Samish Island

Rapid Shoreline Inventory

Prepared for the Skagit County Marine Resources Committee

December 2002

Phil Bloch, Tom Dean, and Jacques White

People For Puget Sound
911 Western Avenue
Suite 580
Seattle, WA 98104
www.pugetsound.org

Volunteers Scott Pokswinski and Ted Matts train for the

2002 Samish Island Rapid Shoreline Inventory

This page is intentionally blank.

Table of Contents

Acknowledgements

This report was produced by People For Puget Sound for the Skagit County Marine Resources Committee (MRC), with funding from the Northwest Straits Commission and the Packard Foundation. Many thanks to MRC members Charlie O'Hara, Ivar Dolph, and Paul Dinnell; the 17 volunteers who gathered the data; and to the 59 shoreline property owners who participated in this study. The authors would like to thank staff members Rachel Strasz, Lisa Markovchick-Nicholls, Britta Escheté, and expert volunteer Lisa Younger.

This page is intentionally blank

Executive Summary

During the summer of 2002, People For Puget Sound staff and volunteers conducted a Rapid Shoreline Inventory (RSI) on select marine shorelines of Samish Island. Working under contract and in partnership with the Skagit County Marine Resources Committee, a detailed set of physical and biological data for five and seven-tenths miles of shoreline on the Island were compiled.

People For Puget Sound designed the Rapid Shoreline Inventory to gather information about the relationships between shoreline land use and indicators of beach health. By looking closely at these relationships, areas can be identified that may be appropriate for voluntary conservation and restoration actions. RSI participants — volunteers who help collect RSI data and property owners who grant permission — gain a better understanding of shoreline habitat and how it functions, and are therefore better able to protect and restore the shoreline.

The Skagit County Marine Resources Committee (MRC) funded and assisted with the 2002 Samish Island Rapid Shoreline Inventory in order to:

1) Assess nearshore habitats on Samish Island;
2) Assist habitat conservation efforts by individual property owners, community groups, and resource managers, and;
3) Identify opportunities for voluntary conservation and restoration activities in the area.

By comparing their beach to more "natural" beaches, property owners can determine what sorts of landscaping activities they can undertake to improve the habitat qualities of their shoreline. Property owners who own large stretches of beach or who join together a group of neighbors might qualify for permanent habitat protection by way of a conservation easement. Property owners who are interested in voluntarily protecting or restoring habitat on their property are encouraged to contact the MRC or People For Puget Sound.

Key Findings of the Rapid Shoreline Inventory

In the 5.7 miles of shoreline inventoried in 150-foot sections, 42% of those sections contained at least one patch[1] of potential forage fish spawning gravel, 61% had a backshore at the mid-point, 85% contained bluffs or banks, 33% contained invasive plant species, 66% were predominantly undeveloped, and 53% contained no manmade structures on the shoreline. The most common wildlife sighted were barnacles, mud snails (*Batillaria*, a non-native species), shore crabs, clams, limpets, oysters (also non-native), snails, and gulls (Appendix B). The most common aquatic vegetation observed were sea lettuce, *Enteromorpha spp.*, rock weed, and native and dwarf eelgrass, while the most common terrestrial species were ocean spray, Douglas fir, willows, roses, dunegrass, madrone, and red alder (Appendix B).

The RSI data were analyzed by feeding them into five semi-quantitative, multi-factor, causal models developed by King County and People For Puget Sound. These models describe the relationship between habitat features and indicators of habitat

[1] It is not known how small of a "patch" of sand can be located and used by forage fish for spawning. The Rapid Shoreline Inventory located only "potential" forage fish spawning areas — the right size sand in the right part of the beach in patches or continuous stretches along the length of the section. The RSI protocol defines "patch" as anything that dominates your view from a standing position looking straight down at the beach.

quality. The models are an attempt to define how various measurable characteristics of nearshore habitat affect habitat quality with respect to target biological communities or physical processes. This methodology is being prepared as a paper for submittal to the scientific journal Restoration Ecology.

The areas that scored the highest for the combined conservation analysis were Scott's Point, points northwest of Wharf Road, points north and east of Samish Point, and a string of points along Samish Island Road (Map 6A). The areas that scored the highest for the combined restoration analysis were Scott Road, west Samish Beach, points north and east of Samish Point, and a couple of points along Samish Island Road (Map 6B). Three general areas of focus for combined conservation and restoration consideration are recommended based on these scores and a general knowledge of Samish Island and the surrounding areas. The focus areas, as shown on Map 7, are:

1) The Samish Point area;
2) The Wharf Road area, and;
3) The Scott Road area.

The Samish Point focus area contains conservation areas in the vicinity of the spit, with restoration areas outlying to the north and east. For the Wharf Road area, the conservation and restoration areas are overlapping. The Scott Road conservation and restoration areas are adjacent each other, with Scott's Point being a conservation area and Scott Road being a restoration area.

Recommendations

Further ground investigation of the three combined focus areas is recommended to assess their potential for voluntary habitat conservation and restoration actions.

About the Rapid Shoreline Inventory

In 1995, following a report by marine scientists from Washington State and British Columbia, People For Puget Sound recognized the need for more detailed information about marine "nearshore," habitats — from the eelgrass and kelp beds to the adjacent uplands (Figure 1). Working with many partners and experts, People For Puget Sound began to develop what would become the Rapid Shoreline Inventory. As of this publication, inventories have been completed in San Juan, Kitsap, Whatcom, Skagit, and King Counties, for a total of 30.5 miles of data.

The Rapid Shoreline Inventory is designed to gather information about the relationships between shoreline land use and indicators of beach health. By looking closely at these relationships, areas can be identified that may be appropriate for voluntary habitat conservation and restoration actions. RSI also contains a strong educational component. RSI participants — volunteers who help collect RSI data and property owners who grant permission for the survey — better understand nearshore habitat and how it functions, and are therefore better able to steward and restore the shoreline.

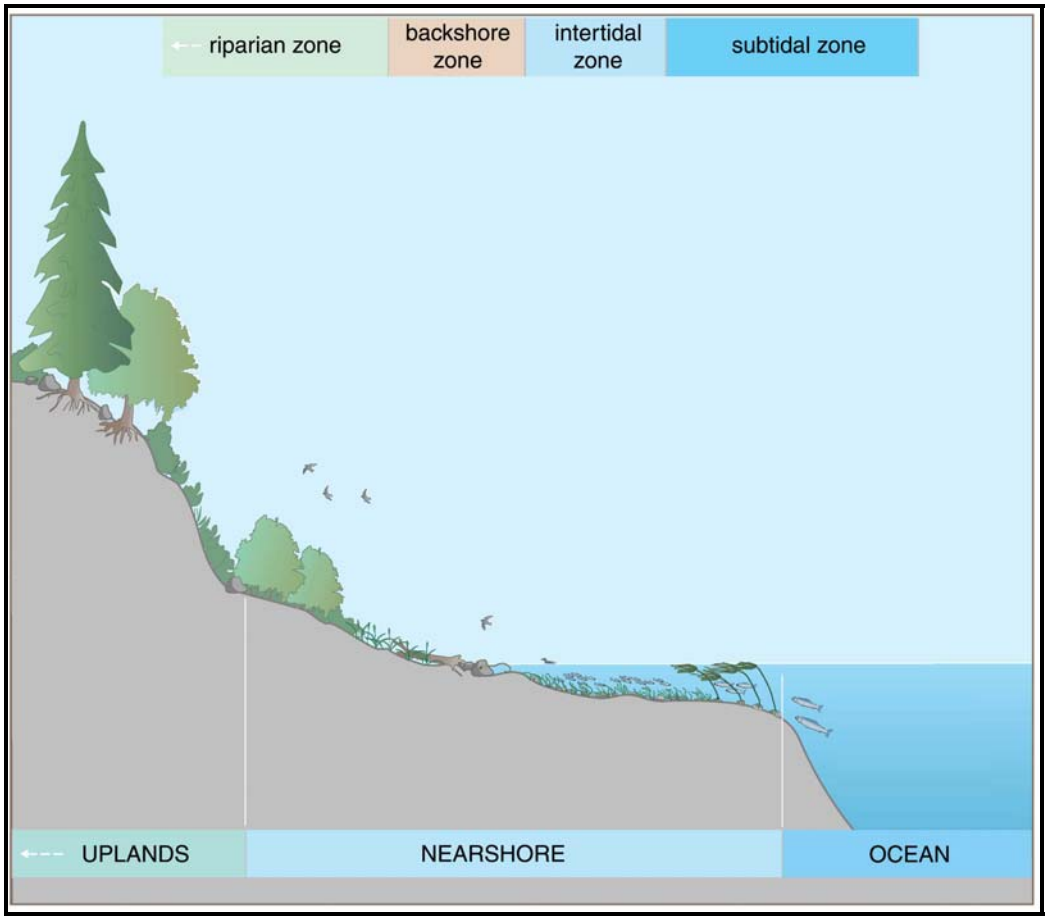


Figure 1: Nearshore habitat extends from the deeper water of the ocean into the adjacent uplands. The nearshore represents a transitional area that integrates characteristics of both environments. (Image courtesy of King County DNR.)

The primary objectives of the Rapid Shoreline Inventory are to:

- Educate and involve local citizens by training volunteers to collect accurate data;
- Identify relationships between nearshore habitat conditions and adjacent land uses;
- Develop an inventory of high-quality data useful for assessing the health of nearshore habitats in Puget Sound;

- Present data that can be used by property owners and public agencies to make informed decisions about conservation and restoration of nearshore habitat;
- Further develop the concept of "shoreline ecosystems" and the importance of nearshore habitat;
- Refine models that identify areas of high resource value and high restoration potential, and;
- Assure agreement and compatibility with existing coarse-grain data sets such as Washington State Department of Natural Resources' *ShoreZone*.

