

Port Gardner Bay

Final Damage Assessment Restoration Plan and Environmental Assessment

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Prepared by

THE SUQUAMISH TRIBE

The Port Gardner Natural Resource Trustee Council

Port Gardner Bay NRDA Restoration Plan and Environmental Assessment

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ABSTRACT

Hazardous substance releases into Port Gardner Bay area resulted in the contamination of the sediments and injuries to natural resources. The Port Gardner Bay Trustee Council (Trustees) is developing the Port Gardner Bay Natural Resource Damage Assessment to determine the extent of injuries to natural resources resulting from these releases. Natural resources include fish, shellfish, wildlife, sediments, and water quality, and the services they provide. Trustees are also determining how to restore injured natural resources and lost resource services.

The Restoration Plan, which is also an Environmental Assessment, will guide implementation of Natural Resource Damage Assessment (NRDA) restoration activities. The Environmental Assessment (EA) analyzes the environmental impacts of the alternatives considered by the Trustees to restore, replace, rehabilitate, and/or acquire the equivalent of the injured natural resources and their services.

The Trustees evaluated three alternatives: the No-Action Alternative, which is required to be included in the analysis; the Smith Island Restoration Project Alternative; and the Blue Heron Slough Restoration Project Alternative. The Trustees' preferred alternative is the Blue Heron Slough project, an example of Integrated Habitat Restoration, which is a comprehensive plan based on restoration of key habitats that, together, will benefit the range of different resources injured by releases of hazardous substances in Port Gardner Bay. In addition, the Trustees have included a detailed description of the methodology considered for use in a settlement-based approach to injury assessment for Port Gardner Bay.

EXECUTIVE SUMMARY

The Port Gardner Bay Trustee Council (Trustees) is developing the Port Gardner Bay Natural Resource Damage Assessment (NRDA) to determine the extent of injuries to natural resources, such as fish, shellfish, wildlife, sediments, and water quality, and the services they provide. The NRDA is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the Oil Pollution Act of 1990, and other applicable laws. Concurrent with the damage assessment process, the Trustees are conducting restoration planning to determine the best approach for restoring, rehabilitating, replacing, and acquiring the equivalent of the injured natural resources and their associated services. To guide the restoration process, and to evaluate any environmental impacts associated with the proposed action under the National Environmental Policy Act (NEPA), the Trustees have prepared this Restoration Plan/Environmental Assessment (RP/EA). The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of the Interior, Fish and Wildlife Service (USFWS) are the lead federal agencies for NEPA. The cooperating agencies are the other Trustees.

The overall goal of this Restoration Plan, through the selection of a preferred alternative, is to restore, replace, or acquire the equivalent of those natural resources injured as the result of hazardous substance releases in Port Gardner Bay. This EA analyzes the suitability and environmental impacts of the alternatives that may be employed by the Trustees to restore, replace, rehabilitate, and/or acquire the equivalent of the injured natural resources.

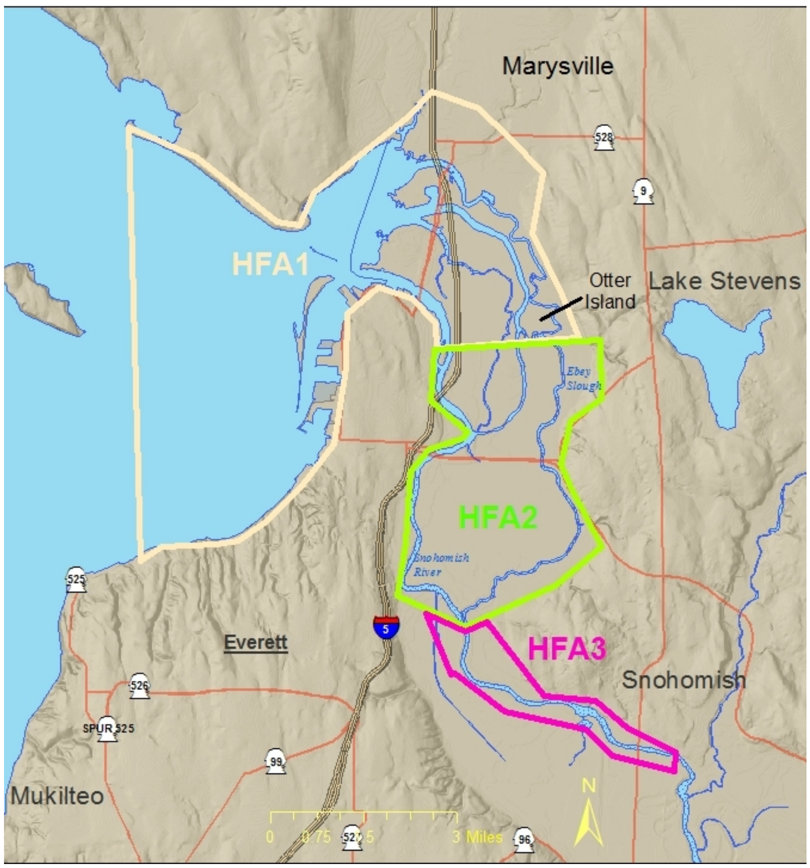
Three alternatives are evaluated in this RP/EA:

1) **No Action**, an alternative that is required to be considered, under which the Trustees would not conduct restoration actions to restore natural resources;
2) **Smith Island Restoration Project**, under which 350 acres of estuary habitat that had been diked and drained would be restored to benefit salmonid and bird species. This restored habitat includes off channel habitat, marsh habitat, mudflat habitat, and riparian habitat.
3) **Blue Heron Slough Restoration Project**, under which 354 acres of habitat complexes would be developed to benefit, directly or indirectly, the suite of natural resources that were injured by releases of hazardous substances into Port Gardner Bay. These habitat complexes include off channel habitat, marsh habitat, mudflat habitat, and riparian habitat.

The Trustees preferred alternative is the **Blue Heron Slough Restoration Project**, which is a comprehensive project that would restore key habitats that together, will benefit the range of different resources injured by releases of hazardous substances in Port Gardner Bay. This alternative best meets the needs of the Trustees' restoration goals and principles because it is in a preferred location, restores preferred habitats, will be developed in a sustainable way, and has a high likelihood of project completion and success if it becomes constructed through the anticipated NRDA settlement. After a full evaluation under NEPA of environmental impacts associated with this project, and its alternatives, the Federal Trustees do not anticipate any long term or major adverse impacts. However, the project is anticipated to create long term benefits for the ecosystem.

The Trustees have taken an ecosystem approach to plan for restoration projects as part of the NRDA. The Trustees established priority focus areas for restoration that fulfill CERCLA requirements (restoration with a strong nexus to the injured resources) and put restoration in areas where habitat is scarce and essential for fish and wildlife in the Snohomish Estuary. Each Habitat Focus Area (HFA) places boundaries around important target habitat features and incorporates geographic boundaries, restoration site clusters, exposure to wave energy, location, maritime uses, land uses, and development. Three HFAs are covered under this document and are shown in Figure 1:

Figure 1 Habitat Focus Areas for Restoration



- **HFA1—Port Gardner Bay and portions of the lower estuary**, extending from portions of Possession Sound to the bifurcation of Steamboat, Union Slough, and Main Stem Snohomish River and up Ebey Slough to Otter Island.
- **HFA2—Saline portions of the Snohomish River Estuary**, between the Main Stem bifurcation to Otter Island including Ebey Slough and the Main Stem Snohomish River.

- **HFA3—Upstream of HFA2 to the end of tidal influence** (Approximately the City of Snohomish).

The Trustees' approach and ability to restore injured resources and the approach required varies among the HFAs. Priority was given to projects within HFA1—Lower Snohomish River and Possession Sound and HFA2. Projects in HFA3 had a lower priority and therefore, a discounted value.

Restoration Goals

The overall goal of the Restoration Plan is to restore, replace, or acquire the equivalent of those natural resources injured as the result of hazardous substance releases. To accomplish this goal, the Trustees will restore important habitats that support injured resources. Estuarine and riparian habitats of the Port Gardner Bay are a fraction of their historic acreage and this lack of habitat is believed to be a limiting factor for many natural resources and services within this system.

To restore injured resources and improve Port Gardner Bay's ability to support these resources, the Trustees considered habitat rehabilitation, creation, and enhancement projects. Marshes are a top priority, because of their high habitat value to injured natural resources. Riparian buffers, especially those adjoining marsh habitats, are also targeted because they support wildlife, filter runoff, and provide material inputs. The Trustees' primary focus is restoration of mudflats, marshes, and riparian buffers in integrated habitat complexes, because these have been determined to have the most direct benefits to injured resources. However, Trustees also considered other project types that show clear benefits to injured natural resources.

Restoration in Port Gardner Bay is constrained by commercial and industrial uses and other physical developments in the river and along the shorelines. Restoring areas of habitat within a system that has undergone such a high level of alteration while supporting numerous land uses—including industrial, commercial, agricultural, residential, open space, and urban infrastructure—without negatively affecting those existing uses is challenging. However, there are several examples of successful habitat restoration projects that have been built in the Port Gardner Bay area without negatively impacting existing uses.

Primary objectives of the Trustees for Port Gardner Bay include:

1. Implement restoration with a strong nexus to the injuries caused by releases of hazardous substances in Port Gardner Bay.
2. Provide a net gain of habitat function beyond existing conditions for injured fish and wildlife by restoring important habitat types and the physical processes that sustain them.
3. Integrate restoration strategies to increase ecosystem structure and function.
4. Preserve existing threatened functioning habitats while enhancing or creating new high-value habitats.

5. Coordinate restoration efforts with other planning and regulatory activities to maximize restoration potential.
6. Ensure that restoration sites and associated habitat functions are preserved in perpetuity.
7. Involve the public in restoration planning and implementation through education and outreach.

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ACRONYMS AND ABBREVIATIONS

AET—Apparent Effects Threshold

ACOE—U.S. Army Corps of Engineers

AQI – Air Quality Index

CERCLA—Comprehensive Environmental Response, Compensation, and Liability Act

CEQ—Council on Environmental Quality

Cfs—Cubic feet per second

CWA—Clean Water Act

DOC—U.S. Department of Commerce

DOI—U.S. Department of the Interior

DSAY – Discount Service Acre Year

EA – Environmental Assessment

ECY—Washington State Department of Ecology

EIM – Environmental Information Management (database)

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

ESU – Evolutionary Significant Unit

FWCA – Fish and Wildlife Coordination Act

GIS – Geographic Information System

HEA – Habitat Equivalency Analysis

HFA—Habitat Focus Area

HSI—Habitat Suitability Indices

Port Gardner Bay/NRDA—Port Gardner Bay Natural Resource Damage Assessment

MBTA – Migratory Bird Treaty Act

MHW -- Mean High Water

MHHW -- Mean High High Water

MLLW—Mean Lower Low Water

MOA – Memorandum of Agreement

MSA- Magnuson-Stevens Fishery Conservation and Management Act

MSQS—Marine Sediment Quality Standards

MTCA – Model Toxics Control Act

NAAQS – National Ambient Air Quality Standards

NEPA—National Environmental Policy Act

NMFS – National Marine Fisheries Service

NOAA—National Atmospheric and Oceanic Administration

NRDA—Natural Resource Damage Assessment

PAH—Polycyclic aromatic hydrocarbons

PCBs—Polychlorinated biphenyls

PRP—Potentially Responsible Party

PSCAA – Puget Sound Clean Air Agency

OPA—Oil Pollution Act of 1990

RCRA—Resource Conservation and Recovery Act

RI—Remedial Investigation

RI/FS—Remedial Investigation and Feasibility Study

RM—River mile

RP/EA—Restoration Plan/Environmental Assessment

SEPA—State Environmental Policy Act

SEWIP – Snohomish Estuary Wetland Integration Program

SOC—Substance of Concern

TOC—Total Organic Carbon

TRT -- Technical Recover Team

USFWS – U.S. Fish and Wildlife Service

WRIA – Water Resource Inventory Area

1. INTRODUCTION

1.0 Background

This document addresses natural resource damage assessment (NRDA) and ecological restoration activities related to Port Gardner Bay in Everett, Washington. NRDA, generally, is the process by which state, tribal and federal natural resource "trustee" agencies evaluate injuries to natural resources caused by releases of hazardous materials or discharges of oil. The result of a NRDA is an estimate of the magnitude of injury and, ultimately, the ecological restoration required to compensate the public for the injuries to their natural resources. In this case, the Port Gardner assessment area includes the lower Snohomish River, Everett Waterfront, East Waterway, and a portion of Possession Sound near Everett. This area serves a commercial shipping industry and contains many facilities and both private and municipal wastewater outfalls. Numerous industrial operations have been identified as sources of contamination to Port Gardner.

Releases of hazardous substances into Port Gardner Bay have become commingled and have likely combined to cause injury to trust resources. There are many potential sources for this contamination, including numerous industrial facilities. Discharges and releases of hazardous substances into Port Gardner Bay have resulted from industrial and municipal processes since the early 1900s. Facilities released materials through permitted and non-permitted discharges, spills during cargo transfer and refueling, stormwater runoff through contaminated soils at upland facilities, and discharge of contaminated groundwater. Other releases into Port Gardner Bay are a result of lumber operations, such as sawmills, and pulp and paper mills (Anderson 1985, Long 1999, WDOH 2011).

Many sites have contamination in soils, groundwater, and sediment due to spills, mishandling of chemicals, and improper chemical disposal. Ecology is currently overseeing cleanup of several sites on the Everett Waterfront and East Waterway.

The Port Gardner Bay Trustee Council (Trustees) is conducting a NRDA to determine the extent of injuries to natural resources, such as fish, shellfish, wildlife, sediments, and water quality, and the services they provide. Natural resource services are defined as the functions performed by a natural resource for the benefit of another natural resource and/or the public (15 CFR Subpart C §990.30). The NRDA is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Oil Pollution Act of 1990 (OPA), the Clean Water Act (CWA), the Model Toxics Control Act (MTCA), and other applicable laws. [1]

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[1] Because this NRDA is being generally conducted pursuant to the processes established under CERCLA, discussions throughout this document will focus primarily on CERCLA; however, all of the relevant statutes listed above are applicable.

Concurrent with the damage assessment process, the Trustees are conducting restoration planning to determine the best approach for restoring, rehabilitating, replacing, and acquiring the equivalent of the injured natural resources and their associated services. To guide the restoration process, the Trustees have prepared this Restoration Plan and Environmental Assessment (RP/EA). This document describes the process undertaken by the trustee agencies to evaluate natural resource injuries and their ultimate conclusions regarding the estimated amount of injury. It also describes the restoration projects that are proposed to compensate the public for these injuries.

1.1 Purpose and Need

The purpose of this action is to implement a restoration action that will compensate the public for the natural resource injuries mentioned above and described in more detail throughout this document. To ensure the public is compensated for these lost services, the Trustee are seeking to identify the project that has the best overall fit in terms of availability, preferred location, sustainability, and ability to restore natural resource services lost in the Port Gardner Bay.

The need for this action is established by the existence of a large area of Port Gardner Bay that has been contaminated by municipal and industrial processes over decades. In the absence of restoration activities, the public would not be compensated for interim natural resource service losses caused by this contamination. Interim losses are those losses that occurred from the time of injury until the completion of restoration.

1.1.2 Natural Resource Trustees

Natural resource trustees act on behalf of the public to manage, protect, and restore natural resources. Stewardship of the nation's natural resources is shared among several federal agencies, states, and tribal trustees. The designation of trustees is explained in CERCLA (42 U.S.C. § 9607(f)). During Natural Resource Damage Assessments under CERCLA, the trustees assess natural resource injuries resulting from hazardous substance releases. Trustees determine how to restore and compensate the public for such injuries, and seek funds to implement restoration projects from Potentially Responsible Parties (PRPs) or reach settlements for PRPs to build these projects.

Natural resource trustees for Port Gardner Bay established the Port Gardner Bay Trustee Council which operates under a 2012 Memorandum of Agreement (MOA). Members of the Port Gardner Bay Trustee Council are the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce; the U.S. Department of the Interior, which includes the Fish and Wildlife Service and the Bureau of Indian Affairs; the State of Washington, as represented by the Department of Ecology; the Tulalip Tribes; and the Suquamish Tribe. Under the MOA, these governmental entities are collectively referred to as the "Trustees."

1.1.3 Legal Mandates and Authorities

This RP/EA will guide decision-making to implement Port Gardner Bay/NRDA restoration activities. This RP/EA was developed in order to satisfy mandates under both CERCLA and the National Environmental Policy Act (NEPA).

This RP/EA serves the function under CERCLA of describing to the public the Trustees' proposed means to restore, and to compensate the public for, natural resource injuries caused by hazardous substance releases in Port Gardner Bay.

Under NEPA,, (42 U.S.C. §§ 4321 *et seq.*), this RP/EA analyzes the environmental impacts of the alternatives that the Trustees considered to restore, replace, rehabilitate, and/or acquire the equivalent of the injured natural resources.

1.1.4 Overview of the Damage Assessment Process

Natural resource damage assessment is a complex process that may take years to complete. The three phases described below— Preliminary Assessment, Injury Assessment and Restoration Planning, and Restoration Implementation—provide a framework to structure the process.

1.1.4.1 Preliminary Assessment (Pre-assessment)

The purpose of the Pre-assessment is to provide a rapid review of readily available information to ensure that there is a reasonable probability of making a successful claim (i.e., there is likely to have been injury and damage to trustee resources). This work included a review of existing information at the site along with applicable scientific literature. Based on the Pre-assessment, the Trustees determine whether it is appropriate to move forward with the damage assessment process. The Port Gardner Pre-assessment Screen was completed in March of 2013.

1.1.4.2 Injury Assessment/Restoration Planning

During the second phase, the Trustees quantify injuries to natural resources and the loss of resource services. This quantification can be done by conducting site-specific economic and/or scientific studies, especially if litigation is required. Alternatively, as discussed below, the results of injury studies conducted in similar areas and/or information in the scientific literature can be used to estimate injury using site-specific data (such as sediment contaminant levels). The results are used to develop a restoration plan that outlines alternative approaches to speed the recovery of injured resources and compensate for their loss or impairment from the time of injury to recovery. The type of resource that was injured, the type of oil or hazardous substance, and the amount and duration of exposure are among the factors that affect how quickly resources are assessed and how quickly restoration and recovery occurs.

Once the injury assessment is complete or nearly complete, the Trustees develop a plan for restoring the injured natural resources and services. Trustees must identify a reasonable range of alternatives, evaluate and select the preferred alternatives(s), and develop a draft and final

Restoration Plan. Acceptable restoration actions include restoration, rehabilitation, replacement, or acquisition of the equivalent natural resources and services.

Restoration actions are either primary or compensatory (see Section 1.3). Primary restoration is action taken to return injured resources and services to baseline, including natural recovery. Compensatory restoration is action taken to compensate for the interim losses of natural resources and/or services pending recovery. The type and scale of compensatory restoration depends on the nature of the primary restoration action, and the level and rate of recovery of the injured natural resources. When identifying compensatory restoration alternatives, trustees must first consider actions that provide services of the same type and quality and of comparable value as those lost. If compensatory actions of the same type and quality and of comparable value cannot provide a reasonable range of alternatives, Trustees then consider other compensatory restoration actions that will provide services of at least comparable type and quality as those lost. The restoration process and objectives are described in more detail in Section 6.4.

1.1.4.3 Restoration Implementation

The final phase is to implement restoration and monitor its effectiveness. Trustees seek public input to select and implement restoration projects. Examples of restoration include replanting wetlands and restoring salmon habitat. The PRP pays the costs of assessment and restoration and is often a key participant in implementing the restoration.

1.1.5 Current Stage of Natural Resource Damage Assessment in Port Gardner Bay

For Port Gardner Bay, the Trustees are currently in the second phase—Injury Assessment and Restoration Planning. Trustees have begun the process of assessing injury in Port Gardner Bay based on existing water, sediment and tissue data, scientific literature and studies conducted as part of the Commencement Bay NRDA process. Restoration planning is also underway. The Trustees have determined that restoration can be implemented relatively quickly at locations where there would be little risk of the restoration project becoming contaminated from the surrounding area.

1.2 Differences between the Remediation Process and Natural Resource Damage Assessment

Trustees work in a complementary way with other agencies with cleanup responsibility, such as EPA and state cleanup agencies. An effective response and/or remediation process will reduce the amount of injury to natural resources. Removal and remedial actions (collectively, “response actions”) are conducted by the Environmental Protection Agency (EPA) or state response agencies and focus on controlling exposure to released hazardous substances by removing, neutralizing, or isolating them in order to protect human health and the environment from harm. Although response actions can reduce the need for restoration, the two types of actions are separate and distinct. Trustees work to ensure that the remedies selected are protective of natural resources and consider the potential for deleterious impacts from cleanup actions when locating sites for restoration projects and timing their implementation.

Trustees support integrating restoration and remediation when this can be accomplished. However, this may not always be possible. Alternatively, the NRDA restoration may take place once cleanups are complete, as this also provides the Trustees with a degree of certainty regarding how quickly recovery will take place. In some situations, NRDA restoration may take place prior to cleanup, when the Trustees can effectively estimate a recovery period based on existing information, and the restoration would occur in areas where recontamination from the cleanup is unlikely.

Cleanup of Port Gardner Bay is being addressed through the Washington State Department of Ecology (Ecology). Ecology is currently overseeing cleanup of more than 10 sites on the Everett Waterfront and East Waterway. Cleanup actions, such as removal of contaminated sediments and sediment capping, may be considered at these sites. Several sites have already completed cleanup actions to remove contaminated soil. It is important to note that while Ecology has subdivided Port Gardner Bay into several MTCA cleanup sites, the Trustees are treating it as a single site for NRDA purposes.

The Trustees recognize that some of the Port Gardner Bay cleanup sites do not yet have completed investigations or cleanup plans. While cleanup processes are more focused on evaluating the current state of the site, NRDA evaluates data from over the past 34 years to evaluate natural resource injury. The Trustees have evaluated existing data and have determined that it is sufficient to document the occurrence of natural resource injury post-1980 (the enactment of CERCLA). The Trustees believe that it is beneficial to implement restoration as soon as possible to maximize recovery efforts. The Trustees also believe there are more opportunities for restoration now then there will be after the cleanup actions, so it is advantageous to pursue restoration settlements in Port Gardner Bay earlier rather than after the cleanups are completed.

1.3 Restoration under CERCLA

Restoration actions for natural resource injuries and service losses under CERCLA are generally categorized as either “primary” or “compensatory.”

Primary Restoration

Primary restoration is any action taken to enhance the return of injured natural resources and services to their baseline, i.e., the condition or level that would have existed had the hazardous substance releases not occurred. In many instances, the cleanup actions undertaken at a site are sufficient to serve the purpose of primary restoration with natural recovery taking place within a reasonable period of time. As part of restoration planning for this site, the Trustees will consider the extent to which cleanup actions undertaken as part of Ecology’s remedial process may be sufficient to allow natural resources and services to return to baseline without primary restoration actions by the Trustees. The Trustees are providing input to Ecology in order to decrease the need for primary restoration actions. Therefore, our focus in this document will be on compensatory restoration.

Compensatory Restoration

Compensatory restoration is any action taken to compensate for interim losses, the reduction of resources and the services they provide relative to baseline levels, which occur from the onset of the injury until complete recovery of the injured resources or services. The scale of the required compensatory restoration will depend both on the degree of the resource injuries and how quickly each resource and associated service returns to baseline. Remedial actions that facilitate or speed resource recovery reduce interim losses and the compensatory restoration required to offset those losses. Resource injuries and service losses caused by implementation of remedial actions are also injuries that may be compensated through appropriate restoration actions if not otherwise addressed through mitigation.

This Port Gardner Bay RP/EA discusses two potential compensatory restoration actions that would restore injured natural resources and services in Port Gardner Bay, and evaluates them as to their likely effectiveness and potential impacts on the environment. This document also describes the process the Trustees used to identify and rank restoration projects. The PRPs, as well as the public, need to be informed of the Trustee's decision-making process in order to properly engage in the process. Engagement in the process by all interested parties is a necessary component in the expeditious settlement of Natural Resource Damage liabilities.

1.4 Restoration Goals

The goals of NRDA process are to restore injured natural resources to baseline and compensate the public for losses from the time of injury until full recovery. Restoration in Port Gardner Bay is constrained by industrial uses and other physical developments in the river and along the shorelines. Restoring to historical (pre-1900s) conditions is not possible in a system that has undergone such a high level of alteration and that supports numerous land use types, including industry, agriculture, commercial and residential uses, open space, and urban infrastructure. The existing state of development with all the physical alterations to the Port Gardner Bay system, minus the contamination from hazardous substance releases, is included within the concept of baseline for Port Gardner Bay.

The Snohomish River, once a wide meandering river with thousands of acres of mudflats and wetlands, was channelized and narrowed through filling projects by the 1940s (Figure 1). The river flows through agricultural and industrial areas and numerous facilities line its banks. In addition to industry, important uses of the waterway include fishing, recreation, and providing habitat for wildlife. Resources at risk include resident and migratory birds, the benthic community, flatfish, and salmon. Several species of anadromous fishes have been listed as threatened or endangered under the Endangered Species Act in Puget Sound and Western Washington, specifically Chinook salmon, bull trout and steelhead (NOAA 2007, USFWS 1999).

The present-day Port Gardner Bay ecosystem has habitat limitations that constrain fish and wildlife populations. The Snohomish River watershed has been hydrologically altered. Some native populations of fish and wildlife are in decline and the watershed is increasingly urbanized. Despite this, important opportunities exist to restore ecosystem functions and processes to create and maintain natural habitats over time.

The overall goal of the Trustees is to restore, replace, or acquire the equivalent of those natural resources injured as the result of hazardous substance releases. To accomplish this goal, the Trustees propose to restore important estuarine and riparian habitats that support injured resources. Estuarine and riparian habitats of Port Gardner Bay are a fraction of their historic acreage and this lack of habitat is a limiting factor for many natural resources and services within this system. To restore injured resources and improve Port Gardner Bay's ability to support these resources, the Trustees considered rehabilitation, creation, and enhancement projects.

