## SHORELINE RESTORATION PLAN FOR THE CITY OF OCEAN SHORES



## Prepared for the City of Ocean Shores

Prepared by Herrera Environmental Consultants, Inc. on behalf of AHBL, Inc.

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## **LIMITATIONS**

As with any report, the authors and contributors acknowledge there are limitations (inherent or otherwise); this report is limited to the subjects covered, materials reviewed, and data available at the time the report was prepared. The authors and reviewers have made a sincere attempt to provide accurate and thorough information using the most current and complete information available and their own best professional judgment. Any questions regarding the content of this report should be referred to city staff.



## INTRODUCTION

This restoration plan serves as a guide for the city of Ocean Shores (hereafter referred to as Ocean Shores or simply the city) to achieve improvements in ecological functions of degraded shoreline areas as required by WAC 173-26-201(2)(f). The plan identifies proposed and planned, site-specific, restoration projects identified by others and by Herrera on a one-day field visit.

The plan includes recommendations for shoreline restoration and protection, shoreline cleanup and removal of debris and derelict structures. It also describes types of programmatic activities that would support shoreline restoration including beach nourishment, soft shore armoring where appropriate, and invasive species removal. Finally, this document describes partners and grant opportunities that could facilitate implementation of the restoration plan, and provides suggested implementation mechanisms for achieving restoration goals.

Note: The Ocean Shores Planning Commission prepared this document, based on a document by Herrera Environmental Consultants called the "Shoreline Restoration Plan for the Cities of Westport and Ocean Shores" dated September 30, 2015. To tailor this document to Ocean Shores, all data pertaining exclusively to the city of Westport was removed and the Ocean Shores data was edited and expanded. This document is the official restoration plan for the 2016 Ocean Shores Shoreline Master Program.





## **PURPOSE AND INTENT**

The purpose of this restoration plan is to improve degraded areas of shoreline within Ocean Shores over time by restoring shoreline ecological functions and processes. This plan will be accomplished through voluntary and incentive-based public and private programs to restore and enhance shoreline areas.

This plan serves as a guide for Ocean Shores to support and develop projects that are planned to improve ecological functions (physical, chemical, and biological) of degraded shoreline areas as required by WAC 173-26-201(2)(f). Preliminary and general restoration recommendations were made in the Shoreline Inventory and Characterization (Herrera and AHBL 2015). However, this plan expands on that work to:

- Identify current planned restoration projects;
- Suggest targets for shoreline habitat protection and conservation;
- Summarize existing studies that prioritize where future restoration can be most effective and should have highest priority; and
- Identify programmatic restoration opportunities that could be applied to candidate shorelines within Ocean Shores.

#### Scope

The scope of this plan is to identify restoration and programmatic opportunities to improve shoreline ecological functions along the marine and freshwater shorelines of Ocean Shores. As directed by the Washington State Department of Ecology (Ecology), projects to improve shoreline access and other shoreline attributes are beyond the scope of this plan. The shoreline areas included in this plan are defined in Section 1.05.01 of the city's Shoreline Master Program (SMP).

#### Context

This plan relies on multiple strategies that use physical restoration to improve and protect shoreline functions and resources. This plan's success depends on the involvement of a number of government and nonprofit organizations that are protecting and restoring land in Ocean Shores. They include, for example, the Ocean Shores Fresh Waterways Corporation and Advisory Board (OSFWC), the Quinault Indian Tribe, the Washington Department of Natural Resources (WDNR), the Washington Department of Fish and Wildlife (WDFW), Ecology,



the U.S. Army Corps of Engineers (USACE), the Chehalis River Basin Land Trust, and the Coastal Interpretive Center.

One of the largest stressors on the ecological health of Ocean Shores is the past shoreline modifications, such as fill and the placement of hard infrastructure like the North Jetty, which actually enables the city's existence. Natural disturbance due to the intense wave activity common on the beaches of the outer coast must be considered when planning restoration activities. These same disturbance processes will likely generate a need for future shoreline armoring, as they have historically affected along the southern shoreline in Ocean Shores.

This plan recommends preservation of habitat and ecological functions where possible. While protecting shorelines from future development does not directly restore or improve habitats, preservation does help maintain no net loss. For example, preservation of marine riparian areas with intact native vegetation will help maintain shoreline habitat for salmon and other economically important species, provide a native plant seed source, and supply large woody debris; these are all functions that support adjacent shoreline ecological processes.

#### Shoreline Master Program

Ecology's Shoreline Master Program Guidelines document (Ecology 2011) requires the development of a shoreline restoration plan as part of the SMP update process. This plan supports the goals, policies, and regulations of the city's SMP. Although the protective and mitigation provisions of the SMP is intended to achieve no net loss of ecological functions from new adverse impacts, this restoration plan will help ensure that the shoreline ecological functions within Ocean Shores achieves no net loss with potential for improvement over time. As such, this plan serves as a technical and programmatic companion to the city's SMP.

#### **Restoration Plan Objectives**

- Encourage and facilitate cooperative restoration programs between local, state, and federal public agencies, tribes, nonprofit organizations, and landowners to address shorelines with impaired ecological functions or processes.
- Restore and enhance shoreline ecological functions and processes, as well as shoreline features, through voluntary and incentive-based public and private programs.
- Target restoration and enhancement toward improving habitat required to support the life cycles of priority or locally important fish and wildlife species.
- Ensure restoration and enhancement is consistent with and prioritized (where
  practicable) based on the biological recovery goals for steelhead, salmon (CBPHWG
  2008), and other species or populations for which a recovery plan is available, such as
  snowy plover.



• Seek funding for restoration, enhancements, easements or acquisitions using federal, state, county, grant, private donation, or other funding sources.

#### **Restoration Policies**

The following policies will guide the Ocean Shores restoration projects:

- Policy 1. Restoration and enhancement actions will improve shoreline ecological
  functions and processes, and should be designed using principles of landscape and
  conservation ecology. The primary goal is to restore or enhance physical and biological
  ecosystem-wide processes that create and sustain shoreline habitat structures and
  functions.
- **Policy 2.** Encourage and facilitate cooperative shoreline restoration and enhancement programs to address shorelines with impaired ecological functions between local, state, and federal agencies, tribes, nonprofit organizations, and landowners.
- **Policy 3**. Target restoration and enhancement projects that will support the life cycles of priority species (such as Chinook and other anadromous fish), locally important plants, fish and wildlife (e.g., snowy plover), and other populations or habitats for which a prioritized restoration or recovery plan is available (CBPHWG 2008, USFWS 2007).
- **Policy 4.** Integrate restoration and enhancement with other natural resource management efforts such as the Grays Harbor Estuary Management Plan (GHEMP).
- **Policy 5**. Seek and support funding opportunities to implement restoration and enhancement projects from state, federal, private, and other sources.
- **Policy 6**. Avoid adverse impacts on existing critical areas, fish and wildlife habitat conservation areas, water quality, and water storage capacity in all shoreline restoration and enhancement projects.
- **Policy 7**. Integrate restoration and enhancement projects with other city management efforts to provide public safety and property protection in the shoreline jurisdiction.