Samish Island Rapid Shoreline Inventory 2002

In 2001, People For Puget Sound conducted a Rapid Shoreline Inventory on March's Point for the Skagit County Marine Resources Committee (MRC). The results of that effort are available on the web at www.pugetsound.org/rsi. In 2002, People For Puget Sound was awarded a contract by the MRC, with funding coming from the Northwest Straits Commission, to conduct another Rapid Shoreline Inventory in Skagit County. Funds from the Packard Foundation also supported this project. This report represents the result of that effort.

Founded in 1998, the Skagit County Marine Resources Committee is citizen-based, with representatives appointed by the county commissioners from local government, the tribal government co-managers, and the scientific, economic, recreational, and conservation communities. Members of the Skagit County MRC are working to restore nearshore, intertidal, and estuarine habitats, improve shellfish harvest areas, and support bottomfish recovery.

Site Selection

During the fall of 2001, the MRC reviewed existing natural resource data and determined that Samish Island was an area of high resource value but lacked a detailed habitat inventory, and thus would be a good candidate for the Rapid Shoreline Inventory. Samish Island is somewhat unique in that it contains a wide variety of beach habitats that describes Puget Sound in general – from mudflats to sandy shores to rocky headlands. The MRC entered into a discussion with People For Puget Sound about the possibility of an assessment of conservation and restoration potential for this area. The proposal was approved by the Northwest Straits Commission, so People For Puget Sound entered into a contract with the MRC and so began making preparations for a summer 2002 Inventory.

Figure 2: The survey area for this project was the marine shoreline of Samish Island.

Methodology Overview

Each RSI employs a well-trained and highly supervised team of volunteers to survey shorelines by foot, in 150-foot sections during extreme low daytime tides, taking observations but no samples. The data is carefully entered and compiled in a Microsoft Access database and then transferred to an ESRI ArcInfo 8.1 Geographic Information System (GIS), which displays the data on maps. (Each dot on each map represents a specific, geo-referenced, 150-foot beach section.) The GIS is then used to assign values to the data to produce priority areas for voluntary conservation and restoration actions.

Property Owner Permission

In the spring of 2002, a mailing to 320 shoreline property owners in this study area (all of Samish Island) asked for permission to conduct the inventory on their beaches, and was followed by phone attempts. By the end of this effort, 59 landowners (18%) had agreed to participate, 13 declined permission (4%), and 248 did not respond (78%). Since several of the participants hold large parcels, this gave People For Puget Sound permission to inventory about six miles of beach, roughly 60% of the Island. Focus areas were created by concentrating on stretches of beach where the most contiguous permissions existed — thus, some who had agreed to participate did not have their beach surveyed.

Volunteer Training and Data Collection

For this RSI, 17 volunteer stewards attended three training sessions for a total of ten hours of training (two three-hour sessions in the classroom and one four-hour session in the field) before they were ready to begin field data collection. People For Puget Sound staff prepared the beach for the inventory by placing temporary flags delineating each 150-foot section and recording the coordinates of each section with a Trimble GeoExplorer 3 Geographic Positioning System (GPS). The data were taken during extreme low tides on June 22 through 26, 2002. Stewards recorded information for each 150-foot shoreline section including:

1. Section number, volunteer's name, time of day
2. Characteristics of intertidal zone
3. Characteristics of backshore zone
4. Bluff/bank characteristics
5. Invasive species
6. Adjacent land use
7. Streams, outfalls, and other freshwater discharges
8. Artificial shoreline structures
9. Wildlife
10. Vegetation

Volunteers used a detailed data form, which placed data into clear, discrete categories, to collect this information (Figure 3). The data form limits errors and makes the data as consistent as possible.

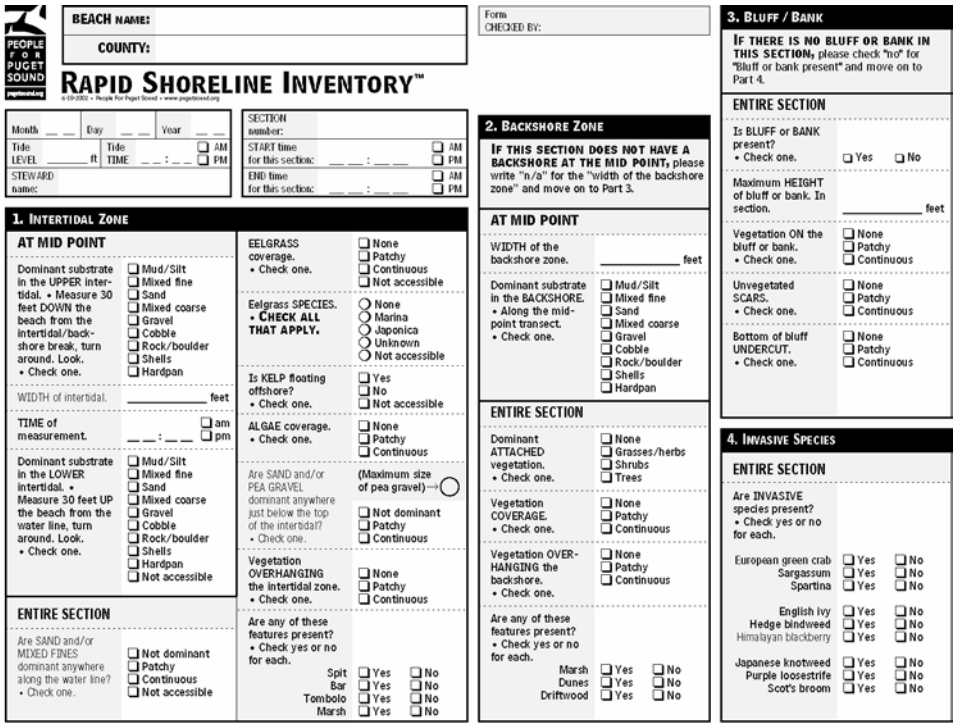


Figure 3: The Rapid Shoreline Inventory data collection form is divided into discreet categories and provides reminders about data collection standards. This two-sided form is provided in Appendix D, Rapid Shoreline Inventory Data Form.

The volunteers were instructed to gather this data in very specific ways (Appendix C, RSI Protocol). Volunteers were deployed in teams of five or less, led by a highly experienced staff person or volunteer (team leader). The team leaders were available at all times while the volunteers were gathering data to answer questions about methodology and data standards. The team leaders checked each data form for accuracy and completeness on-site (within the 150-foot section of beach represented by that data form), with the volunteer standing by to clarify any outstanding issues. The volunteers gathered 199 data sheets (one for each 150-foot segment of beach) for a total of 5.7 miles of data.

In the People For Puget Sound office, the information from the 199 two-sided forms was carefully entered into a Microsoft Access database. Volunteers were trained to enter the data, and their work was reviewed systematically by staff (more frequently at first, but never less than one out of five forms). The data were checked and corrected in table form, and transferred to a Geographic Information System (GIS).

The data are displayed on 50 maps (Appendix A) that can be viewed at www.pugetsound.org/rsi, where one can also find a sampling protocol for the Rapid Shoreline Inventory (Appendix C). A complete copy of this report, with maps, was provided to the Mount Vernon City Library (Skagit County, Washington).

Data Uses

The data are intrinsically valuable as indications of beach types and as baselines of physical and biological information. For instance, in the case of an oil spill, restoration goals could be set using RSI data gathered prior to any damage. The data can also show simple correlations between upland and intertidal land use and ecosystem health indicators on the adjoining beach.

People For Puget Sound staff, working with nearshore habitat experts, created a system to analyze RSI data in a way that enhances its value. Different "scores" are assigned to different pieces of datum in order to prioritize areas that are appropriate for voluntary habitat conservation and restoration actions (see Rapid Shoreline Inventory Data Analysis, below).

Data Limitations

Because of the form-by-form, on-site data check, and because of the urgency to gather data while the tide is low, replicate data is not gathered. All components of the RSI Protocol have been through expert review.

The data describing physical shoreline features (data form parts one through eight) are the most specific, as they represent physical characteristics of the nearshore that can be seen and measured. The biological data (data form parts nine and ten) are more generalized. Plants and animals are sometimes identified to the species level, but often are only identified to the level of genus, family, or order. While the RSI training contains an overview of flora and fauna, it is not possible to fully train volunteers on complicated taxonomic distinctions in the allotted time. As a result, the species lists represent only a general view of what was found on the beach on a particular day by volunteers with various skill levels. However, these species lists are often the first ever compiled for many of the beaches inventoried.

Results and Discussion

Description of Study Area

Samish Island contains a wide variety of beach habitat types, from the rocky headlands of Point Williams to the sandy shores of Camp Kirby to the mudflats of Alice Bay. The mouth of the Samish River hosts a vibrant shellfish growing industry in a place where naturally gravelly substrates support oysters without expensive or destructive cultivation techniques. The south shore of the Island along Samish Island Road contains a healthy buffer of Douglas fir and other native shoreline plants.

Washington State holds title to either part of or the entire intertidal zone for 57% (5.6 miles) of the Island's shoreline. Many state-held parcels are adjacent to private holdings in the upland. Most of the delta of the Samish River is owned (or leased from private owners) by shellfish growers. The only public beach access on the Island is the DNR property at the end of Wharf Road.

Characteristics of the Intertidal Zone

The intertidal zone, the shoreline between the low and high tide lines, is home to a wide range of flora and fauna — many of which spend their entire lives there, or are dependent on the intertidal for some critical stage of their lives. The Rapid Shoreline Inventory captures detailed information at the low tide line, where such things as eelgrass and geoducks can be observed (Figure 4), and near the high tide line where several species of forage fish spawn. Two of Puget Sound's three primary forage fish,

surf smelt and sand lance, need specific sizes of substrate at or near the top of the intertidal zone in which to lay their eggs: namely, from sand to very small gravel below 4 mm in diameter[2] (Bargmann, 1998). Pacific herring, the third of these three forage fish, attach their eggs to eelgrass and kelp (Bargmann, 1998).

