7. Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary.

The SMA requires a "higher level of effort in implementing its objectives on shorelines of statewide significance" (WAC 173-26-251).

As part of SMP development, the shoreline is to be classified into specific shoreline environment designations based upon existing land use patterns, baseline inventory and analysis results, goals stipulated in the City's Comprehensive Plan, Harbor Resource Management Plan, and Department of Ecology criteria. Ecology Guidelines include six recommendations for shoreline environment designations (listed below). However, each jurisdiction may use alternate or parallel environment designations, as appropriate, as long as they provide equal or better protection than the standard.

- Natural
- Urban Conservancy
- Rural Conservancy
- Aquatic
- High Intensity
- Shoreline Residential

5.1 Land Supply and Demand Analysis Summary

As part of the SMP update, BST Associates performed a waterfront inventory and analyzed the supply and demand of waterfront property for water-dependent uses. For a full discussion, please refer to the draft *Inventory of Current Use* (BST Associates 2010a) and *Supply and Demand of Land for Water Dependent Uses* (BST Associates 2010b). In general, the supply of land for water-dependent uses appears to be adequate, and some detail for specific industries is outlined below.

Table 18. Summary of Demand for Water-dependent Uses

Industry	Demand for Additional Land
Ship Repair and Boat Building	• Topside repair is sufficiently handled by Terminal 1 and probably will not expand unless cruise ship traffic increases. • Port Angeles probably does not need additional boat repair facilities. • There may be a need for additional mega-yacht boat yard land in the future.
Passenger Vessels	• The ferry operations do not need more land. • The Blackball terminal requires approximately $9 million in repairs, primarily for wood pilings. • There is opportunity for increased large and small cruise ship vessel calls, primarily in the spring and fall, but no additional land is needed.
Commercial and Recreational Boats	• The marina will most likely not need to expand for at least 10 years.
Fish Processing	• There is a small market for fish processing, but facilities could be build on the Port property.
Forest Products	• There is currently no need to expand forest product handling facilities.
Waterborne Cargo	
Containers	• Local cargo moving by barge through Port Angeles could potentially increase, but non-local cargo traffic will most likely not increase.
Breakbulk	• There is currently excessive capacity for breakbulk cargo.
Autos	• There is no need for expansion.
Log Imports and Exports	• Log volumes may increase slightly, but existing facilities are adequate.
Grain	• There are no opportunities for grain exports.
Dry Bulks	• Lakeside Industries, which leases 1 acre on Terminal 6, has interest in expanding their gravel storage yard to 5 to 10 acres.
Liquid Bulks	• Port Angeles is ideally positioned for fueling commercial vessels heading into Puget Sound. This is likely to continue at the current level.

5.2 Reach Conditions

This section examines the data gathered in the inventory and describes for each reach the (1) likely future land uses and activities, and (2) implications for shoreline management (Table 19). Likely or appropriate environment designations are listed for each reach.

Table 19. Possible changes in land use and implications for shoreline management.

Reaches	Possible Changes in Land Use	Implications for Shoreline Management
Reach 1: Landfill	This area is zoned Public Buildings and Parks and may be redeveloped as a park, golf course, or other public use with potential access to the beach and water's edge. Pending further research and available funding, the wall and contaminated material may be removed.	Urban Conservancy appears to be the most appropriate environment designation for this reach. It will be important to ensure that there are provisions for golf courses or other potential uses in the SMP.
Reach 2: Western City	This area has two distinct segments: (a) the Ocean View Cemetery and (b) the residences on the bluffs. a) Ocean View Cemetery is zoned Public Buildings and Parks, and land use change is unlikely. Switchback trails may be developed to provide improved access to the beach. b) East of the cemetery, land is zoned for single family and trailer park residential uses. Residential development is underway, and as this fits the Comprehensive Plan designation, land use change is unlikely.	a) Urban Conservancy appears to be the most appropriate designation for the cemetery. It will be important to ensure that there will be provisions to accommodate trail improvements between the bluffs and beach in the SMP. b) A Shoreline Residential designation seems to be most appropriate, but regulations should address impacts due to new development, setbacks from the bluffs, and public access to the beach. In addition, the beach below these areas may be most appropriately designated Natural, or provided for in the designations listed above.
Reach 3: Outer Industrial	This area is zoned Industrial Heavy, and land uses are unlikely to change.	High-Intensity appears to be an appropriate environment designation for this reach.
Reach 4: Outer Ediz Hook	This area is zoned Public Buildings and Parks and is likely to remain public open space. The eastern portion of Ediz Hook is likely to remain the U.S. Coast Guard Base.	Urban Conservancy appears to be the most appropriate environment designation for this reach.
Reach 5: Inner Ediz Hook	This area is mostly zoned Public Buildings and Parks with two spots of Commercial Arterial. Along Harborview Park, boat launching uses will most likely remain, kayaking and sailing uses may increase over time, and near the western U.S. Coast Guard Base boundary, a scuba diving area may	Urban Conservancy seems to be the most appropriate environment designation for the majority of this reach, but may need to accommodate some commercial uses in the small Commercial Arterial zones. It will be important to ensure provisions for a variety of

Reaches	Possible Changes in Land Use	Implications for Shoreline Management
	develop. The eastern portion of Ediz Hook is likely to remain the U.S. Coast Guard Base.	recreational activities in the SMP, but regulations should address the impacts of a more intense use of the water and shoreline. Commercial development or redevelopment impacts should also be regulated in the SMP.
Reach 6: Inner Industrial	This area is zoned Industrial Heavy, and land uses are unlikely to change in the majority of the reach, although Nippon Paper Industries may redevelop portions of their property. The Waterfront Trail will likely remain in this reach, although its route and wayfinding may be improved. In addition, opportunity exists for a public access corridor along the east boundary of the Nippon property.	High-Intensity appears to be the most appropriate environment designation for the majority of this reach. Special consideration should be given to the possibility of a new public access route in this reach and to the impacts of log rafting.
Reach 7: Mill Pond	This area is zoned Public Buildings and Parks and is unlikely to change land uses. There is potential for restoration of the pond and a new public access corridor connecting the eastern shore of Ediz Hook to the western beach around the south edge of the pond.	Urban Conservancy appears to be the most appropriate environment designation for this reach and special consideration should be given to the possibility of a new public access route.
Reach 8A: Downtown – Tse-whit-zen	This reach is zoned Industrial Heavy, but its use is likely to change due to cultural resources on the property. Potential uses may include an approximately 20,000 sq. ft. artifact curation facility and/or an international research institute and could include public access around the perimeter as appropriate.	Some form of High-Intensity seems to be an appropriate environment designation with special provisions to allow a wide range of possible uses, including civic/cultural, industrial, marine, and commercial. Alternatively, Urban Conservancy may be appropriate if it is determined that the site remain largely undeveloped.
Reach 8B: Downtown – Marina	The marina is zoned Industrial Heavy and will likely remain a boat moorage facility and boat launch, with some commercial uses, and additional marine commercial development is likely. The Port of Port Angeles is the owner/manager of the Marina, and produced a master plan for the Boat Haven in 2004. In that plan, the breakwater may be reconfigured, additional boat slips created, and public access improved over time.	High-Intensity appears to be the most suitable environment designation. The SMP should provide for redevelopment of the breakwater and additional commercial development.

