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Strategies for Nearshore Protection and Restoration in Puget Sound

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Prepared in Support of the Puget Sound Nearshore Ecosystem Restoration Project

PUGET SOUND NEARSHORE ECOSYSTEM RESTORATION PROJECT

Puget Sound Nearshore Ecosystem Restoration Project

U.S. Army Corps of Engineers, Seattle District Seattle, Washington

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PUGET SOUND NEARSHORE
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Definitions

The following terms are used throughout this document, and are in part derived from previous Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) work. Words carry the risk of ambiguous meaning or may have more precise definition within a technical community. A precise vocabulary is necessary for the informed, inclusive, and productive discussion of nearshore restoration and protection.

action	A set of management measures employed over a given footprint, over a specific timeframe, to achieve a particular outcome—potentially synonymous with project. This definition of action is derived from the U.S. Army Corps of Engineers' conventions.
barrier-type embayment	A barrier estuary, barrier lagoon, or closed lagoon or marsh landform (as per Shipman 2008) which depends on a barrier beach for wave protection, and thus, is linked through sediment supply and transport to the updrift beach system.
convergence zone	A drift cell component where sediments from two transport zones converge in an area of indistinct longshore drift direction, often containing an accretion feature like a barrier beach or cuspate foreland.
degradation	We define degradation as a kind of change to ecosystem processes or structures where modification of the nearshore landscape reduces the quantity or diversity of historical ecosystem functions, goods, and services. The historical ecosystem thus, serves as a baseline for evaluating the current ecosystem condition. Degradation of the historical state is estimated (with variable levels of accuracy and precision) by the presence and intensity of stressors and landform change.
delta process unit (DPU)	A polygon identified by Simenstad et al. (2011) encompassing one of Puget Sound's 16 large river watersheds. The nearshore zone, where the river floodplain meets marine waters, extends from the upstream extent of tidal influence to a depth approximately 10 meters below Mean High Water offshore. A DPU attempts to encompass those nearshore lands believed to be strongly shaped by river processes like distributary channel migration, and freshwater input.
detritus recruitment and retention processes	This class of physiographic processes includes those mechanisms whereby organic matter enters the nearshore and is transported and transformed over time. Insect fallout, wrack accumulation, drift logs, and soil organic matter are structural evidence of these processes. Degradation of this process could result from the narrowing of beaches preventing wrack accumulation, the stabilization of naturally eroding banks reducing recruitment of debris, or loss of shoreline or watershed forests.
distributary channel migration processes	This class of physiographic processes includes mechanisms whereby river channels move in a floodplain over time through the erosion of banks, deposition of bars, and formation of wood jams. The network of primary and secondary channels as well as sloughs, oxbows and other floodplain structures are evidence of these processes. Degradation can result from stabilization of channels and constriction of overbank flows resulting in potential reduction of habitat services to species adapted to complex tidal floodplain environments.
divergence zone	A drift cell component with an indistinct direction of net longshore drift such that sediment likely moves away from the site in two different directions. As these sites commonly face prevailing wave direction, divergence zones are anticipated to be more rapidly eroding than other drift cell components, and may contribute substantially to sediment budgets in many drift cells.

drainage unit (DU)	A DU is one of several thousand polygons that are the building blocks of the Puget Sound nearshore geo-database. DUs are based on a division of the shoreline into drift cell components. These polygons extend waterward, perpendicular to the shoreline, to a depth of 10 meters below Mean High Water (a typical depth to which light penetration supports photosynthesis, known as the photic zone). DUs extend landward along drainage divides to include the extent of the contributing watershed. Each DU is further sub-divided into three 'zone units' (or ZUs): a 'wet nearshore zone' from the shoreline to the edge of the photic zone, a 'dry nearshore zone' from the shoreline to 200 meters landward, and a 'watershed zone' from the edge of the nearshore zone to the watershed divide. Drainage units are grouped by the Nearshore Project into overlapping process units for the purpose of evaluating nearshore ecosystems.
drift cell	A drift cell, or littoral cell, is a segment of shoreline that encompasses a single system of sediment input, transport and deposition. The structure of beaches within a drift cell is anticipated to be strongly affected by sediment input and sediment transport processes. Puget Sound has mapped 812 drift cells that are used to delineate an equal number of Shoreline Process Units that are the basis for strategic analysis of beach and barrier embayment sites.
drift cell components	Both conceptually and as found in the nearshore geo-database, drift cell components divide the shoreline into one of five regimes of net shoreline drift: divergence zones (DZ), convergence zones (CZ), left-to-right (LtR), right-to-left (RtL), and no appreciable drift (NAD). Directions are as if facing landward. A drift cell contains at least one transport zone (LtR or RtL) and may include a convergence or divergence zone and may contain multiple zones of no appreciable drift.
ecosystem dynamics	The way that the interplay of process and structure over time results in either an dynamic equilibrium or a change in ecosystem state affecting the quantity and quality of ecosystem functions, goods, and services provided by a site.
erosion and accretion of sediment processes	This class of physiographic processes includes mechanisms whereby sediment is eroded in high energy environments and is transported to where it accretes in low energy environments. The texture and variable elevation of floodplains and the structure of beaches are evidence of these processes. Degradation includes the loss of erodible sediment sources, and the isolation of portions of the nearshore such that they are no longer subject to accretion. Erosion and accretion of sediment are naturally influenced by variable sources of sediment and hydrodynamic phenomena at multiple scales.
estuarine marsh wetlands (EM)	One of four classes of tidal wetlands proposed by Simenstad et al. (2011). Estuarine marsh wetlands are marine to brackish systems dominated by salt tolerant herbaceous species like pickleweed, saltgrass, or Lyngby's sedge.
euryhaline unvegetated wetlands (EU)	One of four classes of tidal wetlands proposed by Simenstad et al. (2011). Euryhaline unvegetated wetlands are mud flats inundated by marine waters commonly found in open coastal inlets, at the mouths of large rivers and streams, and along sheltered shorelines.
exchange of aquatic organism processes	This class of physiographic processes includes mechanisms whereby suspended or slowly swimming organisms, like plankton, seeds, or larvae are dispersed throughout the nearshore resulting in the dispersal of populations. The distributions of populations are structural evidence of these processes. Degradation includes the isolation of nearshore areas from aquatic organism dispersal by berms and dikes. Transport of aquatic organisms is naturally influenced by tides, currents, freshwater inputs and species characteristics.

freshwater input processes
This class of physiographic processes includes mechanisms whereby rivers, streams, or groundwater enters the nearshore, affecting salinity, causing flood related disturbances, and carrying upland sediments and organic materials. Alluvial fans, flood sediment deposition and patterns of surface and groundwater salinity are structural evidence of these processes. Degradation includes paving and deforestation that increases peak flows and reduces groundwater recharge, isolation of nearshore areas from freshwater inputs by dikes and levees, and the pollution of streams, rivers, and groundwater. Freshwater input processes are naturally influenced by climate and basin hydrology.

ecosystem functions
Any phenomena in an ecosystem that results from the interaction of the structures and processes of that ecosystem (e.g. an animal acquiring food, flood stage changing slowly, a beach remains cool on a sunny day). All the ways that humans recognize value in ecosystems are collectively described as ecosystem functions, goods, and services.

ecosystem goods
Tangible products that are extracted from the ecosystem that have economic or cultural value to our societies.

habitat
An area with the combination of ecosystem functions, goods, and services that promotes residence by individuals of a given species and allows them to survive and reproduce. A particular mix of sand, water, and vegetation may provide a range of habitat functions for a variety of species.

inlet process unit (IPU)
A polygon which includes all drainage units associated with a drift cell component identified as having no appreciable drift (NAD) that contains an embayment landform. These units include areas with low energy tidal exchange and are anticipated to be strongly influenced by their contributing watersheds through the concentration of runoff into enclosed waters, and the resulting accumulation of fine and organic sediments.

landform change
One of the changes documented in Historical Change and Impairment of Puget Sound Shorelines (Simenstad 2011), where a naturally occurring shoreline landform either changes to a different landform (i.e. barrier beach to bluff-backed beach), is replaced by an artificial shoreline, or where shoreline is simply no longer present (due to fill).

landform
A nearshore structure like a beach or an embayment created and maintained through the action of physiographic processes. A Puget Sound shoreline classification system containing the following four classes and twelve landforms are used in this analysis, as described by Shipman (2008):

Rocky coast: plunging, platform, pocket beach

Beach: bluff-backed beach, barrier beach

Embayment: open coastal inlet, barrier estuary, barrier lagoon, closed lagoon and marsh

River delta: river-dominated delta, wave-dominated delta, tide-dominated delta, fan delta

The term shoreform and landform are used alternately among PSNERP publications and are essentially synonymous.

landscape
An imprecise area, large but observable, that may include a diversity of landforms, perhaps united by the domain of some important physiographic process. A drift cell, an inlet, a watershed, or a sub-basin could all define a landscape. Coastal landscapes thus, may include their contributing terrestrial watersheds

PSNERP management measures
A classification scheme of 21 physical and non-physical activities that are commonly implemented as part of actions to restore and protect the Puget Sound nearshore ecosystem (Clancy et al. 2009).

metrics	Attributes from the nearshore geo-database, or calculated indices from those attributes used to indicate site conditions. In these analyses, metrics are divided into those that indicate historical potential to provide ecosystem services, those that indicate degradation of those services, and risk factors which indicate challenges to management of those services. Metrics are also used to group sites based on the similarity among metrics among sites.
nearshore ecosystems	Nearshore ecosystems include those ecosystems within a narrow strip where the land and rivers meet the sea. The Nearshore extends from the waterward depth of light penetration (estimated as 10 meters below Mean High Water) across the shoreline to the uplands that directly influence or are influenced by the shoreline (estimated as 200 meters landward of the shoreline). In addition, the nearshore includes streams and rivers to the upstream extent of tidal influence, and their riparian areas. These ecosystem boundaries and occasional use of words like 'buffer' are conceptual and are not intended to indicate legal policies.
nearshore geo-database	A geo-database developed by the Puget Sound Nearshore Ecosystem Restoration Project from which are derived a range of assessment metrics for describing and comparing sound-wide shorelines and associated watersheds, which are be displayed and analyzed as part of a geographic information system (GIS).
nearshore zone	The nearshore zone is that portion of a drainage unit nearest the water. In the nearshore geo-database, the nearshore zone includes all drainage units where the attribute ZU > 0.
oligohaline transition wetlands (OT)	One of four classes of tidal wetlands proposed by Simenstad et al. (2011). Oligohaline transition wetlands are typically low salinity systems that are shrub dominated, or contain a mosaic of swamp and marsh defined by soil texture and elevation and the distribution of tidal channels.
physiographic	Pertaining to physical geography, including geomorphology, hydrology, oceanography, climatology, biogeography, landscape ecology, and other geographic disciplines that study the physical structures and dynamics of landscapes.
physiographic processes	Those ecosystem processes assumed responsible for creation and maintenance of the structure of nearshore landforms (Simenstad et al. 2011). Due to the scale of their operation, we anticipate that the dynamics that determine shoreline ecosystem structure can be most completely explained at the scale of drift cells, river deltas, or watersheds. Three classes of processes are identified by this report as target processes: freshwater input, sediment input, and tidal flow. An additional 8 processes (described by Schlenger et al. 2011) are referenced as critical to the function of nearshore systems: detritus recruitment and retention, distributary channel migration, erosion and accretion of sediment, exchange of aquatic organisms, physical disturbance, sediment transport, solar incidence, tidal channel formation and maintenance.
site potential	The relative historical potential of a site to provide ecosystem services, by using metrics that compare the size and complexity of sites within a framework of landform based strategies.
process units	Overlapping segments of the Puget Sound shoreline that describe the scale of ecosystem processes. Shoreline process units (SPU) are based on the division of Puget Sound into 812 littoral drift cells, with a SPU encompassing one drift cell. Sixteen (16) delta process units include the extent of tidal flow in Puget Sound's major river deltas. A process unit overlaps each adjacent process unit to the extent to which they are believed to share important physiographic processes, such as two drift cells sharing sediment from a divergence zone (see Simenstad et al. 2011). This report additionally identifies 266 Inlet Process Units (IPUs) as a proposed delineation of physiographically significant sites not associated with the operation of sediment transport systems or large river deltas.

nearshore processes — Flows, fluxes, and transformations that occur within or between ecosystems that shape and are shaped by forcing factors like climate and respond to ecosystem structure. In response to initial work by Simenstad et al. (2006), Shipman (2008), Clancy et al. (2009) and Simenstad (2011), The Nearshore Project focuses on 11 classes of physiographic processes believed to most strongly structure Puget Sound shoreline nearshore ecosystems (Schlenger et al. 2011).

protection — The prevention of ecosystem degradation through the use of management measures, particularly governmental regulation, purchase of property rights, or education (Clancy et al. 2009).

process-based restoration — The application of a set of management measures designed to restore historical ecosystem function, goods and services through the restoration of physiographic processes

restoration — The recovery of historical ecosystem processes, structures, or functions on a site through the use of management measures. The rehabilitation of physiographic processes proposed by these strategies is a subset of all potential restoration activities.

risk factors — Assessment metrics used to indicate site conditions with the potential to compromise restoration efficiency or effectiveness, but where the effects are either unique or less predictable than site metrics used to describe site degradation. This includes, for example, the potential for breakwater jetties or active nearshore railroad lines to degrade sediment supply and transport processes, or the potential for future population growth to result in land cover change and the degradation of watershed functions.

sediment input processes — This class of physiographic processes includes mechanisms where the erosion of coastal bluffs delivers sediment into a beach system, where it is then subject to wave-driven transport. Eroding bluffs, beach texture, and beach profile are structural evidence of these processes. Degradation includes the reduction of the rate of input, as occurring over long time frames through the stabilization of bluffs with bulkheads. Sediment input is naturally influenced by geology, hydrology, climate, bathymetry, and shoreline orientation.

sediment transport processes — This class of physiographic processes includes mechanisms whereby waves suspend and move sediment within a drift cell, often resulting in net directional drift aligned with prevailing wave direction. Beach texture and profile, as well as the structure of the low tide bench may provide evidence of these processes over time. Degradation may include impoundment behind cross shore structures like groins or docks, or increased transport through boat traffic. Sediment transport is naturally influenced by sediment source texture, wind waves, bathymetry, and shoreline orientation.

ecosystem services — Those ways that ecosystems provide amenities to our societies that are not in the form of an extractable product (i.e. ecosystem goods) such as the provision of animal habitats, clean water, recreational settings, psychological or cultural wellbeing, or storm protection.

shoreline process unit (SPU) — A group of drainage units anticipated to encompass a single drift cell. An SPU may contain areas of no appreciable drift due to the inclusion of rocky shorelines or embayments. Shoreline process units frequently overlap with adjacent process units where sediment transport diverges or converges.

sites	Discrete overlapping locations in the nearshore landscape, at the scale of a drift cell, river delta, or coastal inlet, identified by a strategy as a location where PSNERP restoration or protection objectives could be achieved. The scale of a site is based on the scale of the prevailing physiographic processes which structure the environment. Four kinds of sites are considered by these analyses: river delta sites, beach sites, barrier embayment sites, and coastal inlet sites.
strategy	A series of principles about where and how to develop actions to achieve the ecosystem restoration and protection planning objectives defined by the Nearshore Project. Strategies define a discrete population of ecosystem sites, make assumptions about how to best protect or restore their ecosystem functions goods and services, define principal management measures, target processes, and consider how to best describe and respond to the constraints and opportunities found in the landscape.
stressors	Stressors are measurable changes to the structure of the ecosystem resulting from our activities. The Nearshore Project has assembled sound-wide data describing shoreline armoring, groins, over-water-structures, breakwater jetties, marinas, roads, tidal barriers, land cover, impervious surfaces, wetlands and fill. Stressors are used in conjunction with landform change to estimate degradation.
ecosystem structure	Ecosystem structure, refers to the composition and configuration of the physical and biological components of an ecosystem at a moment in time, including water, sediments, gases, and biota. Roughly synonymous with ecosystem state but perhaps more exclusive of process, and without any assumption of equilibrium.
tidal channel formation and maintenance processes	This class of physiographic processes includes mechanisms whereby drainage of tide waters from intertidal zones results in the scouring of a network of channels. These tidal channel networks and the distribution of organisms within them are structural evidence of these processes. Degradation includes reduction of the volume of tidal flows that reduces the scouring of channels through fill or constriction at road crossings, or isolation of areas from tidal flow processes. Tidal channel formation can be naturally influenced by sediment texture, river and stream flooding, tidal amplitude, vegetation, and hydraulic phenomena.
tidal flow processes	This class of physiographic processes includes mechanisms whereby fluctuating sea level first forces marine water into the intertidal landscape and then as it ebbs allows that water to drain away. Patterns of inundation, salinity, and tidal channel networks are all structural evidence of these processes. Degradation includes isolation of areas from tidal flow, or constriction of tidal flows with fill. Tidal flow processes are naturally influenced by tidal amplitude and by both local as well as regional bathymetry.
tidal freshwater wetlands (TF)	One of four classes of tidal wetlands proposed by Simenstad et al. (2011). Tidal freshwater wetlands are freshwater wetlands where water level is influenced by tidal flux and typically include a forested wetland component (commonly Sitka spruce).
tidal wetlands	Wetlands where hydrology is influenced by tides. Simenstad et al. (2011) divides tidal wetlands into four classes based on potential vegetation structure as controlled by salinity regime: euryhaline unvegetated (EU), estuarine marsh (EM), oligohaline transition (OT), and tidal fresh (TF).
tombolo	A depositional feature that connects two upland areas with a length of barrier beach.
updrift	A direction along the shoreline that is opposite the net direction of sediment transport in a littoral drift cell. Where net sediment transport is 'left to right' when facing landward, updrift is to the left.

watershed	A polygon in the nearshore geo-database associated with a shoreline segment, where all rainfall is predicted to flow into marine waters along that segment, based on evaluation of digital elevation models.
wrack	Organic material deposited at or near the high tide line.

Executive Summary

Puget Sound is an estuary of international significance, in decline after five generations of rapid development. Simenstad et al. (2011) and Schlenger et al. (2011) describe this transformation of the nearshore, the estimated loss of historical ecosystem services, and the degradation of ecosystem processes. This massive change, suggests that in addition to protecting against future injuries, extensive restoration is necessary to recover historical ecosystem services, and to recover nearshore dependent biota. Restoration will be challenging and expensive.

Our success in this multigenerational challenge depends on having an ecologically robust strategy that defines where and how we apply effort. Our strategy should be based on our best knowledge, and must be adaptable as knowledge changes. We should test our strategy for weaknesses. Because of this our strategy should be accessible, transparent, and subject to discussion and critique. A strategy should push actions to meet sound-wide outcomes and targets, while being responsive to local knowledge. The purpose of this report is to provide the first iteration of that evolving strategy for the protection and restoration of physiographic dynamics in the nearshore.

The Puget Sound landscape is vast and complex. Sixteen large river deltas are the irreplaceable cornerstones of this landscape, through which flow 70% of the Puget Sound Sub-basins water, sediment, and organic debris. The northern extents of Puget Sound, and particularly the Whidbey Sub-basin, contain the largest and most complex of these river delta sites. The Snohomish and Skagit deltas alone contain over half of the historical tidal marsh in Puget Sound. By contrast, the southern extents of Puget Sound are lined by a mosaic of relatively short beaches and drowned stream valleys arrayed among larger coastal inlets. South Sound is a stark contrast to the exposed outer shorelines of Whidbey Island, where sweeping beaches are punctuated by massive barrier estuaries and lagoons. The San Juan Archipelago more resembles the intricate shorelines of South Sound, but with small beaches and embayments lodged among rocky headlands.

This report attempts to achieve two goals:

1. Logically organize restoration and protection efforts in this complex landscape.
2. Identify sites where we can best protect and restore nearshore ecosystem services, regardless of whether the necessary actions have been developed or are socially acceptable.

Nearshore ecosystems are slowly and constantly reshaped by waves, tides, and floods. Effective management must consider the critical ecosystem processes that shape the shoreline. The supply and transport of sand and gravel, the ebb and flow of tides, and the inputs of streams and rivers fundamentally create and maintain the structure of these ecosystems at a landscape scale. This structure is what provides the services we value, like a beach's ability to dissipate storms or provide food for salmon. Our attempts to stabilize these otherwise dynamic systems, as we strive to achieve our economic and social goals, result in the loss of historical ecosystem services.

This work comes at the end of a ten year effort by The Puget Sound Nearshore Ecosystem Restoration Project (The Nearshore Project), a collaborative effort among diverse agencies to develop a strategic approach to the restoration and protection of Puget Sound shorelines. In addition to extensive literature review and guidance, the Nearshore Project has produced a Puget Sound-wide geo-database that documents both historical and current condition of the shoreline. These data tell a detailed story about how we have changed our 2,500 mile-long inland sea shoreline.

This report uses Nearshore Project findings, and new analyses of the nearshore geo-database, to provide a regional context for project development and local planning. By providing a Sound-wide framework and perspective, we hope to answer regional questions about nearshore ecosystem management:

1. Where should we go to recover the ecosystem services we have lost?
2. How should our approach respond to the variable conditions found in the landscape?
3. How should we consider an individual project as part of a cohesive landscape strategy?
4. What kinds of opportunities and risks should we keep in mind as we work in different settings?

We organize the landscape into four different kinds of places: river deltas, beaches, barrier embayments, and coastal inlets. These four distinct systems describe four different ways that ecosystem processes structure the shoreline to sustain a unique set of ecosystem services. Each landform is subject to distinct patterns of human settlement. Deltas have been either drained for agriculture or transformed into industrial ports. Beaches are valued residential and recreational sites, increasingly armored to prevent erosion. Many barrier embayments have been partially or completely filled, or developed as marinas surrounded by intensive residential communities. Degradation of barrier beach sediment sources may threaten some embayments. Muddy coastal inlets with their stream deltas have been the least developed, but are vulnerable to changes in their contributing watersheds, and several have been lost completely.

For each of these four settings we develop a strategy, beginning with the identification of a population of sites. Each site is defined at a scale to encompass the important processes that structure the ecosystem. Drift cells are used to define shoreline process units and associated beach and barrier embayment sites, which are shaped by wave-driven sediment supply and transport. Delta Process Units define the 16 locations where large river floodplains meet the sea. Inlet Process Units are developed to define 266 coastal inlet sites, where tides flow twice-daily in protected muddy settings, frequently in drowned stream valleys.

Each landform provides a discrete set of services, not replaceable by another landform. Therefore our strategies do not attempt to compare deltas to beaches or beaches to inlets. We need deltas, beaches, embayments, and inlets to restore historical ecosystem services in the nearshore. The physical structure of the landscape defines landform, and the potential for a landscape to provide these services.

For each strategy we develop three sets of assessment metrics. Our first set of metrics is used to identify the largest and most historically complex sites—those that we describe as having high potential. These are the sites that we anticipate will 'make or break' Puget Sound ecosystem recovery. Substantial increases in regional ecosystem services are unlikely without addressing the condition of these large complex sites. Given limited resources for conservation, and our abundance of shoreline, we recommend focusing initial work at our high potential sites—those sites in Puget Sound where a large quantity of ecosystem services were likely once provided within a single large and complex physiographic system. For each strategy we rank sites using a potential score, and place them in groups, based on their similarity. Groups of sites with the highest ranking are assigned a high potential rating.

We use a set of degradation metrics to compare the impacts to sites from development. We consider the loss of wetlands and landforms, cumulative shoreline modification, as well as nearshore and watershed urbanization. We rank and group sites based on the intensity and complexity of degradation.

The assessment of degradation is central to our preliminary recommendations for site management. We anticipate that as the degradation of ecosystem processes increases, it becomes increasingly uncertain whether we can reliably protect or restore ecosystem services. Where these high potential sites are only moderately degraded, lie the greatest opportunities to regain resilient and self-sustaining ecosystem services. Where sites have been severely degraded, restoration efforts will be expensive, and face higher risk. Thus, based on site degradation we distinguish among three different approaches to site management: protect, restore, or enhance. (Table A).

These recommendations should not be misinterpreted as proposing an exclusive reliance on either protective or restorative actions at a site as a whole, but rather a suggestion of how a site is most likely to contribute to regional goals, based on how the extent and intensity of degradation affects the costs and risks of restoration.

To complement our degradation assessment, we develop a set of risk metrics to identify uniquely challenging sources of degradation, like active railroad, or substantial

Table A – Preliminary site recommendations based on degradation. Cluster groups were assigned one of three management approaches, based on degradation scores and metrics (see Section 4.2.1). This recommendation suggests an overall goal for an ecosystem site. Work at the scale of an ecosystem site is assumed to combine a mixture of protective and restorative measures.

Protection	Restoration	Enhancement
Recommended for sites where degradation is relatively low, such that a site likely provides substantial ecosystem services in its existing state. Restoration actions may be an important part of management, however the primary goal of management is to prevent any substantial loss of ecosystem processes or functions that are currently intact.	Recommended for sites where indicators of degradation suggest the opportunity to substantively increase ecosystem services through restoration, but where degradation is not so complex or intense that recovery of self-sustaining and resilient ecosystem services becomes unlikely.	Recommended for sites where the level of degradation appears so complex or intense that restoration of self-sustaining and resilient ecosystem services may be severely compromised. For these sites we recommend that work focus on strategic enhancement of critical habitat functions (for example habitat services to migrating salmon), and the mitigation of urbanization effects like stormwater pollution.

impoundment of river sediment by dams, or the risks posed by anticipated population-driven development.

We do not wish to overstate our current ability to precisely predict and manage the dynamics of nearshore systems. We do not define how much restoration is sufficient, nor how much more development can be withstood at a particular site. We propose that given our limited investment in basic nearshore ecosystem science, managing close to the edge of ecosystem integrity is essentially an ethical question. We have documented tremendous changes that affect many ecosystem functions. We anticipate that we will not restore historical ecosystem services, by protecting or restoring only deltas, or only beaches, or by neglecting ongoing impacts from urbanizing watersheds, or by focusing only on the protection of intact sites. Our focus is on identifying where and by what means we can maximize the potential benefits of protection and restoration actions among our four most altered landforms.

Using principles from previous Nearshore Project work, and through analysis of our findings, we developed this landform-based framework for restoration and protection. This framework helps us identify important sites, and develop actions consistent with Puget Sound-scale problems. In summary:

- We propose organizing our strategies, identifying sites, and evaluating actions within a finite and measurable landscape of sites: 16 deltas, 744 beaches, 518 barrier embayment systems, and 266 coastal inlets.
- Protection and restoration of physiographic processes, specific to each kind of site, provides the most reliable mechanism for providing resilient ecosystem services. A precautionary and adaptively managed approach is warranted.
- Restoration cannot compensate for inadequate protection. Ecosystem services, either existing or restored, are most likely to be resilient and sustained as we protect ecosystem processes at the scale of a site. Our ability to predict the sufficiency of different protection measures, in the context of a specific site, is rudimentary.
- Within each landform-based strategy, we propose: 1) the physiographic processes anticipated to most strongly control ecosystem structure and services, and 2) the management measures anticipated to be most cost effective for restoration of those processes.
- To minimize risk, we propose a preference for actions that fully and rapidly protect and restore historical ecosystem processes, and consider the scale and character of the site.
- As we deviate from the complete and rapid restoration of sites, we should systematically consider how partial restoration creates risks to the provision and resilience of ecosystem services. Our four process-based strategies help us be systematic in this evaluation process.
- By considering the composition of each sub-basin, we better understand what has been lost, and how actions within a sub-basin contribute to Puget Sound recovery.
- To encourage development of large scale restoration actions, we identify historically large and complex sites, with moderate to low degradation, which we suspect could contribute substantially to the restoration or protection of ecosystem services. We do not evaluate whether the necessary actions at those sites are socially acceptable at this time.

To move from assessments and recommendations to socially acceptable protection and restoration actions, requires on-the-ground project development work and political and social negotiations. The identification and assessment of sites at this sound-wide scale is valuable. When we enter the landscape, we better know where to look, and what we are looking for. We propose that this strategy will help to evaluate whether local actions are responsive to large scale problems identified by the Nearshore Project. A rough approach for site evaluation is proposed in Section 4.2, beginning with the preliminary recommendations described above. Increasing detail can be derived from these assessments, enclosed maps, the nearshore geodatabase, and other Nearshore Project products.

The organization of a nearshore strategy around physiographic landforms is robust. As the scientific record develops, and spatial data become more organized and precise, our preliminary assessment models can be refined and repeated. Individual stakeholder groups may compliment our assessment of physical dynamics, with models designed to describe an interest in specific ecosystem services, like forage fish spawning, or juvenile salmon forage. We describe some planned and potential future work in Section 4.4.

Finally, this report describes in tables, figures, and maps 1,544 overlapping sites, among four landform classes, across seven sub-basins, over 2,500 miles of shoreline. To provide a sampling of these findings, Table B identifies three ecosystem sites, per strategy, per sub-basin, identified as having among the highest scores for historical potential, and recommended for protection or restoration based on a moderate to low degradation state. A more inclusive listing of high potential sites is found in Section 4.3. Complete tables, maps of sites, and assessment metrics are listed in appendices.

Table B – A Sample of high potential restoration and protection sites by sub-basin. The three highest potential sites for each strategy in each sub-basin are listed. A place name is followed by a preliminary recommendation, the process unit number, and a normalized potential score listed in parentheses (from 0 to 100). For the barrier embayment strategy, both process units and the largest lost barrier embayments within protection or restoration sites are listed with the specific embayments in italics . Lost barrier embayments that have been completely developed are listed with an (*) asterisk. A more complete listing of high potential sites is found in Section 4.3 by sub-basin.

Sub-basin	Sample Beach Sites	Sample Barrier Embayment Sites	Sample Coastal Inlets Sites
Hood Canal	**West Dabob** – Protect SPU 2059 **East Dabob –** Protect SPU 2062 **Mid-Tonandas Divergence North** – Protect SPU 2065	**Foulweather –** Protect SPU 2077 **Coos Bay Convergence (Coos Bay Lost Lagoon) –** Restore SPU 2099 **Misery Pt. South to Stavis Bay –** Protect SPU 2081	**Tahuya Estuary –** Restore IPU 146 **Thorndyke Bay –** Protect IPU 216 **Dewatto Bay –** Protect IPU 158
Juan de Fuca	**Port Angeles West to Dungeness Spit –** Restore SPU 1025 **Seal Rock West to Clallam Bay –** Restore SPU 1029 **Pitship Point Divergence South to Jimmycomelately Estuary –** Restore SPU 1019	**Grays Harbor South to Gibson Spit –** Protect SPU 1021 **Dungeness Bay –** Protect SPU 1023 **Seal Rock West to Clallam Bay –** Restore SPU 1029 ***Protection Island Lost Closed Lagoon,*** 1103 m ***Cape George Lost Closed Lagoon,*** 708 m *Few large barrier embayments have been lost in Juan de Fuca Sub-basin.*	**Salmon/Snow Estuary –** Restore IPU 227 **Washington Harbor –** Protect IPU 235 **Jimmycomelately Estuary –** Restore IPU 229
North Central	**Double Bluff Divergence North to Bush Pt** – Restore SPU 5031 **Lake Hancock Divergence South to Bush Pt –** Restore SPU 5030 **Fort Townsend Divergence North to Point Wilson –** Restore SPU 5027	**Possession Point West to Cultus Bay –** Restore SPU 5035 **Cultus Bay Divergence NW to Useless Bay Convergence –** Restore SPU 5033, including ***Deer Harbor Lost Barrier Estuary,*** 13,727 m; and ***Maxwellton Lost Barrier Estuary,*** 7,862 m **Double Bluff Divergence North to Bush Pt –** Restore SPU 5031, including ***Mutiny Bay Lost Barrier Estuary,*** 4999 m	**Cultus Bay –** Restore IPU 224 **Chimacum Inlet –** Protect IPU 231 **Mats Mats Harbor –** Protect IPU 226
San Juan	**Cherry Point (Point Whitehorn South to Sandy Point) –** Restore SPU 7146 **Padilla Bay North to Samish Island –** Restore SPU 7165 **Point Partridge North to Deception Pass –** Restore SPU 8057	**Fisherman Bay South (Lopez Island) –** Protect SPU 7088 **Jackson Beach (San Juan Island) –** Protect SPU 7023 **Henry Island Embayments –** Protect SPU 7042 ***South Beach Lost Barrier Lagoon*,*** 4880 m ***Sandy Point Lost Barrier Lagoon*,*** 4221 m ***Birch Point Lost Barrier Lagoon*,*** 5551 m	**Padilla Bay –** Restore IPU 244 **Drayton Harbor –** Protect IPU 270 **Chuckanut Bay –** Restore IPU 268
South Central	**NE Kitsap Divergence South to Apple Cove -** Restore SPU 4081 **Skiff Point North to Fay Bainbridge** – Restore IPU 4132 **West Colvos (Maplewood North to Pt. Southworth) –** Restore SPU 4036	**Skiff Point North to Fay Bainbridge –** Restore IPU 4132 including **Fay Bainbridge Lost Closed Lagoon,** 3030m **Point Jefferson to Miller Bay –** protect SPU 4077 *Only 2 remaining high potential sites received a protection or restoration recommendation in South Central Sub-basin. A large number of very large barrier embayments have been lost in systems now recommended for enhancement.*	**Miller Bay –** Protect IPU 212 **Chico Estuary –** Protect IPU 177 **Fletcher Bay –** Protect IPU 187
South Sound	**SE Harstene (Brisco Pt. North to Fudge Pt.) –** Restore SPU 3221 **Taylor Bay Divergence North to Herron –** Restore SPU 3141 **West Henderson (Glen Cove Divergence North to Burley Spit)** – Restore SPU 3168	**Gull Harbor –** Protect SPU 3038 **East Oro Bay –** Protect SPU 3263 **SW Harstene (Brisco Pt. North to Peale Shallows)** – Protect SPU 3208 ***Whiteman Cove Lost Barrier Estuary –*** SPU 3141; 3132m ***Purdy Lost Barrier Estuary –*** SPU 3171; 1107m ***Unnamed Lost Barrier Estuary (north of Whiteman Cove) –*** SPU 3141; 921 m	**Skookum Inlet –** Protect IPU 41 **Kennedy Creek Estuary –** Protect IPU 11 **Inner Henderson Inlet –** Protect IPU 24
Whidbey	**Possession Point North to Sandy Point –** Restore SPU 8001 **Barnum Point North to Livingston Convergence –** Restore SPU 6049 **NW Camano -** Lowell Point North to Utsalady convergence – Restore SPU 6042	**Barnum Point North to Livingston Convergence** – Restore SPU 6049, including **Livingston Bay Lost Lagoon**, 5620 m **Barnum Point West to Triangle Cove –** Protect SPU 6048 **Mueller Park North to Coveland –** Restore SPU 6017 ***Dugualla Lost Barrier Estuary,*** 8953 m ***Greenbank Farm Lost Barrier Estuary,*** 3963 m	**Tulalip Bay –** Restore IPU 234 **Race Lagoon –** Protect IPU 238 **Kennedys/Coveland Lagoons –** Restore IPU 239

1. Introduction

This report provides: a strategic framework, a landscape assessment for large-scale protection and restoration of nearshore ecosystems, and a set of recommendations based on that assessment. These analyses were developed as part of the Puget Sound Nearshore Ecosystem Restoration Project (Nearshore Project). While these assessments are intended to organize and broadly guide the scope and focus of capital investment for protection and restoration of ecosystem processes in the Puget Sound nearshore, we anticipate that the effectiveness of restoration is dependent on the effectiveness of protections provided by regulation, education, and property acquisition. We anticipate there are multiple benefits for strong coordination between regulatory and capital projects work. These strategies reflect the collaboration of the local, state, tribal, federal, and non-profit partners engaged in the Nearshore Project.

1.1 Puget Sound Context

Puget Sound is an 8,000 km^2 inland sea, part of the internationally recognized Salish Sea ecosystem, located in the northwestern region of Washington State with nearly 4,000 km of crenulated shoreline receiving runoff from a 36,000 km^2 watershed that includes 16 major rivers. When settlers arrived in the United States Washington Territory, it was a landscape of abundant forests and fisheries. Puget Sound was occupied by an ancient trading civilization built on the bountiful and sustained natural surplus of the land and waters, epitomized by the region's western red cedar and Pacific salmon.

The nearshore is the transitional zone among three major ecosystem types: terrestrial, freshwater, and marine. Many of the important and unique characteristics of Puget Sound depend upon the nearshore, including its physical complexity, high productivity, complex food webs, diverse habitats, and diversity of organisms (Kozloff 1973; Sound Science 2007).

The Puget Sound nearshore has a complex shoreline. The 812 mapped beach systems are dissected by more than 2,800 small creek mouths, historically studded by 884 embayments, and punctuated by 16 major river deltas (Simenstad et al. 2011). These landforms are created and sustained by physical processes that have been at work since the last glacial retreat: tidal flux, river erosion and deposition, wave-driven bluff erosion, and the long-shore transport of sediment. The structure of the nearshore is plastic and in continuous flux. Complex biological communities conform to that shifting structure. The operation of these natural physiographic processes has allowed the shoreline to adjust to changing sea levels following glacial retreat and have created a complex mosaic of exposed and protected habitats. Adapted to the structures found in these dynamic systems, Puget Sound shorelines are home to a rich and productive biota that has sustained its inhabitants for millennia.

More than 200 years ago when Captain George Vancouver sailed Puget Sound waters, there were some 50,000 native peoples left surviving the introduction of Eurasian diseases. Now, Puget Sound is home to approximately 4.4 million people or about 70 percent of Washington State's population. This population is concentrated in the Everett-Seattle-Tacoma metropolis and around the Bellingham and Olympia-Lacey-Tumwater municipalities. Puget Sound is the economic hub of the northwestern United States and a center of American global trade on the Pacific Rim.

Since the first surveys of coastal ecosystems in the last half of the 19th century, 90.9 percent of freshwater tidal and 97.8 percent of oligohaline transition (low-salinity) wetlands have been lost, and 75 percent of all vegetated tidal wetlands have been isolated from Puget Sound tides, either dredged and filled as seaports or drained behind 260 miles of dikes and levees. In addition, 305 small embayments have been destroyed, in part to create buildable flat land near water. Fill and tidal barriers have shortened the Puget Sound shoreline by an estimated 430 miles (Simenstad et al. 2011). As the twenty-first century opens, early coastal settlements have spread across the lowland watersheds in a network of cities, towns, and suburban developments. The old forests in the lowlands are gone. Thirty percent of the shoreline has been armored to protect private property from erosion. Landsat imagery suggests 34.6 percent of shorelines lack natural vegetation (Simenstad et al. 2011). At least 7.8 percent of lowland Puget Sound is now covered in pavement, rooftops, or other impervious surfaces (PSAT 2007). While economic activity has shifted away from resource extraction, population growth and development continue. Between 1991 and 2001, 3.9 percent of remaining lowland forests were cut, and 43 square miles of impervious surfaces were added in lowland Puget Sound (PSAT 2007).

The precipitous development of the Puget Sound region has resulted in 20 listings under the Endangered Species Act (including three listings since the initiation of this report) and a long list of proposed and candidate species. Local fisheries are impoverished and shorebird populations have declined. In reaction, the state of Washington has charged a succession of state agencies to protect and restore Puget Sound. A growing and increasingly sophisticated community of restoration and conservation professionals has emerged in response to the symptoms of ecosystem decline, authorized and financed by a range of federal, tribal, state, and local agencies.

Despite these historical injuries and ongoing threats, Puget Sound remains a national ecological resource at the center of Puget Sound culture. The nearshore provides habitat for 211 fish species, 100 species of sea bird, and 13 marine mammals. Washington provides the largest shellfish harvest in the nation, and much of this harvest comes from Puget Sound (valued at $86 million per year). Commercial and recreational fisheries are still valued at $61 million per year. Tourism provides $9.2 billion in economic activity. The $102 billion per year in private sector jobs (WDOE 2008) in part depends on our regional quality of life. The population, estimated at 3.7 million in 2010, is growing by about 44,000 people per year (1.2 percent per year), and is expected to reach 4.2 million by 2020 and 5.0 million by 2040 (PSRC 2007). The region appears to be on a course of relentless ecological decline from cumulative impacts not unlike many other major urbanizing estuaries.

1.2 The Nearshore Project

The Nearshore Project was initiated in 2001 to guide the restoration and protection of Puget Sound nearshore ecosystems. The Nearshore Project is a General Investigation study jointly managed as a partnership between the U.S. Army Corps of Engineers and the Washington Department of Fish and Wildlife, with the active engagement of federal, tribal, state, local, non-profit, and industry stakeholders. The Nearshore Project aims to achieve a shared understanding that can guide and coordinate Puget Sound nearshore ecosystem restoration, including a recommendation to Congress for authorization of an ecosystem restoration project, through the Water Resources Development Act (Figure 1). Many planning partners support development of these strategies to help organize and focus existing and future restoration and protection efforts under federal and state authorities, most broadly outlined by the Puget Sound Action Agenda (PSP 2009).

Simenstad et al. (2011) systematically quantifies historical changes in Puget Sound shorelines over five generations, between the earliest land surveys of the General Land Office and US Coast and Geodetic Survey (c. 1850-1890) and present conditions (c. 2000-2006). These dramatic changes indicate a broad scale loss of nearshore ecosystem functions, goods and services (Fresh et al. 2011; Schlenger et al. 2011; Simenstad et al. 2011). To recover these lost ecosystem services, the Nearshore Project has proposed a set of four planning objectives to describe actions necessary to recover lost ecosystem structures and processes (Table 1). The first three objectives, concerning deltas, beaches, and embayments, are consistent with Shipman's (2008) division of the landscape into physiographic systems.

This listing of objectives does not describe the potential for interaction among objectives (for example, the potential dependence of some coastal embayments on beach processes), the risks of partial restoration or future development, or the appropriate scale at which to manage the physiographic processes that drive ecosystem dynamics. Random attainment of objectives across the landscape is unlikely to optimize the recovery of durable ecosystem services. The principles proposed by Goetz et al. (2004) and ecosystem restoration theory reviewed by Greiner (2010) explicitly identify the need to respond to landscape setting, consider the landscape configuration impacted by conservation work, integrate protection and restoration into cohesive suites of actions, and strongly integrate social, cultural and political processes into solving ecosystem problems.

Figure 1 – Relationship between strategies and other PSNERP analytical products. Strategies integrate principles and objectives derived from landscape analysis to identify recommended sites – those places where objectives can best be met. This document describes the analytical procedures in the blue boxes, and their relation to development of a recommended plan for WRDA consideration.

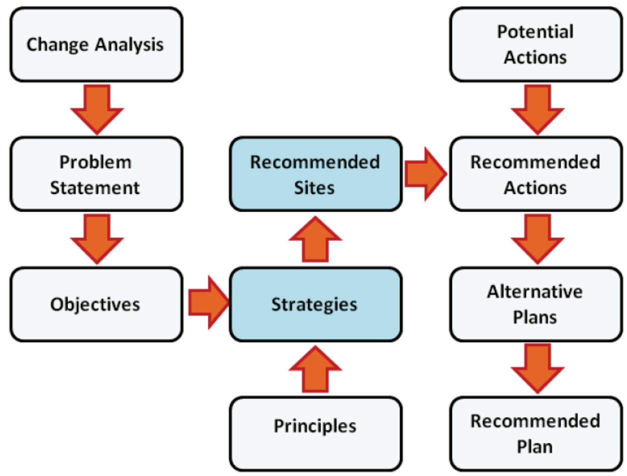


Table 1 – Nearshore ecosystem restoration project planning objectives. Four planning objectives were identified by the Nearshore Project. No prioritization is intended.

1. Restore and/or protect large river delta estuaries
2. Restore and/or protect coastal embayments
3. Restore and/or protect beaches and bluffs
4. Increase understanding of natural process restoration to improve effectiveness of project actions.

1.3 The Restoration and Protection of Physiographic Processes

Goetz et al. (2004) provides an analysis of restoration in nearshore ecosystems that elevates the importance of ecosystem processes in structuring nearshore ecosystems, thereby strongly affecting habitat functions. As biota are strongly affected by structure, and structure is relatively dynamic in nearshore ecosystems, biota can only be conserved by managing those ecosystem processes responsible for structuring the landscape. Shipman (2008) further describes the relative influence of processes most responsible for structuring landforms, while Greiner (2010) reinforces and expands on the recommendations of Goetz et al. through a review of conservation literature.

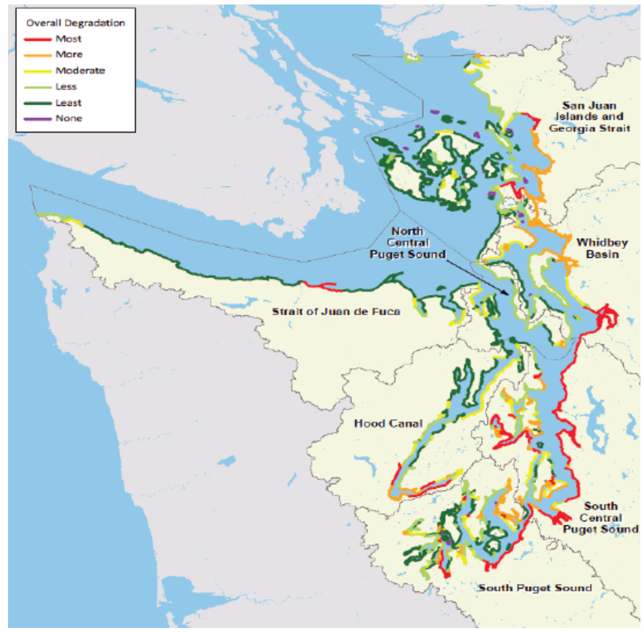
The Nearshore Project has also proposed a preference for cost effective actions that integrate restoration and protection of landscape scale process with minimum risk (Goetz et al. 2004). This preference leads us away from landscapes where processes are severely degraded, where restoration is costly and highly constrained, and toward sites where restoration actions could fully recover historical ecosystem processes at the scale at which they operate. However, to neglect the protection and restoration action in developed landscapes may result in unacceptable loses of species (for example, White River spring Chinook salmon), or fail to mitigate the impacts or urban water pollution.

Thus, while we anticipate that large scale protection and restoration of ecosystem processes is a foundational and irreplaceable component of nearshore ecosystem management that will affect the success of related efforts, it functions as a part of a broader suite of actions, including species recovery and water quality management—more fully described by the Puget Sound Action Agenda (PSP 2009).

These assessments and recommendations are based on the following hypotheses derived from Goetz et al. (2004) and Greiner (2010):

1. By restoring degraded physical processes we maximize the sustainability and resilience of a complex nearshore ecosystem structure that is similar to the historical template, and to which a diverse biota are best adapted.
2. A complex and dynamic nearshore ecosystem, with intact physiographic processes, is most likely to continue to provide functions, goods, and services into the future, as compared to systems with degraded processes.
3. This management of physiographic processes most reliably occurs at the scale at which those processes operate in the landscape.

Figure 2 – Pattern of process degradation across Puget Sound. From Schlenger et al. (2011). Colors indicate cumulative degradation of multiple ecosystem processes relative to other Puget Sound locations, as estimated by the presence of anthropogenic stressors.



4. Protection of existing unimpaired systems is more effective and efficient then restoration of impaired systems, and protection and restoration must be used in combination to achieve ecosystem restoration goals at the necessary scale.

In many cases, the feasibility of large scale process restoration is limited by the intensity of human development. Both Simenstad et al. (2011) and Schlenger et al. (2011) clearly identify a pattern of cumulative impacts (Figure 2). These patterns of development have been broadly linked to impairment of ecosystem services (Rice 2009; Toft et al. 2007; Bilkovic & Roggero 2008).

Severely modified ecosystems are more likely to present chronic, cumulative, or future sources of stress that increase the risk that restoration investments will not produce sustained or resilient ecosystem services. The importance of a 'supportive landscape' for restoration is discussed in Greiner (2010) and by others (NRC 1992; Toth 1995; Diefenderfer et al. 2005). In developed landscapes, the costs of restoration per unit of area can increase dramatically due to increasing land value, complexity of permitting, and the constraints and challenges imposed by existing infrastructure (PSSS 2003). Thus, both costs and risks may increase as we attempt to restore historical ecosystem services in more severely altered landscapes.

Some of the nearshore changes observed by Simenstad et al. (2011) are not ongoing (i.e. the diking and draining of deltas and filling of embayments). Future stressors (i.e. declining water quality, complex pollutants, nitrogen loading, and shoreline armoring) are qualitatively different than these observed historical changes. This difference suggests, 1) there are two different bodies of restoration work necessary to address both historical and more recent impacts, and 2) restoration of large historical delta and embayment ecosystems provides an opportunity to recover lost ecosystem goods and services unlikely to be directly undone by future development. Our challenge here is to evaluate the most advantageous role for physiographic process restoration across a range of different settings. That evaluation will necessarily consider both the unique dynamics of physiographic sites, and the character and intensity of degradation specific to those dynamics.

1.4 Puget Sound Nearshore Landforms

The importance of physiographic processes varies across the coastal landscape (Shipman 2008). For our assessment to describe the degradation of physiographic processes, where physiographic processes vary based on landform, then our assessment cannot be uniform among all landforms. Shipman (2008) provides a classification approach for Puget Sound, broadly differentiating among river delta, beach, embayment and rocky shorelines on the basis of their physiographic dynamics. As both process and structure varies among landforms beaches, embayments, and river deltas, each provide a different suite of ecosystem goods and services (in the sense of MEA 2005; Batker et al. 2010; Simenstad et al. 2011).

Even within a landform, where dynamics are similar, the quantity and quality of ecosystem services will vary. For example, river deltas are similar in that tides and alluvial flows create a mosaic of wetlands, however, Puget Sound river deltas vary dramatically in the magnitude of watershed discharge, and the extent and topography of historical wetlands. A large river delta likely provides a greater quantity of ecosystem services than a small river delta. This difference in quantity can be estimated by a number of metrics like hectares of vegetated wetland, shoreline length, or volume of tidal prism. Concepts like complexity, connectivity, heterogeneity, and rarity are commonly advanced in the ecological literature for differentiating relative function among sites of equal size (Greiner 2010). Thus, to reflect the relative contribution of historical landforms to the provision of ecosystem services, we would want to be able to compare both the size and the complexity of similar landforms.

1.4.1 River Deltas and Coastal Inlets

River deltas and coastal inlets (commonly associated with drowned stream valleys) are those sites most strongly affected by watershed hydrology and alluvial processes (Shipman 2008). The 16 major river deltas where broad floodplains meet marine waters account for 89 percent of the historical tidal wetlands of Puget Sound. An additional 2.2 percent of tidal wetlands are associated with smaller stream and river deltas (Collins & Sheik 2005). Because of freshwater inputs, these systems include a uniquely complex and fluctuating salinity environment, receive terrestrial sediments and flotsam, and are critical for the rearing and smoltification of juvenile Pacific Salmon (Fresh 2006).

All 16 major deltas have been extensively modified. Total delta shoreline length has declined 47.1 percent from historical conditions. Among these sites, 56 percent of all delta wetland area (inclusive of mud flats) has been filled or isolated from tidal flows by dikes. Furthermore, the upper-estuary and tidal freshwater wetlands have been almost completely eliminated, with 98.5 percent and 90 percent lost, respectively. The nearshore zone of the two Central Puget Sound deltas, the Duwamish and Puyallup, has been almost entirely filled and developed, creating a large gap in historical delta services in the Central Puget Sound Sub-basin (Simenstad et al. 2011). Large deltas provide unique habitat for a range of estuarine dependent fish and bird species (Buchanan 2006; Fresh 2006; Eissinger 2007)

Coastal inlets have also been modified, with 38 percent of the length of historically mapped open coastal inlets no longer identifiable as natural shoreline. Many of these systems contain creek deltas, with extensive and complex wetlands providing some of the ecosystem services found in river deltas. Coastal inlets provide rearing habitat for migrating juvenile salmon and frequently receive waters from large lowland basins with diverse natal salmon populations (WDFW 2002). Relatively shallow warm waters, rich mudflats, and a complex forested edge, create a unique suite of services, including the historical habitat of degraded Olympia oyster populations, as well as shellfish production for harvest (Cheney & Mumford 1986; Baker 1995; Dethier 2006).

Puget Sound agricultural communities depend on high quality river floodplains soils found in estuaries. River deltas include both high value agricultural lands as well as rapidly urbanizing areas. Conflicting priorities over land use among stakeholder groups strongly influences opportunities for restoration or protection of historical ecosystem services found in deltas.

Puget Sound coastal watersheds were historically dominated by old conifer forest, with rivers and streams interacting with forested floodplains and a network of wetlands. Urbanization has resulted in the complex modification of these systems, altering the hydrologic character of streams and rivers, their ability to support a diverse biota, and ultimately the quality of receiving waters (Booth & Jackson 1997; Mallin et al. 2000; Paul & Meyer 2001; Brabec et al. 2002; Alberti 2005; Alberti et al. 2007). River deltas and coastal inlet sites identified by our queries account for 14 percent of shoreline length; they receive runoff from 80 percent of the Puget Sound watershed. These systems serve as depositional sites for watershed sediments. More distant watershed conditions may strongly affect the dynamics and functions of these systems compared to sites with less enclosed shorelines and more active sediment transport.

1.4.2 Beaches and Barrier Embayment Systems

Half of the Puget Sound shoreline is composed of systems where beach sediments are transported by waves, from eroding bluff-backed beaches to accreting barrier beaches, and many gradations between (Shipman 2008; Simenstad et al. 2011). Historically, this beach matrix enclosed 711 barrier-type embayments, accounting for another 9 percent of shoreline length (Simenstad et al. 2011). Simenstad et al. (2011) divides Puget Sound into 812 semi-discrete littoral drift cells. Sediment typically originate in coastal bluffs and move in a direction of net sediment transport defined by prevailing wave direction, until reaching some terminus (Downing 1983; Finlayson 2006; Johannessen & MacLennan 2007). Of these beach systems, 518 historically included one or more embayments partially contained by a barrier beach, some located at the convergence zone of two drift cells. To a greater or lesser degree, the structures and functions of these embayments are affected by the condition of the beach system that sustains the barrier. Barrier embayments are anticipated to evolve over time dependent on sediment supply and geologic setting (Shipman 2008), and so from the perspective of managing discrete physical systems, it is useful to consider beach and embayment complexes as a subset of all Puget Sound beach systems, and evaluate their condition at the scale of the littoral drift cell in which they are embedded.

Beach systems provide a range of goods and services across their profiles: fringing submerged aquatic vegetation on low tide benches (Mumford 2007), shellfish production (Dethier 2006), salmon and shorebird forage (Buchanan 2006; Fresh 2006), obligate beach spawning forage fish in high beaches (Penttila 2007), as well as direct and indirect cultural and economic services to our communities (Leschine & Peterson 2007; Batker et al. 2010).

Barrier embayments lack the wetland area of river deltas but provide a network of distributed tidal wetlands believed important for rearing of juvenile salmon (Beamer et al. 2003). Barrier embayments currently account for 6.9 percent of Puget Sound tidal wetlands, and provide diverse functions due to their sheltered microclimate, high terrestrial inputs, frequent stream inflow, and organic sediments (Fresh et al. 2011). The ecological functions of these relatively uncommon systems, however, are poorly studied.

Degradation of beach ecosystems can be organized by the scale at which functions are changed. At a local scale shoreline modification and de-vegetation can reduce beach productivity. Nearshore vegetation moderates shoreline microclimate with benefits for forage fish (Rice 2006), and vegetated shorelines have been observed to produce dramatically more terrestrial arthropods than un-vegetated shorelines (Romanuk & Levings 2003) providing a critical food source for endangered Juvenile Chinook Salmon (Fresh 2006; Toft et al. 2007). Where shoreline armoring and fill extends into the intertidal it may affect shoreline biota by reducing wrack accumulation, reducing both diversity and abundance of beach fauna (Sobocinski et al. 2010), and potentially reducing accumulation of wood debris (Holsman & Willig 2007) and thus, infauna dependant on drift wood (Tonnes 2008).

At a drift cell scale, cumulative shoreline stabilization in response to coastal erosion can degrade sediment supply and transport. Shoreline armoring fixes the position of the shoreline, while wave driven sediment transport continues, resulting in the potential for loss of beach area over time (Hall & Pilkey 1991; Johannessen & MacLennan 2007; Defeo et al. 2009, O'Connell 2010). Our ability to predict the dynamics of individual systems in Puget Sound is challenged by the complexity and unique character of our beaches (Finlayson 2006) and the complex dynamics of heterogeneous sediments (Holland & Ellmore 2008). Despite general observations and understanding of Puget Sound beaches (Canning & Shipman 1995), we currently lack quantitative methods for predicting the effects of sediment supply impoundment and sea level rise at specific sites (Finlayson 2006; Gelfenbaum et al. 2006).

Beach armoring has increased rapidly in recent history (Gabriel & Terich 2005). Washington State law requires permitting of residential bulkheads (RCW 77.55.141) while local governments continue to seek definition of legal concepts and weigh the legal boundaries of regulating private property use (Titus 1998). The challenges of coastal erosion and sea level rise are accompanied by a complex and enduring international and interdisciplinary discussion (Pilkey & Wright 1988; Pethick 2001; Cooper & McKenna 2008; Cai et al. 2009; Defeo et al. 2009; McKenna et al. 2009; Shipman et al. 2010). The strategic role of public restoration and protection funding programs in this complex setting is still being defined (Cereghino 2010). Inevitably, public funding strategies for restoration and protection of beach systems will benefit from considering both long term cost benefit analysis, system dynamics under climate change, as well as legal and social justice issues related to long term coastal erosion strategies (Titus 1998; Pethick 2001; Cooper & McKenna 2008; McKenna et al. 2009).

2. Quantitative Methods

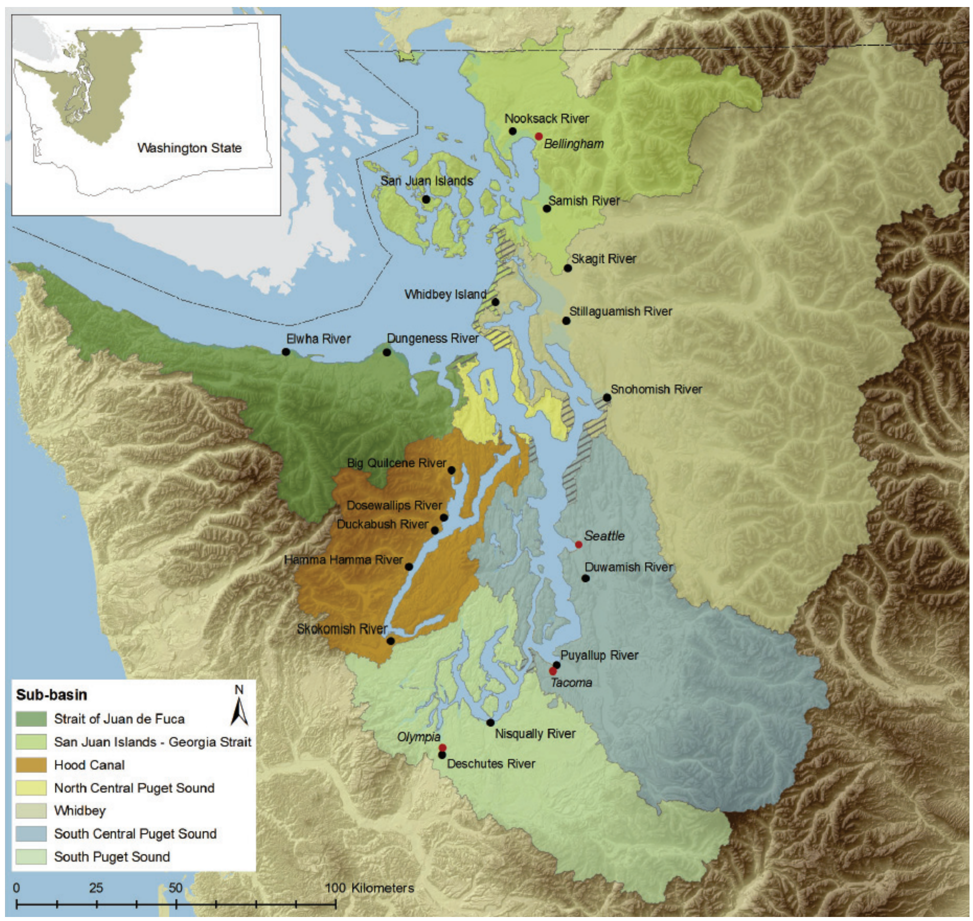
This assessment identifies and compares prospective restoration and protection sites at the scale of river deltas, drift cells, and coastal inlets across Puget Sound. These units encompass the contiguous operation of important physiographic processes identified by Shipman (2008). Using this scale to identify ecosystem sites allows for the management of ecosystem processes. Sites are described using a set of metrics that estimate 1) a site's relative historical *potential* to provide ecosystem services based on historical size and complexity, 2) the relative anthropogenic *degradation* of that historical potential, and 3) *risk* metrics that indicate the presence of a potential challenge to the effectiveness of restoration. To identify similar scenarios around which to develop managment recommendations, we group sites based on the similarly of their metrics using an agglomerative cluster analysis for both potential and degradation. Cluster analysis provides a repeatable and objective method for categorizing sites without the use of arbitrary thresholds. In addition, we order sites from highest to lowest for both potential and degradation, using a rank-sum score combining the appropriate metrics. Risk metrics are provided as an aid to planning, they are not integrated into index scores or cluster analyses.

2.1 Approach

Our study area includes the entire Puget Sound watershed from Cape Flattery to the northern border with Canada, including all coastlines and islands between—a watershed area of 36,080 km^2 and a coast line of 3,969 km (Figure 3).

The nearshore geo-database, developed by Simenstad et al. (2011), provides continuous data over the study area with a known and consistent resolution and accuracy. While higher resolution data are available for portions of Puget Sound, their inclusion in a sound-wide assessment could result in those areas with higher quality data being considered differently from areas with lower quality data, regardless of actual site conditions.

Figure 3 – Nearshore project study area. Seven sub-basins are based on somewhat distinct domains of varying geology, tidal hydrology, physiography and oceanography (from Simenstad et al. 2011).



In contrast to recent local planning efforts (for example Diefenderfer et al. 2009) we completed an assessment at a single, relatively large spatial scale using a single set of overlapping landscape assessment units of variable size, largely based on the estimated extent of littoral drift cells, deltas, and coastal inlets. Results are further summarized and discussed at the scale of Puget Sound Sub-basins – a division of the Puget Sound landscape based on somewhat distinct domains of varying geology, tidal hydrology, geomorphology and oceanography (also following Simenstad et al. 2011; Figure 3).

These analyses are intended to be supportive of, and complementary to, local assessments for land use planning, which must ultimately support policy decisions at the scale of a shoreline reach or even a parcel. To meet local planning objectives we anticipate these assessments would be integrated with the finer resolution physical, legal, and biological data available within planning jurisdictions.

Our quantitative analysis aims to describe a population of distinct deltas, drift cells and coastal inlets where restoration or protection actions could occur. These methods use two complementary approaches to assessment: 1) development of a pair of rank-sum indices that first describe the relative historical potential of a site to provide ecosystem services, and then the estimated anthropogenic degradation of those services, and 2) a cluster analysis that groups sites by the similarity among metrics used to define those index measures of potential and degradation. These paired analyses are complementary, with the indices ordering sites along a gradient of higher to lower relative score, and the cluster analysis providing a means of differentiating among similarly ranked sites of a notably different character for the purpose of developing more sophisticated management recommendations.

In our discussion of the results of these analyses, we propose a policy framework to organize and guide the development of nearshore ecosystem protection and restoration efforts. We then use cluster analysis results to apportion sites among three management approaches based on relative degradation. Finally, we identify a set of notably large and complex sites that we propose are critical to any attempt to recover historical ecosystem services.

In summary, our analytical methods involve the following steps:

1. Define a general strategy for restoration and protection for four distinct physiographic settings: river deltas, beaches, barrier embayment complexes, and coastal inlets.
2. Identify and describe a set of sites for each strategy, by:
    a. identifying the locations and boundaries of sites using Nearshore Project geo-database queries,
    b. calculating metrics to estimate the 'potential' and 'degradation' of each site, and
    c. identify metrics to indicate risk factors that may affect planning.
3. Complete a comparison of sites at a sound-wide scale, by:
    a. ranking each site based on the estimated level of *potential* and *degradation*, and
    b. clustering groups of sites based on similarity of *potential* or *degradation* metrics.
4. Assign cluster groups to one of three strategic approaches: *Protect*, *Restore*, or *Enhance* on the basis of *degradation* group.
5. Identify a set of sites that provide a notable proportion of historical ecosystem services on the basis of *potential* group.

These methods are intended to provide a durable framework for organizing and understanding nearshore ecosystem protection and restoration efforts, a systematic analysis of prospective sites based on the best available sound-wide data, concluding with a preliminary recommendation of how to approach the management of these sites, and their relatively importance as a source of ecosystem services.

2.2 Defining Physiographic Sites

Shipman (2008) provides a geomorphic classification of Puget Sound coastal landforms based on the relative influence of coastal geomorphic processes. Following Shipman's approach, Simenstad et al. (2011) divide and classify the Puget Sound shoreline into four landform classes: delta, beach, embayment, and rocky shoreline. This classification identifies 16 large river deltas where the floodplains of large river floodplains meet the sea. These deltas are nested in a mosaic of beaches and embayments, and in Northern Sub-basins there are, increasingly frequent blocks of rocky shoreline.

Rocky shorelines were excluded from these analyses. The Nearshore Project specifically focuses on the observation of change and degradation of physical shoreline structure. Rocky shorelines have both experienced limited physical change from historical conditions, and their essential structure is only very gradually affected by coastal processes. This is not intended to suggest that there are no beneficial restoration or protection actions for rocky shorelines, or that such systems cannot become degraded from anthropogenic impacts, but rather that the process-based restoration approach that informs the Nearshore Project (best described in Goetz et al. 2004) is poorly suited for planning, evaluating, or addressing impacts to rocky shorelines. These analyses focus on the more dynamic and frequently modified beach, delta, and embayment systems.

Within drift cells, Simenstad et al. (2011) divided shorelines into drift cell components describing sediment transport: right-to-left (RtL), left-to-right (LtR), convergence zone (CZ; where sediment accumulates from two converging cells), divergence zone (DZ; where an eroding bluff ambiguously distributes sediment into two diverging drift cells), and an additional class where no-appreciable drift is anticipated (NAD). Eight-hundred and twelve (812) Shoreline Process Units (SPUs) were identified within the study area, each unit estimated to encompass a single littoral

Table 2 – Summary description of four restoration and protection strategies. Each strategy is used to identify a population of potential sites, and define a methodology for making comparisons among those sites.

Name	Strategy Description	Site Identification Criteria
River Delta (16 Sites)	Protect and restore freshwater input and tidal flow processes where major river floodplains meet marine waters.	All 16 Delta Process Units (DPUs)
Beach (744 Sites)	Protect and restore sediment input and transport processes in littoral drift cells where wave energy results in bluff erosion that sustains beach structure.	All Shoreline Process Units (SPUs) where Bluff Backed Beach (BLB) is found under historical or current conditions
Barrier Embayment (518 Sites)	Protect and restore sediment input and transport processes to littoral drift cells where bluff erosion sustains barrier beaches that form barrier embayments, and restore the tidal flow processes found therein. Consider historical embayments that have been lost.	All Shoreline Process Units (SPUs) where Barrier Estuaries (BE) or Barrier Lagoons (BL) or Closed Lagoon Marsh (CLM) landforms are found under historical or current conditions
Coastal Inlet (266 Sites)	Protect and restore tidal flow processes in coastal inlets, and protect and restore freshwater input and detritus transport processes therein. These systems are defined by an area protected from wave energy by landscape configuration, and largely independent on sediment transport systems. Consider historical inlets that have been lost.	An Inlet Process Unit (IPU) was defined where Drainage Units (DUs) categorized as No Appreciable Drift (NAD) contain a contiguous Open Coastal Inlet (OCI) landform or where DUs contain a contiguous Drowned Channel landform (McBride et al. 2009).

drift cell. These SPUs commonly overlap at divergence zones, convergence zones, and areas of no-appreciable drift such as coastal inlets and where beaches meet river deltas. Among SPUs, 744 contain erosional shorelines (Bluff-backed Beach; BLB) either in historical or current mapping. These sites are assessed under the beach strategy.

SPUs frequently contain one or more embayments; a kind of landform with low wave energy due to a short fetch or protective barrier beaches. A total of 884 discrete embayments are mapped by Simenstad et al. (2011) from historical Puget Sound charts, and are classified as barrier lagoons, barrier estuaries, closed lagoons or marshes, and open coastal inlets (Shipman 2008). These embayment landforms are very diverse in their size, structure, and dynamics. Where embayments are dependent on barrier beaches, their structure may be strongly affected by up-drift sediment supply and transport. Shipman (2008) separates barrier embayment landforms (i.e. barrier lagoon, barrier estuary, and closed lagoon marsh) from those embayments not associated with barrier beaches (open coastal inlets), while warning of the risks of oversimplifying the classification of these complex landforms.

This variable dependence of embayments on barrier beaches affects what processes are anticipated to influence embayment structure, and in turn their provision of ecosystem services. Where structure appears dependent on a barrier beach, restoration of sustained ecosystem services may depend on the protection and restoration of sediment supply and transport processes that affect that beach. Where the structure of inlets is not dependent on a barrier beach, ecosystem function may be relatively independent of sediment supply and transport.

A review of the nearshore geo-database suggested that using landform coding to separate embayments into either open coastal inlets (coded as OCI) or barrier-type embayments (coded as BL, BE or CLM) poorly describes the relative dependence of site structure on barrier beach. The presence of a barrier does not define the importance of that barrier for ecosystem functions. An embayment landform may be identified as a 'barrier estuary' by the presence of a small barrier beach that does not constrain tidal flow, while most of the embayment shoreline length may be associated with a drowned stream valley, protected from wave processes due to geologic setting.

To address this variable dependence of embayments on drift cell processes, we developed two overlapping strategies for the identification and assessment of embayment sites (Table 2). The *Barrier Embayment Strategy* considers embayments as components of a beach/embayment complex, assessing both sediment processes and embayment conditions at the scale of a drift cell. This Barrier Embayment Strategy only considers the extent of barrier lagoons, barrier estuaries, and closed lagoon/marsh, while ignoring open coastal inlets. By contrast, the *Coastal Inlet Strategy* assesses open coastal inlets and drowned stream valleys where ecosystem services are anticipated to be relatively independent of beach structure and associated sediment processes. McBride et al. (2009) provides a sound-wide, systematic classification of shorelines developed contemporaneously with the PSNERP change analysis by the Northwest Indian Fisheries Commission. McBride et al. provide a more detailed discrimination among coastal embayments to describe anticipated patterns of salmon utilization. To this end, McBride et al. specifically identifies embayments associated with drowned stream valleys. A population of 101 embayments with freshwater input and barrier beaches (thus, identified as barrier estuaries by Simestand et al. 2011, and not open coastal inlets), were labeled as drowned stream valleys by McBride et al. 2009, and were added as sites in the Coastal Inlet Strategy. In addition, 86 sites were identified by both methods (suggesting that roughly half of Shipman's OCI landforms are McBride's drowned channels). Sites identified only by the drowned channel query have much smaller mean drainage and potential wetland area than sites identified only by the OCI method (66,188 m^3 of wetland and 9.15 km^3 watershed for drowned channel sites as compared to 651,500 m^3 and 31.7 km^3 for OCI), however the drowned channel sites were not substantially different in terms of shoreline length, and there is considerable overlap among the two populations. The 101 barrier estuary landforms identified through the drowned channel query are also analyzed as part of barrier embayment complexes due to the presence of spits, creating some overlap between the barrier embayment and coastal inlet strategies.

Together, the four proposed strategies support all Nearshore Project planning objectives, and provide a framework for integrating protection and restoration within ecosystem scale sites based on the continuity of dominant physiographic processes consistent with Goetz et al. (2004) and Greiner (2010).

We anticipate that this proposed scale of assessment and management, combined with consideration of the composition and configuration of these sites in the larger landscape, provides a robust foundation for planning and adaptively managing the recovery of ecosystem services. Our ability to understand and manage ecosystem processes at this 'site scale' is likely to determine whether our local actions to protect and restore ecosystem structures and functions, result in a functioning landscape and lead to Puget Sound recovery, or are overwhelmed by the cumulative degradation of underlying physiographic processes.

2.3 Metric and Score Development

For each of our four landform-based strategies, a different set of metrics is used to estimate the potential and degradation of each site (Table 3). While some metrics are common to all strategies (like the estimated levels of impervious surfaces in the nearshore zone), metrics selected to indicate relative potential and relative degradation also vary based on the strategy in question. Potential and degradation metrics will later be used in two different ways: 1) through the development of rank-sum indices that reduce all metrics to a single unitless potential and degradation score, and 2) through multivariate cluster analysis which groups sites with similar metric values.

Potential describes the relative quantity and diversity of ecosystem services provided by a particular site in its historical state. A site's potential is assumed to remain latent in the geomorphology of a site, and is restorable despite degradation, given sufficient will and resources. We estimate potential using a combination of historical size and physical complexity as surrogates for the quantity and diversity of ecosystem services.

Degradation reflects the relative loss of those historical ecosystem services as indicated by landform change and shoreline modification. Particular attention is given to indicators of degradation thought to be important to the process dynamics of a site. Typically one metric is used to describe any loss of shoreline length, others with loss of wetland area, intensity of shoreline modification, and development in the nearshore zone. Where freshwater input is anticipated to strongly structure a site, as in the case of deltas and coastal inlets, we include a metric describing the level of watershed development. In this way the set of degradation metrics are used to describe both proximate and more distant factors anticipated to degrade a site, in a manner consistent with the four tiers of change described by Simenstad et al. (2011).

A final set of metrics was used to describe potential risk factors that are either uniquely impactful or relatively uncertain in their potential to compromise protection and restoration efficiency or effectiveness within a site. Risk factors used include: scale of marina development, position of breakwater or jetty development within a drift cell, the presence of active railroad lines, parcel density, and the predicted future development of the nearshore zone or watershed. Degradation metrics were selected to be relatively continuous in their variation, and broadly indicative of degradation at the scale of the site. Risk factors tend to be more isolated features, or if broadly distributed, are anticipated to co-occur with high levels in other degradation metrics. While we didn't want our assessment to ignore these features that may substantially affect ecosystem processes, we did not want these risk factors to obscure, or make less reliable, the assessment of existing site-wide conditions.

We selected an assessment approach using a limited set of metrics, as opposed to including a larger number of metrics. We wanted to maintain a relatively high level of transparency, in how different metrics define groups of sites, how each metrics affects scores, and we wanted to avoid the subjective deliberation over the relative influence of metrics, when a large number of metrics are described. In addition, Schlenger et al. (2011) has completed some of this work already, by proposing some useful mechanisms for estimating process degradation while accounting for the co-occurrence of multiple stressors. A more inclusive, multivariate, and opaque approach to assessment could be complementary and provide useful observations. We favored this simpler approach for this initial application of a landform-based framework.

We used Bolte and Vache's (2010) estimation of future land cover change due to population growth to describe risk of future development, both in the nearshore zone and in watersheds. These population growth estimates are based on Washington State Office of Financial Management county level population growth estimates, and a 'status quo' land use planning regime. These analyses resulted in a 60-year projected change in percent total impervious area, both within the nearshore zone and associated watersheds. These percent increase figures were used to indicate how future population growth may result in future impacts to nearshore ecosystems within a site, potentially undermining planned restoration efforts.

For each site where a risk metric was greater than zero, the site was placed into one of three risk categories (high, medium, low) with category cutoffs determined by standard deviations above the mean, where high risk sites have scores greater than 2 standard deviations above mean, medium with greater than 1, and low with less than 1.

Metrics were selected from a broad range of attributes in the nearshore geo-database as well as composite metrics developed by Schlenger et al. (2011). A brief description of each selected metric is provided in Table 3, and a narrative of metric development by strategy follows. A summary of how metrics are used among strategies to estimate potential, degradation, and risk is provided in Table 4. A discussion of metric correlation is provided by strategy in the results section.

2.3.1 Delta Metrics

Delta metrics are calculated within delta process units. Delta size is described primarily by a combination of the *delta shoreline length* and the extent of *historical wetland area*. System complexity (as well as size) is described by using the greatest of historical or current area of oligohaline transition and tidal freshwater wetlands (simplified as *swamp area*), as well as overall *watershed area*.

The freshwater components of delta tidal wetlands are both uncommon, and largely destroyed. Sites with the potential to support these systems are likely important for the restoration of a full range of wetland types in Puget Sound. The calculation using the greatest of the historical or current wetland area is used to compensate for sites where historical mapping of freshwater-influenced swamp is less than found in current systems, with the assumption that in these cases historical boat-based methods used in mapping underestimated the extent of tidal swamp. The size of alluvial flows, estimated by watershed area, is anticipated to reflect both greater transport of materials through delta sites, as well as a more complex disturbance regime.

Lost delta length, *lost wetland area*, *tidal flow degradation*, *nearshore impervious*, and *watershed impervious* are used to characterize degradation, representing four tiers of change discussed by Simenstad et al (2011). The freshwater input process degradation metric proposed by Schlenger et al. (2011) is itself derived solely from impervious surface levels, augmented by the percentage of area behind dam impoundment. To increase the transparency of analysis, we used *watershed impervious* as our degradation metric instead of freshwater input process degradation, while retaining consideration of dam impoundment as a risk factor. We did not want the potentially variable effects of dam impoundment on delta function to obscure the relatively well documented effects of watershed urbanization on freshwater input processes. *Future watershed and nearshore development* were used as risk factors.

2.3.2 Beach Metrics

Beach metrics are calculated at the scale of shoreline process units. *Beach length* is used to describe beach size (the sum of both barrier and bluff-backed beach length). Complexity is estimated by the prevalence of barrier beaches within the site, as well as *stream mouth density*. Stream mouths are anticipated to increase the diversity if not the quantity of shoreline functions through the presence of alluvial fans, variation in the salinity gradient, interaction with freshwater biota, and organic inputs from the contributing watershed. In addition, many creek mouths include small and unmapped barrier estuary landforms with modest tidal marsh. *Barrier beach prevalence* is used to further describe the complexity of beach system. Barrier beach landforms are relatively rare. Barrier beach backshore supports a unique set of biota and habitat services (Guttman 2009). Thus, the highest potential beaches are long systems with extensive barrier beaches and a high density of stream mouths.

Degradation of beach sites was described using *sediment supply degradation*, *nearshore impervious*, and *parcel density* metrics. Sites with high parcel density are difficult to restore because of the uncertainty in coordinating a large

Table 3 – Description of metrics used to compare sites. Metrics are listed alphabetically, and grouped by type. Metadata for site metrics are provided in Appendix C.

Potential Metrics	Description
Barrier Beach Prevalence	The total length of barrier beach within a shoreline process unit is divided by the total beach length (bluff-backed and barrier beach) to describe the prevalence of barrier beaches within the unit. Puget Sound currently has 440 km of barrier beach as compared to 1529 km of bluff-backed beach. Barrier beaches commonly include a backshore component or fine textured or marshy areas protected from wave energy and are frequently associated with small streams, increasing the structural diversity on the shoreline. Thus, we anticipate that beach sites with extensive barrier beaches are likely to provide more diverse services than those that do not, and the provision of those services is likely to be sensitive to changes in sediment supply and transport processes.
Beach Length	The total length of beach landforms within a drift cell (both bluff-backed and barrier beach) describes the linear extent of beach that would be affected by protection or restoration of sediment supply and transport processes. We assume that ecosystem services of beach systems are in part a function of the length of shoreline, and beach length is used to estimate the quantity of ecosystem service at beach sites.
Delta Length	The historical length of delta shoreline in a delta process unit is used to complement wetland area measures to describe the historical size of a delta site. We assume that the quantity of ecosystem services provided by deltas is in part a function of the length of the waterward edge of the site and complements our use of wetland area measurements in describing the relative scale of delta sites.
Embayment Density	The number of discrete embayments divided by the total length of the shoreline process unit describes the density of embayments. This metric complements embayment length, as we assume that sites with a high density of embayments provide an uncommon continuity of embayment services, providing a set of ecosystem services dependent on embayment frequency, as well as maximizing embayment service 'return on investment' for sediment management within a given drift cell. This metric has the additional effect of providing a high metric value where very short sites support barrier-type embayments.
Embayment Length	The total length of embayment landform shoreline within a shoreline process unit is used to describe the extent of embayments found at a site and therefore estimates the quantity of ecosystem services provided.
Lost Embayment Isolation	Lost embayment isolation provides additional information about lost embayments. This metric is used to characterize the potential for restoration of an individual lost barrier embayment to provide ecosystem services as a function of the landscape gap in services that it would fill. The metric measures the distance between the centroid of a contiguous embayment land form and its nearest neighboring embayment. We assume that an embayment that is isolated from other similar land forms provides a relatively irreplaceable function as compared to where embayments are located near other embayments. This metric is used for map representation of lost embayment sites, and not in score calculation or cluster analysis.
Stream Mouth Density	The number of stream mouths divided by the total Shoreline Process Unit length is used to describe the structural complexity found where streams enter the nearshore across beach systems, either as small barrier estuaries and/or creek deltas. Creek mouths are assumed to increase both the quantity and diversity of ecosystem services at beach sites. This metric may also return high values where a single creek mouth enters a very short process unit.
Swamp Area	Swamp includes tidal freshwater (TF) and oligohaline transition (OT) wetlands, where moderated salinity allows for the development of woody vegetation. The historical area and current area of oligohaline transition plus tidal freshwater wetlands were tabulated, and the greater of the two numbers was used to represent the potential for the site to support freshwater influenced wetland. Historical analysis observed that these components of river deltas have been disproportionately lost in Puget Sound (Fresh et al. 2011; Simenstad et al. 2011), and restoration of these wetlands has been adopted as a planning objective by the Nearshore Project. Swamp Area is used to describe the complexity of ecosystem services at river delta sites.
Wetland Area	Historical area and current area of all vegetated tidal wetlands (i.e. estuarine marsh (EM), oligohaline transition (OT) and tidal freshwater (TF)), are each summed and the greater of the two numbers is used to represent the potential for the site to support vegetated tidal wetland. This 'greatest of historical or current' approach was used to reduce observed underestimation of woody wetlands by boat-based historical mapping. Wetland area is used to describe the quantity of ecosystem services at river delta, barrier embayment, and coastal inlet sites.
Watershed Area	We assume that the discharge of freshwater into a shoreline is primarily a function of the watershed area draining into a site. Freshwater inputs including organics and sediment and the effect of freshwater in creating complex salinity gradients increases the structural complexity of a site and supports unique functions. This metric was used to complement embayment length and wetland area to describe the complexity and quantity of ecosystem services at coastal inlet sites.

