

Improving Shoreline Master Program Decision-Making Applying Puget Sound Nearshore Ecosystem Restoration Project Tools and Information

Prepared By: Jim Kramer, Margaret Clancy and Carol MacIlroy

November 2010

1 Introduction

This paper is intended to supplement existing Washington State Department of Ecology (Ecology) guidance for marine shorelines (Chapter 4: No Net Loss Guidance and Chapter 7: Inventory and Characterizations). The purpose of this paper is to help local governments understand what relevant information is available from the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) and provide examples of where it can be applied to the Shoreline Master Program (SMP) update process.

This paper attempts to address the diverse needs of those involved in shoreline master planning, so it may feel overly technical to some readers and somewhat general to others. The authors acknowledge that this guidance is an early step in a broader effort to make PSNERP information and analyses available to local planners, consultants, elected officials, and interested citizens. Additional training, support, and guidance will be necessary to maximize the benefits for the shoreline management community and address specific needs across the spectrum. The authors hope that the document piques the interest of the shoreline community to investigate further how best to use PSNERP information and analyses as part of shoreline master planning and shoreline management.

This document cites and is built on an understanding of PSNERP products and documents. Some of the products cited are in draft form and not widely available to the public. The authors believe that an understanding of the preliminary conclusions will inform immediate planning efforts and allow the shoreline management community to better understand what information is likely to be available in the near future.

This guidance was produced with funding from the National Fish and Wildlife Foundation and developed by an independent consultant team of Jim Kramer, Margaret Clancy and Carol MacIlroy with support from Ecology and the Washington Department of Fish and Wildlife (WDFW) PSNERP staff. The National Fish and Wildlife Foundation is committed to improving ecosystem protection in Puget Sound in a manner that builds on existing efforts and improves public policy in support of human communities and the natural ecosystem.

2 Background

This section provides a brief overview of the elements of a Shoreline Master Program (SMP) as well as background information on the Puget Sound Nearshore Ecosystem Restoration and Protection Project (PSNERP).

Washington State's SMP update process directs local governments to gather available information, conduct useful analyses, and establish sound policies and programs that create livable, ecologically healthy, and economically robust shoreline environments.

Ecology's SMP guidelines (WAC 173-26) direct local governments to inventory shoreline conditions using available data. The inventory is a critical step to understanding where and how development should occur in a way that minimizes impacts on shoreline ecology, provides public access, and supports water-dependent uses. By gathering and connecting data to support specific management goals, local governments characterize shoreline conditions in a way that informs community discussions and illustrates the technical foundation for policy and regulatory decisions. Local governments use cumulative impact analyses and restoration plans to help ensure ecological functions are maintained as development occurs under the new set of policies and regulations.

PSNERP was created in 2001 through an agreement between the U.S. Army Corps of Engineers and the Washington Department of Fish and Wildlife (WDFW). The purpose was to complete a feasibility study to identify significant ecosystem problems along Puget Sound marine shorelines and evaluate potential solutions and protective measures. PSNERP generated information for the specific purpose of identifying a suite of protection and restoration strategies and projects of value at the Puget Sound regional scale. Because of the specific intent of PSNERP's effort, local governments choosing to use PSNERP information will need to supplement and adapt it with more specific or detailed local information, such as may be available through local salmon recovery plans or other efforts. Thus, although PSNERP's charter does not specifically include supporting shoreline master planning, PSNERP's recently released database, reports, and data-derived analyses can help support important shoreline management decisions, especially when thoughtfully combined with more specific local information and analyses.

PSNERP has accomplished three main tasks directly relevant to Puget Sound marine and estuarine shoreline planning that will be discussed in greater detail in this guidance document. They have:

- Characterized the health of nearshore processes (by documenting and compiling information on shoreforms and human alterations) for every Puget Sound drift cell and river delta;
- Produced technical papers on the importance of coastal and nearshore processes to species or ecosystem functions; principals for restoration and protection projects and programs derived from peer-reviewed literature; and restoration and protection best practices; and
- Evaluated opportunities across Puget Sound to protect and restore nearshore ecosystem processes for the purpose of identifying federal cost-shared projects.

Local governments can use PSNERP products in part to address key SMP policy issues and to help fulfill some of Ecology's SMP update grant requirements. The grant requirements where PSNERP accomplishments may be most useful include the:

- Inventory and characterization of marine shorelines;
- Restoration plan;
- Environment designations;
- Cumulative impacts analysis; and
- Public participation and SMP policy decisions.

Examples of policy issues that local decision-makers and planning staff need to address as part of the SMP update that may be informed by the PSNERP work are:

- Armoring of shorelines;
- Size, location, and density/intensity of shoreline development and use;
- Buffer and setback requirements;
- Conservation of native vegetation near shorelines;
- Placement of docks, marinas, and other in-water / overwater structures; and
- Water-dependent uses such as aquaculture and adjacent upland land uses.

3 What SMP Update Tasks can PSNERP Information Support?

For each of the SMP planning tasks listed below, this section provides examples for how to apply the PSNERP database, technical reports, and data-derived analyses.

- 3.1 Marine and Estuarine Shoreline Inventory;
- 3.2 Marine and Estuarine Shoreline Characterization and Shoreline Environment Designations;
- 3.3 Development of Draft Policies and Regulations;
- 3.4 Restoration Planning;
- 3.5 Cumulative Impacts Analysis; and
- 3.6 Community Dialogue and SMP Policy Decisions.

3.1 How Can PSNERP Help During the Marine and Estuarine Shoreline Inventory?

Key Recommendations:

- *Use PSNERP drift cell unit layer for marine reach delineation.*
- *Use PSNERP delta unit layer for estuarine reach delineation.*
- *Use PSNERP drift cell and delta unit data and supplement it with more specific local information and biological information.*
- *Use PSNERP shoreform classification system to document shoreline conditions (current and historic) as they provide a scientifically credible and documented basis for policy decisions.*

Use PSNERP drift cell and delta unit layers for marine and estuarine reach delineation.

PSNERP has geographically defined marine and estuarine reaches that can be directly used in the SMP inventory. PSNERP scientists used Ecology's digital drift cell dataset as a starting point and identified net shore-drift patterns in areas where drift was classified as "unknown" or where drift data were absent. They also corrected and refined the data and mapped convergent zones where two drift cells come together to deposit sediment and form a prograding feature. PSNERP also refined the drift cell maps to reflect historic or "natural" conditions. For example, the Des Moines marina bisects a long drift cell that historically originated near Dumas Bay. The marina creates another short drift cell with southward drift just north of the marina. By interpreting these changes in terms of historic or unaltered conditions, PSNERP delineated the altered drift cells into a single cell diverging from what was in the Ecology dataset.