Figure 4: Beds of eelgrass that occur in the lower intertidal and subtidal zones are critical nursery habitat for a variety of species (image courtesy of NOAA).

Forty-two percent of the beaches had at least one patch[3] of potential spawning gravel at the upper edge of the intertidal zone, with 24% having continuous coverage along the 150 feet. Despite this high occurrence of sand and/or small gravel at the high tide mark, most of the upper-intertidal samples (the top 30 feet at the mid-point) were

[2] Surface substrate size in the intertidal zone is subject to seasonal fluctuations. RSI data is gathered during daytime low tides, which restricts the data to late spring and summer observations. In most cases, RSI data is gathered only once in any one location.

[3] It is not known how small of a "patch" of sand/gravel can be located and used by forage fish for spawning. The Rapid Shoreline Inventory located only "potential" forage fish spawning areas — the right size sand in the right part of the beach in patches or continuous stretches along the length of the section. The RSI protocol defines "patch" as anything that dominates your view from a standing position looking straight down at the beach.

dominated by cobble (35%) or larger gravel (26%). Along the water line at low tide, 40% of the sections had substrate that would support eelgrass (sand or sandy mud, but not just mud) in whole or in part (Koch, 2001). However, the low tide mark was not observed in 42% of sections because the tide in Padilla Bay and parts of Samish Bay goes out too far for volunteers to walk. Eelgrass was observed in 76% of sections.

Vegetation that hangs over the intertidal zone is important to shade forage fish spawn (to keep the eggs from drying out), and as a source of insects that drop into the water thus providing food for juvenile salmon[4]. A majority of sections, 56%, contained at least some vegetation overhanging the intertidal zone. Only 15% of those sections had continuous coverage.

Characteristics of Backshore Zone

The backshore is a "splash zone," often a flat area at the top of the beach that collects driftwood and where most of the plants can tolerate occasional salt spray (Figure 5). The driftwood and plants in the backshore provide habitat for small invertebrates, which in turn provide food for migrating juvenile salmon (King County Department of Natural Resource, 2001). This zone is often reduced or eliminated when bulkheads are built. High energy beaches with high bluffs may naturally have no backshore present at all.

[4] Jeff Cordell and others at the University of Washington have been doing research on this issue for several years. By trapping insects as they fall into the water and comparing those insects to those found in the stomachs of juvenile salmon, they have been able to prove that overhanging and riparian vegetation provide food for juvenile salmon both in restored estuarine marshes and along marine shorelines (Cordell et al., 2001). Jim Brennan at King County has been adding to this pool of research by seining and pumping the stomachs of juvenile salmonids on marine shorelines.

Figure 5: Backshore habitat can include driftwood, salt-tolerant vegetation, salt marshes, and sand dunes.

Sixty-one percent of the sections surveyed had backshores at the mid-point of the section. This is close to the 66% of sections with sand at the top of tide, which is not surprising since these two features often occur together on natural beaches where no bulkheads have been constructed. The average width of the backshore, where present, was 17.9 feet. Driftwood was present on 95% of backshores (the highest number recorded in any RSI study to-date), and 42%, had overhanging vegetation.

Bluff/Bank Characteristics

Bluffs and banks just shoreward of the beach (Figure 6) provide a variety of unique habitat niches. Two birds found in marine environments, the kingfisher and the pigeon guillemot, are known to nest in holes in sandy bluffs (Alsop, 2001). (One guillemot and 12 kingfisher sightings were recorded during this RSI.) Most importantly, sand and gravel slide from bluffs and banks to re-supply fine substrates to the intertidal zone, maintaining the structure and profile typical of beaches from Anderson Island north to Samish Island. Bluffs of banks that provide a steady source of sediment to the shoreline are commonly called "feeder bluffs".

Figure 6: Large and small feeder bluffs are critical sources of sediment for Puget Sound shorelines.

Bluffs or banks, either natural or armored, were present on 85% of sections, with the average height being 41.8 feet. Ninety-six of these sections had at least some vegetation coverage (the highest recorded in any RSI study to date). Un-vegetated scars[5], usually an indication of a recent slide and potential supply of sand to the beach, were continuous for 4% of sections, while 51% had patchy scars. Forty-three percent of all sections had at least some undercutting at the base of the bluff or bank. When this number is compared to the very high number of sections that contain continuous vegetation (85%), it suggests that erosion at the toe of the bank does not necessarily lead to certain or rapid bank failure on Samish Island.

[5] RSI records "scars" as any area that lacks vegetation. Volunteers are not asked to attempt to differentiate between natural erosion and that which is caused by human activity.

Invasive Species

Plants and animals that are introduced from other parts of the country or the world, whether intentionally or accidentally, can sometimes present a threat to native flora and fauna (Figure 7). "Invasive species" are those that aggressively crowd out, out-compete, or consume native species. They often spread rapidly and can completely cover the landscape. Perhaps the worst current threat to Puget Sound nearshore habitats is *Spartina*, an invasive aquatic cordgrass that can completely cover mid to upper intertidal mud flats. While the impacts of *Spartina* infestations on fish and wildlife are little studied, it is reasonable to assume that the loss of mudflats in Puget Sound would have a detrimental effect on the shellfish that live there and the salmon and shorebirds that depend on mudflats as important forage areas (Feist, 2002). Alice Bay reportedly contains some *Spartina*, but it was not observed directly during this inventory – nor was Alice Bay entire accessible to volunteers. Additional investigation of the existence and/or extent of *Spartina* in Alice Bay is recommended.

Figure 7: Upland invasives like Scot's broom thrive in edge habitats like those found along shorelines. Intertidal invasive organisms often grow and expand unchecked.

The most prevalent invasive plant found was Himalayan blackberry, identified on 33% of sections, followed by English ivy, 16%, the algae *Sargassum*, 13%, hedge bindweed (morning glory), 11%, and Scot's broom, 7%. No occurrences of *Spartina*, purple loosestrife, Japanese knotweed, or European green crabs were recorded. Dwarf eelgrass (*Zostera Japonica*) was found in 45% of sections, which is nearly equivalent to the occurrence of the native eelgrass (51%). This is the highest occurrence of dwarf eelgrass recorded by RSI to date. It should be noted that the level of threat posed by *Sargassum* and dwarf eelgrass has not yet been established.

Adjacent Land Use

The ways that land owners build on and maintain the land adjacent to the shoreline[6] can directly impact the quality of nearshore habitat (Figure 8). Vegetated riparian buffers act as natural filters, absorbing water from flood events and filtering out toxins and excess nutrients. Clearing trees and shrubs to create views removes shade and food sources on which many species rely (King County Department of Natural Resources, 2001), and lawn and garden fertilizers and pesticides can be washed into the water. Un-managed access points can cause erosion and trampling of shoreline vegetation. Roads and parking lots along the water can increase the runoff of oil, gas, and antifreeze. Agricultural and industrial runoff is not always filtered or treated.

[6] The RSI records information on adjacent land use by noting features which are dominant for that 150-foot segment, immediately adjacent the high tide line, and can be seen from the beach.

Figure 8: Land use adjacent to the shoreline has an impact on many characteristics of the nearshore environment, including riparian vegetation, aquatic vegetation, erosion, pollutants, and wildlife habitat use.

Sixty-six percent of the immediately adjacent upland was predominately undeveloped as of the time of this survey. This is a relatively high number, and is likely related to the fact that much of the residential shoreline development on Samish Island is set well back from the beach, with healthy riparian buffers adjacent the high tide line. The fact that Samish Island Road was constructed at the top of the bluff instead of the toe greatly contributed to the low impact of residential development on the Island. The next highest category of adjacent land use was unpaved road, path, or lot at 7%, followed by residential structure at 6%, and lawn at 5%. One instance of commercial development and no industrial development were recorded. Thirty-three percent of the sections had a trail or staircase to provide beach access, with an average of 1.3 access points for those sections.

Streams, Outfalls and Other Freshwater Outflows

In many cases, fresh water flowing onto the beach can be an important part of the nearshore ecosystem. Streams and creeks can create deltas or marshes, and can allow fish to move upstream to spawn. But water can also bring pollutants and garbage onto the beach (Figure 9). The Rapid Shoreline Inventory counts the numbers and types of discharges (which include rivers, creeks, ditches, pipes, and seeps), looks for potential signs of pollution (i.e. darkened sediment, excessive algal growth, etc.), and records whether or not the discharge is flowing. No water samples were taken or tested.

Figure 9: Freshwater discharges entering the nearshore environment can carry excess nutrients or toxic pollutants onto the beach.

Only 38% of sections surveyed contained one or more discharge. A total of 118 discharges were recorded, with 64% being seeps, 29% pipes, 3% creeks, 2% ditches, and 2% rivers. Sections that contained outfalls had an average of 1.9 per section. There were very few signs of potential concern with discharges in the study area, the highest numbers being excessive erosion at 8%, and darkened sediment and associated algae growth both at 3%. Samish Island has a relatively large amount of freshwater seeping

onto the beach, and a very low percentage of associated algae. However, the survey area in general showed a relatively high occurrence of algae (continuous or patchy on 88% of sections, with sea lettuce identified on 61% and *Enteromorpha* on 45%) This suggests that Samish and Padilla Bays are nutrient rich in general – but no obvious evidence of problems with excessive residential fertilizer or failing onsite septic systems was observed on Samish Island.

