Padilla Bay National Estuarine Research Reserve

Management Plan

2016-2020

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Management Plan
2016-2020

Prepared by:

Padilla Bay NERR
10441 Bayview-Edison Road
Mount Vernon WA 98273
(360)428-1558

www.padillabay.gov

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Acronyms

ACLIPSE:	Advancing Climate Literacy through In-Service and Pre-Service Educators
ACOE:	United States Army Corps of Engineers
ADA:	Americans with Disabilities Act
AED:	Automatic External Defibrillator
BNSF:	Burlington Northern Santa Fe (Railway)
B-WET:	Bay-Watershed Education and Training
C-CAP:	Coastal Change Analysis Program
CDMO:	Central Data Management Office
CELCP:	Coastal and Estuarine Land Conservation Program
CERCC:	Coastal Ecosystem Response to Climate Change
CERF:	Coastal and Estuarine Research Federation
CFR:	Code of Federal Regulations
CMO:	Coastal Management Office
CPR:	Cardio Pulmonary Resuscitation
CSC:	Coastal Services Center
CTP:	Coastal Training Program
CTPC:	Coastal Training Program Coordinator
CVP:	Coastal Volunteer Program
CZM:	Coastal Zone Management
CZMA:	Coastal Zone Management Act
DES:	Washington State Department of Enterprise Services
DRP:	Disaster Response Plan
DSP:	Diarrhetic Shellfish Poisoning
ECO:	Education, Communication, Outreach
EIS:	Environmental Impact Statement
ENSO:	El Niño Southern Oscillation
EPA:	United States Environmental Protection Agency
ESRI:	Environmental Systems Research Institute
ESRP:	Estuary and Salmon Recovery Program
FEMA:	Federal Emergency Management Agency
FHL:	Friday Harbor Laboratory
FTE:	Full Time Equivalent
GIS:	Geographic Information Systems
GISP:	Geographic Information Systems Professional
GDP:	Gross Domestic Product
GPS:	Global Positioning System
HVAC:	Heating, Ventilation, Air Conditioning
KEEP:	Kindergarten – 12th Estuary Education Program
LED:	Light Emitting Diode
LEPC:	Local Emergency Planning Committee
LIDAR:	Light Detection and Ranging
MARINe:	Multi-Agency Rocky Intertidal Network

Acronyms

MEM:	Marsh Equilibration Model
MHHW:	Mean Higher High Water
MLLW:	Mean Lower Low Water
MRC:	Marine Resources Committee
NCI:	North Cascades Institute
NANOOS:	Northwest Association of Networked Ocean Observing Systems
NERR:	National Estuarine Research Reserve
NERRA:	National Estuarine Research Reserve Association
NERRS:	National Estuarine Research Reserve System
NNOCCI:	National Network for Ocean and Climate Change Interpretation
NOAA:	National Oceanic and Atmospheric Administration
NRCA:	Natural Resource Conservation Area
NRCS:	Natural Resources Conservation Service
NSRS:	National Spatial Reference System
NWAC:	Northwest Area Committee
NWESD:	Northwest Educational Service District
OA:	Ocean Acidification
OCM:	Office for Coastal Management
OCRM:	Office of Coastal Resource Management
PADI:	Professional Association of Diving Instructors
PBF:	Padilla Bay Foundation
PBNERR:	Padilla Bay National Estuarine Research Reserve
PCBs:	Polychlorinated Biphenyls
PDF:	Portable Document Format
PDO:	Pacific Decadal Oscillation
PERS:	Pacific Estuarine Research Society
PIC:	Pollution Identification and Correction
PNNL:	Pacific Northwest National Laboratory
PSEMP:	Puget Sound Environmental Monitoring Program
PSNRP:	Puget Sound Nearshore Restoration Program
PSP:	Paralytic Shellfish Poisoning
PSP:	Puget Sound Partnership
QA/QC:	Quality Assurance/Quality Control
RTK:	Real-Time Kinematic
SCEA:	Skagit Conservation Education Alliance
SCD:	Skagit Conservation District
SCUBA:	Self-Contained Underwater Breathing Apparatus
SEA:	Shorelands and Environmental Assistance
SEAP:	Shorelands and Environmental Assistance Program
SET:	Surface Elevation Table
SSAM1:	Sentinel Site Application Module 1
STEM:	Science, Technology, Engineering, Mathematics
SWMP:	System-Wide Monitoring Program

Acronyms

SWSS:	Sea Star Wasting Syndrome
TOTE:	Teachers On The Estuary
USFWS:	United States Fish and Wildlife Service
USGS:	United States Geological Service
UW:	University of Washington
WAURISA:	Washington Urban and Regional Information Systems Association
WCC:	Washington Conservation Corps
WDFW:	Washington State Department of Fish and Wildlife
WDNR:	Washington State Department of Natural Resources
WERC:	Western Ecological Research Center
WSU:	Washington State University
WWU:	Western Washington University
YSI:	Yellow Springs Instruments, Inc.

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Executive Summary

This management plan was developed to guide the Padilla Bay NERR's activities and direction over the next five years (2016-2020). Reserve priorities were determined by reviewing relevant documents such as the NERRS Strategic Plan (2011-2016) and NERRS Research and Monitoring Plan (2012-2017), along with agency and stakeholder input. The Reserve has developed meaningful and informed goals with these priorities in mind.

Padilla Bay NERR was designated as the nation's eighth National Estuarine Research Reserve in August 1980. Within the NERRS, it represents the Columbian biogeographic region and the Puget Sound sub-region. The 11,966-acre Reserve is located in western Skagit County in western Washington State, north of Seattle and south of Bellingham. The Washington State Department of Ecology (Ecology) is the Reserve's managing agency with a strategic focus on preventing and reducing toxic threats, delivering integrated water solutions, reducing and preparing for climate impacts, and protecting and restoring Puget Sound. Padilla Bay NERR plays a key role for the agency in the latter two objectives.

Padilla Bay is an estuarine system within the larger Skagit River delta and located along the fertile Puget Sound lowlands adjacent to the San Juan Archipelago. The Reserve contains upland and aquatic habitats that support a wide variety of plant and animal species, many of high commercial and recreational value. It is representative of the greater Puget Sound biogeographic region and is currently the only NERRS designated in Washington State. Habitats in the Reserve range from forested uplands to deep water benthic environments. The majority of the Bay is intertidal with extensive meadows of eelgrass that provide homes and nursery areas for species such as Dungeness crab, juvenile salmon, and hundreds of thousands of waterfowl and marine birds. The Reserve is located in an area that is rural and agricultural with nearby industrial development and offers recreational and educational opportunities for citizens and visitors to the area.

Padilla Bay NERR operates in partnership with many other agencies, organizations, tribes, and volunteers, and relies on advisory committees and a non-profit foundation (Padilla Bay Foundation) to carry out its mission. Many local and regional (Puget Sound) management issues are part of the Reserve's work plan. Responsibilities for addressing these issues reside with the managing agency (Ecology), the Puget Sound Parnership (PSP), and a host of other federal, state, local and tribal governments.

The Reserve's priority coastal management issues currently are:

- Climate change impacts: The Reserve is educating planners and local residents about the impacts they can expect and how to adapt and adjust.
- Water quality in estuaries and watersheds: The Reserve's SWMP program monitors water quality in the estuary and the Skagit Conservation District's Citizen Science programs (Stream Team and Storm Team) help monitor water quality in the streams and sloughs emptying into major

water bodies (Samish Bay, Padilla Bay) in this area. Our education program manages the volunteers for this effort.

- Invasive species impacts: The Reserve implements and models invasive species best management practices (invasive species decontamination protocols, survey and control methods).
- Loss of shoreline processes: The Coastal Training Program offer classes such as "Nearshore Geological Processes" for coastal planners.
- Habitat loss: Habitat loss is important and can range from changes in natural resources use or health (such as seagrasses) to increased storm frequency or strength leading to erosion.

Padilla Bay NERR is unique in this area because its primary focus is on estuaries, why they are important, and the coastal zone management issues associated with them. The Reserve's staff are skilled at making scientific information understandable for stakeholders, partners and other Reserves.

The Education Program provides programs for school children from pre-school to college. They implement a K-12 Estuary Education Program (KEEP) and offer Teachers on the Estuary (TOTE) workshops for teachers. They also offer a wide range of programs for the public and classes about climate change.

The Coastal Training Program (CTP) targets planners in Washington State. The CTP develops classes (such as a Climate Change Workshop) using needs assessments and guidance from the CTP Advisory Committee. This kind of education leads to better decisions by planners and lessens impacts on natural resources.

The Research and Monitoring Program coordinates and implements the NERR System Wide Monitoring Program (SWMP), promotes research in Padilla Bay and provides information to researchers about NERRS Science Collaborative funding. The System-Wide Monitoring Program collects data on water quality, weather, and eelgrasses and is available to the public via a website managed by the Central Data Management Office (CDMO).

The Natural Resources Stewardship Program develops relationships with stakeholders to better understand how the Reserve's resources are managed by other agencies and used by the public. Natural resources staff implement programs to monitor invasive species, manage noxious weeds, and get baseline data on resources.

The Reserve is committed to remaining a vital resource for the community, region, state, and nation. Always evolving, PBNERR is dedicated to engaging the public and volunteers, staying abreast of the latest issues and opportunities, and encouraging science-based exploration and learning.

The Strategic Plan in Chapter 2 addresses the Reserve's goals, objectives and actions for 2016-2020. Specific objectives and actions are found at the end of each chapter.

Chapter 1 – Introduction

Introduction to the National Estuarine Research Reserve System

The National Estuarine Reserve System (NERRS) was created by the Coastal Zone Management Act of 1972, as amended, to augment the National Coastal Zone Management Program which is dedicated to comprehensive, sustainable management of the nation's coasts.

The Reserve System is a network of protected areas representative of the various biogeographic regions and estuarine types in the United States. Reserves are established for long-term research, education and interpretation to promote informed management of the Nation's estuaries and coastal habitats (15 C.F.R. § 921.1(a)). The Reserve System currently consists of 28 reserves in 23 states and territories, protecting over one million acres of estuarine lands and waters (Fig. 1.1).

The Reserve System is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance and technical assistance. The state partner manages reserve resources on a daily basis working collaboratively with local and regional partners.

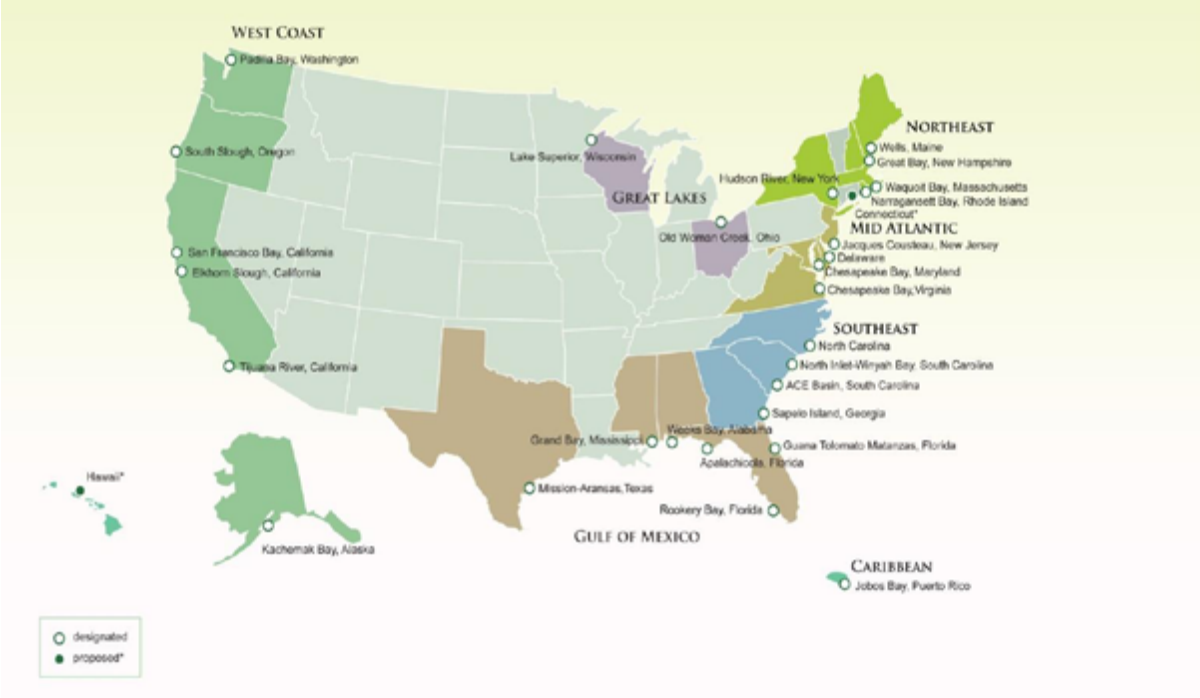


Figure 1.1 National Estuarine Research Reserve System Map

National Estuarine Research Reserve System Strategic Goals

Estuaries are biologically rich, economically valuable, and highly vulnerable ecosystems. The vision and mission of the Reserve System reflect the importance of these systems within our communities.

> Vision: Resilient estuaries and coastal watersheds where human and natural communities thrive.
>
> Mission: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas.

The program goals, per Federal regulations 15 C.F.R. § 921.1(b), outline five specific goals for the Reserve System:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the system;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

These foundational goals are complemented by those that are systematically set by the program every five years. Strategic planning has been an integral part of the National Estuarine Research Reserve System for nearly twenty years. The planning process is designed to bridge national program direction with local coastal management needs through a representative and participatory process that supports NOAA's mission of science, service, and stewardship. The 2011-2016 Reserve System Strategic Plan focuses reserves' core strengths of research, education, and training on three core issues: climate change, habitat protection, and water quality. The Reserve System Strategic Plan Goals are:

1. Protected Places: Estuaries and coastal watersheds are better protected and managed by implementing place-based approaches at reserves.
2. Science: National Estuarine Research Reserve System scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds.
3. People: National Estuarine Research Reserve System education and train-

ing increase participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds.

Biogeographic Regions and Boundaries of the National Estuarine Research Reserve System

NOAA has identified eleven distinct biogeographic regions and 29 sub-regions in the United States, each of which contains several types of estuarine ecosystems (15 C.F.R. § 921.1(a)), Appendix A). When complete, the Reserve System will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2014, the Reserve System includes 28 reserves and two states in the process of designating a reserve.

Reserve boundary size will vary greatly depending on the nature of the ecosystem. Boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Reserve boundaries encompass areas for which adequate state control has or will be established by the managing entity over human activities occurring within the reserve. Reserve boundaries include a "core" area which is comprised of key lands and waters encompassing resources representative of the total ecosystem, which if compromised could endanger the research objectives of the reserve. Reserve boundaries also include a "buffer" area designed to protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. Buffer areas may also include areas necessary for research and interpretation facilities. Additionally, buffer areas are identified to accommodate a shift of the core area as a result of biological, ecological or geo-morphological change, which reasonably could be expected to occur. (15 C.F.R. § 921.11(c)(3))

National Estuarine Research Reserve Administrative Framework

The process for federal designation of a National Estuarine Research Reserve has many steps and involves many individuals and organizations. While each reserve is a partnership program between NOAA and a coastal state, there are many entities that collaborate to support designation of a reserve. Other partners include federal and state agencies, non-profit groups, universities and members of the local community. For more information on the designation process see nerrs.noaa.gov/about/designation-process.html.

Upon designation, the reserve implements the approved management plan and is eligible for NOAA financial assistance on a cost-share basis with the state. A reserve may apply to NOAA for funds to help support implementation of the management plan largely funding operations, research, monitoring, education/interpretation, training, stewardship, development projects, facility construction, and land acquisition. Management plans provide a vision and framework to guide reserve activities during a five-year

period and enable the reserves and NOAA to track progress and realize opportunities for growth. Each management plan contains the reserve goals, objectives, and strategies supported by programs focused on research and monitoring, education and outreach, training, and stewardship. They also outline administration, public access, land acquisition and facility plans and needs, as well as restoration and resource manipulation plans, if applicable. Reserves are increasingly confronted with complex questions regarding new uses in or near reserves that may or may not be compatible with the Reserve System's mission. A thoughtful and comprehensive management plan provides a foundation for addressing these challenges to protect and manage reserve resources wisely and ensure the public and coastal decision makers value and protect coastal resources.

NOAA administers the Reserve System and establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the Reserve System, and integrates information from individual reserves and programs to support decision-making at the national level. Additionally, NOAA periodically evaluates reserves for compliance with federal requirements and with the individual reserve's federally approved management plan, as mandated under Section 312 of the Coastal Zone Management Act (15 C.F.R. § 921.40).

NOAA currently provides leadership and support for three system-wide programs including the System-Wide Monitoring Program (SWMP), the K-12 Estuarine Education Program (KEEP), and the Coastal Training Program (CTP), as well as the NERRS Science Collaborative. They also provide support for initiatives focused on the Reserve System's priorities: climate change, water quality and habitat protection.

Introduction to the Padilla Bay NERR

Local History

Evidence shows Native American habitation in the general Padilla Bay-Skagit River area for at least 5,000 years. Several prehistoric sites are found near Padilla Bay but none actually on the bay or its margin. This is probably due to extensive diking which occurred in the late 19th and early 20th centuries. Habitation by Native Americans elsewhere in Washington can be traced back some 12,000 to 15,000 years. The Noo-Wha-Ah, the Samish, and the Swinomish all used the resources of Padilla Bay.

Spanish explorers traveled through Skagit and Padilla Bay in the 1790s and Padilla Bay was "discovered" by Jose Narvaez and named after the Viceroy of Mexico, Juan Vicente de Guemes Pacheco de Padilla. Many of the islands and landforms in northern Puget Sound were named by the original Spanish explorers.

In the early 1800s, many Native American tribes were decimated by diseases brought by white trappers, traders, and settlers. The Swinomish tribe has hunted and fished at Padilla Bay for hundreds of years. The current boundary of the Swinomish Reservation is adjacent and across the channel from the southwest boundary of the Reserve.

The earliest settlers built log cabins on Fidalgo Island in 1858 (just west of Padilla Bay). In 1867 a trading post was erected about five miles south of Padilla Bay on the Swino-mish flats in La Conner. Shortly thereafter the agricultural and timber potential of the area was recognized. In 1867, a logging camp was established on Samish Island at the north end of Padilla Bay. The wetlands that separated Samish Island from the diked mainland were eventually diked and filled, making it an island no longer. By 1888 eleven camps were situated between Edison (to the east of Padilla Bay), and Bay View, near the southern end of the bay. In 1874 much of the area was served by steamboats as there were few roads. Land access was limited to horse trails and short, local wooden plank roads, called puncheon roads.

By 1882 the community of Bay View had a butcher shop, hotel/saloon and other stores. One of the state's biggest logging companies was headquartered there. By 1890 most of the area had been logged off except portions of Bay View Ridge, and this area was soon to be cut. Huge fires consumed large areas of the ridge and the thriving community of Bay View in 1910. Bay View was never rebuilt to its previous size. This logging and clearing, along with the diking of the southern end of the bay, brought a pronounced agricultural movement to the region that thrives to this day. The original marsh areas, when diked and flushed with freshwater, provided much valuable acreage for farms and brought even more settlers to the area.

Fishing was an important part of the Padilla Bay history and still is today. Clam beds and native oysters were abundant early in the bay's history, although few remain today. Many early attempts to stock the bay with non-native seed oysters and clams were initially successful. However, increased sedimentation and predators made commercial use of the bay infeasible. Crabbing and salmon harvesting occur on the fringe of the bay but are not as productive as they were at the turn of the 20th century.

Historic Uses

The area around Bay View ridge was once a tidally influenced river delta and marsh (Fig. 1.2). Since the arrival of settlers in the late 1800s and the initiation of logging, diking, and agriculture, there have been significant changes to the margins of the bay and surrounding lands. Thousands of acres of marsh and mudflat were converted to farmland with the construction of drainage systems. The incorporation of many farms into diking and drainage districts provided comprehensive protection of farmland. The districts collect taxes for construction and maintenance of dikes and drainage ditches. The dikes that exist around the perimeter of Padilla Bay's eastern and southern shores have been in existence since about 1918.

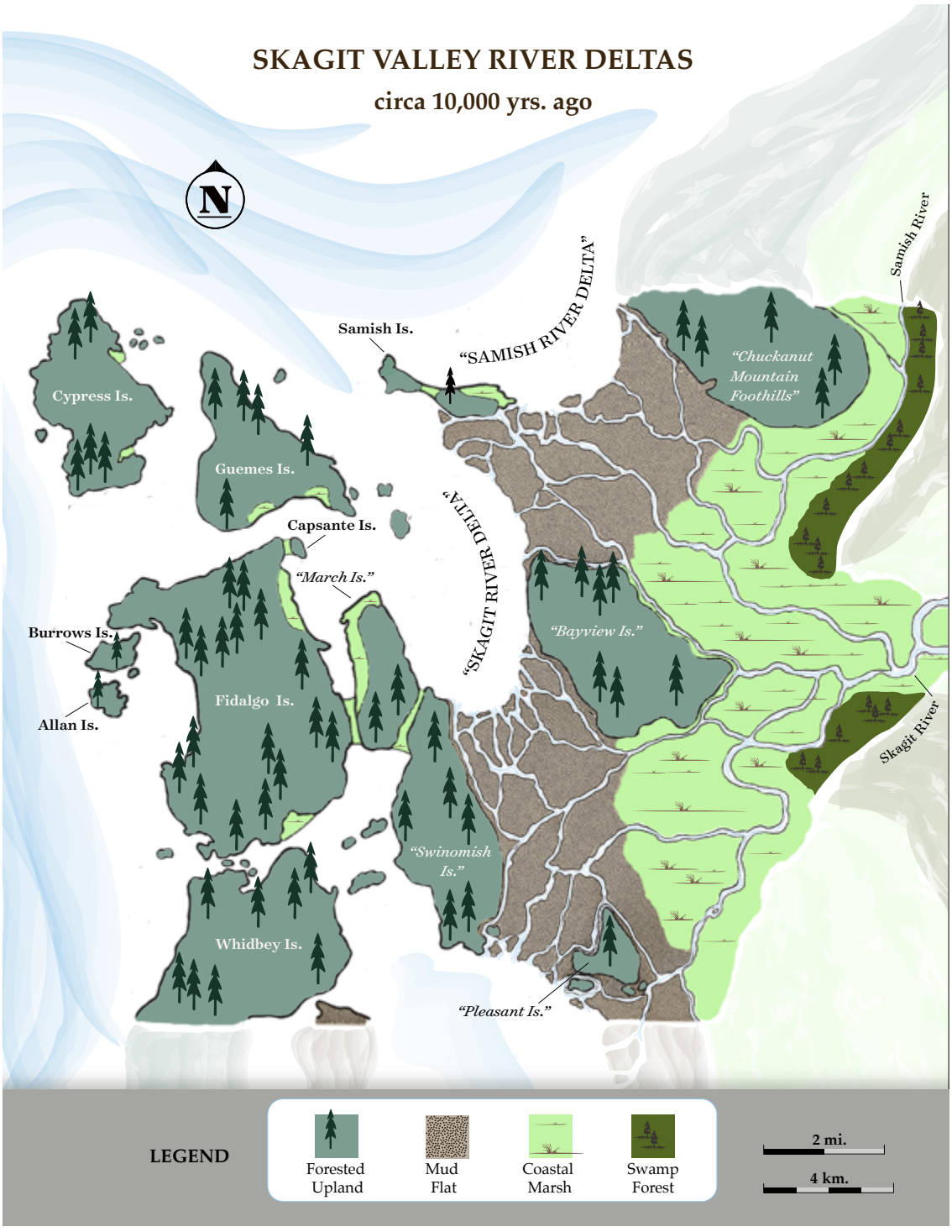


Figure 1.2 Post-glacial Skagit-Samish delta.

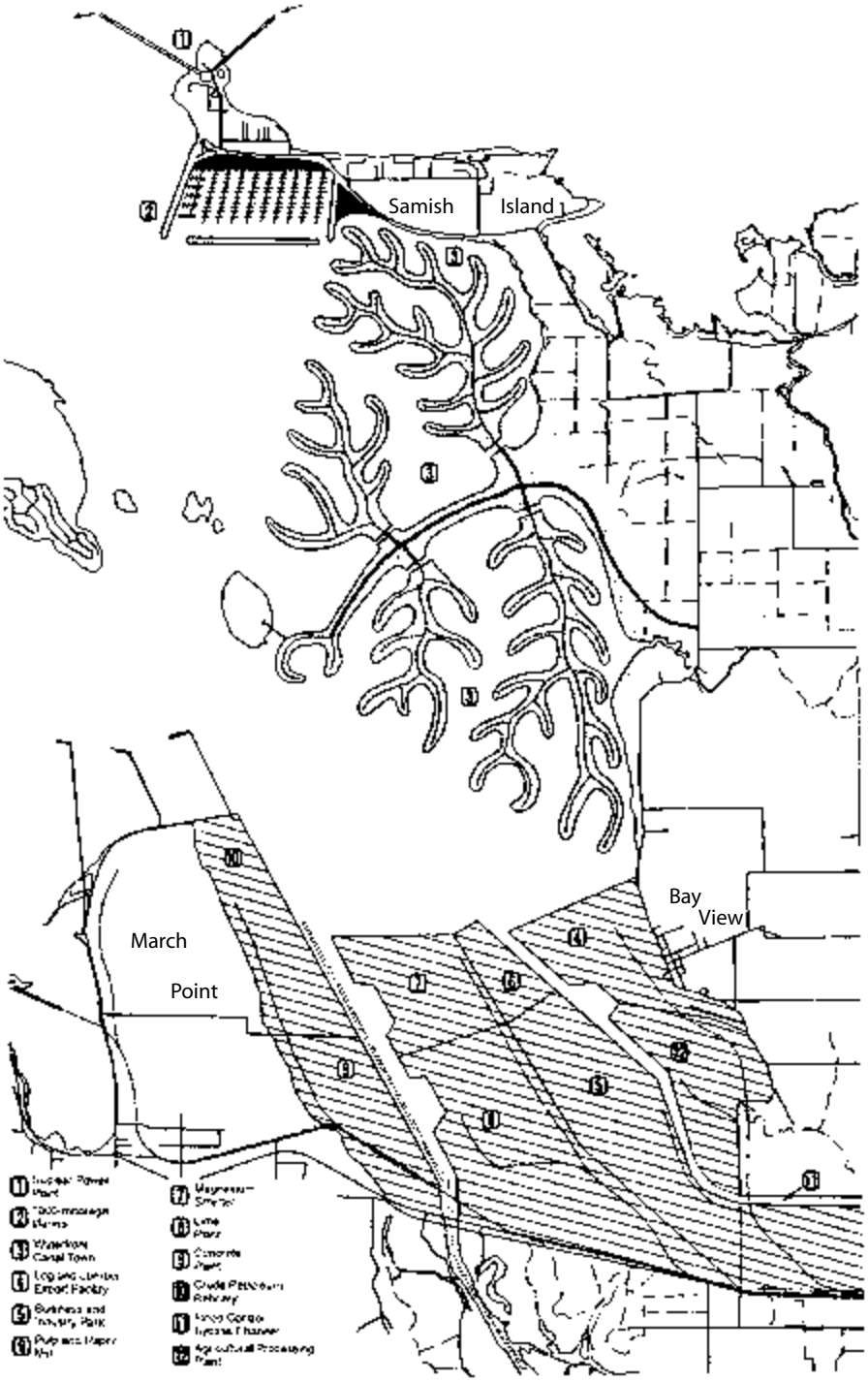


Figure 1.3 Composite of past development proposals.

Proposals for Development

During the last 70 years various other projects and developments have been proposed for the bay. Many of these proposals are located on Figure 1.3. In-text references to these proposals are keyed to the map legend by numbers in brackets (e.g. [1]). Most prominent was a massive dredge-and-fill residential development proposed by the Orion Corporation [3]. With the State's 1993 acquisition of their 8,004 acres of Orion's tidelands this proposal is no longer under consideration. Public meetings and hearings in the 1960s identified a proposal for a massive industrial park development for the entire south end of the bay [4, 5, 6, 7, 8, 9, 10, and 12]. Diking proposals were considered, such as the one to dike the entire bay (this was actually started in the early 1920s), but were abandoned due to financial or physical problems.

With the passage of the State Shoreline Management Act in 1971 and the designation of Padilla Bay as a Shoreline of Statewide Significance under the act, the majority of such proposals are no longer feasible. This act and designation help to protect habitats and species in the Reserve.

Designation of the Reserve

The potential benefits of having Padilla Bay become a National Estuarine Research Reserve were significant but not without potential conflict. As early as l974, state and federal working groups were trying to find areas in Washington that would be eligible for estuarine reserve status under the provisions of the Coastal Zone Management Act. Approximately 40 areas were listed as potential sites by a committee working with the Washington State Department of Ecology. A final list of 10 sites was reached after applying criteria from the federal guidelines. Padilla Bay, with its unique eelgrass resource, was selected for consideration by NOAA's Office for Ocean and Coastal Resource Management (OCRM). Upon formal application to NOAA in 1979, the Governor established steering and technical committees to study boundaries, research, education, and administrative alternatives for the newly proposed Reserve. A draft environmental impact statement was published in April, 1980, and the final in July of that year. Formal designation of the Padilla Bay NERR took place in August 1980.

Ecological Attributes

Geomorphology

Puget Sound was carved out by continental glaciers containing up to 2,500 cubic miles of ice. This crushing weight descended on the Puget Sound area probably four times in the last 100,000 years. The massive sheets of ice created valleys, basins, and the north-south aligned bays commonly found here. The retreat and melting of the last glacier some 12,000 to 13,000 years ago left most of the topographic features we recognize today (see Figure 1.2). Saddlebag, Dot, and Hat Islands are the oldest geological features in the Reserve, consisting of serpentine rocks over 200 million years old.

The majority of sediments in the bay originated as historic delta deposits from the Skagit River complex. For thousands of years the Skagit River carried water and sediment from the watershed into the estuary. It has only been since the mid-1850s that extensive areas of coastal marsh and mudflat have been diked and drained to create agricultural lands.

Hydrology

With diking of the river and bay completed during the last century, normal river flow (and sediment load) no longer enters Padilla Bay but is carried directly into Skagit Bay through the diked channels of the north and south forks of the Skagit River.

Adjacent water bodies provide Padilla Bay with waters of varying salinity. From the south via the Swinomish Channel, Skagit Bay waters diluted by the Skagit River provides lower salinity (10-20 parts per thousand), while open exposures to the west (Guemes Channel to Rosario Straits) provide waters in the range of 25-35 parts per thousand. The average salinity of the bay is 26-29 parts per thousand. Much of the regional freshwater influence is from the Fraser River in Canada to the north.

Padilla Bay is a vast natural resource, covering more than 14,000 acres in its total geographic boundary. It is a broad, flat intertidal embayment that fills and empties fairly rapidly with the two daily tides. The tides are mixed semi-diurnal with two low tides and two high tides a day that vary in height daily. It is an "orphaned estuary," abandoned by normal flows of the Skagit River due to diking, but truly estuarine in the sense of the characteristics of the entire Puget Sound estuary.

Waters in Padilla Bay are well-mixed, with little entrapment. Water temperatures approach a mean of 52^{o}F although very hot summers can elevate temperatures in the shallow bay significantly. The normal range of temperatures is 40^{o}F to 65^{o}F. Water depths average around 2.74 m (9 feet) with channel depths approaching 4.5 - 6 m (15 to 20 feet) below Mean Lower Low Water (MLLW). At a usual summer low tide approximately 60 to 70 percent of the bay is exposed, including substantial portions of the eelgrass meadow, which covers approximately 7,500 acres (Bulthuis 1991a). This extensive eelgrass area, one of the largest on the western coastline of North America, is an important nursery habitat for fish and crab and a wintering ground for many migratory waterfowl.

Climate and Weather

The Pacific Northwest climate results from the weather and close proximity to mountain ranges, such as the Cascades. Precipitation falls largely between October and March, while high pressure systems keep the region fairly dry from May – October. Temperatures are mild all year with an average annual precipitation of greater than 30 inches (Climate Impacts Group 2014). Annual rainfall at Padilla Bay is approximately

Table 1.1 Upland and estuarine habitat types and acreages.		
	Habitat Type	**Acreage**
Upland	Forested**	23
	Grassland/meadow**	19
	Thicket/hedgerow**	12
	Freshwater wetland#	13
Estuarine	*Zostera marina**	7,734
	*Zostera japonica**	1,652
	Macroalgae*	867
	Salt marsh*	143
	Intertidal bare*	2,855
	Subtidal bare*	2,065

**Shull (2015). Habitats delineated on aerial photo.
Graham-Bunting Associates (2004). Wetland delineation.
* Bulthuis and Shull (2006). 2004 data.

27 inches, increasing as one moves east toward the Cascade Range (e.g., Mount Vernon's average is 34 inches).

The El Niño/Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) phenomena affect climate in this region. In warm phases, they increase the odds of a warmer-than-average Pacific Northwest winter and spring and decrease the odds for a wetter-than-average winter. The opposite is true for the cool phases of these phenomena (Climate Impacts Group 2014).

Both temperature and precipitation have increased over the 20th century. The region has warmed about 1.5^{o}F and warming was greatest west of the Cascades during winter/spring. There is a predicted warming rate of about 0.5^{o}F per decade in the future with climate change (Climate Impacts Group 2014). For more information, see "Climate Sensitivity and Impacts" later in this chapter.

Key Habitats and Species

Habitat types

Habitats in the Reserve are represented in Table 1.1 and Figs. 1.4 and 1.5. Key habitats and species descriptions follow. The upland habitats on the 64-acre site near the Breazeale Interpretive Center were delineated on an aerial photo (Fig. 1.4) by our GIS Analyst and approximate acreages are provided (Table 1.1). About five of the 64 acres

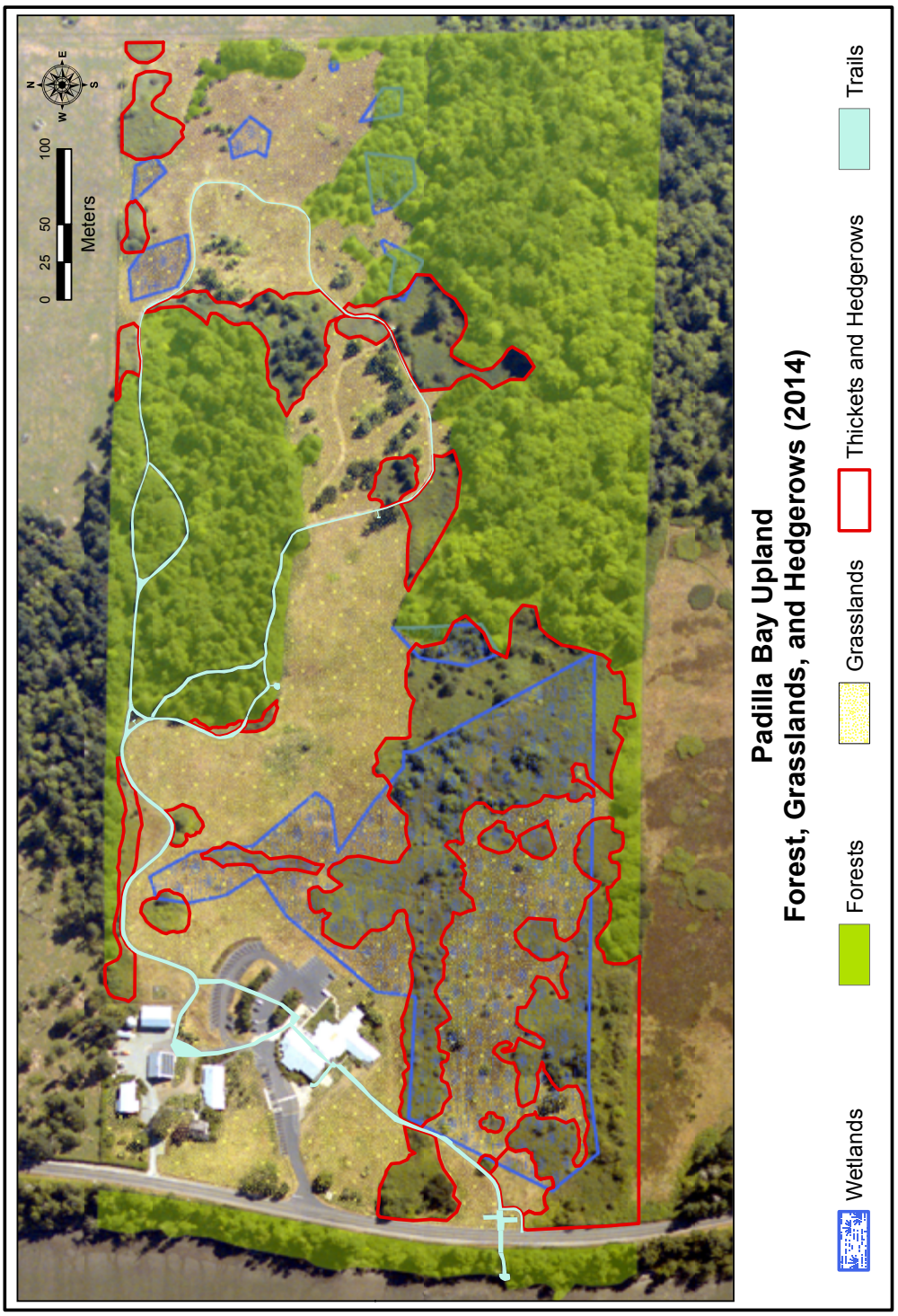


Figure 1.4 Upland habitats on the 64-acre upland site where the Breazeale Interpretive Center is located.

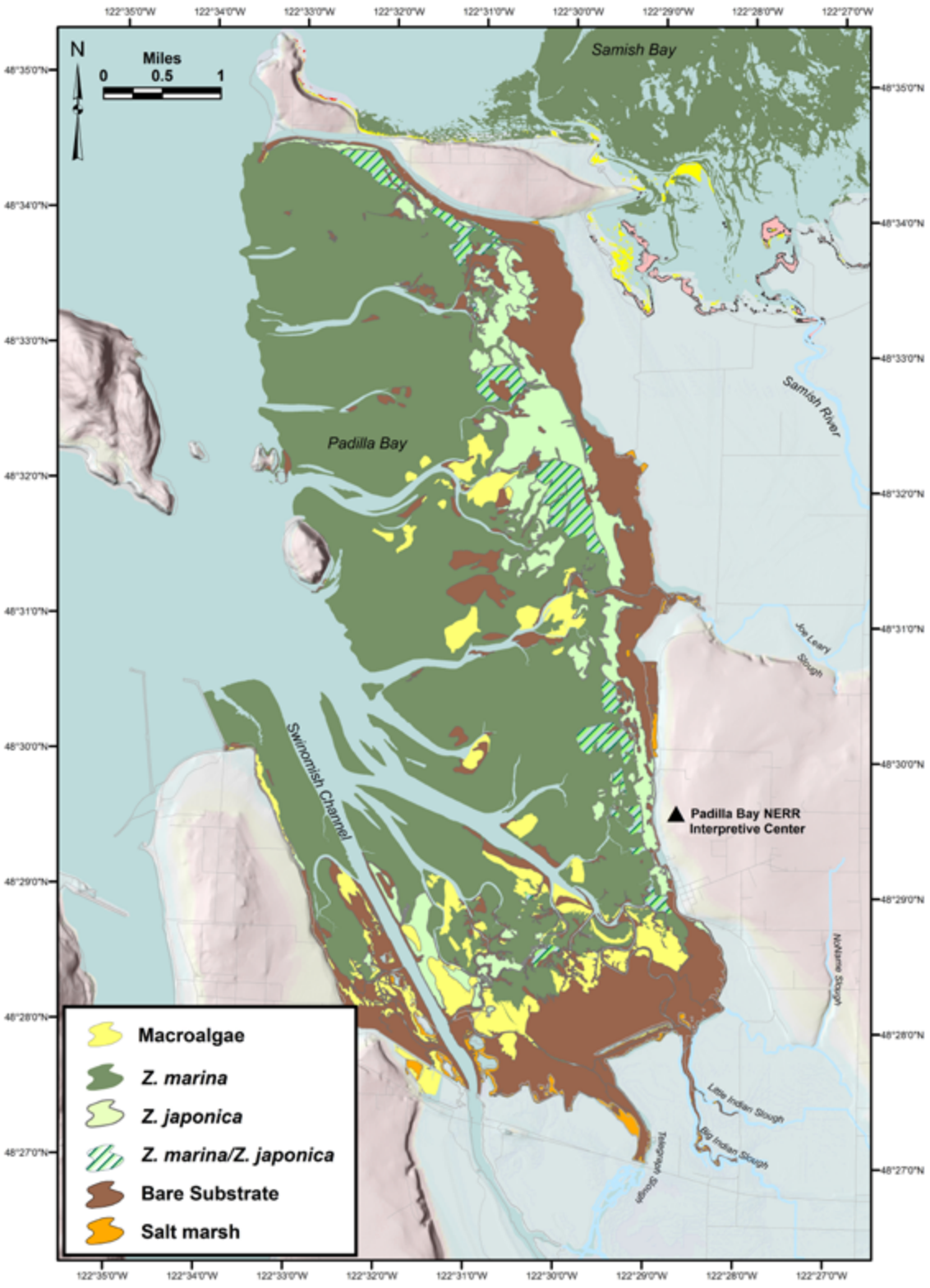


Figure 1.5. Estuarine habitats in Padilla Bay in Skagit County, Washington. [2004 map created by Suzanne Shull].

are developed (buildings, parking lots, trails). The freshwater wetlands in the uplands were delineated in 2004 (Graham-Bunting Associates 2004) and overlap with mapped grassland and forested habitats (Fig 1.4). The estuarine habitats delineated in 2004 were reported in Bulthuis and Shull (2006) and are shown in Fig. 1.5. Some of the area shown in the 2004 delineation lies outside the Reserve boundary (west of the Swinomish Channel). Therefore the habitat acreage totals are greater than the ownership acreages within the boundary.

Upland Habitats

Forests

There are two types of forest on the 64-acre upland site: conifer dominated and deciduous dominated. There are also trees on the bluff between Bay View-Edison Road and the shoreline that we will call the coastal edge.

The coniferous forest harbors second-growth Douglas-fir (*Pseudotsuga menziesii*), western red-cedar (*Thuja plicata*), red alder (*Alnus rubra*), and big-leaf maple (*Acer macrophyllum*) (Fig. 1.4, north). Shrubs and understory include Oregon grape (*Berberis nervosa*), salal (*Gaultheria shallon*), ocean spray (*Holodiscus discolor*), Indian plum (*Oemleria cerasiformis*), red elderberry (*Sambucus racemosa*), salmonberry (*Rubus spectabilis*), red-flowering currant (*Ribes sanguineum*) and sword fern (*Polystichum munitum*). Stinging nettle is also present (*Urtica dioica*).

The deciduous forest habitat is dominated by red alder (*Alnus rubra*), with some scattered Douglas-fir (*Pseudotsuga menziesii*) (Fig. 1.4, south). The understory includes Nootka rose (*Rosa nutkana*), salmonberry (*Rubus spectabilis*), red elderberry (*Sambucus racemosa*), ocean spray (*Holodiscus discolor*) and sword fern (*Polystichum munitum*).

The coastal edge forest is similar to the upland forests, but some additional trees are present, such as Pacific madrone (*Arbutus menziesii*) and bitter cherry (*Prunus emarginata*) (Fig. 1.4, west). The understory is similar to the coniferous dominated forest (above).

Small mammals in the forested areas include Douglas squirrel (*Tamiasciurus douglasii*), northern flying squirrel (*Glaucomys sabrinus*), and Eastern cottontail (*Sylvilagus floridanus*). Coyote (*Canis latrans*) and long-tailed weasel (*Mustela frenata*) prey on small mammals, while raccoon (*Procyon lotor*) feed on a wide range of food items. Owls such as the great horned owl (*Bubo virginianus*) and barred owl (*Strix varia*) also prey on small mammals. Black-tailed deer (*Odocoileus hemionus columbianus*) browse on low-hanging branches and shrubs. Accipiters include the bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned (*Accipiter striatus*) and Cooper's hawk (*Accipiter cooperii*) with the occasional falcon, such as merlin (*Falco columbarius*). Woodpeckers such as the downy (*Picoides pubescens*), hairy (*Picoides villosus*) or pileated (*Dryocopus pileatus*) search for insects and ants in dead trees and

stumps. The wooded habitats also provide feeding, roosting and nesting areas for migratory songbirds and ephemeral ponds for Pacific tree frogs (*Pseudacris regilla*) and Northwestern salamanders (*Ambystoma gracile*).

The coastal edge trees and shrubs provide perching and nesting sites for bald eagles (*Haliaeetus leucocephalus*) and perching sites for merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*) and hawks. Bald eagles feed on small mammals in the surrounding agricultural land but also prey on fish and ducks in the bay. In addition to a large wintering population, a few pairs of bald eagles reside in the area year-round, using nest sites around Padilla Bay. Other birds on this edge include Steller's jays (*Cyanocitta stelleri*), crows (*Corvus* spp.) and ravens (*Corvus corax*).

Padilla Bay and Samish Bay support one of the largest known wintering populations of peregrine falcons (*Falco peregrinus*) in North America. All five species of North American falcons have, on occasion, been seen here in a single day. Ten species of raptors winter in this area including peregrine falcon, merlin (*Falco columbarius*) and snowy owl (*Nyctea scandiaca*).

Upland Grasslands, Hedgerows and Thickets

The upland grasslands are open areas dominated by grasses and adjacent to forests and wetlands (Fig. 1.4). The grasslands are important as habitat for rodents such as moles, voles and mice that are prey items for red-tailed hawks and northern harriers (*Circus cyaneus*), great blue heron (*Ardea herodias*), long-tailed weasels (*Mustela frenata*) and coyotes (*Canis latrans*). Striped skunks (*Mephitis mephitis*) are largely nocturnal and eat rodents, but also eat insects, fruits, and nuts.

The hedgerows occur along fencelines and are dominated by dwarf rose (*Rosa gymnocarpa*) and Nootka rose (*Rosa nutkana*), intermixed with snowberry (*Symphoriocarpus alba*) (Fig. 1.4). Thickets are shrubby "islands" of vegetation in the grasslands and near wetlands and are dominated by snowberry, trailing blackberry (*Rubus ursinus*), and non-native Himalayan (*Rubus armeniacus*) and Evergreen (*Rubus laciniatus*) blackberries (Fig. 1.4). Black hawthorn (*Crataegus douglasii*) can also form impenetrable thickets.

Upland Freshwater Wetlands

There are ten delineated freshwater wetlands in the uplands totaling 13.08 acres (Graham-Bunting Associates, 2004)(Fig. 1.4). The dominant vegetation, depending on the wetland, is either the common rush (*Juncus effusus*) or slough sedge (*Carex obnupta*). Other wetland plant species are present as well.

These seasonally wet areas are habitat for Pacific tree frogs (*Pseudacris regilla*), Northern red-legged frogs (*Rana aurora*), salamanders such as *Ensatina* spp., and Common

snipe (*Gallinago gallinago*). They are also feeding areas for Great blue heron (*Ardea herodias*).

Estuarine Habitats

Salt marsh

Tidal salt marsh was once the dominant habitat in the lowlands around Bay View ridge. It now exists in a few small areas around the bay (143 acres) (Fig. 1.5). The dominant salt marsh species are salt grass (*Distichlis spicata*), pickleweed (*Salicornia pacifica*), and salt bush (*Atriplex patula*). Other species present include seaside arrowgrass (*Triglochin maritima*), Lyngby's sedge (*Carex lyngbyei*), American bulrush (*Schoenoplectus americanus*), and Canadian sandspurry (*Spergularia marina*). In a couple of areas, such as at the mouth of Joe Leary Slough and marsh at the south end of the bay, Sea milk-wort (*Glaux maritima*) and Silverweed (*Potentilla anserina*) are present. Voles and other small mammals are present and provide a food resource for northern harriers (*Circus cyaneus*), and red-tailed hawks (*Bubo jamaicensis*), and coyotes (*Canis latrans*).

One major salt marsh area (the former Sullivan-Minor property) located on the central eastern shore of the bay is a result of an early dike breaching and washing away. This area is characterized by seven plant communities listed in Granger and Burg (1986) as: 1) log dump (low elevation), 2) Lyngby's sedge (*Carex lyngbyei*; eastern border/northern third), 3) Cattail (*Typha latifolia*) - reed canarygrass (*Phalaris arundinaceae*; southeast corner), 4) saltgrass (*Distichlis spicata*; transitional between low and high marsh), 5) pickleweed (*Salicornia virginica*); low elevation and around salt pans), 6) saltgrass (*Distichlis spicata*) – pickleweed (*S. virginica*); low to moderate elevations in marsh), and 7) bentgrass (*Agrostis alba*) - Aster sp.; (high elevation, southern portion).

Unvegetated Mudflat

The mudflat is home to a wide variety of worms, clams, shrimp, amphipods, and crabs, as well as a feeding area for birds such as Great blue heron (*Ardea herodias*) (bare substrate, Fig. 1.5). Two Great blue heron (*Ardea herodias*) rookeries are located north and southwest of the bay, both outside of Reserve property. The larger heron rookery (around 200 pair) is located on private property on Samish Island. The smaller rookery is located just north of Highway 20 on March Point. At times over 100 herons have been counted in the bay stalking fish and crabs in the shallow water.

Common algae found in the intertidal zone are sea lettuce (*Ulva* sp.) and *Enteromorpha* spp., thin translucent green algae. Other common genera include *Laminaria, Ceramium, Gracilaria*, and *Fucus*. Colonial diatoms coat the surface of the mud exuding silver bubbles of oxygen. A larger red alga (*Tiffaniella snyderae*) is sometimes found.

Marine invertebrates are abundant in the bay's mud and sand. Examples are polychaete worms such as the lugworm (*Abarenicola* sp.) and *Capitella*. Clams include the bent-

nosed clam (*Macoma nasuta*), the mud clam (*Mya* sp.) and *Transenella* sp. Many other organisms live on the surface probing the sediment for food or discarded material. Shrimp and crab, particularly the Dungeness crab (*Metacarcinus magister*), are the most common.

One of the most prolific visitors to the mudflats is the dunlin (*Calidris alpina*). These shore birds probe the mud with their long beaks on receding tides for amphipods, insects, worms, and small molluscs.

Vegetated Mudflat (Eelgrass)

The estuarine flora of Padilla Bay consists primarily of the eelgrasses *Zostera marina* and *Zostera japonica* (Fig. 1.5). These are vascular marine grasses that spread vegetatively through underground stems or rhizomes and also by seed. They flower and pollinate underwater. This seagrass meadow covers approximately 7,500 acres of the bay (Bulthuis 1991a). Nowhere else in coastal Washington state is there such a large, contiguous meadow of seagrasses. A number of factors contribute to the success of eelgrass in Padilla Bay: the salinity, sediments, shallow depth and water clarity. The eelgrass is used by a myriad of creatures from small marine snails to the small sea goose or Black brant (*Branta bernicla*), which eats eelgrass as a major part of its diet. Many smaller organisms live around and on the seagrass blades such as brooding anemones (*Epiactis prolifera*), skeleton shrimp (*Caprella* spp.), isopods (*Idotea* sp.), stalked jellyfish (*Haliclystus* sp.) and others. Small fish find food such as amphipods and isopods. Worms burrow in the mud and digest bacteria off of eelgrass detritus. Common algae found in the intertidal zone are sea lettuce (*Ulva* sp.) and *Enteromorpha* spp., both of which are thin translucent green algae. Other common genera include *Laminaria, Ceramium, Gracilaria*, and *Fucus*.

Slough and Channel

Sloughs include Telegraph, Indian, No Name and Joe Leary (Fig. 1.5). The largest channel within the Reserve is the Bayview Channel (Fig. 1.5). Freshwater sloughs around Padilla Bay generally have lower salinities than the open bay. The edges of sloughs support plants like Lyngby's sedge (*Carex lyngbyei*), American bulrush (*Schoenoplectus americana*), tufted hairgrass (*Deschampsia caespitosa*), and seaside arrowgrass (*Triglochin maritima*). Small fish such as sculpins, sticklebacks, and juvenile salmon live in and move around via sloughs. Dabbling ducks, such as mallard or teal may be found in the sloughs feeding on vegetation, while harbor seal (*Phoca vitulina*) may be looking for fish or crustaceans to feed on. Harbor seal haul out on the edges of channels at low tide and Padilla Bay is a pupping area for them. River otter (*Lutra canadensis*) also use slough habitats as areas to raise young and find food.

Open Water

When the bay is flooded by high tides, all the habitat area in Fig. 1.5 is covered except

for beaches and high marsh. Marine mammals found in Padilla Bay include the harbor seal (*Phoca vitulina*) and river otter (*Lutra canadensis*). Harbor seals use the bay's isolated sand and mudflats along tidal channels as haul-out sites for resting, grooming, and sunning. Large numbers of seals have been observed in the bay near Indian and Joe Leary sloughs. Outside of Padilla Bay in deeper water, pods of killer whales (*Orcinus orca*) are not uncommon. The harbor porpoise (*Phocoena phocoena*) and Dall's porpoise (*Phocoenoides dalli*) are occasionally found in the deeper waters near the bay as are California (*Zalophus californianus californianus*) and Steller's (*Eumetopias jubata*) sea lions.

Padilla Bay is an important migration route for juvenile chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), pink (*O. gorbuscha*) and chum salmon (*O. keta*). To pink and chum salmon, Padilla Bay is especially important as a rearing area. They use the nearshore and shallow areas to obtain food before they venture into deeper water. Common flat fish include English sole (*Parophrys vetulus*), Dover sole (*Microstomus pacificus*), rock sole (*Lepidopsetta bilineata*) and starry flounder (*Platichthys stellatus*). Pacific herring (*Clupea harengus pallasi*) use Padilla Bay, but do not spawn in Padilla Bay.

During the winter the bay contains on average 50,000 ducks of 26 species. Counts as high as 120,000 have been made in some years. The Black brant (*Branta bernicla nigricans*) winters at Padilla Bay. Peak numbers of 20,000 dwindled to 2,000 to 3,000 in 1980-1981 causing a temporary ban on hunting from 1983-1987. A limited brant season was opened again in 1987.

Dredged Spoil Islands (sandy)

Dredged spoil materials were historically pumped along the perimeters of the Swinomish Channel when maintenance dredging operations were carried out. The islands on the east side of the channel created by this activity are referred to as the Swinomish Spit and are quite sandy and dune-like with little elevation (Fig. 1.5). The lowest edges of the islands are salt marsh habitat dominated by pickleweed (*Salicornia virginica*) and salt grass (*Distichlis spicata*) with some American bulrush (*Schoenoplectus americana*) at the northern end and some Gerard's rush (*Juncus gerardii*) on the eastern side of the spit. The next higher elevation harbors big-headed sedge (*Carex macrocephala*), seaside plantain (*Plantago maritima* spp. *juncoides*), and dune wildrye (*Elymus mollis*), among others. A biological soil crust of lichens and mosses has formed on the upper surface of the interior of the islands. Other grasses present in this location include red fescue (*Festuca rubra*), and cheat grass (*Bromus tectorum*).

Common animals include shore crabs (*Hemigrapsus* spp.) and rodents such as voles and mice. The few trees provide perches for eagles and hawks and this area is a gravelling site for Black brant (*Branta bernicla*). It would not be unheard of to see a river otter or coyote in this location. Terns and gulls fly over or rest along the shorelines.

Rocky Islands

The rocky islands within our boundary include Hat Island (owned by Washington Department of Natural Resources), Dot and Saddlebag (both owned and managed by Washington's Parks and Recreation Commission) (Fig. 1.5). Brown marine algae such as bull kelp (*Nereocystis luetkeana*) grows subtidally off of Saddlebag and rockweed (*Fucus distichus*) grows in the rocky intertidal. Also in the rocky intertidal, there are green algae (*Ulva* spp., *Enteromorpha* spp.) and red algae (*Caulacanthus ustulatu*s, *Endocladia muricata, Gelidium* spp., *Mastocarpus papillatus, Mazzaella* spp., and *Porphyra* spp.).

Barnacles (*Chthamalus dalli/fissus, Balanus glandula, Semibalanus cariosus*), chitons (*Katharina tunicata, Lepidochitona dentiens, Lepidozona* spp., *Mopalia* spp.), snails (*Bittium* spp., *Calliostoma* spp., *Nucella* spp.), crabs (*Hemigrapsus* spp., *Pagurus* spp., *Petrolisthes* spp., *Pugettia* spp.), seastars (*Pisaster* spp., *Leptasterias* spp.), isopods (*Idotea* spp.), and mussels (*Mytilus trossulus*) are found in the rocky intertidal habitat on Saddlebag and Hat Islands.

Harbor seals (*Phoca vitulina*) regularly haul out on the rocky shores of Hat Island to rest at high tide. Birds such as Bald eagle (*Haliaeetus leucocephalus*), Great blue heron (*Ardea herodias*), and Peregrine falcon (*Falco peregrinus*) frequent these offshore islands to look for food or to roost.

Beaches

Beaches are in the high intertidal and range from cobble to gravel to muddy sand. They can host shore crabs (*Hemigrapsus nudus*), littleneck clams (*Leukoma staminea*), worms, and amphipods, among other invertebrates. The beaches are fed by bluffs composed of glacial till on Samish Island and Bay View Ridge. Normal shoreline function is disrupted in various locations by dikes and seawalls. Old wooden pilings from the early diking efforts in the mid-1800s to early 1900s can still be seen, but are slowly decaying and breaking off. There is at least one forage fish spawning beach for smelt (*Hypomesus pretiosus*) on the shorelines of Padilla Bay.

Social Attributes

Population demographics

Population demographics can help the Reserve understand the community it serves and who the target audiences may be, including underserved audiences (U.S. Census Bureau 2014).

- The population in Skagit County grew by 1.7% between 2010 and 2013 (116,901 to 118,837) and was 50.4% female in 2013. In 2013, people under 18 years of age made up 22.7% of the population and 18.1% were people 65 years and older.

- The county was mostly white in 2013 (75.8%) while the rest of the population was Hispanic or Latino (17.6%), two or more races (2.9%), American Indian and Alaska Native (2.7%), Asian (2.1%), black or African American (0.9%), and Native Hawaiian or other Pacific Islander (0.3%).