Reaches	Possible Changes in Land Use	Implications for Shoreline Management
Reach 8C: Downtown – Transition	This reach is zoned Industrial Heavy, but may contain more of a mix of uses in the future. Topside repair and vessel berthing uses will most likely remain. Boatyards for mega-yacht construction may expand. If uses change in some areas, public access may be improved. In addition, the port's Terminal 3 pier may be extended.	High-Intensity would be an appropriate environment designation for this reach. However, if the Waterfront Trail is rerouted into the shoreline jurisdiction, a parallel Urban Conservancy environment designation may be appropriate for the trail corridor. It will also be important to ensure provisions for the extension of the pier and expansion of boat construction yards.
Reach 8D: Downtown – Mixed Use	This area is mostly zoned Central Business District with some Commercial Arterial. Some properties may intensify their uses, increase recreational activities on the water, and establish water taxis. The City Pier may improve transient moorage, and the Feiro Marine Life Center may be upgraded, refurbished to include expanded uses, or relocated. The Oak Street property may be redeveloped to include a public park on the City-leased Department of Natural Resources portion and more park or other fairly intense uses on the privately owned portion. The Waterfront Trail is likely to remain and possibly be rerouted closer to the water through the Oak Street property. Likewise, the Valley Creek Estuary Park and Hollywood Beach Park are likely to remain parks. Existing piers and docks may be redeveloped over time to support existing or expanded uses. In addition, residential uses may increase in and adjacent to the shoreline jurisdiction.	High-Intensity appears to be the most appropriate environment designation for this reach, although Urban Conservancy may be appropriate for the Waterfront Trail corridor, Valley Creek Estuary Park, Hollywood Beach Park, and possibly the City-owned portion of the Oak Street property, depending on its redevelopment. The SMP should include provisions for redevelopment of the City Pier's transient moorage, increased recreational uses of the water, pier and dock repair, potential redevelopment, and redevelopment of docks to be used for water taxis, but also consider their impacts. Special consideration should be given to the impacts of higher density residential uses in the area, especially on the water quality at Hollywood Beach Park.
Reach 9: Olympic (Francis Street Reach)	The Public Buildings and Park zone stretches along the waterfront, accommodating the Waterfront Trail. The landward residential uses are in a Residential Single Family zone and are unlikely to change. Some small areas are zoned Commercial Office around the Olympic Memorial Hospital (which is zoned	Natural or Urban Conservancy seem the most appropriate environment designations for the Waterfront Trail corridor and Francis Street Park, with provisions for light recreational use of the trail, park, and water. Shoreline Residential appears to be most appropriate for the residential areas, while the

Reaches	Possible Changes in Land Use	Implications for Shoreline Management
	for Public Buildings and Parks), and over time, some of the residences in this area may be redeveloped as offices. None of the parcels zoned Commercial Office are located within the 200-foot shoreline jurisdiction. Francis Street Park is partially located on land zoned for single family residential uses, but its use is not likely to change.	commercial offices and hospital may be best served with an Urban Conservancy environment designation.
Reach 10: Rayonier (Ennis Creek Reach)	This reach is zoned for Industrial Heavy and Public Buildings and Parks. The Rayonier site will most likely be redeveloped with a mix of uses that may include a park and restored estuary, waterfront public access, cultural, high density residential, commercial, and industrial.	High-Intensity seems appropriate for this reach, but may need special natural or conservation areas around Ennis Creek or new park land. The SMP should provide for a wide range of potential uses.
Reach 11: Eastern City (UGA)	This reach is outside of the City's boundary and contains residential uses in the uplands, which are unlikely to change. The Olympic Discovery Trail runs along the beach and will most likely remain.	Natural or Urban Conservancy would be appropriate for the Olympic Discovery Trail corridor, while Shoreline Residential seems appropriate for the uplands.

6 PUBLIC ACCESS ANALYSIS AND IMPLICATIONS

6.1 Introduction

Public access includes the ability of the general public to reach, touch, and enjoy the water's edge, to travel on the waters of the state, and to view the water and the shoreline from adjacent locations.

WAC 173-26-221(4)(c) states that:

> *"Local governments should plan for an integrated shoreline area public access system that identifies specific public needs and opportunities to provide public access... This planning should be integrated with other relevant comprehensive plan elements, especially transportation and recreation."*

To support this planning, WAC 173-26-201(3)(c) calls for local governments to inventory existing and potential shoreline public access sites, including public rights-of-way and utility corridors. Because shoreline access includes visual access, important views of the water from shoreline areas were also identified.

Information about public access sites in the City was drawn from site visits, aerial photographs, the City's Comprehensive Plan, the City's park and recreation staff and website, the City's land use and parks maps, the Olympic Discovery/Waterfront Trail maps and website, and local knowledge through community workshops and focus groups.

6.2 Existing City Parks and Open Space

The City of Port Angeles provides nearly continuous public access to the shoreline through public trails and parks. The existing public access sites provide for a number of water-oriented uses. These include water-dependent uses, such as swimming and boat launching, and water-related and water-enjoyment uses, such as trails, viewpoints, picnic areas, seating, and open lawns that benefit from a visual connection to the water. The trails connect most of the parks along the waterfront, providing an interconnected system of open space and access to the shoreline. Views from the bluffs above visually connect the uplands to the waterfront.

Beginning from the western City limits, the following public properties provide public access to the shoreline (see Maps 20A and B):

6.2.1 Reaches 1 and 2 – Landfill and Western City

The 41-acre Ocean View Cemetery and rights-of-way in the uplands provide views of the water. The beach along the length of this reach provides physical access to the water's edge. However, physical access is limited and in some instances difficult. The access through the Dry Creek ravine requires access through the City's Transfer Station and is not widely known as an access point. The access trail at the east end of Ocean View Cemetery is steep, and somewhat difficult to negotiate if a person is not in good physical condition. Access to both the Transfer Station and the cemetery are limited.

A second issue regarding public access to this reach is the possible stranding during high tides. Occasionally the tide will reach the toe of the marine bluff and if a beach walk is not well planned, a person may have difficulty reaching upland areas in a timely manner.