Degradation Metrics	Description
Lost Delta Length	The difference between historical and current delta shoreline length is divided by the total historical delta shoreline length. The percent of shoreline length loss is used to estimate the degradation of ecosystem services at delta sites.
Lost Embayment Length	Loss of length is calculated as the total length of current embayment landform subtracted from the total length of historical embayment landforms within a site. While some change in length can be attributed to mapping error, this metric provides a measure of gross physical change in the system to complement presence of linear stressors and nearshore zone development in coastal inlet and barrier embayment sites.
Nearshore Impervious	The percentage of land area within 200 m of the shoreline with impervious surfaces estimated as greater than 10% is used to describe the intensity of development at a site. Development indicated by impervious surface was assumed to indicate the combination of intensive use, chronic pollution, modified hydrology, and loss of vegetation. Nearshore impervious is used to estimate degradation under all strategies.
Parcel Density	The mean number of parcels per 100m in a shoreline process unit is used to characterize both challenges and costs of negotiating protection or restoration of sediment supply and transport under complex parcel ownership, as well as chronic impacts from high density residence on vegetation and drift wood. Parcel density is used along with sediment supply degradation and nearshore impervious to indicate degradation of beach sites.
Sediment Supply Degradation	The sediment input degradation metric was developed by Schlenger et al. (2011) to predict the effect of overlapping stressors on the degradation of sediment input. In shoreline process units, this metric calculates the percentage of bluff-backed beach landforms located in a drift cell component showing either divergence or transport (i.e. DZ, LtR or RtL) that is covered by either fill, armoring, railroads, roads or an artificial landform, all of which are anticipated to potentially affect sediment inputs. Sediment Supply degradation is used to indicate degradation at beach and barrier embayment sites.
Tidal Flow Degradation	The tidal flow degradation metric was developed by Schlenger et al. (2011) to predict the effect of overlapping stressors on the degradation of tidal flow in embayments and river deltas. This metric indicates the percentage of delta shoreline length with either tidal barriers, fill, railroads, roads, or artificial shore forms. Within shoreline process units, tidal flow degradation was estimated as the percent of embayment landform length with either tidal barrier, fill, railroad, or an artificial landform. Tidal flow degradation is used to estimate degradation at delta, barrier embayment, and inlet sites.
Watershed Impervious	Watershed impervious measures the percentage of land area within a drainage, where impervious surface is estimated as greater than 10%. This metric is used to describe the intensity of development in a basin that contributes freshwater to a nearshore site where freshwater input is anticipated to strongly structure the nearshore. Watershed impervious is anticipated to estimate degradation of flow regime, water quality, and associated ecosystem services for deltas and coastal inlet sites.
Wetland Loss	The sum of current vegetated wetland area is subtracted from the sum of historical vegetated wetland area and divided by the sum of historical vegetated wetland area to describe the overall loss of wetlands and associated ecosystem services at delta and coastal inlet sites. Because this metric was intended to describe loss of wetland, those sites with a reported gain in wetland area were re-scored to indicate zero, or 'no-loss'.
Risk Metrics	**Description**
Active Railroad	The percentage of beach where active railroad is found adjacent to the shoreline represents a potentially insurmountable barrier to restoration of sediment supply that could potentially undermine restoration of sediment supply processes at beach and barrier embayment sites. Active railroad commonly co-occurs with sediment supply degradation.
Dam Impoundment	The percentage of the contributing basin that is located behind a dam is used to describe the degree to which dams may affect hydrology and sediment delivery at river delta sites. We assume that river delta sites with substantial dam impoundment may have reduced sediment budgets, resulting in reduced aggregation of marsh surface under sea level rise, reduced delivery of large wood and moderated flood flows that affect distributary migration and channel formation processes. Many other factors may affect how the effect of dam impoundment on sediment routing affects delta systems.
Future Nearshore Development	Bolte and Vache (2010) calculated model change in land cover resulting from predicted population growth and status quo land use planning. The point increase in impervious surface within the nearshore zone (i.e. a change from 5% to 15% is a 10 point increase) is used to describe the likely intensity of future development in the nearshore. Future development is anticipated to potentially undermine process-based restoration efforts, depending on the development approach used.

Future Watershed Development	Bolte and Vache (2010) calculated model change in land cover resulting from predicted population growth and status quo land use planning. The point increase in impervious surface within the watershed zone (i.e. a change from 5% to 15% is a 10 point increase) is used to describe the likely intensity of future development in the watershed. Future development is anticipated to potentially undermine process-based restoration efforts at delta and coastal inlet sites where freshwater inputs are anticipated to strongly structure the nearshore, depending on the development approach used.
Jetty Influence	The percentage of a shoreline process unit down-drift of the most up-drift breakwater or jetty structure was calculated. Breakwaters and jetties may have a strong influence of sediment transport and reflect a very difficult to remove source of sediment transport degradation that could potentially undermine restoration of sediment supply processes at beach and barrier embayment sites. The actual sediment sources that are most important within a drift cell site may vary in relation to the position of a particular jetty system.
Marina Development	The combined area of marinas and overwater structures within a coastal inlet site were summed, and divided by the length of inlet process unit shorelines, to describe the intensity of boating activity at a coastal inlet site. Areas with intensive marina development are more likely to be degraded by chronic stress, potentially undermining restoration benefits in those settings.

number of private land owners around conservation goals. Conversely, sites with low *parcel density,* and thus, simpler land ownership structure, may represent opportunities for restoration despite the presence of shoreline development. In addition, a high density of parcel boundaries is likely to indicate more use and manipulation of beach systems, harvest of drift wood, or impacts from coastal septic systems. The ultimate purpose of developing a set of degradation metrics is to differentiate among sites based on the potential for broad scale restoration of ecosystem processes. We believe that parcel density provides a useful metric not only for indicating potential direct impacts, but also provides a unique indicator of the legal and cultural complexity of restoration, and thus, is a reasonable compliment to other degradation metrics.

Sediment supply degradation (Schlenger et al. 2011) was selected over estimates of sediment transport degradation given the importance of sediment supply in sustained system function, the difficulty of reinitiating coastal erosion after bulkheads are installed, and its specific reference in Nearshore Project planning objectives. The presence of *active railroad* and the percentage of site down-drift of breakwater/jetty systems were flagged as risk factors, along with the predicted future increases in nearshore impervious surfaces.

A metric describing the degradation of watersheds was not considered in our assessment of beach systems. There is strong correlation between nearshore impervious and watershed impervious among beach sites (given the spatial proximity of those polygons), and so nearshore impervious was assumed to adequately represent potential impacts of watershed development. In addition, due to the relatively open nature of these shorelines, we assumed that some of the effects of watershed degradation would be muted compared to where streams flow into more enclosed embayment systems.

2.3.3 Barrier Embayment Metrics

As with beach metrics, barrier embayment metrics are also calculated at the scale of shoreline process units. The character of each and every discrete embayment within a drift cell is aggregated for the calculation of metrics. An alternate approach, where embayments are considered components of beach sites, and an evaluation is made of individual barrier embayments in relation to specific sediment sources would be preferable, but are not available at this time at a sound-wide scale.

Wetland area and *embayment length* are used to indicate embayment system size. *Embayment density* (count of discrete embayments divided by the length of beach) is used to describe embayment system complexity. Thus, the highest potential sites have a high density of embayments with extensive wetlands and long sheltered shorelines.

As with beach systems, degradation is estimated using sediment supply degradation and nearshore impervious. In addition, tidal flow degradation is calculated for all embayment shorelines within each site, also following Schlenger et al. (2011). In this way, both the degradation of beach dynamics, as well as the degradation of barrier embayments landforms embedded within drift cells, are used to describe the condition of a barrier embayment site encompassing a whole drift cell.

Loss of wetland area is not used as a degradation metric. Many embayment wetlands are very small, and minor mapping errors between historical and current wetland area can result in large inaccuracies when those area measures are described as a proportional loss. We also map the location and historical shoreline length of all lost embayments to compliment drift cell scale quantitative analyses.

No risk metrics were developed specifically for barrier embayment sites. The risk metrics developed for beach sites, adequately describe the risk factors we identified

Table 4 – Summary of metrics used by strategy. Narrative definition of individual metrics is provided in Table 3. Use of metrics by a particular strategy is indicated by the columns on the right. For the purpose of preparing metrics for cluster analysis: square root transformation was used where log normal frequency distributions would result in an emphasis on high values, with limited differentiation between moderate and low values (see section 2.5). Data were normalized with a maximum scale of 1 by dividing all values by the highest value. Lost embayment isolation and risk metrics were used in mapping to inform recommendations but not for scores or grouping.

Potential Metrics	Trans.	Norm.	Delta	Beach	Embayment	Inlet
Barrier Beach Prevalence	NA	Y		■		
Beach Length	SQRT	Y		■		
Delta Length	SQRT	Y	■			
Embayment Density	NA	Y			■	
Embayment Length	SQRT	Y			■	■
Lost Embayment Isolation	NA	Y				
Stream Mouth Density	NA	Y		■		
Swamp Area	SQRT	Y	■			
Wetland Area	SQRT	Y	■		■	■
Watershed Area	SQRT	Y	■			■
Degradation Metrics	**Trans.**	**Norm.**	**Delta**	**Beach**	**Embayment**	**Inlet**
Lost Delta Length	NA	Y	■			
Lost Embayment Length	NA	N			■	■
Nearshore Impervious	NA	Y	■	■	■	■
Parcel Density	NA	Y		■		
Sediment Supply Degradation	NA	N		■	■	
Tidal Flow Degradation	NA	N	■		■	■
Watershed Impervious	NA	Y	■			■
Wetland Loss	SQRT	Y	■			
Risk Metrics	**Trans.**	**Norm.**	**Delta**	**Beach**	**Embayment**	**Inlet**
Active Railroad	NA	N		■		
Dam impoundment	NA	N	■			
Future Nearshore Development	NA	Y	■	■		■
Future Watershed Development	NA	Y	■			■
Jetty Influence	NA	Y		■		
Marina Development	SQRT	Y				■

as useful for barrier embayment sites, and should be used to inform the development of a restoration or protection approach. As suggested in section 4.4, more precise recommendations for barrier embayments, will require more sophisticated characterization of individual embayment landforms and sites, than allowed by the scope of this study.

Consistent with beach site methods, the degradation of watersheds is not used to assess the condition of embayment sites. In addition to the reasons provided for beaches, those barrier estuary systems with a substantial watershed and containing a drowned stream channel system, are identified and assessed under the coastal inlet strategy, where a watershed impervious metric is used to characterize the contributing watershed.

The loss of embayments is specifically identified by Fresh et al. (2011). Therefore, in addition to the assessment of whole drift cell complexes, we mapped and developed some attributes for discrete lost barrier embayments (i.e. where embayment shoreline length had been reduced to zero). While lost embayment length is mentioned above, we also developed a metric to describe the relative isolation of lost embayments. Coastal embayments are anticipated to provide unique services to migrating fish (Beamer et al. 2003; Fresh 2006) and birds. We propose that the continuity of embayment service provides services to mobile species in part dependant on the connectivity between embayment sites. Where loss of an embayment creates a larger gap in the continuity of embayment services, the relative benefit derived from restoration would be greater than if the gap filled were smaller. To describe this rarity we calculated the distance from each lost embayment to the nearest existing embayments to describe the potential for restoration to fill a gap in embayment services.

Lost Barrier Embayment Isolation

We completed a brief assessment of individual embayments where historically mapped embayments now have a current embayment shoreline length of zero. For this analysis, each missing embayment was identified as a discrete object, in contrast to the previous assessment which describes barrier embayments as undifferentiated components within a whole drift cell system.

There are several factors that make a more thorough analysis of individual barrier embayments challenging with existing data:

- Historical and current wetlands are not associated with line segments, preventing simple comparison of associated historical wetlands as an attribute of a given embayment.
- Watershed spatial data boundaries are not currently aligned with embayment landforms.
- The majority of lost embayment shorelines are not located on the ShoreZone line work used as the foundation for change analysis (WDNR 2011), and there is no specific line work available to associate with either watershed or wetland attributes.
- Sediment supply is directional, and the entire sediment supply processes within a drift cell is not an appropriate characterization of the sediment supply affecting a single barrier embayment system.

We measured the distance from each lost embayment to its nearest existing neighbor, which is represented on maps (see Appendix A). This is a rudimentary start to a range of analyses that could ultimately describe relative rarity, connectivity or other biogeographic concepts.

2.3.4 Coastal Metrics

Coastal inlet metrics were calculated within Inlet Process Units. Inlet Process Units, are new to this analysis, and are defined as a set of adjacent drainage units with No Appreciable Drift (NAD), containing a landform segment of open coastal inlet (Shipman 2008) or drowned channel landform (as per McBride et al. 2009). Similar to river deltas, the size of coastal inlets is described using the *embayment length* and the extent of historical *wetland area*. We found the historical mapping of freshwater influenced wetlands was frequently inaccurate when compared to the current mapping at minimally developed sites, and so we do not use swamp area to describe coastal inlets. Consistent with delta sites, we use the size of the contributing *watershed area* to complement overall wetland size as a surrogate for the structural complexity of coastal wetlands structured by the effects of freshwater input processes.

Lost embayment length, *lost wetland area*, *tidal flow degradation*, and *nearshore impervious* were used to characterize degradation. Percent loss of length may not be an entirely accurate indicator of degradation among small sites, as the length of apparently undeveloped inlets frequently varies between historical and current mapping. This suggests the potential for historical mapping error in the length of minor inlets. It is easy to imagine that during the geodetic survey, the boundaries of small inlets were only visually estimated from the water, particularly at lower tides. The predicted future nearshore and watershed increase in impervious surface extent and the intensity of *marina development* were used to indicate risk. Intense *marina development* is a somewhat unique attribute of coastal inlets. Sites with extensive marinas provide a high level of economic service that may compete with historical ecosystem services as communities evaluate restoration.

2.4 Site Score Calculation

Our selected metrics exhibit a variety of statistical distributions: log normal, normal, and highly skewed. To aggregate metrics into a single measure of overall site potential or degradation we chose a non-parametric rank-sum method for calculating an index score. Non-parametric methods, like summation of rank, are used where you want to make comparisons among populations, but you do not want to make any assumptions about the character of the parameters you are comparing other than their relative value (Zar 1998).

Each site was assigned a rank for each metric from lowest (score of 1) to highest (score equal to the number of sites). Sites with equal metrics were given equal rank, while the next site in the ascending sequence was given a rank one integer higher, for each previous tie (see sidebar). An overall potential or degradation rank for a site was calculated by adding the ranks of all metrics, resulting in a raw potential score and a raw degradation score for each site. For example the potential rank of a coastal inlet site is the sum of that site's rank for watershed size, embayment shoreline length, and wetland area.

Thus, within each strategy, all sites are arrayed along two gradients from least degraded to most degraded, and from the lowest potential to the highest potential. However, for any two sites of similar degradation or potential, the metrics responsible for the degradation or potential score may be very different. To better describe patterns of potential and degradation we used a multivariate cluster analysis to divide sites into similar groups.

To support easy comparison among sub-basins and discussion of regional patterns, the potential and degradation of all sites within a strategy were divided into equal groups of high, medium, and low scoring sites (i.e. a strategy with 60 sites would be divided into 20 high, 20 medium and 20 low sites). The cutoff between groups is not intended to describe an ecologically significant difference in site character, but is used only to describe patterns among sub-basins.

2.5 Cluster Analysis

Existing research does not provide us with clear thresholds that define when the degradation state of a site should drive management or is known to affect ecosystem services. Cluster analysis provides a systematic mechanism for placing similar sites into groups based on a repeatable mathematical comparison of multiple metrics. Cluster analysis has been used recently to characterize estuarine conditions at landscape scale sites (Edgar et al. 2000; Valesini et al. 2010) as well as a long history of indispensible use in community ecology, psychological, and sociological research.

Ranking Example

Score	*Rank*
70	*6*
52	*4*
52	*4*
51	*3*
30	*2*
10	*1*

For each landform based strategy, a hierarchical agglomerative cluster analysis (DENDROGRAM) was completed using the PRIMER v6 multivariate statistics program (Clarke & Gorley 2006) to separate all sites into groups of similar sites, first on the basis of their potential metrics, and then by degradation metrics. Cluster analysis uses a mathematical algorithm that proceeds in a step-wise manner. The process begins with each individual site assigned to its own group. Considering the differences among metrics between all groups, those two groups that are most similar are lumped into a new group now containing the members of the two similar groups. That group is assigned a 'position' relative to all other groups based on the differences among metrics. This stepwise process continues until all sites are finally lumped into a single group.

Cluster analysis requires that characterization metrics be normalized to a comparable scale. We used simple division by range to normalize for range, resulting in a maximum value of 1 while minimum value varies. Preserving the position of the metric value relative to zero was assumed to have importance in the meaning of metrics reflecting area or length. This method of normalization had negligible effect on metrics already represented as a percentage, as range and maximum were similar. Normalization method is considered less important than the methods used to calculate group position and distance (Milligan & Cooper 1988).

To calculate the position of a group containing multiple sites we used the 'group average' method. Euclidian distance was used as the distance measure to compare differences among metrics between groups. Group average and Euclidian distance together provide a relatively robust mechanism for accurately identifying objective groups in statistical tests (Milligan 1981) and performs well with our standardization methods (Milligan & Cooper 1988).

Once the agglomerative routine is complete the remaining task is to identify a cutoff for the number of groups. We assume that there are no objective groups of sites to be 'discovered'. In this setting, multivariate methods provide us with a systematic tool for describing a complex and variable continuum of sites. Thus, the use of statistical tests is not assumed to indicate some level of ecological significance, but rather provides a consistent and repeatable standard for dividing sites into similar groups. We used a SIMPROF permutation test to determine the number of groups to report, generated with 999 simulations used to calculate the test statistic. This test identifies at what level of agglomeration the resulting group is no longer statistically different than the remaining population. A probability of type I error (alpha) equal to 0.05 was used to define the cutoff for number of groups. Where this resulted in a large number of groups (in the cases of beach degradation and barrier embayment potential) we reduced the tolerance for type I error to 0.01, thereby lumping the most similar groups to reduce the total number of groups presented.

Prior to cluster analysis, metrics were examined for the character of their distribution, potential transformations, outliers, and correlated metrics. Many metrics displayed a log-normal distribution, where a small number of sites with exceptionally high metric scores resulted in a strong difference between mean and median values. If normalized without transformation, this would lead the cluster analysis to consider a large proportion of sites as being very similar even though there may be substantial differences between them in terms of their relative size. We assumed that the relative size of habitat patches is important to estimating ecosystem service provision, and so to increase the sensitivity of the cluster analysis to differences between low and median values, a square root transformation was applied to metrics prior to normalization that exhibited a roughly log-normal distribution (Table 5).

Following transformation, many metrics still contain extreme outlier values. For example, the watershed area draining to Salmon Bay, or the historical wetland area of Padilla Bay greatly exceeds that for all other coastal inlets. In these cases, outlier values were changed to equal the next highest value within the metric, so that outlier metric scores did not inordinately affect the range used to normalize metrics. Those outlier sites are identified explicitly in results.

3. Quantitative Results

The findings of our quantitative analysis are presented separately for each of four strategies. Preliminary recommendations for restoration and protection are proposed in the recommendations section and are based on cluster analysis groups. For each strategy a full set of maps is provided in Appendix A, that presents a wide range of site parameters and our preliminary recommendations. All metric and cluster group data for each site and strategy are provided in Appendix B.

3.1 River Deltas

Sixteen large river delta sites are identified by Simenstad et al. (2011). Given their limited number, unique character, critical importance in salmon recovery, and social complexity, the major river deltas of Puget Sound will likely require the development of individual ecosystem management plans (see the river delta strategy discussion in section 4.2.1). An “average Puget Sound river delta” has a 740 km^2 watershed and 4.8 km^2 of wetlands, 1.0 km^2 of which are freshwater influenced swamp—a mix of the historical Puyallup, Duwamish, Elwha, and Skokomish River deltas. Most deltas do not fit this description, with most Olympic delta sites falling below this average, and Cascade delta sites commonly exceeding this average. The largest delta sites have a watershed area of 7,154 km^2 (Skagit), an overall wetland area of 77.6 km^2 (Skagit) and historical swamp area of 66.2 km^2 (Snohomish). The three Whidbey Sub-basin deltas (Skagit, Stillaguamish, and Snohomish) together account for 70 percent of all historical delta wetlands in Puget Sound. By contrast the seven Olympic deltas account for less than 5 percent of historical Puget Sound delta wetland area.

Table 5 – Correlation of delta potential metrics.

Metrics	Watershed Area	Swamp Area	Wetland Area
Swamp Area	0.859		
Wetland Area	0.897	0.969	
Delta Length	0.789	0.888	0.926

Table 6 – Correlation of delta degradation metrics.

Metrics	Lost Delta Length	Wetland Loss	Tidal Flow Deg.	Nearshore Impervious
Wetland Loss	0.286			
Tidal Flow Deg.	0.612	0.439		
Nearshore Impervious	0.743	0.340	0.748	
Watershed Impervious	0.839	0.525	0.671	0.842

3.1.1 Delta Metrics

All three delta potential metrics are highly correlated, such that larger river basins tended to have longer delta fronts with larger wetlands containing larger swamps (Table 5).

Watershed *impervious* and *nearshore impervious* are highly correlated, with sites having higher levels of nearshore impervious also having higher levels of watershed impervious (r=0.84). Other degradation metrics are also strongly correlated with the strongest relationships found among *nearshore impervious, lost delta length,* and t*idal flow degradation* (Table 6).

During analysis, we found several data quality issues related to historical mapping of delta wetlands. Skokomish data reports a doubling of vegetated tidal wetland area from the historical record despite substantial wetland area behind dikes at the time of current mapping. This is likely due to a misclassification of historical wetland type EU as current type EM, resulting in the appearance of an increase in vegetated wetlands.

In the Deschutes delta, very few historical tidal wetlands were mapped, resulting in a 20-fold increase in wetland area when compared to current mapping. Similarly the historical record for the Quilcene and the Elwha may under-report wetland area. This trend of apparent under-reporting of historic delta wetland area suggests that Puget Sound wetland loss summary data may also under-report area of wetland losses. While improving and standardizing these data may be useful, they do not affect our ultimate strategic recommendations.

3.1.2 Delta Potential

Potential score ranges from a low of seven at the Duckabush and Hamma Hamma deltas, to 63 at the Skagit out of a maximum possible score of 64. Potential was highest among Whidbey Sub-basin deltas, with the northeastern Puget Sound likely containing a disproportionate quantity of historical delta ecosystem services (Figure 4).

Cluster analysis using watershed area, wetland area, potential swamp and delta length metrics were produced four distinct groups using a SIMPROF permutation test (α=0.05). The Snohomish and Skagit deltas were similar, and very different from other sites (Figure 5).

Half of delta sites fall within a single group of eight lower potential sites (P1) including all Hood Canal and Juan de Fuca sub-basin sites, and the Deschutes River delta in South Sound Sub-basin. Among these smaller deltas, the Skokomish and Dungeness River deltas are most similar and larger in size. The Skagit and Snohomish deltas (P4) consistently ranked the highest across all metrics.

The increase of mean potential score among potential groups is reflected in a general increase across all potential metrics. One exception is between Group P2 and Group P3. While both groups are similar in mean watershed area, the Duwamish and the Puyallup had shorter shorelines, and smaller historical wetlands than the other Cascade deltas and thereby separate into Group P2 (Figure 7).

Overall Group P1 includes a wide continuum of sites, with

Figure 4 – Delta mean potential score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each sub-basin with the count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The gray box indicates a range of 0.5 standard deviations above or below the mean value.

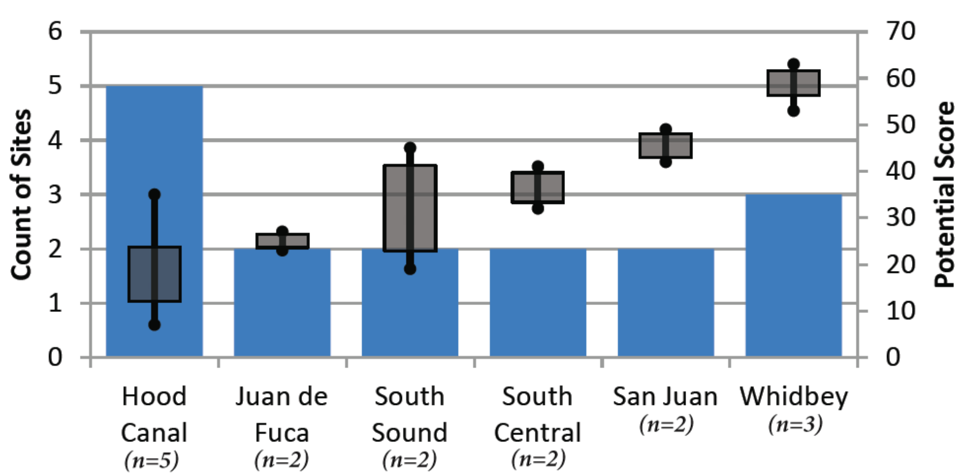


Figure 5 – Delta potential cluster dendrogram. A SIMPROF permutation test with α=0.05 resulted in 4 groups. Group codes were based on calculation of mean potential score, with groups numbered from P1 with the lowest mean score, to P4 with the highest mean score.

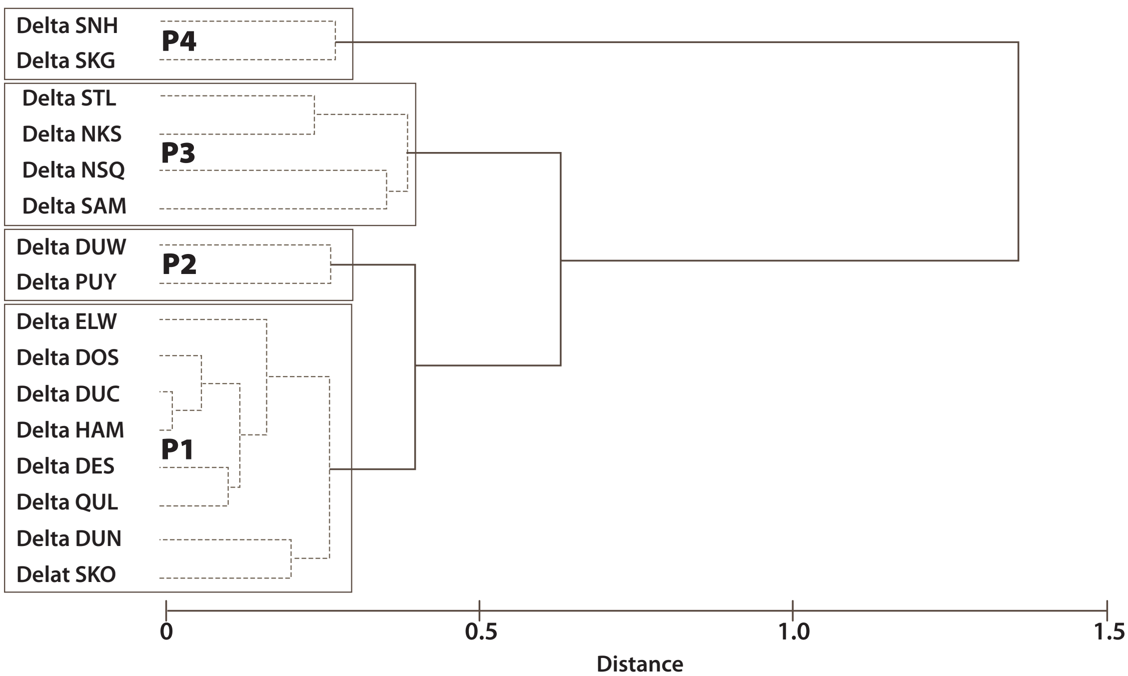


Figure 6 – Delta mean potential score by cluster group. Groups are listed from left to right in order of increasing mean site potential, with a maximum possible score of 64. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The grey box indicates a range within 0.5 standard deviations of the mean value.

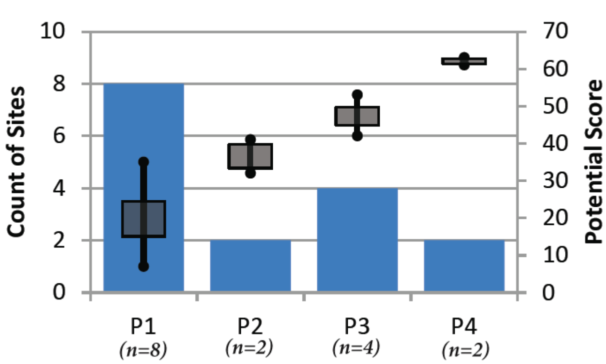


Figure 7 – Delta mean potential metrics by cluster group. Cluster groups are listed in order of increasing mean potential score. Metrics are normalized (division by maximum) with a maximum possible score of one for each metric.

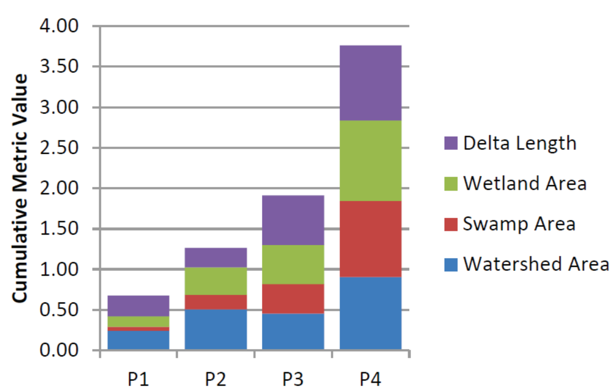
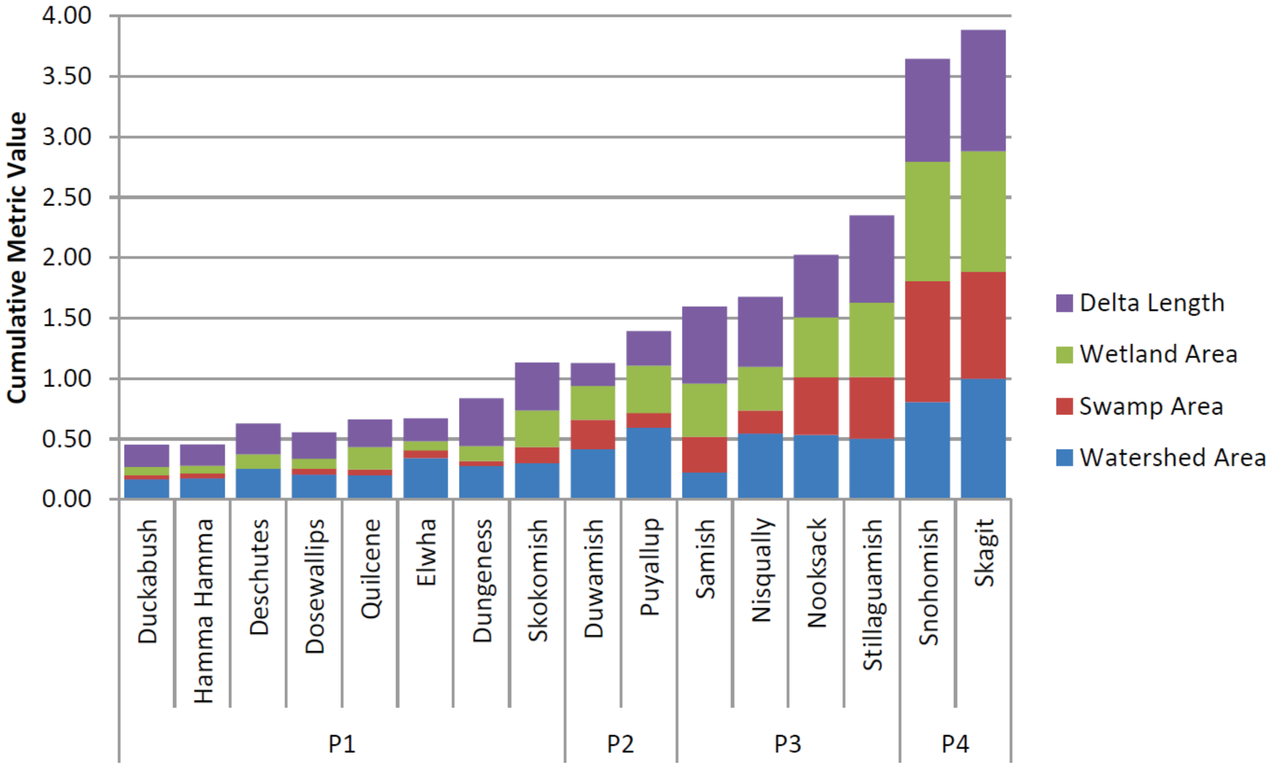


Figure 8 – Delta potential metrics for individual delta sites. Sites are listed in order of increasing rank-sum potential score. Metrics are normalized (division by maximum) with a maximum possible score of one for each metric.



Skokomish in Group P1 having a similar potential score to the Duwamish in Group P2, though with a substantially smaller watershed. The Skagit and Snohomish Deltas clearly stand out by all metrics as having much greater historic potential than other deltas in Puget Sound (Figure 8).

Potential groups are distributed unevenly among sub-basins. The seven delta sites in Hood Canal and Juan de Fuca sub-basins are smaller systems in Group P1. The massive P4 deltas, including the Snohomish and Skagit, are both found in the Whidbey Sub-basin, along with the Stillaguamish delta in Group P3 (Figure 9). Two of the remaining P3 deltas are also located in the north Puget Sound in the San Juan Sub-basin.

The importance of deltas in the historical character of sub-basins can also be described by the historical delta shoreline length as a proportion of total sub-basin shoreline length (Table 7). The Whidbey Sub-basin stands out again, with 53 percent of shoreline length historically composed of river delta landform. However, Hood Canal, with its high frequency of relatively small systems, contains a relatively high proportion of delta shoreline compared to other sub-basins. North Central Sub-basin lacks any delta shoreline, and so all tidal wetland services are provided by barrier embayments and coastal inlets.

Figure 9 – Delta potential group composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar.

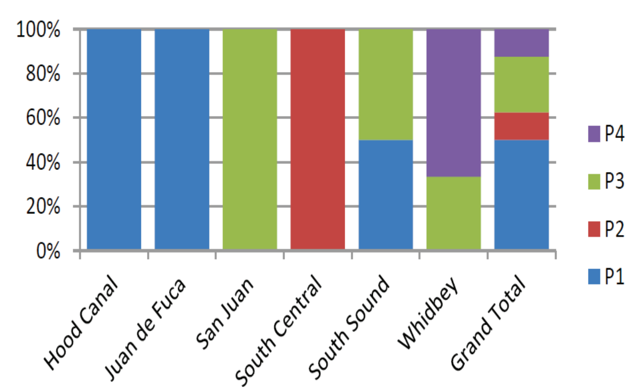


Table 7 – Delta length as a proportion of sub-basin shoreline length. Shoreline length by sub-basin uses the current ShoreZone shoreline, and for ease of calculation does not include shoreline process units shared between sub-basins. Delta shoreline length figures are from historical mapping (Simenstad et al. 2011).

Sub-basin	Approx. Shoreline Length (km)	Delta Shoreline Length (km)	Delta as % of Shoreline Length
Hood Canal	395	48	12.2%
Juan de Fuca	329	29	8.8%
North Central	249	-	0.0%
San Juan	1,187	101	8.5%
South Central	648	18	2.8%
South Sound	725	60	8.3%
Whidbey	634	336	52.9%

3.1.3 Delta Degradation

The degradation of deltas varies dramatically among Puget Sound Sub-basins. Degradation scores range from 6 at the Elwha to 76 at the Duwamish, with a maximum possible score of 80. The South Central Sub-basin and South Sound have the highest mean degradation. Juan de Fuca and Hood Canal have the lowest mean degradation score (Figure 10).

Cluster analysis divided sites into two distinct degradation groups (SIMPROF; α=0.05). Group D2 includes the three urbanized deltas: Duwamish, Puyallup, and Deschutes. The remaining 13 sites form a more difficult to separate continuum of sites, although the Cascade and Olympic deltas each appear similar as groups, with Cascade deltas having higher degradation scores (Figures 11 and 12). The most degraded river deltas are concentrated in the South Central and South Sound sub-basins, with the least degraded deltas in the Juan de Fuca and Hood Canal sub-basins (Figure 15).

The intersection of degradation and potential groupings suggests the division of Puget Sound river deltas into five distinct groups. The more highly degraded urban deltas (D2) straddle two potential groups, with the Deschutes being more diminutive (Group P4) than the Puyallup and Duwamish (Group P3), which are more similar in terms of watershed, wetlands, and length (Table 10). The great swamps of the Skagit and Snohomish are uniquely large systems, and thus, distinct from the four remaining Cascade deltas. The Olympic deltas fall into a single group of smaller less degraded sites, among which the Skokomish and the Dungeness have the highest potential score.

Figure 10 – Delta mean degradation score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site degradation score. The blue bars and left axis indicate the number of sites within each sub-basin with the exact count indicated above the bar. The range of site degradation found within each sub-basin is indicated by the black bar and the right axis. The grey box indicates a range within 0.5 standard deviations above and below the mean value.

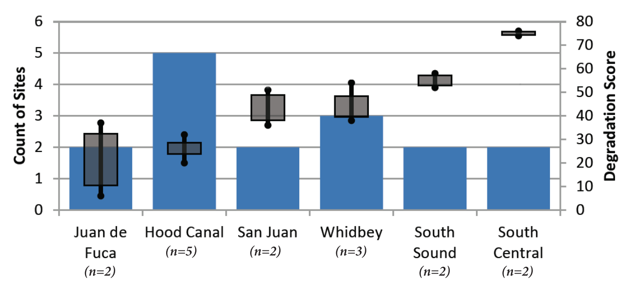


Figure 11 – Delta degradation cluster dendrogram. A SIMPROF permutation test with α=0.05 resulted in 2 groups. Site codes were based on calculation of mean degradation score, Group D1 with the lowest mean score and D2 with the highest mean score.

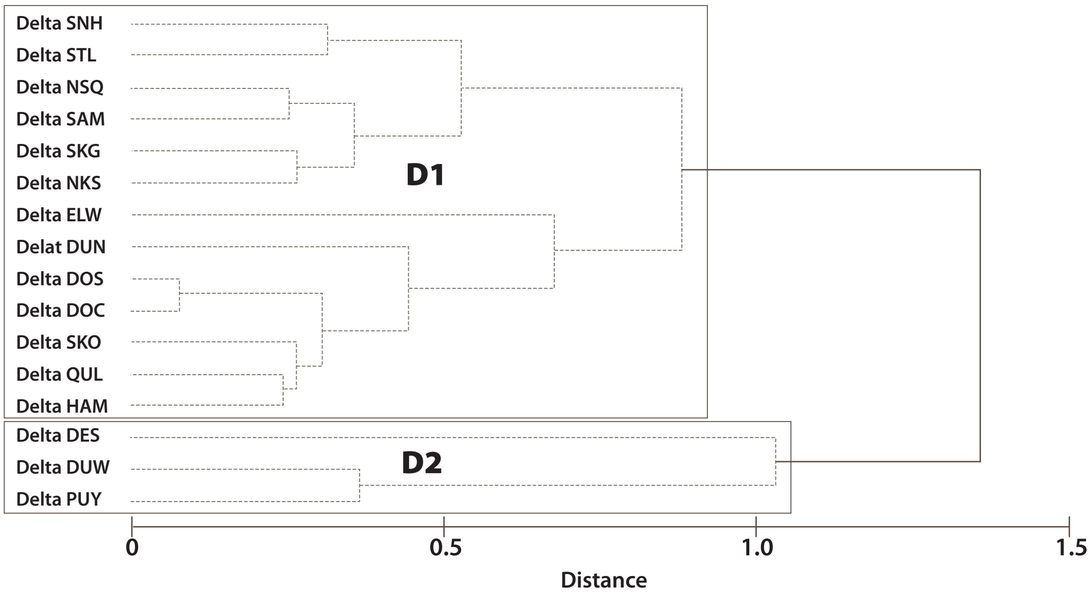


Figure 12 – Delta mean degradation score by cluster group. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar. The range of site degradation found within each group is indicated by the black bar and the right axis. The grey box indicates a range within 0.5 standard deviations of the mean value.

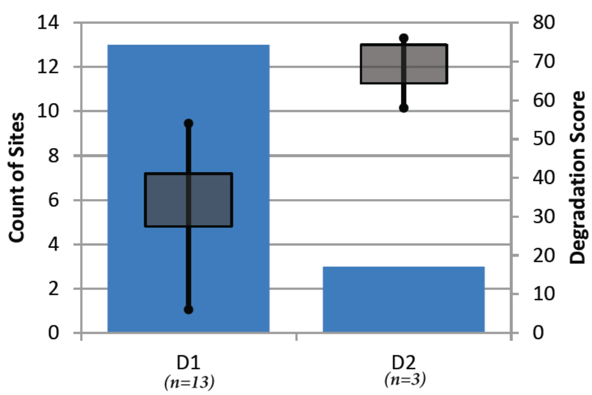


Figure 13 – Delta mean degradation metrics by cluster group. Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated within the bar graph. Mean values among all sites are provided on the far right bar.

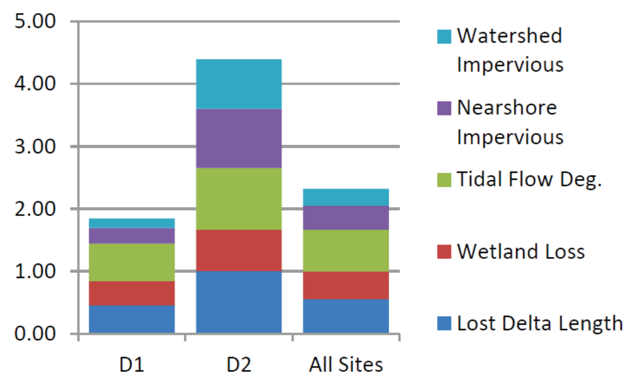
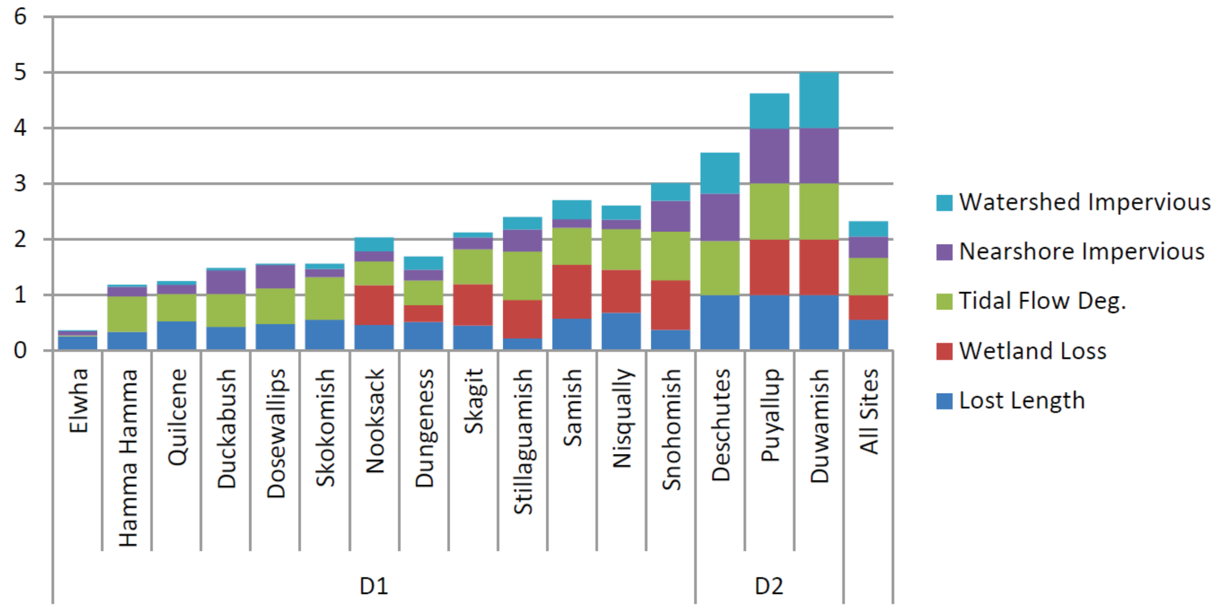


Figure 14 – Delta degradation metrics by site. Cluster groups are listed in order of increasing degradation score (based on rank-sum and not the sum of mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean values among all sites are provided on the far right bar.



3.1.4 Delta Risk Factors

Anticipated future development and dam impoundment estimates are summarized in Table 9. Cascade deltas generally face a higher risk of future development than Olympic deltas. Increase in watershed development is highest in urban delta watersheds (Duwamish, Puyallup and Deschutes), as well as the Nooksack, and Samish watersheds. Anticipated development in the nearshore zone is highest in the Deschutes, but also well distributed among cascade deltas. Among the most severely impounded watersheds, the historic removal of Elwha dams is underway at the time of this writing, and removal of the Deschutes dam has been well studied but is not imminent. Both the Skagit and Snohomish have some level of dam impoundment that should be considered in restoration of these massive systems.

Figure 15 – Delta degradation group composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar for comparison.

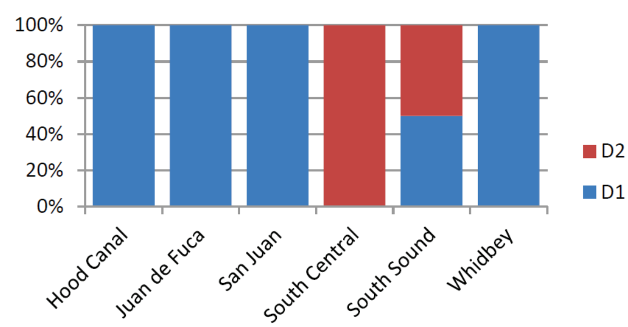


Table 8 – Distribution of 16 deltas by degradation and potential group and score. The list of 16 delta sites is divided into five groups based on a unique combination of potential and degradation group membership.

Delta Group	Delta Site	Potential Group	Potential Score	Degradation Group	Degradation Score
Great Swamps	Skagit	P4	63	D1	38
	Snohomish	P4	61	D1	54
Cascade Deltas	Stillaguamish	P3	53	D1	40
	Nooksack	P3	49	D1	36
	Nisqually	P3	45	D1	52
	Samish	P3	42	D1	51
Urban Deltas	Puyallup	P2	41	D2	74
	Duwamish	P2	32	D2	76
Deschutes	Deschutes	P1	19	D2	58
Olympic Deltas	Skokomish	P1	35	D1	32
	Dungeness	P1	27	D1	37
	Elwha	P1	23	D1	6
	Quilcene	P1	21	D1	24
	Dosewallips	P1	19	D1	29
	Duckabush	P1	7	D1	26
	Hamma Hamma	P1	7	D1	20

Table 9 – Delta Risk Metrics. Groupings follow table 8. Asterisk (*) indicates a relatively moderate risk classification; double asterisk (**) indicates a high risk classification. Increase in impervious based on 60 year population increase projection (Bolte & Vache 2010). Watershed impoundment based on Simenstad et al. (2011).

Delta Group	Name	Increase in nearshore impervious area (%)	Increase in watershed impervious area (%)	Dam Impoundment
Great Swamps	Skagit	6.4 **	2.4	53%*
	Snohomish	3.6 *	4.1	53%*
Cascade Deltas	Nisqually	4.6 *	5.0*	44%*
	Nooksack	3.6 *	7.7**	0%
	Samish	5.6 *	8.3**	2%
	Stillaguamish	3.6 *	4.8*	0%
Deschutes	Deschutes	11.5 **	9.1 **	100%**
Urban Deltas	Duwamish	5.2 *	8.2**	52%*
	Puyallup	0.4	7.6**	43%*
Olympic Deltas	Dosewallips	1.3	1.0	0%
	Duckabush	1.3	1.0	0%
	Dungeness	2.0	1.1	0%
	Elwha	-	0.0	98%**
	Hamma Hamma	0.2	0.7	0%
	Quilcene	1.4	2.4	0%
	Skokomish	0.7	3.1	42%*

3.2 Beaches

Puget Sound includes 744 independent littoral cells that either contain or once contained a bluff-backed beach, indicating potential for active recruitment and transport of sediment (Table 10). A median beach site is 1.9 km long, with 289 meters of barrier beach, and one stream mouth every four kms. Extremely high potential sites may contain 50 km of beach (Seattle to Everett), 17.1 km of barrier beach (Dungeness Spit), or over 6 stream mouths per km (along a small drift cell along North Shore Road in southwest Kitsap County).

Several very small drift cells were included in the analysis (19 sites have beaches less than 200 meters in length). This extreme variation in beach length, orientation, and interaction between beaches, as well as the potential for distinct sub-cells within a mapped drift cell, suggests that a more refined classification of these systems might better inform restoration and protection practice.

3.2.1 Beach Metrics

Beach length appears to have a log-normal distribution, with two-thirds of beaches shorter than 3,500 meters, and the remaining third ranging out to 20 times that length. While 147 sites have no barrier beach present, among sites with a barrier beach, the proportion of barrier is very broadly distributed around a median of 21.5 percent. Sites where barrier beach comprises over 70 percent of beach length are mostly limited to sites less than 5,000 meters long.

There are no mapped stream mouths at 339 sites, and stream density at the remaining sites is distributed broadly around a median of one stream every 1.1 km. Sites with no streams were typically small beaches. Beach systems without mapped stream mouths were conspicuously common in South Sound, Whidbey and San Juan sub-basins. Beach potential metrics showed negligible correlation (Table 11).

Sediment supply degradation is evenly distributed from zero to 100 percent except for a block of 160 sites with near zero sediment supply degradation, and another block of 72 sites with near 100 percent sediment supply degradation. By contrast, our nearshore impervious metric follows a declining distribution, with a block of 84 sites with near zero, and a decreasing frequency of sites as impervious surface levels increase, and a median among all sites of 18 percent.

Parcel density was distributed relatively evenly across low and moderate levels until around 20 parcels per km, at which point the frequency declines to a maximum value of 54 parcels/km. Parcel densities of over 40 parcels/km were

Table 10 – Summary statistics for beach sites.

Statistic	Value
Number of Sites	744
Beach Length (m)	
Maximum	63,229
Mean	3,894
Minimum	16
Percent Barrier Beach (%)	
Maximum	99.7
Mean	20.6
Minimum	0.0
Stream Count (#)	
Maximum	48
Mean	2
Minimum	0
Stream Density (#/km)	
Maximum	6.13
Mean	0.66
Minimum	0

Table 11 – Correlation of beach potential metrics.

Metrics	Length	Barrier Prevalence
Barrier Prevalence	0.083	
Stream Mouth	0.127	-0.056

Table 12 – Correlation of beach degradation metrics.

Metrics	Sediment Supply Deg.	Nearshore Impervious
Nearshore Impervious	0.512	
Parcel Density	0.429	0.315

only maintained at beaches less than approximately 6,000 meters in length. Degradation metrics show moderate to low positive correlation, such that sites with higher nearshore impervious levels tend to have higher sediment supply degradation and higher parcel density (Table 12).

3.2.2 Beach Potential

Potential score is based on the sum of length, barrier prevalence and stream density rank, and ranges from 3 to 1,998 with a maximum possible score of 2,232. The top third of sites have scores above 1,354, while the bottom third of sites have scores below 790, with a mean score of 1,026. North Central and Juan de Fuca sub-basins have the highest mean site potential, although mean site potential does not vary dramatically among sub-basins. South Central and San Juan sub-basins have the lowest mean site potential among beach sites (Figure 16).

North Central, Hood Canal and Juan de Fuca sub-basins have a relatively high proportion of sites with high potential score, and an absence of sites with particularly low potential (Table 13). A large proportion of small beaches without stream mouths are found in South Puget Sound.

Perhaps due to the combination of very low correlation among potential metrics, and a general lack of outliers, no significantly different groups of sites could be identified using an agglomerative cluster analysis and the SIMPROF test, even allowing for a high Type I error (α=0.10). It is clear that there is substantial variation among Puget Sound beaches. Exploratory work using a wider range of metrics would be useful for better differentiating among Puget Sound beaches for the purpose of developing restoration and protection policy.

3.2.3 Beach Degradation

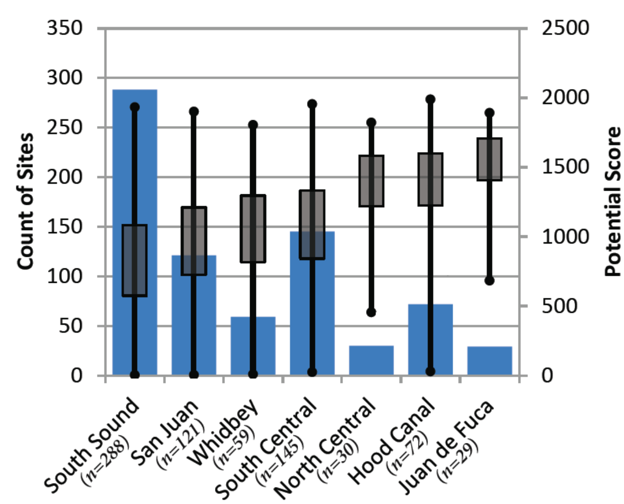
Degradation score reflects a sum of the ranks of sediment supply degradation, nearshore impervious and parcel density. Degradation score ranges from 3 to 2,127. The top third of sites have scores above 1,423, while the bottom third of sites have scores below 870, with a mean score of 1,092. Degradation is unevenly distributed among sub-basins, with Juan de Fuca and North Central sub-basins having the lowest mean degradation score. Predictably, South Central Sub-basin has the highest proportion of highly degraded beaches (Figure 17; Table 14).

Cluster analysis produced 17 distinct groups with a Type I error set at 0.05. 16 groups were identified with error allowance reduced to 0.01. As the additional division offered no substantive improvement in our ability to discuss restoration or protection policy, we retained the 16 group dendrogram (Figure 18).

Table 13 – Beach potential classes by sub-basin. Class is based on division of all sites in to three groups with an equal number of sites. Highest, Medium and Lowest groups are based on rank order.

	Percent			
Sub-basin	**HIGHEST**	**MED**	**LOWEST**	**Total**
Hood Canal	68%	25%	7%	72
Juan de Fuca	83%	14%	3%	29
North Central	60%	33%	7%	30
San Juan	22%	49%	29%	121
South Central	37%	34%	29%	145
South Sound	20%	28%	52%	288
Whidbey	31%	44%	25%	59
Puget Sound	33%	33%	33%	744

Figure 16 – Beach mean potential score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each sub-basin with the count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The box indicates a range of 0.5 standard deviations above and below the mean value.



D1 through D6 are more similar to each other than to other groups, and all have relatively low mean degradation scores. D11 through D16 are composed of relatively degraded sites, with D11 notable as a group of 36 sites in relatively developed landscapes with low estimated sediment supply degradation (Figure 19). While 16 distinct groups provide a complicated basis for discussion, consideration of the relationships among groups described by the dendrogram provides useful insight into the differences among beaches with similar degradation index scores. Group D12 is very similar to the highly degraded Groups D15 and D16, except in a notably lower mean parcel density. Group D14 is more closely related to the less degraded groups, except by the presence of exceptionally high parcel density. The detection of these patterns suggests the value of multivariate analysis as a compliment to index development.

Based on mean degradation scores, three general levels of degradation can be seen among groups. Groups D1 through D6 show relatively low levels of degradation. Groups D7 through D10 show moderate levels of degradation. Groups D11 through D16 show the highest levels of degradation (Figure 19).

The uneven distribution of highly degraded sites can be seen in the distribution of groups among sub-basins. Groups D15 and D16, representing the most degraded shorelines in Puget Sound, constitute a majority of sites within the South Central Sub-basin. Group D8, 26 sites with high parcel density but relatively low shoreline development, disproportionately occur in Hood Canal (Figure 21).

Table 14 – Beach degradation class by sub-basin. Degradation class is based on division of all sites in to three groups with an equal number of sites. Higher, Medium and Lower groups are based on rank order.

	Percent by Degradation Class			
Sub-basin	**HIGHEST**	**MED**	**LOWEST**	**Total**
Hood Canal	26%	35%	39%	72
Juan de Fuca	7%	48%	45%	29
North Central	7%	43%	50%	30
San Juan	17%	28%	55%	121
South Central	64%	29%	7%	145
South Sound	33%	30%	36%	288
Whidbey	25%	54%	20%	59
Puget Sound	33%	33%	33%	744

Figure 17 – Beach mean degradation score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site degradation. The blue bars and left axis indicate the number of sites within each sub-basin with the count indicated above the bar. The range of site degradation found within each sub-basin is indicated by the black bar and the right axis. The box indicates a range of 0.5 standard deviations above and below the mean value.

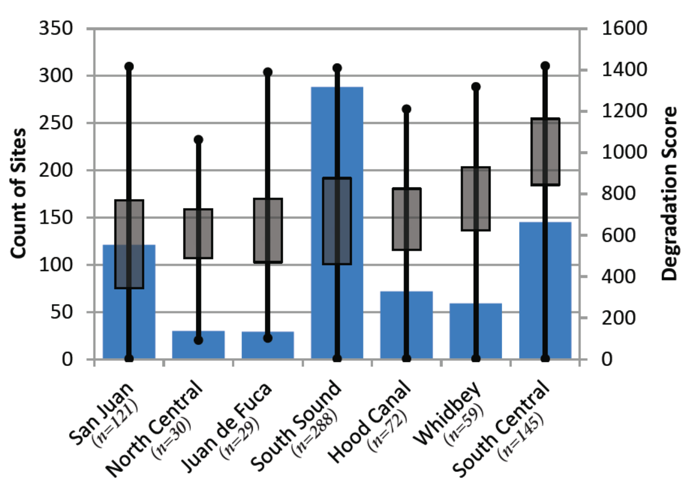


Figure 18 – Beach degradation cluster dendrogram. Sediment supply degradation, nearshore impervious, and parcel density metrics were used to complete an agglomerative hierarchical cluster analysis of all sites using a group mean clustering algorithm. A SIMPROF permutation test with p=0.01 resulted in 16 groups. Site codes were based on calculation of mean degradation score, with groups numbered from D1 with the lowest mean score, to D16 with the highest mean score.

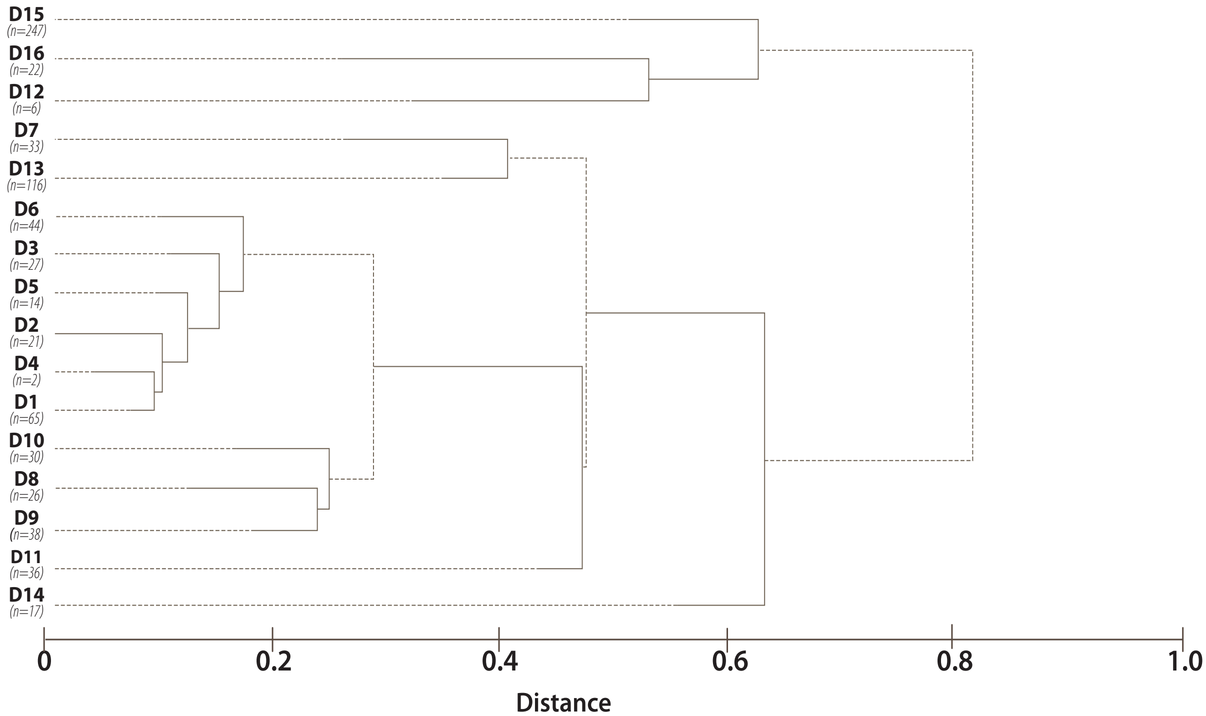


Figure 19 – Beach mean degradation score by cluster group. Groups are listed from left to right in order of increasing mean site degradation. The blue bars and left axis indicate the number of sites within each degradation group with the exact count indicated above the bar. The range of site degradation found within each group is indicated by the black bar and the right axis. The grey box indicates a range within 0.5 standard deviations of the mean value.

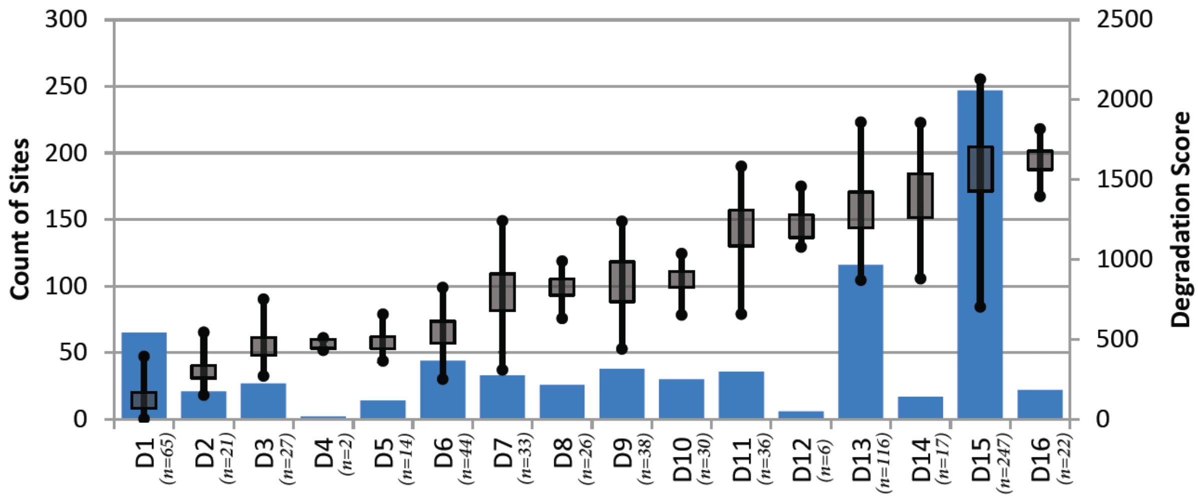


Figure 20 – Beach mean degradation metrics by cluster group. Cluster groups are listed in order of increasing degradation score (based on rank-sum and not the sum of mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated by the bar graph. Mean values among all sites is provided in the far right bar.

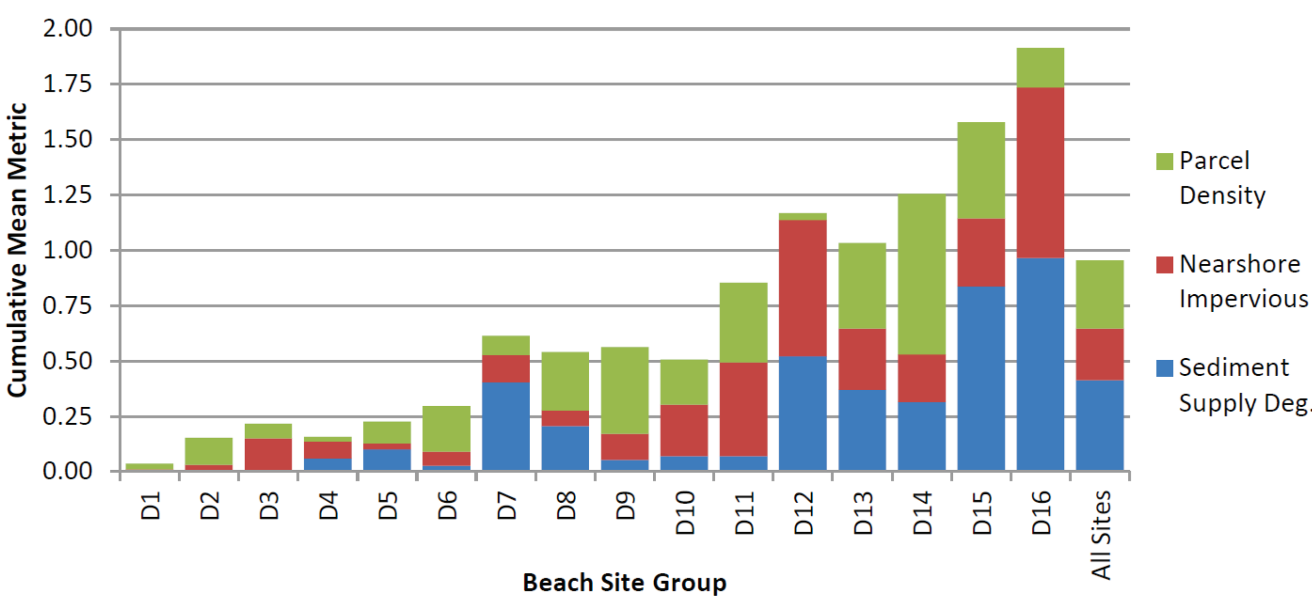
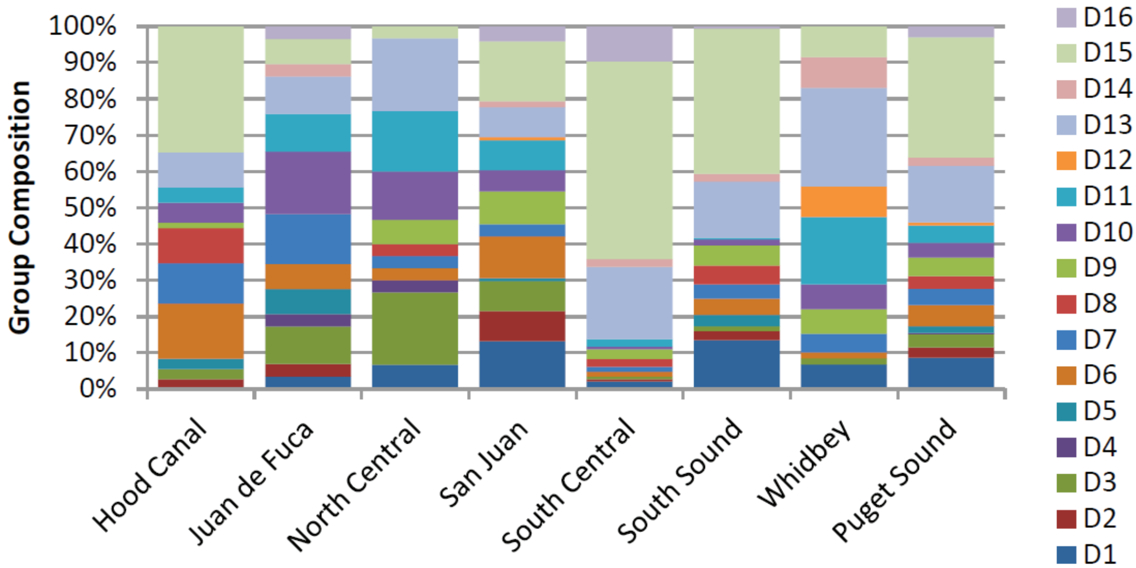


Figure 21 – Beach degradation group composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar for comparison.



3.2.4 Beach Risk Factors

Risk from increasing nearshore impervious cover was based on 60 year population projections by Bolte & Vache (2010). Nearshore impervious risk displays an exponential distribution, with many sites showing no or very low levels of increase, and few sites showing increasingly high levels. 404 beach sites show no increase in impervious surface under future population growth models. A risk rating was assigned based on standard deviations above the mean, such that low risk sites have an increase in percent impervious less than 1 standard deviation above the mean (5.8 points) and high risk sites more than two standard deviations above the mean (10 points). Risk from future shoreline development is concentrated in the San Juan, South Central and South Sound sub-basins (Table 16).

Breakwater jetty influence was found at 94 beach sites in Puget Sound. Risk rating was again based on standard deviations above the mean. Sites with greater than 19.5 percent of their length down drift of a breakwater jetty were classed as medium risk, while sites with greater than 34.6 percent were classed as high risk. Juan de Fuca, Whidbey, and South Central tended to have a disproportionate representatin of the highest risk sites, with South Sound and Hood Canal having very few high risk sites (Table 17).

Active Railroad was only found at 25 beach sites in Puget Sound. A rating was again based on standard deviations above the mean. Sites with greater than 7.1 percent of their length in active railroad were classed as medium impact, while sites with 13.4 percent of their length in active railroad were classed as high impact. All degradation from Active Railroad is found in three discrete areas in South Sound, South Central, and San Juan sub-basins (Table 18).

Table 15 – Beach future shoreline development risk classes by sub-basin. HIGHEST indicates sites where increase in percent impervious is more than two std. dev. above mean; MED = one std. dev. above mean; LOWEST = increase present but within 1 std. dev. of mean.

	Percent by Future Development Risk				Count by Future Development Risk				
Sub-basin	HIGHEST	MED	LOWEST	NONE	HIGHEST	MED	LOWEST	NONE	TOTAL
Hood Canal	0.0%	0.0%	30.6%	69.4%			22	50	72
Juan de Fuca	0.0%	0.0%	62.1%	37.9%			18	11	29
North Central	0.0%	3.3%	66.7%	30.0%		1	20	9	30
San Juan	5.8%	2.5%	37.2%	54.5%	7	3	45	66	121
South Central	16.6%	3.4%	46.2%	33.8%	24	5	67	49	145
South Sound	1.7%	2.8%	27.4%	68.1%	5	8	79	196	288
Whidbey	0.0%	5.1%	55.9%	39.0%		3	33	23	59
Puget Sound	4.8%	2.7%	38.2%	54.3%	36	20	284	404	744

Table 16 – Beach breakwater/jetty risk classes by sub-basin. HIGH indicates sites where percent of drift cell down drift of a breakwater/jetty system is more than two std. dev. above mean; MED = one std. dev. above mean; LOWEST = increase present but within 1 std. dev. of mean.

	Percent by breakwater/jetty risk				Count by breakwater/jetty risk				
Sub-basin	HIGHEST	MED	LOWEST	NONE	HIGHEST	MED	LOWEST	NONE	TOTAL
Hood Canal	1.4%	2.8%	2.8%	93.1%	1	2	2	67	72
Juan de Fuca	27.6%	3.4%	3.4%	65.5%	8	1	1	19	29
North Central	3.3%	10.0%	3.3%	83.3%	1	3	1	25	30
San Juan	7.4%	2.5%	5.0%	85.1%	9	3	6	103	121
South Central	9.0%	4.8%	4.8%	81.4%	13	7	7	118	145
South Sound	1.4%	0.3%	3.1%	95.1%	4	1	9	274	288
Whidbey	10.2%	8.5%	6.8%	74.6%	6	5	4	44	59
Puget Sound	5.6%	3.0%	4.0%	87.4%	42	22	30	650	744

Table 17 – Beach active railroad risk classes by sub-basin. HIGH indicates sites where percent of drift cell with active railroad is more than two std. dev. above mean; MED = one std. dev. above mean; LOWEST= increase present but within 1 std. dev. of mean.

	Percent by active railroad risk class				Count by active railroad risk class				
Sub-basin	HIGHEST	MED	LOWEST	NONE	HIGHEST	MED	LOWEST	NONE	TOTAL
Hood Canal	0.0%	0.0%	0.0%	100.0%				72	72
Juan de Fuca	0.0%	0.0%	0.0%	100.0%				29	29
North Central	0.0%	0.0%	0.0%	100.0%				30	30
San Juan	3.3%	2.5%	1.7%	92.6%	4	3	2	112	121
South Central	1.4%	2.1%	2.8%	93.8%	2	3	4	136	145
South Sound	2.1%	0.3%	0.0%	97.6%	6	1		281	288
Whidbey	0.0%	0.0%	0.0%	100.0%				59	59
Puget Sound	1.6%	0.9%	0.8%	96.6%	12	7	6	719	744

3.3 Barrier Embayments

Barrier-type embayments are found in historical or current mapping in 518 Puget Sound SPUs. The average site has 1.9 barrier embayments (Table 18). 246 sites have more than 1 barrier embayment; 68 sites have more than 3 embayments. A median barrier embayment site contains 2.3 km of beach and a single embayment surrounding 137 m^2 of wetland. Outliers include sites with 42.2 km of beach (Seattle to Everett), 15 embayments (southwest Harstene Island), or 47 km^2 of wetland (Padilla Bay). At 100 sites, barrier embayments are found in the convergence zone with an adjacent drift cell (i.e. 50 instances where two neighboring drift cells share a barrier embayment). For 59 of those 100 sites the shared embayment is the only embayment within the site.

In addition to evaluating barrier embayments at a drift cell scale, an *embayment isolation* metric was developed for individual embayments found in historical mapping with a shoreline length reduced to zero under current conditions. These 'lost barrier embayments' of Puget Sound include 68 barrier embayments, 73 barrier lagoons, and 142 closed lagoon marshes, with a median shoreline length of 349 meters.

South Sound Sub-basin has the highest count and density of barrier embayments in Puget Sound, followed by Hood Canal Sub-basin. San Juan and Whidbey sub-basins have both the lowest density of barrier embayments, as well as the lowest proportion of shoreline length in barrier embayment landform. North Central Sub-basin is noteworthy in that while barrier embayment density is low, it has a very high proportion of its shoreline length in its few large embayment shorelines. Since North Central Sub-basin is the only sub-basin without a river delta site, this reinforces the importance of barrier embayment associated wetlands in this sub-basin (Table 19).

Table 18 – Summary statistics for all barrier embayment sites.

Statistic	Value
Number of Sites	**518**
Embayment Density (count/km)	
Minimum[1]	0
Average	2.46
Maximum	570.83
Historical Embayment Length (m)	
Minimum[1]	0
Average	1,633
Maximum	23,526
Embayment Count	
Minimum[1]	0
Average	1.86
Maximum	15
Total Beach Length (km)	
Minimum[2]	0
Average	3.83
Maximum	42.24
Wetland Area (ha)	
Minimum[1]	0
Average	12.57
Maximum	471.65

[1] Thirteen sites with current embayments have no mapped historical embayments.

[2] Nine sites with a barrier type embayment shoreform present had no beach shoreform present within the SPU.

3.3.1 Barrier Embayment Metrics

Embayment density displays a log-normal distribution with a peak frequency of around 0.3 embayments per km, a median at 0.6, and a very long tail of higher values. Three sites show exceptional historical embayment density metrics resulting from their very short beach length (the divisor in calculating the density statistic). Density values for these three outlier sites (SPU 7020, 5004, and 7024) were excluded from normalization (i.e. their values were not considered the 'maximum' and were not used as the divisor for normalization) and were given a normalized score of 1. Embayment density was negligibly correlated with other potential metrics (Table 20).

Embayment length also shows a log-normal distribution, with a mean length of 1,634 meters, and a median of 774 meters. SPU 5033 (southwest Whidbey Island) had the highest length of barrier embayment shoreline at 23,526 meters. The next highest value was 15,524 meters. Neither was re-scored for normalization. Embayment length is strongly correlated with wetland area such that longer embayments tend to have larger vegetated wetlands (Table 20).

Wetland area also shows a log normal distribution with the exception of 50 sites which have no mapped historical or current vegetated wetlands within their embayments. While Padilla Bay had the greatest wetland extent, it was not notably higher than other barrier embayment systems along the southwest Whidbey Island shoreline.

Loss of length appears to have a very broad normal distribution around a mean of 42 percent, but with a block

Table 19 – Barrier embayment sites by sub-basin.

Sub-basin	Count of Sites	Count of Hist. Embayments	Total Hist. Embayment Length (km)	Sub-basin Shoreline Length (km)	Sites/km	Embayment as proportion of Sub-basin Length
Hood Canal	64	112	108	395	0.28	27%
Juan de Fuca	23	38	47	329	0.12	14%
North Central	29	48	100	249	0.19	40%
San Juan	89	79	238	1187	0.07	20%
South Central	88	116	137	648	0.18	21%
South Sound	179	292	305	725	0.40	42%
Whidbey	46	54	83	634	0.09	13%

Table 20 – Correlation of barrier embayment potential metrics.

Metrics	Embayment Length	Embayment Density
Embayment Density	-0.100	
Wetland Area	0.773	-0.194

of 137 sites reporting 100 percent loss of length, and 107 with no loss of length. It is important to recognize that a difference between historical and current length can result from mapping error, and so mapped loss of length may not indicate fill or site alteration, but rather higher loss of length suggests an increasing probability of modification.

Sediment supply degradation was evenly distributed with a block of 47 sites reporting complete degradation of sediment supply, and 107 sites with no estimated degradation. Tidal flow degradation showed a similar pattern, with a greater frequency at low values. Nearshore impervious by contrast, and consistent with other strategies, shows a log-normal distribution around a mean of 24 percent.

Correlation among barrier embayment degradation variables was generally weak, with the strongest correlation between nearshore impervious and sediment supply degradation (Table 21). Tidal degradation was weakly correlated with loss of length.

3.3.2 Barrier Embayment Potential

Potential score varies from 3 to 1,418 with a maximum possible score of 1,554. The top third of sites have scores above 946, while the bottom third of sites have scores below 632, with a mean score of 777. North Central and Juan de Fuca sub-basins have the highest mean potential score, though mean site potential of barrier embayment systems does not vary dramatically among sub-basins. Higher mean site potential appears to be driven by the absence of lower potential sites in some sub-basins. South Central and South Sound sub-basins have the lowest mean site potential, as well as a large number of small barrier embayment sites (Figure 22).

The distribution of site potential classes was even among sub-basins, with South Central Sub-basin alone having a notably high proportion of high potential sites, and Juan de Fuca Sub-basin showing the opposite tendency, with relatively few embayment systems in high potential classes (Table 22).

An initial cluster analysis of potential metrics returned 23 distinct groups (SIMPROF α=0.05). By reducing the Type 1 error allowance, this was reduced to 10 distinct groups (SIMPROF α=0.01). The reduced error allowance decreased distinctions among sites within Group P2, a large group of low potential sites. As the purpose of our analysis was to identify important sites, we retained the 10 group dendrogram for our analysis (Figure 23).

Table 21 – Correlation of barrier embayment degradation metrics.

Metrics	Loss of Length	Sediment Supply Degradation	Tidal Flow Degradation
Sediment Supply Degradation	0.184		
Tidal Flow Degradation	0.349	0.192	
Nearshore Impervious	0.214	0.483	0.262

Figure 22 – Barrier embayment mean potential score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each sub-basin with the exact count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The gray box indicates a range within 0.5 standard deviations above and below the mean value.

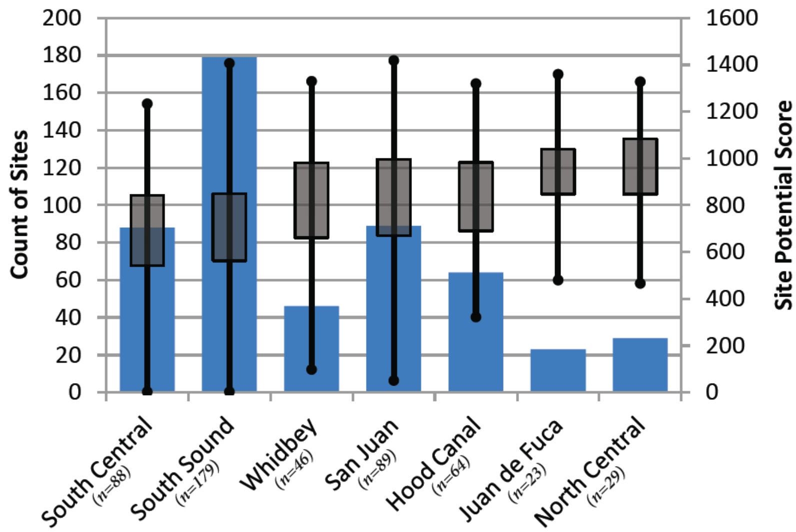


Table 22 – Barrier embayment potential class by sub-basin. Class is based on division of all sites evenly into high/medium/low groups based on rank order. The number of sites is unevenly distributed among sub-basins. Within each sub-basin, the ratio of sites among potential classes also varies.