The data below is for Skagit County from 2009-2013:

- People born in a foreign country (9.3%).
- People (5+ years old) speaking a language other than English at home (14.2%).
- High school graduates (or higher) age 25+ years old (88.2%).
- Bachelor's degree or higher and 25+ years old (23.6%).
- 45,293 households
- 2.56 people/household
- Median household income: $55,925
- Median value of owner-occupied housing units: $261,400
- Persons below poverty level (13.5%)
- 67.5 people/square mile

Jobs and employment trends

In 2012 the U.S. Bureau of Economic Analysis estimated that manufacturing was the largest contributor to Skagit County real gross domestic product (GDP). In 2011, contributors to total GDP were: manufacturing (36%); agriculture, forestry, fishing and hunting (3%); private goods and service-providing industries (86%) with more than half of that coming from private goods-producing industries; and government (14%) (Vance-Sherman 2014).

Skagit County's annual peak nonfarm employment level was reached in 2007, just before the recession. During the recession, Skagit County lost 3,500 jobs or just over 7%. Relative to Washington State, Skagit County entered the recession early, experienced a greater decline and took longer to recover. Recovery began slowly in 2012 and picked up in 2013. From 2012 to 2013, Skagit County recovered 1,300 jobs, with growth in most sectors (Vance-Sherman 2014).

Skagit County's civilian labor force averaged 55,880 in 2013. Of that, 51,260 people were employed and 4,620 were estimated to be unemployed and actively seeking work. The peak unemployment rate in Skagit County in February 2010 was 12.7% while the average unemployment rate that year was 10.7%. The unemployment rate fell slowly but consistently throughout 2012 and 2013. The unemployment rate in July 2014 was down to 5.8 percent (Vance-Sherman 2014).

The resident labor force in Skagit County is seasonal in nature, largely due to the agricultural sector. Every summer, the labor force swells and then contracts during off peak

seasons. From 2002 to 2008, the Skagit County labor force averaged 1.9% growth per year. Since reaching peak levels in 2008, the labor force in Skagit County has been falling (Vance-Sherman 2014).

Climate sensitivity and impacts

One recent study (Robinson, et al. 2013) compared the sensitivity of Reserve sites in the NERRS to climate change. Padilla Bay, when compared to other Reserve sites, was generally predicted to be less affected by climate change than many of the other sites. However, the reality is that we are already affected by climate change in the Pacific Northwest.

- Ocean acidification has been documented. Low pH (or acidity) in seawater can kill oyster larvae outright and also reduces the availability of aragonite in the water so oyster larvae cannot form shells. This affects other shell-forming animals as well.
- Air temperature has increased over time. Pacific Northwest air temperatures have increased 1.5^{o}F since 1920.
- Sea surface water temperature is increasing. A large mass of warm water has formed in the Pacific Ocean off the coast of North America. It was detected in late 2013 and was expected to continue throughout 2015. It is roughly 2.5^{o}C (4.5^{o}F) higher than normal in the upper 100 m of ocean. The waters are nutrient poor and have adversely affected marine life. Whether this is directly related to climate change or not is not yet known. It could be due, in part, to the Pacific Decadal Oscillation and El Niño events.
- Snowpack is decreasing. The Olympic Mountains had only 7% of average snow water content in winter 2015, while the Cascade Mountains in Washington ranged from 18% of average in the south to 56% of average snow water content in the north.
- Fire frequency and intensity have increased. As of September 2015, wildfires in Washington State had burned 900,000 acres and were declared a federal emergency. Even though most fires in the summer of 2015 were in eastern Washington State, the Reserve saw reduced air quality as smoke from these fires.

Based on National Research Council (2012), sea level rise for the Washington, Oregon and California coasts north of Cape Mendocino is:

- -4 cm to +23 cm by 2030 (1.6" – 9.0")
- -3 cm to +48 cm by 2050 (1.2" – 18.9")
- 10 cm to 143 cm by 2100 (0.9" – 56.3")

The sources of uncertainty in these estimates are assumptions about future ice losses and a constant rate of vertical land motion over the projection period (National Research Council 2012). The threat of future sea level rise is reduced by land uplift and gravitational and deformational effects in this area, but the land is likely rising because

of the strain that is building in the Cascadia subduction zone. The threat of a major earthquake is real and land along the coast could subside instantly and be flooded.

Social sensitivity to climate change

The relative social sensitivity of the Reserves with regards to climate change was compared in a 2013 study by Robinson et al. In that study, Padilla Bay Reserve was ranked in the upper third of Reserves in its socially sensitivity to climate change. In part, that is due to the fact that local communities rely on many natural resources to support their economic, social and cultural integrity. Two of the groups that are predicted to face immediate impacts from climate change are local shellfish growers and Native American Tribal communities.

There are two shellfish farms in close proximity to Padilla Bay (i.e., Taylor Shellfish Farms and Blau Oyster) located in Samish Bay and more than 300 shellfish farms throughout Washington state. Both Taylor Shellfish Farms and Blau Oyster are located in nearby Samish Bay. As with shellfish operations throughout the state, these growers contribute to state and local economies, with Taylor Shellfish being one of the largest producer of farmed shellfish in the United States. Washington leads the country in production of farmed clams, oysters, and mussels with an annual value of over $107 million. Collectively the shellfish industry in Washington state provides about 25% of the domestic production of shellfish by weight in the United States.

The effect of climate change on the shellfish industry has already been observed in waters of the Pacific Northwest as ocean acidification interferes with the ability of shellfish such as clams and oysters to make shell. By providing real-time local water quality data collected under SWMP, Padilla Bay provides instantaneous updates and long-term trends in pH of local waters that are used by the shellfish growers. Further, the Reserve plays an important role in understanding drivers of ocean acidification, identifying seasonal variability, and predicting patterns so shellfish growers can adapt.

The effect of climate change on Tribal communities will also include effects of ocean acidification on resources that rely on calcifying marine organisms (e.g., oysters, geoduck and salmon), as well as effects of sea-level rise and tidal inundation on Tribal lands. Most of the local tribes have treaty rights to harvest shellfish, which they use for subsistence, ceremonial purposes, or as a source of income. As with other shellfish growers in the region, ocean acidification will impact Tribal shellfish harvests and livelihood, as well as threaten cultural practices and ceremony related to harvest of natural resources. In an effort to quantify the effects of local climate change, the Swinomish Tribal Community has produced a "Climate Change Adaptation Plan" that outlines the economic, cultural and natural resources that will be threatened by climate change. The Swinomish Tribal Lands are south of Padilla Bay and adjacent to the southern boundary of the Reserve. At the top of the list of effects reported in the Swinomish document are inundation from sea level rise and storm surge (and habitat and natural resources within those areas) and decreased habitat viability due to changing water quality pa-

rameters. In this regard, through sentinel site build-out Padilla Bay offers resources to assess a local rate of sea-level rise that can be used by local county and Tribal planners, as well as access to the SWMP real-time data to help understand short-term variability and long-term trends in water quality. PBNERR will be engaging Swinomish, Samish and Lummi Tribal communities to identify common research and management priorities and to help guide the work at PBNERR so as to best meet the needs of local natural resource stakeholders.

The ability to adapt to climate change – and thus reduce sociocultural vulnerability – relies in part on fostering a generation of young adults that are aware of climate change, facile in the nuances of climate science, and understand ocean-atmosphere connectivity on a global scale. It is this community that can make choices and behavioral changes related to sustainability on a local scale that can have global consequences. To this end, PBNERR through a NOAA Environmental Literacy Grant titled "Advancing Climate Literacy through Investment in PreService Educators (ACLIPSE)" is helping foster the next generation of climate-literate science students by integrating real-time SWMP and ocean observing data into well-established middle-school ocean and climate science curricula. This three-year project will develop an undergraduate course for pre-service science teachers, implement the course in several teacher education programs an universities around the U.S., and ultimately bring climate and ocean literacy into middle school classrooms across the country.

Ecosystem services

A 2010 study in the Puget Sound Basin identified 23 natural goods and services that benefit people, businesses and government agencies, the value of which is between $305 billion and $2.6 trillion. This study listed land cover types and associated ecosystem services. Based on this study, the land cover types within the Padilla Bay NERR include forest, wetland, shrub, grassland, beach, estuary, salt marsh, eelgrass beds and marine water. These provide services such as gas and climate regulation, water flow regulation waste treatment, water supply, habitat (refuge), pollination, soil erosion control, soil formation, biological control, nutrient cycling, disturbance regulation, and opportunities for aesthetic and recreational pursuits (Batker et al. 2010).

The Reserve's freshwater wetlands help to store and filter water and produce oxygen. Its salt marshes and seagrass meadows help to store carbon and produce oxygen. Upland forests store water, cool the air, store carbon, and produce oxygen. The Reserve's terrestrial and estuary habitats help support nutrient cycling and primary production (the basis of food chains and the foods we eat).

Ecosystem valuation plays a role in estuary restoration and may be a factor in ranking funding proposals. Organizations in Puget Sound that have identified and utilized ecosystem valuation and services are the Puget Sound Nearshore Ecosystem Restoration Program (PSNERP) and the Estuary Salmon Restoration Program (ESRP).

Ecosystem services can be broken into categories of: provisioning (e.g., providing food, water, raw materials and medicinal resources), regulating (e.g., control of climate, carbon sequestration, water and air purification, protection from storms/flooding, drought recovery, soil erosion control, etc.), supporting (e.g., nutrient cycling, primary production, biodiversity and habitat, and pollination), and cultural (e.g., spiritual and recreational benefits, scientific and educational benefits, and aesthetic benefits) (Millenium Ecosystem Assessment 2005).

Although the ecosystem services attributed to eelgrass meadows are many, there are two that will be the focus of upcoming research at PBNERR: carbon sequestration and effects on CO_2/O_2 cycling. Eelgrass habitats are widely accepted as having tremendous carbon storage potential (Luisetti et al. 2013; Duarte et al. 2013), but this potential is based on a limited number of empirical studies where temperate eelgrass communities are poorly represented. Further, carbon sequestration may be greatly overrated in erosional systems such as Padilla Bay. Coupled with the sentinel site build-out and SWMP biomonitoring at PBNERR and there will be a more in-depth evaluation of the carbon sequestration potential of this ecosystem. This will be helpful as managers and planners prioritize coastal restoration and development activities, as it will help accurately attribute value to eelgrass carbon storage potential. Evaluating carbon capture potential of eelgrass beds will also provide information regarding the magnitude of CO_2 drawdown in these systems. When coupled with SWMP water quality data this will help predict the extent to which Padilla Bay may locally mitigate fluctuations in pH and serve as a refuge from acidic conditions for sensitive biota.

Threats and Stressors

Natural and anthropogenic stressors

Natural stressors include invasive species, climate change, weather patterns, earthquakes and proximity to earthquake zones, and disease-causing organisms (such as those that cause sea star wasting disease and eelgrass wasting disease).

Invasive species crowd out native species and compete for space, food, nutrients, and habitats. The most publicized invasive species in the Padilla Bay estuary has been *Spartina*, but others were introduced for commercial or recreational purposes (e.g., Pacific oysters and Manila clams) or came as a result of the commercial introductions (e.g., oyster drills, east coast clams, and *Zostera japonica*). Whether or not these species are targeted for control can be an economic or even political issue, rather than a purely ecological one.

Periodic long-term climatic events such as El Niño have promoted the movement of European green crab (*Carcinus maenas*) up the Pacific Coast from San Francisco to the west coast of Vancouver Island. An increase in winter storms or storm severity can speed up erosion, leading to loss of salt marsh habitat, or increase turbidity in the water column, leading to stress on eelgrasses due to reduced light.

Earthquakes can cause uplift or subsidence, landslides and tsunamis, all of which can impact habitats and species. Harmful algal blooms have been shown to impact fish or marine mammals in some instances. Organisms that cause illness or fatalities due to weakening the immune system of animals or interfering with a plant's ability to photosynthesize or function normally are present in Padilla Bay and can impact individuals or populations.

Anthropogenic stressors include pollution (such as excess nutrients, high bacterial counts in water due to failing septic systems, heavy metals, PCBs, hydrocarbons, etc.), increasing population (which can lead to increased development), and increased development (which can lead to habitat loss). These stressors can be alleviated by: using best management practices in residential, agricultural and industrial areas, practicing appropriate personal behaviors (e.g., proper use of pesticides and fertilizers, and recycling), waste management (e.g., composting), and using approaches like low-impact development.

The Reserve is in close proximity to oil refineries, industry, and agriculture. With refineries, there is the potential for spills (either in loading or offloading from oil tankers, lightering from barges, or with transport of oil by train and possible accidents) (Fig. 1.6). The Reserve participates in local planning for oil spills and in oil spill drills, along with industry, state agencies, tribes and local emergency management. The Reserve also participates in the Local Emergency Planning Committee, which includes planning for all types of local disasters.

There is a wide range of businesses at the Port of Skagit County, some of which use or store chemicals (Fig. 1.6). Part of the runoff from the Port drains toward Padilla Bay via ditches and Big Indian Slough, so there is a potential for spills at the Port to impact the bay. However, those companies have to follow regulations and there is permitting for releases into water. Many companies have containment in the case of a spill, so any spills that do reach the bay would be a worst-case scenario and might result from a major earthquake or accident.

Commercial agriculture plays a major role in the Skagit Valley and land adjacent to Padilla Bay is farmed. Runoff flows to ditches around the fields, then into sloughs and ultimately into Padilla Bay, or neighboring bays or waterways. Agricultural best management practices can greatly reduce sediment. Application of fertilizers, herbicides and pesticides according to labels can reduce the impact of chemicals on the bay and its resources (e.g., the eelgrass community). Application of herbicides near water bodies takes additional training, approved products and monitoring of water quality after application. Application of best management practices for water quality by hobby farmers can reduce impact on the estuary the same as for commercial farmers.

Residential development and an increase in impervious surfaces, septic systems, and use of fertilizers, herbicides and pesticides can have an impact on runoff and runoff water quality. Excess nutrients can create algal blooms that can reduce light to eelgrass-

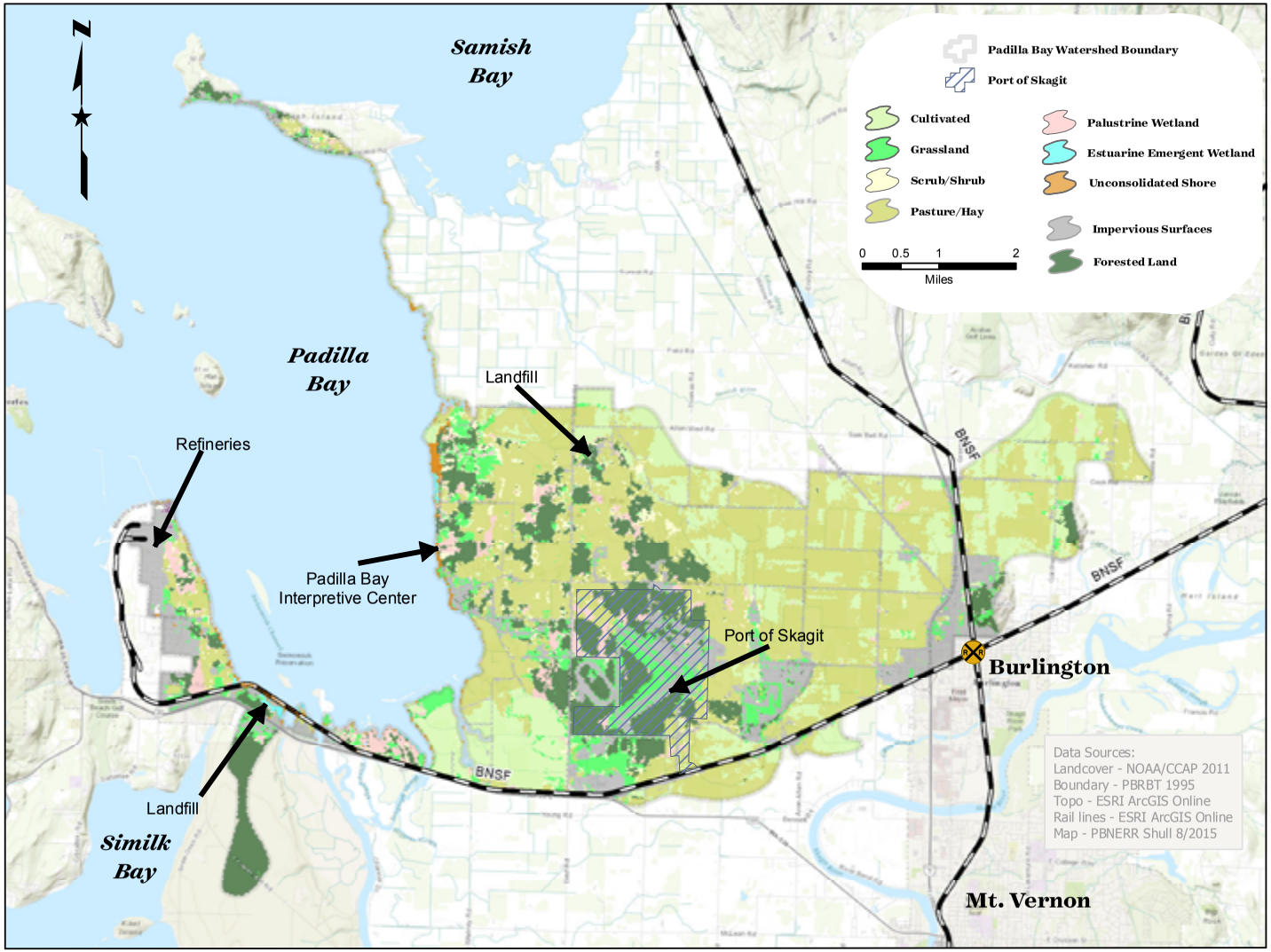


Figure 1.6 The Padilla Bay watershed encompasses agricultural, residential, commercial and industrial areas, including oil refineries and the Port of Skagit County.

es or can use up oxygen in the water column as they decay. Pesticides can impact more than the target species if applied improperly. The Reserve supports community education about products and practices that have the least impact on the environment. Management of floodwater in the Skagit River basin has been an issue for many years. The Army Corps of Engineers (ACOE), working with Skagit County, has spent several million dollars conducting studies and evaluating many flood control scenarios. Working with many state and local committees the Corps released a draft of their plan (and EIS) in 2014 identifying the five highest-ranked projects for bringing 100-year flood protection to key areas of the Skagit Valley. These included four projects that would channelize river flow away from the cities and into Padilla Bay, and one project to increase the height of existing dikes. The Corps has identified the dike-raising project as their preferred alternative, although there are many agencies and tribal interests that believe other options, or combinations of options, still need to be explored. Options that channelize floodwater into Padilla Bay have been proposed over the years and the Reserve and Department of Ecology have identified possible impacts to seagrasses from these types of proposals. Reserve staff will continue to work with federal, state and local government entities as flood planning moves forward.

A railroad line runs east to west along the southern shore of Padilla Bay and crosses the Swinomish Channel. This line carries many tank cars to and from the refineries and other industrial sites on March Point. Preparation for the possibility of derailments and spills in this area, given the type of materials transported, is prudent.

Other threats to Reserve resources include leachate from the county's current and historic landfills within the watershed, development along shorelines and in the watershed and resulting runoff, and other uses that might adversely impact the eelgrass community. In 2008 the old March Point landfill, just west of the Reserve boundary, was added to the Department of Ecology's list for cleanup action. Reserve staff coordinates with Ecology's Toxic Cleanup personnel and can provide historic and scientific data from our library. An analysis of issues within Padilla Bay NERR that may require research can be found in the Research and Monitoring Section of this document (Chapter 3).

With growth occurring throughout Skagit County, increasing residential, commercial and industrial development in the Padilla Bay watershed poses rising water quality and water quantity issues. Water quality monitoring results have forced a recreational shellfish harvest closure adjacent to the community of Bay View and the Skagit County Natural Resources Division (Water Resources Section) will be developing Pollution Indicator Controls for the Bay View watershed. Either too much (winter) or too little (summer) surface water entering the sloughs, combined with excess nutrients from farming and lawn care, have placed some sloughs on the State's Impaired Waters list. The Reserve is participating in studies with agencies and local citizens to remedy these problems while improving habitat function, and increasing upland surface water storage and groundwater recharge.

Padilla Bay NERR Boundary

Background

The state, including Washington State Departments of Ecology, Fish and Wildlife, Natural Resources and the Washington State Parks and Recreation Commission, owns 11,966 acres that comprise the Reserve (see Fig. 1.7 and "Core and Buffer Rationale" below).

There is still private ownership of some of the Padilla Bay Tracts north of Hat Island and in the Associated Oyster Tracts in the southwestern part of the bay and shared ownership of a salt marsh on the eastern shoreline. There is private ownership in the buffer lands in the south as well.

Boundary Description

A general description of the Reserve's boundary is as follows:

- South: The southern boundary is a diagonal line west to east just north of Dike Island.
- East: The eastern boundary, approximately 8 miles long, follows northward from the diagonal line mentioned above near the mouth of Indian Slough north along the Shore Trail and then the shoreline along Bay View Ridge and then the dikes to Samish Island. It also includes Bay View State Park and the Breazeale property where the Reserve's facilities are located. There are 2 or 3 parcels along that shoreline that are still in private ownership.
- North: The northern boundary is parallel with, but located 500 feet south of, Samish Island, a high-density residential area.
- West: The western boundary is open water and is east of the Swinomish Channel. The southwestern boundary is located consistent with the claimed Swinomish Indian Tribal Community eastern reservation boundary. The northwestern boundary is the seaward boundary established in 1931 by the State Commissioner of Lands and the western boundaries of Saddlebag Island State Park and Hat Island.

Core and Buffer Rationale

The boundary area encompasses two zones: 1) Core: key tideland and water areas and 2) Buffer: uplands adjacent to Padilla Bay. The core area consists of state-owned salt marsh, intertidal mudflat and sub-tidal habitats (Fig. 1.7). This is the most ecologically productive and sensitive area, and includes the extensive eelgrass meadow and areas important for juvenile salmon and crab. The state owns 11,490 acres in the "core" with 738 acres remaining in private ownership (Appendix B, Tables B.1, B.2). The state owns 476 acres in the "buffer" with 614 acres remaining in private ownership (Appendix B, Tables B.1, B.3). Therefore, the state owns 11,966 acres in the combined core and buffer

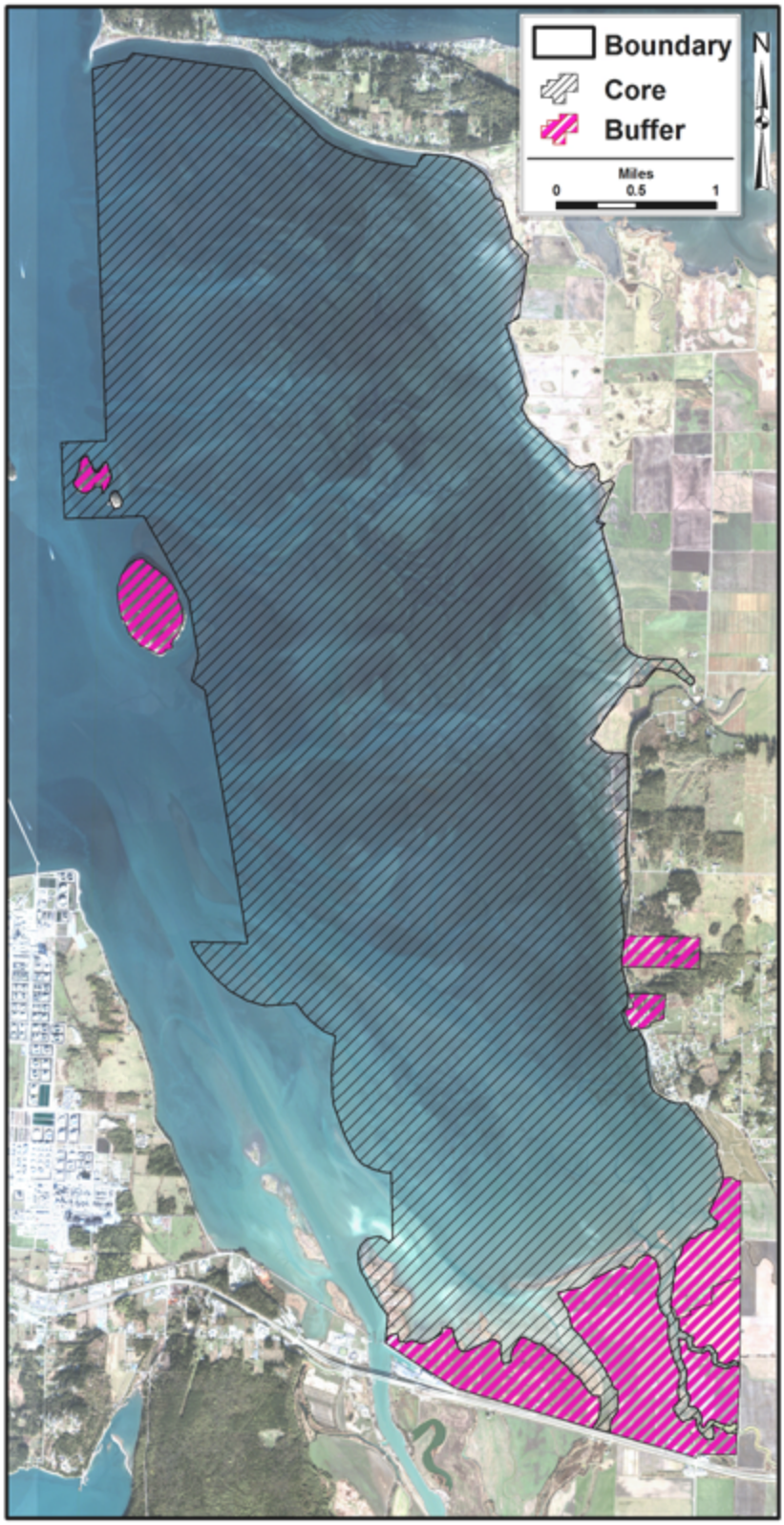


Figure 1.7 Padilla Bay NERR proposed boundary with core (tideland) and buffer (upland) areas.

while 1,352 acres remain in private ownership. Buffer acreage includes farmland and upland (such as rocky islands and the 64 acres where the Reserve offices are located).

Acreage Acquired Between 2008 and 2015

The Reserve has acquired an additional 110 acres of "core" tidelands inside the boundary since the last management plan in 2008. Eleven Padilla Bay Tracts were acquired (4 tracts in the north: 40 acres, and 7 full tracts in the eastern bay: 70 acres). Acquisition of core tidelands is necessary for geographic continuity for research projects and access. Acquisition of these parcels also helps protect eelgrass beds.

Boundary Expansion

No specific land acquisitions are identified for the five year period of this plan. Reference Chapter 11 - Land Acquisition Plan for the state's acquisition strategy (willing sellers) and Appendix B for parcels remaining in private ownership.

Private Lands Status

As of 2015, 11,966 acres of tidelands and uplands are under Reserve or other state agency management (Appendix B, Table B.1). Appendix B (Tables B.2 and B.3) contains a list of parcel numbers and tract numbers for the remaining 1,352 acres of private land in the proposed core and buffer areas of the bay and adjacent lands.

Land Use Type

The region surrounding Padilla Bay NERR is part of the Skagit Valley agricultural complex, one of the most fertile regions in the world (Fig. 1.6). Crops in 2013 included 35,000 acres of field crops (alfalfa, barley, corn and grass silage, grass, oats, pea hay, small grain and wheat), 14,000 acres of potatoes, 4,000 acres in miscellaneous crops, nearly 3,500 acres in vegetable seed, 2,000 acres in blueberries and 1,100 acres in bulb crops (such as tulips). Lesser acreages (100-800 acres each) included grass seed, raspberries, strawberries, cucumbers, carrots, blackberries and apples (WSU Skagit County Extension, 2013). It produces 25% of the nation's frozen peas and 85% of the cabbage and beet seed crop. It is a world leader in daffodil and tulip bulb and flower production. The agricultural richness is a result of thousands of years of sediment deposition by the Skagit River, combined with river and bay-front diking programs over the past 100 years.

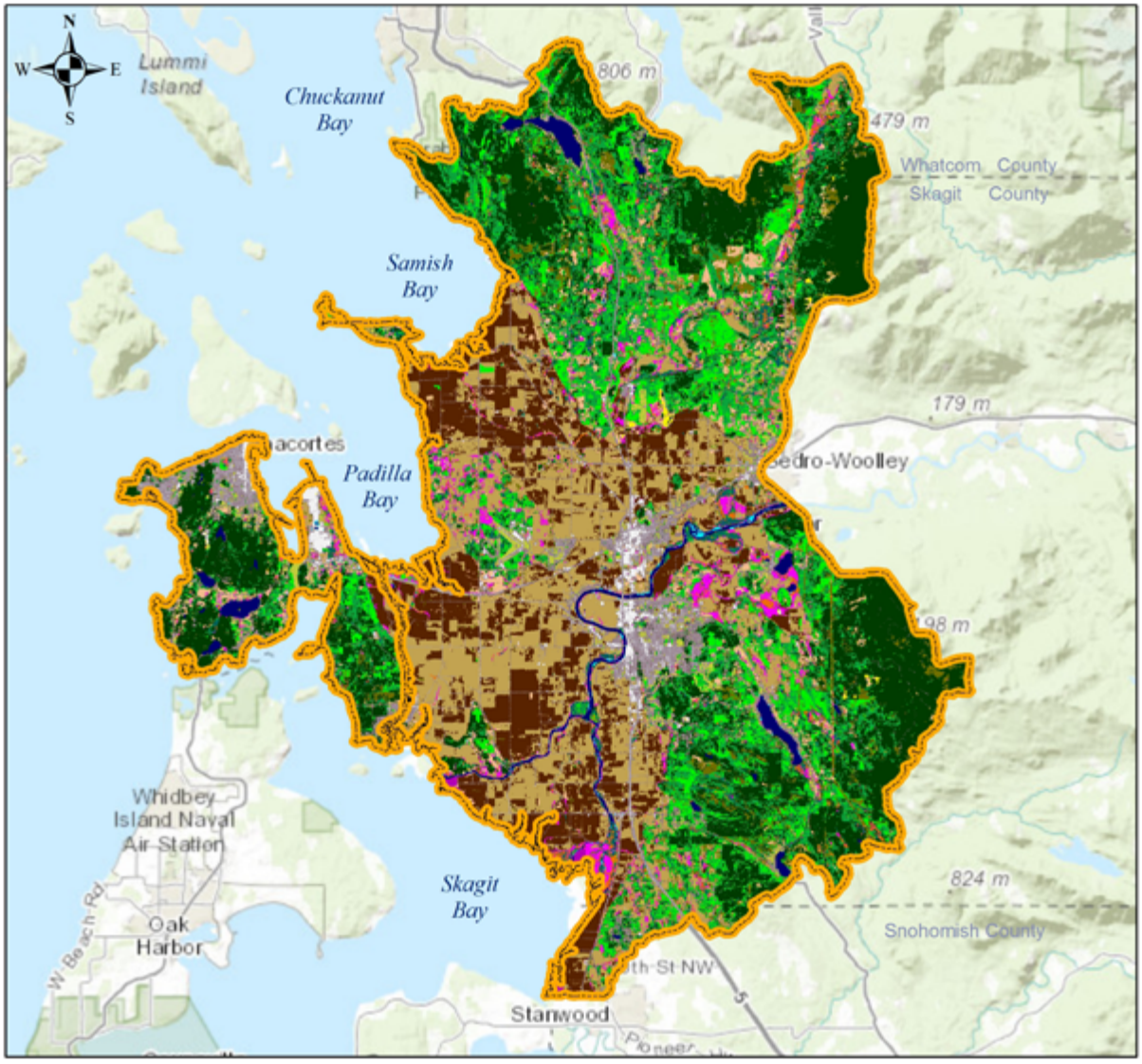
Land use in the watershed was approximately 52% cropland, 20% pasture, 20% forest (mainly on Bay View Ridge), and 8% in urban and miscellaneous uses (which includes industrial, commercial, and residential areas), airport runways, etc. in the 1980s. There have been small shifts to more urban uses, but the vast majority of the lands in the watershed are still used for agricultural or dairy operations. There were approximately 30 dairies producing milk with a value of $52 million in 2013 (WSU Skagit County Exten-

sion, 2013). Several residential areas are located in the western reaches of the county, with the Port of Skagit County industrial park and airport located on Bay View Ridge near the Breazeale Interpretive Center (Fig. 1.6). The eastern half of March Point, site of refineries and chemical processing industries, also drains directly to Padilla Bay.

Commercial development and light industry are located along major transportation routes adjacent to the Reserve. On the western fringe, near the City of Anacortes, industrial development is intensive (Fig. 1.6). This area (March Point) harbors two large oil refineries (Shell and Tesoro), along with other chemical industries. Both refineries have large unloading wharves extending into Padilla and Fidalgo Bays, which receive oil tankers from around the world. The Burlington Northern Railroad crosses the Swinomish Channel in the southwestern part of the bay, and carries petroleum and products in both directions. Fertilizer, feed, and seed processing facilities are also located adjacent to the southern boundary of the Bay.

Targeted Watershed

The "targeted watershed" map was created to aid with habitat mapping and land use/land change. Coastal Change Analysis Program (C-CAP) data can be "clipped" to this targeted watershed boundary (orange boundary on Fig. 1.8). This large boundary was chosen because Padilla Bay is affected by activities in a much larger area than its own boundaries or watershed (e.g., the Fraser River in Canada dilutes the Salish Sea; activities in the Samish River watershed can affect water quality just to the north of Padilla Bay, etc.). The northern boundary is near Lake Samish in Whatcom County. The eastern boundary stretches to Sedro Woolley, the south boundary to Stanwood and the western boundary to Fidalgo Island.



Padilla Bay Targeted Watershed and 2001 Land Cover

Legend

Background	Cultivated Land	Scrub/Shrub	Estuarine Emergent Wetland
Unclassified	Pasture/Hay	Palustrine Forested Wetland	Unconsolidated Shore
High Intensity Developed	Grassland	Palustrine Scrub/Shrub Wetland	Bare Land
Medium Intensity Developed	Deciduous Forest	Palustrine Emergent Wetland	Open Water
Low Intensity Developed	Evergreen Forest	Estuarine Forested Wetland	Palustrine Aquatic Bed
Developed Open Space	Mixed Forest	Estuarine Scrub/Shrub Wetland	Estuarine Aquatic Bed

Figure 1.8. The Padilla Bay "targeted watershed" boundary.

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Chapter 2 - Padilla Bay NERR Strategic Plan

Introduction

Padilla Bay NERR is housed within a regulatory and environmental state agency that has similar concerns to the Reserve's about climate change and water quality and is aligned with using the best available science to inform decisions. The Reserve is housed within a program in that agency with a focus on healthy watersheds and habitats and passing those on to future generations.

The Reserve has and will continue to "practice and promote stewardship of coasts and estuaries" through research, education and training and using Padilla Bay as an example of what people can achieve locally or regionally. The Reserve commits to engaging citizens and communities, creating strong partnerships, using best management practices and seeking regional collaborations.

A Focus on Coastal Management Issues

For the purposes of revising this Management Plan, Reserve staff met to discuss coastal issues of importance to the Reserve and other agencies and organizations, social and cultural factors that influence decisions, stakeholder involvement and other topics of importance for planning strategically for the next five years.

The coastal management issues of focus for Padilla Bay NERR in the next five years (2016-2020) are:

1) Climate change impacts
2) Water quality in estuaries and watersheds
3) Invasive species impacts
4) Loss of shoreline processes
5) Habitat loss in estuaries and watersheds

The list of issues was based on a search of local, state agency, and non-profit organization documents and the ranking was by Padilla Bay staff and stakeholders through the use of an on-line tool. These issues were also discussed with stakeholders to better understand their needs and perspectives and how those needs differed from the Reserve's (see Chapter 6-Natural Resources Stewardship, Table 6.5).

NERRS Guiding Principles

The NERRS is guided by several principles, as stated in the NERRS Strategic Plan (2011-2016):

- Engage local communities and citizens to improve stewardship of coastal resources
- Create strong partnerships to enhance the success of Reserve programs
- Integrate research, education, and stewardship to address complex coastal problems
- Implement best management practices at reserves to lead by example
- Seek regional collaborations to extend the influence of reserve programs and products.

National Estuarine Research Reserve System Vision and Mission

NERRS Vision: Resilient estuaries and coastal watersheds where human and natural communities thrive.

NERRS Mission: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas.

The NERRS identified three areas of focus over the 2011-2016 period: climate change, habitat protection, and water quality. As we revise our management plan, the NERRS is gearing up for a new strategic plan for the 2017-2022 period and the focus may change for the national system during the term of this management plan.

Washington State Department of Ecology Vision and Mission

The Reserve is managed by the Washington State Department of Ecology (Ecology) whose focus is currently on: facing climate change, managing water, reducing toxic threats, caring for shorelines and using the best science and research to improve the health of Puget Sound.

Ecology's Vision: Innovative partnerships sustain healthy land, air and water in harmony with a strong economy.

Ecology's Mission: Protect, preserve and enhance Washington's environment for current and future generations.

Ecology's goals are to: protect and restore land, air, and water; prevent pollution; promote healthy communities and natural resources; and deliver efficient and effective services.

There are ten programs within Ecology: Air Quality, Environmental Assessment, Hazardous Waste and Toxics Reduction, Nuclear Waste, Shorelands and Environmental Assistance, Spills, Toxics Cleanup, Waste to Resources, Water Quality, and Water Resources. The Reserve, along with the Coastal Zone Management Program, is housed within the Shorelands and Environmental Assistance Program (SEAP). SEAP helps communities manage shorelands and wetlands and the primary focus is on state and local responsibilities for administering Washington State and federally delegated laws. Padilla Bay NERR is a section within that program.

SEAP's Vision: Healthy watersheds provide viable habitat for fish, plants and animals, and support economic growth in communities.

SEAP's Mission: To work in partnership with communities to support healthy watersheds and promote statewide environmental interests.

Padilla Bay NERR Vision and Mission

Padilla Bay NERR's Vision: Healthy and resilient estuaries and coastal watersheds that support sustainable natural and human communities.

Padilla Bay NERR's Mission: To protect and restore coastal and estuarine ecosystems in Puget Sound and the Salish Sea through research, education, stewardship and community partnerships.

The Padilla Bay NERR Strategic Framework is shown in Table 2.1. This framework will help guide our actions under this management plan revision for the period from 2016-2020.

Padilla Bay NERR Policies

Public Access

1. Public access to sensitive biological sites or protected areas shall be limited to protect public safety, critical resources, or the integrity of research areas.
2. Major public access points (trails, observation deck, campus pathways) shall be barrier free to the handicapped.

Facilities Development

1. Reserve facilities shall be free of barriers to the handicapped. ADA standards shall be met and reasonable accommodation shall be provided.

Education

1. Education programs will be designed to meet state and federal standards such as Washington State Essential Academics Learning Requirements, National Science Standards and Ocean Literacy.

Table 2.1 Padilla Bay NERR Strategic Framework

Vision	Healthy and resilient estuaries and coastal watersheds that support sustainable natural and human communities.
Mission	To protect and restore coastal and estuarine ecosystems in Puget Sound and the Salish Sea through research, education, stewardship and community partnerships.
Our Commitment	➢ Perform our work in a professional and respectful manner. ➢ Listen carefully and communicate in a responsive and timely manner. ➢ Solve problems through innovative ways. ➢ Build and maintain cooperative relationships. ➢ Practice continuous improvement.
Core Goals	➢ Improved scientific understanding of coastal (ecological) communities leads to informed management of natural resources and resilient and sustainable ecosystems. ➢ Informed citizens, students and decision-makers have the knowledge and understanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea. ➢ Citizens and decision-makers understand the impacts of climate change on human and natural resource communities and can make informed decisions. ➢ The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.
Strategic Priorities	➢ Climate change impacts ➢ Water quality in estuaries and watersheds ➢ Invasive species impacts ➢ Loss of shoreline processes ➢ Habitat loss in estuaries and watersheds

2. Efforts will be made to reach underserved audiences.
3. Programs will emphasize field-based and inquiry learning whenever appropriate.
4. All programs will be evaluated and changes made as necessary.

Coastal Training Program

1. A comprehensive needs assessment will be conducted with shoreline planners, private consultants, state regulatory staff, and other coastal managers every three years to ensure that the CTP is staying on track with their training needs.
2. Performance monitoring data will be collected and reported every six months via an established website. Data includes statistics on the number of professionals served, satisfaction with the content, and intention of decision-makers to apply what they have learned.
3. Online class evaluations will continue to be given after every training class. Programs will be evaluated and changes made as necessary.

Research

1. Research projects in Padilla Bay NERR will be conducted with a Research Permit issued by the Research Coordinator for the purposes of coordination, tracking, and protection of resource integrity.
2. All field and laboratory activities, including watercraft operation, will be carried out consistent with applicable safety plans and manuals.
3. Research in Padilla Bay NERR will be carried out in a manner designed to minimize impact to the bay's biological communities and resources.

Monitoring

1. All field and laboratory activities, including watercraft operation, will be carried out consistent with applicable safety plans and manuals.
2. Monitoring in Padilla Bay NERR will be carried out in a manner designed to minimize impact to the bay's biological communities and resources.
3. Monitoring will be carried out in a manner consistent with policies and protocols established by NERRS.
4. All biotic, abiotic, and GIS data sent to the Coastal Data Management Office (CDMO) will include the appropriate metadata.

Natural Resources Stewardship

1. Natural resources issues are solved by multiple sectors meeting to discuss the issue or by the establishment of a qualified focus group.
2. The Society for Ecological Restoration's "Guidelines for Developing and Managing Ecological Restoration Projects" are used when implementing restoration on Padilla Bay NERR property (www.ser.org, Resources/ Publications/Foundation Documents).
3. Appropriate laws and regulations will be applied to protect threatened and endangered species and migratory birds.

4. The aquatic and upland resource of the Reserve will be protected by all available local, state, and federal regulations consistent with the established uses of the lands.

Strategic Plan Terms

For the purposes of this strategic plan our terms are defined as:

A *goal* is what is desired; it is what the Reserve is working to achieve in a broad sense. These goals provide a stable, long-term direction for the Padilla Bay National Estuarine Research Reserve.

Objectives are statements of expected results that contribute to the goal; they are specific, measurable, and realistic.

Actions are specific items or tasks, performed within a given time, to accomplish the goals and objectives, consistent with our policies.

Policies are the standards the Reserve follows to achieve its goals and objectives.

Regulations are general or specific rules established to protect natural resources and/or the biological integrity of the Reserve. They are implemented through a variety of federal, state and local codes (See Appendix C).

Padilla Bay NERR Performance Measures

The Education Program, Coastal Training Program, and Research and Monitoring Program submit NERRS performance measures via the NERRS Performance Database every six months during progress reporting to NOAA (or at requested intervals). Volunteer hours are also submitted at those times.

Every five years, the Reserve's performance is evaluated by CZM Section 312. The current performance measures and targets associated with this evaluation are:

- Total number of people participating in education programs from 2012-2017. Target: 50,000 people.
- Percent of CTP participants from 2012-2017 who intend to apply knowledge or skills in their work or in future decisions. Target: 92%.
- Percent of water quality and weather data that meet the established standards for Quality Assurance/Quality Control (QA/QC) submitted to CDMO from 2012-2017. Target: 90%.

Padilla Bay NERR Goals, Objectives and Actions

There are two supporting goals and four core goals for the Reserve for 2016-2020. Table 2.2a lists the supporting goals and objectives for each sector. These goals are:

SUPPORT GOAL 1: The Washington State Department of Ecology provides support for the Reserve's administrative, operational and capital resources activities.

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers, and partners.

Table 2.2b lists the core goals and objectives for each sector. Those goals are:

CORE GOAL 1: Improved scientific understanding of coastal (ecological) communities leads to informed management of natural resources and resilient and sustainable ecosystems.

CORE GOAL 2: Informed citizens, students and decision-makers have the knowledge andunderstanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.

CORE GOAL 3: Citizens and decision-makers understand the impacts of climate change on human and natural resource communities and can make informed decisions.

CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.

Also included in the tables are which sectors will accomplish each objective, which important coastal management issues they address for the Reserve and which NERR Strategic Plan focus areas (2011-2016) are addressed by the objectives. Actions for 2016-2020 are listed at the end of each chapter.

Table 2.2a Padilla Bay NERR Goals and Objectives (2016-2020).	
PBNERR SUPPORT GOALS & OBJECTIVES	**SECTOR**
SUPPORT GOAL 1: The Washington State Department of Ecology provides support for the Reserve's administrative, operational and capital resources activities.	
Objective: Ecology provides state agency administrative framework for the Reserve from 2016-2020.	MGR
Objective: Ecology provides adequate operational support for the Reserve from 2016-2020.	MGR
Objective: Ecology provides support for capital resources activities from 2016-2020.	MGR
Objective: The vehicles will be maintained as per Washington State Department of Enterprise Services and Washington State Department of Ecology during 2016-2020.	MGR
Objective: Boats will be maintained in good repair during 2016-2020.	RES
Objective: Ecology-owned public access areas are maintained by Reserve staff during the 2016-2020 period.	MGR
Objective: Padilla Bay NERR infrastructure and facilities will be maintained during the 2016-2020 period.	MGR
Objective: Padilla Bay NERR will continue green improvements to facilities during the 2016-2020 time period, if funding is secured by the Manager.	MGR
SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers and partners.	
Objective: The Manager reviews staffing needs no less than annually from 2016-2020.	MGR
Objective: The Manager and staff will maintain strategic partnerships throughout 2016-2020.	MGR
Objective: The Manager will arrange for volunteer coordination services for the Reserve from 2016-2020.	MGR
Objective: Padilla Bay NERR vessels and vehicles will be maintained in good working condition during 2016-2020.	MGR/RES
Objective: The Manager will meet with staff to communicate news from Ecology, NOAA and others throughout 2016-2020.	MGR
Objective: The Manager will maintain continuity for the Reserve's volunteer program from 2016-2020.	MGR
Objective: The CVP Coordinator will continue to develop and refine the volunteer program during 2016-2020.	MGR
Objective: The Reserve coordinates with local and regional agencies and environmental organizations that protect and preserve key lands in the watershed from 2016-2020.	MGR
Objective: The Education Coordinator will maintain strategic education partnerships throughout 2016-2020.	ED

Table 2.2a Padilla Bay NERR Goals and Objectives (2016-2020).	
PBNERR SUPPORT GOALS & OBJECTIVES	**SECTOR**
SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers and partners.	
Objective: The Education Coordinator understands the needs of education stakeholders from 2016-2020.	ED
Objective: The education program will encourage volunteer participation from 2016-2020.	ED
Objective: The education program will work with partners from 2016-2020 to accomplish education goals	ED
Objective: The CTPC will maintain strategic Coastal Training Program partnerships throughout 2016-2020.	ED
Objective: The Stewardship Coordinator will maintain strategic stewardship partnerships throughout 2016-2020.	STEW
Objective: County or state-owned public access areas adjacent to the Reserve are maintained by those respective agencies from 2016-2020.	STEW
Objective: The Reserve coordinates with local and regional agencies and environmental organizations that protect and preserve key lands in the watershed from 2016-2020.	MGR

Key for Tables 2.2a and 2.2b

Sectors
MGR: Management
RES: Research
ED: Education
CTP: Coastal Training Program
STEW: Stewardship

PBNERR Coastal Management Issues (In the "PB" columns)
CC: Climate change
WQ: Water quality
IS: Invasive species
SP: Shoreline processes
HL: Habitat loss

NERRS Strategic Plan (2011-2016) Areas of Focus [In the "NERRS" columns]
CC: Climate change
WQ: Water quality
HP: Habitat protection

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	**SECTOR**	**CC**	**WQ**	**IS**	**SP**	**HL**	**CC**	**WQ**	**HP**
CORE GOAL 1: Improved scientific understanding of coastal (ecological) communities leads to informed management of natural resources and resilient and sustainable ecosystems.									
Objective: Identify and promote research priorities at Padilla Bay NERR from 2016-2020 that advance our understanding of the habitats, ecology, organisms, diversity and/or ecosystem functions of Padilla Bay.	RES	X	X	X		X	X	X	
Objective: Provide resources, data and support from 2016-2020 to approved, independent research projects within the Reserve's boundary and watershed.	RES	X	X	X	X	X	X	X	
Objective: Enhance communication and collaboration among the scientific and resource management community from 2016-2020 to improve knowledge of PBNERR habitats, species, diversity, ecosystem functions and to advance management objectives for Washington state.	RES	X	X	X	X	X	X	X	
Objective: The Education and Research Coordinators will communicate regularly about planned activities, projects and programs to identify opportunities for integration during 2016-2020.	ED/ RES	X	X				X	X	
Objective: The Education Specialist will collaborate with the Skagit Conservation District or Skagit County Water Quality Program from 2016-2020 to offer citizen science programs such as Stream Team and Storm Team.	ED		X					X	

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	SECTOR	CC	WQ	IS	SP	HL	CC	WQ	HP
CORE GOAL 2: Informed citizens, students and decision-makers have the knowledge and understanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.									
Objective: Scientific data and research findings will be shared with the broader scientific, resource management, and stakeholder communities from 2016-2020.	RES	X	X		X	X			
Objective: Engage citizens, students and other non-scientists in research at PBNERR and other aspects of the process of science and research.	RES	X	X				X	X	
Objective: Research findings will be made available to Reserve visitors, students, CTP participants and other interested public audiences from 2016-2020.	RES	X	X				X	X	
Objective: The Research Coordinator will communicate regularly with the Education and CTP Coordinators to identify opportunities for integration of research into planned activities, projects and programs during 2016-2020.	RES	X	X		X		X	X	
Objective: The education staff will offer effective education programs that focus on the values of estuary systems and appropriate stewardship behaviors during 2016-2020.	ED		X			X		X	X
Objective: The education staff will offer effective teacher training that focuses on the values of estuary systems and appropriate stewardship behaviors from 2016-2020.	ED	X	X			X	X	X	X

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	**SECTOR**	**CC**	**WQ**	**IS**	**SP**	**HL**	**CC**	**WQ**	**HP**
CORE GOAL 2: Informed citizens, students and decision-makers have the knowledge and understanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.									
Objective: The education staff will identify and reach out to underserved audiences from 2016-2020.	ED		X			X		X	X
Objective: The education staff will work with partners to offer "Storming the Sound" annually .	ED	X	X	X		X	X	X	X
Objective: The CTP will offer 18-21 classes in western Washington and 1-3 classes in eastern Washington each year from 2016-2020.	CTP	X	X		X	X	X	X	X
Objective: The CTP Coordinator will explore partnerships in 2016 in order to create new CTP classes from 2016-2018.	CTP	X	X		X	X	X	X	X
Objective: The CTP Coordinator will work with instructors to update three existing classes in 2016 and 2017.	CTP		X			X		X	X
Objective: The CTP Coordinator will work with instructors to adapt and/or offer existing classes for eastern Washington from 2016-2020.	CTP				X	X			X
Objective: The CTP Coordinator will work with instructors to develop new classes on priority issues from 2016-2020.	CTP		X		X	X		X	

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	**SECTOR**	**CC**	**WQ**	**IS**	**SP**	**HL**	**CC**	**WQ**	**HP**
CORE GOAL 3: Citizens and decision-makers understand the impacts of climate change on human and natural resource communities and can make informed decisions.									
Objective: PBNERR will support and actively engage in research during 2016-2020 that addresses the effects of climate change on the Padilla Bay ecosystem and coastal waters of the Salish Sea.	RES	X			X		X		
Objective: Education staff will implement programs that help citizens to reduce carbon emissions and help them adapt to a changing climate from 2016-2020.	ED	X					X		
Objective: The Education Coordinator will seek grant funding over the 2016-2020 time period to develop climate-oriented classes for citizens.	ED	X					X		
Objective: The CTP Coordinator will work with instructors to offer a series of climate-related courses from 2016-2020.	CTP	X					X		

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	**SECTOR**	**CC**	**WQ**	**IS**	**SP**	**HL**	**CC**	**WQ**	**HP**
CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.									
Objective: Provide scientific information and research findings that support the efforts of local and regional resource managers during the 2016-2020 period.	RES	X	X				X	X	
Objective: The Stewardship Coordinator will lead the effort to survey, map, and control noxious weeds on Reserve properties from 2016-2020.	STEW			X					X
Objective: The Stewardship Coordinator will monitor selected natural resources in Padilla Bay from 2016-2020.	STEW	X	X	X			X		
Objective: The Stewardship Coordinator will attend meetings of local groups from 2016-2020 to better understand their projects and how those projects may affect natural resources in Padilla Bay.	STEW	X	X	X	X	X	X	X	X
Objective: The Stewardship Coordinator will review and update the Padilla Bay NERR Disaster Response Plan in 2020 and participate in disaster training and exercises throughout this period.	STEW	X	X	X	X	X	X	X	X
Objective: The Manager and Stewardship Coordinator will review the guidelines for allowable/non-allowable uses no less than every five years.	MGR/ STEW	X	X			X	X	X	X
Objective: Maintain good communication with natural resources stakeholders from 2016-2020.	MGR/ STEW	X	X	X	X	X	X	X	X

Table 2.2b Padilla Bay NERR Goals and Objectives (2016-2020).									
		PB	PB	PB	PB	PB	NERRS	NERRS	NERRS
PBNERR CORE GOALS & OBJECTIVES	**SECTOR**	**CC**	**WQ**	**IS**	**SP**	**HL**	**CC**	**WQ**	**HP**
CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.									
Objective: Review and update resource unit policies no less than every five years.	MGR/ STEW		X	X	X	X	X	X	X
Objective: All Padilla Bay NERR staff will report any prohibited uses of Reserve natural resources to the Manager or Stewardship Coordinator during 2016-2020.	MGR/ STEW		X		X	X		X	X

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Chapter 3 – Research and Monitoring Plan

Introduction

Padilla Bay NERR is located in a region of the Salish Sea known as the Northwest Straits, with Canada and the Georgia Basin to the north and the greater Puget Sound and Strait of Juan de Fuca to the south and west. As such, the research program at PBNERR is able to help address science and management issues relevant to not only Puget Sound, but also the greater Salish Sea ecosystem and the Columbian biogeographic region as a whole. Padilla Bay has a wide range of marine and nearshore habitats (e.g., mudflats, rocky intertidal, and deep pelagic zones) and is also home to one of the largest contiguous eelgrass habitats in North America (~8,000 acres) that includes both the native eelgrass *Zostera marina* and non-native *Zostera japonica*.

The region in which Padilla Bay is located remains underrepresented in research and monitoring relative to other parts of the greater Puget Sound. When combined with routine collaboration that occurs with research faculty at nearby universities and other government agencies, Padilla Bay NERR is in an ideal position to engage in, support and/or promote research endeavors in local waters that might not otherwise occur and that address local, regional and national issues. Research and management priorities to which PBNERR monitoring and research contributes includes recovery and expansion of eelgrass habitat in Washington State, investigating effects of climate change, sea-level rise, and ocean acidification, addressing needs of nearby Native American Tribal communities and commercial shellfish operations, engaging volunteers in citizen-based science, and using SWMP data to identify long-term changes in water quality and oceanographic properties of the Salish Sea.

NERR Research and Monitoring Program

The National Estuarine Research Reserve System's mission provides that reserves are protected and managed to afford opportunities for long-term research. Research at each reserve is designed to fulfill the Reserve System goals as defined in the regulations (15 C.F.R. § 921(b)):

- Address coastal management issues identified as significant through coordinated estuarine research within the system;
- Promote federal, state, public and private use of one or more reserves within the system when such entities conduct estuarine research;
- Conduct and coordinate estuarine research within the system, gather and making available information necessary for improved understanding and management of estuarine areas.

To sustain these system goals, the 2011-2016 Reserve System Strategic Plan outlines research objectives that support the focus areas of climate change, habitat protection, and water quality:

- Expand capacity to monitor changes in water quality and quantity, habitat, and biological indicators in response to land use and climate change drivers.
- Improve understanding of the effects of climate change and coastal pollution on estuarine and coastal ecology, ecosystem processes, and habitat function.
- Characterize coastal watersheds and estuary ecosystems and quantify ecosystem services to support ecosystem-based management of natural and built communities.
- Increase social science research and use of social information to foster coastal stewards that value and protect estuaries.

The Reserve System's research and monitoring programs provide the scientific basis for addressing coastal management challenges. Reserve research and monitoring activities provide valuable information about estuarine resources to increase understanding and awareness of their importance to a variety of audiences including scientists, resource managers, educators, and the general public.

NERRS Research Programs

Currently, there is one focused effort to fund estuarine research in the Reserve System. The National Estuarine Research Reserve System Science Collaborative is a program that focuses on integrating science into the management of coastal natural resources. Through an adaptively managed program, the Science Collaborative funds collaborative research and science transfer programs and projects that develop and apply science-based tools to better understand how to detect, prevent, and reverse the impacts of coastal pollution, habitat degradation and ecosystem processes in a time of climate change. The program is designed to enhance the Reserve System's ability to support decisions related to coastal resources through collaborative approaches that engage the people who produce science and technology with those who need it. In so doing, the Science Collaborative seeks to make the process of linking science to coastal management decisions, practices, and policies more efficient, timely, and effective and share best practices and examples for how this can be done.

NERRS System-Wide Monitoring Program

The System-Wide Monitoring Program provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern and is guided by the Reserve System-Wide Monitoring Program Plan. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in water quality, biolog-

ical systems, and land use/cover characteristics of estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national references sites and focuses on three ecosystem characteristics:

1. *Abiotic Characteristics*: Abiotic measurements are supported by standard protocols, parameters, and approaches that describe the physical environment including weather, water quality, hydrological, and sediment related parameters. The monitoring program currently provides data on water temperature, specific conductivity, percent saturation of dissolved oxygen, pressure, pH, turbidity, salinity, concentration of dissolved oxygen, and pressure corrected water depth. Meteorological data include air temperature, relative humidity, barometric pressure, wind speed, wind direction, rainfall, and photosynthetically active radiation (PAR). In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Data is Federal Geographical Data Committee compliant and available via the Reserve System Centralized Data Management Office.
2. *Biotic Characteristics*: As funds are available, reserves are focusing on monitoring habitats and biodiversity.
3. *Watershed and Land Use Classifications*: The Reserve System is examining the link between watershed land use and coastal habitat quality by tracking and evaluating changes in coastal habitats and watershed land use/cover. This element is guided by the "NERRS Habitat Mapping and Change Plan."