Using these and other GIS layers (i.e., those found in PSNERP's Change Analysis database) as the basis of the inventory allows a local government to more easily understand the physical processes at work along the shoreline and how different segments of shoreline may respond to human alteration. Standardizing the way local jurisdictions define reach boundaries will enable local governments and state planning entities such as the Puget Sound Partnership to more easily conduct regional assessments and compare shoreline conditions across jurisdictional boundaries over time.

Use PSNERP drift cell and delta unit data and supplement it with more specific local information and biological information.

PSNERP's database and analysis results can help planners identify the following inventory components required in WAC 173-26-201-3c (i-iv and vii):

- Impervious surfaces (i);
- Land cover (i);
- Transportation facilities (roads and railroads) (i);
- Shoreline modifications (i);
- Marinas (i);
- Wetlands (ii);
- Degraded areas and sites with potential for ecological restoration (iii); and
- Eroding shorelines (iv).

Within a given drift cell or delta unit PSNERP gathered datasets for:

- Loss/gain in intertidal wetlands;
- Armoring;
- Tidal barriers;
- Breakwaters/jetties;
- Overwater structures;
- Nearshore fill;
- Marinas; and
- Roads and active/inactive railroads within 25 meters of the shoreline.

Within adjacent upland areas (defined as 200 feet from the ordinary high water mark) PSNERP gathered datasets for:

- Land cover;
- Impervious surface;
- Stream crossings; and
- Roads and active and inactive railroads.

Within the entire watershed area PSNERP gathered datasets for:

- Land cover;
- Impervious surface;
- Stream crossings;
- Roads and active and inactive railroads;
- Impounded drainage areas (behind dams); and
- Current drainage extent based on historic drainage.

Using these existing datasets as the starting point for the shoreline inventory can save time and expense, particularly if more detailed local information is not available. Local jurisdictions can evaluate the PSNERP information and determine whether they have better information for a particular inventory component. PSNERP did not compile biological data as part of their inventory because these data were not comprehensively available across Puget Sound. Local governments will need to supplement the PSNERP datasets with other available information on vegetation, habitats, species presence/absence, water quality, etc. from sources such as the Puget Sound salmon recovery watershed chapters, Salmon and Steelhead Habitat Inventory and Assessment Program, ShoreZone, WDFW Priority Habitats and Species, and other sources.

Although PSNERP did not assess conditions at the parcel scale, local jurisdictions could combine the parcel layer with PSNERP's data to increase the value of the database for making local decisions. Gathering and layering this type of detailed information at the parcel scale may be useful during both the SMP update and implementation. For example, during implementation, permit reviewers must decide how best to avoid, minimize, or mitigate impacts of development proposals. Having spatially specific information tied to the policies and regulations could help permit reviewers to better understand the potential impacts and, where impacts are unavoidable, how they would be effectively mitigated.

Use PSNERP shoreform classification system to document current and historic shoreline conditions as they provide a scientifically credible and documented basis for policy decisions.

PSNERP defined and mapped different shoreforms as defined in a geomorphic (not biologic) classification system developed for Puget Sound (Shipman 2008) (Table 1). PSNERP relies on this scientifically vetted and peer-reviewed classification system as a way to organize data and develop conservation and restoration strategies. Local governments that employ the same systems will be able to more easily access datasets concerning shoreline attributes and make management decisions that complement and conform to PSNERP's strategies.

Table 1: Nearshore Geomorphic Classification System (Shipman 2008)

SYSTEMS	SHOREFORMS
River Deltas	River-dominated delta Wave-dominated delta Tide-dominated delta Fan delta
Rocky Coast	Plunging rocky shoreline Rocky platform Pocket beach
Beaches	Bluff-backed beach Barrier beach
Embayments	Open coastal inlet Barrier estuary Barrier lagoon Closed lagoon and marsh

PSNERP's policy choices may differ from local policy decisions because PSNERP is developing a Puget Sound-wide management strategy, while local governments must consider and conform to a somewhat different set of circumstances. For example, PSNERP strategies emphasize the importance of deltas, beaches, and embayments in terms of restoration efforts, but local governments may have reasons for focusing restoration and protection strategies on rocky shorelines. Similarly, while PSNERP focuses on large-scale efforts, in more urbanized settings, local governments may be one of only a few entities focused on smaller scale protection and restoration efforts.

3.2 How Can PSNERP Help with the Marine and Estuarine Shoreline Characterization?

Key Recommendations:

- *Use PSNERP drift cell and delta unit characterizations to add to local information.*
- *Integrate PSNERP upland and watershed characterizations with Ecology's and WDFW's watershed characterizations to understand ecosystem-wide processes.*
- *Use PSNERP's oceanographic sub-basin characterization to inform stakeholders and decision-makers about the condition of local shores relative to historic conditions.*
- *Use PSNERP information to characterize how human stressors impact nearshore functions.*
- *Use PSNERP information to designate shoreline environments.*

PSNERP analyzed the datasets mentioned in Section 3.1 to characterize nearshore environments. These characterizations can be used in part to fulfill Ecology's requirement to assess ecosystem-wide processes and may provide local planners with a valuable synthesis of local conditions within a regional context. Planners can use the information to understand processes operating at the drift cell, shoreform, upland, watershed, and sub-basin scales. How these characterizations can be used will be discussed in more detail below.

Use PSNERP drift cell and delta unit characterizations.

PSNERP characterized each reach of marine and estuarine shoreline in Puget Sound. These characterizations show where nearshore processes are likely functioning and where they are likely degraded. PSNERP did this by analyzing the relative health of 11 physical processes that are vital to the creation, maintenance, and function of Puget Sound's nearshore ecosystems. PSNERP conducted this analysis for each of Puget Sound's 812 drift cells and 16 delta (estuary) units. Drift cell and delta unit scale information is available for each of the following processes:

- Sediment Input;
- Sediment Transport;
- Erosion and Accretion of Sediments;
- Tidal Flow;
- Distributary Channel Migration;
- Tidal Channel Formation and Maintenance;
- Freshwater Input;
- Detritus Import and Export;
- Exchange of Aquatic Organisms;
- Physical Disturbance (e.g., change of shoreline shape caused by wind or wave energy); and
- Solar Incidence.

The PSNERP datasets allow a planner to see where human alterations (such as shoreline armoring, vegetation loss, roads, etc.) are located relative to specific shoreforms (i.e., bluffs, low bank beaches, and other features described in Table 1). Knowing this helps determine where armoring and other alterations have the potential to be most ecologically harmful and where SMP policies and regulations may be most critical. Having this information (which will be published this year in the Strategic Needs Assessment Report [SNAR]¹) can assist a jurisdiction in strategic planning and facilitate robust community discussions about which shoreforms are most at risk due to human alterations and which could most benefit from regulatory and programmatic actions. A jurisdiction that knows where shoreforms such as low bank beaches exist in the absence of major alterations is better able to develop specific strategies to protect these areas from future development and degradation. Where these alterations exist, the PSNERP Change Analyses can help direct strategic restoration actions.