	Percent by Potential Class			
Sub-basin	HIGH	MED	LOW	Total
Hood Canal	31%	27%	42%	64
Juan de Fuca	17%	35%	48%	23
North Central	34%	28%	38%	29
San Juan	27%	28%	45%	89
South Central	65%	24%	11%	88
South Sound	23%	42%	35%	179
Whidbey	35%	39%	26%	46
Puget Sound	33%	33%	33%	518

Figure 23 – Barrier embayment potential cluster dendrogram. Embayment length, embayment density, and wetland area were used to complete an agglomerative hierarchical cluster analysis of all sites using a group mean clustering algorithm. A SIMPROF permutation test with p=0.01 resulted in 10 groups. Site codes were based on calculation of mean potential score, with groups numbered from P1 with the lowest mean score, to P10 with the highest mean score.

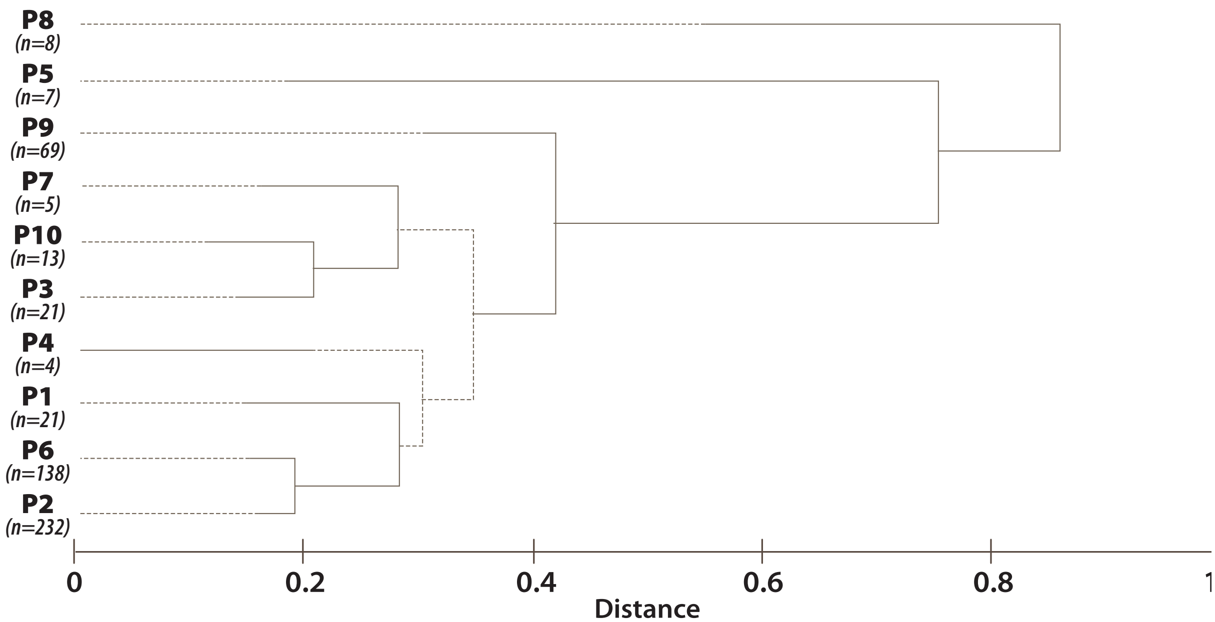


Figure 24 – Barrier embayment mean potential score by group. Groups are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The gray box indicates a range within 0.5 standard deviations of the mean value.

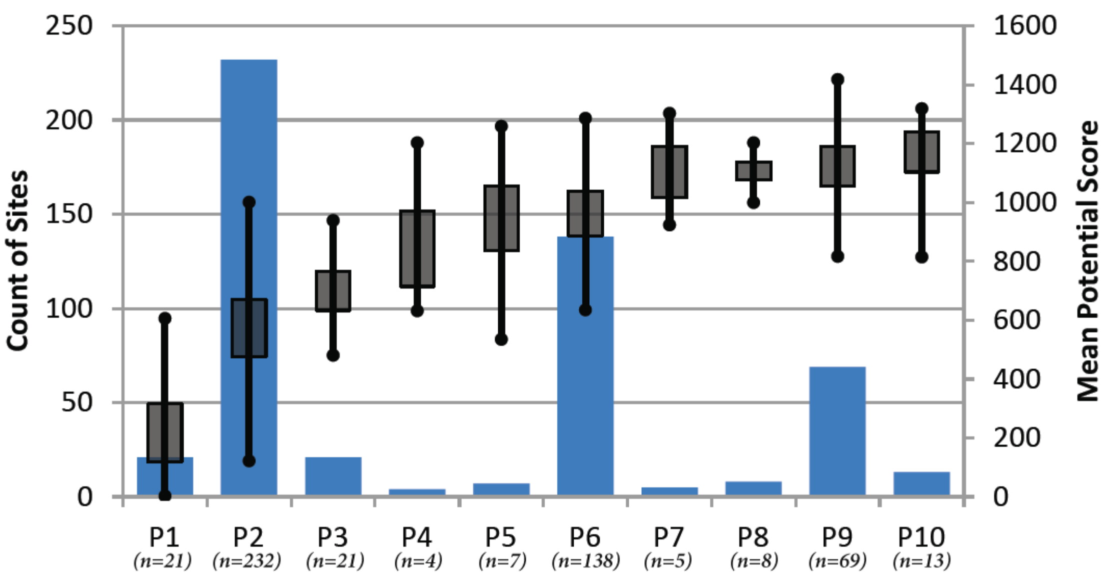


Figure 25 – Barrier embayment mean potential metric by group. Cluster groups are listed in order of increasing potential score (which is based on rank-sum and not the sum of displayed mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated within the bar graph. Mean values among all sites are provided on the far right bar.

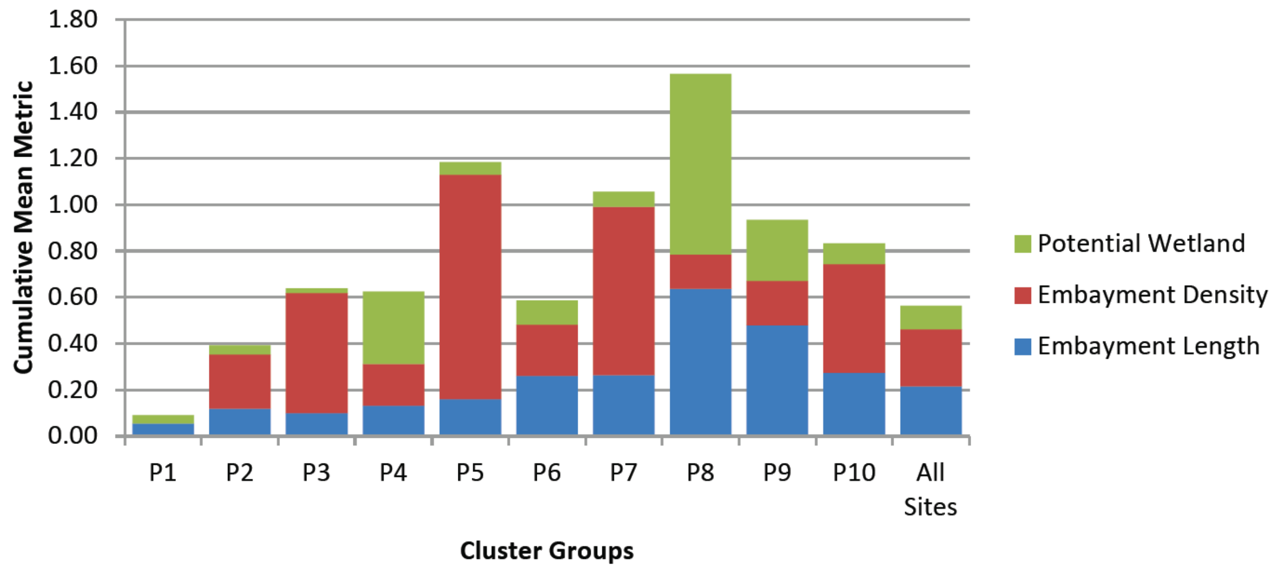
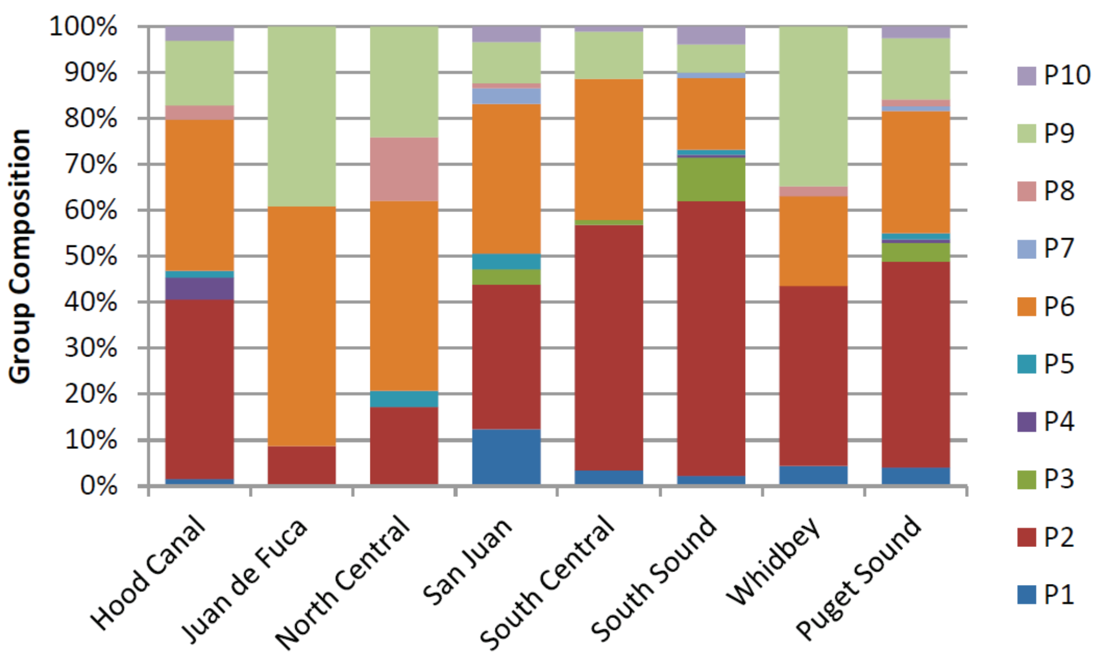


Figure 26 – Barrier embayment potential group composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar.



The majority of sites (85 percent) fall into three large groups. Group P2 (n=232) was composed of systems with smaller than average embayments at an average density. Group P6 (n=138) included sites that are more or less average in all metrics. Group P9 (n=69) includes sites with very long embayments and higher than average wetland area. Other groups range from four to twenty-one sites each (Figures 24 and 25).

The representation of potential groups varies among sub-basins. Group P10 includes systems with very high densities of embayments, although with typical wetland area, and are disproportionately found in the Hood Canal, San Juan and South Sound sub-basins. High density metrics have been observed to sometimes indicate a single embayment on a short drift cell. It is not uncommon to have small drift cells diverge from a bluff, with drift pushed into an immediately adjacent barrier estuary formed in a drowned creek valley. Future analyses may benefit from better classification of drift cell character prior to assessment, using a large number of metrics.

By contrast, the large Group P9 (n=69) includes large embayments with substantial wetlands, at a below average density, and are strongly represented in the Juan de Fuca, Whidbey, and to a lesser degree North Central Sub-basins. Group P2 (n=232) by contrast, includes small embayments with small wetlands at a typical density. Sites in Group P2 are poorly represented in the Juan de Fuca and North Central sub-basins, and are most strongly represented in South Sound, South Central, and Hood Canal sub-basins (Figure 26).

3.3.3 Barrier Embayment Degradation

Barrier embayment degradation scores vary from 4 to 1,801 with a maximum possible score of 2,072. The top third of sites have scores above 1,112, while the bottom third of sites have scores below 726, with a mean score of 921. Degradation metric scores are evenly distributed among Puget Sound Sub-basins, except for Juan de Fuca, which has a low proportion of highly degraded sites, and South Central with a high proportion of highly degraded sites (Table 23).

Sub-basins did not differ dramatically in their mean degradation, containing a range of both degraded and undegraded sites, with the exception of the South Central Sub-basin, which has a relatively high mean degradation score. Whidbey Sub-basin has a relatively narrow range of degradation scores, lacking both highly degraded and undegraded sites (Figure 27).

Cluster analysis returned nine distinct groups (SIMPROF; α=0.05; Figure 28). 66 percent of sites were assigned to three Groups (D1-D3) with mean degradation below 1,000. The remaining sites are distributed in groups with increasing mean degradation score. D9 has the highest mean degradation score and includes 39 of the most severely degraded barrier embayment sites, 20 of which are located in the Sound Central Sub-basin. Except for the least degraded sites in D1, the maximum score in each group does not drop below 1,500, suggesting high variability in degradation score, even within less degraded sites (Figure 29).

Table 23 – Barrier embayment degradation class by sub-basin. Class is based on division of all sites evenly into highest/medium/lowest based on degradation score.

	Percent by Degradation Class			
Sub-Basin	**HIGHEST**	**MED**	**LOWEST**	**Total**
Hood Canal	31%	27%	42%	64
Juan de Fuca	17%	35%	48%	23
North Central	34%	28%	38%	29
San Juan	27%	28%	45%	89
South Central	65%	24%	11%	88
South Sound	23%	42%	35%	179
Whidbey	35%	39%	26%	46
Total	33%	33%	33%	518

Degradation groups show a variety of patterns in their mean metric values. Groups D2, D5, D7 and D9 show a high loss of embayment length. While in Group D2 this is the primary source of degradation, in higher degradation groups, loss of length is increasingly accompanied by other factors. Sediment supply degradation was highest in Groups D3, D7 and D9, while tidal flow degradation was a strong source of degradation in Groups D4, D5, and D8. Mean nearshore impervious by contrast appears to increase gradually from Group D1 to D9 (Figure 30).

Representation of degradation groups varies among sub-basins, with six to nine groups represented in each sub-basin. Group D2 (n=64) which includes relatively undegraded systems but with substantial loss of embayment length, was disproportionately represented in the Whidbey Sub-basin. Group D3 (107), where the primary source of degradation was sediment supply degradation, was most strongly represented in the South Sound and Whidbey sub-basins. Group D5 (n=50) which includes sites with loss of length and tidal flow degradation, but relatively lower sediment supply degradation and impervious surface, is most strongly represented in the North Central Sub-basin (Figure 31). Typically, relatively undegraded sites in Group D1 are uncommon in the South Central Sub-basin.

Figure 27 – Barrier embayment mean degradation score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site degradation score. The blue bars and left axis indicate the number of sites within each sub-basin with the exact count indicated above the bar. The range of site degradation found within each sub-basin is indicated by the black bar and the right axis. The gray box indicates a range within 0.5 standard deviations above and below the mean value.

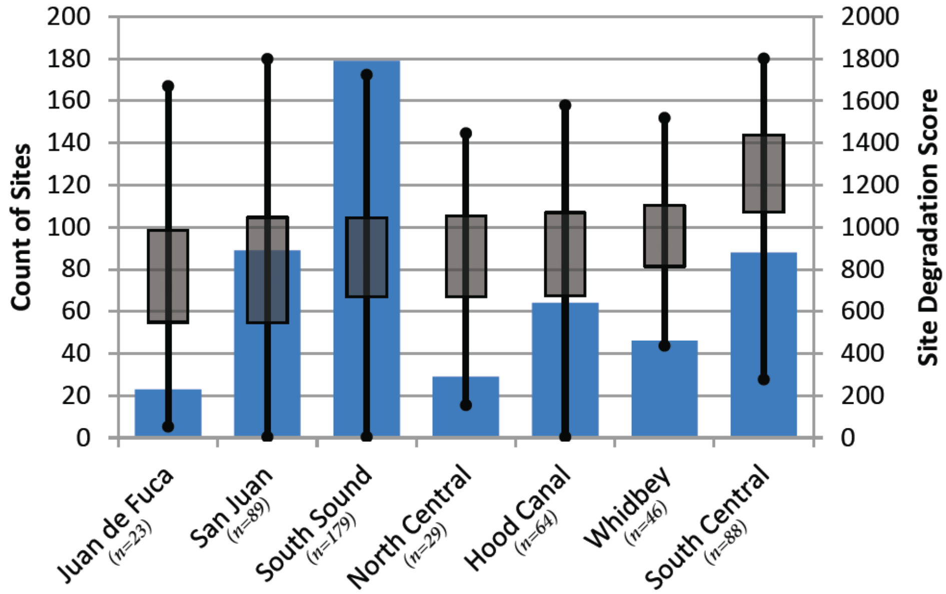


Figure 28 – Barrier embayment degradation cluster dendrogram. Loss of length, sediment supply degradation, tidal flow degradation, and nearshore impervious metrics were used to complete an agglomerative hierarchical cluster analysis of all sites using a group mean clustering algorithm. A SIMPROF permutation test with p=0.05 resulted in 9 groups. Site codes were based on calculation of mean degradation score, with groups numbered from D1 with the lowest mean score, to D9 with the highest mean score.

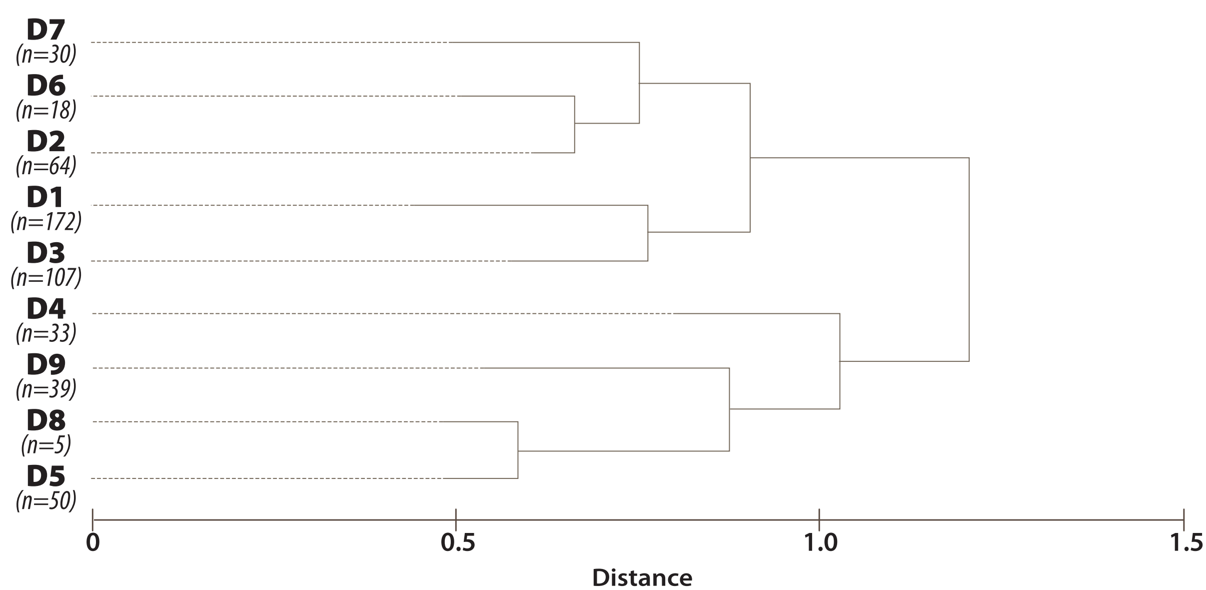


Figure 29 – Barrier embayment mean degradation score by group. Groups are listed from left to right in order of increasing mean site degradation. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar. The range of site degradation found within each group is indicated by the black bar and the right axis. The gray box indicates a range within 0.5 standard deviations of the mean value.

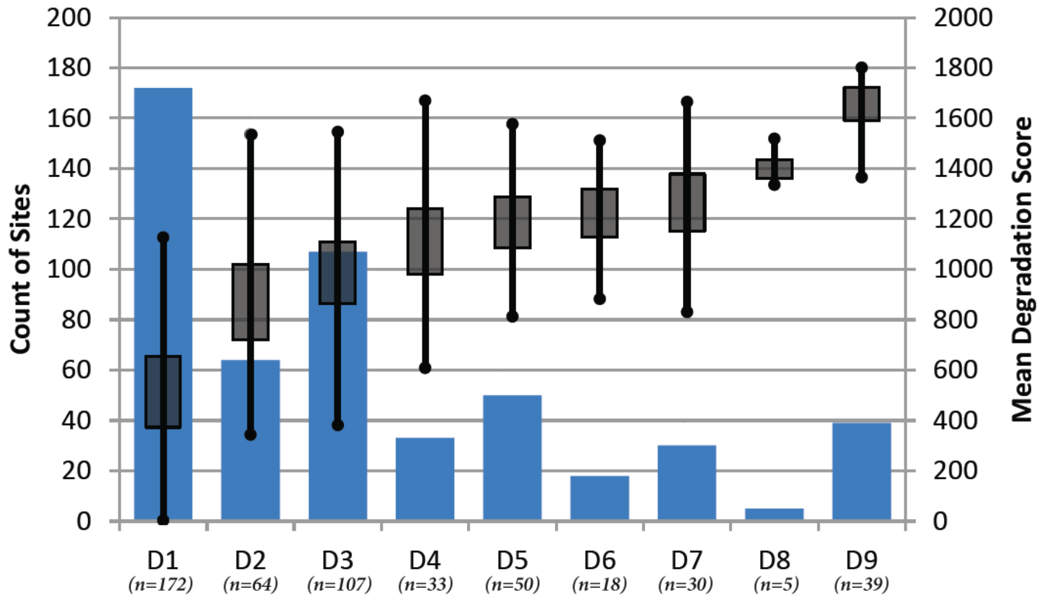


Figure 30 – Barrier embayment mean degradation metric by group. Cluster groups are listed in order of increasing degradation score (which is based on rank-sum and not the sum of displayed mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated within the bar graph. Mean values among all sites is provided on the far right bar.

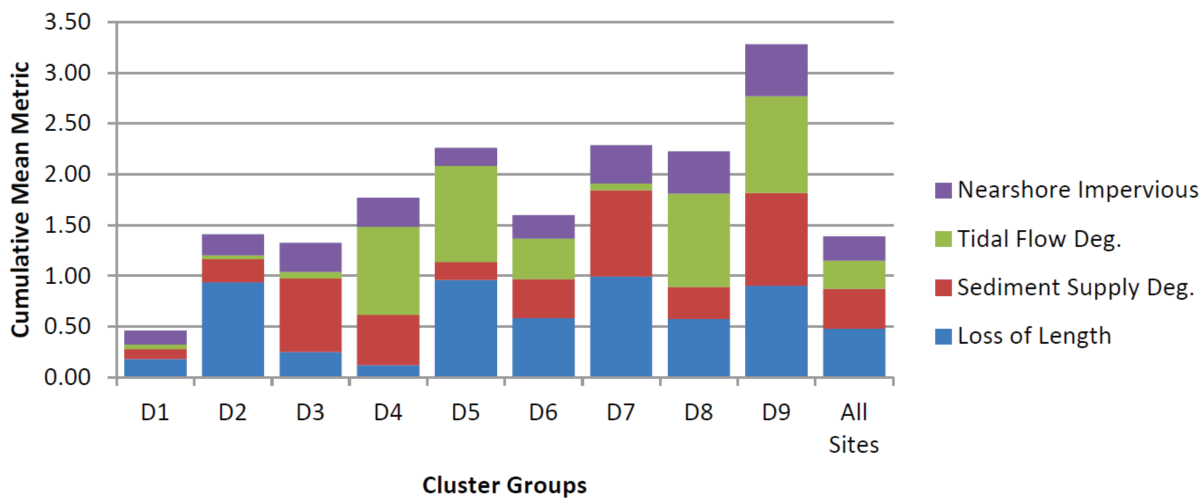
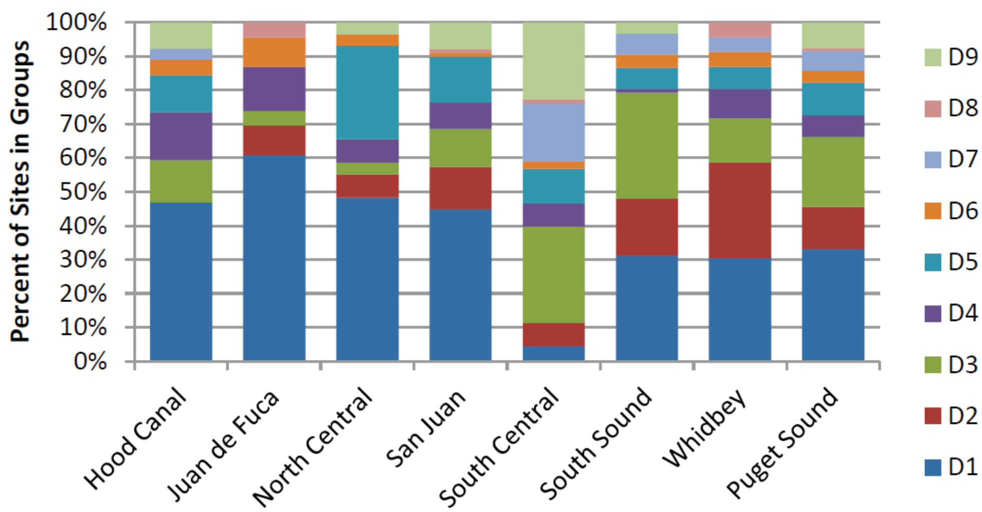


Figure 31 – Barrier embayment degradation group composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar for comparison.



3.4 Coastal Inlets

The coastal inlet strategy protects and restores sites where the shape of the shoreline creates a tidal environment protected from waves. Some sites are associated with the heads of inlets or drowned channels along shorelines, and frequently receive stream flow from small to moderately sized watersheds. Other sites are not associated with streams, but happen to occupy particularly concave or leeward portion of shoreline.

Initial queries of open coastal inlet landforms (Simenstad et al. 2011) resulted in the delineation of 165 coastal inlet sites. Queries using McBride et al's (2009) drowned stream valley landform identified an additional 101 sites, classified as barrier estuary by Simenstad et al. (2011), resulting in a total of 266 coastal inlet sites (Table 24).

Coastal inlets are distributed very unevenly throughout Puget Sound. Juan de Fuca, Whidbey, and North Central together have only 23 inlet sites, roughly similar in aggregate to either Hood Canal or San Juan Sub-basin alone. South Central Sub-basin has roughly twice that number of sites, and South Sound Sub-basin, three times again the number in South Central Sub-basin. Over half the coastal inlet sites in Puget Sound are located in South Sound Sub-basin, where they constitute approximately 35 percent of shoreline length (Table 25).

Table 24 – Summary statistics for all coastal inlet sites.

Statistic	Value
Number of Sites	266
Wetland Area (ha)	
Minimum	0.00
Mean	24
Maximum	4,251
Watershed Area (km^3)	
Minimum	0.04
Mean	18.00
Maximum	1,560.23
Inlet Length (km)	
Minimum	0.00[1]
Mean	2.23
Maximum	93.42

[1]Ten sites are very small inlets identified as drowned stream channels by SSHIAP but not identified as an embayment landform by PSNERP and thus, had no measurable inlet length directly comparable to lengths measured in PSNERP data.

Table 25 – Coastal inlet sites by sub-basin.

Sub-basin	Count of Sites	Sum of coastal inlet site length (km)	Sub-basin shoreline length (km)	Sites/km	Coastal inlet as proportion of sub-basin shoreline length
Hood Canal	23	47.84	395	0.058	12.1%
Juan de Fuca	7	19.89	329	0.021	6.0%
North Central	10	23.30	249	0.040	9.4%
San Juan	28	143.52	1187	0.024	12.1%
South Central	49	95.31	648	0.076	14.7%
South Sound	144	254.99	725	0.199	35.2%
Whidbey	5	9.44	634	0.008	1.5%

Table 26 – Correlation of coastal inlet potential metrics.

Metrics	Wetland Area	Watershed Area
Watershed	0.515	
Embayment Length	0.593	0.648

Table 27 – Correlation of coastal inlet degradation metrics.

Metrics	Lost Embayment Length	Tidal Flow Degradation	Nearshore Impervious
Tidal Flow Degradation	0.362		
Nearshore Impervious	0.110	0.322	
Watershed Impervious	0.066	0.264	0.668

3.4.1 Coastal Inlet Metrics

In coastal inlet sites, wetland area appears to follow a log-normal distribution with the exception of 56 sites that have no mapped vegetated wetlands. Among sites identified as coastal inlets, Padilla Bay (IPU 244) is an extreme outlier with twenty times the wetland area of the next largest wetland complex (the Union River estuary). Excluding Padilla Bay, wetland area averages 7.67 ha, with a median of 0.94 ha.

Typically, watershed area and embayment length both display a log-normal distribution. However, ten sites which have no embayment shoreline within the PSNERP geo-database could not be assigned a length. These are small creek mouth inlets that were not delineated as embayments during PSNERP mapping. Potential metrics are all moderately correlated, with the strongest correlation between inlet length and watershed area perhaps indicating the association of our largest inlets with large drowned river valleys (Table 26).

Among degradation metrics, lost embayment length shows a log-normal distribution, except for 39 sites with no recorded loss of length. Tidal flow degradation is distributed as with barrier embayments. A group of 154 sites have very little tidal degradation, another group of 27 sites have 100 percent tidal degradation, with remaining sites evenly distributed.

Consistent with other strategies, both nearshore impervious and watershed impervious metrics display a log-normal distribution. However in the case of coastal inlets, there is a block of 20 and 16 sites with no nearshore and watershed impervious respectively, suggesting an overall lower level of shoreline and watershed development associated with inlet sites as compared with other sites. Degradation metrics are weakly correlated, with the exception of nearshore and watershed impervious which are moderately correlated (Table 27).

3.4.2 Site Potential

Site potential scores ranged from 22 to 792 of a maximum possible score of 798, and a mean of 394 (Figure 32). Potential score, while greatly overlapping, varies among sub-basins (Figure 32). While the Juan de Fuca, Hood Canal, and Whidbey Sub-basins have few inlets, a greater proportion of inlets in those sub-basins have higher potential scores. South Sound Sub-basin has more inlets than all other sub-basins combined. Despite a high proportion of low potential sites, South Sound Sub-basin still has more high potential inlets than the combined sum of all other sub-basins less South Central (Table 28).

A cluster analysis of potential metrics returns nine distinct groups (SIMPROF α=0.05; Figure 33). Three Groups, P2 (the drowned stream behind Burley Lagoon spit), P3 (the drowned stream along west shore of Liberty Bay), and P5 (Grays Marsh and west Quilcene Bay), contain only 1 or 2 sites each (Figure 34). Their separation into groups is likely a result of how inlet process unit boundaries are defined by the limits of the nearshore geo-database, resulting in an unusual combination of metric values.

Among the 6 remaining groups, 37 percent of lower scoring sites (172) are grouped as P1. Another 68 sites fall within Group P4 with average length but below average wetland and watershed area. Group P6 and P7 scores range around the Puget Sound average. Group P6 is generally higher in watershed and wetland area, and P7 contains sites with longer embayment shoreline length. Sites in P8 are well above average in all metrics, and Group P9 is distinguished by an exceptionally large mean wetland area (Figure 35).

The potential group representation in sub-basins varies somewhat. A greater proportion of inlet sites in the San Juan and South Sound sub-basins belong to the groups P1 and P4, containing smaller inlets. Juan de Fuca has only a few inlet sites, all belonging to the higher potential groups (Figure 36).

Table 28 – Coastal inlet potential class by sub-basin. Class is based on division of all sites evenly into high/medium/low groups based on rank order. The number of sites is unevenly distributed among sub-basins. Within each sub-basin, the ratio of sites among potential classes also varies.

	Percent by Potential Class			
Sub-Basin	HIGH	MED	LOW	Total
Hood Canal	57%	30%	13%	23
North Central	50%	30%	20%	10
San Juan	29%	25%	46%	28
South Sound	24%	36%	40%	144
South Central	43%	33%	24%	49
Juan de Fuca	86%	14%	0%	7
Whidbey	60%	20%	20%	5
Puget Sound	34%	33%	33%	266

Table 29 – Coastal inlet degradation class by sub-basin. Class is based on division of all sites evenly into high/medium/low groups based on rank order.

	Percent by Degradation Class			
Sub-Basin	HIGH	MED	LOW	Total
Hood Canal	17%	48%	35%	23
Juan de Fuca	43%	43%	14%	7
North Central	40%	30%	30%	10
San Juan	36%	18%	46%	28
South Central	73%	22%	4%	49
South Sound	22%	36%	42%	144
Whidbey	0%	60%	40%	5
Puget Sound	33%	33%	33%	266

Figure 32 – Coastal inlet mean potential score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each sub-basin with the exact count indicated above the bar. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The box indicates a range within 0.5 standard deviations above and below the mean value.

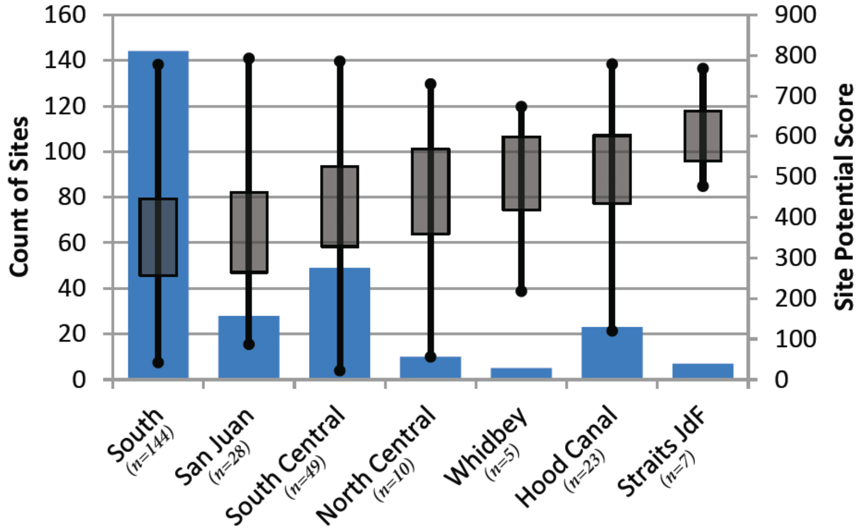


Figure 33 – Coastal inlet potential cluster dendrogram. Historical wetland area, watershed area, and embayment shoreline length were used to complete an agglomerative hierarchical cluster analysis of all sites using a group mean clustering algorithm. A SIMPROF permutation test with p=0.05 was used in place of a stopping rule, resulting in 9 groups. Site codes were based on calculation of mean potential score, with groups numbered from P1 with the lowest mean score, to P9 with the highest mean score.

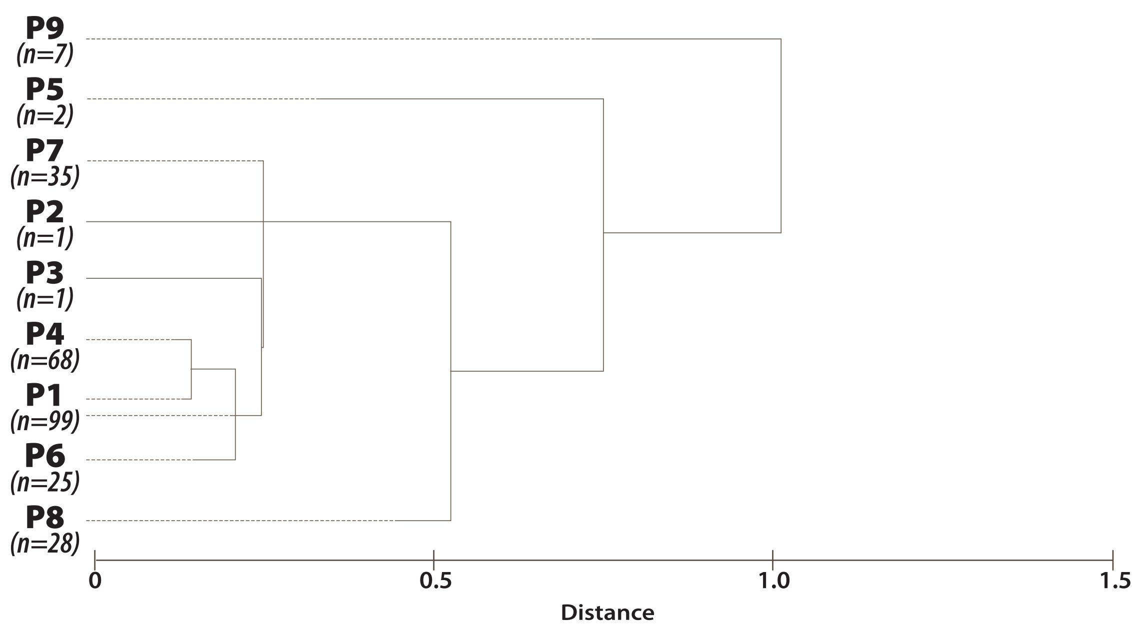


Figure 34 – Coastal inlet mean potential score by group. Groups are listed from left to right in order of increasing mean site potential. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar, with all but 4 exceptional sites falling in 6 of the nine groups. The range of site potential found within each sub-basin is indicated by the black bar and the right axis. The grey box indicates a range within 0.5 standard deviations of the mean value.

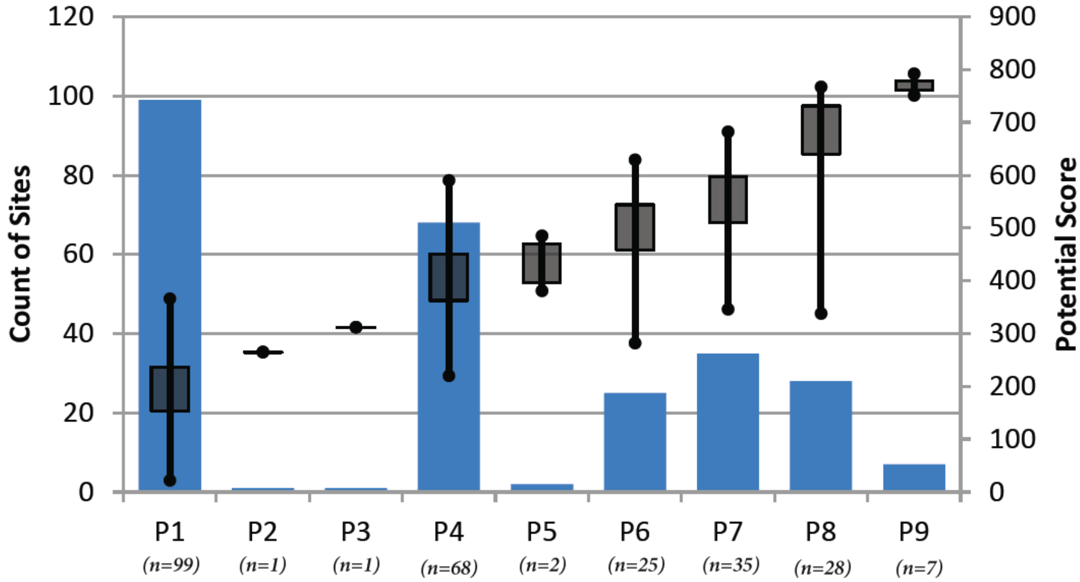


Figure 35 – Coastal inlet mean potential metrics by group. Cluster groups are listed in order of increasing potential score (which is based on rank-sum and not the sum of displayed mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated within the bar graph. Mean values among all sites is provided on the far right bar.

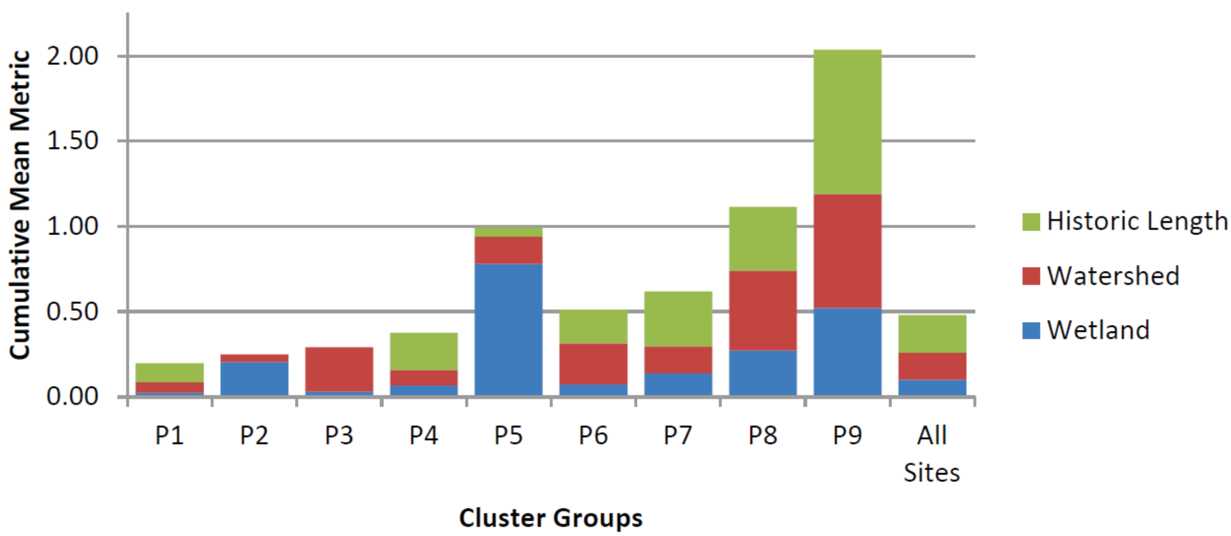
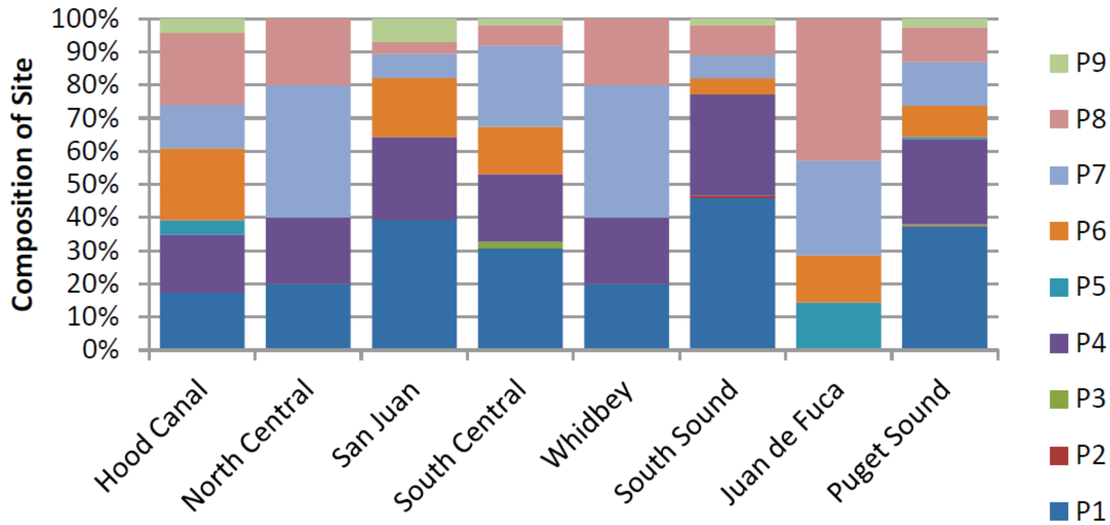


Figure 36 – Coastal inlet group potential composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar.



3.4.3 Coastal Inlet Degradation

Degradation scores for coastal inlets range from 32 to 1,016 out of a maximum possible score of 1,064, with a mean of 491. Inlet degradation is unevenly distributed among sub-basins. The South Sound and San Juan sub-basins have the highest proportion of low degradation sites. South Central Sub-basin has a very high proportion of high degradation sites (Table 29).

Sub-basins don't vary dramatically in their mean degradation score (except of course South Central Sub-basin). There is some variation in the range of degradation scores present. Whidbey, North Central and Juan de Fuca sub-basins, each with few inlets, had neither very high nor very low scoring sites (Figure 37).

A cluster analysis of degradation metrics returns eight distinct groups of coastal inlet sites (SIMPROF α=0.05; Figure 38). 60 percent of sites are grouped in D1, with below average levels of degradation. The remaining sites are arrayed in groups with increasing degradation. Groups D6, D7 and D8 appear to have a notably higher mean degradation than other groups (Figure 39).

Groups D2 and D5 include 40 sites that are similar in that the nearshore zones and watersheds have high impervious surface levels while inlet shorelines are relatively intact. Group D4 by contrast is composed of 23 sites where relatively typical to low levels of impervious surface but extensive shoreline modification. Sites in Group D3 have typically low levels of shoreline modification but substantial loss of length, although we have observed that for some sites loss of length may result from discrepancies between historical and current mapping. Groups D6 and D7 include sites with increasing intensity of degradation with D7 showing much higher levels of shoreline modification (Figure 40). While there are small differences in mean degradation score among sub-basins, there are more obvious patterns in the composition of degradation groups among sub-basins. Group D3 sites (lost length sites with low development) are most commonly found in the Whidbey Sub-basin, while D2 sites (moderate impervious only) are common in the South Central, Whidbey, Juan de Fuca and to a lesser degree North Central, and South Sound sub-basins, but are relatively uncommon in San Juan and Hood Canal (Figure 41).

Figure 37 – Coastal inlet mean degradation score by sub-basin. Sub-basins are listed from left to right in order of increasing mean site degradation score. The blue bars and left axis indicate the number of sites within each sub-basin with the exact count indicated above the bar. The range of site degradation found within each sub-basin is indicated by the black bar and the right axis. The box indicates a range within 0.5 standard deviations above and below the mean value.

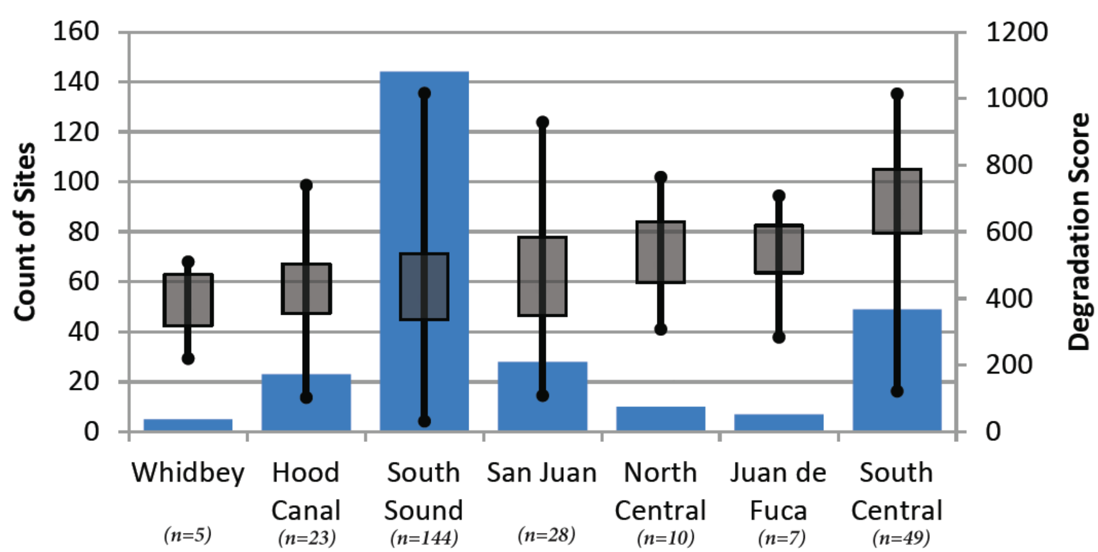


Figure 38 – Coastal inlet degradation cluster dendrogram. Loss of length, tidal flow degradation, and nearshore and watershed impervious are used to complete an agglomerative hierarchical cluster analysis of all sites using a group mean clustering algorithm. A SIMPROF permutation test with p=0.05 resulted in 8 groups. Site codes were based on calculation of mean potential score, with groups numbered from D1 with the lowest mean score, to D8 with the highest mean score.

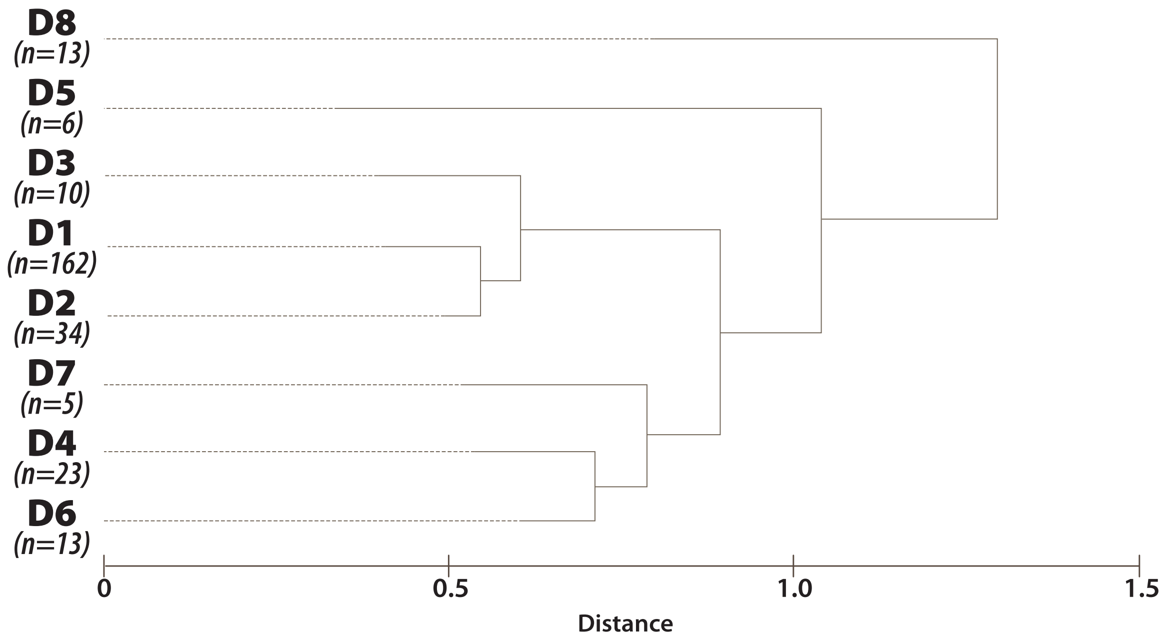


Figure 39 – Coastal inlet mean degradation score by group. Groups are listed from left to right in order of increasing mean site degradation. The blue bars and left axis indicate the number of sites within each cluster group with the exact count indicated above the bar. The range of site degradation found within each sub-basin is indicated by the black bar and the right axis. The gray box indicates a range within 0.5 standard deviations of the mean value.

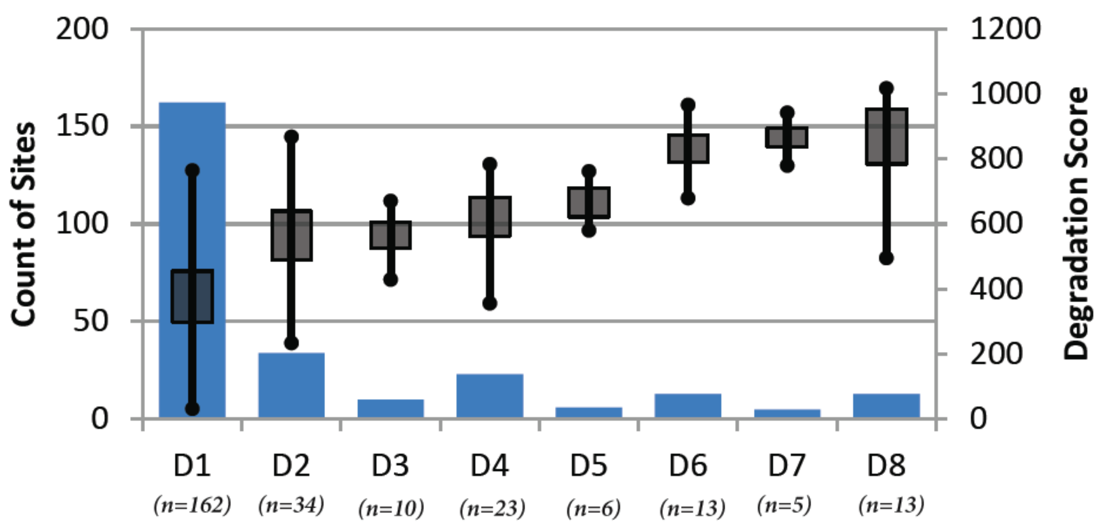


Figure 40 – Coastal inlet mean degradation metrics by group. Cluster groups are listed in order of increasing degradation score (which is based on rank-sum and not the sum of displayed mean metrics). Metrics are defined in Table 4 and occur in a normalized range from zero to one. Mean within group metric is indicated within the bar graph. Mean values among all sites is provided on the far right bar.

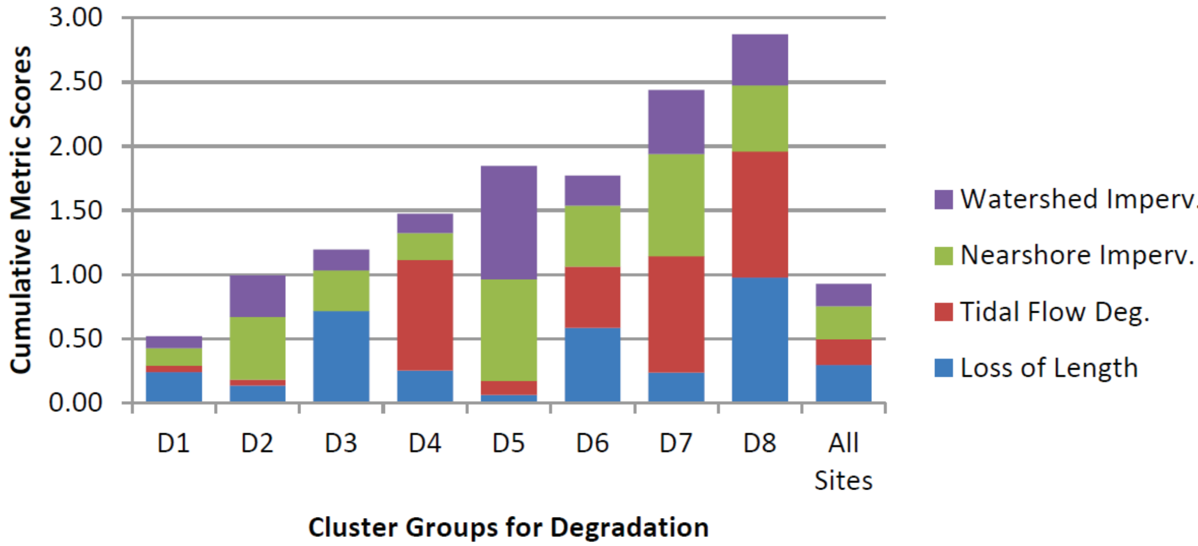
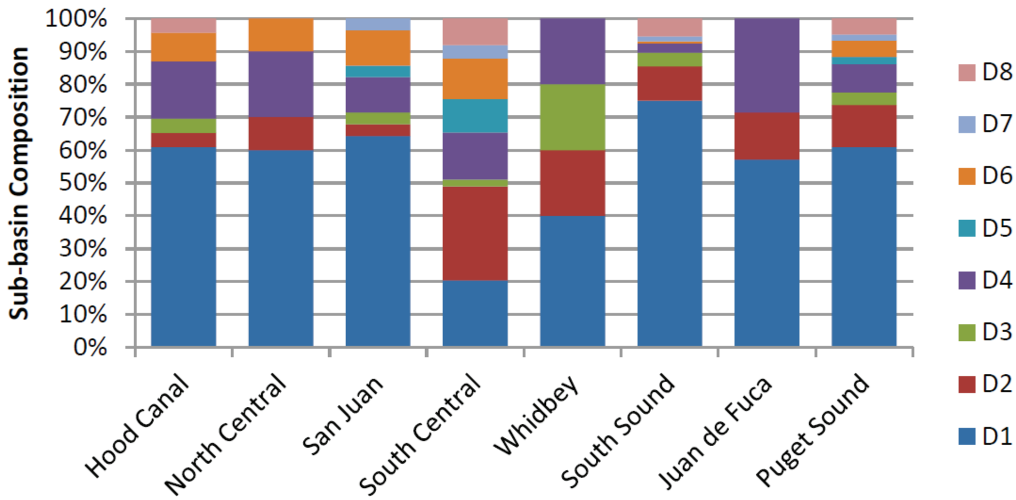


Figure 41 – Coastal inlet group degradation composition by sub-basin. Percent values indicate the proportion of sites within a cluster group as a proportion of all sites within the sub-basin. Puget Sound wide proportions are provided in the far right bar for comparison.



3.4.4 Coastal Inlet Risk Factors

Marina development in coastal inlets is largely focused in North Central, South Central, and San Juan sub-basins. Two thirds of South Central Sub-basin coastal inlets have some kind of over-water structure. Some increase in impervious surface is anticipated in roughly half of Puget Sound coastal inlet watersheds. Juan de Fuca Sub-basin, where all coastal inlets are located in the east, has the highest proportion of sites in the highest risk class. South Central Sub-basin has the next highest proportion, and the greatest number of coastal inlet watersheds with the highest risk of future development. Predicted nearshore development also concentrated in the South Central Sub-basin. Notably, all but one of North Central Sub-basin's coastal inlet shorelines are anticipated to face some level of development pressure.

Table 30 - Coastal inlet marina development risk class by sub-basin. HIGHEST indicates sites where the ratio of overwater structure area divided by embayment shoreline length is more than two standard deviations above mean; MED = more than one std. dev. above mean; LOWEST = within one std. dev. of mean.

	Percent by marina development risk				Count by marina development risk				
Sub-basin	**HIGHEST**	**MED**	**LOWEST**	**NONE**	**HIGHEST**	**MED**	**LOWEST**	**NONE**	**Total**
Hood Canal	0%	4%	43%	52%		1	10	12	23
Juan de Fuca	0%	0%	29%	71%			2	5	7
North Central	10%	0%	50%	40%	1		5	4	10
San Juan	7%	11%	18%	64%	2	3	5	18	28
South Central	18%	14%	35%	33%	9	7	17	16	49
South Sound	3%	6%	25%	67%	4	8	36	96	144
Whidbey	0%	20%	0%	80%		1		4	5
Grand Total	6%	8%	28%	58%	16	20	75	155	266

Table 31 - Coastal inlet watershed development risk class by sub-basin. HIGHEST indicates sites where the anticipated future increase in impervious surface is more than two standard deviations above mean; MED = more than one std. dev. above mean; LOWEST = within one std. dev. of mean.

	Percent by future watershed development risk				Count by future watershed development risk				
Sub-basin	**HIGHEST**	**MED**	**LOWEST**	**NONE**	**HIGHEST**	**MED**	**LOWEST**	**NONE**	**Total**
Hood Canal	13%	9%	26%	52%	3	2	6	12	23
Juan de Fuca	43%	14%	29%	14%	3	1	2	1	7
North Central	30%	10%	60%	0%	3	1	6		10
San Juan	25%	14%	7%	54%	7	4	2	15	28
South Central	33%	14%	22%	31%	16	7	11	15	49
South Sound	4%	16%	24%	56%	6	23	35	80	144
Whidbey	0%	40%	0%	60%		2		3	5
Grand Total	14%	15%	23%	47%	38	40	62	126	266

Table 32 - Coastal inlet nearshore development risk class by sub-basin. HIGHEST indicates sites where the anticipated future increase in impervious surface is more than two standard deviations above mean; MED = more than one std. dev. above mean; LOWEST = within one std. dev. of mean.

	Percent by future nearshore development risk				Count by future nearshore development risk				
Sub-basin	**HIGH**	**MED**	**LOW**	**NONE**	**HIGH**	**MED**	**LOW**	**NONE**	**Total**
Hood Canal	5%	18%	9%	68%	1	4	2	16	23
Juan de Fuca	0%	14%	43%	43%		1	3	3	7
North Central	0%	40%	50%	10%		4	5	1	10
San Juan	11%	11%	11%	68%	3	3	3	19	28
South Central	31%	7%	10%	52%	15	4	5	25	49
South Sound	4%	4%	17%	75%	8	8	22	106	144
Whidbey	0%	20%	20%	60%		1	1	3	5
Grand Total	11%	11%	16%	61%	27	25	41	173	266

4. Strategic Recommendations

Our aim is to integrate previous Nearshore Project efforts without extensively restating previous work. Goetz et al. (2004) develops an approach to the restoration of nearshore ecosystems focused on the management of physiographic processes in an adaptive management framework. Shipman (2008) provides a geomorphic basis for shoreline classification. Simenstad et al. (2011) applies that classification to the identification of landscape units, and the inventory of change and impairment of Puget Sound shorelines over five generations of human settlement. Schlenger et al. (2011) organize observations of change to estimate the degradation of physiographic processes. Greiner (2010) develops conservation principles developed over several generations of conservation research and practice.

This landscape assessment and strategy framework proposes a systematic approach for developing and evaluating actions to protect and restore nearshore ecosystem sites. We believe this assessment provides a practical tool to support conservation decision making, while initiating a conceptual framework for managing Puget Sound shorelines into the future.

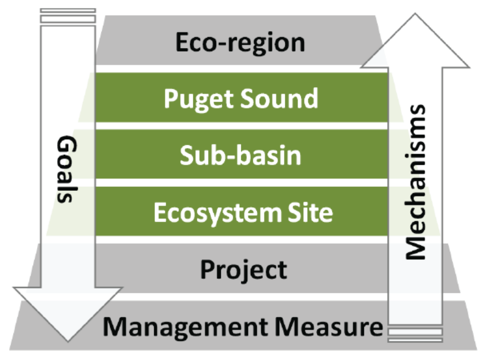
Our recommendations are organized in four sections:

1. Clarification of how we propose a hierarchical landform-based approach supports policy development.
2. Recommendations for where and how to approach work at deltas, beaches, barrier embayments, and coastal inlets using these assessments.
3. A summary by sub-basin of prospective high potential ecosystem scale sites for protection and restoration.
4. Brief recommendations on how to improve these ecosystem recovery strategies over time.

4.1 A Hierarchical Landform-based Approach

These assessments were completed using both remotely sensed and field data, encompassing a globally significant estuary with 2,500 miles of crenulated shoreline. Our 828 landscape units have an average length of 3.9 km (in the case of beaches) or contain tidal wetland complexes with an average area of 4.8 km^2 (in the case of deltas). We reduce each of these sites to a set of metrics, and reduce metrics to potential and degradation groups and scores, and then summarize these variables in a single color coded recommendation. We are necessarily simplifying a complicated universe. It is important to recognize the function and limitations of this scale of analysis, and to carefully define how large scale analysis should support the definition of local actions.

Figure 42 – Hierarchies of Scale. Adapted from Lyle (1986) provides a framework for multi-scale planning which identifies the importance of larger scale analysis for establishing goals in the design of human ecosystems.



Lyle (1985) describes a framework for multi-scale policy development drawn heavily from Feibleman (1954), whom he quotes with emphasis: "for any given organization at any level, its mechanism lies at the level below and its purpose at the level above". This suggests that the goals we develop for an 'ecosystem site' have integrity when they are informed by our understanding of the needs and patterns observed at Puget Sound and sub-basin scales. Our observations about the character and condition of ecosystem sites in turn informs our investigation and development of local actions (Figure 42). By this approach, each scale of analysis passes increasingly detailed goals down to finer and finer scales until a project specific prescription is defined. The integration of goals from a large scale down to smaller scales helps to insure that cumulative actions at a smaller scale in turn result in the changes and services envisioned at larger scales. Conversely, Feibleman and Lyle argue that any effort attempting to achieve an impact at the scale of an ecosystem site, let alone a sub-basin or the Puget Sound, is dependent on the effectiveness and efficiency of the mechanisms offered by the specific management measures employed on the ground.

In this way, the purpose of this nearshore strategy is not to replace the systematic development of actions within sites, but rather to imbue those projects with context and goals that increase the relevance of that work to the functioning of ecosystems. This context may include how the services of beaches are affected by sediment dynamics, or how coastal inlets are affected by watershed processes. Conversely, if well planned, our collective monitoring and evaluation of actions improves our understanding of the mechanisms by which ecosystem services are delivered within sites, thus, informing our ability to achieve our larger goals. Multi-scale planning requires the integration of levels, and the consideration of what it important to consider at each level.

Process-based restoration and protection planning at the scale of sites has repeatedly provoked in the Nearshore Study Team three questions, shaping both the methods and interpretation of this assessment:

1. How do we evaluate actions that only partially or incrementally restore ecosystem processes within a large site, when the threshold of effect is unknown?
2. How do we use planning to integrate and balance the need for protection, restoration, and enhancement in the landscape?
3. How does our strategy allocate limited resources among sites with a wide range of degradation, from minimally degraded to severely degraded?

Our quantitative assessment provides a 'game board' of deltas, beaches, and inlets, but does not tell us how to respond to the patterns we observe. Nearshore conservation, like many endeavors, requires that we define a conceptual basis from which to develop policy. Only by clearly stating these strategic assumptions, do we open the opportunity to identify uncertainty, test our assumptions, and improve that strategy over time.

4.1.1 Valuing Partial and Incremental Restoration

In practice, our actions rarely address all sources of physiographic process degradation at the scale of a whole drift cell, river delta, or coastal inlet. Restoration designers typically propose an acceptable level of *partial* restoration, or suggest that a proposed action will be part of a suite of future actions that results in *incremental* restoration. Frequently, proposed actions are both partial *and* incremental, and accompanied by other land uses developed independent of conservation goals. Managing and leveraging small actions to cumulatively result in the recovery of landscape scale services, is perhaps the fundamental challenge of natural resource management.

While the conceptual basis for managing processes like sediment input, tidal flow, and freshwater inputs is clear, there is a shortage of data that allows prediction of how, for example, a specific number of bulkheads results in a predictable change to beach structure, causing a measurable change in forage fish spawning capacity. Degradation effects may be gradual and additive, or they may involve thresholds after which a system rapidly changes state. Furthermore, a threshold event may be driven by unseen factors, new stressors, natural cycles, the interaction between factors, or in response to external forces like climate (see Greiner 2010 for further discussion of cumulative impacts and threshold phenomena). This uncertainty does not make these phenomena or risks less real.

Given these uncertainties, and a mandate to protect and restore ecosystems, the lowest risk approach would be to rapidly and completely protect or restore processes at the site scale. The complete and rapid restoration of ecosystem processes contrasts with the typically small incremental scale of on-the-ground activities operating under legal, financial, and social constraints. Although there are exceptions, incremental and incomplete restoration of ecosystem sites is the norm in the restoration and protection industry.

Fortunately, management amidst uncertainty is not uncommon in human affairs. Fiscal or social policy decisions are almost always made using a conceptual understanding in the face of quantitative uncertainty. For example, the decision to increase interest rates to reduce inflation is made without knowing the extent to which a particular increase will result in a predictable response, or have unintended consequences. Our ecosystem management actions are likely similar.

As we develop actions to manage nearshore ecosystems, we recommend the following conceptual principles as a basis for action—where we are unable to identify reliable quantitative targets, or precisely predict outcomes:

1. As historical ecosystem dynamics are increasingly restored, the likelihood that the site will sustainably provide historical ecosystem services also increases.
2. Some processes are more important than others for ensuring the sustained delivery of ecosystem services. These *target processes* are those which control physical structure at a landscape scale, and where there is the greatest risk of threshold changes to ecosystem state. Target processes differ among sites, based on the relative influence of tidal flows, wave driven sediment transport, or alluvial processes on the dynamics of a site.
3. As long as a full range of system dynamics are addressed, it is likely possible to restore self-sustaining services within a constrained footprint that is smaller than the historical footprint, although, such a constrained site will likely provide a lower quantity and quality of ecosystem services than the historical site.
4. Given the scale of existing degradation and ongoing population pressures, conducting restoration only where we are able to restore a full suite of self-sustaining historical processes is likely insufficient to achieve recovery of highly valued ecosystem services, such as forage to support populations of wild salmon. Enhancement of habitat function amidst degraded landscape processes may be necessary to recover imperiled species, or water quality, or to increase ecosystem resilience to potential climate change impacts.

Thus, we recommend an approach which strongly values the rapid protection and restoration of ecosystem processes at the scale which they operate, with a focus on those physiographic processes most important for structuring the landscape. We simultaneously recognize a need for projects that enhance strategically identified functions in degraded landscapes.

Partial and incremental restoration presents an important technical challenge to adaptive management. It is more difficult to detect changes in ecosystem services where restoration is incremental, partial, or small in scale relative to the scale of affected ecosystem processes. Large scale projects that completely or dramatically restore ecosystem processes provide easier opportunities to test conceptual models and measure restoration benefits. The outcome of small projects may be too subtle to detect restoration benefits without enormous investments in monitoring, limiting our ability to use adaptive management to adjust our strategies (with 'adaptive management' used in the strict sense of Holling 1978, as contrasted to the increasingly casual and expedient use of the term).

4.1.2 Linking Protection and Restoration

Protection prevents future degradation while restoration redresses historical degradation. When aiming for recovery of ecosystem processes at the scale of a site, any failure of protection is a serious challenge to the effectiveness of restoration actions. There is broad technical consensus that we must integrate protective and restorative actions to achieve future conservation targets (Goetz et al 2004; Greiner 2010). In all cases, large-scale restoration of ecosystem processes assumes and requires the concurrent protection of intact ecosystem processes while restoration is attempted. This protection component becomes increasingly important where restoration actions are incremental.

The Nearshore Project analysis of management measures (Clancy et al. 2009) describes three protective measures: *property acquisition and conservation, habitat protection policy or regulations*, and *public education and involvement*. As one moves from property acquisition to regulation to education, the short term certainty of achieving a change in a degradation trend declines, while actions become less expensive. Over longer time spans, one could argue that even acquisition of property does not provide durable protection if the culture, shaped by education and involvement, does not support protection of ecosystem services. It's safe to assume that some combination of all three measures are necessary for achieving cost effective recovery or for that matter, no-net-loss of ecosystem services at a particular site in perpetuity. It is also likely that each site has a different current level of protection, and that the cost and potential for increasing that protection varies across the landscape in response to a range of social, economic, and political factors. In the public sector, the authority, appropriations, and political will to implement different kinds of protective or restorative actions in different locations are divided by political and organizational boundaries. There are many barriers to the collaborative and innovative integration of protection and restoration strategies acceptable to stakeholders.

This framework offers a population of sites, where the physiographic setting, historical change, and current condition can be observed and discussed among citizens and within communities. We anticipate that this framework, which involves dividing the landscape into ecologically meaningful, and human-scaled places, supports the engagement and dialog necessary as we invite citizens and communities to become more involved in ecosystem management.

Given the importance of protection, site scale evaluation of protection status and potential is likely a critical component of ecosystem restoration planning, and evaluation of site restoration opportunities. To our knowledge there are no existing mechanisms for easily evaluating site protection status and potential as a basis for the investment of capital funds in restoration. Such an evaluation mechanism would identify within sites:

1. the threats to ecosystem processes and services,
2. the effectiveness of existing and potential regulatory and educational mechanisms in mitigating those threats, which in turn defines
3. the relative importance of real estate acquisition in protection as compared to other measures.

Some of these assessments are supported by this proposed strategy framework, as threats, opportunities, and measures may be estimated in a preliminary way—by considering the physiographic setting and the presence of stressors in addition to other demographic metrics. We anticipate this to be a significant consideration, as we move from comparison of a population of sites, to evaluating the risks of project work within sites.

4.1.3 Responding to Different Levels of Degradation

Degradation is unevenly distributed across Puget Sound. Historical degradation is different than ongoing degradation. The risk of poor restoration performance increases as degradation increases, and necessary protection and restoration measures are likely to shift as efforts move from more intact to more degraded systems (Figure 43). Different sites may be degraded by different local mechanisms.

These concerns over degradation suggest that restoration and protection strategy should be responsive to degradation. Our recommendations (Section 4.2) focus in large part on the evaluation of degradation as a means of creating a more sophisticated conservation policy, by 1) hypothesizing the mechanisms by which ecosystem services are lost through the degradation of a network of physiographic processes (target processes within sites), 2) more clearly defining the position of individual sites within the degradation gradient (i.e. degradation score), and 3) differentiating among different patterns of degradation within sites (i.e. use of cluster analysis, and risk metrics).

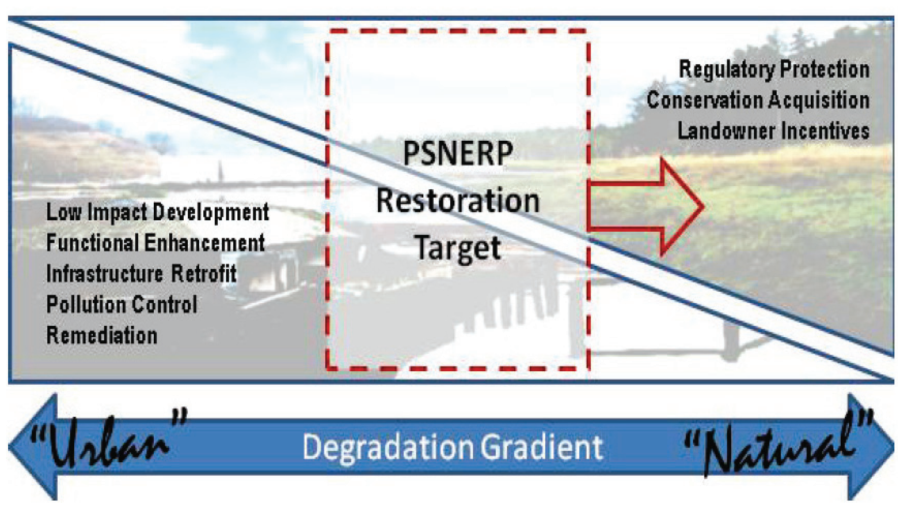
As degradation increases, full restoration of physiographic processes becomes more expensive and constrained. Many authors point to the efficiency of protection over restoration (see Greiner 2010). However, if we do not work in degraded sites, we miss the opportunity to substantially recover those lost ecosystem services. Thus, there is a theoretical optimization of restoration cost/benefit by focusing on sites where there is enough degradation to make substantial gains in ecosystem services, but not *so much* degradation that site constraints and risks undermine benefits, or drive up costs.

Recovery of services can be achieved within a site either by increasing the quantity of ecosystem services, or by increasing the diversity of ecosystem services. Thus, restoration of rare but small ecosystem elements may have a similar value to the restoration of large but common ecosystem elements. Protection and restoration costs per unit of area typically increase as the intensity of human settlement increases, due to competition from other economic uses of land, or constraints imposed by extensive infrastructure (PSSS 2003). Thus, in more degraded environments, optimal cost-benefit would be found through restoring or enhancing rare components over a smaller footprint, as compared to attempting to restore or enhance relatively common components over a larger footprint. This tradeoff is likely only valid when made in moderation, as consistent preference for restoration of small rare components may neglect the recovery of ecosystem services dependent on the restoration of a more extensive or connected network of habitat services.

The following three idealized scenarios represent different approaches to optimizing the cost effectiveness of restoration in response to the intensity of site degradation:

1. **At intact sites** we *protect* processes across a site to prevent loss of ecosystem services. This could further involve a focus on sites where risk of degradation is high. While the imminence of development may ultimately increase costs, these costs are still likely lower than restoration of the lost services. Thus, focusing ecosystem protection on the cutting edge of development represents a cost-benefit compromise with strategic value.
2. **At moderately degraded sites** we *restore* processes to substantially recover the quantity and diversity of lost ecosystem services. This assumes the simultaneous protection of processes and restoration gains.
3. **At highly degraded sites** we *enhance* target ecosystem functions with a focus on restoring the diversity and continuity of services. These target functions attempt to achieve the largest and most persistent benefits from the least effort.

Figure 43 – General model of restoration and protection approach across a degradation gradient. This diagram suggests that the management measures used for protection and restoration of ecosystems shift as a site becomes increasingly degraded. PSNERP is focused on the restoration of physiographic processes, and this class of activities is best focused on moderately degraded sites where there is the greatest potential for cost effective restoration of these processes, returning a site to a self-sustaining state.



This adaptation of restoration approach to landscape setting has been discussed extensively by others (Bradshaw 1996; Bell et al. 1997; Thom et al. 2005; Greiner 2010), and provides the framework for our site specific recommendations.

4.2 Site Specific Recommendations

We have organized our analysis of Puget Sound shorelines around four landform-based strategies (Deltas, Beaches, Barrier Embayments, and Coastal Inlets). Each landform makes a unique contribution to Puget Sound ecosystem services. The natural composition and configuration of landforms has unknown effects on the abilities of nearshore biota to flourish. We have no evidence that any one of these systems can be removed from the landscape or substantively degraded, and the Puget Sound continue to function well. By contrast, valued migratory species like salmon, move among different systems and are likely dependent on redundant representation of these systems across the landscape (Fresh 2006; Beamer et al. 2003). Thus, we are relatively confident that we must protect and restore the historical services of deltas, beaches, embayments and coastal inlets to some extent across Puget Sound to effectively protect and restore Puget Sound ecosystem services.

With four strategies, a score of metrics, eight indices and eight multi-variant groupings (two of each per strategy), we have many ways to categorize sites for the purpose of organizing our thinking. Our purpose is not to prescribe specific actions at a site, but rather to inform and organize action development from a sound-wide and historical perspective. A specific but potentially unreliable recommendation at a specific site is ultimately less valuable than the development of a robust framework for managing, organizing, and informing nearshore ecosystem protection and restoration. Testing our assessments and recommendations at sites is the necessary feedback mechanism by which we improve the design of a restoration system, achieving Feibleman's (1954) integration of levels.

4.2.1 Using Cluster Groups for Recommendations

Our recommendations attempt to answer two questions: 1) where should we work first, and 2) what should we do there? We use our quantitative results to support and justify our recommendation. However, the exercise of defining a set policy's approaches is the conclusion of a logical argument, not a scientific finding. There are many different ways to use the same data for different purposes.

Given limited resources for conservation, and our abundance of shoreline, we recommend focusing initial work at sites with a high potential score. These are sites in Puget Sound where a large quantity of ecosystem services were historically provided by a single large and complex physiographic system. Substantial increases in regional ecosystem services are unlikely without addressing the degradation of these large complex sites. They are simply finite in number. As degradation increases at large sites, it becomes increasingly challenging to protect or restore the integrity of ecosystem processes given the incremental nature of our conservation actions. It is at high potential sites that we anticipate we will 'make or break' Puget Sound ecosystem recovery.

Based on our discussion of degradation (summarized in Figure 43) we describe three different approaches to restoration based on the intensity of site degradation: protect, restore, or enhance. These recommendations should not be misinterpreted as suggesting an exclusive reliance on either protective or restorative actions, but rather a suggestion of what kind of site-scale management goal will make a cost effective contribution to regional goals—by considering how site-scale degradation affects the costs and risks of restoring physiographic processes. When combined with our identification of high potential sites, we end up with six preliminary recommendations (Table 30).

We propose that cluster groups are the most useful basis for assigning sites to these six preliminary recommendations. Cluster groups represent objective aggregations of sites that are similar in terms of their potential and degradation metrics. These groups are arrayed by mean rank-sum score (for example Group P2 has a lower mean potential score than Group P3), however, a similar mean degradation score in two groups of sites can be driven by very different metrics. By comparing mean degradation score, degradation metric composition, and the number of sites in each group, we identify cutoffs that assign groups among our three recommendations for approach (Figure 44). A similar process is used to identify a population of 'high potential sites'. This assignment of groups to recommendations using cutoffs is described by landform in Sections 4.2.3 through 4.2.7.

Group assignment is only one of many ways that our quantitative results could lead to the identification of sites. It suits our purpose of providing generalized recommendations about large scale process based restoration to a diverse and broad audience. Recommendations could be based on rank-sum score cutoffs, some kind of percentile cutoff, or by using a decision tree of logic statements to integrate multiple metrics and indices.

Table 33 – Preliminary recommendations based on potential and degradation group. Color coding is used to indicate site recommendations in strategy maps, and subsequent tables and figures. Recommendations suggest a broad approach to site management, based on assessment of degradation and historical size and complexity.

PROTECT HIGH Sites are large, complex, and are minimally degraded and indicate substantial opportunities to protect ecosystem services.	**RESTORE HIGH** Sites are large, complex, and are moderately degraded suggesting there may be substantial opportunities to increase ecosystem services.	**ENHANCE HIGH** Sites are large, complex and have been severely modified; cautious action may enhance target ecosystem services and mitigate ongoing impacts of development.
PROTECT Sites are minimally degraded and indicate opportunities to protect ecosystem services.	**RESTORE** Sites with moderate degradation, where there may be opportunity to increase ecosystem services.	**ENHANCE** Sites that have been severely modified; cautious action may enhance target ecosystem services and mitigate ongoing impacts of development

▲ Increasing Potential ▲

► Increasing Degradation ►

Ultimately, the physical restoration and protection of ecosystems is an intensely local affair, which engages our systems of belief, ownership, law, engineering, and stewardship. For this reason our site recommendations are identified as preliminary, and intended to be supportive of local planning and project development. Towards this end, we embed our recommendations in the definition of a landform based strategic approach. We conclude with suggestions for how to integrate, the full range of Nearshore Project outputs to support the practice of protection and restoration.