The proposed Dry Creek Trail and Bridge project will connect the Waterfront Trail with the regional Olympic Discovery Trail Adventure Route west of the city, increasing pedestrian and bicycle access to the water.

6.2.2 Reach 3 – Outer Industrial

Although public access is extremely limited along the shoreline in this reach, the 1.7-acre Crown Park provides views overlooking the Nippon site, Ediz Hook, and the water. Crown Park is located at the top of the marine bluff and gains access from 4th Street. An informal social trail leads down the bluff from the park to the base of the bluff and to the beach.

The Olympic Discovery Trail, as proposed, will run through this park, incorporating it into the open space system. The trail currently follows Hill Street up to 4th Street, then along 4th Street to Milwaukee Drive. The rerouting of the trail up Hill Street will move the trail to the one-time railroad grade and separate it from the street system, providing a more gradual climb and improved safety for trail users.

Public access to this reach was discussed at length during public visioning meeting as the Harbor Resource Management Plan and Shoreline Master Program were being updated. A trail connection from the base of Hill Street, following the industrial water line, to the Strait of Juan de Fuca shoreline was proposed and generally agreed on. The properties along the shoreline in this reach accessed by such a trail are all in private ownership and concerns were raised regarding potential vandalism to industrial facilities.

6.2.3 Reach 4 – Outer Ediz Hook

Direct shoreline access exists between the Nippon site and the U.S. Coast Guard Base, as well as views over the Strait of Juan de Fuca to Mount Baker, the San Juan Islands, and Vancouver Island, Canada. Ediz Hook Road provides year round access to the hook, with the exception of the USCG base, which is closed to the public for security reasons. Parking areas are available throughout the length of Ediz Hook Road, primarily on the south side. Many of the parking areas are informal or not well maintained.

Physical and visual access to the northern shoreline in this segment is inhibited by the large rock used as shoreline protection. The rip rap in this reach is stacked so high that the shoreline is not visible from a car window as it travels along Ediz Hook Road. Although no formal access is developed, the shoreline can be reached by scrambling over the large stones.

6.2.4 Reach 5 – Inner Ediz Hook

The Olympic Discovery/Waterfront Trail extends the length of Ediz Hook Road to the U.S. Coast Guard Base. The majority of the Hook provides unobstructed views of the inner harbor, downtown, and the Olympic Mountains and physical access to the water. Three parks are located along the inner edge of the Hook: the mostly undeveloped Ediz Hook open space (19 acres), Sail and Paddle Park (.46 acres), and Harborview Park (.40 acres). The latter two offer picnic areas and boat launches, and scuba divers enjoy the area near the Coast Guard Base. Public restrooms are provided at the Sail and Paddle Park on the west end and near Harborview Park and the public boat launch at the east end of the Hook. According to the City of Port Angeles Parks and Recreation *Draft Comprehensive Park Plan*, the Harborview Park will transfer to the control of

the Bureau of Indian Affairs at some point in the future for the eventual development of a marina. The plans maintain park-like public access and provide for improvement of the waterfront trail.

An existing building located east of the Sail and Paddle Park has been leased by the YMCA of Clallam County and is used for the storage of rowing shells. A large group of people participated in the rowing activities provided. The shells are launched at the neighboring Sail and Paddle Park.

6.2.5 Reaches 6, 7, and 8A – Inner Industrial, Mill Pond, and Downtown: Tse-whit-zen

Although the Waterfront Trail passes through this area, it is not adjacent to the waterfront in much of this reach. Shoreline properties are typically privately owned and use for industrial purposes. Due to safety concerns, public access to the Port Angeles Harbor shoreline is restricted. The lagoon at the base of Ediz Hook is also privately owned industrial property which also limits public access.

Many opportunities exist for improvements to shoreline access in this area. It has been suggested that a connecting trail between Hill Street/Marine Drive intersection to the beach west of Nippon be developed. Many conversations about improvements to the Waterfront/Olympic Discovery Trail through the Nippon Mill site have occurred. Enhancements to the lagoon shoreline to attract wildlife and thus bird watching or similar activities is a popular idea.

6.2.6 Reach 8B – Downtown: Marina

The Port of Port Angeles Boat Haven provides moorage for pleasure and commercial boats. A viewpoint at South C Street and West 4th Street overlooks the marina, water, and Ediz Hook. The Waterfront/Olympic Discovery Trail is located adjacent to the south side of the Boat Haven Marina in this area, as it follows Marine Drive.

6.2.7 Reach 8C – Downtown: Transition

The Waterfront Trail shies away from the water's edge in this area because of security requirements and potential conflicts with industrial operations, and public access is limited. Viewpoints at South A Street and West 4th Street and from the West 8th Street bridge over Tumwater Street visually connect people to the water and water-related uses.

This reach has contained a plywood mill for many years. The most recent mill has been closed due to market conditions and the site owner, that Port of Port Angeles, intends to demolish the mill structures and develop a marine trades campus on the site. This redevelopment may provide new opportunity to provide increased public access to the harbor shoreline and to the west side of the Valley Creek estuary.

As a transition area between the Boat Haven Marina and the downtown area, a better physical connection is needed. The area is highly industrialized and portions of it are adjacent to the Hwy 117 Truck Route, which carries large amounts of truck traffic and funnels a large amount of vehicle traffic into a single corridor. This tends to make for an unwelcoming environment for pedestrians and bicyclist alike. This trail segment is the least friendly portion of the entire trail system and will require significant improvements to bring it into consistent quality of the remainder of the trail.

6.2.8 Reach 8D – Downtown: Mixed-use

This reach has continuous shoreline access, two parks, the Waterfront Trail, and numerous viewpoints. The 3.5-acre Valley Creek Estuary Park provides viewing of the harbor and a restored creek estuary. It is also a major access point for the Waterfront Trail and has public amenities such as an interpretive pavilion, viewing tower, viewing platform, pathways, landscaping, public art, and interpretive signage.

The 2.2-acre City Pier and Hollywood Beach Park located at the east end of this reach, provide opportunities for community activities (e.g., performances and festivals) at the water's edge and on the pier, swimming, and boating. The park also has a children's playground, the Feiro Marine Life Center, a viewing tower, moorage for transient boaters, and is a major access point to the Olympic Discovery/Waterfront Trail.

The Red Lion Motel is situated on the south side of the Olympic Discovery/Waterfront Trail, opposite Hollywood beach. The motel offers views of the harbor, direct access to the beach, and eating and drinking facilities adjacent to downtown and the waterfront.

The downtown section of the Olympic Discovery/Waterfront Trail has already been enhanced with public art, seating, and landscaping, and planning is in progress for further improvements. Moreover, people can access the ferry docks for another type of water-related experience.