## **METHODS**

#### **Inventory Data and Information Sources**

Ocean Shores is a unique city that was fully platted 50 years ago and established as a planned development. The city is a narrow marine peninsula, subject to the accretion and erosion from wave action of the Pacific Ocean and Grays Harbor. It has no creeks or rivers flowing into the salt waters that support spawning salmonid species. Its interior contains about 26 miles of dredged or man-made fresh waterways, with the majority of the shoreline properties in private residential ownership. This makes restoration projects complicated. However, there have been a number of innovative ecological management approaches performed to address the particular challenges faced in Ocean Shores. The city has developed positive, effective innovative solutions to the unique environmental challenges of the Washington outer coast.

To augment the city's efforts, the primary source of information for specific projects, aside from interviews with local interest groups, was a one-day visit to Ocean Shores and the Grays Harbor area to identify projects on the ground by Herrera consultants. The site visit was preceded by an in-office meeting attended by a geomorphologist, a fisheries biologist, a restoration engineer, and a wetlands scientist, where the best available science described in the Shoreline Inventory and Characterization Report and other related studies were discussed. The entire shoreline was examined during this meeting, and potential targets for restoration were identified after a more detailed examination on the site visit. The site visit occurred on October 17, 2014, and on that day, the Pacific Ocean had a high tide of 8.45 feet above mean lower low water (MLLW) at 9:48 a.m. and a low tide of 4.48 feet above MLLW at 3:00 p.m., as observed at Westport, Washington (NOAA 2014).

#### **Identification of Restoration Opportunities**

Restoration opportunities were identified during the site visit noted above. In addition, members of the Citizens Advisory Committee (CAC) and the public have also identified prospective and on-going projects for this plan that will enhance both the marine and freshwater shoreline environments.

A project information sheet is provided, below, for each proposed, planned, or currently active site-specific project. In particular, restoration activities were identified according to the following site characteristics found to be good targets for restoration of the Ocean Shores Shoreline Inventory and Characterization Report (Herrera and AHBL 2014) in conjunction with conditions observed on the one-day site visit reconnaissance:

• The site is degraded and presents an opportunity for restoration that will produce a net gain in shoreline ecological functions and habitat in the future.



- The site has unused or relict shoreline armoring and infrastructure, which if removed would likely lead to habitat enhancements or improvements in physical processes.
- The site has, or is adjacent to, areas having specific, high-value, biological features such as mature riparian forest or wetland habitats that support important fish species, birds, and other wildlife.
- The site is potentially contributing contamination to the surrounding landscape.



## **RESTORATION PRIORITIES**

Shoreline restoration priorities for Ocean Shores focus on increasing the net ecological value of the shorelines by protecting and enhancing existing shorelines, restoring damaged or low quality shoreline habitat, and creating new shoreline habitat. The priorities are to:

- Protect shellfish resources by creating vegetation buffers along marine shorelines to reduce stormwater contaminant loading to receiving waters;
- Provide potentially improved salmonid habitat along Grays Harbor shorelines;
- Reduce hard shoreline armoring and fill, and remove deleterious shoreline debris including creosote-treated pilings;
- Protect eroding coastal shorelines with soft-armoring methods such as sand fencing and sandy dredge spoils;
- Remove invasive species from the shoreline jurisdiction, and revegetate with native species or creating shoreline habitat; and
- Increase the quality of the shoreline habitat and water by reducing stormwater runoff problems and sewage issues from failing septic systems.





## SITE-SPECIFIC RESTORATION PROJECTS

#### Overview

Ocean Shores contains a wide variety of shoreline types with approximately six miles of Pacific Ocean waterfront, eleven miles of Grays Harbor shoreline, and 26 miles of freshwater shoreline mainly associated with Duck Lake and its canal system. Ocean Shores' shorelines are predominantly residential, with a small portion of them being recreational or containing vacant/open space.

As stated in the *Identification of Restoration Opportunities* section above, restoration projects were drawn primarily from field observations by Herrera and meetings of the CAC. Six site-specific restoration opportunities have been identified in Ocean Shores. Figure 1 shows the city boundaries and the general locations of these proposed and planned projects.

There are two site-specific opportunities on the outer coast: South End Erosion Restoration (Table 1) and Restore and Extend South End Beach Driving Restrictions (Table 5). Three on the Grays Harbor shoreline: Ocean Shores Marina (Table 3), Protection Island Road Removal and RV Park Relocation (Table 4), and Mariner Court Debris Removal (Table 6) and one on the inland fresh waterways: North Canal Park Restoration and Cleanup (Table 2).

#### **Restoration Priorities and Opportunities**

The first site-specific restoration opportunity is on the Pacific coast near the North Jetty. This area has experienced extreme wave erosion over the last 20 years, and the rate of lost shoreline and shoreline habitat is increasing with more frequent and severe winter storms and rising sea levels. This project provides opportunities to restore the lost shoreline, as shown in Table 1.

Although most of the Ocean Shores shoreline is fresh water when measured by length, the area is mostly artificial along Duck Lake and its canals and is not accessible to salmonids or other marine species. It is also mainly in private ownership. The primary restoration / conservation action on these freshwater shorelines was implemented with the establishment of the Weatherwax Wetland and Habitat Bank. However, some additional restoration opportunities remain in the city parks. North Canal Park is located at the north end of the Grand Canal where Oyehut Creek flows into the city. The water quality at that location is low because the community of Oyehut has no sewer system and there are many failing septic tanks in this area. There are opportunities for cleanup and restoration as shown in Table 2.

The Grays Harbor shoreline is used extensively by commercially important species, such as salmonids and shellfish. The shoreline is largely in its natural alignment, but there are also several relicts, decaying structures on this shoreline due to past derelict development. These attributes make it a logical place for restoration activities. Both of these opportunities are



associated with tribally owned property that bounds Grays Harbor at the southeast end of the city. Both of these projects would remove deleterious, decaying infrastructure. Mariner Court was a city street that has collapsed into the bay due to erosion, leaving large chunks of asphalt in the water. This project would remove that unnatural debris from the shoreline environment, possibly allowing the downed trees in the water to move to shore, providing a more natural shoreline habitat. See Tables 3, 4, and 6 for project descriptions.