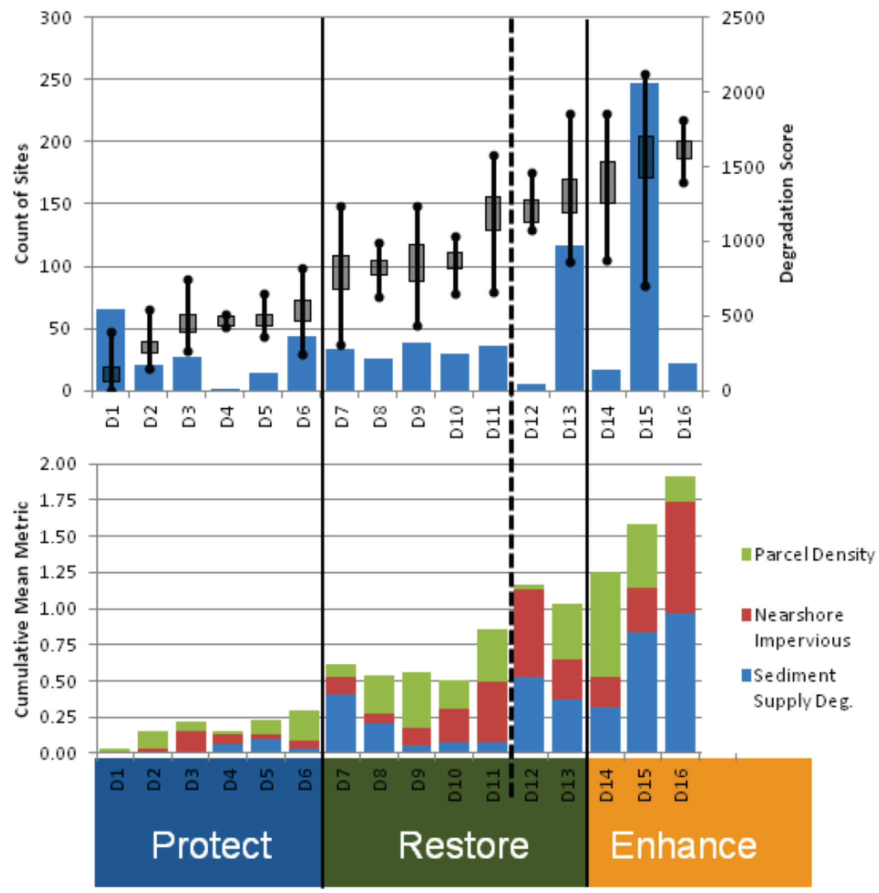


Figure 44 – Sample development of cutoffs for beach recommendations based on degradation groups. Groups are arrayed by mean degradation score, and are divided into three groups. The location of cutoffs (solid lines) are based on a shift in mean degradation score, or justified based on change in metric composition. Other differences between groups (e.g. the reduction of sediment supply degradation between groups less degraded than D11 and more degraded than D12; dotted line) may be important for policy development.

4.2.2 River Delta Strategy

The degradation of river delta sites is largely historic. Delta wetlands account for 90% of historical Puget Sound tidal wetlands (Collins & Sheik 2005). Deltas thus, represent the most substantial opportunity to recover lost ecosystem services in Puget Sound. The disproportionate loss of oligohaline and freshwater wetland components (Simenstad et al. 2011) suggests that restoring the distribution and resilience of these now rare wetlands may strongly support recovery of lost ecosystem services.

Among the 16 river delta sites, four potential groups were identified (Table 31). Based on their massive wetland area, watershed size, and the extent of historical swamps, the Snohomish and Skagit River deltas were grouped together (P4), and were given a high potential rating. Group P3 includes the four additional Cascade deltas: Nooksack, Samish, Stillaguamish, and Nisqually, which are distinct from Group P2 (Duwamish and Puyallup) due to their longer delta shorelines. Otherwise the distinction between P3 and P2 was not dramatic. Thus, we chose to only assign the Snohomish and Skagit a high potential rating.

Two degradation groups were identified. Group D2 includes our three urbanized deltas: Duwamish, Puyallup, and Deschutes. All three were recommended for an enhancement approach. The Deschutes is more similar to the Duwamish and Puyallup in degradation than to other delta sites, but has a notably different pattern of degradation. The relative lack of fill and impoundment by a dam and flood gate provide the opportunity for near complete restoration of tidal flow processes. The remaining 13 delta sites form a continuum of degradation with the 7 small Olympic deltas generally less degraded than the 6 Cascade deltas. This large, complex group of less degraded deltas were all recommended for restoration, as there are ample opportunities to recover lost services among these sites, however, the cluster dendrogram (Figure 11) and mean metric values (Figure 14) suggest some distinctions between Olympic and Cascade sites.

Table 34 – Recommendations for 16 delta sites. Color coding is used to indicate site recommendations in strategy maps.

Group	D1	D2	Total
P1	7	1	8
P2		2	2
P3	4		4
P4	2		2
Total	13	3	16

Potential Metrics

Delta Shoreline Length

Potential Vegetated Wetland Area

Potential Swamp Area

Watershed Area

Degradation Metrics

Loss of Wetland Area

Tidal Flow Degradation

Nearshore Impervious Surface

Watershed Impervious Surface

Risk Metrics

Dam Impoundment

Future Nearshore Development

Future Watershed Development

Target Processes

Tidal Flow

Freshwater Input

Management Measures

Dike/Berm Removal/Modification

Channel Modification

Topographic Restoration

Revegetation

Of the physiographic processes discussed by Simenstad et al. (2011), *tidal hydrology* and *freshwater input* (including river sediment transport) are the target processes of the River Delta Strategy, without which restoration of ecosystem services is likely to be compromised. The processes of d*istributary channel migration*, *tidal channel formation and maintenance*, *detritus recruitment and retention*, *erosion and accretion of sediments* and *exchange of aquatic organisms* are anticipated to be critical for the restoration of river delta ecosystem services, and are anticipated to operate most fully where *tidal hydrology* and *freshwater input* processes are fully restored.

Following Clancy et al. (2009), *berm or dike removal or modification* is the most efficient method of rapidly restoring tidal flow processes. This measure is frequently complemented by *channel modification*, and minor *topographic restoration* like the filling of ditches, initiation of channels, and removal of road fill. In many settings, tidal floodplain has been extensively filled, and in these cases *topographic restoration* becomes the primary management measure. Fill frequently degrades the functions of underlying sediments, and *revegetation* site preparations are commonly employed in an attempt to accelerate recovery of functions.

We propose restoration of whole delta sites, from the head of tide to offshore shoals, to insure the integrity of ecosystems services. Because of constraints imposed by competing land uses, restoration of many deltas is anticipated to be both partial and incremental. As the contiguous footprint of restored processes increases, ecosystem goods and services are anticipated to increase in a non-linear manner as larger patches tend to 1) contain a greater diversity of structures, 2) support a greater diversity of species, and 3) provide a greater redundancy in services, increasing resilience (Greiner 2010). This may be particularly important in delta systems where flood erosion and deposition creates a mosaic of disturbance; which may require a minimum dynamic area to provide the redundant representation of delta components that provide services to a full complement of estuarine species, while remaining resilient to sea level rise.

Based on these principles, where full restoration of historical structures and processes are infeasible (as it is anticipated to be in most cases), we propose a preference for restoration actions which result in a site where:

1. Ecosystem processes are fully restored within a new site footprint, particularly the undegraded tidal flows and freshwater inputs necessary to support a full range of delta ecosystem processes.
2. The system has redundant representation of the full range of delta ecosystem components (*as per* Shipman 2008) including river floodplain, tidal fresh and oligohaline transition swamp, salt marsh, tidal flat, subtidal flat, distributary channel, tidal channel and riparian forest.
3. The site is formed of contiguous large patches that are well connected to each other and to the surrounding riverine, terrestrial and marine landscape.
4. The site is internally connected through a network of deformable distributaries that allow for the unconstrained movement of organisms, water, and sediments.
5. The landward edges adjacent to, and the freshwater inputs into the delta site, are managed to protect riparian buffer functions, and maintain freshwater quantity and quality.
6. The contributing basin provides an approximation of historical flood discharge, large wood recruitment, organism dispersal, and sediment supply to sustain delta functions.

As site constraints increasingly prevent these conditions from being met, we assume the potential for sustained and resilient restoration of diverse ecosystem services declines. Thresholds of cumulative degradation resulting in precipitous loss of ecosystem services are documented (Greiner 2010), but no specific estimates are available for the existence of such thresholds in Puget Sound delta sites.

The potential effects of sea level rise should be factored into the evaluation of the sustainability of site conditions. Sea level rise may reduce relative elevation of wetlands, resulting in changes in alluvial sediment budgets, and, increase saltwater penetration into river systems. Increasing sea level will reduce the extent of existing buffers, and cause wetlands to migrate landward. In addition, the supply of river sediment is important to maintain elevation of existing marsh. Impoundment of drainage area behind dams or road crossings within a delta's watershed may indicate that river systems are less able to provide sediment to sustain delta elevation, and the ability of local topography and land uses to accommodate landward migration will more strongly affect system resilience to changing sea levels. The relative rate of isostatic rebound may affect the ability of a system in maintaining wetland elevation relative to sea level. Glacial dynamics may increase sediment inputs to systems dependent on glacial melt. Change in snowpack may further affect the seasonality and intensity of flood flows, changing both sediment budgets and discharge regime.

4.2.3 Beach Strategy

Puget Sound beach sites are plentiful and diverse. Our analysis identifies 744 shoreline process units, where the historical or current mapping of eroding bluff-backed beach indicates that the input and transport of sediment likely plays a role in the maintenance of beach structure. No distinct groups were identified by cluster analysis using our selected potential metrics. Our relatively continuous and poorly correlated variables prevent any discussion about how groups of beaches differently provide ecosystem services. As we can observe on-the-ground differences and patterns in beach system character through aerial photography, additional work classifying and describing the relative ecosystem services provided by Puget Sound's diverse beach systems would be valuable for restoration and protection planning. This work will ultimately benefit from integration of the ShoreZone inventory (WDNR 2011), and increasing availability of sediment source estimates.

For the purpose of a preliminary recommendation, we divide all beaches into three equal groups based on potential score, and identified the top 33 percent of beach sites as high potential, such that large beach systems with extensive depositional features and frequent stream mouths are anticipated to have the highest value for conservation (Table 33).

Of the physiographic processes discussed by Simenstad et al. (2011), *sediment supply* is the target process on beaches, without which ecosystem process restoration should be considered incomplete. *Sediment transport, erosion and accretion of sediments, solar incidence, freshwater input,* and *detritus recruitment and retention* are critical to the restoration of ecosystem services, and all of these, except perhaps freshwater input, are most likely to operate when *sediment supply* is fully restored.

Given the likely importance of sediment supply and following Clancy et al. (2009), *Armor Removal* is the primary restoration management measure for this strategy. Shoreline armoring protects bluffs and banks from toe erosion. Armor removal allows sediment to enter the drift cell where it can be transported down-drift, forming or augmenting a beach. 'Soft' armoring using organic materials or including naturalistic features is unlikely to achieve protection or restoration of sediment supply. *Groin removal* or *removal of overwater structures* are primary measures in circumstances where cross-shore structures impound sediment and starve down drift beaches. Given the complex functions of nearshore forests (Brennan 2007), the frequency of fill behind armoring, and the historical construction of berms and channels to affect freshwater flows or impound tidal waters, *revegetation*, *topographic restoration,* and *channel rehabilitation or creation* should be considered important complementary measures.

Potential Metrics

Beach Length

Barrier Prevalence

Stream Mouth Density

Degradation Metrics

Sediment Supply Degradation

Nearshore Impervious

Parcel Density

Risk Metrics

Jetty Influence

Future Nearshore Development

Active Railroad

Target Process

Sediment supply

Primary Management Measures

Armor Removal

Groin Removal

Topographic Restoration

Channel Rehabilitation or Creation

Revegetation

Removal of Overwater structures

Shoreline armoring is ongoing. Regulatory authority is currently insufficient to prevent armoring of sediment sources. Under these circumstances, incremental protection and restoration at a site that is also facing development pressure is likely to result in only partial restoration of sediment supply. Within a site, an early focus on protection of remaining sediment supply may allow for more incremental restoration of sediment supply processes over time. This approach may be particularly important, where increased erosion from sea level rise combined with increased nearshore development to result in increased armoring in an attempt to protect private property against natural shoreline retreat. A more extensive strategic assessment of beach restoration is offered by Cereghino (2010).

Of the 744 sites we identified in Puget Sound with eroding bluffs and beaches, 16 degradation groups are identified by cluster analysis. Groups D1-D6 all have relatively low sediment supply degradation, but variable levels of nearshore impervious and parcel density. There is a substantial jump in mean degradation score between Groups D6 and D7 (Figure 19) accompanied by a significant increase in mean sediment supply degradation (Figure 20). Groups D1 to D6 were thus, recommended for a 'protect' approach.

Recommending the break between restoration and enhancement was more difficult. While there appears to be a jump in mean degradation between Groups D10 and D11, there likely remain substantial opportunities for partial restoration at a within-drift cell scale for Groups D15 and D16 as both show extremely high sediment supply degradation. A break point was selected between D13 and D14, where an increase in parcel density in Group D14 (Figure 20) makes substantial restoration of degraded sediment supply very unlikely. We simply have no examples of restoration efforts that have reinitiated bluff erosion on residential shorelines. Even where parcel density is lower, we anticipate that given the challenges of sediment supply restoration in developed shorelines, the 122 sites in Groups D12 and D13 while recommended for a restoration approach, are likely to offer only partial sediment supply restoration opportunities, and should be approached with caution.

Partial restoration of sediment supply within a littoral drift cell increases the risk that there will be insufficient sediment input to sustain historical beach structure. While the principles guiding the beach strategy are simple, the practical management of sediment supply faces multiple uncertainties:

- The rate of sediment supply necessary to sustain a particular beach structure is unknown,
- The factors that make a given beach sensitive to change in sediment supply are only understood conceptually,
- Except for some notable recent research, the linkage between beach structure and ecosystem services has not been strongly researched,
- Except for occasional case study opportunities, many important differences between the current and historical beach structure, like slope, width, biogenic structure, or substrate composition, are commonly unknown,
- The potential for accelerating loss of beach services due to sea level rise is thus, difficult to estimate, and
- Beach structural change in response to changing sediment supply is gradual and driven by episodic events, complicating quantitative investigation.

Given these uncertainties, there is substantial risk that a suite of actions designed to partially protect or restore sediment supply would over time be insufficient to protect or restore ecosystem services. Some sites may have already crossed an unidentified threshold after which gradual degradation of some beach services is assured. While beach sediment management cannot be overlooked as an important part of Puget Sound recovery (half of current shoreline length is composed of beaches) we should employ well planned and long-term adaptive management strategies

Table 35 – Recommendations for 744 beach sites.
Color coding is used to indicate site recommendations in strategy maps.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Total
P1	33	9	8		6	14	8	2	16	6	6	3	34	6	89	9	249
P2	27	9	12		3	14	11	11	11	9	17	2	36	6	71	8	247
P3	5	3	7	2	5	16	14	13	11	15	13	1	46	5	87	5	248
Total	**65**	**21**	**27**	**2**	**14**	**44**	**33**	**26**	**38**	**30**	**36**	**6**	**116**	**17**	**247**	**22**	**744**

(*as per* Holling 1978) as we attempt to protect and restore beach ecosystem services. The uncertainties surrounding the protection and restoration of beach ecosystem services create a uniquely compelling problem of conflicting social values that may only be addressed through improved communications and learning (Cereghino, 2010).

Three situations may provide viable opportunities for partial beach restoration at a smaller than a littoral cell, and should be explored:

1. Where a fully restorable section of beach can be identified within an SPU, and the given beach segment contains a substantial proportion of historical sediment supply found within the drift cell.
2. Where higher resolution data can be used to identify portions of shoreline responsible for historical sediment supply, and sediment supply processes can be fully restored in those segments.
3. Where shoreline sediment transport within a single SPU is naturally interrupted by rocky shoreline features suggesting a sub-cell that could be managed independently. Several examples can be found along the west shore of the Hood Canal Sub-basin, in the Juan de Fuca Sub-basin, and in the San Juan archipelago.

While the beach strategy is primarily focused on restoration of sediment supply and transport, the importance of nearshore vegetation has been well demonstrated. Thus, while restoration of sediment supply and transport is foundational to beach restoration, local ecological functions may strongly depend on restoration of primary production, detritus recruitment and retention processes, and the condition of shoreline forests and creek deltas. Thus, where full restoration of historical structures and processes is infeasible, we propose a preference for restoration actions which result in a site where:

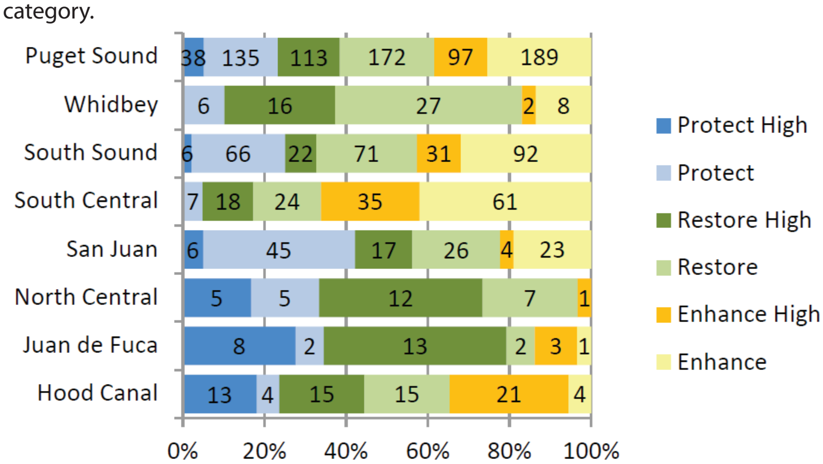
1. Sediment supply approaches historical levels due to a balance of shoreline erosion and creek mouth inputs, and long shore transport is unimpeded.
2. Stream mouth structure is unconstrained and allows for the formation of small and commonly unmapped barrier estuaries and stream deltas.
3. The landward ecosystems provide riparian functions and a historical quantity and quality of ground and surface freshwater inputs.
4. Wrack accumulation and movement is largely unconstrained by shoreline fill and armoring.
5. Bluff slumping and forest stand development, where naturally occurring, supports the development of robust detritus recruitment and shading from overhanging vegetation.

We anticipate that as site constraints increasingly prevent these conditions from being met, the potential for sustained and resilient restoration of diverse ecosystem services declines. Thresholds of cumulative stress resulting in precipitous loss of ecosystem services are documented (Greiner 2010, p17), but are currently unknown for Puget Sound beaches.

Given the high value placed on property protection by coastal land owners, removal of armoring may become increasingly difficult to implement with anticipated increasing erosion from rising sea levels. Restoration of sediment supply may rely either on the restoration of public land, sites where public trust interests are particularly strong, or on minimally developed shorelines where landowner conflict is less and protection of sediment supply is supported by existing land owners to reduce future erosion risk. Furthermore, the sediment supply necessary to sustain beach structure under historical conditions may be less than necessary to sustain future beaches under sea level rise. Temporary management measures such as beach nourishment are being considered for beaches affected by the Burlington Northern-Santa Fe railroad grade, despite the likely reoccurring costs of restoring beach structure without restoring supporting processes in these dynamic systems.

Across Puget Sound, our assessment assigns only 38 potential beaches to a protection approach. Just under 40

Figure 45 – Beach site recommendations by sub-basin. Color coding matches that on strategy maps. Numbers indicate number of sites. Percentage along the axis indicates the percent of all sites within a sub-basin falling within a recommendation category.



percent of beach sites are assigned to an enhance approach due to high levels of nearshore impervious and sediment supply degradation. High potential beach restoration sites are more or less well distributed throughout Puget Sound. South Central, South Sound, and Hood Canal have a relatively high level of high potential beaches with an enhance recommendation based on high levels of degradation. San Juan has the highest proportion of its beaches recommended for protection, followed by North Central and Juan de Fuca (Figure 45).

4.2.4 Barrier Embayment Strategy

Among 518 barrier embayment sites, the nearshore geo-database identifies 711 distinct historical barrier embayments features. Only 422 remain today (Simenstad et al. 2011). Numerous creek mouth structures were likely too small to be recorded on historical maps or to be identified using aerial photography.

Barrier embayment sites strongly overlap with our identified beach sites. A total of 496 out of 518 drift cells containing barrier embayments also contain bluff-backed beach. Only 22 barrier embayment sites appear to occur in the absence of bluff-backed beach (Table 33). That barrier systems exist in the absence of eroding shorelines, suggests there are mechanisms other than contemporary sediment deposition by which barrier systems have been formed in post-glacial history.

Individual barrier-type embayments are anticipated to vary in geomorphic setting, structure, sensitivity to sediment supply, and geomorphic origin. Similar to beach sites, our ability to classify and differentiate among these systems is supported by very limited field data or even conceptual analyses of how differently structured sites provide a different suite of ecosystem services.

Due to our conceptual understanding that depositional features like barrier embayments are dependent on sediment supply, barrier embayments were assessed at the scale of a drift cell, such that all the associated embayments and beaches within a littoral cell were evaluated as a single site. Metrics are the sum of all barrier type embayments added together. An accounting of each barrier embayment feature, individually considering sediment supply and embayment character, would provide value to local planning, is recommended in Section 4.4, and should be integrated with future beach work.

Groups P7 and P10, have distinctly high barrier embayment density (length of drift cell divided by count of embayments). A number of Puget Sound drift cells are short systems where sediment from a divergence zone or bluff backed beach immediately moves to forms a small spit at the mouth of an adjacent drowned stream valley

Potential Metrics

Embayment Shoreline Length

Vegetated Wetland Area

Embayment Density

Degradation Metrics

Loss of Embayment Length

Loss of Wetland Area

Tidal Flow Degradation

Sediment Supply Degradation

Nearshore Impervious

Risk Metrics

Jetty Influence

Future Nearshore Development

Target Processes

Sediment Supply

Tidal Flow

Management Measures

Topographic Restoration

Dike/Berm Removal Modification

Armor Removal

Groin Removal

Revegetation

Overwater structure removal

system. Frequently mirroring this small spit, on the other side of the barrier system, is another larger spit associated with a longer drift cell. The two cells flanking the inlet, and their winged barrier beaches are considered separate drift cells. Due to the conventions developed by Simenstad et al. (2011), each drift cell includes the terminal 'no appreciable drift' shoreline (the embayment) within its length. In this case, the short system would have a high embayment density while the longer system a lower embayment density. Both systems together in fact contribute to the structure of the embayment, and due to the structure of the drowned stream valley, neither system may be entirely responsible for sustaining embayment functions. These kinds of discrepancies point to the need to better define analytical units for characterizing individual barrier embayments, and to use field research to explore the relationships between embayments and drift cell systems. Development of a next generation barrier embayment strategy will benefit from our being able to discriminate amongst different kinds of barrier systems. Regardless, this initial inventory and effort provides an improvement on our accounting of these systems.

Of the physiographic processes discussed by Simenstad et al. (2011), *sediment supply* and *tidal flow* are the target processes of this strategy, without which ecosystem restoration is considered likely incomplete. The processes of *sediment transport*, *erosion and accretion of sediments, detritus recruitment and retention*, *solar incidence*, and *tidal channel formation and maintenance* are anticipated to be critical to the full restoration of embayment ecosystem services, and are most likely to be in operation where sediment supply and tidal flow are unconstrained.

Following Clancy et al. (2009), *dike or berm removal or modification* can efficiently restore tidal flow in some settings, while *topographic restoration* is necessary where embayments have been filled for development. *Armor Removal* and *Groin Removal* are among primary management measures, as they were for the beach strategy as the restoration of sediment supply and its transport to barrier beaches may be necessary to sustain barrier beach structure. In some cases c*hannel rehabilitation* may restore tidal flow to sites, however, channel formation is commonly supported by tidal flows. More engineered tidal openings, falling into the category of *hydraulic modification,* are proposed where restoration of natural tidal channel formation and maintenance processes are constrained by infrastructure. The effects of different levels of tidal flow on ecosystem services are poorly understood.

Ten distinct potential groups are identified through cluster analysis, which compares historical embayment length, historical embayment density, and historical wetland area. A large proportion of sites fell within Groups P2, P6 and P9. Group P6 represents a large number of sites with a metric average similar to the Puget Sound average. Groups P7 and higher contain sites with above average potential scores (Figure 24), and have one or more higher than average potential metrics (Figure 25). Sites in Group P7 and higher, account for 18% of all sites in Puget Sound, and were assigned a high potential rating (Table 34).

Nine distinct degradation groups are identified by cluster analysis, based on the similarities among degradation metrics. The restoration of barrier embayment systems combines metrics related to drift cell degradation defined for beach restoration as well as for tidal flow and wetland degradation from the delta strategy.

Sites in Group D2 display a high loss of embayment length, indicating that substantial restoration is likely necessary

Table 36 – Overlap among sites identified by the beach and barrier embayment strategies. Both Beach and Barrier Embayment sites use SPUs as the analytical unit. In all sub-basins most barrier embayment sites are a subset of beach sites with the remaining beach sites not containing any barrier embayments. In 22 cases, barrier embayment landforms were present in the absence of a mapped eroding beach (bluff-backed beach) and so an embayment site exists in the absence of a corresponding beach site.

Sub-Basin	Beach Only	Both	Embayments Only	Total
Hood Canal	10	62	2	74
Juan de Fuca	6	23		29
North Central	3	27	2	32
San Juan	44	77	12	133
South Central	59	86	2	147
South Sound	113	175	4	292
Whidbey	13	46		59
Grand Total	**248**	**496**	**22**	**766**

Table 37 – Recommendations for 518 barrier embayment sites. Color coding is used to indicate site recommendations in strategy maps.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	D9	Total
P1	12	1	4	4						21
P2	68	44	47	10	19	6	23		15	232
P3	4	4	8	2			3			21
P4			2	1					1	4
P5	4	1	1	1						7
P6	47	11	29	9	15	8	4		15	138
P7	3		1		1					5
P8	2		1	1	4					8
P9	23	3	14	4	9	4		5	7	69
P10	9			1	2				1	13
Total	**172**	**64**	**107**	**33**	**50**	**18**	**30**	**5**	**39**	**518**

to restore functions. Thus, the large minimally degraded Group D1 (172 sites) was the only group recommended for a 'protect' approach (Table 34). In evaluating a cutoff to distinguish between enhancement and restoration recommendations, there appeared to be a jump in mean degradation score between Groups D6 and D7 (Figure 24). Among D7 sites, while tidal flow degradation (within embayments) remains low, there is a substantial jump in sediment supply degradation in the drift cell along with a substantial increase in the loss of historical embayment length (Figure 25).

Our analysis of embayment systems at the scale of a drift cell does reduce the utility of our analysis within a drift cell. A median barrier embayment site is 4 kms in length, and contains 1.2 embayments. However, 44 sites are over 10 km long, and 66 sites contain 3 to 7 embayments. Embayments may be at the up drift or down drift end of long beach systems. As with the Beach Strategy, there are situations where partial restoration of a shoreline process unit could be justified. Where the distribution of sediment supply sources can be identified, a portion of a system consisting of one or more barrier embayments, and a prevalence of up-drift sediment sources could be reasonably identified as a viable sub-site, smaller in scale than the entire shoreline process unit (SPU). In addition selective removal of armoring to restore a prevalence of historical sediment sources could be argued to completely restore target processes without complete removal of armor within an SPU.

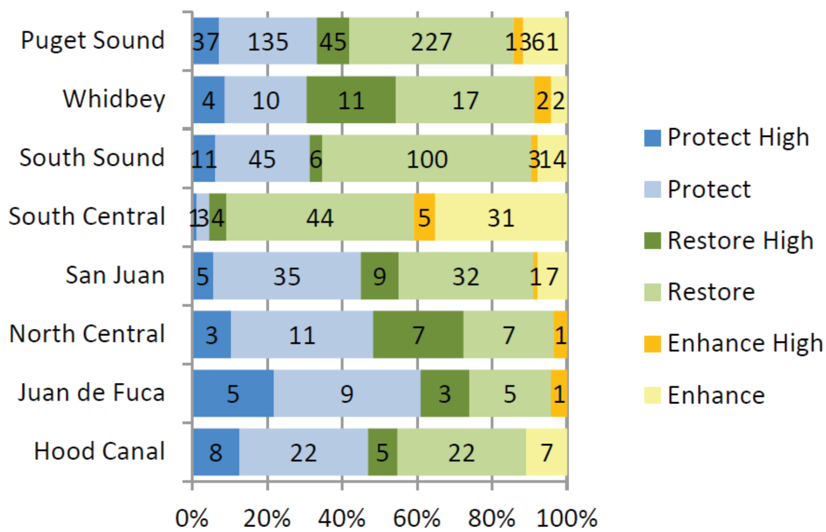
As with restoration of river delta wetlands, property ownership and conflicting land uses may prevent full restoration of historical tidal flow processes in degraded embayments. Full restoration of tidal flow and associated ecosystem processes could likely be achieved within a smaller than historical footprint, while providing a lesser quantity and quality of ecosystem services. Where necessary we have a preference for partial restoration actions which result in a system where:

1. Ecosystem processes are fully restored within a partial footprint, including the unconstrained tidal flows necessary to support a full range of embayment ecosystem processes.
2. The system has redundant representation of the full range of embayment ecosystem components including stream delta or ponds (where historically present), tidal flats, salt marsh, channels, tidal delta, beach berm, beach face, and low tide terrace where historically present.
3. The partially restored system is formed of a contiguous large patch that is well connected to adjacent terrestrial and marine landscapes.
4. The wetland system is internally connected through a network of tidal channels that allow for the unconstrained movement of organisms, water, and sediments.
5. The landward edges and freshwater inputs into the partial embayment ecosystem are managed to provide riparian functions and to protect the quantity and quality of freshwater inputs from surrounding land use impacts.

As with delta systems, as site constraints increasingly prevent these conditions from being met, the likelihood of the sustained and resilient restoration of diverse ecosystem services declines. Thresholds of cumulative stress resulting in precipitous loss of ecosystem services are documented (Greiner 2010, p17), but are currently unknown.

The potential interaction with sea level rise should be part of the evaluation of partial restoration. Sea level rise will reduce the relative elevation of barrier beaches and embayments. This may result in evolution of these systems, for example from a closed lagoon marsh to a barrier estuary or lagoon. Up-drift sediment supply and transport processes are anticipated to be essential for maintaining barrier beach structure over longer time spans under sea level rise. When associated with drowned channel systems, higher sea level may result in increased potential marsh area, where landward migration is allowed. Individual sites should be evaluated for their ability to allow landward migration and the relative integrity of sediment supply processes. Alternately, to protect infrastructure on embayment shorelines under sea level rise, private property owners may consider regulating tides through construction of causeways, similar to many historical developments.

Figure 46 – Barrier embayment site recommendations by sub-basin. Color coding matches that on strategy maps. Numbers indicate number of sites. Percentage along the axis indicates the percent of all sites within a sub-basin falling within a recommendation category.



4.2.5 Coastal Inlet Strategy

Coastal inlets sites often contain large stream deltas with many of the components and functions of river deltas, but on a smaller scale. There is tremendous variation among coastal inlets, from the extensive creek mouth wetland complexes of the south Puget Sound finger inlets formed during glaciation, to numerous small coastal drowned creek valleys. Compared to Puget Sound's 16 large river delta sites, which encompass nearly 70 percent of the Puget Sound Watershed, coastal inlets offer a more intimate and 'human-scaled' setting, commonly falling within a single municipal jurisdiction or even a neighborhood. In this way, coastal inlet sites may provide a unique opportunity to engage local communities in ecosystem recovery and management.

There appears to be a strong north to south gradient in the frequency and extent of coastal inlet sites, perhaps related to the relative rates of sea level rise and isostatic rebound following glacial recession. South Puget Sound Sub-basin has the highest density and extent of coastal inlets, only matched by south Hood Canal Sub-basin (Table 25). Many of these systems are relatively small drowned creek channels contained within a single shoreline process unit.

The relatively small inlets (P1 to P4) make up the majority of sites (169 out of 266; Figure 34). It may be tempting to discount these low potential sites as inherently less important than the larger embayments. However, these small sites, which overlap with barrier embayment features, may provide for a connectivity of habitat functions between larger wetlands. The character of the services provided by small coastal wetlands, compared to large coastal wetlands, has been poorly researched. Compared to barrier embayment systems, these sites may be more resilient to climate change, were sea level rise and degraded sediment supply to result in loss of barrier features. Wetland migration up drowned creek channels is supported by continued input of creek sediment at many sites.

Tidal flow and *freshwater input* (including river sediment inputs) are the target processes for this strategy, without which restoration is likely incomplete. *Solar incidence*, *tidal channel formation and maintenance*, and *detritus recruitment and retention* processes are likely important in the restoration of full ecosystem services, and are most likely to support historical services where tidal flows and freshwater inputs are fully restored.

Berm or dike removal or modification is the most cost-effective method of embayment restoration where the topography is largely intact, but where tidal flows are constrained by a berm or dike. *Revegetation* of shoreline forest provides important services and may be necessary

Potential Metrics

Embayment Shoreline Length

Vegetated Wetland Area

Watershed Area

Degradation Metrics

Loss of Embayment Length

Loss of Wetland Area

Tidal Flow Degradation

Nearshore Impervious

Watershed Impervious

Risk Metrics

Marina Development

Future Nearshore Development

Future Watershed Development

Target Processes

Freshwater Input

Tidal Flow

Primary Management Measures

Dike/Berm Removal Modification

Topographic Restoration

Revegetation

Hydraulic Modification

Table 38 – Recommendations for 266 coastal inlet sites. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	Total
P1	63	17	7	3	3	2	1	3	99
P2							1		1
P3		1							1
P4	48	7	2	5	2	2	1	1	68
P5	1			1					2
P6	14	1		4		2	2	2	25
P7	19	4	1	4	1	4		2	35
P8	13	4		5		2		4	28
P9	4			1		1		1	7
Total	**162**	**34**	**10**	**23**	**6**	**13**	**5**	**13**	**266**

where local seed source does not allow for natural regeneration of forest cover. *Topography restoration* becomes the primary management measure where coastal inlets have been filled. More engineered approaches to *hydraulic modification* may be useful for restoring tidal flow in some settings but may not support a full range of ecosystem services or may require continued operating costs.

Eight distinct potential groups were identified by cluster analysis, with most sites falling into Groups P1, and P4, with a lesser proportion among Groups P6, P7, and P8 (Figure 34). Group P4 was at or slightly below the regional mean potential score, while Group P5 contained two sites with small watersheds but exceptionally large historic wetlands. Groups P5 and higher were assigned a high potential rating, accounting for 97 sites, or 36% of Puget Sound's coastal inlet sites.

Eight distinct degradation groups were identified by cluster analysis. A total of 162 out of 266 sites fell in Group D1 (Figure 39). Groups D2 and D3 appear to have higher mean degradation scores (Figure 39), driven by jumps in nearshore impervious and loss of length respectively (Figure 40). Only the large Group D1 was recommended for a protection approach. Mean degradation score appears to jump again between Group D5 and D6 (Figure 39) with degradation becoming apparent among multiple metrics (Figure 40). While Group D5 has high levels of shoreline and watershed impervious, inlet shorelines are relatively intact. Therefore Groups D6 and higher were recommended for an enhancement approach, accounting for 31 sites or 12% of all Puget Sound coastal inlets.

Due to the enclosed nature of coastal inlet hydraulics, and their frequent association with coastal streams, we anticipate that compared to beaches and barrier embayments, inlet functions are more consistently and strongly linked to freshwater input processes and conditions in the contributing watershed. Thus, the size of the contributing watershed is used to describe site potential, and watershed impervious is used as an indicator of likely degradation. Degradation groups can be differentiated based on whether degradation is related to watershed and buffer impervious surface (Groups D2 and D5), shoreline modification (D3, D4, D6), or both (D7 and D8; Figure 40), suggesting different approaches to management.

As with the restoration of river delta wetlands, property ownership and conflicting land uses may prevent full restoration of historical tidal flow or freshwater input processes in degraded embayments. Full restoration of tidal flows and associated ecological processes could likely be achieved within a smaller than historical footprint, while providing a lesser quantity and quality of ecosystem services. Where full restoration of historical structures and processes is not feasible, we propose a preference for restoration actions that result in sites where:

1. Ecosystem processes are fully restored within a partial footprint, including the undegraded tidal flows and freshwater inputs necessary to support a full range of coastal inlet ecosystem processes.
2. The system has redundant representation of the full range of coastal inlet ecosystem components including creek delta with swamp, salt marsh, tide flat, and channels where historically present.
3. The partially restored system is formed of contiguous large patches that are well connected to each other and

to the adjacent river, terrestrial, and marine landscapes.

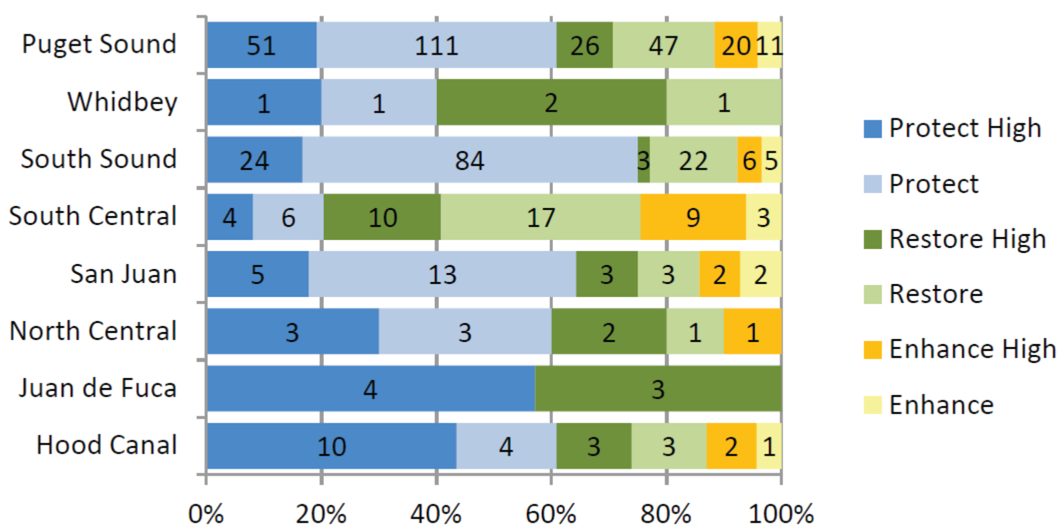
4. The system is internally connected through a channel network that allows unconstrained movement of organisms, water, and sediments.
5. The landward edges and stream watersheds are managed to provide riparian functions and to prevent degradation of freshwater inputs from surrounding land uses.
6. The contributing basin provides the flood discharge, wood recruitment, organism dispersal and sediment supply that support coastal inlet functions.

As site constraints increasingly prevent these conditions from being met, the potential for sustained and resilient restoration of diverse ecosystem services declines. Thresholds of cumulative stress resulting in precipitous loss of ecosystem services are documented (Greiner 2010), but are currently unknown.

At many sites, the primary sources of mapped degradation are from causeway fill and armoring at road crossings and the potential for tidal flow constrictions. The effect of these constrictions on habitat functions is poorly researched, and a consistent approach for evaluation of these sites would be beneficial.

Similar to river delta systems, the potential effects of sea level rise should be part of the evaluation of partial restoration. Sea level rise will reduce relative elevation of coastal inlet wetlands, and increase saltwater penetration into associated river systems. Increasing sea level may reduce the area of existing buffers, and may cause wetlands to migrate landward. The supply of stream sediment is likely important to maintain marsh elevation or slow the rate of marsh loss, while landward migration may result in increases or restoration of marsh area depending on local topography and land use constraints.

Figure 47 – Coastal inlet site recommendations by sub-basin. Color coding indicates strategic recommendation. Numbers indicate number of sites. Percentage along the axis indicates the percent of all sites within a sub-basin falling within a recommendation category.



4.2.6 Implementing Strategies

Ultimately our hope is that these strategies and assessments inform how we choose to manage landscapes. Were the only outcomes of this work to be color coded maps, than we anticipated little improvement in nearshore ecosystem management.

The maps referred in Appendix A do provide a way to see data quickly. One map is provided for each sub-basin, for each strategy. They are not simple maps. In a single map you can view, at a sub-basin scale, all sites within a strategy, our preliminary recommendations, potential and degradation group and scores, as well as a variety of spatial attributes important to the strategy being displayed.

To support exploration of these results, we offer an introduction to how different elements of these analyses, and other Nearshore Project products, could support planning and decision in a particular place. These are presented from the most general to the most detailed sources of information. We anticipate that nearshore ecosystem assessment may support three tasks, each requiring a different sequence of integrative analysis:

- Identifying places in the landscape in which to achieve specific objectives (one of the intended functions of this work in relation to the Nearshore Project).
- Developing policy for managing physiographic processes within portions of the shoreline of landscapes.
- Evaluating the potential for a suite of actions to achieve ecosystem restoration within a site.

1. **The Strategy** defines the physiographic character of a site based on the presence of river deltas, beaches, barrier embayments, and coastal inlets.	*Each location can be associated with one or more landform-based strategies (described in sections 4.2.2 to 4.2.5). Strategies suggest how locations provide ecosystem services based on physiography. Strategies define the target processes (per Simenstad 2011) and primary management measures (per Clancy 2009) likely to be most important in restoration or protection. The strategy narrative suggests approaches for evaluating the partial restoration of sites. All additional evaluation follows this designation of a process unit as a potential strategic site.*
2. **The Site Recommendation** proposes an approach to site work based on Potential and Degradation group.	*Recommendations integrate potential and degradation analysis to provide a broad and simple approach to management within a strategy (i.e. compared to other beaches, inlets, or deltas). Within a population of sites it suggests where services are best provided, and how an ecosystem restoration effort might allocate different kinds of efforts across the landscape. It further suggests what locations may be most important if sequencing that ecosystem effort. The site recommendation identifies the essential problem that one might hope to solve at a site through management. Site recommendations are preliminary and should be validated through more detailed site observations.*
3. **The Sub-basin Summary** provides an overview of strategic sites within a sub-basin, providing insight into the relative rarity. (See the summary for **Hood Canal, Juan de Fuca, North Central, San Juan, South Central, South,** and **Whidbey** sub-basins)	*Sub-basin summaries provide a synopsis of what kinds of sites are common or rare within a sub-basin, further refining how different strategies may serve sub-basin needs. Considering the pattern of ecosystem services within a sub-basin helps to identify where local features are particularly relevant to how the sub-basin provides services relative to Puget Sound. This context helps inform whether a particular action pointedly addresses the loss of ecosystem services within the sub-basin, and at a scale relevant to the sub-basin.*

4 **The Potential Score and Group** further defines the importance and unique qualities of a site. (See results for **Deltas, Beaches, Barrier Embayments** and **Coastal** Inlets)	*Potential score and group expands on the site recommendation, providing a more detailed view into the degree to which a site was important to the historic delivery of ecosystem services. By understanding a potential group, we understand the ways in which a site might be unusually significant among similar Puget Sound sites, and thus, the attributes toward which management might attempt to achieve protection or restoration. The evaluation of management measures might be informed by the degree to which the potentially unique or rare characteristics of a site, as represented by potential group are restored.*
5. **The Degradation Score and Group** describes the extent and character of degradation affecting the site either as a target for action and as a potential constraint. (See results for **Deltas, Beaches, Barrier Embayments** and **Coastal** Inlets)	*While site recommendation provides an overview of the essential problem, degradation group better characterizes the nature of that problem. Using degradation group helps identify sites that are most responsive to an available toolset (i.e. whether a coastal inlet requires mitigation of impervious surfaces or fill removal.) Degradation groups may suggest how different management approaches could be developed to better address the variation in the problems faced by different areas of the landscape. A suite of actions proposing to achieve restoration of a site should address the full range of degradation sources.*
6. **The Risk Factors** suggest issues that should be investigated in the development of site alternatives.	*Risk factors might suggest prioritization of one site over another based on anticipated future risks of population growth. Risk factors might indicate the need for special management strategies to insure the effectiveness and resilience of management. Any proposed suite of actions at a sight.*
7. **Maps** describe all six components of the strategy and their spatial organization.	*The issues above are described in the atlas in Appendix A. A map view allows us to perceive spatial patterns in the distribution of sites in the landscape.*
8. **The Individual Metrics and Change Analysis Data** determine whether a site is typical for its grouping and provide the spatial configuration of stressors and change within sites, supporting feasibility planning.	*Individual site metrics (Appendix C), can be compared to Puget Sound and group averages to better observe whether a site is typical for its group and score. Individual metric may be combined with more summary scores and ratings to target specific conditions to meet specific objectives or constraints. The configuration of site features and stressors may suggest ways to manage ecosystem processes within a site. Some stressors, while affecting our summary analyses, may in fact not strongly affect ecosystem services due to some unpredictable aspect of their configuration or position in the landscape.*

9. The Partial Restoration Checklist for each system provides a framework for considering the degree to which partial restoration of a site may affect service provision. (See strategy discussion for **river deltas, beaches,** and **barrier embayments,** and **coastal inlets**.)	*In working within a site, this component of our strategy framework supports a more detailed evaluation of ecosystem processes. This provides a starting point for determining whether a site management proposal is addressing the range of processes and structures that may be necessary to support full and resilient restoration of ecosystem services. Simenstad et al. (2011), Appendix B, provides a more involved consideration of the range of ecosystem processes at work within a landform, and directly supports application of these strategies.*
10. Management Measures may then be considered based on their potential to address site needs and the extent to which the site constrains best restoration or protection practices.	*Clancy et al. (2009) provides an assessment of 21 management measures commonly employed by nearshore protection and restoration projects, including a checklist of considerations during planning, implementation and evaluation.*

4.3 High Potential Sites by Sub-basin

Our strategic recommendations point to sites that are larger and more complex. We propose that these sites are potentially more important for ecosystem management. If ecosystem processes at these large complex sites become degraded, it will be extremely difficult to reverse. If too large a proportion of these large complex sites are irreversible degraded, our ability to restore ecosystem services is lost.

In many settings, and particularly in the southern extent of Puget Sound, the shoreline is finely divided into many small drift cells and inlets. Large scale restoration and protection in these settings may necessarily involve clusters of sites. We believe this strategy framework provides a strong foundation for development of spatial plans by describing a population of distinct landscape components. The following sub-basin summaries provide some spatial observations, but stop short of providing a spatial plan. For a sub-basin scale spatial plan to be effective, it would ultimately integrate freshwater, terrestrial, and off-shore systems, as well as important biotic populations. Several of these pieces are underway at the time of this publication, and so we do not attempt to complete that integration here. A tentative summary of this anticipated future work is described in section 4.4.

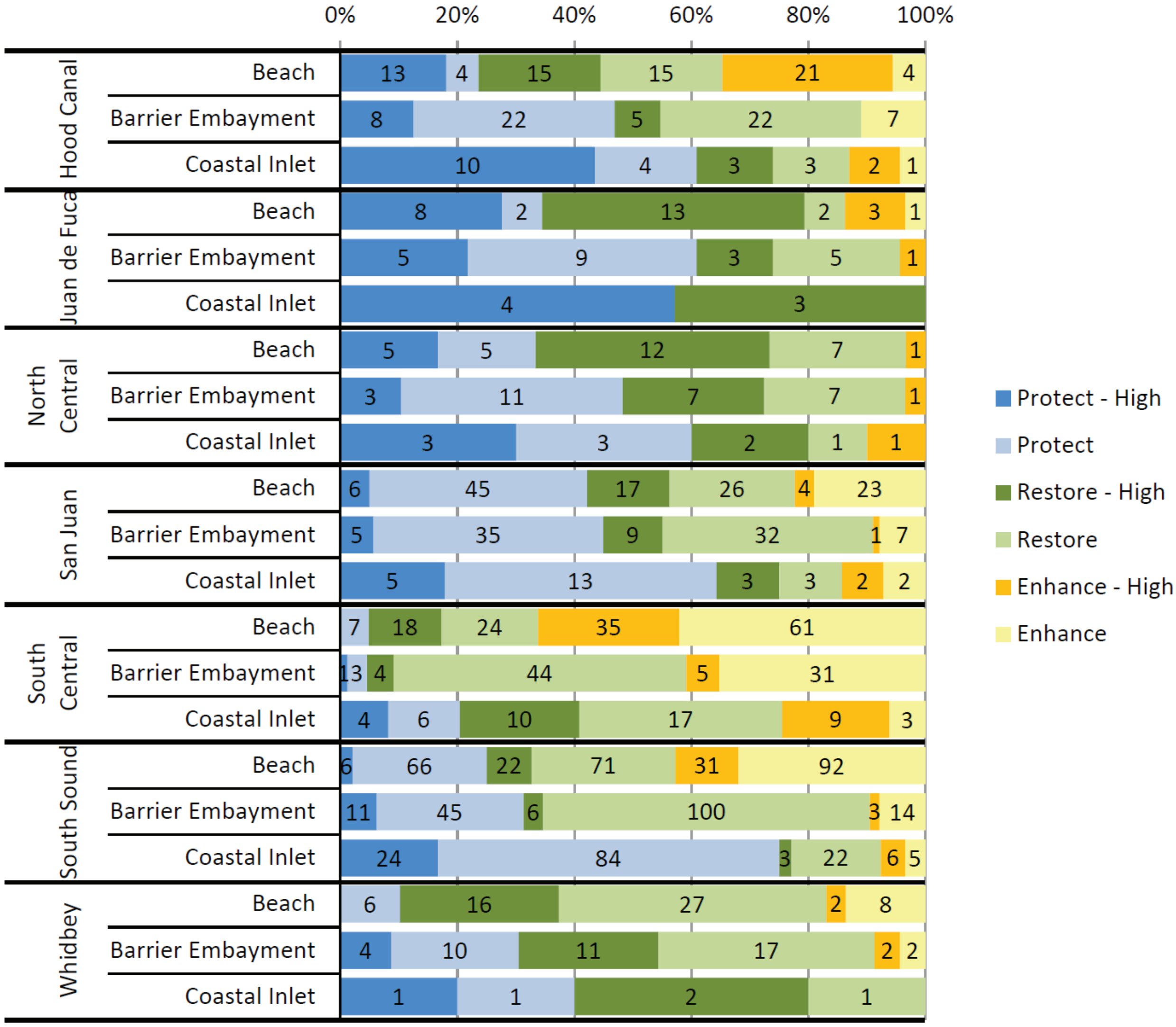
Each Puget Sound Sub-basin contained historically a mosaic of deltas, beaches, barrier embayments and coastal inlets. Considering the 'composition' of sub-basins in terms of the distribution of high potential sites (Table 36) and the balance between protection, restoration, and enhancement recommendations (Figure 48) provides a framework for strategic planning at a sub-basin scale while considering regional context.

Where restoration or protection opportunities are uncommon within a landform and sub-basin, then those few remaining sites may be more important for ecosystem recovery. When a particular sub-basin has a high proportion of high potential sites of a particular landform then that landform may be critical to the historical ecological services provided by that landscape (e.g. barrier embayments in North Central, or coastal inlets in South Sound, or deltas in Whidbey)

Table 39 – Proportion of high potential sites by strategy and sub-basin.

Strategy	% of sites High Potential
Beach	**33%**
Hood Canal	68%
Juan de Fuca	83%
North Central	60%
San Juan	22%
South Central	37%
South Sound	20%
Whidbey	31%
Barrier Embayment	**18%**
Hood Canal	20%
Juan de Fuca	39%
North Central	38%
San Juan	17%
South Central	11%
South Sound	11%
Whidbey	37%
Coastal Inlet	**36%**
Hood Canal	65%
Juan de Fuca	100%
North Central	60%
San Juan	36%
South Central	47%
South Sound	23%
Whidbey	60%

Figure 48 – Strategic site recommendations by sub-basin. Color coding indicates strategic recommendation. Numbers indicate number of sites. Percentage along the axis indicates the percent of all sites within a sub-basin falling within a recommendation category.



4.3.1 Hood Canal

Deltas

There are five delta sites in the Hood Canal Sub-basin (Table 37). All are small when compared to delta sites draining the Cascade Mountains. The Skokomish River delta is the largest in Hood Canal. These are among the least degraded delta sites in Puget Sound. Hood Canal deltas are arrayed along the western edge of the Hood Canal. Despite their small size, the number of delta sites results in substantial delta length, accounting for approximately 12 percent of the historical shoreline, relatively high among Puget Sound Sub-basins.

Beaches

There are 72 beach systems in the Hood Canal Sub-basin (Table 38). Over two thirds of sites are high potential systems, characterized by higher than typical length, density of creek mouths, and barrier beach features. About half of these high potential systems are substantially developed. All drift cells in the Big Bend, and along the west shore from Skokomish north past Lilliwaup, as well as the beach from Seabeck north past Big Beef Creek are identified as sites likely suited for enhancement with substantial degradation. The remainder of Hood Canal is composed of high potential beach sites including substantial areas recommended for a protection approach, including several drift cells from the Hood Canal Bridge south around Hazel Point and including all of Dabob Bay. The beaches from Frenchman's Cove south to Dewatto Bay are also notably complex and minimally degraded. Future development risk is relatively low, but present particularly around Stavis Bay.

Barrier Embayments

Of 72 beach systems in Hood Canal, 64 have one or more barrier embayments (Table 39). Within the relatively degraded beaches of the Great Bend, the two embayment sites bracketing Union Creek coastal inlet site are notable as having high potential. The beaches from Dewatto north to Port Gamble, and from Hood Canal Bridge around Hazel Point and including all of Dabob Bay are high potential barrier embayment sites and recommended for restoration or protection.

Coastal Inlets

Coastal inlets are not uncommon in Hood Canal, accounting for approximately 12 percent of shoreline length. Twenty-three coastal inlets sites occur in Hood Canal (Table 40). Eight of these sites are relatively small systems in varying states of degradation (P1-4/D1-6). Thirteen are high potential sites, two-thirds of which are in a relatively undegraded state (P5-8/D1), indicating that protection of those sites may protect a substantial portion of coastal inlet functions. Of the remaining five high potential sites, three show evidence of extensive shoreline development which may constrain restoration (P8/D4), but all have relatively intact watershed conditions suggesting a potential for comprehensive system protection and restoration. The two larger and highly modified inlets are the Union River estuary near Belfair (P9/D6), and the Rendsland Cove site in SW Kitsap County (P6/D8). Union River estuary is one of the seven largest and most complex inlets in Puget Sound.

Table 40 – Hood Canal river delta recommendation. Color coding indicates strategic recommendation.

Group	D1	Total
P1	5	5
Total	5	5

Summary of Sites

The following sites may provide exemplary opportunities for large scale process-based ecosystem restoration and protection in the Hood Canal Sub-basin:

Skokomish Delta Restoration (DPU SKO) – The Skokomish site is the largest delta in Hood Canal by any measure and provides the largest extent of tidal wetlands in the southern Hood Canal.

Quilcene Bay Delta Restoration and Beach Protection (DPU QUL/SPU 2054-56) – This river delta site which is the subject of extensive restoration work is nested in a matrix of high potential beach sites recommended for protection.

Hamma Hamma, Duckabush, and Dosewallips Delta Restoration (DPU HAM, DUC, DOS) – These delta sites are relatively undegraded with relatively protected watersheds. Duckabush and Dosewallips have relatively high nearshore impervious.

Dabob Bay and Toandos Peninsula Ecosystem Protection (SPU 2059-2065/IPU 196 & 216) – This region presents a relatively continuous reach of high potential beaches, barrier embayments and inlets recommended for protection, including large spits in Dabob bay, Fisherman Harbor, and Thorndyke Cove which is notably at risk for both future nearshore and watershed impervious.

Port Gamble, Seabeck Bay, Stavis Bay, Dewatto Bay (IPU 158, 183, 186, 217) – These coastal inlets are identified as high potential coastal inlet protection sites along the East shore of Hood Canal.

Jackson Cove Protection and Restoration (IPU 210/ SPU 2050-52) – This site is identified as a high potential coastal inlet protection site however there may also be opportunities to restore adjacent associated barrier embayment sites that have been degraded.

Table 41 – Hood Canal beach sites recommendation. Color coding indicates strategic recommendation.

Groups	D2	D3	D5	D6	D7	D8	D9	D10	D11	D13	D15	Total
P1				1					1	1	2	5
P2		1		2	4	2		3	1	3	2	18
P3	2	1	2	8	4	5	1	1	1	3	21	49
Total	2	2	2	11	8	7	1	4	3	7	25	72

Table 42 – Hood Canal barrier embayment site recommendation. Color coding indicates strategic recommendation.

Groups	D1	D3	D4	D5	D6	D7	D9	Total
P1			1					1
P2	13	2	4	2	1	2	1	25
P4		1	1				1	3
P5	1							1
P6	8	4	2	3	1		3	21
P8	1	1						2
P9	6		1	1	1			9
P10	1			1				2
Total	30	8	9	7	3	2	5	64

Table 43 – Hood Canal coastal inlet site recommendation. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D6	D8	Total
P1	1	1	1	1			4
P4	3				1		4
P5	1						1
P6	4					1	5
P7	3						3
P8	2			3			5
P9					1		1
Total	14	1	1	4	2	1	23

Cattail Lake Restoration (IPU 213) – While identified as a protection site, there appears to be complete tidal flow degradation at this site which is otherwise very intact.

Shine Creek Restoration (IPU 220) – This site has been the recent target of restoration investment.

Union River/Lynch Cove Restoration (IPU 157, SPU 2024-25) – These sites make Lynch Cove one of Puget Sound's largest and most complex coastal inlets, and while the inlet site is recommended for enhancement due to extensive development associated with Belfair, overlapping barrier embayment sites are recommended for protection and restoration.

Seabeck Bay to Port Gamble Beach and Embayment Restoration (SPU 2002 & 2088) – These adjacent sites are both exceptionally long and complex beaches, including several lost embayments, that may be nearing a state of cumulative degradation that is very difficult to reverse.

Great Bend Lost Barrier Embayment Restoration – There are a large number of lost barrier embayments in the Great Bend and north in continuity to the Hamma Hamma delta that reflect a substantial loss of barrier embayment services in this area of Hood Canal.

Tahuya River Estuary Restoration (IPU 146) – This site is among the most significant coastal inlets in Puget Sound with moderate degradation.

Lilliwaup Inlet Restoration (IPU 159) – This site is a high potential coastal inlet with low levels of degradation.

Rendsland Cove North to Dewatto Beach Restoration (SPU 2011) – This beach site is moderately degraded with the potential for achieving large scale sediment management.

Dewatto North Beach Protection (SPU 2007-09) – These long complex beaches are lightly degraded and could be targets for sediment supply management.

Some high potential sites identified as potential ecosystem restoration sites like the developed Coon Bay near Foulweather Bluff are likely poorly suited as restoration sites. We anticipate that the area within the big bend, between the Skokomish delta and Union River, and back to Rendsland Cove will provide a substantial challenge to the restoration of beach ecosystem processes, not to mention threats from water quality, and that restoration efforts should carefully target the enhancement of specific ecosystem functions in that landscape.

The two Anderson creeks, and Big Beef Creek inlets along the East coast of Hood Canal were not identified under the coastal inlet strategy but should be considered for addition, as they appear to be strongly associated with drowned creek valleys and substantial watersheds, meeting our definition for coastal inlet sites.

4.3.2 Juan de Fuca

The Juan de Fuca Sub-basin is more exposed to Pacific Ocean waves than other sub-basins. Two major river deltas are complemented by several very large coastal inlets, but much of the coastline is primarily long drift cells punctuated by barrier embayments and rocky shorelines. Degradation varies widely from highly degraded sites around Port Angeles (the largest urbanizing area), to among the least degraded in Puget Sound. Juan de Fuca has the highest proportion of sites recommended for protection in all of Puget Sound. Most of the shoreline is in Clallam County, except where Discovery Bay extends into Jefferson County.

Deltas

Juan de Fuca's river delta sites are larger than those draining into the central Hood Canal, more similar in scale to the Skokomish than other Hood Canal river deltas, but still small by Puget Sound standards. The Elwha is somewhat unique as a national ecosystem restoration site. The Dungeness River has the second highest potential of the Olympic deltas next to the Skokomish, and is relatively highly degraded, providing a significant opportunity for recovery of lost ecosystem services (Table 41).

Beaches

There are 29 beach systems in the Juan de Fuca Sub-basin (Table 42). Juan de Fuca beaches are among the longest beaches in Puget Sound, and are more exposed to oceanic waves than other Puget Sound beaches. Juan de Fuca shoreline includes numerous rocky shorelines, and how these features affect sediment transport systems is uncertain. The eighty-three percent of beach sites are considered high potential, the highest proportion in Puget Sound. A wide range of degradation groups are represented in Juan de Fuca, however only three sites (the Port Angeles waterfront, The Port of Sequim, and Neah Bay) are considered so degraded that opportunities for process restoration are likely infeasible. A fourth site on the inside of the Dungeness spit placed in Group D14 was given a similar recommendation, based on an unusually high parcel density. Based on this observation, the recommendations for the 17 sites in Group D14, which

Table 44 – Juan de Fuca delta site recommendations. Color coding indicates strategic recommendation.

Group	D1	Total
P1	2	2
Total	2	2

Table 45 – Juan de Fuca beach site recommendations.
Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D10	D11	D13	D14	D15	D16	Total
P1			1											1
P2		1					1		1			1		4
P3	1		2	1	2	2	3	5	2	3	1	1	1	24
Total	1	1	3	1	2	2	4	5	3	3	1	2	1	29

Table 45 – Juan de Fuca barrier embayment site recommendations.
Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D6	D8	Total
P2	1			1			2
P6	8	2		1	1		12
P9	5		1	1	1	1	9
Total	14	2	1	3	2	1	23

have variable degradation but very high parcel density, should be evaluated with caution, as described in our recommendations for future analysis.

Barrier Embayments

Of the 29 beach systems in Juan de Fuca, 23 include some barrier embayment features (Table 43). A total of 39 percent of sites are identified as high potential, the highest proportion in Puget Sound.

Juan de Fuca has the highest proportion of sites with a protect recommendation. Future risk projections indicate a moderate to low future nearshore development risk. Notable is the moderate future rate of population growth surrounding the high potential sites that converge at Washington Harbor (SPU 1020 & 1021) that are anticipated to be affected by future population growth surrounding the City of Sequim.

Coastal Inlets

Seven coastal inlet systems are identified in the Juan de Fuca Sub-basin, all of which were rated as high potential (Table 44). While there are few coastal inlets identified, in no other sub-basin is every mapped inlet of noteworthy size and complexity. None of these sites appear to be so degraded that substantial restoration or protection of ecosystem processes should not be evaluated. Three of these large sites show a high risk of future increases in watershed impervious: Grayland Marsh, Washington Harbor, and the Salmon-Snow Estuary. The Salmon-Snow and JimmyComeLately Creek estuaries and Washington Harbor are the highest potential sites in the sub-basin (Group P8).

Table 47 – Juan de Fuca coastal inlet site recommendations.
Color coding indicates strategic recommendation.

Groups	D1	D2	D4	Total
P5			1	1
P6	1			1
P7	2			2
P8	1	1	1	3
Total	4	1	2	7

Summary of Sites

The following sites may provide exemplary opportunities for large scale process-based ecosystem restoration and protection in the Juan de Fuca Sub-basin:

Dungeness River Restoration (DPU DUN) – The Dungeness River offers the greatest opportunity for recovery of lost river delta services in the sub-basin.

Grayland Marsh Restoration (IPU 236) – Grayland marsh was once a substantial coastal inlet adjacent to the Dungeness River. The Grayland Marsh watershed has a relatively high risk of future increase in impervious surface.

Salmon-Snow and JimmyComeLately Estuary Restoration (IPU 227 & 229) – These are among the highest potential coastal inlet sites in Puget Sound, and have received substantial attention as restoration sites. Salmon-Snow has a relatively high risk of future increase in impervious surface.

Washington Harbor Restoration and Watershed Protection (SPU 1020/1021) – Both restoration of the inlet, and restoration and protection of sediment sources could be investigated. The watershed is at relatively high risk of future increase in impervious surface.

Dungeness Spit Beach Protection (SPU 1025) – This long complex beach site supports both substantial barrier embayments as well as providing sediment to the Dungeness Spit, an exceptionally large barrier estuary to the Dungeness River.

West Juan de Fuca Drift Cells (SPU 1027-29) – Extensive long drift cells include both rock outcrops and extensive barrier embayment systems, and are variably degraded. There are likely substantial opportunities to protect and restore sediment supply processes. Future nearshore development risk is relatively low.

Sequim Bay to Discovery Bay Beach Protection and Restoration (SPU 1008-1019) – These sites while not individually noteworthy provide a long stretches of relatively intact and complex beaches with modest embayments adjacent to regionally important coastal inlets and with multiple opportunities for restoration and protection. Local planning could result in a contiguous network of functioning sites unusual for Puget Sound.

4.3.3 North Central

North Central Sub-basin, composed of waters surrounding Admiralty Inlet, is the smallest Puget Sound Sub-basin, and has no large river deltas. Similar to Juan de Fuca, North Central has relatively few sites and a high proportion of high potential sites. The west shore falls in Jefferson County and the east shore in Island County, with the northern tip of the Kitsap Peninsula to the South. Port Townsend is the largest urbanized area.

Beaches

North Central Sub-basin encompasses 30 beach sites (Table 45). 60 percent of these are identified as high potential, making North Central similar to both Hood Canal and Juan De Fuca which also have a preponderance of long beaches with frequent depositional features. The beaches of SW Whidbey Island are particularly noteworthy as high potential restoration sites. North Central beaches are among the least degraded in Puget Sound, with 33 percent of sites recommended for a protection approach. Group D3 is disproportionately represented for protection, a group of sites with no mapped sediment supply degradation. Group D11 is also strongly represented, where very low sediment supply degradation is accompanied by relatively high nearshore impervious and parcel density. Risk of future nearshore development is relatively low.

Barrier Embayments

North Central historically had among the highest proportion of its shoreline length as barrier embayments, and has the highest mean potential for barrier embayment sites among Puget Sound Sub-basins (Table 46). Group P8 is strongly represented, particularly along the SW Whidbey Island sites, which is made of sites with exceptional large embayments and extensive wetlands but at a low density.

Very few sites have such extensive development that they are recommended for and enhancement approach, leaving ample opportunities for substantial restoration. Group D5 is strongly represented, containing sites with low sediment supply degradation and nearshore impervious, but with substantial loss of embayment length and estimated tidal flow degradation. Many very large barrier embayments have been completely lost in North Central, with three notable clusters around Port Townsend Bay, Useless Bay, and Point No Point. Some very large embayments, like Lagoon Point on Whidbey Island are likely unrecoverable.

Coastal Inlets

Ten coastal inlets were identified in the North Central Sub-basin, which has a moderately low density of such sites (Table 47). While potential ranges widely, six of ten sites were identified as high potential. Three high potential sites face a high future risk of watershed development:

Table 48 – North Central beach site recommendations.
Color coding indicates strategic recommendation.

Groups	D1	D3	D4	D6	D7	D8	D9	D10	D11	D13	D15	Grand Total
P1		1						1				2
P2	2	1		1				2	2	2		10
P3		4	1		1	1	2	1	3	4	1	18
Total	2	6	1	1	1	1	2	4	5	6	1	30

Table 49 – North Central barrier embayment site recommendations.
Color coding indicates strategic recommendation.

	D1	D2	D3	D4	D5	D6	D9	Total
P2	3			1	1			5
P5		1						1
P6	8		1		2	1		12
P8	1			1	2			4
P9	2	1			3		1	7
Total	14	2	1	2	8	1	1	29

Chimacum Inlet, Port Ludlow, and Mats Mats Bay, with Chimacum and Mats Mats both recommended for protection. Port Ludlow appears to be a complex of inlets, with Port Ludlow itself extensively developed and recommended for enhancement, while three lower potential inlets along the southern edge of Ludlow Bay are recommended for protection or restoration. Given their contiguous character, these four sites could be considered a single coastal inlet. Cultus Bay is the highest potential site identified for restoration, and was historically among the largest and most complex inlets in Puget Sound.

Table 50 – North Central coastal inlet site recommendations.
Color coding indicates strategic recommendation.

Groups	D1	D2	D4	D6	Total
P1	1	1			2
P4	2				2
P7	2		1	1	4
P8	1		1		2
Total	6	1	2	1	10

Summary of Sites

A large number of high-potential beach systems are present in North Central and are not addressed exhaustively in this summary. The following sites may be exemplary opportunities for large scale process-based ecosystem restoration and protection in the North Central Sub-basin:

Cultus Bay Restoration (SPU 5034; IPU 224) – Cultus Bay/Deer Harbor is a regionally significant high potential coastal inlet/barrier embayment site.

Chimacum Creek Inlet Protection – This is the highest potential inlet remaining in Port Townsend Bay and may be at risk of increasing watershed impervious.

Mats Mats Harbor Protection – This site may be at risk from increasing watershed impervious.

Oak Bay Restoration – This degraded site has been substantially modified by a federal dredge channel, and may offer restoration potential.

Port Townsend Bay Lost Embayment Restoration – Prospective sites include the Port Townsend mill (SPU 5027), Squid Road site (SPU 5016; Navy), Greer Road site (SPU 5019; Navy) and sites associated with Fort Flaggler and Rat Island (SPU 5010-11 & 5017).

Point No Point Lost Embayment Restoration (SPU 5001) – Three severely degraded embayments are located between Point No Point and Hansville.

Southwest Whidbey Beach Protection and Restoration (SPU 5029-34 & 8058) – These long and complex beach systems support a large number of depositional features and are in varied states of degradation.

Mutiny-Useless Bay Embayment Restoration (SPU 5031-33) – In addition to Useless Bay itself, three lost barrier type embayments are located among Mutiny Bay communities.

Maxwellton Road Embayment Restoration (SPU 5033) – This site offers potential to restore a substantial embayment.

Killisut Harbor Vicinity Protection and Restoration (SPU 5009-5017) – A large number of contiguous drift cells offer the opportunity for comprehensive restoration and protection resulting in an extensive patch of complex and intact habitats.

4.3.4 San Juan

Most of the San Juan Sub-basin shoreline is scattered across an extensive network of peninsulas and archipelagos covered by a complex mosaic of small beaches, embayments and inlets, and rocky shorelines. A reach of long complex beach sites are located on the northern mainland from Lummi Island to the Canadian border. As with other northern sub-basins, a large proportion of sites are minimally degraded and therefore recommended for protection. Unlike other northern sub-basins, San Juan is composed of a multitude of smaller sites with fewer individual sites of noteworthy size or complexity. The Sub-Basin is anchored in the NE and SE by the extensive Nooksack River and Samish River deltas. The combination of continental river deltas and longer beaches differentiates the mainland San Juan from the archipelagos. San Juan Sub-basin falls primarily in Whatcom and San Juan counties, with southern portions including most of the Samish River delta in Skagit County. Bellingham is the largest urbanized area, followed by Anacortes with its industrialized neighbor Marches Point.

River Deltas

The Nooksack and Samish River deltas cover approximately 8.5 percent of the San Juan shoreline (Table 7), and these large historical wetlands make San Juan second only to Whidbey Sub-basin in mean delta site potential (Table 48). The Nooksack is among the least degraded of the larger Cascade deltas.

Table 51 – San Juan delta site recommendations. Color coding indicates strategic recommendation.

Groups	D1	Total
P3	2	2
Total	2	2

Beaches

There are 121 beach sites in San Juan, third to the South Sound and the South Central sub-basins, and they are frequently small relatively simple beaches with a mean potential only higher than South Sound (Table 49). San Juan shorelines include frequent rocky shoreline landforms. San Juan beaches have the lowest mean degradation of any sub-basin. Sites in Groups D2, D6, and D9 are disproportionately represented, all groups characterized by lower sediment supply degradation and nearshore impervious but high parcel density. While the largest proportion of beaches recommended for protection in Puget Sound are located in San Juan, only a few sites are individually high potential, and they are almost exclusively located in the archipelago. A number of archipelago shoreline process units are dissected by rocky shorelines and should be more carefully evaluated for their continuity of sediment transport. Along with South Sound, San Juan has a high proportion of beaches with a high or medium risk of future increases in nearshore impervious surfaces. On the mainland there are several beach systems strongly affected by active railroads.

Barrier Embayments

Eighty-nine sites containing barrier-type embayments were identified in the San Juan Sub-basin (Table 50). Twelve of these were not associated with a current or historical bluff-backed beach. These sites are frequently not exceptional in their potential, with a high representation of extremely small sites (Group P1). High levels of degradation are uncommon in the San Juan Sub-basin with only the Juan de Fuca Sub-basin having lower mean barrier embayment degradation. As with beaches there is a distinct difference between moderately degraded sites along the mainland and a high proportion of sites recommended for protection in the archipelago.

Coastal Inlets

Twenty-eight coastal inlets were identified, including a healthy representation of very small sites, along with the largest single coastal inlet wetland complex in Puget Sound, Padilla Bay (Table 51). Almost all of San Juan's coastal inlet watersheds face a high risk of future watershed development. Both Padilla Bay and Drayton Harbor are inlet sites with very high potential scores in Group P9, with Drayton Harbor recommended for protection and Padilla Bay for restoration. Chuckanut Bay is the other high potential inlet recommended for restoration. In addition four archipelago inlets are high potential and recommended for protection. Fidalgo Bay and Padden Lagoon are high

Table 52 – San Juan beach site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D5	D6	D7	D9	D10	D11	D12	D13	D14	D15	D16	Total
P1	5	3	4		7		3	2	2		1		6	2	35
P2	8	6	6	1	5	2	7	1	5	1	2	2	10	3	59
P3	3	1			2	2	1	4	3		7		4		27
Total	16	10	10	1	14	4	11	7	10	1	10	2	20	5	121

Table 53 – San Juan barrier embayment site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D8	D9	Total
P1	7	1	2	1					11
P2	16	3	1	2	1			5	28
P3	1		1	1					3
P5	2			1					3
P6	9	6	5	2	5			2	29
P7	2				1				3
P8					1				1
P9	1	1	1		3	1	1		8
P10	2				1				3
Total	40	11	10	7	12	1	1	7	89

Table 54 – San Juan coastal inlet site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	Total
P1	9	1				1		11
P4	4		1	1		1		7
P6	3			1			1	5
P7	1				1			2
P8						1		1
P9	1			1				2
Total	18	1	1	3	1	3	1	28

potential sites recommended for enhancement due to their complex and extensive degradation.

Summary of Sites

A range of regional ecosystem restoration sites are located in San Juan Sub-basin as well as the challenge of protecting many diffuse small systems scattered across a complex landscape. The following sites may be exemplary opportunities for large scale process-based ecosystem restoration and protection in the San Juan Sub-basin:

Nooksack Delta Restoration (DPU NKS) – This site provides extensive existing tidal wetlands and the greatest opportunity to restore historical tidal wetlands in the sub-basin.

Samish Delta Restoration (DPU SAM) – This site offers an extensive opportunity to restore coastal wetlands associated with a major Puget Sound river.

Padilla Bay Restoration (IPU 244) – The Padilla Bay inlet includes extensive existing wetlands, and an opportunity to restore tidal wetlands at a scale only found at river delta sites.

Samish Island Barrier Embayment Restoration (SPU 7163-65) – The Samish Island and tombolo complex provides opportunity to restore embayments through dike modification including the lost embayment at Friestad Lake. Sediment supply degradation is variable and future nearshore development risk is high.

Chuckanut Bay Restoration (IPU 268) – The inlet at the north side of Chuckanut Bay may be affected by a railroad causeway and faces risk from future nearshore development.

Drayton Harbor Protection (IPU 270) – This regionally significant embayment is relatively intact but with relatively high levels of nearshore impervious and moderate risk of watershed development.

Cherry Point Drift Cell Restoration (SPU 7146) – This extensive and minimally degraded beach provides opportunity to restore or protect an extensive and complex beach system.

San Juan Archipelago Inlet Protection – Scattered amongst the San Juan Islands are four substantial watersheds that drain to coastal inlets. These features are relatively uncommon and face high levels of watershed development risk.

North Blakely Island Embayment (SPU 7068) – This otherwise intact drift cell once supported over 2000m of barrier embayment.

Aleck and Barlow Bay Embayment Restoration (SPU 7085) – The rocky shorelines of South Lopez Island once harbored two now lost barrier embayments in Aleck and Barlow bays.

Fisherman's Bay Restoration (SPU 7086-88) – An unusually complex system also on Lopez island where a large intact beach transports sediment north to a tombolo and a collection of tidal wetlands in a relatively large enclosed embayment. The potential for restoration is unclear.

San Juan Archipelago Beach Protection – The San Juan Islands contain a mosaic of undegraded beach sites that while individually small, form a large network of complex sites that will only be successfully managed through a more comprehensive approach.

Extensive historical embayments identified at Birch Bay, along Sucia Drive in Lummi Bay, and at Flounder Bay in Anacortes may be permanently lost due to the extent of residential development. Enhancement of high potential systems may be viable at Fidalgo Bay, Padden Lagoon, and Birch Bay sites.

4.3.5 South Central

The South Central Sub-basin includes Puget Sound's most heavily developed sites. It has the highest proportion of sites where degradation levels suggest that restoration of large scale physiographic processes may not be feasible, and ecosystem management should focus on enhancement of function and mitigation of development impacts. It has a moderately high density of drift cells relative to other sub-basins, second only to South Sound in numbers of sites. There is a distinct difference between east and west shorelines, with the east shoreline containing the Everett-Seattle-Tacoma metropolitan area, and the three most populous counties in Washington State. Within Kitsap County along the west shore of the South Central Sub-basin, many areas show a high future risk of increasing impervious surfaces in both the nearshore and watershed, particularly in the vicinity of Bainbridge Island and Bremerton/Port Orchard area.

Table 55 – South Central delta site recommendations. Color coding indicates strategic recommendation.

Group	D2	Total
P2	2	2
Total	2	2

River Deltas

The South Central Sub-basin contains the Duwamish and Pullayup River deltas (Table 52). They are the two most degraded river deltas in Puget Sound, and are relatively similar in physical character in that they are small compared to other Cascade deltas, but larger than the Olympic deltas (P1). As with all major river deltas, they provide an irreplaceable suite of ecosystem services; however, we anticipate that substantial restoration of physiographic processes is unlikely.

Beaches

37 percent of South Central Sub-basin beaches were identified as high potential, a greater proportion than South Sound or San Juan with their many small beaches, but less so than the vast beach systems of more northerly sub-basins (Table 53).

Only a handful of the 145 beach systems in the South Central Sub-basin were identified where substantive protection or restoration of ecosystem processes was likely to be a viable strategy. Only seven sites were identified for protection, though none are high potential sites. They are located at Blake Island, in Blakely Harbor and one site at Christenson Cove, on Colvos Passage. The vast majority of 53 high potential beach sites were assessed for enhancement (35 sites) or restoration where complete restoration is very unlikely (Group D13; 14 sites). The remaining 'High Potential Restoration' sites are Point Heyer north on Vashon Island, and two sites along the North Kitsap Peninsula between Point No Point and Sandy Beach and a very small beach system with extensive barriers and a creek mouth on Dumas Bay in Pierce County. Areas with extensive opportunity for partial restoration of high potential sites include: Colvos Passage, The mouth of Liberty Bay on Port Orchard Bay, the NE shore of Bainbridge Island, and the North Kitsap beaches from Carpenter Creek, around President's Point to Indianola. Notably, Bainbridge Island faces high risk from future nearshore development.

Table 56 – South Central beach site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D6	D7	D8	D9	D10	D11	D13	D14	D15	D16	Total
P1		1					2		2	6	1	25	5	42
P2	3		1	2	2	2			1	9		25	5	50
P3						1	2	1		14	2	29	4	53
Total	3	1	1	2	2	3	4	1	3	29	3	79	14	145

Table 57 – South Central barrier embayment site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	D9	Total
P1	1		1	1						3
P2	1	6	11	1	7		13		8	47
P3				1						1
P6	1		9	3	2	2	2		8	27
P9	1		4					1	3	9
P10									1	1
Total	4	6	25	6	9	2	15	1	20	88

Barrier Embayments

86 of South Central's 145 beach systems contain barrier type embayments, as well as two additional sites without mapped bluff backed beach (Table 54). A high proportion of these sites are of low potential. Degradation is commonly high, with only one high potential site recommended for a protection approach: the drift cell that diverges from Presidents Point to the spit at the mouth of Miller Bay, including Doe Kag Wats.

There has been extensive loss of barrier embayments in many areas of the South Central Sub-basin, with notable concentrations near Silverdale, in south Dyes Inlet, Sinclair Inlet, around Point White, in Colvos Passage, Normandy Park, North Port Orchard Bay, south of Kingston, in Elliot Bay, Golden Gardens Park in Seattle, in Woodway, Edmonds and off Hoffman road in North Kitsap. Only four high potential systems are recommended as candidates for ecosystem restoration, all in the D3 group, where relatively intact embayments are potentially degraded by extensive sediment supply degradation.

Restoration of lost barrier embayments while a priority in this landscape may over long time frames be frustrated by severe modification of sediment transport systems. The observed condition of beach systems suggests that we are likely to benefit from a careful coordination of beach restoration and protection with barrier embayment restoration in the South Central Sub-basin.

Coastal Inlets

The South Central Sub-basin contains a large number and wide variety of coastal inlet sites which may provide opportunities for restoration and protection of embayment function in the absence of fully functioning sediment systems (Table 55). South Central Sub-basin also includes among the most degraded sites in Puget Sound. Salmon Bay in Seattle is noteworthy not only for its great length and vast watershed, but its exceptional degradation, and exceptional risk from marina development. Of the four coastal inlets recommended for protection, two are located on Bainbridge Island (Port Madison and Fletcher Bay), with the other two sites part of high potential sites recommended for protection by the Barrier Embayment Strategy: Miller Bay, and Doe Kag Wats. Ten high potential sites are recommended for restoration, eight of which are on the Kitsap peninsula and the remaining two on Bainbridge Island.

Summary of Sites

Due to the likely extent of process degradation, ecosystem restoration in South Central Sub-basin faces a particular challenge in weighing the relative benefits of enhancing degraded sites, partially restoring processes, or focusing effort on the few opportunities for fully restoring processes. The following sites or groups of sites may provide opportunities for large scale process-based ecosystem restoration and protection in the South Central Sub-basin, although due to generally high levels of degradation, these are advanced with uncertainty:

Table 58 – South Central coastal inlet site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	Total
P1	5	4		1	3	1		1	15
P3		1							1
P4	1	4		2	2		1		10
P6		1		3		1	1	1	7
P7	3	3	1	1		3		1	12
P8	1	1				1			3
P9								1	1
Total	10	14	1	7	5	6	2	4	49

Point Heyer North Beach Restoration and Protection (SPU 4093) – This site is provides a relatively high potential for substantive restoration of beach processes.

North Kitsap Beach Restoration and Protection (SPU 4081 & 8211) – These long complex beaches may offer opportunities for substantive restoration of beach processes.