Shoreline Structures

The Rapid Shoreline Inventory looks for structures built on the shoreline such as bulkheads, docks, ramps, jetties, and levees. Shoreline structures can serve many purposes, from helping protect upland areas from erosion to providing a place to dock or launch boats (Figure 10). Some may be un-necessary or in disrepair, with owners that may be un-aware of their potential impacts on nearshore habitat. Bulkheads and jetties can block the flow of sand onto and along the beach, and can force juvenile salmon into deep water, exposing them to predators (Williams and Thom, 2001). Many structures can amplify the energy of waves, which in turn can scour sand from the top of the beach or increase erosion on adjacent or neighboring properties (Shipman, 1995). Failing structures, especially rip-rap bulkheads, can litter the beach with large materials that cover habitat for clams and other sand-dwelling invertebrates (People For Puget Sound, 2001).

Figure 10: Structures are often intended to prevent erosion or to provide people with access to the shoreline. Both types of structures can negatively impact nearshore habitat, especially as the structures begin to fail.

The volunteers described 193 structures for this inventory. Just under half of the 150-foot sections, 47%, contained structures. Of those sections, the average number of structures was 2.3. The majority of structures, 62%, were bulkheads or seawalls, 7% piers or docks, 6% stairs, and 5% each for the categories launches or ramps, jetties or groins, and dikes or levees. The combined length of these structures was 10,679 feet – 35% of the distance surveyed.

Seventy percent of the structures were in good or excellent condition, meaning that they were serving their intended purpose. Thirty percent were in poor condition, meaning that they were in some stage of obvious failure.

Wildlife and Vegetation

Volunteers for this inventory were not explicitly trained nor expected to identify wildlife and vegetation beyond a few common species. However, many of them already had extensive experience with species identification, and all volunteers at all times had access to "team leaders" for assistance with identification. This inventory was not designed to produce an exhaustive or quantitative assessment of species on the beach, but it does indicate the presence and distribution of species in the survey area, and it often provides the first species list compiled for an area. Since RSI data is usually taken only once, it does not reveal the use of the nearshore by species over time.

Figure 11: Wildlife found in the intertidal can provide indications of ecosystem health. This is a mud snail, *Batillaria attramentaria* (Image courtesy of NOAA).

The most common intertidal wildlife sightings were barnacles at 73% of sections, mud snails (*Batillaria*) at 40% (Figure 11), shore crabs at 31%, clams at 25%, limpets at 23%, oysters at 22%, snails at 20%, and gulls at 19%. Notably absent from this list are mussels, which are sometimes as common as barnacles. The high number of oysters observed is probably due to commercial cultivation of oysters in the study area. It should also be noted that 40% is a high occurrence of mud snails, *Batillaria attramentaria*, a non-native invertebrate.

The most common algal sightings were sea lettuce at 61%, *Enteromorpha spp*. at 45%, rockweed at 29%, and sugar wrack at 15%. The most common vascular plant sightings were native eelgrass (*Zostera marina*) at 52%, dwarf eelgrass at 45%, ocean spray at 36%, Himalayan blackberry at 33%, Douglas fir at 35%, willows at 29%, roses at 27%, dunegrass at 24%, madrone at 20%, and red alder at 19%. The high occurrence of trees, and in particular of Douglas fir, suggests a relatively healthy and mature shoreline plant community. Another sign of relative health is the fact that none of the invasive plant species were found more frequently than these native species. A complete list of the flora and fauna identified in this inventory is provided in Appendix B.

Rapid Shoreline Inventory Data Analysis

While habitat inventories contain significant intrinsic value, descriptions of habitat can be most valuable to inform habitat conservation decisions when used to build and populate geospatial models that define and describe habitat quality. Working with King County Department of Natural Resources in Washington State, People For Puget Sound developed five semi-quantitative, multi-factor, causal models[7] using the data collected during Rapid Shoreline Inventories. These models describe the relationships amongst habitat features, measured during the RSI for each 150-foot section of shoreline, and indicators of habitat quality. The models assign values for each 150 ft. shoreline section relative to the number of shoreline features present that either support the habitat requirements of specific species groups or provide habitat forming/maintaining processes. The models are an attempt to define how various measurable characteristics of nearshore habitat affect habitat quality with respect to target biological communities or physical processes (model targets).

This methodology is based on the best available science for the relationship between marine nearshore habitats and key ecosystem processes and nearshore-dependent species in Puget Sound. However, scientific study in this area is not abundant. Moreover, the scoring system presented below represents value judgments made by staff scientists based on the scientific literature and other unpublished scoring schemes. These values can be adjusted to reflect other priorities and emerging research. This methodology is being prepared as a paper for submittal to the scientific journal *Restoration Ecology*.

[7] A causal model is based on the knowledge that certain physical attributes create or "cause" features that provide habitat for fish and wildlife.

The five models characterize nearshore habitat for:

- Forage fish spawning (species group)
- Nearshore juvenile salmonid use (species group)
- Aquatic vegetation (species group/ecosystem process)
- Feeder bluffs and nearshore sediment dynamics (ecosystem process)
- Shoreline-dependent terrestrial wildlife, with a focus on birds (species group).

These five models were chosen because they represent key elements of a functioning nearshore ecosystem typical of much of Puget Sound.

Due to the inexact state of scientific knowledge about nearshore processes and the interaction between shoreline development and biological community health, these models serve several purposes. First, the models allow one to compare and contrast large amounts of geospatially-referenced species and habitat data. Secondly, they force one to develop formal hypotheses about species-habitat connections that can be tested through restoration actions followed by monitoring and adaptive management.

The models are designed to assess each site for both the current condition of the site (conservation opportunities) and for the potential condition of the site (restoration opportunities). Each model employs two series of "habitat attributes." One series of attributes is valued positively for perceived benefits or indications of benefits to habitat quality. The second series of "habitat impacts" is assigned negative values for impacts on ecosystem processes, indications of physical disturbance, or direct impact on the model's focal species group.

Habitat Conservation Opportunities

To locate conservation opportunities, the models are used to rate individual 150-foot sections of shoreline on a scale of -100 to 100 with higher scores reflecting higher quality habitat. Positive scores were assigned to positive attributes such as riparian vegetation or feeder bluffs. Negative scores were assigned to habitat impacts such as bulkheads or signs of pollution. The conservation score is then simply the sum of the positive and negative values accrued for any 150 ft. section.

This analysis is helpful for identifying areas of highly functional habitat as well as those places that are not being directly or indirectly impacted by habitat altering processes related to invasive organisms or anthropogenic development. While scores vary linearly on this scale, it is important to recognize that this is a semi-quantitative model that provides a relative indication of site conservation value (sites scoring higher will generally be more favorable) for areas included in this study. The precise scores achieved may have little meaning taken outside the context of this specific cross-site analysis.

Habitat Restoration Opportunities

Ranking sites for restoration potential is complex and must account for both existing habitat conditions and potential future conditions should the site be restored. Since no system currently exists for evaluating nearshore restoration potential, the creation of a new scoring scheme was required. For the restoration ranking scheme, the ultimate goal was to target high value sites with restoration actions that produce the largest reduction in impacts. This scheme is designed to achieve the overall objective of identifying those sites with a high level of current ecosystem function or potential, and a significant degree of impairment.

The restoration analysis was based on the same scientific literature and data-driven, semi-quantitative rankings of site characteristics used in the conservation model. The specific objective was to develop the most appropriate restoration model that would accentuate those sites scoring high in both the habitat attribute and habitat impact categories while giving relatively little value to sites that score low in either category. This objective was achieved by multiplying the habitat attribute score and the habitat impact score, and then taking the absolute value of the product of the two numbers. Thus the restoration scores vary from zero – those sites that have either no current habitat attribute or no obvious habitat impacts, to 10,000 – those sites that have both the maximum score in habitat attributes and impacts present. A site with high restoration potential might have multiple positive habitat attributes such as pea gravel, a spit, eelgrass, and riparian vegetation, but also habitat impacts such as intertidal structures, a boat ramp, and several outfalls.

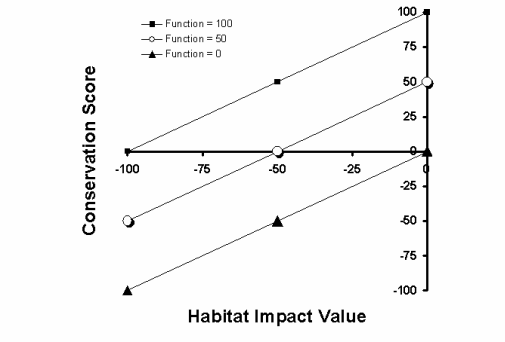
As with any model, the interpretation of scores requires care and consideration. It is recommended that scores for this model be interpreted on a logarithmic scale. Since the model is semi-quantitative, the direction of scores (higher being more favorable than lower) is more important than the specific score or precise difference between scores.

One way to visualize the analyses is to plot conservation and restoration scores versus habitat function and impact values (the independent variables used to calculate the scores). Table 1 shows a series of idealized habitat function and impact values and the corresponding conservation and restoration scores. These values are plotted on Figures 12a-d. Notice that when conservation scores are plotted along lines of constant habitat function or habitat impact values, scores increase linearly with *improvements* in both habitat function and impact (i.e. less impact). *The point of the conservation scoring system is to identify sites that have the greatest existing habitat value and the fewest negative impacts*.

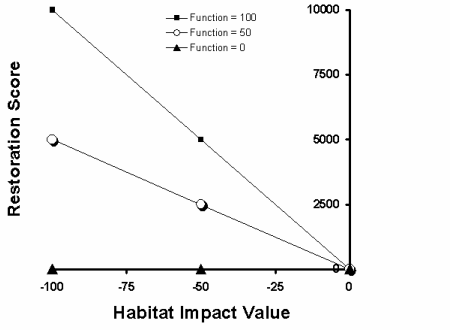
Function	Impact	Conservation	Restoration
100	-100	0	10000
100	-50	50	5000
100	0	100	0
50	-100	-50	5000
50	-50	0	2500
50	0	50	0
0	-100	-100	0
0	-50	-50	0
0	0	0	0

Table 1: Idealized habitat function and impact values for corresponding conservation and restoration scores. For demonstration purposes only -- see Figure 12a-d.