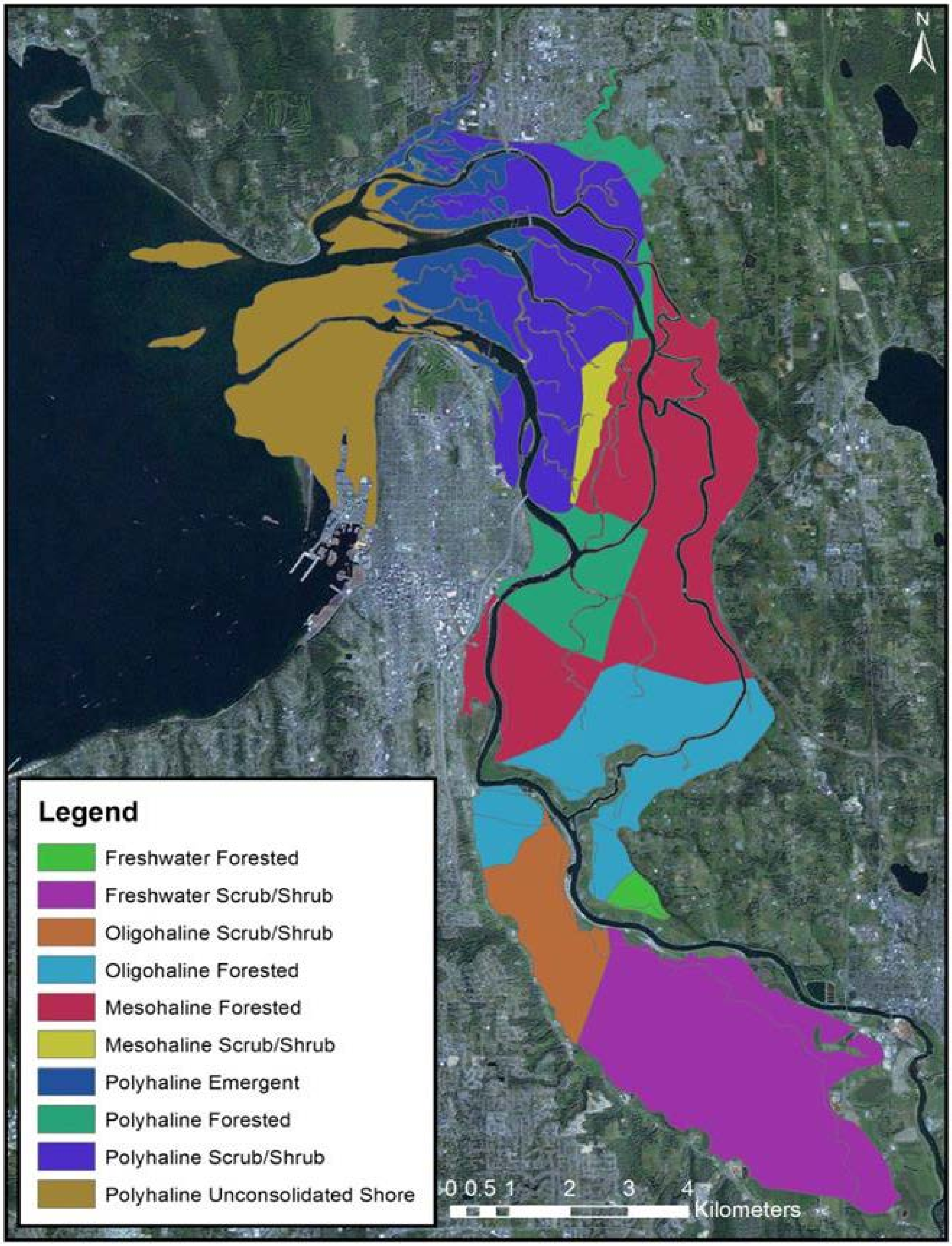
While CERCLA requires the Trustees to seek restoration of injured trust resources, their actions should benefit whole ecosystems by:

1. Meeting statutory objectives of restoring, replacing, rehabilitating, or acquiring the equivalent of natural resources and services injured or destroyed as a result of the release of hazardous substances and discharge of oil.

2. Providing alternatives for those natural resources that will not recover without efforts above and beyond regulatory requirements for source control, sediment cleanup, and habitat restoration (e.g., certain fish and wildlife species, and water quality).

3. Providing a diversity of sustainable habitat types within Port Gardner Bay ecosystem to enhance fish and wildlife resources.

Figure 2. Historic view of Port Gardner Bay showing historic extent of wetlands (Hall et al in prep)



2. INJURY ASSESSMENT METHODOLOGY

2.1 Introduction to Habitat Equivalency Analysis (HEA)

The Trustees conducted the Port Gardner injury assessment and restoration scaling using a methodology called Habitat Equivalency Analysis (HEA). HEA enables Trustees to apply a consistent approach based on a described methodology, relying on the available scientific information and utilizing existing data sets collected by agencies and private parties. Because HEA can assess both injury impacts and beneficial effects from restoration, it enables the Trustees to scale restoration appropriate to the injury when evaluating settlements with responsible parties.

HEA is an economic model used as a tool to estimate the amount of habitat restoration that is needed to produce environmental gains sufficient to compensate for losses resulting from natural resource injuries. HEA is commonly used to estimate the amount of compensation required to address natural resource injuries resulting from discharges of oil and releases of hazardous substances. HEA is an example of a service-to-service approach to determine the scale of restoration projects that will ensure that the present discounted value of natural resource service gains equals the present discounted value of interim natural resource service losses (NOAA, 2006). "Natural resource services" are defined as the functions performed by a natural resource for the benefit of another natural resource and/or the public (15 CFR Subpart C §990.30). In an HEA (also known as Resource Equivalency Analysis, or REA[2]) the Trustees develop estimates for the duration and level of service losses until recovery to baseline. The HEA also estimates the amount of services to be provided by the compensatory restoration project over the lifetime of the project. The analysis determines the size of the restoration project needed to equal the total interim losses of service resulting from the injury. Additional information about HEA is available online at https://darrp.noaa.gov/economics/habitat-equivalency-analysis.

HEA has been used successfully in a number of natural resource damage cases around the country for settlements as well as for litigated claims.[3] HEA has been used as the method for estimating natural resource injuries and the scale of restoration necessary to address these injuries in most of the NRDA settlements for the past several years (Roach and Wade 2006, Zarafonte and Hampton 2007).

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[2] The HEA method is specifically used in cases of habitat injury when the service of the injured area is ecologically equivalent to the service that will be provided by the replacement habitat. This is termed service-to-service approach. When used for scaling losses of fish, birds, and other wildlife, the method is sometimes termed resource equivalency analysis (REA).

[3] *United States v. Fisher*, 977 F.Supp. 1193 (S.D. Fla. 1997); *State of Idaho, et al. v. The M.A. Hanna Company, et al.*, No. 83-4179, Consent Decree (D. Idaho Sept. 1, 1995).

2.2 Port Gardner Bay & Snohomish River Estuary Habitat Equivalency Description

Because of the central role that sediments and the sediment-based biological community play in the Port Gardner Bay environment, the Trustees have decided to quantify natural resource injuries for settlement purposes in terms of affected habitat rather than numbers of individual species impacted. HEA is an ecosystem approach that in Port Gardner Bay focuses on assessing injury to benthic habitat. As the foundation for a complex web including small animals and plants, fish and birds, the benthic habitat is essential for a healthy aquatic ecosystem (See Figure 3). By benthic habitat we mean the bottom of the river or bay and the plants and animals that live there or use the habitat for feeding. To determine how much habitat restoration needs to be developed to compensate for contaminant-related injuries to marine sediments, the Trustees use the concept of *ecological services* (see Appendix C of the Lower Duwamish Programmatic EIS/Restoration Plan, Elliott Bay Trustee Council, 2013). Port Gardner Bay HEA calculates the amount of ecological services lost as a result of contamination, and the amount of ecological services that would be gained from restoration projects, making past and future losses and gains comparable by applying a discounting factor. The results of the calculations are stated in terms of *discounted service acre-years (DSAYs)*.

In determining the amount of ecological services lost due to sediment contamination, the Trustees take into consideration the type of habitat affected and its importance to key species. The Trustees reviewed scientific literature, technical data, applicable regulatory standards and the results of their own studies to determine the effect that varying concentrations of hazardous substances in sediment have on key species or species groups. This information was used to develop a series of concentration threshold levels for each hazardous substance, which are assigned a corresponding percent reduction in ecological services per acre of affected habitat. Using a geographical information system (GIS) and data developed by the Trustees and by PRPs, the Trustees calculate the acreage of areas exceeding the sediment contamination threshold criteria, taking into account whether areas were slated for remediation or natural recovery and when natural resource injuries are likely to cease.

In its simplest form, HEA considers how much of a particular environmental component was lost (*e.g.*, number of acres destroyed, numbers of fish lost, etc.), to calculate how much restoration would be required to generate a net gain of an equivalent amount of the lost component. Because environmental losses and gains are not experienced at a single point in time, the calculation also takes into account the number of years of losses that were experienced and the rate at which losses and gains decrease or increase to determine the amount of gains the restoration must produce over what period of time (e.g., fish-years, acre-years, etc).

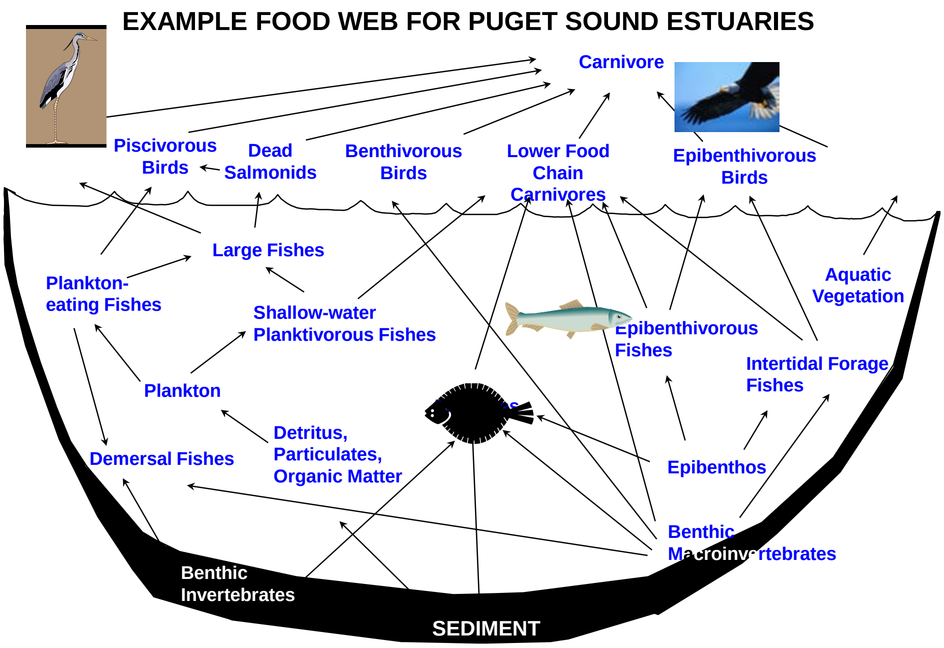


Figure 3. Example ecosystem food web, showing species used in Port Gardner Bay HEA.

2.2.1 Discounting

HEA requires the Trustees take into account not just the number of years of losses and gains but the timing of the injuries, remediation, and restoration. Environmental losses and gains that occur at different points in time need to be equated in resolving natural resource damage claims. The Trustees are using HEA in essence to quantify natural resource damages in terms of environmental values rather than dollar values. However, by using non-monetary terms, the Trustees must ensure that any resulting settlement still adequately compensates the public for natural resource injuries. One important aspect of a monetary claim is the effect of the time-value of money. Payments made at different points in time have different values in the present. In order to compare payments made at different times, economists routinely apply a discount rate, compounding past gains and losses and discounting future gains and losses. If a discount rate were not applied to natural resource damage claims, the public would not be fully compensated, and responsible parties would have incentive to delay settlement (and thus postpone restoration) as long as possible. To avoid this outcome, Port Gardner Bay HEA applies a 3 percent discount rate to compound past environmental losses and discount future environmental gains and losses to a present value (NOAA, 1999).

2.2.2 Port Gardner Bay & Snohomish River Estuary Habitat Equivalency Model

To apply Port Gardner Bay HEA, the Trustees perform the following steps:

1) Identify the environmental components to measure losses from natural resource injuries and gains from restoration actions.

2) Identify and quantify the losses that occurred.

3) Identify the time period over which the losses occurred.

4) Calculate the total losses over time and apply the discount rate to the losses to determine the present value of the total losses.

5) Determine what restoration actions need to be undertaken to generate ecological service gains with a present value equal to the total losses.

These steps are summarized below.

1. *Identify the environmental components to measure losses from natural resource injuries and gains from restoration actions.*

Some hazardous substances released to the environment have accumulated in the sediments of Port Gardner Bay. The organisms that live in and on the sediment and are exposed to sediment contamination from the base of the food web on which most of the fish, birds, and other wildlife that use the Snohomish River environment depend. As illustrated by Figure 3, sediment contamination consequently affects nearly all aspects of the Lower Snohomish aquatic ecosystem. As mentioned above, Trustee studies and other research have documented the contaminant-related impacts to salmon and flatfish as well as benthic invertebrates (SAIC 1989, 2009, Meador 2002a, Meador 2002b, Johnson 2008a, Johnson 2008b).

Studies and sampling conducted through Ecology's MTCA Remedial Investigation process and other studies have identified contaminated sediments throughout Port Gardner Bay. Extensive studies conducted in other parts of Puget Sound such as Commencement Bay and Elliott Bay/Duwamish River, and the results of studies from elsewhere, have linked contaminated sediments with adverse impacts to trust resources, including flatfish, salmonids, and birds. Organisms can be exposed to contamination directly through contact with the sediments or water, or through the consumption of contaminated prey. There can also be injuries due to resources that acquire contamination from Port Gardner Bay, causing exposure to additional resources in the food chain. A number of different hazardous substances are contaminating Port Gardner Bay sediments and therefore a wide range of different types of adverse effects could occur to resources within Port Gardner Bay and indirectly to resources outside Port Gardner Bay. The types of injuries to organisms can range from minor effects such as impaired cellular function to more serious impacts such as impaired reproduction or death.

It would be extremely difficult and time-consuming to quantify injuries to all of the individual resources potentially impacted and to combine this information into resource service loss estimates for an HEA. The ecological service losses ultimately result from contaminated habitats and the organisms that directly or indirectly depend on those habitats. Because of the central role that sediments and the sediment-based biological community play in the Snohomish River Estuary, the Trustees decided to evaluate the potential loss of natural resources in terms of affected sediment habitat (i.e., loss of ecological services from the sediments) rather than numbers of individual organisms impacted. This was done using existing sediment chemistry data together with injury thresholds developed by the Trustees.

Juvenile Chinook salmon and English sole were used as representative species to assess the value of habitat to fish. Although the various fish species in the Snohomish River Estuary display a variety of life history requirements, juvenile Chinook salmon and English sole have feeding modes, behavioral characteristics, and habitat requirements that sufficiently overlap those of similar species to consider them appropriate surrogates. Four bird assemblages, representing the bird species occurring in the area, were used to assess the value of habitat to birds. The four bird assemblages are grouped according to their foraging behavior and include both resident and migratory species. These four assemblages are: 1) shallow-probing and surface searching shorebirds (e.g., sandpiper), 2) waders (e.g., great blue heron), 3) surface and diving birds (e.g., lesser scaup), and 4) aerial searchers (e.g., osprey). The bird assemblages use similar habitat as juvenile Chinook salmon, and are linked through their food webs, so habitat value for birds is linked to habitat value for juvenile salmon. Existing habitats in the River were classified and a determination made of the value, or ecological services, these habitats provided to the representative species. Although birds and fish were used to determine the value of restoration projects, a great many different species will benefit from these restoration projects, including clams and other shellfish that will have additional clean habitat to utilize from these restoration efforts.

Port Gardner Bay environment is currently dominated by deep channels, uplands, and steep hard-surfaced (e.g., rip-rapped) banks. The habitats that are in short supply are intertidal mudflats and marshes. These latter types of habitats are ecologically important as food sources, rearing and refuge areas, and spawning and nursery habitat for a variety of Port Gardner Bay and Snohomish River Estuary species. Because of their scarcity, these habitats serve as a limiting factor on the overall health of Port Gardner Bay and Snohomish River Estuary environment. As described in Section 1.7, the Trustees' restoration goals include developing a diversity of habitat types, with particular emphasis on habitats in short supply that are necessary to critical life stages of key injured species.

Trustees evaluated a range of habitat types in terms of their relative importance to impacted species. To keep the process manageable, the Trustees conducted the evaluation using Chinook salmon and English sole as representative fish species to assess the value of habitats to all fish. The Trustees used assemblages of bird species rather than individual species to assess habitat value to birds.

Allowing for the creation of one habitat type to compensate for losses suffered in other habitat types requires the development of some means to equate different habitats. From a biological perspective, it is overly simplistic and difficult to calculate, for example, the amount of marsh habitat that needs to be created to compensate for contamination of Port Gardner Bay bottom sediments on a straight one-to-one, acre-for-acre basis. An acre-for-acre replacement approach does not take into account how the different habitats function or what ecological services the different habitats provide. Ecological services—providing food, cover, spawning, nursery or rearing habitat, refuge from predators, etc.—determine the value that different habitats have from a restoration perspective. As a result, the Trustees have decided to use the *ecological services* provided by the various habitats as the environmental component for measuring losses from natural resource injuries and gains from restoration actions. In essence, ecological services function as the currency for equating losses and gains for different habitat types.

2. *Identify and quantify the losses that occurred*

In order to use the ecological services currency to identify and quantify losses from natural resource injuries, the Trustees assigned an ecological services value to each of the injured habitats and the habitats potentially to be created through restoration actions. To compare different habitat types, the Trustees first identified a benchmark, or "gold standard," against which all habitat types would be measured. The Trustees reviewed scientific literature and consulted with experts to determine the benefits provided to key species by each of the other existing and potential Port Gardner Bay habitat types. Because of the Endangered Species Act listing of Chinook salmon and the significance of salmon to Indian Tribe Trustees and all regional populations, the Trustees weight habitats in terms of their importance to Chinook salmon at twice the value assigned due to their importance to flatfish or birds. Based on this analysis, the Trustees have created a matrix of assigned ecological service baseline values for the different habitat types that either exist now in Port Gardner Bay and the Snohomish River Estuary or that may be the subject of restoration actions in Port Gardner Bay and surrounding estuary. Since estuarine marsh habitats provide the greatest amount of ecological services to the species and species groups used as surrogates for all Port Gardner Bay resources, the ecological services provided by a given area of fully functioning estuarine marsh were chosen as that standard and assigned a baseline value of 1.0. The assigned baseline values range from 1.0 for fully functioning estuarine marsh, down to 0.1 for degraded habitat or areas of rip-rap. The following table shows the values assigned.

Table 1. Existing and Potential Port Gardner Bay Habitat Values

Habitat	**Habitat Value**
Estuarine Marsh	1.0
Intertidal	0.9
Shallow Subtidal	0.7
Deep Subtidal	0.3
Rip-rap	0.1

A more detailed explanation of the assignment of ecological service values and the underlying information and literature on which it is based can be found the following document of March 14, 2002 Hylebos Waterway Natural Resource Damage Settlement Proposal Report at https://casedocuments.darrp.noaa.gov/northwest/cbay/admin.html (NOAA 2002).

To quantify the impact of hazardous substances, the Trustees begin with the assumption that habitats contaminated to the point that they cause harm to species that use them provide less in the way of ecological services than do uncontaminated habitats. The Trustees reviewed scientific literature, technical data, and applicable regulatory standards to determine the effect that varying sediment concentration levels of the different hazardous substances have on key species or species groups. The Trustees judge contamination to be injurious when the concentration of the contaminants in the sediments is sufficient to result in an adverse effect to identified species. The adverse effects range from subcellular alterations up to mortality. The information shows that as hazardous substance sediment concentrations increase, the number of species adversely affected increases, and the effects themselves increase in severity. From this information, the Trustees have developed a series of concentration threshold levels for each hazardous substance, and have assigned to each threshold an increasing *percent reduction in ecological services*, also called “service loss”, per unit of habitat as shown in Table 2.

In this case, ecological service losses were determined similar to the Elliott Bay/Duwamish River and Commencement Bay NRDA cases. Injury thresholds based on sediment contaminant concentrations are used to estimate the amount of service loss within a given area. The injury thresholds are based on scientific literature, regulatory thresholds, and other correlations that have established “Apparent Effects Thresholds” or AETs that describe typical sediment concentrations that are correlated with effects in most cases. For example, the lowest contaminant concentration associated with an AET for benthic invertebrates may have a 5% service loss assigned. At higher sediment concentrations that exceed more AET values, the service loss becomes greater. The maximum service loss based only on benthic AET values is 20% per contaminant. If the scientific literature provides more information on effects to other organisms, such as fish, service loss levels may be higher. Detailed explanation of the basis of each injury threshold and service loss may be found in Appendix C of the Lower Duwamish Programmatic EIS/Restoration Plan.

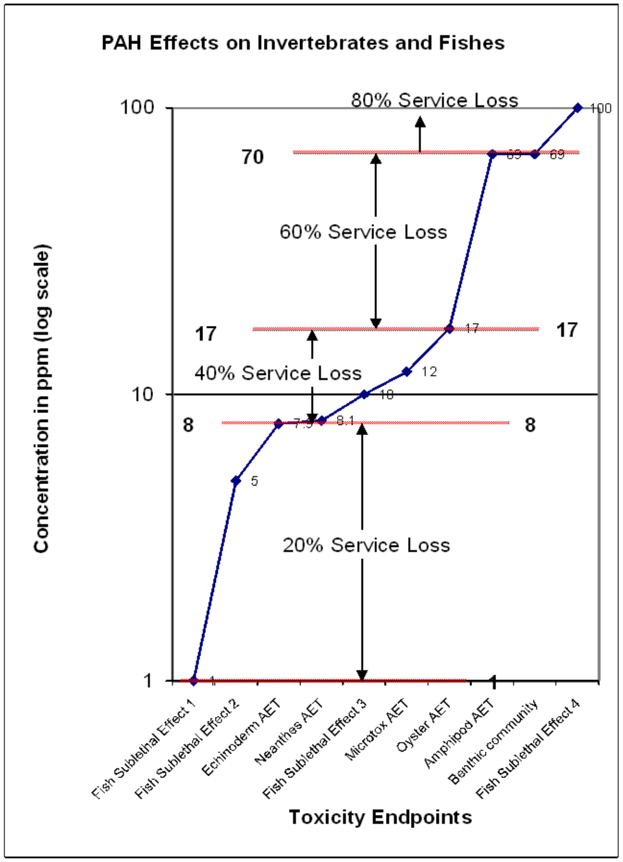
One example of an injury threshold is summarized in this document for illustration purposes. Figure 4 shows a summary of the injury thresholds for PAH chemicals including effects data for both invertebrates and fish. The invertebrate effects are based on sediment contaminant Apparent Effects Thresholds (AET) for benthic organisms, determined by laboratory bioassays and benthic community studies. The effects on fish are based on numerous studies of English Sole that show that English sole from PAH-contaminated areas are highly susceptible to the development of liver cancer and related lesions, and are prone to several other adverse health effects, such as reproductive abnormalities, immune dysfunction, and alterations in growth and development (Myers 1994, 1990, Arkoosh 1996, Johnson 1998).

To map PAH injuries and identify a range of service losses, impacts on English sole and invertebrate AETs are graphed against PAH concentration in sediments (Figure 4). The PAH concentrations are represented on the y-axis in (base 10) logarithmic form to allow effects at both high and low concentrations to be viewed on the same graph. A 20% service loss is assigned at a threshold of 1.0 ppm dry weight total PAH, which is a contaminant level where you would begin to see effects on invertebrates and fishes. A 40% service loss is assigned between 8 ppm up to 17 ppm dry weight total PAH based on a significant reduction in invertebrates and reproductive effects on English sole. At higher concentrations, greater amounts of service loss are estimated based on more significant effects to benthic invertebrates, and reduced reproduction and increased liver lesions affecting English sole.

Table 2	Injury Thresholds for contaminants of concern with associated ecological service loss percentages.									
	Substances of Concern	**symbol**	**units**	**5% Service Loss**	**10% Service Loss**	**15 % Service Loss**	**20% Service Loss**	**40% Service Loss**	**60% Service Loss**	**80% Service Loss**
	PAHs (total)	PAH	ppb dw				1000	8000	17000	70000
	PCBs	PCB	ppb dw				128	1100	3100	15200
Metals	Arsenic	As	ppm dw	57	130	450	700			
	Cadmium	Cd	ppb dw	2700	5100	9600	14000			
	Chromium	Cr	ppm dw	63.5	94		260			
	Copper	Cu	ppm dw	270	390	530	1300			
	Lead	Pb	ppm dw	360	450	530	1200			
	Mercury	Hg	ppb dw	410	1300	1400	2300			
	Silver	Ag	ppb dw	3000	3300	6100	8400			
	Zinc	Zn	ppm dw	410	530	1600	3800			
	Tributyltin	Tbt	ppb dw	102			1000			
Chlorobenzenes	1,2-dichlorobenzene	oDCB	ppt dw	35000			50000			
	1,4-dichlorobenzene	pDCB	ppt dw	110000	110000		120000			
	1,2,4-trichlorobenzene	TCB	ppt dw	31000	51000		62000			
	Hexachlorobenzene	HCB	ppt dw	22000	70000	130000	230000			
Phthalate	bis (2-Ethylhexyl) phthalate	bEPH	ppb dw	1300	1900		2000			
	Butylbenzyl phthalate	BBPH	ppb dw	63	200	900	970			
	Di-n-butyl phthalate	DnBPH	ppb dw				1400			
	Di-n-octyl phthalate	DOPH	ppb dw	61			6200			
	dimethylphthalate	DMPH	ppb dw	71	85		160			
Phenols and HCBD	4-methyl phenol	MP4	ppb dw	110	670	1800	3600			
	Phenols & HCBD	DMP	ppb dw	29	55	77	210			
	Phenol	Phenol	ppb dw	180	420		1200			
	Hexachlorobutadiene	HCBD	ppb dw	11	120	180	270			

For a more detailed description, see information on the Lower Duwamish River in the Elliott Bay Trustee Council Programmatic EIS and Restoration Plan, Appendix C "Defining Injuries to Natural Resources in the Lower Duwamish River".

Figure 4. This figure demonstrates how ecological effects and sediment concentrations are used to estimate the loss of ecological services due to sediment contamination. These "injury thresholds" are used in the Habitat Equivalency Analysis geographic tool that estimates loss of ecological services over time and space. This example is based on effects from PAH contamination to fish and benthic invertebrates. Additional examples can be found in the Lower Duwamish Programmatic EIS/Restoration Plan Appendix C.