Building on these foundational elements, the Reserve System is developing a network of sentinel sites and the capacity to assess the impact of sea level/lake level changes and inundation on the diverse set of coastal vegetative habitats represented in the system. Reserves are implementing a suite of activities, as described in the 2012 Reserve System Sentinel Site Guidance Document, to assess the relationship between vegetative communities (marsh, mangrove and submerged aquatic vegetation) and sea level. Reserves are adding surface elevation tables and monitoring pore water chemistry along vegetation monitoring transects and linking their System-Wide Monitoring Program to a network of specialized spatial infrastructure to allow precise measurement of local sea level and lake level changes and subsequent impacts to key habitats. The Reserve System is working in partnership with NOAA's National Geodetic Survey and the Center for Operational Oceanographic Products and Services to support the development of sentinel sites.

Padilla Bay NERR Research Program Context

This chapter provides strategic direction for the Reserve's Research and Monitoring for the next five years. This plan reflects the research and monitoring efforts necessary to work towards addressing local, regional and national questions regarding the science, management, and assessment of impacts of global change on estuarine ecosystems. Local and regional priorities are identified through regular communications and inter-

actions with research scientists and natural resource managers working in the greater Salish Sea ecosystem and Washington's outer coast. This approach is built on basic principles regarding current needs in estuarine research (e.g., assessing impacts of climate change, sea level rise, eutrophication, ocean acidification, and water quality) while allowing flexibility to strategically pursue research questions as they arise and adapt to changing science, monitoring and research needs over the next five years. This chapter concludes with a list of actions and strategies the Research and Monitoring staff will implement to address goals and objectives related to Reserve priorities.

Overview

The National Estuarine Research Reserve System (NERRS) was created in 1972 by the Coastal Zone Management Act (16 U.S.C. § 1461) to increase our ability to responsibly manage estuarine ecosystems (see Chapter 1, The NERR System). The NERR System provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach as stated in the mission of the NERRS in 15 C.F.R. § 921.1(a). NERRS research and monitoring activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries.

Regional and Geographic Context of Research at Padilla Bay

Padilla Bay is located in a region of the Salish Sea known as the Northwest Straits, with Canada and the Georgia Basin to the north and the greater Puget Sound and Strait of Juan de Fuca to the south and west. Padilla Bay was designated a National Estuarine Research Reserve under the CZMA for the "Columbian Biogeographic Region" and the "Puget Sound Sub-region". Thus, the research program at PBNERR has a responsibility to address science and management issues relevant to not only Puget Sound, but also the greater Salish Sea ecosystem and the Columbian biogeographic region as a whole in which PBNERR is centrally located (Fig. 3.1). Many of these issues have emerged as part of the Puget Sound Partnership (PSP), an organization created by Washington State government to clean up the Sound, making it "fishable, swimmable, and diggable" by the year 2020.

The Washington Department of Ecology (Ecology) Coastal Management Office (CMO) has become increasingly involved in these actions, with additional mandates to address the health of Puget Sound. As part of the Shorelands and Environmental Assistance (SEA) Program in Ecology, PBNERR has a responsibility to support research on priority issues for both Ecology and the SEA Program, including issues related to broader coastal zone management. In addition, conservation and environmental quality in Puget

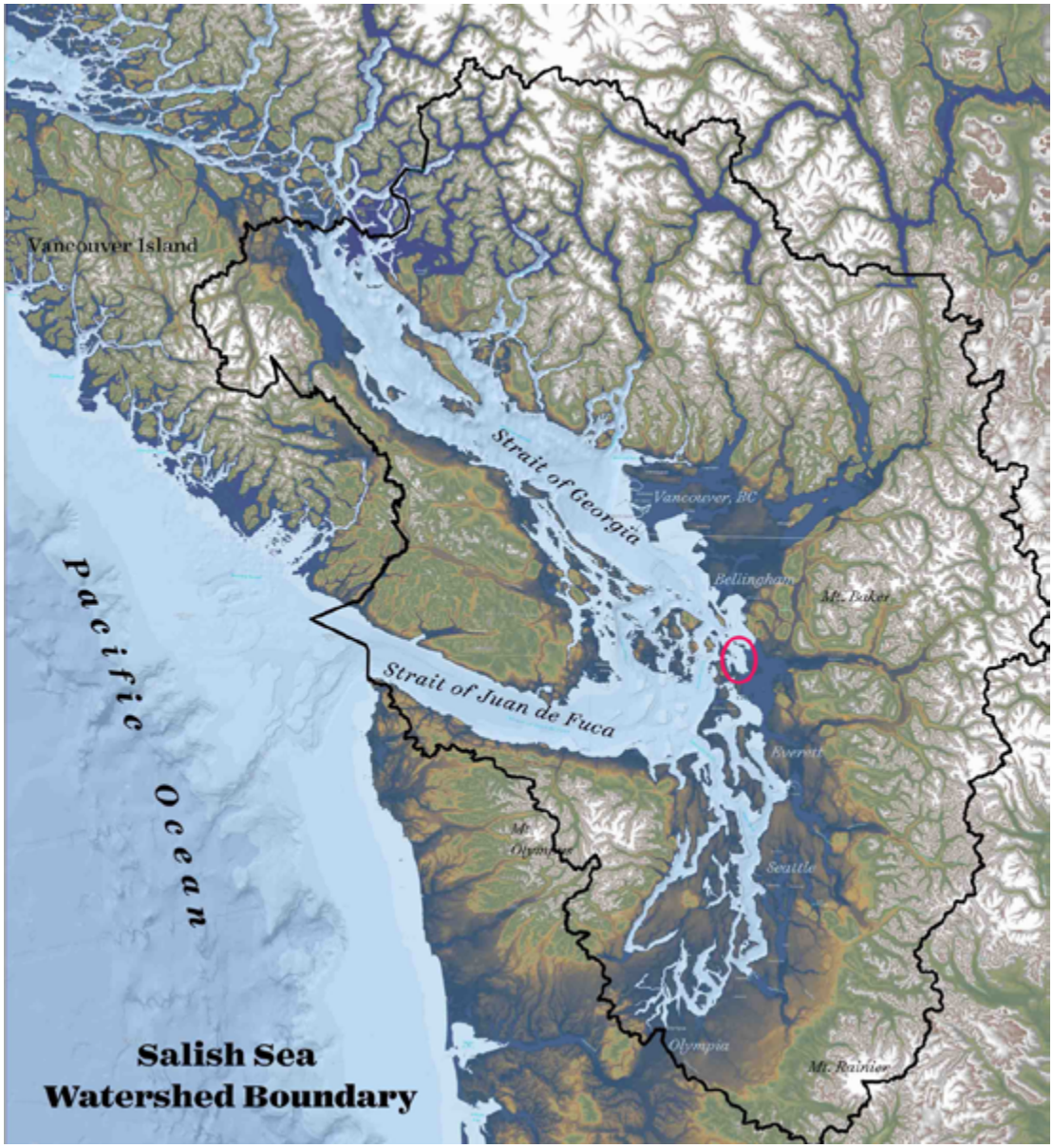

Figure 3.1 Salish Sea and associated watershed with Padilla Bay indicated (circle).

Sound is and has been the concern of federal and state agencies. To this end, over the years research at Padilla Bay has addressed priorities and issues of the EPA Puget Sound Estuary Program, Washington State Puget Sound Water Quality Authority, Puget Sound Action Team, and Puget Sound Partnership. Research conducted at PBNERR will continue to advance scientific knowledge that can address issues of importance in the Salish Sea and for other stakeholder organizations within the region.

Regional and local issues and priorities continue to shape the research conducted at Padilla Bay. Issues of regional importance include protection and restoration of coastal habitat, reduction of toxic inputs, reduction of human and animal waste inputs, protection of ecosystem biodiversity and imperiled species, controlling invasive species, and

understanding the impacts of climate change. Place-based management issues specifically relevant to Padilla Bay include overland flow and nutrient inputs from the predominately agricultural watershed, evaluating the ecological role and ecosystem functions of eelgrass in Padilla Bay and potential threats to these communities, interactions between native eelgrass *Zostera marina* and the non-native *Zostera japonica*, invasion and spread of non-native *Spartina* on the intertidal flats, the effect of climate change, ocean acidification and sea-level rise on habitats, shorelines, biota, water quality and ecological functions in Padilla Bay, and general improvement of our understanding and awareness of changing environmental conditions, trends, and their drivers.

Alignment with NERRS Strategic Plan

Research and monitoring at Padilla Bay addresses all of the science objectives set forth in the 2011-2016 NERRS Strategic Plan and thus works towards the goal that "scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds". The continued growth of our monitoring program through efforts of PBNERR research staff and through collaboration and support of external researchers has allowed expansion of monitoring (i.e., Science Objective #1) to include additional biotic characteristics such as plankton communities, community metabolism rate measurements, and monitoring of rocky intertidal habitats. Through increased monitoring and analysis of sea-level rise, pH and carbonate chemistry, we are working towards improved understanding of the effects of climate change (Science Objective #2). Work investigating the ecology of native and non-native seagrass communities in Padilla Bay and their role in carbon sequestration will help us evaluate ecosystem services and better inform ecosystem-based management (Science Objective #3). Finally, a new direction of growth is the integration of public stakeholder needs and priorities into research efforts at Padilla Bay by growing our capacity to support volunteer-based science, which will allow the reserve to engage and recruit public audiences in the process of science and foster coastal stewards that value and protect estuaries (Science Objective #4).

Activities and efforts of the Research and Monitoring programs at Padilla Bay will address other goals and objectives of the 2011-2016 NERRS Strategic Plan that fall under the "Protected Places" and "People" goals. Collaboration with local university partners has allowed field testing and deployment of newly-developed pH sensors in the Reserve, which will advance our progress on evaluating water quality and climate change impacts (Protected Places, Objective#2). This objective is also met by the expansion of monitoring measurements to include rates of water-column oxygen consumption and CO_2 production, and experimentation to evaluate the temperature dependence of these processes. With respect to the NERR educational goal, the Research Coordinator is co-PI on a NOAA Environmental Literacy grant that is working to incorporate real-time SWMP data into inquiry-based activities for middle schools classrooms and pre-service teacher training (Objective#1) and through continued work with the Education, CTP and Volunteer coordinators at PBNERR, we assist in the development and delivery of programs addressing climate change and water quality awareness among public audiences (Objective#2).

Importance of Padilla Bay as a Research Reserve

Padilla Bay and its operation as a National Estuarine Research Reserve allow the research program to contribute to research in the Salish Sea in numerous ways. Specific factors that contribute to the value of PBNERR in advancing estuarine research include:

- The status of Padilla Bay and its habitats as part of the National Estuarine Research Reserve System ensure that is protected both by federal and state agreements.
- The region in which Padilla Bay is located (i.e., central Salish Sea/Northwest Straits) remains underrepresented in research and monitoring relative to other parts of the greater Puget Sound. In this regard, the Padilla Bay Reserve is poised to engage in, support and/or promote research endeavors in local waters that might not otherwise occur.
- Recovery of eelgrass communities and expansion of eelgrass habitat is a priority for Washington State and other management entities focused on marine water quality in the region. With one of the most extensive areas of contiguous eelgrass beds in North America, Padilla Bay provides a living laboratory in which the ecology, management and restoration of eelgrass – and the role of eelgrass in the larger estuarine ecosystem – can be explored.
- Padilla Bay includes a mosaic of other habitats, including native salt marsh, sand flats, mud flats, rocky intertidal communities, and extensive network of tidal channels throughout the bay.
- As a result of colder water temperatures and periodic intrusion of more acidic waters associated with upwelling, pelagic processes and physico-chemical properties of the Salish Sea are particularly vulnerable to the effects of climate change and ocean acidification (OA). There is evidence, however, that eelgrass may be able to locally mitigate the effects of ocean acidification in shallow embayments. Thus, PBNERR is in a position to investigate local effects of climate change and OA, while also exploring how these are related to ecosystem services associated with submerged aquatic vegetation.
- PBNERR is in close proximity to several Native American Tribal communities and commercial shellfish operations, all of which are economically and socially reliant on coastal ecosystems and will likely be negatively impacted by sea-level rise and ocean acidification. Partnering with these stakeholders will help guide research and monitoring priorities to increase the social and economic relevance of work at PBNERR.
- Because the Padilla Bay ecosystem is not directly impacted by extensive anthropogenic activities, perturbations, or other point-sources of contamination, the Reserve can serve as a reference site (i.e. control) for larger-scale studies within the region and beyond.
- Over forty years of research in Padilla Bay has established a collection of historical and baseline data that provide valuable insight, background, and context for initiating additional research projects in Padilla Bay. This

research and other relevant knowledge about Padilla Bay are detailed in a comprehensive site profile that was recently published in 2013.

- Long-term (i.e., >10 years) datasets of weather, marine physicochemical parameters, and other metrics of water quality are well established at Padilla Bay NERR and are available to scientists to supplement their work as they develop research questions, investigate hypotheses, identify trends, and interpret results from their studies.
- The Reserve shares geographic proximity and/or professional affiliations with other National Estuarine Research Reserves, state, local and Tribal governments, other Washington State management agencies, and several universities and colleges within the region. This network provides an opportunity for collaborative studies among diverse stakeholders.
- The Reserve has extensive laboratory space, research vessels, field equipment and other infrastructure to support visiting scientists in a variety of different types of research endeavors. The Reserve also offers lodging facilities for overnight or short-term stays at Padilla Bay.

Ecological Setting

Padilla Bay contains extensive beds of seagrasses, mainly *Zostera marina* but with a significant proportion that is non-native *Zostera japonica* (Webber et al. 1987; Bulthuis 1991a, 1995; Bulthuis and Shull 2002, 2006). These seagrasses are a critical ecological resource of the bay. They are the major primary producer (Thom 1988, 1989, 1990); they provide direct food supply for the resident and migratory sea birds such as Black Brant (Jeffrey 1976; Reed et al. 1989); they directly and indirectly support a diverse and productive invertebrate infauna and epifauna that, in turn, are the major food organisms for fish (Simenstad et al. 1988, Caine 1991, Thom et al. 1991) and avifauna; they provide habitat and shelter for resident and transitory fish including juvenile salmon (Fresh 1979; Simenstad et al. 1988); and they are the preferred habitat for young Dungeness crab (Dinnel et al. 1990). Intertidal flats that lack macroscopic vegetation are rich in benthic diatoms (Thom 1989) and are important as habitat for crustaceans and other invertebrates that are important prey items for juvenile salmon and wading birds (Simenstad et al. 1988).

Padilla Bay is an important nursery and feeding area for fish such as juvenile chum and Chinook salmon, surf smelt, Pacific sand lance and threespine stickleback (Simenstad et al. 1988). Dungeness crabs appear to use the bay as a nursery area, with high populations of young crabs in the seagrasses and larger crabs in the channels (Dinnel et al. 1986, McMillan et al. 1995).

Padilla Bay contains extensive populations of resident and migratory Black Brant (Reed et al. 1989), other waterfowl and wading birds (Jeffrey 1976). The abundance of waterfowl supports several Peregrine Falcons (endangered), and the Bald Eagle (threatened) uses the bay and surrounding uplands for feeding and nesting.

Historical Context

The earliest record of research in Padilla Bay is in a paper by Shelford et al. (1935). Later, the lack of success of an oyster industry in Padilla Bay prompted investigations of pollution sources. The construction of oil refineries on March Point in the early 1950s prompted the first extensive attempt to survey the plants and animals in Padilla Bay (Sylvester and Clogston 1958), followed by several reports of environmental effects in the area after an oil spill occurred near Anacortes in 1971. Washington State agencies such as the Department of Fish and Wildlife have conducted various surveys over the years that have included data from Padilla Bay. The possibility of oil pipelines and shipment of oil to and through northern Puget Sound prompted numerous surveys and baseline studies of the area and many of these studies included one or more sampling sites in Padilla Bay (Bulthuis and Stevens 1991).

Since the establishment of Padilla Bay as a National Estuarine Research Reserve, NOAA sponsored research during the 1980s specific to Padilla Bay on seagrasses and tidal flat plants, crabs, and water quality. PBNERR research staff mapped the vegetative communities and habitats of Padilla Bay and studied flood currents into Padilla Bay (Bulthuis 1991a, 1995; Bulthuis and Conrad 1995a, 1995b, Bulthuis and Shull 2002, 2006). The establishment of a Research Assistantship in Estuarine Science and Coastal Zone Management at PBNERR has resulted in numerous Master of Science theses and student reports on the Padilla Bay ecosystem. This body of graduate research has been supplemented by students participating in the NOAA Graduate Research Fellowship program. Bibliographies of reports that include these studies on Padilla Bay have been published as PBNERR Technical reports (Bulthuis 1989; Bulthuis 1993a; Bulthuis and Shull 1998) and a general review of these studies was published as a U.S. Army Corp of Engineers Technical report (Bulthuis 1996a). All of these studies provide an indication that Padilla Bay is a productive and important estuarine ecosystem, and one that is ecologically unique with respect to the extent of eelgrass beds and related ecosystem services.

Monitoring Program

An Environmental Monitoring Plan for PBNERR was developed in 1996 and revised in 2004. The following section outlines some of the main elements of that plan, with further details available elsewhere (Bulthuis 1996b). The institutional framework that guides monitoring at PBNERR includes (1) its role as a National Estuarine Research Reserve and participation in the System-wide Monitoring Program, (2) management by the Washington State Department of Ecology, and (3) cooperative links and collaborations with many institutions including universities and research groups in government agencies. Monitoring efforts at PBNERR make a valuable contribution to the growing monitoring network in the greater Puget Sound, which includes Department of Ecology Marine Waters Unit and buoys and platforms supported by the Northwest Association of Networked Ocean Observing Systems (NANOOS). Padilla Bay is one of the few locations in the greater Puget Sound where continuous, long-term monitoring of water quality parameters is being implemented – especially considering the high frequency and spatial

resolution of SWMP at PBNERR. The Monitoring Plan addresses long-term monitoring efforts from a scientific, management and stewardship perspective and thereby supports the PBNERR Research Plan and the Natural Resources Stewardship Plan.

Monitoring at PBNERR includes both implementation of the NERRS System-wide Monitoring Program (SWMP) and implementation of monitoring programs specific to Padilla Bay NERR. SWMP includes: 1) continuous monitoring physicochemical water quality parameters at four sites within the Reserve, 2) continuous monitoring of meteorological parameters at a weather station in Padilla Bay, and 3) monthly monitoring of nutrient, total suspended solids and chlorophyll concentrations at the four water quality sites. Other elements of environmental monitoring have been implemented at PBNERR to establish a long-term record of change in multiple habitats of the Reserve. Areal coverage of eelgrasses, salt marsh, and macroalgae began in 1989 and was mapped again in 2004 using a combination of aerial photography, groundtruthing, and GIS mapping. In 2009, Padilla Bay began an annual monitoring program targeting invertebrate and macroalgal species at four rocky intertidal sites as part of the Multi-Agency Rocky Intertidal Network (MARINe) monitoring endeavor. Following regional outbreaks of Sea Star Wasting Syndrome (SSWS) in 2012, we expanded this effort to semi-annual monitoring of the four sites. The MARINe monitoring is being implemented throughout waters of the US Pacific coast and has become a routine part of environmental monitoring at Padilla Bay. The reserve began monitoring vegetative characteristics of eelgrass with the implementation of an annual biomonitoring program in 2011. This effort entails a comprehensive assessment of eelgrass performance at 126 permanent plots along three 4 km transects. A monthly zooplankton monitoring effort began in 2007 and has been conducted by the monitoring specialists with assistance from AmeriCorps and Reserve volunteers. More details on the PBNERR monitoring program are included in Chapter 3, Research Program Delivery – Current Research and Monitoring Efforts.

Padilla Bay NERR Research Program Capacity

This section includes a discussion of the personnel, facilities, equipment and other relevant resources that provide the basis for an active research program at Padilla Bay. We also provide an overview of the ecological setting and history of research at the Reserve.

Staff

The research and monitoring program is supported by a variety of PBNERR staff. The core Reserve Research and Monitoring Team consists of the Research Coordinator, two part-time (i.e., 0.8 FTE) research and monitoring staff, a GIS/geospatial analyst, and an AmeriCorps intern assigned annually to the Reserve. The Research Coordinator provides overall management and oversight for research and monitoring at PBNERR and also assists in research and monitoring efforts. The two part-time research and monitoring staff have been with PBNERR for over eight years, implement the NERRS System-wide Monitoring Program, and are funded primarily through the annual operations award to PBNERR. The research technicians also take the lead in implementing

the MARINe monitoring, eelgrass biomonitoring, and zooplankton surveys. A Geographic Information Systems (GIS) Analyst with 18 years of experience at Padilla Bay is also part of the research team and leads the Habitat Mapping and Change (Tier 1 Biomonitoring efforts), Real Time Kinematic (RTK) control and data acquisition, tidal datum referencing, Sentinel Site planning and data compilation for Sentinel Site Synthesis on Marsh Resilience. The GIS Analyst also contributes to the transect Biomonitoring (Tier 2) project. In addition, one of the three AmeriCorps Members hired each year to work at Padilla Bay are placed with the Research Team and assist with field work, collection of samples, exchange of datasondes, and other research related responsibilities. Unpaid interns, graduate students, and volunteers also help with many aspects of research and monitoring, including eelgrass and rocky intertidal monitoring, establishing new data for and groundtruthing intertidal habitat maps, surveys and enumeration of plankton communities, and laboratory-based research activities (e.g., barnacle settlement, sediment characterization, and eelgrass seed distribution). The Padilla Bay Foundation has recently hired a volunteer coordinator, who is playing an active role in recruiting qualified volunteers to assist with research and monitoring and help expand the volunteer-based science capacity at PBNERR.

At times it is necessary extend beyond the PBNERR staff and coordinate with external parties to implement ongoing monitoring activities, modify activities in response to methodological advancements, or design new approaches altogether. Datasondes and other equipment, such as weather station equipment, can be prone to occasional problems and manufacture representatives and personnel at the CDMO are particularly helpful. Water quality specialists at the Ecology Water Quality and Environmental Assessment offices have years of expertise in monitoring and data management.

Facilities, Equipment and Infrastructure

Research and monitoring at Padilla Bay NERR is made possible by a wide range of facilities, equipment and other resources that support in-house research and monitoring efforts, as well as research conducted by Padilla Bay Research Assistants, graduate students, and scientists at collaborating institutions.

The PBNERR laboratory is certified as an accredited laboratory through the Washington Department of Ecology's Lab Accreditation Program and offers a place where students, interns, visiting scientists and PB research staff are able to sort field samples, conduct preliminary analyses, or prepare samples for analysis elsewhere. General laboratory facilities include extensive bench and lab workspace, wet lab for processing field samples, commercial refrigerators and -20°F ScienTemp chest freezer for sample storage, two total exhaust fume hoods, laminar flow hood, autoclave, Nanopure water purification system, and basic instruments for analysis of water samples. Instrumentation includes various high-precision balances, Olympus SZX7 zoom stereo microscope with video and still imaging capacity, Turner Trilogy and TD-700 fluorometers for chlorophyll analyses, two large capacity drying ovens, Thermolyne benchtop muffle furnace, Presens Fibox 4 Optode for dissolved oxygen measurements and estimates of pelagic respiration, and

Metrohm Titrino for Winkler titrations and other potentiometric assays. In support of SWMP, the lab facility also houses numerous Yellow Springs Instrument (YSI) sondes and supporting instrumentation for calibration and deployment, and a Sigma 900 autosampler.

GIS capabilities have been developed at Padilla Bay in support of the research, monitoring and stewardship programs. GIS has been particularly important in mapping and tracking the distribution of vegetation (emergent marsh and eelgrass), managing location of numerous study sites, helping investigators locate appropriate study sites for their research questions, place their study sites in a wider context, or locate their sites relative to other research sites. GIS capabilities are also critical in the first stages for developing both the Biomonitoring and the Sentinel Site Programs, as well as in continued development of data visualization products at PBNERR.

Padilla Bay has two research vessels (22-foot R/V *Edna B* and 16-foot R/V *Marcellus*) that provide field support to research and monitoring efforts, and are equipped with GPS instruments, safety gear, marine radios, and equipment for water quality and plankton sampling. Access to sites in Padilla Bay for research is often difficult and vessel support is provided on a limited basis. Padilla Bay NERR is not able to provide support for research projects that require substantial vessel support from the reserve.

The PBNERR guesthouse provides overnight accommodation for students and scientists conducting research in Padilla Bay. The guesthouse was opened in 2007 and provides a wide range of accommodations, including kitchen and laundry facilities and lodging for up to 16 people.

Scientific Community

The research staff at PBNERR remain engaged with several relevant scientific networks and communities. The Reserve's Research Coordinator (RC), is currently president of the Pacific Estuarine Research Society (PERS), which is the regional chapter of the Coastal and Estuarine Research Federation (CERF). As part of this role, the RC remains in active communication with regional estuarine scientists, assists in organizing and hosting the annual PERS meeting, and serves on the CERF Governing Board. The RC is also an active member of the Puget Sound Environmental Monitoring Program (PSEMP) Marine Waters Workgroup, which is one of several technical workgroups operating under the PSEMP umbrella that has a specific focus on the inland marine waters of Puget Sound and the greater Salish Sea, including the oceanic, atmospheric, and terrestrial influences and drivers affecting the Sound. Since leaving his appointment at Western Washington University (WWU), the RC has maintained adjunct faculty status with the Biology Department and the Environmental Science Department in Huxley College of the Environment. As such, the RC remains an active and collaborative member of the research community, continues to serve on graduate committees, serves as mentor for graduate students, and promotes the use of PBNERR as a site for WWU faculty research. Through previous and ongoing work in ocean science education, the RC has remained

involved in the Centers for Ocean Sciences Education Excellence (COSEE) network and serves as an advisor for Seattle-based Red Eagle Soaring/SIYAP (Seattle Indian Youth Arts and Performance) group in their efforts to integrate climate and ocean science and traditional knowledge in the education of Native youth.

Both PBNERR Monitoring Specialists are members of PERS and CERF and actively participate in annual and biannual meetings of these organizations. The Monitoring Specialist 2 is actively involved in the Multi-Agency Rocky Intertidal Network (MARINe) and coordinates the participation of PBNERR in the large-scale MARINe monitoring program. MARINe is a partnership of agencies, universities and private groups extending from Alaska to Baja who are committed to determining the health of the rocky intertidal habitat, tracking long-term change, and providing this information to the public.

The PBNERR GIS Analyst, contributes to the Washington State Chapter of the Urban and Regional Information Systems Association (WAURISA), a national GIS community, and has recently served as Board member, Chair of the Membership Committee, and poster session organizer at the annual conference. The GIS Analyst is the co-organizer of the Northwest Washington GIS User Group which provides networking and professional sharing for GIS practitioners in the local and three adjacent counties through quarterly meetings, often hosted at Padilla Bay NERR.

Finally, the research and monitoring team engages others in the local scientific community through the support and involvement of the Board of Directors of the Padilla Bay Foundation. Three members of the Board are scientists, have close research and management connections to Padilla Bay, and have continued to serve in an advisory capacity for research and monitoring efforts in Padilla Bay.

Padilla Bay NERR Research Program Delivery

Padilla Bay is well suited as a research reserve to address local, regional and national-scale issues, as described in the Research Program Context section above. Using the Padilla Bay Strategic Framework, input from PBNERR research staff, regional managers and scientists, current trends in estuarine research and literature, and other stakeholders, the reserve has narrowed the almost infinite aspects of estuarine ecology and management that could be addressed at PBNERR. The following research topics have been identified as both a high priority for the next several years at Padilla Bay and consistent with the NERRS Research and Monitoring Plan (15 C.F.R. § 921.50). Research and monitoring at PBNERR focuses primarily on marine, sub-tidal, intertidal and emergent ecosystems, as Padilla Bay NERR owns only two parcels of upland within the proposed boundaries of the Reserve and terrestrial ecosystems are not presently identified as a high priority. However, it is important to note that the influence of uplands through groundwater, river discharge, and sediment, nutrient and fecal loading is an important component of water quality in Padilla Bay and part of the watershed-scale approach to research at the Reserve.

The Padilla Bay Strategic Framework identifies five Strategic Priorities to broadly guide research efforts. These include:

- Climate change (including sea-level rise, ocean acidification, and temperature variability)
- Water quality in estuaries and watersheds
- Invasive species impacts
- Loss of shoreline processes
- Habitat loss in estuaries and watersheds

Specific focus areas and research questions within these broad priorities are described below:

1) Investigating ecology of eelgrass, including seasonal and interannual variability, and factors controlling growth, productivity and survival,
2) Identifying interactions between native eelgrass *Zostera marina* and non-native *Zostera japonica*, including inter-specific comparisons such as ecological services and function, habitat suitability, carbon sequestration, and contribution to sedimentation/shoreline stabilization,
3) Quantifying the contribution of eelgrass in Padilla Bay to carbon sequestration, net ecosystem metabolism, and potential mitigation of changes in pH related to ocean acidification,
4) Geospatial analyses that include distribution mapping of *Z. marina, Z. japonica*, and the interface between the two species; habitat suitability and usage indices; and other physical properties including substrate type, temperature, light, and water depth/bathymetry,
5) Use of SWMP data to evaluate changes in Padilla Bay as a result of regional and watershed-scale effects of climate change, including reduced summer freshwater flow, episodic high-flow events in winter and spring, and changes in basin-scale circulation patterns and stratification that influence water temperature and salinity,
6) Investigating plankton community dynamics and metabolism, including factors that regulate seasonal patterns in zooplankton abundance and diversity and the biological contribution of respiration to changes in ocean pH and ocean acidification,
7) Monitoring local sea-level rise (e.g., Sentinel Site protocols) and evaluating the effect of sea-level rise on intertidal organisms and communities, such as changes in distribution of native and non-native eelgrass in Padilla Bay,
8) Investigating ecological effects of non-native and/or invasive species (e.g., Japanese eelgrass (*Zostera japonica*), Asian mud snail (*Batillaria attramentaria*), and European green crab (*Carcinus maenas*)) in the Padilla Bay estuary,
9) Research into species of special interest in the region (e.g., Puget Sound Chinook, Dungeness crab, Pacific herring, and various species of birds) and other faunal communities associated with eelgrasses, including the many

juvenile and early life stages that use the eelgrass community as habitat, and

10) Continued evaluation of sources of fecal coliform, nutrient and other water-borne contaminants in Padilla Bay.

Current Research and Monitoring Efforts

Current research efforts include: investigation of community composition and long-term change of rocky intertidal ecosystems as part of the Multi-Agency Rocky Intertidal Network (MARINe), biomonitoring of native (*Zostera marina*) and non-native (*Zostera japonica*) eelgrass, and investigation of growth rates of the resident seastar (*Pisaster ochraceus*) which is being conducted by AmeriCorps/WCC interns in conjunction with a larger collaboration to investigate seastar wasting disease in the region (Fig. 3.2). The Reserve is also evaluating rates of pelagic oxygen consumption and CO_2 production in Padilla Bay and other regional waters, conducting water column profiles to identify inputs of low pH waters of marine origin, and tracking spatial and temporal variability in zooplankton community dynamics. These research and monitoring projects at PBNERR have improved our knowledge of the functioning and characteristics of Padilla Bay, as well as provide insight into regional-scale climatic process and ecological perturbations. An overview of these research projects and recent findings are described below.

Biomonitoring Efforts at Padilla Bay

Rocky Intertidal Habitat Monitoring: In 2009, the Reserve began monitoring rocky intertidal habitats in Padilla Bay as part of the Multi-Agency Rocky Intertidal Network (MARINe) (Fig. 3.3). Semi-annual monitoring of sea stars and other rocky intertidal populations (e.g., barnacles, macroalgae, and motile invertebrates) has been conducted at four permanent sample sites on two islands located on the western edge of Padilla Bay (Saddlebag Island and Hat Island). Long-term data from this effort provide a mechanism to track changes in populations, community structure, and responses to natural or human-induced disturbances. One such change evident in our data is the dramatic mortality of the Ochre Star (*Pisaster ochraceus*) that occurred between June and September of 2014 (see Fig. 3.4) and has been attributed to the recent regional outbreak of Sea Star Wasting Syndrome (SSWS). The Ochre Star (*Pisaster ochraceus*) was the dominant species of sea star at the Padilla Bay monitoring sites. However, populations of *P. ochraceus* decreased by over 90% throughout our study areas, with the most recent data collected in 2015 providing no evidence of recovery of this keystone population. PBNERR will continue its involvement in the MARINe monitoring program and continue monitoring populations at these sites in an effort to document other changes in community structure and/or recovery of seastar populations in subsequent years.

Eelgrass Habitats: The interaction between the native eelgrass, *Zostera marina*, and the non-native Japanese eelgrass, *Zostera japonica*, has important implications for native estuarine fauna and flora throughout Puget Sound and Washington State. There is increasing concern that *Z. japonica* may have a deleterious effect on *Z. marina* and many

Figure 3.2 The growth rates of the Ochre sea star (*Pisaster ochraceus*) are one study currently conducted by the Washington Conservation Corps/AmeriCorps assistants.

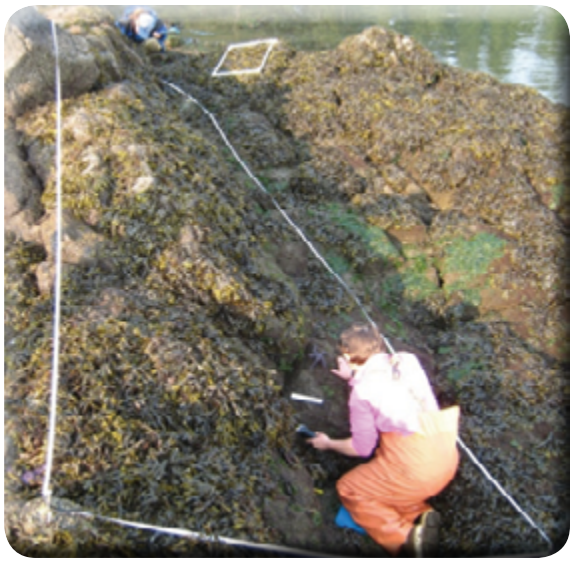

Fig. 3.3 Research staff documenting abundance of sea stars and other invertebrates at one of the PBNERR Saddlebag Island sites.

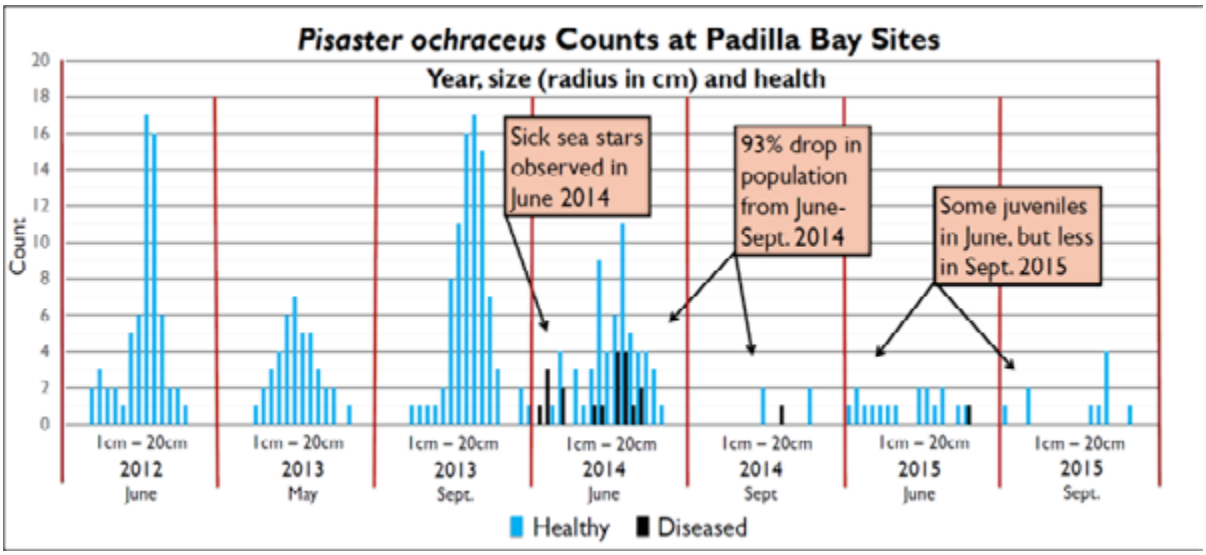

Figure 3.4 Data from PBNERR rocky intertidal MARINe monitoring efforts revealing the dramatic decline in abundance of the resident sea star *Pisaster ochraceus* during the study period.

questions remain regarding the ecosystem services associated with these organisms, interactions between the two species, and the habitats they provide. Furthermore, commercial shellfish growers are seeking approval to control and possibly remove *Z. japonica* in select intertidal habitats of Washington through the application of herbicides. In 2011, an annual monitoring program was established in PBNERR to document changes in resident eelgrass (i.e., *marina* vs. *japonica*) to address the questions surrounding these issues and to advance our understanding of basic eelgrass ecology. This biomonitoring effort includes surveys of eelgrass density, percent cover, height, elevation, relative abundance of *Z. marina* and *Z. japonica*, and species specific biomass at over 126 permanent plots along three 4 km transects that span the upper intertidal to subtidal range of these two eelgrass species (Fig. 3.5). Data derived from this monitoring effort reveal a substantial increase in density of *Z. japonica* relative to *Z. marina*, with an overall increase in both species of plant height and percent cover (Fig. 3.6). Use of SWMP

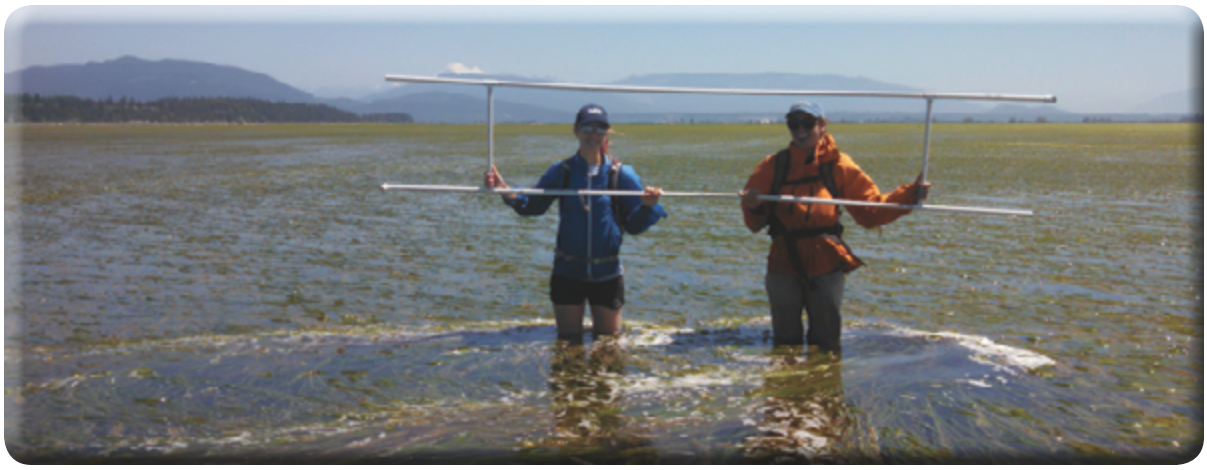

Figure 3.5 The eelgrass biomonitoring project is a labor intensive data collection effort. Above are two Washington Conservation Corps/AmeriCorps assistants participating in biomonitoring fieldwork.

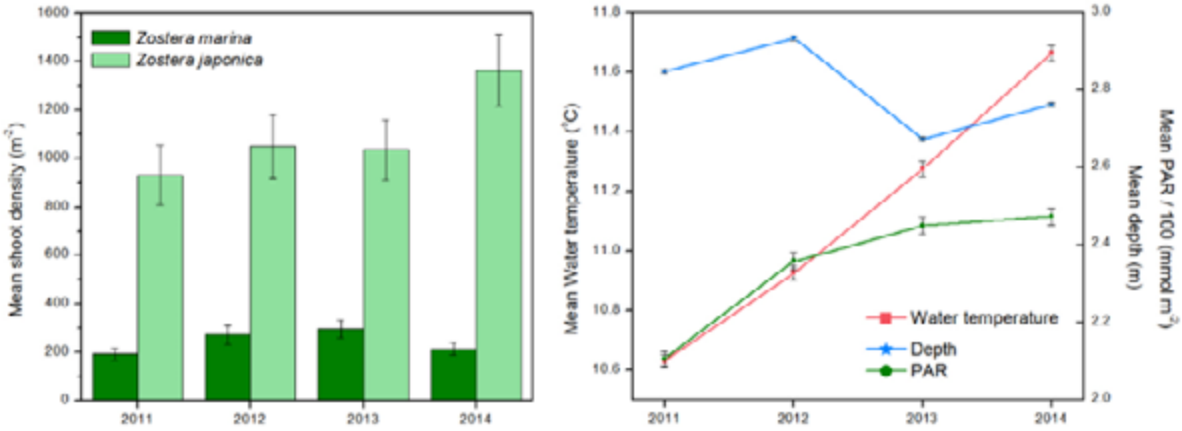

Figure 3.6 Data from PBNERR eelgrass biomonitoring revealing an increase in density of native eelgrass *Zostera marina* relative to non-native eelgrass *Zostera japonica.*

data parameters recorded in Padilla Bay (i.e., temperature, light availability, and water depth) provides evidence that *Zostera* spp. are most likely responding positively to a transition from cooler temperatures and lower light conditions in 2011 to more favorable growing conditions in subsequent years, and that this effect may potentially favor the performance of *Z. japonica* over *Z. marina*.

In addition to the eelgrass biomonitoring described above, PBNERR will continue to seek funding to monitor interannual variability on a baywide scale by means of acquisition of airborne imagery on extreme summer low tide. When possible, these images will be complemented by monitoring of ground reference sites throughout Padilla Bay during summer. Coverage of estuarine vegetation will then be delineated using hybrid methods of automated segmentation and/or the on-screen protocol developed by Bulthuis and Shull (2006). Other vegetative communities that will be monitored with these methods include *Spartina* spp., native salt marsh, and macroalgal mats.

In 2015, researchers from the University of Washington Friday Harbor Labs (UW-FHL) joined in the eelgrass biomonitoring effort to conduct a side-by-side survey of eelgrass wasting disease and investigated the prevalence of the pathogenic protist (*Labyrinthula zosterae*) in Padilla Bay eelgrass. This preliminary work by UW-FHL will help guide inclusion of metrics for eelgrass wasting disease in our annual monitoring and is also an example of the value of establishing a monitoring infrastructure that can foster collaborative efforts. PBNERR staff will continue to seek funding opportunities and collaborations to support and enhance our biomonitoring and research of eelgrass in Padilla Bay.

Figure 3.7 Collection of zooplankton is conducted throughout the year in conjunction with SWMP sampling.

Plankton community abundance, composition and respiration: Monitoring of zooplankton abundance in the water column was initiated in 2007 to identify the phenological variability of various marine and intertidal invertebrates in Padilla Bay and explore the use of zooplankton community composition as an integrative ecological indicator of ecosystem change. Surveys entailed surface and vertical tows using a 153 µm plankton net at three of the SWMP water quality monitoring sites in Padilla Bay (Gong buoy, Bayview, and Ploeg) (Fig. 3.7). In 2015 sample analysis was expanded to include class-level identification of echinoderm larvae, motivated by an interest in evaluating recruitment potential of juvenile seastars following widespread mortality of adults in Padilla Bay the previous year. Recent analyses

reveal recurring annual patterns in the most abundant predatory species (i.e., copepods and larvaceans) and a predictable community succession throughout the year. These data also reveal a dramatic shift in the timing of this annual succession in 2013 and 2014, presumably related to large scale climatic shifts.

Another aspect of plankton community dynamics that has been initiated in 2015 is estimating rates of water column oxygen consumption and CO_2 production, which will be conducted monthly at SWMP monitoring sites. This monitoring effort is to assess the biological contribution of planktonic processes to ambient dissolved CO_2 concentrations, pH (as a surrogate for ocean acidification) and hypoxia, and begin to document long-term changes in water-column metabolism as a result of increasing temperatures and nutrient/organic matter loading associated with coastal eutrophication. In a related effort, PBNERR has also begun conducting water column profiles at two deep water (20 and 70 meters) locations to examine water column structure, deep water circulation, and identify potential inputs of low pH water of marine origin into Padilla Bay.

Student Research at PBNERR

Each year over the past decade, PBNERR has awarded a Research Assistantship in Estuarine Science and Coastal Zone Management to graduate students conducting Master's or Ph.D. thesis research in the Reserve. The total amount of the award is $5,000 and distributed over a 12-18 month period in support of the student's research. In 2015, through support from the Padilla Bay Foundation, PBNERR was able to offer two graduate student assistantships. One student from Western Washington University is investigating the role of eelgrass in carbonate chemistry and ocean acidification, while the student from University of Washington is investigating interactions between eelgrass and both native and non-native oysters in Padilla Bay. Support for two annual assistantships will continue as long as funds are available through the generous contributions of the Padilla Bay Foundation. Funding for the assistantships are currently supported by the Tesoro Corporation and Borman Family Foundation, but are also sought from a variety of sources including private foundation grants, coastal zone management grants to the states, and Reserve operations funds. Proposals are requested from students, reviewed by scientists who serve on the Padilla Bay Foundation and other relevant experts in the field, and awarded as contracts to the students.

Student research at the reserve is not limited to projects supported by the PBNERR Graduate Assistantship. Many undergraduate and graduate students work in the Reserve as part of thesis projects at neighboring institutions. Current projects being conducted in the reserve include an investigation of eelgrass wasting disease (Ph.D. student at UW Friday Harbor Labs), inclusion of PBNERR in regional eelgrass surveys conducted by students at Northwest Indian College, and investigations of eelgrass, carbonate chemistry, and carbon sequestration by graduate students at Western Washington University.

Cooperative Research with Other Scientists

Another element of the PBNERR research program is cooperative investigations with other scientists or institutions. Padilla Bay research staff work cooperatively with scientists from a variety of institutions, with levels of involvement ranging from an advisory role to providing field or laboratory support, and even participating as principal investigators. PBNERR is able to promote research involving outside investigators by offering use of laboratory space and equipment, assistance in the field, sharing of PBNERR monitoring data, use of field instruments, GIS support, overnight facilities, and research vessel support. Most collaborative projects are funded through external institutions and/or programs and consequently vary from year to year. Examples of current or recent collaborative research efforts at PBNERR include a Washington SeaGrant funded projects to investigate the effect of sulfides on eelgrass performance (Drs. Shull and Yang, Western Washington University) and another proposal to track health, recruitment and recovery of juvenile seastars following widespread mortality associated with seastar wasting disease (Drs. Miner, Arellano and Kodner, Western Washington University). Other ongoing projects in Padilla Bay include: an investigation of sea-level rise and rates of sedimentation through the deployment of a network of surface-elevation tables (SETs) that includes an adaptation of the Marsh Equilibrium Model (MEM) to compute carbon sequestration and marsh response to sea level rise; deployment of DuraFET pH sensors to conduct an investigation of diel, seasonal and spatial variability of pH and pCO_2 in Padilla Bay; and participation in the USGS Western Ecological Research Center (WERC) multidisciplinary Coastal Ecosystem Response to Climate Change (CERCC) program.

Volunteer-Based Research and Monitoring

Another aspect of research and monitoring at PBNERR entails the involvement of public audiences. Volunteers currently assist with the eelgrass biomonitoring project and zooplankton study, but the greatest participation is through the volunteer-based Skagit Stream Team. As part of this project, teams of volunteers monitor fecal coliform and physical water quality parameters in Joe Leary Slough, No Name Slough, Bay View Drainage, other streams and within the Padilla Bay watershed and elsewhere in Skagit County. Monitoring data and field sampling protocols from several years of Stream and Storm Team activities are currently being used by Washington Department of Ecology to help develop a fecal coliform TMDL for Padilla Bay.

System Wide Monitoring Program (SWMP)

As with all the NERRS, long-term monitoring is an integral part of the work conducted at PBNERR. Ongoing monitoring efforts include full participation in collection of physical water quality, water column nutrient, and meteorological parameters associated with NERRS System-wide Monitoring Program (1995-present). As described previously, PBNERR has initiated several other long-term biological monitoring efforts to complement SWMP, including zooplankton community abundance and diversity in the pelagic zone (2007-present), rocky intertidal communities through participation in the Multi-

Agency Rocky Intertidal Network (2009-present), and biomonitoring of submerged aquatic vegetation in the extensive eelgrass beds of Padilla Bay (2011-present) (Fig. 3.8). As of 2015, monthly grab sample collection has expanded to also include water column metabolism (i.e., rates of oxygen consumption/CO_2 production) as a measure of the potential biological contribution of planktonic processes to hypoxia and ocean acidification.

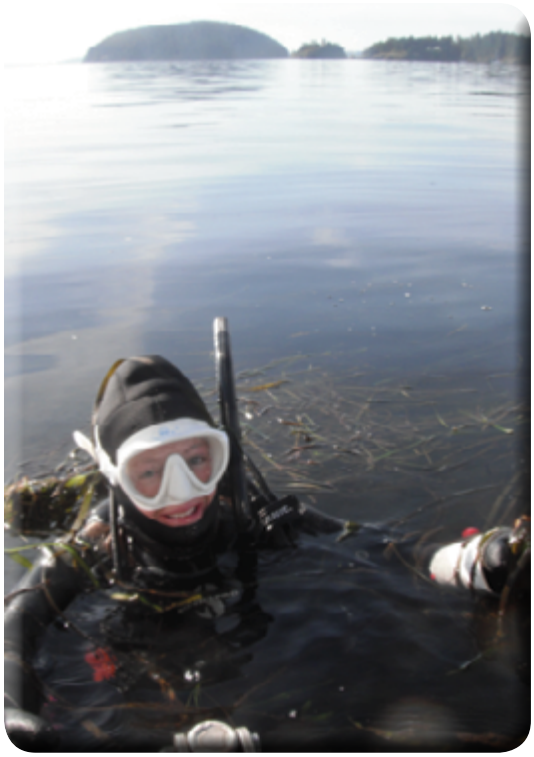

Figure 3.8 Research diver sampling sub-tidally in Padilla Bay.

Four water quality sites have been established in Padilla Bay (Fig. 3.9) where physical water quality parameters (temperature, salinity/conductivity, turbidity, dissolved oxygen, and pH) are continuously measured at 15-minute intervals. Bay View Channel site and Ploeg Channel site are located amidst extensive eelgrass beds and represent the southern and northern reaches of Padilla Bay, respectively. Joe Leary Estuary site (formerly Joe Leary Slough site) is located near the mouth of tidally influenced Joe Leary Slough on the eastern side of Padilla Bay. The Joe Leary Slough site was removed in July of 2009 because of persistent infill and was replaced with Joe Leary Estuary site, which is located on the marine side of the tide gates in the slough. In addition, water column profiles are now being collected at two deep water (20 and 70 meters) locations (Gong Deep and Guemes Channel) to examine water column structure, deep water circulation, and identify potential inputs of low pH water of marine origin into Padilla Bay. A chlorophyll fluorescence sensor has been added to the EXO Sonde deployed at the Gong buoy.

Nutrients and chlorophyll-*a* are measured at two spatial and temporal scales as part of SWMP. Grab samples are collected from all four monitoring sites and processed for orthophosphate, ammonium, nitrite and nitrate, silicate, chlorophyll-*a,* phaeophytin, total nitrogen, total dissolved nitrogen, total phosphorus, total dissolved phosphorus and total suspended solids. Additionally, the Bayview Channel site is sampled hourly (diel) over an entire tidal cycle scheduled around the lowest tide of the month and analyzed for chlorophyll *a*, phaeophytin, PO_4, NH_4, NO_2, NO_3, and $Si(OH)_4$.

Weather related factors are measured at a weather station located at the Padilla Demonstration Farm at the southeast corner of Padilla Bay. Parameters that are measured include rainfall, wind speed and direction, air temperature, relative humidity, barometric pressure, and photosynthetically active radiation (PAR; 400-700 nm). Data are recorded continuously throughout the year at 15-minute intervals.

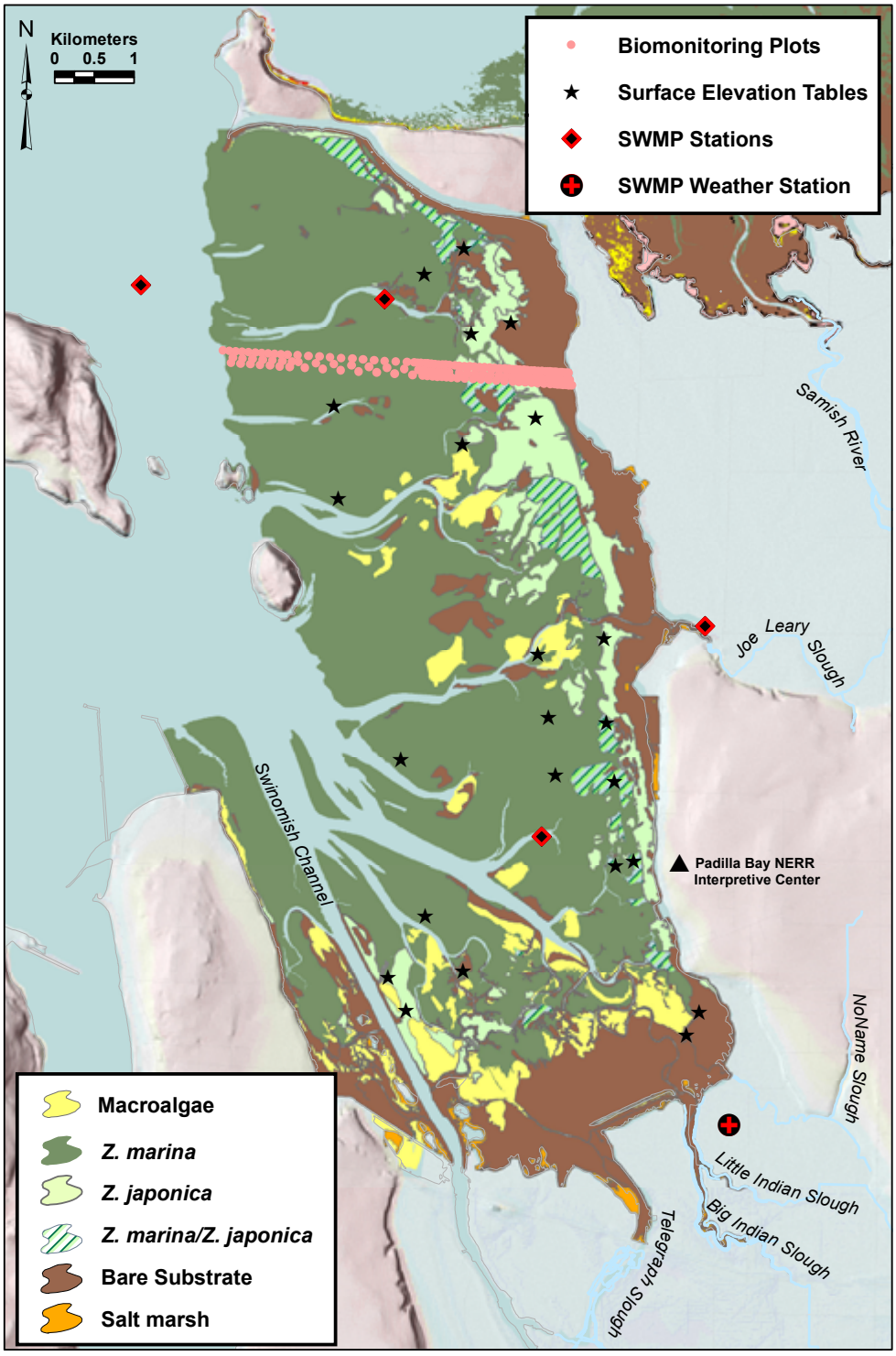

Figure 3.9 Map of Padilla Bay NERR including 1) location of SWMP water quality and meteorological stations, 2) location of SAV biomonitoring transect, 3) location of surface elevation tables (SETs), and 4) distribution of submerged and emergent eelgrass, macroalgae, and salt marshes in Padilla Bay as delineated from aerial photos taken during summer 2004.

Cooperative Monitoring Projects

For the past several years, researchers at WWU (Dr. John Rybczyk and graduate student Katrina Poppe) have been maintaining SETs in Padilla Bay (Figs. 3.9, 3.10). We will continue to work with these researchers to support and expand the coverage of SETs in Padilla Bay, as this is an important aspect of establishing a Sentinel Site (SSAM1) monitoring program. Another cooperative monitoring effort that has recently evolved and will continue into the future is collaboration with Dr. Brooke Love (WWU) in the deployment of high-precision SeaFET pH sensor at the SWMP monitoring stations. These data will help in QA/QC of in situ pH data, as well as provide high-precision estimates of the diel, tidal and seasonal fluctuation of pH in Padilla Bay waters. It is anticipated that these collaborative monitoring efforts will continue, and PBNERR will continue to develop cooperative monitoring with the Puget Sound Partnership, Ecology, and other monitoring by local, state, and tribal agencies.

Figure 3.10 WWU graduate student and PBNERR research assistant Katrina Poppe taking measurements at a surface elevation table (SET) in Padilla Bay. Photo credit: Abe Lloyd.

Information Dissemination

Results of research conducted at PBNERR and monitoring data collected as part of SWMP and other efforts are distributed in a variety of formats. Data from SWMP are available real-time via the CDMO data portal, as well as served through the regional Northwest Association of Networked Ocean Observing Systems (NANOOS). PBNERR produces a technical report series that is available as hard copies and as PDFs on the PBNERR website. This series provides a mechanism for thesis research, research conducted by PBNERR Research Assistants, WCC/AmeriCorps Assistants, and other research at Padilla Bay to be made available to a wider audience. Padilla Bay also contributes to the Puget Sound Environmental Monitoring Program (PSEMP) Annual Report, which provides a regional synthesis of monitoring data and context for the monitoring data collected at Padilla Bay. PBNERR will also contribute to the monthly "Eyes Over Puget Sound" Marine Conditions update coordinated by the Marine Waters Workgroup at Washington Department of Ecology. On a regional and national scale, PBNERR staff, students and affiliated researchers regularly attend and present at Scientific Meetings and Conferences, including the Pacific Estuarine Research Society (PERS) regional meeting and the Coastal and Estuarine Research Federation (CERF) national meeting. Finally, the Padilla Bay web site provides a portal for accessing information about the research

program, student research opportunities, and reports and summaries of research in Padilla Bay. We are in the process of developing a searchable database of all the research projects (and related data and publications) that have been and are being conducted in Padilla Bay. This database will eventually serve as a publicly-accessible, web-based portal for those interested in research in Padilla Bay. Soon to be accessible via the PBNERR website are a series of story maps providing a user-friendly, publicly accessible view of eelgrass research and Sentinel Site buildout at the Reserve.