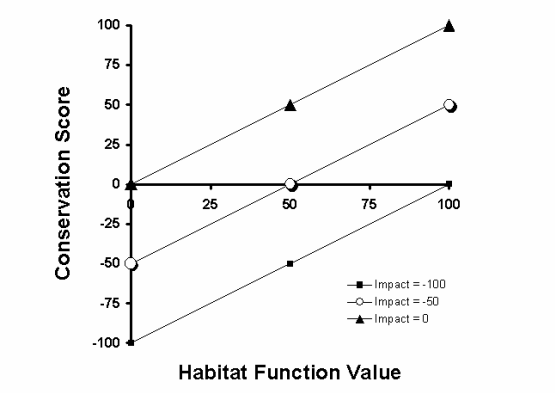
a. Conservation Score versus Habitat Impact Value: Constant Habitat Functions



c. Restoration Score versus Habitat Impact Value: Constant Habitat Functions



b. Conservation Score versus Habitat Function Value: Constant Habitat Impacts



d. Restoration Score versus Habitat Function Value: Constant Habitat Impacts

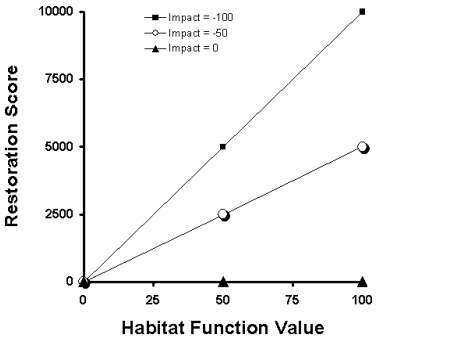


Figure 12a-d: Relationship between conservation and restoration scores and habitat function and impact values. Idealized for presentation -- see Table 1.

For the restoration analyses, the scores increase along with increasing attributes and increasing *intensity* of impact (more impact equals a larger negative number). This results because the impact and attribute values are multiplied instead of added. *The implications of this model are that sites with very low habitat attribute or very low habitat impact are not prime targets for restoration, whereas sites that still have substantial remaining or intrinsic habitat value, but also have significant impairment, represent the best opportunity to make significant gains for the ecosystem through restoration.*

This ranking system reveals those restoration opportunities that would provide the highest value to the living resources — not merely those that are the cheapest or most convenient. While sites identified using this tool are likely to provide ecosystem benefits if they are protected and restored, this ranking scheme should only serve as a guide and pre-ranking tool for further detailed site inspections and analysis of site-specific circumstances.

Because the precise meaning of each individual score is uncertain, it is best to compare sites within a given physical sampling area. In the specific examples presented later, the sites are ranked according to their scores and display those ranks rather than the raw scores. Those sites scoring in the highest decile (top 10%) are likely the most noteworthy sites and should be reviewed for potential conservation or restoration. Depending on the sampling area, sites in lower quantiles (the next 20%) may also be of interest for review. Overall conservation and restoration values were calculated by averaging the rank order (between 1 and 199 [the number of samples] with 199 being the highest scoring site) for the five models described here.

This conservation and restoration ranking scheme does not take into account the quality of immediately adjacent 150 ft. sections, or groups of adjacent sections. In this sense, the study and analysis does not explicitly account for habitat continuity along the shoreline. For example, multiple continuous sections of good to moderate quality habitat might be more important for conservation than one cell of excellent quality habitat in the middle of a larger area of very low quality habitat. While scores for individual sections do not reflect this larger spatial context, viewing groupings of scores on the display maps can help identify important habitat "clusters", and at this point, the summary maps probably represent the appropriate tool for such integrative ranking of spatial relationships.

Finally, since this is the second time this scoring system has been applied, the model would benefit from further validation through: 1) taking conservation and restoration actions on sites identified by the model; 2) direct observations of target species and habitat processes at sites identified by the model; 3) further scientific inquiry into general habitat requirements of various species modeled here; and 4) review and exploration of the modeling method put forth here, incorporating newly collected information.

Forage Fish Spawning Habitat Analysis

Forage fish, including populations of Pacific herring (*Clupea harengus*), surf smelt (*Hypomesus pretiosus*), and Pacific sand lance (*Ammodytes hexapterus*), are an essential component of the Puget Sound food web. Though phylogenetically unrelated, these three species comprise an essential trophic link within the nearshore environment, and are a major component of the diet of many predatory species including salmonids (Bargmann 1998). While relatively little is known about adult life stages of forage fish (e.g. Figure 13), spawning

preferences and requirements are generally understood. This analysis is an important extension of surveys that identify forage fish spawn, because this model focuses on both current and potential spawning habitat. While forage fish may use the same sites for spawning over long periods of time (Penttila 1995), a site may be abandoned for no apparent reason only to become used again at some point in the future (Robards et al. 1999).

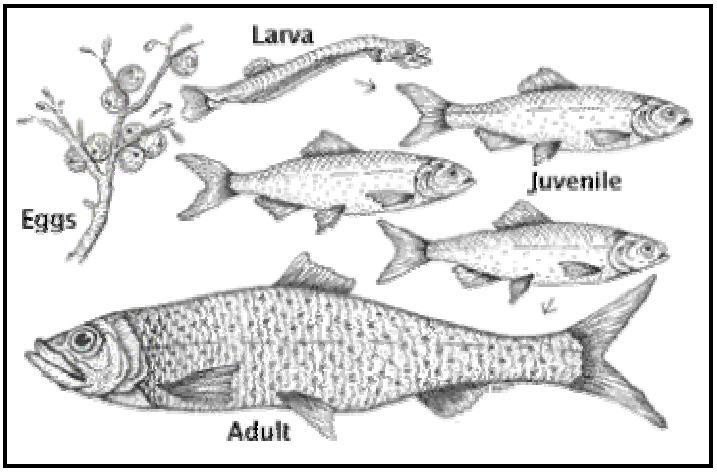


Figure 13: Life stages of Pacific herring (Courtesy of USGS).

Shoreline surveys to identify spawning beaches have been conducted by the Washington State Department of Fish & Wildlife (formerly the Department of Fisheries) since 1972. Based on information obtained during these surveys, surf smelt and sand lance are thought to spawn selectively on shorelines that have deposits of either sand or pea-gravel sized sediment in the upper intertidal zone (Bargmann 1998). In addition to substrate preferences and requirements, forage fish eggs tend to have lower mortality when there is riparian vegetation adjacent to the shoreline that can shade the shoreline and moderate temperatures (Robards et al. 1999). Pacific herring vary slightly from smelt and sand lance in that herring spawn primarily in the lower intertidal and shallow subtidal zones, attaching their eggs to vegetation such as eelgrass or kelp (Penttila, personal communication 2001).

The forage fish analysis focuses on identifying those beaches with conditions that would seem to favor forage fish spawning and spawn survival. Positive attributes for shorelines include appropriate sediment found in the upper intertidal, overhanging vegetation, as well as aquatic vegetation that might be used for spawning.

Negative components of this model are primarily those that interrupt or disturb potential spawning areas or the processes that form potential spawning areas. These include artificial outfalls which might supply excess nutrients or toxic chemicals to the shoreline, bulkheads which alter nearshore hydrography, or piers that shade subtidal vegetation (Figure 14).

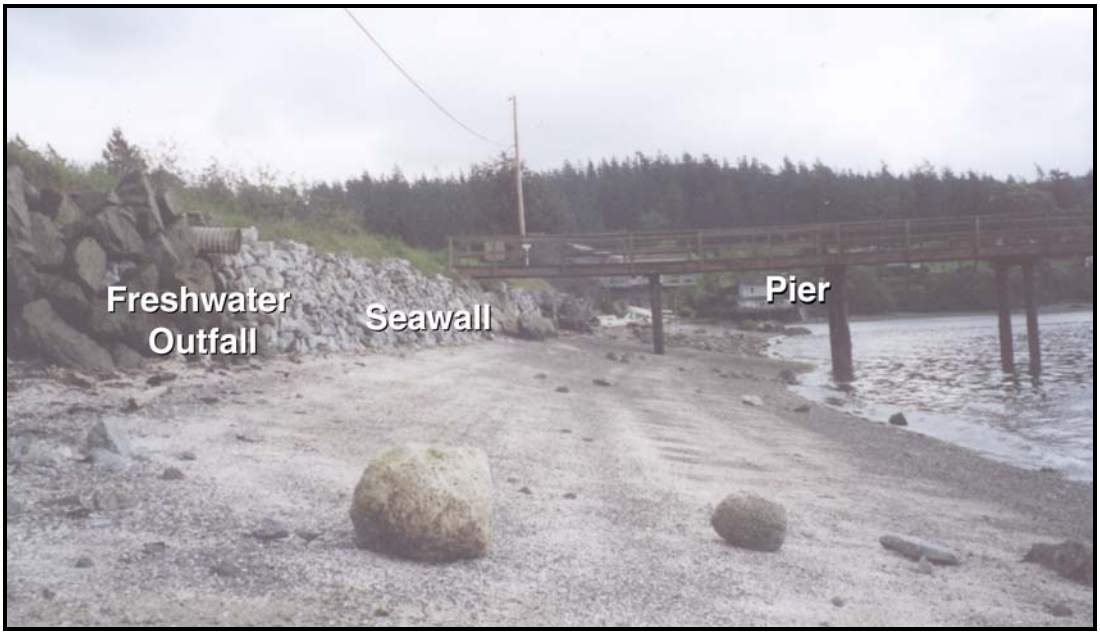


Figure 14: Examples of Development that can impact nearshore forage fish habitat.