Beach driving is currently closed south of Marine View Drive in spring and summer. The signposts enforcing this closure were destroyed by the 2015-2016 winter storms. When replaced, posting new signs that extend this to a year-round closure will not only protect and improve shoreline and water quality, but will also keep vehicles away from the shoreline restoration project in Table 1. See Table 5.



	Table 1.	South Beach Shoreline R	estoration	
Product No.		oreline Restoration	CSCOI ALIOII	
Project Name		oreline Restoration		
Location	Ocean Shores		Project Sponsor	City
		Roth Beat Subset	Project Status	In progress
		September 1	Target Habitat	Marine Shoreline
	人。直	Surface of the surfac	Current Ownership	City
		Charles and the second	Zoning	High Density Residential
		X1 South beach profile	Hydrogeomorphic Classification	Marine shoreline
			Project Size	1/2 mile of Pacific Ocean shoreline
			Strategy	Shoreline restoration, and vegetation enhancement
Existing Conditions	The Ocean Shores Pacific Ocean shoreline north of the North Jetty is susceptible to extreme erosion that studies have tied to the height of the jetty and the winter storm high water mark. Climate change and El Nino currents both aggravate this situation. Several projects have been attempted in order to curtail the erosion and to protect the shoreline and the residential properties adjacent to it. Since 1996, emergency repairs have been attempted in an <i>ad hoc</i> fashion. The addition of riprap has mitigated the risk of a coastline breach, but this unattractive solution destroys habitat and is subject to erosion.			
Project Description	A combination of approaches is being taken to protect this shoreline from further erosion and to begin building up new sand to restore the shoreline. Torn geotubes were topped with geobags, which were then buried with "sacrificial sand" which the winter storms took away quickly. The next temporary winter measure was to bring in rock to stabilize the geotubes and geobags and put sacrificial sand on top of the rock. Permanent solutions are being sought to rebuild the shoreline. Sand fencing will be installed, to trap incoming sand and start to restore the dunes. Studies to identify permanent solutions continue. As the shoreline rebuilds, vegetation will be added to stabilize it.			
Future Threats	Rising seas and climate change mean more severe winter storms and higher tides.  Additional shoreline could be lost. Some properties might be lost or become undevelopable. The beach might have to be closed. Future monitoring will be required to assure that the restoration project does not result in cascading erosion moving further north up the beach.			
Project Rationale	Preventing the ocean from reclaiming this land is important for several reasons. City infrastructure and commercial and residential development are at risk. Shoreline and shoreline habitats are being lost. Attempt to respond to weather and wave conditions to not only reduce further loss, but to regain shoreline habitat.			
Functions Restored	Shoreline restora	ation followed by shoreline habitat	; Public safety	



Table 2. North Canal Park Restoration and Cleanup				
Project Name	North Canal Park Restoration and Cleanup			
Location	Ocean Shores			



Project Sponsor	City
Project Status	Conceptual
Target Activity	Water quality improvement, public health, habitat improvement
Current Ownership	City
Zoning	Recreational
Hydrogeomorphic Classification	Lacustrine fringe, potential depressional wetlands
Project Size	2 acres
Strategy	Water filtering, invasive weed removal, vegetation enhancement

Existing Conditions	North Canal Park lies at the south end of Oyehut Creek and the north end of the Grand Canal. It is a small park with picnic tables and a waterfront trail. The creek originates in the town of Oyehut just north of Ocean Shores in Grays Harbor County. Oyehut has many failing septic tanks. There is a County project plan to install sewers in Oyehut, but the creek currently flows through ditches and culverts, then surfaces at this park, carrying contaminated water into the Grand Canal, thus through the entire fresh waterways system. Weeds clog the water, reducing water flow. There are two large ponds on the west side of the park. At one point, they were intended to filter storm runoff from Point Brown Ave. in the commercial area. However, with the current slope of the land it does not seem likely that they serve that purpose as they contain stagnant, muddy water with no indication of wildlife or wetland function.
Project Description	Water in the main stream must be filtered and the ponds must be tested and cleaned up as their water enters groundwater, which feeds the canal. There are also invasive weeds to be cleared around the canal and ponds. With proper vegetation, the ponds could possibly become a wetland creation project. Floating aquatic weeds cover the canal water in the south end of the park. These weeds are advancing and they should be cleared. There is also a derelict dock to remove. Another option to clean up the stream water quality is to install a filtering system north of Chance a la Mer Street where the creek runs in an open ditch surrounded by eight-foot fencing.
Future Threats	Continued spread of contaminated water throughout fresh waterway system; Advancing aquatic weed coverage; Increased loss of shoreline habitat
Project Rationale	The contaminated water is a public health hazard and has an unknown effect on shoreline vegetation and on species at all levels of the food chain. The surface vegetation limits habitat for waterfowl. The stagnant standing water is a breeding ground for undesirable insects.
Functions Restored	Improved water quality and water flow; Removal of invasive weeds; Potential new wetlands; Improved wildlife habitat



	Table 3. Ocean Shores Marina			
Project Name	Ocean Shores Marina			
Location	Ocean Shores			
		Project Sponsor	City, Quinault Indian Tribe	
	(c 0.4)	Project Status	Conceptual	
	Market	Target Habitat	Salmonid spawning and rearing habitat	
		Current Ownership	Quinault Indian Tribe	
		Zoning	Commercial	
		Hydrogeomorphic Classification	Estuarine shoreline	
Project Size 2000 feet of short			2000 feet of shoreline	
	Strategy Debris removal			
Existing Conditions	The Ocean Shores Marina is protected by two 500-foot-long riprap jetties, which shelter more than 17 acres of Grays Harbor. The active marina is confined to a single set of piers at the southern end of the marina. The rest of the marina has no formal existing use, with the exception of a decaying boardwalk (see picture). The boardwalk is missing in places, and the remaining boards are in various stages of rot. Invasive species (predominantly) on the adjacent shoreline are common. The shoreline itself is steep and completely covered by the boardwalk.			
Project Description	Approximately 2,000 feet of decaying decking would be removed, and the shoreline slope would be made more gradual. Nourishment (sand) would be placed where appropriate. Invasive species would be removed and replanted with native plants that would grade from emergent wetland species in the upper intertidal, scrub-shrub near and above mean higher high water (MHHW), to upland species near the top of the slope.			
Future Threats	Further decay of remnant infrastructure; Continued presence of overwater structures impairing nearshore habitat			
Project Rationale	The overwater decking that surrounds the marina is harmful to salmonid migration, useless in its current state, a public safety hazard, and prevents access to the water. The decking could be easily removed and shoreline access improved, while improving salmonid migration along the shoreline and potentially opening up new rearing areas in this crucial location.			
Functions Restored	Improved salmonid migration; Juv	enile salmonid rearing		