Central Colvos Passage Protection and Restoration – Anchored by the relative intact beach north of Christensen Cove (SPU 4118) on Vashon Island, and Ollalla Inlet (IPU 156) in the west, Colvos Passage provides multiple opportunities for partial restoration among large complex beaches and lost barrier embayments.

Doe Kag Wats Beach and Embayment Protection and Restoration – The drift cell and embayments from President's Point west up to and including Miller Bay and Doe Kag Wats provide a unusually intact suite of embayment and beach services.

South Kingston Barrier Embayment Restoration (SPU 4078) – Adjacent to the Doe Kag Wats drift cell, this site with multiple lost barrier embayments may provide an opportunity for partial restoration or enhancement.

NE Bainbridge Barrier Embayment Restoration (SPU 4132) – The drift cell culminating at Fay Bainbridge State Park also includes a lost closed lagoon marsh and may provide opportunities for partial restoration.

South Agate Pass Restoration and Protection (SPU 4076) – The southern portion of this site had relatively long historical embayments and extensive wetlands.

Outer Liberty Bay (SPU 4066 & 75) – These complex and long beach sites include lost and existing barrier systems, and may have potential for partial restoration.

Poulsbo Inlet Restoration (IPU 209) – This extensive high potential inlet is partially developed and is at high risk of future nearshore development.

Ilahee Inlet Restoration (IPU 190) – This extensive and largely intact inlet may have a road fill constriction at its mouth.

Chico Creek Estuary Restoration (IPU 175) – This was recommended as a high potential restoration site.

Barker Creek Estuary Restoration (IPU 185) – Some restoration work has been completed at this high potential restoration site.

Colby Inlet Restoration (IPU 161) – This extensive and largely intact inlet may have road fill induced constriction at its mouth.

Bainbridge Island Inlet protection (IPU 187 & 198) – Bainbridge Island has six inlets recommended for protection two of which (Fletcher Bay & Hidden Cove) are of notably high potential. All sites have a high risk of future nearshore and watershed development.

Lynwood Center, Bainbridge Island (IPU 176) – This site was identified as a high potential site for restoration due to extensive historical wetlands. It also has a high risk of nearshore and watershed development.

East Sinclair Inlet Barrier Embayment Restoration – A large number of lost barrier embayments were located in Sinclair Inlet, while surrounding beach systems are highly degraded.

It is important to note the lack of large scale process restoration opportunities in the South Central Sub-basin, combined with a dramatic loss of ecosystem goods and services along the east shore, among Puget Sound's most degraded shorelines. The following enhancement activities may be the only available option for recovering lost ecosystem services in this urban landscape:

Duwamish and Puyallup Delta Enhancement (DPU DUW & PUY) – The Duwamish and Puyallup River deltas are largely occupied by the ports and industrial areas of Seattle and Tacoma. There is ongoing partial and incremental enhancement work at these sites, largely funded through Superfund and Natural Resource Damage Assessment mechanisms (authorized under the Comprehensive Environmental Response, Compensation and Liability Act).

Lost Barrier Embayment Reconstruction (Urban Sites) – There were once several relatively isolated large historical barrier embayments within degraded barrier embayment sites along the east shore of the South Central Sub-basin. These sites are now entirely absent creating a large gap in historical ecosystem services. Some sites like the Normandy Park Community Center property may provide substantial opportunities for partial restoration.

4.3.6 South Sound

In stark contrast to the sprawling beaches of North Central or Juan de Fuca Sub-basins, South Sound is a mosaic of inlets and embayments embedded in short beaches. This complex shoreline contains a greater frequency of sites than any other sub-basin. In addition, South Sound has a very high number of high potential (P8 & P9) inlets draining large watersheds, representing 24 of Puget Sound's 51 high potential inlets recommended for protection. The development of a South Sound strategy may need to respond in unique ways to crenulated shorelines, short fetches, and high densities of drift cells.

Deltas

South Sound has two delta sites, Nisqually and Deschutes (Table 56). The Nisqually has been the focus of considerable restoration effort; however the tidal fresh wetland component of the site is still largely lost. The Deschutes is a small delta, with a potential score similar to the smaller Hood Canal systems. While the Deschutes is among the most degraded river deltas in Puget Sound (Group D2) it is unique in that it has not been completely filled and that substantial restoration of tidal flow is primarily dependent on economic resources and social will.

Beaches

South Sound beaches have the lowest mean potential of any sub-basin and the greatest proportion of beaches in the bottom 33 percent of potential score (Table 57). Even so, South Sound still has the greatest number of high potential beach sites, given the overwhelming number of discrete sediment systems, and the frequency of depositional features. Degradation is highest at the heads of Case and Carr inlets, in Hale Passage, in the vicinity of Cooper Point, and particularly along the urbanized Pierce County shoreline which shows high risk from active railroad in the nearshore. High potential protection opportunities are found on the west shorelines of Anderson and McNeil islands, and the neighboring Devil's Head at the tip of the Key Peninsula (the target of recent property acquisition), and inner Totten Inlet. In addition the entire north

Table 59 – South Sound delta site recommendations. Color coding indicates strategic recommendation.

Group	D1	D2	Total
P1		1	1
P3	1		1
Total	1	1	2

Harstene Island and all of the Squaxin Island shoreline have contiguous short beaches recommended for protection. High potential restoration opportunities are likely along the south coast of Fox Island, outer east coast of Key Peninsula, portions of Eld Inlet, southern half of Harstene Island, remainder of Totten Inlet and along the shallows north of Oakland Bay.

Barrier Embayments

Few South Sound barrier embayment sites are of regional significance (Table 58). Both sides of Henderson Bay, and the outside of Burley Lagoon are sites with multiple large embayments recommended for restoration. The west coast of Key Peninsula is again recommended for restoration (as by the beach assessment) and includes two large lost embayments. While the high potential site between Ellis Cove and Gull Harbor is recommended for protection, two lost embayments are found therein. The SW shore of Harstene Island has an unusually high density of small embayments recommended for protection. A large number of small embayments have been lost in middle Totten Inlet, near the mouth of Skookum Inlet. Fish Trap Inlet, Oro Bay and Taylor Bay are also small barrier sites associated with inlets of high potential, and overlapping with our coastal inlet strategy.

Coastal Inlets

South Sound has the highest concentration of large coastal inlet sites in Puget Sound (Table 59). 144 sites were identified, 108 of which were recommended for protection. 24 of those protection sites are high potential. Of these Henderson Inlet, Mill Creek estuary, Skookum, and Totten inlets face a relatively moderate to high risk of increasing

Table 60 – South Sound beach site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D5	D6	D7	D8	D9	D10	D11	D13	D14	D15	D16	Total
P1	24	5	2	6	6	7	2	11	1		24	4	55	2	149
P2	14	2	2	2	3	1	7	3	2	1	12	1	30		80
P3	1			1	4	3	6	2	2		9	1	30		59
Total	39	7	4	9	13	11	15	16	5	1	45	6	115	2	288

Table 61 – South Sound barrier embayment site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D9	Total
P1	2		1	1					4
P2	28	25	32		8	5	8	1	107
P3	3	4	7				3		17
P4			1						1
P5	1		1						2
P6	11	1	10		2	2		2	28
P7	1		1						2
P9	4		3		1			3	11
P10	6			1					7
Total	56	30	56	2	11	7	11	6	179

watershed impervious surface over the next 60 years. In addition, three high potential inlets are recommended for restoration, including Burley Lagoon, Chapman Bay, and Wollochet Bay, each including a substantial creek estuary. Six inlets are so degraded that restoration may be severely constrained, including Oakland Bay, East Bay (in Olympia), Squalichew Creek, Chambers Creek, Von Geldern Cove (at the town of Home), and the Purdy Creek Estuary.

Summary of Sites

A large overall number of ecosystem restoration and protection sites are located across the South Sound Sub-basin landscape. Protection and restoration of the few large systems may be compromised by extensive development. As with the archipelago sites of the San Juan Sub-basin, ecosystem restoration and protection may benefit from evaluating restoration opportunities across multiple small adjacent sites. The following sites may be exemplary opportunities for large scale process-based ecosystem restoration and protection in the South Sound:

Nisqually Estuary Restoration (DPU NSQ) – Following restoration at Nisqually National Wildlife Refuge, restoration of tidal fresh zones, and the distribution of freshwater inputs could still be addressed.

South Sound Coastal Inlet Protection – The following 24 creek estuaries and inlets are of regionally significant size and complexity and received a protection recommendation: Three from Group P9 including Woodard-Woodland, McClane-Mud Bay, and Skookum Inlet; Eight from Group P8, including Inner Totten Inlet, Mill Creek, Deer Creek, Chapman Cove-Campbell Creek, Sherwood Creek, Coulter Creek, Rocky Bay, and Minter Creek; 13 smaller inlets including Fish Trap, Gull Harbor, Fry Cove, Johns Creek, and Malaney Creek, Jarrell Cove, McClane Cove, Stretch Island Cove, Vaughn Bay, Dutcher Cove, west Filucy Bay, Glen Cove, and west Oro Bay.

South Sound Coastal Inlet Restoration – Three large coastal inlets are recommended for restoration: Burley Lagoon, Chapman Bay, and inner Wolochet Bay, due to higher levels of mapped stressors. Ultimately local assessments may be necessary to discern where substantial restoration of ecosystem services is warranted or viable among these sites as compared to sites identified for protection.

Table 62 – South Sound coastal inlet site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D6	D7	D8	Total
P1	46	10	6	1		1	2	66
P2						1		1
P4	38	3		2			1	44
P6	6				1			7
P7	7	1		1			1	10
P8	8	1					4	13
P9	3							3
Total	108	15	6	4	1	2	8	144

Totten Inlet Barrier Embayment Restoration – Near the confluence of Totten and Skookum inlets there has been substantial loss of barrier embayments. SPU 3086 is a notably large complex beach system in this location with only moderate sediment supply degradation.

North Oakland Bay Protection and Restoration (SPU 3092-95) – This inlet is a complex of sites, including the aforementioned Johns Creek, Malaney Creek, Deer Creek, and Chapman Cove-Campbell Creek inlets, as well as two high potential moderately degraded beach sites recommended for restoration.

Anderson Island Protection – The entire island is ringed by relatively intact beaches, embayments and inlets, including high potential embayment sites in Oro Bay and long complex beaches along the west shore. Several sites face relatively high risk of nearshore development. There has been substantial loss of mapped embayment length at Amsterdam Bay, although no fill is obvious in aerial photos.

McNeil Island Protection and Barrier Embayment Restoration – This island is surrounded by largely intact beaches, and has lost three barrier embayments at Eden Creek, Floyd Cove, and Still Harbor. McNeil landing is sitting on a lost coastal inlet.

South Harstene Island Restoration (SPU 2008, 10, & 21) – Adjacent to the intact Squaxin Island landscape, several long complex beach systems with embayments have moderate levels of sediment supply degradation.

Eld Inlet Beach Restoration (SPU 3049 & 60) – Eld Inlet includes two particularly long complex beaches with moderate levels of sediment supply degradation.

West Key peninsula Restoration (SPU 3141) –This long complex beach with moderate sediment supply degradation has lost two substantial barrier embayments.

Fox Island South Shore Restoration (SPU 3286-87) – These two long complex beaches have an intact divergence zone, moderate sediment supply degradation and several lost barrier embayment systems.

Ellis cove to Gull Harbor Restoration (SPU 3039) – This site has relatively low sediment supply degradation and has lost two small barrier embayments.

Glen Cove North Beach Restoration (SPU 3168) – The southern portion of this moderately degraded high potential beach and barrier embayment system includes extensive spits at Minter Creek (identified for protection). Restoration would be challenging due to high levels of armoring on more northerly reaches.

Oro Bay Protection (SPU 3261-64 & IPU 32 & 38) – This complex of sites includes high potential beach and inlet sites.

The following sites, while recommended for enhancement may provide unusual opportunities for substantial recovery of historical ecosystem function:

Deschutes Estuary Restoration (DPU DES) – This site may offer the largest single action opportunity to increase nearshore ecosystem function in South Sound.

McNeil Island Landing (IPU 62) – A lost inlet completely located on state owned land with uncertain future use (see McNeil Island above).

Squalitchew Inlet (IPU 18) – This extensive coastal inlet adjacent to the Nisqually Delta is disconnected by the Burlington Northern Railroad line, but the site remains relatively undeveloped.

4.3.7 Whidbey

Deltas

The Whidbey Sub-basin is unique in that 53 percent of its historical shoreline length was composed of river deltas. The three Whidbey delta sites include the Snohomish and Skagit deltas, by all measures the two largest delta sites in the Puget Sound, accounting for an estimated 70 percent of all historical delta tidal wetlands. These sites have been highly modified to support agricultural land use. The Snohomish is the most degraded, with higher levels of impervious surface and more complete shoreline modification than found in the Skagit or Stillaguamish which have similar degradation scores (Table 60).

Beaches

Whidbey Sub-basin's 59 beach sites have a moderate mean potential (Table 61). Next to South Central, Whidbey has the highest mean beach degradation score in Puget Sound, but not a particularly high occurrence of highly degraded sites, rather a large proportion of beaches are in moderately high degradation groups (D11-13) and may require sediment supply assessment at a smaller than drift cell scale to develop effective process restoration strategies. A few small beaches are identified as protection sites: Baby Island, SE Hope Island, and Kiket Island North. Sixteen long drift cells covering much of Strawberry Point, Crescent Harbor, North Penn Cove, North Saratoga Passage, SE Whidbey Island, and Port Susan Bay are recommended as high potential sites for restoration, however moderately high levels of degradation suggest that full restoration even over time would be very difficult. Among these sites, Possession Point north, Saratoga north, Tulalip Bay north, the Livingston Bay convergence, Honeymoon Bay north may have the greatest opportunities for substantive restoration of beach processes. Beaches around Rocky Point and from Everett South have very high levels of degradation suggesting that an enhancement strategy may be more appropriate.

Barrier Embayments

Barrier embayments were a relatively small proportion of Whidbey Sub-basin shoreline, however there are a substantial number of high potential sites (Table 62). Mean degradation is high for Puget Sound – no sites have a degradation score below 400. The four high potential sites recommended for a protective approach (Honeymoon Bay north, Camano Head north and the Triangle Cove convergence zone, and east Similk Bay) have lost embayments and moderate armoring and are at the high end of their group for degradation. High potential barrier embayment systems with moderate degradation include the Livingston Bay convergence zone with its large lost embayment, Strawberry Point north with a very large and potentially restorable embayment at it terminus, Dugualla Bay, Possession Point north with four lost embayments, the Tulalip Bay drift cells, Lowell Point north including three lost barrier embayments, and Forbes Point west and its associated Oak Harbor Marsh. Oak Harbor proper and Crescent Harbor degradation metrics were high enough to recommend an enhancement approach, and in the case of Crescent Harbor some work has been completed to date.

Table 63 – Whidbey delta site recommendations. Color coding indicates strategic recommendation.

Groups	D1	Total
P3	1	2
P4	2	2
Total	4	4

Coastal Inlets

In contrast to South Sound, South Central, and Hood Canal, where drowned river valley features are ubiquitous, only five coastal inlet sites were identified in Whidbey (Table 63). Three were of substantial size and complexity and with moderate to low degradation: Tulalip Bay, Race Lagoon, and Coveland in Penn Cove. Of these, Race Lagoon is recommended for protection and faces a moderate risk of future increase in watershed impervious. Both Race Lagoon and Tulalip Bay are likely to be strongly influenced by sediment drift and are also assessed under the Barrier Embayment strategy.

Summary of Sites

Skagit Delta Restoration (DPU SKG) – With protected headwaters, moderate degradation and the largest historical swamps in Puget Sound, this site is one of two river delta sites identified as high potential.

Snohomish Delta Restoration (DPU SNH) – A large number of actions have been identified in the Snohomish River delta, which along with the Skagit is one of two delta sites identified as high potential.

Stillaguamish Delta Restoration (DPU STL) – The Stillaguamish delta site is adjacent to the Livingston Bay convergence zone.

East Similk Bay Beach Protection (SPU 6034) – This relatively intact beach site is adjacent to recently protected Kikit Island and deposits sediment at Turner's Bay.

Livingston Bay Convergence Restoration (SPU 6049-50) – This embayment site provides an opportunity to protect and restore sediment supply and substantial historical wetlands.

Table 64 – Whidbey beach site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D3	D6	D7	D9	D10	D11	D12	D13	D14	D15	Total
P1	4			1		2	1	3	2	1	1	15
P2		1	1	1	1	1	6	1	8	3	3	26
P3				1	3	1	4	1	6	1	1	18
Total	4	1	1	3	4	4	11	5	16	5	5	59

Table 65 – Whidbey barrier embayment site recommendations. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	D5	D6	D7	D8	Total
P1	2								2
P2	6	10	1	1					18
P6	2	2		1	1	1	2		9
P8					1				1
P9	4	1	5	2	1	1		2	16
Total	14	13	6	4	3	2	2	2	46

Strawberry Point North/Dugualla Bay Restoration (SPU 6025) – This long complex beach ends with the extensive historical wetlands at Dugualla Bay.

Tulalip Bay North Beach Restoration (SPU 6052) – The long complex beach north of Tulalip Bay may provide opportunity for large scale restoration of sediment supply processes and contains three lost embayments including the potential action at Kayak Point.

Tulalip Bay Protection and Restoration (SPU 6052-54) – This coastal inlet has a developed shoreline but a relatively intact watershed.

Honeymoon Bay North Restoration (SPU 6011) – This long and complex beach includes two lost embayments including the Greenbank Farm site, as well as the Race Lagoon protection site.

Race Lagoon Protection (IPU 238) – This inlet site and its watershed are a high potential protection site within SPU 6011 described above.

Sandy Point to East Point Beach Restoration (SPU 6002-03) – These long complex beaches may provide opportunities for sediment supply restoration.

Possession Point North Barrier Embayment Restoration (SPU 8001) – This long complex beach includes four lost barrier embayments, although they have all been substantially developed.

Table 66 – Whidbey coastal embayment site recommendations by group. Color coding indicates strategic recommendation.

Groups	D1	D2	D3	D4	Total
P1	1				1
P4			1		1
P7	1			1	2
P8		1			1
Total	2	1	1	1	5

Lowell Point North Restoration (SPU 6042) – This long complex beach may provide opportunities for sediment supply restoration, however the four lost embayments are heavily developed and not easily restored.

Forbes Point West Barrier Restoration (SPU 6020) – This complex beach and its associated barrier wetlands may provide a large scale restoration and protection site.

Coveland Convergence (SPU 6017-18 & SPU 239) – Two complex and potentially restorable beaches converge at the Coveland coastal inlet site.

4.4 Recommended Future Analyses

In the course of scoping and implementing this analysis we worked within constraints of data, capacity, and time. Additional assessment is always possible and may deliver value, but we believe there is substantial work to be done on-the-ground, and these existing analyses provide considerable value over regional nearshore planning to date. Assessment is not a replacement for the development, implementation, and careful evaluation of on-the-ground actions—by evaluation of implementation we gain field experience that cannot be obtained through remote sensing. We propose that improving our ability to prioritize actions goes hand-in-hand with field work, and we will be rewarded if we attempt to integrate field research, project-based learning and strategic planning and assessment in a cohesive and interactive manner.

Additional work on watershed assessment conducted by the Washington State Department of Ecology will allow integration of shoreline and watershed planning. Local planning driven by Shoreline Master Plan requirements create a crucible where federal and state agencies can support local jurisdictions to test integration. To the extent that we build from, integrate, and improve these existing frameworks, we can continue to advance a spatially explicit ecosystem-based management strategy in Puget Sound.

Our analyses point to a set of potential future products that we believe would increase the utility of Puget Sound wide nearshore assessment for protection and restoration planning, implementation and evaluation. The following eight products are provided in no specific order. Some of these investigations may be immediately feasible, while other efforts may require additional data acquisition or field investigation to insure that conceptual models are sound enough for policy development.

Table 67 – Recommendations for future planning analysis of nearshore ecosystems.

#	Prospective Product	Notes
1	**BEACH CLASSIFICATION** – Develop and apply a model to estimate the ability of beach systems to provide ecosystem services. Such a model should incorporate additional physical attributes including slope, sediment source, watershed condition, and stream mouth structure, as well as the biological structure provided by eelgrass, kelp, or coastal forest, while resolving the extreme variation of beach system length, using more precise estimates of sediment source, and with a more sophisticated framework for integrating barrier embayments, and the interactions between beach systems in creating and sustaining barriers and barrier-type embayments.	• Existing WDFW work integrates shorezone assessment units into the Nearshore Geo-database. • Estuary and Salmon Restoration Program has identified beach classification as a priority action in its 2011 Investment Plan. • The WA. Department of Ecology has funding to complete some level of of sound-wide feeder bluff mapping that would strongly support evaluation of sediment degradation. • USGS has completed GIS routing work better describing drift cell components.
2	**EMBAYMENT CLASSIFICATION** – Develop and apply a more robust model describing the potential and degradation of individual barrier-type embayments and coastal inlets that considers a mix of both physical and biogenic habitat attributes, the relative importance of barrier features, as well as the condition of those up-drift sediment systems anticipated to affect each barrier feature.	• ESRP has identified embayment classification as a priority enhancement of its 2011 Investment Plan. • More detailed sediment supply estimates are available for a portion of Puget Sound shorelines, driven by Shoreline Management Plan update requirements.

3	**COASTAL MANAGEMENT AREA ANALYSIS -** Identification of discrete or overlapping units for evaluating ecosystem potential and degradation at scales larger than a process unit, but smaller than a sub-basin. This would support resolution of variable assessment unit area. This would better support analysis of rarity and representation at a scale. This could involve division of Puget Sound based on circulation patterns, or a range of approaches for describing 'neighborhood' in GIS.	• No known work is being completed to identify management units at a scale between drift cell and sub-basin for evaluation of local rarity or condition
4	**BIOGEOGRAPHY -** A more robust consideration of rarity and other aspects of landscape composition and configuration in the evaluation of potential restoration actions. This requires a finer definition of what kind of sites attributes are relevant to rarity evaluation, such that variation in their spatial distribution strongly controls the quantity or quality of ecosystem services, as well as the development of metrics to describe the relative landscape contribution of sites based on their position and relationship to other sites. This could be completed with existing data but should follow work described above.	• Some initial work on defining landscape metrics of homogeneity and rarity have been developed by the Nearshore Project benefits measure – the status of future testing and application is unknown. • Some of this could be integrated with product #2, as embayments are notable in their spatial discontinuity.
5	**HABITAT MODELS -** Models of landscape use by target species, for the purpose of comparing past, current, and proposed future landscapes to provide ecosystem services specific to target organisms. Factors other than nearshore attributes like oceanic circulation and upwelling patterns may strongly affect use by some species.	• Forage fish spawning is the subject of sampling efforts intended to develop the ability to predict forage fish use of beaches.
6	**SEDIMENT BUDGETS -** Data resources and modeling strategies for cost effective planning of protection and restoration of sediment supply in diverse and complex sediment systems. The ultimate challenge is to define targets for protection or restoration of sediment supply based on the sensitivity of systems to sediment starvation. This will require much higher quality data than proposed under beach classification and proposed feeder bluff mapping, and development of strong field data from representative sites in Puget Sound.	• US Geological Survey in collaboration with WDOE has been pursuing resources to evaluate some representative Puget Sound sediment budgets.
7	**PROTECTION ASSESSMENT** - A more robust evaluation of the current and potential protection status of ecosystem sites, including an assessment of the distribution of existing protected lands in the nearshore. Such an analysis would better define the relative threat to ecosystem services by anticipated landscape change as compared to the existing intensity and sustainability of regulatory, educational, and acquisition measures.	• Some data on the distribution of private, public and tribal conservation lands are available but have not been strongly integrated into these analyses • Existing shoreline management plans and implementation tracking may provide a basis for such an analysis – and in turn such an analysis may provide stronger mechanisms for evaluating the relative effects of different protective approaches.
8	**TRANSPORTION IMPACTS** - Identify sites where roads and railroads along shorelines provide the primary source site degradation, as a mechanism to identify where restoration can collaborate with transportation projects to increase shoreline function.	• Sound-wide road polygon layers are available in the Geo-database and may be useful for identifying potential sites. • Washington Department of Transportation may have additional data useful for site identification.

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Appendices

Appendix A – Map Atlas

Twenty two map plates describe sites for each strategy within each sub-basin. Simenstad et al. delineated areas of overlap among process units, to represent where physiographic processes are likely to be shared among two sites, as in where sediment from a south facing eroding bluff diverges to feed two drift cells, or the sediment from two drift cells converges at a depositional beach. On the beach maps we represent divergence and convergence zones, two common kinds of overlap, to help with interpretation. However, the color coding of these shared zones is arbitrarily that of either one or the other of the overlapping process units.

At delta and coastal embayment sites, due to the anticipated importance of freshwater input processes, the entire watershed is used to represent the site. The nearshore zones of shoreline process units (where Z=1 or 2) are used to represent the extent of barrier embayment sites. Only those drainage units with sediment movement (where cell type is LtR, RtL, CZ, or DZ) are used to represent beach sites.

Sheet	Sub-basin	Strategy
1	Hood Canal	Beach
2		Barrier Embayment
3		Coastal Inlet
4	Juan de Fuca	Beach
5		Barrier Embayment
6		Coastal Inlet
7	North Central	Beach
8		Barrier Embayment
9		Coastal Inlet
10	San Juan	Beach
11		Barrier Embayment
12		Coastal Inlet
13	South Central	Beach
14		Barrier Embayment
15		Coastal Inlet
16	South Sound	Beach
17		Barrier Embayment
18		Coastal Inlet
19	Whidbey	Beach
20		Barrier Embayment
21		Coastal Inlet
22	Puget Sound	Delta

These maps are the result of a sound-wide large scale assessment, and are intended to organize and inform site level investigation of restoration and protection opportunities. Please refer to Strategies for Nearshore Protection in Puget Sound (Cereghino et al. 2012) before interpreting map results.

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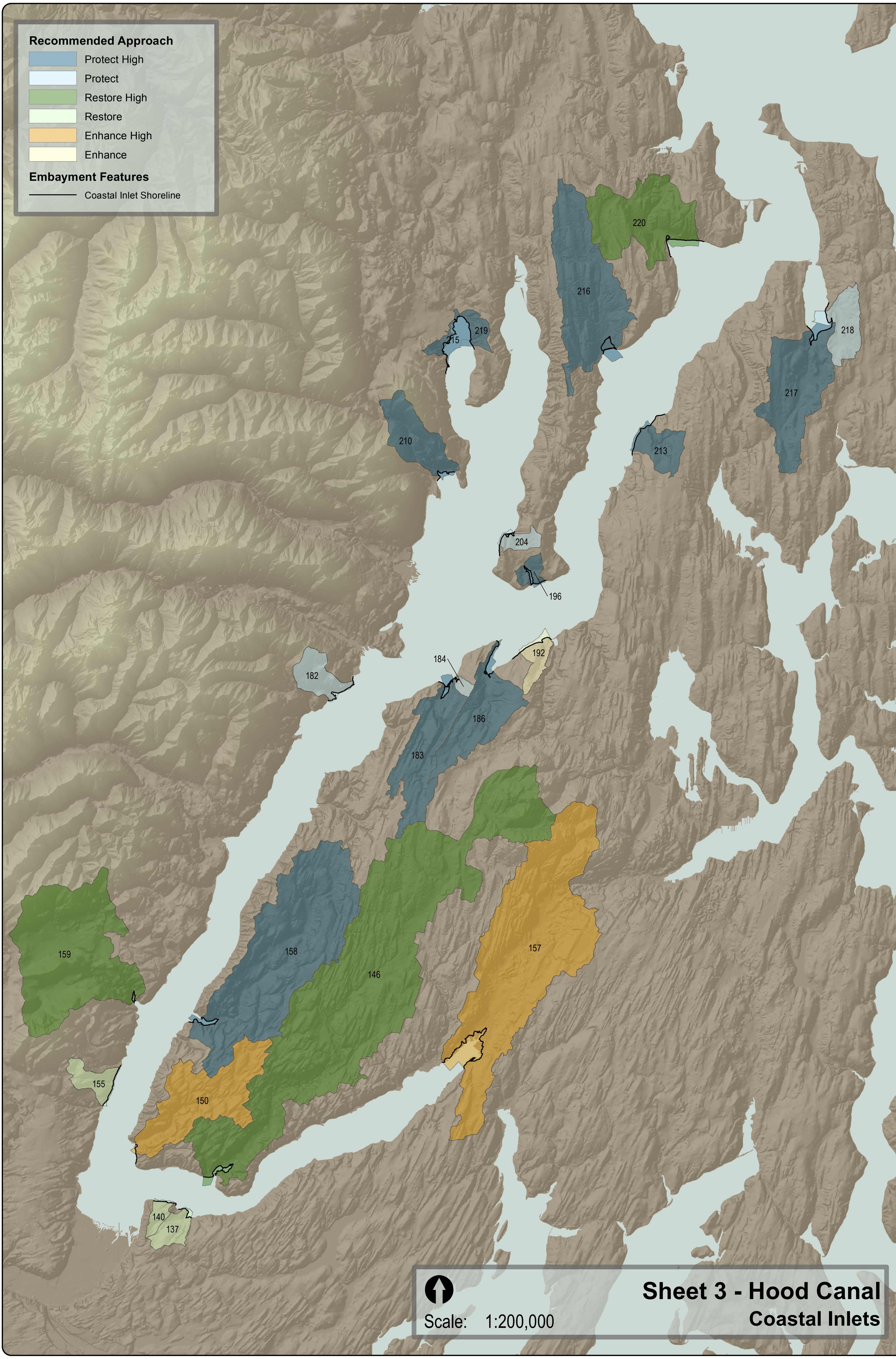

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Sheet 4 - Juan de Fuca

Beaches

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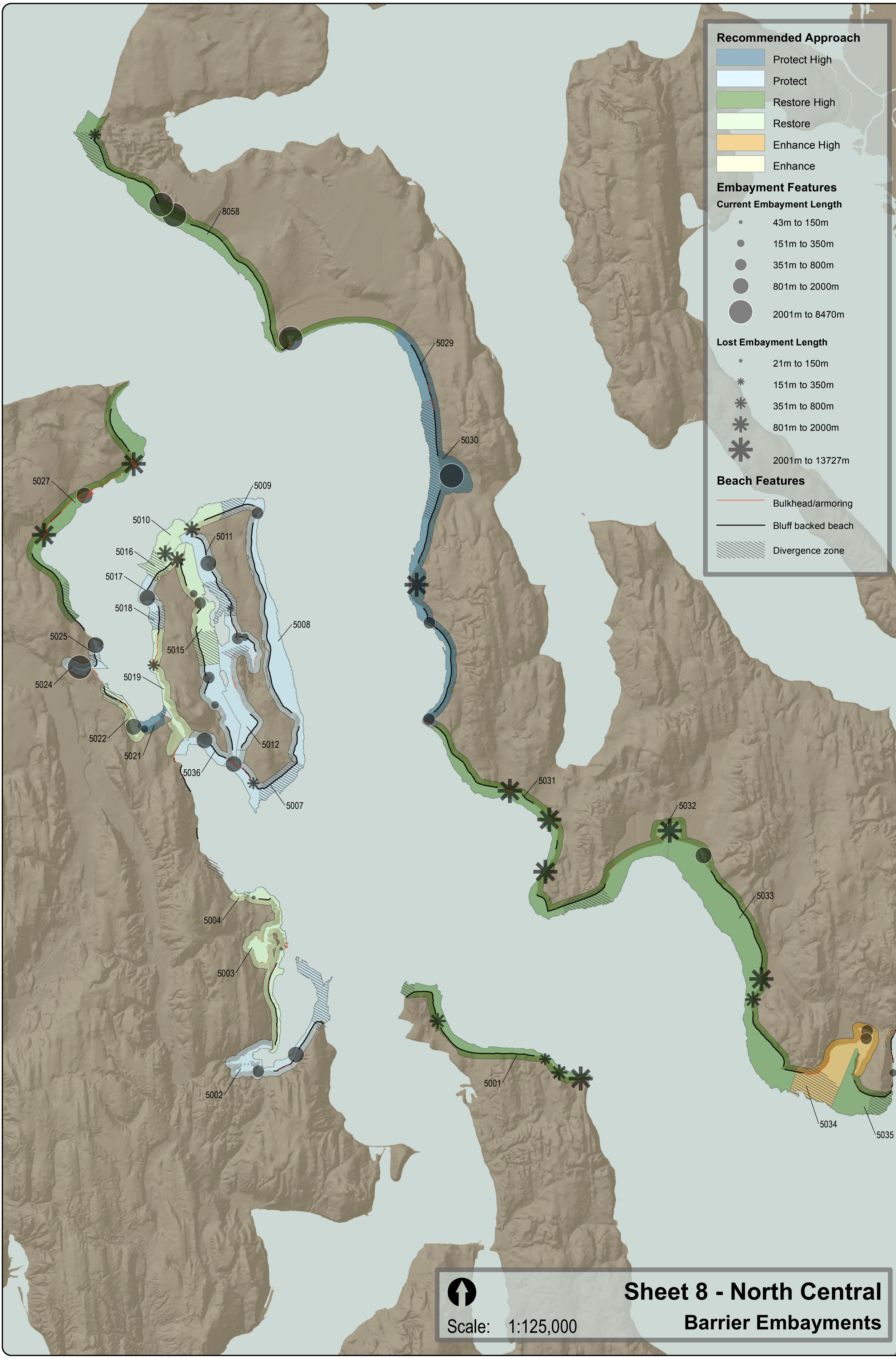

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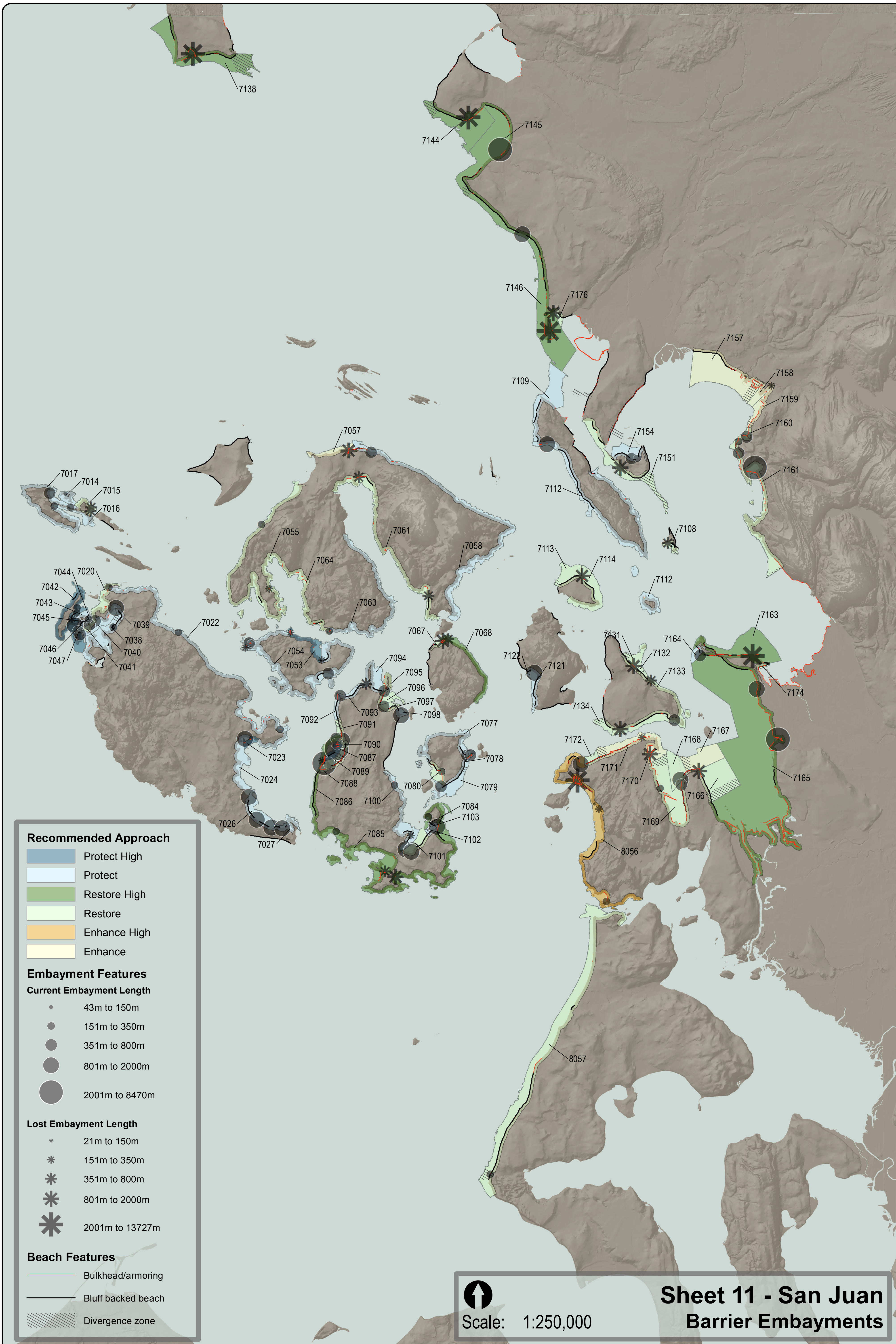

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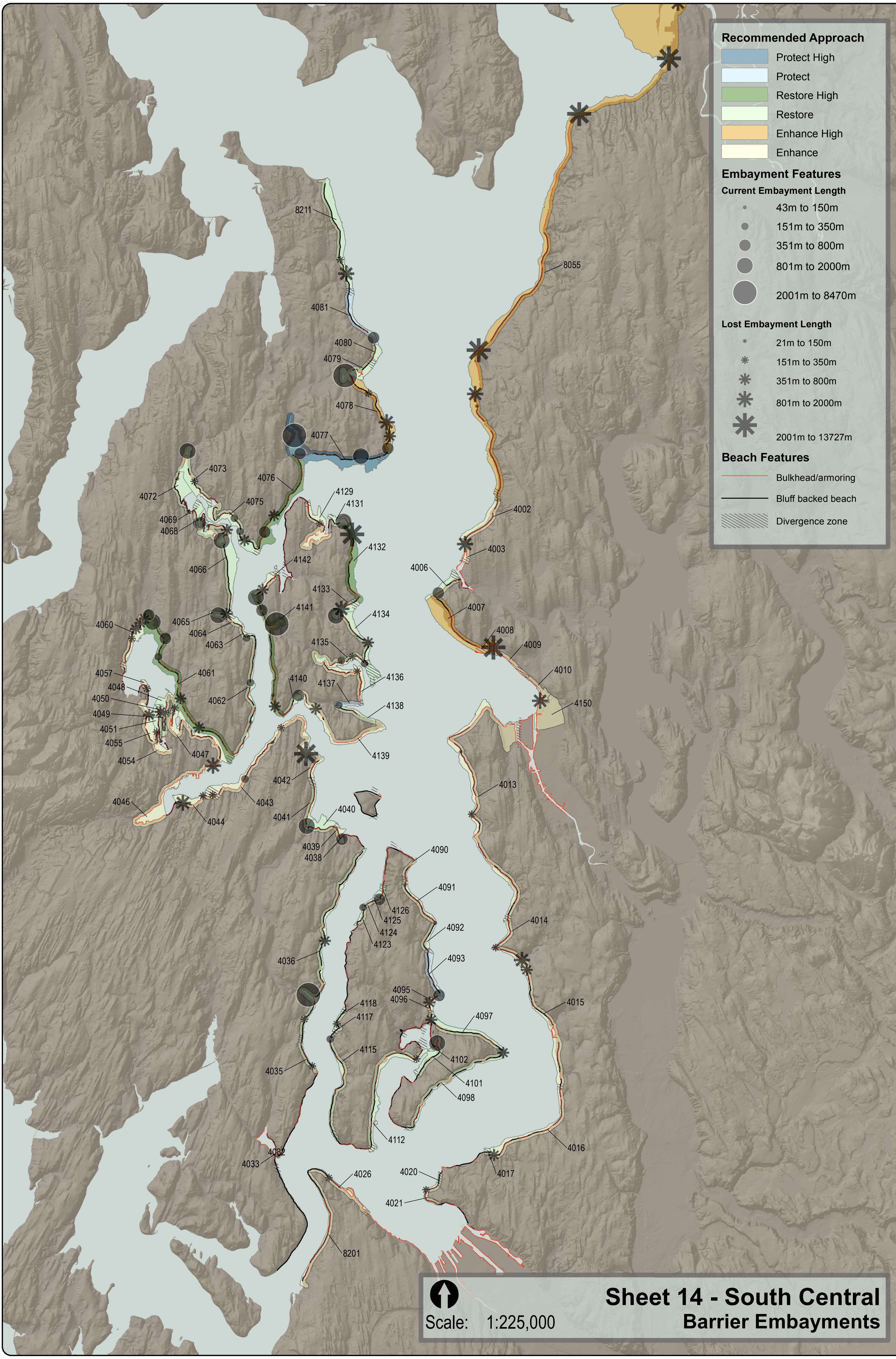

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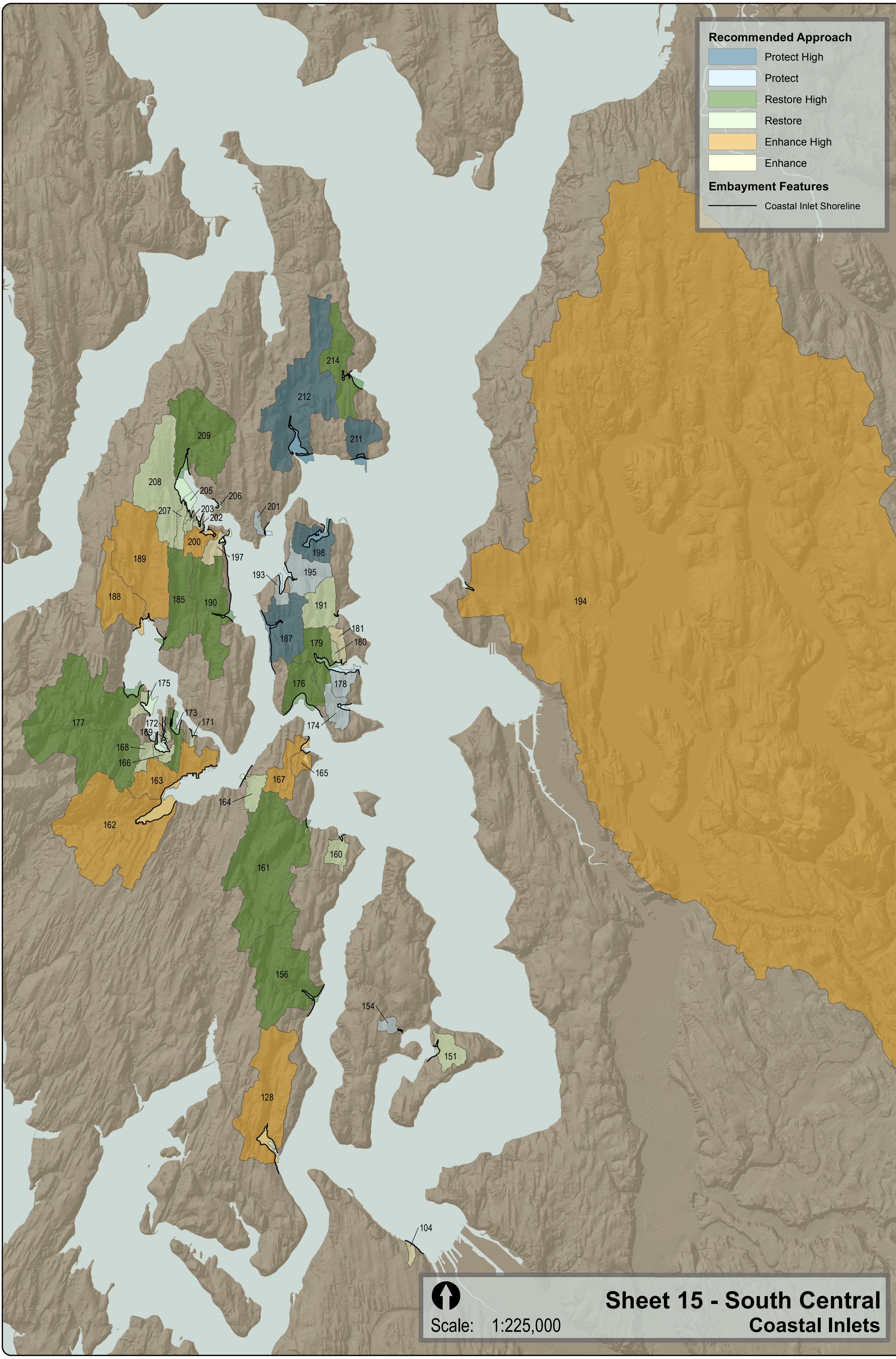

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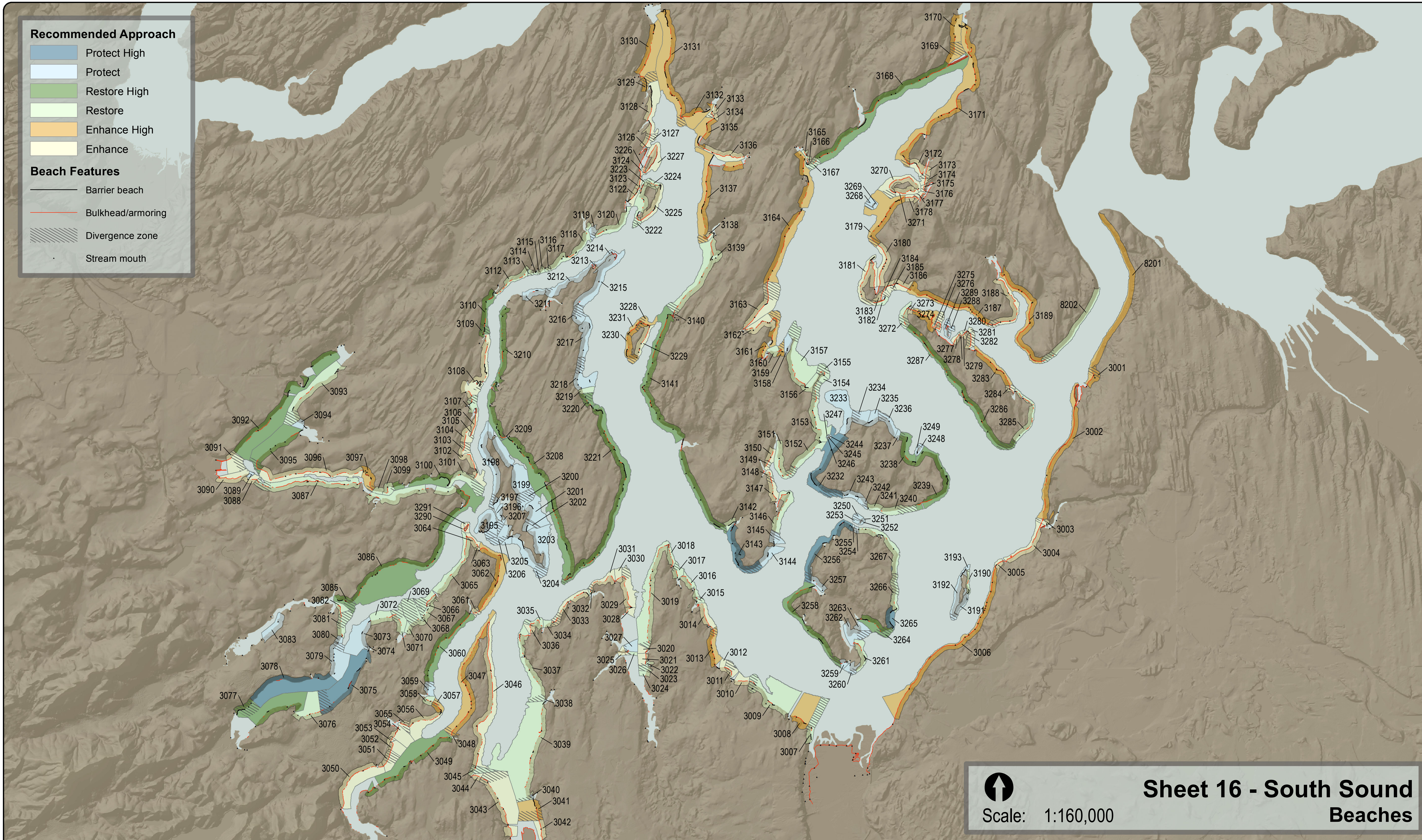

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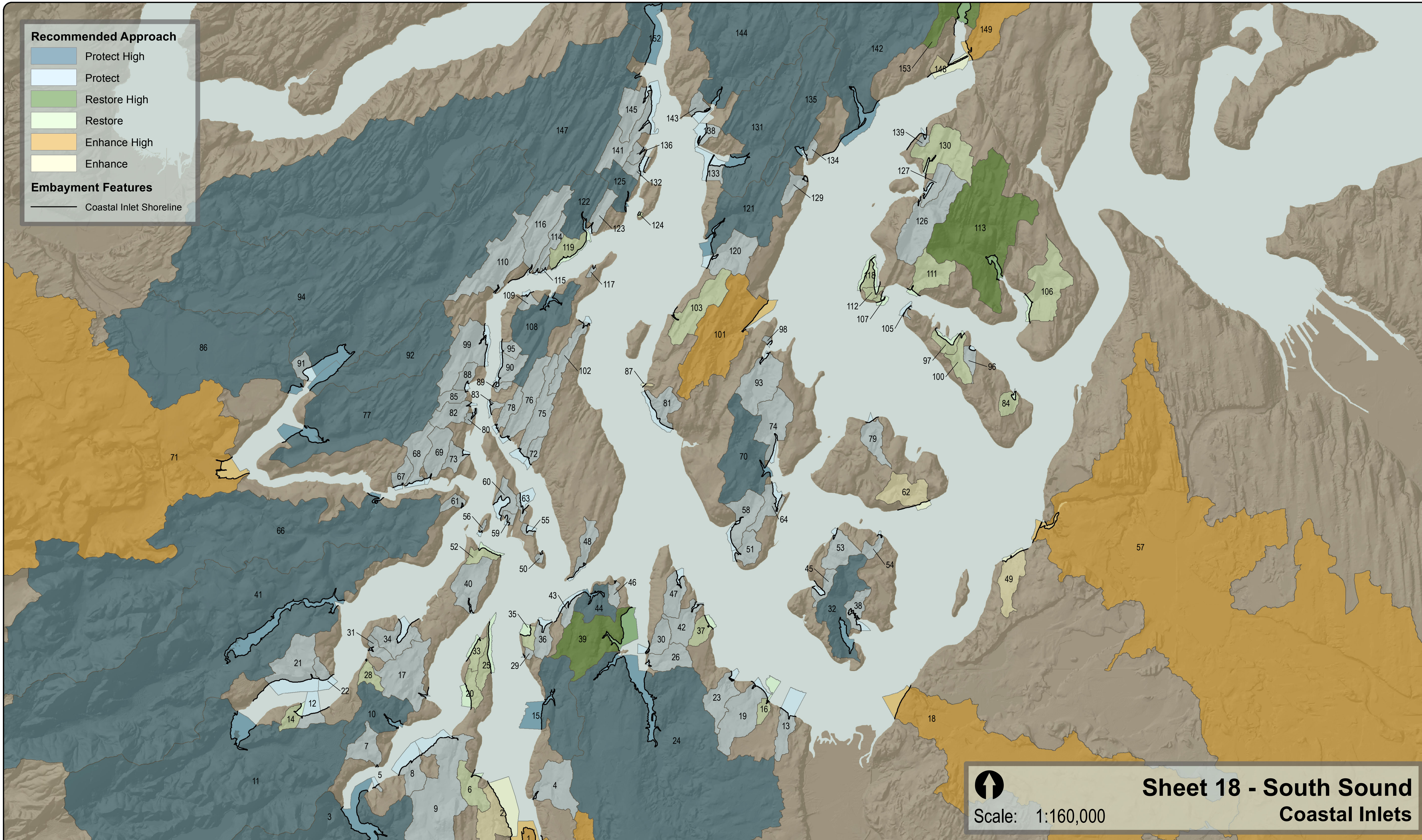

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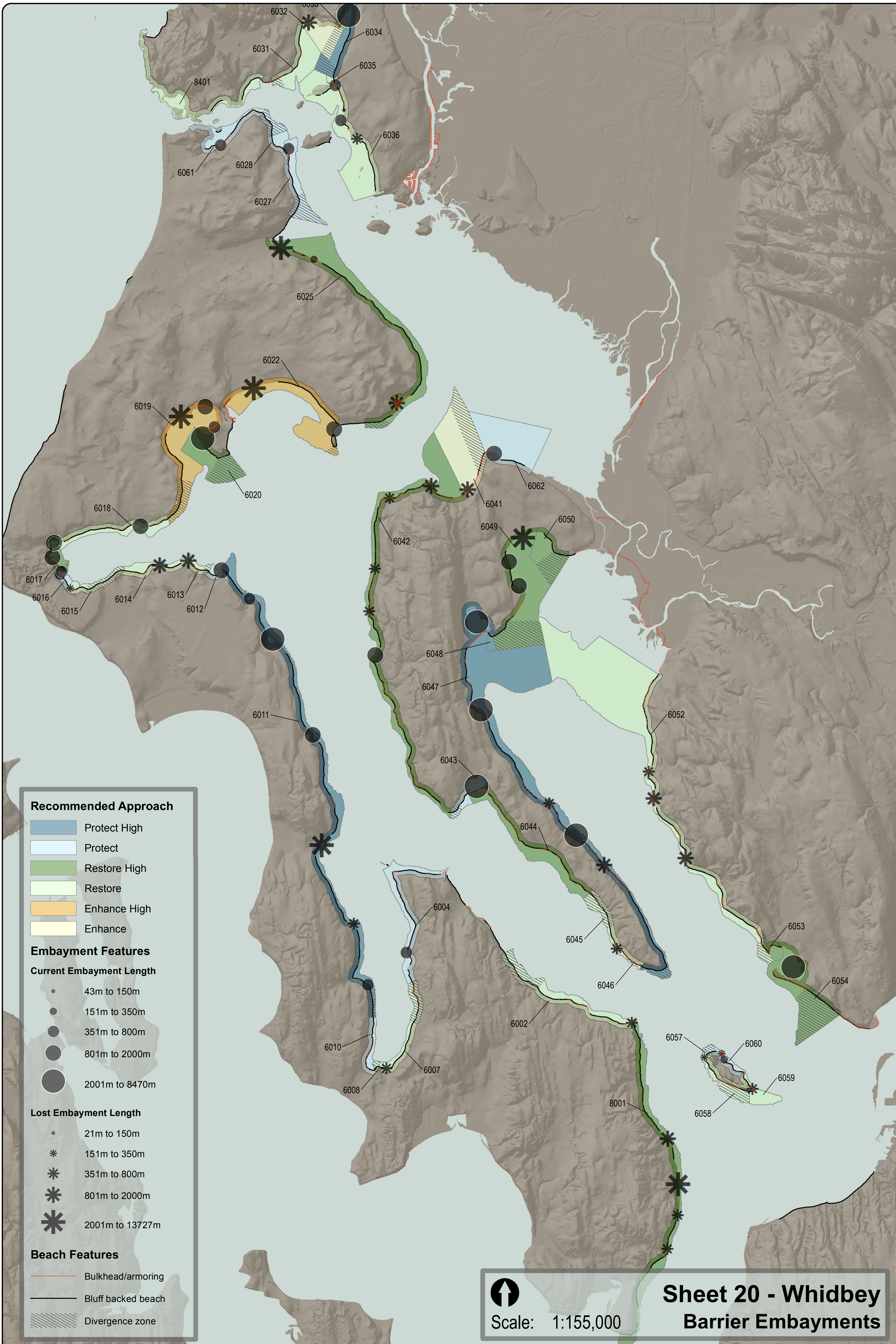

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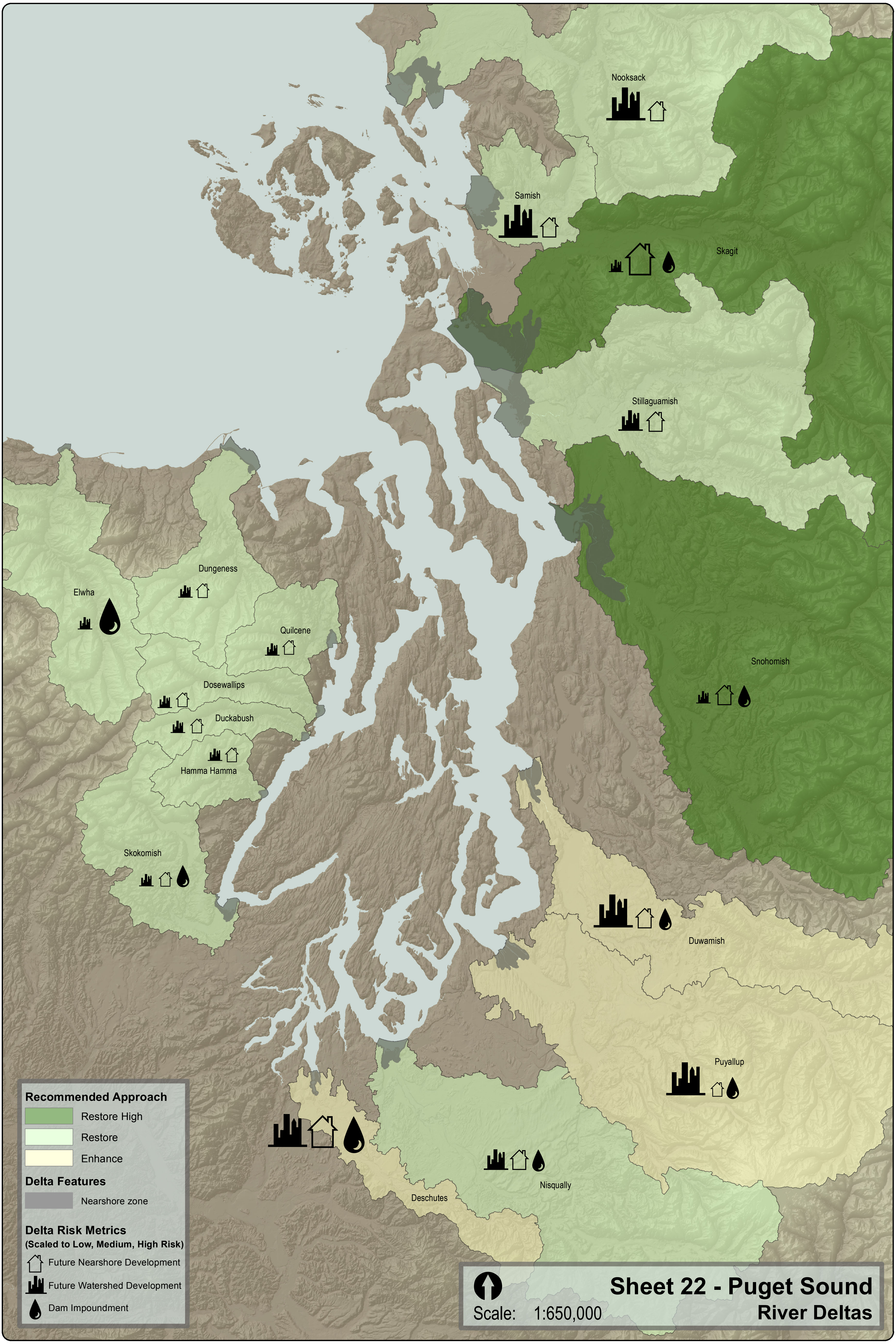

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Appendix B – Site Data

Data for all sites among four strategies are provided in the following tables. 'Group' indicates the output of the cluster analyses. 'Score' is the normalized rank sum of the selected metrics. The metrics are those used both for deriving group, and score, and are normalized through division by mean, as discussed in methods. All scores and metrics are risk ratings are relative to other sites within the strategy. Recommendations are based on degradation group membership, as elaborated on in the discussion section. Sites in bold with darker shading are identified as 'high potential' sites based on potential group, as discussed in the recommendations sections. Sites are sorted by site code. Among beach and barrier embayment sites the first number of the site code and indicates sub-basin: 1 = Juan de Fuca, 2 = Hood Canal, 3 = South Sound, 4 = South Central, 5 = North Central, 6 = Whidbey, 7 = San Juan, 8 = overlapping two sub-basins.

River Delta Sites

Site	Potential Group	Potential Score	Watershed Area	Swamp Area	Wetland Area	Delta Length	Degradation Group	Degradation Score	Lost Length	Wetland Loss	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Dam Risk	Future Nearshore Development Risk	Future Watershed Development Risk
Deschutes	P1	21	0.25	0.00	0.12	0.26	D2	74	1.00	0.00	0.97	0.85	0.74	Enhance	HIGH	HIGH	HIGH
Dosewallips	P1	21	0.21	0.05	0.08	0.22	D1	33	0.48	0.00	0.64	0.42	0.02	Restore	NONE	LOW	LOW
Duckabush	P1	0	0.17	0.03	0.07	0.18	D1	29	0.43	0.00	0.59	0.43	0.04	Restore	NONE	LOW	LOW
Dungeness	P1	36	0.28	0.04	0.12	0.40	D1	44	0.51	0.30	0.44	0.20	0.24	Restore	NONE	LOW	LOW
Duwamish	P2	45	0.42	0.24	0.28	0.19	D2	100	1.00	1.00	1.00	1.00	1.00	Enhance	MED	MED	HIGH
Elwha	P1	29	0.34	0.07	0.07	0.19	D1	0	0.25	0.00	0.02	0.07	0.02	Restore	HIGH	NONE	LOW
Hamma Hamma	P1	0	0.18	0.04	0.07	0.18	D1	20	0.34	0.00	0.64	0.17	0.04	Restore	NONE	LOW	LOW
Nisqually	P3	68	0.55	0.19	0.36	0.58	D1	66	0.68	0.77	0.73	0.17	0.25	Restore	MED	MED	MED
Nooksack	P3	75	0.53	0.48	0.50	0.52	D1	43	0.47	0.71	0.42	0.19	0.25	Restore	NONE	MED	HIGH
Puyallup	P2	61	0.59	0.12	0.39	0.29	D2	97	1.00	1.00	1.00	0.99	0.64	Enhance	MED	LOW	HIGH
Quilcene	P1	25	0.20	0.05	0.18	0.23	D1	26	0.53	0.00	0.49	0.17	0.06	Restore	NONE	LOW	LOW
Samish	P3	63	0.22	0.29	0.44	0.64	D1	64	0.58	0.97	0.66	0.15	0.34	Restore	NONE	MED	HIGH
Skagit	**P4**	**100**	**1.00**	**0.88**	**1.00**	**1.00**	**D1**	**46**	**0.45**	**0.74**	**0.63**	**0.21**	**0.09**	**Restore**	**MED**	**HIGH**	**LOW**
Skokomish	P1	50	0.30	0.13	0.31	0.40	D1	37	0.56	0.00	0.76	0.15	0.10	Restore	MED	LOW	LOW
Snohomish	**P4**	**96**	**0.81**	**1.00**	**0.99**	**0.85**	**D1**	**69**	**0.37**	**0.90**	**0.87**	**0.55**	**0.32**	**Restore**	**MED**	**MED**	**LOW**
Stillaguamish	P3	82	0.50	0.51	0.61	0.72	D1	49	0.22	0.69	0.87	0.40	0.22	Restore	NONE	MED	MED

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
1008	**P3**	**81**	**0.35**	**0.17**	**0.17**	**D10**	**44**	**0.05**	**0.28**	**0.19**	**Restore**	**HIGH**	**LOW**	**NONE**
1009	**P3**	**85**	**0.41**	**0.15**	**0.23**	**D10**	**43**	**0.09**	**0.17**	**0.26**	**Restore**	**NONE**	**LOW**	**NONE**
1010	**P3**	**84**	**0.38**	**0.15**	**0.22**	**D7**	**46**	**0.47**	**0.15**	**0.17**	**Restore**	**NONE**	**LOW**	**NONE**
1011	**P3**	**84**	**0.31**	**0.15**	**0.37**	**D13**	**51**	**0.22**	**0.34**	**0.18**	**Restore**	**NONE**	**LOW**	**NONE**
1012	**P3**	**80**	**0.25**	**0.20**	**0.24**	**D3**	**28**	**0.01**	**0.15**	**0.05**	**Protect**	**NONE**	**LOW**	**NONE**
1013	**P3**	**78**	**0.34**	**0.23**	**0.08**	**D6**	**33**	**0.05**	**0.10**	**0.21**	**Protect**	**NONE**	**LOW**	**NONE**
1014	**P3**	**82**	**0.27**	**0.30**	**0.13**	**D10**	**42**	**0.00**	**0.32**	**0.27**	**Restore**	**NONE**	**NONE**	**NONE**
1015	**P3**	**89**	**0.35**	**0.40**	**0.12**	**D6**	**24**	**0.00**	**0.12**	**0.16**	**Protect**	**NONE**	**NONE**	**NONE**
1016	**P3**	**80**	**0.36**	**0.30**	**0.05**	**D1**	**10**	**0.00**	**0.02**	**0.06**	**Protect**	**NONE**	**NONE**	**NONE**
1017	**P3**	**91**	**0.31**	**0.44**	**0.15**	**D5**	**24**	**0.07**	**0.05**	**0.10**	**Protect**	**NONE**	**NONE**	**NONE**
1018	**P3**	**88**	**0.35**	**0.24**	**0.21**	**D13**	**57**	**0.32**	**0.30**	**0.25**	**Restore**	**NONE**	**NONE**	**NONE**
1019	**P3**	**92**	**0.41**	**0.31**	**0.18**	**D13**	**60**	**0.30**	**0.42**	**0.24**	**Restore**	**HIGH**	**LOW**	**NONE**
1020	**P3**	**86**	**0.32**	**0.47**	**0.08**	**D15**	**53**	**0.64**	**0.20**	**0.18**	**Enhance**	**HIGH**	**LOW**	**NONE**
1021	**P3**	**86**	**0.29**	**0.48**	**0.09**	**D4**	**24**	**0.06**	**0.08**	**0.04**	**Protect**	**NONE**	**LOW**	**NONE**
1023	P2	45	0.22	0.22	0.00	D11	57	0.12	0.44	0.26	Restore	NONE	NONE	NONE
1024	**P3**	**69**	**0.31**	**1.00**	**0.00**	**D14**	**41**	**0.00**	**0.08**	**0.60**	**Enhance**	**NONE**	**NONE**	**NONE**