Integration with Other Sectors

Integration with Padilla Bay stewardship. Natural resource management and stewardship at Padilla Bay requires monitoring of many species and other natural resources at several spatial and temporal scales. A primary area of overlap between research, monitoring, and stewardship is assessing the distribution of salt marsh vegetation using GIS, aerial photography, and employing modified SAV/emergent macrophyte monitoring protocols. Other opportunities for collaboration include obtaining baseline data on benthos in Padilla Bay, water quantity data for selected freshwater inflows into Padilla Bay, contaminants in the sediments and freshwater sources, surveys for forage fish spawning areas in Padilla Bay, monitoring for invasive species (e.g., European green crab *Carcinus maenas*), and research on the feasibility and the possible impacts of re-introducing Olympia oyster (*Ostrea lurida*) in Padilla Bay.

Integration with Padilla Bay education. Padilla Bay research staff will continue to work with education staff on mutual projects, assist in the development of materials based on Padilla Bay research, improve the Padilla Bay web site for public information, contribute articles for the Padilla Bay newsletter, and incorporate interpretive displays on research and monitoring in the exhibits. The PBNERR Research Coordinator has extensive professional experience, training, and an interest in science education. This collaboration between research and education is formalized through the NOAA Environmental Literacy Grant that the Research Coordinator has transferred to PBNERR and Washington Department of Ecology, titled "Advancing Climate Literacy through Inservice and Pre-Service Educators (ACLIPSE)". This is a collaborative project with science educators at the UC Berkeley Lawrence Hall of Science and the Ocean Observatories education team at Rutgers University and works towards integrating real-time and web-based data sources into middle school classrooms. Products from this project include numerous inquiry-based activities to have students engage with data in support of concepts in ocean and climate science, and an undergraduate course and curriculum to train pre-service and in-service teachers how to integrate ocean and estuarine observing data into the classroom. The modules and workshops resulting from this project will be offered to local educators involved with Padilla Bay.

Integration with CTP at Padilla Bay. Padilla Bay research staff will work with CTP staff in development and implementation of training classes and helping use research and monitoring findings to better inform managers, decision makers and other participants in the CTP program. Through the NOAA ACLIPSE project, several modules will be de-

veloped to provide basic conceptual and scientific understanding of climate change and promote climate literacy. To the degree that it is helpful, these will be offered to supplement programs offered by the CTP program at PBNERR.

Program Efficacy and Evaluation

PBNERR has a wide range of research and monitoring endeavors, which produce data and findings that are disseminated through a variety for formats. The quality of these data is validated through several mechanisms. All data collected as part of the SWMP monitoring adheres to strict monitoring and analytical protocols developed by NERR CDMO, as well as additional in-house QA/QC procedures designed to assure high quality data. Data are submitted quarterly and annually to CDMO for approval. PBNERR contributes research and monitoring findings to the annual peer-reviewed PSEMP report and monthly data reviews. The focus and quality of research conducted by the PBNERR Research Assistants is validated by a panel of expert external reviewers who help determine those research projects that are of high scientific quality and are also well aligned with the research and management priorities of PBNERR.

Research Impacts and Outcomes

Several deliverables and outcomes have been realized by the Research and Monitoring Program that have had a direct effect on target audiences and scientific goals.

Research Assistantships are a means by which PBNERR is able to provide funding opportunities for graduate students, expand the scope of research conducted at the reserve, and foster collaboration with regional academic institutions. In collaboration with the Padilla Bay Foundation, PBNERR has continued to offer one research assistantship each year to a graduate student conducting research in Padilla Bay. In 2015, the Research Coordinator worked with the Padilla Bay Foundation to acquire funding to support an additional research assistantship. Through donations from the Tesoro Corporation and the Borman Family Foundation, PBNERR has offered two separate 18-month, $5000 assistantships. The two most recent recipients include Cale Miller (Western Washington University Huxley College of the Environment) who is investigating effects of native and non-native seagrasses on pH and carbonate chemistry and Alex Lowe (University of Washington Department of Biology) who is investigating the ecology of the native oyster *Ostrea lurida* across stress gradients in Padilla Bay. An additional impact of the research assistantship is the elevated level of collaboration it fosters between the advisors and Padilla Bay.

Submissions to the Annual PSEMP Report. The annual PSEMP report is a synthesis of patterns and trends in water quality monitoring throughout the Puget Sound/Salish Sea. This year (2015) was the first year that PBNERR contributed to the annual report, including a synthesis of the annual variability and long term trends in salinity and water temperature in Padilla Bay, and an invited two-page section highlighting the research and monitoring being conducted at PBNERR with eelgrass and rocky intertidal habitats.

There are three notable impacts of the inclusion of Padilla Bay content in the annual report. First, the Northwest Straits/Central Salish Sea is poorly represented in terms of real-time water-quality monitoring, and Padilla Bay SWMP infrastructure and data fill a large data gap in the annual synthesis. Second, inclusion of PBNERR in the PSEMP report achieves the goal of increasing the representation of Padilla Bay research and monitoring among other Washington Department of Ecology programs. Third, annual submissions to the report provides an incentive and context for using SWMP data to address regional-scale questions and issues.

PBNERR MARINe Biomonitoring Data is unique in that it is a marine monitoring project that was initiated prior to the mass mortality associated with SSWS and was able to capture the widespread mortality, and track recovery and recruitment. This helps provide a context for researchers to conduct additional work in Padilla Bay.

Presentations at conferences are another means by which research findings are disseminated. The Research Coordinator and other PBNERR staff presented work being done at the reserve at the 2015 Coastal and Estuarine Research Federation (CERF) conference held in Portland, Oregon and expect to present at similar conferences in the next five years.

WCC/AmeriCorps research assistantships provide an important opportunity for young professionals in the natural resource field to gain experience in research, monitoring and contribute to the PBNERR. One objective is to provide these assistants with mentoring in an independent research project and authentic research experience. The 2015 assistant conducted an independent research project investigating and quantifying growth rates of resident seastars, which contributed to an ongoing collaboration with a faculty member at Western Washington University who is investigating seastar wasting syndrome in Padilla Bay and other regional waters.

External funding opportunities are a means by which PBNERR engages in collaboration and seeks support for research infrastructure. The Research Coordinator has worked with Dr. Ben Miner and other co-PIs at Western Washington University as a partner on a Washington SeaGrant proposal to investigate the recruitment and biodiversity of seastar larvae in the Salish Sea. The proposal has moved through the pre-proposal stage to full submission, and has been reviewed positively by the reviewing committee. Funding is likely, which will support additional zooplankton monitoring in Padilla Bay and provide additional equipment for enumeration and quantification of echinoderm larvae.

Research Program Needs and Opportunities

PBNERR continues to maintain an active research program and conducts high-quality data collection as part of SWMP. However, new research opportunities and evolving NERR monitoring priorities may exceed the existing capacity and infrastructure at PBNERR. Most critical of these is the need to establish a PBNERR SSAM1 Sentinel Site focused on Submerged Aquatic Vegetation and in doing so accurately evaluate changes in

local sea-level rise, as well as the biological and ecological consequences of these changes and those associated with larger-scale climate change. Aging monitoring equipment and the need deploy sondes at greater water depth and conduct real-time water column profiles is another area where PBNERR has equipment and infrastructure needs related to upgrading the Reserve's YSI sonde inventory.

Establishing Padilla Bay as a Sentinel Site (Sentinel Site Application Module 1)

Present day sedimentation rates in Padilla Bay are less than historical levels and eustatic sea level rise is accelerating (Rybczyk and Kairis 2010), placing the extensive *Zostera* (eelgrass) meadows in the bay at risk of eventual submergence. Coastal managers have keen interest in the elevation dependencies of the intermixed *Zostera* species, due to the recent declaration of the introduced species *Zostera japonica* as a noxious weed. Further, salt marsh vegetation along the perimeter of the bay depends on water levels and marsh elevation, therefore precise monitoring of elevation, sediment accumulation and water levels are essential for addressing all of these questions.

PBNERR is developing the critical infrastructure and data analysis capacity to evaluate the ecological and physical effects of climate change and sea-level rise on Padilla Bay and adjacent waters. Existing biomonitoring efforts and SET placements in Padilla Bay are making a valuable contribution, but need to be supplemented by additional capacity and infrastructure for a complete Sentinel Site build-out. These include improved capacity for accurate and precise determination of water level at monitoring stations and SETs in Padilla Bay, developing a local geodetic control network tied to the National Spatial Reference System (NSRS) so water-level and bathymetry measurements are collected on the same vertical datum, and installation of additional SETs throughout Padilla Bay, specifically in the saltmarsh and along the biomonitoring transect. Finally, we need guidance from NGS to develop a local geodetic control network tied to the National Spatial Reference System (NSRS) so measurements are collected on the same vertical datum.

The current observational infrastructure includes:

- Submerged Aquatic Vegetation (SAV) transects to monitor changes in spatial distribution and community composition of vegetated habitats PBNERR.
- Twenty-three Surface Elevation Tables (SETs) installed and monitored throughout the mudflat with plans (funding dependent) to add SETs in the saltmarsh and along biomonitoring transect;
- SWMP Water Quality data (specifically water height) and PBNERR meteorological data;
- Multi-decadal aerial image analysis of shoreline and vegetation community boundaries;
- Two USGS water levels installed in 2013 and an additional one-year installation (mid-2015) at the historic tidal bench mark at the north end of

Swinomish Channel; and
- Potential for enhanced circulation modeling by Battelle and USGS.

Other Desired Expansion of Capacity and Equipment

Building and Sharing a Geospatial Research Database: Numerous scientists and other researchers visit Padilla Bay each year to conduct a wide range of studies and field experiments at specific locations within the bay. In addition, PBNERR has archived technical reports and summaries from over 30 years of research conducted at Padilla Bay. However, other than through institutional knowledge or archived paper documents, this vast body of information is virtually inaccessible to both Padilla Bay staff and others interested in research at Padilla Bay. PBNERR staff are currently in the preliminary stages of developing a map-based, queriable geospatial database of all the studies conducted in Padilla Bay, including the location of the study, data collected, investigator, and summary of research findings. This will help provide valuable context for future work in Padilla Bay, as well as allow for large spatial- and temporal-scale syntheses of research findings and knowledge about this unique estuarine ecosystem. Successful development of this database would require digitization of existing research reports for which only hard copies exist, software and architecture to build a queriable geospatial database, and upgrade/redesign of the PBNERR website to host the database for both internal and external users. Although functional, the PBNERR website is antiquated and doesn't reflect the highly professional and high caliber research, monitoring and education at Padilla Bay. An improvement in this area would benefit all sectors at PBNERR. Furthermore, many other NERRs are hoping to establish similar web-based databases as a resource to end-users. Development of a database at PBNERR could serve as a model and/or template for other reserves.

Expansion of Sonde Monitoring Capacity: Research and monitoring at PBNERR is moving into the realm of ocean/estuarine acidification and exploring the oceanographic interactions between Padilla Bay and surrounding waters. This will require continuous monitoring of deep waters in Padilla Bay (i.e., Gong Deep station), as well as conducting water column profiles at deep water stations to determine the extent of marine water intrusion and estuarine circulation dynamics. The current YSI sonde infrastructure limits the ability to achieve these goals, based on the inability to conduct real-time water column profiling and depth limitations of existing sondes that prevent deep water deployment. Four additional Xylem EXO sondes with profiling hardware (i.e., handheld unit and field cable) would meet this need and greatly advance our ability to assess effects of marine inputs of corrosive, low pH water of marine origin.

Research and Monitoring Objectives and Actions

Many of the actions below address multiple goals and objectives. In the interest of avoiding redundancy, these actions have been described in their first iteration and referenced thereafter. Examples include establishment of a research database, coordinating annual gatherings of researchers and scientists at Padilla Bay, contributing to the annual

PSEMP report, attending and presenting at professional meetings, and hosting the annual Padilla Bay Research Symposium.

CORE GOAL 1: Improve scientific understanding of coastal ecosystems and in doing so inform management of natural resources and work towards resilience and sustainability of Padilla Bay and the surrounding coastal ecosystems.

Objective 1: Identify and promote research priorities at PBNERR from 2016-2020 that advance our understanding of the habitats, ecology, organisms, diversity and/or ecosystem functions of Padilla Bay.

Action: The RC will establish and maintain an ongoing, adaptive list of research priorities that is revised annually and addresses questions and/or challenges consistent with the five-year goals of the Reserve and is aligned with management priorities for Washington State and NERRS.

Action: The RC and research staff will expand research and monitoring efforts to include the following:

- Routine monitoring of water-column plankton communities at SWMP stations;
- Routine measurements of oxygen consumption, productivity, and/or other ecologically relevant rate processes at SWMP stations;
- Conduct routine water-column profiles at two deep stations in Padilla Bay; and
- Semi-annual monitoring of rocky intertidal habitats following the Multi-Agency Rocky Intertidal Network (MARINe) sampling protocol.

Action: The RC and research staff will increase the analysis of SWMP and other monitoring data collected within the Reserve to identify long-term trends and provide a more comprehensive understanding of ecological change in Padilla Bay and the greater Salish Sea. Contribute annual analyses to PSEMP report and monthly analyses to Ecology's Eyes Over Puget Sound.

Action: The RC will host annual gathering of regional researchers, scientists, resource managers, Padilla Bay research staff, and/or informed stakeholders to identify regional research and management goals and inform the research priorities at PBNERR.

Action: The RC will re-establish the Research Advisory Committee and consult this group in making decisions regarding program direction, allocation of student funding, and proposal review.

Action: The RC and collaborators will use PBNERR research priorities to provide focus and guidance for:

- Independent research projects conducted by students and interns;

- Focus and direction for the annual PBNERR research assistantships for undergraduate/graduate students;
- Research collaborations with external researchers, university faculty and other natural resource scientists; and
- Research proposals submitted by PBNERR for internal and/or external funding.

Objective 2: Provide resources, data and support from 2016-2020 to approved, independent research projects within the Reserve's boundary and watershed.

Action: Research projects within the Reserve will be reviewed and evaluated by the RC, research staff and Research Advisory Committee to determine consistency with Reserve goals, promote synergy with other ongoing projects, and identify any potential conflicts with existing research.

Action: The Padilla Bay Foundation will provide annual support for graduate student research through the Padilla Bay Research Assistantship (pending continued funding through the Padilla Bay Foundation).

Action: The institution will provide equipment, watercraft, and staff support as available for relevant research projects within the Reserve.

Action: The RC will promote use and incorporation of spatial, biogeographic and monitoring data collected at PBNERR into independent research projects conducted in Padilla Bay, achieved by articulating this as a priority in the graduate assistantship proposal solicitations and familiarizing other outside researchers with the geospatial database.

Action: The RC and research staff will actively participate in internal and external programs that offer support for student research, internships and/or apprenticeships at PBNERR.

Objective 3: Enhance communication and collaboration among the scientific and resource management community from 2016-2020 to improve knowledge of PBNERR habitats, species, diversity, ecosystem functions and advance management objectives for Washington State.

Action: The RC and GIS Analyst will create, populate and maintain a searchable and publicly-accessible database of the research projects that have been conducted at PBNERR.

Action: The RC and research staff will contribute a synthesis of PBNERR monitoring data each year to the Puget Sound Ecosystem Monitoring Program (PSEMP) annual report.

Action: Members of the Reserve research team will attend and present findings at relevant scientific and professional conferences; Research findings that make a substantive scientific contribution will be submitted to peer-reviewed journals for publication.

Action: The PBNERR RC will meet regularly with management and research entities in the greater Puget Sound region, including but not limited to the Ecology/SEA Technical Team, Northwest Straits Commission, and PSEMP Advisory Board.

Action: The following actions are also listed in greater detail as part of Goal 1, Objective 1 above: The RC will re-establish the Research Advisory Committee and host an annual gathering to share knowledge, research findings, and discuss solutions to challenges.

Action: PBNERR research staff will work with other eelgrass scientists in the Pacific Northwest in a variety of workgroups, expert panels, and committees to provide the best possible scientific information in guiding policy and management for eelgrasses in the region.

CORE GOAL 2: Foster through improved knowledge and understanding a community of informed citizens, students and decision-makers so they can make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.

Objective 1: Scientific data and research findings will be shared with the broader scientific, resource management, and stakeholder communities from 2016-2020.

Action: The RC and GIS Analyst will make reserve technical reports, reprints, research projects, and data available through the Padilla Bay Geospatial Research Database and accessible through the web via the PBNERR website.

Action: In collaboration with the Padilla Bay Foundation and pending continued funding, the research team will host an annual Research Symposium to share and disseminate ongoing research at PBNERR to scientific and public audiences (also addresses Objective 2 below).

Action: The RC and research staff will develop products that communicate trends and observations revealed by improved analysis of long-term monitoring data and share these with appropriate management and stakeholder communities.

Action: The RC and research staff will attend relevant scientific and professional conferences (also listed and described in greater detail as part of Goal 1, Objective 3 above).

Objective 2: Engage citizens, students and other non-scientists in research at PBNERR and other aspects of the process of science and research from 2016-2020.

Action: The RC will collaborate with the Coastal Volunteer Program at PBNERR to continue volunteer-based support of research and monitoring (e.g., zooplankton counts, eelgrass surveys, rocky intertidal surveys, fecal coliform monitoring by Stream and Storm Teams, etc.).

Action: The RC and Reserve staff will use professional development for teachers to facilitate the use of PBNERR SWMP data in middle and high school STEM classrooms.

Objective 3: Research findings will be made available to Reserve visitors, students, CTP participants and other interested public audiences from 2016-2020.

Action: The RC and research staff will host annual Research Symposium (see Goal 2, Objective 1 above).

Action: Current research projects and/or findings will be presented by the RC and research staff in the Interpretive Center via posters, educational displays or electronic media (e.g., information kiosk).

Objective 4: The Research Coordinator will communicate regularly with the Education and CTP Coordinators to identify opportunities for integration of research into planned activities, project and programs during 2016-2020.

Action: The RC will work with the Education and CTP Coordinators to develop and implement meaningful contributions to educational programs, classes and workshops at PBNERR.

Action: Every year from 2016-2020, there will be at least one education program that includes a presentation by one or more Reserve research staff members.

Action: Every year from 2016-2020, there will be at least one opportunity for education and CTP staff members, or other qualified volunteers to participate in a research projects in the lab or in the field.

CORE GOAL 3: Promote an improved understanding by citizens and public officials of the impacts of climate change on human and natural resource communities so they can make well-informed, sustainability-based decisions.

Objective 1: PBNERR will support and actively engage in research during 2016-2020 that addresses the effects of climate change on the Padilla Bay ecosystem and coastal waters of the Salish Sea.

Action: The RC, research staff and GIS Analyst will work together to make progress towards establishing a Sentinel Site at PBNERR to evaluate the effect of sea-level rise and other climate-related perturbations on intertidal ecosystems (pending funding).

Action: The RC, research staff and collaborators will engage in and promote research projects that investigate the role of eelgrass in ocean acidification, carbon sequestration, and potential mitigation of elevated carbon dioxide in coastal waters.

Action: The RC and research staff will use SWMP data to evaluate long-term and other climatic changes in water quality parameters of Padilla Bay and adjacent waters of the Salish Sea.

Action: The RC and research staff will share findings from climate related research with scientific, management and public audiences and engage with Education and CTP Coordinators to enhance their efforts in climate literacy (See Goal 2 above).

Action: Contribute to the series of climate-related courses being offered by CTP at Padilla Bay from 2016-2020.

CORE GOAL 4: Manage the Reserve's natural resources in a sustainable manner for the benefit of the ecosystem and the public.

Objective 1: Provide scientific information and research findings that support the efforts of local and regional resource managers during the 2016-2020 period.

Action: The RC and research staff will work with the Stewardship Coordinator to identify priority areas of interest and/or concern related to management of Padilla Bay natural resources.

Action: The RC will use these priority areas to guide the focus of graduate research assistantships, research projects.

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Chapter 4 - Education Program Plan

Introduction

Humans have inhabited the shorelines of Padilla Bay for thousands of years. First, Native Americans found shelter and sustenance here, then explorers came hoping to claim land, then trappers and traders, then settlers moved across the United States from the east. Some settlers changed the landscape in ways others before them had not. Padilla Bay is an estuary "orphaned" from the Skagit River due to river and ocean dikes built by settlers to reduce flooding and "reclaim" land from the sea. This rich environment between the Cascade Mountain range and the inland Salish Sea is where Padilla Bay lies. It is a perfect example of the riches of an estuary, with its extensive eelgrass beds, and the impacts of people on their environment. Our education programs focus on helping all ages better understand estuaries and what they can do to sustain them.

NERRS Education Program

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education at each reserve is designed to fulfill the Reserve System goals as defined in the regulations (15 C.F.R Part 921(b)):

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas;

To sustain these system goals, the 2011-2016 Reserve System Strategic Plan outlines education objectives that support the focus areas of climate change, habitat protection and water quality:

- Enhance the capacity and skills of teachers and students to understand and use Reserve System data and information for inquiry-based learning; and
- Increase estuary literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection, and water quality.

The Reserve System provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation incorporate

science-based content into a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues.

Reserves conduct formal and informal education activities, as well as outreach activities that target culturally diverse audiences of educators and students, environmental professionals, resource users and the general public. Education and public programs, interpretive exhibits and community outreach programs integrate elements of Reserve System science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

The Reserve System is committed to preparing tomorrow's future leaders with the knowledge and understanding of the nation's oceans and coasts to be responsible stewards. To fulfill this commitment, the Reserve System has created the K-12 Estuarine Education Program (KEEP) to increase the estuary literacy of students, teachers and the general public. The KEEP Program helps students and teachers learn about essential coastal and estuarine concepts, develop data literacy skills and strengthen their critical thinking, team building, and problem-solving skills. K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity.

Community education is another priority for the Reserve System. Community education programs foster behavioral change to promote resource conservation. These programs work with audiences whose choices directly impact the integrity of estuaries and their associated watersheds.

Padilla Bay NERR Program Context

Geographic Scope

Most of the Reserve's education programs are taught on-site at the Reserve. For this reason, most participants come from within a reasonable travel distance, west of the Cascade Mountains in Whatcom, Skagit, Snohomish, and Island counties (Fig. 4.1). Sometimes programs take place at sites away from the Reserve but still within those same four counties. Rarely, Reserve educators travel further afield to other parts of the Salish Sea Watershed. These decisions are made on a case-by-case basis depending on an assessment of the value of the program balanced against the cost to resources such as staff time and transportation.

Market Analysis/Needs Assessment

The Reserve Education Program completed a Market Analysis and a Needs Assessment for K-12 programs in 2011 (Riggs 2011; Alexander 2012). The Market Analysis was a survey of environmental education programs in Skagit, Snohomish, Whatcom and Island

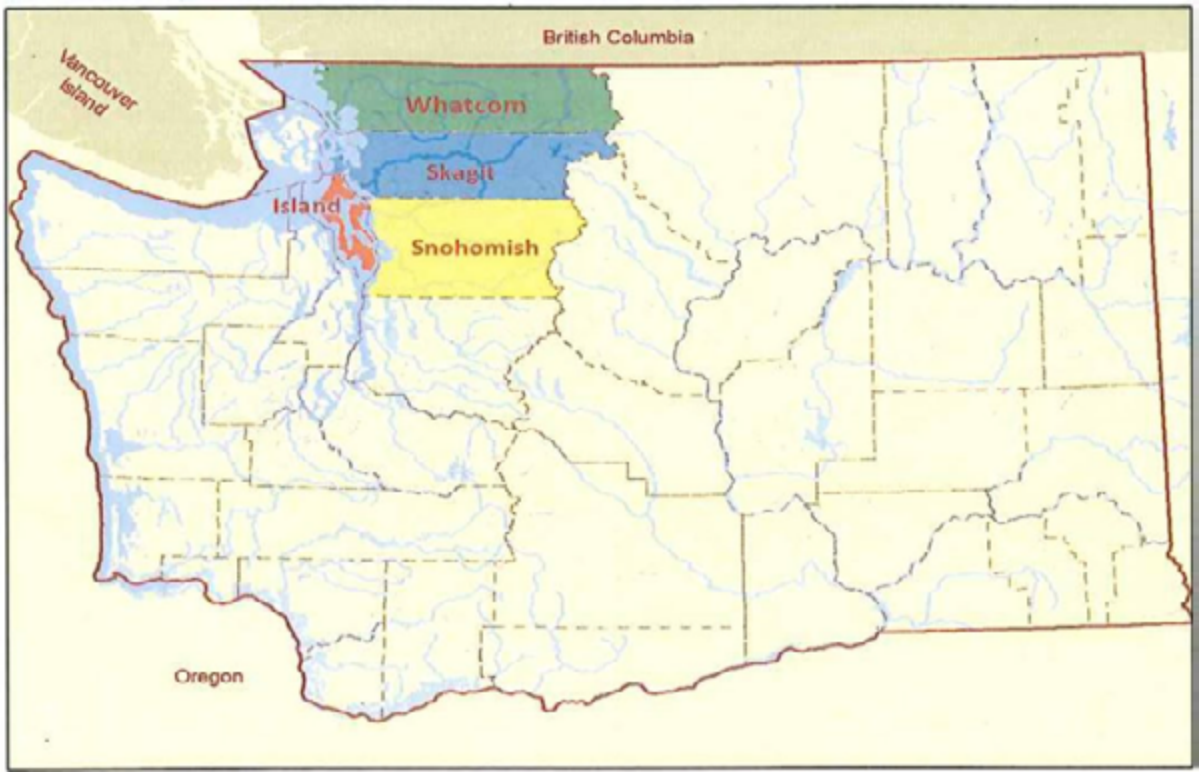


Figure 4.1 Map of four-county local service area.

counties. The purpose was to improve understanding of how the Reserve fits into the regional environmental education community and to help prepare for the needs assessment. The needs assessment was a survey of K-12 classroom teachers in the same four counties to help Reserve educators understand the needs of teachers in the region. The final reports from both of these projects are available in the publications section of the Reserve web page (http://padillabay.gov/publications.asp). The topics local service providers think need more attention are shown in Fig. 4.2.

"Stewardship actions people can take," "Climate change and sea level rise," "Human impact on the environment," and "Estuaries as nurseries" are topics that the Reserve will continue to cover in K-12 programs.

The Needs Assessment showed that over 80% of responding teachers were aware that a National Estuarine Research Reserve exists in the state of Washington. Of those that were aware, over 80% reported having utilized Reserve educational services or products in the past. These data seem high but possibly it is because teachers that know about the Reserve and use Reserve services are more likely to respond to the request to take the survey.

Some teachers that were aware of the Reserve have not used services provided by the Reserve. The most common reason given for this is that they did not know about the services that were available. This shows a need for increased outreach to teachers. In

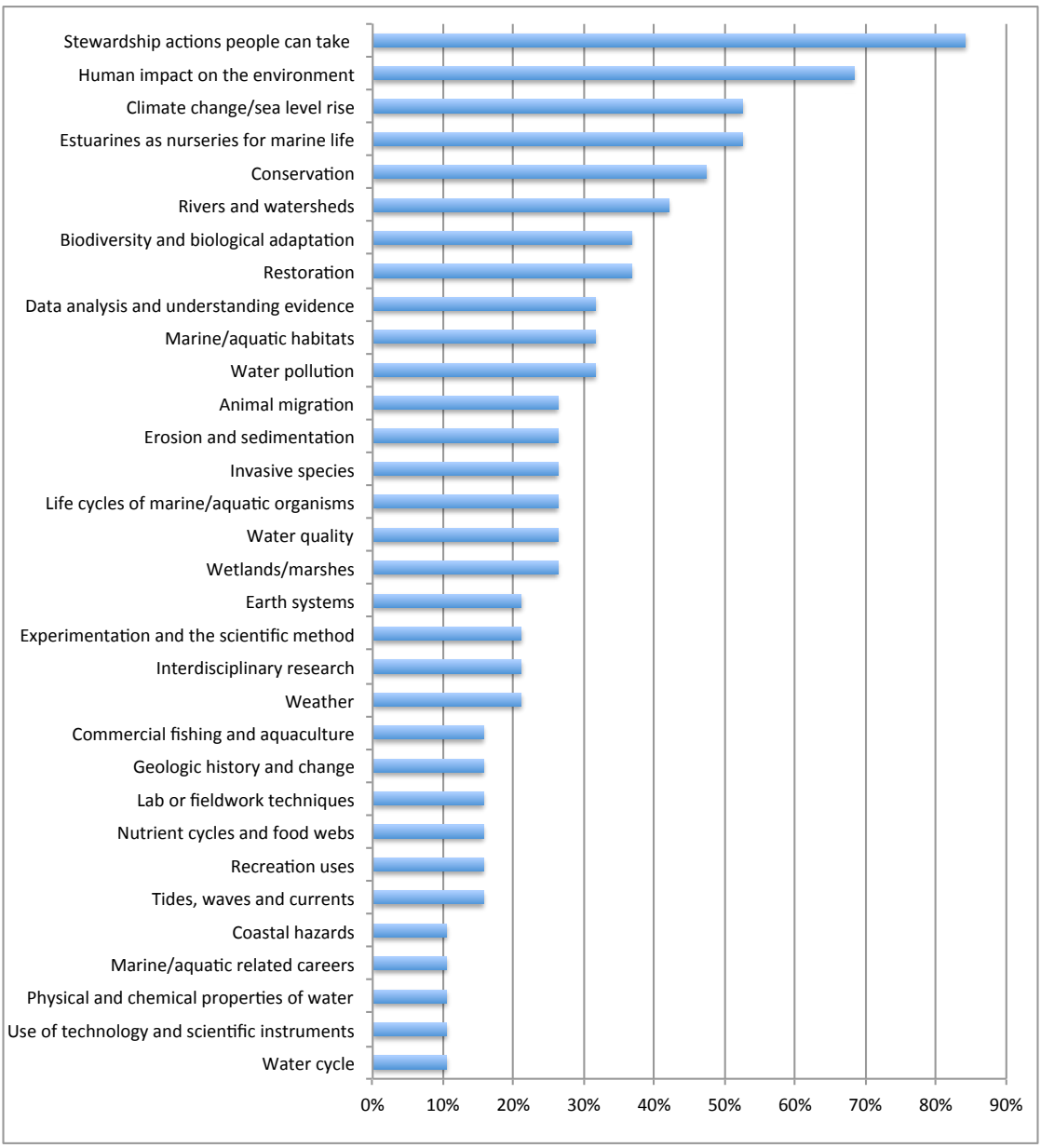


Figure 4.2 Topics local environmental education service providers think need more attention.

the next five years, Reserve educators will place a higher value on presentations to this audience.

Responding teachers also said that lack of time is the greatest barrier to teachers attending teacher workshops. Teachers said they are more likely to attend workshops that are one day in length than multi-day workshops. When asked about the preferred method to receive teacher information from the Reserve, workshops in their district were favored and workshops at the Reserve were next. Printed materials were less favored and distance learning (using technology that allows not face-to-face communication

such as video conferencing and the Internet) was least favored. For the next five years these results will be used in designing teacher workshops.

Logic Model/Evaluation Tools

In 2010-11, a professional outside evaluator was contracted to help the Reserve's education program develop a logic model and evaluation tools for upper elementary school field trips (grades 4 through 8) and teacher training workshops (Stromholt 2010; Stromholt 2011). The evaluation tools were administered, tested, and refined by the education staff and consultant and the data were analyzed by the consultant. Figs. 4.3 and 4.4 are examples of results from the evaluations administered by teachers to students. Findings were summarized in final reports available on the publications web page (http://padillabay.gov/publications.asp).

The consultant concluded "*that the Padilla Bay programs have a positive impact on students and teachers alike. Students were able to recall many of the important lessons they learned during their time at Padilla Bay Reserve and consistently demonstrated enthusiasm for the programs. Teachers had an overwhelmingly positive response to the professional development training they received from Padilla Bay and have shared what they have learned with their students and other teachers. Several teachers reported a willingness to share their work and examples of student learning with Padilla Bay in an effort to show the merits of the program*."

The Reserve does not currently use the evaluation tools, although they are still available to teachers online, as the education programs have not changed. In the next five years, Reserve educators will develop a logic model and develop and implement evaluation tools for other audiences such as lower elementary (grades K through 3) or teacher workshops.

New Educational Standards in Washington State

There have been changes in formal education in Washington State that may have an impact on future programs. New educational standards were developed and adopted including the Next Generation Science Standards and the Integrated Environmental and Sustainability Learning Standards. In the next five years the Reserve will align K-12 education programs with these new standards.

Target Audiences

The Reserve's target audiences range from children to adults and students to teachers. All are willing, self-selected participants that come for advertised programs or that request a program for their group.

Programs aimed at *adults* include monthly programs on a range of topics such as "Sounds of Fall Migration", "Wild Edible and Medicinal Plants", and "Introduction to

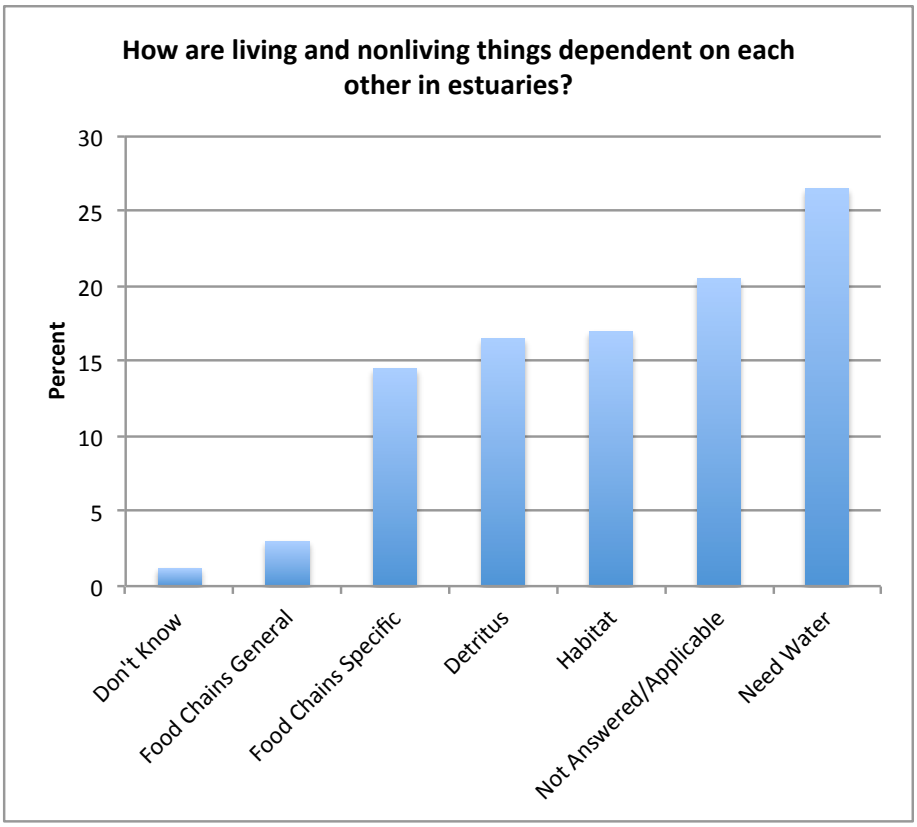


Figure 4.3 Responses showing that students participating in Reserve education programs for grades 4-8 can describe interdependencies in estuaries. Responses are recorded as percentage of student respondents.

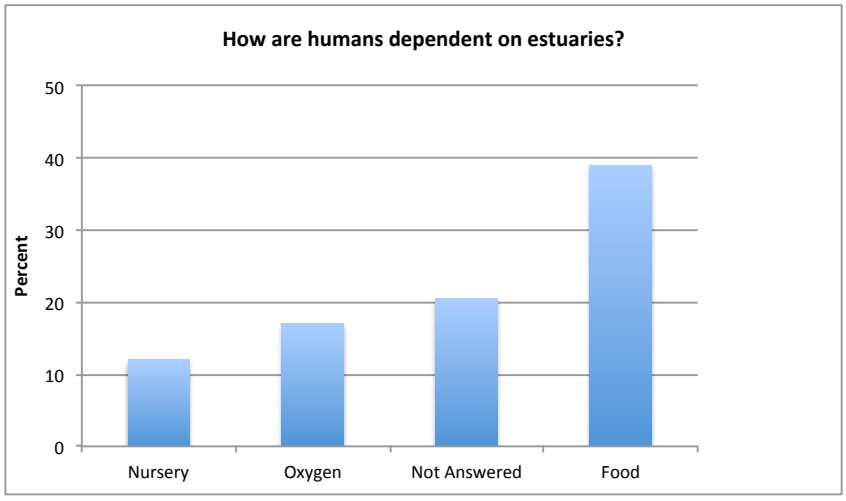


Figure 4.4 Responses show that students participating in Reserve education programs for grades 4-8 can describe human dependencies on estuaries. Responses are recorded as percentage of student respondents.

Hawks." The Reserve contracts with local experts for these programs. Some of the programs use the outdoor trails.

Family programs target families with children and include public programs such as Mudflat Safaris and Beach Seines. These programs take place on the beach. Mini Explorers (3-5 years old) and Junior Ecologists (6-9 years old) meet every month for a different lesson in estuarine ecology.

Students (pre-K through 12th grades) come with their teachers and parent volunteers to learn about estuaries in on-site programs (Level 1 and Level 2 estuary curriculum and the interpretive exhibits).

Outreach programs inform the *general public* or specific groups about Reserve services. This may include displaying a portable exhibit at a community event like Fidalgo Bay Day or giving a brief talk to a target audience such as teachers.

Teachers benefit from teacher workshops (such as Teachers on the Estuary or TOTE) offered by the Reserve. TOTE workshops follow guidelines that include incorporating System Wide Monitoring Program (SWMP) data.

Reserve Education Programs

The Reserve education program serves over 11,000 people each year (Fig. 4.5). Group composition can be further divided as in Fig. 4.6. The various programs offered can also be split into three categories: group programs, public programs and outreach programs.

Group programs are for groups of 10 to 60 people that contact the Reserve to request a presentation. These groups learn about estuary systems, how estuaries relate to the audience and what the audience can do to keep these systems healthy. These programs are specially designed to meet the learning needs of the group.

More than half (60%) of all the people who attend education programs at the Reserve come with classes on school field trips, making this the strongest component of the K-12 Estuary Education Program (KEEP). Each school brings one adult for every five to seven students so these parent volunteers are also a significant audience. Many of them would not otherwise choose to attend an environmental program.

Children who come as part of a group such as scouts or other youth programs outside of school are less than 10% of the total audience. Groups of adults, including college classes and civic groups also make up less than 10% of the total audience. Families that attend public programs targeting children at various age ranges make up just over 10% of the total audience.

Public programs are planned and scheduled by education staff members, advertised in the newsletter and individuals and families can sign up. The purpose of public programs

Figure 4.5 Number of individuals attending programs from July 1, 2014 - June 30, 2015

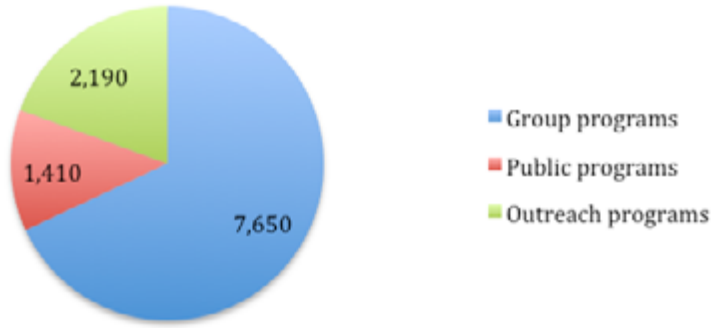
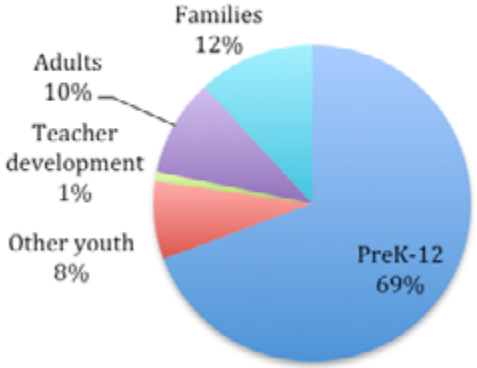


Figure 4.6 Breakdown of group program attendees.



is the same as group programs – to learn about estuary systems, how the audience relates to these systems and what the audience can do to keep these systems healthy.

The purpose of *outreach programs* is to inform people about Reserve activities so audiences know how they can participate and have their needs met. As a result of the Needs Assessment of K-12 teachers, outreach to teachers will increase in the next five years.

The Reserve also offers *professional teacher development* on various subjects and in different delivery formats to increase the amount and effectiveness of environmental education in schools. The State Office of Public Instruction authorizes the Reserve to offer professional continuing education credits (Washington State Clock Hours). This is a great incentive for teachers to attend the workshops. The Reserve is planning to implement a workshop in the summer of 2016 for middle school teachers to learn about a new ocean acidification curriculum. This workshop will meet the standards of a Teach-

ers on the Estuary (TOTE) workshop. Other TOTE workshops will also be implemented in future years.

Priority Issues

The Padilla Bay Strategic Framework (Chapter 2) identifies Strategic Priorities and this section illustrates how the Education Program will address these priorities.

1) *Climate change impacts.* Since 2008 the Education Specialist has been assigned responsibility for climate change education. This includes educating the public about climate change and carbon reduction strategies to reduce greenhouse gas emissions. The Education Specialist and the seasonal educator (employee of the Padilla Bay Foundation) participated in a study circle of the National Network for Ocean and Climate Change Interpretation (NNOCCI) in the fall of 2015. This will result in more effective planning and implementation of climate change interpretation over the next five years.
2) *Water quality in estuaries and watersheds*. The Education Specialist oversees the "Stream Team" program where water samples are collected locally and tested for the presence of fecal coliform. The Reserve K-12 curriculum also teaches personal behaviors that students can do to help keep water clean.
3) *Invasive species impacts*. Reserve education programs, including public programs, teacher workshops, adult groups and K-12, will continue to include information about the dangers of introducing non-native species. Participants will learn to identify non-native species and strategies to avoid new introductions.
4) *Loss of shoreline processes*. The K-12 program will continue to identify examples in Padilla Bay of human alterations to the shoreline and teach how these changes have reduced estuary health. Reserve educators will continue to present a popular historical program about the building of dikes in the area. This program includes information about current shoreline restoration projects.
5) *Habitat loss in estuaries and watersheds*. This is another subject covered in the K-12 program. It is cited as one of many reasons for declining populations of salmon and Orca whales. Though students have little control over habitat loss, these losses serve as motivation for behaviors students do have control over such as picking up dog waste, reducing the use of automobiles and practicing thoughtful conservation when visiting the beach.

Alignment with NERRS Strategic Plan

All Reserve education programs directly address the "People" goal of the 2011-2016 NERRS Strategic Plan (Objective 2). The goal states "NERRS education and training increases participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds" while Objective 2 promotes "Increas-

ing estuary literacy and promoting active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection and water quality."

Teachers on the Estuary (TOTE) workshops address Objective 1 of the "People" goal which promotes "Enhancing the capacity and skills of teachers and students to understand and use NERRS data and information for inquiry-based learning." A TOTE teacher workshop was implemented by the Reserve for three years (2009 through 2011) with Bay-Watershed Education Training (B-WET) funding. Over the next five years new TOTE workshops will be developed and implemented as funding and staff time allow. Additional staffing and funding are required to make this a sustainable addition to the Reserve education program.

Padilla Bay NERR Program Capacity

Staff

The Reserve Education Team consists of two full-time professional educators (Education Coordinator and Education Specialist). These two leaders have Masters degrees in Environmental Education and over 25 years of experience each in these positions. In addition, one AmeriCorps member works with the Education Team each year. Also, for several years now the Padilla Bay Foundation has hired a seasonal temporary educator to help with school field trips in the spring. Adult citizen volunteers assist with school field trips that go to the beach, as docents in the exhibits, and with outreach at conferences and festivals. Unpaid interns also help with all aspects of the education program. The Padilla Bay Foundation created a Volunteer Coordinator position in late 2014 to strengthen the volunteer program.

Volunteers

Adult volunteers help with various tasks in the education program. They help with school field trips at the beach, setting up equipment, and roving from group to group to make sure students stay on task. Back at the Interpretive Center, volunteers help set up the microscopes in the classroom with live samples of organisms the group finds at the beach. They then help students use the microscopes and clean up at the end of the day.

Sometimes volunteers act as docents in the exhibits and aquarium. Volunteers also assist with outreach at conferences and festivals. Unpaid interns (such as Hollings scholars or students from local colleges and universities) also help with all aspects of the education program.

Facilities

The Reserve has indoor exhibits and interpretive signs on trails that augment education programs. Public indoor exhibits are open Wednesday through Sunday (10:00 a.m. –

5:00 p.m.) and the outdoor trails (Upland and Observation Deck) are open during daylight hours and offer interpretation through signs and booklets.

The education program utilizes several rooms in the Breazeale Interpretive Center for education and interpretation. Educators use the theater which seats 50 for group programs. They also use the classroom with its 15 microscopes, the main exhibit area which consists of interpretive displays about human and natural interactions in estuaries and watersheds, the "hands-on" room with games, puzzles, puppets and books that can keep learners engaged for hours, and the aquarium display that houses live organisms found in Padilla Bay. For larger groups, there is also a large conference room that can be used for education and accommodates 60-100 people.

Most of the Reserve education groups access the beach at Bay View State Park (about a quarter-mile south of the Interpretive Center) because of its accessibility. However, the beach below the Interpretive Center is available and can be used if the beach at Bay View is closed for any reason.

Partners in Education

The Padilla Bay Foundation provides numerous valuable services to the Education Program. They often serve as the fiscal agent on grants that the state agency either cannot receive or would be cumbersome to work with. The Foundation also hires a seasonal temporary educator to help with the increased workload of school field trips in the spring and they generously provide money and equipment to support education programs.

Skagit ECO Network is a collaborative network of local environmental, conservation and stewardship organizations working together to improve the watershed and estuarine environments in Skagit County. The efforts of this group are coordinated, guided and supported by the Puget Sound Partnership (Partnership), an EPA National Estuary Project. The Partnership provides training, capacity building, funding and other forms of support to Skagit ECO Network and 11 other local networks surrounding the Puget Sound. This ECO Network structure facilitates unified messaging and the Partnership shares vital social research about watershed residents.

Bay View State Park provides access to the beach and a site for a shed for Reserve education equipment. Reserve educators provide technical assistance to the State Park for education and interpretation projects.

The Education Program works hand-in-hand with the Skagit Conservation District to implement the "Stream Team" and "Storm Team" programs. The Stream Team is a highly successful citizen science project for monitoring fecal coliform. Stream Team volunteers collect water samples on a schedule (October-June) at long-term sites. The Stream Team data is used by cities (Burlington, Mount Vernon and Anacortes), Skagit County, Washington State Department of Ecology, and the county and state health departments.

The Storm Team collects water samples during storm events year round. The sites can change year-to-year based on the needs of the County and the Health Department.

Taylor Shellfish Farm and Blau Oyster Company are shellfish farmers who strongly advocate for water quality projects in Skagit County. They provide shellfish for education programs and events here at the Reserve. Taylor Shellfish also helps plan the "Storming the Sound" conference, a conference for environmental educators, and has been a partner on B-WET grant applications for TOTE. The Reserve provides a traveling exhibit at public outreach events hosted by Taylor Shellfish.

The Northwest Educational Service District (NWESD) is one of 12 regional educational units in the state. Each collectively provides services and expertise to dozens of school districts. NWESD provides expertise to advise the Reserve education program with grant applications and to help plan and implement projects such as teacher workshops. They also attend and make presentations at "Storming the Sound."

Watershed Masters, Friends of Skagit Beaches and Salish Sea Stewards are all examples of local volunteer programs that provide training to adult citizens and require participants to contribute volunteer time to conservation and environmental activities. Reserve educators help train these citizens who in return become knowledgeable, motivated volunteers.

School districts and individual teachers participate in KEEP school field trips. They also help market teacher workshops and provide support for grant applications. They can also be strong advocates for the Reserve in situations when staff members cannot.

Skagit County Public Works helps plan "Storming the Sound" and provides recycling and waste reduction services at large public events.

The Skagit Conservation Education Alliance (SCEA) is a non-profit organization dedicated to conserve and enhance the natural ecosystems in Skagit County watersheds. The Reserve provides office space and works with SCEA to plan and implement workshops, events and festivals such as the "Youth Earth Summit" and "Storming the Sound." The Reserve participates in various activities led by SCEA such as a coordinated watershed letterbox activity and the planning and placement of signs aimed at encouraging good behavioral choices.

The Samish Indian Nation helps organize "Storming the Sound" and is also active in the Skagit ECO Network. The Reserve also participates in the Fidalgo Bay Research Conference.

Educators from the Reserve offer classes and programs for several universities in the region, especially Western Washington University (WWU) and Skagit Valley College. The Reserve participates in the Huxley College Environmental Career Fair at WWU and pro-

vides internships to their students. They in turn present at "Storming the Sound" and the "Youth Earth Summit."

Shannon Point Marine Center, a division of WWU, provides water and animals for the aquaria and participates in various outreach programs such as "Storming the Sound." They use Reserve facilities for access to field sites for research.

Snohomish County Surface Water Management partners with Reserve educators to offer the "Watershed Words" teacher workshop.

North Cascades Institute (NCI) uses Padilla Bay facilities for some of their natural history programs and the Reserve works with NCI on projects such as the Beach Summer Camp and the International Birding Day.

Washington State Department of Ecology provides three Washington Conservation Corps/AmeriCorps members at the Reserve, all of which help in the Education Program (one full-time and two part-time).

Padilla Bay NERR Education Program Delivery

The K-12 Estuary Education Program (KEEP) is a national initiative that includes professional teacher development, hands-on field experiences and web-based resources for K-12 teachers and students. School field trips meet the direction and standards of KEEP and remain the highest priority of the Reserve's Education Program. These classroom and field-based experiences with children will continue in the next five years (Fig. 4.7). Students receive from their own teachers, pre- and post-trip lessons in their school classrooms before and after the on-site field trip to the Reserve. Suggested lessons and other curricular materials are available for free to the teachers via the Reserve's web page (www.padillabay.gov).

The National Estuarine Research Reserve System prioritized Teachers on the Estuary (TOTE) workshops that include instruction on how to access and use NOAA data and other products. These TOTE workshops follow a nationally standardized format for professional teacher training developed by Reserve educators. TOTE was implemented by the Reserve using B-WET funding for three years beginning in 2009. In 2016, with NOAA Environmental Literacy funds, the Reserve will develop and implement a TOTE workshop about the Ocean Sciences Sequence for grades 6 to 8. This will help teachers use NOAA and SWMP data to teach about the causes and effects of climate change. New funding sources must be identified to make TOTE a sustainable program at the Reserve.

Climate change education is a national priority addressed by the Reserve in public programs and community education. New interpretive signs at the start of the Upland Trail will be completed in 2016 and will include a display on climate change and the Reserve's alternative energy installations. Reserve educators include climate change education in two conferences, the "Youth Earth Summit" and "Storming the Sound."

Figure 4.7 Education Coordinator Glen Alexander with a school field trip to the beach.

Skagit Stream Team is a highly successful citizen science program that will continue in the next five years. Adult citizen volunteers are trained to collect water quality data and water samples in streams located in priority Skagit County watersheds while others are trained to process the water samples in a laboratory to monitor for fecal coliform and turbidity. The Skagit "Stream Team" program utilizes standard operating procedures and a Quality Assurance/Quality Control Plan to train participants and to assure that data are collected properly. An elite group, the "Storm Team", collects samples following storm events and their data are trusted by local and state regulatory agencies that make decisions about opening and closing recreational and commercial harvest of shellfish.

"Storming the Sound" is an annual one-day conference for environmental educators in this four-county target region. This event attracts about 150 educators from both formal and non-formal education spheres. Substitute reimbursement is offered to encourage teachers to take time away from school to attend. The conference is a forum for participants to share new programs, new information about environmental topics and best practices in environmental education.

The annual "Youth Earth Summit" is a one-day conference for high school environmental clubs. Each year, 80-100 high school students and their advisors gather for a day of speakers, workshops, and discussions. They have the opportunity to hear about projects, accomplishments, and challenges at other schools, and meet community volunteers who can help with their projects. Past student projects have included photovoltaic solar panels on school buildings, a water bottle filling station, environmental videos, waste audits, and community campaigns addressing pet waste.

Outreach to the community happens largely at local events, such as "Fidalgo Bay Day." A portable exhibit is displayed at these events and presents a selection of images and text appropriate to various audiences. A microscope is used with a video camera to display images of live estuary organisms to attract interest and attention. This portable exhibit is used at community festivals, fairs and conferences. Reserve educators also make presentations to community groups upon request.

Marketing/Communication

The quarterly Padilla Bay Newsletter advertises public programs offered at the Reserve. It includes articles about current research, community events, stewardship activities, priority issues of climate change, habitat protection, and water quality, and local natural history. Reserve policy encourages the use of a digital version of the newsletter and reduces the need for paper and postage. It reaches an audience of about 800 people.

The extensive Reserve web site has a section for each department: Research, Education, GIS, Stewardship, the International Brant Monitoring Program and the Padilla Bay Foundation. Users can sign up for public programs, get information about Reserve services and download publications. They can even submit data to the Brant Observation Log.

Integration With Other Programs

The Reserve Stewardship Coordinator makes presentations at teacher workshops and works with the Education Department to identify stewardship projects for other education program audiences such as students and adult citizen groups. These participants help with upland restoration and non-native plant control.

The Research Sector keeps Reserve educators informed about current research projects by including educators in field projects and presentations and providing opportunities to learn about estuary science from scientists. These scientists are also generously available to educators when needed for scientific expertise. Also, Reserve scientists make presentations for various education audiences, especially teacher workshops and college groups. They also host high school job shadows. The Reserve GIS Analyst helps provide maps and graphics as needed for programs, visual aids and publications.

Impacts and Outcomes

Education programs are designed to increase estuary literacy and change behaviors to improve estuary health. Literacy includes understanding what an estuary is and how it is important biologically, economically, culturally and aesthetically. Education programs focus on the value of estuary resources to the learner and how the learner is related to these resources. Except in outreach programs educators always include information, discussion and inquiry about what the learner can do to help keep estuaries healthy. Social research provided by Washington State's Puget Sound Partnership guides the education program. Their research and expertise have identified specific behavior changes

to promote: specific behaviors related to visiting the beach, boating, car maintenance, alternative transportation, septic maintenance, pets and gardening. The Partnership also provides a toolbox of resources for educators.

Padilla Bay NERR Education Program Needs and Opportunities

Needs

The Reserve lacks resources to meet this list of identified needs:

- The education program could expand programming and reach with a larger staff of professional educators.
- A computer lab or collection of handheld devices would allow implementation more digital aspects of the K-12 Estuary Education Program (KEEP) such as Estuaries 101 and access to SWMP data.
- The ability to take education programs out into the bay on boats would enhance learning as all field-trips are currently shore-based. The Reserve would need appropriate boats and policies in place to allow for boat-based learning.
- With additional funding the Reserve could facilitate transportation to the Reserve for audiences that currently find this a barrier.
- Another need is for improved water quality at Bay View State Park, where students experience the field-based portion of the estuary education programs. The beach has been closed several times due to high fecal coliform counts. Skagit County continues to work on this issue.

Opportunities

The Padilla Bay Foundation added a Volunteer Coordinator to their staff in 2014 and is providing volunteer coordination services for the Reserve. Over the next five years this will provide more volunteers that are better trained and able to assist with education programs.

A new Research Coordinator was hired in 2015 after the previous coordinator retired. This new coordinator has extensive experience, training, and interest in science education. The education staff sees an opportunity for increased integration of the education and research sectors because of this.

The education program will increase programming targeting the local Hispanic community, the largest underserved population in the county. For the next five years, a priority for hiring will be candidates with Spanish language skills. Partnerships will be explored with organizations that supply services to this population.

Education Program Objectives and Actions

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers and partners.

Objective 1: The Education Coordinator will maintain strategic education partnerships throughout 2016-2020.

Action: The Education Coordinator will maintain strategic partnerships (e.g., the Padilla Bay Foundation, Skagit ECO Network, Northwest ESD, and Skagit Conservation District) to further Reserve interests in this time period.

Objective 2: The Education Coordinator understands the needs of education stakeholders from 2016-2020.

Action: A new Needs Assessment will be completed during this performance period.

Objective 3: The education program will encourage volunteer participation from 2016-2020.

Action: The Education Coordinator will provide volunteer job descriptions to the PBF Volunteer Coordinator and update those annually.

Action: In this time period, the education staff will participate in volunteer trainings and appreciation events at the request of the Volunteer Coordinator.

Action: The Education Coordinator will meet monthly with the PBF Volunteer Coordinator to identify volunteer needs in the education program.

Objective 4: The education program will work with partners from 2016-2020 to accomplish education goals.

Action: The Education Coordinator attends Skagit ECO Network meetings. The Network is supported by the Puget Sound Partnership.

Action: The Northwest Educational Service District advises education staff on grant applications and helps plan teacher workshops.

Action: The education program works with the Padilla Bay Foundation on grants and submits requests for a seasonal educator and education equipment.

Action: Education staff work with the Skagit Conservation Education Alliance (SCEA) to plan workshops, events and festivals.

Action: Education staff work with Snohomish County Surface Water Management to offer a "Watershed Words" teacher workshop.

CORE GOAL 1: Improved scientific understanding of coastal communities leads to informed management of natural resources and resilient and sustainable ecosystems.

Objective 1: The Education and Research Coordinators will communicate regularly about planned activities, project and programs to identify opportunities for integration during 2016-2020.

Action: Every year during 2016-2020, there will be at least one education program that includes a presentation by one or more Reserve research staff members.

Action: Every year during 2016-2020, there will be at least one opportunity for education staff members and qualified volunteers to participate in a research project in the lab or in the field.

Action: In 2016 a new TOTE workshop about ocean acidification will be developed by Reserve education and research staff members.

Objective 2: The Education Specialist will collaborate with the Skagit Conservation District or Skagit County Water Quality Program from 2016-2020 to offer citizen science programs such as Stream Team and Storm Team.

Action: The Skagit Conservation District and Education Specialist will train volunteers annually to collect water samples at locations in the watershed from October to June and test for fecal coliform.

Action: The Skagit Conservation District and Education Specialist will train volunteers annually to collect water samples at fixed sites during storm events year round and test for fecal coliform.