By summer of 2011, PSNERP will have an additional peer-reviewed report that will be relevant to Puget Sound marine and estuarine shoreline planning. PSNERP's nearshore conservation strategies can help locate and evaluate the restoration and conservation opportunities based on regional criteria. This document will integrate the characterization of nearshore processes with conservation and restoration principles from scientific literature. It will also recommend actions that could be applied to a given drift cell and delta unit in order to achieve sustained services from the Puget Sound nearshore ecosystem.

Lastly, PSNERP has a searchable website that shows the suite of potential restoration projects that are priorities for implementation. PSNERP is taking a sub-set of these projects into conceptual design and will ultimately develop a list of projects to submit for federal funding. PSNERP focuses on projects and actions in areas where complete and immediate restoration of nearshore processes can be achieved at a scale of regional importance. Planners can use the information on the website as they develop policies that minimize conflicts between new development and future restoration efforts, leverage federal investments for local benefit, and ensure that future degradation does not diminish or preclude planned or likely restoration opportunities. As PSNERP continues to refine its set of projects, local governments can review and refine their management of the shoreline relative to these large-scale efforts.

Integrate PSNERP upland and watershed characterizations with Ecology's and WDFW's watershed characterization to understand ecosystem-wide processes.
PSNERP's data can also help local planners understand and characterize conditions beyond the shoreline reach scale as required by Ecology (WAC 173-26-201.3.d.(i)).

Local planners can use PSNERP's characterization of upland areas and watersheds to supplement Ecology's characterization of water flow processes. This can create a more detailed understanding of the broader ecosystem influencing nearshore habitats (see: <http://www.ecy.wa.gov/mitigation/landscapeplan/peerreview.html>).

¹ Strategic Needs Assessment Report. Schlenger et al. In press. Available winter 2010-2011 at: www.PugetSoundNearshore.org

Use PSNERP's oceanographic sub-basin characterization to inform stakeholders and decision-makers about the condition of local shores relative to historic conditions.

PSNERP characterized conditions throughout seven Puget Sound oceanographic sub-basins: San Juan Islands and Georgia Strait, Whidbey, North Central Puget Sound, Strait of Juan de Fuca, South Central Puget Sound, Hood Canal, and South Puget Sound. PSNERP analyzed the historic and current information for each shoreform type and drift cell to describe areas of ecological value and changes to the shoreline. Given the policy focus of PSNERP, the characterizations summarize the amount of barrier estuary, barrier lagoon, closed lagoon/marsh, open coastal inlet, and tidal wetland habitat that has been lost in each sub-basin (SNAR, pages 26-44). Describing the types and amount of various shoreforms that have been lost over time may motivate stakeholders to embrace protection and restoration strategies that might not otherwise be widely understood.

The PSNERP characterization also describes changes to shoreline features caused by tidal barriers, nearshore fill, shoreline armoring, railroads, nearshore roads, marinas, breakwaters and jetties, overwater structures, dams, stream crossings, impervious surfaces, and land cover (SNAR pages 49-123). For instance, the report shows the percent of shoreline armored by current shoreform (barrier beach, bluff-backed beach, etc.) for each sub-basin. PSNERP found that bluff-backed beaches and barrier beaches are the most armored of all the shoreforms (33% and 27%, respectively). Correlating past development to shoreform may help planners focus their analyses to understand likely locations for future development pressures. Shoreforms may also be a useful construct for organizing types of regulations and policies.

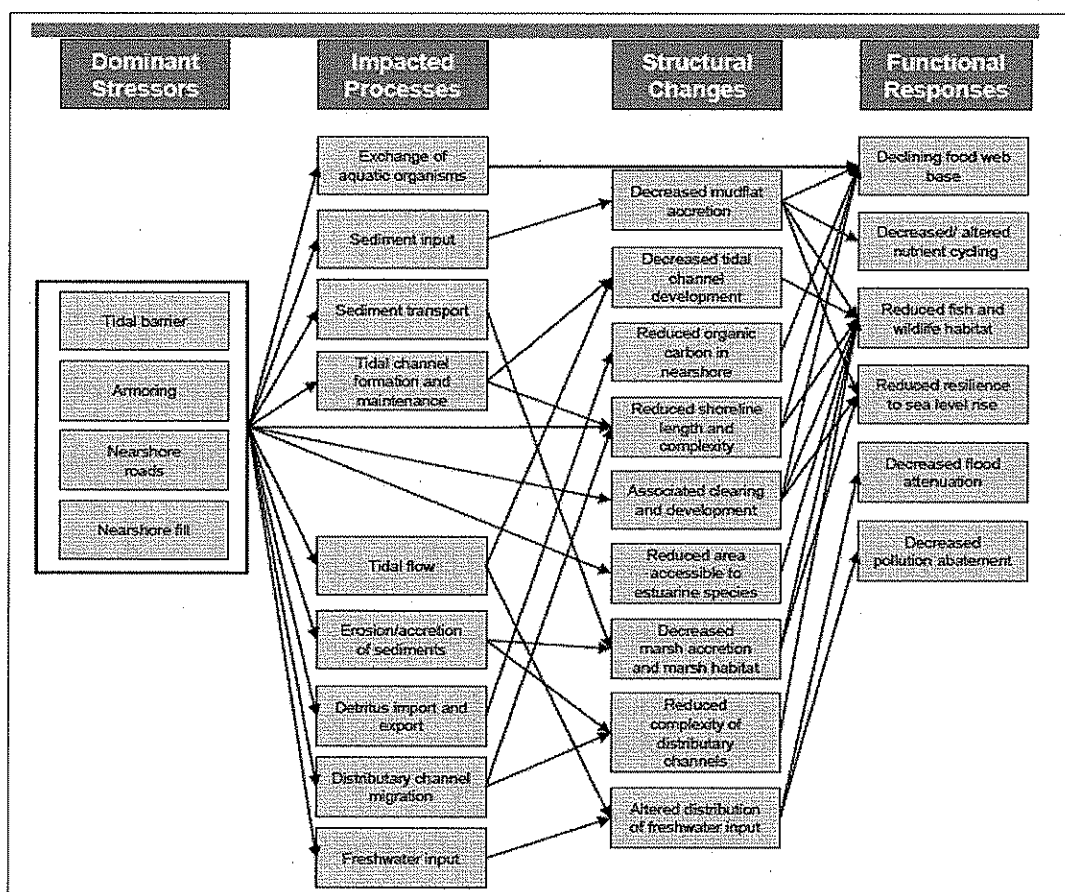
PSNERP summarizes its findings and conclusions about the state of Puget Sound marine shorelines as part of the problem statement in the SNAR (pages 233-244). The report offers Sound-wide conclusions about the physical changes to the various shoreforms and their implications for ecological health. These summary conclusions may put the need to protect remaining ecological assets into context for the public and decision-makers, and provide information in response to questions about “what is the problem?” and “why is protection of remaining habitat important?”