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
1025	P3	95	0.89	0.52	0.09	D10	43	0.14	0.21	0.18	Restore	NONE	LOW	NONE
1026	P3	95	0.45	0.58	0.10	D16	74	1.00	0.68	0.13	Enhance	NONE	LOW	NONE
1027	P3	87	0.66	0.22	0.15	D5	22	0.05	0.03	0.09	Protect	NONE	LOW	NONE
1028	P2	63	0.24	0.93	0.00	D2	15	0.00	0.05	0.12	Protect	HIGH	LOW	NONE
1029	P3	93	0.43	0.27	0.21	D7	40	0.55	0.08	0.12	Restore	HIGH	LOW	NONE
1100	P2	54	0.20	0.00	0.33	D15	71	1.00	0.25	0.28	Enhance	HIGH	LOW	NONE
1101	P2	55	0.22	0.00	0.28	D7	45	0.50	0.17	0.12	Restore	HIGH	LOW	NONE
1200	P3	76	0.26	0.34	0.05	D3	16	0.00	0.14	0.00	Protect	NONE	NONE	NONE
1201	P3	82	0.23	0.63	0.08	D11	38	0.05	0.37	0.00	Restore	HIGH	NONE	NONE
1202	P3	74	0.21	0.40	0.08	D11	35	0.03	0.32	0.00	Restore	NONE	NONE	NONE
1203	P1	34	0.17	0.14	0.00	D3	18	0.00	0.17	0.00	Protect	NONE	NONE	NONE
1400	P3	91	0.67	0.68	0.03	D7	49	0.45	0.26	0.10	Restore	MED	LOW	NONE
2002	P3	88	0.73	0.17	0.21	D13	55	0.31	0.22	0.31	Restore	NONE	NONE	NONE
2003	P3	83	0.27	0.19	0.33	D8	35	0.15	0.04	0.26	Restore	NONE	LOW	NONE
2004	P3	81	0.26	0.16	0.35	D8	33	0.17	0.06	0.19	Restore	NONE	NONE	NONE
2005	P3	75	0.25	0.12	0.28	D5	21	0.12	0.00	0.08	Protect	NONE	NONE	NONE
2006	P2	59	0.17	0.09	0.21	D7	27	0.22	0.01	0.12	Restore	NONE	NONE	NONE
2007	P3	88	0.30	0.20	0.48	D6	33	0.10	0.09	0.19	Protect	NONE	NONE	NONE
2008	P3	71	0.22	0.06	0.75	D2	12	0.00	0.01	0.11	Protect	NONE	NONE	NONE
2009	P3	82	0.40	0.05	0.65	D6	26	0.01	0.04	0.20	Protect	NONE	NONE	NONE
2010	P2	61	0.12	0.13	0.38	D6	32	0.08	0.05	0.23	Protect	NONE	NONE	NONE
2011	P3	83	0.45	0.06	0.43	D8	43	0.31	0.06	0.31	Restore	NONE	NONE	NONE
2013	P3	100	0.34	0.44	0.37	D15	62	0.79	0.09	0.44	Enhance	MED	NONE	NONE
2014	P3	76	0.22	0.15	0.37	D15	68	0.86	0.02	0.73	Enhance	NONE	NONE	NONE
2015	P3	74	0.14	0.27	0.71	D15	53	0.54	0.01	0.48	Enhance	NONE	NONE	NONE
2016	P3	72	0.15	0.21	0.88	D15	61	0.82	0.01	0.54	Enhance	NONE	NONE	NONE
2017	P3	74	0.15	0.22	1.00	D15	70	0.88	0.05	0.77	Enhance	NONE	NONE	NONE
2018	P3	85	0.25	0.20	0.60	D15	62	0.82	0.12	0.38	Enhance	NONE	NONE	NONE
2019	P3	79	0.15	0.34	0.44	D15	67	1.00	0.23	0.24	Enhance	NONE	NONE	NONE
2020	P3	79	0.17	0.27	0.45	D15	62	0.80	0.11	0.40	Enhance	NONE	NONE	NONE
2021	P1	29	0.11	0.22	0.00	D15	59	0.97	0.07	0.32	Enhance	NONE	NONE	NONE
2022	P3	100	0.34	0.41	0.46	D15	82	0.91	0.22	0.64	Enhance	NONE	NONE	NONE
2023	P3	83	0.24	0.67	0.07	D15	85	0.93	0.30	0.55	Enhance	NONE	NONE	NONE
2025	P3	84	0.30	0.41	0.08	D15	83	0.89	0.20	0.76	Enhance	NONE	LOW	NONE
2026	P2	55	0.14	0.13	0.16	D15	88	0.92	0.26	0.95	Enhance	NONE	NONE	NONE
2027	P3	78	0.36	0.11	0.20	D15	80	0.93	0.18	0.64	Enhance	NONE	NONE	NONE
2028	P3	73	0.16	0.40	0.14	D15	69	0.92	0.10	0.50	Enhance	NONE	NONE	NONE
2029	P3	95	0.42	0.22	0.53	D15	70	0.97	0.06	0.56	Enhance	NONE	NONE	NONE
2030	P3	90	0.17	0.99	0.55	D15	89	1.00	0.26	0.81	Enhance	NONE	NONE	NONE
2031	P3	77	0.31	0.11	0.24	D15	69	0.96	0.22	0.30	Enhance	HIGH	NONE	NONE
2032	P3	81	0.30	0.15	0.30	D15	79	0.76	0.34	0.47	Enhance	NONE	NONE	NONE
2034	P3	87	0.38	0.19	0.24	D15	74	0.94	0.25	0.37	Enhance	NONE	LOW	NONE
2035	P2	44	0.14	0.00	0.26	D7	30	0.32	0.06	0.05	Restore	NONE	NONE	NONE
2036	P3	91	0.36	0.23	0.32	D15	58	0.64	0.24	0.20	Enhance	NONE	NONE	NONE
2037	P3	80	0.16	0.34	0.38	D7	48	0.42	0.30	0.04	Restore	NONE	NONE	NONE
2038	P3	77	0.24	0.13	0.36	D7	40	0.51	0.17	0.01	Restore	NONE	LOW	NONE
2039	P3	72	0.14	0.26	0.32	D3	34	0.04	0.17	0.14	Protect	NONE	NONE	NONE
2041	P3	74	0.07	0.52	0.87	D15	62	1.00	0.32	0.06	Enhance	NONE	NONE	NONE
2042	P3	86	0.29	0.19	0.39	D7	54	0.45	0.23	0.21	Restore	NONE	LOW	NONE
2047	P2	65	0.20	0.22	0.08	D10	38	0.01	0.26	0.12	Restore	NONE	LOW	NONE
2048	P1	1	0.06	0.00	0.00	D13	70	0.20	0.32	0.56	Restore	NONE	LOW	NONE
2049	P2	53	0.18	0.09	0.08	D13	68	0.26	0.33	0.48	Restore	NONE	LOW	NONE
2050	P3	69	0.22	0.04	0.48	D13	56	0.39	0.33	0.19	Restore	NONE	NONE	NONE
2052	P3	70	0.23	0.25	0.06	D6	35	0.09	0.07	0.24	Protect	NONE	LOW	NONE
2054	P3	73	0.08	0.45	0.55	D2	10	0.00	0.00	0.10	Protect	NONE	LOW	NONE
2055	P3	80	0.13	0.50	0.47	D5	17	0.05	0.00	0.12	Protect	NONE	LOW	NONE
2056	P3	73	0.25	0.09	0.31	D8	40	0.17	0.05	0.32	Restore	NONE	LOW	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
2059	P3	97	0.39	0.32	0.35	D6	25	0.05	0.01	0.20	Protect	NONE	LOW	NONE
2062	P3	94	0.63	0.22	0.37	D6	24	0.07	0.02	0.15	Protect	MED	LOW	NONE
2063	P3	76	0.30	0.12	0.19	D6	28	0.01	0.08	0.18	Protect	NONE	NONE	NONE
2064	P3	78	0.27	0.09	0.49	D6	32	0.05	0.04	0.27	Protect	NONE	NONE	NONE
2065	P3	94	0.66	0.23	0.28	D6	27	0.04	0.05	0.19	Protect	LOW	LOW	NONE
2066	P3	75	0.26	0.13	0.21	D13	70	0.47	0.51	0.32	Restore	NONE	LOW	NONE
2067	P3	81	0.33	0.40	0.03	D10	41	0.14	0.13	0.25	Restore	NONE	LOW	NONE
2068	P2	59	0.24	0.48	0.00	D8	30	0.16	0.02	0.19	Restore	NONE	LOW	NONE
2069	P1	36	0.17	0.16	0.00	D6	12	0.00	0.00	0.19	Protect	NONE	NONE	NONE
2071	P2	43	0.22	0.00	0.05	D7	32	0.15	0.16	0.02	Restore	NONE	NONE	NONE
2072	P2	66	0.22	0.13	0.12	D10	42	0.13	0.20	0.16	Restore	NONE	NONE	NONE
2073	P2	49	0.25	0.22	0.00	D13	58	0.42	0.13	0.44	Restore	NONE	NONE	NONE
2074	P2	66	0.24	0.13	0.10	D10	43	0.08	0.29	0.14	Restore	NONE	NONE	NONE
2075	P3	89	0.26	0.38	0.21	D11	53	0.05	0.39	0.26	Restore	NONE	NONE	NONE
2076	P2	67	0.25	0.11	0.14	D11	69	0.10	0.36	0.59	Restore	NONE	NONE	NONE
2077	P2	59	0.29	0.36	0.00	D6	39	0.04	0.14	0.26	Protect	NONE	NONE	NONE
2080	P2	52	0.23	0.32	0.00	D13	59	0.38	0.30	0.26	Restore	NONE	NONE	NONE
2081	P2	59	0.30	0.32	0.00	D8	43	0.23	0.10	0.29	Restore	NONE	LOW	NONE
2082	P3	68	0.13	0.32	0.20	D7	34	0.41	0.07	0.08	Restore	NONE	LOW	NONE
2083	P2	48	0.13	0.05	0.17	D7	36	0.30	0.07	0.17	Restore	NONE	NONE	NONE
2084	P1	31	0.14	0.16	0.00	D15	74	0.92	0.10	0.70	Enhance	NONE	NONE	NONE
2088	P3	86	0.39	0.25	0.14	D15	64	0.58	0.19	0.40	Enhance	LOW	NONE	NONE
2098	P3	78	0.22	0.47	0.08	D8	41	0.10	0.12	0.29	Restore	NONE	LOW	NONE
2099	P1	27	0.13	0.14	0.00	D11	69	0.03	0.41	0.63	Restore	NONE	NONE	NONE
2100	P2	51	0.15	0.00	0.55	D15	57	0.94	0.09	0.24	Enhance	NONE	NONE	NONE
3001	P3	80	0.19	0.39	0.20	D15	78	0.74	0.54	0.38	Enhance	NONE	MED	MED
3002	P3	80	0.40	0.29	0.04	D15	71	1.00	0.45	0.16	Enhance	NONE	MED	HIGH
3003	P1	39	0.12	0.36	0.00	D15	68	1.00	0.46	0.08	Enhance	NONE	LOW	HIGH
3004	P2	52	0.26	0.25	0.00	D15	69	1.00	0.56	0.05	Enhance	LOW	MED	HIGH
3005	P1	34	0.10	0.32	0.00	D16	71	1.00	0.78	0.04	Enhance	NONE	HIGH	HIGH
3006	P3	75	0.39	0.05	0.21	D15	47	1.00	0.11	0.02	Enhance	NONE	MED	HIGH
3007	P2	67	0.14	0.31	0.17	D13	59	0.27	0.40	0.26	Restore	NONE	NONE	NONE
3008	P3	71	0.16	0.20	0.37	D15	63	0.59	0.23	0.32	Enhance	NONE	NONE	NONE
3009	P2	66	0.22	0.22	0.06	D10	37	0.14	0.16	0.14	Restore	NONE	LOW	NONE
3010	P2	42	0.17	0.28	0.00	D15	45	0.64	0.06	0.21	Enhance	NONE	LOW	NONE
3011	P1	35	0.13	0.24	0.00	D15	52	0.84	0.06	0.27	Enhance	NONE	NONE	NONE
3012	P2	66	0.14	0.27	0.18	D15	65	0.64	0.09	0.56	Enhance	NONE	NONE	NONE
3013	P3	69	0.19	0.09	0.64	D15	71	0.66	0.19	0.51	Enhance	NONE	NONE	NONE
3014	P1	33	0.18	0.12	0.00	D15	68	0.70	0.22	0.40	Enhance	NONE	NONE	NONE
3015	P1	30	0.07	0.31	0.00	D13	51	0.46	0.11	0.32	Restore	NONE	NONE	NONE
3016	P1	36	0.18	0.15	0.00	D13	43	0.46	0.03	0.27	Restore	LOW	NONE	NONE
3017	P1	37	0.11	0.35	0.00	D13	69	0.42	0.59	0.30	Restore	LOW	NONE	NONE
3018	P1	35	0.16	0.19	0.00	D13	75	0.55	0.32	0.49	Restore	NONE	NONE	NONE
3019	P2	62	0.30	0.03	0.09	D13	66	0.55	0.17	0.50	Restore	NONE	NONE	NONE
3020	P1	20	0.11	0.10	0.00	D14	77	0.64	0.20	0.76	Enhance	NONE	NONE	NONE
3021	P1	5	0.09	0.00	0.00	D15	80	0.79	0.26	0.57	Enhance	NONE	NONE	NONE
3022	P1	1	0.06	0.00	0.00	D13	44	0.26	0.18	0.19	Restore	NONE	NONE	NONE
3023	P1	16	0.09	0.08	0.00	D9	36	0.00	0.11	0.42	Restore	NONE	NONE	NONE
3024	P1	16	0.10	0.06	0.00	D9	43	0.06	0.09	0.39	Restore	NONE	NONE	NONE
3025	P1	4	0.09	0.00	0.00	D15	48	0.82	0.09	0.15	Enhance	NONE	NONE	NONE
3026	P1	2	0.06	0.00	0.00	D7	29	0.59	0.00	0.09	Restore	NONE	NONE	NONE
3027	P1	1	0.06	0.00	0.00	D5	18	0.12	0.00	0.07	Protect	NONE	NONE	NONE
3028	P1	28	0.13	0.14	0.00	D15	40	0.72	0.06	0.10	Enhance	NONE	NONE	NONE
3029	P1	30	0.17	0.08	0.00	D15	72	0.73	0.31	0.39	Enhance	NONE	NONE	NONE
3030	P1	24	0.11	0.12	0.00	D15	77	0.86	0.17	0.65	Enhance	NONE	NONE	NONE
3031	P1	27	0.17	0.05	0.00	D14	67	0.53	0.12	0.66	Enhance	NONE	NONE	NONE
3032	P1	19	0.09	0.11	0.00	D13	57	0.33	0.09	0.54	Restore	NONE	NONE	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
3033	P2	65	0.21	0.15	0.14	D15	55	0.60	0.13	0.33	Enhance	NONE	LOW	NONE
3034	P1	38	0.13	0.00	0.15	D13	55	0.34	0.19	0.33	Restore	NONE	LOW	NONE
3035	P1	29	0.14	0.14	0.00	D13	74	0.59	0.33	0.44	Restore	NONE	NONE	NONE
3036	P1	5	0.09	0.00	0.00	D15	90	0.82	0.65	0.54	Enhance	NONE	NONE	NONE
3037	P2	61	0.27	0.10	0.04	D13	59	0.26	0.24	0.38	Restore	LOW	LOW	NONE
3038	P1	3	0.08	0.00	0.00	D1	11	0.00	0.03	0.05	Protect	NONE	LOW	NONE
3039	P2	66	0.30	0.08	0.09	D13	51	0.35	0.16	0.31	Restore	NONE	LOW	NONE
3040	P1	25	0.10	0.17	0.00	D3	15	0.00	0.12	0.02	Protect	NONE	LOW	NONE
3041	P3	72	0.16	0.38	0.14	D15	60	0.97	0.27	0.08	Enhance	NONE	MED	NONE
3042	P1	38	0.15	0.00	0.12	D16	78	0.96	0.68	0.22	Enhance	NONE	HIGH	NONE
3043	P2	54	0.23	0.00	0.19	D15	73	0.73	0.46	0.29	Enhance	LOW	LOW	NONE
3044	P1	38	0.11	0.00	0.20	D15	80	0.82	0.29	0.52	Enhance	NONE	NONE	NONE
3045	P1	39	0.08	0.00	0.41	D13	78	0.45	0.38	0.56	Restore	NONE	NONE	NONE
3046	P2	65	0.36	0.05	0.08	D15	78	0.78	0.30	0.49	Enhance	NONE	LOW	NONE
3047	P3	70	0.32	0.05	0.16	D15	71	0.75	0.23	0.42	Enhance	NONE	LOW	NONE
3048	P1	3	0.08	0.00	0.00	D15	60	0.64	0.21	0.28	Enhance	NONE	LOW	NONE
3049	P3	76	0.30	0.12	0.19	D13	57	0.45	0.20	0.31	Restore	NONE	LOW	NONE
3050	P2	52	0.23	0.01	0.05	D15	75	0.89	0.27	0.39	Enhance	NONE	NONE	NONE
3051	P1	8	0.12	0.00	0.00	D15	73	0.98	0.09	0.56	Enhance	NONE	NONE	NONE
3052	P1	11	0.13	0.00	0.00	D15	74	0.97	0.10	0.59	Enhance	NONE	NONE	NONE
3053	P1	39	0.06	0.00	0.62	D15	60	0.77	0.06	0.44	Enhance	NONE	NONE	NONE
3054	P2	46	0.12	0.67	0.00	D15	72	0.76	0.19	0.49	Enhance	NONE	NONE	NONE
3055	P1	24	0.10	0.16	0.00	D15	76	0.85	0.19	0.55	Enhance	NONE	NONE	NONE
3056	P2	50	0.18	0.06	0.08	D15	65	0.65	0.13	0.49	Enhance	NONE	NONE	NONE
3057	P3	76	0.13	0.48	0.22	D15	63	0.60	0.05	0.65	Enhance	NONE	NONE	NONE
3058	P1	25	0.12	0.13	0.00	D13	41	0.51	0.02	0.24	Restore	NONE	NONE	NONE
3059	P1	38	0.10	0.00	0.24	D5	20	0.10	0.01	0.08	Protect	NONE	NONE	NONE
3060	P3	70	0.28	0.07	0.18	D13	58	0.47	0.13	0.42	Restore	NONE	LOW	NONE
3061	P1	29	0.11	0.21	0.00	D14	69	0.51	0.13	0.68	Enhance	NONE	NONE	NONE
3062	P3	70	0.28	0.16	0.08	D15	72	0.61	0.24	0.49	Enhance	NONE	NONE	NONE
3063	P1	1	0.04	0.00	0.00	D14	82	0.30	0.56	0.73	Enhance	NONE	NONE	NONE
3064	P1	17	0.12	0.03	0.00	D15	96	0.87	0.68	0.70	Enhance	MED	NONE	NONE
3065	P1	36	0.26	0.04	0.00	D13	70	0.50	0.26	0.47	Restore	NONE	NONE	NONE
3066	P1	22	0.07	0.16	0.00	D15	79	1.00	0.14	0.64	Enhance	NONE	NONE	NONE
3067	P1	33	0.10	0.29	0.00	D8	40	0.19	0.11	0.24	Restore	NONE	NONE	NONE
3068	P1	29	0.07	0.29	0.00	D10	46	0.21	0.24	0.16	Restore	NONE	NONE	NONE
3069	P1	18	0.11	0.07	0.00	D9	52	0.08	0.23	0.36	Restore	NONE	NONE	NONE
3070	P1	19	0.13	0.04	0.00	D9	40	0.05	0.07	0.38	Restore	NONE	NONE	NONE
3071	P1	11	0.14	0.00	0.00	D13	63	0.39	0.17	0.49	Restore	NONE	NONE	NONE
3072	P1	28	0.17	0.07	0.00	D13	56	0.32	0.15	0.42	Restore	NONE	NONE	NONE
3073	P1	38	0.17	0.20	0.00	D6	33	0.02	0.12	0.20	Protect	NONE	NONE	NONE
3074	P2	41	0.10	0.63	0.00	D1	8	0.00	0.01	0.04	Protect	NONE	NONE	NONE
3075	P3	79	0.27	0.24	0.13	D6	31	0.07	0.04	0.24	Protect	NONE	NONE	NONE
3076	P2	50	0.18	0.00	0.25	D8	45	0.26	0.12	0.30	Restore	NONE	NONE	NONE
3077	P3	76	0.28	0.16	0.15	D10	42	0.17	0.15	0.21	Restore	NONE	NONE	NONE
3078	P3	69	0.30	0.08	0.12	D5	25	0.10	0.03	0.12	Protect	HIGH	NONE	NONE
3079	P2	61	0.17	0.04	0.36	D2	9	0.00	0.00	0.12	Protect	LOW	NONE	NONE
3080	P2	59	0.12	0.17	0.21	D5	26	0.08	0.05	0.12	Protect	NONE	NONE	NONE
3081	P1	26	0.14	0.10	0.00	D13	45	0.31	0.11	0.26	Restore	NONE	NONE	NONE
3082	P1	24	0.15	0.06	0.00	D7	44	0.52	0.08	0.20	Restore	NONE	NONE	NONE
3083	P1	0	0.02	0.00	0.00	D2	16	0.00	0.05	0.14	Protect	NONE	LOW	NONE
3085	P3	69	0.15	0.32	0.16	D9	48	0.11	0.19	0.32	Restore	NONE	LOW	NONE
3086	P3	73	0.41	0.07	0.13	D13	53	0.28	0.17	0.36	Restore	NONE	NONE	NONE
3087	P2	68	0.42	0.04	0.09	D13	53	0.46	0.12	0.35	Restore	NONE	LOW	NONE
3088	P1	38	0.14	0.00	0.12	D15	64	0.57	0.22	0.37	Enhance	NONE	LOW	NONE
3089	P1	2	0.06	0.00	0.00	D1	4	0.00	0.00	0.03	Protect	NONE	LOW	NONE
3090	P1	15	0.16	0.00	0.00	D15	56	0.71	0.40	0.02	Enhance	NONE	LOW	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
3091	P1	5	0.10	0.00	0.00	D15	59	0.81	0.38	0.04	Enhance	LOW	LOW	NONE
3092	P3	73	0.36	0.15	0.07	D7	45	0.43	0.17	0.15	Restore	HIGH	LOW	NONE
3093	P2	43	0.26	0.12	0.00	D8	35	0.18	0.07	0.20	Restore	NONE	LOW	NONE
3094	P1	35	0.15	0.22	0.00	D1	12	0.00	0.03	0.08	Protect	NONE	LOW	NONE
3095	P3	69	0.24	0.12	0.15	D13	52	0.36	0.11	0.39	Restore	NONE	LOW	NONE
3096	P2	65	0.32	0.07	0.08	D15	75	0.74	0.24	0.50	Enhance	NONE	NONE	NONE
3097	P3	76	0.16	0.48	0.15	D15	69	0.64	0.19	0.50	Enhance	NONE	NONE	NONE
3098	P1	9	0.12	0.00	0.00	D13	50	0.27	0.06	0.46	Restore	NONE	NONE	NONE
3099	P1	38	0.11	0.00	0.20	D13	48	0.46	0.06	0.34	Restore	NONE	NONE	NONE
3100	P3	72	0.25	0.26	0.05	D9	24	0.00	0.04	0.30	Restore	NONE	NONE	NONE
3101	P2	48	0.16	0.04	0.10	D8	34	0.20	0.02	0.24	Restore	NONE	NONE	NONE
3102	P1	35	0.18	0.14	0.00	D15	51	0.72	0.07	0.29	Enhance	NONE	NONE	NONE
3103	P1	6	0.10	0.00	0.00	D15	77	0.69	0.26	0.53	Enhance	NONE	NONE	NONE
3104	P1	8	0.11	0.00	0.00	D15	88	0.92	0.46	0.49	Enhance	NONE	NONE	NONE
3105	P1	38	0.05	0.84	0.00	D15	50	1.00	0.11	0.10	Enhance	NONE	NONE	NONE
3106	P2	43	0.17	0.27	0.00	D15	75	0.99	0.20	0.42	Enhance	NONE	NONE	NONE
3107	P1	39	0.14	0.28	0.00	D13	60	0.29	0.22	0.40	Restore	NONE	NONE	NONE
3108	P2	61	0.32	0.35	0.00	D15	70	0.61	0.26	0.42	Enhance	NONE	NONE	NONE
3109	P3	74	0.12	0.46	0.25	D13	47	0.31	0.22	0.16	Restore	NONE	NONE	NONE
3110	P3	81	0.22	0.39	0.15	D13	62	0.32	0.31	0.36	Restore	NONE	NONE	NONE
3112	P2	48	0.18	0.03	0.08	D13	66	0.45	0.24	0.42	Restore	NONE	NONE	NONE
3113	P1	3	0.08	0.00	0.00	D9	26	0.00	0.00	0.45	Restore	NONE	NONE	NONE
3114	P1	29	0.08	0.24	0.00	D9	21	0.00	0.00	0.36	Restore	NONE	NONE	NONE
3115	P1	2	0.06	0.00	0.00	D9	22	0.00	0.00	0.39	Restore	NONE	NONE	NONE
3116	P1	4	0.08	0.00	0.00	D9	25	0.00	0.00	0.39	Restore	NONE	NONE	NONE
3117	P1	3	0.08	0.00	0.00	D9	36	0.00	0.07	0.47	Restore	NONE	NONE	NONE
3118	P2	59	0.24	0.05	0.09	D8	42	0.14	0.11	0.29	Restore	NONE	NONE	NONE
3119	P1	5	0.09	0.00	0.00	D6	21	0.00	0.09	0.17	Protect	NONE	NONE	NONE
3120	P2	58	0.21	0.12	0.06	D13	63	0.17	0.26	0.46	Restore	NONE	NONE	NONE
3122	P2	51	0.16	0.74	0.00	D15	77	0.93	0.35	0.34	Enhance	NONE	NONE	NONE
3123	P1	38	0.12	0.36	0.00	D15	69	1.00	0.14	0.39	Enhance	NONE	NONE	NONE
3124	P1	11	0.08	0.02	0.00	D15	76	1.00	0.19	0.45	Enhance	NONE	LOW	NONE
3126	P2	41	0.08	0.95	0.00	D9	37	0.00	0.17	0.35	Restore	NONE	NONE	NONE
3127	P1	14	0.11	0.01	0.00	D15	69	1.00	0.18	0.33	Enhance	NONE	NONE	NONE
3128	P2	63	0.26	0.54	0.00	D15	67	1.00	0.21	0.26	Enhance	NONE	NONE	NONE
3129	P3	81	0.14	0.87	0.23	D15	62	1.00	0.21	0.17	Enhance	NONE	NONE	NONE
3130	P3	81	0.25	0.24	0.20	D15	65	0.79	0.37	0.19	Enhance	NONE	LOW	NONE
3131	P3	97	0.37	0.41	0.24	D15	68	0.66	0.21	0.42	Enhance	NONE	LOW	NONE
3132	P3	71	0.20	0.23	0.16	D15	73	0.73	0.29	0.41	Enhance	NONE	LOW	NONE
3133	P2	63	0.12	0.23	0.23	D15	64	0.58	0.19	0.40	Enhance	NONE	LOW	NONE
3134	P1	2	0.06	0.00	0.00	D15	64	0.81	0.01	0.69	Enhance	NONE	NONE	NONE
3135	P3	79	0.22	0.52	0.08	D15	56	0.67	0.10	0.35	Enhance	NONE	LOW	NONE
3136	P2	53	0.20	0.00	0.13	D15	81	0.85	0.33	0.48	Enhance	NONE	LOW	NONE
3137	P3	79	0.32	0.21	0.12	D15	71	0.65	0.18	0.55	Enhance	NONE	LOW	NONE
3138	P1	21	0.11	0.10	0.00	D15	57	0.55	0.06	0.48	Enhance	NONE	NONE	NONE
3139	P2	61	0.28	0.11	0.04	D13	44	0.45	0.03	0.30	Restore	NONE	LOW	NONE
3140	P1	39	0.12	0.41	0.00	D15	62	0.62	0.09	0.53	Enhance	NONE	NONE	NONE
3141	P3	86	0.47	0.15	0.23	D8	40	0.25	0.03	0.33	Restore	NONE	LOW	NONE
3142	P2	56	0.20	0.65	0.00	D9	35	0.02	0.03	0.36	Restore	NONE	LOW	NONE
3143	P3	82	0.27	0.31	0.14	D6	22	0.01	0.00	0.17	Protect	NONE	LOW	NONE
3144	P2	60	0.21	0.15	0.07	D3	17	0.00	0.10	0.07	Protect	NONE	LOW	NONE
3145	P1	38	0.12	0.34	0.00	D6	16	0.00	0.02	0.18	Protect	NONE	NONE	NONE
3146	P2	41	0.24	0.12	0.00	D13	55	0.37	0.19	0.31	Restore	NONE	LOW	NONE
3147	P2	50	0.15	0.07	0.13	D15	65	0.71	0.12	0.48	Enhance	NONE	LOW	NONE
3148	P1	7	0.11	0.00	0.00	D15	71	0.70	0.19	0.50	Enhance	NONE	LOW	NONE
3149	P1	3	0.08	0.00	0.00	D15	71	0.66	0.20	0.51	Enhance	NONE	LOW	NONE
3150	P1	38	0.11	0.00	0.20	D15	69	0.87	0.09	0.52	Enhance	NONE	NONE	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
3151	P2	56	0.21	0.04	0.12	D8	41	0.31	0.06	0.28	Restore	NONE	NONE	NONE
3152	P1	31	0.20	0.06	0.00	D9	48	0.18	0.08	0.43	Restore	NONE	NONE	NONE
3153	P2	64	0.23	0.04	0.20	D13	54	0.33	0.13	0.41	Restore	NONE	LOW	NONE
3154	P1	23	0.15	0.05	0.00	D8	39	0.23	0.08	0.24	Restore	NONE	NONE	NONE
3155	P1	18	0.10	0.10	0.00	D7	33	0.48	0.02	0.11	Restore	NONE	NONE	NONE
3156	P2	65	0.16	0.15	0.22	D8	35	0.15	0.08	0.20	Restore	NONE	LOW	NONE
3157	P1	31	0.21	0.04	0.00	D13	42	0.38	0.08	0.24	Restore	NONE	NONE	NONE
3158	P2	62	0.15	0.22	0.14	D1	10	0.00	0.01	0.08	Protect	NONE	NONE	NONE
3159	**P3**	**69**	**0.08**	**0.35**	**0.54**	**D15**	**33**	**0.78**	**0.01**	**0.01**	**Enhance**	**NONE**	**NONE**	**NONE**
3160	P1	32	0.13	0.22	0.00	D7	36	0.35	0.13	0.04	Restore	NONE	LOW	NONE
3161	**P3**	**75**	**0.22**	**0.25**	**0.13**	**D15**	**49**	**0.68**	**0.11**	**0.20**	**Enhance**	**LOW**	**LOW**	**NONE**
3162	P2	63	0.19	0.09	0.24	D15	76	0.71	0.23	0.54	Enhance	NONE	LOW	NONE
3163	P2	58	0.22	0.12	0.06	D15	91	0.98	0.44	0.56	Enhance	NONE	NONE	NONE
3164	**P3**	**76**	**0.37**	**0.12**	**0.15**	**D15**	**62**	**0.68**	**0.14**	**0.40**	**Enhance**	**NONE**	**LOW**	**NONE**
3165	P1	4	0.09	0.00	0.00	D13	54	0.45	0.18	0.29	Restore	NONE	LOW	NONE
3166	P1	1	0.06	0.00	0.00	D15	59	0.75	0.00	0.67	Enhance	NONE	NONE	NONE
3167	P1	31	0.12	0.22	0.00	D13	44	0.24	0.03	0.41	Restore	NONE	NONE	NONE
3168	**P3**	**85**	**0.46**	**0.24**	**0.11**	**D13**	**67**	**0.50**	**0.32**	**0.36**	**Restore**	**NONE**	**LOW**	**NONE**
3169	**P3**	**76**	**0.21**	**0.43**	**0.08**	**D15**	**78**	**1.00**	**0.51**	**0.25**	**Enhance**	**NONE**	**LOW**	**NONE**
3170	**P3**	**74**	**0.21**	**0.15**	**0.34**	**D15**	**86**	**1.00**	**0.41**	**0.45**	**Enhance**	**NONE**	**NONE**	**NONE**
3171	**P3**	**85**	**0.43**	**0.21**	**0.15**	**D15**	**76**	**0.81**	**0.29**	**0.43**	**Enhance**	**NONE**	**LOW**	**NONE**
3172	P2	52	0.20	0.44	0.00	D15	78	0.85	0.23	0.51	Enhance	NONE	NONE	NONE
3173	P1	5	0.10	0.00	0.00	D15	84	0.82	0.27	0.66	Enhance	NONE	NONE	NONE
3174	P1	5	0.09	0.00	0.00	D15	89	0.79	0.48	0.63	Enhance	NONE	NONE	NONE
3175	P1	2	0.07	0.00	0.00	D15	90	0.86	0.67	0.49	Enhance	NONE	NONE	NONE
3176	P1	1	0.06	0.00	0.00	D15	84	0.95	0.37	0.45	Enhance	NONE	NONE	NONE
3177	P1	6	0.10	0.00	0.00	D15	80	0.99	0.31	0.41	Enhance	NONE	NONE	NONE
3178	P1	6	0.10	0.00	0.00	D15	79	0.92	0.33	0.40	Enhance	NONE	LOW	NONE
3179	**P3**	**72**	**0.23**	**0.10**	**0.32**	**D15**	**64**	**0.69**	**0.19**	**0.37**	**Enhance**	**NONE**	**MED**	**NONE**
3180	P2	53	0.21	0.00	0.23	D15	82	0.84	0.26	0.57	Enhance	NONE	NONE	NONE
3181	P2	61	0.27	0.10	0.04	D15	82	0.70	0.36	0.55	Enhance	NONE	NONE	NONE
3182	P1	31	0.15	0.13	0.00	D7	55	0.47	0.22	0.24	Restore	NONE	NONE	NONE
3183	P1	4	0.08	0.00	0.00	D15	97	1.00	0.57	0.68	Enhance	NONE	NONE	NONE
3184	P1	4	0.08	0.00	0.00	D15	100	1.00	0.81	0.72	Enhance	NONE	NONE	NONE
3185	P2	41	0.11	0.50	0.00	D15	96	1.00	0.56	0.62	Enhance	NONE	NONE	NONE
3186	P2	63	0.13	0.22	0.17	D15	89	1.00	0.37	0.54	Enhance	NONE	LOW	NONE
3187	**P3**	**84**	**0.30**	**0.16**	**0.33**	**D15**	**90**	**0.89**	**0.47**	**0.55**	**Enhance**	**NONE**	**LOW**	**NONE**
3188	P2	55	0.24	0.00	0.18	D15	88	0.91	0.45	0.53	Enhance	NONE	LOW	NONE
3189	**P3**	**70**	**0.34**	**0.10**	**0.10**	**D15**	**85**	**0.84**	**0.47**	**0.48**	**Enhance**	**NONE**	**LOW**	**NONE**
3190	P1	34	0.15	0.19	0.00	D13	45	0.39	0.02	0.38	Restore	NONE	NONE	NONE
3191	P1	39	0.18	0.20	0.00	D6	21	0.00	0.07	0.20	Protect	NONE	NONE	NONE
3192	P2	44	0.22	0.17	0.00	D6	23	0.00	0.07	0.22	Protect	NONE	LOW	NONE
3193	P1	29	0.07	0.28	0.00	D1	5	0.00	0.00	0.06	Protect	NONE	NONE	NONE
3195	P2	47	0.21	0.26	0.00	D1	4	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3196	P1	40	0.14	0.33	0.00	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3197	P2	45	0.15	0.42	0.00	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3198	P2	67	0.27	0.13	0.08	D1	4	0.00	0.00	0.04	Protect	NONE	NONE	NONE
3199	P2	56	0.26	0.05	0.04	D1	4	0.00	0.00	0.04	Protect	NONE	NONE	NONE
3200	P1	23	0.13	0.10	0.00	D1	4	0.00	0.00	0.03	Protect	NONE	NONE	NONE
3201	P1	38	0.16	0.22	0.00	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3202	P2	45	0.12	0.57	0.00	D1	4	0.00	0.00	0.04	Protect	NONE	NONE	NONE
3203	P1	22	0.22	0.00	0.00	D1	4	0.00	0.00	0.03	Protect	NONE	NONE	NONE
3204	P2	50	0.22	0.29	0.00	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3205	P2	42	0.10	0.65	0.00	D6	17	0.00	0.00	0.27	Protect	NONE	NONE	NONE
3206	P1	24	0.11	0.14	0.00	D2	7	0.00	0.00	0.10	Protect	NONE	NONE	NONE
3207	P1	11	0.08	0.02	0.00	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
3208	**P3**	**85**	**0.42**	**0.38**	**0.04**	**D8**	**37**	**0.29**	**0.04**	**0.22**	**Restore**	**NONE**	**NONE**	**NONE**

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
3209	P1	11	0.07	0.04	0.00	D15	71	1.00	0.14	0.44	Enhance	NONE	NONE	NONE
3210	**P3**	**74**	**0.39**	**0.12**	**0.11**	**D8**	**38**	**0.17**	**0.06**	**0.26**	**Restore**	**NONE**	**NONE**	**NONE**
3211	P2	57	0.21	0.06	0.13	D6	34	0.07	0.10	0.20	Protect	NONE	NONE	NONE
3212	P1	36	0.24	0.05	0.00	D3	23	0.00	0.12	0.14	Protect	HIGH	NONE	NONE
3213	P1	14	0.06	0.08	0.00	D15	37	0.74	0.05	0.04	Enhance	HIGH	NONE	NONE
3214	P1	28	0.14	0.13	0.00	D1	18	0.04	0.02	0.04	Protect	NONE	NONE	NONE
3215	P2	65	0.26	0.11	0.08	D3	35	0.06	0.18	0.12	Protect	NONE	NONE	NONE
3216	P1	38	0.13	0.00	0.16	D2	14	0.00	0.01	0.15	Protect	NONE	NONE	NONE
3217	P2	65	0.21	0.10	0.19	D2	13	0.00	0.03	0.10	Protect	NONE	NONE	NONE
3218	P2	65	0.21	0.06	0.32	D1	9	0.00	0.01	0.06	Protect	NONE	NONE	NONE
3219	P2	43	0.11	0.00	0.43	D7	47	0.47	0.21	0.10	Restore	NONE	NONE	NONE
3220	**P3**	**72**	**0.14**	**0.22**	**0.62**	**D13**	**49**	**0.34**	**0.17**	**0.25**	**Restore**	**NONE**	**NONE**	**NONE**
3221	**P3**	**89**	**0.43**	**0.22**	**0.22**	**D8**	**35**	**0.19**	**0.03**	**0.25**	**Restore**	**NONE**	**NONE**	**NONE**
3222	P2	52	0.21	0.36	0.00	D13	72	0.44	0.45	0.41	Restore	NONE	NONE	NONE
3223	P2	41	0.11	0.47	0.00	D11	51	0.00	0.24	0.54	Restore	NONE	NONE	NONE
3224	P1	24	0.11	0.13	0.00	D13	83	0.47	0.46	0.65	Restore	NONE	NONE	NONE
3225	P2	67	0.21	0.24	0.07	D15	81	0.56	0.47	0.51	Enhance	NONE	LOW	NONE
3226	P1	11	0.08	0.01	0.00	D15	99	1.00	0.63	0.78	Enhance	NONE	NONE	NONE
3227	P2	57	0.23	0.46	0.00	D15	99	0.92	0.72	0.84	Enhance	NONE	NONE	NONE
3228	**P3**	**76**	**0.11**	**0.55**	**0.36**	**D15**	**67**	**1.00**	**0.02**	**0.58**	**Enhance**	**NONE**	**NONE**	**NONE**
3229	P2	64	0.19	0.07	0.30	D14	62	0.43	0.07	0.73	Enhance	NONE	LOW	NONE
3230	**P3**	**68**	**0.19**	**0.29**	**0.10**	**D14**	**50**	**0.12**	**0.02**	**0.67**	**Enhance**	**NONE**	**LOW**	**NONE**
3231	**P3**	**73**	**0.14**	**0.29**	**0.33**	**D15**	**75**	**1.00**	**0.07**	**0.74**	**Enhance**	**NONE**	**NONE**	**NONE**
3232	**P3**	**76**	**0.29**	**0.17**	**0.14**	**D1**	**11**	**0.01**	**0.00**	**0.00**	**Protect**	**NONE**	**NONE**	**NONE**
3233	P2	67	0.17	0.26	0.11	D1	1	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3234	P1	7	0.11	0.00	0.00	D1	1	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3235	P2	66	0.14	0.26	0.16	D1	1	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3236	P2	57	0.16	0.06	0.22	D1	12	0.09	0.00	0.00	Protect	NONE	NONE	NONE
3237	P2	55	0.10	0.12	0.28	D1	1	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3238	**P3**	**68**	**0.19**	**0.20**	**0.17**	**D7**	**20**	**0.44**	**0.00**	**0.00**	**Restore**	**NONE**	**NONE**	**NONE**
3239	**P3**	**73**	**0.32**	**0.13**	**0.11**	**D7**	**25**	**0.27**	**0.07**	**0.00**	**Restore**	**NONE**	**NONE**	**NONE**
3240	P1	16	0.16	0.00	0.00	D7	19	0.36	0.00	0.00	Restore	NONE	NONE	NONE
3241	P1	38	0.13	0.00	0.15	D7	15	0.18	0.00	0.00	Restore	NONE	NONE	NONE
3242	P1	6	0.10	0.00	0.00	D1	9	0.04	0.00	0.00	Protect	NONE	NONE	NONE
3243	P2	67	0.19	0.18	0.17	D1	14	0.07	0.00	0.00	Protect	NONE	NONE	NONE
3244	P1	19	0.05	0.15	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3245	P1	16	0.03	0.12	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3246	P1	22	0.04	0.20	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3247	P1	17	0.06	0.12	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3248	P1	19	0.09	0.11	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	HIGH	NONE
3249	P1	29	0.09	0.24	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	HIGH	NONE
3250	P1	1	0.06	0.00	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3251	P1	1	0.05	0.00	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3252	P1	2	0.06	0.00	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3253	P1	2	0.06	0.00	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
3254	P1	39	0.07	0.00	0.61	D6	18	0.00	0.01	0.22	Protect	NONE	NONE	NONE
3255	P1	1	0.06	0.00	0.00	D2	15	0.00	0.04	0.12	Protect	NONE	NONE	NONE
3256	**P3**	**70**	**0.27**	**0.16**	**0.08**	**D6**	**23**	**0.02**	**0.01**	**0.19**	**Protect**	**NONE**	**LOW**	**NONE**
3257	P2	52	0.14	0.01	0.25	D5	23	0.10	0.03	0.09	Protect	NONE	LOW	NONE
3258	**P3**	**74**	**0.32**	**0.16**	**0.09**	**D8**	**30**	**0.12**	**0.01**	**0.22**	**Restore**	**NONE**	**LOW**	**NONE**
3259	P1	32	0.14	0.19	0.00	D5	23	0.11	0.03	0.07	Protect	NONE	LOW	NONE
3260	P1	35	0.12	0.28	0.00	D6	21	0.00	0.03	0.24	Protect	NONE	LOW	NONE
3261	P2	43	0.20	0.22	0.00	D8	40	0.28	0.01	0.34	Restore	NONE	LOW	NONE
3262	P1	15	0.16	0.00	0.00	D5	23	0.07	0.05	0.09	Protect	LOW	MED	NONE
3263	P1	14	0.10	0.00	0.00	D2	11	0.00	0.01	0.11	Protect	NONE	HIGH	NONE
3264	**P3**	**70**	**0.20**	**0.32**	**0.08**	**D8**	**37**	**0.25**	**0.04**	**0.26**	**Restore**	**NONE**	**MED**	**NONE**
3265	**P3**	**82**	**0.22**	**0.42**	**0.16**	**D6**	**26**	**0.05**	**0.04**	**0.16**	**Protect**	**NONE**	**LOW**	**NONE**

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
3266	P1	33	0.19	0.12	0.00	D9	52	0.07	0.13	0.50	Restore	NONE	LOW	NONE
3267	P2	60	0.27	0.06	0.08	D9	58	0.17	0.19	0.48	Restore	NONE	LOW	NONE
3268	P1	19	0.06	0.14	0.00	D1	4	0.00	0.00	0.03	Protect	NONE	NONE	NONE
3269	P1	15	0.07	0.08	0.00	D1	4	0.00	0.00	0.03	Protect	NONE	NONE	NONE
3270	P1	28	0.20	0.02	0.00	D15	79	0.79	0.35	0.45	Enhance	NONE	NONE	NONE
3271	P2	54	0.16	0.03	0.20	D15	90	0.84	0.63	0.52	Enhance	NONE	NONE	NONE
3272	P1	37	0.16	0.22	0.00	D13	47	0.53	0.06	0.28	Restore	NONE	LOW	NONE
3273	P1	4	0.08	0.00	0.00	D15	62	1.00	0.13	0.29	Enhance	NONE	NONE	NONE
3274	P3	86	0.21	0.58	0.18	D15	92	0.94	0.56	0.52	Enhance	NONE	NONE	NONE
3275	P1	7	0.11	0.00	0.00	D15	89	1.00	0.36	0.55	Enhance	NONE	NONE	NONE
3276	P1	38	0.12	0.00	0.19	D15	85	1.00	0.33	0.49	Enhance	NONE	NONE	NONE
3277	P1	6	0.10	0.00	0.00	D15	81	0.91	0.36	0.43	Enhance	NONE	NONE	NONE
3278	P1	1	0.05	0.00	0.00	D13	68	0.41	0.56	0.30	Restore	NONE	NONE	NONE
3279	P1	17	0.06	0.12	0.00	D15	84	1.00	0.48	0.39	Enhance	NONE	NONE	NONE
3280	P1	39	0.07	0.65	0.00	D15	85	1.00	0.38	0.45	Enhance	NONE	NONE	NONE
3281	P1	37	0.13	0.29	0.00	D15	85	1.00	0.30	0.52	Enhance	NONE	NONE	NONE
3282	P1	20	0.11	0.09	0.00	D15	85	1.00	0.30	0.51	Enhance	NONE	LOW	NONE
3283	P3	81	0.23	0.23	0.23	D15	91	0.87	0.49	0.59	Enhance	NONE	LOW	NONE
3284	P2	54	0.10	0.11	0.29	D15	75	0.77	0.40	0.37	Enhance	NONE	LOW	NONE
3285	P2	56	0.27	0.04	0.04	D13	62	0.29	0.35	0.34	Restore	NONE	LOW	NONE
3286	P3	76	0.31	0.12	0.18	D10	47	0.16	0.22	0.22	Restore	NONE	LOW	NONE
3287	P3	81	0.31	0.21	0.16	D13	61	0.39	0.21	0.39	Restore	NONE	LOW	NONE
3288	P1	30	0.11	0.23	0.00	D5	21	0.16	0.00	0.11	Protect	NONE	NONE	NONE
3289	P1	36	0.14	0.24	0.00	D5	21	0.12	0.00	0.14	Protect	NONE	NONE	NONE
3290	P2	46	0.13	0.62	0.00	D15	83	1.00	0.17	1.00	Enhance	NONE	NONE	NONE
3291	P1	17	0.07	0.11	0.00	D15	69	1.00	0.03	0.58	Enhance	NONE	NONE	NONE
4002	P3	76	0.28	0.10	0.29	D15	61	1.00	0.39	0.00	Enhance	LOW	LOW	LOW
4003	P3	82	0.20	0.35	0.27	D15	62	1.00	0.35	0.03	Enhance	HIGH	LOW	NONE
4004	P3	75	0.22	0.16	0.32	D16	85	1.00	0.71	0.34	Enhance	LOW	LOW	MED
4005	P2	57	0.16	0.14	0.11	D15	96	0.91	0.62	0.69	Enhance	LOW	MED	LOW
4006	P3	73	0.23	0.33	0.07	D15	63	0.70	0.30	0.22	Enhance	NONE	LOW	NONE
4007	P3	80	0.34	0.16	0.16	D15	81	0.71	0.66	0.40	Enhance	HIGH	LOW	NONE
4008	P3	76	0.18	0.47	0.12	D16	76	1.00	0.82	0.14	Enhance	LOW	LOW	NONE
4009	P2	68	0.23	0.23	0.06	D16	75	1.00	0.86	0.13	Enhance	NONE	NONE	HIGH
4010	P2	53	0.26	0.25	0.00	D16	81	1.00	0.98	0.22	Enhance	NONE	NONE	MED
4013	P3	83	0.63	0.13	0.18	D15	91	0.92	0.58	0.52	Enhance	NONE	LOW	NONE
4014	P3	72	0.23	0.13	0.22	D15	95	0.94	0.46	0.82	Enhance	NONE	HIGH	NONE
4015	P3	95	0.55	0.37	0.15	D15	88	0.67	0.58	0.58	Enhance	HIGH	HIGH	NONE
4016	P3	81	0.37	0.11	0.27	D15	91	0.79	0.58	0.63	Enhance	NONE	HIGH	NONE
4017	P3	70	0.12	0.36	0.24	D10	42	0.00	0.30	0.30	Restore	NONE	HIGH	NONE
4018	P2	64	0.26	0.14	0.04	D13	69	0.36	0.33	0.44	Restore	NONE	LOW	NONE
4019	P3	71	0.18	0.35	0.10	D14	81	0.24	0.57	0.74	Enhance	NONE	NONE	NONE
4020	P2	61	0.19	0.18	0.09	D13	87	0.53	0.67	0.64	Restore	NONE	NONE	NONE
4021	P1	39	0.19	0.16	0.00	D15	94	0.85	0.73	0.58	Enhance	NONE	NONE	NONE
4022	P2	45	0.16	0.00	0.19	D15	72	0.79	0.53	0.23	Enhance	MED	NONE	NONE
4023	P2	51	0.18	0.00	0.31	D15	66	1.00	0.14	0.33	Enhance	HIGH	LOW	NONE
4024	P1	22	0.21	0.00	0.00	D16	74	1.00	0.82	0.11	Enhance	NONE	LOW	HIGH
4025	P2	52	0.26	0.00	0.12	D15	77	1.00	0.53	0.23	Enhance	NONE	LOW	LOW
4026	P2	66	0.34	0.03	0.11	D15	59	0.77	0.48	0.01	Enhance	HIGH	LOW	NONE
4029	P2	59	0.28	0.00	0.20	D11	67	0.05	0.61	0.45	Restore	NONE	NONE	NONE
4030	P1	38	0.15	0.00	0.11	D14	87	0.37	0.76	0.84	Enhance	NONE	LOW	NONE
4031	P1	39	0.16	0.00	0.10	D15	95	0.91	0.60	0.64	Enhance	NONE	LOW	NONE
4032	P1	16	0.10	0.07	0.00	D15	89	1.00	0.27	0.70	Enhance	NONE	NONE	NONE
4033	P1	39	0.13	0.31	0.00	D13	67	0.33	0.22	0.54	Restore	NONE	LOW	NONE
4034	P3	76	0.34	0.07	0.27	D13	66	0.44	0.21	0.47	Restore	NONE	LOW	NONE
4035	P3	75	0.23	0.21	0.17	D13	61	0.38	0.17	0.46	Restore	NONE	NONE	NONE
4036	P3	89	0.52	0.13	0.41	D13	54	0.32	0.13	0.41	Restore	NONE	LOW	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
4037	P3	77	0.21	0.24	0.21	D16	81	0.89	0.68	0.31	Enhance	NONE	NONE	NONE
4038	P2	41	0.09	0.91	0.00	D15	55	1.00	0.18	0.08	Enhance	NONE	NONE	NONE
4039	P2	46	0.13	0.03	0.16	D15	66	0.93	0.27	0.20	Enhance	NONE	NONE	NONE
4040	P2	61	0.19	0.01	0.35	D15	86	0.95	0.50	0.43	Enhance	NONE	NONE	NONE
4041	P2	65	0.25	0.08	0.14	D15	95	0.86	0.69	0.66	Enhance	NONE	NONE	NONE
4042	P1	39	0.18	0.00	0.08	D15	84	0.75	0.59	0.44	Enhance	NONE	NONE	NONE
4043	P3	83	0.38	0.15	0.21	D15	73	0.98	0.38	0.22	Enhance	HIGH	LOW	NONE
4044	P3	87	0.27	0.26	0.27	D15	78	0.98	0.45	0.29	Enhance	MED	MED	NONE
4045	P2	53	0.15	0.10	0.12	D16	72	0.84	0.63	0.17	Enhance	HIGH	LOW	NONE
4046	P2	46	0.33	0.10	0.00	D16	75	0.82	0.73	0.21	Enhance	MED	LOW	NONE
4047	P2	46	0.17	0.33	0.00	D15	81	0.75	0.52	0.42	Enhance	MED	LOW	NONE
4048	P2	54	0.22	0.37	0.00	D13	82	0.40	0.51	0.61	Restore	NONE	LOW	NONE
4049	P2	52	0.20	0.45	0.00	D13	83	0.46	0.47	0.65	Restore	NONE	HIGH	NONE
4051	P1	30	0.19	0.05	0.00	D15	82	0.63	0.36	0.61	Enhance	NONE	HIGH	NONE
4052	P1	1	0.06	0.00	0.00	D11	68	0.14	0.44	0.47	Restore	NONE	HIGH	NONE
4053	P1	5	0.10	0.00	0.00	D15	87	0.61	0.62	0.59	Enhance	NONE	HIGH	NONE
4054	P1	38	0.17	0.19	0.00	D15	98	0.91	0.68	0.77	Enhance	NONE	HIGH	NONE
4055	P3	85	0.24	0.36	0.18	D16	76	0.95	0.60	0.20	Enhance	NONE	LOW	NONE
4056	P1	20	0.13	0.05	0.00	D13	83	0.48	0.56	0.57	Restore	NONE	LOW	NONE
4057	P1	31	0.12	0.21	0.00	D15	85	0.85	0.34	0.58	Enhance	NONE	NONE	NONE
4058	P1	7	0.11	0.00	0.00	D15	92	0.84	0.62	0.58	Enhance	NONE	NONE	NONE
4059	P2	54	0.18	0.00	0.54	D15	99	0.93	0.73	0.75	Enhance	NONE	NONE	NONE
4060	P3	92	0.31	0.35	0.21	D15	94	0.86	0.77	0.56	Enhance	MED	LOW	NONE
4061	P3	82	0.48	0.21	0.11	D15	77	0.69	0.55	0.37	Enhance	NONE	LOW	NONE
4062	P3	78	0.40	0.07	0.24	D15	80	0.62	0.42	0.51	Enhance	NONE	LOW	NONE
4063	P2	48	0.13	0.05	0.17	D15	81	0.75	0.45	0.46	Enhance	NONE	NONE	NONE
4064	P2	45	0.16	0.00	0.20	D15	72	0.94	0.25	0.33	Enhance	NONE	NONE	NONE
4065	P3	75	0.10	0.48	0.39	D13	50	0.28	0.28	0.15	Restore	NONE	NONE	NONE
4066	P3	85	0.38	0.15	0.25	D13	67	0.36	0.46	0.33	Restore	HIGH	NONE	NONE
4067	P1	11	0.13	0.00	0.00	D15	85	0.68	0.51	0.55	Enhance	NONE	NONE	NONE
4068	P1	31	0.17	0.12	0.00	D15	86	0.78	0.47	0.53	Enhance	NONE	NONE	NONE
4069	P1	31	0.14	0.17	0.00	D15	81	0.75	0.43	0.46	Enhance	NONE	NONE	NONE
4070	P1	3	0.08	0.00	0.00	D15	78	0.88	0.38	0.37	Enhance	NONE	NONE	NONE
4071	P1	39	0.18	0.00	0.08	D13	74	0.48	0.43	0.43	Restore	NONE	NONE	NONE
4072	P2	64	0.23	0.04	0.19	D13	72	0.41	0.61	0.34	Restore	NONE	LOW	NONE
4073	P1	33	0.22	0.05	0.00	D16	80	0.86	0.67	0.31	Enhance	HIGH	LOW	NONE
4074	P1	38	0.12	0.00	0.19	D16	83	1.00	0.68	0.29	Enhance	NONE	LOW	NONE
4075	P3	78	0.34	0.20	0.11	D13	71	0.47	0.36	0.42	Restore	NONE	LOW	NONE
4076	P2	66	0.38	0.10	0.04	D15	83	0.71	0.37	0.57	Enhance	NONE	LOW	NONE
4077	P3	86	0.37	0.32	0.10	D13	70	0.26	0.33	0.53	Restore	NONE	LOW	NONE
4078	P3	81	0.39	0.27	0.06	D13	75	0.32	0.39	0.55	Restore	NONE	LOW	NONE
4079	P2	60	0.25	0.11	0.05	D15	82	0.77	0.39	0.50	Enhance	MED	LOW	NONE
4080	P2	56	0.23	0.39	0.00	D15	74	0.83	0.22	0.45	Enhance	NONE	NONE	NONE
4081	P3	87	0.30	0.24	0.24	D9	47	0.16	0.09	0.41	Restore	NONE	NONE	NONE
4082	P1	38	0.09	0.00	0.33	D9	38	0.00	0.18	0.35	Restore	NONE	NONE	NONE
4084	P2	54	0.16	0.11	0.10	D1	3	0.00	0.00	0.01	Protect	NONE	NONE	NONE
4085	P2	64	0.15	0.24	0.15	D7	21	0.22	0.02	0.01	Restore	HIGH	NONE	NONE
4086	P2	64	0.19	0.13	0.16	D1	6	0.00	0.01	0.01	Protect	LOW	NONE	NONE
4087	P2	50	0.21	0.04	0.06	D1	3	0.00	0.00	0.02	Protect	NONE	NONE	NONE
4088	P1	38	0.10	0.00	0.27	D15	66	0.66	0.09	0.61	Enhance	NONE	NONE	NONE
4089	P3	73	0.20	0.17	0.30	D15	80	0.82	0.23	0.59	Enhance	NONE	LOW	NONE
4090	P3	85	0.21	0.36	0.31	D15	60	0.84	0.07	0.41	Enhance	NONE	LOW	NONE
4091	P3	77	0.26	0.09	0.53	D15	64	0.64	0.13	0.48	Enhance	NONE	LOW	NONE
4092	P2	62	0.21	0.07	0.19	D13	61	0.49	0.15	0.43	Restore	NONE	LOW	NONE
4093	P3	73	0.26	0.12	0.22	D8	41	0.23	0.08	0.28	Restore	NONE	LOW	NONE
4094	P1	2	0.07	0.00	0.00	D15	96	1.00	0.86	0.53	Enhance	NONE	NONE	NONE
4095	P3	77	0.11	0.59	0.32	D15	95	1.00	0.53	0.61	Enhance	NONE	LOW	NONE

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Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
4096	P3	73	0.14	0.29	0.32	D15	73	1.00	0.32	0.26	Enhance	NONE	LOW	NONE
4097	P3	76	0.34	0.12	0.15	D13	64	0.48	0.19	0.44	Restore	NONE	LOW	NONE
4098	P3	72	0.40	0.09	0.11	D15	59	0.53	0.18	0.34	Enhance	NONE	LOW	NONE
4099	P3	80	0.32	0.11	0.32	D15	77	0.66	0.23	0.61	Enhance	LOW	LOW	NONE
4100	P2	67	0.13	0.21	0.36	D8	45	0.24	0.15	0.25	Restore	HIGH	LOW	NONE
4101	P2	67	0.22	0.05	0.40	D8	46	0.20	0.12	0.33	Restore	NONE	NONE	NONE
4102	P1	30	0.08	0.29	0.00	D13	70	0.34	0.45	0.39	Restore	NONE	LOW	NONE
4103	P1	36	0.18	0.14	0.00	D15	90	0.80	0.48	0.66	Enhance	NONE	LOW	NONE
4104	P1	37	0.14	0.26	0.00	D15	68	0.90	0.36	0.19	Enhance	NONE	NONE	NONE
4105	P2	42	0.10	0.00	0.56	D15	92	0.89	0.59	0.55	Enhance	NONE	NONE	NONE
4106	P1	8	0.12	0.00	0.00	D15	99	0.97	0.71	0.73	Enhance	NONE	LOW	NONE
4107	P1	3	0.08	0.00	0.00	D13	58	0.24	0.24	0.37	Restore	NONE	NONE	NONE
4108	P1	4	0.09	0.00	0.00	D11	52	0.00	0.33	0.46	Restore	NONE	LOW	NONE
4109	P2	47	0.14	0.00	0.38	D15	90	0.67	0.54	0.77	Enhance	HIGH	LOW	NONE
4110	P1	24	0.17	0.00	0.00	D15	85	0.80	0.34	0.62	Enhance	NONE	LOW	NONE
4111	P1	38	0.12	0.34	0.00	D15	70	0.87	0.17	0.42	Enhance	NONE	LOW	NONE
4112	P3	72	0.41	0.11	0.09	D15	72	0.63	0.21	0.52	Enhance	NONE	LOW	NONE
4113	P2	52	0.17	0.07	0.09	D15	80	0.80	0.22	0.67	Enhance	NONE	LOW	NONE
4114	P2	57	0.18	0.06	0.17	D13	62	0.41	0.19	0.44	Restore	NONE	LOW	NONE
4115	P3	76	0.35	0.03	0.38	D13	47	0.43	0.04	0.35	Restore	NONE	LOW	NONE
4116	P1	7	0.11	0.00	0.00	D9	39	0.05	0.05	0.40	Restore	NONE	NONE	NONE
4117	P2	48	0.11	0.04	0.22	D6	27	0.10	0.03	0.16	Protect	NONE	NONE	NONE
4118	P2	68	0.15	0.16	0.40	D6	22	0.00	0.08	0.20	Protect	NONE	NONE	NONE
4119	P1	39	0.07	0.00	0.51	D2	12	0.00	0.00	0.14	Protect	NONE	NONE	NONE
4120	P1	2	0.07	0.00	0.00	D13	48	0.24	0.10	0.38	Restore	NONE	NONE	NONE
4121	P3	74	0.30	0.02	0.41	D13	57	0.37	0.12	0.45	Restore	NONE	NONE	NONE
4122	P2	64	0.13	0.15	0.57	D15	52	0.65	0.17	0.20	Enhance	NONE	NONE	NONE
4123	P3	75	0.17	0.19	0.83	D13	53	0.42	0.16	0.32	Restore	NONE	LOW	NONE
4124	P3	75	0.16	0.25	0.40	D15	63	0.64	0.15	0.44	Enhance	NONE	LOW	NONE
4125	P2	67	0.10	0.23	0.98	D15	68	0.91	0.16	0.40	Enhance	NONE	NONE	NONE
4126	P2	54	0.13	0.03	0.48	D15	73	0.84	0.16	0.52	Enhance	NONE	LOW	NONE
4127	P2	59	0.22	0.00	0.49	D15	75	0.91	0.12	0.65	Enhance	NONE	LOW	NONE
4128	P1	32	0.15	0.15	0.00	D15	64	0.85	0.05	0.50	Enhance	NONE	HIGH	NONE
4129	P2	50	0.21	0.04	0.06	D15	66	0.72	0.18	0.41	Enhance	NONE	HIGH	NONE
4130	P2	43	0.16	0.33	0.00	D15	62	0.53	0.23	0.33	Enhance	NONE	HIGH	NONE
4131	P3	81	0.21	0.59	0.09	D14	71	0.45	0.18	0.78	Enhance	NONE	LOW	NONE
4132	P3	88	0.39	0.36	0.09	D13	82	0.48	0.41	0.66	Restore	NONE	MED	NONE
4133	P3	69	0.19	0.29	0.09	D13	74	0.55	0.50	0.36	Restore	NONE	HIGH	NONE
4134	P2	52	0.30	0.20	0.00	D13	78	0.47	0.40	0.54	Restore	NONE	HIGH	NONE
4135	P3	80	0.28	0.41	0.05	D15	80	0.74	0.58	0.39	Enhance	LOW	MED	NONE
4136	P3	73	0.29	0.16	0.11	D15	81	0.88	0.35	0.44	Enhance	HIGH	HIGH	NONE
4137	P2	41	0.08	0.99	0.00	D3	22	0.00	0.20	0.01	Protect	NONE	HIGH	NONE
4138	P2	51	0.16	0.00	0.51	D7	58	0.50	0.30	0.20	Restore	NONE	LOW	NONE
4139	P3	98	0.27	0.69	0.30	D15	80	0.89	0.35	0.42	Enhance	NONE	LOW	NONE
4140	P3	92	0.23	0.39	0.54	D15	80	0.78	0.54	0.38	Enhance	NONE	HIGH	NONE
4141	P3	84	0.42	0.24	0.11	D15	64	0.71	0.19	0.37	Enhance	NONE	HIGH	NONE
4142	P3	68	0.21	0.27	0.07	D15	71	0.85	0.16	0.49	Enhance	NONE	HIGH	NONE
4143	P1	14	0.16	0.00	0.00	D15	72	0.98	0.10	0.53	Enhance	NONE	HIGH	NONE
4144	P1	11	0.13	0.00	0.00	D15	67	0.71	0.12	0.54	Enhance	NONE	HIGH	NONE
4145	P1	4	0.09	0.00	0.00	D15	65	0.92	0.17	0.31	Enhance	NONE	HIGH	NONE
4146	P1	12	0.14	0.00	0.00	D15	61	0.79	0.14	0.35	Enhance	NONE	HIGH	NONE
4147	P2	57	0.29	0.04	0.03	D13	67	0.54	0.18	0.50	Restore	NONE	HIGH	NONE
4148	P2	48	0.08	0.04	0.40	D16	67	1.00	1.00	0.00	Enhance	NONE	LOW	NONE
4149	P1	11	0.14	0.00	0.00	D16	66	1.00	0.72	0.00	Enhance	NONE	MED	LOW
4150	P1	28	0.20	0.03	0.00	D16	67	1.00	0.92	0.00	Enhance	NONE	LOW	NONE
5001	P3	84	0.43	0.34	0.06	D11	56	0.00	0.29	0.59	Restore	NONE	NONE	NONE
5002	P3	90	0.26	0.31	0.34	D13	55	0.19	0.23	0.35	Restore	NONE	LOW	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
5003	P3	70	0.28	0.17	0.08	D13	66	0.25	0.29	0.46	Restore	HIGH	LOW	NONE
5006	P3	78	0.25	0.42	0.06	D13	61	0.17	0.28	0.41	Restore	NONE	LOW	NONE
5007	P3	83	0.26	0.31	0.14	D10	39	0.14	0.18	0.14	Restore	NONE	LOW	NONE
5008	P2	67	0.44	0.08	0.04	D10	41	0.01	0.19	0.24	Restore	NONE	LOW	NONE
5009	P2	48	0.20	0.32	0.00	D1	19	0.02	0.05	0.02	Protect	NONE	NONE	NONE
5010	P2	67	0.32	0.60	0.00	D1	7	0.00	0.01	0.01	Protect	NONE	NONE	NONE
5011	P2	62	0.30	0.41	0.00	D6	32	0.05	0.12	0.17	Protect	NONE	LOW	NONE
5012	P3	69	0.31	0.15	0.06	D13	55	0.20	0.27	0.30	Restore	NONE	LOW	NONE
5015	P3	80	0.31	0.38	0.04	D4	20	0.06	0.07	0.00	Protect	NONE	NONE	NONE
5016	P3	69	0.17	0.31	0.12	D3	24	0.02	0.14	0.00	Protect	NONE	NONE	NONE
5017	P3	77	0.22	0.44	0.08	D3	17	0.00	0.16	0.00	Protect	NONE	NONE	NONE
5018	P1	33	0.14	0.20	0.00	D3	19	0.00	0.18	0.00	Protect	NONE	NONE	NONE
5019	P3	79	0.26	0.41	0.05	D7	37	0.55	0.14	0.00	Restore	LOW	LOW	NONE
5022	P2	50	0.21	0.35	0.00	D13	69	0.31	0.44	0.41	Restore	NONE	NONE	NONE
5023	P2	57	0.17	0.06	0.18	D13	68	0.51	0.42	0.31	Restore	NONE	LOW	NONE
5024	P1	23	0.10	0.14	0.00	D10	31	0.00	0.24	0.13	Restore	NONE	MED	NONE
5025	P2	42	0.12	0.47	0.00	D11	31	0.00	0.39	0.02	Restore	NONE	LOW	NONE
5026	P2	56	0.25	0.35	0.00	D10	32	0.00	0.32	0.09	Restore	NONE	NONE	NONE
5027	P3	91	0.59	0.55	0.05	D11	61	0.28	0.57	0.20	Restore	MED	LOW	NONE
5029	P3	89	0.52	0.51	0.03	D8	47	0.16	0.14	0.33	Restore	MED	LOW	NONE
5030	P3	91	0.63	0.48	0.07	D9	47	0.05	0.19	0.34	Restore	NONE	LOW	NONE
5031	P3	92	0.54	0.43	0.09	D11	59	0.02	0.39	0.40	Restore	NONE	LOW	NONE
5032	P3	90	0.36	0.63	0.07	D3	24	0.00	0.19	0.08	Protect	NONE	LOW	NONE
5033	P3	87	0.53	0.41	0.04	D9	53	0.11	0.25	0.32	Restore	NONE	LOW	NONE
5034	P3	85	0.30	0.59	0.04	D15	59	0.81	0.19	0.23	Enhance	NONE	LOW	NONE
5035	P2	59	0.26	0.41	0.00	D11	67	0.13	0.32	0.52	Restore	NONE	LOW	NONE
5036	P2	62	0.35	0.35	0.00	D3	13	0.00	0.10	0.00	Protect	NONE	LOW	NONE
6002	P3	70	0.36	0.10	0.09	D13	67	0.23	0.35	0.45	Restore	MED	LOW	NONE
6003	P3	79	0.37	0.20	0.11	D9	55	0.12	0.17	0.47	Restore	MED	LOW	NONE
6004	P3	78	0.42	0.10	0.17	D14	73	0.34	0.25	0.70	Enhance	MED	LOW	NONE
6005	P1	0	0.04	0.00	0.00	D1	0	0.00	0.00	0.00	Protect	NONE	NONE	NONE
6006	P1	1	0.04	0.00	0.00	D1	6	0.00	0.00	0.08	Protect	NONE	NONE	NONE
6007	P2	64	0.28	0.06	0.10	D13	64	0.27	0.25	0.46	Restore	NONE	LOW	NONE
6008	P3	73	0.12	0.41	0.25	D11	55	0.00	0.72	0.36	Restore	NONE	LOW	NONE
6009	P1	6	0.10	0.00	0.00	D11	54	0.15	0.58	0.13	Restore	NONE	LOW	NONE
6010	P1	37	0.27	0.03	0.00	D13	71	0.30	0.45	0.43	Restore	NONE	LOW	NONE
6011	P3	83	0.70	0.26	0.06	D9	58	0.10	0.23	0.45	Restore	NONE	LOW	NONE
6012	P2	45	0.16	0.41	0.00	D11	48	0.00	0.44	0.31	Restore	NONE	NONE	NONE
6013	P2	46	0.17	0.36	0.00	D11	74	0.22	0.46	0.56	Restore	NONE	LOW	NONE
6014	P2	52	0.32	0.18	0.00	D13	65	0.24	0.39	0.39	Restore	NONE	LOW	NONE
6015	P1	35	0.22	0.07	0.00	D10	46	0.10	0.24	0.22	Restore	NONE	NONE	NONE
6016	P2	44	0.16	0.34	0.00	D9	55	0.22	0.16	0.43	Restore	NONE	LOW	NONE
6017	P2	59	0.22	0.56	0.00	D13	56	0.29	0.25	0.30	Restore	NONE	LOW	NONE
6018	P3	72	0.38	0.17	0.02	D13	67	0.31	0.54	0.33	Restore	NONE	LOW	NONE
6019	P3	78	0.37	0.30	0.02	D11	55	0.11	0.62	0.17	Restore	NONE	NONE	NONE
6020	P2	62	0.26	0.53	0.00	D11	50	0.11	0.65	0.05	Restore	NONE	LOW	NONE
6021	P1	26	0.24	0.00	0.00	D12	58	0.52	0.78	0.01	Restore	LOW	NONE	NONE
6022	P3	86	0.41	0.39	0.06	D12	51	0.35	0.48	0.01	Restore	NONE	NONE	NONE
6023	P2	48	0.17	0.42	0.00	D11	37	0.02	0.42	0.00	Restore	NONE	NONE	NONE
6024	P2	43	0.22	0.18	0.00	D11	57	0.02	0.54	0.30	Restore	NONE	LOW	NONE
6025	P3	83	0.52	0.24	0.08	D11	56	0.10	0.34	0.32	Restore	HIGH	LOW	NONE
6026	P1	33	0.21	0.07	0.00	D13	57	0.22	0.41	0.22	Restore	NONE	LOW	NONE
6027	P2	65	0.26	0.16	0.04	D13	51	0.27	0.29	0.19	Restore	NONE	MED	NONE
6028	P2	40	0.20	0.00	0.07	D10	39	0.05	0.24	0.12	Restore	NONE	LOW	NONE
6030	P1	38	0.15	0.00	0.11	D15	97	0.84	0.75	0.79	Enhance	NONE	LOW	NONE
6031	P2	46	0.27	0.15	0.00	D13	80	0.44	0.60	0.51	Restore	NONE	MED	NONE
6032	P2	50	0.15	0.75	0.00	D15	75	1.00	0.39	0.25	Enhance	NONE	LOW	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
6033	P2	50	0.15	0.66	0.00	D15	59	1.00	0.18	0.17	Enhance	NONE	NONE	NONE
6034	P2	45	0.24	0.17	0.00	D3	23	0.00	0.15	0.12	Protect	NONE	NONE	NONE
6035	P2	41	0.15	0.31	0.00	D6	29	0.00	0.12	0.26	Protect	NONE	NONE	NONE
6036	P3	81	0.39	0.35	0.02	D13	74	0.35	0.41	0.49	Restore	NONE	NONE	NONE
6037	P1	6	0.10	0.00	0.00	D1	3	0.00	0.00	0.01	Protect	NONE	NONE	NONE
6038	P1	6	0.10	0.00	0.00	D1	3	0.00	0.00	0.01	Protect	NONE	NONE	NONE
6041	P3	80	0.23	0.50	0.07	D15	90	0.70	0.64	0.64	Enhance	HIGH	LOW	NONE
6042	P3	85	0.65	0.22	0.12	D13	78	0.39	0.42	0.57	Restore	MED	LOW	NONE
6043	P1	29	0.16	0.10	0.00	D7	35	0.32	0.10	0.09	Restore	NONE	LOW	NONE
6044	P2	68	0.41	0.08	0.07	D13	75	0.53	0.36	0.48	Restore	HIGH	LOW	NONE
6045	P2	67	0.23	0.07	0.22	D13	74	0.33	0.49	0.45	Restore	HIGH	LOW	NONE
6046	P2	59	0.22	0.07	0.12	D13	61	0.42	0.15	0.47	Restore	NONE	LOW	NONE
6047	P3	82	0.64	0.25	0.05	D13	71	0.32	0.28	0.55	Restore	NONE	LOW	NONE
6048	P1	21	0.15	0.02	0.00	D10	40	0.00	0.28	0.26	Restore	NONE	LOW	NONE
6049	P3	91	0.42	0.64	0.05	D11	57	0.11	0.30	0.36	Restore	NONE	LOW	NONE
6050	P3	83	0.29	0.49	0.05	D10	49	0.07	0.25	0.27	Restore	NONE	LOW	NONE
6051	P2	58	0.23	0.50	0.00	D11	70	0.05	0.42	0.66	Restore	HIGH	MED	NONE
6052	P3	81	0.54	0.15	0.14	D7	41	0.38	0.20	0.03	Restore	LOW	NONE	NONE
6053	P1	28	0.17	0.07	0.00	D12	58	0.66	0.60	0.00	Restore	NONE	NONE	NONE
6054	P1	39	0.26	0.07	0.00	D12	51	0.44	0.46	0.01	Restore	NONE	NONE	NONE
6056	P2	67	0.28	0.16	0.04	D12	54	0.50	0.55	0.00	Restore	NONE	NONE	NONE
6057	P2	45	0.14	0.46	0.00	D14	50	0.02	0.06	0.71	Enhance	NONE	NONE	NONE
6058	P2	42	0.23	0.14	0.00	D14	69	0.48	0.14	0.70	Enhance	NONE	NONE	NONE
6059	P1	39	0.22	0.13	0.00	D14	69	0.49	0.12	0.81	Enhance	LOW	NONE	NONE
6060	P2	44	0.21	0.22	0.00	D14	57	0.26	0.06	0.71	Enhance	HIGH	NONE	NONE
6061	P2	42	0.29	0.08	0.00	D7	32	0.26	0.07	0.11	Restore	MED	LOW	NONE
6062	P3	83	0.28	0.39	0.09	D13	61	0.31	0.26	0.38	Restore	NONE	NONE	NONE
7005	P1	5	0.09	0.00	0.00	D1	2	0.00	0.00	0.01	Protect	NONE	LOW	NONE
7007	P2	56	0.30	0.02	0.03	D2	16	0.00	0.04	0.14	Protect	NONE	NONE	NONE
7008	P3	69	0.29	0.15	0.07	D2	16	0.00	0.06	0.11	Protect	NONE	NONE	NONE
7013	P1	11	0.14	0.00	0.00	D6	19	0.00	0.01	0.25	Protect	NONE	NONE	NONE
7026	P3	74	0.27	0.22	0.09	D1	10	0.00	0.02	0.05	Protect	NONE	LOW	NONE
7027	P2	49	0.16	0.52	0.00	D3	20	0.00	0.19	0.01	Protect	NONE	NONE	NONE
7028	P1	23	0.22	0.00	0.00	D3	21	0.00	0.20	0.01	Protect	NONE	LOW	NONE
7030	P1	0	0.03	0.00	0.00	D3	21	0.00	0.11	0.14	Protect	NONE	LOW	NONE
7031	P1	37	0.09	0.43	0.00	D6	25	0.00	0.12	0.19	Protect	HIGH	NONE	NONE
7033	P1	1	0.04	0.00	0.00	D15	51	1.00	0.14	0.05	Enhance	NONE	NONE	NONE
7034	P1	3	0.08	0.00	0.00	D6	21	0.07	0.00	0.18	Protect	NONE	HIGH	NONE
7035	P1	4	0.08	0.00	0.00	D6	22	0.00	0.08	0.20	Protect	NONE	LOW	NONE
7036	P1	7	0.11	0.00	0.00	D9	32	0.00	0.11	0.34	Restore	NONE	NONE	NONE
7037	P1	0	0.02	0.00	0.00	D3	22	0.00	0.16	0.07	Protect	NONE	LOW	NONE
7038	P2	51	0.17	0.07	0.09	D3	21	0.00	0.12	0.12	Protect	NONE	LOW	NONE
7039	P2	53	0.14	0.11	0.14	D11	52	0.00	0.49	0.37	Restore	NONE	NONE	NONE
7042	P2	49	0.20	0.35	0.00	D2	14	0.00	0.02	0.15	Protect	NONE	NONE	NONE
7043	P1	37	0.04	0.71	0.00	D3	20	0.00	0.11	0.11	Protect	HIGH	NONE	NONE
7044	P1	36	0.08	0.42	0.00	D6	17	0.00	0.02	0.19	Protect	NONE	NONE	NONE
7045	P1	24	0.13	0.11	0.00	D9	33	0.00	0.06	0.43	Restore	NONE	NONE	NONE
7046	P2	45	0.13	0.54	0.00	D6	22	0.00	0.09	0.18	Protect	NONE	NONE	NONE
7047	P2	46	0.12	0.86	0.00	D6	13	0.00	0.00	0.20	Protect	NONE	NONE	NONE
7053	P2	61	0.11	0.21	0.24	D7	33	0.33	0.09	0.07	Restore	NONE	NONE	NONE
7054	P3	81	0.23	0.36	0.13	D7	41	0.51	0.08	0.15	Restore	NONE	NONE	NONE
7055	P1	4	0.09	0.00	0.00	D15	54	0.64	0.17	0.22	Enhance	NONE	LOW	NONE
7057	P3	76	0.19	0.45	0.10	D15	81	1.00	0.40	0.36	Enhance	MED	LOW	NONE
7058	P1	5	0.10	0.00	0.00	D9	37	0.00	0.16	0.37	Restore	NONE	LOW	NONE
7061	P3	82	0.24	0.25	0.23	D13	49	0.33	0.26	0.14	Restore	NONE	LOW	NONE
7064	P2	56	0.13	0.08	0.35	D15	59	0.66	0.23	0.22	Enhance	MED	LOW	NONE
7067	P3	80	0.15	0.70	0.19	D13	66	0.23	0.29	0.48	Restore	NONE	NONE	NONE

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
7072	P1	0	0.03	0.00	0.00	D1	9	0.00	0.04	0.02	Protect	NONE	NONE	NONE
7073	P1	32	0.18	0.11	0.00	D1	8	0.00	0.01	0.04	Protect	NONE	NONE	NONE
7074	P2	41	0.18	0.22	0.00	D11	61	0.05	0.27	0.52	Restore	NONE	NONE	NONE
7077	P1	37	0.16	0.20	0.00	D2	15	0.00	0.06	0.09	Protect	NONE	NONE	NONE
7078	P2	55	0.21	0.47	0.00	D3	20	0.00	0.11	0.11	Protect	NONE	NONE	NONE
7079	P1	33	0.21	0.08	0.00	D2	13	0.00	0.02	0.12	Protect	NONE	LOW	NONE
7080	P2	53	0.22	0.36	0.00	D7	49	0.55	0.24	0.06	Restore	NONE	LOW	NONE
7084	P1	26	0.09	0.21	0.00	D1	10	0.00	0.03	0.04	Protect	NONE	NONE	NONE
7085	P2	47	0.21	0.25	0.00	D2	26	0.02	0.09	0.11	Protect	NONE	LOW	NONE
7086	**P3**	**84**	**0.37**	**0.43**	**0.03**	**D6**	**35**	**0.01**	**0.10**	**0.27**	**Protect**	**HIGH**	**LOW**	**NONE**
7087	P2	50	0.15	0.91	0.00	D11	64	0.00	0.43	0.81	Restore	NONE	NONE	NONE
7088	P2	50	0.16	0.53	0.00	D13	62	0.15	0.30	0.42	Restore	NONE	NONE	NONE
7089	P2	47	0.19	0.31	0.00	D15	64	0.89	0.22	0.24	Enhance	HIGH	NONE	NONE
7090	P2	62	0.20	0.19	0.07	D15	70	0.80	0.34	0.27	Enhance	HIGH	NONE	NONE
7091	**P3**	**73**	**0.19**	**0.25**	**0.18**	**D13**	**70**	**0.42**	**0.42**	**0.39**	**Restore**	**NONE**	**NONE**	**NONE**
7092	**P3**	**76**	**0.24**	**0.26**	**0.11**	**D10**	**34**	**0.00**	**0.18**	**0.27**	**Restore**	**NONE**	**NONE**	**NONE**
7093	P2	49	0.21	0.32	0.00	D3	19	0.00	0.09	0.12	Protect	NONE	NONE	NONE
7094	P2	67	0.20	0.25	0.08	D10	33	0.00	0.20	0.22	Restore	NONE	NONE	NONE
7095	P2	41	0.09	0.65	0.00	D15	63	1.00	0.21	0.19	Enhance	HIGH	NONE	NONE
7096	**P3**	**81**	**0.22**	**0.56**	**0.08**	**D15**	**73**	**0.74**	**0.20**	**0.50**	**Enhance**	**NONE**	**NONE**	**NONE**
7097	**P3**	**75**	**0.18**	**0.42**	**0.11**	**D10**	**47**	**0.12**	**0.20**	**0.26**	**Restore**	**NONE**	**NONE**	**NONE**
7098	P2	51	0.18	0.49	0.00	D1	10	0.00	0.02	0.05	Protect	NONE	NONE	NONE
7099	P2	66	0.28	0.12	0.07	D6	27	0.00	0.15	0.19	Protect	NONE	NONE	NONE
7100	P2	59	0.24	0.49	0.00	D9	30	0.00	0.09	0.33	Restore	NONE	LOW	NONE
7101	P2	56	0.24	0.37	0.00	D9	40	0.00	0.16	0.41	Restore	NONE	LOW	NONE
7102	P2	41	0.13	0.38	0.00	D6	28	0.00	0.14	0.22	Protect	NONE	NONE	NONE
7103	P2	42	0.11	0.49	0.00	D3	16	0.00	0.12	0.03	Protect	NONE	NONE	NONE
7107	P2	54	0.25	0.30	0.00	D9	22	0.00	0.00	0.38	Restore	NONE	LOW	NONE
7108	P2	47	0.15	0.50	0.00	D9	24	0.00	0.00	0.36	Restore	NONE	NONE	NONE
7109	P1	35	0.20	0.12	0.00	D13	49	0.29	0.28	0.14	Restore	NONE	NONE	NONE
7111	P2	63	0.29	0.12	0.03	D9	52	0.15	0.12	0.47	Restore	NONE	LOW	NONE
7112	**P3**	**79**	**0.38**	**0.25**	**0.07**	**D6**	**32**	**0.05**	**0.08**	**0.21**	**Protect**	**NONE**	**LOW**	**NONE**
7113	P2	45	0.20	0.24	0.00	D2	16	0.00	0.03	0.14	Protect	NONE	NONE	NONE
7114	P2	51	0.22	0.30	0.00	D2	15	0.00	0.04	0.13	Protect	NONE	LOW	NONE
7115	P2	49	0.14	0.71	0.00	D2	17	0.00	0.08	0.10	Protect	NONE	LOW	NONE
7116	P1	3	0.08	0.00	0.00	D10	36	0.00	0.22	0.25	Restore	NONE	NONE	NONE
7117	P1	0	0.03	0.00	0.00	D1	9	0.00	0.01	0.05	Protect	NONE	NONE	NONE
7118	P2	44	0.14	0.00	0.28	D1	12	0.00	0.04	0.06	Protect	NONE	NONE	NONE
7119	P2	45	0.16	0.00	0.20	D1	12	0.00	0.03	0.07	Protect	NONE	NONE	NONE
7120	P2	47	0.21	0.00	0.11	D1	9	0.00	0.02	0.04	Protect	NONE	NONE	NONE
7121	**P3**	**69**	**0.24**	**0.23**	**0.06**	**D1**	**8**	**0.00**	**0.02**	**0.02**	**Protect**	**NONE**	**NONE**	**NONE**
7122	**P3**	**80**	**0.16**	**0.72**	**0.18**	**D9**	**27**	**0.00**	**0.06**	**0.31**	**Restore**	**NONE**	**NONE**	**NONE**
7123	P1	35	0.22	0.07	0.00	D2	13	0.00	0.01	0.12	Protect	NONE	NONE	NONE
7124	P2	42	0.11	0.53	0.00	D1	10	0.00	0.01	0.08	Protect	NONE	NONE	NONE
7128	P1	19	0.19	0.00	0.00	D6	34	0.06	0.06	0.27	Protect	NONE	LOW	NONE
7129	P1	15	0.16	0.00	0.00	D6	24	0.00	0.11	0.20	Protect	NONE	LOW	NONE
7130	P1	12	0.14	0.00	0.00	D10	43	0.00	0.26	0.34	Restore	NONE	LOW	NONE
7131	P2	50	0.19	0.42	0.00	D14	48	0.00	0.14	0.72	Enhance	NONE	LOW	NONE
7132	P2	51	0.17	0.52	0.00	D3	20	0.00	0.13	0.10	Protect	NONE	LOW	NONE
7133	**P3**	**80**	**0.35**	**0.31**	**0.05**	**D13**	**55**	**0.38**	**0.18**	**0.32**	**Restore**	**NONE**	**LOW**	**NONE**
7134	P2	59	0.23	0.57	0.00	D6	20	0.00	0.07	0.18	Protect	NONE	LOW	NONE
7135	P2	42	0.21	0.19	0.00	D9	34	0.00	0.15	0.32	Restore	NONE	LOW	NONE
7136	P2	61	0.22	0.95	0.00	D15	88	1.00	0.24	0.78	Enhance	NONE	LOW	NONE
7137	P1	28	0.18	0.05	0.00	D11	61	0.10	0.19	0.60	Restore	NONE	LOW	NONE
7138	**P3**	**87**	**0.44**	**0.49**	**0.02**	**D11**	**59**	**0.10**	**0.40**	**0.35**	**Restore**	**HIGH**	**LOW**	**NONE**
7139	P2	64	0.29	0.50	0.00	D9	54	0.05	0.25	0.40	Restore	NONE	NONE	NONE
7140	P2	49	0.32	0.00	0.03	D16	79	0.95	0.74	0.22	Enhance	LOW	NONE	LOW

Beach Sites

Site	Potential Group	Potential Score	Beach Length	Barrier Prevalence	Stream Mouth Density	Degradation Group	Degradation Score	Sediment Supply Degradation	Nearshore Impervious	Parcel Density	Recommendation	Jetty Influence Risk	Future Nearshore Development Risk	Active Railroad Risk
7141	P1	38	0.15	0.00	0.11	D15	80	0.86	0.39	0.40	Enhance	NONE	LOW	HIGH
7142	P3	86	0.33	0.46	0.07	D11	57	0.15	0.34	0.30	Restore	LOW	NONE	LOW
7143	P2	63	0.40	0.33	0.00	D11	59	0.11	0.32	0.39	Restore	LOW	LOW	NONE
7144	P3	82	0.33	0.42	0.03	D11	56	0.03	0.54	0.26	Restore	MED	NONE	NONE
7145	P3	93	0.48	0.46	0.10	D15	86	0.58	0.50	0.68	Enhance	NONE	NONE	NONE
7146	P3	96	0.64	0.44	0.14	D10	43	0.16	0.23	0.13	Restore	NONE	NONE	NONE
7150	P2	54	0.22	0.36	0.00	D11	71	0.10	0.45	0.57	Restore	NONE	NONE	NONE
7151	P3	70	0.41	0.51	0.00	D7	40	0.39	0.19	0.04	Restore	NONE	LOW	NONE
7152	P2	60	0.31	0.32	0.00	D1	2	0.00	0.00	0.01	Protect	NONE	HIGH	NONE
7153	P2	57	0.20	0.89	0.00	D1	2	0.00	0.00	0.01	Protect	NONE	HIGH	NONE
7154	P2	52	0.25	0.26	0.00	D1	2	0.00	0.00	0.01	Protect	NONE	HIGH	NONE
7155	P2	59	0.24	0.48	0.00	D15	66	1.00	0.22	0.21	Enhance	NONE	MED	NONE
7156	P2	49	0.31	0.00	0.03	D15	54	0.76	0.28	0.05	Enhance	NONE	NONE	NONE
7157	P2	67	0.42	0.08	0.05	D12	69	0.66	0.81	0.16	Restore	HIGH	LOW	NONE
7158	P1	27	0.25	0.00	0.00	D16	81	1.00	0.82	0.23	Enhance	NONE	LOW	NONE
7159	P1	21	0.21	0.00	0.00	D16	75	1.00	0.81	0.13	Enhance	NONE	LOW	MED
7160	P1	2	0.06	0.00	0.00	D15	93	1.00	0.85	0.47	Enhance	NONE	LOW	HIGH
7161	P1	39	0.19	0.18	0.00	D15	68	0.98	0.35	0.16	Enhance	LOW	MED	HIGH
7163	P3	84	0.37	0.45	0.03	D13	67	0.51	0.26	0.39	Restore	NONE	LOW	NONE
7164	P2	45	0.15	0.41	0.00	D5	31	0.16	0.09	0.10	Protect	NONE	HIGH	NONE
7165	P3	90	0.67	0.61	0.01	D13	49	0.29	0.13	0.33	Restore	NONE	NONE	NONE
7166	P2	55	0.25	0.32	0.00	D13	52	0.34	0.32	0.15	Restore	NONE	NONE	NONE
7167	P2	48	0.16	0.47	0.00	D15	68	1.00	0.56	0.04	Enhance	NONE	NONE	NONE
7168	P2	60	0.23	0.63	0.00	D15	68	1.00	0.45	0.09	Enhance	NONE	NONE	NONE
7169	P3	73	0.34	0.22	0.03	D15	70	1.00	0.52	0.10	Enhance	HIGH	LOW	MED
7170	P2	61	0.24	0.52	0.00	D16	80	1.00	0.89	0.21	Enhance	NONE	NONE	LOW
7171	P2	58	0.34	0.02	0.02	D16	83	0.98	0.74	0.29	Enhance	LOW	MED	HIGH
7172	P2	45	0.21	0.24	0.00	D15	62	1.00	0.32	0.06	Enhance	NONE	HIGH	NONE
7174	P1	23	0.13	0.08	0.00	D15	78	0.81	0.35	0.42	Enhance	NONE	HIGH	NONE
7175	P2	55	0.26	0.04	0.04	D14	67	0.17	0.21	0.80	Enhance	NONE	NONE	NONE
7176	P3	70	0.14	0.36	0.18	D1	7	0.00	0.02	0.01	Protect	NONE	NONE	NONE
7177	P1	5	0.09	0.00	0.00	D11	40	0.00	0.46	0.16	Restore	NONE	NONE	NONE
8001	P3	91	0.59	0.34	0.12	D9	58	0.10	0.19	0.50	Restore	LOW	LOW	NONE
8055	P3	89	1.00	0.24	0.14	D15	69	1.00	0.52	0.08	Enhance	MED	LOW	MED
8056	P3	88	0.35	0.26	0.19	D13	56	0.34	0.28	0.24	Restore	LOW	LOW	NONE
8057	P3	90	0.74	0.55	0.03	D10	44	0.02	0.27	0.22	Restore	NONE	LOW	NONE
8058	P3	85	0.60	0.37	0.03	D3	30	0.07	0.13	0.08	Protect	MED	LOW	NONE
8201	P3	69	0.37	0.02	0.15	D15	47	0.71	0.20	0.03	Enhance	NONE	LOW	HIGH
8202	P2	55	0.27	0.00	0.15	D10	47	0.08	0.32	0.17	Restore	NONE	NONE	NONE
8211	P3	75	0.37	0.13	0.10	D9	48	0.09	0.15	0.37	Restore	NONE	NONE	NONE
8220	P2	47	0.17	0.39	0.00	D3	23	0.00	0.14	0.12	Protect	NONE	NONE	NONE
8230	P3	87	0.37	0.19	0.25	D9	54	0.08	0.23	0.39	Restore	NONE	LOW	NONE
8400	P3	73	0.44	0.15	0.05	D10	42	0.04	0.20	0.22	Restore	LOW	LOW	NONE
8401	P2	40	0.19	0.00	0.07	D15	63	0.63	0.21	0.34	Enhance	NONE	LOW	NONE

Barrier Embayment Sites

The number of historical and current barrier embayments found within a drift cell scaled site is provided. Three values are provided to describe the presence of barrier embayments within convergence zones. 'CZ present' indicates that the site includes a barrier embayment located within a convergence zone shared with another site (often numbered sequentially). 'CZ only' indicates that the barrier embayment within the convergence zone is the only embayment present within the site.