Table 4	4. Protection Island Road Remo	oval and RV Park Rel	ocation
Project Name	Protection Island Road Removal and F	RV Park Relocation	
Location	Ocean Shores		
3.0		Project Sponsor	Unknown
		Project Status	Conceptual
N/A		Target Activity	Water quality
		Current Ownership	Quinault Indian Tribe, DNR
		Zoning	Recreational
		Hydrogeomorphic Classification	Marine shoreline
		Project Size	6 acres
		Strategy	Debris removal, revegetation
	eastwards. The shoreline migration has caused roadway asphalt to be transported along the beach and then out to Damon Point. Eventually, the shoreline will likely migrate to Marine Drive, possibly requiring shoreline protection. At the adjacent RV Park, there are developed sites that are immediately adjacent to marine inundated areas with no vegetative buffer. Finally, there is a portion of Protection Island Road that remains on Damon Point (outside city limits in Grays Harbor County), but the road is now isolated from the mainland.		
Project Description	The roadway would be removed and disposed of at an upland disposal site. The RV Park would be relocated on other tribal land in the area. The site would be revegetated with a suite of vegetation that will buffer the existing shoreline from Marine View Drive Southeast. Substantial woody vegetation (e.g., shore pine and other shrubs) would be included in this vegetation mix to retard shoreline migration. If possible, removal of Protection Island Road on Damon Point would be included in this project, though logistically it would be more difficult than the mainland road removal and would likely require a barge.		
Future Threats	Sea level rise and wave energy increases eroding more pollutant generating surfaces; Wave-induced erosion of Marine View Drive Southeast		
Project Rationale	More than 100 feet of unused roadway remains exposed to the erosive conditions at the former connection point to Damon Point. As shown in the photo, the pavement is in contact with marine waters during high water events and has eroded progressively into the sea over the last 20 years. In addition, immediately adjacent to the road is an RV Park, with some sites having no buffer between them and the intertidal. Both the roadway and the RV Park likely contribute hydrocarbons (via leaking oil lines and gas tanks, exhaust, etc.) to the marine environment and potentially interrupt high tide migration of juvenile salmonids.		
Functions Restored	Improved water quality; Improved human safety (by slowing and preventing migration of the shoreline into Marine View Drive Southeast); Improved salmonid migration		



Table	5. Restore and E	xtend South Beach [	Priving Restrictions	
Project Name	Restore and Extend So	outh Beach Driving Restric	tions	
Location	Ocean Shores			
	Project Sponsor City			
		Project Status	Repair and Conceptual	
		Target Habitat	Marine Shoreline	
		Current Ownership	City, State	
		Zoning	N/A	
		Hydrogeomorphic Classification	Marine shoreline	
		Project Size	2 miles of Pacific Ocean shoreline	
	Strategy Shoreline and habitat protection, water quality			
	September for many years. This restriction was posted on a line of 10-12 foot high signposts running east to west across the beach. The winter storms of 2015 – 2016 destroyed all of the signage. The posts and signs need to be replaced. This project also recommends the new signs restrict driving year-round. There is no beach access road or parking lot at Marine View Drive, only a foot trail. By Driftwood St, about one-half mile south, high tide starts to hit the dunes. From there and continuing south, the bluffs grow from three feet to about 25 feet at the most eroded area of the beach near the North Jetty. This part of the beach is also known for sneaker waves that catch unsuspecting walkers and drivers who have parked their cars. Allowing vehicles in the worst erosion area also allows people to drive their trucks in and remove beach logs, which provide additional protection from erosion in the lower energy wave areas The amount of media coverage of the extensive erosion in this area is drawing increased vehicle traffic. In addition, vehicles are a known vector for contamination of water, including, but not limited to, heavy metal bioaccumulation.			
Project Description	This project would require replacing the Marine View Drive posts and signs, which should be done as storm damage repair, and adding posts on the Jetty end of the beach. Since the Jetty is a popular place to drive down to the beach, the suggested post placement is at the first private developed lot of waterfront property. The signs must be larger and more obvious than the current white-on-blue signs. Large red stop signs will probably be needed. Exceptions could be made for clamming weekends. This project would increase the likelihood of success of the South Beach Shoreline Restoration Project, described in Table1.			
Future Threats	_	~	more severe winter storms and higher by. See Future Threats in Table 1.	
Project Rationale		est project providing an incontrant site-specific project	rease in ecological function and	
Functions Restored		habitat; Water quality; Ero		



Table 6. Mariner Court Debris Removal				
Project Name Mariner Court Debris Removal				
Location	Ocean Shores			
		Project Sponsor	City	
		Project Status	Conceptual	
20		Target Activity	Debris Removal	



Project Sponsor	City
Project Status	Conceptual
Target Activity	Debris Removal
Current Ownership	City
Zoning	N/A
Hydrogeomorphic Classification	Marine shoreline
Project Size	100 feet
Strategy	Water quality

Existing Conditions	The city street Mariners Court on Grays Harbor has collapsed into the harbor due to erosion. Large chunks of asphalt are in the water. The tide washes over them. There are downed trees waterward of the asphalt.		
Project Description	This project would remove the debris, thus improving water quality and allowing the natural debris to be moved potentially ashore by the tides.		
Future Threats	Strong tides could cause the heavy sharp-edged pieces to pound against the remaining bluff, thus causing worse erosion, undercutting the bluff further. Continued leaching of chemicals into the water.		
Project Rationale	This low cost project will result in an increase in water quality as well as potential erosion protection and increased ecological function.		
Functions Restored	Water quality		

## **HABITAT BENEFITS**

Numerous benefits to habitats will result from these projects:

- The buildup of the shoreline from the coastal erosion restoration project will slowly
  accrete new dune habitat. The closure of south end beach driving will further protect
  the area of the beach threatened by erosion, increase the likelihood of success of the
  first coastal project, and reduce vehicle pollution into the clam beds and ocean waters.
- The habitat benefits from the Pacific Ocean site-specific actions will restore and protect shorelines, thus enhancing shoreline habitat, and improve water quality.
- The habitat benefits from the Grays Harbor site-specific actions will improve physical conditions for rearing and migrating salmonids using the Grays Harbor nearshore. Further revegetation of the shorelines will also provide a food source (macroinvertebrates) to both juvenile and adult salmonids. Finally, the vegetation will also provide shade that is currently lacking in many locations, though water temperature is generally not a concern in the area due to its geographic location.
- The benefits from the North Canal site-specific project will extend south into the Grand Canal and entire fresh waterway system, improving water quality and shoreline habitat.