The waterfront walk along Railroad Avenue now connects to the larger Olympic Peninsula Discovery Trail, a valuable amenity for the community and visitors. Streetscape and walkway improvements with new furnishings, lighting and signage would make the experience more compelling for residents to use and visitors to explore. There are plans for the ferry landing redevelopment and the replacement of an existing parking lot with a pedestrian esplanade. These projects, if designed well, can successfully tie the waterfront to the downtown while enhancing connectivity and wayfinding.

City Pier, the main waterfront park, is in need of renovation and reorganization. It could become the focal point of the city, providing a strong sense of arrival and welcome. Currently, its entry is a parking lot and its viewshed is comprised primarily of blank building walls, the overlook tower and the waterfront in general. The performance venue used in the summer is particularly challenged by wind conditions and should be relocated in a more sheltered place nearby in the downtown. The city needs a special focal point of arrival on the waterfront.

The intersection of Lincoln and Railroad Streets, the City Pier and the entrances to The Landing Mall and Red Lion Hotel could all be redesigned as a multi-modal gathering place and community focal point plaza on the waterfront that gives unique identity and an undated character to Port Angeles. Adjacent to the Visitor's Center, the plaza can also act as a trailhead, including directional signage and a regional map for visitors. Portions of Peabody Creek's outfall at the foot of Lincoln Street need to be daylighted in a more attractive and environmentally beneficial way and should be included as part of the plaza design.

Daylighting the creek through large sections of downtown is not possible due to a low invert of the flow line and existing development but is possible that one or two sections could be daylighted. Army Corps of Engineers funding for such a scheme could be pursued. Private properties can contribute positively to the waterfront if well designed and in scale with the city. The Oak Street parcel west of downtown is a unique site that holds many possibilities for development or as public open space.

A large portion of the parcel along the waterfront is owned by the state and can connect to the waterfront trail. The Landing Mall is also a great opportunity site for mixed-use redevelopment, given its size, location and relative scale. Its entries are currently uninviting for pedestrians, particularly on the southeast side due to the landscape, signage and a confusing vehicular entry. The Red Lion Hotel has developed in a linear form that acts as a "wall" along the waterfront, limiting views and pedestrian connectivity to the waterfront. If the site is redeveloped in the future, more aesthetic ways to mass buildings, design parking, enhance views and add open space should be considered.

Currently, plans for redevelopment of the downtown waterfront, from Hollywood beach to the Valley Creek estuary Park have been developed, and permit review is on-going at the time of this writing. Many of the improvements to parking, signage, pedestrian access and other aesthetic considerations mentioned above are include in the plan.

Inland, the West 8th Street bridge over Valley Street provides a view toward the water. The Oak Street and James Park viewpoints and pedestrian connections visually connect viewers to the water, provide seating, and pathways for walking down to the water. Likewise, the Haynes Viewpoint Park provides wide views of the harbor.

6.2.9 Reach 9 – Olympic (Francis Street Reach)

The Olympic Discovery/Waterfront Trail follows the shoreline in this reach and passes through the 5.8-acre Francis Street Park. This park is a major trail access point and provides public amenities such as seating, a viewing pavilion, children's play area, a sculptural element, a 9-11 memorial, landscaped areas and open lawn with views of the water. It also provides a convenient link with State Hwy 101. Parking is provided at the south side of the park (outside of the 200 foot shoreline jurisdiction), which provides a convenient access point to the trail. Currently no restroom facilities are located in the park.

6.2.10 Reach 10 – Rayonier (Ennis Creek Reach)

The Olympic Discovery/Waterfront Trail passes through the Rayonier site, but is located away from the shoreline and takes a circuitous route. Shoreline access is currently restricted in this reach, but views to the east and west from the uplands provide visual access to the water.

The City of Port Angeles recently purchased a 5-million gallon storage tank on the Rayonier site for use in remediating its combined sewer overflow problem. As part of this project, the City will be relocating the Waterfront Trail to a more direct line crossing the site. This change will shorten the trail somewhat and move it closer to the shoreline, however, the trail will remain a significant distance from the marine shoreline for the near term. Future development of the site is anticipated to include additional rerouting of the trail closer to the shoreline.

Much study has been done regarding the Rayonier site and specifically Ennis Creek. Restoration of Ennis Creek has been planned for and a Restoration Plan is in place and will be followed during any site restoration projects.

6.2.11 Reach 11 – Eastern City (UGA)

The Olympic Discovery/Waterfront Trail runs along the beach for the extent of this reach. It provides direct access to the shoreline and views of the water. It is important to note that this trail continues east of the City to Port Townsend, connecting the local Waterfront Trail with the regional trail system.

6.3 Public Access Needs or Opportunities

6.3.1 Rayonier Site

Future development has the potential to provide more public access to the shoreline. The Olympic Discovery/Waterfront Trail through the Rayonier site will be improved with the more direct route planned with the CSO project. A new route at the water's edge would also improve access to the water. Ennis Creek, if restored, would provide unique opportunities for nature viewing.

6.3.2 Oak Street Property

Opportunities at the Oak Street property for improved public access include extending the Olympic Discovery/Waterfront Trail along the shoreline to Valley Creek Estuary Park and creating a public park on the City-leased portion of the property or purchasing the whole site for public use.

6.3.3 Nippon Area

Public access would be improved with the creation of a public access corridor along the east edge of the Nippon property and around the southern edge of the mill pond to the western beach. In addition, the route through the Nippon property could be enhanced with an improved trail alignment and signage.

6.3.4 Trail Improvements

Completion of the Dry Creek Bridge and Trail project will improve the connection from the central waterfront to the western areas of the City and to the region. In particular, the current route on West Hill Street between Marine Drive and West 4th Street requires a bicycler to cross to the "wrong" side of the street for climbing the hill. The railroad grade route will be a great improvement over the existing route.

The existing Olympic Discovery/Waterfront Trail is an excellent amenity, but could be improved in a few places. The route through the industrial area at the base of Ediz Hook discourages waterfront access and would benefit from better signage. The trail could also be improved by altering the route so that it does not require two street crossings in the Nippon area.

Pedestrian and bicycle connections from the Boat Haven (marina) to downtown are currently limited due to some precarious intersections at Marine Drive and Boat Haven Drive, and Marine Drive and West 2nd Street. Route alignment at those intersections could be improved. In addition, offering an alternative to the Front Street route on the city-owned portion of the Oak Street property would extend the Olympic Discovery/Waterfront Trail along the water's edge and away from automobile traffic.

As mentioned above, the Olympic Discovery/Waterfront Trail route through the Rayonier site could also be improved.