The causal model and scoring for this model are described in Figure 15 and Table 2, respectively.

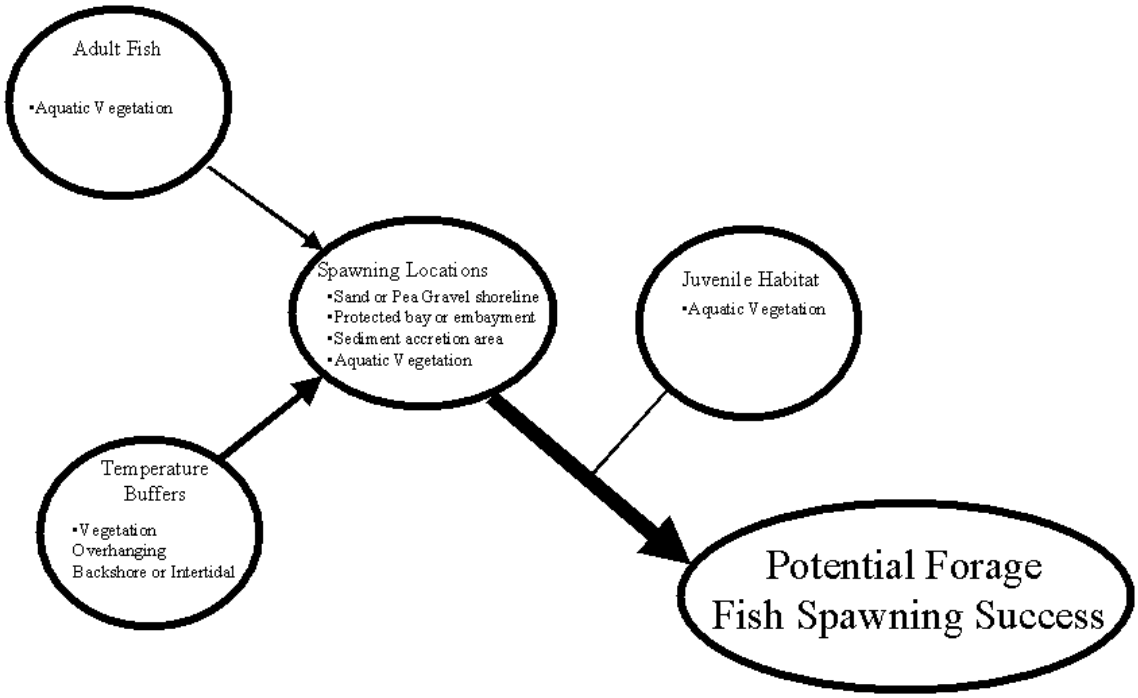


Figure 15: Causal model describing the relationship between shoreline characteristics and forage fish spawning success. Weight of arrows reflects assumed relative importance of those attributes for "success" in this particular model.

Habitat Attribute	Habitat Quality Value	Score Justification
Geophysical Characteristics		
Upper Intertidal Substrate	5	Appropriate substrate size in appropriate location
Sand/Pea Gravel Bed	20	Spawning bed of adequate size
Spit, Bar, or Tombolo	10	Substrate source present in area
Seep	5	Moderates substrate temperatures
Bluff Size	5	Substrate source present in area
Vegetation Characteristics		
Eelgrass (*Z. marina*)	10	Spawning medium
Kelp and intertidal algae	10	Spawning medium
Overhanging Vegetation	5 to 15	Shades spawn
Marsh	5	Provides prey resource
Anthropomorphic Group		
Undeveloped/Natural Adjacent Land use	5	Natural habitat with less disturbance
No intertidal structures	10	Signals nearshore hydrography is likely intact
Habitat Impact	**Habitat Quality Value**	**Score Justification**
Intertidal Structures	-10 to -30	Intertidal structures impact nearshore hydrography and sediment transport
Upland Land use	-10	Potential or actual impacts to shoreline
Boat Ramp	-20	Potential for continuing damage through use and potentially altered nearshore hydrography
Potentially Polluted Outfalls	-10	Signs of pollutants and/or excess nutrients to nearshore

Table 2: Description of model scores and justification for forage fish spawning model.

This analysis has a biased toward upper intertidal sand lance and surf smelt spawning habitat, as the Rapid Shoreline Inventory only partially accounts for subtidal herring spawning areas. This can be corrected, however, by comparing this analysis to documented spawning areas for the three species.

The conservation analysis reveals forage fish conservation priorities northwest of Wharf Road, at Scott's Point, and at points along Samish Island Road (Map 1A). While points north and west of Samish Point scored higher than

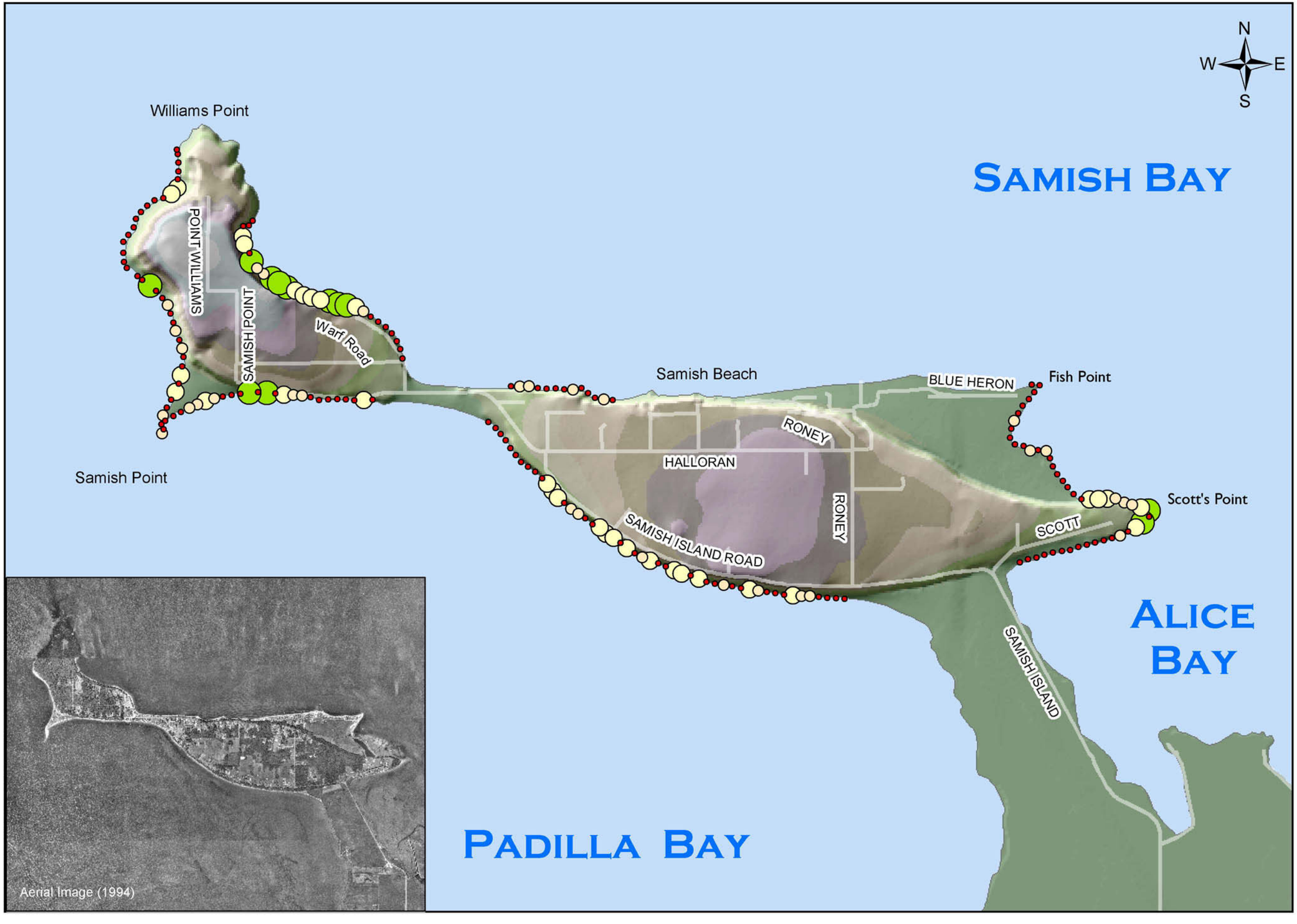
any on Samish Island Road, the length of the string of moderate scores along Samish Island Road points to it as the more important conservation target.

The restoration analysis reveals forage fish restoration priorities on west Samish Beach, along Scott Road, and at points north and east of Samish Point (Map 1B). West Samish Beach and Scott Road were the two most developed stretches of beach surveyed.