**City of Ocean Shores**Shoreline Master Program

# Figure 1: Proposed Site-Specific Restoration Opportunities





## **RESTORATION PROGRAMS**

In addition to the site-specific actions mentioned and summarized in the previous sections, several broad-scale programs are being implemented, or are suggested to be implemented to assist with the city's restoration efforts. They are described below.

#### **Expansion of the Beach Nourishment Program**

Erosion of land at private residences and public infrastructure is a critical environmental issue in Ocean Shores. USACE guidance is clear that beach nourishment should be encouraged wherever possible. The USACE currently dredges on average (between 2000 and 2012) 887,600 cubic yards annually from the Grays Harbor Navigation Channel near Ocean Shores (USACE 2014). These efforts began more than twenty years ago after erosion destroyed the access to Westhaven State Park and threatened the city of Westport's Waste Treatment Plant. After the isthmus at the South Jetty was breached, the USACE began using a small subset of dredged material as beach nourishment, near the Westhaven State Park parking lot and at the east end of Half Moon Bay. This was made a quasi-regular practice in 2002, with placed volumes typically being between ten to twenty percent of the total volume of dredged material (USACE 2014). Although the material placed here has eroded because of wave and wind energy conditions, regular nourishment has more or less arrested the dramatic erosion that precipitated the original beach nourishment program.

Currently the most acute erosion problem throughout Ocean Shores is near the North Jetty in Ocean Shores. At that location, erosion has been a chronic problem and has been accelerating in recent years, possibly due to sea level rise and increased wave energy due to climate change (further discussed below). Although the North Jetty is further from current dredge operations, the placement of even a fraction of the currently wasted spoils could be beneficial to the community to slow erosion and prevent emergency actions, such as the placement of rock and other permanent shoreline structures.

## **Encourage Soft Shore Armoring**

In Ocean Shores, there are a large number of residential properties along the Grays Harbor shoreline. Some of these properties are subject to high intensity wave energy, especially during winter storms. Property owners in these areas usually need hard shore armoring to retain their property shorelines. However, further into the bay, the wave energy decreases significantly. In areas with low energy wave patterns, a program to encourage alternative means of protecting property and residences may be an effective way to improve shoreline ecological functions.



These are ideal conditions for soft shore armoring approaches, such as beach nourishment, revegetation, or secured wood placement. These approaches could replace existing riprap revetments or bulkheads, or could be employed on currently unarmored shorelines that are vulnerable from high water induced (sea level rise induced) erosion.

#### **Encourage Soft Shore Armoring of Duck Lake Shorelines**

In Ocean Shores, there are residential properties along the Duck Lake shoreline that have bulkheads to protect from wave action erosion of their shorelines. A program to encourage alternative means of protecting vulnerable property and residences in this area could prove to be an effective way to improve shoreline functions while still protecting shoreline property. These are ideal conditions for soft shore armoring approaches, such as vegetation buffers and secured wood placement. Although the shoreline is fragmented into small residential lots, the cumulative effect of removing multiple bulkheads will have a positive impact on no net loss.

#### **Revegetate Dune Fire Areas**

There have been several significant wildfires in the oceanfront dunes in the past ten years. As climate change brings warmer and drier summers, more wildfires can reasonably be expected. Left alone, the burnt areas quickly revegetate with invasive European dunegrass and Scotch Broom. This is an ideal condition to revegetate with native grasses and plants to create new native habitat.

#### Removal of European Beachgrass for Snowy Plover Habitat

The Western Snowy Plover is considered a Priority Species for recovery in Washington State. Although Ocean Shores is near the northern limit of the nesting range of the Western Snowy Plover, it has been well documented that European beachgrass (*Ammophila arenaria*) impairs the formation of Western Snowy Plover nesting habitat. Invasion of European beachgrass also degrades overall species richness, cutting plant diversity in half as compared to areas where native dune grasses are dominant (Barbour and Major 1990). Based on discussions with Ecology (February 2016), it is not recommended that Ocean Shores remove or mow down all European beachgrass. It does provide benefit by binding the loose, mobile sand of the coastal dunes and provides erosion protection. In contrast, Native beachgrass does not resist erosion to the same degree as the invasive grasses and might initiate landward migration of the shoreline.

However, there are areas in Ocean Shores, most particularly the northern half, where accretion is significant. There is a substantial buffer between existing development and those areas that would be a target for European beachgrass removal. In these areas, habitat for Western Snowy Plover could be expanded by selecting areas to replant native grasses and restore the physical processes that lead to Snowy Plover habitat formation (i.e., gaps in grass



clumps, interspersed with sand). These changes might also accommodate any northern shift in Western Snowy Plover populations due to climate change.

#### **Phase Out Remaining Septic Systems**

Ocean Shores installed a citywide sewer system in 1995. However, approximately 100 septic systems are still licensed with the county. The city should set a deadline of 2025 for property owners to remove or fill and seal these septic systems and connect with the city sewer system. If a lot with a septic system is not in use, then the septic tank should be removed, or filled and sealed per city and county regulations, and should be required to connect to the city sewer system.

#### **Remove Abandoned Creosote-Treated Pilings**

Recently WDNR completed a survey of abandoned creosote-treated piles in Grays Harbor (WDNR 2014). Puget Sound has had a program to remove abandon creosote-treated pilings since 2004. This program has removed more than 14,000 tons of creosote-treated timber from Puget Sound since its inception (WDNR 2015). Removal of these pilings not only has ecological benefits, but also has human health benefits, particularly in Grays Harbor where recreational shellfish harvesting is a key shoreline activity.

#### **Remove Derelict Homes**

There are, and could be in the future, derelict homes within the shoreline jurisdiction in Ocean Shores. Removal of these homes would benefit nearby shorelines through the reduction of impervious surface and reduction in contaminant loading. It would also benefit human health, as derelict homes are a known vector for human diseases and vermin (Shane 2012). They can also attract illegal dumping, leading to further contamination of nearby water bodies. This program could also improve property values and benefit public safety, as derelict homes typically depress property values and increase local crime rates (Shane 2012). Cataloging these homes throughout the shoreline jurisdiction is the first step in the removal process. After cataloging, Ocean Shores should prioritize those homes that would provide the greatest ecological benefit if removed and begin negotiations with property owners. Where possible, properties with derelict homes should be acquired, the properties revegetated, and any placed fill removed to provide further habitat benefits.

#### **Remove Derelict Docks**

There are, and could be in the future, derelict docks within the shoreline jurisdiction of Ocean Shores. Removal of these docks would benefit shorelines by leaving them open and natural. Some of these older docks might also have treated wood in the water that is no



longer in compliance with WDFW standards, so removal has additional ecological benefits. This program could also improve property values and benefit public safety. Cataloging these docks throughout the shoreline jurisdiction is the first step in the removal process. This could be a possible project for the Fresh Waterways organization. After cataloging, Ocean Shores should prioritize those docks that would provide the greatest ecological benefit if removed, and begin negotiations with property owners. Where possible, the docks should be removed, the shoreline revegetated, and any placed fill removed to provide further habitat benefits.