The city will develop an east/west waterfront walk that connects to Olympic Discovery/Waterfront Trail. There are many other opportunities for pedestrian and bike trails that will give residents new, more sustainable transportation and recreation infrastructure. An east-west trail at the top of the bluff could link the viewpoints and the Olympic Discovery/Waterfront Trail while taking advantage of the topographic break in the city. Some portions would need to be on local streets and sidewalks that parallel the bluff if public

access cannot be accommodated at the top of bank.

North/south foot trails may be feasible at the top of banks along the five ravines. Due to steep banks and sensitive environmental conditions, bike connections may need to be on local streets to avoid impacts to the slopes and vegetation. A trail along Peabody Creek could connect the waterfront to the Olympic National Park Visitor Center and Hurricane Ridge, for example. A trail along White Creek could connect the waterfront with Peninsula College, serving student populations well. It could also link to the Fine Arts Center, a high quality cultural resource and special "diamond in the rough" destination. Again, signage is the key to making a coherent trail system.

6.3.5 Western Beach

Access to the western beach is difficult due to limited trails from the uplands. The cemetery and landfill are opportune sites for better pedestrian and bicycle routes to the water's edge. In addition, an existing trail from Crown Park to the western beach could be formalized and improved. A new route around the mill pond, especially useful because it would remain at the grade below the bluffs, would provide another option for accessing the west beach.

6.3.6 Scuba Diving

Although scuba divers already access the area near the Coast Guard Base by boat, moving the fence east would provide easier land-side access to the desirable diving spot. Other potential areas for scuba diving could be explored if the Coast Guard Base area is unfeasible.

6.3.7 Fishing

The existing public access sites do not explicitly provide fishing opportunities, and the community has expressed interest in more fishing areas. This option should be explored but may be dependent on water quality and clean-up.

6.3.8 Views

Visitors and residents of Port Angeles enjoy scenic sweeping panoramas due the natural topography. In general, the paucity of large trees and the downtown building scale allow for open viewsheds. The bluff offers an interesting break in the city and an opportunity for many view points over the Strait. Some neighborhoods and the commercial district on the bench have views of both the waterfront and the Olympic Mountains.

As the city grows and adds density over time, new buildings will be constructed and trees will mature. These elements will tend to either frame or block many views. While all views cannot be preserved without encouraging the disinvestment downtown has already experienced, a focus on ensuring that new development frames views and preserves character defining views is critical.

7 SHORELINE MANAGEMENT RECOMMENDATIONS

The following are recommended actions for translating inventory and characterization findings into the draft SMP policies, regulations, environment designations, and restoration strategies for areas within shoreline jurisdiction.

7.1 Shoreline Master Program

7.1.1 Shoreline Environment Designation Provisions

- See Section 5.2 for recommendations by reach.

7.1.2 General Policies and Regulations

Critical Areas

- Consider whether the City's critical areas regulations should be incorporated into the SMP by reference or through direct inclusion of required elements as an appendix. The latter is recommended to provide maximum flexibility to the Cities in development and modifications of critical areas regulations outside of shoreline jurisdiction.

- The City currently requires use of the latest version of Ecology's *Washington State Four-Tier Wetland Rating System*. If the City's critical areas regulations are incorporated into the SMP as an appendix, then reference to and incorporation of relevant information from the current guidance documents should be included for classification, mitigation ratios, etc.

- The City's critical areas regulations as included in the appendix should also regulate all jurisdictional wetlands regardless of size, exclude the reasonable use exception and any other exceptions or exemptions inconsistent with the Shoreline Management Act, and provide any other critical updates based on recent scientific information.

Flood Hazard Reduction

- Sea level rise and its myriad consequences have some potential to impact the water-dependent, water-enjoyment, and other water-related private and public uses on Port Angeles' shoreline through possible increases in frequency and severity of coastal flooding. As identified in Appendix A (Addressing Sea Level Rise in Shoreline Master Programs) of Ecology's Shoreline Master Program Handbook (http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/sea_level_guidance.pdf), much of Port Angeles would fall into categories of landforms that are "particularly vulnerable … to the impacts of sea level rise…" These categories include, among others, historically filled lands, spits, and coastal bluffs. The SMP should include goals and policies that recognize possible sea level rise and require a suitable level of project-level planning and design to address that potential.

Public Access

- Work with the Parks and Recreation department to continue to enhance Port Angeles' wealth of public access features and identify potential locations for new public access sites. The Waterfront Trail and Promenade, Olympic Discovery Trail, Ediz Hook open space and parks, Valley Creek Estuary Park, City Pier, Hollywood Beach, Francis Street Park and multiple viewpoints from the uplands already provide a high quality of public access to the shorelines. SMP provisions should address:
  - Public access enhancements to the bluffs and beach west of the harbor, along Ediz Hook, in the Downtown and at the Rayonier Site
  - Potential view blockages from shoreline development
  - Opportunities to improve transient moorage in the downtown
  - Opportunities for hand-held craft launching
  - Ensure prominent signage of the Olympic Discovery/Waterfront Trail and all its access trails and paths.
  - Develop a prominent system of bicycle/pedestrian feeder trails connecting US 101 to the Olympic Discovery/Waterfront Trail utilizing, among other options, creek bottom corridors such as Tumwater and Valley Creek Trails to provide efficient non-motorized transportation options in the Port Angeles urban growth area.
  - Maintain working relationship with Pacific Northwest Trails Association in the development of feeder trails and lowland alternatives to their primary Pacific Northwest Trail Route (PNT). As a lowland option to the PNT, the Olympic Discovery/Waterfront Trail Route may be designated a National Recreation Trail where it qualifies and not a National Scenic Trail should the PNT achieve that status.
  - Encourage further development of saltwater access points for recreation, such as trails, boating, and passive uses.
  - Provide public access on the south side of the lagoon linking Marine Drive to beaches west of Ediz Hook. Utilize the existing but incomplete route along the industrial pipeline. Coordinate with restoration of the lagoon. Improve the connection from Crown Park to western beaches.
  - Mark a Trail offshoot between Marine Drive and the beach adjacent to the lagoon outlet channel. Provide bicycle racks and maintain seating and picnic tables at the beach. Coordinate with tree plantings.

Vegetation Conservation

- Craft regulations that are consistent with requirements in the WAC Guidelines. Consider special incentives to encourage re-establishment of eelgrass meadows and other aquatic vegetation communities.

Water Quality, Stormwater, and Nonpoint Pollution

- Include policies and regulations that appropriately incorporate recommendations of the City's, County's, Ecology's or others' water quality-related studies, particularly as related to impaired parameters listed by Ecology.
- Consider whether special stormwater management provisions may be necessary beyond the standard City requirements contained in the latest version of the *Stormwater Management Manual for Western Washington*. The City has already strengthened Ecology's Best Management Practices Manual for use in the City. The City has also recently developed a stormwater incentives program, which may provide a model for SMP incentives.
- Site, design and maintain marinas and marine facilities to protect *against* adverse *effects on* shellfish resources, wetlands, submerged aquatic *vegetation, or* other important riparian and aquatic habitat areas. The design of marinas and marine facilities should consider the migration, survival, and harvestability of food fish and shellfish.