Use PSNERP information to characterize how human stressors impact nearshore functions.

PSNERP provides SMP planners important information about the connection between human activities and changes to ecosystem function. PSNERP produced a series of technical reports on Valued Ecosystem Components (VECs), which include juvenile salmon in marine environments, forage fish, marine birds, great blue herons, beaches and bluffs, eelgrass and kelp, marine riparian vegetation communities and orcas. These VECs are important to people; indicate a healthy Puget Sound ecosystem and are made healthier by nearshore restoration. The VECs can help planners explain the importance and need for an updated SMP.

In addition, the SNAR describes the various ecological processes (i.e., sediment transport) necessary for embayments to be ecologically healthy. This information is helpful to planners as a synthesis of the science for how human actions affect various nearshore processes, functions, and biota. Among the most helpful parts of the SNAR are diagrams that show the relationship between human actions and ecological functions. These diagrams can become the scientific foundation for policies and regulations that limit or foster certain actions in specific locales.

For example, the following graphic shows a combination of four dominant stressors to tidal wetland processes, structures, and functions and the resultant structural and functional responses of the ecosystem (SNAR, page 128).



Example graphic showing the relationship between human actions and ecological functions.

Planners can use the information from the model above, combined with PSNERP and other inventory and characterizations, and ask questions such as: Will armoring in a given shoreform (beaches, bluffs, etc.) or drift cell impact the processes described in the diagram or result in structural changes that decrease ecosystem functions? The answers to these questions can become the basis for policy choices that address avoid-minimize-mitigate-restore policies and regulations, restoration planning, and cumulative impacts analyses.

Use PSNERP information to designate shoreline environments.

Environment designations are used to establish permitted uses and development standards, and include an accurate map of the shoreline area. The PSNERP Change Analysis can help ensure that shoreline environment designations are supported with accurate and relevant information (i.e., existing land uses, shoreline function, potential for restoration/protection).

3.3 How Can PSNERP's Analyses Inform Policies and Regulations?

Key Recommendations:

- *Consider PSNERP's seven key priorities while setting SMP goals and objectives for the marine shoreline.*
- *Use an integrated inventory and characterization to address specific policy choices.*

Consider PSNERP's seven key priorities while setting SMP goals and objectives for the marine shoreline.

PSNERP's work can assist local governments as they establish their SMP goals and objectives. Local governments should consider PSNERP's seven nearshore ecosystem priorities and determine their relevancy based on local circumstances, information, and analysis. The seven nearshore ecosystem priorities are:

- Conserve relatively intact large river delta areas.
- Conserve intact or minimally degraded sediment input, sediment transport, and sediment accretion processes.
- Conserve relatively intact embayment shoreforms.
- Restore the connectivity and size of large river deltas.
- Restore sediment input, sediment transport, and sediment accretion processes.
- Restore embayments to increase distribution, shoreline complexity, and length.
- Enhance landscape heterogeneity² and ecological connectivity.

Use an integrated inventory and characterization to address specific policy choices.

SMP planners and decision-makers face many policy choices that may benefit from PSNERP data and analyses. This section will show some of the ways PSNERP information can be used to support key SMP decisions about:

- Armoring of shorelines;
- Size, location, and density/intensity of shoreline development and use;
- Buffers and setbacks needed to achieve various ecological functions;
- Placement and design of docks, marinas and other in-water / overwater structures; and
- Water-dependent uses such as aquaculture and adjacent upland land uses.

² **Heterogeneous** is an adjective used to describe an object or system consisting of multiple items having a large number of structural variations.

The examples below demonstrate potential uses of the body of work and provide concrete connections and citations for some of the common issues local governments face. None of the PSNERP products contain explicit answers to policy questions such as how wide marine shore buffers should be; however, they represent a technical and policy perspective that has been vetted with the scientific community.

▪ *Policy Choice - Armoring of shorelines.*

PSNERP provides site-specific information about geologic conditions and relative wind and wave actions around Puget Sound. This type of information can help planners identify areas that may be more susceptible to erosive forces. These same areas may need special attention to determine how best to address shoreline stability to minimize the need for future armoring. Using this information, local planners can ensure that their policies, regulations, and ultimately technical assistance address the critical human and environmental needs. These areas where human and ecological needs can be in direct conflict will likely be the areas where the most creative and thoughtful management strategies are necessary. PSNERP data can help planners call out these areas for additional scrutiny, effort, and community dialogue.

The most pertinent PSNERP technical reports highlighting sensitive shoreline areas and considerations for armoring are:

- Forage Fish (Technical Report 2007-3);
- Beaches and Bluffs (Technical Report 2007-4);
- Marine Riparian Vegetation (Technical Report 2007-2);
- Eelgrass and Kelp (Technical Report 2007-5);
- Juvenile Salmon (Technical Report 2006-6); and
- Management Measures for Protecting and Restoring the Puget Sound Nearshore (Technical Report 2009-1).

These technical reports can supplement the guidance provided by the WDFW Aquatic Habitat Guidelines program in *Protecting Nearshore Habitat and Functions in Puget Sound* (Envirovision et al. 2007). The Forage Fish Report cites current WDFW standards and perceived limitations of these standards in achieving protection of these species. The Management Measures Report provides insight into armor removal and modification, large wood placement, and other measures that can be used to stabilize shorelines and reduce the need for hard armoring. This and other PSNERP technical information may help planners as they write policies and regulations for shoreline modifications or develop mitigation measures.

▪ *Policy Choice - Control the size, location, and density/intensity of shoreline development and use.*

In addition to identifying sensitive shoreline areas as noted above, PSNERP also identifies key regional assets that can be affected by density and intensity of shoreline use. For example, the technical paper on great blue herons (Technical Report 2007-6) notes that 80% of the Puget Sound breeding population is located in 11 colonies. The report cites that few of these colonies are fully protected (page 19). The report describes

how protection of these colonies requires not only protection of the roosting site itself, but the nearshore features the birds need in close proximity such as eelgrass and shallow water. This type of information can assist planners in developing a list of factors to consider in controlling the size, location, and density/intensity of shoreline development and use.

- *Policy Choice - Buffers and setbacks needed to achieve various ecological functions.*
Local governments have to make the policy choice about appropriate buffers and setbacks. PSNERP reports describe the role that buffers play and important elements to maintain healthy nearshore, delta, and estuarine environments, but their work does not provide guidance on the appropriate size of buffers or setbacks. For example, the Marine Riparian Report and the Beaches and Bluffs Report provide a scientific rationale for the importance of buffers and setbacks. One example is a table that shows the direct or indirect linkage between marine riparian habitat and various other valuable ecosystem components such as shellfish, eelgrass, kelp, beaches and bluffs, and marine birds (Marine Riparian Report, page 13). The Marine Riparian Report also describes the types of marine shoreline vegetation communities that historically existed and the extent to which these communities have been lost (see page 14). Understanding the historic context can help in the establishment of policies and regulations as well as potential mitigation measures and requirements. The reports supplement two guidance documents provided by the WDFW Aquatic Habitat Guidelines program: *Protection of Marine Riparian Functions in Puget Sound, Washington* (Brennan et al. 2009) and *Protecting Nearshore Habitat and Functions in Puget Sound* (Envirovision et al. 2007).