This page is intentionally blank

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 1A



CONSERVATION ANALYSIS

FORAGE FISH

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 90th to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

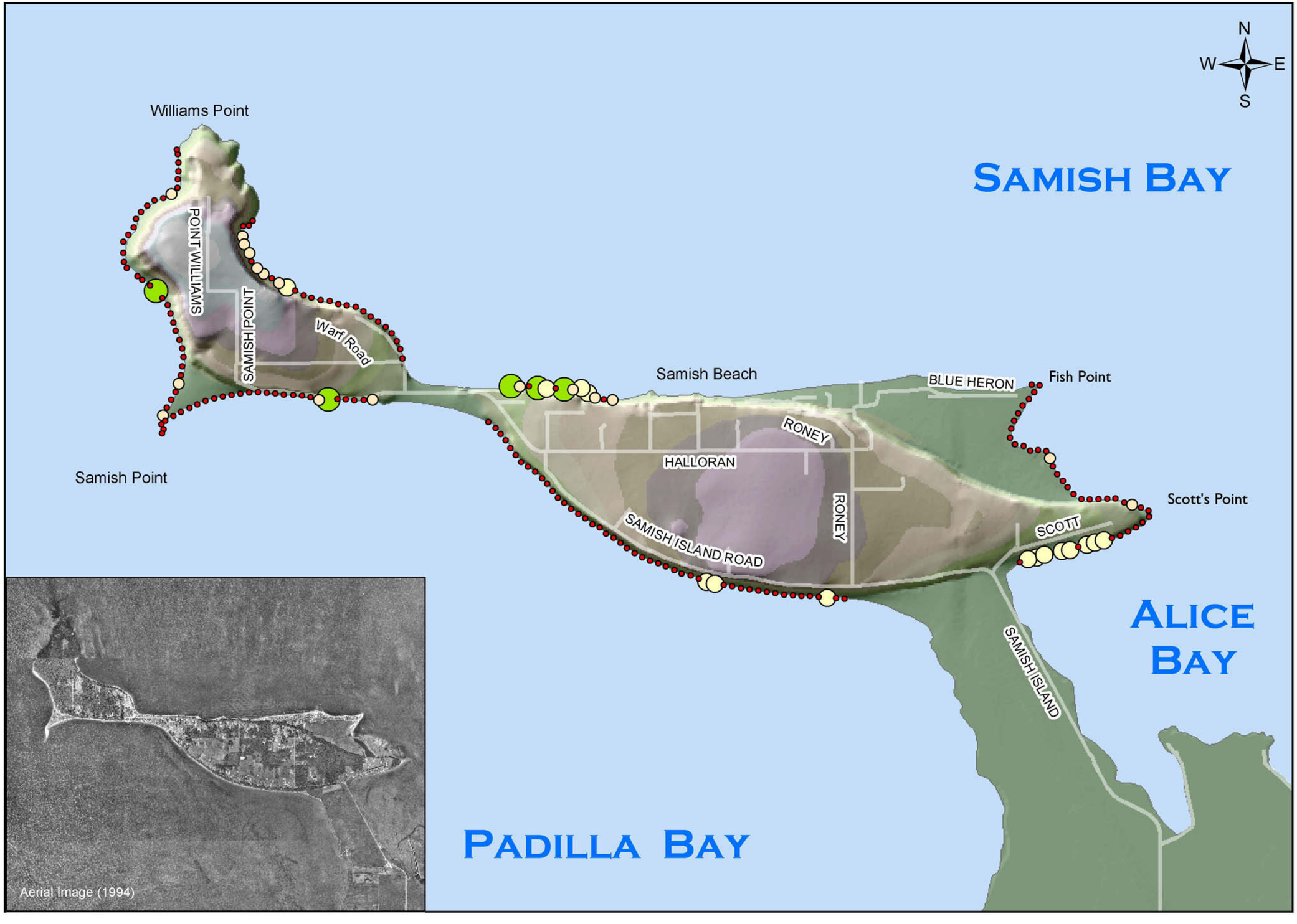
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 1B



RESTORATION ANALYSIS

FORAGE FISH

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 90th to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Nearshore Juvenile Salmonid Habitat Analysis

The salmon habitat analysis relies on the assumption that nearshore habitats provide key functions for juvenile salmon development and survival. Nearshore marine habitat may serve as migration corridors, feeding areas, physiological transition zones, refuge from predators, or refuge from high energy wave dynamics (Mason 1970; MacDonald et al. 1987, Thorpe 1994; Levings 1994; Spence et al. 1996). All juvenile salmon utilize the shallow waters of estuaries and nearshore areas as migration corridors to move from their natal streams through Puget Sound to the ocean (Willliams and Thom 2001). Estuarine environments provide a gradual transition area for juvenile salmon to adjust physiologically to salt water (Simenstad et al. 1982). With declines in aquatic vegetation that formerly served as feeding grounds and refugia for juvenile salmonids, it is likely that juvenile salmon have shifted their distributions and now utilize shallow water as an alternate refuge habitat (Ruiz et al. 1993).

This model focuses on valuing individual sites for their capacity to serve as feeding areas, refugia, or migration corridors. Emergent vegetation (*Carex lyngbyei*, *Scirpus spp*., etc.) and riparian shrubs and trees have been identified as vital components that provide detritus and habitat for chinook food organisms (Levings et al. 1991, Cordell et al. 2001), and were therefore scored appropriately.

Habitat impacts are those features that are known or believed to displace habitat or impede habitat forming processes. These include structures that reduce shallow water nearshore refuge and habitat or adjacent land uses that may impact vegetation and upland food sources. The causal model and scoring for this model are described in Figure 16 and Table 3, respectively.

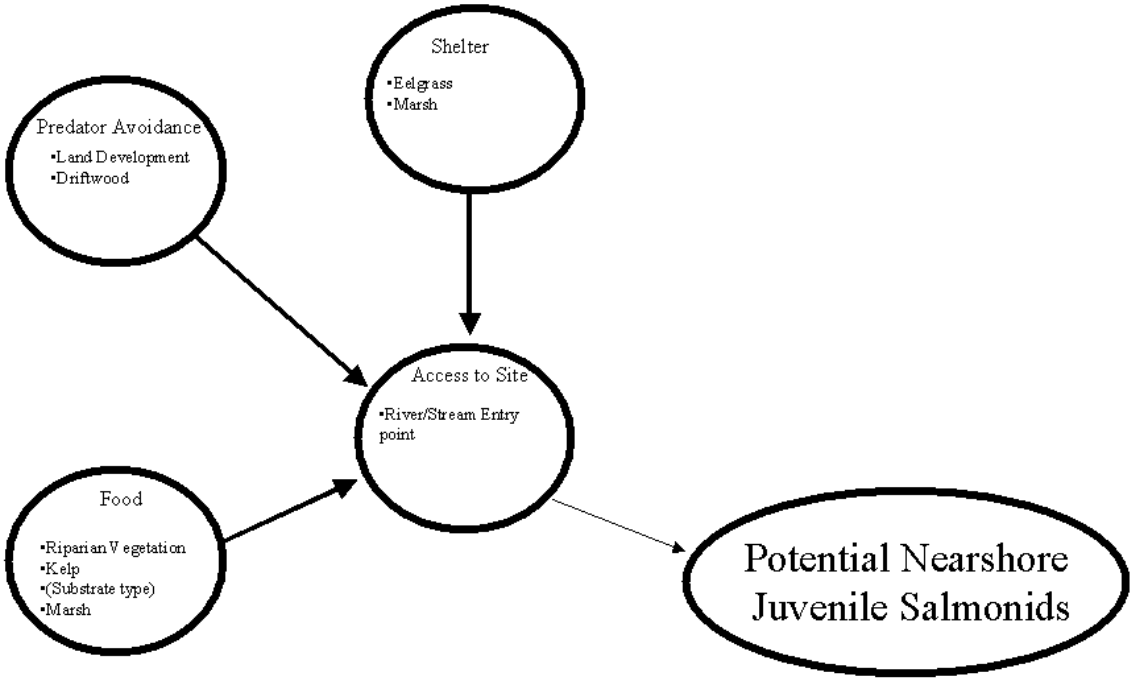


Figure 16: Causal model describing the relationship between shoreline characteristics and nearshore juvenile salmonid success. Weight of arrows reflects assumed relative importance of those attributes for "success" in this particular model.

Habitat Attribute	Habitat Quality Value	Score Justification
Geophysical Characteristics		
Intertidal Substrate	10 to 15	Habitat for prey resource
Driftwood Presence	5	Habitat for prey resource Refugia
Creek or River Mouth	5	Habitat for prey resource Migration corridor Physiological transition zone
Vegetation Characteristics		
Eelgrass (*Z. marina*)	15	Habitat for prey resource Refugia
Kelp	5	Habitat for prey resource Refugia
Riparian Vegetation	10 to 30	Habitat for prey resource Refugia
Marsh	15	Habitat for prey resource Refugia
Bluff/Bank Vegetation	3 to 5	Habitat for prey resource
Anthropogenic Group		
Undeveloped/Natural Adjacent Land use	5	Undeveloped areas represent areas that lack disturbance and are more likely to have native flora.
Habitat Impact	**Habitat Quality Value**	**Score Justification**
Structures		
Intertidal Structure	-30	Removes refugia Removes prey resource
Shoreline Armoring	-10 to -30	Removes refugia Removes prey resource
Upland Land use	-10 to -30	Adverse land uses increase disturbance, reduce habitat and introduce pollutants
Potentially polluted Outfalls	-10	Pollutants entering the system can reduce dissolved oxygen content and act as stressors.

Table 3: Description of model scores and justification for nearshore juvenile salmonid habitat model.