7.1.3 Shoreline Modification Provisions

Shoreline Stabilization

- The City's shoreline is heavily armored in places, and additional armoring proposals are expected, particularly given the potential for sea level rise. Regulations in the SMP should fully implement the intent and principles of the WAC Guidelines and provide clear provisions for new, repair and replacement stabilization. Incentives should be included in the SMP that would encourage modification of existing armoring, where feasible, to improve habitat while still maintaining any necessary site use and protection.

Piers and Docks

- Port Angeles does not have any private residential pier or dock facilities, likely because of residential access issues directly to the shoreline and the steep bluffs. Consider prohibiting these in the SMP. Other pier or dock facilities would be covered under the Boating Facilities shoreline use category below.

Fill

- Restoration fills should be encouraged, including improvements to shoreline habitats, material to anchor LWD placements, and as needed to implement other shoreline restoration.
- The potential for upland fill proposals, rather than aquatic, may increase in the future if the sea level rise expectations are realized. Detailed regulations governing upland fills should be developed.

Breakwaters, Jetties, Groins and Weirs

- Consider prohibiting new modifications in the SMP except where they are essential to restoration or maintenance of existing water-dependent uses.

Dredging and Dredge Material Disposal

- Dredging is an important modification activity in Port Angeles, both for furthering restoration and cleanup and for maintaining existing uses. Regulatory requirements in the WAC Guidelines are quite specific. In addition to compliance with those requirements, consider crafting regulations that reference and incorporate as appropriate recommendations and information provided in various studies related to Harbor cleanup.

Shoreline Habitat and Natural Systems Enhancement Projects

- The SMP should include incentives to encourage restoration projects, particularly in areas identified as having lower function. Emphasize that certain fills can be an important component of some restoration projects.

7.1.4 Shoreline Uses

Agriculture

- The County allows some agricultural uses in the eastern Urban Growth Area, and there may be some small agricultural activities in the shoreline jurisdiction in this area. Consider including provisions for agricultural uses in this area.

Aquaculture

- Consider prohibiting this use and removing it from this section. This issue will require further discussion.

Boating Facilities

- Public and private, commercial boating facilities are prevalent in Port Angeles Harbor and an important part of the City's economy and culture. Regulations should be crafted that are consistent with the WAC, as well as accommodate any known plans for modifications of any of these facilities. Incentives should be used where appropriate to encourage site restoration.

Commercial Development

- Coordinate policies and regulations for commercial development with the City of Port Angeles' Comprehensive Plan, Waterfront and Transportation Improvement Plan and Harbor Resource Management Plan (currently under development); and the Port of Port Angeles' Central Waterfront Master Plan and Marine Facilities Master Plan, while ensuring that new commercial development will achieve no net loss of shoreline ecological functions. Accommodate a wide range of maritime commercial uses west of Downtown.

Forest Practices

- Provide general policies and regulations for forest practices according to the WAC Guidelines.

Industry

- Include provisions for industrial uses while ensuring no net loss of shoreline ecological functions. Consider requiring vegetated windbreaks in key locations to capture dust from mill and logging operations.

Mining

- Consider prohibiting this use and removing it from this section.

Recreational Development

- Policies and regulations related to parks management should provide clear preferences for shoreline restoration consistent with public access needs and uses. Existing natural parks should be protected and enhanced.
- Include provisions for existing and potential recreational uses, including boating, a golf course, scuba diving, swimming, and surfing.

Residential Development

- Address building setbacks and shoreline armoring for residential properties on the bluffs. In new developments on the water's edge, also address piers and docks and vegetation conservation. A standard buffer and/or setback should be developed for the properties on the bluffs, and an effective but practical list of buffer/setback reduction options that would result in a net improvement in shoreline functions should be developed for new development or redevelopment at the water's edge. The SMP should consider developing regulations that encourage or require shoreline restoration when specific new development or redevelopment activities are proposed.
- Include a policy to educate waterfront homeowners about the use of fertilizers and landscape chemicals and encourage natural lawn care and landscaping methods to reduce chemical output into surrounding shorelines.
- Encourage low impact development techniques that reduce impervious surface areas and use of ecologically responsible stormwater management.

Transportation/Parking and Utilities

- Include provisions for public transportation and utilities development in the shoreline jurisdiction. There are some roadways in SMA jurisdiction. Goals, policies and regulations for these activity types should require careful consideration of short-term and long-term impacts on shoreline functions and processes, particularly in their management of stormwater runoff, shoreline hardening and potential for generating a later need for shoreline hardening, and placement of in-water structures which can affect flows and substrates, among others.

7.1.5 Design and Construction Geotechnical Engineering Considerations

The following is a summary of *geotechnical* design and construction considerations related to future development in the shoreline area of Port Angeles. As needed, a corresponding SMP recommendation can be found after the consideration.

Geotechnical *Design* Considerations

Settlement – Portions of the City of Port Angeles shoreline are underlain by loose/soft compressible soil. Constructing heavy structures or placing significant heights of fill (more than 3 or 4 feet) directly on these soils could cause varying amounts of settlement. Such settlement could potentially result in damage to adjacent structures and underground utilities. In order to preclude adverse settlement impacts, special construction measures may need to be implemented. Such measures could include using deep foundation systems to support heavy structures and preloading a building site prior to construction of relatively light structures (buildings under about two stories) on shallow spread foundations. The presence of existing subsurface foundation elements in some areas along the shoreline may locally reduce the likelihood of settlement.

- Recommendation: In the Critical Areas chapter or in the Critical Areas Regulations appendix of the SMP, consider requiring analysis of and mitigation for settlement.

Flooding Hazards – Portions of the Port Angeles shoreline in the vicinity of creeks could be susceptible to flooding during extreme storm events or as a result of rain-on-snow events. Impacts associated with flooding can be reduced in a number of ways. Examples of possible methods that could be used include incorporating stormwater controls into the future development plans and adjusting grades adjacent to creeks. Adjustment to grades could be accomplished either through area-wide filling or construction of dikes.

- Recommendation: As needed and consistent with WAC Guidelines, integrate regulations into the SMP addressing potential for supplementary stormwater controls beyond that typically required by City regulations. Flood Hazard Reduction, Fill and Critical Areas Regulations chapters of the SMP may also require special attention to craft regulations that address possible unavoidable fills and other shoreline modifications in stream buffers and shoreline jurisdiction to protect against flooding, particularly associated with water-dependent uses. Any such uses or modifications should be balanced with the requirement to utilize mitigation sequencing to avoid and minimize impacts to ecological functions. Special stream or shoreline setbacks should be considered to minimize conflicts.