The Beaches and Bluffs Report correlates human actions that accelerate erosion and landslides to the geology of banks and bluffs (pages 9-10). This information can help in determining appropriate setbacks and buffers.

PSNERP also provides guidance for planners to consider the impacts of sea level rise (see pages 18-19 of the Beaches and Bluffs Report and Appendices 1 and 2 in the Management Measures Report). This includes encouraging shoreline planners to provide increased setback requirements in areas at greater risk of erosion from sea level rise, such as low bank and high erosion areas. In the Beaches and Bluffs Report, PSNERP notes that if setbacks are inadequate in locations where there is a high risk of increased storm pressures and rising water levels, the need for armoring may be greater (compared to places where the structures are set further back). This information can help local governments set policies and programs before there is an emergency need.

- *Policy Choice - Placement and design of docks, marinas and other in-water/overwater structures.*
Several PSNERP products may be useful to planners as they focus on areas where a desire to place docks conflicts with ecological needs. PSNERP's physical disturbance ratings (found in the Change Analysis) and shoreform information can help planners understand the demand for and impact of overwater structures. For example, an Island County planner described a situation where, due to bluffs and high wave action, few people on the western shore of Whidbey Island request docks, whereas other parts of

Island County need greater planning and foresight because dock requests are more common and the ecological impact is greater. The Forage Fish Report describes the various places where forage fish spawn and the most recent perspective on dock design and location (see pages 15-16). This report also describes WDFW dock design and placement standards, as well as concerns about where current standards may fall short of full protection. Impacts of overwater structures and boat use on eelgrass and kelp beds are described in the Eelgrass and Kelp Report (see page 14). The Management Measures Report provides guidance for removing or modifying overwater structures that may be useful to consider as policies and restoration plans are established (see pages 12-5 to 12-6).

- *Policy Choice – Water-dependent uses such as aquaculture and adjacent upland land uses.*

PSNERP provides several different reports that may help planners think about policies associated with aquaculture. Specifically, the Native Shellfish Report (Technical Report 2006-04) notes the sensitivity of shellfish to water quality, deforestation (causing disruption in sediment and water quality), and shoreline modifications that disrupt sediment supply processes (see page 11). The report also links protection of eelgrass to protection of crabs by providing nursery and feeding areas. The Kelp and Eelgrass Report notes that harrowing or rototilling for on-ground oyster culture can stress eelgrass beds (see page 14). Lastly, the report provides background information that may be useful, such as the current annual value of commercial shellfish (see page 1).

3.4 How Can PSNERP Help in Restoration Planning?

Key Recommendations:

- *Use PSNERP restoration project information.*
- *Use the Change Analysis and Management Measures and Strategic Needs Assessment reports to inform the local restoration strategy.*

Use PSNERP restoration project information.

Using the results of the Change Analysis and Strategic Needs Assessment, as well as information from governmental and non-governmental restoration proponents throughout the region, PSNERP created a list of candidate restoration sites and actions designed to achieve strategic process-based restoration across Puget Sound. PSNERP is evaluating the feasibility of achieving restoration at each of these sites and will select the best projects to bring forward into full design and implementation. The initial list (which should be available in late 2010) includes mainly larger scale projects involving major estuaries, large river deltas, and coastal inlets and lagoons, so many local projects may not be captured. PSNERP developed the list in consultation with Lead Entities, Marine Resource Committees, and other local groups. Jurisdictions can collaborate with these local entities to focus on restoration projects that do not fit into PSNERP's Sound-wide strategy, but instead accomplish local restoration goals.

Use the Change Analysis and Management Measures and Strategic Needs Assessment Reports to inform the local restoration strategy.

PSNERP's Strategic Needs Assessment Report and Change Analysis help form the technical rationale for restoration, as well as setting Sound-wide conservation and protection priorities that can be adopted and enhanced where consistent with local priorities. PSNERP identifies four regional restoration priorities:

- Restore the connectivity and size of large river deltas.
- Restore sediment input, sediment transport, and sediment accretion processes.
- Restore embayments to increase distribution, shoreline complexity, and length.
- Enhance landscape heterogeneity and ecological connectivity.

By identifying local restoration opportunities and developing a restoration strategy within the context of these regional priorities, local governments can potentially leverage federal funds in the future and may position themselves for funding and technical support from restoration entities.

To execute the restoration strategy, local governments can take advantage of information in the Management Measures Report to plan and design actions involving large wood placement, bulkhead removal, invasive species removal, overwater structure modification or removal, and revegetation. This report describes Best Professional Practices for each management measure and criteria to consider as restoration projects are undertaken.

3.5 How Can PSNERP Help in the Cumulative Impacts Assessment?

Key Recommendations:

- *Use PSNERP characterizations and information to understand how existing development is contributing to nearshore degradation.*
- *Use PSNERP spatially explicit datasets and characterizations to set baseline conditions.*
- *Use PSNERP restoration information to identify the potential functional gains that can be realized through strategic, process-based restoration.*

The information provided by PSNERP can help create a detailed understanding of current conditions against which potential changes caused by actions regulated through the SMP can be evaluated. By accurately forecasting potential land uses changes in light of PSNERP's existing conditions assessment and linkages between human actions and nearshore processes, local jurisdictions will be better able to assess whether the proposed SMP policies and regulations are adequate to prevent cumulative losses in ecological functions. Local government can also consider PSNERP's planned restoration portfolio once it becomes available and begin to assess potential gains in ecological function over time.

3.6 How Can PSNERP Help Meaningful Engagement of the Public and SMP Decision-Makers?

Key Recommendations:

- *Use PSNERP's information at the regional scale to provide overall context for ecological protection and restoration needs.*
- *Use PSNERP's historical information to show decision-makers and the public the level of ecological loss that has already occurred.*
- *Use PSNERP's peer-reviewed scientific information to bring scientific credibility.*
- *Use PSNERP's information to inform spatially explicit local conversations about what is important to protect ecologically, what types of changes have occurred and are likely to occur into the future, how nearshore systems work (bulkheading here impacts beaches and functions there), and where ecological needs and other community needs may likely conflict without planning, foresight, and creativity.*

The PSNERP products can provide the public and decision-makers a broader historic and regional context about their local shorelines. They can help focus policy discussions on the most important protection and restoration issues and best management practices given the current status of the shoreline's ecological health. Readily available maps and statistics at the drift cell, major river delta, and Puget Sound sub-regional scale can provide information about what attributes various marine and estuarine shorelines contribute to ecosystem health and special locations where ecosystem health remains high. This information, when used and interpreted consistent with its design, can inform the public and decision-makers and provide a regional perspective in addition to the local one.