References	Toxicity Endpoint	Concentration ppm dw
4	Fish Sublethal Effect 1	1
4	Fish Sublethal Effect 2	5
1	Echinoderm AET	7.9
1	Neanthes AET	8.1
4	Fish Sublethal Effect 3	10
1	Microtox AET	12
1	Oyster AET	17
1	Amphipod AET	69
1	Benthic community	69
4	Fish Sublethal Effect 4	100

References
1 Washington Department of Ecology
4 Johnson 2000

Flatfish Injuries
Sublethal 1 — initial effects on fecundity and occurrence of lesions in soft tissue
Sublethal 2 — significant increases lesion occurrence (>30%) and reduced fecundity (>15%)
Sublethal 3 — >40% of all individuals with lesions and fecundity reduced by ~25%
Sublethal 4 — ~75% occurrence of lesions and fecundity reduced by ~50%.

80% Service Loss > 70 ppm dry weight	All tested invertebrates affected; flatfish injuries include ~50% reduction in fecundity and ~75% occurrence of at least one lesion/fish
60% Service Loss 17 to 70 ppmt	All tested invertebrates affected.
40% Service Loss 8 to 17 ppm	One-half of tested invertebrates affected; sig-nificant injuries to flatfish include ~25% reduc-tion in fecundity & 31% occurrence of lesions
20% Service Loss 1 to 8 ppm	Begin to see effects on invertebrates and fishes. Flatfish fecundity reduced by ~5% and up to 10% of all fish with some form of lesion.

Figure D1. Information used to determine injury threshold concentrations for total PAHs and their associated percent Service Losses.

3. Identify the time period over which the losses occurred, and the rate at which any changes in the losses occurred

Once hazardous substances are in marine sediments, they can be biologically available and contribute to natural resource injuries over an extended period of time. The contaminants can cause ecological service reductions over years, beginning when the concentrations reach injurious levels and continuing until the sediments are remediated or naturally recover. For example, in Port Gardner Bay area there are areas of PCB-contaminated sediments years after PCB production and use in the United States was banned. Releases of contaminants to Port Gardner Bay, and resulting natural resource injuries, have occurred over many years. Significant efforts by industry and regulatory agencies to control many releases did not begin in earnest at some Port Gardner Bay facilities until the 1980s or later. Much of this effort has only begun to have an impact on sediment contamination.

Although natural resource injuries have apparently been occurring for decades, CERCLA precludes recovering natural resource damages where the damages and the releases from which the damages resulted occurred wholly before December 11, 1980. CERCLA's stipulation that both the releases and damages must have occurred prior to that date to be exempt from the statute means that the Trustees can legally seek compensation for natural resource damages that occurred after that date even if the release that resulted in the damages occurred before it. The Trustees must ultimately exercise their discretion and authority in determining, within the limits of CERCLA, what compensation they will consider appropriate from the PRPs for natural resource injuries. In Port Gardner Bay, the Trustees have focused on restoration that would be scaled based on ecological service losses from 1981 (post-CERCLA) through the completion of natural recovery following remediation.

The Trustees assume that service losses from contamination have occurred and will continue to occur at a constant rate until completion of remediation. Once the remediation is completed, the Trustees assume that ecological services provided by the affected area will increase at a constant rate until the area produces the services it would otherwise produce but for the contamination. The Trustees use information on scheduled or proposed remediation. If an area does not yet have proposed remediation, the Trustees made assumptions to estimate the year of remediation completion. Trustees assume that areas subject to active remediation will recover to full service levels 4 to 10 years after remediation (depending on the type of remediation), and that areas subject to natural recovery will take 25 years to recover.[4]

4. Calculate the total losses over time and apply the discount rate to the losses to determine the present value of the total losses

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[4] Presumably, areas actively dredged as part of the remedial process will have injurious concentrations of contaminants immediately removed. However, it will take time for benthic organisms to re-colonize these areas to the point that they are generating the levels of ecological services they would be expected to produce.

The Trustees have compiled a database of relevant information and used that database to develop a series of maps using a geographical information system (GIS). The database puts together the assignments of habitat ecological services, designation of degraded areas, service reductions from contamination, and estimates of recovery based on remedial plans. The Trustees developed GIS map layers showing habitat types (in terms of water depth and type of substrate), baseline adjustments, areas exceeding hazardous substance threshold concentrations, and areas for which active remediation is planned. When the map layers are overlaid, the result is a combined map showing a series of patches or polygons, each with a unique combination of ecological characteristics. Figure 5 presents a portion of the GIS map for Port Gardner Bay showing the polygons generated by the combined map layers.

Relevant surface sediment data within the boundaries of Port Gardner Bay are compiled and quality checked. The initial HEA evaluation data was done using relevant data collected prior to 2012, but may be re-evaluated in the future as more data become available. Appropriate types of data for the contaminants of concern to the Trustees (listed in Table 3) are extracted from Ecology's Environmental Information Management (EIM) database. These data points are mapped using a spatial data analysis called "inverse distance weighting" [5] to average concentration of each contaminant and create a contaminant "footprint." Values of sediment contamination are compared to values known to adversely impact benthic organisms and higher level predators. When actual contamination values exceed the toxicity threshold (service loss levels) of toxicity to aquatic animals and plants, this constitutes a service loss, or injury.

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[5] Inverse distance weighting is a method of determining the characteristics of objects from those of nearby objects. At locations where data has not been sampled, values are estimated, based on nearby sample values. More information is available online at http://www.ncgia.ucsb.edu/pubs/spherekit/inverse.html. A description of inverse distance weighting and its use in the HEA can be found in Appendix E: How habitat and sediment injury information is mapped via a geographic information system (spatial analysis of sediment chemistry data), prepared for The Commencement Bay Natural Resource Co-Trustees, February 28, 2002. Available at: https://casedocuments.darrp.noaa.gov/northwest/cbay/admin.html

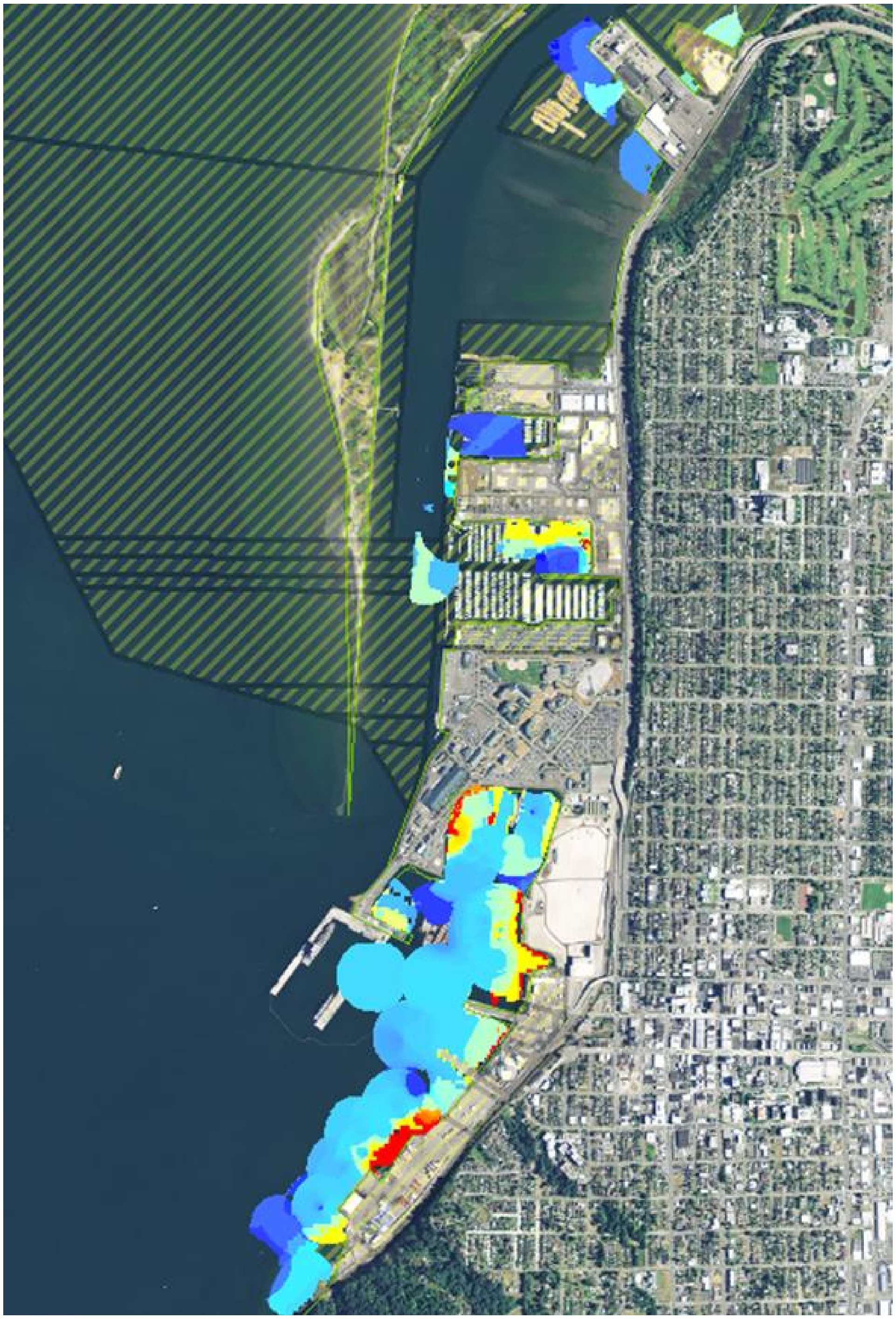


Figure 5. GIS map showing areas generated by combined map layers in the Habitat Equivalency Analysis (HEA), with greater injury represented by red and orange, and lower levels of injury represented by cool colors.

By comparing data on surface sediment concentrations to injury thresholds, injury maps are created for each contaminant of concern. Brighter colors ranging from red, indicating higher levels of service losses to light blue, lower levels of service loss, indicate the level of injury calculated.

Table 3. Substances of Concern for Port Gardner Bay NRDA

Metals	**Other**	**Phenols**	**Phthalates**
Arsenic	PAHs (total)	4-methyl phenol	bis(2-Ethylhexyl) phthalate
Chromium	PCBs (total)	2,4-dimethyl phenol	Butylbenzyl phthalate
Copper		Phenol	Di-n-butyl phthalate
Lead		Pentachlorophenol	Di-n-octyl phthalate
Mercury			
Silver			
Zinc			

The particular combination of characteristics and habitat types that define a polygon generates a specific value of ecological service loss for that polygon. A value of service acre-years loss is generated for the polygon taking into account the size of the polygon, and applying assumptions about the timing of remedial action and rates of recovery for remediated areas. Adding those values for all polygons produces a total service acre-years loss for the waterway as a whole. Applying the 3 percent discount rate to past and future losses to determine their present value results in a calculation of a total *discounted service acre-years (DSAYs)* loss.

5. *Determine what restoration actions need to be undertaken to generate ecological service gains with a present value equal to the total losses*

Calculating the amount of restoration needed to compensate for the natural resource injuries follows a similar analysis, using the same assumptions. As the goal of natural resource damage assessment is to compensate for natural resource losses, the objective of a restoration-based settlement must be to produce ecological service gains that are equivalent to the calculated service losses.

To judge the gains expected from an individual proposed restoration project, the Trustees begin by calculating the present value of the ecological services the project site would generate without the restoration project. The Trustees analyze the current condition of the project site to determine the type of habitat present and the level at which it is functioning, and make informed judgments about any potential change in the service levels the site would provide without the project into the future. This information is used to calculate the present value of the total service acre-years the site would provide if the project were not built.

A proposed project design must then be developed and reviewed to determine the types of habitat and levels of services the project will provide once constructed. The services to be provided each year of the project are summed up and the present value of the total service acre-years calculated. Subtracting the DSAYs produced by the site without the project from the DSAYs to be produced by the site assuming the project is constructed generates the total DSAY gain from the project.

Since many proposed projects have not yet been constructed, the Trustees must predict the likelihood of project success and the rate at which project elements may change over time (e.g., growth rate for vegetation) based on their own experience and the experience of others. Appendix C of the Lower Duwamish Programmatic EIS/Restoration Plan details the information and analysis Trustees have used in developing projections for the time different habitats will require to reach full function. Chapters 6 and 7 describe example restoration projects of types the Trustees expect to be developed and illustrate how the Trustees will evaluate the DSAY credit to be granted to proposed projects.

2.2.3 Allocation of Liability

Releases of hazardous substances into Port Gardner Bay have become commingled and have likely combined to cause injury to trust resources. Under these circumstances, the law holds any party contributing to the contamination to be jointly and severally liable for the whole injury. However, in order to encourage settlement, the Trustees have attempted to apportion settlement shares among responsible parties. The Trustees have allocated the proposed settlement among Port Gardner Bay facilities or sites. They have relied upon publicly available data and information, along with information obtained from public libraries.

The Trustees' allocation analysis is designed to be fair and equitable to PRPs while ensuring that the interests of the public are appropriately served. To trigger allocation of liability to a site there has to be all of the following:

- Evidence of an activity conducted at the site that is a likely source of a substance of concern.
- Evidence of a pathway for water or sediment to travel from the site to Port Gardner Bay.
- Evidence of actual environmental contamination by the hazardous substance in soil or sediment or the presence of a sediment contamination footprint adjacent to the site.

Responsibility for contamination is based on the footprint maps, tax parcel information, and data on types of activities occurring on parcels adjacent to Port Gardner Bay, the substances used or stored on site, wastewater, soil, groundwater and other sampling data, reports of spills/releases, and similar factors. For the purposes of early settlement, the Trustees use a contaminant footprint approach to the extent possible rather than assigning each facility associated with a particular contaminant a fixed percentage of liability. By examining concentration gradients of contaminants in surface sediments, and reviewing available information on hazardous substance releases, the Trustees assign liability for areas of sediment contamination to one or more facilities for most contaminants.

The Trustees use each of the above approaches to allocate liability for injury DSAYs generated by the contaminants in the mapped polygons described earlier. As mentioned previously, the Trustees allocate liability to facilities rather than to parties and expect multiple parties associated with a given facility to resolve among themselves how to sub-allocate that facility's share of liability.

It is important to underscore that the Trustees have developed this allocation solely for early settlement purposes. By performing this particular allocation, the Trustees are not suggesting or conceding that the effects of Port Gardner Bay contamination are readily divisible among contaminants, natural resource injuries, facilities, or parties. In the event that not all Port Gardner Bay natural resource damage claims can be resolved through voluntary settlement, the Trustees reserve the right to pursue all possible claims against non-settling parties on a joint and several liability basis through litigation

3. ENVIRONMENTAL SETTING/AFFECTED ENVIRONMENT

The Port Gardner Assessment Area includes the lower Snohomish River, Everett Waterfront, East Waterway, and a portion of Possession Sound near Everett, Washington.

3.1 Affected Environment

The Port Gardner Bay watershed lies within Snohomish County, Washington. The area of restoration focus begins at the Everett Waterfront and ends at the end of tidal influence in the Snohomish River Estuary (see Figure 1).

3.1.1 Sediment Quality

The Port Gardner Bay assessment area receives contaminant inputs from multiple sources, including industrial activities. Discharges and releases of hazardous substances into Port Gardner Bay have resulted from industrial and municipal processes since the early 1900s. Facilities released materials through permitted and non-permitted discharges, spills during cargo transfer and refueling, stormwater runoff through contaminated soils at upland facilities, and discharge of contaminated groundwater. Other releases into Port Gardner Bay are a result of lumber operations, such as sawmills, and pulp and paper mills (Anderson 1985, Long 1999, WDOH 2011).

There are numerous facilities associated with contamination within Port Gardner Bay. Many sites have contamination in soils, groundwater, and sediment due to spills, mishandling of chemicals, and improper chemical disposal. Ecology is currently overseeing cleanup of more than 10 sites on the Everett Waterfront and East Waterway. Cleanup actions, such as removal of contaminated sediments and sediment capping, are being considered at these sites. Several sites have already completed cleanup actions to remove contaminated soil or sediment. There may be additional sources and cleanup sites that have not yet been identified.

3.1.2 Air Quality

The Puget Sound Clean Air Agency (PSCAA) is the primary entity responsible for regulating air pollution from business and industrial activities in King, Kitsap, Pierce, and Snohomish counties. PSCAA issues air quality data summary reports annually that summarize regional air quality by presenting air monitoring results for six criteria air pollutants. The EPA sets national ambient air quality standards (NAAQS) for these pollutants: particulate matter (10 micrometers and 2.5 micrometers in diameter), ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, and lead. The Air Quality Index (AQI) is a nationwide reporting standard developed by the EPA to report daily air quality. Beginning in 2004, the agency added additional information on air toxics to the Air Quality Data Summary. Air toxics are pollutants broadly defined by the agency to include over 400 chemicals and compounds. Most air toxics are a component of either particulate matter or volatile organic compounds so there are overlaps between the criteria pollutants and toxics. Toxic pollutants are associated with a broad range of adverse health effects, including cancer.

PSCAA and the Washington State Department of Ecology work together to monitor air quality within the Puget Sound region. Real-time air monitoring data are available for some pollutants online at http://www.pscleanair.org/airq/aqi.aspx. Continuous air monitoring data provide information on how concentration levels of various pollutants vary throughout the year. An air monitoring station is located close to the Snohomish River near 7th Street in Marysville (PSCAA 2011).

3.1.3 Water Quality

The 2012 Water Quality Assessment (Ecology 303(d) list) shows that some areas of Possession Sound North and Port Gardner Inner Everett Harbor are impaired for water column bacteria and dissolved oxygen. (https://fortress.wa.gov/ecy/wqamapviewer/default.aspx?res=1920x1080).

Several areas along the shoreline are listed in the 2012 Water Quality Assessment as having impaired sediment as characterized by sediment bioassay failures.

Several areas through Possession Sound North and the shoreline are impaired for elevated contamination in tissue. The tissue contamination includes dioxins and PAH compounds (https://fortress.wa.gov/ecy/wqamapviewer/default.aspx?res=1920x1080).

3.2 Physical Environment

The Lower Snohomish River is a heavily traveled and industrialized section of the Snohomish River adjacent to Everett, Washington. The primary depositional area of the Snohomish River system is Port Gardner Bay which contains an industrialized area around the city of Everett, Washington. The Snohomish River and its watershed originates in the Washington Cascade Range and drains approximately 1,856 square miles of the western Cascades and is the second largest river basin surrounding Puget Sound.

Tidal influence reaches 20 miles upstream. Sediment from the river is carried downstream and deposited into the lowlands of the estuary delta. Historically there were an estimated 19 square miles of marshes, forested wetlands, distributary sloughs, mudflats, and connecting channels. Only 17% of the historical estuary area remains due to extensive diking and tide gate construction in the assessment area (Qwuloolt Estuary Restoration Project 2012, n.d.). Figure 2 shows the historical habitat types in the estuary prior to modification.

The Lower Snohomish River branches into four segments, Main Stem, Ebey Slough, Steamboat Slough, and Union Slough, begins roughly 5 miles upriver from Everett. The Main Stem flows around Everett and nearly forms three sides of the city. From the split, the Main Stem flows north along the eastern city boundary, meanders west to form the northern city boundary, and thereafter flows south along the western boundary between the city and Jetty Island. Jetty Island is a man-made island created from the dredged material from East

Waterway and Main Stem. Figure 6 shows a current map of the Port Gardner Bay assessment area.

The Everett Waterfront is located along the Lower Snohomish River between Priest Point to the north, Jetty Island to the west, and East Waterway to the south. This area was historically the location of the Hibulb village, one of the largest Native American villages in the Puget Sound area, as well as several other seasonal villages. Following the Treaty of Point Elliott of 1855 and the formation of the City of Everett, this area became heavily industrialized and contained numerous factories, ports, and smelters (Eldridge and Orlob, 1951).

Currently the Everett Waterfront is more commercialized; however some shipping activities and industry remain. Along the north end, several sites currently under cleanup orders have been used since the last century for lumber and mill operations. The middle portion of the waterfront is more commercialized with the Port of Everett Marinas and commercial development areas. Several large marinas, boat ramps, and a fuel dock are currently active along the Everett waterfront. Shipbuilding, ship repair, and associated boat maintenance businesses have been located in the Everett Waterfront. Some of these businesses are currently operating, while others have moved or closed and are in the process of remediating contamination at their sites. Currently the bulk of Everett's industrial presence is located along the East Waterway.

Figure 6. Area map of Port Gardner Bay and the Lower Snohomish River.

The East Waterway is historically and currently the most industrialized area within Port Gardner Bay (Figure 6). The waterway was created to facilitate Everett waterfront shipping and the dredged material was used to create Jetty Island. The waterway has an average depth of 10 m below MLLW. During World War II, the East Waterway was used for repair and outfitting of ships (Eldridge and Orlob, 1951). Historically also, the area was used extensively for log rafting and the transportation of timber products, some of which continues today (Eldridge and Orlob, 1954 and Gara et al. 1997). Currently, the East Waterway is used primarily for deep water shipping. Two pulp and paper mills have operated for decades in or near East Waterway, including historical untreated discharges directly into the Waterway. There are also several stormwater outfalls that discharge into East Waterway.

The section of Possession Sound considered for this document stretches from Everett to the west as far as Gedney (Hat) Island. Located within the greater Puget Sound, the larger Possession Sound is the body of water extending between Mukilteo to the south, Everett to the east, Tulalip Bay to the north, and Whidbey Island to the west. The majority of areas surrounding Possession Sound are residential except the rail line running along the shoreline between Everett and Mukilteo (about 5 miles).

Mukilteo, also known as Point Elliott, was historically a Native American year-round village providing subsistence resources and playing a prominent role in the settlement of Native American communities. The water front area between Everett and Mukilteo was dotted with small lumber mills located at the mouths of small streams draining into Possession Sound.

Historically the Snohomish River Estuary was made up entirely of fresh and brackish water wetlands including marshes, scrub shrub and forested types. These were extremely rich ecosystems that provided food, shelter, flood protection, and many other services. Nearly all of the historic wetlands have been cut off from the river by a system of levees.

3.3 Biological Resources

The Port Gardner and Snohomish River estuary area provides important spawning, rearing, and feeding areas for many fish and wildlife species. Historically, the lower estuary consisted of mudflats, tidal marshes, and scrub-shrub wetlands with grasses, sedges, bulrush, cattails, willow, and rose growing in lower elevations with Sitka spruce, pine, fir, crab apple, and alder present in the tidally influenced swamp forests at higher elevations.

The estuary functions as an important corridor and refuge for fish and wildlife thereby linking urban and rural open space from the Puget Sound lowlands to the Cascade crest. During the field inventory process for the Snohomish Estuary Wetland Integration Plan (SEWIP), the City of Everett conducted a field inventory in 1997 in the estuary and reported a variety of rare and uncommon species present, in addition to a great diversity of common species (City of Everett et al. 1997). The USFWS identified 116 species of migratory and resident birds during a 1978 to 1980 study of the estuary (Tanner, C.D., USFWS, Pers. Comm. 2012) and the State's Priority Habitat and Species Program listed 40 out of 62 "wetland associated" priority species occur in the estuary (WDFW, 1993).

<u>Vegetation</u>

The surrounding uplands support a variety of plant communities, ranging from cultivated land to forest habitat. Cultivated land comprises the majority of the riverbank, with mostly bare ground and agricultural crops that include strawberries, raspberries, seed kale, and pumpkins. Scattered across the river bank are Douglas fir (*Pseudotsuga menziesii*) and other conifer species, plus a variety of non-native broad-leaved deciduous trees including maples (*Acer* sp.), weeping birch (*Betula* spp.), cherry (*Prunus* spp.) and London plane (*Plantanus* spp.). Himalayan blackberry (*Rubus armeniacus*), grasses and other understory and ground cover species occur under the forest canopy.

Fallow areas are dominated by grassland that supports primarily ryegrass (*Lolium perenne*), reed canarygrass *(Phalaris arundinacea)* and Canada thistle (*Cirsium arvense*). Narrow bands of scrub-shrub and forest habitat occur along the outer dikes and on the dredge spoils that flank the central slough. These areas are dominated by Himalayan blackberry, salmonberry (*Rubus spectabilis*), Nootka rose (*Rosa nootkana*), red elderberry (*Sambucus racemosa*), and red alder (*Alnus rubra*). Other common, but not dominant, plant species observed throughout the site include evergreen blackberry (*Rubus laciniatus*), Douglas spirea (*Spiraea douglasii*), cutleaf geranium (*Geranium dissectum*), vetch (*Vicia* spp.) and black twinberry (*Lonicera involucrata*).

The assessment area includes numerous estuarine and palustrine wetland habitat types.

There are a number of invasive species that have been brought into the Snohomish River Estuary ecosystem from various sources. There are many noxious plants that should be eradicated according to the Snohomish County Noxious Weed Control Board. Some arrived as plants sold for gardens or landscapes. The species that are often found in estuaries and wetlands are purple loosestrife, Japanese knotweed, Himalayan blackberry, and Reed canary grass.

<u>Aquatic Vegetation</u>

Extensive beds of eelgrass (*Zostera* spp.) are found on the tidal flats in Possession Sound and extend up the slough channels as far up as the Highway 529 trestles. Kelp (primarily *Nereocystis luetkeana)* and eelgrass serve a wide variety of ecological functions in nearshore ecosystems. Both are highly productive, annually producing large amounts of carbon that fuel nearshore food webs, principally through detritus pathways and provide critical three-dimensional structure in otherwise two-dimensional environments, and are utilized by many marine organisms (Mumford, T.F. 2007).

<u>Fish</u>

A large commercial fishery exists in Possession Sound and a recreational fishery exists throughout the estuary and Snohomish River system. The nearshore and estuary supports a diverse array of habitats providing spawning, rearing, and feeding areas for many aquatic species including seven species of anadromous salmon. They include: Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), chum (*Oncorhynchus keta*) and pink salmon (*Oncorhynchus gorbuscha*); anadromous and resident cutthroat (*Oncorhynchus clarkii*), steelhead/rainbow trout (*Oncorhynchus mykiss*); bull trout (*Salvelinus confluentus*), and brook trout (*Salvelinus fontinalis*).

According to the Pentec Survey (Pentec 1992), juvenile starry flounder (*Platichthys stellatus*) were considered to be the most widely distributed and abundant non-salmonid fish species in the Snohomish River Estuary. Peamouth chub (*Mylocheilus caurinus*), was considered the second most abundant non-salmonid estuary species, and was found to be widely distributed throughout the estuary as was the Pacific staghorn sculpin (*Leptocottus armatus*). The freshwater prickly sculpin (*Cottus asper*), three-spined sticklebacks (*Gasterosteus aculeatus*), shiner perch (*Cymatogaster aggregata*), juvenile smelt, and lamprey were also found in the survey.