#### Implement a Noxious/ Invasive Weed Removal Program

The city, Ecology, and the OSFWC control weed spraying and removal on the fresh waterways. Property owners are not allowed to use pesticides or herbicides in the water. Many efforts have been made to remove the most troublesome weeds, for example Brazilian elodea. Projects have included stocking grass carp to eat the weeds, building a weed harvesting boat, and systematic chemical spraying. However, the best way to get rid of Brazilian elodea is to pull it. A recent effort was undertaken in parts of the Chehalis River Basin to do this. It requires a lot of transportation equipment and physical labor. The OSFWC could seek grants to plan multiple projects like this in the fresh waterways system.

Although property owners are not allowed to spray in the water, it is important that they be educated on what they can do on their own shoreline property to minimize chemical runoff into the waters. In addition to the public outreach programs mentioned below, a citywide program to assist homeowners with specific weed removal methods should be considered. For example, Scotch Broom is best removed without chemicals, but with a tool called a Weed Wrench™. Knotweed eradication is only effective with a specific pesticide that requires scheduled spraying and a pesticide license. The OSFWC already provides homeowners with special rakes for removing shoreline weeds. They could also provide Weed Wrenches™ and coordinate a knotweed spraying program.

#### **Monitor Success of Restoration Projects**

One of the primary means to ensure success of restoration projects in meeting the goal of restoring ecological functions is to monitor existing and future restoration projects to determine if they are performing as designed, and to evaluate the effectiveness of different approaches. Whenever possible, monitoring of future restoration projects should include baseline monitoring prior to project construction, as that is critical to understanding and demonstrating the effects of restoration.

Determining a physical and ecological baseline is crucial for documenting the ecological improvement resulting from restoration projects. As such, it is recommended that all of the proposed and potential restoration projects be monitored both prior to and following their construction and that such monitoring be included as part of the project implementation and funding.



#### **Develop Public Outreach and Educational Programs**

Public outreach and education is a key restoration plan strategy. As property owners become increasingly aware of the important roles of shoreline vegetation and natural geomorphic processes, it is expected that more property owners will initiate private restoration projects.

One of the largest stressors on the ecological health of Ocean Shores is the cumulative impact of private development that alters important shoreline ecological functions. Thus, homeowner education on activities that would improve shoreline conditions is viewed as an essential strategy for maintaining and improving ecological conditions along the shoreline. Reduction and removal of such impacts will be more common and effective with an educated shoreline populace. Educating landowners on the effects of their activities on shoreline functions can help to ensure those functions are maintain or improved.

Programs could include providing information and education on a variety of topics such as the importance of shoreline vegetation buffers, limiting the use of yard chemicals that drain into the waterways, limiting the use of broad-spectrum herbicides, identification of invasive weeds and the proper time and method to remove them, and using native plants in their landscape.

Educational programs could also include stormwater education, which would help residents become more aware that their storm drains contribute to the water used by aquatic species. A program could be developed similar to the one set up by the Puget Sound Partnership for Puget Sound (Puget Sound Starts Here 2014: <a href="http://www.pugetsoundstartshere.org/">http://www.pugetsoundstartshere.org/</a>). Such education could also help minimize illicit discharges into the city's important water bodies.



# COMMUNITY RESOURCES AND PARTNERS FOR RESTORATION

The following programs, organizations, and agencies support the types of restoration projects described in this plan. There are local organizations described that could lead the work or serve as partners to accomplish restoration goals as well as organizations that will fund restoration projects that meet their mission.

## Ocean Shores Fresh Waterways Corporation and the City of Ocean Shores Advisory Board

These two organizations work to preserve and improve the quality and safety of the city's fresh waterways. The Advisory Board is a City Council-appointed board that advises the city in the areas of fresh waterways administration and maintenance. The Corporation is a non-profit 501(c)(3). Through the work of members and volunteers, the two organizations' activities include work parties, weed control, erosion control, monthly water sampling, education, and fundraising. They also sponsor several annual events on the waterways.

## **Coastal Interpretive Center**

The mission of the Coastal Interpretive Center is to educate the public concerning natural and man-made environments through presentation of the history and ecology of Washington State's coastal life. They have a professional staff that seeks grants and donations to maintain and improve their educational displays and programs, in addition to a large a group of dedicated volunteers and members. In addition to the learning experience in and around the Center, they are also interested in getting children out into nature to learn to be stewards of the natural world.

## Salmon Recovery Funding Board

In 1999, the Washington State legislature created the Salmon Recovery Funding Board (SRFB), which is now administered by the Puget Sound Partnership. The SRFB provides grants to protect or restore salmon habitat. Composed of five citizens appointed by the governor and five state agency directors, the SRFB brings together the experiences and viewpoints of citizens and the major state natural resource agencies.



## **Aquatic Lands Enhancement Account**

In 1984, the Washington State legislature created the Aquatic Lands Enhancement Account (ALEA) to ensure that money generated from aquatic lands was used to protect and enhance those lands. Aquatic lands are all tidelands, shore lands, harbor areas, and the beds of navigable waters. ALEA grants may be used for the acquisition, improvement, or protection of aquatic lands for public purposes. They also may be used to provide or improve public access to the waterfront. The ALEA program is targeted at re-establishing the natural, self-sustaining ecological functions of the waterfront, providing or restoring public access to the water, and increasing public awareness of aquatic lands as a finite natural resource and irreplaceable public heritage. It is administered by the Washington State Recreation and Conservation Office and is funded almost entirely by revenue generated by WDNR's management of state-owned aquatic lands (WSRCO 2014).

## **Washington Wildlife and Recreation Program**

The Washington Wildlife and Recreation Program (WWRP) is a state grant program that provides a variety of funding programs to protect habitat, restore habitat and species, and acquire properties with valuable natural resources. It is administered by the Washington State Recreation and Conservation Office and is funded by the legislature in the state's capital construction budget (WWRP 2014).

- The Critical Habitat Category fund program provides funding to protect habitat for wildlife including habitat for endangered, threatened, or sensitive species. Project sites may include high-quality habitat or degraded habitat that once restored will support the target species.
- The Natural Areas Category fund provides funding to protect high quality, representative native ecosystems or unique plant or animal communities, endangered, threatened, or sensitive species, rare geological features, or similar features of scientific or educational value. Project sites must have, to a major degree, retained their natural character and be managed primarily for resource preservation, protection, and study.
- The Riparian Protection Category fund provides funding to protect riparian areas.
   Projects may include a wide variety of site conditions on either fresh or saltwater riparian areas.
   Projects must include property acquisition.
   Projects to extend riparian protection for a minimum of 25 years on lands enrolled in the federal Conservation Enhancement Reserve Program are allowed.
- The State Lands Restoration and Enhancement fund provides funding to two state
  agencies (WDNR and WDFW) to repair damaged plant and animal habitat. Restoration
  projects must bring a site back to its original function through activities that will help the
  site be self-sustaining. Enhancement projects must improve the ecological functionality
  of a site.