CORE GOAL 2: Informed citizens, students and decision-makers have the knowledge and understanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.

Objective 1: The education staff will offer effective education programs and teacher trainings that focus on the values of estuary systems and appropriate stewardship behaviors during 2016-2020.

Action: The education staff will implement the K-12 Estuary Education Program (KEEP) each year in this time period with 100 field trips for 7,000 students.

Action: The education staff will offer programs for 1,000 adults per year in this time period with an increased focus on personal choices

and behavioral change.

Action: The Reserve will align programming with the new federal Next Generation Science Standards that have been adopted by the state.

Action: Reserve educators will identify a target audience other than upper elementary (grades 4-8) and develop a logic model and develop and implement evaluation tools for lower elementary (grades K-3) or teachers participating in workshops.

Objective 2: The education staff will offer effective teacher training that focuses on the values of estuary systems and appropriate stewardship behaviors during 2016-2020.

Action: The Education Coordinator will write two grant applications per year during this time period to seek funding to develop and implement Teachers on the Estuary (TOTE) workshops.

Action: The education staff will offer 300 hours of professional development for 80 teachers for attendance and participation in Reserve-led classes, seminars, and presentations in this time period.

Objective 3: The education staff will identify and reach out to underserved audiences from 2016-2020.

Action: There will be a priority to hire candidates with Spanish language skills and partnerships will be expanded with other organizations that supply services to this underserved population.

Action: The Education Coordinator will seek partnerships to develop opportunities for underserved audiences in this time period.

Action: The Education Coordinator will seek funding to promote and implement programs for underserved audiences in this time period.

Objective 4: The education staff will work with partners to offer "Storming the Sound" annually from 2016-2020.

Action: The education staff will offer "Storming the Sound" annually.

CORE GOAL 3: Citizens and decision-makers understand the impacts of climate change on human and natural resource communities and can make informed decisions.

Objective 1: Education staff will implement programs that help citizens to reduce carbon emissions and help them adapt to a changing climate from 2016-2020.

Action: The education staff will offer a one-day annual Climate Change Volunteer Summit for adults working on climate change issues.

Action: The education staff will work with partners and volunteers to organize the Youth Earth Summit (YES) annually. It is a one-day annual conference for about 100 members of high school environmental clubs and will provide training on climate change, among other activities.

Objective 2: The Education Coordinator will seek grant funding over the 2016-2020 time period to develop climate-oriented classes for citizens.

Action: The Education Coordinator will apply to B-WET if that funding is available in this time period.

Action: The education staff will apply for the National Network for Ocean and Climate Change Interpretation (NNOCCI) funding for professional development to organize a Study Circle (a cross-disciplinary learning group) for building knowledge around ocean, climate, and cultural sciences if that funding is available in this time period.

Action: The Education Coordinator will review grant opportunities as they arise and apply for them if they fit the climate education needs of citizens or stakeholders.

Chapter 5 – Coastal Training Program Plan

Introduction

This chapter provides strategic direction for the Reserve's state-wide Coastal Training Program (CTP) for the next five years. Padilla Bay's CTP strategy reflects the primary components of the NERRS CTP, the local needs and priorities identified through assessments of and interactions with decision-makers working in Washington's Puget Sound, the Pacific Coast, and riverine shorelines in Eastern Washington. The priority goals and objectives for Padilla Bay NERR are presented in Chapter 2. The CTP has been developed to reflect lessons learned and to build upon program successes since its establishment in 2001. It is designed to be directed by adaptive management principles and informed by regular needs assessments that allow for flexibility to emerging decision-maker needs and changing coastal conditions. The program will use best available science of the Reserve focus areas, including climate change, habitat protection and water quality. This chapter concludes with a list of actions and strategies the CTP staff will implement to address goals and objectives related to Reserve priorities.

National Estuarine Research Reserve Coastal Training Program

The National Estuarine Research Reserve System's mission includes an emphasis on education and interpretation. The Reserve System recognizes it has a responsibility to educate coastal decision makers and supports the Reserve System goals, as defined in the regulations (15 C.F.R Part 921(b)), through the Coastal Training Program:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation.
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.
- To sustain these system goals, the 2011-2016 Reserve System Strategic Plan outlines coastal training objectives that support the focus areas of climate change, habitat protection and water quality.
- Increase estuary literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection, and water quality.
- Improve the capacity and skills of coastal decision makers to use and apply science- based information in decisions that affect estuaries and coastal watersheds.

The Coastal Training Program provides up-to-date scientific information and skill-building opportunities to coastal decision makers responsible for making decisions affecting coastal resources. Through this program, reserves ensure that coastal decision makers have the knowledge and tools they need to address local critical resource management issues.

Coastal decision makers are defined as individuals whose duties include making decisions that affect the coast and its resources. The target decision-maker groups vary according to reserve priorities, but generally include groups such as local elected or appointed officials, managers of both public and private lands, natural resource managers, coastal and community planners, and coastal business owners and operators. They may also include groups such as watershed councils, professional associations, researchers, and more.

Reserves are uniquely positioned to deliver of pertinent information to local and regional decision makers given their place-based nature. Coastal Training Program coordinators know the local people, places, and science are able to skillfully convene training participants and experts to address coastal management issues. Coastal training programs are built upon solid and strategic program documents, including an analysis of the training market and assessment of audience needs. Coordinators then work with the results to identify how their program can best address local and Reserve System priority issues.

Partnerships are integral to the success of the program. Reserves work closely with several other NOAA programs, as well as a host of local partners in determining key coastal resource issues, target audiences, and expertise to deliver relevant and accessible programs.

Padilla Bay NERR Coastal Training Program Context

In 2001, the Reserve initiated the CTP with approval from NOAA. The CTP is based on the principle that coastal decision-makers need to have scientific information available and the means to understand the science in order to make informed decisions about coastal issues and resources. Providing coastal decision-makers with science-based information, tools, and skills needed to make informed resource management decisions is one of the primary objectives of the program (Figs. 5.1 and 5.2).

Priority Audience and Geographic Range

After an initial market analysis and needs assessment, it was determined that “shoreline planners” be targeted as the Coastal Training Program’s primary audience. The professionals who fall within this category include city and county shoreline planning and permit staff; consultants who advise local government and private clients in planning issues; staff from state regulatory agencies who advise local planners, process permit

Figure 5.1 Group of coastal planners learning about eelgrass in the "Planning for Protection and Restoration of Eelgrass Habitats" class.

Figure 5.2 Decision makers in a classroom setting learning about "How to Administer Development Permits in Washington Shorelines."

applications, and enforce environmental regulations; and tribal biologists and resource managers who manage aquatic lands.

There were several reasons that shoreline planners are a critical group upon which to focus:

- No other training providers in Washington State were offering regular, 1-2 day science-based trainings for shoreline planners focusing on environmental regulations.
- A majority of local planners have multiple land-use planning obligations, for which shoreline planning may not be their primary task. Therefore, training is important to this segment of planners to ensure proper implementation of shoreline programs.
- Two-hundred sixty coastal counties and cities in Washington State are required to regularly update and implement their shoreline master plans. These plans include rivers, large lakes, and marine waterfronts along with their associated shorelands, wetlands and floodplains. These updates require knowledge of the environmental regulatory laws, proper techniques for assessing field indicators, criteria for evaluating scientific assessments and permit applications, and the basic science and justification for protecting or developing shoreline areas.

Approximately, 33% of attendees are private consultants, 32% are local staff, 21% are staff from state agencies, and the final 14% represent the other sectors.

The Reserve offers most of its classes in North Puget Sound and in South Puget Sound. North Sound classes are typically held at the Reserve near Mount Vernon (1 hour north of Seattle), and the South Sound classes are typically held in Olympia (1 hour south of Seattle). Classes are also held in southwest Washington near the Columbia River, in the Seattle area, and occasionally in Eastern Washington. Classes are promoted via the Reserve's CTP listserv and all registration is handled online.

Partnerships

Building and maintaining partnerships is critical to the Coastal Training Program's success. One of the most important partnerships is with the CTP Advisory Group. This group is a technical committee that offers guidance on the development of classes and the direction of the program. Members represent Washington State Department of Ecology, Washington Sea Grant, the Puget Sound Partnership, and local government planners. Meetings are held approximately every four to six months and focus on strategies and decisions. The meetings last three hours and are typically held in Olympia. Between meetings, the CTP Coordinator may contact individual members for assistance and direction with certain projects. This has been an extremely helpful and effective group. They are cooperative and action-oriented, with practical ideas based on experience.

Other partnerships result in the Coastal Training Program's ability to offer a wide variety of training classes. Agency staff members from the Washington State Departments of Ecology, Fish and Wildlife, and Natural Resources and the United States Army Corps of Engineers have all been engaged as instructors.

Padilla Bay NERR Coastal Training Program Delivery

Training Model

The Coastal Training Program classes are offered on a regular basis, and new classes are added each year. This "course catalog" approach reassures the target audience that classes will come around again and helps guarantee that CTP gets the "biggest bang for the buck" when investments are made in new class development. The CTP fills an important niche in the training market with its emphasis on planning and regulatory issues.

A recent email from a long-time participant stated: "Short of getting involved in a master's program, the courses offered by the coastal training program are the best and most diverse in the region."

Figure 5.3 Participants learning about hydric soils in the "Using the Revised Washington State Wetland Rating System in Western Washington" class.

At this point, there are 31 classes in the course catalog, and nine of the classes have a field component (Fig. 5.3). CTP averages 19 to 25 one-day and two-day classes per year and has served over 7,000 professionals since the first classes were offered in 2003. Class fees are typically $75-$95 for a one-day class and $125-$190 for a 2-day class. Fees cover a working lunch and class materials, and students continue to find the classes extremely affordable and a very good value. Class fees enable the Coastal Training Program to maintain an administrative staff person and offer many more classes than would otherwise be possible.

After each class, students are sent an online evaluation. Success is gauged by how the students rate the different topics, indicate their level of satisfaction, and predict how they will use the information learned. Their written comments are carefully considered

and provide information about what they especially liked and what they think could use improvement. All survey results are shared with the class instructors.

Every six months, data is submitted from the CTP survey results to the NERRS Performance Measures Database. Once a year, a success story is also submitted. Case studies are often presented at the annual NERRS meetings and regular updates are given to Department of Ecology managers. Coastal Training Program staff has presented at Coastal Zone conferences and anticipate presenting at future national conferences, such as the American Planning Association and Social Coast Forum.

CTP offers support to other sectors at the reserve who need assistance with online surveys, workshops logistics, and presentation feedback. Opportunities exist for incorporating staff expertise (particularly, the Research and Stewardship Coordinators) into classes on climate change and invasive species.

On a national level, CTP is aligned with OCM's Climate Implementation Plan by offering climate-based trainings on adaptation to coastal decision-makers. CTP is also aligned with the 2011-2016 NERRS Strategic Plan by offering trainings that "improve the capacity and skills of coastal decision makers to use and apply science-based information in decisions that affect estuaries and coastal watersheds."

Padilla Bay NERR Coastal Training Program Capacity

Staff

The CTP staff currently consists of a full-time CTP Coordinator (CTPC) with a master's degree in Adult and Higher Education and a full-time CTP Assistant. The CTPC is funded through the NOAA Operations Award and the CTP Assistant is funded through class registration fees. In order to expand CTP's capacity, additional funding is needed. This would allow us to offer more classes and broaden our reach.

Facilities

A large training room is located at the Reserve and has made it possible to offer several CTP classes each year on-site. The room includes a kitchen, space for 64 people sitting classroom style, sound system, and projection equipment. It also has easy access to the outdoors and nearby wetlands area for field observation.

Program Administration

Ongoing administrative functions include developing the class schedules, coordinating with instructors, publicizing and promoting classes to target audiences, conducting class evaluations, and distributing completion certificates to students. Comprehensive needs assessments are conducted every four years which informs future class development. The next needs assessment is scheduled for fall of 2018, with a new program

strategy developed in 2019. Other functions include coordinating three to four Advisory Group meetings per year to assess, plan, and develop classes and conducting "topic surveys" to dive deeper into the needs of our audience. Upcoming tasks include: creating a guidance document for instructors on "best practices for small group exercises" (2016); adding course objectives to all class agendas (2016); creating operational manuals for CTP staff positions (2016); choosing classes for a 6-month follow up to determine "on the ground" application (2017 and 2020). In compliance with the national CTP Performance Measure Standards, staff will help ensure that at least "90% of all attendees plan to apply what they learned in their work or decisions."

Padilla Bay NERR CTP Needs, Challenges and Opportunities

Potential training needs were identified by the 2014 CTP Needs Assessment survey. The following is a list of priority topics. An "x" has been placed by topics that CTP will offer as classes or incorporate into existing curriculum. The x's represent 72% of the topics for Western Washington and 60% of topics for Eastern Washington. The Office for Coastal Management (OCM) is identified beside topics for which they can provide training or assistance.

Western Washington

1. Restoration Monitoring ×
2. Wetland Ecology ×
3. Structure and Function of Freshwater Riparian Habitats ×
4. Bank Stabilization Strategies ×
5. Alternative Shoreline Stabilization Techniques and Incentives ×
6. Restoration Techniques: Marine ×
7. Structure and Function of Marine Riparian Habitats ×
8. Nearshore Geological Processes ×
9. Recognizing Wetlands: How to Visually Identify a Potential Wetland ×
10. In-water Structures and Activities (weirs, jetties, dredging, etc.) ×
11. Wetland Avoidance and Minimization Best Practices ×
12. Protecting Wetlands Using Non-regulatory Approaches
13. Over-water Structures (docks, piers, etc.)
14. In-lieu Fee Mitigation Basics ×
15. Environmental Negotiations ×
16. Wetland Regulation/Administration ×
17. Hydric Soils – Level 2 (wetland soil processes, identifying layer of interest)×
18. Aquatic Invasive Species (prevention, removal, management)
19. Climate Adaptation Strategies × (OCM)
20. Determining Clean Water Act jurisdictional ditches
21. Flood Hazard Management Strategies ×
22. Managing Conflict in Public Interactions × (OCM)
23. Non-point Source Pollution
24. Landslide Hazard Management Strategies
25. Enforcement/Compliance

Eastern Washington

1. Structure and Function of Freshwater Riparian Habitats ×
2. Bank Stabilization Strategies ×
3. Wetland Plant Identification in Eastern Washington ×
4. Wetland Ecology ×
5. Recognizing Wetlands: How to Visually Identify a Potential Wetland ×
6. Protecting Wetlands Using Non-regulatory Approaches
7. Environmental Negotiations ×
8. Alternative Shoreline Stabilization Techniques and Incentives ×
9. Restoration Monitoring ×
10. Wetland Avoidance and Minimization Best Practices ×
11. Managing Conflict in Public Interactions × (OCM)
12. Hydric Soils - Level 2 (wetland soil processes, identifying layer of interest)
13. Wetland Regulation/Administration ×
14. Determining Clean Water Act Jurisdictional Ditches
15. In-water Structures and Activities (weirs, jetties, dredging, etc.)
16. Flood Hazard Management Strategies ×
17. Channel Migration ×
18. Using Accessible Language with Non-technical Audiences
19. Facilitating Collaborative Meetings × (OCM)
20. Flood Plain Regulation/Administration ×
21. Over-water Structures (docks, piers, etc.)
22. Enforcement/Compliance
23. Aquatic Invasive Species (prevention, removal, management)
24. Determining Wetland Hydrogeomorphic (HGM) Classes
25. Nearshore Geological Processes

Although the list above is comprehensive, the CTP will maintain enough flexibility to prioritize training topics based on changing needs and/or to address the Reserve's focus areas (climate change impacts, water quality in estuaries and watersheds, invasive species impacts, loss of shoreline processes, and habitat loss). A critical component of future training will be to use relevant science to link local policy, planning, and resource management decisions to the viability of coastal resources.

Opportunities exist to develop new partnerships. CTP will explore partnerships with agencies and programs that hold expertise in areas that were identified in the above priority topics list. These potential partnerships include the Washington State Department of Fish and Wildlife, the Northwest Indian Fisheries Commission, the Federal Emergency Management Agency (FEMA), and the Washington State Department of Ecology's Floodplain Management Program. The specific classes associated with these agencies are listed below.

Important existing partnerships which are continuing to evolve include Washington Sea Grant, the Northwest Climate Impacts Group, Ecology's Shorelands and Technical

Assistance Program, and OCM's West Coast Office. Staff from these agencies are working with CTP to develop a Climate Training Series. The goal of the Series is to assist planners and coastal managers in addressing existing and future impacts of shoreline change in Washington by providing a locally relevant, in-depth, sequential curriculum on adaptation planning. The series will also provide participants with helpful resources to better address practitioners needs (i.e., visualization, modeling, and decision support).

Another emerging opportunity is the growing need for more effective communication and presentation skills by Washington's scientists and public officials. CTP staff have developed a two-day class called "How to Explain Science, Share Data, and Build Trust: Presentation Skills for Scientists and Public Officials." This class is co-taught with Washington Sea Grant staff and will likely be offered several times in the next five years. As a much shorter complement to the two-day class, a 40-minute presentation has been developed called "15 Strategies for Keeping Your Audience Awake, Alert, and Interactive". This presentation has also been made into a webinar (with technical support from OCM staff) and will likely continue to get many requests.

Challenges to our program include vulnerability that comes with having a small staff. If something unexpected happened to either staff member, there would be a disruption in services. One way to address this will be to create operations manuals for each position. Another program impact would occur if CTP instructors from State agencies were no longer able to offer their services due to retirement or work load. If we had to pay outside consultants for those services, the cost of the programs would increase and that might limit participation. Our program will continue to demonstrate the value of our partnership with agency staff by assisting them in delivering important guidance and encouraging managers to retain retired instructors for training classes while their successors are brought up to speed.

Coastal Training Program Objectives and Actions

The mission of the Reserve is to engage with stakeholders to identify coastal management issues of concern and, through education and research, to help find solutions to those issues. In keeping with the Reserve's mission, the CTP strives to provide science-based information for use by local decision-makers within local communities, which will increase the local understanding of coastal management issues. The CTP fosters informed decision-making and resource management across the coastal landscape by enhancing the decision-making abilities of professional audiences whose actions influence the management of natural resources along Washington's coasts and shorelines.

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members and volunteers.

Objective 1: The Coastal Training Program Coordinator (CTPC) will maintain strategic Coastal Training Program partnerships throughout 2016-2020.

Action: The CTPC will maintain strategic partnerships with the CTP Advisory Group and state agency instructors in this time period.

CORE GOAL 2: Informed citizens, students and decision-makers have the knowledge and understanding to make wise personal and professional choices that benefit the health of Puget Sound and the Salish Sea.

Objective 1: The CTP will offer 18-21 classes in Western Washington and 1-3 classes in Eastern Washington each year from 2016 – 2020.

Action: The CTPC will offer 18-21 classes each year for Western Washington audiences.
Action: The CTPC will offer 1-3 classes each year for Eastern Washington audiences.

Objective 2: The CTP Coordinator will explore partnerships in 2016 in order to create new classes in 2016 – 18.

Action: The CTPC, along with the Puget Sound Ambient Monitoring Program, will explore development of a "Restoration Monitoring" training;
Action: The CTPC, along with Washington State Department of Fish and Wildlife and the Northwest Indian Fisheries Commission, will explore development of a "Structure and Function of Riparian Habitats" training;
Action: The CTPC, along with Washington Department of Fish and Wildlife, will create a class on "New Washington State Shoreline Design Guidelines";
Action: The CTPC, along with FEMA and Ecology's Floodplain Management Staff, will create a class on "Flood Hazard Management Strategies and Flood Plain Regulation/Administration" for eastern Washington;
Action: The CTPC, along with FEMA and Ecology's Floodplain Management Staff, will create a class on "Flood Hazard Management Strategies and Flood Plain Regulation/Administration"; "Channel Migration" and "Flood Plain Regulation/Administration" for western Washington.

Objective 3: The CTP Coordinator will work with instructors to update three existing classes in 2016 and 2017.

Action: The CTPC will update "Designing Compensatory Mitigation and Restoration Projects" (2016)

Action: The CTPC will update "Shoreline Management and Stabilization using Vegetation" (2016)
Action: The CTPC will update "Managing Shoreline Drainage for Slope Stability, Habitat and Water Quality" (2017)

Objective 4: The CTP Coordinator will work with instructors to adapt and/or offer existing classes for Eastern Washington from 2016 -2019.

Action: The CTPC will offer "Environmental Negotiations" for eastern Washington (2016)
Action: The CTPC will offer "Bank Stabilization Strategies" (2016)
Action: The CTPC will adapt "Shoreline Management and Stabilization Using Vegetation" (2017)
Action: The CTPC will offer "Planning and Facilitating Collaborative Meetings" (2017)
Action: The CTPC will offer "How to Explain Science, Share Data, and Build Trust: Presentation Skills for Scientists and Public Officials" (2018)

Objective 5: The CTP Coordinator will work with instructors to develop new classes on priority issues from 2016-2020.

Action: The CTPC will develop a class on "Permitting In-Water Structures" (2016)
Action: The CTPC will develop a class on "Identifying Wetland Plants" for eastern Washington (2017)
Action: The CTPC will develop a class on "Restoration Monitoring" (2017)
Action: The CTPC will develop a class on "Wetland Avoidance and Minimization Best Practices" in both western and eastern Washington (2018)
Action: The CTPC will develop a class on "Using In-lieu Fee Mitigation Basics" (2018)
Action: The CTPC will offer "Structure and Function of Riparian Habitats" (2018)
Action: The CTPC will offer "Restoration Monitoring" adapted from western Washington curriculum (2019)
Action: The CTPC will develop a class on "Channel Migration" in eastern Washington (2020)

CORE GOAL 3: Citizens and decision-makers understand the impacts of climate change on human and natural resource communities and can make informed decisions.

Objective 1: The CTP Coordinator will work with instructors to offer a series of climate-related courses from 2016-2018.

Action: The CTPC will offer a class on “Climate Communication”(2016)
Action: The CTPC will offer a class on “Climate Adaptation Case Studies (2017)
Action: The CTPC will offer OCM’s class on “Climate Adaption for Coastal Communities” (2018)

Chapter 6 – Natural Resources Stewardship Plan

Introduction

Under the federal Coastal Zone Management Act (16 U.S.C. §§ 1451 *et seq*.), which created the NERRS, sites are to ensure "a stable environment for research" and to "provide information to state agencies and other entities involved in addressing coastal management issues." This includes protection, conservation, and restoration of Reserve properties when feasible.

Padilla Bay NERR Stewardship Program Context

The role of natural resources stewardship at Padilla Bay NERR is to identify and carry out the work that needs to be done to keep natural resources in the Reserve intact. This includes monitoring resources and identifying positive or negative trends. If negative trends are identified, then the causes for decline are sought and corrected, if possible. If research questions arise, then the Stewardship Coordinator notifies the Research Coordinator of the research need and there is an opportunity for discussion and/or collaboration.

The vision for natural resources stewardship at Padilla Bay NERR is that the Reserve will be a leader in encouraging and applying coastal watershed best management practices, protecting coastal water quality for people and marine wildlife through collaboration with other agencies, organizations and stakeholders, and helping local residents become more resilient to changes in climate.

The Reserve uses an ecosystem-based management approach that considers the whole ecosystem, rather than separate parts. The principles of ecosystem-based management are: 1) adopt an integrated approach to ecosystem management, 2) maintain healthy, productive, and resilient ecosystems, 3) maintain and restore connectivity between social and ecological systems, 4) incorporate economic, social, and cultural values, 5) involve stakeholders, 6) recognize uncertainty and plan for adaptive management, and 7) use all relevant forms of scientific, traditional and local knowledge (Clarke and Jupiter, 2010). Adaptive management is essentially planning, implementing the plan, reviewing the outcomes and adjusting the plan as necessary to incorporate what was learned in implementing the plan.

Ecosystem-Based Management

Integrated Approach to Ecosystem Management

The Reserve structure is based on sectors (Management, Education, Coastal Training Program, Research/Monitoring, Stewardship)(see Chapter 7 - Administrative Plan).

Projects can be integrated among sectors, whether in the development phase of proposals or in implementing smaller projects on-site or regionally. Issue-based projects lend themselves well to sector integration as issues often cross sector boundaries.

Natural resources in Padilla Bay are managed by various agencies (Tables 6.1 and 6.2) and local or regional groups may have an interest in how the resources are managed (Table 6.3). Achieving integration across agencies can happen naturally, but the Reserve's role can be to bring agencies to the table to discuss current and future practices, goals and objectives.

Maintain Healthy, Productive, and Resilient Ecosystems

The seven components for natural resources management are: 1) determine the scale at which you work, 2) collect and use knowledge, 3) manage information, 4) monitor resources and evaluate, 5) manage risk, 6) engage the community, and 7) look for opportunities to collaborate.

Scale. The scales at which work is accomplished are: 1) reserve, 2) watershed, 3) region, and 4) nation. For any activity the Reserve does it needs to define the scale first. Much of the natural resources work the Reserve implements is on a Reserve-based scale. We partner at a watershed or regional scale and may participate in national projects with other Reserve sites.

Collect and Use Knowledge. Data on natural resources is generated by various sources (Table 6.4) and not all the data is readily available to the Reserve. Data that is available can be compared annually to look for trends.

Manage Information. The Stewardship Coordinator manages data collected by the Reserve for noxious weeds, salt marsh vegetation and invasive species. The GIS Analyst manages the Reserve's mapping database and natural resources layers. The Monitoring Specialists manage the SWMP water quality, weather and biomonitoring data.

Monitor Resources and Evaluate. Resources in the Reserve are monitored by various entities (Tables 6.1 and 6.4). Some of the data is evaluated by Reserve staff (such as water quality, weather, and eelgrass) and other data is evaluated by entities that collect the data (such as WDFW waterfowl surveys).

Research and GIS staff monitor eelgrass transects (species counts, stem densities, percent cover, leaf length, above- and below-ground biomass) as part of the System-Wide Monitoring Program (SWMP)(see Chapter 3). In addition, areal coverage of seagrasses is monitored via a contact print archive of aerial photographs acquired on extreme low tide on an annual basis (funding dependent) and habitats have been mapped in multiple years by GIS staff. This provides the basis for GIS analysis with the objective to differentiate inter-annual variation from long-term change.

Table 6.1 Agencies managing natural resources in the Padilla Bay NERR	
Agency	**Resources Managed**
Northwest Clean Air Agency	Air quality
Skagit Co. Environmental Health	Marine biotoxins in shellfish
Skagit Co. Noxious Weeds	Noxious weed control enforcement
Skagit Co. Public Works	Surface water management; ambient water quality monitoring; implementing Pollution Identification Control protocols in the Padilla Bay watershed.
Wash. State Dept. of Agriculture	Coordination of *Spartina* control
Wash. State Dept. of Ecology	Air quality, climate change, rules and regulations, permits; water supply, pollution protection, monitoring, measuring, cleaning up contaminated water; cleaning up contaminated land; toxic chemicals in sediments; solid waste, hazardous waste.
Northwest Straits Commission	Work with seven coastal counties (Whatcom, Skagit, Snohomish, Island, San Juan, Jefferson, Clallam) to administer voluntary Marine Resources Committees (MRCs) that work to restore and protect the health of marine ecosystems. MRCs work at a local level.
Padilla Bay NERR	Maintain species list; monitor for non-native crabs; noxious weed control; monitor emergent salt marsh vegetation; SWMP (water quality and weather monitoring, eelgrass biomonitoring); Sentinel Site (water levels, SETs); land acquisition (tideland and upland); wetland delineation; habitat restoration.
Wash. State Dept. Fish and Wildlife	Aquatic habitat guidelines; management recommendations for amphibians, reptiles, birds; regulations for fishing, shellfishing, hunting, seaweed harvest; scientific collection permits; processes in watersheds.
Wash. State Dept. Health	Marine biotoxins in shellfish
Wash. State Dept. Natural Resources	Natural Area Preserves (Natural Resource Conservation Areas - Hat Island); manage state-owned aquatic lands; wildfire control (Hat Island); aquaculture; clean up and restore Puget Sound.
Wash. State Parks & Recreation Commission	Develop and manage state parks (Bay View State Park, Saddlebag Island Marine Park)
U.S. Dept. of Commerce, NOAA, NMFS	Permits for marine mammal specimens for education

Table 6.1 Agencies managing natural resources in the Padilla Bay NERR	
Agency	**Resources Managed**
U.S. Dept. of Commerce, NOAA, OCM	Administer operating, construction and acquisition grants for the National Estuarine Research Reserve System (NERRS)
U.S. Fish & Wildlife Service	Threatened and endangered species; permits (migratory bird, bald eagle, federal salvage); restore significant national fisheries; enforce federal wildlife laws; conserve and restore wetlands

Table 6.2 Tribal considerations in managing natural resources at Padilla Bay NERR	
Tribes	**Considerations**
Samish Indian Nation	Wholistic view of natural resources management; concerned with availability of traditional foods in the face of development and sea level rise; oil spill drill participants; partner with others in projects such as creosote log removal.
Skagit River Systems Cooperative	Provides natural resource management services for the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribal Community; works to improve fisheries management within Usual and Accustomed Fishing Areas (including the Skagit and Samish River basins).

Table 6.3 Non-governmental organizations that support natural resource management at Padilla Bay NERR.	
Organization	**Role**
Skagit Audubon Society	Bird appreciation, wildlife habitat protection, education
Skagit Conservation District	Protection and improvement of surface and groundwater quality; watershed planning; riparian restoration; forest stewardship; community wildfire prevention; wildlife habitat; conservation education (Stream Team, Storm Team, Watershed Masters)
Skagit Fisheries Enhancement Group	Habitat restoration for salmon
Skagit Land Trust	Protect natural lands, open space and wildlife habitat in Skagit County for the benefit of this and future generations

Table 6.3 Non-governmental organizations that support natural resource management at Padilla Bay NERR.	
Organization	**Role**
Washington Native Plant Society	Native plant appreciation, education
Skagit Marine Resources Committee (MRC)	Work to restore and protect the health of marine ecosystems of the Northwest Straits region.
Skagit Watershed Council	Voluntary salmon habitat restoration and protection; community engagement on the broader salmon recovery topic.

Table 6.4 Natural resources monitored in the Padilla Bay NERR	
Resource	**Sector or Entity**
Birds	Skagit Audubon Society (annual Padilla Bay Christmas bird counts); Falcon Research Group raptor census.
Eelgrass characteristics (species, leaf length, stem densities, percent cover, above- and below-ground biomass)	Research & Monitoring Sector (SWMP)
Eelgrass habitat change (areal extent, species composition)	Stewardship Sector/GIS
Estuarine noxious weeds (e.g. *Spartina*)	Stewardship Sector
Intertidal crabs (looking for invasive crab)	Stewardship Sector
Plankton	Research & Monitoring Sector
Rocky intertidal habitat (species, percent cover)	MARINe*, Research & Monitoring Sector
Salt marsh habitat change (in acres)	Stewardship Sector/GIS
Salt marsh vegetation (species, percent cover of live vs. dead)	Stewardship Sector
Sediment (Surface Elevation Tables)	Dr. John Rybczyk, WWU
Shellfish (for biotoxins)	Skagit County Environmental Health
Spartina locations and acreage over time	Stewardship Sector/GIS
Upland noxious weeds (e.g. thistle)	Stewardship Sector
Water quality in bay and Joe Leary Slough (dissolved oxygen, salinity, temperature, turbidity, conductivity, pH, chloropyll *a*, nutrients)	Research & Monitoring Sector (SWMP)
Weather (air temperature, relative humidity, barometric pressure, wind speed, wind direction, total PAR, cumulative precipitation)	Research & Monitoring Sector (SWMP)
* Multi-Agency Rocky Intertidal Network (MARINe, www.marine.gov)	

Manage Risk. Risk to natural resources in the Reserve comes from threats such as oil or chemical spill, invasive species, poor watershed management practices, etc. The Reserve has a Disaster Response Plan in place to help mitigate and manage threats. It can be viewed at: www.padillabay.gov (Publications).

Engage the Community. The Stewardship Coordinator meets regularly with stakeholders, engages volunteers and interns, participates in local meetings and workshops, and hosts meetings and workshops of interest to stakeholders.

Look for Opportunities to Collaborate. Natural resources partners include the Skagit Conservation District (with conservation education for Skagit County residents and Citizen Science opportunities), tribes, Washington State Department of Agriculture (*Spartina*), Washington Department of Natural Resources (Hat Island), and WDFW (farmland north and south of the Padilla Demonstration Farm and the Wells Unit at the western 90-degree bend in Samish Island Road).

Maintain and Restore Connectivity between Social and Ecological Systems

Systems thinking is used in ecological and social systems. It is a way to understand how systems respond to external perturbations and what fundamental structures and functions are critical for resilience and sustainability (McPhearson 2013). Systems thinking focuses on connections and relationships. Connectivity and feedback occurs within and between components. Systems thinking can be illustrated using ocean acidification as an example. As the ocean becomes more acidic, chemical processes are disrupted and shell-forming in clams and oysters is affected. Systems thinking looks at the problem scientifically: Why is ocean acidification happening? What it is impacting? Can it be slowed or halted? What are viable solutions to the problem? Ocean acidification directly impacts shellfish growers in this area who are trying to keep their businesses intact and who also provide jobs for people in this area. Systems thinking looks at who ocean acidification impacts, whether or not there are actions they can take to ameliorate or modify the impacts and whether society as a whole can take actions to help lessen the impacts.

Resilience is the capacity of the system (social or ecological) to continually change and adapt and yet remain within critical thresholds. Regarding the ocean acidification example, we can ask about how much buffering capacity the ocean has and which factors affect that buffering capacity. We can ask whether shellfish farms can adapt or not and how much impact ocean acidification may have on those businesses. There are principles of complexity in systems such as feedbacks, nonlinearity, unpredictability, and scale (McPhearson 2013). Because ecological and social systems are complex, understanding the connections between them and the potential impacts of change, the Reserve is better able to adapt.

Incorporate Economic, Social, and Cultural Values

The Reserve draws on economic, social and cultural values when faced with natural resources issues. One example is the discussion in Washington state over whether Japanese eelgrass (*Zostera japonica*) is a beneficial non-native species or a harmful one is a good example of how these concepts come into play.

The oyster/shellfish industry in this state is a thriving business, which brings over $100 million to the state each year. It is thought that the initial introduction of *Z. japonica* to Washington was by the oyster industry in the 1930s. It invades tidelands that were previously without vegetation and, in some areas, grows intermixed with the native species *Zostera marina.* Shellfish growers feel it interferes with their ability to raise shellfish and have asked that it be added to the Washington State noxious weed list so they can control it. Some research has been done on the ecological effects of *Z. japonica*, mostly about its effects on *Z. marina*, but natural resources agencies generally view it as habitat for estuarine animals such as salmon.

At this point in time, resource agencies may be less inclined to control it due to the fact it is intermixed with *Z. marina* and the concept that it provides habitat or food for species such as endangered Chinook salmon. Also, any disturbance, such as using herbicides to kill or suppress a plant may encourage other invasive species to gain a foothold. Herbicides can also impact other native plants or animals.

In this example, the economic impact of a non-native species on shellfish growers may lead to pressure on natural resources managers to remove a non-native species that may have some benefits, but may also be expensive to control or remove. More research needs to be done to sufficiently address these conflicts.

The stewardship program at the Reserve uses the following concepts when making decisions about natural resources:

Economic values are useful when making economic choices or tradeoffs in allocating resources. Economic valuation of natural resources can be estimated by the price individuals will pay in order to obtain the benefit of those resources. Economic valuation is used in the cost-benefit analysis of environmental issues as well as others.

Ecosystem services are "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life." They are the "actual life support functions such as cleansing, recycling, and renewal." Ecosystem goods are tangible, material products such as seafood, timber, and natural fiber that result from ecosystem processes. Ecosystem processes (or functions) are the complex physical and biological cycles and interactions that underlie the natural world (Brown et al. 2007).

Social values are values held by a larger group (e.g., human survival, human well-being, fairness and justice, compassion and charity) and can change over time. Environmental ethics stems from how we view nature and the environment. There are at least two views of nature: moralistic (humans have dominion over nature), and humanistic (humans are part of nature) (Carnegie Mellon University 2003).

Cultural values (e.g., tribal, religious, Hispanic, Asian, African American, etc.) are passed down through various generations via the family unit. Cultural values toward the environment can vary widely among cultural groups so it is good to understand the cultural groups that might be involved in natural resource use, management, and issues in our Reserve and region.

Involve Stakeholders

The more we know about the Reserve's stakeholders, the better we can meet their needs within the context of natural resource management at the Reserve. Natural resources stakeholders for the Reserve are represented in Tables 6.1-6.3, but this is not an all-inclusive list. The Stewardship Coordinator meets one-on-one with natural resources managers or technicians on a regular basis and adds to the list of stakeholders through those discussions. Other tools for communication with stakeholders are surveys (using on-line tools such as Survey Monkey), focus groups, workshops, symposiums, and meetings on coastal issues and/or management topics of interest to stakeholders.

Cooperation with natural resources stakeholders includes: collecting shellfish for marine biotoxin analysis (Skagit County Department of Public Health), monitoring for non-native crabs (Washington Department of Fish and Wildlife), controlling *Spartina* (Washington Department of Agriculture) and thistle control on Hat Island (Washington Department of Natural Resources). The Reserve co-manages Hat Island (a Natural Resources Conservation Area) with Washington State Department of Natural Resources who owns the island.

The GIS Analyst also develops partnerships with stakeholders that can aid the Reserve in understanding natural resources better. This includes the potential for partnering with local colleges and universities (Skagit Valley College, Western Washington University, University of Washington) and organizations such as the Northwest Straits Commission (and Marine Resource Committees) or the Skagit River Systems Cooperative (a tribal entity that works to improve fisheries management for the Sauk-Suiattle and Swinomish tribes). The analyst also works with NOAA and other federal offices such as USGS to further our ability to detect climate change.

Recognize Uncertainty and Plan for Adaptive Management

Whenever managers rely on data, there is uncertainty. Uncertainty in the way the data was collected, in how it was analyzed, and in assumptions used to collect and analyze

the data. This means when managers use data to make management decisions, they should be cautious in the conclusions they draw from data. Uncertainty can be reduced by recognizing potential sources of error and in making adjustments in management planning when the outcomes are not what we expect.

Use All Relevant Forms of Scientific, Traditional and Local Knowledge

Communicating with a wide range of stakeholders, from scientists to tribal members to older residents, can broaden our base of knowledge. We can use scientific data (from studies or journals), gain a better understanding of tribal cultures and their relationships to natural resources, and draw on local anecdotal information contained in oral histories. The more inclusive the knowledge base, the better the Reserve's grasp of what is important and why.

Priority Coastal Management Issues

An on-line survey was developed in 2014 around coastal management issues for estuaries and watersheds using relevant agency documents to develop a list of current issues. The survey was used to poll Padilla Bay NERR staff and natural resources stakeholders. The coastal management issues of concern for stakeholders and the Padilla Bay NERR in 2014 are shown in Table 6.5. The largest difference between stakeholders and the Reserve was the ranking of threatened and endangered species and disease-causing organisms. Threatened and endangered ranked at the top for stakeholders and at the bottom for Padilla Bay NERR. The Reserve ranked it low because other agencies manage threatened and endangered species (USFWS, WDFW, and WDNR) not because it is not important ecologically. Threatened or endangered Chinook salmon (*Onchorhynchus tshawytscha*) and the occasional American white pelican (*Pelecanus erythrorhychos*), marbled murrelet (*Brachyramphus marmoratus*), or Steller Sea Lion (*Eumetopias jubatus*) use Padilla Bay habitats as do bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus*) which are both common in winter. The Reserve's job is to keep the habitat intact for all native species. Habitat loss in estuaries ranked higher for stakeholders than Reserve staff. Habitat loss in watersheds is ranked slightly higher by the Reserve than it is by stakeholders. Otherwise, the top nine are similar in topic while ranking differently. Three subjects fell out lower on the ranking for both: toxins in estuaries, toxins in watersheds and sediment dynamics in estuaries.

Threats to Natural Resources

Threats to natural resources include impacts to water quality in estuaries and watershed, invasive species in estuaries and watersheds, climate change, and habitat loss in estuaries.

Water Quality in Estuaries

Water quality is the Reserve's most pressing issue. It affects human health and the

Table 6.5 Coastal management issues of concern to Padilla Bay NERR and stakeholders in late 2014 and rankings by each.			
PBNERR	**Rank**	**Stakeholders**	**Rank**
Water quality in estuaries	1		
Water quality in watersheds	1		
Invasive species in estuaries	1	Threatened and endangered species	1
Global climate change	2	Habitat loss in estuaries	2
Habitat loss in estuaries	3	Water quality in estuaries	3
Water quantity in estuaries	4	Invasive species in estuaries	4
Disease-causing organisms in estuaries	5	Loss of shoreline processes in estuaries	5
Habitat loss in watersheds	6		
Loss of shoreline processes in estuaries	6		
Toxins in estuaries	6	Global climate change	6
Toxins in watersheds	7	Habitat loss in watersheds	7
Sediment dynamics in estuaries	8	Water quality in watersheds	7
Threatened and endangered species	9	Water quality in estuaries	8
		Sediment dynamics in estuaries	9
		Toxins in estuaries	10
		Toxins in watersheds	11

health of estuarine animals and the larger ecosystem. Marine water quality in the community of Bay View has declined in the past few years. Skagit County will soon be implementing a Pollution Identification and Correction (PIC) program in Bay View (just south of the Reserve's facilities) to identify where the pollution is coming from and to try to correct the problems.

Currently, the main indicator of bacterial contamination in Padilla Bay is fecal coliform counts that exceed acceptable levels. Fecal coliform is an indicator that the contamination is coming from humans and other warm-blooded animals.

In rural areas in Skagit County, some septic systems are leaking. Skagit County has implemented septic education classes to encourage property owners to maintain and care for septic systems and to have regular inspections. Leaking septic systems mean that bacteria and pathogens find their way into stormwater runoff, then into the bay where they may contaminate shellfish or make swimmers sick.

Recreational harvest of shellfish has been closed at Bay View State Park on the eastern shoreline of Padilla Bay and the public beach at Bay View State Park has been closed periodically to swimming and wading. As Bay View State Park is where most of our education field trips take place, this directly impacts the Reserve's ability to carry out those programs.

The Reserve will cooperate with Skagit County Public Works Clean Water Program and the Skagit Conservation District to identify and mitigate water pollution in the Bay View watershed. The Reserve will continue to work with the Skagit Conservation District to implement the Citizen Science programs "Stream Team" and "Storm Team". The Education Specialist will continue to train and supervise these volunteers over the next five years.

Potential for Oil Spill

Recently, there has been an increase in crude oils being shipped to this area via unit trains (100-cars/train) (see Appendix G, BNSF comment). Crude oil/pertroleum products also contiue to be transported in this region via marine vessels. Both modes of shipping have the potential for accidents and oil spill into the bay or nearby bodies of water.

Natural resources staff members monitor emergent salt marsh vegetation at one location on the shoreline of Padilla Bay. Staff used random placement of plots from 2006-2011 and switched to permanent plots in 2013 to collect percent cover data once a year in late July for species and live and dead vegetation. This project provides baseline data on salt marshes because of our close proximity to oil refineries and the potential for oil spill.

The Stewardship Coordinator attends quarterly Local Emergency Planning Committee (LEPC) meetings and drills (which include oil spill, unit trains, hazardous spill incidents, etc.) to become familiarized with local emergency responders, procedures, and concerns. The Stewardship Coordinator also attends oil spill drills that involve Padilla Bay, as requested by the Washington State Department of Ecology or oil/pipeline industries.

The Stewardship Coordinator will work through the LEPC to host an emergency drill in the next five years that will exercise some aspect of the Padilla Bay NERR Disaster Response Plan.

Water Quality in the Watershed

Water quality in the watershed is as important as water quality in the estuary. All activities in the Padilla Bay watershed that involve impacts to water can affect Padilla Bay if the contamination flows downstream through creeks and sloughs. Skagit County Household Hazardous Waste Collection accepts chemicals used by homeowners such as pesticides, insecticides, brake and transmission fluid, oil and gasoline, batteries and

fluorescent light bulbs to try to keep these things from polluting the environment. The County also hosts a "small quantity generator" program for businesses generating less than 200 pounds of most types of chemical wastes per month.

Based on past growth figures, population in Skagit County will likely increase in the next five years (around 3%). Increasing population means more demand for jobs and homes. The Skagit County housing market has picked up after a 15-year low in housing inventory.

New business or industrial development may attract more people to the area. Skagit County's economy is "booming", according to the Skagit County website (www.skagitcounty.net). The major industries are: agriculture, fishing, wood products, tourism, international trade, specialized manufacturing, oil, and retail.

Impervious surfaces increase with development. In rural areas, impervious surfaces are around 1-2%, in residential areas 10-50%, and in industrial or commercial areas >70%. Stormwater runoff increases with increasing development and groundwater recharge and flood storage declines. Impervious surfaces also indicate that wildlife habitat is lost as ecosystems are disrupted or destroyed. Trees, shrubs, groundcover and the host of animals and insects that used that area are displaced or die. The ecosystem services they provide are lost (e.g., production of oxygen, groundwater recharge, and flood storage).

With increased development, the potential for impacts to water quality increases. Farmers and hobby farmers may use chemicals for crops or tend farm animals that produce manure. Following best management practices can reduce impacts to water. Homeowners in residential areas may use chemicals such as herbicides, pesticides and fertilizers or have cars that leak small amounts of oil. Applying chemicals at label rates and keeping cars tuned up or in good repair can reduce impacts to water quality. Business and industry can pay close attention to the activities in their companies that produce chemicals or hazardous waste and dispose of those things properly to reduce impacts to water.

As with estuary water quality above, the Reserve's Education Specialist will continue to administer the Stream Team and Storm Team Citizen Science efforts for the Skagit Conservation District over the next five years.

The Reserve will continue to support the Skagit Conservation District's stewardship and conservation classes in the county, such as providing meeting space for trainings such as Watershed Masters and Monitoring for Marine Biotoxins and lab space for Stream Team and Storm Team volunteers. The Conservation District also provides best management practice workshops such as "Winter Horse Pasture Management", small farm programs, manure management tools, and more. These help people in the watershed reduce impact to water quality by implementing best management practices.

Invasive Species in the Estuary and Watershed

The Reserve's natural resources focus has largely been on invasive species the past 20 years. The Reserve started *Spartina* survey in 1987 and annual survey and control commenced in 1996. Natural resources staff members have been successful in reducing the infestation from 17 acres in 1998 to a few square meters in 2014 with the help of partners such as Washington Department of Fish and Wildlife and Washington Department of Agriculture and Skagit County Noxious Weeds.

Natural resources staff members have monitored for non-native crab annually since 2001 because of the close proximity of European green crab (*Carcinus maenas*) on the west coast of Vancouver Island. The Reserve has not found any non-native crabs to date in our trapping effort that runs April-September with one sampling a month. The information is shared with Washington Department of Fish and Wildlife.

The Reserve has control programs in place for upland noxious weeds including: Shiny geranium (*Geranium lucidum*), Reed canarygrass (*Phalaris arundinaceae*), Canada thistle (*Cirsium arvense*), Bull thistle (*Cirsium vulgare*) and Himalayan and Evergreen blackberry (*Rubus armeniacus* and *Rubus laciniatus*). Most of this control is ongoing.

The Stewardship Coordinator will develop an Integrated Weed Management Plan for the Reserve's uplands (meadow, forest, hedgerow and freshwater wetlands), identify potential contractors to implement the plan. The outcome will be a significant reduction in noxious weeds on the 64-acre upland site.

Natural resources staff will continue, over the next five years, to monitor for *Spartina*, non-native crabs, and upland noxious weeds while remaining vigilant for new invasive species arrivals.

Climate Change

Climate change is affecting the Pacific Northwest. The Climate Impacts Group (2015, College of the Environment, University of Washington) has identified the following potential impacts from "global warming" or human-caused climate change in this region:

Changes in water resources:

- Decreased mountain snowpack
- Earlier snowmelt
- Higher winter streamflow in rivers that depend on snowmelt
- Higher winter streamflow in rain-fed river basins if winter precipitation increases in the future as projected
- Lower summer streamflow in rivers that depend on snowmelt (most rivers in the Pacific Northwest)
- Earlier peak (spring) streamflow in rivers that depend on snowmelt (most

rivers in the Pacific Northwest)
- Decreased water for irrigation, fish, and summertime hydropower production
- Increased conflict over water
- Increased urban demand for water

Changes in salmon:
- Increased difficulties due to increased winter floods, decreased summer streamflow, and increased water temperature

Changes in forests:
- Seedling regeneration:
  - Increased in high snow forests
  - Decreased in dry forests
- Tree growth:
  - Increased in high snow forests
  - Decreased in dry (east-side) forests
  - Potential increases in forest fires
  - Overall, the Pacific Northwest is likely to see increased forest growth region-wide over the next few decades followed by decreased forest growth as temperature increases overwhelm the ability of trees to make use of higher winter precipitation and higher carbon dioxide.
  - Potential for extinction of local populations and loss of biological diversity if environmental shifts outpace species migration rates and interact negatively with population dynamics.

Changes along the coasts:
- Permanent inundation, especially in south Puget Sound around Olympia
- Increased coastal flooding due to sea level rise and increased winter streamflow from interior and coastal watersheds
- Increased coastal erosion and beach loss due to rising sea levels
- Increased landslides due to increased winter rainfall

Actions the Stewardship sector will take to address climate change in the next five years include:

- Monitor saltmarsh distribution in Padilla Bay through aerial photograph analysis (GIS Analyst).

- Document erosion along the seaward edge of Sullivan Minor salt marsh using GPS (Natural Resources staff, GIS Analyst).

- Plant at least fifty trees in the upland to sequester carbon and moderate water flow (Natural Resources staff, volunteers, interns).

Habitat Loss in Estuaries

Habitat loss has impacted estuaries in the Pacific Northwest, mainly through conversion of salt marsh to agriculture and commercial development prior to the Coastal Zone Management Act of 1970 and the state Shoreline Management Act (Appendix C). The greatest habitat loss in the future may be due to the effects of climate change and/or restoration that improves one kind of habitat, but impacts another.

The greatest threat to salt marshes in Padilla Bay is probably sea level rise due to climate change. As most of the salt marshes in Padilla Bay are trapped by dikes and or coastal bluffs, there is no where for them to "migrate" as the sea rises. They will be inundated. We do not yet know the rate of sea level rise in Padilla Bay, but we have estimates for greater Puget Sound and the Sentinel Site infrastructure will help us better understand this in the next 5-10 years.

Eelgrass is another habitat that could be negatively impacted by the effects of climate change (rising sea level, reduced light), wasting disease (*Labyrinthula zosterae*), spill event (oil or other toxin) or efforts to control the non-native eelgrass (*Z. japonica*). At this time, the Reserve chooses not to control *Z. japonica*, but could be forced to if the state noxious weed law changes in the future. The Reserve's SWMP effort currently monitors eelgrass through measurements along designated transects and the GIS Analyst tracks extent through aerial photography (see Chapter 3).

Habitat Restoration

A crude oil by rail project is proposed by the Shell Oil Company on March's Point. The project will impact freshwater wetlands on March's Point on the west side of Padilla Bay. It is outside the boundary of the Reserve. They are proposing an out-of-kind mitigation project west of Telegraph Slough in the buffer area at the south end of Padilla Bay (estuarine). The land where the mitigation project is located is privately owned, within a dike, and currently planted in hybrid poplar. The project is designed to restore tidal processes to over 50 acres of diked agricultural land and to minimize impact on existing salt marsh habitat. The project proposes to do a dike setback, with addition of material to raise the elevation of the mudflat (as it has subsided due to agriculture and diking/drainage over the years) in order to create better hydrology and to restore habitat function. The draft Environmental Impact Statement will be released in fall 2016, with a final in the spring of 2017, if their project goes according to plan. The Manager, Research Coordinator, and Stewardship Coordinator are tracking this project.

In the next five years, the Reserve will:

- Track proposed restoration and mitigation projects within proximity to the Reserve's boundary and buffer areas and take measures, when possible, to stop

or lessen habitat impacts from these projects (Stewardship Coordinator, Manager).

- Monitor eelgrass extent in the bay through SWMP biomonitoring transects and aerial photography analysis to better understand if it is changing and how *Z. marina* and *Z. japonica* interact (GIS Analyst, Monitoring staff).

- Monitor percent cover of salt marsh vegetation at the Sullivan Minor marsh to better understand if it is changing and how (Natural Resources Staff).

- Control noxious weeds within the Reserve's boundary to improve habitat function (Stewardship Coordinator).

Padilla Bay NERR Stewardship Program Alignment and Delivery

The natural resources stewardship program is aligned with the System-Wide Monitoring Program, 2012-2017 NERRS Research and Monitoring Plan, Sentinel Site Program and Climate Change Implementation Plan. The stewardship program can use data from SWMP (such as water quality and eelgrass biomonitoring) to identify trends over time to help us identify whether resources are stable, in decline or improving. The 2012-2017 NERRS Research and Monitoring Plan and NERRS 2011-2016 Strategic Plan priorities are climate change, water quality and habitat protection. Data collected at the Reserve around these priorities benefits stewardship of natural resources by providing data for trend analysis through SWMP water quality, weather and biomonitoring. The Sentinel Site effort, although housed in the Research sector, tracks changes over time and can benefit stewardship planning efforts through establishing water levels and the ability to better measure sea level rise.

Stewardship of natural resources begins with human attitudes so education is a vital element of managing resources better. The Padilla Bay NERR K-12 Estuary Education Program (KEEP) focuses on instilling environmental values in youth, while the Skagit Conservation District has programs that engage adult audiences in topics such as the "Watershed Masters Volunteer Training", "Stream Team", "Storm Team" and "Shellfish Monitoring for Biotoxins." The purpose of these trainings is to increase public awareness of water quality problems and solutions and to inspire community stewardship of water resources.

Program Delivery

Planning for natural resources management at Padilla Bay NERR is usually accomplished in the winter. Supplies for the next field season are ordered and stocked, a draft schedule is completed based on tides and the work is implemented from April through September.

Data is collected throughout the field season and entered onto field sheets, then checked for accuracy and entered into spreadsheets. The findings are summarized in reports. If GPS has been used to collect data points, those points are mapped by the GIS Analyst and stored in the database as well as reflected in summary reports. The reports are posted on our website (www.padillabay.gov) and sent to the agencies interested in the data.

Our efforts are shared at the NERRS Annual Meetings where core staff (Managers, Research Coordinators, Education Coordinators, Coastal Training Program Coordinators and Stewardship Coordinators) meet as a group to receive training, share information, network and plan for the future of the NERRS.

Our efforts are shared locally through speaker's bureau or other events, through articles published in our newsletter, and through presentations or posters at events such as the Pacific Estuarine Research Society (PERS) annual meetings that cater to other estuarine scientists and students.

Program Impacts and Outcomes

Program impacts to date include: improved shoreline and salt marsh function by removal of non-native *Spartina*, improved freshwater and upland habitat function through control of noxious weeds, increase in forested habitat through re-forestation efforts, tracking land use change (through C-CAP data), mapping and change detection in the extent of eelgrass habitat, and planning for natural and human-caused disasters.

Program outcomes are products or results the Reserve would like to see happen and that would improve management of natural resources at the Reserve. Outcomes in the next five years include:

- Develop an Integrated Weed Management Plan.
- Improve understanding of the Reserve's natural resources stakeholder needs through regular communication with stakeholders.
- Update the Disaster Response Plan.
- Host an emergency drill with Local Emergency Planning Committee and/or NOAA (e.g., chemical or oil spill, earthquake, etc.).

Program Monitoring and Evaluation

The Natural Resources Stewardship work program is established in fall/winter for the next year. It is based on staff availability, funding and partnership opportunities. Interns are often identified in that time frame for work the following summer.

Tasks and outcomes are developed for the annual NOAA Operations Award based on the Reserve's work program. Performance is reported to NOAA Program Officers in biannual progress reports to NOAA (Office for Coastal Management). Performance measures (such as stewardship volunteer hours) are reported in the NERRS performance database.

Performance for the Stewardship Coordinator and GIS Analyst is tracked through state employee performance plans. The Reserve Manager annually evaluates performance to the tasks established in those plans.

Padilla Bay Stewardship Program Capacity

Staff

Currently, the natural resources program is staffed with one Stewardship Coordinator (0.5 FTE), a seasonal Natural Resources Assistant (0.25 FTE), and Geographic Information Systems support through the GIS Analyst (0.20 FTE). The funding comes from an annual NOAA Operations Award (70%) and state general fund (30%).

The Stewardship Coordinator has master's level education in marine and estuarine science and certifications for: hazardous waste operator (Hazwoper), boat operator, diving (PADI), first aid/CPR/AED, and public operator pesticide license.

The Natural Resources Assistant is often from the Environmental Conservation program at Skagit Valley College (or equivalent) with a technical degree or has a bachelor's degree in biological science or natural resources management from a college or university. The Reserve has been able to hire Washington Conservation Corps/AmeriCorps (Individual Placement or IP) when the budget and allocation of positions allows for this.

The GIS Analyst has a master's in Environmental Science with emphasis on remote sensing and extensive experience with ESRI's ArcGIS software and maintains GPS equipment, a map database for the Reserve, GIS data layers on research sample sites and pertinent outside data such as parcels and property ownership, as well as historical ecological maps and data. The Analyst earned GIS Professional (GISP) certification in 2008 and recertified for 2013-2018. GISP certification is awarded for contributions through: presentations at conferences, publications, training, and for contributions to the professional community through service as board member on the local chapter of the National GIS association (WAURISA).

The GIS Analyst serves on the NERRS Habitat Mapping and Change Committee to develop protocols and assist with ongoing refinements to the NERRS habitat classification scheme, mapping protocols, Coastal Services Center (CSC) automated segmentation application, and metadata requirements. The GIS Analyst continues to provide peer review on papers for NOAA, EPA, Northwest Straits and Battelle Pacific Northwest Na-

tional Laboratory (PNNL) Marine Sciences Laboratory among others. The Analyst also collaborates with other sectors and partners to apply for grant opportunities.

The stewardship program's capacity is extended through mentoring environmental conservation and natural resources management students and volunteer opportunities. Skagit Valley College has a "Cooperative Education" program where students gain job experience while earning college credit and donate up to 180 hours of their time while gaining skills in natural resources management and outdoor fieldwork. In the past, the Reserve also hosted an international environmental intern and is open to those kinds of opportunities as well.

The Reserve has provided volunteer opportunities for people interested in outdoor work and has had the greatest success with promoting volunteer events such as blackberry removal work parties or planting parties to restore areas where blackberry has been removed.