The Pentec Survey also identified starry flounder and English sole (*Parophrys vetulus*) as common flatfish, and surf smelt (*Hypomesus pretiosus*) and sand lance (*Ammodytes hexapterus*) as important forage fish present in the Port Gardner Bay and Possession Sound assessment area (Pentec 1992). Additionally, other species of significance encountered in surveys are longfin smelt (*Spirinchus thaleichth*ys), eulachon (*Thaleichthys pacificus*), and green sturgeon (*Acipenser medirostris*) (Weatherly, N., Tulalip Tribes, Pers. Comm. 2012).

<u>Shellfish and Invertebrates</u>

Port Gardner Bay and Possession Sound support an important shellfish commercial fishery. The lower reaches of the estuary are known to have a large biomass of shrimp (*Pandalus* spp.) and provide rearing habitat for juvenile Dungeness crab (*Metacarcinus magister*). The open tidal flats of Possession Sound have a high density of ghost shrimp (*Callianassa californiensis*). The extensive eelgrass beds on the flats provide important rearing and foraging habitat for Dungeness crab. Spot prawns and tiger stripe shrimp (*Pandalus* spp.) are also found in Possession Sound and support small commercial and recreational fisheries.

<u>Marine and Terrestrial Mammals</u>

Wildlife species including river otter (*Lontra canadensis*), mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), weasel (*Mustela frenata*), beaver (*Castor canadensis*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and deer (*Odocoileus* spp.) are all common terrestrial mammal species in the estuary. Southern resident killer whale (*Orcinus orca*), California sea lion (*Zalophus californianus*) and Steller sea lion (*Eumetopias jubatus*), porpoise (*Phocoena* spp.), and harbor seal (*Phoca vitulina*) are present in the marine environment. In the spring migrating gray whale (*Eschrichtius robustus*) will come to feed on the ghost shrimp bed on the Possession Sound tidal flats. For federally-listed species, refer to section C for more information.

<u>Birds</u>

The lower estuary in the assessment area supports a variety of marine birds, waterbirds, waterfowl, raptors and passerines. Species observed include:

- Mallard (Anas platyrhynchos)
- Mergansers (*Mergus spp*)
- Loon (*Gavia* spp.)
- Grebe (*Podicipediformes* spp.)
- Cormorant (*Phalacrocorax* spp.)
- Pigeon guillemot (*Cepphus columba*)
- Great-blue heron (*Ardea herodias*)
- Marsh wren (*Cistothorus palustris*)

- Cedar waxwing (*Bombycilla cedrorum*)
- Song sparrow (*Melospiza melodia*),
- Red-tailed hawk (*Buteo jamaicensis*),
- Merlin (*Falco columbarius*), and
- Several gull and tern species (*Laridae* spp.).

The estuary is important foraging, nesting, and roosting habitat for Puget Sound and resident bird populations and an important staging and stop-over area for bird migration along the Pacific Flyway. Shorebirds such as dunlin (*Calidris alpina*) and western sandpiper (*Calidris mauri*) are most common in the fall migration, with waterfowl and raptors dominating in the fall. Nesting cormorants are present in the estuary near Union slough and marbled murrelet (*Brachyramphus marmoratus*) have been observed using the bay and Possession Sound for foraging.

Marsh-dependent species such as American bittern (*Botaurus lentiginosus*), American coot (*Fulica americana*), Virginia rail (*Rallus limicola*), and western grebe (*Aechmophorus occidentalis*) rely on the estuary for wintering and breeding habitat.

The estuary is a significant overwintering habitat for thousands of dabbling ducks and a few trumpeter swan (*Cygnus buccinator*) and supports over 25 species of waterfowl including: northern shoveler (*Anas clypeata*), ruddy duck (*Oxyura jamaicensis*), northern pintail (*Anas acuta*), and several species that breed in the estuary, including Canada geese (*Branta canadensis*), mallard (*Anas platyrhynchos*), and gadwall (*Anas strepera*). Snow geese (*Chen caerulescens*) have been observed along the lower Snohomish channel with American wigeon (*Anas americana*) and brant (*Branta bernicla*) on or just offshore of Jetty Island.

Raptor species are found throughout the estuary, including in the mudflats, emergent marshes, agricultural fields, and forested swamps. Species that nest in the estuary include northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), great-horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), bald eagle (*Haliaeetus leucocephalus*), and osprey (*Pandion haliaetus*). Twenty-six pairs of osprey were observed nesting on pilings in Port Gardner Bay in 2002 (Henny, C. J., USGS, pers. comm., 2011), and bald eagle use the mudflats year round with at least seven pairs known to nest in the estuary.

<u>Federally Listed Species</u>

Federally-listed species under the Endangered Species Act are known to occur or may be found in the vicinity of the Port Gardner Assessment Area and include Coastal-Puget Sound Bull Trout, Puget Sound Chinook salmon, and Puget Sound steelhead. Other federally-listed species that may occur within the area include Steller sea lion, humpback whale (*Megaptera novaeangliae*), southern resident killer whale, eulachon (*Thaleichthys pacificus*), leatherback sea turtle (*Dermochelys coriacea*), and marbled murrelet. Federal Species of Concern include bald eagle, black swift (*Cypseloides niger*), northern goshawk (*Accipiter gentilis*), and peregrine falcon (*Falco peregrinus*). In addition, the assessment area has been included in the area designated as critical habitat for Puget Sound Chinook salmon (September 2005). Critical habitat for Puget Sound steelhead, which occur in this area is under development (US DOC, NOAA, http://www.nwr.noaa.gov/ESA-Salmon-Listings/).

The State of Washington and the Federal Government has listed killer whale and humpback whale and the leatherback sea turtle as endangered species. The state lists Steller sea lion as threatened species, and bald eagle, peregrine falcon, purple martin (*Carpodacus purpureus*), coho and chum salmon, as species of concern.

Several unique features of the Snohomish River basin make it a crucial component in the overall success of recovering salmon populations in the Puget Sound region. At 1,856 square miles, the Snohomish River basin is the second-largest basin draining to the Puget Sound. There are over 1,730 tributary rivers and streams that total approximately 2,718 miles in length. Nine salmonid species live in the basin including: Chinook, coho, chum, and pink; steelhead and rainbow, cutthroat, and bull trout; and mountain whitefish (*Prosopium williamsoni*). There are two populations of Chinook salmon in the basin: Skykomish and Snoqualmie. These populations have the highest and third-highest respectively, of the Chinook recovery abundance target set in Puget Sound and with several other Chinook salmon populations, rely on the Snohomish nearshore for spawning, rearing, and feeding. The other Chinook populations include those from the Skagit and Stillaguamish River basins to the north and the Hood Canal, Lake Washington, Green, Puyallup-White, and Nisqually populations to the south. There is evidence of use of the area by Skagit and Stillaguamish Chinook.

Within the Snohomish-Skykomish Rivers bull trout core area, four local populations (spawning groups) have been identified: North Fork Skykomish River, South Fork Skykomish River, Salmon Creek, and Troublesome Creek.

The basin also supports the largest number of Coho spawners between the Columbia River and Canadian border. It produces between 25 and 50 percent of the Coho in Puget Sound.

Nearshore and estuarine habitats of the Snohomish River are critical to the health of Puget Sound and its marine life. They provide shelter, and are used as spawning, rearing and feeding grounds for species that live in and around the Sound (PSAT 1998). The loss of rearing habitat, in quantity and quality, along mainstems and within the estuary and nearshore environment, is thought to be a limiting factor in the recovery (Snohomish Basin Salmon Recovery Forum 2005).

Federally-Listed Species - Chinook Salmon

Puget Sound stocks of Chinook salmon are listed as a threatened species. In the Snohomish River there are four recognized stocks of naturally spawning Chinook salmon: Snohomish River summer, Snohomish River fall, Bridal Veil Creek fall, and Wallace River summer/fall (City of Everett and Pentec, 2001). Designated critical habitat for Puget Sound Chinook salmon within the assessment area include freshwater rearing sites, freshwater migration corridors, estuarine and nearshore rearing areas, and estuarine and nearshore migration corridors. These estuarine and nearshore area are of critical importance for Chinook and constitute a primary factors limiting survival. These areas are necessary in the transition from freshwater to the critically important first year at sea.

The Port Gardner Bay assessment area is within the range of a Puget Sound Chinook Evolutionarily Significant Unit (ESU). An ESU is a distinct population segment that is substantially, reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species (Waples 1991). The geographic area of the Puget Sound Chinook ESU encompasses the entire Puget Sound drainage basin west to the Elwha River basin and north to the Canadian Border. The Puget Sound Chinook ESU was listed as threatened on March 24, 1999 (64 FR 14307).

The Puget Sound ESU is a complex of many individual populations of naturally spawning Puget Sound Chinook and 36 hatchery populations (64 FR 14308; March 24, 1999). The Puget Sound Technical Recovery Team (TRT), an independent scientific body convened by NOAA's National Marine Fisheries Service (NMFS) to develop technical delisting criteria and guidance for salmon recovery planning in Puget Sound, identified 21 geographically distinct populations representing the primary historical spawning areas of Chinook in Puget Sound (NMFS 2001).

Overall abundance of Puget Sound Chinook in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high. Trends in abundance are predominantly downward, and several populations exhibit short-term declines. Factors contributing to the downward trends are widespread blockages of streams, degraded freshwater and marine habitat, upper river tributaries widely affected by poor forest practices, and lower tributaries and mainstem rivers affected by urbanization and agriculture. Hatchery production and release of Puget Sound Chinook is widespread and more than half of the recent total escapement returned to hatcheries. All spring- and summer- run populations throughout this ESU are depressed and are of special concern to NMFS (Myers 1998).

Federally-Listed Species - Bull Trout

Coastal-Puget Sound bull trout are listed as a threatened species under the Endangered Species Act (USFWS 1999). The anadromous form of bull trout is unique to the Coastal Puget Sound region within their distribution in the coterminous United States (Ardren 2011). Puget Sound populations include both resident and migratory forms. The Port Gardner Bay Assessment Area is part of the Puget Sound Management Unit for bull trout designated as critical habitat (USFWS 2004; USFWS 2010). Although both bull trout and Dolly Varden (*S. malma*) occur in the Puget Sound region (Spruell and Maxwell 2002; Ardren 2011), and WDFW treats both species the same (as "native char") for management and regulatory purposes (WDFW 1998), based on genetic analyses, bull trout are the only anadromous char in Puget Sound (Goetz 2004) and only bull trout are present in the Snohomish River drainage (Hawkins, in litt. 2008). Within the Port Gardner assessment area, freshwater and estuarine migration corridors and rearing habitats are important for the anadromous life-history type of bull trout. Functional estuarine and nearshore habitats are not only critical to anadromous bull trout for foraging and migration (WDFW 1997, Goetz 2004), but also to their prey species (e.g., herring, surf smelt, sand lance) for spawning, rearing, and migration (WDFW 2000, BMSL 2001).

Unlike most Pacific salmon species, bull trout are iteroparous (survive over multiple seasons) and may make multiple migrations to and from nearshore waters of Puget Sound as part of their life history (Hayes 2012). Bull trout also have more specific habitat requirements than most other salmonids, especially the need for cold water (Rieman and McIntyre 1993). Therefore, they may be at higher exposure risk than Chinook because of greater sensitivity to temperature increases and possibly contaminants from storm water runoff, and because of more frequent or increased exposure to contaminants over their lifetime.

Federally-Listed Species - Steelhead

Puget Sound Steelhead were listed as threatened on May 11, 2007 (72 FR 26722)(NOAA 2008). Steelhead are the anadromous version of freshwater rainbow trout. The typical life history involves spending two to three years in freshwater before migrating downstream into marine waters. Once the juveniles emigrate they move rapidly through Puget Sound into the North Pacific Ocean where they reside for several years before returning to spawn in their natal streams. Unlike many other members of the *Oncorhynchus* genus, steelhead do not die after spawning and can undergo multiple spawning cycles (Wydoski and Whitney 2003).

The Puget Sound steelhead Distinct Population Segment (DPS) is composed primarily of winter-run populations (37 of the 53 populations). No abundance estimates exist for most of the summer-run populations; all appear to be small, most averaging less than 200 spawners annually. Summer-run populations are concentrated in northern Puget Sound and Hood Canal; only the Elwha River and Canyon Creek support summer-run steelhead in the rest of the DPS. Steelhead are most abundant in northern Puget Sound, with winter-run steelhead in the Skagit and Snohomish rivers supporting the two largest populations (approximately 3,000 and 5,000 respectively).

Summer-run and winter-run steelhead stocks are present in the Snohomish basin; both runs are composed of wild and hatchery-raised steelhead. The winter run is the larger of the two stocks. Three wild winter steelhead stocks have been identified from the Snohomish/Skykomish, Snoqualmie, and Pilchuck rivers. The wild steelhead winter run occurs primarily between February and April, while the hatchery fish generally run from mid-November through mid-February. Spawning occurs through most of this entire winter/spring period. Three summer steelhead stocks are present in the Snohomish basin - the upper Tolt, North Fork Skykomish, and South Fork Skykomish. The summer steelhead in the Tolt and North Fork Skykomish are native and the South Fork Skykomish summer steelhead stock was developed by colonization of non-native fish. Native summer stocks are small runs of fish limited by their habitats, spawning in areas isolated from native winter stocks. This occurs upstream of falls that were probably once migration barriers except during the low flows of summer and fall. Since only a few miles of stream are used for spawning, native summer steelhead populations are small. Total populations are not known and data are not sufficient to set escapement goals.

Federally-Listed Species - Steller Sea Lion

Steller sea lions are listed as threatened, but only rarely occur in Puget Sound south of Admiralty Inlet (Yates 1988). Both California and Steller sea lions have been observed in the estuary (Carroll, J.R., Snohomish County, pers.comm., 1996 *as cited in* City of Everett and Pentec, 2001). Steller sea lion is found around the North Pacific Rim from the Channel Islands of southern California to northern Hokkaido, Japan; the center of distribution is in Alaska (NMFS 1992). Within this distribution, land sites used by the animals include rookeries and haul outs. Rookeries are used for pupping and nursing; haul outs are used by the entire Steller sea lion community as onshore rest areas, but generally are not used for breeding. Although animals of all ages have been observed in the Washington population, no rookeries have been identified in Washington.

Steller sea lions are migratory and appear to be most abundant during spring and fall. They are known to migrate into Puget Sound. Steller's sea lions were also seen in the area between

October 1987 and January 1988 during the steelhead fishing season (Gearin 1988, Chumbley 1993, Gearin 1999, Jeffries 2000). There is growing evidence that the vast majority of feeding dives occur in the top 328 feet of the ocean, although feeding to depths over 820 feet has been reported. The animals appear to be largely opportunistic feeders. The primary Steller sea lion prey in Washington appears to be species of gadids (cod and pollock), rockfishes, herring, and smelt that are abundant at various areas along the Washington Coast. For the most part, Steller sea lions are not known to prey significantly on bottom-dwelling invertebrates.

Federally-Listed Species – Marbled Murrelet

Marbled murrelets are listed as threatened and have been observed using Port Gardner Bay and Possession Sound for foraging (City of Everett and Pentec, 2001). Marbled Murrelets feed on fish and invertebrates usually within two miles of shore and nest in stands of mature and old growth forest. Marbled murrelets typically forage for prey during the day and visit their nest site in the canopy of old-growth forests at dawn or dusk. No critical habitat for marbled murrelets is present within the Port Gardner Bay Assessment Area.

Federally-Listed Species - Killer Whale

Southern resident killer whales, identified as J, K and L pods, reside for part of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, especially during the spring, summer and fall. The J pod contains approximately 18 whales, the K pod 16 whales, and the L pod 46 whales. Pods regularly visit coastal sites off Washington and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands. Orcas enter Puget Sound between June and October as they hunt the salmon runs. The J pod is the pod most likely to be observed near Port Gardner. Groups of orcas belonging to both the J and K pods have been sighted off Vashon Island in summer (Balcomb and Goebal 1976, Balcomb 1982, Olesiuk 1990, Forney 1999, 2000, Dahlheim 2000, NOAA 2008). Winter movements and distribution are poorly understood for the population.

Federally-Listed Species - Humpback Whale

Humpback whales are found in all oceans to the edges of polar ice. They follow definite migration paths from their summer feeding grounds to warmer waters in the winter. Three distinct and non-interactive groups of humpbacks are noted in the North Pacific: the eastern North Pacific stock, central North Pacific stock, and western North Pacific stock (NMFS 1991). In the North Pacific, where the total humpback population is around 15,000 individuals, humpbacks feed in the summer along the coast from California to Alaska. In the winter, they migrate to breeding grounds off Hawaii, Mexico, Costa Rica, and Japan.

Humpback whales historically frequented the Puget Sound area and sporadic observations of humpback whales have been reported in the Puget Sound since the 1970s (Osborne 1988). In recent years, humpback whale sightings have increased in Puget Sound, including a 2004 report of a whale around Vashon Island, a May 2005 report of a humpback in central Puget Sound, and a July 2006 report of a juvenile humpback apparently injured by a small boat in southern Puget Sound (Calambokidis in *The Olympian,* July 11, 2006).

Federal Listed Species - Eulachon

Eulachon are listed as threatened and have been observed using Port Gardner Bay and Possession Sound (pers. communication, Todd Zackey). Eulachon, also commonly called smelt, candlefish, or hooligan, are small anadromous fish from the eastern Pacific Ocean. Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn. After the eggs hatch, the larvae are swept downstream and dispersed by currents. Juvenile eulachon may use shallow nearshore areas to mid-depth areas. No critical habitat for Euclachon is present within the Port Gardner Assessment Area.

3.4 Socioeconomic/Cultural Resources

The contemporary Snohomish River channels and floodplains between Snohomish and Port Gardner developed within a trough carved by continental ice sheets during the Pleistocene (Lewarch, 2003a). The Puget Lobe of the Cordilleran Ice Sheet filled the trough until approximately 16,000 years ago, when the ice sheet melted throughout the Central Puget Sound Basin during the glacial retreat at the end of the Pleistocene. The project area was available for pre-contact hunter-fisher-gatherer settlement during two periods over the past 16,000 years. Groups of generalized foragers may have inhabited the trough when glacial outwash deposits at the base of the Snohomish River trough were exposed during a time of much lower relative sea level in the Puget Sound Basin, between approximately 13,000 and 10,000 years ago (Dragovich et al., 1994; Zehfuss et al., 2003).

The initial inhabitants may have left archaeological deposits dating to the early Holocene at depths between 60 and 30 meters below the contemporary floodplain surface. Base camps and specialized activity areas probably were located on the margins of wetlands that formed on the surface of the glacial outwash deposits and on stream levees and the confluences of streams that dissected the outwash plains. Geologists do not have data on the areal extent and locations of the early Holocene streams and wetlands (Nelson, 1989; Butler, 1990). Tribal members used the area to hunt, fish and to gather vegetation for foods, medicines, baskets, beadwork, carvings, and other traditional uses. The Snohomish Tribe had several village sites along the lower Snohomish River Delta with hundreds of longhouses lining the river. The area is still used for tribal fishing, hunting and gathering. Fishing and Gathering has been greatly reduced due to the risks of handling and consuming plants contaminated from industrial discharges in to marine waters and contaminated bottomfish with visible tumors and lesions. Due to the dense populations around the project area, bird hunting is limited to areas a little north of the project area.

The entire project area was a marine fjord between approximately 10,000 and 5,600 years ago (Dragovich et al., 1994; Lewarch, 2003a; Zehfuss et al., 2003). Relative sea level elevation was approximately 7 meters lower than today around 5,600 years ago (Dragovich et al., 1994; Zehfuss et al., 2003). The surface of the ancestral Snohomish River floodplain in the southern portion of the project area may have archaeological deposits dating around 5,600 to 5,000 years ago at depths up to 10 meters below the modern floodplain. The marine littoral of Port Gardner was backed by bluffs prior to historic period of filling and development, and had a low probability for pre-contact archaeological resources (United States Coast and Geodetic Survey 1884, 1885). A variety of hunter-fisher-gatherer archaeological resources may occur in the project area, including remnants of tribal residential or village sites, base camps, and specialized fishing, hunting, and plant collecting sites (Campbell, 1981; Butler, 1990).

The Snohomish River valley was among the first areas of Puget Sound to be extensively settled by European-American immigrants. Growth has continued unabated since the mid-1800s, and now includes the cities of Edmonds, Mukilteo, Everett, Marysville, Lake Stevens, Snohomish, Monroe, Sultan Startup, Gold Bar, Index, Skykomish, Duvall, Stillwater, Carnation, Fall City, Snoqualmie and North Bend. The watershed lies within both Snohomish and King Counties and is the ancestral home to the Snohomish, Skykomish, Snoqualmie and other allied tribes that make up the Tulalip Tribes today.

The majority of jobs in King and Snohomish Counties are in the manufacturing, wholesale and retail trade, financial services, and government sectors. These data are somewhat inappropriate for the Snohomish basin area since there is still a large rural agricultural, timber harvest, and mining component in the basin.

Port Gardner Bay and the neighboring estuary have a remarkable and lengthy history, starting with the first humans to live there, the Tulalip Indians. Settlers arrived in the late 1800's and quickly harvested timber and developed the associated sawmills. At the turn of the century, agricultural development in the estuary increased. Diking and draining activities were used to control the constant flooding of the area. Much of the estuarine area has been or is currently in agricultural production. A decline in timber led to a decline in saw mills and other related industries such as pulp paper mills. However dikes and industrial shorelines still make up the bulk of the shoreline land use. Many of the dikes are still used to protect homes and infrastructure such as waste water treatment facilities and transportation related facilities such as roads, highways, and bridges. However many of the dikes are aging a below federal standards.

Port Gardner Bay and the Snohomish River Estuary provide abundant recreational opportunities. Along the Everett waterfront and the nearby Jetty Island provides places to sail, power boat and to recreate on sand beaches. The estuary provides places to hunt, fish, hike, view wildlife, and explore using power boats, canoes and kayaks.

4. NEPA REQUIREMENTS

4.1 NEPA Requirements

This RP/EA has been prepared in accordance with requirements of the National Environmental Policy Act (NEPA) (42 USC 4321 *et seq.*). It evaluates restoration actions for potentially significant impacts on the quality of the human environment. To comply with NEPA—including the Council on Environmental Quality's (CEQ) implementing regulations for NEPA (40 CFR 1500-1508)—this document includes a description of the purpose and need for action, the affected environment, and the proposed action, alternatives, and environmental consequences.

4.2 Public Participation

Public participation is an important part of the NRDA restoration planning process and is required under NEPA and the CEQ Regulations (40 CFR 1500-1508). The Trustees have provided this RP/EA to the public via announcement and the Trustee web page.

https://darrp.noaa.gov/hazardous-waste/port-gardner

Other Opportunities for Public Involvement

The Trustees maintain a public website with information on the Port Gardner Bay NRDA at https://darrp.noaa.gov/hazardous-waste/port-gardner. This website is updated periodically and provides a forum for the public to access documents. It also provides contact information for questions or comments.

4.3 Administrative Record

This RP/EA references a number of resource documents prepared by and for the Trustees and through the NEPA process. These documents, incorporated by reference into this RP/EA, are part of the Administrative Record on file for these alternatives with the Lead Administrative Trustee and may be viewed at:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
510 Desmond Drive SE, Suite 102
Lacey, WA 98503
Contact: Jeff Krausmann
Phone: (360) 753-9440
E-mail: Jeff_Krausmann@fws.gov

5. REGIONAL RESTORATION PLANNING

5.1 Restoration of Injured Natural Resources and Services

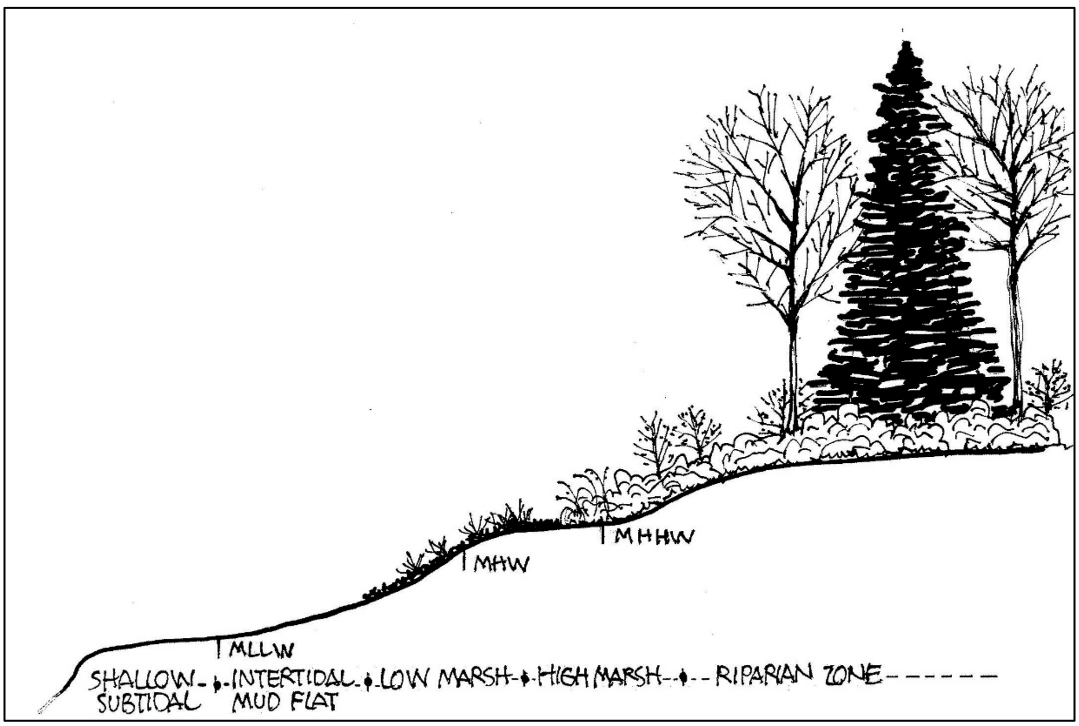
The Trustees have identified key natural resources—including salmonids, flatfish, invertebrates, and birds—that are likely to have been injured by contaminated sediments in Port Gardner Bay based on scientific literature, and sediment investigations studies and studies conducted in the Commencement Bay NRDA case. The major services provided by natural resources in the Port Gardner Bay Assessment Area that may have been injured include ecological services provided by one resource to other resources, recreational services, non-consumptive uses, passive uses, and tribal services. Additional information regarding potential injuries in Port Gardner Bay is presented in the Pre-assessment Screen for Port Gardner Bay (Port Gardner Bay Trustee Council, 2013).