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
1008	2	1	NONE	P6	54	0.23	0.15	0.09	D2	47	0.86	0.05	0.00	0.29	Restore	NONE	HIGH	MED	LOW
1009	3	3	NONE	P6	59	0.27	0.16	0.09	D1	29	0.08	0.09	0.00	0.17	Protect	NONE	NONE	MED	LOW
1010	3	4	NONE	P6	54	0.23	0.17	0.07	D4	59	0.04	0.47	0.91	0.16	Restore	NONE	NONE	LOW	LOW
1011	2	4	NONE	P2	45	0.17	0.18	0.05	D4	57	0.00	0.22	0.93	0.34	Restore	NONE	NONE	LOW	LOW
1012	2	2	NONE	P6	52	0.19	0.21	0.05	D1	18	0.00	0.01	0.00	0.16	Protect	NONE	NONE	LOW	LOW
1013	3	3	NONE	P6	76	0.32	0.20	0.14	D1	34	0.00	0.05	0.21	0.10	Protect	NONE	NONE	MED	LOW
1014	2	2	CZ PRESENT	P6	69	0.24	0.20	0.12	D1	29	0.09	0.00	0.00	0.32	Protect	NONE	NONE	LOW	NONE
1015	2	2	CZ PRESENT	P6	64	0.29	0.17	0.10	D1	10	0.00	0.00	0.00	0.13	Protect	NONE	NONE	LOW	NONE
1016	1	1	CZ ONLY	P2	34	0.17	0.11	0.05	D1	3	0.00	0.00	0.00	0.02	Protect	NONE	NONE	LOW	NONE
1017	2	2	CZ PRESENT	P6	70	0.26	0.19	0.13	D1	13	0.00	0.07	0.00	0.05	Protect	NONE	NONE	LOW	NONE
1018	4	3	NONE	P6	69	0.32	0.22	0.07	D1	59	0.03	0.32	0.16	0.30	Protect	NONE	NONE	LOW	NONE
1019	5	3	NONE	P6	77	0.37	0.23	0.10	D6	72	0.38	0.30	0.47	0.42	Restore	NONE	HIGH	LOW	LOW
1020	4	2	NONE	P9	96	0.49	0.32	0.22	D6	71	0.46	0.64	0.48	0.20	Restore	NONE	HIGH	LOW	MED
1021	1	1	NONE	P9	72	0.45	0.14	0.22	D1	49	0.42	0.06	0.27	0.08	Protect	NONE	NONE	LOW	MED
1023	2	2	NONE	P9	80	0.45	0.25	0.09	D1	60	0.19	0.12	0.11	0.45	Protect	NONE	NONE	MED	NONE
1024	2	2	NONE	P9	86	0.55	0.22	0.18	D1	32	0.17	0.00	0.06	0.08	Protect	NONE	NONE	LOW	NONE
1025	3	3	NONE	P9	66	0.40	0.08	0.17	D1	48	0.00	0.14	0.04	0.22	Protect	NONE	NONE	LOW	LOW
1026	1	1	NONE	P9	68	0.35	0.10	0.27	D4	93	0.45	1.00	1.00	0.70	Restore	NONE	NONE	LOW	LOW
1027	2	3	NONE	P9	72	0.55	0.08	0.46	D1	36	0.14	0.05	0.07	0.03	Protect	NONE	NONE	LOW	MED
1028	1	1	CZ ONLY	P6	68	0.32	0.19	0.10	D1	5	0.00	0.00	0.00	0.05	Protect	NONE	HIGH	LOW	MED
1029	3	3	CZ PRESENT	P9	75	0.43	0.15	0.34	D3	26	0.00	0.55	0.00	0.08	Restore	NONE	HIGH	LOW	LOW
1201	1	0	NONE	P6	57	0.22	0.19	0.07	D2	51	1.00	0.05	0.00	0.38	Restore	NONE	HIGH	LOW	NONE
1400	1	1	NONE	P9	65	0.35	0.07	0.22	D8	74	0.45	0.45	1.00	0.27	Enhance	NONE	HIGH	LOW	HIGH
2002	12	7	NONE	P9	80	0.50	0.18	0.22	D4	62	0.20	0.31	0.65	0.22	Restore	NONE	NONE	MED	NONE
2003	1	0	NONE	P6	49	0.22	0.14	0.07	D5	60	1.00	0.15	1.00	0.04	Restore	NONE	NONE	MED	LOW
2004	2	1	NONE	P2	53	0.18	0.20	0.06	D1	35	0.00	0.17	0.21	0.06	Protect	NONE	NONE	MED	NONE
2005	1	1	NONE	P2	23	0.10	0.15	0.03	D1	24	0.36	0.12	0.00	0.00	Protect	NONE	NONE	LOW	NONE
2006	1	1	NONE	P2	29	0.08	0.22	0.02	D1	27	0.36	0.22	0.00	0.01	Protect	NONE	NONE	LOW	NONE
2007	2	1	NONE	P6	62	0.28	0.18	0.09	D5	59	0.75	0.10	0.72	0.10	Restore	NONE	NONE	LOW	NONE
2008	1	1	CZ ONLY	P2	23	0.09	0.16	0.02	D1	14	0.33	0.00	0.00	0.01	Protect	NONE	NONE	LOW	NONE
2009	2	1	CZ PRESENT	P2	30	0.16	0.13	0.04	D1	27	0.56	0.01	0.00	0.04	Protect	NONE	NONE	LOW	NONE
2011	2	1	NONE	P2	23	0.12	0.11	0.03	D6	55	0.47	0.31	0.31	0.06	Restore	NONE	NONE	MED	NONE
2013	4	2	NONE	P6	74	0.22	0.24	0.15	D4	53	0.00	0.79	0.67	0.09	Restore	NONE	HIGH	LOW	NONE
2015	1	0	NONE	P2	35	0.07	0.29	0.02	D5	65	1.00	0.54	1.00	0.01	Restore	NONE	NONE	HIGH	NONE
2018	2	1	CZ PRESENT	P6	52	0.21	0.22	0.04	D9	76	0.72	0.82	1.00	0.12	Enhance	NONE	NONE	MED	NONE
2019	1	1	CZ ONLY	P2	47	0.16	0.25	0.03	D3	59	0.49	1.00	0.00	0.23	Restore	NONE	NONE	LOW	NONE
2020	1	1	CZ ONLY	P2	41	0.12	0.24	0.03	D4	68	0.34	0.80	1.00	0.11	Restore	NONE	NONE	MED	NONE
2021	1	1	CZ ONLY	P2	44	0.12	0.31	0.02	D4	68	0.34	0.97	1.00	0.07	Restore	NONE	NONE	MED	NONE
2022	5	2	CZ PRESENT	P6	84	0.30	0.25	0.19	D3	60	0.00	0.91	0.22	0.22	Restore	NONE	NONE	HIGH	NONE
2023	3	1	CZ PRESENT	P4	85	0.22	0.30	0.28	D3	78	0.23	0.93	0.57	0.31	Restore	NONE	NONE	MED	NONE
2024	3	2	NONE	P8	85	0.36	0.21	0.64	D1	39	0.00	0.00	0.32	0.28	Protect	NONE	NONE	NONE	MED
2025	3	1	NONE	P8	78	0.21	0.22	0.52	D3	72	0.30	0.89	0.40	0.20	Restore	NONE	NONE	MED	MED
2027	1	0	NONE	P4	44	0.09	0.09	0.36	D9	84	1.00	0.93	1.00	0.19	Enhance	NONE	NONE	HIGH	NONE
2028	2	0	CZ PRESENT	P2	63	0.16	0.34	0.06	D9	78	1.00	0.92	1.00	0.10	Enhance	NONE	NONE	MED	NONE
2029	6	0	CZ PRESENT	P6	66	0.24	0.22	0.08	D9	76	1.00	0.97	1.00	0.06	Enhance	NONE	NONE	HIGH	NONE
2030	1	0	NONE	P2	26	0.07	0.24	0.00	D7	66	1.00	1.00	0.00	0.26	Enhance	NONE	NONE	HIGH	NONE
2031	2	0	NONE	P2	23	0.06	0.16	0.03	D7	63	1.00	0.96	0.00	0.22	Enhance	NONE	HIGH	MED	NONE
2032	2	1	NONE	P6	64	0.26	0.17	0.11	D9	88	0.73	0.76	1.00	0.35	Enhance	NONE	NONE	HIGH	NONE
2034	4	1	NONE	P6	70	0.28	0.19	0.13	D4	79	0.31	0.94	1.00	0.25	Restore	NONE	NONE	MED	LOW

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
2035	0	1	NONE	P1	28	0.00	0.00	0.12	D4	44	0.00	0.32	1.00	0.06	Restore	NONE	NONE	LOW	NONE
2036	3	1	NONE	P6	66	0.26	0.19	0.11	D6	79	0.72	0.64	0.52	0.25	Restore	NONE	NONE	MED	NONE
2037	1	0	NONE	P2	48	0.14	0.24	0.04	D5	82	1.00	0.42	1.00	0.31	Restore	NONE	NONE	LOW	NONE
2038	1	0	NONE	P6	52	0.24	0.16	0.07	D5	76	1.00	0.51	1.00	0.17	Restore	NONE	NONE	LOW	LOW
2039	1	1	NONE	P2	52	0.12	0.28	0.05	D1	20	0.00	0.04	0.00	0.17	Protect	NONE	NONE	LOW	NONE
2042	3	4	NONE	P6	60	0.20	0.22	0.08	D3	58	0.10	0.45	0.09	0.23	Restore	NONE	NONE	LOW	LOW
2047	1	1	NONE	P2	24	0.06	0.19	0.02	D1	25	0.00	0.01	0.00	0.27	Protect	NONE	NONE	LOW	LOW
2048	**1**	**1**	**NONE**	**P10**	**76**	**0.28**	**0.55**	**0.05**	**D1**	**40**	**0.08**	**0.20**	**0.00**	**0.32**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
2049	1	1	NONE	P6	61	0.29	0.20	0.05	D1	41	0.08	0.26	0.00	0.33	Protect	NONE	NONE	MED	LOW
2050	1	1	NONE	P2	48	0.18	0.16	0.08	D3	50	0.34	0.39	0.00	0.34	Restore	NONE	NONE	LOW	NONE
2051	2	1	NONE	P5	72	0.18	1.00	0.06	D1	27	0.54	0.00	0.00	0.13	Protect	NONE	NONE	NONE	NONE
2052	4	3	NONE	P6	82	0.29	0.33	0.10	D1	44	0.28	0.09	0.18	0.07	Protect	NONE	NONE	LOW	LOW
2056	1	1	NONE	P2	41	0.16	0.14	0.07	D1	42	0.22	0.17	0.06	0.05	Protect	NONE	NONE	MED	LOW
2059	**3**	**3**	**NONE**	**P9**	**81**	**0.68**	**0.18**	**0.26**	**D1**	**20**	**0.28**	**0.05**	**0.00**	**0.01**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
2062	**5**	**5**	**NONE**	**P9**	**76**	**0.78**	**0.13**	**0.28**	**D1**	**34**	**0.17**	**0.07**	**0.01**	**0.02**	**Protect**	**NONE**	**HIGH**	**LOW**	**LOW**
2063	**3**	**3**	**CZ PRESENT**	**P9**	**82**	**0.41**	**0.21**	**0.19**	**D1**	**21**	**0.15**	**0.01**	**0.00**	**0.08**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
2064	2	2	CZ PRESENT	P2	44	0.14	0.19	0.06	D1	19	0.09	0.05	0.00	0.04	Protect	NONE	NONE	MED	NONE
2065	**5**	**5**	**NONE**	**P9**	**75**	**0.56**	**0.13**	**0.36**	**D1**	**38**	**0.13**	**0.04**	**0.13**	**0.05**	**Protect**	**NONE**	**MED**	**LOW**	**MED**
2066	1	1	NONE	P4	59	0.19	0.14	0.27	D4	72	0.05	0.47	0.55	0.52	Restore	NONE	NONE	MED	MED
2067	3	3	NONE	P6	76	0.31	0.22	0.12	D1	21	0.00	0.14	0.00	0.13	Protect	NONE	NONE	LOW	LOW
2068	2	2	NONE	P6	78	0.29	0.25	0.11	D1	14	0.00	0.16	0.00	0.02	Protect	NONE	NONE	MED	LOW
2069	1	1	NONE	P2	30	0.05	0.22	0.03	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	MED	NONE
2072	1	1	NONE	P6	51	0.27	0.16	0.05	D1	35	0.21	0.13	0.00	0.20	Protect	NONE	NONE	LOW	NONE
2073	4	1	NONE	P6	69	0.27	0.31	0.05	D1	40	0.36	0.42	0.00	0.14	Protect	NONE	NONE	MED	NONE
2074	1	1	NONE	P2	31	0.11	0.16	0.04	D1	28	0.00	0.08	0.00	0.29	Protect	NONE	NONE	MED	NONE
2075	1	1	NONE	P2	51	0.19	0.16	0.08	D1	30	0.00	0.05	0.00	0.40	Protect	NONE	NONE	MED	NONE
2076	**2**	**2**	**NONE**	**P9**	**79**	**0.41**	**0.20**	**0.15**	**D5**	**75**	**0.91**	**0.10**	**0.90**	**0.36**	**Restore**	**NONE**	**NONE**	**HIGH**	**NONE**
2077	**3**	**2**	**NONE**	**P9**	**86**	**0.39**	**0.24**	**0.18**	**D1**	**28**	**0.24**	**0.04**	**0.00**	**0.14**	**Protect**	**NONE**	**NONE**	**MED**	**NONE**
2080	2	2	NONE	P6	70	0.24	0.25	0.09	D3	45	0.17	0.38	0.00	0.31	Restore	NONE	NONE	MED	NONE
2081	**3**	**2**	**NONE**	**P9**	**88**	**0.46**	**0.23**	**0.23**	**D1**	**49**	**0.25**	**0.23**	**0.15**	**0.11**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
2082	1	1	NONE	P6	87	0.28	0.29	0.20	D3	38	0.00	0.41	0.05	0.07	Restore	NONE	NONE	LOW	LOW
2083	1	1	NONE	P2	60	0.13	0.26	0.08	D4	42	0.00	0.30	0.72	0.07	Restore	NONE	NONE	MED	NONE
2084	1	1	NONE	P2	64	0.11	0.26	0.15	D4	55	0.00	0.92	0.62	0.10	Restore	NONE	NONE	LOW	NONE
2088	**7**	**4**	**NONE**	**P9**	**91**	**0.48**	**0.26**	**0.20**	**D6**	**71**	**0.49**	**0.58**	**0.55**	**0.19**	**Restore**	**NONE**	**LOW**	**MED**	**NONE**
2098	3	2	NONE	P6	77	0.25	0.34	0.08	D1	26	0.09	0.10	0.00	0.12	Protect	NONE	NONE	MED	LOW
2099	**2**	**1**	**NONE**	**P10**	**93**	**0.33**	**0.41**	**0.14**	**D5**	**75**	**0.97**	**0.03**	**0.97**	**0.42**	**Restore**	**NONE**	**NONE**	**HIGH**	**NONE**
3001	**2**	**2**	**NONE**	**P9**	**96**	**0.39**	**0.34**	**0.24**	**D9**	**92**	**0.75**	**0.74**	**0.92**	**0.55**	**Enhance**	**LOW**	**NONE**	**LOW**	**HIGH**
3002	2	1	NONE	P6	69	0.34	0.14	0.21	D9	94	0.82	1.00	0.90	0.46	Enhance	HIGH	NONE	LOW	HIGH
3003	**1**	**1**	**NONE**	**P9**	**99**	**0.47**	**0.37**	**0.23**	**D9**	**94**	**0.70**	**1.00**	**1.00**	**0.47**	**Enhance**	**HIGH**	**NONE**	**LOW**	**HIGH**
3004	**1**	**1**	**NONE**	**P9**	**78**	**0.47**	**0.17**	**0.23**	**D9**	**96**	**0.70**	**1.00**	**1.00**	**0.57**	**Enhance**	**HIGH**	**HIGH**	**LOW**	**HIGH**
3007	1	0	NONE	P2	35	0.11	0.28	0.00	D2	58	1.00	0.27	0.00	0.41	Restore	NONE	NONE	MED	NONE
3008	2	2	NONE	P2	69	0.20	0.33	0.07	D3	48	0.25	0.59	0.00	0.24	Restore	NONE	NONE	MED	NONE
3009	4	4	NONE	P6	84	0.30	0.33	0.10	D1	53	0.26	0.14	0.28	0.16	Protect	NONE	NONE	LOW	MED
3010	2	2	NONE	P6	77	0.26	0.33	0.08	D3	51	0.21	0.64	0.02	0.07	Restore	NONE	NONE	LOW	MED
3011	1	1	NONE	P2	64	0.19	0.29	0.06	D3	53	0.15	0.84	0.03	0.06	Restore	NONE	NONE	MED	NONE
3012	1	1	NONE	P2	65	0.19	0.28	0.07	D3	45	0.55	0.64	0.00	0.10	Restore	NONE	NONE	HIGH	NONE
3013	1	1	NONE	P2	51	0.17	0.20	0.07	D3	52	0.55	0.66	0.00	0.20	Restore	NONE	NONE	HIGH	NONE
3014	2	2	NONE	P6	84	0.33	0.28	0.12	D3	52	0.44	0.70	0.00	0.23	Restore	NONE	NONE	MED	NONE
3015	**1**	**1**	**NONE**	**P10**	**86**	**0.27**	**0.46**	**0.10**	**D1**	**38**	**0.33**	**0.46**	**0.00**	**0.11**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
3016	3	3	NONE	P6	78	0.35	0.35	0.06	D1	36	0.46	0.46	0.00	0.04	Protect	NONE	LOW	LOW	NONE
3017	1	1	NONE	P2	39	0.05	0.36	0.02	D3	57	0.36	0.42	0.00	0.61	Restore	NONE	MED	MED	NONE
3018	2	1	NONE	P2	56	0.16	0.33	0.04	D3	57	0.59	0.55	0.00	0.33	Restore	NONE	NONE	HIGH	NONE
3019	1	0	NONE	P2	14	0.08	0.12	0.02	D2	53	1.00	0.55	0.00	0.17	Restore	NONE	NONE	HIGH	NONE
3020	1	1	NONE	P2	56	0.19	0.33	0.02	D3	46	0.25	0.64	0.00	0.21	Restore	NONE	NONE	HIGH	NONE
3021	1	1	NONE	P2	56	0.18	0.36	0.02	D3	52	0.25	0.79	0.00	0.27	Restore	NONE	NONE	HIGH	NONE
3023	1	1	NONE	P2	44	0.13	0.40	0.00	D1	20	0.26	0.00	0.00	0.11	Protect	NONE	NONE	MED	NONE

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
3024	1	2	NONE	P2	39	0.02	0.36	0.02	D1	35	0.00	0.06	0.24	0.09	Protect	NONE	NONE	LOW	NONE
3025	0	1	NONE	P1	6	0.00	0.00	0.02	D3	50	0.00	0.82	0.24	0.09	Restore	NONE	NONE	LOW	NONE
3030	1	1	NONE	P2	42	0.14	0.33	0.00	D3	68	0.53	0.86	0.03	0.17	Restore	NONE	NONE	HIGH	NONE
3031	1	1	NONE	P2	30	0.14	0.21	0.00	D3	60	0.53	0.53	0.03	0.12	Restore	NONE	NONE	HIGH	NONE
3032	**1**	**1**	**NONE**	**P9**	**65**	**0.41**	**0.37**	**0.00**	**D1**	**34**	**0.28**	**0.33**	**0.00**	**0.09**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
3033	**3**	**2**	**NONE**	**P9**	**82**	**0.47**	**0.28**	**0.08**	**D3**	**56**	**0.32**	**0.60**	**0.01**	**0.13**	**Restore**	**NONE**	**NONE**	**LOW**	**LOW**
3035	1	0	NONE	P2	43	0.11	0.28	0.03	D2	81	1.00	0.59	0.21	0.34	Restore	NONE	NONE	MED	NONE
3037	1	1	NONE	P2	17	0.09	0.14	0.02	D1	48	0.62	0.26	0.00	0.24	Protect	NONE	LOW	MED	LOW
3038	**1**	**1**	**NONE**	**P9**	**97**	**0.41**	**0.47**	**0.17**	**D1**	**15**	**0.29**	**0.00**	**0.00**	**0.03**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
3039	**3**	**1**	**NONE**	**P9**	**82**	**0.44**	**0.21**	**0.18**	**D1**	**56**	**0.34**	**0.35**	**0.06**	**0.16**	**Protect**	**NONE**	**NONE**	**MED**	**LOW**
3040	1	1	NONE	P2	53	0.20	0.38	0.00	D1	31	0.09	0.00	0.01	0.12	Protect	NONE	NONE	LOW	LOW
3041	1	1	NONE	P2	43	0.20	0.25	0.00	D3	67	0.09	0.97	0.01	0.27	Restore	NONE	NONE	MED	HIGH
3046	4	1	NONE	P6	45	0.20	0.19	0.03	D9	84	0.65	0.78	0.71	0.31	Enhance	NONE	NONE	HIGH	LOW
3047	4	2	NONE	P6	53	0.21	0.21	0.05	D3	55	0.50	0.75	0.00	0.24	Restore	NONE	NONE	MED	LOW
3049	5	4	NONE	P6	73	0.20	0.26	0.12	D3	49	0.00	0.45	0.12	0.20	Restore	NONE	NONE	LOW	LOW
3050	1	1	NONE	P2	38	0.05	0.15	0.12	D3	61	0.00	0.89	0.13	0.28	Restore	NONE	NONE	LOW	NONE
3054	1	0	NONE	P2	45	0.10	0.35	0.02	D7	58	1.00	0.76	0.00	0.20	Enhance	NONE	NONE	LOW	NONE
3055	2	0	NONE	P3	39	0.07	0.53	0.00	D7	74	1.00	0.85	0.03	0.19	Enhance	NONE	NONE	LOW	NONE
3056	1	0	NONE	P2	21	0.05	0.19	0.02	D7	52	1.00	0.65	0.00	0.13	Enhance	NONE	NONE	HIGH	NONE
3057	3	1	NONE	P3	54	0.13	0.52	0.02	D3	51	0.19	0.60	0.09	0.05	Restore	NONE	NONE	HIGH	NONE
3058	3	0	NONE	P3	44	0.09	0.53	0.01	D2	59	1.00	0.51	0.11	0.02	Restore	NONE	NONE	MED	NONE
3060	3	1	NONE	P6	74	0.32	0.22	0.10	D1	58	0.42	0.47	0.06	0.13	Protect	NONE	NONE	MED	LOW
3061	**2**	**1**	**NONE**	**P10**	**88**	**0.30**	**0.50**	**0.10**	**D1**	**41**	**0.32**	**0.51**	**0.00**	**0.14**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
3062	2	1	NONE	P2	37	0.16	0.18	0.03	D6	74	0.53	0.61	0.38	0.24	Restore	NONE	NONE	HIGH	NONE
3065	1	1	NONE	P2	32	0.16	0.13	0.04	D3	49	0.30	0.50	0.00	0.27	Restore	NONE	NONE	HIGH	NONE
3066	1	1	NONE	P2	46	0.11	0.47	0.01	D3	50	0.33	1.00	0.00	0.15	Restore	NONE	NONE	MED	NONE
3067	2	2	NONE	P3	54	0.15	0.50	0.02	D2	38	0.58	0.19	0.00	0.11	Restore	NONE	NONE	MED	NONE
3068	1	1	NONE	P3	48	0.11	0.57	0.01	D1	45	0.49	0.21	0.00	0.25	Protect	NONE	NONE	LOW	NONE
3069	1	1	NONE	P2	43	0.10	0.35	0.01	D1	41	0.49	0.08	0.00	0.24	Protect	NONE	NONE	MED	NONE
3070	1	0	NONE	P2	29	0.05	0.29	0.00	D2	50	1.00	0.05	0.03	0.08	Restore	NONE	NONE	LOW	NONE
3072	1	0	NONE	P2	23	0.04	0.21	0.01	D2	47	1.00	0.32	0.00	0.15	Restore	NONE	NONE	HIGH	NONE
3073	1	0	NONE	P2	25	0.07	0.21	0.01	D5	61	1.00	0.02	1.00	0.12	Restore	NONE	NONE	MED	NONE
3074	**1**	**1**	**NONE**	**P10**	**57**	**0.23**	**0.46**	**0.00**	**D1**	**15**	**0.37**	**0.00**	**0.00**	**0.01**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
3075	4	2	NONE	P6	75	0.36	0.28	0.06	D6	52	0.67	0.07	0.41	0.04	Restore	NONE	NONE	LOW	NONE
3077	2	1	NONE	P2	42	0.16	0.19	0.05	D2	58	0.69	0.17	0.07	0.15	Restore	NONE	NONE	LOW	NONE
3078	1	1	NONE	P2	26	0.12	0.12	0.04	D6	49	0.66	0.10	0.19	0.03	Restore	NONE	HIGH	LOW	NONE
3080	1	0	CZ ONLY	P2	31	0.03	0.29	0.01	D2	35	1.00	0.08	0.00	0.05	Restore	NONE	NONE	LOW	NONE
3081	1	0	CZ ONLY	P2	28	0.03	0.25	0.01	D2	44	1.00	0.31	0.00	0.12	Restore	NONE	NONE	MED	NONE
3082	1	0	NONE	P2	25	0.06	0.24	0.00	D2	62	1.00	0.52	0.02	0.08	Restore	NONE	NONE	LOW	NONE
3085	1	0	NONE	P2	32	0.08	0.26	0.01	D2	59	1.00	0.11	0.01	0.19	Restore	NONE	NONE	LOW	LOW
3086	5	1	NONE	P6	57	0.23	0.19	0.06	D6	62	0.53	0.28	0.31	0.18	Restore	NONE	NONE	MED	NONE
3087	2	2	NONE	P2	14	0.12	0.11	0.00	D3	36	0.20	0.46	0.00	0.12	Restore	NONE	NONE	MED	LOW
3092	3	0	NONE	P6	67	0.27	0.17	0.13	D2	69	1.00	0.43	0.23	0.17	Restore	NONE	HIGH	LOW	LOW
3093	3	1	NONE	P2	59	0.16	0.24	0.07	D2	54	0.87	0.18	0.03	0.07	Restore	NONE	NONE	MED	LOW
3096	4	3	CZ PRESENT	P6	47	0.19	0.22	0.04	D3	56	0.55	0.74	0.00	0.24	Restore	NONE	NONE	HIGH	NONE
3097	4	4	CZ PRESENT	P3	63	0.18	0.48	0.04	D3	49	0.41	0.64	0.00	0.20	Restore	NONE	NONE	MED	NONE
3100	1	0	NONE	P2	27	0.14	0.15	0.03	D5	47	1.00	0.00	0.52	0.04	Restore	NONE	NONE	MED	NONE
3101	1	0	NONE	P2	19	0.04	0.21	0.00	D5	60	1.00	0.20	1.00	0.03	Restore	NONE	NONE	MED	NONE
3102	1	1	NONE	P2	20	0.06	0.20	0.00	D3	36	0.15	0.72	0.00	0.07	Restore	NONE	NONE	MED	NONE
3104	1	1	NONE	P2	49	0.13	0.30	0.03	D3	78	0.12	0.92	0.34	0.48	Restore	NONE	NONE	HIGH	NONE
3105	1	1	NONE	P5	61	0.12	0.90	0.05	D3	43	0.12	1.00	0.00	0.11	Restore	NONE	NONE	LOW	NONE
3106	2	2	NONE	P2	45	0.10	0.31	0.03	D3	69	0.35	0.99	0.02	0.21	Restore	NONE	NONE	MED	NONE
3107	2	1	NONE	P2	42	0.08	0.39	0.02	D2	65	0.90	0.29	0.02	0.23	Restore	NONE	NONE	MED	NONE
3108	4	3	NONE	P6	74	0.30	0.24	0.09	D3	38	0.00	0.61	0.00	0.27	Restore	NONE	NONE	MED	NONE
3109	1	0	NONE	P2	49	0.10	0.29	0.05	D2	51	1.00	0.31	0.00	0.22	Restore	NONE	NONE	LOW	NONE
3110	3	2	NONE	P6	67	0.26	0.31	0.05	D1	50	0.46	0.32	0.00	0.32	Protect	NONE	NONE	MED	NONE

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
3111	1	1	NONE	P5	64	0.22	1.00	0.02	D1	31	0.29	0.00	0.00	0.30	Protect	NONE	NONE	NONE	NONE
3114	1	1	NONE	P3	52	0.18	0.48	0.00	D2	19	0.70	0.00	0.00	0.00	Restore	NONE	NONE	MED	NONE
3115	1	1	NONE	P3	54	0.18	0.59	0.00	D2	19	0.70	0.00	0.00	0.00	Restore	NONE	NONE	MED	NONE
3118	1	1	NONE	P2	20	0.14	0.15	0.00	D2	40	0.91	0.14	0.00	0.12	Restore	NONE	NONE	MED	NONE
3120	2	1	NONE	P6	57	0.36	0.23	0.02	D1	58	0.37	0.17	0.03	0.27	Protect	NONE	NONE	MED	NONE
3121	1	1	NONE	P7	67	0.35	0.68	0.00	D1	30	0.33	0.00	0.00	0.26	Protect	NONE	NONE	NONE	NONE
3122	1	1	CZ ONLY	P2	47	0.10	0.29	0.04	D3	47	0.00	0.93	0.00	0.36	Restore	NONE	NONE	MED	NONE
3123	1	1	CZ ONLY	P2	38	0.07	0.32	0.02	D3	37	0.00	1.00	0.00	0.15	Restore	NONE	NONE	MED	NONE
3124	1	1	NONE	P3	34	0.01	0.41	0.00	D3	55	0.40	1.00	0.00	0.20	Restore	NONE	NONE	LOW	LOW
3125	1	1	NONE	P3	39	0.05	0.44	0.01	D1	30	0.40	0.00	0.00	0.21	Protect	NONE	NONE	NONE	LOW
3126	1	1	NONE	P3	40	0.04	0.58	0.00	D1	27	0.40	0.00	0.00	0.18	Protect	NONE	NONE	HIGH	NONE
3127	1	1	NONE	P2	32	0.01	0.31	0.00	D3	54	0.40	1.00	0.00	0.18	Restore	NONE	NONE	MED	NONE
3128	3	3	NONE	P6	74	0.33	0.28	0.06	D3	68	0.07	1.00	0.21	0.22	Restore	NONE	NONE	LOW	NONE
3129	2	2	NONE	P2	50	0.08	0.46	0.04	D3	63	0.00	1.00	0.38	0.22	Restore	NONE	NONE	LOW	NONE
3130	2	1	NONE	P2	40	0.13	0.21	0.04	D3	65	0.00	0.79	0.25	0.38	Restore	NONE	NONE	LOW	LOW
3131	4	1	NONE	P2	54	0.18	0.22	0.05	D6	76	0.75	0.66	0.27	0.22	Restore	NONE	NONE	MED	LOW
3132	2	2	NONE	P2	59	0.19	0.27	0.05	D3	51	0.18	0.73	0.00	0.30	Restore	NONE	NONE	MED	LOW
3133	1	1	NONE	P2	42	0.09	0.32	0.02	D3	47	0.39	0.58	0.00	0.19	Restore	NONE	NONE	MED	LOW
3135	1	0	NONE	P2	33	0.10	0.19	0.04	D7	51	1.00	0.67	0.00	0.11	Enhance	NONE	NONE	LOW	LOW
3138	1	1	NONE	P6	76	0.28	0.32	0.07	D3	24	0.00	0.55	0.00	0.06	Restore	NONE	NONE	LOW	NONE
3139	2	2	NONE	P6	65	0.35	0.18	0.08	D3	21	0.00	0.45	0.00	0.03	Restore	NONE	NONE	LOW	LOW
3140	2	1	NONE	P10	79	0.22	0.50	0.08	D4	64	0.39	0.62	0.80	0.09	Restore	NONE	NONE	MED	NONE
3141	6	2	NONE	P9	81	0.50	0.19	0.21	D5	59	0.84	0.25	0.79	0.03	Restore	NONE	NONE	MED	LOW
3142	4	3	NONE	P10	77	0.29	0.46	0.05	D1	40	0.36	0.02	0.08	0.03	Protect	NONE	NONE	LOW	LOW
3143	5	5	NONE	P6	86	0.35	0.33	0.10	D1	34	0.21	0.01	0.10	0.00	Protect	NONE	NONE	LOW	LOW
3144	2	1	NONE	P2	40	0.11	0.25	0.03	D1	24	0.48	0.00	0.00	0.10	Protect	NONE	NONE	LOW	LOW
3145	1	1	NONE	P2	45	0.11	0.28	0.04	D1	3	0.00	0.00	0.00	0.02	Protect	NONE	NONE	MED	NONE
3146	1	0	NONE	P2	27	0.11	0.15	0.04	D2	70	1.00	0.37	0.22	0.20	Restore	NONE	NONE	MED	LOW
3156	1	1	NONE	P2	45	0.13	0.23	0.05	D2	36	0.63	0.15	0.00	0.08	Restore	NONE	NONE	MED	LOW
3157	1	1	NONE	P2	24	0.09	0.16	0.03	D1	40	0.63	0.38	0.00	0.08	Protect	NONE	NONE	MED	NONE
3158	2	0	CZ PRESENT	P2	52	0.14	0.36	0.02	D5	47	1.00	0.00	1.00	0.01	Restore	NONE	NONE	LOW	NONE
3159	1	0	CZ ONLY	P3	48	0.09	0.51	0.02	D7	46	1.00	0.78	0.00	0.01	Enhance	NONE	NONE	LOW	NONE
3162	1	0	NONE	P2	22	0.07	0.19	0.02	D7	75	1.00	0.71	0.06	0.24	Enhance	NONE	NONE	HIGH	HIGH
3163	1	0	NONE	P2	37	0.10	0.16	0.07	D7	92	1.00	0.98	0.47	0.45	Enhance	NONE	NONE	HIGH	NONE
3164	4	2	NONE	P6	64	0.23	0.20	0.10	D3	58	0.06	0.68	0.24	0.14	Restore	NONE	NONE	MED	LOW
3166	1	1	NONE	P3	49	0.11	0.61	0.02	D3	31	0.16	0.75	0.00	0.00	Restore	NONE	NONE	HIGH	NONE
3167	1	1	NONE	P2	48	0.11	0.32	0.03	D1	25	0.16	0.24	0.00	0.03	Protect	NONE	NONE	MED	NONE
3168	1	1	NONE	P9	71	0.46	0.08	0.33	D3	63	0.05	0.50	0.09	0.33	Restore	NONE	NONE	MED	LOW
3170	1	1	NONE	P4	49	0.02	0.18	0.35	D3	57	0.07	1.00	0.00	0.42	Restore	NONE	NONE	LOW	NONE
3171	7	5	NONE	P9	88	0.38	0.24	0.30	D3	73	0.35	0.81	0.13	0.30	Restore	NONE	NONE	MED	LOW
3172	2	0	NONE	P2	57	0.16	0.30	0.05	D7	83	1.00	0.85	0.57	0.23	Enhance	NONE	NONE	MED	NONE
3179	1	1	NONE	P2	36	0.16	0.15	0.04	D6	71	0.47	0.69	0.36	0.20	Restore	NONE	NONE	MED	HIGH
3185	1	0	NONE	P2	53	0.11	0.41	0.04	D7	74	1.00	1.00	0.00	0.57	Enhance	NONE	NONE	HIGH	NONE
3186	2	0	NONE	P2	68	0.18	0.38	0.06	D9	94	1.00	1.00	1.00	0.38	Enhance	NONE	NONE	HIGH	LOW
3187	2	1	NONE	P2	45	0.18	0.17	0.05	D3	63	0.38	0.89	0.00	0.48	Restore	NONE	NONE	HIGH	LOW
3189	3	2	NONE	P2	52	0.20	0.18	0.06	D3	81	0.57	0.84	0.01	0.48	Restore	NONE	NONE	MED	LOW
3192	0	1	CZ PRESENT	P1	10	0.00	0.00	0.03	D1	7	0.00	0.00	0.00	0.08	Protect	NONE	NONE	MED	LOW
3193	0	1	CZ PRESENT	P1	0	0.00	0.00	0.00	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3194	1	1	NONE	P2	34	0.07	0.33	0.00	D1	11	0.27	0.00	0.00	0.00	Protect	NONE	NONE	NONE	NONE
3197	1	0	NONE	P2	44	0.10	0.24	0.05	D2	21	1.00	0.00	0.00	0.00	Restore	NONE	NONE	LOW	NONE
3198	3	1	NONE	P2	46	0.14	0.24	0.04	D2	19	0.71	0.00	0.00	0.00	Restore	NONE	NONE	LOW	NONE
3199	2	2	NONE	P2	23	0.12	0.18	0.00	D1	10	0.20	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3200	1	1	NONE	P2	38	0.09	0.27	0.03	D1	10	0.22	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3201	1	1	NONE	P2	37	0.10	0.23	0.03	D1	9	0.15	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3204	2	2	NONE	P6	77	0.30	0.24	0.10	D1	9	0.17	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3205	1	1	NONE	P10	80	0.22	0.54	0.08	D1	13	0.36	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
3208	**15**	**11**	**NONE**	**P9**	**87**	**0.46**	**0.36**	**0.08**	**D1**	**50**	**0.44**	**0.29**	**0.11**	**0.04**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
3209	**3**	**3**	**NONE**	**P7**	**65**	**0.17**	**0.78**	**0.04**	**D3**	**55**	**0.61**	**1.00**	**0.00**	**0.14**	**Restore**	**NONE**	**NONE**	**MED**	**NONE**
3210	3	3	NONE	P2	34	0.18	0.15	0.03	D1	28	0.25	0.17	0.00	0.06	Protect	NONE	NONE	MED	NONE
3211	1	1	NONE	P2	15	0.09	0.16	0.00	D1	27	0.25	0.07	0.00	0.10	Protect	NONE	NONE	MED	NONE
3215	1	1	NONE	P2	44	0.18	0.13	0.07	D1	33	0.32	0.06	0.00	0.18	Protect	NONE	NONE	LOW	NONE
3217	1	1	NONE	P6	63	0.27	0.16	0.11	D1	21	0.60	0.00	0.00	0.03	Protect	NONE	NONE	LOW	NONE
3218	1	0	NONE	P2	22	0.07	0.16	0.03	D2	23	1.00	0.00	0.00	0.01	Restore	NONE	NONE	LOW	NONE
3220	2	1	NONE	P2	64	0.17	0.38	0.05	D1	58	0.21	0.34	0.34	0.18	Protect	NONE	NONE	MED	NONE
3221	7	4	NONE	P6	77	0.32	0.23	0.10	D5	55	0.67	0.19	0.61	0.03	Restore	NONE	NONE	MED	NONE
3222	2	0	CZ PRESENT	P2	57	0.22	0.27	0.04	D2	80	1.00	0.44	0.17	0.46	Restore	NONE	NONE	MED	NONE
3223	1	0	CZ ONLY	P2	46	0.10	0.37	0.02	D2	39	1.00	0.00	0.00	0.24	Restore	NONE	NONE	MED	NONE
3224	1	1	NONE	P2	44	0.06	0.32	0.04	D3	43	0.00	0.47	0.00	0.47	Restore	NONE	NONE	HIGH	NONE
3225	2	2	NONE	P2	56	0.18	0.25	0.05	D3	45	0.00	0.56	0.00	0.48	Restore	NONE	NONE	HIGH	LOW
3226	1	0	NONE	P3	34	0.01	0.45	0.00	D7	75	1.00	1.00	0.00	0.64	Enhance	NONE	NONE	MED	NONE
3227	2	0	NONE	P2	51	0.16	0.25	0.04	D7	74	1.00	0.92	0.00	0.73	Enhance	NONE	NONE	HIGH	NONE
3228	2	1	NONE	P3	56	0.15	0.57	0.02	D3	49	0.78	1.00	0.00	0.02	Restore	NONE	NONE	HIGH	NONE
3229	1	0	NONE	P2	22	0.06	0.19	0.02	D2	44	1.00	0.43	0.00	0.07	Restore	NONE	NONE	HIGH	LOW
3230	2	2	NONE	P2	62	0.18	0.29	0.06	D1	12	0.00	0.12	0.00	0.02	Protect	NONE	NONE	HIGH	LOW
3231	2	2	NONE	P2	54	0.16	0.38	0.02	D3	50	0.59	1.00	0.00	0.07	Restore	NONE	NONE	HIGH	NONE
3232	1	0	NONE	P2	14	0.11	0.13	0.00	D5	52	1.00	0.01	1.00	0.00	Restore	NONE	NONE	LOW	NONE
3233	1	0	NONE	P2	28	0.10	0.23	0.00	D5	45	1.00	0.00	1.00	0.00	Restore	NONE	NONE	LOW	NONE
3235	1	1	NONE	P2	58	0.14	0.27	0.07	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3236	1	1	NONE	P2	46	0.15	0.23	0.04	D1	23	0.40	0.09	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3237	1	1	NONE	P2	54	0.13	0.35	0.04	D1	14	0.40	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE
3238	2	1	NONE	P2	50	0.14	0.28	0.04	D6	57	0.71	0.44	0.35	0.00	Restore	NONE	NONE	LOW	NONE
3239	2	1	NONE	P2	50	0.18	0.16	0.09	D1	47	0.19	0.27	0.19	0.07	Protect	NONE	NONE	LOW	NONE
3243	1	0	NONE	P2	41	0.14	0.20	0.04	D5	54	1.00	0.07	1.00	0.00	Restore	NONE	NONE	LOW	NONE
3256	2	2	NONE	P6	63	0.26	0.19	0.08	D1	20	0.33	0.02	0.00	0.01	Protect	NONE	NONE	LOW	MED
3257	1	1	NONE	P2	27	0.03	0.24	0.01	D2	31	0.66	0.10	0.00	0.03	Restore	NONE	NONE	LOW	LOW
3258	3	2	NONE	P6	71	0.33	0.20	0.10	D1	27	0.47	0.12	0.00	0.01	Protect	NONE	NONE	LOW	MED
3259	1	1	NONE	P2	56	0.16	0.26	0.05	D1	30	0.55	0.11	0.00	0.03	Protect	NONE	NONE	LOW	LOW
3260	1	1	NONE	P2	63	0.17	0.32	0.06	D1	20	0.55	0.00	0.00	0.03	Protect	NONE	NONE	MED	MED
3261	1	1	NONE	P2	40	0.15	0.18	0.04	D1	15	0.00	0.28	0.00	0.01	Protect	NONE	NONE	MED	MED
3263	**2**	**1**	**NONE**	**P10**	**89**	**0.29**	**0.46**	**0.11**	**D1**	**16**	**0.00**	**0.00**	**0.01**	**0.01**	**Protect**	**NONE**	**NONE**	**LOW**	**HIGH**
3264	3	2	NONE	P6	86	0.30	0.34	0.11	D1	35	0.00	0.25	0.19	0.04	Protect	NONE	NONE	LOW	HIGH
3265	1	1	NONE	P2	35	0.11	0.19	0.04	D1	12	0.00	0.05	0.00	0.04	Protect	NONE	NONE	LOW	LOW
3267	2	2	NONE	P2	42	0.17	0.19	0.04	D1	36	0.26	0.17	0.00	0.19	Protect	NONE	NONE	HIGH	LOW
3274	0	1	NONE	P1	0	0.00	0.00	0.00	D4	76	0.00	0.94	1.00	0.57	Restore	NONE	NONE	MED	NONE
3279	1	1	NONE	P3	39	0.03	0.49	0.01	D3	68	0.50	1.00	0.00	0.49	Restore	NONE	NONE	MED	NONE
3280	1	1	NONE	P3	48	0.06	0.56	0.03	D3	65	0.50	1.00	0.00	0.39	Restore	NONE	NONE	MED	NONE
3281	1	1	NONE	P2	49	0.08	0.29	0.05	D3	63	0.50	1.00	0.00	0.31	Restore	NONE	NONE	HIGH	NONE
3282	1	1	NONE	P2	36	0.03	0.31	0.02	D3	62	0.50	1.00	0.00	0.30	Restore	NONE	NONE	HIGH	LOW
3285	1	1	NONE	P2	37	0.17	0.13	0.05	D1	51	0.47	0.29	0.00	0.36	Protect	NONE	NONE	MED	MED
3286	1	0	CZ ONLY	P2	26	0.12	0.12	0.04	D5	72	1.00	0.16	1.00	0.22	Restore	NONE	NONE	MED	MED
3287	3	0	CZ PRESENT	P6	60	0.20	0.21	0.08	D5	76	1.00	0.39	1.00	0.21	Restore	NONE	NONE	MED	LOW
3288	1	0	NONE	P2	38	0.06	0.35	0.02	D2	32	1.00	0.16	0.00	0.00	Restore	NONE	NONE	LOW	NONE
3289	1	0	NONE	P2	37	0.08	0.27	0.02	D2	31	1.00	0.12	0.00	0.00	Restore	NONE	NONE	LOW	NONE
4002	1	0	CZ ONLY	P2	28	0.10	0.13	0.05	D9	95	1.00	1.00	1.00	0.40	Enhance	LOW	LOW	LOW	HIGH
4003	1	0	CZ ONLY	P6	59	0.21	0.21	0.07	D9	94	1.00	1.00	1.00	0.36	Enhance	NONE	HIGH	LOW	MED
4006	1	1	NONE	P6	63	0.25	0.17	0.10	D3	60	0.66	0.70	0.00	0.31	Restore	NONE	NONE	MED	MED
4007	**1**	**0**	**NONE**	**P9**	**68**	**0.36**	**0.11**	**0.23**	**D9**	**94**	**1.00**	**0.71**	**1.00**	**0.68**	**Enhance**	**NONE**	**HIGH**	**MED**	**MED**
4008	**1**	**0**	**NONE**	**P9**	**83**	**0.36**	**0.22**	**0.22**	**D9**	**100**	**1.00**	**1.00**	**1.00**	**0.84**	**Enhance**	**NONE**	**HIGH**	**LOW**	**LOW**
4009	1	0	NONE	P2	27	0.22	0.14	0.00	D9	100	1.00	1.00	1.00	0.88	Enhance	MED	NONE	LOW	NONE
4010	1	0	NONE	P2	37	0.17	0.13	0.05	D9	100	1.00	1.00	1.00	1.00	Enhance	MED	NONE	LOW	NONE
4013	2	0	NONE	P2	29	0.13	0.08	0.05	D7	73	1.00	0.92	0.00	0.59	Enhance	NONE	NONE	HIGH	MED
4014	1	0	NONE	P2	13	0.07	0.16	0.00	D7	72	1.00	0.94	0.00	0.48	Enhance	NONE	NONE	HIGH	HIGH

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
4015	3	0	NONE	P6	60	0.26	0.14	0.13	D9	93	1.00	0.67	1.00	0.59	Enhance	NONE	HIGH	HIGH	HIGH
4016	1	0	NONE	P2	36	0.13	0.10	0.08	D9	95	1.00	0.79	1.00	0.60	Enhance	NONE	NONE	HIGH	HIGH
4017	1	0	NONE	P2	48	0.09	0.34	0.04	D5	65	1.00	0.00	1.00	0.31	Restore	NONE	NONE	MED	HIGH
4020	1	0	CZ ONLY	P2	31	0.08	0.20	0.03	D2	68	1.00	0.53	0.00	0.68	Restore	NONE	NONE	HIGH	NONE
4021	1	0	CZ ONLY	P2	29	0.08	0.19	0.03	D7	73	1.00	0.85	0.00	0.74	Enhance	NONE	NONE	HIGH	NONE
4026	1	0	NONE	P2	22	0.10	0.11	0.04	D7	69	1.00	0.77	0.00	0.49	Enhance	NONE	HIGH	LOW	LOW
4032	1	0	NONE	P2	35	0.02	0.37	0.00	D7	66	1.00	1.00	0.00	0.27	Enhance	NONE	NONE	HIGH	NONE
4033	1	0	NONE	P2	42	0.05	0.28	0.05	D2	52	1.00	0.33	0.00	0.23	Restore	NONE	NONE	HIGH	MED
4035	1	0	NONE	P2	26	0.10	0.16	0.03	D2	49	1.00	0.38	0.00	0.17	Restore	NONE	NONE	HIGH	NONE
4036	4	1	NONE	P6	64	0.39	0.14	0.10	D4	62	0.36	0.32	1.00	0.14	Restore	NONE	NONE	MED	LOW
4038	**1**	**1**	**NONE**	**P10**	**84**	**0.26**	**0.47**	**0.09**	**D9**	**81**	**0.66**	**1.00**	**0.90**	**0.18**	**Enhance**	**NONE**	**NONE**	**LOW**	**NONE**
4039	1	1	NONE	P6	72	0.26	0.27	0.07	D9	86	0.66	0.93	0.90	0.27	Enhance	NONE	NONE	MED	NONE
4040	1	1	NONE	P2	34	0.06	0.18	0.07	D3	51	0.00	0.95	0.00	0.51	Restore	NONE	NONE	HIGH	NONE
4041	1	1	NONE	P2	42	0.16	0.15	0.07	D3	52	0.00	0.86	0.00	0.71	Restore	NONE	NONE	HIGH	NONE
4042	1	0	NONE	P6	74	0.32	0.19	0.16	D7	90	1.00	0.75	0.26	0.60	Enhance	NONE	NONE	MED	NONE
4043	5	1	NONE	P6	68	0.24	0.20	0.11	D9	92	0.80	0.98	0.83	0.39	Enhance	NONE	HIGH	LOW	MED
4044	3	0	NONE	P6	66	0.24	0.22	0.09	D9	96	1.00	0.98	1.00	0.46	Enhance	NONE	HIGH	MED	HIGH
4046	1	0	NONE	P6	45	0.20	0.11	0.08	D9	95	1.00	0.82	0.70	0.75	Enhance	NONE	HIGH	LOW	MED
4047	2	0	NONE	P2	57	0.13	0.33	0.05	D7	87	1.00	0.75	0.12	0.53	Enhance	NONE	HIGH	MED	MED
4048	2	0	NONE	P2	51	0.15	0.24	0.05	D2	84	1.00	0.40	0.43	0.52	Restore	NONE	NONE	MED	MED
4049	1	0	NONE	P2	51	0.14	0.20	0.08	D2	85	1.00	0.46	0.49	0.48	Restore	NONE	NONE	HIGH	HIGH
4050	1	0	CZ ONLY	P2	53	0.11	0.37	0.04	D5	67	1.00	0.00	1.00	0.34	Restore	NONE	NONE	NONE	HIGH
4051	1	0	CZ ONLY	P2	15	0.05	0.18	0.00	D5	88	1.00	0.63	1.00	0.37	Restore	NONE	NONE	HIGH	HIGH
4054	1	0	NONE	P2	36	0.09	0.22	0.04	D7	74	1.00	0.91	0.00	0.70	Enhance	NONE	NONE	HIGH	HIGH
4055	2	0	NONE	P2	53	0.18	0.23	0.05	D7	91	1.00	0.95	0.12	0.61	Enhance	NONE	NONE	LOW	MED
4057	1	0	NONE	P2	37	0.08	0.30	0.01	D9	91	1.00	0.85	1.00	0.34	Enhance	NONE	NONE	HIGH	NONE
4060	6	1	NONE	P6	84	0.32	0.31	0.11	D9	95	0.73	0.86	0.81	0.79	Enhance	NONE	HIGH	HIGH	LOW
4061	8	4	NONE	P9	81	0.43	0.22	0.14	D3	84	0.45	0.69	0.53	0.56	Restore	NONE	NONE	MED	MED
4062	3	2	NONE	P2	42	0.21	0.15	0.04	D3	61	0.62	0.62	0.00	0.43	Restore	NONE	NONE	HIGH	LOW
4063	1	1	NONE	P2	44	0.12	0.27	0.03	D3	60	0.38	0.75	0.00	0.46	Restore	NONE	NONE	HIGH	NONE
4064	0	2	NONE	P1	9	0.00	0.00	0.03	D4	67	0.00	0.94	1.00	0.25	Restore	NONE	NONE	MED	NONE
4065	1	2	NONE	P2	62	0.15	0.43	0.05	D4	57	0.00	0.28	1.00	0.29	Restore	NONE	NONE	LOW	NONE
4066	3	2	NONE	P6	60	0.35	0.17	0.07	D6	78	0.48	0.36	0.57	0.48	Restore	NONE	HIGH	MED	NONE
4068	1	1	NONE	P6	61	0.24	0.22	0.06	D3	82	0.37	0.78	0.34	0.48	Restore	NONE	NONE	HIGH	NONE
4069	1	1	NONE	P6	66	0.24	0.26	0.06	D3	80	0.37	0.75	0.34	0.44	Restore	NONE	NONE	MED	NONE
4072	1	1	NONE	P2	29	0.07	0.14	0.07	D3	61	0.00	0.41	0.16	0.62	Restore	NONE	NONE	MED	MED
4073	1	1	NONE	P2	33	0.08	0.16	0.07	D3	70	0.00	0.86	0.17	0.69	Restore	NONE	HIGH	MED	MED
4075	4	2	NONE	P6	69	0.25	0.22	0.10	D3	58	0.63	0.47	0.00	0.37	Restore	NONE	NONE	MED	LOW
4076	**3**	**2**	**NONE**	**P9**	**81**	**0.58**	**0.17**	**0.48**	**D3**	**63**	**0.00**	**0.71**	**0.21**	**0.38**	**Restore**	**NONE**	**NONE**	**MED**	**LOW**
4077	**2**	**2**	**NONE**	**P9**	**79**	**0.61**	**0.15**	**0.50**	**D1**	**52**	**0.00**	**0.26**	**0.15**	**0.34**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
4078	**5**	**2**	**NONE**	**P9**	**87**	**0.50**	**0.22**	**0.22**	**D8**	**76**	**0.45**	**0.32**	**1.00**	**0.40**	**Enhance**	**NONE**	**NONE**	**MED**	**LOW**
4079	1	1	NONE	P6	76	0.36	0.19	0.18	D4	77	0.07	0.77	1.00	0.40	Restore	NONE	HIGH	LOW	LOW
4080	1	1	CZ ONLY	P6	57	0.16	0.18	0.12	D3	53	0.34	0.83	0.00	0.23	Restore	NONE	NONE	MED	NONE
4081	1	1	CZ ONLY	P6	51	0.18	0.13	0.12	D1	31	0.34	0.16	0.00	0.09	Protect	NONE	NONE	MED	NONE
4090	1	0	NONE	P2	24	0.07	0.19	0.02	D7	51	1.00	0.84	0.00	0.07	Enhance	NONE	NONE	MED	LOW
4091	2	0	CZ PRESENT	P2	31	0.10	0.19	0.03	D7	52	1.00	0.64	0.00	0.14	Enhance	NONE	NONE	HIGH	LOW
4092	1	0	CZ ONLY	P2	20	0.06	0.17	0.02	D2	51	1.00	0.49	0.00	0.15	Restore	NONE	NONE	HIGH	LOW
4093	1	1	NONE	P2	42	0.17	0.14	0.07	D1	30	0.23	0.23	0.00	0.08	Protect	NONE	NONE	MED	LOW
4095	1	0	CZ ONLY	P2	58	0.12	0.39	0.05	D9	97	1.00	1.00	1.00	0.55	Enhance	NONE	NONE	HIGH	MED
4096	1	0	CZ ONLY	P2	50	0.12	0.27	0.05	D9	92	1.00	1.00	1.00	0.33	Enhance	NONE	NONE	MED	MED
4097	2	0	CZ PRESENT	P6	54	0.21	0.15	0.10	D5	77	1.00	0.48	1.00	0.19	Restore	NONE	NONE	HIGH	LOW
4098	1	0	CZ ONLY	P2	38	0.14	0.09	0.08	D5	77	1.00	0.53	1.00	0.19	Restore	NONE	NONE	MED	LOW
4101	1	1	NONE	P6	54	0.21	0.16	0.08	D4	55	0.21	0.20	1.00	0.12	Restore	NONE	NONE	MED	NONE
4102	1	1	NONE	P3	66	0.16	0.54	0.05	D4	73	0.21	0.34	1.00	0.46	Restore	NONE	NONE	LOW	LOW
4112	1	0	NONE	P2	8	0.09	0.09	0.00	D5	81	1.00	0.63	1.00	0.21	Restore	NONE	NONE	HIGH	LOW
4115	1	1	NONE	P2	16	0.09	0.10	0.03	D3	21	0.00	0.43	0.00	0.05	Restore	NONE	NONE	MED	LOW

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
4117	1	0	NONE	P2	33	0.04	0.32	0.00	D5	58	1.00	0.10	1.00	0.03	Restore	NONE	NONE	LOW	NONE
4118	1	0	NONE	P2	35	0.09	0.25	0.02	D5	52	1.00	0.00	1.00	0.08	Restore	NONE	NONE	MED	NONE
4123	1	1	CZ ONLY	P2	41	0.10	0.21	0.05	D3	28	0.00	0.42	0.00	0.17	Restore	NONE	NONE	MED	LOW
4124	1	1	CZ ONLY	P2	46	0.10	0.24	0.05	D3	31	0.00	0.64	0.00	0.15	Restore	NONE	NONE	HIGH	LOW
4125	1	1	NONE	P2	48	0.09	0.40	0.03	D3	37	0.00	0.91	0.00	0.16	Restore	NONE	NONE	HIGH	NONE
4126	1	1	NONE	P2	31	0.04	0.27	0.02	D3	36	0.00	0.84	0.00	0.17	Restore	NONE	NONE	HIGH	LOW
4129	1	0	NONE	P2	23	0.08	0.17	0.02	D7	73	1.00	0.72	0.13	0.18	Enhance	NONE	NONE	MED	HIGH
4131	1	1	NONE	P6	70	0.27	0.21	0.10	D3	39	0.12	0.45	0.00	0.18	Restore	NONE	NONE	HIGH	MED
4132	**2**	**1**	**NONE**	**P9**	**69**	**0.45**	**0.15**	**0.13**	**D3**	**60**	**0.68**	**0.48**	**0.00**	**0.42**	**Restore**	**NONE**	**NONE**	**HIGH**	**HIGH**
4133	2	1	NONE	P6	81	0.32	0.29	0.10	D6	84	0.67	0.55	0.38	0.51	Restore	NONE	NONE	MED	HIGH
4134	3	2	NONE	P6	53	0.26	0.21	0.03	D3	57	0.48	0.47	0.00	0.41	Restore	NONE	NONE	HIGH	HIGH
4135	3	2	NONE	P6	71	0.26	0.26	0.08	D3	86	0.72	0.74	0.14	0.60	Restore	NONE	MED	MED	HIGH
4136	1	0	NONE	P2	26	0.12	0.13	0.04	D7	87	1.00	0.88	0.26	0.36	Enhance	NONE	HIGH	MED	HIGH
4137	0	3	NONE	P1	0	0.00	0.00	0.00	D1	15	0.00	0.00	0.00	0.20	Protect	NONE	NONE	LOW	HIGH
4138	0	2	NONE	P1	0	0.00	0.00	0.00	D3	39	0.00	0.50	0.00	0.31	Restore	NONE	NONE	LOW	HIGH
4139	2	1	CZ PRESENT	P6	65	0.19	0.23	0.10	D7	67	0.82	0.89	0.00	0.36	Enhance	NONE	NONE	LOW	MED
4140	1	1	CZ ONLY	P6	55	0.21	0.17	0.08	D3	67	0.63	0.78	0.00	0.56	Restore	NONE	NONE	HIGH	HIGH
4141	**5**	**3**	**NONE**	**P9**	**83**	**0.49**	**0.20**	**0.19**	**D3**	**64**	**0.37**	**0.71**	**0.03**	**0.20**	**Restore**	**NONE**	**NONE**	**MED**	**HIGH**
4142	1	0	NONE	P2	42	0.13	0.19	0.06	D7	57	1.00	0.85	0.00	0.16	Enhance	NONE	NONE	HIGH	HIGH
4150	1	0	NONE	P2	37	0.09	0.19	0.05	D9	100	1.00	1.00	1.00	0.94	Enhance	NONE	NONE	NONE	HIGH
5001	**3**	**0**	**NONE**	**P9**	**77**	**0.45**	**0.17**	**0.22**	**D5**	**65**	**1.00**	**0.00**	**1.00**	**0.30**	**Restore**	**NONE**	**NONE**	**HIGH**	**NONE**
5002	3	2	NONE	P6	71	0.23	0.26	0.09	D1	48	0.00	0.19	0.31	0.23	Protect	NONE	NONE	LOW	LOW
5003	3	2	NONE	P6	67	0.27	0.23	0.07	D6	69	0.56	0.25	0.23	0.30	Restore	NONE	HIGH	LOW	LOW
5004	1	1	NONE	P5	38	0.02	1.00	0.00	D2	26	0.79	0.00	0.00	0.06	Restore	NONE	NONE	NONE	MED
5007	2	1	NONE	P6	69	0.23	0.22	0.11	D1	32	0.12	0.14	0.00	0.18	Protect	NONE	NONE	LOW	LOW
5008	1	1	CZ ONLY	P2	33	0.15	0.08	0.05	D1	21	0.00	0.01	0.00	0.20	Protect	NONE	NONE	MED	LOW
5009	1	1	CZ ONLY	P2	43	0.13	0.20	0.05	D1	12	0.00	0.02	0.00	0.06	Protect	NONE	NONE	LOW	NONE
5010	2	0	CZ PRESENT	P6	66	0.26	0.17	0.13	D5	47	1.00	0.00	1.00	0.02	Restore	NONE	NONE	LOW	NONE
5011	3	1	CZ PRESENT	P6	70	0.25	0.22	0.10	D1	52	0.38	0.05	0.44	0.12	Protect	NONE	NONE	MED	LOW
5012	4	2	NONE	P6	68	0.22	0.24	0.09	D1	62	0.41	0.20	0.13	0.28	Protect	NONE	NONE	LOW	LOW
5015	3	1	NONE	P2	54	0.17	0.23	0.06	D4	38	0.00	0.06	1.00	0.08	Restore	NONE	NONE	LOW	NONE
5016	1	0	NONE	P6	51	0.21	0.22	0.04	D5	62	1.00	0.02	1.00	0.14	Restore	NONE	NONE	LOW	NONE
5017	1	1	NONE	P6	67	0.22	0.19	0.13	D1	34	0.02	0.00	0.04	0.17	Protect	NONE	NONE	LOW	NONE
5018	1	1	NONE	P2	34	0.06	0.25	0.03	D1	20	0.02	0.00	0.00	0.19	Protect	NONE	NONE	LOW	NONE
5019	1	0	NONE	P2	46	0.18	0.16	0.07	D5	75	1.00	0.55	1.00	0.14	Restore	NONE	HIGH	LOW	LOW
5021	**2**	**2**	**NONE**	**P9**	**62**	**0.33**	**0.00**	**0.19**	**D1**	**47**	**0.27**	**0.00**	**0.03**	**0.31**	**Protect**	**NONE**	**NONE**	**NONE**	**LOW**
5022	1	1	NONE	P6	75	0.31	0.19	0.19	D3	65	0.32	0.31	0.03	0.45	Restore	NONE	NONE	LOW	NONE
5024	1	1	NONE	P6	89	0.31	0.36	0.13	D1	24	0.04	0.00	0.00	0.25	Protect	NONE	NONE	LOW	HIGH
5025	1	1	NONE	P6	83	0.23	0.35	0.13	D1	23	0.00	0.00	0.00	0.40	Protect	NONE	NONE	LOW	MED
5027	**3**	**1**	**NONE**	**P9**	**76**	**0.59**	**0.14**	**0.35**	**D2**	**60**	**0.78**	**0.28**	**0.00**	**0.58**	**Restore**	**NONE**	**HIGH**	**LOW**	**MED**
5029	**1**	**1**	**NONE**	**P8**	**70**	**0.40**	**0.08**	**0.84**	**D1**	**22**	**0.00**	**0.16**	**0.00**	**0.14**	**Protect**	**NONE**	**HIGH**	**LOW**	**MED**
5030	**4**	**3**	**CZ PRESENT**	**P9**	**79**	**0.64**	**0.15**	**0.50**	**D1**	**58**	**0.48**	**0.05**	**0.48**	**0.19**	**Protect**	**NONE**	**NONE**	**LOW**	**LOW**
5031	**4**	**1**	**CZ PRESENT**	**P9**	**79**	**0.76**	**0.15**	**0.32**	**D5**	**74**	**0.96**	**0.02**	**1.00**	**0.39**	**Restore**	**NONE**	**NONE**	**MED**	**LOW**
5032	**1**	**0**	**NONE**	**P8**	**77**	**0.76**	**0.12**	**0.90**	**D5**	**59**	**1.00**	**0.00**	**1.00**	**0.19**	**Restore**	**NONE**	**NONE**	**LOW**	**LOW**
5033	**4**	**1**	**NONE**	**P8**	**81**	**1.00**	**0.16**	**0.85**	**D5**	**71**	**0.93**	**0.11**	**0.73**	**0.26**	**Restore**	**NONE**	**NONE**	**LOW**	**LOW**
5034	**3**	**1**	**NONE**	**P9**	**94**	**0.54**	**0.25**	**0.46**	**D9**	**80**	**0.82**	**0.81**	**0.79**	**0.19**	**Enhance**	**NONE**	**NONE**	**LOW**	**MED**
5035	**2**	**1**	**NONE**	**P9**	**92**	**0.52**	**0.24**	**0.44**	**D5**	**75**	**0.80**	**0.13**	**0.79**	**0.33**	**Restore**	**NONE**	**NONE**	**MED**	**MED**
5036	4	4	NONE	P6	78	0.29	0.23	0.14	D1	8	0.00	0.00	0.00	0.10	Protect	NONE	NONE	LOW	LOW
6002	1	0	NONE	P2	31	0.14	0.10	0.05	D2	56	1.00	0.23	0.00	0.36	Restore	NONE	HIGH	HIGH	MED
6004	0	1	NONE	P1	7	0.00	0.00	0.02	D1	33	0.00	0.34	0.00	0.25	Protect	NONE	HIGH	HIGH	LOW
6007	1	0	CZ ONLY	P2	43	0.17	0.13	0.08	D2	52	1.00	0.27	0.00	0.25	Restore	NONE	NONE	HIGH	LOW
6008	1	0	CZ ONLY	P2	71	0.17	0.36	0.08	D2	49	1.00	0.00	0.00	0.74	Restore	NONE	NONE	MED	LOW
6010	1	1	NONE	P2	18	0.08	0.13	0.02	D1	45	0.05	0.30	0.00	0.47	Protect	NONE	NONE	HIGH	LOW
6011	**7**	**5**	**NONE**	**P9**	**77**	**0.66**	**0.15**	**0.29**	**D1**	**58**	**0.34**	**0.10**	**0.26**	**0.24**	**Protect**	**NONE**	**NONE**	**MED**	**LOW**
6012	1	1	NONE	P2	55	0.16	0.26	0.05	D1	24	0.00	0.00	0.00	0.45	Protect	NONE	NONE	MED	NONE
6013	1	0	NONE	P2	51	0.13	0.25	0.05	D2	58	1.00	0.22	0.00	0.47	Restore	NONE	NONE	HIGH	MED

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
6014	2	0	NONE	P6	56	0.24	0.17	0.07	D2	57	1.00	0.24	0.00	0.40	Restore	NONE	NONE	MED	MED
6015	1	0	CZ ONLY	P2	22	0.10	0.16	0.02	D2	48	1.00	0.10	0.00	0.25	Restore	NONE	NONE	MED	NONE
6016	2	2	CZ PRESENT	P2	70	0.20	0.35	0.07	D1	24	0.00	0.22	0.00	0.17	Protect	NONE	NONE	MED	LOW
6017	**3**	**3**	**NONE**	**P9**	**94**	**0.37**	**0.34**	**0.18**	**D4**	**63**	**0.09**	**0.29**	**1.00**	**0.26**	**Restore**	**NONE**	**NONE**	**LOW**	**MED**
6018	2	3	NONE	P6	68	0.36	0.14	0.18	D4	70	0.02	0.31	1.00	0.55	Restore	NONE	NONE	MED	LOW
6019	**2**	**1**	**NONE**	**P9**	**77**	**0.52**	**0.15**	**0.32**	**D8**	**79**	**0.70**	**0.11**	**0.74**	**0.63**	**Enhance**	**NONE**	**NONE**	**MED**	**NONE**
6020	**1**	**1**	**NONE**	**P9**	**77**	**0.44**	**0.17**	**0.23**	**D4**	**66**	**0.06**	**0.11**	**0.71**	**0.66**	**Restore**	**NONE**	**NONE**	**LOW**	**LOW**
6022	**2**	**1**	**NONE**	**P9**	**76**	**0.49**	**0.14**	**0.46**	**D8**	**84**	**0.72**	**0.35**	**1.00**	**0.49**	**Enhance**	**NONE**	**NONE**	**LOW**	**NONE**
6025	**3**	**1**	**NONE**	**P8**	**77**	**0.72**	**0.13**	**0.71**	**D5**	**76**	**0.98**	**0.10**	**1.00**	**0.35**	**Restore**	**NONE**	**HIGH**	**MED**	**LOW**
6027	1	1	NONE	P2	34	0.15	0.14	0.05	D1	33	0.00	0.27	0.00	0.30	Protect	NONE	NONE	MED	HIGH
6028	1	1	NONE	P2	38	0.13	0.18	0.05	D1	24	0.00	0.05	0.00	0.24	Protect	NONE	NONE	MED	LOW
6031	1	0	CZ ONLY	P6	52	0.20	0.13	0.11	D2	65	1.00	0.44	0.00	0.61	Restore	NONE	NONE	HIGH	HIGH
6032	1	0	CZ ONLY	P6	77	0.20	0.33	0.11	D7	71	1.00	1.00	0.00	0.40	Enhance	NONE	NONE	LOW	MED
6033	**1**	**1**	**NONE**	**P9**	**93**	**0.39**	**0.29**	**0.25**	**D3**	**68**	**0.30**	**1.00**	**0.11**	**0.18**	**Restore**	**NONE**	**NONE**	**LOW**	**NONE**
6034	**1**	**1**	**NONE**	**P9**	**74**	**0.39**	**0.16**	**0.24**	**D1**	**40**	**0.30**	**0.00**	**0.10**	**0.15**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
6035	1	1	NONE	P2	61	0.13	0.27	0.10	D4	40	0.00	0.00	1.00	0.13	Restore	NONE	NONE	LOW	NONE
6036	4	2	NONE	P6	76	0.30	0.20	0.17	D6	79	0.62	0.35	0.58	0.42	Restore	NONE	NONE	MED	NONE
6041	1	0	CZ ONLY	P6	64	0.21	0.18	0.13	D7	70	1.00	0.70	0.00	0.65	Enhance	NONE	HIGH	MED	MED
6042	**6**	**1**	**CZ PRESENT**	**P9**	**73**	**0.46**	**0.14**	**0.23**	**D3**	**58**	**0.65**	**0.39**	**0.00**	**0.43**	**Restore**	**NONE**	**HIGH**	**HIGH**	**LOW**
6043	1	1	NONE	P6	80	0.26	0.23	0.25	D1	41	0.00	0.32	0.18	0.10	Protect	NONE	NONE	LOW	LOW
6044	**1**	**1**	**NONE**	**P9**	**63**	**0.27**	**0.09**	**0.25**	**D3**	**60**	**0.00**	**0.53**	**0.23**	**0.37**	**Restore**	**NONE**	**HIGH**	**MED**	**LOW**
6045	1	0	NONE	P2	31	0.11	0.16	0.04	D2	62	1.00	0.33	0.00	0.50	Restore	NONE	HIGH	HIGH	MED
6046	1	0	NONE	P2	29	0.10	0.16	0.04	D2	49	1.00	0.42	0.00	0.15	Restore	NONE	NONE	HIGH	MED
6047	**5**	**3**	**NONE**	**P9**	**77**	**0.65**	**0.13**	**0.51**	**D1**	**62**	**0.14**	**0.32**	**0.33**	**0.28**	**Protect**	**NONE**	**NONE**	**HIGH**	**LOW**
6048	**1**	**1**	**NONE**	**P9**	**90**	**0.46**	**0.23**	**0.48**	**D1**	**48**	**0.16**	**0.00**	**0.26**	**0.29**	**Protect**	**NONE**	**NONE**	**MED**	**LOW**
6049	**3**	**2**	**CZ PRESENT**	**P9**	**84**	**0.60**	**0.18**	**0.54**	**D6**	**70**	**0.70**	**0.11**	**0.44**	**0.30**	**Restore**	**NONE**	**NONE**	**MED**	**LOW**
6050	**1**	**0**	**CZ ONLY**	**P9**	**75**	**0.44**	**0.15**	**0.46**	**D2**	**47**	**1.00**	**0.07**	**0.00**	**0.26**	**Restore**	**NONE**	**NONE**	**LOW**	**MED**
6052	3	0	NONE	P6	61	0.32	0.12	0.12	D5	76	1.00	0.38	1.00	0.20	Restore	NONE	LOW	LOW	NONE
6053	**1**	**1**	**NONE**	**P9**	**69**	**0.46**	**0.20**	**0.07**	**D3**	**58**	**0.20**	**0.66**	**0.00**	**0.62**	**Restore**	**NONE**	**NONE**	**LOW**	**NONE**
6054	**1**	**1**	**NONE**	**P9**	**58**	**0.46**	**0.13**	**0.07**	**D3**	**51**	**0.20**	**0.44**	**0.00**	**0.47**	**Restore**	**NONE**	**NONE**	**LOW**	**NONE**
6057	1	0	CZ ONLY	P2	59	0.12	0.28	0.08	D2	33	1.00	0.02	0.00	0.06	Restore	NONE	NONE	HIGH	NONE
6058	1	0	CZ ONLY	P2	42	0.12	0.16	0.08	D2	50	1.00	0.48	0.00	0.15	Restore	NONE	NONE	HIGH	NONE
6059	1	0	NONE	P2	32	0.13	0.17	0.03	D2	49	1.00	0.49	0.00	0.12	Restore	NONE	LOW	HIGH	NONE
6060	1	1	NONE	P2	33	0.12	0.19	0.03	D1	24	0.01	0.26	0.00	0.06	Protect	NONE	HIGH	HIGH	NONE
6061	0	1	NONE	P1	11	0.00	0.00	0.04	D1	37	0.00	0.26	0.16	0.08	Protect	NONE	HIGH	LOW	LOW
6062	1	1	NONE	P6	56	0.19	0.15	0.16	D1	33	0.00	0.31	0.00	0.27	Protect	NONE	NONE	MED	NONE
7014	1	1	NONE	P1	11	0.09	0.00	0.02	D1	15	0.47	0.00	0.00	0.00	Protect	NONE	NONE	NONE	NONE
7015	2	0	NONE	P1	39	0.20	0.00	0.07	D2	25	1.00	0.00	0.00	0.04	Restore	NONE	NONE	NONE	NONE
7016	1	1	CZ ONLY	P1	21	0.12	0.00	0.04	D1	11	0.17	0.00	0.00	0.01	Protect	NONE	NONE	NONE	NONE
7017	3	3	CZ PRESENT	P1	31	0.18	0.00	0.05	D1	3	0.00	0.00	0.00	0.02	Protect	NONE	NONE	NONE	NONE
7020	3	3	NONE	P5	74	0.20	1.00	0.06	D4	42	0.00	0.00	0.54	0.31	Restore	NONE	NONE	NONE	LOW
7022	3	3	NONE	P1	22	0.14	0.00	0.03	D1	45	0.11	0.00	0.32	0.24	Protect	NONE	NONE	NONE	LOW
7023	**3**	**3**	**NONE**	**P7**	**92**	**0.29**	**0.81**	**0.12**	**D1**	**44**	**0.09**	**0.00**	**0.17**	**0.26**	**Protect**	**NONE**	**NONE**	**NONE**	**LOW**
7024	1	1	NONE	P5	89	0.25	1.00	0.12	D1	32	0.08	0.00	0.00	0.47	Protect	NONE	NONE	NONE	NONE
7026	4	4	NONE	P6	86	0.34	0.29	0.13	D1	3	0.00	0.00	0.00	0.03	Protect	NONE	NONE	LOW	LOW
7027	1	1	NONE	P2	67	0.19	0.29	0.07	D1	14	0.00	0.00	0.00	0.19	Protect	NONE	NONE	LOW	NONE
7038	1	1	NONE	P2	23	0.04	0.19	0.02	D1	24	0.00	0.00	0.01	0.12	Protect	NONE	NONE	LOW	LOW
7039	1	1	NONE	P6	65	0.18	0.22	0.11	D1	32	0.03	0.00	0.00	0.50	Protect	NONE	NONE	MED	NONE
7040	1	1	NONE	P1	43	0.17	0.00	0.10	D1	26	0.03	0.00	0.00	0.28	Protect	NONE	NONE	NONE	NONE
7041	2	2	NONE	P1	37	0.19	0.00	0.06	D4	41	0.00	0.00	0.61	0.28	Restore	NONE	NONE	NONE	LOW
7042	**5**	**5**	**NONE**	**P10**	**92**	**0.30**	**0.43**	**0.16**	**D1**	**9**	**0.02**	**0.00**	**0.00**	**0.02**	**Protect**	**NONE**	**NONE**	**LOW**	**NONE**
7043	1	1	NONE	P5	70	0.12	0.89	0.09	D1	24	0.46	0.00	0.00	0.12	Protect	NONE	HIGH	LOW	NONE
7044	1	1	CZ ONLY	P2	46	0.09	0.45	0.02	D1	3	0.00	0.00	0.00	0.02	Protect	NONE	NONE	LOW	NONE
7045	1	1	CZ ONLY	P2	38	0.08	0.29	0.02	D1	5	0.00	0.00	0.00	0.06	Protect	NONE	NONE	MED	NONE
7046	2	2	CZ PRESENT	P3	64	0.13	0.49	0.06	D1	23	0.43	0.00	0.00	0.10	Protect	NONE	NONE	LOW	NONE
7047	1	2	CZ ONLY	P2	64	0.15	0.39	0.06	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	LOW	NONE

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
7053	5	2	CZ PRESENT	P7	76	0.22	0.72	0.06	D1	54	0.47	0.33	0.07	0.09	Protect	NONE	NONE	LOW	NONE
7054	5	3	CZ PRESENT	P6	88	0.31	0.39	0.10	D1	56	0.40	0.51	0.06	0.09	Protect	NONE	NONE	LOW	NONE
7055	2	1	NONE	P3	52	0.12	0.55	0.02	D4	67	0.30	0.64	0.69	0.18	Restore	NONE	NONE	LOW	LOW
7057	2	1	NONE	P6	87	0.30	0.30	0.17	D9	93	0.82	1.00	0.74	0.41	Enhance	NONE	HIGH	LOW	LOW
7058	1	1	NONE	P2	62	0.15	0.36	0.05	D1	40	0.31	0.00	0.08	0.16	Protect	NONE	NONE	LOW	LOW
7061	2	0	NONE	P6	63	0.22	0.23	0.07	D2	74	1.00	0.33	0.33	0.26	Restore	NONE	NONE	LOW	LOW
7063	1	1	NONE	P1	7	0.06	0.00	0.01	D1	25	0.00	0.00	0.03	0.13	Protect	NONE	NONE	NONE	NONE
7064	1	1	NONE	P2	37	0.07	0.29	0.02	D3	56	0.00	0.66	0.20	0.23	Restore	NONE	HIGH	LOW	MED
7067	1	0	NONE	P6	77	0.26	0.30	0.09	D5	77	1.00	0.23	1.00	0.30	Restore	NONE	NONE	MED	NONE
7068	2	0	NONE	P7	89	0.30	0.66	0.10	D5	48	1.00	0.00	1.00	0.03	Restore	NONE	NONE	NONE	NONE
7077	2	2	NONE	P2	70	0.22	0.32	0.07	D1	5	0.00	0.00	0.00	0.06	Protect	NONE	NONE	LOW	NONE
7078	1	1	NONE	P2	48	0.14	0.20	0.07	D1	9	0.00	0.00	0.00	0.11	Protect	NONE	NONE	LOW	NONE
7079	1	1	NONE	P2	40	0.12	0.17	0.06	D1	3	0.00	0.00	0.00	0.02	Protect	NONE	NONE	LOW	LOW
7080	1	1	NONE	P6	63	0.28	0.18	0.10	D2	56	0.81	0.55	0.00	0.24	Restore	NONE	NONE	LOW	LOW
7084	1	1	NONE	P2	51	0.10	0.46	0.03	D1	12	0.12	0.00	0.00	0.03	Protect	NONE	NONE	LOW	NONE
7085	5	3	NONE	P10	91	0.33	0.41	0.12	D5	55	0.71	0.02	0.63	0.09	Restore	NONE	NONE	LOW	LOW
7086	6	3	NONE	P9	88	0.41	0.27	0.15	D6	53	0.63	0.01	0.34	0.11	Restore	NONE	HIGH	LOW	LOW
7087	2	2	NONE	P10	81	0.25	0.43	0.09	D1	24	0.00	0.00	0.00	0.44	Protect	NONE	NONE	LOW	NONE
7088	3	3	NONE	P9	100	0.40	0.48	0.25	D1	58	0.10	0.15	0.22	0.31	Protect	NONE	NONE	LOW	NONE
7089	2	2	NONE	P6	91	0.32	0.29	0.24	D3	63	0.08	0.89	0.03	0.22	Restore	NONE	HIGH	LOW	NONE
7090	1	1	NONE	P6	63	0.22	0.19	0.11	D3	74	0.24	0.80	0.19	0.35	Restore	NONE	HIGH	LOW	NONE
7091	1	1	NONE	P6	65	0.21	0.20	0.11	D3	69	0.24	0.42	0.20	0.43	Restore	NONE	NONE	MED	NONE
7092	1	1	CZ ONLY	P2	50	0.17	0.16	0.09	D1	30	0.56	0.00	0.00	0.18	Protect	NONE	NONE	MED	NONE
7093	1	1	CZ ONLY	P2	44	0.16	0.19	0.05	D1	25	0.56	0.00	0.00	0.10	Protect	NONE	NONE	LOW	NONE
7094	2	1	NONE	P2	58	0.16	0.27	0.06	D1	31	0.50	0.00	0.00	0.20	Protect	NONE	NONE	LOW	NONE
7095	1	1	NONE	P3	56	0.08	0.51	0.05	D3	42	0.00	1.00	0.00	0.21	Restore	NONE	HIGH	LOW	NONE
7096	2	2	CZ PRESENT	P6	83	0.29	0.27	0.15	D3	55	0.64	0.74	0.00	0.21	Restore	NONE	NONE	LOW	NONE
7097	1	1	CZ ONLY	P6	76	0.25	0.23	0.15	D2	44	0.71	0.12	0.00	0.20	Restore	NONE	NONE	LOW	NONE
7098	1	1	NONE	P6	72	0.25	0.23	0.11	D1	33	0.25	0.00	0.27	0.02	Protect	NONE	NONE	LOW	NONE
7100	3	2	CZ PRESENT	P2	69	0.19	0.32	0.07	D1	27	0.00	0.00	0.24	0.09	Protect	NONE	NONE	LOW	LOW
7101	3	3	CZ PRESENT	P6	78	0.23	0.29	0.12	D4	34	0.00	0.00	0.52	0.17	Restore	NONE	NONE	MED	LOW
7102	1	1	NONE	P6	77	0.20	0.32	0.13	D1	27	0.00	0.00	0.07	0.14	Protect	NONE	NONE	LOW	NONE
7103	1	1	NONE	P6	82	0.20	0.39	0.12	D1	9	0.00	0.00	0.00	0.12	Protect	NONE	NONE	LOW	NONE
7108	1	0	NONE	P2	62	0.14	0.29	0.08	D2	23	1.00	0.00	0.00	0.00	Restore	NONE	NONE	MED	NONE
7109	1	1	CZ ONLY	P2	19	0.09	0.18	0.00	D1	33	0.00	0.29	0.00	0.29	Protect	NONE	NONE	LOW	NONE
7112	1	1	CZ ONLY	P6	50	0.24	0.10	0.08	D1	15	0.00	0.05	0.00	0.09	Protect	NONE	NONE	LOW	MED
7113	1	0	CZ ONLY	P6	59	0.21	0.19	0.09	D2	25	1.00	0.00	0.00	0.03	Restore	NONE	NONE	LOW	NONE
7114	1	0	CZ ONLY	P2	52	0.19	0.18	0.07	D2	26	1.00	0.00	0.00	0.04	Restore	NONE	NONE	LOW	LOW
7121	1	1	CZ ONLY	P6	58	0.23	0.16	0.10	D1	10	0.06	0.00	0.00	0.02	Protect	NONE	NONE	LOW	NONE
7122	1	1	CZ ONLY	P6	75	0.23	0.28	0.10	D1	13	0.06	0.00	0.00	0.06	Protect	NONE	NONE	LOW	NONE
7131	1	0	CZ ONLY	P6	74	0.25	0.22	0.17	D5	56	1.00	0.00	1.00	0.14	Restore	NONE	NONE	MED	MED
7132	1	0	CZ ONLY	P6	78	0.25	0.24	0.17	D5	55	1.00	0.00	1.00	0.13	Restore	NONE	NONE	LOW	LOW
7133	3	1	CZ PRESENT	P6	74	0.32	0.19	0.14	D5	74	0.85	0.38	1.00	0.19	Restore	NONE	NONE	LOW	LOW
7134	1	0	CZ ONLY	P6	64	0.22	0.19	0.12	D2	28	1.00	0.00	0.00	0.07	Restore	NONE	NONE	LOW	LOW
7138	1	0	NONE	P9	72	0.46	0.10	0.46	D2	54	1.00	0.10	0.00	0.41	Restore	NONE	HIGH	MED	LOW
7144	1	0	NONE	P9	74	0.49	0.13	0.35	D5	78	1.00	0.03	1.00	0.55	Restore	NONE	HIGH	LOW	NONE
7145	1	1	NONE	P9	68	0.58	0.09	0.16	D3	55	0.19	0.58	0.00	0.52	Restore	NONE	NONE	HIGH	NONE
7146	5	1	CZ PRESENT	P9	76	0.48	0.15	0.32	D5	71	0.84	0.16	0.90	0.24	Restore	NONE	NONE	LOW	NONE
7151	1	0	NONE	P6	49	0.22	0.10	0.09	D2	51	1.00	0.39	0.00	0.19	Restore	NONE	NONE	LOW	HIGH
7154	2	2	NONE	P2	52	0.16	0.22	0.06	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	LOW	HIGH
7157	1	0	NONE	P2	15	0.08	0.11	0.03	D9	94	1.00	0.66	1.00	0.83	Enhance	NONE	HIGH	LOW	MED
7158	1	0	NONE	P2	41	0.09	0.25	0.04	D9	100	1.00	1.00	1.00	0.84	Enhance	NONE	NONE	LOW	MED
7159	1	0	NONE	P2	33	0.09	0.19	0.04	D9	100	1.00	1.00	1.00	0.83	Enhance	LOW	NONE	LOW	LOW
7160	1	1	NONE	P2	52	0.08	0.36	0.05	D4	89	0.21	1.00	1.00	0.87	Restore	MED	NONE	MED	HIGH
7161	1	4	NONE	P6	65	0.18	0.22	0.13	D4	72	0.00	0.98	1.00	0.35	Restore	HIGH	HIGH	LOW	HIGH

Barrier Embayment Sites

Site	Historical Count	Current Count	Convergence	Potential Group	Potential Score	Embayment Length	Embayment Density	Wetland Area	Degradation Group	Degradation Score	Lost Embayment Length	Sediment Supply Degradation	Tidal Flow Degradation	Nearshore Impervious	Recommendation	Active Railroad Risk	Jetty Influence Risk	Parcel Density Risk	Nearshore Development Risk
7163	1	1	NONE	P9	67	0.31	0.11	0.30	D5	82	0.97	0.51	1.00	0.27	Restore	NONE	NONE	MED	MED
7164	0	1	NONE	P1	8	0.00	0.00	0.03	D1	19	0.00	0.16	0.00	0.09	Protect	NONE	NONE	LOW	HIGH
7165	3	3	NONE	P8	76	0.81	0.11	1.00	D5	67	0.76	0.29	0.83	0.14	Restore	NONE	NONE	LOW	NONE
7166	1	0	CZ ONLY	P6	56	0.21	0.16	0.10	D5	81	1.00	0.34	1.00	0.33	Restore	NONE	NONE	LOW	NONE
7167	1	0	CZ ONLY	P2	60	0.15	0.27	0.08	D9	98	1.00	1.00	1.00	0.57	Enhance	NONE	NONE	LOW	NONE
7168	2	2	NONE	P6	80	0.29	0.25	0.12	D3	74	0.05	1.00	0.10	0.46	Restore	NONE	NONE	LOW	NONE
7169	2	3	NONE	P2	44	0.19	0.16	0.05	D4	75	0.00	1.00	0.68	0.53	Restore	MED	HIGH	LOW	MED
7170	1	0	CZ ONLY	P6	70	0.25	0.20	0.13	D9	100	1.00	1.00	1.00	0.91	Enhance	LOW	NONE	LOW	NONE
7171	2	0	CZ PRESENT	P2	21	0.10	0.16	0.02	D9	99	1.00	0.98	1.00	0.76	Enhance	MED	HIGH	MED	HIGH
7172	0	1	CZ PRESENT	P1	26	0.00	0.00	0.10	D3	47	0.00	1.00	0.00	0.32	Restore	NONE	NONE	LOW	HIGH
7174	0	1	NONE	P1	3	0.00	0.00	0.01	D3	45	0.00	0.81	0.00	0.36	Restore	NONE	NONE	HIGH	HIGH
7176	1	0	CZ ONLY	P2	39	0.13	0.29	0.00	D5	47	1.00	0.00	1.00	0.02	Restore	NONE	NONE	LOW	NONE
8001	6	1	NONE	P9	76	0.54	0.17	0.15	D5	68	0.96	0.10	1.00	0.20	Restore	NONE	LOW	HIGH	LOW
8055	6	0	NONE	P9	74	0.75	0.10	0.37	D9	97	1.00	1.00	1.00	0.53	Enhance	LOW	HIGH	LOW	MED
8056	4	2	CZ PRESENT	P9	84	0.36	0.22	0.30	D8	75	0.55	0.34	0.87	0.29	Enhance	NONE	MED	LOW	MED
8057	2	1	NONE	P2	21	0.15	0.08	0.02	D2	43	0.65	0.02	0.00	0.27	Restore	NONE	NONE	LOW	LOW
8058	5	4	NONE	P8	80	0.81	0.15	0.77	D4	54	0.29	0.07	1.00	0.14	Restore	NONE	HIGH	LOW	MED
8201	1	1	NONE	P6	53	0.22	0.09	0.13	D9	78	0.64	0.71	1.00	0.20	Enhance	HIGH	NONE	LOW	MED
8211	3	0	NONE	P6	70	0.28	0.17	0.19	D5	66	1.00	0.09	1.00	0.16	Restore	NONE	NONE	MED	NONE
8220	1	1	NONE	P6	74	0.22	0.25	0.12	D1	26	0.45	0.00	0.00	0.14	Protect	NONE	NONE	LOW	NONE
8230	3	3	NONE	P2	39	0.10	0.18	0.07	D1	26	0.00	0.08	0.00	0.24	Protect	NONE	NONE	MED	MED
8401	1	1	NONE	P2	25	0.09	0.17	0.03	D3	36	0.00	0.63	0.00	0.22	Restore	NONE	NONE	LOW	MED

Coastal Inlet Sites

Coastal inlets sites frequently occur in an overlap zone between two shoreline process units, and so for each site, an associated SPU is provided for geographic reference. The selection criteria used to identify sites used both PSNERP and SSHIAP data, as described in methods. Whether a site is selected based on the presence of an Open Coastal Inlet (PSNERP), or by the presence of a drowned stream valley (SSHIAP), or by both is indicated in the two columns.