Landslide Hazards – There is a moderate potential for landsliding of portions of the existing steeper slopes present along the marine bluffs and the ravines along the City of Port Angeles shoreline. Landsliding could potentially be triggered by a seismic event, the natural process of stabilization of a steep slope to a flatter profile, an increase in pore-water pressure from excessive rainfall that could destabilize a portion of a slope, or construction that traverses or cuts into a steep slope (especially if planes of weakness in the slope are adversely affected). Accordingly, the stability of unsupported steep slopes should be evaluated and addressed as necessary.

- Recommendation: Assess whether the City's existing geologically hazardous area regulations require adequate analysis and mitigation of landslide hazards. It should be noted that landsliding along marine waters can be an important natural process that supplies much-needed gravels and other material for maintaining and establishing landforms and habitats.

Ground Shaking and Ground Motion Amplification – Seismic design using the most recent design codes and generally accepted engineering standards and practices should be conducted during the design phase of the future improvements. This includes conducting site-specific seismic analyses, when appropriate, and using the most recent version of the International Building Code, which contains provisions to address life safety issues and incorporates data obtained from recent seismic events in the seismic design standards.

- Recommendation: Assess whether the City's existing geologically hazardous regulations require adequate analysis of and design for ground shaking and ground motion amplification hazards. Consider providing supplementary regulations in the SMP as needed.

Ground Rupture – It is anticipated that designing against ground surface rupture along the City of Port Angeles shoreline during a seismic event will not be a significant part of the site-specific seismic design for future improvements.

Liquefaction – Soil liquefaction, should it occur, would likely lead to consolidation of loose, saturated soil deposits, resulting in some surface settlement. Impacts associated with soil liquefaction can be reduced in a number of ways. Examples of possible methods that could be used include ground improvement, use of deep foundations, installing wick drains, and/or designing for potential soil liquefaction impacts. The specific measure(s) to reduce soil liquefaction impacts should be determined during the site-specific design and permit process for future improvements. The presence of existing subsurface foundation elements in the shoreline area may locally reduce the likelihood of soil liquefaction.

- Recommendation: Assess whether the City's existing geologically hazardous area regulations require adequate analysis and mitigation of liquefaction potential. Consider providing supplementary regulations in the SMP as needed.

Lateral Spreading – Lateral spreading is a phenomenon where lateral ground displacements occur as a result of soil liquefaction. Lateral spreading is typically observed on very gently sloping ground or on virtually level ground adjacent to slopes. Lateral spreading displacements can range from a few centimeters to a few meters, depending on the magnitude and duration of the seismic event and the local soil and groundwater conditions. From accounts of recent large earthquakes, lateral spreading at waterfront facilities typically appears to be more prevalent in upland areas within about 300 feet of the shoreline; however, case histories have documented lateral spreading occurring up to about 1,200 feet from the unsupported face of a soil mass. Lateral spreading should be specifically evaluated during the site-specific design and permit process for future buildings located within (at a minimum) 300 feet of the shoreline. The presence of existing subsurface foundation elements in some areas may locally reduce the likelihood of lateral spreading.

- Recommendation: Assess whether the City's existing geologically hazardous area regulations require adequate analysis and mitigation of lateral spreading. Consider providing supplementary regulations in the SMP as needed.

Tsunamis – Depending on the height of any tsunami wave produced by a major rupture along the Cascadia Subduction Zone, a tsunami could potentially pose a temporary hazard along the City of Port Angeles shoreline; however, the return period for large earthquakes along the Cascadia Subduction Zone that might generate a large tsunami is on the order of several hundreds of years. Measures to address the potential impact of a tsunami could include public notification and warnings; additionally, raising grades for other redevelopment purposes would also serve to reduce this potential impact.

- Recommendation: The potential need or demand for large upland fills to address tsunamis should be considered in SMP regulations. However, given the long return period, tsunami hazard might not provide adequate justification for large-scale upland fills.

Sea Level Rise – As previously discussed, the sea level in Port Angeles Harbor could rise by between 0 and several feet over current levels by 2100. Grades along the shoreline could be raised to reduce the potential impact of a long-term sea level rise in Port Angeles Harbor.

- Recommendation: Track sea level rise information to assess impact on Port Angeles shoreline

Geotechnical *Construction* Considerations

Erosion Hazards – Certain soil types along the City of Port Angeles shoreline may be susceptible to erosion when disturbed by construction activities, particularly on slopes exceeding 15 percent. Fill material placed to raise grades along the shoreline may also be susceptible to erosion. Therefore, construction activities should include employing temporary erosion control measures and Best Management Practices (BMPs) to reduce erosion impacts. In addition, the exposed shoreline along the northern limits of the Port Angeles Harbor could be protected from erosion due to storm and wave action by providing shoreline protection measures in areas that are currently not armored.

- Recommendation: In Port Angeles, retention of Ediz Hook is an important element of the regional economy and critical to enabling operation of the many water-dependent uses on Port Angeles Harbor. Armoring may be a necessary tool, but regulations consistent with the WAC Guidelines should be crafted that strongly favor armoring designs that combine the necessary structural elements with habitat elements, and that support long-term sustainability of Ediz Hook (e.g., such as structures that capture and retain material to balance ongoing erosion).

Buried obstructions and foundations – As previously discussed, buried portions of former foundation elements (e.g., piles, pile caps, and grade beams) may be present in the uplands area near former shoreline structures. As a result, these buried elements may be encountered during future excavation, dredging and construction activities. Depending on the location of future improvements, the buried foundation elements could either be beneficial for some aspects of the development or make it difficult to construct other subsurface features such as installing new pile foundations, new underground utilities and/or conduct dredging.

Sunken material - Sunken logs may be on or in marine sediments in areas of former log rafting. Decomposing wood material may be present in intertidal and subtidal sediments. Sunken material can present impediments to dredging, dredged disposal and marine construction activities.

- Recommendation: Consult with natural resources agencies, such a Washington Department of Fish and Wildlife, to craft an SMP regulation that addresses treatment of sunken logs during authorized dredging, dredge disposal, and marine construction activities.

7.1.6 Environmental Contamination Considerations for Design and Construction

The following is a summary of *environmental contamination considerations* for design and construction related to future development in the shoreline area of Port Angeles. This section offers planning elements that can limit impacts from environmental conditions in the upland and marine portions of the shoreline zone during development. As needed, a corresponding SMP recommendation can be found after the consideration.