The Trustees have concluded that cleanup of intertidal and subtidal contaminated sediments—combined with restoration of marshes, intertidal mudflats, shallow subtidal habitats, and riparian habitat—would directly benefit injured key resources. The overall health of Port Gardner Bay ecosystem also benefits since some of these habitats have been virtually eliminated from this system. The restoration of key habitats will directly benefit natural resources that depend on those habitats, but also will increase services to benefit humans. For example, increased salmon production in Port Gardner Bay ecosystem benefits recreational, commercial, and tribal fishing; restoration of these green spaces and increases of waterfowl and other birds benefit humans from an aesthetic point of view.

5.2 Key Snohomish Habitats

When seeking and evaluating potential restoration projects, the Trustees considered a number of key Snohomish habitat types that would greatly benefit the injured resources: marshes, intertidal mudflats, shallow subtidal, and riparian habitats. Other habitats, such as deep subtidal, are not as valuable to the representative species and groups used by the Trustees.

Figure 7. Schematic showing cross section of mudflat, marsh, and riparian habitat

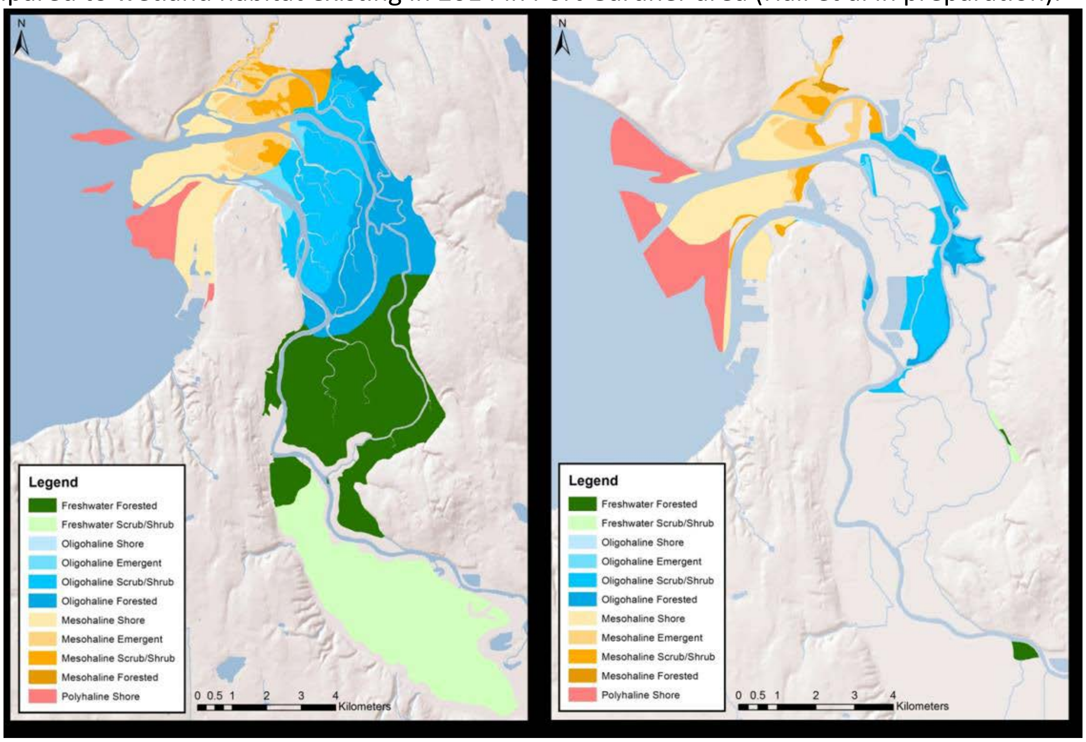


Marshes

Salt marsh habitat that was once common in the Lower Snohomish is now limited to a few areas in the lower river and estuary. Marsh vegetation increases the productivity of animals and plants living in and on the sediment and fosters a more complex community structure, providing high-quality refuge habitat for juvenile salmonids and other fishes. Marsh vegetation is also a valuable source of detritus to the ecosystem.

Restoration of estuarine marsh would provide habitat for salmon juveniles to forage, rest, and grow. Salmon species in Port Gardner Bay have limited shallow protected areas in the river where juveniles can feed and grow before migrating into the Sound. Marshes will benefit Chinook salmon in particular, because ocean-type Chinook rear for up to several months in estuaries. Other salmon species will benefit from the increased rearing opportunities and cover provided by the marsh vegetation. Many birds and waterfowl use estuarine marshes for perching, foraging, and nesting.

Figure 8. These two figures compare wetland habitats estimated to exist around 1884 compared to wetland habitat existing in 2014 in Port Gardner area (Hall et al in preparation).



Intertidal mudflats

Along with fringing salt marshes, low-gradient mudflats were once extensive in Port Gardner Bay and Snohomish River estuary and provided habitat for bottom-dwelling organisms important in the food web. Mudflats support diverse and abundant benthic and epibenthic communities, which serve as important food resources for numerous fish species, including juvenile salmonids and shorebirds. If located on side channels, mudflats serve as potential resting and feeding places for juvenile salmon, including Chinook. These shallow water habitats in the transition zone are critical for salmon as they move from freshwater to saltwater. Juvenile Chinook salmon migrating downriver prefer mudflats with channels that retain water at low tide and include quiet areas with lower water flow. Mudflats also provide key foraging opportunities for shorebirds and habitat for resident fish.

Shallow subtidal

Along with the loss of intertidal habitat, the amount of shallow subtidal habitat has been reduced by human activities in Port Gardner Bay. Shallow subtidal sediments are less productive than intertidal flats, but do support benthic and epibenthic organisms that are important prey items for salmonids, flatfishes, and some birds. Shallow subtidal habitat serves as an important resting and foraging habitat for salmon, especially during lower tides when intertidal flats are exposed. Wading birds also utilize shallow subtidal habitat for foraging.

Riparian Habitat

The riparian zone, defined as the area of upland vegetation above the intertidal zone, is an important transition area, and increases the habitat value of adjacent marshes and mudflats. Containing a mix of trees, shrubs, and other plants, riparian buffers create complexity in the habitat, support insect production, provide food for fish and birds, and provide habitat for birds and other wildlife. Riparian areas also dampen noise and act as a filter for land-based runoff, improving water quality in the river. Wider buffers provide more benefit than narrow ones. Through these many functions, riparian buffers increase the likelihood that wetland and marsh habitats will be able to provide ecosystem services and sustain them over the long term.

When no marsh or mudflat is present and the riparian buffer abuts the river along a steep or armored bank (such as rip-rap), its benefits to the ecosystem are reduced. However, trees and plants along such a buffer still provide some habitat for birds and wildlife. They also contribute detritus and insects to the river and provide some degree of water filtration and shade.

5.3 General Restoration Strategy

The Trustees' goal is to restore the kinds of habitats that contribute to estuarine and aquatic resource services lost as a result of contamination in the waterway. To establish a frame of reference, historic conditions in the waterway are used as a model for the desired mix of productive habitats that have lost function through dredging, building of dikes, and shoreline armoring. Although the return to historic conditions is not a goal of Port Gardner Bay NRDA restoration effort, the restoration of some of the key habitat complexes that were abundant in the past will benefit natural resources and restore the services lost due to the releases of hazardous substances. Specific habitat preferences and corresponding elevations are site-specific within Port Gardner Bay and are largely dependent on site constraints and sustainability of the habitat within the context of the surrounding conditions. Restoration of these key habitats would benefit the larger Snohomish River ecosystem and Puget Sound because the restored habitats contribute to ecosystem processes such as water filtration, nutrient input, and food webs.

Trustees prefer restoration projects that enhance ecosystem processes, are integrated into the adjacent natural landscape, and are naturally sustainable. Larger, integrated projects are likely to support a more diverse ecosystem similar to the historical landscape and are more likely to persist and function over time in the absence of active maintenance. Individual restoration sites may lend themselves to different approaches, depending on the constraints and opportunities at each site. Close coordination with the Trustees early in the restoration process will help ensure that the restoration projects include appropriate habitat types for the site.

5.4 Restoration Process and Objectives

Trustees developed the following primary objectives for this restoration plan. Several of these objectives are shared by other restoration plans in the region.

1. Implement restoration with a strong nexus to the injuries caused by releases of hazardous substances in Port Gardner Bay.

2. Provide a functioning and sustainable ecosystem where selected habitats and species of injured fish and wildlife will be enhanced to provide a net gain of habitat function beyond existing conditions.

    - The restored ecosystem need not be pristine, but must contain the functional elements of a healthy ecosystem, support a diversity of habitats and species historically native to the area, and be environmentally sustainable and cost-effective.
    - Restoration will address limiting factors to fish and wildlife resource use in the waterway and enhance ecosystem processes.

3. Integrate restoration strategies to increase the likelihood of success.

    - Pursue an *ecosystem-based* approach to habitat restoration projects by integrating projects into their surrounding environment and focusing on restoring function and processes as well as habitat structures.
    - Set priorities for restoration projects in accordance with sound restoration planning with a focus on habitats that provide functional benefits to injured natural resources. In general, if functioning and diverse habitats similar to naturally occurring habitats are provided, the appropriate species will follow.

4. Coordinate restoration efforts with other planning and regulatory activities to maximize habitat restoration.

    - Protect habitat restoration and preservation sites in perpetuity.
    - Encourage enforcement of existing municipal, county, state, tribal, and federal laws and regulations to ensure that restored habitat is not degraded and remaining habitat is protected.
    - Use the natural resource damage settlement to help leverage additional funds, property, or services to expand or enhance Port Gardner Bay/NRDA restoration.
    - Consider non-monetary components, such as land, long-term stewardship, in-kind services, and PRP-constructed projects under Trustee oversight.

5. Involve the public in restoration planning and implementation.

    - Incorporate public input into restoration planning, implementation, and monitoring.

- Foster greater public understanding and appreciation of indigenous (native) habitat resources.
- Encourage long-term public stewardship of restoration projects and existing natural habitats through education and public involvement.
- Guide public access at restoration sites by a concern for controlling disturbances and disruption of the sites.

5.5 Habitat Focus Areas

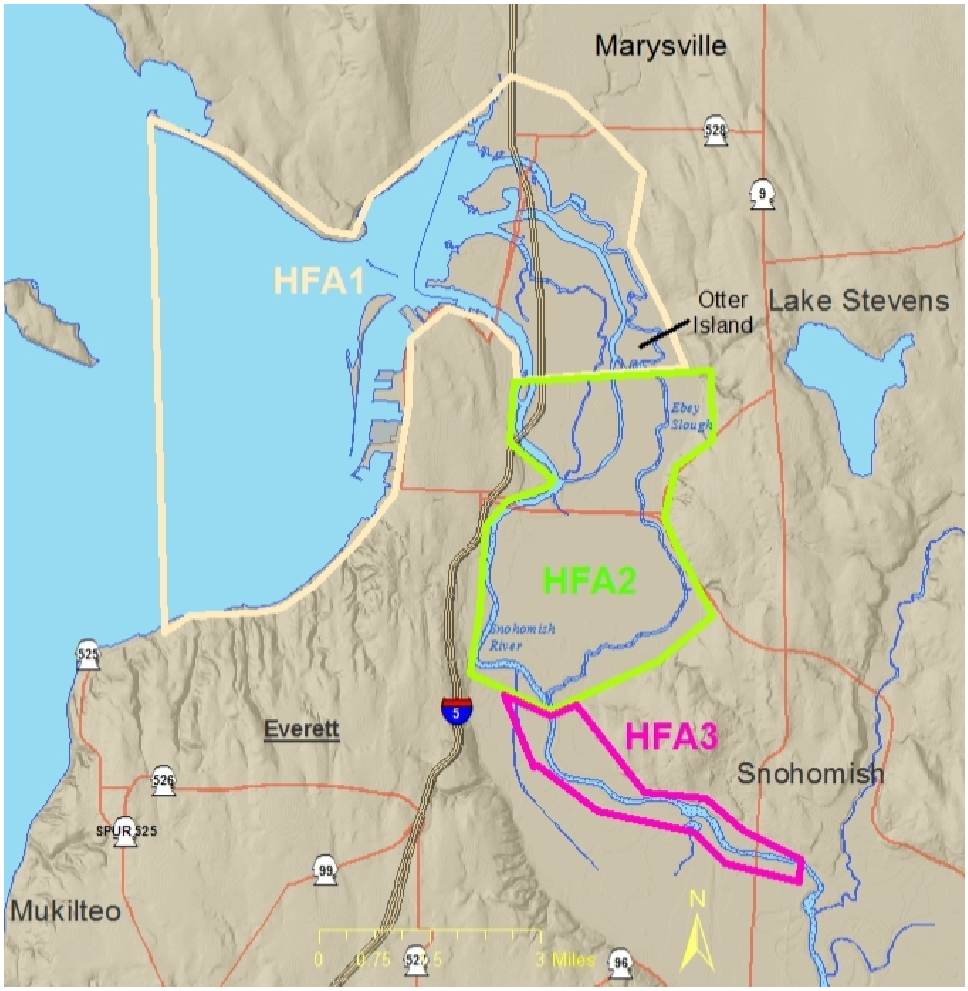
The purpose of creating Habitat Focus Areas (HFAs) is to break up a large, complex, industrial river corridor into smaller geographic and functional units so that potential restoration options can be more easily visualized. The location of a given project and the specific HFA in which it is located were used to evaluate and rank potential restoration projects.

Each HFA was developed based on the nexus of injuries, important target habitat features, and considerations such as obvious geographic boundaries, clusters of restoration sites, exposure to wave energy, location, land uses and development, and maritime use. The Trustees' ability to restore injured resources and the approaches required for such restoration vary among the HFAs. Highest priority is assigned to HFAs that provide habitat for all the injured species groups identified by the Trustees (marine fish and shellfish, birds, and juvenile salmonids). Lower priorities are assigned to areas that provide habitat for some but not all of the natural resources the Trustees seek to restore. The Trustees have developed three HFAs to evaluate potential restoration projects for Port Gardner Bay (Figure 9).

The Trustees have taken an ecosystem approach to planning for the implementation of restoration as part of the NRDA. Trustees established priority focus areas for restoration that fulfill CERCLA requirements (restoration with a strong nexus to the injured resources) and puts restoration in areas where habitat is scarce and essential for fish and wildlife in the Snohomish Estuary. Each Habitat Focus Area (HFA) places boundaries around important target habitat features and incorporates geographic boundaries, restoration site clusters, exposure to wave energy, location, maritime uses, land uses, and development. Three HFAs are covered under this document:

- **HFA1—Port Gardner Bay and portions of the lower estuary**, extending from portions of Possession Sound to the bifurcation of Steamboat, Union Slough, and Main Stem Snohomish River and up Ebey Slough to Otter Island.
- **HFA2—Saline portions of the Snohomish River Estuary**, between the Main Stem bifurcation to Otter Island including Ebey Slough and the Main Stem Snohomish River.
- **HFA3—Upstream of HFA2 to the end of tidal influence** (Approximately the City of Snohomish).

The Trustees' ability to restore injured resources and the approach required varies among the HFAs. Projects within HFA1 (Port Gardner Bay) were ranked the highest, followed by HFA2



(Saline portions of the Snohomish River Estuary). Projects in HFA3 (upstream of HFA2 to the end of tidal influence) were given a lower priority and the value was discounted (Figure 9).

Projects that restore habitat and natural resources within Port Gardner Bay (HFA1) were ranked highest because they provide the most direct benefits to the whole suite of injured natural resources (including salmonids, marine fish, and birds). Projects outside of Port Gardner Bay were still considered, but they were valued less than those within HFA1 and HFA2 because of their distance from the injury. Restoration projects in HFA3 were only considered in case viable projects were not available in HFAs 1 and 2.

Figure 9: Habitat Focus areas for restoration projects in the Port Gardner area.

6. RESTORATION TYPES

An overall guiding principal for an ecosystem-based approach is to prioritize larger, more integrated projects that sustainably restore or enhance ecosystem processes and that are closely linked to the injured species. Larger projects that are well-integrated into the landscape are more likely to support diverse habitats and species. For example, a larger project in HFA1 could incorporate low and high marsh habitat as well as vegetated upland buffers, and therefore support aquatic and terrestrial species. Projects that sustainably restore or enhance ecosystem processes are more likely to endure for longer periods of time with less active maintenance and are more likely to adapt to changes in the environment, such as those that may result from climate change.

Successful restoration projects share certain attributes that contribute to their long-term sustainability. The five attributes described here were developed specifically for Port Gardner Bay. Restoration projects that included some or all of these elements received extra value and/or higher priority for selection.

1. **Overall size –** In general, larger projects are preferred because these projects can incorporate more types of habitats, can support a more diverse assembly of species, and will likely be more resilient to stressors and climate change.

2. **Habitat type –** Restoring or creating habitats that help replace lost estuarine and aquatic services are prioritized, such as marsh and mudflat. Also valued are habitats that are highly important to key organisms, such as threatened or endangered species, and habitats that have become scarce in a given part of the river. More details on desired habitat types are provided in Section 7.1.

3. **Diversity –** Projects that support several ecological niches as well as a diversity of species are preferred. Projects that support an array of habitats are more likely to have larger numbers of niches and species.

4. **Location in the estuary –** This attribute includes historic location for similar habitat, access and use by multiple species, societal/cultural factors, and potential for contamination. Most often, restoration projects are purposely designed to return an area back to its historical habitat condition. However, since the Snohomish River has been so drastically altered over time, the Trustees need to consider the types of habitats that were historically present in the lower river and where these habitats can now occur given current and altered ecosystem processes, existing physical constraints, and potentially conflicting site uses.

5. **Restoration type –** Priority was given to projects that are process-based and therefore more likely to be sustainable over time.

Projects were also deemed more or less desirable due to societal/cultural factors. Projects might provide increased recreational opportunities or enhance the aesthetics of neighborhoods. Public access must be balanced with safety concerns for a particular site as well as potential negative impacts of overuse or conflicting uses that might discourage some wildlife species or degrade habitats. As a result, some sites may provide more benefits by incorporating public access while others may not be appropriate for access. In addition, the selection and construction of restoration sites must also take into account the cultural consideration of tribes such as archeological artifacts or culturally important sites.

Evaluation of projects and the determination of their benefits also included an examination of residual on-site or potential off-site contamination sources. Contamination of restored habitat may reduce the ability of that system to recover to a functional state and could negatively impact the species that use the site. Clean-up of contaminated areas would be completed as part of or prior to the implementation of the restoration project.

Projects that are located immediately adjacent to existing habitat will generally provide more ecological services than projects isolated from existing habitat. Connecting existing and restored habitats creates a larger overall habitat area and increases the transport of plants and animals to the newly restored site. Because Port Gardner Bay has lost such significant amounts of natural habitat, it is also important that habitat restoration be located at regular intervals throughout the estuary. Habitat that is spaced at regular intervals will provide juvenile Chinook salmon with the opportunities to forage, find refuge, and osmoregulate during their lengthy seaward migration. Off-channel and side channel habitat are especially needed in the estuary.

Other important considerations related to functional uses of habitats by injured resources and their long-term sustainability include whether projects are located in the river's transition zone or in off-channel habitat.

Habitats in the River Transition Zone

The transition zone is the area where freshwater and saltwater mix, resulting in brackish conditions. Port Gardner Bay (HFA1) and estuary (HFA2) encompasses most of the transition zone; the Snohomish River Reach (HFA3) is upstream of the transition zone.

The transition zone is where juvenile salmon osmoregulate so they can survive in the saline conditions of Puget Sound. Historically the transition zone was a wide swath of marshes located further downstream; today it is greatly reduced in size and complexity with far fewer off-channel habitats. The transition zone is a prime focus of recovery effort because of its critical role for supporting a key life stage of salmon and its importance for salmon recovery. Several restoration projects have already been established in this zone, and locating additional projects in this zone or near the existing projects may be particularly valuable.

Off-channel habitat

Historically, the Snohomish estuary contained numerous small streams, oxbows, dead-end sloughs, and connected wetlands that provided off-channel habitats. These habitats allowed for easier downstream migration of salmon by providing staging areas for acclimation, feeding, and resting away from high water flows and large predators. They also provided isolated refuge for birds, access to water for wildlife, and overall habitat for a more diverse assemblage of species. The reduction of these habitat features limits efforts to maintain or enhance injured fish populations and other natural resources. Creating off-channel sloughs, lagoons, and dendritic channels serves many of the NRDA target species (salmonids, flatfish, invertebrates, and birds). Off-channel habitat in the transition zone is particularly important to the recovery of Chinook salmon because the zone supports a key Chinook life stage.

6.1 Desired Types of Restoration

The Trustees are interested in restoring habitats that substantially contribute to marine and aquatic resources impacted from contamination of the river. Marsh and mudflat restoration are top priories for NRDA restoration. Also important are riparian buffers, especially those adjacent to marsh habitat. Riparian habitat supports wildlife and the ecological connection between the land and the river. Riparian habitats filter runoff and provide sources of organic material into the river. Restoration of mudflats, intertidal marshes, and riparian habitats also benefit the larger marine system of Puget Sound and the species that inhabit that system such as Orca whales and other marine mammals and top-level predators. The NRDA habitat priorities directly contribute to the larger ecosystem through the food web; primary, secondary, and tertiary productivity; nutrient cycling; and more natural sediment inputs.

The Trustees considered other project types for inclusion under the NRDA. However, clear and specific benefits to injured natural resources needed to be shown. The restoration of mudflats, marshes, and riparian buffers is the primary focus of the Trustees for the NRDA process because these have been determined to have the most direct benefits to injured resources following clean-up of the river. The description below for the creation of these habitat types in the Snohomish estuary is based upon the experience of Trustees on other restoration projects in the Snohomish and elsewhere in Puget Sound and the input from experts.

6.1.1 Creation of Intertidal Mudflat

Intertidal mudflats are defined here as those habitats that occur within the tidal range of -4 and +12 feet mean lower low water (MLLW). This includes low intertidal mudflats between -4 and +4 feet MLLW as well as high intertidal mudflats between +4 and +12 feet MLLW. Intertidal mudflats in Port Gardner Bay support a variety of benthic and epibenthic communities that are important food sources for fish—including juvenile Chinook salmon—and birds. Mudflats that are a part of a side channel also serve as important resting areas for juvenile salmon, including Chinook. Construction of mudflats also provides direct benefits to other species such as English sole.

Constructed mudflats should have a relatively shallow grade of less than 2 percent of unvegetated silt/clay to fine sand substrate. Ideally, restored mudflats would have a width (distance perpendicular to either the main or side channel) of at least five meters. Where possible and appropriate, mudflats should be constructed to border existing or restored marsh or vegetated buffer habitat. Where the appropriate mudflat elevations still exist, construction activities may involve a less extensive bank cutting and site re-grading to create the elevation gradient from mudflat up to low and high marshes. In some locations there may be a combination of cutting into the bank as well as filling in lower reaches to achieve the -4 to +12 mudflat elevations. Appropriate sediment grain size fractions and total organic carbon content may need to be added to restored mudflats. In addition, any derelict vessels, trash, or rubble located within the intertidal mudflat range will be removed during the course of construction.

6.1.2 Creation of Marsh

Marsh habitats include both low marsh that occurs between +5.5 and +10 feet MLLW and high marsh that occurs between +10 and +12 MLLW. Both the low and high marsh habitats experience regular tidal inundation and are vegetated with vascular plants. The vegetation of the marsh habitat and its primary productivity are key components of an estuarine food web. Primary productivity and the resulting secondary productivity influence the structure and abundance of the epibenthic and benthic communities, the ability of the marsh to serve as an adequate refuge, and the foraging habitat for salmonids and other fish and wildlife species.

High and low marsh habitat can be constructed on either the main channel or as side channels off of the Snohomish River. Side channel habitat will be more protected from boat wake and other related disturbances within the mainstem channel. Off-channel or side channel habitat also provides more of a refuge for juvenile salmon than habitats in the mainstem because they are subject to reduced currents.

The sustainability and ecological value of restored marsh habitat will depend, in part, on its size and depth (distance perpendicular to either the main or side channel). Judgments about these sizes and depths can be formed by observing systems of similar size in the Pacific Northwest. Creation of marsh habitat will have an increased value if it contains both low and high marsh habitat as well as adjacent vegetated buffers and/or mudflats. Restored marshes that are adjacent to existing marsh habitat will also have greater value.

As with intertidal mudflats, marshes may be constructed in many portions of the Snohomish estuary main channel by creating set back levees and opening existing levee structures. For off-channel habitat, existing tributaries could be enhanced by more natural marsh elevation, increased channel sinuosity, and additional native plantings. Side channels could also be created by removing fill or digging into upland habitat to create a side channel and its associated marsh and upland habitats. Side channels should be constructed to have a high level of shading to maintain cooler water temperatures and retain water during low tides so that fish can remain in these habitats for longer periods of time.

Marsh creation may also entail the placement of large woody debris to increase habitat complexity. Marshes should be well planted with native species to reduce time to full ecological function and prevent the establishment of invasive species. High marsh communities should contain a variety of herbaceous species such as *Deschampsia*, *Atriplex*, *Distichlis*, and *Potentilla* as well as appropriate shrubs such as willows and dogwood. Low marsh vegetation communities are dominated by herbaceous species, in particular *Carex* species. Dense vegetation communities in marshes will support insect inputs to the river and terrestrial wildlife habitat.

6.1.3 Creation of Riparian Habitat

Riparian habitats have an elevation of +13 feet MLLW or higher and contain a mixture of native scrub/shrub vegetation and trees that range from water-tolerant species such as willows and Sitka spruce to more upland species such as hemlock, Douglas fir, salal, and Oregon grape.

Many other native plant species have been used successfully in restoration efforts on the Snohomish and these will also be considered for use in riparian restoration projects.

Construction or restoration of upland habitat is beneficial to Snohomish estuary injured resources when it is adjacent to either restored or existing marshes, mudflats, or creek tributaries. These riparian habitats can dampen noise and filter stormwater runoff flowing into the wetland habitat and exchange materials and energy with adjacent marsh systems. Placement of riparian areas next to marshes increases the ability of multiple species to use both habitat types, such as birds that may perch in the larger trees and bushes and forage in the marsh and river system. Riparian habitats that are not located adjacent to restored or existing marshes, mudflats, or tributaries provide reduced ecological benefits to injured resources. The width of a restored riparian area will influence the integrity of the habitat and its ability to support wildlife.