To expand the stewardship and GIS capacity beyond what is currently supported in our work program, the stewardship program needs more funding and staff support, including additional permanent funding for the GIS Analyst position.

We are encouraged by management to seek outside funding and cooperate in developing cross-sector proposals. As a non-profit organization, the Padilla Bay Foundation broadens our ability to seek and manage funds.

Facilities

Facilities that support stewardship at the Reserve include staff offices in the Breazeale House and Breazeale Interpretive Center, storage and access to lab equipment in the research laboratory, reports in the reference library, pesticide storage cabinet in the boat garage, and access to tools in the tool shop and tool shed. The Stewardship sector also uses conference and meeting spaces for staff, planning and stakeholder activities.

Padilla Bay NERR Stewardship Program Needs and Gaps

As natural resource management is largely based on monitoring resources and understanding the status of that resource through monitoring, the first challenge in the stewardship program is that we do not manage most of the natural resources in Padilla Bay. We own most of the tideflat in Padilla Bay and thereby offer some protection to eelgrass (*Zostera marina*) and some upland habitats (64 acres). Washington Department of Fish and Wildlife manages fish, birds and invertebrates in the bay and Washington Department of Natural Resources manages tidal bedlands and leases, priority species and habitats (see Table 6.1). Also, the stewardship program does not engage on a meaningful level with other agencies or tribes that manage other estuaries in Washington State (such as EPA's National Estuary Program or the Nisqually National Wildlife Refuge).

This underscores the need to establish working relationships with targeted individuals in those agencies and a better understanding of the data they manage that could help us. This could be accomplished through improved, regular communication with technical staff at state agencies managing natural resources and with federal agencies managing estuarine habitat and species. There might be opportunities here for information sharing, lessons learned, or partnerships.

The next gap is better communication with natural resources stakeholders. This communication is not just with agency and tribal managers and technicians, but with any group interested in natural resources in the Reserve (such as the Audubon Society). This takes time, but will result in better management of resources over time through a better understanding of what our stakeholders want and need and through potential partnerships.

Needs of the Natural Resources Stewardship Program

There is a large dataset associated with SWMP water quality and weather, but little useful analysis of the data for management purposes. Annual analysis of the data would allow for trend analysis over time and better enable us to recognize when a resource is improving or declining (see Chapter 3).

GIS helps us visualize existing natural resources data in context to the landscape and our greatest needs relate to GIS. The Stewardship Program needs:

- High quality/high resolution LiDAR of upland and intertidal areas. With this data we can document hydro-geomorphic conditions, do 3-D visualizations with natural resources overlays, do predictive species distribution modeling such as for *Spartina* and *Z. japonica,* identify areas for priority protection in case of an oil spill, develop visual aids for accessing areas in case of a spill, evaluate potential dike setback for restoration projects, identify areas with potential for salt marsh migration in the face of climate change, and monitor changes in channel morphology.
- Continuous bathymetry data from sub-tidal to MHHW (current data is 50+ years old).
- Elevations from MHHW into the uplands.
- Assistance accessing the ACOE/USGS-acquired bathymetry LiDAR data from 2014.
- To establish a two-year water level at the historic Tidal Bench Mark at the north end of the Swinomish Slough in order to update the tidal datum at Padilla Bay to a modern epoch. This would also allow us to correlate water level to the SWMP dataloggers.

In addition to GIS needs, there is a limit to what we can accomplish with current funding and staff levels so there continues to be a need to seek outside funds. We can collaborate among sectors and/or identify partners to help us meet our goals.

Stewardship Program Objectives and Actions

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members and volunteers.

Objective 1: The Stewardship Coordinator will maintain strategic stewardship partnerships throughout 2016-2020.

Action: The Stewardship Coordinator will maintain strategic partnerships with natural resources stakeholders (e.g., WDNR and WDFW) in this time period by meeting with one or two stakeholders a month to better understand their goals and any opportunities for partnerships.

Objective 2: County or state-owned public access areas adjacent to the Reserve are maintained by those respective agencies from 2016-2020.

Action: The Stewardship Coordinator will monitor public access areas and notify respective agencies if there are actions that need to be taken.

CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.

Objective 1: The Stewardship Coordinator will lead the effort to survey, map, and control noxious weeds on Reserve properties from 2016-2020.

Action: Stewardship staff will survey for and control *Spartina* in Padilla Bay every summer from 2016-2020.

Action: Stewardship staff will survey the 64-acre upland site in 2016 to gain a better understanding of noxious weed presence and locations.

Action: In 2016, the Stewardship Coordinator will research which methods are best to control which weeds and when to apply the methods for best result. If using herbicides, the SC or contractor will use the least toxic herbicide possible.

Action: The Stewardship Coordinator will write an Integrated Weed Management Plan in 2017 for noxious weeds on the 64-acre upland site.

Action: The Stewardship Coordinator will hire a contractor to control thistle on the 64-acre upland site and on Hat Island every 2-3 years (2017, 2019)

Objective 2: The Stewardship Coordinator will monitor selected natural resources in Padilla Bay from 2016-2020.

Action: Stewardship staff will set folding fish traps at one of three locations once a month for a 24-hour cycle April – September. Locations: Indian Slough - 2016, Sullivan Minor -2017, Bay View State Park - 2018, Indian Slough - 2019, Sullivan Minor - 2020.

Action: Stewardship staff will collect shellfish at one location in Padilla Bay every two weeks from April – September from 2016-2020 and transport to the Skagit County Department of Health. The samples are sent to Washington Department of Health for analysis for Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Amnesic Shellfish Poisoning (ASP) and shellfish harvesting at beaches is closed accordingly.

Action: Stewardship staff will annually at one location (Sullivan Minor salt marsh) collect percent cover data of emergent vegetation from 20 permanent plots (50 points/plot) over a 2-3 day period in late July, enter into database, and compare results year-to-year.

Objective 3: The Stewardship Coordinator will attend meetings of local groups from 2016-2020 such as the Skagit Watershed Council and the Skagit Marine Resources Committee to better understand their projects and to keep those groups updated on natural resources activities and projects at the Reserve.

Action: The SC will attend the quarterly Skagit Watershed Council meetings.

Action: The SC will attend the monthly Skagit Marine Resources Committee meetings and provide information on Reserve activities and projects.

Objective 4: The Stewardship Coordinator will review and update the Padilla Bay Disaster Response Plan (DRP) in 2020 and participate in local training and exercises.

Action: In 2019, the SC will identify appropriate and willing stakeholders to review the Padilla Bay DRP and to make necessary changes.

Action: The SC will participate in oil spill drills as requested by Washington State Department of Ecology or refineries (periodic).

Action: The SC will host at least one tabletop drill through the Local Emergency Planning Committee during 2016-2020.

Action: The Stewardship Coordinator keeps Hazwoper certification current (annual 8-hour re-certification).

Action: The Stewardship Coordinator attends quarterly Local Emergency Planning Committee meetings.

Action: The Stewardship Coordinator attends (via webinar) Northwest Area Committee meetings (Region 10 Regional Response Team, NWAC).

Chapter 7 – Administrative Plan

Introduction

The NERRS is a federal and state partnership, so there are expectations of the Reserve from the Office for Coastal Management within the National Ocean and Atmospheric Administration, such as how to apply for funding and progress reporting for grants. Padilla Bay NERR is within the Washington State Department of Ecology, so daily activities such as purchasing, payroll, training, and such conform to state laws and regulations. The Reserve has a highly capable administrative staff that interact with agency staff to perform the necessary administrative duties.

Organizational Framework

Since the management of all National Estuarine Research Reserves is delegated by Section 315 of the Coastal Zone Management Act (CZMA) to the states, the overall management and administration of the Padilla Bay NERR is the responsibility of Washington State. This responsibility, by written agreement, rests with the Department of Ecology (Appendix E). Implementation of various program elements at the Reserve is accomplished through a coordinated and cooperative effort among several governmental agencies, tribes, committees, universities, and private (non-profit) organizations. This type of effort is essential given that much of the management, enforcement, and operational structure relies on existing state and county authorities, laws, and programs. Figure 7.1 outlines the Padilla Bay NERR management and operational structure.

Padilla Bay NERR is administered and managed by the Shorelands and Environmental Assistance Program of the Washington State Department of Ecology (Ecology). From 1977 to 1980 Ecology managed the nomination and project planning functions to establish the Reserve, and after official designation became the managing agency. Ecology's Shorelands and Environmental Assistance Program is the State's designated coastal management office, and is the recipient for all federal Coastal Zone Management Act (CZMA) funding, including Sections 306, 306A, 309, 310 and 315 CZMA cooperative agreements. As the managing agency, state funding for Reserve operations and programs are provided from the State General Fund to Ecology. All staff members are employees of the Washington State Department of Ecology.

Since Section 315 of the federal CZMA does not create or designate any federal regulatory authority specific to the Padilla Bay NERR, Ecology manages the Padilla Bay NERR under existing state authority. No new regulations were adopted or implemented as a result of the designation of Padilla Bay NERR. Meeting the standards of the federal operating guidelines is dependent on the adequacy of existing local, state and federal laws.

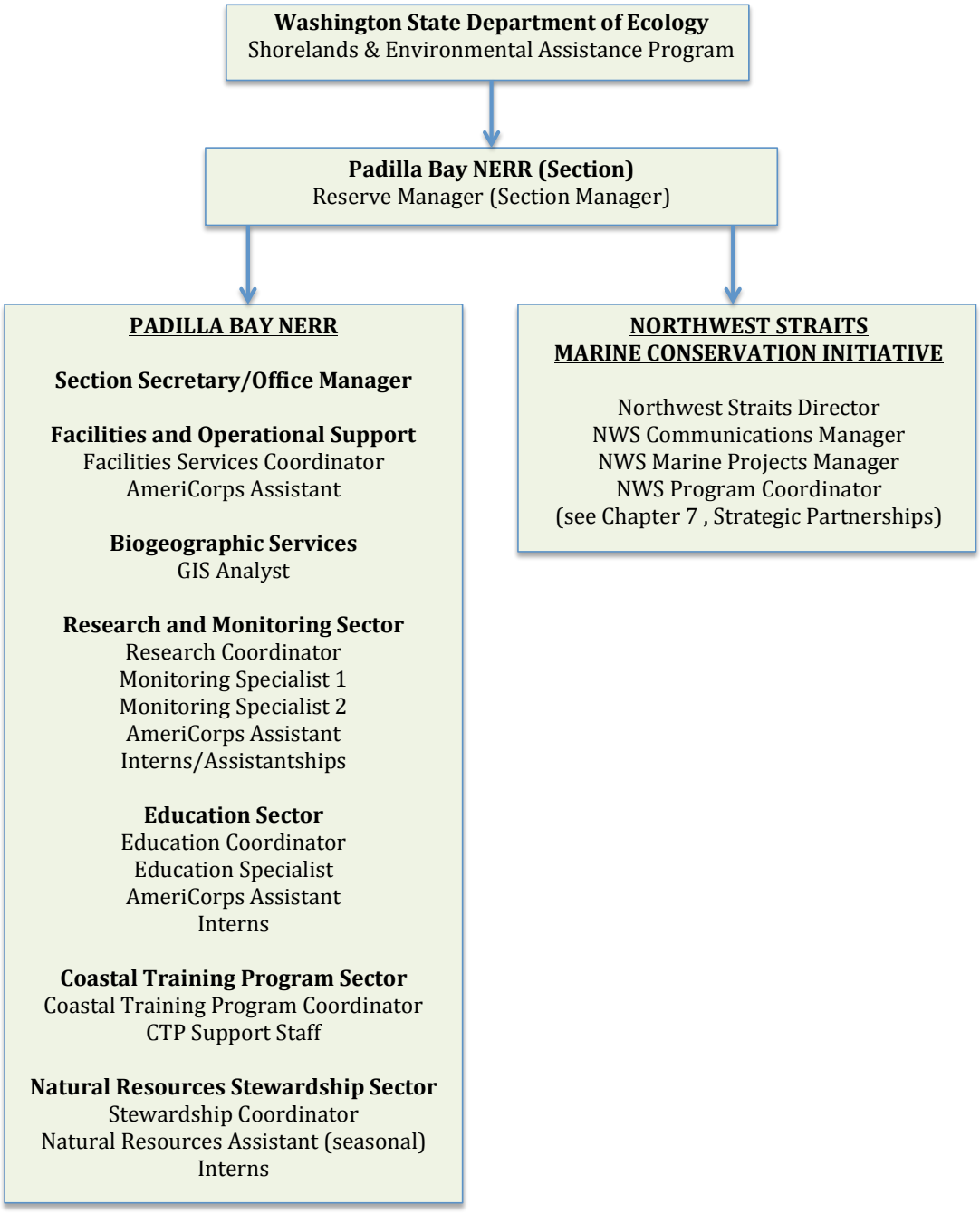


Figure 7.1. Padilla Bay NERR organizational chart. Northwest Straits Marine Conservation Initiative staff are part of Washington State Department of Ecology and have offices at Padilla Bay NERR.

Padilla Bay NERR is a Section within the Shorelands and Environmental Assistance Program (SEAP) within the Washington State Department of Ecology. The Reserve Manager is a designated Section Manager within SEAP (Fig. 7.2). The Skagit County Commissioners serve as the oversight committee for the Reserve.

The Reserve functions with administrative staff that provides support for functions such as payroll, purchasing, training, travel, vehicles, and scheduling meeting space. Department of Ecology provides human resources, legal, facility services, and Information Technology (IT) support for Reserve staff. On-site facilities staff provide facilities and utilities support.

The work of the Reserve is coordinated by sector or "core" staff (Manager, Education Coordinator, Coastal Training Program Coordinator, Research Coordinator and Stewardship Coordinator) and carried out by them and their staff members. Core staff members are encouraged to contribute to the national system (NOAA/NERRS), work collaboratively (integrate), and to interact with stakeholders (either through their Advisory Groups, focus groups, surveys or one-on-one communication) (Fig. 7.2). Core staff are also encouraged to seek outside grant funding when that is possible. The Coordinators report to the Reserve Manager (Ecology Section Manager) who reports to the SEAP Program Manager (Fig 7.1). The SEAP Program Manager reports to the Deputy Director of the Washington State Department of Ecology who reports to the Director of Ecology (a Governor-appointed position) (Fig 7.2).

Staffing has been consistent the past 17 years with all core staff (defined by NOAA/OCM) in position. The Research Coordinator retired in 2014 and that position was refilled in 2015. All other core staff positions remain staffed with long-term hires. However, there are likely to be additional retirements in core positions in the next five years.

Advisory Committee

The Padilla Bay NERR Advisory (Oversight) Committee is composed of the Skagit County Board of Commissioners and was established during preparation of the final environmental impact statement for Padilla Bay NERR in 1980. Skagit County is split into three geographic commissioner districts, based on population. Each Commissioner is elected to a four-year term. At the time of election, each Commissioner must live in the district he/she represents. The Commissioners are partisan elected officials, and candidates are nominated in a primary election, by ballots cast only in their home district. All voters in the county vote in the general election to select the Commissioner who will ultimately serve. The Reserve is in District No. 1 which encompasses Anacortes and Fidalgo Island, La Conner, Bay View, Bow, Edison, and north to the Whatcom County line. District No. 2 includes Mount Vernon, Conway, and south to the Snohomish County line. District No. 3 includes Burlington, Sedro-Woolley, and all of eastern Skagit County. The County Commissioners' primary duty is to levy the taxes to operate the County and to adopt a balanced budget for each calendar year. As administrators, County Commissioners are responsible for:

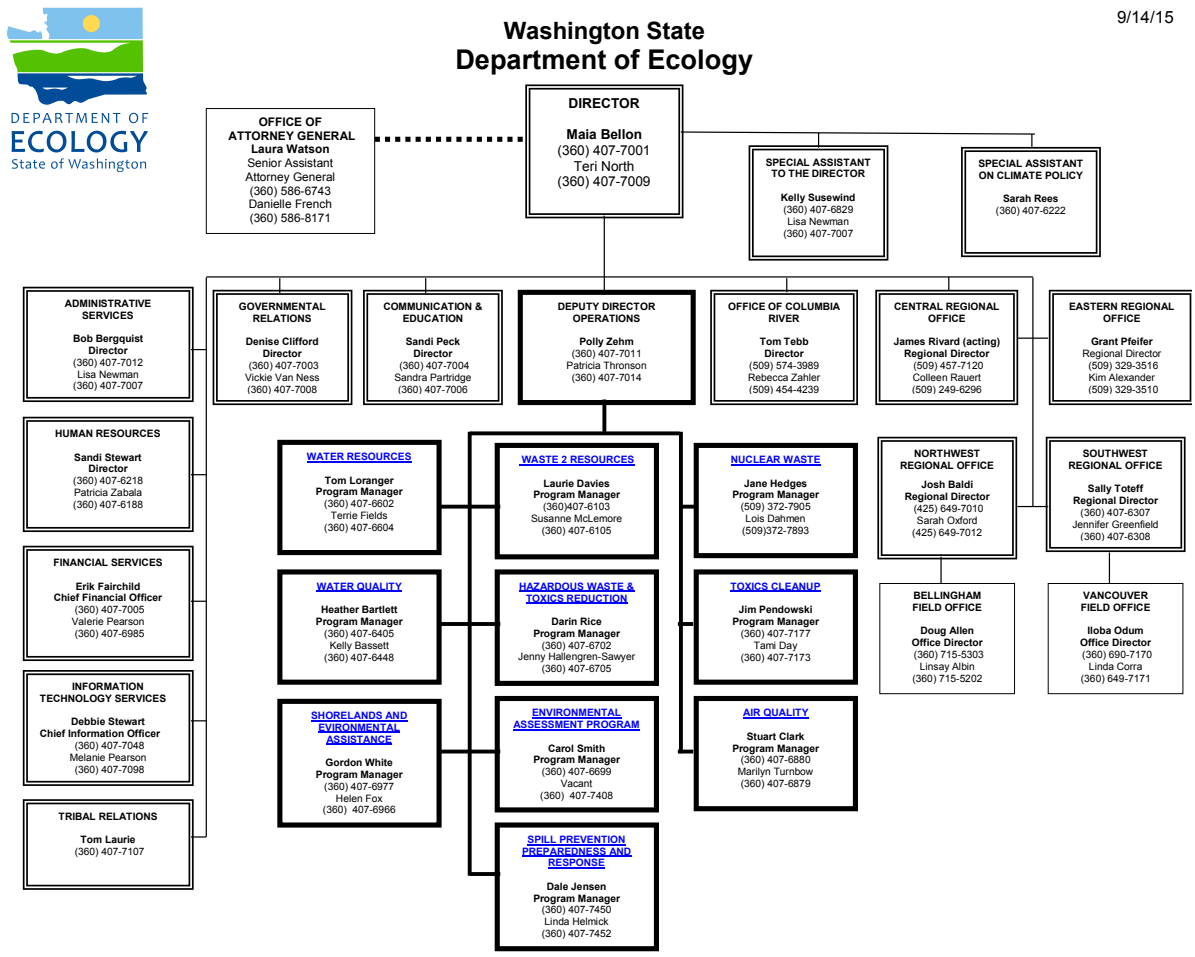


Figure 7.2 Washington State Department of Ecology organizational chart. Padilla Bay NERR is in the Shorelands and Environmental Assistance Program (second column from left, bottom).

- Public roads and public works programs;
- Public health services;
- Planning and zoning of unincorporated areas;
- Emergency Services or civil defense programs;
- County park and recreation systems; and
- Other services and programs, which are not clearly the responsibility of other elected County officials.

Commissioners also have a key role in a wide variety of community boards and commissions, which affect citizens within and beyond their jurisdictions and also serve on a variety of multi-county boards, state boards, and/or national committees, with other public officials and private citizens.

Their function, as the Reserve's Oversight Committee, is to provide the Reserve Manager with input and be a "sounding board" for ongoing and proposed activities in and adja-

cent to the Reserve, both from the Commissioner's perspective as well as on behalf of their individual constituents. The county has provided invaluable assistance and advice to Padilla Bay NERR over the past several years. The committee does not approve or disapprove Reserve policy but lends advice and counsel on how Reserve programs may affect the county's residents and provides input from interested citizens. The Reserve Manager provides the Oversight Committee with an annual report outlining accomplishments and significant actions and/or issues of concern, and is available to meet with the Committee at their request.

Current Staffing and Needs

Personnel at Padilla Bay NERR are employees of the Washington State Department of Ecology and funded through the state. Core staff positions are permanent state positions. Adequate and well-trained staff members are essential to meet the administrative, educational, coastal training, research, monitoring, stewardship, and support needs related to program operations at Padilla Bay NERR. Padilla Bay NERR staff and their general program responsibilities are listed below:

Manager: This full-time position serves as an Ecology Section Manager, reporting to the agency's Shorelands and Environmental Assistance Program's Manager (Fig. 7.1). The role is multi-functional in scope, with responsibility for overall operation, administration, policy and budget development for the Reserve. Duties include supervision of Reserve staff and Reserve programs, short- and long-term planning, facilities management and capital development, public relations, policy development and enforcement, establishment of operational procedures, coordination with other agencies and the Padilla Bay Foundation, contract and administrative agreements, budget development, and liaison responsibilities with senior management within Ecology, NOAA's Office for Coastal Management, and with other elected and appointed government officials. The manager also participates on the Shorelands and Environmental Assistance Program's Management Team and the CZM Team, and provides administrative oversight for the Northwest Straits Marine Conservation Initiative budget and staff.

Research and Monitoring Coordinator and Staff: The full-time Research Coordinator (RC) is responsible for implementation of the Reserve's research and monitoring programs. The RC's duties include direct field and laboratory work, grant preparation, coordination with visiting researchers and the Research Advisory Committee, technical assistance to Ecology staff, publication of Reserve technical reports, and coordination with the national Research Coordinator within NOAA's Office for Coastal Management. Duties also include implementation and supervision of the NERR System-Wide Monitoring Program and the Padilla Bay NERR Research Assistantships. Due to the scientific expertise of this position this individual often is called upon to provide technical assistance to other offices of the Department of Ecology on coastal habitat issues. Two additional part-time technical staff are employed as well as one full-time WCC/AmeriCorps position. Contractors provide laboratory, sampling, research vessel, and data management services.

Education Coordinator and Staff: The full-time Education Coordinator (EC) position is responsible for the development and implementation of the Reserve's estuary education program, including curriculum development, maintaining exhibits and displays, teaching, leading teacher workshops, supervising educational volunteers, conducting programs, and coordination with the national education coordinator within NOAA's Office for Coastal Management. One full-time AmeriCorps position is involved in implementation of educational and outreach programs related to estuaries, watersheds, and coastal habitats, along with a seasonal Education Assistant position funded through the Padilla Bay Foundation. The full-time Education Specialist assists with education programs but also manages the Stream Team program. This program, in cooperation with the Skagit Conservation District, implements a 70-member volunteer water quality sampling program along tributaries of the Samish and Skagit Rivers and Padilla Bay.

Coastal Training Program Coordinator: This full-time Coastal Training Program Coordinator (CTPC) position is responsible for development and implementation of the Coastal Training Program that provides on-going training for coastal zone managers. It requires close coordination with the State CZM Office, NOAA's Office for Coastal Management, and local land-use planning organizations and staff. A full-time Program Assistant provides support for the Coastal Training Program (65%) and assists the Reserve Manager with other administrative tasks (35%).

Natural Resources Stewardship and Operations Coordinator and Staff: The Stewardship Coordinator (SC) is a full-time position responsible for implementation of the natural resources stewardship program (50%) and for Padilla Bay NERR operations in the scheduled absence of the manager (50%). This includes coordination with natural resources stakeholders from many other resource agencies and tribes, field investigations, and management of significant projects and contracts. Seasonal staff is hired to assist with fieldwork in the summer (3 months).

GIS Analyst: This full-time position is responsible for coordinating GIS-based projects for Padilla Bay NERR and providing relevant technology and products for other Reserve and agency programs as needed (see Chapter 6 Program Capacities).

Facilities Services Coordinator: This full-time position is responsible for the maintenance, safety and security of all facilities, grounds and vehicles, and the operation and stocking of display aquariums in the Breazeale Interpretive Center. This position is also responsible for supervision of other maintenance workers and private contractors, along with minor construction duties and supervision of Washington Conservation Corps/AmeriCorps employees involved in facilities operations and support functions. Funding for an additional maintenance position is needed.

Section Secretary/Office Manager: This is a full-time position responsible for managing the secretarial duties for the Reserve and the Manager, including word-processing, mailing, telephone coordination, filing, ordering, scheduling, budget reports and record keeping, and answering questions from the general public.

AmeriCorps/Washington Conservation Corps Employees: These programs, funded by the state legislature and the federal government, are aimed at providing entry-level employment for persons 18-25 years of age in conservation-oriented jobs. At Padilla Bay NERR, three full-time employees are retained under an agreement with Ecology's AmeriCorps/ Washington Conservation Corps office and are supervised by applicable Reserve staff. These positions are normally assigned to operations, education and research tasks.

Assistantships and Internships: Funding from federal and state grants and the Padilla Bay Foundation provides opportunities for college-level internships in both research and education at the Reserve. These positions can be either temporary staff appointments or arranged as contracted projects. Intern positions require at least junior-year standing. Padilla Bay NERR Research Assistantships are available at the graduate level. All positions require participation of the student's undergraduate or graduate advisors in designing and approving project content.

Strategic Partnerships

Washington State Department of Ecology

Our most important partner is our managing agency, the Washington State Department of Ecology. We depend on the agency for all our internal administrative needs and services and utilize its position as a Governor's Cabinet Office to work with other elected and appointed officials in Washington State and in Washington, D.C.

The Reserve is part of Ecology's Shorelands and Environmental Assistance Program (SEAP). SEAP serves as the state's Coastal Management Office through appointment by the Governor. All state CZM activities, including those funded by NOAA, Office for Coastal Management, are managed by SEAP and the Reserve Manager is a member of the CZM Team. Reserve priorities are "cross-walked" with SEAP priorities and share many collaborative tasks. Several Reserve staff work closely with SEAP staff in the Olympia and regional offices on special projects and Reserve expertise in nearshore science, invasive species, coastal training, and educational programming is shared.

SEAP works cooperatively with various divisions in Ecology to implement core activities, such as the Water Quality Program, Environmental Assessment Program, Toxics Cleanup Program, Spill Prevention, Preparedness and Response Program and others. Reserve staff participate on advisory committees for these divisions and respond to requests for data, field services, SCUBA work, and project review, among others.

Other Washington State Agencies

Program and project support comes from other offices within the Washington State Department of Ecology. Department of Ecology is a key partner in the Puget Sound Partnership, which was created by the Governor in 2007 to focus efforts on the health and restoration of Puget Sound.

The Puget Sound Partnership (PSP) is a state agency serving as the backbone organization for Puget Sound recovery. It coordinates the efforts of citizens, governments, tribes, scientists, businesses and nonprofits to set priorities, implement a regional recovery plan, and ensure accountability for results. Puget Sound was designated as part of the National Estuary Program in 1987 under the U.S. Environmental Protection Agency and falls under the PSP. The Partnership also serves as a Regional Recovery Organization to coordinate Puget Sound partners around salmon recovery efforts and convenes a number of other state priority workgroups that impact Puget Sound recovery. Their Action Agenda is a road map for restoring the health of Puget Sound by 2020 and contains 300 actions, some of which are addressed by the Reserve's managing agency, Washington State Department of Ecology.

Details related to cooperation with other agencies for specific programs can be found in other chapters of this plan (3 - Research and Monitoring, 4 - Education, and 6 - Natural Resources Stewardship). Padilla Bay NERR coordinates with the Washington State Parks and Recreation Commission in the management of Saddlebag and Dot Islands and with the Washington State Department of Natural Resources in the management of Hat Island (see Appendix D). These islands on the Reserve's western perimeter are owned by these respective agencies, but the properties are managed under a cooperative agreement. Padilla Bay NERR also utilizes the services of the Washington State Department of Enterprise Services for real estate services related to property acquisition, and for architectural/engineering services related to facility construction and design.

Northwest Straits Marine Conservation Initiative

In 1998, at the request of U.S. Senator Patty Murray and Representative Jack Metcalf, Padilla Bay NERR was asked to administer and house the newly established Northwest Marine Conservation Initiative. This program, rising from the ashes of a long-proposed marine sanctuary, was established and funded by Congress as a grass-roots organization representing the seven northwestern coastal counties (each with a volunteer Marine Resource Committee), tribes, and local citizens. Based on a series of priority objectives and benchmarks adopted by a citizen's committee, the Initiative, through an elected and appointed Northwest Straits Commission and its staff, is focused on making improvements to marine habitats and related species populations throughout the region. Funds for this program are directed from NOAA and other federal and state agencies to the Department of Ecology and expended for a variety of planning, scientific, and on-the-ground projects consistent with the annual work plan prepared by the Northwest Straits Commission. The Commission is staffed with a full-time director and three-to-four additional staff members that assist with program implementation. The director of the Commission is hired by Ecology and the Commission and reports through the Reserve Manager in cooperation with the Commission's Executive Committee. There are many opportunities for joint programming and projects between the Reserve and the Northwest Straits program, including education, habitat restoration, scientific study and monitoring.

Skagit County

The Reserve interacts with Skagit County on many levels. The Skagit County Board of Commissioners provides oversight for the Reserve, Skagit County Parks manages the Shore Trail on the southeastern shoreline of Padilla Bay, the Health Department monitors shellfish for biotoxins in Padilla Bay and Water Resources will be implementing Pollution Identification and Correction (PIC) program in the watershed within the next five years.

Conservation districts are legal sub-divisions of Washington State government, but are self-governed by a five-member volunteer board that establishes local priorities and sets policy. The Skagit Conservation District (SCD) Board is composed of local farmers, landowners, and concerned citizens and is dedicated to maintaining Skagit County's renewable natural resources. SCD staff works with private partners, local, state and federal government agencies, agricultural and environmental organizations, and other conservation districts. The SCD is funded through grants, an annual native plant sale, and state general fund money requiring a dollar-for-dollar match.

The SCD's mission is to provide voluntary, incentive based options that support working landscapes while protecting and enhancing our natural resources. Its priorities and goals include:

- Protection and improvement of surface and groundwater quality
- Watershed planning and implementation
- Riparian restoration and enhancement
- Forest stewardship
- Community wildfire prevention and protection
- Fish and wildlife habitat enhancement
- Conservation education

The Reserve partners with SCD on the Stream Team and Storm Team volunteer water quality monitoring and the SCD provides conservation education to residents in the watershed (Backyard Wildlife Habitat, Watershed Masters, Marine Biotoxin Volunteers, Stream Team) as well as programs such as: Community Wildfire Protection Planning, FireWise Guidelines, Dairy Nutrient Management, Manure Exchange for small farms, Storm Drain Marking, and Low-Impact Development.

Educational Institutions

Partnerships with local higher educational institutions include community colleges (Skagit Valley College, Whatcom Community College), universities (Western Washington University, University of Washington) and marine teaching facilities (WWU's Shannon Point Marine Center, UW's Friday Harbor Laboratory). We provide programs on request and opportunities for students to job-shadow, intern, mentor under Padilla Bay NERR staff, and apply for graduate level research assistantships. Shannon Point Marine Cen-

ter provides access to saltwater for our aquaria exhibit and oversight for our research diving program.

The Northwest Educational Service District 189 advises education staff on educational standards and development of teacher workshops. They have also offered programs at educational events throughout the years.

Non-Governmental Organizations

Padilla Bay Foundation

The Padilla Bay Foundation, incorporated in late 1987 as a non-profit, tax-exempt corporation in the State of Washington, was established for the purpose of generating and providing supportive funds and resources for the management, development and operation of Padilla Bay NERR. The Foundation is managed by a 15-member Board of Directors, and has a general membership program for all ages. Support for Padilla Bay NERR activities has made possible the creation of research and education assistantship/intern positions, scholarships, matching funds for federal grant awards (educational projects), public interpretive signage and displays, equipment, computer and printing purchases and services, design work on new exhibits for the Interpretive Center, and construction projects. The Reserve Manager meets regularly with the Foundation Board in an advisory capacity and submits both short and long-term project assistance priorities for consideration.

National Estuarine Research Reserve Association (NERRA)

NERRA was established in 1987 and is dedicated to the protection, understanding, and science-based management of the nation's estuaries. NERRA's goals are to: 1) ensure Congress, the Presidential Administration, and NOAA recognize the value of the National Estuarine Research Reserve System (NERRS) and invest in stewardship of the nation's estuaries and coasts, 2) provide an administrative structure that assists the National Estuarine Research Reserve System, the sectors and individual Reserves in accomplishing projects and implementing programs, and 3) increase awareness, use and support for the NERRS and its research, education, and stewardship programs.

Volunteer Program

The Reserve has encouraged volunteers since its inception. In the past, various staff worked one-on-one with volunteers, but there was little time for recruiting, providing training, and support activities such as volunteer appreciation events. Despite many attempts to get a formal program off the ground, without a Volunteer Coordinator it lacked for vision and coordination.

Planning for Volunteers

In mid-2014, two county programs and one non-profit entity with a coastal focus expressed similar issues of administrative limitation and operational inefficiencies regarding the viability of a volunteer program. Through a dialogue with the Reserve Manager it was determined that the best option for all the organizations was to develop an administrative umbrella and central clearinghouse for training, coordinating, and managing volunteers. With all the entities pooling their funding, they created the Coastal Volunteer Partnership (CVP) at Padilla Bay. The CVP is a collaborative volunteer program increasing local capacity to protect and restore natural resources along our region's shorelines.

The volunteer program is administered by the Padilla Bay Foundation, and is currently financially supported by the Padilla Bay National Estuarine Research Reserve, Padilla Bay Foundation, the Skagit County Marine Resources Committee, Friends of Skagit Beaches, and the Skagit County Clean Water Program. A Volunteer Program Coordinator was hired through the Padilla Bay Foundation in November 2014 to work for each group to identify their volunteer training and implementation needs. The Reserve is currently supporting 0.18 FTE of that Coordinator's time and the Foundation 0.10 FTE. The balance of the Coordinator's time is paid by the other cooperating groups.

Recruiting and Organizing Volunteers

As part of the partnership, Padilla Bay NERR contracted with the Padilla Bay Foundation to provide volunteer services for the Reserve in 2015 and is doing the same in 2016. The CVP Program Coordinator serves as the Volunteer Coordinator for the Reserve. Since November 2014, the Coordinator has:

- Developed a logo, temporary website, and Facebook page for the CVP program.
- Created a bi-monthly volunteer newsletter (*The Wave*) which posts positions, training and education opportunities, and upcoming volunteer opportunities.
- Recruited 30 new volunteers specifically for the Reserve and its activities.
- Created two new volunteer job descriptions for the Reserve and updated all other existing volunteer positions.
- Implemented a standardized general volunteer orientation for the Reserve (and coordinated with PBNERR staff for more specialized training when needed).
- Organized two CVP volunteer appreciation events.
- Provided personalized name tags and hats for all CVP volunteers with more than 25 hours of service.
- Written a Reserve Volunteer Handbook that establishes policies and procedures.
- Implemented the use of "Volgistics", an online volunteer tracking system

and database. This system allows volunteers to record their service hours, check the calendar for opportunities, sign-up for shifts, and send messages to the coordinator. This can all be done from any computer with internet access.

Supervising and Retaining Volunteers

The CVP Program Coordinator, in collaboration with Padilla Bay staff, provides supervision of volunteers at Padilla Bay Reserve. Staff members provide job descriptions to the Coordinator, the Coordinator advertises and provides potential volunteers and the staff member with whom the volunteer works oversees their activity in the position.

The approach to retaining volunteers is to develop good avenues of communication (e.g., the volunteer newsletter) and development of volunteer appreciation (e.g., nametags, hats, and social events). Also, feedback from volunteers is encouraged.

Year One Success

Since the start of the Coastal Volunteer Program in November 2014, 30 individual volunteers have provided more than 900 hours to Reserve programs activities in the first year. In addition to the 900 hours of service to the Reserve, the CVP volunteers (all organizations combined) provided 2,000 hours of service to projects and partner organizations that support the conservation, restoration or research of marine and coastal ecosystems in our region.

Currently the CVP manages more than 100 individual volunteers (including Padilla Bay Reserve's volunteers) who participate in a diversity of activities for each of the funding partners including shoreline biota monitoring, water quality sampling, marine debris removal, habitat restoration, research and lab support, and K-12 education, and outreach activities at community events.

Vehicle and Vessel Program

Vehicles

The Washington State Department of Enterprise Services (DES) manages all state vehicles. The Reserve's Facilities Coordinator oversees regular maintenance such as oil changes as approved by DES and the Reserve Manager approves expenditures.

Scheduling

Vehicle scheduling is via SharePoint calendars through the Washington State Department of Ecology. All staff have access to the calendars on-line and sign out vehicles as needed.

The Reserve currently has five vehicles, but that is subject to change. One vehicle is used mainly for hauling the water tank for salt water for the aquarium, another for pulling the research vessels, and a hybrid vehicle for longer trips (such as to Ecology's headquarters in Olympia) in order to conserve gas and reduce carbon. Two other vehicles are used mainly by facilities, education, and stewardship staff.

Driving state vehicles

Staff are required to have a current state driver's license and to submit an "Authorization to Use State Vehicles". Staff must also attend a state-offered "Defensive Driving" class every four years (Department of Ecology's Policy Manual. Attachment A – Policy 4-02: Establishing Required and Recommended Training: 2. Defensive Driving). Ecology's Administrative Policy 14-20 "Operating State Vehicles" governs the safe use of state vehicles. Every vehicle is provided with a first aid kit and fire extinguisher.

Recordkeeping

Every vehicle has a "log" for recording mileage per trip. Staff are responsible for filling these out when they use a vehicle. These logs are maintained by the Reserve's Secretary and sent to Ecology's Fiscal Office monthly.

Vessels

Padilla Bay NERR has two aluminum vessels, a 16-foot skiff (the *Marcellus*) and a 22-foot research vessel with a cabin (the *Edna B*). The boats were purchased for research and monitoring and are maintained by monitoring staff with operations funding. A fiberglass Boston Whaler hull is used as a sampling platform and does not have a motor or steering column. Smaller boats include a wooden rowboat (used by the Education Program at the State Park), a 10-foot aluminum rowboat (the *Michael K*) and a canoe used for retrieving the Joe Leary Slough YSI datasonde.

Safety and Training

All staff operating boats must have a Washington State boater certification, which can be obtained by taking and passing an on-line course that teaches the user about safe boat operation and Washington State laws relating to boating. Staff operating powered boats for over 10 hours per year are required to have classroom training through an approved boating safety program (Department of Ecology's Policy Manual. Attachment A – Policy 4-02: 1. Boating Safety).

The Reserve's Boat Manager reviews a "Safety Checklist" with new staff that reviews boating protocols. This includes the use and storage of safety gear (personal flotation device requirements, first aid supplies, radio communication protocols, air horns, safety flares, etc.). The Reserve's designated Boat Manager works one-on-one with new staff to train them in the skills of boat trailering, launching, handling and navigation. Routine

maintenance of boats after use includes washing surfaces with fresh water, flushing the engine with fresh water, and washing the trailer down.

Maintenance and Replacement Schedules

Boat maintenance is scheduled on a regular basis (Table 7.1). Boat trailers should be replaced about every ten years (or as needed). Boat electronics (GPS, depth transducer) have a life span of around five years. All other problems are dealt with on a case-by-case basis, such as failure of hydraulics or gauges.

Table 7.1 Annual maintenance schedule for Padilla Bay NERR boats.

Service	*Edna B*	*Marcellus*
Service boat motors	X	X
Service kicker motors	X	X
Replace bearings on boat trailer	X	X
Replace windshield wipers	X	

Recordkeeping

Maintenance and service is logged for the boats and kept on file by the Boat Manager (Monitoring Specialist 2) in the research lab. The Boat Manager maintains a file of owner's manuals and receipts for all vessels and associated equipment.

Administrative Objectives and Actions

SUPPORT GOAL 1: The Washington State Department of Ecology provides support for the Reserve's administrative, operational and capital resources activities.

Objective 1: Ecology provides state agency administrative framework for the Reserve from 2016-2020.

Action: Staff members receive core and additional training (as per Training and Development Plans) from 2016-2020.
Action: Ecology provides human resources, payroll, purchasing, fiscal, legal, travel, and training support from 2016-2020.

Objective 2: Ecology provides adequate operational support for the Reserve from 2016-2020.

Action: Ecology provides financial support for the Reserve from 2016-2020.
Action: The Reserve Manager is a Section Manager within the Shorelands and Environmental Assistance Program at Washington State De-

partment of Ecology and attends monthly Program Management Team meetings.

Objective 3: Ecology provides support for capital resources activities from 2016-2020.

Action: Ecology's facilities office provides expertise and support for capital projects and facilities from 2016-2020.

Objective 4: Vehicles will be maintained as per Washington State Department of Enterprise Services and Washington State Department of Ecology during 2016-2020.

Action: The Facilities Coordinator will oversee oil changes and repair.
Action: The Section Secretary will oversee auto logs.

Objective 5: Boats will be maintained in good repair during 2016-2020.

Action: Replace the depth transducer on the *Edna B* in 2016.
Action: Replace the *Edna B's* boat trailer by 2020.

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members and volunteers.

Objective 1: The Manager reviews staffing needs no less than annually from 2016-2020 and identifies funding sources.

Action: The Manager will assess staffing needs for each sector and create and fill or re-fill positions as needed, depending on funding.

Objective 2: The Manager and staff will maintain strategic partnerships throughout 2016-2020.

Action: Padilla Bay NERR Manager and staff will collaborate with the SEA Program on specific tasks related to coastal management and Puget Sound throughout this period at the request of the Program Manager.
Action: Padilla Bay NERR Manager will communicate on a monthly basis with the Padilla Bay Foundation to coordinate activities and funding requests.
Action: Padilla Bay NERR Manager will meet and/or communicate with the Skagit County Commissioners, as well as local, state, federal and tribal offices at least annually and keep these partners updated on Reserve activities and issues.

Action: The Manager will maintain strategic partnerships (e.g., Padilla Bay Foundation, Skagit County, and the Northwest Straits Commission) to further Reserve interests in this time period.

Objective 3: The Manager will arrange for volunteer coordination services for the Reserve from 2016-2020.

Action: Padilla Bay NERR will contract with the Padilla Bay Foundation (PBF) to provide volunteer coordination services subject to availability of funds.
Action: The Manager will work with PBF and their Volunteer Coordinator in this time period to make the Reserve's volunteer needs known and help to further develop the volunteer program.
Action: The Manager and Padilla Bay NERR staff will participate in volunteer appreciation events as requested by Padilla Bay Foundation.

Objective 4: Padilla Bay NERR vessels and vehicles will be maintained in good working condition during 2016-2020.

Action: The Research Coordinator will work with monitoring staff to identify vessel repairs and maintenance and ensure they occur throughout this period.
Action: Reserve staff report vehicle maintenance needs to the Facilities Coordinator (or Manager in the FC's absence).
Action: Washington State Department of Ecology and Reserve staff will ensure that the state vehicles receive regular maintenance and communicate with Department of Enterprise Services as necessary throughout this period.
Action: The Manager will ensure that Reserve staff are familiar with Ecology's vehicle policies and that staff attend Defensive Driving classes as required by Ecology.

Objective 5: The Manager will meet with staff to communicate news from Ecology, NOAA and others throughout 2016-2020.
Action: The Manager holds monthly staff meetings throughout the period of this plan.
Action: The Manager calls for "Core Staff" meetings as needed for planning and budgeting purposes.
Action: The Manager meets with core staff individually on a weekly or as-needed basis.

Objective 6: The Manager will maintain continuity for the Reserve's volunteer program from 2016-2020.

Action: Provide partial financial support for the Coastal Volunteer Partnership at Padilla Bay in 2016 and collaborate with other local groups to provide the balance of funding for the program.

Objective 7: The Coastal Volunteer Program Coordinator will continue to develop and refine the volunteer program during 2016-2020.

Action: Develop an evaluation feedback loop for the volunteers.
Action: Continue development of a recognition program for volunteers.

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Chapter 8 – Resource Protection Plan

Introduction

Long-term protection of natural resources is key to the federally legislated mission of the NERRS. Long-term protection ensures that the lands within the Reserve boundary will be managed so that species and habitats are functioning at the highest possible level for current and future generations. This means consideration of stressors and threats to the resources, including climate change and human impacts on the resources. It also means promoting clear and continued communication with the various agencies that manage natural resources within the Reserve's boundaries so that we move forward on a common pathway.

Management Authorities

Management of natural resources is spread among many agencies (see Table 6.1, Chapter 6). Air quality is under the purview of the Northwest Clean Air Agency. Skagit County has the authority for monitoring shellfish for marine biotoxins, noxious weed control enforcement, implementing Pollution Identification and Correction Program (PIC) protocols in the Padilla Bay watershed, among other factors that impact Padilla Bay (such as surface water management). The Washington State Department of Agriculture coordinates *Spartina* control among the many agencies and entities that work cooperatively on this issue.

The Reserve's state agency, Washington State Department of Ecology, enforces regulations that protect the state's air quality and water supply. They enforce cleanup of toxic sites and regulate solid and hazardous waste. The Northwest Straits Initiative staff, housed within Ecology, work to improve marine habitat through volunteer Marine Resources Committees (MRCs).

The Washington State Department of Fish and Wildlife establishes aquatic habitat guidelines, provides management recommendations for amphibians, reptiles, and birds and regulations for fishing, shellfishing, hunting, and seaweed harvest. They manage scientific collection permits and regulations around watershed processes.

The Washington State Department of Health tests shellfish for biotoxins that cause illnesses such as Paralytic Shellfish Poisoning (PSP) and Diarrhetic Shellfish Poisoning (DSP). Shellfish are collected locally by volunteers for the Skagit County Department of Health who sends them to the state laboratory for testing. The site the Reserve collects at is shown in Fig. 8.1.

Figure 8.1 Shellfish data collection point for natural resources staff in Padilla Bay for the Skagit Conservation District's shellfish biotoxin monitoring program in conjunction with Skagit County Environmental Health.

The Washington State Department of Natural Resources manages state-owned aquatic lands, such as bedlands (subtidal lands) in and around Padilla Bay, some of which are leased for aquaculture. They manage the Natural Heritage Program, which is a database on priority species, and work with rare plants and animals and ecological communities. They own Hat Island, which is a Natural Resources Conservation Area (NRCA) within their Natural Area Preserves program. They also have responsibility for wildfire control on their lands.

The Washington State Parks and Recreation Commission manages state parks and there are two within the Reserve boundary. Bay View State Park is a quarter mile south of the Breazeale Interpretive Center and Saddlebag Island Marine Park is just north of Hat Island on the western boundary of the Reserve. There are campsites and public access and recreation at both parks.

NOAA's Office for Coastal Management (OCM) manages the National Estuarine Research Reserve Program and provides adherence to the Coastal Zone Management Act by the system. The permits necessary for marine mammal specimens used for education purposes are provided through NOAA, National Marine Fisheries Service, Office for Law Enforcement (Seattle).

The U.S. Fish and Wildlife Service (USFWS) establishes threatened and endangered species lists and rules. Padilla Bay NERR applies to the USFWS for permits for migratory bird specimens, bald eagle specimens and salvage of migratory birds for exhibit purposes. They also work to restore national fisheries, enforce federal wildlife laws and conserve and restore wetlands.

Guidelines for Public Use of Reserve Properties

Public Use Allowable Activities

The Reserve's advisory committees and managing and cooperating agencies have established a list of allowable activities. Activities approved for the general public on Reserve properties include the following:

- Public hunting, fishing, and non-commercial harvest of shellfish, subject to federal and state laws and regulations, public safety, and Tribal Treaty rights,
- Hiking on established trails and pathways.
- Swimming at beaches managed by Washington State Parks.

Public Use Restricted Activities

- Certain uses may be restricted on Padilla Bay NERR lands and tidelands to protect sensitive resources, the integrity of research areas, and to protect public safety.

Public Use Prohibited Activities

- Consistent with local, state and federal laws and regulations, the Reserve has developed a list for the general public of activities that are prohibited on Reserve properties:
- Camping (except where specifically permitted by Washington State Parks).
- Hunting on the 64-acre property donated by the Breazeale family, the Bay View boat launch area, adjacent to the Observation Deck, and other areas where public safety is an issue.
- Fires (except where specifically allowed by Washington State Parks).
- Destruction or theft of natural resources as dictated by state and federal laws.
- Overnight parking outside the developed parking areas.

Resource Unit Policies

- Provide long-term protection of Reserve marshes and tidelands for the purposes of research, monitoring, and education.
- Protect and preserve the existing character and quality of the rocky islands and bedlands within the Reserve while allowing for limited and non-damaging access by the public subject to managing agency regulations.
- Manage Reserve agricultural lands consistent with Best Management Practices as identified by the Skagit Conservation District (SCD) and Natural Resources Conservation Service (NRCS).
- Hunting on Reserve agricultural lands, especially lands near public facilities, infrastructure and residential areas, will be permitted only after a thorough review of safety and liability issues and coordination with applicable stakeholders.

Regulations for Resource Units in the Reserve

Resource units include: 1) marshes and tidelands, 2) rocky islands and adjacent bedlands, 3) forested uplands, grasslands and freshwater wetlands, and 4) diked agricultural lands. These regulations are the rules that protect the natural resources in the Reserve.

1) Marshes and Tidelands

As shown in Figure 1.5 (Chapter 1), this extensive area covers all Padilla Bay NERR properties within the bay and its surrounding estuarine wetlands. This includes eelgrass beds, mudflats, and salt marsh areas along the shoreline. These are the key (core) areas of the Reserve and are the most significant and productive biological regions. This intertidal area is used primarily by waterfowl, marine mammals, shorebirds, resident and migratory fishes, and invertebrates such as worms, clams, and shrimp.

Allowable Activities in Marsh/Tideland:

- Recreational clamming and crabbing as per Washington Department of Fish and Wildlife (WDFW) rules and regulations.

Prohibited Activities in Marsh/Tideland:

- Expansion of existing channels or the creation of new navigation channels unless specifically authorized by statutes.
- New public works projects and projects that require dredging, filling, or dumping of dredged spoils.
- Significant alterations of flow patterns, including circulation patterns.
- Any activity that will lead to significant degradation of water quality and/or biologic productivity.
- Commercial aquaculture activities or commercial harvest of shellfish.
- Wheeled vehicles on the tidelands without specific permission.
- Removal of vegetation on Reserve property along Bayview-Edison Road that screens waterfowl areas.

2) Rocky Islands and Adjacent Bedlands:

This area is composed of three islands along the extreme central western boundary of Padilla Bay NERR and their surrounding bedlands: Hat Island, Saddlebag Island and Dot Island. The islands lie just northeast of the Swinomish Channel/Guemes Channel intersection and lie between the intertidal flats of Padilla Bay to the east and the deeper water to the west. Access to the islands is limited to private watercraft (no public transportation). Oil tankers bound for the Shell and Tesoro refineries near Anacortes (March Point) often anchor in deep water to the west of the islands waiting for wharf space or for lightering.

Resources of the islands and surrounding bedlands are protected through existing regulations enforced by the managing agencies.

Hat Island

The Padilla Bay NERR was amended in 1999 to include Hat Island. The Washington State Department of Natural Resources (WDNR) received the title to this 91-acre island from The Nature Conservancy in 1991. Hat Island has limited accessibility as bedrock rises steeply 10-40 feet from the water's edge; only a couple small beach areas exist. Bald eagles nest on Hat Island with nesting activity recorded since 1975. Four alternate nest sites are recorded with all activity attributed to one territorial pair. Bald eagles and peregrine falcons use the island for perching and feeding.

The island is included within WDNR's Natural Areas Program. Prior to any management activities on Hat Island, Reserve staff contacts WDNR. The Department of Ecology en-

tered into an interagency agreement with WDNR in 2000 to cooperatively manage Hat Island consistent with the mandates of Chapter 79.71 RCW (see Appendix D). According to the RCW, the site-specific management of Hat Island identifies the following:

Areas with Potential for Low-impact Public and Environmental Education Uses: Because Saddlebag Island is already under Washington State Parks ownership and managed for public use, it is the logical choice for camping, picnicking, hiking and group activities. Hat Island, because of its steep banks, is not easily accessible. Public use appears to be minimal due to the natural limited accessibility of the island. In order to protect the sensitive grassy bald habitats, WDNR and Padilla Bay NERR agree that additional public use will not be solicited or advertised.

Padilla Bay NERR will cooperate with WDNR to identify inventory and research needs. Research on the island will be conducted under WDNR/PBNERR supervision and may be funded through our Research Assistantship program.

Types of Permitted Management Activities: Management activities on Hat Island include but are not limited to: periodic visits to monitor public use and potential problems (Padilla Bay NERR), fire control (WDNR), response to environmental emergencies, weed inventory, development of weed control plans, noxious weed control (e.g. Canada thistle, Scotch broom, etc.), measures to control plant disease (such as gypsy moth or other equivalent threat), and restoration activities if deemed necessary or appropriate (cooperative effort between WDNR and Padilla Bay NERR).

Types of Permitted Public Uses: Due to the fragile nature of the grassy bald habitats, public use will not be encouraged through advertisement (e.g., brochures or signs). Minimal public use of the island also serves to protect cultural resources. The current Natural Resources Conservation Areas Statewide Management Plan provides further guidance for managing Hat Island (WDNR, 1992).

Saddlebag and Dot Islands

Saddlebag and Dot Islands are owned by the Washington State Parks and Recreation Commission (Saddlebag State Park) and are managed through their Region Two offices in cooperation with the Reserve. Primitive camping, day use and hiking are allowed.

Shallow glacial till covers portions of these islands, permitting conifers (some large), shrubs and grasses to cover the majority of the surface (except tiny Dot Island, which is predominantly exposed rock). No major lakes, ponds, or other surface waters exist. Saddlebag has two beach areas where access is possible and permitted.

Allowable Activities in Rocky Islands/Bedlands:

- Non-damaging, low intensity use is allowed. Primitive-style camping, hiking, and day use is allowed on Saddlebag Island State Park.

- Recreational fishing and shellfishing on public-owned beaches, tidelands and adjacent bedlands is allowed, subject to applicable federal and state regulations and applicable Tribal Treaty rights.

Prohibited Activities in Rocky Islands/Bedlands:

- Power-driven vehicles are not allowed on the islands, except for emergency and approved maintenance purposes.
- The removal of vegetation, except for permitted scientific or management purposes, is prohibited.
- Hunting is prohibited on State Park lands (Saddlebag and Dot Islands).

3) Forested Uplands, Grasslands, and Freshwater Wetlands

Located on Bay View Ridge, this management unit includes areas that are highly developed with moderate-to-high intensity public use as well as low-use undeveloped habitat. This unit includes the 64-acre upland property with Breazeale Interpretive Center, research laboratory, support facilities, and trails (Upland and Observation Deck). Originally old-growth forest, then a working farm, the land is now a mixture of wetland slopes, grasslands, hedgerows and mixed conifer and deciduous forest. This management unit also includes two small wooded properties, one along Bay View-Edison Road and one on the south side of Samish Island.

Bay View State Park is within the Reserve boundary and also located on Bay View Ridge just south of the Breazeale property. It provides overnight camping in a wooded setting and a developed recreational beach area for swimming and beach combing. This area is managed according to the specific policies of the Washington State Parks and Recreation Commission. The Reserve's high tide boat launch is just south of the state park.
Due to similar management goals, the public Shore Trail on the dike top along the southeast shoreline of the bay is also classified in this resource unit. This trail is maintained by the Skagit County Parks Department on land controlled by a local diking district.

Resources and uses of the properties are governed by the recognized managing agencies according to their existing regulations and the cooperative agreement between the Department of Ecology and the Washington State Parks and Recreation Commission and any other agreement developed to address such issues. Activities on these areas shall not damage the key (core) area of the Reserve.

Allowable Activities in Uplands, Grasslands and Freshwater Wetlands:

- High intensity uses are allowed in designated areas. Control measures such as signs, developed trails and fencing are used to protect valuable resources where necessary.
- Vegetation may be managed to prevent succession and to provide habitat diversity.

Prohibited Activities in Uplands, Grasslands and Freshwater Wetlands:

- Hunting is prohibited on State Park lands and the 64-acre property where the Breazeale Interpretive Center is located.
- Dogs off-leash.

4) Diked Agricultural Lands

These lands provide a buffer between residential and commercial development and the Reserve's key management units and are currently in private ownership, with the exception of 107 acres owned by Padilla Bay NERR (the Padilla Demonstration Farm) and 237 acres purchased by WDFW. Totaling approximately 574 acres in size, they are located adjacent to the southern end of the bay, behind dikes created to keep saltwater from intruding onto the farmland. The dikes themselves are vegetated with grasses. Croplands produce a large variety of grains, vegetables, fruits, and flowers. It is the intention of the Reserve to obtain conservation easements or other controls on these lands to allow farming to continue while not allowing more intensive uses of the land. Restoration activity is possible on portions of this property consistent with ownership consent and thorough environmental assessment.

Allowable Activities in Diked Agricultural Lands:

- Farming for demonstration purposes (such as demonstration of best management practices, such as reducing turbidity to improve water quality)
- Hunting on Padilla Bay NERR lands only with permission from Manager.
- Hunting on WDFW lands per published regulations.

5) Dredged Spoil Islands (Swinomish Spit)

The dredged spoil islands were formed from maintenance activities on the Swinomish Channel. They are located just north of the railroad trestle on the east side of the channel. Much of the acreage is owned by Washington State Department of Ecology, but there are still a few privately owned tracts interspersed between Ecology-owned parcels. Washington Department of Fish and Wildlife (WDFW) manages waterfowl hunting within the Reserve and this area has been in a "no-hunt" zone or "hunting reserve" status since Padilla Bay NERR was formed. However, WDFW took it out of "hunting reserve" status in 2015. There is access to this site by boat or with permission through private property.

Allowable Activities on the Swinomish Spit:

- Hunting allowed consistent with WDFW regulations.

Prohibited Activities on the Swinomish Spit:

- Wheeled vehicles of any kind without permission of Manager.

Surveillance and Enforcement Capacities

Reserve stewardship and facilities staff members regularly monitor the Upland and Observation Deck trails and report suspicious activity to the Manager. Facilities staff visit the Observation Deck and trail daily. The Stewardship Coordinator visually monitors the 64-acre site with regular visits to the various habitats at that site. Any staff can call the Skagit County Sheriff if prohibited activities are occurring. No Padilla Bay NERR staff members have law enforcement capability.