• The Urban Wildlife Habitat Category fund provides funding to conserve wildlife habitat in Ocean Shores. Projects must be within five miles of, or inside a city or town (or its adopted urban growth area boundary) with a population of at least 5,000, which would apply to the entire Ocean Shores shoreline jurisdiction.

#### **NOAA Fisheries**

National Oceanic and Atmospheric Administration (NOAA) Fisheries funds land conservation and restoration projects through multiple programs. The particular goals of these programs and level of available funding can vary from year to year. Examples of these programs include the Coastal and Estuarine Land Conservation Program (CELCP) and the Pacific Coastal Salmon Recovery Fund.

- The CELCP provides matching funds to state and local governments to purchase threatened coastal and estuarine lands or obtain conservation easements. To be considered for funding, the land must be important ecologically or possess other coastal conservation values, such as historical features, scenic views, or recreational opportunities.
- Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) in 2000 to reverse the declines of Pacific salmon and steelhead, supporting conservation efforts in California, Oregon, Washington, Idaho, and Alaska. The program, administered by NOAA, is essential to preventing the extinction of the 28 listed salmon and steelhead species on the West Coast and, in many cases, has stabilized the populations and contributed to their recovery course (NOAA Fisheries West Coast Region 2014). The PCSRF has funded most of the work performed by the Wild Fish Conservancy described herein (Sandell et al. 2011, 2013, and 2014; Sandell and McAninch 2013).

## **US Fish and Wildlife Service**

The US Fish and Wildlife Service has grant programs that fund restoration-oriented projects. These programs are often tailored to particular goals of the agency and they can vary from year to year. However, it is likely that there are programs that would apply to the restoration goals described herein, particularly projects that support protection of endangered species and critical habitats.

• The Chehalis Fisheries Restoration Program provides funding for habitat restoration in the Chehalis River and Grays Harbor Basins (USFWS 2014). Private landowners, nonprofit organizations, and local, tribal, state, or federal agencies are eligible to apply for funding through this program. The Chehalis Fisheries Restoration Program funds a variety of projects, including fish passage barrier corrections, removal of invasive species, native plant revegetation, riparian and off-channel fish habitat restoration, agricultural wetland restoration for fish use, and monitoring of fish use of these habitats.



- The National Fish Passage Program provides funding to restore native fish and other
  aquatic species to self-sustaining levels by reconnecting habitat that has been
  fragmented by human-made barriers (USFWS 2014). Private landowners, nonprofit
  organizations, and local, tribal, state, or federal agencies are eligible to apply for
  funding through this program.
- The North American Wetlands Conservation Act (NAWCA) Small Grants is a competitive, matching grants program created in 1996 to promote public-private partnerships and encourage smaller-scale, long-term wetland conservation projects that may otherwise not be able to compete in the US Standard Grants Program (USFWS 2014). Projects must involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefit of all wetland-associated migratory birds. Grants requests may not exceed \$75,000 and funding priority is given to new grantees or partners.
- The Western Native Trout Initiative funds a variety of projects, including riparian restoration, invasive species removal, fish passage barrier correction, and wetland and estuary restoration. The mission of the Western Native Trout Initiative is to serve as a catalyst for the implementation of conservation or management actions, through partnerships and cooperative efforts that result in improved trout species status, improved aquatic habitats, and improved recreational opportunities (WNTI 2007). Private landowners, nonprofit organizations, and local, tribal, state, or federal agencies are eligible to apply for funding through this program (USFWS 2014).

## **Aquatic Restoration Program**

The Aquatic Restoration Program is run by WDNR to establish partnerships with agencies and organizations to restore, enhance, create, and protect healthy ecological conditions in freshwater, saltwater, and estuarine aquatic systems (WSDNRARP 2014). Matching funds in this program require a 1:1 ratio with the goal to provide seed money for projects that leverage existing funds to increase the restoration benefits. Funding provided by the Aquatic Restoration Program is restricted to on-the-ground portions of restoration projects, including on-site preparation and implementation of restoration related activities.

## Wild Fish Conservancy

A nonprofit conservation organization headquartered in Duvall, Washington, Wild Fish Conservancy is dedicated to the recovery and conservation of the region's wild fish ecosystems. Through science, education, and advocacy, Wild Fish Conservancy promotes technically and socially responsible habitat, hatchery, and harvest management to better sustain the region's wild fish heritage (Wild Fish Conservancy 2014). Wild Fish Conservancy has been active in supporting ecological restoration in Grays Harbor through a series of recent studies looking at the most effective ways of improving wild fish numbers in Grays Harbor (Sandell et al. 2011, 2013, and 2014; Sandell and McAninch 2013).



## The Nature Conservancy

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. The Nature Conservancy achieves this mission through the dedicated efforts of a diverse staff, including more than 600 scientists, located in all 50 US states and more than 35 countries, and with the help of many partners, from individuals and governments to local nonprofits and corporations (The Nature Conservancy 2014). The Nature Conservancy has most recently worked in Grays Harbor in collaboration with the Quinault Indian Tribe and WDNR to remove derelict fishing gear from throughout the harbor (Pacific Marine and Estuarine Fish Habitat Partnership 2014).

## **Friends of Grays Harbor**

The Friends of Grays Harbor (FOGH) is a nonprofit citizen's group consisting of crabbers, fishers, oyster growers, and other concerned citizens that advocate for a healthy Grays Harbor estuary. The goal of FOGH is to protect the natural environment and human health in Grays Harbor and surrounding areas via science, advocacy, law, activism, and empowerment (FOGH 2014).



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## IMPLEMENTATION AND MONITORING

Effective implementation of restoration projects and programs may require both regulatory and non-regulatory approaches to be effective. While technically feasible, many of the suggested restoration strategies are extremely challenging from a socio-political perspective and will require consensus on what needs to be accomplished and how.

## **Timelines and Benchmarks**

Many aspects of restoration can be highly opportunistic, for example, where one finds a willing landowner; or where an event, such as a road failure due to flood-induced erosion that requires immediate repair, creates an opportunity for a more ecologically beneficial solution. Establishing timelines is further complicated by the fact that shoreline restoration may largely depend on grant funding, which is unpredictable at best. That said, it is still important to set specific timelines and benchmarks to ensure progress.