6.1.4 Potential Restoration Construction Actions

In addition to the specific construction actions listed above for intertidal mudflat, marsh, and riparian habitat restoration, projects considered under the NRDA process included the following activities (specific restoration actions would vary by the site and the goal of the project):

- Re-grading slopes to create elevations suitable for mudflats, intertidal marshes, and establishing upland vegetated buffers.
- Re-creating off-channel habitats, such as side channels, through excavation.
- Removing artificial debris, including creosote pilings, bank armoring, derelict vessels, and old piers and docks.
- Incorporating natural debris, such as logs and root wads.
- Enhancing substrate of riparian, marsh, or mudflat habitats.
- Planting adjacent uplands to provide riparian habitat appropriate for fish and wildlife, including willow whipping rip-rap armoring that cannot be removed.
- Removing invasive species and planting native species in all target habitat types.
- Removing levees and creating levee setbacks.
- Increasing connectivity between existing and enhanced habitat components.

The removal of previously placed fill material, structures, shoreline armoring, and debris that would occur during restoration efforts can be challenging, and some unanticipated difficulties may occur for some projects.[6] Careful site assessment investigations help reduce the

[6] For example, NRDA restoration projects implemented in the Lower Duwamish River to date have encountered unexpected problems such as underground storage tanks, previously unknown cultural resources, and large amounts of debris that resulted in extra disposal costs.

likelihood of unexpected problems.

6.2 Types of Restoration Not Desired

NRDA restoration projects must benefit natural resources that have been injured as a result of releases of hazardous substances into Port Gardner Bay in order to fulfill the Trustees' mandate under CERCLA to make the public and environment whole. This relates to the type of restoration as well as the location of the restoration projects in relation to the injured resources and services. Beyond that, practical considerations such as the amount and cost of actions necessary to maintain a project are important considerations.

Restoration actions that do not fulfill the Trustees' mandate to restore injured resources or which would be difficult and/or costly to maintain are not appropriate as NRDA restoration for Port Gardner Bay. Information on screening criteria for projects is given in Section 8.2. Projects that will not be considered in the NRDA process include but are not limited to:

- Those located outside of the pre-defined HFAs.
- Those within the HFAs that do not benefit injured resources.
- Activities that only provide benefits to adjacent human communities and not to natural resources or habitats.
- Upland restoration projects without a direct tie to Port Gardner Bay.
- Projects that do not restore natural ecosystem processes.
- Projects that are not sustainable or require an inordinate amount of care and maintenance.

6.3 Restoration Project Monitoring and Performance Criteria

Monitoring is a critical component of any restoration project. Monitoring provides a mechanism to determine whether the project has met its goals or performance criteria and helps to guide adaptive management actions and site maintenance. Monitoring plans must be tailored to specific restoration sites and reflect the project's goals and objectives.

The parameters selected for monitoring should, where possible, also be ones that can be used collectively to evaluate restoration actions across Port Gardner Bay. Collective evaluations of results from multiple restoration sites will allow the Trustees to evaluate the overall benefits from the NRDA restoration process and will help to inform future decisions and designs for projects. Staff from the Northwest Fisheries Science Center, the Tulalip Tribes of Indians, and Snohomish County have developed comprehensive project monitoring plans that should be used to model project monitoring plans.

6.3.1 Performance Criteria

Performance criteria are the measures that will assess the progress of the restoration sites toward project goals. Performance criteria should include both the performance anticipated as well as the time that is predicted for the restored habitat to reach intermediate milestones and the overall project goals. Because habitats and ecosystem processes can take up to 20 years or longer to recover fully, intermediate milestones are necessary to determine whether a project is on an acceptable trajectory towards full recovery. For PRP-implemented projects, all performance criteria and monitoring plans must be reviewed and approved by the Trustees before site construction can begin.

6.3.2 Adaptive Management

Restoration is a relatively young science. To ensure the success of a restoration site it is important for all projects to have an adaptive management strategy that will allow Trustees to determine what attributes are not on target for project success and what actions, including overall course corrections due to site conditions, need to be taken to achieve project success. Adaptive management actions may include replanting species, changing plant species or densities, adding mulch or further amending soils, adjusting or augmenting herbivore exclusion devices, and/or installing irrigation. The Trustees considered lessons learned from previous restoration efforts in the Snohomish estuary—including past practices to avoid—when initially developing restoration concepts and after construction when evaluating whether (and what kinds of) adaptive management actions are appropriate. For PRP-implemented projects, adaptive management plans that detail potential restoration or management actions for a site must be reviewed and approved by Trustees prior to project implementation.

Monitoring parameters should be designed to inform adaptive management actions. Monitoring data collection and analysis is critical in the first few years of site development, as that is the time during which management actions are most effective. Eradicating or controlling invasive species before the population is too large or planting different species because the hydrology or salinity of the site is different than what was originally anticipated are examples of adaptive management actions.

The key to a successful adaptive management plan is the critical evaluation of a problem or attribute that is not performing as expected. Critical analyses before actions are taken helps to ensure that causes are properly addressed and adaptive measures successful. For example, if there is a large die-off of certain plant species, managers should first evaluate potential causes. Was it poor plant stock or unexpected salinities or hydrologic regimes or perhaps herbivore pressure? If the stock was poor, the same species could be successfully replanted. If the die-off resulted from a salinity change, different species should be planted that can tolerate the new salinity regime. Protective structures such as goose-excluder netting or roping can be constructed if herbivore pressure becomes too high.

6.3.3 Monitoring Parameters

The specific parameters being monitored should reflect both the physical structure and biological components of the restored habitat. More importantly, the selected parameters and plan must assess how the system and its ecological processes are functioning. For example, monitoring a low marsh and mudflat restoration might include an examination of how the benthic and epibenthic communities that support larger food webs are developing in relation to healthy systems. One might also examine how juvenile salmonids and birds are using the site; is it for resting and/or foraging? Examples of potential monitoring parameters include:

Physical parameters

- Intertidal area, including area of low and high marsh and mudflats.
- Slope Stability and erosion
- Soil/sediment structure and quality
- Site salinity
- Sediment accumulation patterns
- Channel development.
- Tidal regime and circulation.
- Surface elevation gradients and channel morphology.

Biological parameters

- Vegetation survival and areal coverage.
- Herbivore control effectiveness.
- Invasive species cover and presence.
- Presence of desired fish and wildlife species.
- Fish or wildlife use of site.
- Food web structure.
- Benthic community structure.
- Primary productivity levels.
- Composition of insect fall-out.

Many ecosystem processes and restored habitats take time to fully develop. Monitoring should be conducted for a minimum of 10 years at each site to effectively capture how the system is functioning and whether it will achieve its desired goals. Sites develop more rapidly at first as plants become established and the species return, and then have a slower recovery rate. As previously mentioned, adaptive management actions can be more effective earlier in the restoration process. To account for this temporal variability, monitoring should be completed every year for at least the first three years and can then be spaced more infrequently in subsequent years.

6.3.4 Reporting Requirements

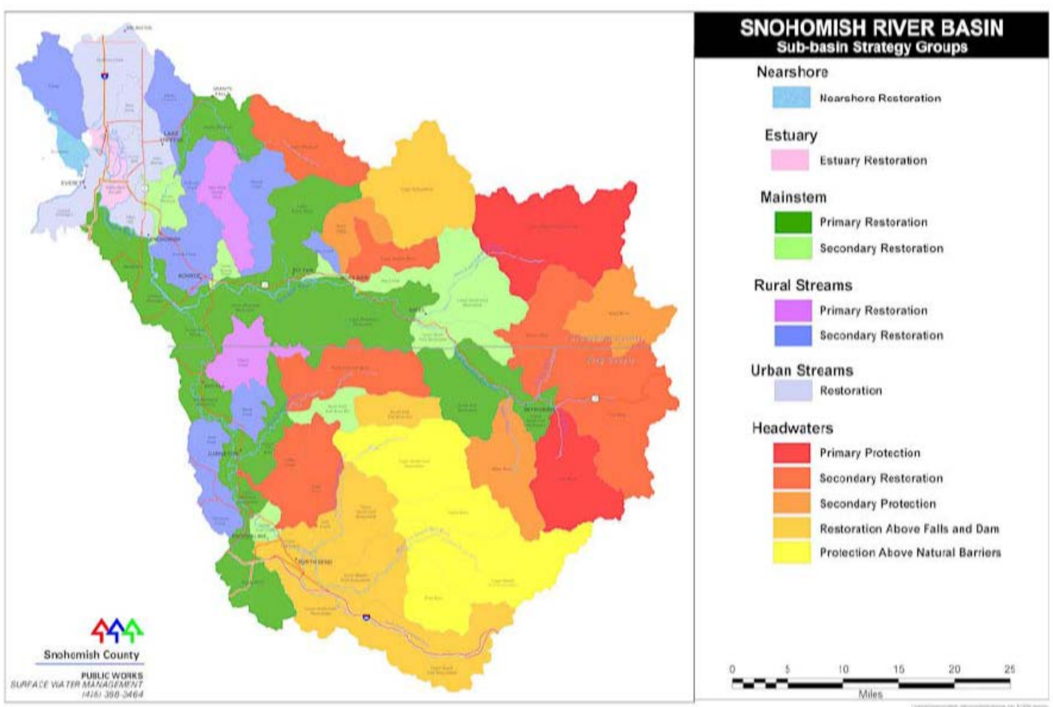
An as-built construction plan must be submitted to the Trustees after completion of a given construction project. Monitoring plans along with identified adaptive management actions that need to be taken must be completed once a year for the first three years and according to the approved monitoring schedule thereafter.

7. PROJECT SELECTION

7.1 Summary of Other Restoration Plans

In addition to this Restoration Plan and EA, several other restoration plans have been developed in the Snohomish River Basin: Chinook Recovery Plan (Snohomish Basin Salmon Recovery Forum 2005) details restoration opportunities and goals as well as the Lead Entity four year work plan. http://www.psp.wa.gov/salmon-four-year-work-plans.php. Figure 10 provides a map with restoration strategies for the Snohomish River watershed.

Figure 10. Map of Snohomish River watershed from the Snohomish Basin Salmon Recovery Plan (2005).



7.2 Selection Criteria Used to Identify Alternatives

Potential restoration sites were identified by Trustees, PRPs, other government agencies, private firms, and the public. Initial screening assessed each site and its suitability for restoration. For example, if a proposed project was not located within one of the HFAs, the Trustees did not evaluate it further. A project within a HFA merited further screening if it was determined to have the potential to benefit injured natural resources and services, but was not considered further if it did not have such potential.

Once a site was proposed, a project-specific restoration concept was developed. This determined what restoration opportunities were possible at the site and how they could be carried out, and included site-specific goals. Based on these goals, specific restoration techniques were designed and preliminary cost estimates prepared and compared with available funding.

Sites were evaluated using a two-step process. For the initial screen (Tier 1), proximity to the affected area, potential to benefit injured natural resources and services, and future management were considered. Sites that meet this initial screen were then examined under Tier 2 criteria that were designed to focus on differences between sites and enable prioritization of potential sites.

Tier 1 Screening:

Habitat Focus Area. Is the potential site located within the higher priority HFA?

Benefits to Injured Resources. How similar are the habitats being created or enhanced to the natural resource injuries and service losses that resulted from the contaminant impacts? Projects that most directly benefit the resources and services that were injured will receive highest priority.

Future Management. Would the landowner agree to a conservation easement or other appropriate land management restriction? Without an understanding of the future management of the specific property under consideration, the Trustees cannot estimate future service flows, and therefore will not further consider the site.

Tier 2 Screening:

Technical Feasibility. What site-specific factors might influence project success? This includes residual contamination that may adversely affect resources and whether there is adequate acreage available for project implementation.

Cost to Carry Out the Restoration Alternative. What are the costs associated with implementation of the restoration project at the proposed location? This includes costs to purchase property or acquire appropriate easements, and costs for implementation. Everything else being equal, projects that cost less than other alternatives are preferred.

Extent to Which Each Location Will Maximize Benefits to Resources. Under this criterion, specific features of the site location, habitat type to be created, size of the project, location in the river, and proximity to other restoration sites will all be evaluated to determine benefits to resources. For example, if the site is located close to an existing restoration site, it may provide added benefit by increasing the habitat complexity of an area. This evaluation will rely on guidelines described in Section 7.

7.3 Initial Range of Restoration Alternatives Considered

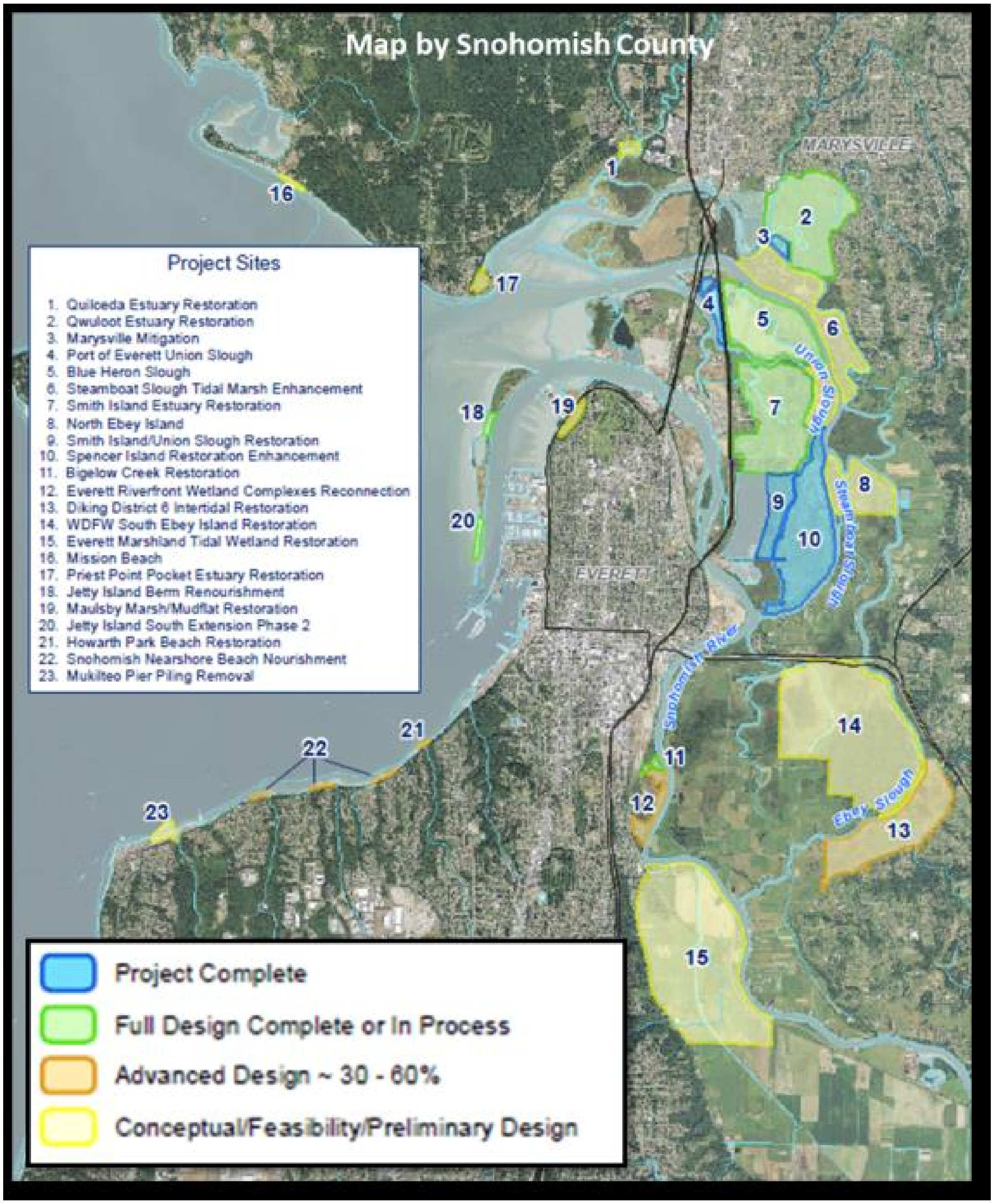
The Trustees reviewed and ranked a number of potential restoration projects in the Snohomish estuary. These projects are listed below and shown in Figure 11. After applying the Tier 1 and Tier 2 criteria, the Trustees noted that four projects scored "high" in the primary selection criteria. Therefore, with several high-scoring options under consideration, the Trustees removed from consideration any projects that had lower scores in those areas. Of the top four, one (Quilceda Estuary) was removed from consideration because it was still in the early phase of feasibility analysis and, therefore, was less certain to provide the benefits being sought. Of the remaining three projects, two (Smith Island and Steamboat Slough) were already fully funded, which led the Trustees to propose Blue Heron Slough. There is a detailed discussion of Blue Heron Slough that follows.

One should also note that Smith Island and Steamboat Slough scored similarly in the Trustees' rankings and would have had similar environmental impacts. Therefore, rather than provide duplicative analyses of these two projects, the Trustees elected to use Smith Island as a proxy but recognize that Steamboat Slough was similarly situated in the rankings. Finally, the Trustees also considered the statutorily-mandated "No Action" alternative for the final phase of review.

Project	Preferred Location	Preferred Habitats	Sustainability	Phase of Development	Has Funding Gap
Blue Heron Slough	High	High	High	Construction	Yes
Smith Island	High	High	High	Construction	No
Quilceda Estuary	High	High	High	Feasibility	Yes

Steamboat Slough	High	High	High	Construction	No
Spencer Island	Medium	High	High	Design	Yes
Maulsby Marsh	High	High	Medium	Feasibility	Yes
Priest Point Pocket Estuary	High	High	Medium	Feasibility	Yes
Drainage District Six	Low	High	High	Design	Yes

Figure 11. Status of restoration projects in Port Gardner / Snohomish estuary in 2014. Compiled by Snohomish County.



7.4 Methods for Resolving Liability

Potentially Responsible Parties (PRPs) for Port Gardner were given the option to resolve their liability in one of three ways. (1) The PRPs could financially support a project selected by the Trustees. (2) A PRP could develop its own restoration project. These projects would be valued for DSAYs by the Trustees on a case-by-case basis. (3) The PRPs may also cash out their liability, and the Trustees would use the funds to support a Trustee-selected project.

In this case, the Trustees anticipate implementing restoration through a hybrid of different settlement types. Some PRPs have indicated a preference to “cash out.” The Port of Everett, another PRP, has proposed to resolve its liability through implementation of the Trustees’ preferred project alternative, Blue Heron Slough. The Port’s settlement option would ensure completion of this major habitat restoration, project which was originally intended to serve as a conservation bank for use by the Port to mitigate environmental impacts from current and future Port development projects in Port Gardner Bay. Accordingly, the Trustees would enter into a project-based settlement with the Port of Everett and use any cash-out settlement funds to support this project. The settlement will result in the purchase of DSAY shares of the Blue Heron Slough project, partially funding the project, with unused shares available for future conservation or NRDA credits.

8. RESTORATION ALTERNATIVE ANALYSIS

8.1 Analysis of the Alternatives for the Purposes of Restoration

Both a CERCLA restoration selection and a NEPA impacts analysis require that federal agencies proposing a restoration action consider a reasonable range of alternatives to the Proposed Action. As described above, the Tier 1 and Tier 2 screening criteria were used to determine whether an alternative is reasonable. Then, the Trustees further narrowed the list to the two most promising projects, which are evaluated in this section.

The Trustees used three criteria to evaluate whether and how each alternative affected their ability to fulfill the Trustees' requirements under CERCLA and other statutes to restore injured natural resources and services in Port Gardner Bay. These criteria are:

- Likelihood that the Trustees' goals in fulfilling their requirements to restore injured natural resources would be achieved.
- Potential to provide benefits to multiple natural resources and services.
- Potential for environmental impacts.

The three Alternatives are discussed below with respect to these criteria and other considerations. Table 4 summarizes the comparison of Alternatives.

The three restoration alternatives proposed for analysis for Port Gardner Bay are:

- Alternative 1: No Action
- Alternative 2: Smith Island Restoration Project
- Alternative 3: Blue Heron Slough Project

Restoration alternatives must be appropriate for NRDA restoration under CERCLA in the initial analysis and then must be analyzed for direct, indirect, and cumulative impacts under

NEPA. The process used in this analysis is first to evaluate how well the alternative meets the goals of restoration under CERCLA. Alternative 1 was determined to be inconsistent with the Trustees' obligation under CERCLA to restore natural resources and resource services that were injured or lost as a result of releases of hazardous substances. The remaining two alternatives would be consistent with CERCLA restoration goals, but Alternative 3 was judged to be more appropriate as a NRDA restoration approach than Alternative 2.

8.1.1 Alternative One: No Action

The No-Action Alternative would result in the Trustees not working to restore natural resources and services that were lost as a result of the release of hazardous substances into Port Gardner Bay. While there would presumably be an eventual recovery of affected resources to or near to the baseline condition that would exist if these releases had not occurred, there would be no restoration actions taken to compensate for interim losses that occurred in the past and are ongoing until the recovery to baseline occurs. This would mean that the Trustees' mandate under CERCLA to make the public and environment whole for injuries to natural resources from the releases of hazardous substances would not be met. This alternative does not address the purpose and need for restoration of lost natural resources and services, and therefore is not a preferred alternative for NRDA restoration plan.

If this alternative was selected, the Trustees would not undertake any NRDA restoration projects. Any restoration actions in Port Gardner Bay or Snohomish estuary would take place under other current or future programs and regulations pursued by tribes, federal and state agencies, and other entities outside the NRDA process.

While short-term negative impacts are expected to continue under no-action as interim losses continue, the No-Action Alternative would have no direct, indirect, or cumulative adverse or beneficial impacts to the human environment as compared to the action alternatives. This is due to the fact that no new restoration actions are implemented under this alternative to improve water or sediment quality, habitat conditions, and fish and wildlife including threatened and endangered species. The No-Action Alternative is by far the least costly alternative. However, the No-Action Alternative is not consistent with the goal under CERCLA to restore natural resources and services that were injured or lost as a result of the release of hazardous substances. Because interim losses of natural resources and services have occurred and continue to occur during the period of recovery, and technically feasible alternatives exist to compensate for these losses, the Trustees determined that restoration actions are required, and the No-Action Alternative is not proposed as the Preferred Alternative.

8.1.2 Alternative Two: Smith Island Restoration Project

The Smith Island Restoration Project Site is located east of Interstate 5, north of the City of Everett and south of the City of Marysville on approximately 580 acres. The land is owned by Snohomish County. The site, once a productive estuary for juvenile salmon, now consists of diked wetlands and drainage ditches designed historically to reclaim land for agricultural uses. As part of the Puget Sound Nearshore Ecosystem Restoration Project (PSNRP) work in 2011, the USFWS conducted a level-1 contaminant survey and associated background and data base queries on the site (USFWS 2011). Findings from that study suggested that additional environmental contaminant investigations and sampling would need to occur prior to implementation of any proposed restoration action. This alternative would include removal of hydrologic barriers to restore estuarine linkages and processes between fresh and salt-water environments. The Smith Island Project involves constructing a dike long the west tidal channel and removing portions of an existing dike to create or enhance approximately 400 acres of estuarine wetlands and tidal marsh conditions and processes. Additional project elements would include the removal and installation of tide gates, construction of access roads, installation of a detention pond with a pump station to collect excess water, creation of a wetland berm over an existing buried pipeline and construction of a parking lot. Thousands of feet of drainage ditches in the area to be breached would be plugged with native material and starter tidal channels would be excavated, to eventually function as tidal estuarine wetlands.

The Smith Island Project focuses primarily on tidal marsh habitat and its target species is Chinook salmon. The project site location makes it one of the best opportunities for restoration in the Snohomish estuary. It contains two of the largest disconnected blind tidal slough channels in the estuary, adding to its restoration value. The Trustees estimated they would need $5.5 million to complete this project. It scored high in Preferred Location, Preferred Habitat, and Sustainability. The Trustees gave it average scores in the categories of Cost/Benefit, Leveraging, Sequencing, Feasibility, and a low score in Tribal Cultural Significance.

While the Smith Island Project was a strong alternative for the Trustees, there are a few concerns identified by the Trustees that prevented them from selecting Smith Island as the Preferred Alternative. First, the underlying land is not owned by a PRP, but rather by Snohomish County. Therefore, in order for the project to succeed, the Trustees or a PRP would first have to purchase the property from the County or require the County to give up the full breadth of its ownership to ensure the conservation of the site. To ensure that this site remains as habitat in perpetuity, the Trustees would need to acquire a conservation easement across the entire project site. This acquisition concern significantly reduced the likelihood that the Trustee's goal to restore injured natural resources would be achieved in a timely and cost-effective manner. At this time, it is the Trustees understanding that the Smith Island Project is fully funded, and therefore, no longer a good option for resolving liability.

8.1.3 Alternative Three: Blue Heron Slough (Preferred)

This alternative would ensure completion of the Blue Heron Slough Conservation Bank, established in June 2008 and approved by NOAA's National Marine Fisheries Service and the USFWS. Blue Heron Slough is a multi-purpose project. Originally conceived, permitted, and certified as a conservation bank, the project enhances and protects a suite of habitats. Because the Trustees consider these habitats highly beneficial to the resources injured in Port Gardner Bay, the Trustees have proposed the site also serve as a restoration bank for the purposes of this NRDA. Finally, the project developers are also considering seeking future certification as a wetlands mitigation bank.

Despite the various potential uses of this site, this RP/EA is focused (and seeking public comment) solely on the use of Blue Heron Slough credits for NRDA purposes. The site is already approved as a conservation bank, and any use as a wetlands mitigation bank would be the subject of a future public outreach and comment effort.

The two current (and third potential) use of the project rely on "credits" assigned to reflect the value of the restored/protected habitat. Because they draw all draw from the same "bank," one critical task will be to establish an accounting system that ensures that no credits are double-counted.

Though the project is approved, it had not yet been substantially implemented due to a lack of available funding. If the Trustees choose this project in the Final RP/EA, and if the Trustees and the Port of Everett can reach agreement on terms of a settlement, the project would be constructed and preserved in perpetuity.

Chinook salmon is the primary beneficiary of this project. The Blue Heron Slough Conservation Bank site is located in the Snohomish River estuary and is comprised of property purchased by the Port of Everett and Wildlands, Inc. to use for habitat mitigation. The Project site was diked and drained in the 1880's for agricultural use. Wildlands, Inc. currently acts as the site's financial manager. Wildlands and the Port plan to record a conservation easement across the 354 acre site that protects the site in perpetuity. Although implemented as an Umbrella Conservation Bank for Puget Sound Salmon, Steelhead and Bull Trout, the Blue Heron Slough Project is a strong example of integrated habitat restoration. The primary goal of the Project is to restore intertidal wetland and mudflat habitat through the breaching of four dikes and restoration of natural ecological processes at the bank site. Specific ecological goals include: "restoration and enhance of approximately 344 acres of disturbed habitat in the lower Snohomish River Estuary (to include high quality sustainable mudflats, intertidal marshes and riparian areas), reconnection of refuge and off-channel rearing habitat to the Snohomish River Estuary, and permanent protection and management of the improved, enhanced, and restored habitats of the bank." *See* The Conservation Fund, Blue Heron Slough Conservation Bank, Case Study Series (2010). The Conservation Bank is anticipated to restore approximately 100 acres of intertidal marsh, 8 acres of uplands, 230 acres of mudflat, 16 acres of subtidal slough, 18,400 linear feet of riverine habitat, and 24,000 linear feet of off-channel habitat in the Snohomish River Estuary.