Information and maps are available for the seven Puget Sound sub-basins, describing losses/gains in wetlands, shoreline length, and the regional distribution of alterations such as breakwaters and jetties, marinas, and bulkheads. This context may be useful in stimulating community dialogue about shorelines and the importance of ecological protection. The technical reports provide accessible information on the status of forage fish, great blue herons, marine shorebirds, eelgrass, salmon, and orcas among other topics which tend to be of interest to citizens and decision-makers. This can be combined with local information about these plant and wildlife species, such as WDFW Priority Habitats and Species data.

The information and mapping capacity that PSNERP has produced can help local governments tell a story about their shorelines and habitat features such as rocky shorelines, low bank beaches, and bluff-backed beaches. They can connect human desires for docks, shoreline armoring, and residential development to potential impacts on eelgrass, marine shorebirds, and forage fish. PSNERP information can be interpreted to show where existing development is causing continued degradation, where high ecological functions exist and are likely to be impacted in the future without careful planning, and where bank hardening, docks, and other uses are either absent or have caused limited degradation of ecological functions. PSNERP's maps, tables, photographs, and datasets can be a valuable resource in creating meaningful dialogue and engagement.

4 Can PSNERP Help Local Governments that Have Updated their SMPs or Are in the Process?

Governments that have already completed or are in the process of completing their SMPs may also benefit from use of the PSNERP datasets and information. The spatially specific information can be helpful in determining permit conditions for new developments. The restoration priorities and mapping can help guide local groups involved in restoration projects. It is also useful for educating shoreline property owners about the past and present ecological values of their shorelines. PSNERP protection and restoration priorities may also serve Planning Directors as they work with limited staff and budgets to prioritize technical assistance or seek regional input on difficult permitting or land use issues.

5 PSNERP PRODUCTS and DATA

This section describes how to find and use the following PSNERP products referenced throughout this paper:

1. *Historic Change and Impairment of Puget Sound Shorelines* includes a geodatabase and a report (Simenstad et al. [in review]), commonly referred to as the Change Analysis;
2. Strategic Needs Assessment Report (Schlenger et al. [in press]); and
3. PSNERP Technical Reports including the Management Measures Technical Report (Clancy et al. 2009).

These products are briefly summarized below with a description of how to access them. The PSNERP database and information were not developed with a local planning audience in mind. For additional information about shoreline project planning and for WDFW technical assistance, go to http://wdfw.wa.gov/conservation/habitat/planning/land_use_planning.html.

Product 1: Historic Change and Impairment of Puget Sound Shorelines (Simenstad et al. [in review]), commonly referred to as the Change Analysis

PSNERP scientists compared spatially specific changes in the physical structures of Puget Sound's deltas, estuaries, and beaches between the earliest land surveys of the General Land Office and U.S. Coast and Geodetic Survey between 1850s-1890s and present conditions (2000-2006). PSNERP conducted this work as part of its Sound-wide assessment of restoration needs. They conducted past to present change analyses at three different scales: shoreform, shoreline (drift cell and delta unit), and adjacent upland and watershed area. The approach and methodology is documented in the Change Analysis that will be published by the end of 2010 (Simenstad et al. [in review]).

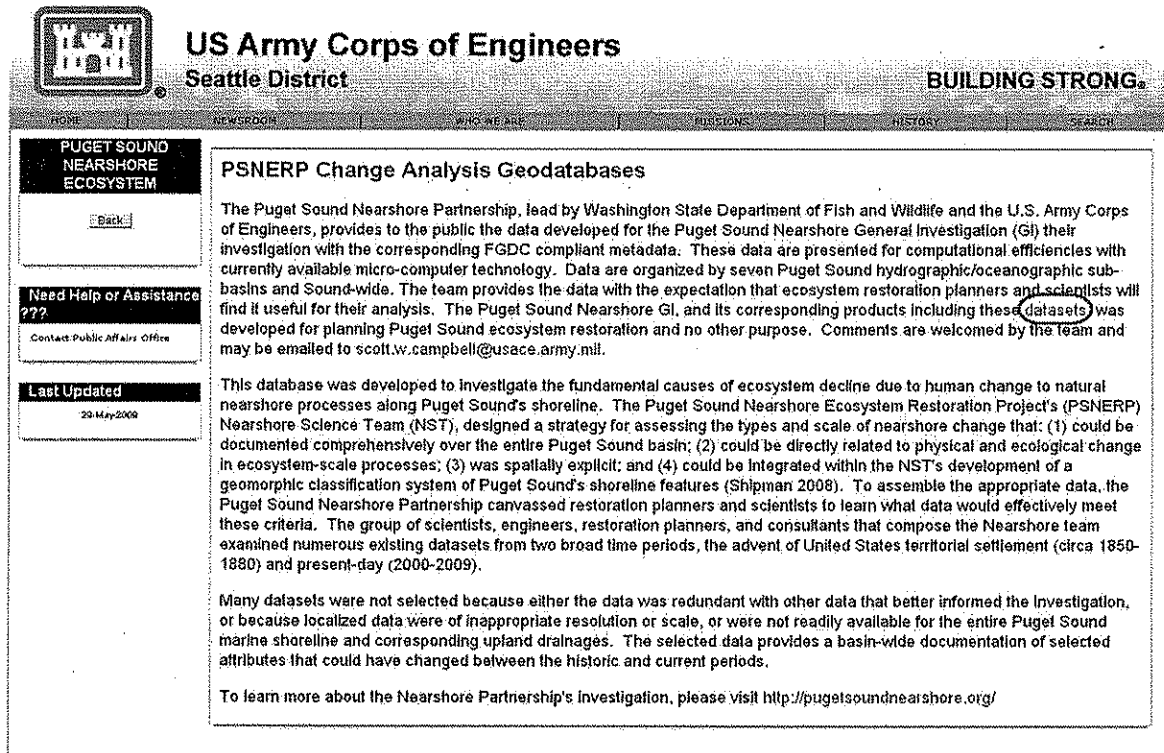
The Change Analysis geodatabase is available on the U.S. Army Corps of Engineers website at: www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=PSNERP&pagename=Change_Analysis.

What is important to know about using or accessing the Change Analysis geodatabase?

Accessing and interpreting the Change Analysis geodatabase requires professional expertise in geospatial analysis. If access to professional expertise is not available, PDF documents

summarizing some of the relevant data and statistics that can be drawn from the geodatabase can also be found on the website. Datasets were selected that were consistent across Puget Sound. In some instances local information may be more specific, accurate, or up to date than the PSNERP information.

When you go to the website link above, you will see the following screen:



US Army Corps of Engineers
Seattle District

BUILDING STRONG.