A suggested timeline for initiating implementation of this plan is as follows. The timeline assumes funding and staffing is available and additional issues do not preclude completing the projects, such as ownership or zoning issues, natural changes such as erosion, or other unforeseen circumstances.

Within seven years of adoption of this plan, the city should:

- Complete one listed site-specific project;
- Develop and implement at least one restoration program; and
- Develop and implement one public outreach and education project to engage private landowners in restoration activities.

Within seven to fourteen years of adoption of this plan, the city should:

- Complete one additional listed site-specific project;
- Develop and implement at least one additional restoration program; and
- Develop and implement one additional public outreach and education project to engage private landowners in restoration activities.

Every ten years thereafter, the city should:

- Complete one additional listed site-specific project; and
- Develop and implement one additional restoration program.



Over time, restoration efforts must be evaluated against a set of benchmarks to determine if adequate progress is being made. Progress can be tracked by reporting benchmarks such as the examples below:

- Acres of wetland restored in the shoreline jurisdiction;
- Acres of noxious weed removal and native vegetation planted; or
- Number of restoration actions implemented.

In the context of the SMP update, restoration planning is a long-term effort. The SMP guidelines include the general goal that local master programs "... include planning elements that, when implemented, serve to improve the overall condition of habitat and resources within the shoreline area" (WAC 173-26-201(c)). The legislature has provided an overall timeframe for future amendments to the SMPs. A jurisdiction is required to review its SMP once every eight years (beginning on or before June 30, 2022), and amend the program if necessary (RCW 90.58.080(4)). During this review period, the city should document progress toward achieving shoreline restoration goals. The review could include:

- Re-evaluating adopted restoration goals, objectives, and policies.
- Summarizing both planning efforts (including application for and securing grant funds) and on-the-ground actions undertaken in the interim to meet those goals.
- Revising the SMP restoration plan to reflect changes in priorities or objectives.

## **Funding**

Potential funding sources for restoration projects and programs are identified in the report section *Community Resources and Partners for Restoration*. In addition to outside funding sources, it may benefit the Ocean Shores restoration efforts to incorporate projects with restoration elements into the city's Capital Improvements Program (CIP) to ensure that shoreline restoration is considered during the budget process. Another option would be to develop a tax-based fund specifically created for restoration projects. It is expected that restoration funding will be derived from a variety of sources selected for their appropriateness to the project or program goals.

## **Monitoring Strategies**

Ocean Shores is required to monitor the effectiveness of their SMP, including this restoration plan, over time to assess whether net loss of ecological functions and processes is occurring. This will require tracking shoreline development activities to ensure permit compliance, periodically reassessing the ecological health and status of shoreline resources, and charting the timelines and benchmarks recommended in the previous section. The latter should include identifying which restoration activities have occurred compared to the stated goals,



objectives, and priorities of this plan. Should restoration projects fall short of being implemented within the general periods recommended in this plan (see *Timelines and Benchmarks* section); the city should take specific steps to remedy that situation in order to remain compliant with the SMP. An annual review of restoration efforts including projects and programs is recommended



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## **DATA GAPS**

## **Monitoring Results**

One of the largest data gaps found during the preparation of this plan was the lack of information on the effectiveness of past and current restoration activities in Ocean Shores. Monitoring of sites has been limited, though that may improve with the establishment of an operating mitigation bank at the Weatherwax property in the city. Such monitoring data should then be used to educate the public, gauge cost effectiveness and determine effectiveness at different approaches. The Weatherwax bank may serve as an excellent opportunity to experiment with restorative approaches, particularly for improving the freshwater shorelines within the city.

## **Climate Change**

The Wild Fish Conservancy recently completed an analysis of climate change for Grays Harbor for the specific purposes of identifying climate-adaptable restoration projects in the Grays Harbor estuary (Sandell and McAninch 2013). Sea level rise and wave energy changes, discussed separately below, will each have their own impact on restoration success and viability. Despite the recent progress in these areas, understanding how these processes will change over time and interact remains a crucial data gap for Ocean Shores.

#### Sea Level Rise

Sandell and McAninch (2013) summarized sea level rise estimates in the estuary as being produced by the combined effects of global sea level rise and local factors, such as vertical land deformation (e.g., tectonic movements) and seasonal water surface elevation changes due to atmospheric circulation effects. Within Ocean Shores, there is little if any tectonic motion (Verdonck 2006; Central Washington University 2014), so sea levels reflect eustatic (globally averaged) changes (Canning 2005; Mote et al. 2008). This explains the relatively modest sea level rise observed at Toke Point, the nearest sea level NOAA gage, in the twentieth century (1.60 mm per year) (NOAA 2014).

With that said, recent (within the last 30 years) sea level rise has been suppressed by large-scale oceanographic processes, the reversal of which may trigger acceleration of sea level rise in the near future (Bromirski et al. 2011). It is also important to consider these predicted changes in known interannual sea level variability associated with El Niño. Mojfeld (1992) has shown that during El Niño years the average water level can be up to one foot higher than in ordinary winters, with deviations during storms of up to three feet.

Therefore, it is expected that lower areas will convert from upland to marsh areas over the next fifty years (e.g., low lying areas on the east edge of Westport: Sandell and McAninch



[2013]). This conversion will decrease the viability of these extremely low-lying lands to be anything other than intertidal marshes. However, it is unclear how these processes will interact, since they are dependent on the nature of the sea level rise (i.e., episodic events versus gradual conversion to intertidal area, see below) and future development. Even though the Sandell and McAninch (2013) model is capable of producing estimates of conversion time scales for different habitat types, the approximations inherent in the model likely limit its applicability at the site scale. Therefore, continued review of sea level rise research will be important to ensuring restoration projects are designed and sited appropriately to be sustainable given expected sea level changes.

## Wave Energy Changes

There are well-documented historical increases in wave energy in the North Pacific Ocean (Allan and Komar 2006; Ruggiero et al. 2010; Bromirski et al. 2013). Allan and Komar (2006) found that between 1975 and 2000, peak wave heights offshore of Ocean Shores increased by 2.7 meters (9 feet). They speculated, and later work confirmed (Bromirski et al. 2013), that these increases were due to climate change and are expected continue to an unknown degree in the future. These changes are related to the same basin-scale dynamics that drive regional changes in sea level rise, though they do have their own internal patterns, which can often dominate the larger overall trend (Bromirski et al. 2013). It is unclear how these changes will interact with sea level, but it is likely that they will exacerbate erosion at both jetties, unless proactive actions are taken such as placement of dredge spoils as nourishment. These changes will no doubt affect restoration projects planned on the exposed coast, but the extent to which this will occur is largely unknown and therefore a data gap.



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