Enforcement of environmental regulations that protect the resources of the Reserve falls within applicable local, state, and federal agencies. Laws and regulations that relate to resource protection are included in Appendix C. While the creation of Padilla Bay NERR did not establish any additional regulatory programs to govern uses and activities with its properties, the appropriate and timely enforcement of existing codes and regulations is important to the protection of the Reserve's resources.

Resource Protection Challenges

Approach

The Reserve's approach is to engage stakeholders in natural resources challenges and to ask questions about what is important to stakeholders and why those things are important. Reserve employees also evaluate what is important for Reserve habitats and species and balance their decisions with stakeholder input.

Another aspect of resource protection is to educate stakeholders about natural resources in the watershed and why it is important to keep those resources intact and functioning, not only for the natural beauty and wild plants and animals, but for the ecosystem services they provide to people.

Challenges

These are examples of challenges we face when addressing resource protection. The "solutions" are possible approaches for facing the challenge, easing the pressure on the resource, or planning for future events.

1) Multiple agencies manage resources in the bay.

- Challenge: All agencies may not all be on the same page about managing resources.

- Challenge: Only enforcement agencies have the authority to enforce regulations.
- Solution: Clear communication about goals, authorities, and enforcement among agencies and the Reserve.

2) Water quality is declining in some areas of the bay.

- Challenge: Beach closures at Bay View State Park. It is thought to be due in part to failing septic systems in Bay View.
- Solution: Work with Skagit County to improve conditions.
- Solution: Educate the public about how their actions in the watershed may affect water flowing into the estuary.

3) Tideland use on private inholdings

- Challenge: Tideland ownership and uses in dispute.
- Solution: Determine tideland ownership through title search and Attorney General review.

4) Noxious weed laws

- Challenge: *Zostera japonica* is listed as a Class C noxious weed in Washington state and is not currently chosen for control in Skagit County. That could change. The Reserve has approximately 580 acres of 100% *Z. japonica* covered tidelands.
- Challenge: The Reserve has approximately 200 acres of tideland with mixed *Zostera marina* (native) and *Zostera japonica* (Class C weed). The challenge is how to control the non-native species without harming the native species.
- Solution: Stay apprised of *Z. japonica's* status.

5) Recreational impacts

- Challenge: Derelict fishing gear (net, line, crab pots).
- Solution: Work with partners to locate and remove marine debris.
- Challenge: Boats anchoring in eelgrass areas.
- Solution: Public education and/or signage.

6) Climate change impacts

- Challenge: Potential for loss of salt marsh habitat due to sea level rise.
- Solution: Explore opportunities for salt marsh habitat migration (could involve property acquisition).
- Challenge: Possible increase in marine biotoxin incidences with changing climate (e.g., warming waters or other triggers).

- Solution: Support Skagit Conservation District and Skagit County efforts to monitor shellfish and to post public beaches and known shellfishing sites if there are closures.
- Solution: Educate the public to use the "clickable maps" on the Washington State Department of Health website: <www.doh.wa.gov/CommunityandEnvironment/Shellfish/ RecreationalShellfish>

7) Potential for oil spill

- Challenge: There are oil refineries within proximity to Padilla Bay, so the potential for oil spill exists.
- Solution: Help update the Geographic Response Plans, attend oil spill drills, get baseline data prior to a spill.
- Solution: Keep Padilla Bay NERR Disaster Response Plan updated.
- Challenge: Trains moving crude oil/petroleum products within the region have the potential for derailment, possibly resulting in oil spill into the bay or nearby bodies of water.
- Solution: Stay updated on this issue by attending Local Emergency Planning Committee meetings and drills (that are also attended by Burlington Northern Santa Fe Railway representatives).
- Solution: Advocate for regular maintenance and inspection of railway bridge that crosses the Swinomish Channel. BNSF has a schedule for maintenance of all rail lines and structures.

Resource Protection Objectives/Actions

CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.

Objective 1: The Manager and Stewardship Coordinator will review the guidelines for allowable/non-allowable uses no less than every five years.

Action: Update the guidelines in 2020.

Objective 2: Maintain good communication with natural resources stakeholders from 2016-2020.

Action: The Manager and Stewardship Coordinator will meet with natural resources stakeholders on a regular basis throughout the year each year for one-on-one discussions, including enforcement of regulations.

Objective 3: Review and update resource unit policies no less than every five years.

Action: The Manager and Stewardship Coordinator will update the policies for resource units in 2020.

Objective 4: All Padilla Bay NERR staff will report any prohibited uses of Reserve natural resources to the Manager or Stewardship Coordinator during 2016-2020.

Action: The Manager and Stewardship Coordinator will address disputed tideland ownerships and quiet the titles during 2016-2020.

Chapter 9 – Public Access and Visitor Use Plan

Introduction

One of the attractions of the Reserve is public access to Padilla Bay. People come to the bay to enjoy the view, the wildlife, and various activities such as boating, bird watching, clamming, crabbing and windsurfing. With a number of places to access the beach and water, visitors can enjoy the many things Padilla Bay has to offer.

Current Public Access

The Reserve provides and maintains public access to Padilla Bay at a number of locations including the Breazeale Interpretive Center, the stairs at the Observation Deck, and the Bay View boat launch (Fig. 9.1). There is also beach access at Bay View State Park and the Padilla Bay Shore Trail (managed by Skagit County) is adjacent to the bay.

Breazeale Interpretive Center

Public access to the Reserve starts at the Breazeale Interpretive Center, located at 10441 Bayview-Edison Road, Mount Vernon, Washington. This is usually the first contact people have with the Reserve and the National Estuarine Research Reserve System. They can learn more about estuaries and watersheds by visiting our indoor exhibits, by walking on the Upland Trail (with interpretive guidebook), or by visiting the Observation Deck to view the bay or to walk down to the beach. Visitors can interact with staff or volunteers at the front desk and learn more about the local area and where they can go to pursue different activities at the Reserve or surrounding area.

Bay View State Park

Most of our school programs, summer Beach Seines and Mudflat Safaris use the beach at Bay View State Park (Fig. 9.2). The casual visitor to the state park will need to purchase a day use pass ($10/day) or annual Discover Pass ($30). These passes are available for purchase at Bay View State Park or local sporting goods stores. Vehicles such as school buses or 12-passenger vans with exempt license plates (such as those who participate in Reserve school programs) do not need a Discover Pass.

Bay View Boat Launch

The boat launch in Bay View allows the public to put boats in the water at high tide and is free of charge (Fig. 9.3). There is a landscaped area and park bench, which attracts

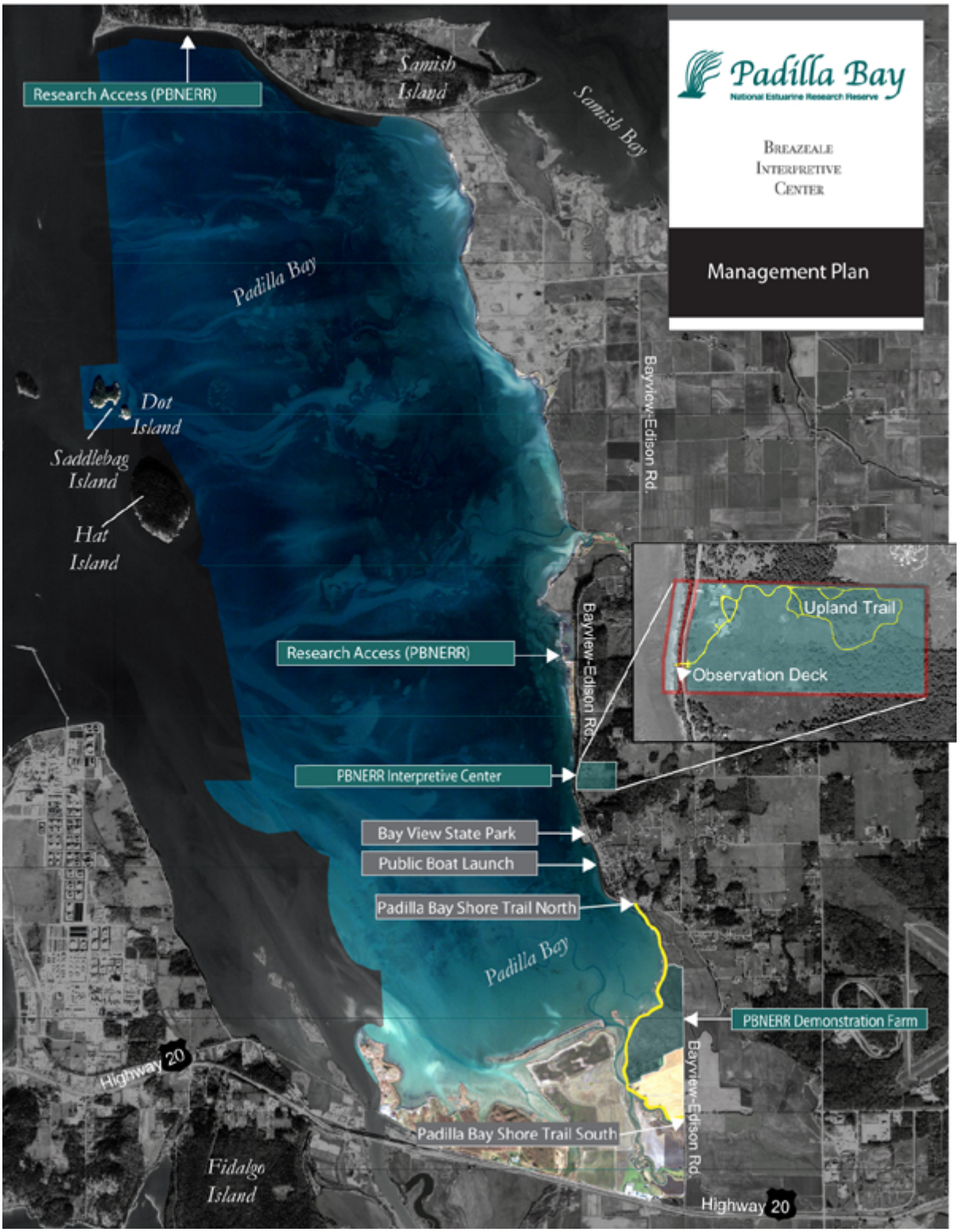

Figure 9.1 Public access points around Padilla Bay. There is ownership by Padilla Bay NERR (Ecology), Washington State Department of Natural Resources, state parks, and Skagit County.

Figure 9.2 The beach at Bay View State Park is open to the public for a day-use fee.

people wanting to stop for a minute and look out at the view, to eat lunch, or to watch a sunset. The improvements to the launch allow for easier kayak access as well. Hunters use the ramp in the fall and winter for launching boats, while kayakers use the ramp whenever the tide allows.

Trails

Two trails provide visitors with interpretive opportunities in different habitats. The Upland Trail starts near the upper parking area and is a 0.8-mile loop through forest and grassland (Fig. 9.4). A booklet at the front desk provides a self-guided interpretive walk. The Skagit County Shore Trail is 2.25 miles long and is located about a mile south of the Interpretive Center. It follows a dike top from the community of Bay View to Little Indian Slough. Pamphlets are available at the Breazeale Interpretive Center showing visitors where the trail is located and how to get there. Visitors may check out a key from the Interpretive Center for the ADA access to the trail. There are interpretive signs along the trail that explain features of the watershed and estuary. It is a very popular trail with the local residents and visitors.

Observation Deck and Beach Access

A short paved trail leads from the Interpretive Center's entrance to an Observation Deck overlooking the bay and to a circular staircase leading to the beach (Fig. 9.5). It provides excellent panoramic views of the bay and access to the beach all year at low tide.

Figure 9.3 The boat ramp in Bay View is used by Reserve staff, kayakers, crabbers and hunters.

Saddlebag Island State Park

Saddlebag Island (including Dot Island) is a 24-acre marine park located in Padilla Bay with 6,750 feet of shoreline. The park is named for the two rocky knobs separated by a narrow "saddle" of land that form the shape of the island. Boaters can camp on the island that is popular for its crabbing

Figure 9.4 The Upland Trail winds through field and forest.

opportunities. It also is a popular site for wildlife viewing, with harbor seals and river otters in the surrounding waters.

Hat Island Natural Resources Conservation Area

This 91-acre conservation area located on the western edge of the Padilla Bay NERR provides habitat for bald eagles, seabirds and shorebirds. The site has no developed public access facilities, but may provide opportunities for long-term scientific study and serve as living laboratories for education.

Other

Several other specific sites around the bay have also been established as limited access areas due to the types of easements held by the State. These sites are accessible either by obtaining direct permission from the landowners/caretakers, or by accompanying Reserve personnel. These areas are mainly used for research and monitoring access, or for staff-guided educational programs. All have been obtained by purchase or gift of easement.

Public Access Challenges

Structures face wear–and-tear and in the past five year period, the boat launch and Upland Trail were upgraded and improved. The Reserve engaged the community in envisioning what changes they wanted to see at the boat launch and then worked to bring that vision to life. The community was consulted because the boat launch is part of Bay View's waterfront. Other challenges include:

- *Damage to habitats from heavy public use.* Our approach is to focus heavy use in two locations (Bay View State Park and Padilla Bay NERR beach) to limit the damage to the majority of habitats.

Figure 9.5 The Observation Deck provides a 180-degree view of Padilla Bay.

- *Litter and vandalism*. Graffiti, damage to structures, and littering largely happens after hours or when some visitors feel they are beyond the view of Reserve staff or management.

- *Damage to structures due to saltwater exposure/storms.* Maintenance of the Observation Deck and Beach Access is substantial due to saltwater exposure and the physical forces of high tides and storms.

Public Access Needs

Padilla Bay NERR is working with the Washington State Department of Fish and Wildlife to evaluate resource protection/enhancement measures and public access opportunities on lands in the south and southeast areas of the Reserve. Both agencies own land adjacent to one another in some locations and public access for hunting is a high priority to the Department of Fish and Wildlife. Hunting on Padilla Bay NERR lands is addressed in Chapter 8 - Resource Protection Plan.

Public Access Objectives and Actions

SUPPORT GOAL 1: The Washington State Department of Ecology provides support for the Reserve's administrative, operational and capital resources activities.

Objective 1: Ecology-owned public access areas are maintained by the Reserve during the 2016-2020 period.

Action: The Facilities Coordinator ensures that janitorial, repairs and maintenance activities are done at Reserve facilities as scheduled.

Action: The Facilities Coordinator will work with contractors and/or facilities staff to repair safety railing on the Observation Deck by 2016.

Action: The Manager will work with contractors and/or facilities staff to improve the Samish Island access by 2018, including signage and a gate to limit access.

Action: Natural resources staff, facilities staff and/or contractors will improve drainage along the Upland Trail by 2020.

Action: Natural resources staff and/or facilities staff will maintain the Upland Trail annually as needed for the safety of visitors and staff.

Action: Natural resources staff and interested volunteers maintain landscaped beds and permeable block pavers at the boat launch on an as-needed basis.

Action: A contractor will be hired to repair the Sullivan Minor stairway in 2016.

Action: Hat Island access areas will be monitored and maintained by Padilla Bay natural resources staff with annual trash collection and signpost maintenance.

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers and partners.

Objective 1: County or state owned public access areas are maintained by those respective agencies from 2016-2020.

Action: The Padilla Bay Shore Trail is maintained by Skagit County Parks and Recreation.

Action: Saddlebag Island State Park and Bay View State Park are maintained by Washington State Parks.

Action: Hat Island access areas are monitored and maintained at least annually by Padilla Bay natural resources staff in cooperation WDNR.

Chapter 10 – Facilities Development and Improvement Plan

Introduction

The presence of adequate facilities and equipment are crucial to successful implementation of research, monitoring, and education programs at Padilla Bay NERR. The Reserve Manager and Facilities Coordinator oversee facilities development and improvement.

Background

In August 1980, an application was accepted by NOAA (Office of Coastal Resource Management) for a 50/50 matching grant to start the first phase of property acquisition and the construction of an interpretive center overlooking the bay. With federal approval complete, property acquisition and facility construction began with the Breazeale Interpretive Center on 64 acres donated by the Breazeale family. It was dedicated in fall, 1982.

During 1984-85 the barn on the 64-acre site was remodeled to provide residential research quarters, laboratory space, a group meeting area, and much needed storage. A 1,900 square foot addition to the Breazeale Interpretive Center was completed in 1986 and provided space for aquarium displays.

With the passing of Miss Edna Breazeale in 1987, her gift of the family residence for Reserve use completed the family's bequest. Minor remodeling provided space for a much needed meeting room and research offices. A Public Access Plan for public beach access was finished in 1987 and trail projects followed soon thereafter, including a pedestrian walkway connecting the interpretive center to the nearby state park. A 2.25-mile trail on the dike in south Padilla Bay opened in 1989, constructed by the Skagit County Parks Department in cooperation with various agencies, including the Department of Ecology. Interpretive signs along the trail were prepared under the direction of Reserve staff. A continuation of the pedestrian walkway along Bay View-Edison Road connected all trail sections. In late 1989 the Reserve finished the final major construction element, which included a pathway from the Interpretive Center under the roadway, an observation deck with interpretive signs, and a stairway to the beach. Additional construction work in the early 1990s provided additional parking for visitors and buses.

In 1997, a Comprehensive Facilities Plan was prepared, identifying the key functional areas needed for the next 15 years. Beginning in 2001, design and site work was completed for the major components of that plan, and the Phase I construction work was completed in 2005 (Interpretive Center expansion and new research laboratory). From 2002-2003 site development work modernized the septic system and established new water, power, data, and communication systems. A complete renovation of the existing

water system was completed, including sufficient storage (60,000 gallons) for fire-suppression and summer landscape irrigation.

Phase II (construction of a bunkhouse and remodeling the Breazeale House and barn) began in 2005 and was completed in early 2007. In late 2006 public water was extended to the campus and fire hydrants were installed. New data and communication lines (fiber optic and category 6 cable) were laid underground, and the entire campus electrical system was upgraded to three-phase power. This phase included design and installation of a 112-panel solar photovoltaic system on the barn roof. In 2009, a boat garage was added to improve security of boats and motors and in 2011 the aquaria exhibit upgrade was completed.

A significant effort has been made over the years to include "green" and "sustainable" elements in our facilities. The original building contained passive solar elements that are still in use today. Shade screens of recycled wood were added on the southern building exposure and native plants for shade were added to reduce cooling costs. Metal roofing is long-lasting and recyclable. Turf-stone driveways provide water permeability and reduce runoff, and bio-filtration swales offer water purification opportunities where runoff does occur. Many interior components are made from recycled and/or recyclable materials, including flooring, tiles, and wallboard. Exterior wood siding is recycled material, and hand dryers reduce paper waste in restrooms. The photovoltaic system on the barn roof reduces electrical costs.

Current Facilities and Descriptions

Locations of current facilities are shown in Fig. 10.1. Descriptions of the facilities follow.

Breazeale Interpretive Center

The Breazeale Interpretive Center covers nearly 11,000 square feet and includes public exhibits, a children's "hands-on" room, aquaria, classroom and small teaching laboratory, theater/lecture auditorium, library, small kitchen and volunteer locker space, staff and intern offices and cubicles and workspace (Fig. 10.2). Constructed in 1982, it was expanded in 1985, 1995 and 2004-2005.

A meeting and office complex was added during the 2004-2005 construction. The downstairs meeting area consists of a lobby, restrooms, kitchen and a meeting space that seats 60 with tables or up to 100 without tables. The space can be divided into two rooms. This space is used by local, state and federal agencies and non-profit groups. This meeting space was utilized by 1,400 people over 90 separate days in 2015. Upstairs there is a smaller conference room that seats about 20 people and office space for three staff members. This space was used for meetings by 200+ people over 40 days in 2015. The use of these rooms was up slightly in 2015 from the previous year. Additional rooms in the meeting complex house the HVAC equipment, elevator and data rooms.

Figure 10.1 Padilla Bay NERR facilities.

Research Laboratory

The 3,400 square foot laboratory (Figs. 10.3, 10.6) has five office cubicles and GIS equipment and map table. The SWMP lab houses the equipment and computers needed to maintain and download the SWMP water quality data and has space for an additional work station, if needed. The lab building also houses a large multi-bench general lab area, storage closet, wet lab, staging area, and volunteer water quality lab. All available technology and data/communications services are provided to this building. This research lab provides facility support for Padilla Bay NERR research, monitoring, and GIS staff and for visiting researchers (about 5 per year), graduate students (2-5 per year) and interns (1-2/year).

Breazeale House

This two-story (1,500 square foot) house was donated to the Reserve by the Breazeale family and became available for Padilla Bay NERR use in 1987 (Figs. 10.3, 10.6). Minor remodeling to meet general fire and building codes was completed in 1988 and a new roof was completed in 1992. The house basement provides a dry storage area for archives, office space for Reserve research and stewardship staff and the Northwest Straits Commission, and a small meeting room for 10-12 people. Under the Phase II construction program, the house underwent interior and exterior upgrades including new windows, insulation, HVAC and electrical systems, new plumbing, flooring, paint and much-improved energy efficiency.

Barn

The 2,500 square foot barn (plus loft) is located adjacent to the Breazeale house. It was remodeled under the Phase II construction program, and provides office space for facilities staff, improved storage capacity for research, an aquarium support tank, and upgraded maintenance workshop. The main open area in the barn and the loft are used for storage. The Phase II construction also created a day-use support area for visiting researchers and staff, including showers, locker room, and small kitchen with tables and internet access. The barn was upgraded with earthquake stability and energy conservation elements. A 112-panel photovoltaic solar generation system on the barn roof provides electrical consumption offsets to the Reserve's demand and costs (Fig. 10.4).

Guesthouse

Another key element of Phase II construction was development of a Guesthouse for 16 residents (Fig. 10.5), with four rooms and four beds (two bunk bed units) in each room. This facility serves both short-term (1-3 day) guests, and longer-term residents (1-4 weeks) with a mix of accommodation styles, work areas, and support infrastructure. It is available for a wide range of visitors, including graduate students, meeting and workshop participants, visiting scientists, and Coastal Training Program participants and

Figure 10.2 The Breazeale Interpretive Center (right) and offices/meeting space facility (left).

Figure 10.3 The Research Laboratory (left) and Breazeale House (right).

Figure 10.4 The Barn facility with solar panels. It houses offices, shop, storage, showers and small kitchen.

Figure 10.5 The Guesthouse or over-night facility.

Figure 10.6 Breazeale House (left), Research Laboratory (middle) and boat garage (right).

Figure 10.7 Multi-purpose shed (left), water storage for fire suppression (silo), and boat garage (right).

instructors. The guesthouse was used by 130 people on 56 separate days in 2015. The use was up slightly over the previous year.

Boat Garage

The 2,800 square foot boat garage (Figs. 10.6 and 10.7) was built in 2010 and houses two research boats (22-foot *Edna B* and 16-foot *Marcellus*), an extra boat trailer, Whaler hull, canoe, and a 10-foot rowboat (*Michael K*). It has a heated room for life jackets and survival suits. The boats were stored outdoors prior to building the garage. The garage is more secure storage and should extend the life of the boats and motors.

Mowers and landscaping equipment and supplies are stored at one end of the garage, along with a gas cabinet for gasoline and diesel. A locked pesticide cabinet is for storage of chemicals used for noxious weed control by a licensed applicator.

Observation Deck

This multi-purpose viewing and beach access facility was completed in 1989 and links the Center to the bay via a short pathway and stairwell. It provides excellent panoramic views of the Bay, access to the beach during spring, summer and fall, and is excellent in winter for waterfowl and raptor observation. Maintenance on this facility is substantial due to saltwater exposure and the physical forces of high tides and winds at the beach. Existing interpretive signs were replaced in 2012.

Upland Trail Visitor Kiosk

A new kiosk at the start of the Upland Trail was built in 2015. It includes interpretive panels about sustainable construction, solar energy, and other topics, along with benches for visitors that want to sit and rest.

Facility Challenges and Gaps

- Some exhibits could be made more inviting to culturally-diverse audiences.
- Office space for interns and graduate students is needed.
- The Breazeale House needs to comply with the Americans with Disabilities Act.
- The energy efficiency of some of the Reserve's buildings could be improved.
- Improved outdoor interpretive signs in some locations.
- Improved public and research access trails, signs, and parking.
- The meeting spaces are popular and have been heavily used by outside groups. The Reserve may begin restricting the use by outside groups so the spaces are more available for Reserve programs and staff.
- Laboratory space has not been heavily utilized by outside researchers but this is addressed in Chapter 3.

Planned Facilities, Facility Upgrades, and Exhibits

The saltwater aquaria in the Interpretive Center are the most popular exhibit at Padilla Bay NERR. Updates to this exhibit over the past six years have enhanced Padilla Bay NERR educational programs and public visitation. The next phase will be a "touch tank" feature that will provide a "hands-on" interpretive experience. We have identified this as a valuable learning tool and the public is strongly supportive of adding this feature to the aquaria display. Also to be included are additional educational displays and making some of the current exhibits inviting to a culturally-diverse audience (e.g., adding a second language).

The Breazeale House provides office space for seven staff and was lightly remodeled several years ago. This facility needs updating to meet requirements of the Americans with Disabilities Act, several "green" improvements such as LED lighting, tankless water heater, insulation, improved doors, etc. An addition to the house would provide much needed work space for interns and graduate students.

Several buildings on the Padilla Bay NERR campus would benefit from energy-saving projects, including installation of a ground-loop HVAC system to reduce heating and cooling costs, solar panels on the laboratory and other buildings, tankless water heaters, LED lighting, and other improvements.

The water access and upland trails are in need of upgrades. This includes the County-managed Shore Trail (needs new interpretive signs) and the shelter on the Upland Trail (structural supports need reinforcement or replacement).

Climate and non-climate stressors

Climate

Because the Reserve's facilities are not on the flood plain, they are protected from river flooding even if the pattern of precipitation and season of flooding change over time. However, severe winter storms and rising sea level could impact the base of the stairs down to the beach from the Observation Deck facility.

The Reserve has started to implement Fire Wise principles (www.firewise.org) to protect facilities from wildfire should hotter, drier summers increase fire danger on Bay View ridge. The grass meadow is very dry by August, so a wider strip is mowed to keep more distance between the tall grass and buildings.

Non-climate

The only non-climate stressors regarding facilities are normal wear-and-tear and occasional vandalism. Dealing with normal wear-and-tear is part of the maintenance plan and any vandalism is repaired as soon as possible.

Facilities Objectives and Actions

SUPPORT GOAL 1: The Washington State Department of Ecology provides support for the Reserve's administrative, operational and capital resources activities.

Objective 1: Padilla Bay NERR infrastructure and facilities will be maintained during 2016-2020.

Action: The Education Coordinator, Education Specialist and Facilities Coordinator (Aquarium Keeper) will cooperate to add a "touch tank" exhibit to the aquarium exhibit, if funding is secured.

Action: The Education Coordinator or Specialist will develop new interpretive signs for the Skagit County Shore Trail by 2020, if funding is secured.

Action: A contractor will be hired to reinforce or replace the structural supports for the Upland Trail shelter by 2020, if funding is secured.

Action: The Manager will arrange for the staircase at the Sullivan Minor research access to be improved or replaced by 2016.

Action: The Manager will arrange for a gate or similar structure to be placed at the Samish Island research access to limit parking.

Objective 2: Padilla Bay NERR will continue green improvements to facilities during 2016-2020, if funding is secured by the Manager.

Action: Ground-loop HVAC will be installed at the Breazeale Interpretive Center by 2020.

Action: Solar panels will be installed on the research laboratory by 2020.

Action: A number of tankless water heaters will replace the more inefficient electric hot water heaters on site by 2020.

Action: Evaluate indoor lighting and convert fluorescent and can lights to LEDs where possible by 2020.

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Chapter 11 – Land Acquisition Plan

Introduction

The State of Washington has been purchasing or receiving (via donation) properties for the Reserve since 1980. The long-term protection of these lands, both core and buffer areas, is critical to the overall mission of Padilla Bay NERR and its uses for research, education, monitoring, and interpretation. Since its establishment in 1980 the Reserve's proposed boundary area has included multiple private ownerships. As of 2015, 11,966 acres of tidelands and uplands are owned by Washington State Department of Ecology or other state agencies for the benefit of the public (Appendix B, Table B.1).

From 1980 to 1989 the State purchased or received by gift a total of over 2,500 acres of tidelands and uplands (2,436 acres tideland + 64 acres upland). This included representative parcels throughout the various habitat types. In 1993 the State obtained 8,004 acres of tidelands held by the Orion Corporation through a negotiated settlement process. After more than twelve years of litigation this settlement brought an end to several rounds of County Superior Court and State Supreme Court actions resulting from the Orion Corporation's lawsuit against the State for purportedly "taking" their tidelands without reasonable compensation (Ecology had offered to purchase these tidelands at appraised value since the early 1980s). Between 1990 and 1997 Padilla Bay NERR continued purchasing tidelands from willing sellers, acquiring 500 acres from many individual private property owners. Renewed acquisition efforts between 2008 and 2014 resulted in purchase of 89 additional acres of tidelands.

In 1995 the Reserve purchased a 129-acre property with 107 acres of farmland and 22 acres of tideland and entered into a cooperative management program with Washington State University, the Skagit Conservation District and local farmers to initiate and monitor experimental farming practices that would hopefully reduce non-point pollution from row-crop agriculture. Discussions also began in 1997 with county officials regarding the purchase of conservation easements on several hundred acres of farmland (within the boundary) through the county's farmland protection program. This program had insufficient funds to acquire the necessary easements. In 2006, Washington State Department of Fish and Wildlife purchased 237 acres of farmland within the buffer. In 1998 the Reserve added the 91-acre Hat Island (owned by Washington Department of Natural Resources) on its western perimeter.

Priority Acquisition Areas and Strategies

Priority acquisition areas. Priority acquisition areas are the remaining tidelands within the boundary and agricultural lands within the buffer (Fig. 1.7).

Acquisition strategy. The strategy is to let willing sellers know through a letter campaign every few years that the Reserve is interested in purchasing these lands. These properties may change ownership over time and new owners may be willing sellers. An on-going purchase program is maintained through the Washington State Department of Enterprise Services/Real Estate Services.

Acquisition of core tidelands is necessary for geographic continuity for research projects and access. Due to the small size and the random distribution of most of the private parcels it is important that Padilla Bay NERR avoid trespass issues by completing fee-simple acquisition of these areas.

Agricultural lands within the buffer on the southern end of the Reserve remain in consideration for less-than-fee acquisition, or by fee-simple acquisition (Fig. 1.7). Some of the agricultural land within the buffer area was purchased by Washington State Department of Fish and Wildlife around 2009 (237 acres). These lands are adjacent to and north and south of the Padilla Bay NERR Demonstration Farm along the southeastern edge of Padilla Bay. The lands are also adjacent to the Shore Trail.

Additional properties lying outside the proposed Padilla Bay NERR boundary, particularly wetlands south of Highway 20 and several critical habitat areas on Bay View Ridge, are important to the ecosystem of Padilla Bay and are under evaluation. These include aquifer recharge areas and wooded stream and drainage corridors of high wildlife value. The Reserve will work with partners to identify and protect key parcels as they become available.

Proposed activity 2016-2020. Purchase offers for the remaining 1,352 acres (Appendix B, Tables B.2, B.3) will be made periodically, with fee-simple title or conservation easements obtained on these lands, consistent with our willing-seller policy. The Reserve will continue to work on all strategies to provide long-term protection of these resources including consideration of major external funding programs.

Climate and non-climate stressors

Climate stressors affecting these lands include rising air and water temperatures, potential flooding due to sea level rise, changing weather patterns, changing precipitation patterns and changes in precipitation itself (rain vs. snow). Rising sea levels may lead to increased saltwater intrusion in agricultural lands adjacent to the bay. Changes in climate may also affect invasive species and this should be considered when purchasing land (e.g., invasive species should be controlled prior to purchase or should be considered when purchasing as they are time intensive and expensive to control over time).

Non-climate stressors include possible nutrient pollution and bacterial pollution (possible declining water quality); development in the watershed (possible increased impervious surfaces and resulting impact on water quantity, increased stormwater runoff

and possible pollution); river flooding in fall or spring; with possible other stressors depending on the property in question.

Acquisition Objectives and Actions

SUPPORT GOAL 2: The Reserve supports a collaborative work environment that involves stakeholders, staff members, volunteers and partners.

Objective 1: The Reserve coordinates with local and regional agencies and environmental organizations that protect and preserve key lands in the watershed from 2016-2020.

Action: The Manager and/or Stewardship Coordinator will communicate with appropriate partners about land acquisition and conservation goals for the Reserve.

Action: The Reserve will support partners, such as the Skagit Land Trust, in obtaining conservation easements or lands in the Padilla Bay watershed that help protect natural resources and the estuary.

CORE GOAL 4: The Reserve manages coastal resources in a sustainable manner for the benefit of the ecosystem and the public.

Objective 1: Obtain remaining private in-holdings within the Reserve's boundary from willing sellers from 2016-2020.

Action: The Manager will retain the Washington State Department of Enterprise Services real estate staff and initiate offers throughout 2016-2020 at appraised value on remaining core (tideland and marsh) areas (approximately 738 acres.)

Action: The Manager will meet with owners of buffer lands within the boundary and critical habitat areas in the watershed and discuss opportunities for easements or less-than-fee acquisition and funding opportunities during this period.

Action: The Manager and Stewardship Coordinator will investigate the availability and priority of Coastal Estuarine Land Conservation Program (CELCP) funding for key purchases during this period.

Action: The GIS Analyst maintains the private parcel (within the Reserve boundary) data layer for use during this period.

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Appendix A

NERRS Regulations

Code of Federal Regulations

Title 15, Volume 3, Revised as of January 1, 2003
From the U.S. Government Printing Office via GPO Access
[CITE: 15CFR921]

TITLE 15--COMMERCE AND FOREIGN TRADE

CHAPTER IX--NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE

PART 921--NATIONAL ESTUARINE RESEARCH RESERVE SYSTEMREGULATIONS

Authority: Section 315 of the Coastal Zone Management Act, as amended (16 U.S.C. 1461).
Source: 58 FR 38215, July 15, 1993, unless otherwise noted.

SubPart A - General

Sec. 921.1 Mission, goals and general provisions.

(a) The mission of the National Estuarine Research Reserve Program is the establishment and management, through Federal-state cooperation, of a national system (National Estuarine Research Reserve System or System) of estuarine research reserves (National Estuarine Research Reserves or Reserves) representative of the various regions and estuarine types in the United States. National Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.

(b) The goals of the Program are to:
1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the System;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.(c) National Estuarine Research Reserves shall be open to the public to the extent permitted under state and Federal law. Multiple uses are allowed to the degree compatible with each Reserve's overall purpose as provided in the management plan(see Sec. 921.13) and consistent with paragraphs (a) and (b) of this section. Use levels are set by the state where the Reserve is located and analyzed in the management plan. The Reserve management plan shall describe the uses and establish priorities among these uses. The plan shall identify uses requiring a state permit, as well as areas where uses are encouraged or prohibited. Consistent with resource protection and research objectives, public access and use may be restricted to certain areas or components within a Reserve.

(d) Habitat manipulation for research purposes is allowed consistent with the following limitations. Manipulative research activities must be specified in the management plan, be consistent with the mission and goals of the program (see paragraphs (a) and (b) of this section) and the goals and objectives set forth in the Reserve's management plan, and be limited in nature and extent to the minimum manipulative activity necessary to accomplish the stated research objective. Manipulative research activities with a significant or long-term impact on Reserve resources require the prior approval of the state and the National Oceanic and Atmospheric Administration (NOAA). Manipula-

tive research activities which can reasonably be expected to have a significant adverse impact on the estuarine resources and habitat of a Reserve, such that the activities themselves or their resulting short- and long-term consequences compromise the representative character and integrity of a Reserve, are prohibited. Habitat manipulation for resource management purposes is prohibited except as specifically approved by NOAA as:

(1) A restoration activity consistent with paragraph (e) of this section; or

(2) an activity necessary for the protection of public health or the preservation of other sensitive resources which have been listed or are eligible for protection under relevant Federal or state authority (e.g., threatened/endangered species or significant historical or cultural resources) or if the manipulative activity is a long- term pre-existing use (i.e., has occurred prior to designation) occurring in a buffer area. If habitat manipulation is determined to be necessary for the protection of public health, the preservation of sensitive resources, or if the manipulation is a long-term pre-existing use in a buffer area, then these activities shall be specified in the Reserve management plan in accordance with Sec. 921.13(a)(10) and shall be limited to the reasonable alternative which has the least adverse and shortest term impact on the representative and ecological integrity of the Reserve.

(e) Under the Act an area may be designated as an estuarine Reserve only if the area is a representative estuarine ecosystem that is suitable for long-term research. Many estuarine areas have undergone some ecological change as a result of human activities (e.g., hydrological changes, intentional/unintentional species composition changes--introduced and exotic species). In those areas proposed or designated as National Estuarine Research Reserves, such changes may have diminished the representative character and integrity of the site. Although restoration of degraded areas is not a primary purpose of the System, such activities may be permitted to improve the representative character and integrity of a Reserve. Restoration activities must be carefully planned and approved by NOAA through the Reserve management plan. Historical research may be necessary to determine the ``natural'' representative state of an estuarine area (i.e., an estuarine ecosystem minimally affected by human activity or influence). Frequently, restoration of a degraded estuarine area will provide an excellent opportunity for management oriented research.

(f) NOAA may provide financial assistance to coastal states, not to exceed, per Reserve, 50 percent of all actual costs or $5 million whichever amount is less, to assist in the acquisition of land and waters, or interests therein. NOAA may provide financial assistance to coastal states not to exceed 70 percent of all actual costs for the management and operation of, the development and construction of facilities, and the conduct of educational or interpretive activities concerning Reserves (see subpart I). NOAA may provide financial assistance to any coastal state or public or private person, not to exceed 70 percent of all actual costs, to support research and monitoring within a Reserve. Notwithstanding any financial assistance limits established by this Part, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available. Predesignation, acquisition and development, operation and management, special research and monitoring, and special education and interpretation awards are available under the National Estuarine Reserve Program. Predesignation awards are for site selection/feasibility, draft management plan preparation and conduct of basic characterization studies. Acquisition and development awards are intended primarily for acquisition of interests in land, facility construction and to develop and/or upgrade research, monitoring and education programs. Operation and management awards provide funds to assist in implementing, operating and managing the administrative, and basic research, monitoring and education programs, outlined in the Reserve management plan. Special research and monitoring awards provide funds to conduct estuarine research and monitoring projects with the System. Special educational and interpretive awards provide funds to conduct estuarine educational and interpretive projects within the System.

(g) Lands already in protected status managed by other Federal agencies, state or local governments, or private organizations may be included within National Estuarine Research Reserves only if the managing entity commits to long-term management consistent with paragraphs (d) and (e) of this section in the Reserve management plan. Federal lands already in protected status may not comprise a majority of the key land and water areas of a Reserve (see Sec. 921.11(c)(3)).

(h) To assist the states in carrying out the Program's goals in an effective manner, NOAA will coordinate a research and education information exchange throughout the National Estuarine Research Reserve System. As part of this role, NOAA will ensure that information and ideas from one Reserve are made available to others in the System. The network will enable Reserves to exchange information and research data with each other, with universities engaged in estuarine research, and with Federal, state, and local agencies. NOAA's objective is a system- wide program of research and monitoring capable of addressing the management issues that affect long-term productivity of our Nation's estuaries.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].

Sec. 921.2 Definitions

(a) Act means the Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.
(b) Assistant Administrator means the Assistant Administrator for Ocean Services and Coastal Zone Management or delegate.
(c) Coastal state means a state of the United States, in or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes. For the purposes of these regulations the term also includes Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Marianas Islands, the Trust Territories of the Pacific Islands, and American Samoa (see 16 U.S.C. 1453(4)).
(d) State agency means an instrumentality of a coastal state to whom the coastal state has delegatticable with the approved state coastal management program as provided by section 1456(c)(1) of the Act, and implementing regulations at 15 CFR part 930, subpart C. In accordance with section 1456(c)(1) of the Act and the applicable regulations NOAA will be responsible for certifying that designation of the Reserve is consistent with the state's approved coastal management program. The state must concur with or object to the certification. It is recommended that the lead state agency for Reserve designation consult, at the earliest practicable time, with the appropriate state officials concerning the consistency of a proposed National Estuarine Research Reserve.
(c) The National Estuarine Research Reserve Program will be administered in close coordination with the National Marine Sanctuary Program (Title III of the Marine Protection, Research and Sanctuaries Act, as amended, 16 U.S.C. 1431-1445), also administered by NOAA. Title III authorizes the Secretary of Commerce to designate discrete areas of the marine environment as National Marine Sanctuaries to protect or restore such areas for their conservation, recreational, ecological, historical, research, educational or esthetic values. National Marine Sanctuaries and Estuarine Research Reserves may not overlap, but may be adjacent.

Subpart B--Site Selection, Post Site Selection and Management Plan Development

Sec. 921.10 General.

(a) A coastal state may apply for Federal financial assistance for the purpose of site selection, preparation of documents specified in Sec. 921.13 (draft management plan (DMP) and environmental impact statement (EIS)), and the conduct of limited basic characterization studies. The total Federal share of this assistance may not exceed $100,000. Federal financial assistance for preacquisition activities under Sec. 921.11 and Sec. 921.12 is subject to the total $5 million for which each Reserve is eligible for land acquisition. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carried out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more coastal states, each state is eligible for Federal financial assistance to establish a sepa-

rate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Each separate National Estuarine Research Reserve is eligible for the full complement of funding. Financial assistance application procedures are specified in subpart I.

(b) In developing a Reserve program, a state may choose to develop a multiple-site Reserve reflecting a diversity of habitats in a single biogeographic region. A multiple- site Reserve allows the state to develop complementary research and educational programs within the individual components of its multi-site Reserve. Multiple-site Reserves are treated as one Reserve in terms of financial assistance and development of an overall management framework and plan. Each individual site of a proposed multiple-site Reserve shall be evaluated both separately under Sec. 921.11(c) and collectively as part of the site selection process. A coastal state may propose to establish a multiple-site Reserve at the time of the initial site selection, or at any point in the development or operation of the Reserve. If the state decides to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award is made for a single site, the proposal is subject to the requirements set forth in Sec. 921.33(b). However, a state may not propose to add one or more sites to an already designated Reserve if the operation and management of such Reserve has been found deficient and uncorrected or the research conducted is not consistent with the Estuarine Research Guidelines referenced in Sec. 921.51. In addition, Federal funds for the acquisition of a multiple-site Reserve remain limited to $5,000,000 (see Sec. 921.20). The funding for operation of a multiple-site Reserve is limited to the maximum allowed for any one Reserve per year (see Sec. 921.32(c)) and preacquisition funds are limited to $100,000 per Reserve. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

[58 FR 38215, July 15, 1993, as amended at 63 FR 26717, May 14, 1998].

Sec. 921.11 Site selection and feasibility.

(a) A coastal state may use Federal funds to establish and implement a site selection process which is approved by NOAA.
(b) In addition to the requirements set forth in subpart I, a request for Federal funds for site selection must contain the following programmatic information:
   1. A description of the proposed site selection process and how it will be implemented in conformance with the biogeographic classification scheme and typology (Sec. 921.3);
   2. An identification of the site selection agency and the potential management agency; and
   3. A description of how public participation will be incorporated into the process (see Sec. 921.11(d)).
(c) As part of the site selection process, the state and NOAA shall evaluate and select the final site(s). NOAA has final authority in approving such sites. Site selection shall be guided by the following principles:
   1. The site's contribution to the biogeographical and typological balance of the National Estuarine Research Reserve System. NOAA will give priority consideration to proposals to establish Reserves in biogeographic regions or subregions or incorporating types that are not represented in the system. (see the biogeographic classification scheme and typology set forth in Sec. 921.3 and appendices I and II);
   2. The site's ecological characteristics, including its biological productivity, diversity of flora and fauna, and capacity to attract a broad range of research and educational interests. The proposed site must be a representative estuarine ecosystem and should, to the maximum extent possible, be an estuarine ecosystem minimally affected by human activity or influence (see Sec. 921.1(e)).
   3. Assurance that the site's boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Boundary size will vary greatly depending on the nature of the ecosystem. Reserve boundaries must encompass the area within which adequate control has or will be established by the

managing entity over human activities occurring within the Reserve. Generally, Reserve boundaries will encompass two areas: Key land and water areas (or ``core area'') and a buffer zone. Key land and water areas and a buffer zone will likely require significantly different levels of control (see Sec. 921.13(a)(7)). The term ``key land and water areas'' refers to that core area within the Reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are ``key'' to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the Reserve. The term buffer zone refers to an area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. National Estuarine Research Reserves may include existing Federal or state lands already in a protected status where mutual benefit can be enhanced. However, NOAA will not approve a site for potential National Estuarine Research Reserve status that is dependent primarily upon the inclusion of currently protected Federal lands in order to meet the requirements for Reserve status (such as key land and water areas). Such lands generally will be included within a Reserve to serve as a buffer or for other ancillary purposes; and may be included, subject to NOAA approval, as a limited portion of the core area;

4. The site's suitability for long-term estuarine research, including ecological factors and proximity to existing research facilities and educational institutions;
5. The site's compatibility with existing and potential land and water uses in contiguous areas as well as approved coastal and estuarine management plans; and
6. The site's importance to education and interpretive efforts, consistent with the need for continued protection of the natural system.

(d) Early in the site selection process the state must seek the views of affected landowners, local governments, other state and Federal agencies and other parties who are interested in the area(s) being considered for selection as a potential National Estuarine Research Reserve. After the local government(s) and affected landowner(s) have been contacted, at least one public meeting shall be held in the vicinity of the proposed site. Notice of such a meeting, including the time, place, and relevant subject matter, shall be announced by the state through the area's principal newspaper at least 15 days prior to the date of the meeting and by NOAA in the Federal Register.

(e) A state request for NOAA approval of a proposed site (or sites in the case of a multi-site Reserve) must contain a description of the proposed site(s) in relationship to each of the site selection principals (Sec. 921.11(c)) and the following information:

1. An analysis of the proposed site(s) based on the biogeographical scheme/typology discussed in Sec. 921.3 and set forth in appendices I and II;
2. A description of the proposed site(s) and its (their) major resources, including location, proposed boundaries, and adjacent land uses. Maps are required;
3. A description of the public participation process used by the state to solicit the views of interested parties, a summary of comments, and, if interstate issues are involved, documentation that the Governor(s) of the other affected state(s) has been contacted. Copies of all correspondence, including contact letters to all affected landowners must be appended;
4. A list of all sites considered and a brief statement of the reasons why a site was not preferred; and
5. A nomination of the proposed site(s) for designation as a National Estuarine Research Reserve by

the Governor of the coastal state in which the state is located.

(f) A state proposing to reactivate an inactive site, previously approved by NOAA for development as an Estuarine Sanctuary or Reserve, may apply for those funds remaining, if any, provided for site selection and feasibility (Sec. 921.11a)) to determine the feasibility of reactivation. This feasibility study must comply with the requirements set forth in Sec. 921.11 (c) through (e).

Sec. 921.12 Post site selection.

(a) At the time of the coastal state's request for NOAA approval of a proposed site, the state may submit a request for funds to develop the draft management plan and for preparation of the EIS. At this time, the state may also submit a request for the remainder of the predesignation funds to perform a limited basic characterization of the physical, chemical and biological characteristics of the site approved by NOAA necessary for providing EIS information to NOAA. The state's request for these post site selection funds must be accompanied by the information specified in subpart I and, for draft management plan development and EIS information collection, the following programmatic information:
   1. A draft management plan outline (see Sec. 921.13(a) below); and
   2. An outline of a draft memorandum of understanding (MOU) between the state and NOAA detailing the Federal-state role in Reserve management during the initial period of Federal funding and expressing the state's long-term commitment to operate and manage the Reserve.

(b) The state is eligible to use the funds referenced in Sec. 921.12(a) after the proposed site is approved by NOAA under the terms of Sec. 921.11.

Sec. 921.13 Management plan and environmental impact statement development.

(a) After NOAA approves the state's proposed site and application for funds submitted pursuant to Sec. 921.12, the state may begin draft management plan development and the collection of information necessary for the preparation by NOAA of an EIS. The state shall develop a draft management plan, including an MOU. The plan shall set out in detail:
   1. Reserve goals and objectives, management issues, and strategies or actions for meeting the goals and objectives;
   2. An administrative plan including staff roles in administration, research, education/interpretation, and surveillance and enforcement;
   3. A research plan, including a monitoring design;
   4. An education/interpretive plan;
   5. A plan for public access to the Reserve;
   6. A construction plan, including a proposed construction schedule, general descriptions of proposed developments and general cost estimates. Information should be provided for proposed minor construction projects in sufficient detail to allow these projects to begin in the initial phase of acquisition and development. A categorical exclusion, environmental assessment, or EIS may be required prior to construction;
   7. (i) An acquisition plan identifying the ecologically key land and water areas of the Reserve, ranking these areas according to their relative importance, and including a strategy for establishing adequate long-term state control over these areas sufficient to provide protection for Reserve resources to ensure a stable environment for research. This plan must include an identification of ownership within the proposed Reserve boundaries, including land already in the public domain; the method(s) of acquisition which the state proposes to use--acquisition (including less-than-fee simple options) to establish adequate long-term state control; an estimate of the fair market value of any property interest--which is proposed for acquisition; a schedule estimating the time required to complete the process of establishing adequate state control of the proposed research reserve; and a discussion of any anticipated problems. In selecting a preferred method(s) for establishing adequate state control over areas within the proposed bound-

aries of the Reserve, the state shall perform the following steps for each parcel determined to be part of the key land and water areas (control over which is necessary to protect the integrity of the Reserve for research purposes), and for those parcels required for research and interpretive support facilities or buffer purposes:

(A) Determine, with appropriate justification, the minimum level of control(s) required [e.g., management agreement, regulation, less-than-fee simple property interest (e.g., conservation easement), fee simple property acquisition, or a combination of these approaches]. This does not preclude the future necessity of increasing the level of state control;

(B) Identify the level of existing state control(s);

(C) Identify the level of additional state control(s), if any, necessary to meet the minimum requirements identified in paragraph (a)(7)(i)(A) of this section;

(D) Examine all reasonable alternatives for attaining the level of control identified in paragraph (a)(7)(i)(C) of this section, and perform a cost analysis of each; and

(E) Rank, in order of cost, the methods (including acquisition) identified in paragraph (a)(7)(i)(D) of this section.

(ii) An assessment of the relative cost-effectiveness of control alternatives shall include a reasonable estimate of both short-term costs (e.g., acquisition of property interests, regulatory program development including associated enforcement costs, negotiation, adjudication, etc.) and long-term costs (e.g., monitoring, enforcement, adjudication, management and coordination). In selecting a preferred method(s) for establishing adequate state control over each parcel examined under the process described above, the state shall give priority consideration to the least costly method(s) of attaining the minimum level of long-term control required. Generally, with the possible exception of buffer areas required for support facilities, the level of control(s) required for buffer areas will be considerably less than that required for key land and water areas. This acquisition plan, after receiving the approval of NOAA, shall serve as a guide for negotiations with landowners. A final boundary for the reserve shall be delineated as a part of the final management plan;

8. A resource protection plan detailing applicable authorities, including allowable uses, uses requiring a permit and permit requirements, any restrictions on use of the research reserve, and a strategy for research reserve surveillance and enforcement of such use restrictions, including appropriate government enforcement agencies;
9. If applicable, a restoration plan describing those portions of the site that may require habitat modification to restore natural conditions;
10. If applicable, a resource manipulation plan, describing those portions of the Reserve buffer in which long-term pre-existing (prior to designation) manipulation for reasons not related to research or restoration is occurring. The plan shall explain in detail the nature of such activities, shall justify why such manipulation should be permitted to continue within the reserve buffer; and shall describe possible effects of this manipulation on key land and water areas and their resources;
11. A proposed memorandum of understanding (MOU) between the state and NOAA regarding the Federal-state relationship during the establishment and development of the National Estuarine Research Reserve, and expressing a long-term commitment by the state to maintain and manage the Reserve in accordance with section 315 of the Act, 16 U.S.C. 1461, and applicable regulations. In conjunction with the MOU, and where possible under state law, the state will consider taking appropriate administrative or legislative action to ensure the long-term protection and operation of the National Estuarine Research Reserve. If other MOUs are necessary (such as with a Federal agency, another state agency or private organization), drafts of such MOUs must be included in the plan. All necessary MOU's shall be signed prior to Reserve designation; and
12. If the state has a federally approved coastal management program, a certification that the National Estuarine Research Reserve is consistent to the maximum extent practicable with that program. See Secs. 921.4(b) and 921.30(b).

(b) Regarding the preparation of an EIS under the National Environmental Policy Act on a National Estuarine Research Reserve proposal, the state and NOAA shall collect all necessary information concerning the socioeconomic and environmental impacts associated with implementing the draft

management plan and feasible alternatives to the plan. Based on this information, the state will draft and provide NOAA with a preliminary EIS.

(c) Early in the development of the draft management plan and the draft EIS, the state and NOAA shall hold a scoping meeting (pursuant to NEPA) in the area or areas most affected to solicit public and government comments on the significant issues related to the proposed action. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the meeting. The state shall be responsible for publishing a similar notice in the local media.

(d) NOAA will publish a Federal Register notice of intent to prepare a draft EIS. After the draft EIS is prepared and filed with the Environmental Protection Agency (EPA), a Notice of Availability of the draft EIS will appear in the Federal Register. Not less than 30 days after publication of the notice, NOAA will hold at least one public hearing in the area or areas most affected by the proposed national estuarine research reserve. The hearing will be held no sooner than 15 days after appropriate notice of the meeting has been given in the principal news media by the state and in the Federal Register by NOAA. After a 45-day comment period, a final EIS will be prepared by the state and NOAA.

Subpart C--Acquisition, Development and Preparation of the Final Management Plan

Sec. 921.20 General.

The acquisition and development period is separated into two major phases. After NOAA approval of the site, draft management plan and draft MOU, and completion of the final EIS, a coastal state is eligible for an initial acquisition and development award(s). In this initial phase, the state should work to meet the criteria required for formal research reserve designation; e.g., establishing adequate state control over the key land and water areas as specified in the draft management plan and preparing the final management plan. These requirements are specified in Sec. 921.30. Minor construction in accordance with the draft management plan may also be conducted during this initial phase. The initial acquisition and development phase is expected to last no longer than three years. If necessary, a longer time period may be negotiated between the state and NOAA. After Reserve designation, a state is eligible for a supplemental acquisition and development award(s) in accordance with Sec. 921.31. In this post-designation acquisition and development phase, funds may be used in accordance with the final management plan to construct research and educational facilities, complete any remaining land acquisition, for program development, and for restorative activities identified in the final management plan. In any case, the amount of Federal financial assistance provided to a coastal state with respect to the acquisition of lands and waters, or interests therein, for any one National Estuarine Research Reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein or $5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].

Sec. 921.21 Initial acquisition and development awards.

(a) Assistance is provided to aid the recipient prior to designation in:
1. Acquiring a fee simple or less-than-fee simple real property interest in land and water areas to be included in the Reserve boundaries (see Sec. 921.13(a)(7); Sec. 921.30(d));
2. Minor construction, as provided in paragraphs (b) and (c) of this section;
3. Preparing the final management plan; and
4. Initial management costs, e.g., for implementing the NOAA approved draft management plan, hir-

ing a Reserve manager and other staff as necessary and for other management-related activities. Application procedures are specified in subpart I.

(b) The expenditure of Federal and state funds on major construction activities is not allowed during the initial acquisition and development phase. The preparation of architectural and engineering plans, including specifications, for any proposed construction, or for proposed restorative activities, is permitted. In addition, minor construction activities, consistent with paragraph (c) of this section also are allowed. The NOAA-approved draft management plan must, however, include a construction plan and a public access plan before any award funds can be spent on construction activities.

(c) Only minor construction activities that aid in implementing portions of the management plan (such as boat ramps and nature trails) are permitted during the initial acquisition and development phase. No more than five (5) percent of the initial acquisition and development award may be expended on such activities. NOAA must make a specific determination, based on the final EIS, that the construction activity will not be detrimental to the environment.

(d) Except as specifically provided in paragraphs (a) through (c) of this section, construction projects, to be funded in whole or in part under an acquisition and development award(s), may not be initiated until the Reserve receives formal designation (see Sec. 921.30). This requirement has been adopted to ensure that substantial progress in establishing adequate state control over key land and water areas has been made and that a final management plan is completed before major sums are spent on construction. Once substantial progress in establishing adequate state control/acquisition has been made, as defined by the state in the management plan, other activities guided by the final management plan may begin with NOAA's approval.

(e) For any real property acquired in whole or part with Federal funds for the Reserve, the state shall execute suitable title documents to include substantially the following provisions, or otherwise append the following provisions in a manner acceptable under applicable state law to the official land record(s):

1. Title to the property conveyed by this deed shall vest in the [recipient of the award granted pursuant to section 315 of the Act, 16 U.S.C. 1461 or other NOAA approved state agency] subject to the condition that the designation of the [name of National Estuarine Reserve] is not withdrawn and the property remains part of the federally designated [name of National Estuarine Research Reserve]; and
2. In the event that the property is no longer included as part of the Reserve, or if the designation of the Reserve of which it is part is withdrawn, then NOAA or its successor agency, after full and reasonable consultation with the State, may exercise the following rights regarding the disposition of the property:

(i) The recipient may retain title after paying the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the current fair market value of the property;

(ii) If the recipient does not elect to retain title, the Federal Government may either direct the recipient to sell the property and pay the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the proceeds from the sale (after deducting actual and reasonable selling and repair or renovation expenses, if any, from the sale proceeds), or direct the recipient to transfer title to the Federal Government. If directed to transfer title to the Federal Government, the recipient shall be entitled to compensation computed by applying the recipient's percentage of participation in the cost of the original project to the current fair market value of the property; and

(iii) Fair market value of the property must be determined by an independent appraiser and certified by a responsible official of the state, as provided by Department of Commerce regulations at 15 CFR part 24, and Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally assisted programs at 15 CFR part 11.

(f) Upon instruction by NOAA, provisions analogous to those of Sec. 921.21(e) shall be included in the documentation underlying less-then-fee-simple interests acquired in whole or part with Federal funds.

(g) Federal funds or non-Federal matching share funds shall not be spent to acquire a real property interest in which the state will own the land concurrently with another entity unless the property

interest has been identified as a part of an acquisition strategy pursuant to Sec. 921.13(7) which has been approved by NOAA prior to the effective date of these regulations.