The Trustees rated the Blue Heron Slough Project high in their review of alternatives. The Project was rated high because it is in a preferred location, restores preferred habitat, and should achieve restoration in a sustainable way similar to the Smith Island Project. The Trustees chose the Blue Heron Project over the Smith Island Project because it needed funding, while the Smith Island Project did not. In addition, the Trustees do not need to worry about preliminary acquisition concerns because the PRP owns the property. The Blue Heron Slough Project has been fully designed and work could begin immediately with funds from either the Trustees or a PRP. In exchange from a release of NRD liability from the Trustees, PRPs could opt to either purchase Blue Heron Slough credits from Wildlands or cash-out with the Trustees. The Trustees would then apply the cash-out funds towards the Blue Heron Slough project.

8.1.4. Alternatives Considered but Eliminated from Detailed Analysis

Following is a table that lists a number of the projects that the Trustees rated. It relates the reasons why the Blue Heron Project was chosen over other projects. Cells highlighted in green indicate a positive criteria and cells highlighted in red indicate negative criteria. The Blue Heron Project was the only project reviewed that had all positive criteria.

Project	Preferred Location	Preferred Habitats	Sustainability	Phase of Development	Has Funding Gap
Blue Heron Slough	High	High	High	Construction	Yes
Smith Island Project	High	High	High	Construction	No
Quilceda Estuary	High	High	High	Feasibility	Yes
Steamboat Slough	High	High	High	Construction	No
Spencer Island	Medium	High	High	Design	Yes
Maulsby Marsh	High	High	Medium	Feasibility	Yes
Priest Point Pocket Estuary	High	High	Medium	Feasibility	Yes
Drainage District Six	Low	High	High	Design	Yes

8.2 Direct, Indirect, or Cumulative Impacts of Alternatives under NEPA

NEPA regulations require the assessment of effects of an action, including direct and indirect effects (defined at 40 CFR 1508.8) and consideration of cumulative impacts as defined at 40 CFR § 1508.7. Accordingly, each of the three alternatives identified above were evaluated to assess their direct, indirect, or potential for cumulative impacts on the human environment. In assessing the impacts, the context of the action is considered in several contexts—e.g., the society as a whole, the affected region and interests, and the locality. By assessing the direct, indirect, and cumulative impacts that could potentially arise from implementing each of the alternatives, the severity (intensity) of the impacts can be determined to support a comparison of alternatives. Since restoration actions are designed to be beneficial but may involve various temporary or long-term adverse impacts, both beneficial and adverse impacts are analyzed. This subsection is specifically provided to serve as the analysis of environmental consequences as required under 40 CFR § 1502.16, including a more detailed analysis relative to specific resource areas, including biological, physical, aesthetic, socioeconomic, historic, and cultural resources. Each alternative has also been evaluated to assess the significance of impacts in accordance with the NEPA context and intensity factors described in 40 C.F.R § 1508.27, including evaluating the intensity of both the beneficial and adverse impacts under short and long-term conditions. In addition, the potential impacts of the alternative were examined.

The following definitions are used to characterize the nature of the various impacts evaluated in this EA:

- *Short-term or long-term impacts.* These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period, or only during the time required for installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
- *Direct or indirect impacts.* A direct impact is caused by a proposed action and occurs at or near the same time and location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.
- *Minor, moderate, or major impacts.* These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR 1508.27) and thus warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.
- *Adverse or beneficial impacts.* An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.
- *Cumulative impacts.* CEQ regulations implementing NEPA define cumulative impacts as the "impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

The Trustees concluded overall that any potential adverse environmental impacts from the Blue Heron Slough Preferred Alternative would largely be short-term and construction-related, while beneficial environmental impacts would result in long-term moderate increases in habitat benefits to the area's natural resources and the aesthetics for humans. There would be direct beneficial impacts to habitat function and indirect beneficial impacts to the suite of species that depend on these habitats.

The Trustees also concluded overall that any potential adverse environmental impacts from the Smith Island Project Alternative would largely be short-term and construction-related, while beneficial environmental impacts would result in long-term moderate increases in habitat benefits to the area's natural resources and the aesthetics for humans. There would be direct beneficial impacts to habitat function and indirect beneficial impacts to the suite of species that depend on these habitats. However, the Smith Island Project alternative does not have a funding need and therefore is not available to resolve NRD liability.

The No-Action Alternative would have no direct impacts, adverse or beneficial, and would result in no additional restoration beyond that that would otherwise be accomplished under other programs and authorities. There would be no actions to offset the continuing loss and degradation of habitat in Port Gardner Bay.

8.2.1 Likely Impacts of the Alternatives

As noted above, adverse environmental impacts from the selection of the Blue Heron Slough Preferred Alternative and the Smith Island Project alternative are short-term and construction-related. The magnitude of environmental impacts would generally be a function of the extent and duration of construction. Mitigation measures (i.e., use of best management practices) would be included to minimize these short-term impacts. Adverse impacts would therefore be expected to be minor. The long-term impacts would be beneficial to the area's natural resources by providing additional fish habitat, protecting and improving water quality, and increasing aesthetics in the area. The Blue Heron Slough Project (Alternative 3) would be developed to comply with all applicable local, state, tribal, and federal permits and approvals.

In contrast, the No-Action Alternative would have no such construction-related impacts, but neither would it have the long-term beneficial impacts to natural resources in Port Gardner Bay.

8.2.1.1 Socio-Economic Impacts

<u>No Action Alternative</u>

Under this Alternative, no actions would be taken so no adverse impacts would occur in terms of socio-economics.

<u>Smith Island Project</u>

No job losses would occur due to the project. However, there will likely be a short term gain in jobs because of the construction of the project. The proposed project precludes future development on-site, but such economic impacts would likely be offset by improving the environmental quality of the area.

<u>Blue Heron Slough</u>

Socio-economic impacts of the Blue Heron Slough project are effectively identical to those for Smith Island.

8.2.1.2 Aesthetics, Light, and Glare

<u>No Action Alternative</u>

Under this Alternative, no actions would be taken so no adverse impacts would occur in terms of aesthetics, light or glare.

Smith Island Project

During the construction phase of the Smith Island Project, the site would have poor aesthetics from disturbed soils, piles of debris, and other construction-related untidiness, resulting in short-term minor impacts. It is possible that lights might be used if some of the construction work is done at night (for example, to work when there are favorable tides). There could be some glare off of machinery used in the construction. However, the duration of this phase would be relatively short, a few weeks to a few months, for projects under this alternative. Following construction, project sites are likely to have much better aesthetics than were present prior to the restoration action, if for example rip-rap or other shoreline armoring is replaced with marsh and riparian vegetation.

Blue Heron Slough

Aesthetic impacts of the Blue Heron Slough project are effectively identical to those for the Smith Island Project.

8.2.1.3 Noise Impacts

No Action Alternative

The No Action Alternative would not result in any noise impacts since no restoration actions would be taken.

Smith Island Project

Implementation of Smith Island Project would result in short-term, moderate noise impacts in a small area around the project location from the use of heavy equipment during the construction phase of the project. Outside of the immediate project area, the increase in noise should be minimal.

Blue Heron Slough

Noise impacts of the Blue Heron Slough project are effectively identical to those for Smith Island Project.

8.2.1.4 Recreational Impacts

No Action Alternative

Under the No-Action Alternative, there would be no impacts, adverse or beneficial, to recreation and education.

Smith Island Project

It is anticipated that the Smith Island Project would increase the aesthetics of the Snohomish estuary and Port Gardner Bay. Therefore kayaking or boating in the area would be enhanced over the long term by the creation of more natural habitat along the river. No adverse impacts to recreation or education would be likely under this alternative. It is possible that some project locations would become parks that could have passive recreational use, provide access to the estuary, and/or possibly have information kiosks that could provide environmental education to visitors. Public use on any restoration project site would need to be carefully considered and designed in order to minimize any loss of potential ecological value, since offsetting ecological injuries in Port Gardner Bay is the primary mandate for the Trustees. Therefore, although there would be some long-lasting beneficial impacts from projects implemented under this alternative, these would not be expected to be major.

Blue Heron Slough

Recreational impacts of the Blue Heron Slough project are effectively identical to those for the Smith Island Project.

8.2.1.5 Health and Safety

No Action Alternative

The No Action Alternative would not result in any health and safety impacts because no restoration actions would be taken.

Smith Island Project

Like the environmental impacts, any health and safety impacts from the Smith Island Project are all expected to be short-term and minor construction-related impacts. Thereafter the project will provide long-term benefits to the areas' humans and natural resources.

Blue Heron Slough

Health and safety impacts of the Blue Heron Slough project are effectively identical to those for the Smith Island Project.

8.2.1.6 Transportation, Utilities, and Public Services

No Action Alternative

The No-Action Alternative would have no impacts on transportation, utilities, and public services.

Smith Island Project

During construction of the Smith Island Restoration Project, there could be short-term, minor impacts to transportation or utilities, such as increased vehicle traffic during construction phases, although the impacts would be limited to small areas for brief time periods. Overall, implementation of the Smith Island Project is not expected to burden or increase demand for transportation, public services and utilities.

Blue Heron Slough

Transportation, utility, and public service impacts of the Blue Heron Slough project are effectively identical to those for the Smith Island Project.

8.2.1.7 Economic Impacts

No Action Alternative

The No-Action Alternative would have no economic impacts, including no short-term benefits to local businesses.

Smith Island Project

No significant economic impacts would occur as a result of the Smith Island Project. This alternative would not result in a significant conversion of commercial property to habitat that could lead to job losses or decreases in income for the jurisdictions in which these projects would occur. There would be short-term, minor economic benefits to local businesses in the general area in which habitat projects would be located from spending by construction workers. Over the long term there should be no major economic impacts from the implementation of this alternative.

Blue Heron Slough

Economic impacts of the Blue Heron Slough project are effectively identical to those for the Smith Island Project.

8.2.1.8 Historic and Cultural Impacts

No Action Alternative

The No-Action Alternative would have no impact on historic and cultural properties.

Smith Island Project

Consultation with the State Historic Preservation Officer and Tribes has been completed for the Smith Island Project. The project has received concurrence from the Tulalip Tribes, the

Suquamish Tribe, and the Washington Department of Archaeology and Historic Preservation under Section 106 of the National Historic Preservation Act.

Blue Heron Slough

Consultation with the State Historic Preservation Officer and Tribes has been completed for the Blue Heron Slough project. The project has received concurrence from the Tulalip Tribes, the Suquamish Tribe, and the Washington Department of Archaeology and Historic Preservation under Section 106 of the National Historic Preservation Act.

8.2.1.9 Environmental Justice

The 1994 Executive Order 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. In the memorandum to heads of departments and agencies that accompanied executive Order 12898, the President specifically recognized the importance of procedures under NEPA for identifying and addressing environmental justice concerns. The memorandum states that "each federal agency shall analyze the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by [NEPA]." The memorandum particularly emphasizes the importance of NEPA's public participation process, directing that "each federal agency shall provide opportunities for community input in the NEPA process." Agencies are further directed to "identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices." The CEQ has oversight of the federal government's compliance with Executive Order 12898 and NEPA.

The Trustees will involve the affected communities by providing a web site with information on the process and pertinent documents. The Trustees will also seek public comments on this document and provide access to the Administrative Record. In addition, all actions are expected to have positive environmental impacts and not to impose any adverse impacts on any community.

8.2.1.10 Land and Shoreline Use

No Action Alternative

The No-Action Alternative would have no impact on land and shoreline use.

Smith Island Project

Approximately 90% of the project area is now vacant open space consisting of fallow farmland and pasture, native and non-native plant species, and freshwater wetlands. The Smith Island Project would result in a conversion of these habitats and land uses to estuarine habitat.

The existing system of aging dikes will be setback with a modernized levee system. The older dikes will be breached in a number of places. The conversion of currently unused land into habitat would remove these areas from potential future uses. However, much of the property located in the estuary is in public and private ownership and has already been proposed for use as restoration sites. As mentioned above, under this alternative it is possible that some of the projects may incorporate some additional passive recreational opportunities and so could increase public use of Snohomish Estuary shoreline.

Blue Heron Slough

Approximately 90% of the project area is now vacant open space consisting of fallow farmland and pasture, native and non-native plant species, and freshwater wetlands. The Blue Heron Slough Project would result in a conversion of these habitats and land uses to estuarine habitat. The existing system of aging dikes will be setback with a modernized levee system. The older dikes will be breached in a number of places. The conversion of currently unused land into habitat would remove these areas from potential future uses. However, much of the property located in the estuary is in public and private ownership and has already been proposed for use as restoration sites. As mentioned above, under this alternative it is possible that some of the projects may incorporate some additional passive recreational opportunities and so could increase public use of Snohomish Estuary shoreline.

8.2.1.11 Wetlands

No Action Alternative

The No-Action Alternative would have no impact on wetlands.

Smith Island Project

Approximately 90% of the project area is now vacant open space consisting of fallow farmland and pasture, native and non-native plant species, and freshwater wetlands. The Smith Island Project would result in a conversion of these habitats and land uses to estuarine habitat. The existing system of aging dikes will be setback with a modernized levee system. The older dikes will be breached in a number of places. Relatively little wetlands remain compared to what was present historically along the Port Gardner shorelines, due to shoreline armoring, dikes and filling of former wetlands. Implementation of the Smith Island Project would increase the amount of wetlands in the estuary. The increase in wetlands from implementing this alternative would help offset any continuing loss of wetlands from other causes.

Blue Heron Slough

Approximately 90% of the project area is now vacant open space consisting of fallow farmland and pasture, native and non-native plant species, and freshwater wetlands. The Blue Heron Slough Project would result in a conversion of these habitats and land uses to estuarine habitat. The existing system of aging dikes will be setback with a modernized levee system. The older dikes will be breached in a number of places. Relatively little wetlands remain compared to what was present historically along the Port Gardner shorelines, due to shoreline armoring, dikes and filling of former wetlands. Implementation of the Blue Heron Slough Project would increase the amount of wetlands in the estuary. The increase in wetlands from implementing this alternative would help offset any continuing loss of wetlands from other causes.

8.2.1.12 Air Quality

No Action Alternative

The No Action Alternative would not result in any air quality impacts.

Smith Island Project

During the construction phase of the Smith Island Project there would be minimal short-term increases in exhaust and dust from use of construction equipment. No major or long-term impacts to air quality would be expected to result from implementation of the project. For areas in which vegetated habitat will replace rip-rap or structures, a minor improvement (expected to be unmeasurable) in air quality should result. The vegetation will also take up carbon dioxide, which will offset greenhouse gas emissions during project construction.

Blue Heron Slough

The potential air quality impacts from Blue Heron Slough would be similar to those at the Smith Island Project.

8.2.1.13 Hydrology

No Action Alternative

The No Action Alternative would not result in any hydrology impacts.

Smith Island Project

The Smith Island Project would not have any significant impacts on flood control. Rather, it would provide a minor, long-term benefit in flood control by providing off-channel habitat that will increase the volume of water that will be kept from contributing to any flood events. There would also be some predicted minor changes to the hydrology of the adjoining sloughs - mainly around the breached areas.

Blue Heron Slough

The potential impacts to hydrology from Blue Heron Slough would be similar to those of the Smith Island Project.

8.2.1.14 Water Quality Impacts

No Action Alternative

The No Action Alternative would not result in any water quality impacts.

Smith Island Project

The Smith Island Project would likely have short-term minor adverse impacts during construction such as an increase in turbidity. The project has received their CWA 401 water quality certification that details the best management practices they must undertake to reduce any impacts. Long-term minor beneficial impacts would result from wetland habitat creation.

Blue Heron Slough

Water quality impacts from Blue Heron Slough would be similar to those from Smith Island.

8.2.1.15 Sediment Quality Impacts

No Action Alternative

The No Action Alternative would not result in any sediment quality impacts.

Smith Island Project

The Smith Island project site is in a developed/disturbed/filled-in area; therefore, construction of habitat would provide a slight increase in the quality of soils and sediments. Opening the site to riverine processes will bring a steady influx of sediment into the site. Over the past century, the sediments on the site have subsided significantly and the influx of new sediment will slowly raise the elevation of the project.

Blue Heron Slough

Water quality impacts from Blue Heron Slough would be similar to those from the Smith Island Project.

8.2.1.16 Prime Agricultural Lands

No Action Alternative

The No Action Alternative would not result in any impacts to prime agricultural lands.

Smith Island Project

The Smith Island Project would prevent land from being used for agricultural purposes; however, the project would be implemented by a willing landowner. The agricultural land has subsided considerably, lies behind an aging dike system, and has become more wet and less usable for agriculture over time. The land has also been fallow for many years. Within the larger estuary restoration context, the farming community has voiced their concern for the loss of agricultural land being converted to restoration projects. Snohomish County initiated the sustainable land strategy group to work through these issues. Much of the publicly owned agricultural land that has been purchased for restoration was no longer economically feasible as farms due to failing infrastructure and subsidence.

Blue Heron Slough

Impacts to agricultural land from Blue Heron Slough would be similar to those from the Smith Island Project.

8.2.2 Biological Impacts

8.2.2.1 Vegetation

No Action Alternative

The No Action Alternative would not result in any impacts to vegetation.

Smith Island Project

Short-term minor adverse impacts could occur as a result of the Smith Island Project such as a die off of plants that aren't tolerant of an increased water regime. Long-term moderate beneficial impacts would be expected such as an eventual colonization of water tolerant plant species that will benefit fish and bird species.

Blue Heron Slough

Impacts to vegetation from the Blue Heron Slough project would be similar to those from the Smith Island Project.

8.2.2.2 Fish and Wildlife Habitat

No Action Alternative

The No Action Alternative would not result in any impacts to fish and wildlife habitat.

Smith Island Project

Relatively little wetlands remain compared to what was present historically along the Port Gardner shorelines, due to shoreline armoring, dikes and filling of former wetlands. Implementation of the Smith Island Project would increase the amount of wetlands in the estuary. The increase in off channel estuary habitat would provide a significant increase in habitat for fish and wildlife. It is expected to provide foraging and rearing habitat for many species of birds and fish. There will be a short term minor impacts to wildlife during the construction period due to noise from earth moving equipment.

Blue Heron Slough

Impacts to fish and wildlife habitat from Blue Heron Slough would be similar to those from the Smith Island Project.

8.2.2.3 Special Status Species

No Action Alternative

The No Action Alternative would not result in any impacts to special status species.

Smith Island Project

The Smith Island Project would provide additional habitat for Chinook salmon and Puget Sound steelhead and would benefit other listed species in the area. This project will provide 25% of the habitat needed to reach the 10 year habitat recovery goal for the estuary. Through selective scheduling of the construction period to minimize impacts to salmonids and implementation of methods to minimize in-water turbidity, short-term impacts to listed species would be minor. The Smith Island Project has already completed the required consultations under federal laws and regulations pertaining to fish and wildlife and Essential Fish Habitat.

Blue Heron Slough

Blue Heron Slough would provide additional habitat for Chinook salmon and Puget Sound steelhead and would benefit other listed species in the area. This project will provide 25% of the habitat needed to reach the 10 year habitat recovery goal for the estuary. Through selective scheduling of the construction period to minimize impacts to salmonids and implementation of methods to minimize in-water turbidity, short-term impacts to listed species would be minor. Because this project has already been certified as a conservation bank by NOAA and the USFWS, required consultations under federal laws and regulations pertaining to fish and wildlife and Essential Fish Habitat, as well as applicable consultation and regulatory terms and conditions, have already been completed.

8.2.2.4 Floodplain and Flood Control

No Action Alternative

There would be no impacts from the No-Action Alternative on the floodplain and flood control.

Smith Island Project

The Smith Island Project will not have any major adverse impacts on flood control. Rather, it would provide a minor, long-term benefit in flood control by providing off-channel habitat that will increase the volume of water that will be kept from contributing to any flood events. The amount of floodplain could increase slightly as a result of this project.

Blue Heron Slough

Impacts on floodplains and flood control from Blue Heron Slough would be similar to the Smith Island Project.

8.2.2.5 Introduction of Non-Indigenous Species [NAO 216-6 6.01(b)(11)].

No non-indigenous species will be introduced as part of the implementation of any alternative. Existing invasive and non-native plant species would be replaced with native species in accordance with the monitoring program and site-specific vegetation plans for either of the action Alternatives. There would be no similar replacement of existing non-indigenous species under the No-Action Alternative.

8.2.3 Cumulative Impacts

The cumulative effects analysis in this RP/EA is commensurate with the degree of direct and indirect effects anticipated by implementing the proposed federal action or the alternatives considered. Restoration projects considered in accordance with an overall CERCLA action are intended to compensate for prior injury to natural resources under the Natural Resource Trustees' jurisdiction, and therefore typically have predominantly beneficial impacts toward addressing impacts to those resources. In this case, the Port Gardner Bay proposed restoration effort is one component of the overall remediation and restoration for Port Gardner Bay; therefore, the potential for cumulative impacts is considered in the context of that overall project site. Although impacts to natural resources under Trustees' jurisdiction, and impacts in general, may occur in the larger regional vicinity of Puget Sound, the potential for the proposed action to incrementally contribute to those effects does not warrant consideration here, as the goal of the effort is to increase available habitat for those resources. Therefore, the cumulative impacts analysis for this restoration action appropriately focuses on the incremental effects of the action in the context of other Port Gardner Bay ongoing actions.

The resources that may be temporarily impacted during construction actions are air quality (by increased dust, noise, and exhaust fumes from construction equipment), disturbance of soils and sediments (largely currently degraded and disturbed), and water quality (from temporary increases in turbidity). Some slight and temporary impacts to marine fauna and flora could occur, but impacts to these and other resources would be minimized by use of best management practices. Cleanup activities and other restoration projects that may occur in the vicinity at the same time would similarly incorporate required BMPs, such as dust control and soil and erosion practices. In some instances, it would be possible to integrate restoration with remediation, thereby reducing the amount of impact, compared to what would occur without this integration. Additionally, the overall footprint of the Preferred Alternative would be relatively small in the context of the overall Port Gardner Bay. Consequently, the minor and temporary impacts of the action on air quality, soils and sediments, and water quality has a low potential to result in cumulatively significant impacts to these resources.

An important consideration for Trustees' conduct while implementing a restoration action is the timing and location of the restoration project. Specifically, it is important that habitat restoration occur at a site where contamination either did not occur, occurred at non-injurious levels, or has been successfully remediated to appropriate standards, and that habitats or living marine resources not be restored in an area where they may be affected by other impacts associated with the larger remediation or restoration action. In the case of the proposed habitat restoration in and around Port Gardner Bay site, completion of the Preferred Alternative would result in additional and/or improved marsh, mudflat, shallow subtidal, and riparian habitat that would be more ecologically productive and support the types of natural resources—such as English sole, salmonids, and crabs—that were injured by releases into Port Gardner Bay. Therefore, with respect to natural resources, over the mid and long term (i.e., after completion of the restoration actions) restoration under the Preferred Alternative will be wholly beneficial with no potential for incremental contribution to significant impacts related to contaminant exposure in the marine environment.

Outside of the area of clean-up actions, it is difficult to predict exactly what other actions may be undertaken by other entities within Port Gardner Bay that could combine with NRDA restoration actions to produce cumulative impacts, but some of these are known. Maintenance dredging within the Bay will occur as needed for navigation, and Port of Everett and others' waterfront facilities will be maintained. Several other entities may conduct habitat restoration projects in Port Gardner Bay and Snohomish estuary for different purposes or under different authorities. Outside of restoration projects, most of these actions would be expected to have at least short-term negative impacts from construction activities, but some of them may have long-term negative impacts if the construction is prolonged. It is possible that some may result in long-term adverse impacts to habitats or species in Port Gardner Bay, although presumably mitigation measures would be used to minimize such impacts and actual mitigation of habitat might be required.

There would be no cumulative impacts under the No-Action Alternative. Restoration efforts would only occur from other programs, and there would be no additional habitat created beyond that which would otherwise occur.

8.2.3.1 Potential Impacts of Climate Change on Proposed Restoration

The climate in the basin is a mid-Atlantic, west coast marine type characterized by cool wet winters and mild summers. The average rainfall in the basin ranges from 39 to approximately 100 inches annually. Approximately 75 percent of the precipitation falls between the months of October and April. The summer months from July through September are typically characterized by minimal, if any, precipitation, causing flows in the river to drop to minimums and water temperatures to increase. Temperature extremes are moderated by the adjacent Puget Sound as well as the more distant Pacific Ocean. The region is partially protected from Pacific storms by the Olympic Mountains and from Arctic air by the Cascade Range. As for temperature, winters are cool and wet with average lows around 35–40 F (2–4 C) on winter nights. Colder weather can occur, but seldom lasts more than a few days. Summers are dry and warm, with average daytime highs around 73–80 F (22.2–26.7 C). Hotter weather usually occurs only during a few summer days.

Climate change is projected to impact Washington State in several ways, including sea level rise, increases in air and water temperatures, and changes in patterns of peak stream and river flows. While specific impacts will vary across the state, it is anticipated that Port Gardner Bay and the habitats located there may be affected by sea level rise, changes in the quantity and timing of peak river flows, temperature increases, and changes in the waters of Puget Sound such as stratification of the water or circulation patterns (Mauger 2015, King County 2005a, University of Washington 2005).

Sea level rise is of particular concern in coastal areas. Factors influencing local sea level rise include global sea level rise, local land movement (such as tectonic land movement), and changes in wind patterns (University of Washington and Washington Department of Ecology 2008). Relative vertical land movement in the Puget Sound area is not completely clear, as different reports show a range of values for vertical land movement. While the local rates of vertical land movement are somewhat uncertain, the driving factor of sea level rise in Puget Sound is the global sea level rise (see Table III, University of Washington and Washington Department of Ecology 2008 and State of Knowledge for Climate Change in Puget Sound 2015). For Puget Sound, the estimated very low, medium, and very high sea level rises are:

By 2050: very low = 8 cm (1”); medium = 15 cm (6”), very high = 55 cm (22”). Range: -1 to +19 inches for a moderate, low, and high greenhouse gas scenario compared to 2000. Other locations may differ by up to 8 inches (updated range estimates from Climate Impacts Group, Mauger 2015: https://cig.uw.edu/resources/special-reports/ps-sok/).