Environmental Cleanup *Design* Considerations

Upland Environmental Contaminants. Portions of the City of Port Angeles shoreline have documented releases of hazardous substances associated with past practices. Subsurface

activities related to development could encounter hazardous substances in soil, groundwater, and/or marine sediments. Such activities have the potential to make hazardous substances accessible for transport to the marine environment. Future commercial and industrial development in the shoreline area will require Ecology construction stormwater and industrial stormwater general permits.

- Recommendation. Consider whether the Critical Areas Regulations appendix of the SMP should address an environmental contamination component of grading permit applications in shoreline industrial areas, such as the need to evaluate and document whether subsurface earthwork activities will encounter contaminated soil or groundwater.
- Recommendation: In the Critical Areas chapter or in the Critical Areas Regulations appendix of the SMP, consider requirements for analysis of appropriate mitigation measures (including Construction Stormwater Management, and dewatering water disposal) to anticipate environmental contamination in industrial areas.
- Recommendation. In many instances, control of upland contaminant sources can provide significant benefits to the marine environment. Make upland source control a publicized City of Port Angeles goal in conjunction with the Ecology Harbor Sediment Study and cleanup strategy.

Marine Sediment Conditions - Ongoing Harbor Study. Ecology started an investigation of aquatic sediment conditions, including the 2008 sampling, and will develop a strategy for cleanup of the harbor.

- Recommendation. Review Ecology Harbor Study findings and strategy. Determine if any changes are appropriate to the SMP. Marine sediment contamination can originate from a variety of upland sources in and beyond the shoreline area. In many instances, control of contaminant sources from development and commerce must start well inland of the shoreline zone.

Marine Sediment Conditions - Dredging Design Considerations. Dredging can encounter contaminated sediments, and can suspend and re-distribute contaminants. Dredging can remove sediment with contaminants and accumulations of organic material. Dredged sediment characterization sampling should be conducted to obtain data that can be used to obtain permit approval for in-water work and open-water disposal of dredged sediments. Sediment characterization data will be reviewed by the DMMP Agencies (DMMP 2008).

- Recommendation: Require use of dredge methods and best management practices (BMPs) to reduce sediment suspension and distribution during dredging.

Environmental Cleanup *Construction* Considerations

Uplands. Properties in and beyond the City of Port Angeles shoreline area have documented releases of hazardous substances associated with past practices. Subsurface activities related to development could expose hazardous substances during the construction phase in soil, groundwater, and/or marine sediments at or near the sites. Construction in the shoreline zone can disturb soil with contaminants that may be more easily transported to the marine environment by stormwater runoff.

- Recommendation. Inspect implementation of construction stormwater plans prepared in accordance with Ecology's Construction Stormwater General Permit. Anticipate requirements for excavated soil management and control of any extracted

groundwater (dewatering water) to limit the potential for a release of contaminants that may impact human health or the Port Angeles Harbor environment.

Marine Sediment, Dredging, and Source Control. Dredging can encounter contaminated sediments, sunken logs and pilings, and can suspend and re-distribute materials.

- Recommendation: In the Critical Areas chapter or in the Critical Areas Regulations appendix of the SMP, consider whether to note the expectation that projects use dredge methods and best management practices (BMPs) to reduce sediment suspension and distribution during dredging.
- Recommendation: Consult with natural resources agencies, including the Washington Department of Fish and Wildlife, to craft an SMP regulation that addresses handling of marine pilings and sunken logs during authorized dredging, dredge disposal, and marine construction activities.

7.2 Restoration Plan

A Restoration Plan document will be prepared as a later phase of the Shoreline Master Program update process, consistent with WAC 173-26-201(2)(f). The Shoreline Restoration Plan must address the following six subjects (WAC 173-26-201(2)(f)(i-vi)) and incorporate findings from this analysis report:

(i) Identify degraded areas, impaired ecological functions, and sites with potential for ecological restoration;

(ii) Establish overall goals and priorities for restoration of degraded areas and impaired ecological functions;

(iii) Identify existing and ongoing projects and programs that are currently being implemented, or are reasonably assured of being implemented (based on an evaluation of funding likely in the foreseeable future), which are designed to contribute to local restoration goals;

(iv) Identify additional projects and programs needed to achieve local restoration goals, and implementation strategies including identifying prospective funding sources for those projects and programs;

(v) Identify timelines and benchmarks for implementing restoration projects and programs and achieving local restoration goals; and

(vi) Provide for mechanisms or strategies to ensure that restoration projects and programs will be implemented according to plans and to appropriately review the effectiveness of the projects and programs in meeting the overall restoration goals.

The Restoration Plan will "include goals, policies and actions for restoration of impaired shoreline ecological functions. These master program provisions should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program." The Restoration Plan will mesh potential projects identified in this report (see Maps 22A and 22B, as well as Chapter 4) with additional projects, regional or City-wide efforts, and programs of the City, watershed groups, and environmental organizations that contribute or could potentially contribute to improved ecological functions of the shoreline.

Key documents in development of the Shoreline Restoration Plan are expected to consist of the following:

- Management measures for protecting and restoring the Puget Sound Nearshore. Prepared in support of the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP)
- Elwha-Dungeness Watershed Plan, Water Resource Inventory Area 18 (WRIA 18) and Sequim Bay in West WRIA 17.
- Port Angeles Harbor Shoreline Habitat Assessment
- Salmon and Steelhead Habitat Limiting Factors, Water Resource Inventory Area 18
- Materials from the Strait of Juan de Fuca Ecosystem Recovery Network (Strait ERN), including the Port Angeles Harbor High Priority Actions Matrix.

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9 LIST OF ACRONYMS AND ABBREVIATIONS

Corps ..... U.S. Army Corps of Engineers
CSO ..... combined sewer overflow
DMMP..... Dredged Material Management Program
DNR ..... Washington Department of Natural Resources
Ecology..... Washington Department of Ecology
GMA..... Growth Management Act
HPA ..... Hydraulic Project Approval
LWD..... Large Woody Debris
MLLW..... Mean lower low water
NOAA ..... National Oceanic and Atmospheric Administration
NPDES ..... National Pollutant Discharge Elimination System
NRCS..... Natural Resources Conservation Service
OHWM..... Ordinary high water mark
PAMC..... Port Angeles Municipal Code
PHS..... Priority Habitats and Species
SMA ..... Shoreline Management Act
SMP ..... Shoreline Master Program
USFWS..... U.S. Fish and Wildlife Service
USGS..... U.S. Geological Service
WAC..... Washington Administrative Code
WDFW ..... Washington Department of Fish and Wildlife

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APPENDIX A

Assessment of Shoreline Jurisdiction

APPENDIX B

Inventory and Analysis Map Folio