(h) Prior to submitting the final management plan to NOAA for review and approval, the state shall hold a public meeting to receive comment on the plan in the area affected by the estuarine research reserve. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the public meeting. The state shall be responsible for having a similar notice published in the local newspaper(s).

Subpart D--Reserve Designation and Subsequent Operation

Sec. 921.30 Designation of National Estuarine Research Reserves.

(a) The Under Secretary may designate an area proposed for designation by the Governor of the state in which it is located, as a National Estuarine Research Reserve if the Under Secretary finds:

1. The area is a representative estuarine ecosystem that is suitable for long- term research and contributes to the biogeographical and typological balance of the System;
2. Key land and water areas of the proposed Reserve, as identified in the management plan, are under adequate state control sufficient to provide long-term protection for reserve resources to ensure a stable environment for research;
3. Designation of the area as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation;
4. A final management plan has been approved by NOAA;
5. An MOU has been signed between the state and NOAA ensuring a long-term commitment by the state to the effective operation and implementation of the area as a National Estuarine Research Reserve;
6. All MOU's necessary for reserve management (i.e., with relevant Federal, state, and local agencies and/or private organizations) have been signed; and 7. The coastal state in which the area is located has complied with the requirements of subpart B.

(b) NOAA will determine whether the designation of a National Estuarine Research Reserve in a state with a federally approved coastal zone management program directly affects the coastal zone. If the designation is found to directly affect the coastal zone, NOAA will make a consistency determination pursuant to Sec. 307(c)(1) of the Act, 16 U.S.C. 1456, and 15 CFR part 930, subpart C. See Sec. 921.4(b). The results of this consistency determination will be published in the Federal Register when the notice of designation is published. See Sec. 921.30(c).

(c) NOAA will publish the notice of designation of a National Estuarine Research Reserve in the Federal Register. The state shall be responsible for having a similar notice published in the local media.

(d) The term state control in Sec. 921.30(a)(3) does not necessarily require that key land and water areas be owned by the state in fee simple. Acquisition of less-than- fee simple interests e.g., conservation easements) and utilization of existing state regulatory measures are encouraged where the state can demonstrate that these interests and measures assure adequate long-term state control consistent with the purposes of the research reserve (see also Secs. 921.13(a)(7); 921.21(g)). Should the state later elect to purchase an interest in such lands using NOAA funds, adequate justification as to the need for such acquisition must be provided to NOAA.

Sec. 921.31 Supplemental acquisition and development awards.

After National Estuarine Research Reserve designation, and as specified in the approved management plan, a coastal state may request a supplemental acquisition and/or development award(s) for acquiring additional property interests identified in the management plan as necessary to strengthen protection of key land and water areas and to enhance long-term protection of the area for research and education, for facility and exhibit construction, for restorative activities identified in the approved management plan, for administrative purposes related to acquisition and/or facility construction and to develop and/or

upgrade research, monitoring and education/interpretive programs. Federal financial assistance provided to a National Estuarine Research Reserve for supplemental development costs directly associated with facility construction (i.e., major construction activities) may not exceed 70 percent of the total project cost, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. NOAA must make a specific determination that the construction activity will not be detrimental to the environment. Acquisition awards for the acquisition of lands or waters, or interests therein, for any one reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein of $5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more states, each state is eligible independently for Federal financial assistance to establish a separate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Application procedures are specified in subpart I. Land acquisition must follow the procedures specified in Secs. 921.13(a)(7), 921.21(e) and (f) and 921.81.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].

Sec. 921.32 Operation and management: Implementation of the management plan.

(a) After the Reserve is formally designated, a coastal state is eligible to receive Federal funds to assist the state in the operation and management of the Reserve including the management of research, monitoring, education, and interpretive programs. The purpose of this Federally funded operation and management phase is to implement the approved final management plan and to take the necessary steps to ensure the continued effective operation of the Reserve.
(b) State operation and management of the Reserves shall be consistent with the mission, and shall further the goals of the National Estuarine Research Reserve program (see Sec. 921.1).
(c) Federal funds are available for the operation and management of the Reserve. Federal funds provided pursuant to this section may not exceed 70 percent of the total cost of operating and managing the Reserve for any one year, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. In the case of a biogeographic region (see Appendix I) shared by two or more states, each state is eligible for Federal financial assistance to establish a separate Reserve within their respective portion of the shared biogeographic region (see Sec. 921.10).
(d) Operation and management funds are subject to the following limitations:
    1. Eligible coastal state agencies may apply for up to the maximum share available per Reserve for that fiscal year. Share amounts will be announced annually by letter from the Sanctuary and Reserves Division to all participating states. This letter will be provided as soon as practicable following approval of the Federal budget for that fiscal year. 2. No more than ten percent of the total amount (state and Federal shares) of each operation and management award may be used for construction-type activities. [58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].

Sec. 921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.

(a) Changes in the boundary of a Reserve and major changes to the final management plan, including state laws or regulations promulgated specifically for the Reserve, may be made only after written approval by NOAA. NOAA may require public notice, including notice in the Federal Register and an opportunity for public comment before approving a boundary or management plan change. Changes

in the boundary of a Reserve involving the acquisition of properties not listed in the management plan or final EIS require public notice and the opportunity for comment; in certain cases, a categorical exclusion, an environmental assessment and possibly an environmental impact statement may be required. NOAA will place a notice in the Federal Register of any proposed changes in Reserve boundaries or proposed major changes to the final management plan. The state shall be responsible for publishing an equivalent notice in the local media. See also requirements of Secs. 921.4(b) and 921.13(a)(11).

(b) As discussed in Sec. 921.10(b), a state may choose to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award for a single site has been made. NOAA will publish notice of the proposed new site including an invitation for comments from the public in the Federal Register. The state shall be responsible for publishing an equivalent notice in the local newspaper(s). An EIS, if required, shall be prepared in accordance with section Sec. 921.13 and shall include an administrative framework for the multiple-site Reserve and a description of the complementary research and educational programs within the Reserve. If NOAA determines, based on the scope of the project and the issues associated with the additional site(s), that an environmental assessment is sufficient to establish a multiple-site Reserve, then the state shall develop a revised management plan which, concerning the additional component, incorporates each of the elements described in Sec. 921.13(a). The revised management plan shall address goals and objectives for all components of the multi-site Reserve and the additional component's relationship to the original site(s).

(c) The state shall revise the management plan for a Reserve at least every five years, or more often if necessary. Management plan revisions are subject to (a) above.

(d) NOAA will approve boundary changes, amendments to management plans, or the addition of multiple-site components, by notice in the Federal Register. If necessary NOAA will revise the designation document (findings) for the site.

Subpart E--Ongoing Oversight, Performance Evaluation and Withdrawal of Designation

Sec. 921.40 Ongoing oversight and evaluations of designated National Estuarine Research Reserves.

(a) The Sanctuaries and Reserve Division shall conduct, in accordance with section 312 of the Act and procedures set forth in 15 CFR part 928, ongoing oversight and evaluations of Reserves. Interim sanctions may be imposed in accordance with regulations promulgated under 15 CFR part 928.

(b) The Assistant Administrator may consider the following indicators of non- adherence in determining whether to invoke interim sanctions:

1. Inadequate implementation of required staff roles in administration, research, education/interpretation, and surveillance and enforcement. Indicators of inadequate implementation could include: No Reserve Manager, or no staff or insufficient staff to carry out the required functions.
2. Inadequate implementation of the required research plan, including the monitoring design. Indicators of inadequate implementation could include: Not carrying out research or monitoring that is required by the plan, or carrying out research or monitoring that is inconsistent with the plan.
3. Inadequate implementation of the required education/interpretation plan. Indicators of inadequate implementation could include: Not carrying out education or interpretation that is required by the plan, or carrying out education/interpretation that is inconsistent with the plan.
4. Inadequate implementation of public access to the Reserve. Indicators of inadequate implementation of public access could include: Not providing necessary access, giving full consideration to the need to keep some areas off limits to the public in order to protect fragile resources.
5. Inadequate implementation of facility development plan. Indicators of inadequate implementation could include: Not taking action to propose and budget for necessary facilities, or not undertaking necessary construction in a timely manner when funds are available.
6. Inadequate implementation of acquisition plan. Indicators of inadequate implementation could include: Not pursuing an aggressive acquisition program with all available funds for that purpose, not requesting promptly additional funds when necessary, and evidence that adequate long-term

state control has not been established over some core or buffer areas, thus jeopardizing the ability to protect the Reserve site and resources from offsite impacts.

7. Inadequate implementation of Reserve protection plan. Indicators of inadequate implementation could include: Evidence of non-compliance with Reserve restrictions, insufficient surveillance and enforcement to assure that restrictions on use of the Reserve are adhered to, or evidence that Reserve resources are being damaged or destroyed as a result of the above.

8. Failure to carry out the terms of the signed Memorandum of Understanding (MOU) between the state and NOAA, which establishes a long-term state commitment to maintain and manage the Reserve in accordance with section 315 of the Act. Indicators of failure could include: State action to allow incompatible uses of state-controlled lands or waters in the Reserve, failure of the state to bear its fair share of costs associated with long-term operation and management of the Reserve, or failure to initiate timely updates of the MOU when necessary.

Sec. 921.41 Withdrawal of designation.

The Assistant Administrator may withdraw designation of an estuarine area as a National Estuarine Research Reserve pursuant to and in accordance with the procedures of section 312 and 315 of the Act and regulations promulgated thereunder.

Subpart F--Special Research Projects

Sec. 921.50 General.

(a) To stimulate high quality research within designated National Estuarine Research Reserves, NOAA may provide financial support for research projects which are consistent with the Estuarine Research Guidelines referenced in Sec. 921.51. Research awards may be awarded under this subpart to only those designated Reserves with approved final management plans. Although research may be conducted within the immediate watershed of the Reserve, the majority of research activities of any single research project funded under this subpart may be conducted within Reserve boundaries. Funds provided under this subpart are primarily used to support management-related research projects that will enhance scientific understanding of the Reserve ecosystem, provide information needed by Reserve management and coastal management decision-makers, and improve public awareness and understanding of estuarine ecosystems and estuarine management issues. Special research projects may be oriented to specific Reserves; however, research projects that would benefit more than one Reserve in the National Estuarine Reserve Research System are encouraged.

(b) Funds provided under this subpart are available on a competitive basis to any coastal state or qualified public or private person. A notice of available funds will be published in the Federal Register. Special research project funds are provided in addition to any other funds available to a coastal state under the Act. Federal funds provided under this subpart may not exceed 70 percent of the total cost of the project, consistent with Sec. 921.81(e)(4) (``allowable costs''), except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].

Sec. 921.51 Estuarine research guidelines.

(a) Research within the National Estuarine Research Reserve System shall be conducted in a manner consistent with Estuarine Research Guidelines developed by NOAA.

(b) A summary of the Estuarine Research Guidelines is published in the Federal Register as a part of the notice of available funds discussed in Sec. 921.50(c).

(c) The Estuarine Research Guidelines are reviewed annually by NOAA. This review will include an

opportunity for comment by the estuarine research community.

Sec. 921.52 Promotion and coordination of estuarine research.

(a) NOAA will promote and coordinate the use of the National Estuarine Research Reserve System for research purposes.
(b) NOAA will, in conducting or supporting estuarine research other than that authorized under section 315 of the Act, give priority consideration to research that make use of the National Estuarine Research Reserve System.
(c) NOAA will consult with other Federal and state agencies to promote use of one or more research reserves within the National Estuarine Research Reserve System when such agencies conduct estuarine research.

Subpart G--Special Monitoring Projects

Sec. 921.60 General.

(a) To provide a systematic basis for developing a high quality estuarine resource and ecosystem information base for National Estuary Research Reserves and, as a result, for the System, NOAA may provide financial support for basic monitoring programs as part of operations and management under Sec. 921.32. Monitoring funds are used to support three major phases of a monitoring program:
1. Studies necessary to collect data for a comprehensive site description/characterization;
2. Development of a site profile; and
3. Formulation and implementation of a monitoring program.

(b) Additional monitoring funds may be available on a competitive basis to the state agency responsible for Reserve management or a qualified public or private person or entity. However, if the applicant is other than the managing entity of a Reserve that applicant must submit as a part of the application a letter from the Reserve manager indicating formal support of the application by the managing entity of the Reserve. Funds provided under this subpart for special monitoring projects are provided in addition to any other funds available to a coastal state under the Act. Federal funds provided under this subpart may not exceed 70 percent of the total cost of the project, consistent with Sec. 921.81(e)(4) (``allowable costs''), except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs.

(c) Monitoring projects funded under this subpart must focus on the resources within the boundaries of the Reserve and must be consistent with the applicable sections of the Estuarine Research Guidelines referenced in Sec. 921.51. Portions of the project may occur within the immediate watershed of the Reserve beyond the site boundaries. However, the monitoring proposal must demonstrate why this is necessary for the success of the project.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].

Subpart H--Special Interpretation and Education Projects

Sec. 921.70 General.

(a) To stimulate the development of innovative or creative interpretive and educational projects and materials to enhance public awareness and understanding of estuarine areas, NOAA may fund special interpretive and educational projects in addition to those activities provided for in operations and management under Sec. 921.32. Special interpretive and educational awards may be awarded under this subpart to only those designated Reserves with approved final management plans.

(b) Funds provided under this subpart may be available on a competitive basis to any state agency.

However, if the applicant is other than the managing entity of a Reserve, that applicant must submit as a part of the application a letter from the Reserve manager indicating formal support of the application by the managing entity of the Reserve. These funds are provided in addition to any other funds available to a coastal state under the Act. Federal funds provided under this subpart may not exceed 70 percent of the total cost of the project, consistent with Sec. 921.81(e)(4) (``allowable costs''), except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs.

(c) Applicants for education/interpretive projects that NOAA determines benefit the entire National Estuarine Research Reserve System may receive Federal assistance of up to 100% of project costs.

[58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].

Subpart I--General Financial Assistance Provisions

Sec. 921.80 Application information.

(a) Only a coastal state may apply for Federal financial assistance awards for preacquisition, acquisition and development, operation and management, and special education and interpretation projects under subpart H. Any coastal state or public or private person may apply for Federal financial assistance awards for special estuarine research or monitoring projects under subpart G. The announcement of opportunities to conduct research in the System appears on an annual basis in the Federal Register. If a state is participating in the national Coastal Zone Management Program, the applicant for an award under section 315 of the Act shall notify the state coastal management agency regarding the application.

(b) An original and two copies of the formal application must be submitted at least 120 working days prior to the proposed beginning of the project to the following address: Sanctuaries and Reserves Division Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration, 1825 Connecticut Avenue, NW., suite 714, Washington, DC 20235. Application for Federal Assistance Standard Form 424 (Non-construction Program) constitutes the formal application for site selection, post-site selection, operation and management, research, and education and interpretive awards. The Application for Federal Financial Assistance Standard Form 424 (Construction Program) constitutes the formal application for land acquisition and development awards. The application must be accompanied by the information required in subpart B (predesignation), subpart C and Sec. 921.31 (acquisition and development), and Sec. 921.32 (operation and management) as applicable. Applications for development awards for construction projects, or restorative activities involving construction, must include a preliminary engineering report, a detailed construction plan, a site plan, a budget and categorical exclusion check list or environmental assessment. All applications must contain back up data for budget estimates (Federal and non-Federal shares), and evidence that the application complies with the Executive Order 12372, ``Intergovernmental Review of Federal Programs.'' In addition, applications for acquisition and development awards must contain:
    1. State Historic Preservation Office comments;
    2. Written approval from NOAA of the draft management plan for initial acquisition and development award(s); and
    3. A preliminary engineering report for construction activities.

Sec. 921.81 Allowable costs.

(a) Allowable costs will be determined in accordance with applicable OMB Circulars and guidance for Federal financial assistance, the financial assistant agreement, these regulations, and other Department of Commerce and NOAA directives. The term ``costs'' applies to both the Federal and non-Federal shares.

(b) Costs claimed as charges to the award must be reasonable, beneficial and necessary for the prop-

er and efficient administration of the financial assistance award and must be incurred during the award period.

(c) Costs must not be allocable to or included as a cost of any other Federally- financed program in either the current or a prior award period.

(d) General guidelines for the non-Federal share are contained in Department of Commerce Regulations at 15 CFR part 24 and OMB Circular A-110. Copies of Circular A-110 can be obtained from the Sanctuaries and Reserves Division; 1825 Connecticut Avenue, NW., suite 714; Washington, DC 20235. The following may be used in satisfying the matching requirement:

1. Site selection and post site selection awards. Cash and in-kind contributions (value of goods and services directly benefiting and specifically identifiable to this part of the project) are allowable. Land may not be used as match.
2. Acquisition and development awards. Cash and in-kind contributions are allowable. In general, the fair market value of lands to be included within the Reserve boundaries and acquired pursuant to the Act, with other than Federal funds, may be used as match. However, the fair market value of real property allowable as match is limited to the fair market value of a real property interest equivalent to, or required to attain, the level of control over such land(s) identified by the state and approved by the Federal Government as that necessary for the protection and management of the National Estuarine Research Reserve. Appraisals must be performed according to Federal appraisal standards as detailed in Department of Commerce regulations at 15 CFR part 24 and the Uniform Relocation Assistance and Real Property Acquisition for Federal land Federally assisted programs in 15 CFR part 11. The fair market value of privately donated land, at the time of donation, as established by an independent appraiser and certified by a responsible official of the state, pursuant to 15 CFR part 11, may also be used as match. Land, including submerged lands already in the state's possession, may be used as match to establish a National Estuarine Research Reserve. The value of match for these state lands will be calculated by determining the value of the benefits foregone by the state, in the use of the land, as a result of new restrictions that may be imposed by Reserve designation. The appraisal of the benefits foregone must be made by an independent appraiser in accordance with Federal appraisal standards pursuant to 15 CFR part 24 and 15 CFR part 11. A state may initially use as match land valued at greater than the Federal share of the acquisition and development award. The value in excess of the amount required as match for the initial award may be used to match subsequent supplemental acquisition and development awards for the National Estuarine Research Reserve (see also Sec. 921.20). Costs related to land acquisition, such as appraisals, legal fees and surveys, may also be used as match.
3. Operation and management awards. Generally, cash and in-kind contributions (directly benefiting and specifically identifiable to operations and management), except land, are allowable.
4. Research, monitoring, education and interpretive awards. Cash and in-kind contributions (directly benefiting and specifically identifiable to the scope of work), except land, are allowable.

Sec. 921.82 Amendments to financial assistance awards.

Actions requiring an amendment to the financial assistance award, such as a request for additional Federal funds, revisions of the approved project budget or original scope of work, or extension of the performance period must be submitted to NOAA on Standard Form 424 and approved in writing.

Appendix I to Part 921-- Biogeographic Classification Scheme.

Acadian
1. Northern of Maine (Eastport to the Sheepscot River.)
2. Southern Gulf of Maine (Sheepscot River to Cape Cod.)

Virginian
3. Southern New England (Cape Cod to Sandy Hook.)
4. Middle Atlantic (Sandy Hook to Cape Hatteras.)

5. Chesapeake Bay.
Carolinian
6. North Carolinas (Cape Hatteras to Santee River.)
7. South Atlantic (Santee River to St. John's River.)
8. East Florida (St. John's River to Cape Canaveral.)

West Indian
9. Caribbean (Cape Canaveral to Ft. Jefferson and south.)
10. West Florida (Ft. Jefferson to Cedar Key.)

Louisianian
11. Panhandle Coast (Cedar Key to Mobile Bay.)
12. Mississippi Delta (Mobile Bay to Galveston.)
13. Western Gulf (Galveston to Mexican border.)

Californian
14. Southern California (Mexican border to Point Conception.)
15. Central California (Point Conception to Cape Mendocino.)
16. San Francisco Bay.

Columbian
17. Middle Pacific (Cape Mendocino to the Columbia River.)
18. Washington Coast (Columbia River to Vancouver Island.)
19. Puget Sound.

Great Lakes
20. Lake Superior (including St. Mary's River.)
21. Lakes Michigan and Huron (including Straits of Mackinac, St. Clair River, and Lake St. Clair.)
22. Lake Erie (including Detroit River and Niagara Falls.)
23. Lake Ontario (including St. Lawrence River.)

Fjord
24. Southern Alaska (Prince of Wales Island to Cook Inlet.)
25. Aleutian Island (Cook Inlet Bristol Bay.)

Sub-Arctic
26. Northern Alaska (Bristol Bay to Damarcation Point.)

Insular
27. Hawaiian Islands.
28. Western Pacific Island.
29. Eastern Pacific Island.

Appendix II to Part 921-- Typology of National Estuarine Research Reserves.

This typology system reflects significant differences in estuarine characteristics that are not necessarily related to regional location. The purpose of this type of classification is to maximize ecosystem variety in the selection of national estuarine reserves. Priority will be given to important ecosystem types as yet unrepresented in the reserve system. It should be noted that any one site may represent several ecosystem types or physical characteristics.

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Appendix B

Property Ownerships

Table B.1 shows the acres owned within the Padilla Bay NERR as of 2015 and breaks ownership into "state" vs. "private" in both the "core" and "buffer" areas of the Reserve as shown in Fig. 1.7, Chapter 1. It is probable the Reserve will never own all the land within the proposed boundary. The Reserve only buys from "willling sellers."

Table B.2 lists Skagit County Parcel numbers and Padilla Bay or Associated Oyster Tract numbers for private property remaining in the "core" area.

Table B.3 lists Skagit County Parcel numbers and type of private property remaining in "buffer."

Table B.1. Ownerships (state and private) within the Padilla Bay NERR in 2015. Acres in "core" (tidelands) vs. "buffer" (uplands).

State Owned within boundary	Type	Acres	Source
Padilla Bay Tracts (811 tracts) (811 x 9.99 ac/tract)	tideland	8029	Skagit Co. parcel data
Assoc. Oyster Lands (514 tracts) (814 x 0.98 ac/tract)	tideland	798	Skagit Co. parcel data
Padilla Bay Associates Option property	tideland	1953	Wyatt-Jaykin: 1989
State Parks tideflat	tideland	27	Skagit Co. parcel data
P32854 & P32856	tideland	32	Skagit Co. parcel data
P34495 (state 3/7th owner)	tideland	15	Skagit Co. parcel data
Su'wan Minor salt marsh	tideland	24	Skagit Co. parcel data
Western edge of boundary (Padilla Bay misc.)	tideland	594	Wyatt-Jaykin: 1989
Padilla Bay Demonstration Farm	tideland	22	Skagit Co. parcel data + TS notes
Total		11490	

Privately Owned within boundary			
Padilla Bay Tracts (35 x 9.89 ac/tract)	tideland	346	Skagit Co. parcel data
Assoc. Oyster Lands (129 x .98 ac/tract)	tideland	126	Skagit Co. parcel data
Other Tideflat (Swinomish Gun Club, Dike Island Gun Club, P21156, P21157, P21158)	tidrland	247	Skagit Co. parcel data
P34495 (4/7th owner)	tideland	19	Skagit Co. parcel data
Total		738	

State Owned within buffer			
Ecology 64 acres	upland	64	Skagit Co. parcel data
Padilla Bay Demonstration Farm	farmland	107	Skagit Co. parcel data + TS notes
Wash. Dept. Fish Wildlife	farmland	234	Skagit co. parcel data
State Parks upland (Bay View St.Pk., Saddlebag & Dot Is.)	upland	41	Skagit Co. parcel data
Wash. Dept. Natural Resources (Flat Island)	upland	91	Skagit Co. parcel data
Total		476	

Privately Owned within buffer			
Farmland	farmland	587	Skagit Co. parcel data
Residential/business	upland	27	Skagit Co. parcel data
Total		614	

SUMMARY		Acres
CORE State owned tideland/salt marsh within boundary		11490
CORE Privately owned tideland/salt marsh within boundary		738
BUFFER State owned upland within boundary		476
BUFFER Privately owned upland within boundary		614
State owned lands within boundary		11966
Privately owned lands within boundary		1352
Total acres within boundary		13318

Table B2. Property remaining in private ownership in "core" in 2015.					
Parcel No.	Padilla Bay Tract Nos.	Assoc. Oyster Tract Nos.	Parcel No.	Padilla Bay Tract Nos.	Assoc. Oyster Tract Nos.
60901	19-22		61182		173
60905	37-38		61188		180
60906	39-40		61190		184-188
60913	46 partial, south		61199		201
60915	47		61201		203-204
60916	48		61206		211
60917	49		61219		232-236
60918	50 partial, east		61225		262
60920	50 partial, west		61240		287
60922	51		61244		290-291
60923	52-54		61246		294
60924	55		61248		296-305
60925	60-70		61257		330-331
60931	101-103		61258		332
60932	104-106		61272		359-363
60933	107-108 east 1/3		61283		393
60934	107-108 west 2/3		61288		410
60936	109		61296		421
60939	111		61306		446
60946	135		61311		452-454
61070		2	61338		503
61072		4-7	61341		509
61076		11-26	61362		541-542
61080		32	61371		572-574
61081		33	61374		580-581
61088		42	61400		629
61092		48	61402		631
61097		53	61403		632
61098		54	61406		635
61114		83	61410		642-643
61115		84-86	61419		656
61134		112	61430		675
61144		123	61431		676
61150		133	61434		691
61155		138-139	61444		711-712
61170		156	61453		726

Table B2. Property remaining in private ownership in "core" in 2015 (continued).					
Parcel No.	Padilla Bay Tract Nos.	Assoc. Oyster Tract Nos.	Parcel No.	Padilla Bay Tract Nos.	Assoc. Oyster Tract Nos.
61174		160	61458		731
61459		732			
61460		733			
61467		745			
61478		815-816			
61480		821			
61498		857			
61508		871			
61513		881-884			
61515		886			
61518		891			
61519		892			
61522		899			
61525		903			
61526		904-907			
61546		943			

Table B3. Property remaining in private ownership in “buffer” in 2015.	
Skagit County Parcel No.	**Type**
19670	business or residential
19673	business or residential
20296	business or residential
20297	business or residential
20298	business or residential
21177	business or residential
21185	business or residential
21191	business or residential
85163	business or residential
103837	business or residential
116989	business or residential
19662	farmland
19663	farmland
19669	farmland
21145	farmland
21146	farmland
21147	farmland
21148	farmland
21149	farmland
21163	farmland
21166	farmland
21167	farmland
21176	farmland
21190	farmland
21195	farmland
21196	farmland
21198	farmland
112018	farmland

Appendix C

Summary of Relevant Federal, State, and Local Laws and Regulations Relating to Resource Protection

Establishment of the Padilla Bay National Estuarine Research Reserve in 1980 did not include the passage of any new regulatory programs directed to water or other environmental quality issues. The Reserve depends upon the implementation of existing codes to protect its resources. The following federal, state and local laws and regulations protect the Reserve and surrounding properties.

Federal

Coastal Zone Management Act (CZMA)

Section 315 of the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 *et seq.*) established the National Estuarine Research Reserve System, the purpose of which is to establish representative estuarine sites suitable for long-term research and education throughout the coastal United States and U.S. Territories. The CZMA makes it national policy to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." The CZMA is implemented by the National Oceanic and Atmospheric Administration, Office for Ocean and Coastal Management. The full text of the CZMA is provided on a NOAA/NOS/OCM website at https://coast.noaa.gov/czm/act/

Endangered Species Act (ESA)

The Endangered Species Act of 1973 (16 USC §§ 1531 *et seq.*) is a complex piece of legislation that contains specific prohibitions as well as general goals intended to protect and rebuild populations of diverse species threatened with extinction because of human actions (Miller and Broches, 1993). The Skagit Watershed Council was formed in 1997 as a community partnership for salmon and they are the lead entity for the Skagit and Samish basins. They are guided in their habitat restoration and protection efforts by the Skagit Chinook Recovery Plan and the Council's 2010 Strategic Approach. A list of the active and completed projects can be accessed at www.skagitwatershed.org. NMFS and/or USFWS can intervene in activities on private and public land deemed critical for listed fish populations and can impose more stringent guidelines for tree buffers along streams. Information on the listing of salmon species in Puget Sound is available at http://www.westcoast.fisheries.noaa.gov/. The ESA is jointly administered by the National Marine Fisheries Service (marine species and habitats) and the US Fish and Wildlife Service (non-marine species and habitats). The full text of the ESA is provided on a US Fish and Wildlife Service web site at www.nmfs.noaa.gov/pr/laws/esa/text.htm.

U.S. Army Corps of Engineers Permit

The U.S. Army Corps of Engineers issues permits for activities regulated by Sections 9 and 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §§ 401 and 403) and Section 404 of the Federal Water Pollution Control Act (33 U.S.C. § 1344, "Clean Water Act"). The Clean Water Act is jointly administered by the Corps and the Environmental Protection Agency. Section 9 of the Rivers and Harbors Act governs dikes while Section 10 governs all other obstructions and activityin navigable waters of the United States. Section 404 of the Clean Water Act applies to discharge of dredge material into navigable waters, including responsibility for wetlands above the mean high water line. For Puget Sound, the Corps' permit program is administered by the Corps' Seattle District Office which provides comprehensive information on the applicable laws and regulations.<http://nws.usace.army.mil> under the "Regulatory" menu item.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321 *et seq*.) is "intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." NEPA directs federal agencies, when planning projects or issuing permits, to conduct environmental reviews to consider the potential impacts on the environment by their proposed actions. Overall, NEPA is administered by the federal Council on Environmental Quality. Each federal agency is required to implement the provisions of NEPA on its public actions or private, permitted projects and must adopt its own regulations for implementation. Comprehensive information on NEPA laws, regulations, and implementation is available from a CEQ NEPA Task Force web site at http://ceq.doe.gov

Washington State

Growth Management Act

The Growth Management Act (RCW 36.70A) states that "uncoordinated and unplanned growth, together with a lack of common goals expressing the public's interest in the conservation and the wise use of our lands, pose a threat to the environment, sustainable economic development, and the health, safety, and high quality of life enjoyed by residents of this state."

Under this act, thirteen planning goals were adopted to guide the development of county comprehensive plans. Included in the goals are: property rights, permits, natural resource industries, open space and recreation, environment, public facilities and services. The act provides the framework for establishing controls on development or land use and provides regulations to protect natural resource lands and critical areas such as wetlands.

State Environmental Policy Act (SEPA)

The State Environmental Policy Act (RCW 43.21C) "is intended to ensure that environmental values are considered (in addition to technical and economic considerations) by state and local government officials when making decisions." SEPA has four primary purposes: 1) to declare a state policy which will encourage productive and enjoyable harmony between people and their environment, 2) to promote efforts which will prevent or eliminate damage to the environment, 3) to stimulate the health and welfare of people, and 4) to enrich the understanding of ecological systems and natural resources important to the state and the nation.

State Hydraulics Code

The State Hydraulics Code (RCW 77.55), administered by the Washington State Department of Fish and Wildlife, governs the obstruction or diversion of any stream and the placement of materials in any body of water of the state. This agency reviews permit applications to ensure that actions will not harm fish populations.

State Implementation of Federal Clean Water Act

Under the Clean Water Act (33 U.S.C. §§ 1251 *et seq.*) delegated authority from the U.S. Environmental Protection Agency, the Department of Ecology regulates the point source discharge of pollutants into the state's surface waters through these "national pollutant discharge elimination system permits". There is currently only one such regulated discharge directly into Padilla Bay. Also, under Section 401 of this Act, a "water quality certification" is required of any applicant for a federal license or permit to conduct any activity that may result in any discharge into surface water. The federal agency is provided a certification from the state that the discharge complies with the discharge requirements of federal law and the aquatic protection requirements of state law.

Shoreline Management Act

The Shoreline Management Act of 1971 (RCW 90.58) established regulations requiring the protection of the State's valuable shoreline resources and required local governments, overseen by the Department of Ecology, to prepare and adopt management programs addressing specific use policies. The Act (RCW 90.58) also established certain bodies of water, including Padilla Bay, as "Shorelines of Statewide Significance." By this designation the Washington State Legislature declared that the interests of all the people shall be paramount in the management of shorelines of statewide significance. The legislature determined that in order to fulfill the goal of statewide public interest in shorelines of statewide significance, local programs must give preference to uses that are consistent with the policies applied in the following order, pursuant to RCW 90.58.020:

- The statewide interest should be recognized and protected over local interest.

- The natural character of shorelines of statewide significance should be preserved.
- Uses of shorelines of statewide significance should result in long term benefits to the people of the state.
- The natural resources and ecological systems of shorelines of statewide significance should be protected.
- Public access to publicly owned areas in shorelines of statewide significance should be increased.
- Recreational opportunities for the public should be increased on shorelines of statewide significance.

The Shoreline Management Act is a comprehensive tool for control of shoreline uses. By requiring a use permit system and mandating a solid environmental planning program as its base, the legislature accepted State responsibility for shoreline quality. The Act serves as the main protection program for the resources of Padilla Bay. The control and permitting of actual and specific uses in the Padilla Bay shoreline falls within the immediate control of the Skagit County Shoreline Management Master Program.

Washington Natural Resources Conservation Areas

Washington Natural Resources Conservation Areas (RCW 79.71) describes the need for conservation of natural areas and defines how these lands are acquired, managed, and funded. Hat Island is currently under this designation.

Washington State Noxious Weed Law

The Washington State Noxious Weed Law (RCW 17.10) directs state agencies to: 1) ensure that state lands set an example of excellence in noxious weed control and eradication on state lands, 2) halt the spread of noxious weeds from state to private lands, 3) recognize that state agencies are ultimately responsible for noxious weed control on state land, regardless of type, timing, or amount of use, and 4) recognize that the public is not well served by the spread of noxious weeds on state lands, in part, because of the decrease in wildlife habitat and loss of land productivity. The law also states that every owner must eradicate all class A noxious weeds and control and prevent the spread of all class B and C noxious weeds on the county noxious weed list.

Skagit County

Skagit County Shoreline Master Program

In 1976 the Skagit County Board of Commissioners adopted the Skagit County Shoreline Management Master Program. This document, prepared in accordance with RCW 90.58 (the State Shoreline Management Act), provides goals, policies, and specific use regulations for various activities on the county's shorelines, including Padilla Bay. It also established a permit system (consistent with State Regulations), for development activities in the shoreline area. The shoreline around Padilla Bay is classified as either rural, rural

residential, or conservancy, with each classification carrying a different level of allowable uses. The "aquatic" classification is given to the areas of the bay lying seaward of the ordinary high water mark. Within each of these classifications specific land or water uses are governed by Master Program policy and regulation. A summary chart (matrix) of allowable uses within each of the shoreline classification areas is found in Appendix D. Activities, development, and projects with the shoreline areas of Padilla Bay may require permits under the county program, or written exemption from its application.

Skagit County Critical Areas Ordinance

This ordinance was developed in response to the Growth Management Act for the purpose of conserving and protecting wetlands, aquifer recharge areas, frequently flooded areas, geologically hazardous areas and fish and wildlife habitat conservation areas. It was drafted to provide regulatory structure for the identification, designation and protection of critical areas in the county and provides incentives to landowners for conservation programs such as open space, conservation easements, density credits and a conservation futures fund (Skagit County, 1996).

Conservation Futures Tax Fund Ordinance

This ordinance establishes a tax of $6.25 on every $100,000 of the assessed value of real estate in Skagit County. Annually, it will generate $30,000-$400,000 in revenues which can be used to back a bond of $4 million or more. This pool of money can then be used to acquire rights and interests in farmland and critical areas. The County will probably purchase easements rather than land to spread the funds further.

Doctrines and Court Cases

Public Trust Doctrine

The Public Trust Doctrine is firmly established in Washington state law and comes from the need for public access to and protection of waters, tidelands, and shorelines (Boyle, 1993). It is a tool to protect the public's interest in instream flows, navigation, commerce, fisheries, recreation, environmental quality and non-appropriative water rights (Lean, 1993). The public trust doctrine covers both state-owned and private lands. It has not yet been challenged regarding the public's rights in areas of non-navigable waters, access across dryland to navigable water, taking of shellfish on privately owned tidelands, and protection of the environment against general harm (Lean, 1993).

United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975).

This decision concerns the nature and extent of off-reservation fishing rights enjoyed by Tribes pursuant to treaties with the United States Government and how these rights affect both non-Indian access to fish and the state's powers and duties regarding regula-

tion of the fisheries resource (Ehlke, 1974). The Indian's rights to fish in off-reservation "usual and accustomed" sites are not exclusive and must be shared with non-Indians. However, the state cannot diminish the rights of the Indians nor can it regulate Indian fishing to the same degree it can non-Indian fishing (Ehlke, 1974). Nineteen western Washington tribes were listed as plaintiffs in the case.

United States v. Washington, 873 F. Supp. 1422 (W.D. Wash. 1994)

Judge Edward Rafeedie's ruling in December 1994 re-affirmed the right of 15 western Washington tribes to take up to half of the harvestable shellfish from beaches within their usual and accustomed harvest areas. This ruling covered all shellfish species, including clams, oysters, mussels, and all deep-water and free-swimming shellfish species — including geoduck, shrimp, crab, scallops, sea cucumber and sea urchin. The Swinomish tribe was one of the 15 tribes whose rights were re-established (NIFC, 1995a, 1995b).

References

Boyle, B. 1993. Politics and the Public Trust Doctrine. *In* Canning, D.J. and J. Scott, eds. The Public Trust Doctrine in Washington State: Proceedings of the Symposium, November 18, 1992. Washington State Dept. of Ecology, Olympia, Washington.

Elhke, R.C. 1974. Analysis of United States v. Washington - Indian treaty fishing rights in the state of Washington. The Library of Congress, Congressional Research Service. Washington, D.C.

Appendix D

Hat Island Cooperative Agreement

Interagency Agreement Concerning the Management of Hat Island Natural Resources Conservation Area

THIS AGREEMENT, by and between the Washington State Department of Natural Resources (DNR) and the Washington State Department of Ecology (Ecology), concerns the cooperative management of the Hat Island Natural Resources Conservation Area (Hat Island NRCA).

Whereas, the Hat Island NRCA is an island of approximately 92 acres in size located in Padilla Bay, Skagit County. The Department of Natural Resources received title to this property from the Nature Conservancy in 1991, but has only been able to perform minimal management activities since that time. As a natural resources conservation area, the Hat Island NRCA is to be managed for conservation purposes which allow appropriate low-impact public use, consistent with the mandates of Chapter 79.71 RCW.

Whereas, the Department of Ecology manages the Padilla Bay National Estuarine Research Reserve (Padilla Bay NERR) in accordance with the State of Washington's coastal zone management program under the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1465. The Padilla Bay NERR was established in 1980, and while Hat Island was not included in the original boundaries of the Padilla Bay NERR because it could not be economically purchased at that time, two smaller, nearby islands which were already owned by the State (Saddlebag Island and Dot Island) were included in the boundary. Hat Island was eventually included in the Padilla Bay NERR boundary in 1998, after review and mutual agreement by both the Departments of Ecology and Natural Resources. The Padilla Bay NERR is managed primarily for the long-term maintenance of the natural estuarine ecosystem, low impact public use, and for long-term research, education, and interpretation. 15 C.F.R. § 921.1.

Whereas, Hat Island is ecologically connected to the areas within the Padilla Bay NERR.

Whereas, the management plans and management goals of both the Hat Island NRCA and the Padilla Bay NERR are consistent with each other.

IT IS HEREBY RESOLVED that the Departments of Ecology and Natural Resources agree as follows:

1. As of the date of all parties' approval of this agreement, the Department of Ecology shall assume the primary day-to-day management responsibilities for the Hat Island NRCA. The purpose of this transfer of primary management responsibility shall be to jointly manage the Hat Island NRCA with the surrounding Padilla Bay

NERR. The Department of Ecology shall have management authority over all aspects of the Hat Island NRCA unless such responsibility is specifically reserved to the Department of Natural Resources in this agreement.

2. In assuming these management responsibilities, the Department of Ecology agrees that it will adhere to all requirements in the deed for the Hat Island NRCA, which includes by reference the requirements of Chapter 79.71 RCW. The deed, attached as Exhibit A hereto, may also be found in Skagit County land records at volume 992, pages 384-386. The deed is Skagit County Auditor's file number 9107100006.
3. The Department of Ecology agrees that its management of the Hat Island NRCA shall be consistent with the Department of Natural Resources' statewide NRCA Management Plan, as periodically updated. The Department of Natural Resources shall provide the statewide NRCA Management Plan, and any updates, to the Department of Ecology, and agrees to specifically point out any significant changes in any amendments to the plan to the Department of Ecology.
4. The site specific management plan requirements to describe "significant resources to be conserved, areas with potential for low-impact public use and environmental education, and types of management activities and public uses permitted" for Hat Island NRCA will be addressed in the Padilla Bay National Estuarine Research Reserve Management Plan which will be prepared consistent with federal regulations governing national estuarine research reserves. If one or more parts of the Padilla Bay National Estuarine Research Reserve Management Plan (PBNERRMP) are not consistent with the requirements of Chapter 79.71 RCW or the NRCA Statewide Management Plan, DNR staff shall propose to Ecology changes in the PBNERRMP which will result in consistency. Ecology and the DNR must jointly agree to the changes before the PBNERRMP will be altered.
5. The Department of Ecology shall supply the necessary staff to carry out its management responsibilities under this agreement.
6. The parties understand the Department of Ecology may receive additional federal grant monies in exchange for their-management of the Hat Island NRCA as part of the Padilla Bay NERR- The Department of Natural Resources also gains from this agreement by reducing its management costs and responsibilities while continuing to meet the management goals for the Hat Island NRCA. Moreover, the Hat Island NRCA benefits from receiving the added protection of being considered within the management area and plan for the Padilla Bay NERR.
7. The Departments of Ecology and Natural Resources agree to share the control and responsibility for any signage to be placed on Hat Island, including the expenses related thereto. The Department of Natural Resources shall retain control over all management activities related to fire control on Hat Island. The Department Ecology and Natural Resources agree to consult and work cooperatively on all major efforts to protect, mitigate, and/or restore the natural conditions of Hat Island NRCA. This would include but not be limited to efforts related to oil spills, severe storms, and/or invasive weeds.
8. The Departments of Ecology and Natural Resources agree that any construction of facilities on Hat Island (including but not limited to docks,, landing areas, or

storage facilities) shall be negotiated on a project by project basis and that a project lead from the appropriate agency will be designated. The Departments agree that the expenses for projects on Hat Island shall be shared as appropriate and negotiated.

9. Should any intergovernmental disputes arise in the course of the Department of Ecology's management of the Hat Island NRCA, the Department of Ecology agrees to inform and involve the Department of Natural Resources in the resolution of such disputes. The term "intergovernmental disputes" is here used to mean disputes with local, state, or Tribal entities, and does not include any dispute the Department of Ecology may have with the National Oceanic and Atmospheric Administration regarding other aspects of the Padilla Bay NERR.
10. The Department of Ecology shall have no ownership interest in the Hat Island NRCA.
11. In the event that a dispute arises under this agreement, it shall be determined by a dispute board in the following manner: Each party to this agreement shall appoint a member to the dispute board. The members so appointed shall jointly appoint an additional member to the dispute board. The dispute board shall evaluate the facts, contract terms and applicable statutes and rules and make a determination of the dispute. The determination of the dispute board shall be final and binding on the parties hereto. As an alternative to this process, either of the parties may request intervention by the Governor, in which event the Governor's process will control.
12. Any and all amendments to this agreement shall be made in writing, and shall be signed by both the Departments of Ecology and Natural Resources.
13. This agreement can be terminated after the authorized representatives of the Departments of Ecology and Natural Resources have met in person to discuss the reasons for termination. After such meeting, the agreement can be terminated upon thirty (30) days written notice by either party.

Exhibit A

Deed of Right to Use Land For Natural Area Purposes

The Grantor, Washington State Department of Natural Resources, for and in consideration of monies coming in whole or in part from the Habitat Conservation Account of the General Fund of the State of Washington and in fulfillment of terms of the Project Agreement identified below, conveys and grants to the State of Washington individually and as the representative of all the people of the State, the right to use the real property described below forever for the natural area purposes described in RCW 43.98A and managed in accordance with RCW 79.71 and the Project Agreement entered into between the Grantor and the State of Washington through the Interagency Committee for Outdoor Recreation entitled Washington Wildlife and Recreation Coalition Multi-Site Acquisitions, Project Number 91-712A, signed by the Grantor on the 24th day of August, 199,0 and by the Interagency Committee on the 31st day of May, 1990 and the applica-

tion and supporting materials which are on file ‘with the Grantor and the State in connection with the Project Agreement.

The Grantor will not make or permit to be made any use of the real property described in this deed, or any part of it), which is inconsistent with the right to use for natural area purposes herein granted unless the State, through the Interagency Committee for Outdoor Recreation or it successors, consents to the inconsistent use, which consent shall be granted only upon conditions which will ensure that other natural area land of at least equal fair market value at the time of change of use and of as nearly as feasible equivalent usefulness and location for the natural area purposes for which State assistance was originally granted, will he substituted in the manner provided in RCW 43.99.100 for marine recreation land, whether or not the real property covered by this deed is marine recreation land. RCW 43.99.100 reads as follows:

“Marine recreation land with respect to which money has been expended under RCW 43.99.080 shall not, without the approval of the committee, be converted to uses other than those for which such expenditure was originally approved. The committee shall only approve any such conversion upon conditions which will assure the substitution of other marine recreation land of at least equal fair market value at the time of conversion and of as nearly as feasible equivalent usefulness and location.”
The real property covered by this deed is described as follows:

Government Lot 2 in Section 9, Township 35 North, Range 2 East, W.M.; Government Lot I in Section 10, Township 35 North, Range 2 East, W.M. ; Government Lot I in Section 15, Township 35 North, Range 2 East, W.M.; and Government Lot I in Section 16, Township 35 North Range 2 East, W.M. Property is also known as Hat or Blanca Island. This property is situated in the County of Skagit, State of Washington.

This deed shall in no way modify or extinguish the functions of the Grantor under the Project Agreement, including the Grantor’s functions to operate and maintain the land for natural area purposes.

Appendix E

APPENDIX 1

Memorandum of Agreement
Between the
National Oceanic and Atmospheric Administration
And the
Washington State Department of Ecology
Detailing the state-federal roles in the Management of the
Padilla Bay National Estuarine Research Reserve

This Memorandum of Agreement states the provisions for the cooperative management of the Padilla Bay National Estuarine Research Reserve in the state of Washington between the Washington State Department of Ecology and the National Oceanic and Atmospheric Administration's Office for Coastal Management. This Memorandum of Agreement supersedes the previous Memorandum of Agreement between NOAA and the Washington State Department of Ecology regarding the Padilla Bay National Estuarine Research Reserve made on September 17, 2008.

I. BACKGROUND

A. The state of Washington has determined that the waters and related coastal habitats of the Padilla Bay National Estuarine Research Reserve provide unique opportunities for study of natural and human processes to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities, and provide scientific information for effective coastal zone management in the state of Washington.

B. The state of Washington has determined that the resources of the Padilla Bay National Estuarine Research Reserve and the values they represent to the citizens of Washington and the United States will benefit from the management of these resources as part of the National Estuarine Research Reserve System.

C. The National Oceanic and Atmospheric Administration has concurred with that finding and, pursuant to its authority under Section 315 of the Coastal Zone Management Act of 1972, as amended (CZMA, 16 U.S.C. § 1461), and in accordance with implementing regulations at 15 C.F.R. § 921.30, has designated the Padilla Bay National Estuarine Research Reserve.

D. The Washington State Department of Ecology, as the agency designated by the Governor of Washington, is responsible for maintaining and managing the Padilla Bay National Estuarine Research Reserve in accordance with Section 315 of the CZMA and acknowledges the value of state-federal cooperation for the long-term management of the reserve in a manner consistent with the purpose of its designation.

E. The Padilla Bay National Estuarine Research Reserve management plan, approved by NOAA, describes the goals, objectives, strategies/actions, administrative structure, and

institutional arrangements for the reserve, including this MOA and others. In consideration of the mutual agreements herein, NOAA and the Washington State Department of Ecology agree to the following roles indicated in Section II of this agreement.

II. STATE-FEDERAL ROLES IN RESERVE MANAGEMENT

A. Washington State Department of Ecology Role in Reserve Management

The Washington State Department of Ecology shall:

1. be responsible for compliance with all federal laws and regulations, and ensure that the Padilla Bay National Estuarine Research Reserve management plan is consistent with the provisions of the CZMA and implementing regulations;

2. ensure protection of the natural and cultural resources of the reserve, and ensure enforcement of the provisions of state law, including rules and regulations of the Washington State Coastal Management Program (if applicable);

3. ensure adequate, long-term protection and management of lands and waters included within the reserve boundary;

4. apply for, budget, allocate, and expend funds in accordance with federal and state laws, the reserve management plan, and annual funding guidance for reserve operations, research and monitoring, education and stewardship, and, as necessary, land acquisition and reserve facility construction;

5. conduct and coordinate research and monitoring programs that encourage scientists from a variety of institutions to work together to understand the ecology of the reserve ecosystem to improve coastal management;

6. conduct and maintain programs that disseminate research results via materials, activities, workshops, and conferences to resource users, state and local agencies, school systems, general public, and other interested parties;

7. provide staff and secure state funding for the manager and core positions;

8. secure facilities and equipment required to implement the provisions within the reserve management plan;

9. ensure adequate funding for facilities operation and maintenance;

10. maintain effective liaison with local, regional, state, and federal policy makers, regulators and the general public;

11. serve as principal contact for issues involving proposed boundary changes and/or amendments to the reserve management plan; and

12. respond to NOAA's requests for information made pursuant to Section 312 of the CZMA, particularly cooperative agreement and grant progress reports and evaluation findings, including necessary actions and recommendations.

B. Federal Role in Reserve Management

NOAA's Office for Coastal Management shall:

1. administer the provisions of the Sections 315 and 312 of the CZMA to ensure that the reserve operates in accordance with goals of the reserve system and the Padilla Bay National Estuarine Research Reserve management plan;

2. review and process applications for financial assistance from the Washington State Department of Ecology, consistent with 15 C.F.R. § 921, for management and operation, and, as appropriate, land acquisition and facility construction;

3. advise the Washington State Department of Ecology of existing and emerging national and regional issues that have bearing on the reserve and reserve system;

4. maintain an information exchange network among reserves, including available research and monitoring data and educational materials developed within the reserve system;

5. to the extent possible, facilitate the allocation of NOAA resources and capabilities in support of reserve goals and programs.

C. General Provisions

1. Nothing in this agreement or subsequent financial assistance awards shall obligate either party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.

2. Upon termination of this agreement or any subsequent financial assistance awards to the Washington State Department of Ecology, any equipment purchased for studies to further this agreement will be disposed of in accordance with 15 C.F.R. § 24.32.

3. A free exchange of research and assessment data between the parties is encouraged and is necessary to ensure success of cooperative studies.

D. Other Provisions

1. Nothing in this agreement diminishes the independent authority or coordination responsibility of either party in administering its respective statutory obligations. Nothing in this agreement is intended to conflict with current written directives or policies of either party. If the terms of this agreement are inconsistent with existing written directives or policies of either party entering this agreement, then those portions of the agreement which are determined to be inconsistent with such written directives and

policies shall be invalid; but the remaining terms not affected by the inconsistency shall remain in full force and effect. At the first opportunity for revision of this agreement, all necessary changes shall be made by either an amendment to this agreement or by entering in a new superseding agreement, whichever is deemed expedient to the interested parties. Should disagreement arise on the interpretation of the provisions and/or amendments of this agreement, such disagreement shall be resolved by negotiations at the operating level of each party.

III. REAL PROPERTY ACQUIRED FOR PURPOSE OF THE RESERVE

As well as acknowledging the rest of the requirements set forth at 15 C.F.R. § 921, the Washington State Department of Ecology specifically acknowledges and will fully comply with conditions set forth at 15 C.F.R. § 921.21 (e), which specify the legal documentation requirements concerning the use and disposition of real property acquired for reserve purposes with federal funds under Section 315 of the CZMA.

IV. PROGRAM EVALUATION

The Office for Coastal Management of NOAA will schedule periodic evaluations of The Washington State Department of Ecology's performance in meeting the terms of this agreement, financial assistance awards, and the reserve management plan. Where findings of deficiency occur, NOAA may initiate action in accordance with the designation withdrawal or interim sanctions procedures established by the CZMA and applicable regulations at 15 C.F.R. § 921.40-41.

V. EFFECTIVE DATE, REVIEW, AMENDMENT AND TERMINATION

A. This agreement is effective on the date of the last signature on this agreement and shall be in effect until terminated by either party.

B. This agreement will be reviewed periodically by both parties and may only be amended by the mutual written consent of both parties.

C. This agreement may be terminated by mutual consent of both parties, or by NOAA if NOAA withdraws designation of the reserve within the reserve system, pursuant to applicable provisions of the CZMA and its implementing regulations as described under 15 C.F.R. § 923 Subpart L, or if NOAA finds that the Washington State Department of Ecology fails to comply with this MOA. Should this agreement be terminated, reimbursement of unexpended funds from financial assistance awards shall be determined on a pro rata basis according to the amount of work done by the parties at the time of termination. Additionally, reimbursement for land purchased and facilities constructed with NOAA funds shall be consistent with terms and special award conditions of financial assistance awards.

D. If any clause, sentence or other portion of this MOA shall become illegal, null, or void for any reason, the remaining portions of this MOA shall remain in full force and effect.

E. No waiver of right by either party of any provision of this MOA shall be binding unless expressly confirmed in writing by the party giving the waiver.

IN WITNESS THEREOF, the parties have caused this agreement to be executed.

Jeff Payne, Acting Director
Office for Coastal Management
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

3/22/16
Date

Maia D. Bellon, Director
Washington State Department of Ecology

12/18/15
Date

Appendix F

Federal Consistency Determination

Coastal Zone Management Act Consistency Determination

This document provides the Washington Coastal Management Program with the National Oceanic and Atmospheric Administration Consistency Determination under the Coastal Zone Management Act § 307 (c)(1) and 15 C.F.R. part 930, subpart C, for management plan approval. The information in this Consistency Determination is provided pursuant to 15 C.F.R. § 930.39. This activity includes approval of a reserve management plan drafted in compliance with 15 C.F.R §921.13. The previous Padilla Bay NERR management plan was completed in 2008 and covered the period from 2008-2015. The current management plan revision covers the period from 2016-2020. It provides a strategic approach for the Padilla Bay NERR to move forward with administrative, research/monitoring, education and stewardship activities over the next five years. It also addresses the Reserve's land acquisition approach and facilities management.

Since 2008, the Reserve added 110 acres of tideland (from willing sellers) to state ownership. This acreage is within the original proposed boundary (so no boundary adjustment is necessary).

There are no substantial changes from the 2008 plan to the revised Management Plan that should impact land, water or natural resources. NOAA has determined that the approval of the Padilla Bay NERR management plan revision affects the land or water uses or natural resources of Washington in the following manner:

- Research activities are carried out under state Scientific Collection permits.
- Monitoring activities remain the same (datasondes deployed in the bay, biomonitoring, Sentinel Sites)
- Education activities remain the same (programs for the public, school groups with field trips to the beach)
- The Coastal Training Program will continue to offer classes for planners and decision-makers (mostly classroom, but some with a field component).
- Stewardship activities remain the same (monitoring for invasive crab, collection of shellfish for marine biotoxin testing, survey and control of *Spartina* in the coastal zone, survey and control of noxious weeds in the upland areas).
- Land acquisition is by willing seller only and is expected to be tideland parcels.

The Washington Coastal Management Program contains the following enforceable policies:

- Shoreline Management Act
- State Environmental Policy Act
- Clean Water Act
- Clean Air Act
- Energy Facility Site Evaluation Council
- Ocean Resource Management Act

Coastal Zone Management Act Consistency Determination

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The Washington Coastal Management Program contains the following enforceable policies:

- Shoreline Management Act
- State Environmental Policy Act
- Clean Water Act
- Clean Air Act
- Energy Facility Site Evaluation Council
- Ocean Resource Management Act

Based upon the following information, data and analysis, NOAA finds that the management plan revision is consistent to the maximum extent practicable with the enforceable policies of the Washington Coastal Management Program.

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Appendix G

Public Involvement and Comments

Development of the Padilla Bay National Estuarine Research Reserve management plan occurred over a two-year period and included direct input from all Reserve staff members, state agencies, tribes and relevant stakeholders, and the National Oceanic and Atmospheric Administration's Office for Coastal Management staff. The Reserve Manager and core staff (Coastal Training Program Coordinator, Stewardship Coordinator, Education Coordinator, Research Coordinator) sought input from advisory committees during the initial phase of revision and met with stakeholders such as Washington Department of Natural Resources and Washington State Parks and Recreation Commission, both of whom own property within the boundary. Draft chapter narratives were made available for comment to relevant stakeholders and state agencies.

NOAA's Office for Coastal Management reviews and approves the plan after ensuring sufficient opportunity for comment by the public, per 15 Code of Federal Regulation 921.33. Once the management plan has been approved by NOAA's Office for Coastal Management, a Federal Register Notice announcing a 30-day public comment period is published.

The public comment period for this plan was published in the Federal Register on March 8, 2016. Additionally, local public notice was published in the Skagit Valley Herald on March 4, 2016 announcing a 30-day comment period. The public had access to the draft document on the Padilla Bay NERR website (www.padillabay.gov) and at the Breazeale Interpretive Center, located at 10441 Bayview-Edison Road, Mount Vernon, Washington. After the required 30-day public comment periods, revisions to the document were made, where appropriate. Four comment letters were received and are summarized in the table on the following page.

Source of Comment	Date Received	Summary of Comments	Response
Burt Newbry, Shell Puget Sound Refinery	3/28/16	• Would like to see proposed mitigation project under "habitat restoration" in plan, not "habitat loss."	• Reserve changed in plan.
Roger Pederson, community member	3/29/16	• Concerned with stability of bluff • Interested in why there is a lack of commercial oyster production in Padilla Bay -- could it be a lack of freshwater plankton to feed them? • Concerned with dike stability • He commented on use of terms: sanctuary vs. reserve vs. preserve	• Reserve is consulting with local geologist regarding bluff & dike stability (Points 1&3) • Reserve acknowledges comment about oysters (Point 2) • Reserve acknowledges comment about terminology (Point 4)
F.E. Kalb, Jr., BNSF Railway Company	4/7/16	• Provided information on rail safety • Provided information on safety measures implemented by BNSF to make transport of crude oil and hazardous materials safer.	• The Reserve now has this information on file.
Matt Marusich, Tesoro Anacortes Refinery	4/8/16	• Would like to see wording changed regarding shipment of crude oils and other petroleum materials by rail and sea.	• Reserve revised wording in plan.