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
1	DES	X		P8	93	0.63	0.20	0.44	D8	100	1.00	1.00	0.98	0.75	Enhance	HIGH	MED	HIGH
2	3043	X	X	P1	17	0.00	0.10	0.10	D8	98	1.00	1.00	0.48	0.72	Enhance	HIGH	MED	HIGH
3	3049	X	X	P9	96	0.24	0.49	0.96	D1	72	0.30	0.13	0.26	0.08	Protect	NONE	NONE	LOW
4	3040		X	P4	36	0.00	0.12	0.19	D1	61	0.09	0.01	0.15	0.30	Protect	NONE	LOW	LOW
5	3049	X	X	P1	11	0.01	0.02	0.13	D1	33	0.48	0.00	0.19	0.03	Protect	NONE	NONE	NONE
6	3044	X		P1	14	0.00	0.09	0.11	D2	37	0.00	0.00	0.25	0.33	Restore	NONE	NONE	MED
7	3050	X		P1	15	0.00	0.09	0.11	D1	48	0.56	0.00	0.05	0.16	Protect	NONE	NONE	NONE
8	3049		X	P1	30	0.02	0.08	0.13	D1	46	0.49	0.00	0.01	0.26	Protect	NONE	NONE	NONE
9	3048	X	X	P4	52	0.02	0.20	0.17	D1	49	0.24	0.00	0.15	0.31	Protect	NONE	LOW	MED
10	3054	X	X	P7	60	0.02	0.14	0.33	D1	56	0.22	0.03	0.19	0.07	Protect	NONE	NONE	NONE
11	3077	X	X	P8	98	0.31	0.57	0.58	D1	68	0.45	0.05	0.20	0.05	Protect	NONE	NONE	MED
12	3076	X		P1	17	0.03	0.05	0.10	D1	25	0.46	0.00	0.05	0.04	Protect	NONE	NONE	NONE
13	3008		X	P1	41	0.07	0.08	0.13	D1	41	0.14	0.00	0.22	0.21	Protect	NONE	NONE	LOW
14	3076	X	X	P1	13	0.03	0.06	0.09	D3	65	0.50	0.00	0.33	0.12	Restore	NONE	NONE	NONE
15	3038		X	P7	89	0.23	0.17	0.39	D1	38	0.29	0.00	0.10	0.19	Protect	NONE	LOW	LOW

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
16	3009		X	P1	36	0.07	0.05	0.16	D4	83	0.41	1.00	0.15	0.15	Restore	LOW	MED	MED
17	3058	X	X	P4	46	0.00	0.14	0.23	D1	22	0.43	0.00	0.01	0.05	Protect	NONE	NONE	NONE
18	3006	X		P8	43	0.00	0.47	0.14	D8	83	1.00	1.00	0.01	0.24	Enhance	NONE	HIGH	LOW
19	3009		X	P4	57	0.08	0.13	0.16	D1	20	0.28	0.00	0.03	0.09	Protect	LOW	HIGH	MED
20	3047		X	P1	24	0.04	0.06	0.10	D2	32	0.00	0.00	0.21	0.22	Restore	NONE	LOW	LOW
21	3078	X	X	P1	27	0.00	0.12	0.14	D1	32	0.17	0.17	0.05	0.03	Protect	LOW	NONE	NONE
22	3078		X	P1	10	0.03	0.05	0.00	D1	2	0.00	0.00	0.01	0.03	Protect	NONE	NONE	NONE
23	3010		X	P4	55	0.07	0.09	0.18	D1	49	0.15	0.03	0.05	0.12	Protect	NONE	NONE	NONE
24	3024	X	X	P9	97	0.23	0.65	0.80	D1	66	0.10	0.24	0.09	0.42	Protect	NONE	NONE	MED
25	3046		X	P1	27	0.04	0.06	0.12	D2	62	0.21	0.00	0.37	0.33	Restore	NONE	LOW	LOW
26	3022	X	X	P1	22	0.00	0.09	0.15	D1	34	0.18	0.00	0.11	0.21	Protect	NONE	NONE	NONE
28	3075		X	P1	40	0.04	0.06	0.18	D3	58	0.79	0.00	0.19	0.10	Restore	LOW	NONE	NONE
29	3037		X	P1	7	0.02	0.03	0.08	D1	52	0.62	0.00	0.08	0.14	Protect	NONE	NONE	NONE
30	3020		X	P1	37	0.03	0.07	0.17	D1	51	0.25	0.00	0.23	0.17	Protect	NONE	NONE	NONE
31	3074		X	P4	23	0.00	0.05	0.21	D1	17	0.37	0.00	0.01	0.05	Protect	NONE	NONE	NONE
32	3262	X	X	P7	86	0.19	0.15	0.34	D1	43	0.10	0.01	0.05	0.13	Protect	LOW	HIGH	MED
33	3047		X	P1	26	0.04	0.06	0.13	D3	74	0.51	0.00	0.37	0.29	Restore	NONE	NONE	NONE
34	3070	X	X	P4	58	0.06	0.09	0.23	D1	58	0.15	0.03	0.13	0.14	Protect	NONE	NONE	NONE
35	3036	X		P1	3	0.00	0.04	0.09	D2	68	0.20	0.00	0.71	0.30	Restore	HIGH	NONE	NONE
36	3034	X	X	P1	40	0.04	0.07	0.17	D1	81	0.27	0.20	0.32	0.20	Protect	NONE	NONE	NONE
37	3014		X	P1	48	0.07	0.06	0.17	D3	69	0.68	0.00	0.21	0.26	Restore	NONE	NONE	NONE
38	3263	X	X	P4	69	0.15	0.07	0.29	D1	31	0.00	0.01	0.01	0.17	Protect	NONE	HIGH	MED
39	3028	X	X	P7	57	0.00	0.16	0.43	D4	51	0.13	0.73	0.06	0.07	Restore	LOW	NONE	NONE
40	3060		X	P4	78	0.13	0.11	0.27	D1	37	0.30	0.00	0.10	0.16	Protect	NONE	NONE	NONE
41	3082	X	X	P9	99	0.37	0.57	1.00	D1	55	0.34	0.04	0.09	0.06	Protect	NONE	LOW	MED
42	3014		X	P4	71	0.14	0.09	0.25	D1	48	0.33	0.00	0.15	0.19	Protect	NONE	NONE	NONE
43	3033		X	P4	52	0.10	0.05	0.20	D1	69	0.36	0.02	0.18	0.10	Protect	NONE	NONE	NONE
44	3032		X	P7	59	0.03	0.09	0.38	D1	29	0.28	0.00	0.10	0.10	Protect	NONE	NONE	NONE
45	3257	X		P4	35	0.01	0.06	0.21	D1	7	0.12	0.00	0.04	0.05	Protect	LOW	LOW	LOW
46	3030		X	P1	14	0.01	0.05	0.13	D1	61	0.53	0.03	0.10	0.06	Protect	LOW	NONE	NONE
47	3016		X	P4	56	0.05	0.08	0.27	D1	25	0.36	0.00	0.15	0.03	Protect	HIGH	NONE	NONE
48	3221		X	P1	32	0.06	0.07	0.11	D1	10	0.32	0.00	0.01	0.02	Protect	NONE	NONE	NONE
49	3004	X		P1	18	0.00	0.10	0.11	D7	97	0.39	1.00	0.87	0.51	Enhance	MED	HIGH	MED
50	3203	X		P1	1	0.00	0.03	0.09	D1	5	0.32	0.00	0.00	0.00	Protect	NONE	NONE	NONE
51	3143		X	P4	50	0.09	0.07	0.16	D1	3	0.13	0.00	0.00	0.02	Protect	NONE	NONE	NONE
52	3062	X		P1	3	0.00	0.05	0.09	D2	71	0.30	0.00	0.31	0.59	Restore	NONE	NONE	NONE
53	3256		X	P4	52	0.07	0.09	0.17	D1	23	0.38	0.00	0.00	0.09	Protect	NONE	HIGH	MED
54	3267		X	P1	29	0.05	0.05	0.14	D1	43	0.29	0.00	0.15	0.16	Protect	NONE	NONE	NONE
55	3202	X		P1	21	0.06	0.03	0.11	D1	6	0.34	0.00	0.00	0.00	Protect	NONE	NONE	NONE
56	3194		X	P1	3	0.01	0.02	0.06	D1	5	0.27	0.00	0.00	0.00	Protect	NONE	NONE	NONE
57	3003		X	P8	98	0.31	1.00	0.44	D8	97	0.70	1.00	0.52	0.61	Enhance	LOW	HIGH	MED
58	3142		X	P4	60	0.07	0.10	0.21	D1	28	0.15	0.16	0.01	0.04	Protect	NONE	MED	MED
59	3206	X		P4	45	0.11	0.03	0.17	D1	0	0.00	0.00	0.00	0.00	Protect	NONE	NONE	NONE
60	3196	X	X	P4	58	0.09	0.06	0.25	D1	1	0.15	0.00	0.00	0.00	Protect	NONE	NONE	NONE
61	3086		X	P1	37	0.07	0.05	0.16	D1	26	0.20	0.00	0.19	0.08	Protect	LOW	NONE	NONE
62	3239	X		P4	42	0.00	0.10	0.25	D8	91	1.00	1.00	0.39	0.08	Enhance	MED	NONE	NONE
63	3199	X	X	P1	19	0.03	0.03	0.13	D1	0	0.00	0.00	0.00	0.00	Protect	MED	NONE	NONE
64	3146	X	X	P4	48	0.01	0.08	0.26	D1	57	0.31	0.03	0.16	0.05	Protect	LOW	NONE	LOW
66	3087	X	X	P8	77	0.06	0.56	0.23	D1	14	0.12	0.00	0.12	0.07	Protect	NONE	NONE	HIGH
67	3100	X	X	P1	11	0.00	0.06	0.13	D1	30	0.46	0.00	0.06	0.06	Protect	NONE	NONE	NONE
68	3100	X		P1	13	0.00	0.09	0.10	D1	36	0.30	0.00	0.00	0.34	Protect	NONE	NONE	NONE
69	3100	X	X	P1	16	0.00	0.09	0.11	D1	2	0.00	0.00	0.00	0.05	Protect	NONE	NONE	NONE
70	3148	X	X	P6	80	0.09	0.17	0.27	D1	54	0.22	0.02	0.22	0.04	Protect	MED	LOW	MED
71	3090	X		P8	95	0.24	0.81	0.37	D8	92	1.00	1.00	0.41	0.08	Enhance	MED	LOW	HIGH
72	3208		X	P1	11	0.02	0.05	0.09	D1	7	0.36	0.00	0.00	0.00	Protect	NONE	NONE	NONE

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
73	3102	X		P1	6	0.00	0.06	0.10	D1	44	0.51	0.00	0.07	0.11	Protect	NONE	NONE	NONE
74	3150	X	X	P4	43	0.00	0.12	0.24	D1	14	0.26	0.00	0.09	0.04	Protect	LOW	NONE	MED
75	3208		X	P1	43	0.04	0.11	0.14	D1	35	0.35	0.00	0.20	0.05	Protect	NONE	NONE	NONE
76	3208		X	P4	53	0.07	0.11	0.17	D1	28	0.61	0.00	0.14	0.00	Protect	NONE	NONE	NONE
77	3094	X	X	P8	94	0.25	0.28	0.52	D1	65	0.45	0.27	0.07	0.06	Protect	NONE	MED	LOW
78	3210		X	P1	22	0.02	0.07	0.12	D1	23	0.51	0.00	0.03	0.04	Protect	NONE	NONE	NONE
79	3235		X	P1	49	0.09	0.08	0.13	D1	1	0.00	0.00	0.00	0.04	Protect	NONE	NONE	NONE
80	3106	X		P4	34	0.06	0.03	0.19	D1	65	0.13	0.02	0.23	0.19	Protect	LOW	NONE	NONE
81	3141		X	P1	35	0.07	0.08	0.09	D1	15	0.00	0.06	0.00	0.07	Protect	NONE	NONE	NONE
82	3107	X	X	P1	32	0.02	0.08	0.15	D1	32	0.52	0.00	0.19	0.00	Protect	LOW	NONE	NONE
83	3210		X	P1	2	0.00	0.03	0.09	D1	8	0.12	0.00	0.00	0.10	Protect	NONE	NONE	NONE
84	3284	X		P4	54	0.13	0.06	0.18	D2	47	0.00	0.00	0.35	0.35	Restore	LOW	MED	LOW
85	3108	X		P1	9	0.00	0.06	0.08	D1	18	0.51	0.00	0.08	0.00	Protect	NONE	NONE	NONE
86	3092	X		P6	54	0.05	0.36	0.11	D1	64	0.00	0.30	0.29	0.13	Protect	NONE	LOW	LOW
87	3141		X	P1	9	0.03	0.02	0.10	D8	54	1.00	1.00	0.00	0.00	Enhance	NONE	NONE	NONE
88	3108	X	X	P1	18	0.01	0.06	0.12	D1	14	0.28	0.00	0.18	0.00	Protect	NONE	NONE	NONE
89	3210	X	X	P1	10	0.03	0.03	0.09	D1	13	0.04	0.00	0.31	0.02	Protect	NONE	NONE	NONE
90	3210	X	X	P1	13	0.01	0.07	0.07	D1	9	0.00	0.00	0.17	0.07	Protect	NONE	NONE	NONE
91	3092	X		P4	50	0.08	0.05	0.19	D1	70	0.24	0.22	0.20	0.10	Protect	LOW	LOW	LOW
92	3093	X		P6	55	0.07	0.20	0.11	D1	38	0.66	0.00	0.02	0.11	Protect	NONE	NONE	LOW
93	3160	X	X	P4	67	0.06	0.12	0.25	D1	22	0.27	0.00	0.18	0.03	Protect	LOW	NONE	LOW
94	3092	X		P8	94	0.24	0.56	0.40	D1	62	0.42	0.03	0.15	0.06	Protect	NONE	LOW	LOW
95	3210		X	P1	5	0.01	0.05	0.00	D1	6	0.00	0.00	0.00	0.10	Protect	NONE	NONE	NONE
96	3282	X	X	P1	6	0.00	0.05	0.13	D1	42	0.12	0.00	0.31	0.16	Protect	LOW	LOW	MED
97	3276	X		P4	47	0.06	0.05	0.22	D2	82	0.07	0.33	0.39	0.42	Restore	MED	NONE	NONE
98	3161	X		P1	22	0.04	0.02	0.14	D1	2	0.16	0.00	0.00	0.00	Protect	NONE	NONE	NONE
99	3108	X	X	P4	69	0.07	0.13	0.25	D1	45	0.44	0.00	0.24	0.06	Protect	NONE	NONE	NONE
100	3278	X	X	P1	8	0.00	0.07	0.09	D2	44	0.00	0.00	0.52	0.25	Restore	NONE	NONE	MED
101	3162	X	X	P6	74	0.09	0.21	0.20	D6	91	0.64	0.46	0.49	0.09	Enhance	LOW	NONE	LOW
102	3217		X	P4	68	0.14	0.08	0.25	D1	26	0.60	0.00	0.02	0.04	Protect	NONE	NONE	NONE
103	3140		X	P4	69	0.10	0.12	0.20	D4	59	0.36	0.80	0.05	0.03	Restore	LOW	NONE	LOW
104	4024	X		P1	20	0.05	0.05	0.09	D8	99	1.00	1.00	0.74	0.96	Enhance	HIGH	NONE	MED
105	3272	X		P1	4	0.01	0.02	0.08	D1	12	0.09	0.00	0.06	0.09	Protect	NONE	NONE	NONE
106	3189		X	P1	28	0.00	0.14	0.13	D3	78	0.65	0.00	0.34	0.35	Restore	LOW	LOW	LOW
107	3182	X		P1	2	0.00	0.02	0.10	D2	11	0.00	0.00	0.46	0.00	Restore	NONE	NONE	NONE
108	3212	X	X	P7	58	0.00	0.16	0.44	D1	26	0.40	0.00	0.14	0.03	Protect	LOW	NONE	NONE
109	3211	X		P1	5	0.00	0.04	0.12	D1	24	0.53	0.00	0.00	0.05	Protect	NONE	NONE	NONE
110	3110		X	P4	53	0.02	0.15	0.21	D1	39	0.29	0.00	0.31	0.06	Protect	NONE	NONE	LOW
111	3187		X	P4	51	0.06	0.10	0.16	D2	66	0.30	0.00	0.40	0.27	Restore	NONE	MED	LOW
112	3180	X		P1	28	0.03	0.04	0.18	D2	82	0.20	0.06	0.51	0.26	Restore	LOW	NONE	NONE
113	3188	X	X	P7	87	0.10	0.27	0.37	D2	80	0.14	0.01	0.50	0.30	Restore	LOW	LOW	MED
114	3114		X	P1	20	0.00	0.07	0.17	D1	18	0.70	0.00	0.00	0.03	Protect	NONE	NONE	NONE
115	3116	X	X	P1	1	0.00	0.03	0.09	D1	18	0.71	0.00	0.01	0.00	Protect	NONE	NONE	NONE
116	3112	X	X	P4	43	0.01	0.13	0.16	D1	8	0.30	0.00	0.00	0.03	Protect	NONE	NONE	HIGH
117	3212	X	X	P1	16	0.03	0.02	0.13	D1	52	0.60	0.00	0.06	0.17	Protect	MED	NONE	NONE
118	3181	X		P1	25	0.07	0.05	0.10	D2	45	0.00	0.00	0.39	0.28	Restore	LOW	NONE	NONE
119	3118		X	P1	15	0.00	0.07	0.13	D3	42	0.91	0.00	0.17	0.04	Restore	NONE	NONE	NONE
120	3139		X	P4	59	0.07	0.11	0.19	D1	8	0.17	0.00	0.01	0.06	Protect	NONE	LOW	LOW
121	3138		X	P6	80	0.10	0.18	0.26	D1	6	0.00	0.00	0.06	0.08	Protect	NONE	NONE	LOW
122	3118	X	X	P7	61	0.02	0.13	0.33	D1	12	0.33	0.00	0.04	0.01	Protect	LOW	NONE	MED
123	3118	X	X	P1	8	0.00	0.07	0.10	D1	9	0.00	0.00	0.11	0.09	Protect	NONE	NONE	NONE
124	3222	X		P1	9	0.02	0.01	0.12	D2	17	0.02	0.00	0.60	0.00	Restore	NONE	NONE	NONE
125	3120		X	P7	46	0.00	0.09	0.32	D1	43	0.33	0.00	0.27	0.06	Protect	NONE	NONE	MED
126	3177	X	X	P4	64	0.07	0.15	0.19	D1	78	0.25	0.25	0.21	0.22	Protect	LOW	NONE	LOW
127	3176	X	X	P4	61	0.08	0.07	0.27	D1	76	0.12	0.08	0.40	0.20	Protect	LOW	NONE	NONE
128	4030	X	X	P7	85	0.07	0.31	0.39	D6	95	0.51	0.53	0.70	0.28	Enhance	HIGH	MED	MED

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
129	3164		X	P4	55	0.12	0.06	0.19	D1	30	0.11	0.04	0.14	0.02	Protect	NONE	HIGH	MED
130	3172	X	X	P4	79	0.12	0.14	0.27	D4	77	0.08	0.57	0.29	0.23	Restore	LOW	NONE	NONE
131	3136	X	X	P6	75	0.06	0.23	0.27	D1	51	0.40	0.00	0.30	0.06	Protect	LOW	NONE	LOW
132	3124	X		P4	38	0.03	0.05	0.23	D1	36	0.07	0.00	0.35	0.11	Protect	MED	LOW	MED
133	3137	X	X	P4	34	0.02	0.05	0.22	D1	34	0.03	0.00	0.28	0.13	Protect	NONE	MED	MED
134	3165	X	X	P1	14	0.04	0.04	0.10	D1	21	0.46	0.00	0.04	0.03	Protect	LOW	NONE	NONE
135	3164	X	X	P6	71	0.07	0.20	0.22	D1	87	0.38	0.43	0.23	0.22	Protect	LOW	LOW	LOW
136	3126	X	X	P4	28	0.01	0.05	0.21	D1	46	0.42	0.00	0.19	0.09	Protect	NONE	NONE	LOW
137	2030		X	P1	31	0.04	0.12	0.04	D3	71	1.00	0.00	0.33	0.13	Restore	LOW	NONE	NONE
138	3135	X		P1	33	0.06	0.04	0.17	D1	14	0.05	0.00	0.09	0.11	Protect	NONE	LOW	LOW
139	3171		X	P4	40	0.10	0.03	0.16	D1	40	0.19	0.00	0.12	0.33	Protect	LOW	NONE	NONE
140	2031		X	P1	8	0.00	0.09	0.00	D2	42	0.00	0.00	0.31	0.29	Restore	MED	NONE	NONE
141	3128		X	P4	71	0.08	0.11	0.27	D1	25	0.28	0.00	0.22	0.02	Protect	NONE	NONE	HIGH
142	**3168**		**X**	**P8**	**95**	**0.39**	**0.42**	**0.43**	**D1**	**71**	**0.05**	**0.09**	**0.37**	**0.20**	**Protect**	**NONE**	**LOW**	**LOW**
143	3132		X	P1	37	0.06	0.05	0.17	D1	20	0.16	0.00	0.38	0.00	Protect	NONE	NONE	NONE
144	**3132**	**X**	**X**	**P8**	**81**	**0.07**	**0.45**	**0.25**	**D1**	**12**	**0.00**	**0.00**	**0.22**	**0.06**	**Protect**	**NONE**	**LOW**	**LOW**
145	3128	X	X	P4	74	0.12	0.10	0.28	D1	67	0.22	0.38	0.24	0.06	Protect	NONE	NONE	LOW
146	**2013**	**X**		**P8**	**97**	**0.34**	**0.72**	**0.39**	**D4**	**50**	**0.15**	**0.60**	**0.14**	**0.03**	**Restore**	**NONE**	**NONE**	**LOW**
147	**3130**	**X**	**X**	**P8**	**74**	**0.07**	**0.59**	**0.17**	**D1**	**78**	**0.36**	**0.36**	**0.36**	**0.05**	**Protect**	**LOW**	**NONE**	**LOW**
148	3168		X	P2	31	0.21	0.04	0.00	D7	89	0.00	1.00	0.75	0.66	Enhance	NONE	NONE	NONE
149	**3171**		**X**	**P7**	**82**	**0.25**	**0.20**	**0.19**	**D8**	**96**	**1.00**	**1.00**	**0.56**	**0.16**	**Enhance**	**LOW**	**NONE**	**LOW**
150	2011	X		P6	65	0.06	0.32	0.16	D8	72	1.00	1.00	0.06	0.04	Enhance	LOW	NONE	NONE
151	4101		X	P4	69	0.11	0.12	0.21	D4	77	0.21	1.00	0.25	0.11	Restore	NONE	LOW	LOW
152	**3130**	**X**	**X**	**P8**	**91**	**0.23**	**0.41**	**0.34**	**D1**	**67**	**0.28**	**0.23**	**0.37**	**0.03**	**Protect**	**LOW**	**LOW**	**LOW**
153	**3170**	**X**	**X**	**P8**	**95**	**0.49**	**0.35**	**0.44**	**D2**	**63**	**0.28**	**0.00**	**0.37**	**0.26**	**Restore**	**NONE**	**NONE**	**LOW**
154	4107	X	X	P1	7	0.00	0.07	0.09	D1	4	0.00	0.00	0.07	0.04	Protect	LOW	NONE	NONE
155	2034		X	P1	33	0.04	0.13	0.00	D4	49	0.00	1.00	0.26	0.00	Restore	LOW	NONE	NONE
156	4036		X	P6	86	0.10	0.29	0.31	D4	73	0.14	1.00	0.19	0.16	Restore	LOW	NONE	LOW
157	**2024**	**X**		**P9**	**99**	**1.00**	**0.55**	**0.71**	**D6**	**85**	**0.53**	**0.32**	**0.23**	**0.12**	**Enhance**	**NONE**	**MED**	**LOW**
158	**2010**	**X**		**P8**	**92**	**0.17**	**0.49**	**0.40**	**D1**	**45**	**0.30**	**0.27**	**0.04**	**0.02**	**Protect**	**NONE**	**NONE**	**LOW**
159	**2034**	**X**	**X**	**P8**	**85**	**0.16**	**0.44**	**0.22**	**D4**	**29**	**0.06**	**1.00**	**0.03**	**0.01**	**Restore**	**LOW**	**NONE**	**LOW**
160	4037		X	P4	72	0.12	0.10	0.24	D4	89	0.66	0.74	0.19	0.19	Restore	LOW	NONE	NONE
161	4040		X	P6	69	0.09	0.38	0.15	D2	47	0.00	0.00	0.56	0.26	Restore	LOW	NONE	LOW
162	**4045**	**X**	**X**	**P8**	**92**	**0.17**	**0.38**	**0.44**	**D6**	**93**	**0.58**	**0.71**	**0.50**	**0.11**	**Enhance**	**MED**	**LOW**	**LOW**
163	**4045**	**X**		**P7**	**88**	**0.16**	**0.20**	**0.39**	**D8**	**100**	**1.00**	**1.00**	**1.00**	**0.68**	**Enhance**	**MED**	**LOW**	**MED**
164	4043	X		P1	42	0.05	0.10	0.12	D4	88	0.30	1.00	0.19	0.42	Restore	LOW	NONE	NONE
165	**4042**		**X**	**P7**	**78**	**0.21**	**0.08**	**0.29**	**D6**	**96**	**1.00**	**0.26**	**0.52**	**0.35**	**Enhance**	**NONE**	**NONE**	**NONE**
166	4053	X		P4	34	0.00	0.06	0.28	D5	69	0.09	0.00	0.80	0.83	Restore	LOW	HIGH	HIGH
167	4042	X	X	P6	56	0.09	0.14	0.13	D6	92	0.29	0.52	0.53	0.25	Enhance	MED	NONE	NONE
168	4054	X	X	P1	25	0.04	0.08	0.09	D5	84	0.00	0.30	0.75	0.74	Restore	LOW	HIGH	HIGH
169	4052	X		P4	37	0.05	0.03	0.22	D2	89	0.23	0.12	0.47	0.82	Restore	NONE	HIGH	HIGH
171	4046		X	P1	0	0.00	0.04	0.00	D5	85	0.00	0.21	0.89	1.00	Restore	HIGH	HIGH	HIGH
172	4048	X		P4	38	0.08	0.03	0.18	D5	70	0.13	0.00	0.64	0.95	Restore	NONE	HIGH	HIGH
173	**4046**	**X**		**P7**	**63**	**0.05**	**0.09**	**0.32**	**D2**	**91**	**0.24**	**0.12**	**0.53**	**0.80**	**Restore**	**HIGH**	**MED**	**MED**
174	4137	X	X	P1	19	0.00	0.11	0.10	D1	48	0.00	0.35	0.17	0.10	Protect	NONE	HIGH	HIGH
175	4055	X	X	P4	66	0.12	0.07	0.23	D2	86	0.15	0.07	0.62	0.56	Restore	NONE	NONE	LOW
176	**4139**		**X**	**P7**	**74**	**0.14**	**0.15**	**0.19**	**D3**	**79**	**0.63**	**0.00**	**0.51**	**0.27**	**Restore**	**NONE**	**MED**	**HIGH**
177	**4058**	**X**	**X**	**P8**	**89**	**0.16**	**0.42**	**0.30**	**D2**	**80**	**0.27**	**0.02**	**0.68**	**0.10**	**Restore**	**NONE**	**NONE**	**MED**
178	4136	X	X	P1	29	0.03	0.10	0.09	D1	86	0.26	0.53	0.28	0.32	Protect	HIGH	HIGH	HIGH
179	**4135**	**X**	**X**	**P7**	**64**	**0.01**	**0.16**	**0.34**	**D2**	**78**	**0.01**	**0.10**	**0.47**	**0.38**	**Restore**	**HIGH**	**HIGH**	**HIGH**
180	4135	X	X	P1	17	0.03	0.05	0.10	D5	87	0.07	0.13	0.88	0.99	Restore	HIGH	HIGH	HIGH
181	4135		X	P1	44	0.04	0.08	0.17	D6	97	0.70	0.39	0.80	0.56	Enhance	MED	MED	HIGH
182	2042	X		P1	45	0.03	0.15	0.12	D1	19	0.30	0.00	0.16	0.02	Protect	NONE	MED	HIGH
183	**2081**		**X**	**P7**	**90**	**0.26**	**0.27**	**0.30**	**D1**	**23**	**0.00**	**0.03**	**0.07**	**0.06**	**Protect**	**NONE**	**LOW**	**NONE**
184	2081		X	P4	60	0.10	0.06	0.26	D1	35	0.49	0.00	0.04	0.09	Protect	NONE	NONE	NONE
185	4061		X	P6	60	0.06	0.21	0.16	D4	81	0.26	0.71	0.13	0.46	Restore	NONE	NONE	LOW

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
186	2080	X	X	P6	84	0.12	0.25	0.26	D1	46	0.22	0.00	0.33	0.10	Protect	NONE	NONE	NONE
187	4141		X	P7	88	0.20	0.19	0.37	D1	60	0.37	0.00	0.23	0.19	Protect	LOW	HIGH	HIGH
188	4060	X	X	P6	63	0.10	0.20	0.13	D8	99	1.00	0.76	0.91	0.44	Enhance	MED	NONE	LOW
189	4060		X	P6	72	0.07	0.30	0.18	D7	93	0.24	0.52	0.79	0.49	Enhance	LOW	LOW	LOW
190	4064	X	X	P6	81	0.07	0.24	0.30	D4	90	0.27	1.00	0.28	0.38	Restore	HIGH	NONE	LOW
191	4133		X	P4	45	0.00	0.16	0.20	D2	62	0.28	0.00	0.32	0.27	Restore	NONE	HIGH	HIGH
192	2088		X	P4	57	0.08	0.11	0.17	D6	82	0.72	0.30	0.26	0.06	Enhance	LOW	NONE	NONE
193	4143	X	X	P1	41	0.06	0.07	0.17	D1	46	0.47	0.00	0.11	0.11	Protect	MED	HIGH	HIGH
194	4004	X		P9	100	0.60	1.00	0.65	D8	98	1.00	1.00	0.62	0.41	Enhance	HIGH	LOW	MED
195	4145	X	X	P4	46	0.00	0.16	0.21	D1	37	0.09	0.00	0.16	0.33	Protect	NONE	HIGH	HIGH
196	2063		X	P7	82	0.24	0.09	0.35	D1	20	0.17	0.00	0.12	0.08	Protect	LOW	NONE	LOW
197	4066		X	P4	73	0.10	0.09	0.28	D7	95	0.34	1.00	0.65	0.33	Enhance	NONE	NONE	NONE
198	4129	X		P7	76	0.06	0.14	0.47	D1	73	0.16	0.13	0.25	0.18	Protect	MED	HIGH	HIGH
200	4066	X	X	P7	86	0.32	0.11	0.37	D6	94	0.48	0.33	0.53	0.29	Enhance	NONE	NONE	NONE
201	4076		X	P1	27	0.03	0.06	0.15	D1	74	0.20	0.33	0.26	0.11	Protect	NONE	NONE	NONE
202	4068		X	P4	49	0.08	0.04	0.22	D2	94	0.37	0.34	0.47	0.56	Restore	LOW	NONE	NONE
203	4070	X	X	P1	12	0.00	0.05	0.17	D2	90	0.37	0.11	0.38	0.33	Restore	LOW	NONE	NONE
204	2062		X	P4	76	0.16	0.10	0.28	D1	39	0.34	0.05	0.01	0.04	Protect	NONE	LOW	MED
205	4071		X	P1	0	0.00	0.03	0.00	D2	52	0.00	0.00	0.34	0.54	Restore	LOW	NONE	NONE
206	4074	X		P1	6	0.00	0.02	0.16	D2	62	0.19	0.00	0.74	0.19	Restore	LOW	NONE	NONE
207	4071		X	P1	24	0.04	0.08	0.00	D2	56	0.00	0.00	0.59	0.38	Restore	LOW	NONE	NONE
208	4072		X	P3	38	0.03	0.26	0.00	D2	53	0.00	0.00	0.66	0.22	Restore	LOW	NONE	LOW
209	4072	X		P7	87	0.11	0.28	0.37	D2	88	0.23	0.16	0.65	0.30	Restore	NONE	HIGH	MED
210	2052	X		P6	67	0.04	0.21	0.22	D1	33	0.15	0.03	0.08	0.04	Protect	LOW	NONE	LOW
211	4077		X	P7	83	0.21	0.14	0.26	D1	24	0.05	0.07	0.01	0.05	Protect	NONE	NONE	NONE
212	4076		X	P8	96	0.62	0.33	0.50	D1	64	0.00	0.17	0.36	0.12	Protect	LOW	NONE	NONE
213	2002		X	P6	66	0.12	0.15	0.14	D1	10	0.00	0.00	0.11	0.11	Protect	LOW	NONE	NONE
214	4078		X	P7	88	0.23	0.20	0.33	D4	74	0.07	1.00	0.27	0.14	Restore	LOW	NONE	LOW
215	QUL	X		P5	51	0.90	0.06	0.11	D1	20	0.00	0.11	0.14	0.01	Protect	LOW	NONE	NONE
216	2065		X	P8	92	0.36	0.36	0.32	D1	2	0.00	0.00	0.03	0.03	Protect	NONE	HIGH	HIGH
217	2072		X	P6	78	0.06	0.30	0.25	D1	38	0.24	0.00	0.18	0.13	Protect	NONE	NONE	NONE
218	2073	X	X	P4	53	0.02	0.17	0.19	D1	34	0.37	0.00	0.09	0.09	Protect	NONE	NONE	NONE
219	2056	X		P7	76	0.29	0.10	0.23	D1	55	0.22	0.21	0.22	0.03	Protect	LOW	MED	MED
220	2066		X	P8	85	0.35	0.31	0.18	D4	66	0.05	0.55	0.56	0.04	Restore	NONE	MED	HIGH
221	5002	X		P1	2	0.00	0.02	0.11	D2	57	0.00	0.00	0.56	0.54	Restore	NONE	LOW	LOW
222	5002	X		P1	20	0.00	0.08	0.14	D1	29	0.08	0.00	0.40	0.06	Protect	NONE	NONE	LOW
223	5002		X	P4	65	0.10	0.12	0.18	D1	88	0.31	0.25	0.47	0.19	Protect	LOW	MED	LOW
224	5034	X	X	P8	94	0.61	0.21	0.51	D4	84	0.71	0.79	0.20	0.08	Restore	LOW	MED	LOW
225	5002	X		P7	83	0.06	0.37	0.34	D6	80	0.52	0.46	0.29	0.04	Enhance	HIGH	LOW	HIGH
226	5003	X	X	P7	75	0.04	0.17	0.37	D1	41	0.10	0.12	0.22	0.02	Protect	LOW	LOW	HIGH
227	1010	X	X	P8	98	0.35	0.69	0.47	D4	75	0.44	0.93	0.30	0.01	Restore	LOW	LOW	HIGH
228	5007	X		P7	63	0.20	0.08	0.18	D1	25	0.04	0.00	0.26	0.09	Protect	LOW	LOW	LOW
229	1018	X	X	P8	91	0.17	0.50	0.33	D2	63	0.13	0.16	0.53	0.03	Restore	NONE	NONE	LOW
230	5019	X		P7	71	0.26	0.05	0.33	D4	86	0.52	1.00	0.21	0.11	Restore	NONE	LOW	MED
231	5024		X	P8	90	0.17	0.61	0.28	D1	21	0.04	0.00	0.26	0.07	Protect	NONE	MED	HIGH
232	5012	X	X	P4	49	0.04	0.07	0.22	D1	60	0.08	0.24	0.23	0.10	Protect	LOW	MED	LOW
233	1013		X	P7	79	0.16	0.15	0.23	D1	53	0.13	0.24	0.13	0.08	Protect	LOW	NONE	LOW
234	6053		X	P8	89	0.09	0.51	0.42	D2	55	0.20	0.00	0.65	0.11	Restore	MED	NONE	NONE
235	1020		X	P8	93	0.28	0.29	0.42	D1	82	0.42	0.26	0.14	0.28	Protect	NONE	LOW	HIGH
236	DUN		X	P5	66	0.66	0.26	0.00	D4	60	0.00	0.87	0.00	0.43	Restore	NONE	MED	HIGH
237	1023		X	P7	68	0.09	0.07	0.36	D1	75	0.29	0.14	0.17	0.25	Protect	NONE	NONE	NONE
238	6011		X	P7	84	0.25	0.16	0.24	D1	11	0.00	0.00	0.15	0.09	Protect	NONE	LOW	MED
239	6017		X	P7	80	0.20	0.15	0.22	D4	58	0.00	1.00	0.22	0.08	Restore	NONE	MED	MED
240	1029	X		P6	65	0.05	0.25	0.18	D1	16	0.33	0.00	0.13	0.00	Protect	NONE	LOW	MED
241	6061	X		P1	23	0.03	0.04	0.14	D1	9	0.11	0.00	0.00	0.11	Protect	NONE	NONE	NONE
242	6036		X	P4	61	0.09	0.10	0.19	D3	57	0.61	0.00	0.48	0.04	Restore	NONE	NONE	NONE
243	8056	X		P1	20	0.04	0.03	0.14	D1	5	0.16	0.00	0.09	0.00	Protect	NONE	NONE	NONE

Coastal Inlet Sites

Site	Shoreline Process Unit	Open Coastal Inlet	Drowned Stream Valley	Potential Group	Potential Score	Wetland Area	Watershed Area	Embayment Length	Degradation Group	Degradation Score	Lost Length	Tidal Flow Degradation	Nearshore Impervious	Watershed Impervious	Recommendation	Marine Development Risk	Nearshore Development Risk	Watershed Development Risk
244	7165	X		P9	100	1.00	0.66	1.00	D4	84	0.74	0.90	0.11	0.13	Restore	LOW	NONE	HIGH
245	7085	X		P6	32	0.00	0.22	0.13	D1	11	0.14	0.00	0.05	0.07	Protect	NONE	MED	HIGH
246	7027	X		P1	12	0.00	0.05	0.15	D1	15	0.05	0.00	0.29	0.03	Protect	MED	NONE	NONE
247	7169	X		P8	91	0.33	0.18	0.49	D6	93	0.35	0.74	0.53	0.27	Enhance	NONE	HIGH	MED
248	7023		X	P7	51	0.15	0.08	0.12	D5	67	0.08	0.00	0.80	0.79	Restore	NONE	NONE	MED
249	7022	X		P4	47	0.04	0.05	0.23	D6	92	0.60	0.43	0.36	0.17	Enhance	HIGH	LOW	LOW
250	7053	X		P4	61	0.05	0.11	0.25	D1	28	0.18	0.00	0.19	0.08	Protect	NONE	NONE	NONE
251	7118	X		P4	30	0.00	0.10	0.17	D1	4	0.08	0.00	0.04	0.00	Protect	NONE	NONE	NONE
252	7053	X		P1	26	0.00	0.08	0.19	D1	19	0.25	0.00	0.02	0.10	Protect	NONE	NONE	NONE
253	7035	X		P1	25	0.04	0.04	0.15	D1	16	0.00	0.00	0.12	0.16	Protect	LOW	NONE	NONE
254	7053	X	X	P1	5	0.00	0.06	0.08	D1	27	0.38	0.00	0.00	0.12	Protect	NONE	NONE	NONE
255	7053	X	X	P1	4	0.00	0.06	0.08	D2	59	0.20	0.00	0.67	0.13	Restore	NONE	NONE	NONE
256	7037	X	X	P7	76	0.06	0.17	0.35	D1	31	0.14	0.01	0.11	0.04	Protect	LOW	LOW	HIGH
257	7062	X		P4	42	0.00	0.15	0.21	D1	17	0.07	0.00	0.18	0.08	Protect	NONE	NONE	NONE
258	7062	X		P4	35	0.00	0.08	0.26	D1	31	0.20	0.00	0.18	0.11	Protect	NONE	NONE	NONE
259	7042	X		P1	31	0.12	0.02	0.13	D1	3	0.00	0.00	0.10	0.00	Protect	LOW	NONE	NONE
260	7042	X		P4	48	0.10	0.03	0.19	D3	54	0.87	0.00	0.22	0.06	Restore	NONE	NONE	NONE
261	7022	X		P1	23	0.00	0.11	0.13	D1	13	0.20	0.00	0.04	0.07	Protect	NONE	NONE	MED
262	7064	X		P1	17	0.00	0.08	0.14	D1	39	0.34	0.00	0.11	0.14	Protect	NONE	HIGH	HIGH
263	7020	X		P1	12	0.00	0.00	0.17	D6	97	0.68	0.75	0.48	0.39	Enhance	HIGH	NONE	NONE
264	7061	X	X	P6	68	0.05	0.23	0.22	D1	76	0.39	0.28	0.43	0.03	Protect	LOW	MED	LOW
265	7055	X	X	P4	82	0.16	0.14	0.27	D4	72	0.09	0.67	0.32	0.10	Restore	MED	NONE	NONE
266	7064	X		P6	39	0.02	0.24	0.08	D1	40	0.37	0.00	0.19	0.08	Protect	NONE	NONE	HIGH
267	7061	X		P1	26	0.00	0.15	0.12	D1	35	0.28	0.00	0.20	0.08	Protect	NONE	NONE	NONE
268	7161	X		P6	83	0.08	0.29	0.29	D4	77	0.12	1.00	0.38	0.11	Restore	NONE	HIGH	HIGH
269	7160		X	P6	73	0.10	0.27	0.17	D7	95	0.21	1.00	0.93	0.51	Enhance	MED	MED	HIGH
270	7141	X	X	P9	97	0.20	0.75	0.82	D1	75	0.16	0.18	0.39	0.12	Protect	NONE	LOW	MED

Appendix C – Metadata

All final site identification queries were completed under contract by Erin Iverson, Anchor QEA. An initial query was used to select a population of sites. For that population of sites a number of calculations were completed to extract metrics used in analyses.

River Delta Strategy

Candidate Sites: feature class "fd_GSUs"
Delta Process Units

Data Needed	Source	Calculation
Historical Estuarine Mixing (EM) Wetland area (m2), Historical Oligahaline Transition (OT) Wetland area (m2), Historical Tidal Freshwater (TF) Wetland area (m2)	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	refqry_PU_TotalHistoricWetlandArea_Xtab: TRANSFORM Sum(refqry_PU_TotalHistoricWetlandArea.HistoricArea) AS SumOfHistoricArea SELECT refqry_PU_TotalHistoricWetlandArea.PU FROM refqry_PU_TotalHistoricWetlandArea WHERE (((refqry_PU_TotalHistoricWetlandArea.Class) Not In ('EU'))) GROUP BY refqry_PU_TotalHistoricWetlandArea.PU ORDER BY refqry_PU_TotalHistoricWetlandArea.PU PIVOT "H_Wetlands_" & [Class] & "_m2";
Current Estuarine Mixing (EM) Wetlands area (m2), Current Oligahaline Transition (OT) Wetland area (m2), Current Tidal Freshwater (TF) Wetland area (m2)	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	refqry_PU_TotalCurrentWetlandArea_Xtab: TRANSFORM Sum(refqry_PU_TotalCurrentWetlandArea.CurrentArea) AS SumOfCurrentArea SELECT refqry_PU_TotalCurrentWetlandArea.PU FROM refqry_PU_TotalCurrentWetlandArea WHERE (((refqry_PU_TotalCurrentWetlandArea.Class) Not In ('EU'))) GROUP BY refqry_PU_TotalCurrentWetlandArea.PU ORDER BY refqry_PU_TotalCurrentWetlandArea.PU PIVOT "C_Wetlands_" & [Class] & "_m2";
Total Historical wetland area excluding euryhaline	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	H_Wetlands_all3_m2: Sum of Historical Estuarine Mixing (EM) Wetland area (m2), Historical Oligahaline Transition (OT) Wetland area (m2), Historical Tidal Freshwater (TF) Wetland area (m2)
Total Current wetland area excluding euryhaline	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	C_Wetlands_all3_m2: Sum of Current Estuarine Mixing (EM) Wetlands area (m2), Current Oligahaline Transition (OT) Wetland area (m2), Current Tidal Freshwater (TF) Wetland area (m2)
Change in veg. wetland area	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	ChangeInVegWetlandArea_m2: Historical EM+OT+TF – current EM+OT+TF
Potential Swamp area	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	LargestWetlands_m2: Greater of Hist OT+TF or Curr OT+TF

Data Needed	Source	Calculation
Historical Delta Shoreform length within DPU	PSNERP_CA_2.0.mdb!fd_shore-form_change	HistDeltaLen_m: SELECT refqry_PU_TotalHistoricShoreformLength_01.PU, refqry_PU_TotalHistoricShoreformLength_01.[Process Units], refqry_PU_TotalHistoricShoreformLength_01.HistSF, Sum(refqry_PU_TotalHistoricShoreformLength_01.ShorelineLength) AS TotalHistLen_m FROM refqry_PU_TotalHistoricShoreformLength_01 WHERE (((refqry_PU_TotalHistoricShoreformLength_01.HistSF)="D")) GROUP BY refqry_PU_TotalHistoricShoreformLength_01.PU, refqry_PU_TotalHistoricShoreformLength_01.[Process Units], refqry_PU_TotalHistoricShoreformLength_01.HistSF;
Current Delta Shoreform length within DPU	PSNERP_CA_2.0.mdb!fd_shore-form_change	CurrDeltaLen_m: SELECT refqry_PU_TotalCurrentShoreformLength_01.PU, refqry_PU_TotalCurrentShoreformLength_01.[Process Units], refqry_PU_TotalCurrentShoreformLength_01.CurrSF, Sum(refqry_PU_TotalCurrentShoreformLength_01.ShorelineLength) AS TotalCurrLen_m FROM refqry_PU_TotalCurrentShoreformLength_01 WHERE (((refqry_PU_TotalCurrentShoreformLength_01.CurrSF)="D")) GROUP BY refqry_PU_TotalCurrentShoreformLength_01.PU, refqry_PU_TotalCurrentShoreformLength_01.[Process Units], refqry_PU_TotalCurrentShoreformLength_01.CurrSF;
Historical Length – Current length	PSNERP_CA_2.0.mdb!fd_shore-form_change	ChangeInDeltaLen_m2: [TotalHistLen_m]-[TotalCurrLen_m]
Tidal Flow degradation (Tier 2 length metric only)	fd_PEF_tidalflow_drainage	TFDegrLen_m, TFPotLen_m, TFPctSL
% area where impervious >10% in nearshore zone (waterline to 200m buffer)	PSNERP_CA_2.0.mdb!fd_im-pervious	Tier3_ImpervAreaGT10_m2
% area where impervious >10% in Watershed (waterline to drainage divide)	PSNERP_CA_2.0.mdb!fd_im-pervious	Tier4_ImpervAreaGT10_m2
Future predicted increase in impervious in Watershed (waterline to drainage divide)	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Drainage_ImpervPct_Yr0, Drainage_ImpervPct_Yr60
Future predicted increase in impervious in nearshore zone (waterline to 200m buffer)	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Zone_ImpervPct_Yr0, Zone_ImpervPct_Yr60

Beach Strategy

Candidate Sites: All SPUs with BLB present currently or historically (n=744)

refqry_SPUsWithBeaches:
SELECT fd_shoreform_change.SPU1 AS PU
FROM fd_shoreform_change
WHERE (((fd_shoreform_change.C_Type) In ("BAB","BLB")) AND ((fd_shoreform_change.SPU1) Is Not Null)) OR (((fd_shoreform_change.H_Type) In ("BAB","BLB")) AND ((fd_shoreform_change.SPU1) Is Not Null))
GROUP BY fd_shoreform_change.SPU1

UNION SELECT fd_shoreform_change.SPU2 AS PU
FROM fd_shoreform_change
WHERE (((fd_shoreform_change.C_Type) In ("BAB","BLB")) AND ((fd_shoreform_change.SPU2) Is Not Null)) OR (((fd_shoreform_change.H_Type) In ("BAB","BLB")) AND ((fd_shoreform_change.SPU2) Is Not Null))
GROUP BY fd_shoreform_change.SPU2
ORDER BY PU;

Data Needed	Source	Calculation
Percent barrier beach length within process unit	PSNERP_CA_2.0.mdb!fd_shoreform_change	refqry_PU_MaxBABLen: SELECT fd_shoreform_change.SPU1 As PU, Sum(fd_shoreform_change.Shape_Length) AS MaxBeachLen_m FROM fd_shoreform_change WHERE (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BAB","BLB"))) OR (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BAB","BLB"))) GROUP BY fd_shoreform_change.SPU1; UNION SELECT fd_shoreform_change.SPU2 As PU, Sum(fd_shoreform_change.Shape_Length) AS MaxBeachLen_m FROM fd_shoreform_change WHERE (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BAB","BLB"))) OR (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BAB","BLB"))) GROUP BY fd_shoreform_change.SPU2 ORDER BY PU; PctBABInPU: [MaxBABLen_m]/[MaxBeachLen_m]
Total beach length of process unit	PSNERP_CA_2.0.mdb!fd_shoreform_change	refqry_PU_MaxBeachLen: SELECT fd_shoreform_change.SPU1 As PU, Sum(fd_shoreform_change.Shape_Length) AS MaxBeachLen_m FROM fd_shoreform_change WHERE (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BAB","BLB"))) OR (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BAB","BLB"))) GROUP BY fd_shoreform_change.SPU1; UNION SELECT fd_shoreform_change.SPU2 As PU, Sum(fd_shoreform_change.Shape_Length) AS MaxBeachLen_m FROM fd_shoreform_change WHERE (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BAB","BLB"))) OR (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BAB","BLB"))) GROUP BY fd_shoreform_change.SPU2 ORDER BY PU;

Data Needed	Source	Calculation
Stream Mouth Density – The presence of freshwater and sediment input from small shoreline streams	PSNERP_CA_2.0.mdb!fd_stream_mouths	Stream Density in streams per km: StreamsPerKM=BeachStreamCount/(MaxBeachLen_m/1000)
Percent sediment input degradation	fd_PEF_sedinput_drainage	SSDegrLen_m, SSPotLen_m, SSPctSL
Percent Area with Impervious >10% in Tier 3 (Nearshore Zone)	PSNERP_CA_2.0.mdb!fd_impervious	Tier2_Impervious_01: SELECT fd_impervious.SPU1 AS PU, Sum(fd_impervious.Shape_Area) AS ImpBin_Area FROM fd_impervious WHERE (((fd_impervious.ZU) In (1)) AND ((fd_impervious.Imperv_Code)>10)) GROUP BY fd_impervious.SPU1 HAVING (((fd_impervious.SPU1) Is Not Null)) UNION SELECT fd_impervious.SPU2 AS PU, Sum(fd_impervious.Shape_Area) AS ImpBin_Area FROM fd_impervious WHERE (((fd_impervious.ZU) In (1)) AND ((fd_impervious.Imperv_Code)>10)) GROUP BY fd_impervious.SPU2 HAVING (((fd_impervious.SPU2) Is Not Null));
Percent process unit length down drift of breakwater/jetties	fd_shoreform_change_co_occurrence_all	refqry_DowndriftBWJLen: SELECT refqry_SPUsWithBeaches.PU, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS DowndriftBWJLen_m FROM refqry_SPUsWithBeaches INNER JOIN fd_shoreform_change_co_occurrence_all ON refqry_SPUsWithBeaches.PU = fd_shoreform_change_co_occurrence_all.SPU1 WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BAB”,”BLB”)) AND ((fd_shoreform_change_co_occurrence_all.Downdrift_BWJMarina)=1)) GROUP BY refqry_SPUsWithBeaches.PU UNION SELECT refqry_SPUsWithBeaches.PU, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS DowndriftBWJLen_m FROM refqry_SPUsWithBeaches INNER JOIN fd_shoreform_change_co_occurrence_all ON refqry_SPUsWithBeaches.PU = fd_shoreform_change_co_occurrence_all.SPU2 WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BAB”,”BLB”)) AND ((fd_shoreform_change_co_occurrence_all.Downdrift_BWJMarina)=1)) GROUP BY refqry_SPUsWithBeaches.PU ORDER BY PU; PctDowndriftBWJ: [DowndriftBWJLen_m]/[MaxBeachLen_m]
Parcel density	PSNERP_CA_2.0.mdb!fd_parcel_lines	refqry_PU_ParcelRatio: SELECT refqry_PU_ParcelRatio_01.PU, refqry_PU_ParcelRatio_01.[Process Units], refqry_PU_ParcelRatio_01.ParcelCount AS BeachParcelCount, refqry_PU_ParcelRatio_01.TotalParcelLength AS BeachParcelLength_m, Round([ParcelCount]*10000/[TotalParcelLength],1) AS BeachParcelRatio FROM refqry_PU_ParcelRatio_01 ORDER BY refqry_PU_ParcelRatio_01.[Process Units];
Future Nearshore Development – the predicted increase in ZU1 impervious cover	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Zone_ImpervPct_Yr0, Zone_ImpervPct_Yr60

Data Needed	Source	Calculation
Active Railroad – The percent of BLB shoreline within a SPU where an active railroad is present on the shoreline	fd_shoreform_change_co_occurrence_all	refqry_RRActiveOnBLB: SELECT fd_shoreform_change_co_occurrence_all.SPU1 AS PU, Sum(IIf([Railroads_Active_Nearshore]=1,[Shape_Length],0)) AS TotalActiveRRLen_m, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS TotalBLBLen_m FROM fd_shoreform_change_co_occurrence_all WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In ("BLB")) AND ((fd_shoreform_change_co_occurrence_all.SPU1) Is Not Null)) OR (((fd_shoreform_change_co_occurrence_all.H_Type) In ("BLB")) AND ((fd_shoreform_change_co_occurrence_all.SPU1) Is Not Null)) GROUP BY fd_shoreform_change_co_occurrence_all.SPU1 UNION SELECT fd_shoreform_change_co_occurrence_all.SPU2 AS PU, Sum(IIf([Railroads_Active_Nearshore]=1,[Shape_Length],0)) AS TotalActiveRRLen_m, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS TotalBLBLen_m FROM fd_shoreform_change_co_occurrence_all WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In ("BLB")) AND ((fd_shoreform_change_co_occurrence_all.SPU2) Is Not Null)) OR (((fd_shoreform_change_co_occurrence_all.H_Type) In ("BLB")) AND ((fd_shoreform_change_co_occurrence_all.SPU2) Is Not Null)) GROUP BY fd_shoreform_change_co_occurrence_all.SPU2 ORDER BY PU;

Barrier Embayment Strategy

Candidate Sites:

SPUs where a "barrier type" embayment (Barrier Estuary, Barrier Lagoon, Closed Lagoon Marsh but not Open Coastal Inlet) is present in historical or current conditions.

refqry_PU_Embayment_Group1:

SELECT fd_shoreform_change.SPU1 AS PU

FROM fd_shoreform_change

WHERE (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.C_TypeEmb) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU1) Is Not Null) AND ((fd_shoreform_change.H_TypeEmb) In ("BE","BL","CLM")))

GROUP BY fd_shoreform_change.SPU1

UNION SELECT fd_shoreform_change.SPU2 AS PU

FROM fd_shoreform_change

WHERE (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.C_Type) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.C_TypeEmb) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.H_Type) In ("BE","BL","CLM"))) OR (((fd_shoreform_change.SPU2) Is Not Null) AND ((fd_shoreform_change.H_TypeEmb) In ("BE","BL","CLM")))

GROUP BY fd_shoreform_change.SPU2;

Data Needed	Source	Calculation
historical barrier embayment length	PSNERP_CA_2.0.mdb!fd_shoreform_change	refqry_PU_TotalHistoricShoreformLength: TRANSFORM Sum(refqry_PU_TotalHistoricShoreformLength_01.ShorelineLength) AS TotalHistLen_m SELECT refqry_PU_TotalHistoricShoreformLength_01.PU, refqry_PU_TotalHistoricShoreformLength_01.[Process Units], Sum(refqry_PU_TotalHistoricShoreformLength_01.ShorelineLength) AS TotalHistSFLen_m FROM refqry_PU_TotalHistoricShoreformLength_01 WHERE (((refqry_PU_TotalHistoricShoreformLength_01.[Process Units]) Like "SPU*") AND ((refqry_PU_TotalHistoricShoreformLength_01.HistSF) In ("BE","BL","CLM"))) GROUP BY refqry_PU_TotalHistoricShoreformLength_01.PU, refqry_PU_TotalHistoricShoreformLength_01.[Process Units] PIVOT "HistSFLen" & [HistSF] & "_m"; HistSFLen(BE,BL,CLM)_m

Data Needed	Source	Calculation
Barrier embayment density (count/ site length)	PSNERP_CA_2.0.mdb!fd_ shoreform_change	refqry_PUGroups_HistSFDensity: SELECT refqry_PUGroups_HistSFTotals.PU, refqry_PUGroups_HistSFTotals.HistBECount, refqry_PUGroups_HistSFTotals.HistBLCount, refqry_PUGroups_HistSFTotals.HistCLMCount, refqry_PUGroups_HistSFTotals.HistLenBE_m, refqry_PUGroups_HistSFTotals.HistLenBL_m, refqry_PUGroups_HistSFTotals.HistLenCLM_m, refqry_PUGroups_HistSFTotals. HistLenBAB_m, refqry_PUGroups_HistSFTotals.HistLenBLB_m, refqry_PUGroups_HistSFTotals. HistEmbayCount, refqry_PUGroups_HistSFTotals.HistBeachLen_m, IIf([HistBeachLen_m]=0,0,1 000*[HistEmbayCount]/[HistBeachLen_m]) AS HistEmbayDensityPerKM FROM refqry_PUGroups_HistSFTotals; refqry_PUGroups_CurrSFDensity: SELECT refqry_PUGroups_CurrSFTotals.PU, refqry_PUGroups_CurrSFTotals.CurrBECount, refqry_PUGroups_CurrSFTotals.CurrBLCount, refqry_PUGroups_CurrSFTotals.CurrCLMCount, refqry_PUGroups_CurrSFTotals.CurrLenBE_m, refqry_PUGroups_CurrSFTotals.CurrLenBL_m, refqry_PUGroups_CurrSFTotals.CurrLenCLM_m, refqry_PUGroups_CurrSFTotals. CurrLenBAB_m, refqry_PUGroups_CurrSFTotals.CurrLenBLB_m, refqry_PUGroups_ CurrSFTotals.CurrEmbayCount, refqry_PUGroups_CurrSFTotals.CurrBeachLen_m, IIf([CurrBeach Len_m]=0,0,1000*[CurrEmbayCount]/[CurrBeachLen_m]) AS CurrEmbayDensityPerKM FROM refqry_PUGroups_CurrSFTotals;
Historical vegetated wetland area associated with barrier type embayments	wetlands_historic_SFjoin	refqry_PU_TidalWetlandLoss_SF: SELECT refqry_PU_TidalWetlandLoss_SF_01.PU, refqry_PU_TidalWetlandLoss_SF_01.[Process Units], refqry_PU_TidalWetlandLoss_SF_01.HistBE_m2, refqry_PU_TidalWetlandLoss_SF_01. HistBL_m2, refqry_PU_TidalWetlandLoss_SF_01.HistCLM_m2, refqry_PU_TidalWetlandLoss_ SF_01.HistTotal_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrBE_m2, refqry_PU_ TidalWetlandLoss_SF_01.CurrBL_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrCLM_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrTotal_m2, 100*IIf([HistTotal_m2]=0,IIf([CurrTotal_ m2]=0,0,1),([HistTotal_m2]-[CurrTotal_m2])/[HistTotal_m2]) AS PctTotalWetlandChange
Percent loss of Vegetated wetland area associated with barrier type embayments	wetlands_historic_SFjoin wetlands_current_SFjoin	refqry_PU_TidalWetlandLoss_SF: SELECT refqry_PU_TidalWetlandLoss_SF_01.PU, refqry_PU_TidalWetlandLoss_SF_01.[Process Units], refqry_PU_TidalWetlandLoss_SF_01.HistBE_m2, refqry_PU_TidalWetlandLoss_SF_01. HistBL_m2, refqry_PU_TidalWetlandLoss_SF_01.HistCLM_m2, refqry_PU_TidalWetlandLoss_ SF_01.HistTotal_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrBE_m2, refqry_PU_ TidalWetlandLoss_SF_01.CurrBL_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrCLM_m2, refqry_PU_TidalWetlandLoss_SF_01.CurrTotal_m2, 100*IIf([HistTotal_m2]=0,IIf([CurrTotal_ m2]=0,0,1),([HistTotal_m2]-[CurrTotal_m2])/[HistTotal_m2]) AS PctTotalWetlandChange
Percent loss of barrier embayment length	PSNERP_CA_2.0.mdb!fd_ shoreform_change	PctEmbayLenLoss: 100*Sum(HistLenBE_m,HistLenBL_m,HistLenCLM_m) - Sum(CurrLenBE_m, CurrLenBL_m,CurrLenCLM_m)/Sum(HistLenBE_m,HistLenBL_m,HistLenCLM_m)
Percent sediment supply degradation (tier 2 length metrics only)	fd_PEF_sedinput_drainage	SSDegrLen_m, SSPotLen_m, SSPctSL/CombSSPctSL
Percent tidal flow degradation (tier 2 length metrics only) among barrier embayments	fd_PEF_tidalflow_drainage	TFDegrLen_m, TFPotLen_m, TFPctSL/CombTFPctSL

Data Needed	Source	Calculation
Active railroad on BLB	fd_shoreform_change_co_occurrence_all	refqry_RRActiveOnBLB: SELECT fd_shoreform_change_co_occurrence_all.SPU1 AS PU, Sum(IIf([Railroads_Active_Nearshore]=1,[Shape_Length],0)) AS TotalActiveRRLen_m, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS TotalBLBLen_m FROM fd_shoreform_change_co_occurrence_all WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BLB”)) AND ((fd_shoreform_change_co_occurrence_all.SPU1) Is Not Null)) OR (((fd_shoreform_change_co_occurrence_all.H_Type) In (“BLB”)) AND ((fd_shoreform_change_co_occurrence_all.SPU1) Is Not Null)) GROUP BY fd_shoreform_change_co_occurrence_all.SPU1 UNION SELECT fd_shoreform_change_co_occurrence_all.SPU2 AS PU, Sum(IIf([Railroads_Active_Nearshore]=1,[Shape_Length],0)) AS TotalActiveRRLen_m, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS TotalBLBLen_m FROM fd_shoreform_change_co_occurrence_all WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BLB”)) AND ((fd_shoreform_change_co_occurrence_all.SPU2) Is Not Null)) OR (((fd_shoreform_change_co_occurrence_all.H_Type) In (“BLB”)) AND ((fd_shoreform_change_co_occurrence_all.SPU2) Is Not Null)) GROUP BY fd_shoreform_change_co_occurrence_all.SPU2 ORDER BY PU;
Breakwater jetty effect length as percent of transport zone (BLB & BAB)	fd_shoreform_change_co_occurrence_all	refqry_DowndriftBWJLen: SELECT refqry_SPUsWithBeaches.PU, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS DowndriftBWJLen_m FROM refqry_SPUsWithBeaches INNER JOIN fd_shoreform_change_co_occurrence_all ON refqry_SPUsWithBeaches.PU = fd_shoreform_change_co_occurrence_all.SPU1 WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BAB”,”BLB”)) AND ((fd_shoreform_change_co_occurrence_all.Downdrift_BWJMarina)=1)) GROUP BY refqry_SPUsWithBeaches.PU UNION SELECT refqry_SPUsWithBeaches.PU, Sum(fd_shoreform_change_co_occurrence_all.Shape_Length) AS DowndriftBWJLen_m FROM refqry_SPUsWithBeaches INNER JOIN fd_shoreform_change_co_occurrence_all ON refqry_SPUsWithBeaches.PU = fd_shoreform_change_co_occurrence_all.SPU2 WHERE (((fd_shoreform_change_co_occurrence_all.C_Type) In (“BAB”,”BLB”)) AND ((fd_shoreform_change_co_occurrence_all.Downdrift_BWJMarina)=1)) GROUP BY refqry_SPUsWithBeaches.PU ORDER BY PU; PctDowndriftBWJ: [DowndriftBWJLen_m]/[MaxBeachLen_m]
Parcel density (# of parcels per unit length of shoreline length, not parcel length) within process unit as percentile score of rank.	PSNERP_CA_2.0.mdb!fd_parcel_lines	refqry_PU_ParcelRatio: SELECT refqry_PU_ParcelRatio_01.PU, refqry_PU_ParcelRatio_01.[Process Units], refqry_PU_ParcelRatio_01.[ShorelineLength] AS ShorelineLength_m, refqry_PU_ParcelRatio_01.ParcelCount AS BeachParcelCount, refqry_PU_ParcelRatio_01.TotalParcelLength AS BeachParcelLength_m, Round([ParcelCount]*10000/[ShorelineLength],1) AS BeachParcelRatio FROM refqry_PU_ParcelRatio_01 ORDER BY refqry_PU_ParcelRatio_01.[Process Units];

Data Needed	Source	Calculation
Percent Nearshore Area with Impervious >10%	PSNERP_CA_2.0.mdb!fd_impervious	Tier3_Impervious_01: SELECT fd_impervious.SPU1 AS PU, Sum(fd_impervious.Shape_Area) AS ImpBin_Area FROM fd_impervious WHERE (((fd_impervious.ZU) In (1)) AND ((fd_impervious.Imperv_Code)>10)) GROUP BY fd_impervious.SPU1 HAVING (((fd_impervious.SPU1) Is Not Null)) UNION SELECT fd_impervious.SPU2 AS PU, Sum(fd_impervious.Shape_Area) AS ImpBin_Area FROM fd_impervious WHERE (((fd_impervious.ZU) In (1)) AND ((fd_impervious.Imperv_Code)>10)) GROUP BY fd_impervious.SPU2 HAVING (((fd_impervious.SPU2) Is Not Null));
Future Nearshore Development – the predicted increase in ZU1 impervious cover	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Zone_ImpervPct_Yr0, Zone_ImpervPct_Yr60

Coastal Inlet Strategy

Embayments Independent of Sediment Transport

Candidate Sites: feature class "fd_GSUs"
Those DUs or groups of DUs which contain a historical or current Open Coastal Inlet (OCI), or a Drowned Channel or Drowned Channel Lagoon using the SSHIAP current typology field "GeoUnit". Each DU was given a Candidate Site ID (CandidateID) to assist in measuring the condition of the area contributing to a specific shoreform. Because the SSHIAP typology was incorporated into this effort, the H_ContigID field wasn't used to assign Candidate Site IDs.

Each Candidate Site also identifies whether it comes from an OCI (Shipman typology, field SourceOCI = "Y") or a Drowned Channel/Drowned Channel Lagoon (SSHIAP typology, field SourceDrownChan = "Y") or both.

Data Needed	Source	Calculation
Area identified as vegetated wetlands (excluding euryhaline unvegetated) in either historical or current (whichever is greater) feature classes – raw area, later normalized 0-1	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	qry_TotalWetlandComparison: SELECT refqry_All_CS_IDs.CandidateID, refqry_CS_TotalCurrentWetlandArea.CurrentArea_m2, refqry_CS_TotalHistoricWetlandArea.HistoricArea_m2, IIf(IIf([HistoricArea_m2] Is Null,0,[HistoricArea_m2])>=IIf([CurrentArea_m2] Is Null,0,[CurrentArea_m2]),IIf([HistoricArea_m2] Is Null,0,[HistoricArea_m2]),IIf([CurrentArea_m2] Is Null,0,[CurrentArea_m2])) AS LargestWetlandArea_m2, [HistoricArea_m2]-[CurrentArea_m2] AS WetlandLoss_m2 FROM (refqry_All_CS_IDs LEFT JOIN refqry_CS_TotalCurrentWetlandArea ON refqry_All_CS_IDs.CandidateID = refqry_CS_TotalCurrentWetlandArea.CandidateID) LEFT JOIN refqry_CS_TotalHistoricWetlandArea ON refqry_All_CS_IDs.CandidateID = refqry_CS_TotalHistoricWetlandArea.CandidateID; SELECT fd_wetlands_union.CandidateID, Sum(fd_wetlands_union.Shape_Area) AS WetlandUnionArea_m2 FROM fd_wetlands_union WHERE (((fd_wetlands_union.CandidateID)>0) AND ((fd_wetlands_union.Wetland_Class_C) In ("EM","OT","TF"))) OR (((fd_wetlands_union.CandidateID)>0) AND ((fd_wetlands_union.Wetland_Class_H) In ("EM","OT","TF"))) GROUP BY fd_wetlands_union.CandidateID;
Drainage Area (zones 0 and 1), calculated as the area of DUs that contain an OCI or drowned channel	fd_GSUs (Sites Only)	refqry_CS_TotalLandwardArea: SELECT fd_GSUs.CandidateID, Round(Sum(IIf([ZU]=1,[Shape_Area],0)/1000000),1) AS ZoneArea_km^{2}, Sum(IIf([ZU]=1,[Shape_Area],0)) AS ZoneArea_m2, Round(Sum([Shape_Area]/1000000),1) AS DrainageArea_km^{2}, Sum(fd_GSUs.Shape_Area) AS DrainageArea_m2 FROM fd_GSUs WHERE (((fd_GSUs.ZU) In (0,1))) GROUP BY fd_GSUs.CandidateID;
Historical embayment shoreform length	fd_shoreform_change (from Candidate Site selection)	
Change in embayment shoreform length, calculated as the sum of natural embayment length (excluding artificial shoreform lengths in current shoreforms) in both historical and current conditions within DUs	PSNERP_CA_2.0.mdb!fd_shoreform_change	qry_ChangeInEmbayLen: SELECT qryQA_PS_Pg2_ShoreformComp.CandidateID, Sum(qryQA_PS_Pg2_ShoreformComp.CurrLen_m) AS SumOfCurrLen_km, Sum(qryQA_PS_Pg2_ShoreformComp.HistLen_m) AS SumOfHistLen_km, Round(Sum([HistLen_m])-Sum([CurrLen_m]),2) AS ChangeInLen_m FROM qryQA_PS_Pg2_ShoreformComp GROUP BY qryQA_PS_Pg2_ShoreformComp.CandidateID;

Data Needed	Source	Calculation
Area of wetland loss (excluding euryhaline unvegetated)	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	qry_TotalWetlandComparison: SELECT refqry_All_CS_IDs.CandidateID, refqry_CS_TotalCurrentWetlandArea.CurrentArea_m2, refqry_CS_TotalHistoricWetlandArea.HistoricArea_m2, IIf(IIf([HistoricArea_m2] Is Null,0,[HistoricArea_m2])>=IIf([CurrentArea_m2] Is Null,0,[CurrentArea_m2]),IIf([HistoricArea_m2] Is Null,0,[HistoricArea_m2]),IIf([CurrentArea_m2] Is Null,0,[CurrentArea_m2])) AS LargestWetlandArea_m2, [HistoricArea_m2]-[CurrentArea_m2] AS WetlandLoss_m2 FROM (refqry_All_CS_IDs LEFT JOIN refqry_CS_TotalCurrentWetlandArea ON refqry_All_CS_IDs.CandidateID = refqry_CS_TotalCurrentWetlandArea.CandidateID) LEFT JOIN refqry_CS_TotalHistoricWetlandArea ON refqry_All_CS_IDs.CandidateID = refqry_CS_TotalHistoricWetlandArea.CandidateID;
Greatest of historical or current wetland area (divide by wetland types EU/EM/OT/TF)	PSNERP_CA_2.0.mdb!fd_wetlands_current PSNERP_CA_2.0.mdb!fd_wetlands_historic	refqry_CS_TotalHistoricWetlandAreaByClass: TRANSFORM Sum(refqry_CS_TotalHistoricWetlandAreaByClass_01.HistoricArea_m2) AS SumOfHistoricArea_m2 SELECT refqry_CS_TotalHistoricWetlandAreaByClass_01.CandidateID FROM refqry_CS_TotalHistoricWetlandAreaByClass_01 GROUP BY refqry_CS_TotalHistoricWetlandAreaByClass_01.CandidateID PIVOT "Hist_" & [Wetland_Class] & "_m2"; refqry_CS_TotalCurrentWetlandAreaByClass: TRANSFORM Sum(refqry_CS_TotalCurrentWetlandAreaByClass_01.CurrentArea_m2) AS SumOfCurrentArea_m2 SELECT refqry_CS_TotalCurrentWetlandAreaByClass_01.CandidateID FROM refqry_CS_TotalCurrentWetlandAreaByClass_01 GROUP BY refqry_CS_TotalCurrentWetlandAreaByClass_01.CandidateID PIVOT "Curr_" & [Wetland_Class] & "_m2";
Percent Area with Impervious >10% in Tier 3 (Zone 1)	PSNERP_CA_2.0.mdb!fd_impervious	Zone1ImpervAreaRatio: SELECT refqry_CS_TotalLandwardArea.CandidateID, Tier3_Impervious_01.ImpBin_Area, refqry_CS_TotalLandwardArea.ZoneArea_m2, Round(([ImpBin_Area])/([ZoneArea_m2]),4) AS Ratio FROM refqry_CS_TotalLandwardArea LEFT JOIN Tier3_Impervious_01 ON refqry_CS_TotalLandwardArea.CandidateID = Tier3_Impervious_01.CandidateID;
Percent Area with Impervious >10% in Tier 4 (Zone 0) within the drainage area identified as draining into relevant embayments	PSNERP_CA_2.0.mdb!fd_impervious	Zone0ImpervAreaRatio: SELECT refqry_CS_TotalLandwardArea.CandidateID, Tier4_Impervious_01.ImpBin_Area, refqry_CS_TotalLandwardArea.Zone0Area_m2, Round(([ImpBin_Area])/([Zone0_m2]),4) AS Ratio FROM refqry_CS_TotalLandwardArea LEFT JOIN Tier4_Impervious_01 ON refqry_CS_TotalLandwardArea.CandidateID = Tier4_Impervious_01.CandidateID;
Future risk assessment – relative increase in impervious in tier 3 of DU	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Zone_ImpervPct_Yr0, Zone_ImpervPct_Yr60
Future risk assessment – relative increase in impervious in tier 4 of DU	FRAP_SQ_Yr0!EM_IMPERV, FRAP_SQ_Yr60!EM_IMPERV	Drainage_ImpervPct_Yr0, Drainage_ImpervPct_Yr60

PUGET SOUND NEARSHORE

ECOSYSTEM RESTORATION PROJECT

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