PUGET SOUND NEARSHORE ECOSYSTEM

[Back](#)

Need Help or Assistance ???
[Contact Public Affairs Office](#)

Last Updated
29 May 2009

PSNERP Change Analysis Geodatabases

The Puget Sound Nearshore Partnership, lead by Washington State Department of Fish and Wildlife and the U.S. Army Corps of Engineers, provides to the public the data developed for the Puget Sound Nearshore General Investigation (GI) their investigation with the corresponding FGDC compliant metadata. These data are presented for computational efficiencies with currently available micro-computer technology. Data are organized by seven Puget Sound hydrographic/oceanographic sub-basins and Sound-wide. The team provides the data with the expectation that ecosystem restoration planners and scientists will find it useful for their analysis. The Puget Sound Nearshore GI, and its corresponding products including these datasets was developed for planning Puget Sound ecosystem restoration and no other purpose. Comments are welcomed by the team and may be emailed to scott.w.campbell@usace.army.mil.

This database was developed to investigate the fundamental causes of ecosystem decline due to human change to natural nearshore processes along Puget Sound's shoreline. The Puget Sound Nearshore Ecosystem Restoration Project's (PSNERP) Nearshore Science Team (NST), designed a strategy for assessing the types and scale of nearshore change that: (1) could be documented comprehensively over the entire Puget Sound basin; (2) could be directly related to physical and ecological change in ecosystem-scale processes; (3) was spatially explicit; and (4) could be integrated within the NST's development of a geomorphic classification system of Puget Sound's shoreline features (Shipman 2008). To assemble the appropriate data, the Puget Sound Nearshore Partnership canvassed restoration planners and scientists to learn what data would effectively meet these criteria. The group of scientists, engineers, restoration planners, and consultants that compose the Nearshore team examined numerous existing datasets from two broad time periods, the advent of United States territorial settlement (circa 1850-1880) and present-day (2000-2009).

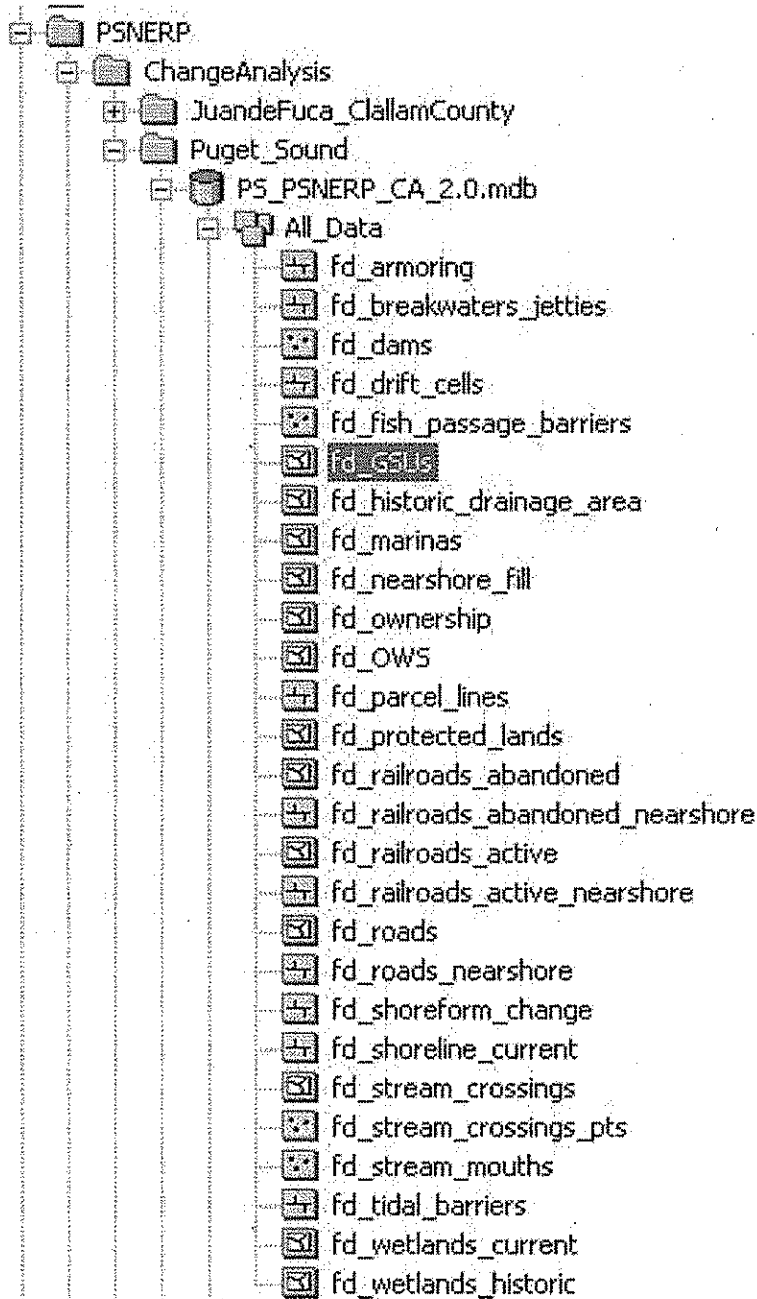
Many datasets were not selected because either the data was redundant with other data that better informed the investigation, or because localized data were of inappropriate resolution or scale, or were not readily available for the entire Puget Sound marine shoreline and corresponding upland drainages. The selected data provides a basin-wide documentation of selected attributes that could have changed between the historic and current periods.

To learn more about the Nearshore Partnership's investigation, please visit <http://pugetsoundnearshore.org/>

Click on the word "datasets" circled in red on the page above to access the ftp site, which will appear as follows:

Name	Size	Type	Modified
HC_PSNERP_CA_3.0.zip	64.8 MB	WinRAR ZIP archive	7/29/2010 12:33 AM
HC_Tabulations.zip	47.0 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
JF_PSNERP_CA_3.0.zip	58.9 MB	WinRAR ZIP archive	7/29/2010 12:31 AM
JF_Tabulations.zip	20.2 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
NC_PSNERP_CA_3.0.zip	23.9 MB	WinRAR ZIP archive	7/29/2010 12:31 AM
NC_Tabulations.zip	17.7 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
PS_PSNERP_CA_3.0.zip	836 MB	WinRAR ZIP archive	7/29/2010 5:05 PM
PS_Tabulations.zip	400 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
PSNERP_CA_MethodsReport.zip	10.7 MB	WinRAR ZIP archive	5/28/2009 12:00 AM
README.txt	515 bytes	Text Document	7/29/2010 12:48 AM
SC_PSNERP_CA_3.0.zip	217 MB	WinRAR ZIP archive	7/29/2010 12:48 AM
SC_Tabulations.zip	88.4 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
SJ_PSNERP_CA_3.0.zip	133 MB	WinRAR ZIP archive	7/29/2010 12:57 AM
SJ_Tabulations.zip	81.7 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
SP_PSNERP_CA_3.0.zip	168 MB	WinRAR ZIP archive	7/29/2010 1:03 AM
SP_Tabulations.zip	117 MB	WinRAR ZIP archive	9/11/2009 12:00 AM
WH_PSNERP_CA_3.0.zip	245 MB	WinRAR ZIP archive	7/29/2010 1:10 AM
WH_Tabulations.zip	33.9 MB	WinRAR ZIP archive	9/11/2009 12:00 AM