By 2100: very low = 16 cm (6”); medium = 34 cm (13”), very high = 128 cm (50”)

Estimated sea level rise must be considered for tidal and estuarine habitats. To ensure survival of the plant and animal communities, the habitat must have room to migrate upslope and stay at the same intertidal elevation required for the specific organisms. For example, if the water level increases over time, but there is no space upslope for a tidal marsh to migrate (i.e., located against a steep slope), the wetland will not be able to survive in the long term. The Trustees endeavored to locate and develop restoration projects in such a way as to maximize the opportunity for restored habitats to migrate upslope. However, given the limited availability of property along Port Gardner Bay, there are likely to be some restoration projects that could be negatively affected if some of the more severe predictions about sea level rise over the next couple of centuries are correct.

In addition to sea level rise, other impacts of climate change to Puget Sound and Port Gardner Bay habitats are predicted from projected changes in air temperature and precipitation (Mauger 2015, King County 2005, University of Washington 2005). By the 2050s, the average year in the Puget Sound region is projected to be +4.2 degrees F (range: +2.9 to +5.4 degree F) warmer under a low greenhouse gas scenario and +5.5 degree F (range: +4.3 to +7.1 degree F) warmer under a high greenhouse gas scenario relative to 1970-1999 (Mauger 2015). Warmer air temperatures change the type of precipitation, with less precipitation falling as snow and more as rain. These changes lead to another possible impact of climate change—lower summer streamflows, higher winter streamflows, or overall changes in the quantity and timing of peak stream and river flows. These potential impacts should be considered in the design of restoration projects.

In addition to the freshwater system impacts, increases in the temperature of Puget Sound marine waters as well as the timing and quantity of freshwater inputs could impact the stratification of the marine waters, contributing to low oxygen events

8.2.4 Unavoidable Adverse Impacts

Unavoidable adverse effects could occur during the construction of either action Alternative. Such potential unavoidable adverse effects would be expected to be limited to temporary increases in turbidity during in-water construction, temporary disturbance and removal of upland vegetation on banks and adjacent uplands (e.g., for bank re-grading), or similar minor effects associated with site preparation and implementation of restoration construction. However, the majority of the locations in Port Gardner Bay are already urbanized or disturbed, so any unavoidable adverse impacts in the context of the surrounding environment would be short-term, not significant, and would be the foundation for permanent improvements at the location via restoration actions. These temporary adverse effects are considered unavoidable because a majority of restoration actions will require disturbance of existing locations in order to implement the restoration action.

8.3 Summary of Alternatives Analysis

The Trustees evaluated the alternatives primarily on the bases of: 1) how well they meet the mandates under NRDA statutes and regulations to restore natural resources and services injured by releases of oil and hazardous substances; and 2) the potential impacts of the alternatives on the human environment. The analysis is summarized in Table 4.

The Trustees concluded that the preferred, Blue Heron Slough Alternative is best for fulfilling the mandates under NRDA statutes and regulations for restoring injured natural resources and services. Neither of the action alternatives analyzed are likely to have significant adverse impacts on the human environment. Both the Smith Island Project and Blue Heron Slough Alternatives would have some minor, short-term direct adverse impacts during construction, but these would be mitigated through use of best management practices as required by permitting agencies including the National Marine Fisheries Service (NMFS) and USFWS. Both projects would be expected to have long-term, moderate beneficial impacts. Based on the location, habitats restored, sustainability, the need for funds, and insignificant adverse impacts to the human environment, the Trustees select the Blue Heron Slough Alternative as the approach they will use in the NRDA restoration effort for Port Gardner Bay.

Table 4. Summary of Potential Impacts from the Alternatives Analyzed

CRITERIA	NO-ACTION ALTERNATIVE	SMITH ISLAND PROJECT ALTERNATIVE	BLUE HERON SLOUGH ALTERNATIVE
1. Potential to meet Trustees' Goal of Restoring Injured Natural Resources	Poor. Under a No-Action Alternative there would be no compensation for interim losses, even if remedial actions and natural recovery return conditions to baseline.	High. Focus on habitat complexes will directly restore lost habitat services and indirectly restore injured species that depend on these habitats.	High. Focus on habitat complexes will directly restore lost habitat services and indirectly restore injured species that depend on these habitats.
2. Potential to Provide Benefits to Multiple Natural Resources and Services	Non-existent. Under this Alternative, no actions would be taken so there would be no benefits provided to any resources.	High. Habitats support communities of interacting species, so provision of additional habitat of various types will benefit many different species.	High. Habitats support communities of interacting species, so provision of additional habitat of various types will benefit many different species.
3. Sustainability	Not Applicable	High. The project type restores natural processes to a prior estuarine environment.	High. The project type restores natural processes to a prior estuarine environment.

CRITERIA	NO-ACTION ALTERNATIVE	SMITH ISLAND PROJECT ALTERNATIVE	BLUE HERON SLOUGH ALTERNATIVE
4. Project Phase	Not Applicable	Construction	Construction
5. Funding Needs	Not Applicable	No Funding Needed	Significant Funding Need.
6. Potential for Environmental Impacts	Non-existent. Under this Alternative, no actions would be taken so no adverse or beneficial environmental impacts would result.	Minor-Moderate. Minor short-term adverse impacts would be expected during construction. Long-term, direct and moderate beneficial impacts to habitat services would be expected. Long-term, indirect and moderate beneficial impacts would be expected to species dependent on restored habitat types.	Minor-Moderate. Minor short-term adverse impacts would be expected during construction. Long-term, direct and moderate beneficial impacts to habitat services would be expected. Long-term, indirect and moderate beneficial impacts would be expected to species dependent on restored habitat types.
Water Quality	No adverse or beneficial impacts.	Short-term minor adverse impacts would occur during construction of projects under this Alternative. Long-term minor beneficial impacts would result from wetland habitat creation.	Short-term minor adverse impacts would occur during construction of projects under this Alternative. Long-term minor beneficial impacts would result from wetland habitat creation.

CRITERIA	NO-ACTION ALTERNATIVE	SMITH ISLAND PROJECT ALTERNATIVE	BLUE HERON SLOUGH ALTERNATIVE
Sediment Quality	No adverse or beneficial impacts	Short-term minor adverse impacts might occur during construction of projects under this Alternative. Sediment quality at the location of projects under this Alternative would be improved at least initially.	Short-term minor adverse impacts might occur during construction of projects under this Alternative. Sediment quality at the location of projects under this Alternative would be improved at least initially.
Air Quality	No adverse or beneficial impacts.	Short-term minor adverse impacts would occur during construction of projects under this Alternative. There would be a long-term minor beneficial impact on air quality provided by the increased vegetation.	Short-term minor adverse impacts would occur during construction of projects under this Alternative. There would be a long-term minor beneficial impact on air quality provided by the increased vegetation.
Fish and Aquatic Resources	No adverse or beneficial impacts	Short-term minor adverse impacts could occur during construction of projects under this Alternative. Long-term moderate beneficial impacts would be expected under this Alternative.	Short-term minor adverse impacts could occur during construction of projects under this Alternative. Long-term moderate beneficial impacts would be expected under this Alternative.

CRITERIA	NO-ACTION ALTERNATIVE	SMITH ISLAND PROJECT ALTERNATIVE	BLUE HERON SLOUGH ALTERNATIVE
Wildlife	No adverse or beneficial impacts.	Short-term minor adverse impacts could occur during construction of projects under this Alternative. Long-term moderate beneficial impacts would be expected under this Alternative.	Short-term minor adverse impacts could occur during construction of projects under this Alternative. Long-term moderate beneficial impacts would be expected under this Alternative.

9. COORDINATION AND CONSULTATION

This section presents a review of the potentially applicable laws and regulations that govern the Trustees' restoration projects. Many federal, state, tribal, and local laws and regulations need to be considered during the development of a restoration project, as well as several regulatory requirements that are typically evaluated during the federal and state permitting process. A brief review of potentially applicable laws and regulations that may pertain to these projects is presented below. When implementing the Blue Heron Slough Project, the project managers will ensure that there is coordination among these programs where possible and that project implementation and monitoring is in compliance with all applicable laws and regulations.

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 USC §§ 9601 *et seq.*, and National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR 300. CERCLA, also known as Superfund, is a federal law that provides the basic legal framework for clean-up and restoration of the nation's hazardous substances sites. CERCLA establishes a hazard ranking system for assessing the nation's contaminated sites, with the most contaminated sites being placed on the National Priorities List. Trustees are responsible, under CERCLA, for restoring injuries to natural resources and losses of natural resource services.

Oil Pollution Act of 1990 (OPA), 33 USC §§ 2701 *et seq.* OPA is a federal law that provides for the prevention of, liability for, removal of, and compensation for the discharge of the substantial threat of discharge of oil into or upon the navigable waters of the United States, adjoining shorelines, or the Exclusive Economic Zone. Section 1006(e) requires the President, acting through the Under Secretary of Commerce for Oceans and Atmosphere, to develop regulations establishing procedures for natural resource trustees in the assessment of damages for injury to, destruction of, loss of, or loss of use of natural resources covered by OPA. Section

1006(b) provides for the designation of federal, state, Indian tribal, and foreign natural resource trustees to determine resource injuries, assess natural resource damages (including the reasonable costs of assessing damages), present a claim, recover damages, and develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the natural resources under their trusteeship.

Model Toxics Control Act (MTCA), Ch. 70.105D RCW (1989) and Ch. 173-340 WAC (1992). Washington's toxic clean-up law is the state equivalent of the federal CERCLA law and is managed by the Washington Department of Ecology. The statewide regulations establish clean-up standards and requirements for managing contaminated sites.

National Environmental Policy Act (NEPA), as amended, 42 U.S.C. §§ 4321 *et seq*.; 40 CFR Parts 1500-1508. NEPA was enacted in 1969 to establish a national policy for the protection of the environment. The Council on Environmental Quality (CEQ) was established to advise the president and to carry out certain other responsibilities relating to implementation of NEPA by federal agencies. Federal agencies are obligated to comply with the NEPA implementing regulations promulgated by (CEQ) (40 CFR Parts 1500-1508). These regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing environmental documentation to comply with NEPA.

This RP/EA was prepared to analyze and disclose whether the preferred action (implementing the Blue Heron Slough restoration project) will have a significant effect on the quality of the human environment.

Sediment Management Standards (SMS), Chapter 173-204 WAC.
The Sediment Management Standards establish standards for sediment quality in Washington State, and provide regulations regarding use of the sediment standards for managing and reducing sources of pollutants, and cleanup of contaminated sediments. The standards include numeric criteria for contaminant concentrations in sediment, biological criteria for sediment laboratory bioassays and benthic community abundance, and narrative criteria for human health, other aquatic organisms and other toxic substances.

State Environmental Policy Act (SEPA), Chapter 43.21C RCW and Chapter 197-11 WAC. SEPA sets forth the state's policy for protection and preservation of the natural environment. Local jurisdictions must also implement the policies and procedures of SEPA. Each project will undergo a public comment period under SEPA requirements and the SEPA checklist; the permit application, the permit, and the public comments will become a part of the administrative record for each project.

Clean Water Act (Federal Water Pollution Control Act), 33 USC §§ 1251 *et seq*. The Clean Water Act is the principal law governing pollution control and water quality of the nation's waterways. It requires the establishment of guidelines and standards to control the direct or indirect discharge of pollutants to waters of the United States. Discharges of material into navigable waters are regulated under Sections 401 and 404 of the Clean Water Act. The U.S. Army Corps of Engineers has the primary responsibility for administering the Section 404 permit program. Under Section 401, projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards.

Rivers and Harbors Act, 33 USC §§ 401 *et seq*. This Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters. Actions that require Section 404 Clean Water Act permits are also likely to require permits under Section 10 of this Act.

Endangered Species Act of 1973 (ESA), 16 USC 1531 §§ *et seq*., 50 CFR Parts 17, 222, 224. The ESA directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authorities to further these purposes. Under the Act, NMFS and USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these agencies to ensure their actions are not likely to jeopardize listed species or result in destruction or adverse modification of designated critical habitat. The regulatory permits and consultation conditions for projects implemented under this plan will set forth a number of operating measures designed to prevent or mitigate any such disturbances to these species.

Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 USC §§ 1801 *et seq.,* 50 CFR Part 600. In 1996, the Act was reauthorized and changed by amendments to require that fisheries be managed at maximum sustainable levels and that new approaches are taken in habitat conservation. Essential Fish Habitat is defined broadly to include "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (62 Fed. Reg. 66551, § 600.10 Definitions). The Act requires consultation for all federal agency actions that may adversely affect Essential Fish Habitat. Under Section 305(b)(4) of the Act, NMFS is required to provide advisory conservation and enhancement recommendations to federal and state agencies for actions that adversely affect Essential Fish Habitat. Where federal agency actions are subject to ESA Section 7 consultations, such consultations may be combined to accommodate the substantive requirements of both ESA and MSA. NMFS will be consulted on each project regarding any MSA-managed species residing or migrating through the proposed project location.

Fish and Wildlife Coordination Act (FWCA), 16 USC §§ 661 *et seq.,* and the Migratory Bird Treaty Act (MBTA) of 1918, 16 USC §§ 703 *et seq*. The FWCA requires that federal agencies consult with the USFWS, NMFS, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. Similarly, the MBTA requires the protection of ecosystems of special importance to migratory birds against detrimental alteration, pollution, and other environmental degradation. These consultations are generally incorporated into Section 404 of the Clean Water Act, NEPA, or other federal permit, license, or review requirements.

Executive Order 11988: Floodplain Management. On May 24, 1977, President Carter issued Executive Order 11988, Floodplain Management. This Executive Order requires each federal agency to provide opportunity for early public review of any plans or proposals for actions in floodplains, in accordance with Section 2(b) of Executive Order 11514, as amended, including the development of procedures to accomplish this objective.

Executive Order 11990: Protection of Wetlands. On May 24, 1977, President Carter issued Executive Order 11990, Protection of Wetlands. This Executive Order requires each agency to provide opportunity for early public review of any plans or proposals for new construction in wetlands, in accordance with Section 2(b) of Executive Order 11514, as amended, including the development of procedures to accomplish this objective.

Executive Order 12898: Environmental Justice, as amended. On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. This Executive Order requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. EPA and the Council on Environmental Quality have emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations.

The Trustees have not identified any disproportionate adverse impacts on human health or environmental effects on implementation of the Preferred Alternative on Native Americans or other minority or low-income populations, and believe that this project will be beneficial to these communities.

Executive Order 11514 (35 Fed. Reg. 4247) – Protection and Enhancement of Environmental Quality. This Executive Order directs federal agencies to monitor, evaluate, and control their activities in order to protect and enhance the quality of the nation's environment; to inform and seek the views of the public about these activities; to share data gathered on existing or potential environmental problems or control methods; and to cooperate with other governmental agencies. The release of this Draft RP/EA and the types of projects envisioned under the Preferred Alternative are consistent with the goals of this Order. The proposed plan is the product of intergovernmental cooperation and will protect and enhance the environment. The restoration planning process has and continues to provide the public with information about the restoration efforts.

Executive Order 13007 – Indian Sacred Sites, and Executive Order 13175 – Consultation and Coordination with Indian Tribal Governments. Executive Order 13007 describes federal policy for accommodating sacred Indian sites. This Executive Order requires federal agencies with statutory or administrative responsibility for managing federal lands to: 1) accommodate access to and ceremonial use of Indian sacred sites by Indian religions practitioners; 2) avoid adversely affecting the physical integrity of such sacred sites; and 3) maintain the confidentiality of these sacred sites.

Executive Order 13175 exists to: 1) promote regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications; 2) strengthen the United States government-to-government relationships with Indian tribes; and 3) reduce the imposition of unfounded mandates upon Indian tribes.

As part of the planning process for individual projects, appropriate coordination with federally recognized Indian tribes (Tulalip Indian Tribes and the Suquamish Indian Tribe) will be conducted.

Executive Order 12962 (60 Fed. Reg. 30,769) – Recreational Fisheries. This Executive Order directs federal agencies to, among other things, foster and promote restoration that benefits and supports viable, healthy, and sustainable recreational fisheries. The restoration projects that would be built under the Preferred Alternative would benefit recreational fish species and their prey.

Executive Order 13112 (64 Fed. Reg. 6,183) – Invasive Species. The purpose of Executive Order 13112 is to prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

No invasive species would be introduced by any projects under the Preferred Alternative, and any invasive species existing at the sites would be removed. Control of invasive species would also occur after restoration is implemented.

Information Quality Guidelines issued Pursuant to Public Law 106-554. Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility, and integrity of such information). This EA is an information product covered by the information quality guidelines established by NOAA and the U.S. Department of the Interior for this purpose. The information collected herein complies with applicable guidelines.

Section 508 of the Rehabilitation Act, 29 U.S.C. 749D. Under Section 508 of the Rehabilitation Act, all federal agencies must take steps to afford persons with disabilities, including members of the public, access to information that is comparable to the access available to others. Section 508 was enacted in part to eliminate access barriers associated with information technology. For web accessibility under Section 508, documents posted must make text equivalents available for any non-text elements (including images, navigation arrows, multimedia objects (with audio or video), logos, photographs, or artwork) to enable users with disabilities access to all important (as opposed to purely decorative) content. Compliance also extends to making accessible other multimedia and outreach materials and platforms, acquisition of equipment and other assistive technologies, and computer software compliance. To provide for access to this document by disabled persons who use special assistive technology type devices and services, an electronic version of this draft RP/EA, incorporating electronically readable text equivalents for all non-text elements, has been created and is available at http://www.darrp.noaa.gov/northwest/port_gardner/restore.html. This website is regularly reviewed for Section 508 compliance. Disabled persons experiencing any difficulty accessing this document on this website should contact the DARRP Program webmaster at darrp.webmaster@noaa.gov for further technical assistance or to request an alternative means of access to the referenced information and data.

1855 Treaty of Point Elliott. The 1855 Treaty of Point Elliott sets forth articles of agreement between the United States and the Suquamish Tribe, and other federally recognized tribes within the Puget Sound area. Under the Supremacy clause of the United States Constitution, treaties are superior to any conflicting state laws or constitutional provisions.

Other potentially applicable federal, state, tribal, and local laws that are integrated into the regulatory process include:

- Archaeological Resources Protection Act, 16 USC §§ 469, *et seq*.
- Clean Air Act, as amended, 42 USC §§ 7401, et seq.
- Coastal Zone Management Act of 1982, as amended, 16 USC 1451 *et seq*.
- Marine Mammal Protection Act, 16 USC §§ 1361 *et seq*.
- National Historic Preservation Act, 16 USC §§ 470 *et seq*.
- Shoreline Management Act, Ch. 90.58 RCW and Ch. 173-14 WAC
- Historic Preservation Act, Ch. 27.34 RCW, Ch. 27.44 RCW, and Ch. 27.53 RCW
- Washington State Executive Order 05-05
- Washington State Hydraulic Code, Ch. 77.55 RCW and Ch. 220-110 WAC

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11. GLOSSARY

Absolute value—in mathematics, the absolute value |a| of a real number is its numerical value without regard to its sign. So, for example, 3 is the absolute value of both 3 and −3.

Acute—having or experiencing a rapid onset and short but severe course; such as an acute disease.

Adaptive management—an explicitly experimental approach to managing natural resource projects by integrating design, management, and monitoring to systematically test assumptions in order to adapt and learn.

Anadromous—a species, such as salmon, that is born in freshwater, spends a large part of its life in the sea, and returns to freshwater rivers and streams to spawn.

Baseline—the condition that would exist but for the releases of hazardous substances.

Benthic—relating to the bottom of a sea or lake or to the organisms that live there

Bioaccumulation—the accumulation of a substance, such as a toxic chemical, in various tissues of a living organism or in the food web over time.

Bioassay—a procedure for determining the biological activity of a substance (e.g., a drug or pollutant) by measuring its effect on an organism, tissue, or cell, compared to a standard preparation.

Bird assemblages—a group of avian species that display similar behavioral traits and perform more or less the same ecological role, making similar use of the same resource.

Chinook salmon (ocean-type)—one of two types (races) of Chinook salmon that typically migrate to sea within the first three months of life, but may spend up to a year in freshwater prior to emigration to the sea. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. Ocean-type Chinook salmon tend to use estuaries and coastal areas more extensively than other pacific salmonids for juvenile rearing.

Compensatory restoration—under CERCLA, restoration that compensates for interim loss of natural resources and services pending recovery.

Detritus—dead plant and animal matter, usually consumed by bacteria, but some remains.

Ecological niche—the ecological space or role occupied by a species in an ecosystem; activities and relationships a species has while obtaining the resources needed to survive; where it lives, how it interacts with other species, and how it obtains food.

Ecological services—the processes by which the environment produces resources that we often take for granted such as clean water, timber, habitat for fisheries, and the decomposition of wastes.

Ecological service loss—diminishment or degradation of ecosystem services (the benefits people, animals, and other organisms obtain from ecosystems) due to physical alteration or pollution.

Ecosystem-based—considers both the individual parts of a system (plants and animals and physical environment) and how the parts are functioning together as a whole system. An ecosystem-based approach relies on a variety of restoration strategies and takes into consideration the current and historical states of the ecosystem, including its structure and functions and the processes that maintain them.

Ecosystem processes—the physical, chemical, and biological actions or events that link organisms and their environment. Ecosystem processes include decomposition, production of plant matter, nutrient cycling, and fluxes of nutrients and energy.

Epibenthic—living on the surface of bottom sediments in a water body.

Estuary—partially enclosed coastal body of water, having an open connection with the ocean, where freshwater from inland is mixed with saltwater from the sea. An estuary is thus defined by salinity rather than geography

Estuarine—describes organisms that live in estuary areas.

Evolutionarily Significant Unit—a classification of populations that have substantial reproductive isolation which has led to adaptive differences so that the population represents a significant evolutionary component of the species; a combination of Distinct Population Segments that are collectively protected by the Endangered Species Act.

Herbivore—an animal that eats only plants.

Immune dysfunction—a reduction in the function of the immune system so that a body, organ, or organ system cannot perform normally.

Intertidal—occurring within, or forming, the area between the high and low tide levels in a coastal zone.

Invasive species—native or non-native species that heavily colonize a particular habitat, displacing desirable native species and adversely affecting the ecosystem.

Lesion—any visible, local abnormality of tissue (e.g., injury, wound, boil, sore, rash).

Lethal—causing death.

Limiting factor—controls a process, such as organism growth or species population size or distribution. The availability of food, predation pressure, or availability of shelter are examples of factors that could be limiting for a species population in a specific area. For example, in the Lower Snohomish River, limiting factors for juvenile salmon include a lack of resting and feeding areas in the estuarine portion of the river as the juveniles acclimate from freshwater to saltwater.

Marsh—an area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Mean lower low water—the average height of the lower of the daily low waters over a 19-year period.

Natural resource services—the physical and biological functions provided by the resource that serve the ecological and human uses of the environment. Examples of ecological services include plant and animal habitat, food supply, etc.

Nekton—Animals that swim or move freely in the ocean.

Nexus—the degree of the linkage between the injured natural resource and the restoration actions. The strength of a nexus is determined, in part, by the location of the restoration in comparison to the location of the injured resources.

Osmoregulation—the control of the concentration of body fluids, a vital function affecting all aspects of fish health. If a fish is unable to regulate the effects of osmosis it will die. Salmon must maintain a constant volume of body fluids while migrating from freshwater to saltwater and back again. The behavioral (drinking or not drinking) and physiological changes a salmon must make when moving from freshwater to saltwater—and vice versa—are essential, but cannot be accomplished immediately. Salmon do this by spending days to weeks in estuarine waters, gradually moving into areas with increased salinity.

Oxbow—a U-shaped bend in a river or stream.

PAHs (polycyclic aromatic hydrocarbons)—a group of chemicals naturally found in coal, coal tars, oil, wood, tobacco, and other organic materials. There are more than 100 different PAHs.

PAHs are the waxy solids found in asphalt, crude oil, coal, coal tar pitch, creosote, and roofing tar. Some types of PAHs are used in medicines and to make dyes, plastics, and pesticides. PAHs can be divided into the following two groups based on their physical, chemical, and biological characteristics:

- PAHs, Low Molecular Weight—PAHs with 2 to 3 rings, such as naphthalenes, fluorenes, phenanthrenes, and anthracenes, that have significant acute toxicity to aquatic organisms. In general, low molecular weight PAHs are more soluble and volatile and have less affinity for surfaces than do high molecular weight PAHs.

- PAHs, High Molecular Weight—PAHs with more than 3 rings (such as crysene). Several members of the high molecular weight PAHs are carcinogenic. In general, high molecular weight PAHs are less soluble and volatile than low molecular weight PAHs.

PCBs (polychlorinated biphenyls)—any of a family of industrial compounds produced by chlorination of biphenyl, noted primarily as an environmental pollutant that accumulates in animal tissue with resultant pathogenic and teratogenic effects.

Primary restoration—under CERCLA, actions taken to directly restore natural resources and services to baseline under an accelerated time frame.

Primary productivity—production by green plants.

Process water—water used in a manufacturing or treatment process or in the actual product manufactured. Examples would include water used for washing, rinsing, direct contact, cooling, solution make-up, chemical reactions, and gas scrubbing in industrial and food processing applications.

Rearing habitat—an area where larval and juvenile fish find food and shelter.

Riparian habitat—areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Salt marsh/fringing salt marsh—a coastal wetland that extends landward up to the highest high tide line and is characterized by plants that are well adapted to living in saline soils. Fringing marshes are small salt marshes that form along estuary channels, protected coves, and other areas shielded from heavy wave action.

Secondary productivity—the biomass produced by heterotrophic organisms (who cannot synthesize their own food, and eat plants or other animals).

Service loss—*see* Ecological service loss.

Sublethal—referring to that which does not kill a cell or organism, but usually forces adaptation for survival.

Subtidal—areas below the low tide that are continuously submerged.

Tiering—a staged approach to NEPA described in the Council on Environmental Quality's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR 1500 – 1508). Tiering addresses broad systems level programs and issues in initial (Tier 1) analyses, and analyzes site-specific proposals and impacts in subsequent tier studies. In our case, the Restoration Plan and Environmental Assessment would be the broad Tier 1 level, and the project-level Environmental Assessments would be done subsequently as specific restoration projects are proposed.

Total organic carbon (TOC)—a measure of the amount of carbon in a sample originating from organic matter only; a physical sediment factor that can influence the concentration of other compounds.

Toxicopathic lesion—abnormal tissue caused by the action of a poison.

Transition zone—area where freshwater and saltwater mix, resulting in brackish conditions.

12. LIST OF PREPARERS

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