Currently the data are posted as zip files on the Corps site by region (i.e., JF – Juan de Fuca) or for the entire Puget Sound (i.e., PS – Puget Sound). Once you extract the zipped files for your region, you will see a geodatabase that can be viewed and analyzed in ArcGIS. The feature classes within the geodatabase can be displayed in ArcCatalog and previewed:



Each dataset contains complete metadata describing the layers in the geodatabase, how they were created, and what attributes are included in the layer:

Geographic Scale Units (GSUs)_PSNERP_2.0		
Description	Spatial	Attributes
Keywords Theme: Database Structure, Units of Analysis, Multiple Scales, User-defined Spatial Units, Metrics, Tiers of Analysis, Sub-basin, Drainage Units, Accounting Units, Process Units, Zone Units Place: Washington State, Puget Sound Stratum: Shoreline, Nearshore, Ordinary High Water, Mean Lower Low Water, Beach, Intertidal		
Description Abstract This polygon dataset contains multiple scales of nested spatial units that form the assessment units for the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) Change Analysis. This Geographic Scale Units (GSUs) spatial organizational structure allows for comparison of historic (late 1800s) and current (circa 2000) watershed conditions at multiple analysis scales. The GSUs nested spatial units area delineated based on watershed topography, drift cells, and major rivers. The basic GSUs over which change analysis metrics will be summarized are the Drainage Unit (DU), the Shoreline Accounting Unit (AU), the Shoreline Process Unit (SPU), Delta Accounting Unit (DAU), Delta Process Unit, and the Zone Unit (ZU). Purpose This data was created for use within the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) Change Analysis to provide the spatial organizational units that will form the basis of the comparison of historic versus current conditions. Supplementary Information The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) was formally initiated as a General Investigation (GI) Feasibility Study in September 2001 through a cost-share agreement between the U.S. Army Corps of Engineers and the State of Washington, represented by the Washington Department of Fish and Wildlife. This agreement describes our joint interests and responsibilities to complete a feasibility study to "...evaluate significant ecosystem degradation in the Puget Sound Basin; to formulate, evaluate, and screen potential solutions to these problems; and to recommend a series of actions and projects that have a federal interest and are supported by a local entity willing to provide the necessary items of local cooperation." The second phase of PSNERP is called the Feasibility Phase and seeks to accomplish three primary objectives: 1) Identify and evaluate significant nearshore ecosystem degradation of Puget Sound. 2) Formulate, evaluate, and screen potential solutions to these problems 3) Recommend a series of actions and projects The geographical domain of the study is defined as the area where a response to all actions is expected to occur and will extend downstream from the upstream limits of tidal influence of any river or stream entering Puget Sound, to the western limit of the Strait of Juan de Fuca. It includes all of Puget Sound and the Strait of Georgia north to the United States/Canada border. Within this region, it includes those adjacent uplands that directly affect nearshore processes, and encompassing intertidal and subtidal areas, extending seaward to the depth limits of the photic zone. The PSNERP approach includes several technical studies necessary to complete an assessment of the historic and current conditions through a Change Analysis of the Puget Sound nearshore. These studies will also attempt to forecast future conditions of the nearshore with and without various restoration and protection measures. Change Analysis is defined as a measurement of changes between historic (pre-1900) and current conditions (circa 2000) of shoreline and estuarine landscape features. A principle feature of these interdisciplinary studies is a spatial analysis framework of terrestrial and aquatic areas of nearshore ecosystems. These studies, including the Change Analysis, will be part of a problem statement for the Feasibility Study entitled the Strategic Needs Assessment Report. Additional information on the project including existing reports can be found at www.pugetsoundnearshore.org .		

For more information on the geospatial data, refer to Appendix C of the PSNERP Change Analysis Report (once it is released in late 2010).

Product 2: Strategic Needs Assessment Report (Schlenger et al. [in press])

The Strategic Needs Assessment Report is currently under review and will likely be posted to the PSNERP website by early 2011.

The Strategic Needs Assessment Report characterizes the impacts of shoreline and watershed alterations on nearshore ecosystem processes, identifies the major problems contributing to the observed ecosystem degradation, and assesses the seven sub-basins of Puget Sound based on the regional policy criteria selected by PSNERP. The report also identifies which of the causes are most important for PSNERP to address through restoration and conservation actions. This

information may assist local governments as they sift through local information and priorities and make their own policy decisions. Specifically, the report documents linkages between nearshore ecosystem processes and human actions that impact their function.¹ Lastly, the Strategic Needs Assessment Report establishes conservation and restoration priorities for PSNERP at the sub-basin scale.

Product 3: Technical Reports

The following technical reports can be found at:

www.pugetsoundnearshore.org/technical_reports.htm

As the additional technical reports discussed above become available, they will be posted to this website. Please visit this site periodically to identify newly-released publications.

[2010-01 Principles for Strategic Conservation and Restoration](#)

[2009-01 Management Measures for Protecting and Restoring the Puget Sound Nearshore](#)

[2008-01 A Geomorphic Classification of Puget Sound Nearshore Landforms](#)

[2007-01 Orcas in Puget Sound](#)

[2007-02 Marine Riparian Vegetation Communities of Puget Sound](#)

[2007-03 Marine Forage Fishes in Puget Sound](#)

[2007-04 Beaches and Bluffs of Puget Sound and the Northern Straits](#)

[2007-05 Kelp and Eelgrass in Puget Sound](#)

[2007-06 Great Blue Herons in Puget Sound](#)

[2007-07 Valuing Puget Sound's Valued Ecosystem Components](#)

[2006-01 Coastal Habitats in Puget Sound: A Research Plan in Support of the Puget Sound Nearshore Partnership](#)

[2006-02 The Geomorphology of Puget Sound Beaches](#)

[2006-03 Conceptual Model for Assessing Restoration of Puget Sound Nearshore Ecosystems](#)

[2006-04 Native Shellfish in Nearshore Ecosystems of Puget Sound](#)

[2006-05 Nearshore Birds in Puget Sound](#)

[2006-06 Juvenile Pacific Salmon in Puget Sound](#)

[2004-02 Guidance for Protection and Restoration of the Nearshore Ecosystems of Puget Sound](#)

[2004-03 Guiding Restoration Principles](#)

[Historical Reconstruction, Classification and Change Analysis of Puget Sound Tidal Marshes](#)

¹ SNAR, page ES-1.