Another criterion for juvenile salmon habitat conservation might be the area's proximity to large, chinook-bearing rivers. Recent research in the Skagit River suggests that juvenile chinook can be prematurely forced out of estuaries and into marine shorelines (Beamer et al., in preparation), although this has yet to be documented for other sub-estuaries of Puget Sound. Juvenile salmon also use the beach as a migration corridor; the continuity of good habitat is an issue not

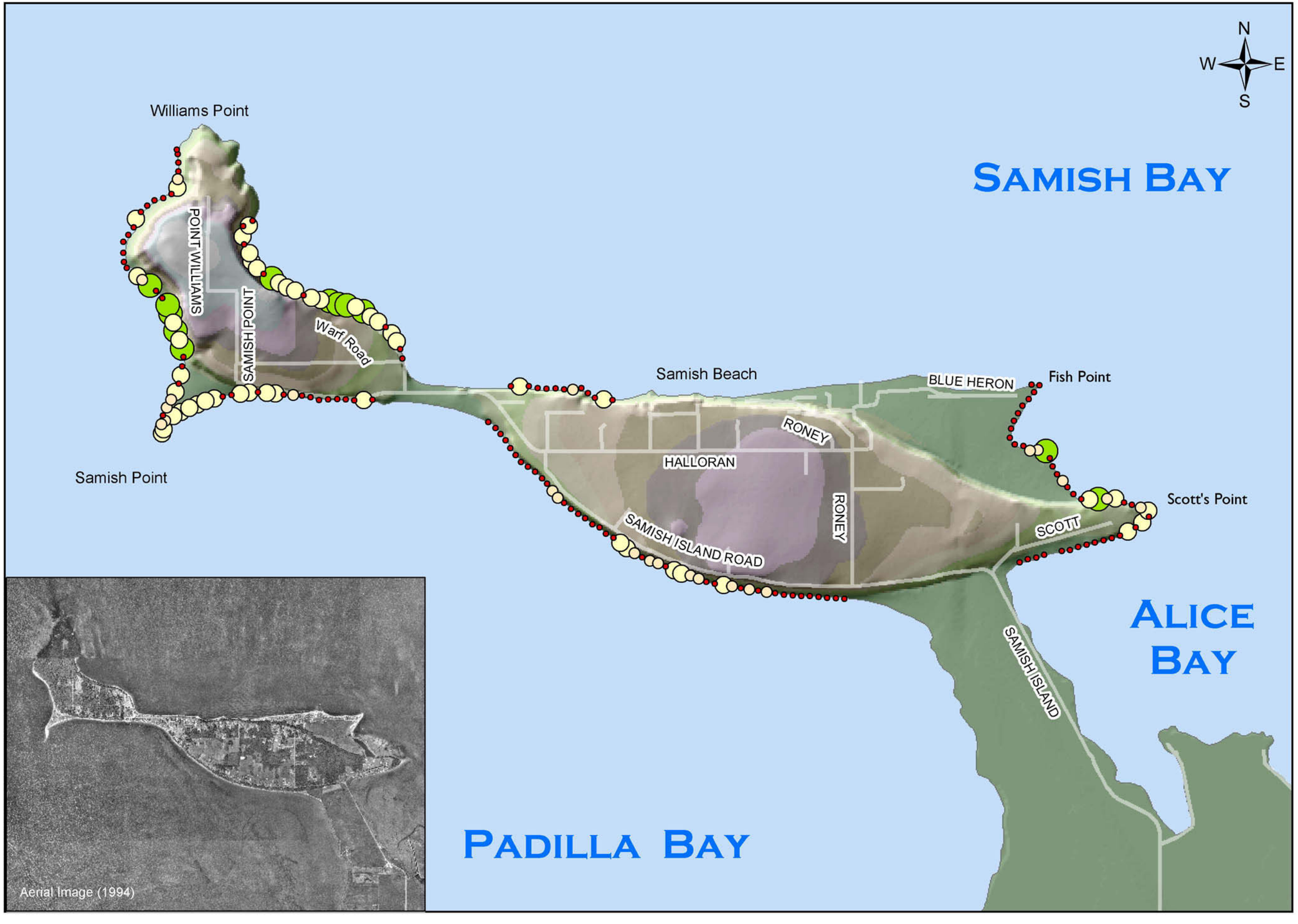
addressed by this report. Area rankings for this analysis should probably be viewed in light of their proximity to the mouth of the Samish River.

The conservation analysis reveals juvenile salmon conservation priorities northwest of Wharf Road and north of Samish Point, as well as points between Fish Point and Scott's Point (Map 2A).

The restoration analysis reveals juvenile salmon restoration priorities along Scott Road, at west Samish Beach, and northwest of Wharf Road (Map 2B). Because the RSI focuses on shorelines, this analysis does not reveal the fact that a large historic wetland between Scott's Point and Fish Point is now impounded. It is reasonable to believe that this wetland once provided important salmon rearing habitat for Samish River runs.

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 2A



CONSERVATION ANALYSIS

JUVENILE SALMONIDS

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

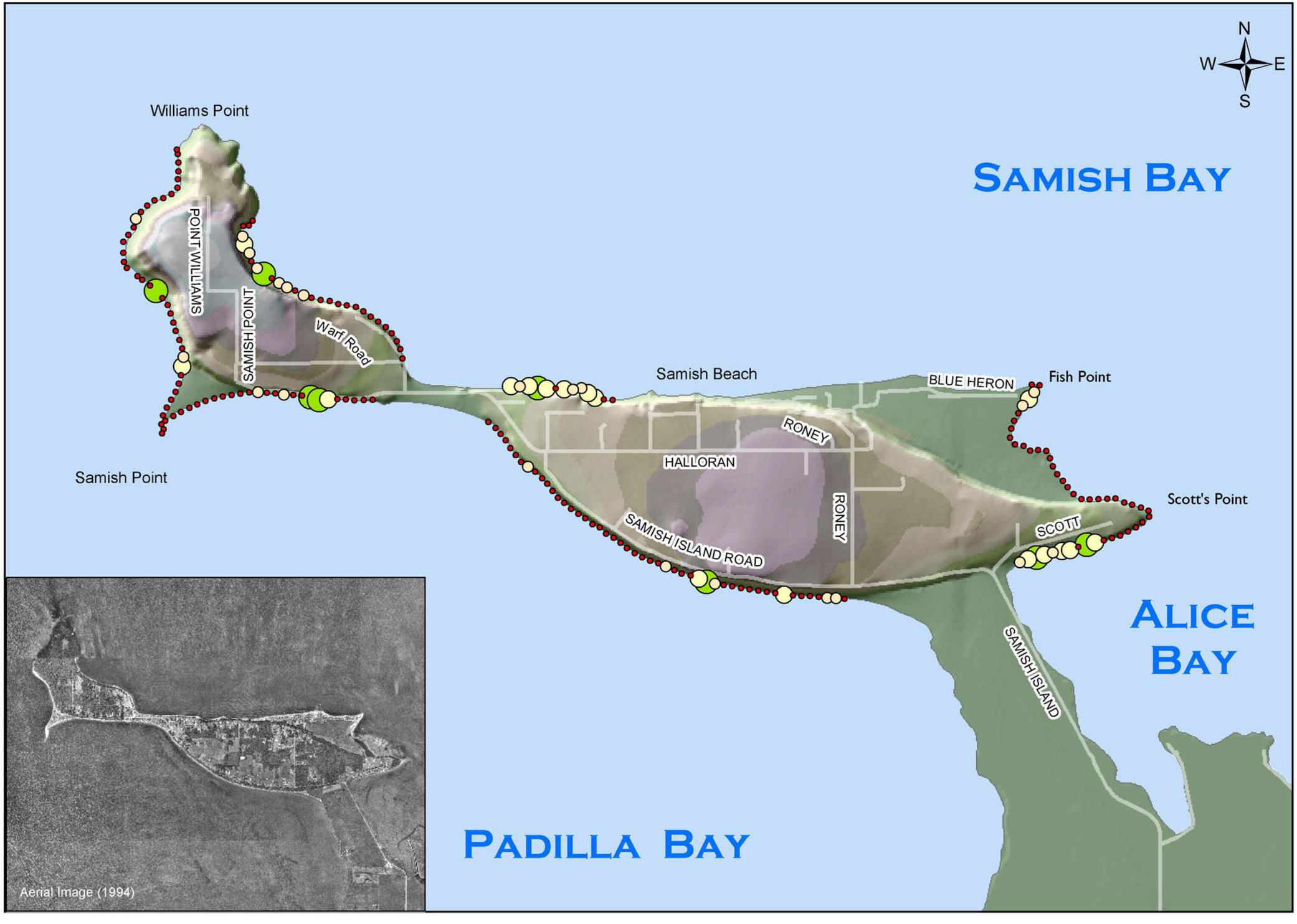
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 2B



RESTORATION ANALYSIS

JUVENILE SALMONIDS

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 90th to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Aquatic Vegetation Analysis

Primary production forms the base of any food web, and in Puget Sound the primary producers are seaweeds, sea grasses, benthic microalage, kelps, marsh macrophytes, and phytoplankton. In Puget Sound, areas of increased algae and seagrass density, or biomass, contain more species and a greater abundance of epibenthic invertebrates than do areas of lower vegetative cover or structure (Cheney et al. 1994). With the exception of estuary marsh vegetation, which was formerly widespread in and around the major bays and deltas of Puget Sound (Bortelson 1980), primary production is limited to a relatively narrow band of habitat as a result of the steep fjord-like character of Puget Sound's nearshore habitat. Any attempt to determine the suitability of a certain area as habitat for submersed aquatic vegetation (SAV) must take into consideration light and parameters that modify light (epiphytes, total suspended solids, chlorophyll concentration, nutrients) (Koch 2001). Anthropogenic nitrogen loads to shallow coastal waters have been linked to shifts from seagrass to algae-dominated communities in many regions of the world (McClelland and Valiela 1998). Propagules of most types of aquatic vegetation are generally found to be ubiquitous, so the absence of aquatic vegetation is generally a result of either inappropriate habitat for colonization and survival or displacement by another type of aquatic vegetation (Moore et al. 1996).

The focus of this analysis is on direct observations of aquatic vegetation with individual types of aquatic vegetation valued primarily for their ecological "services." Implicit in the scoring of this model is the underlying assumption that each type of aquatic vegetation typically occupies a particular zone in the nearshore environment, from the subtidal to the upper intertidal. Species and multi-species assemblage scores are largely based on the ecological services they provide and the number of zones they occupy. Factors affecting light availability

and nutrient loading as well as non-native competitors are assessed as detractors in this model. The causal model and scoring for this model are described in Figure 17 and Table 4 respectively.

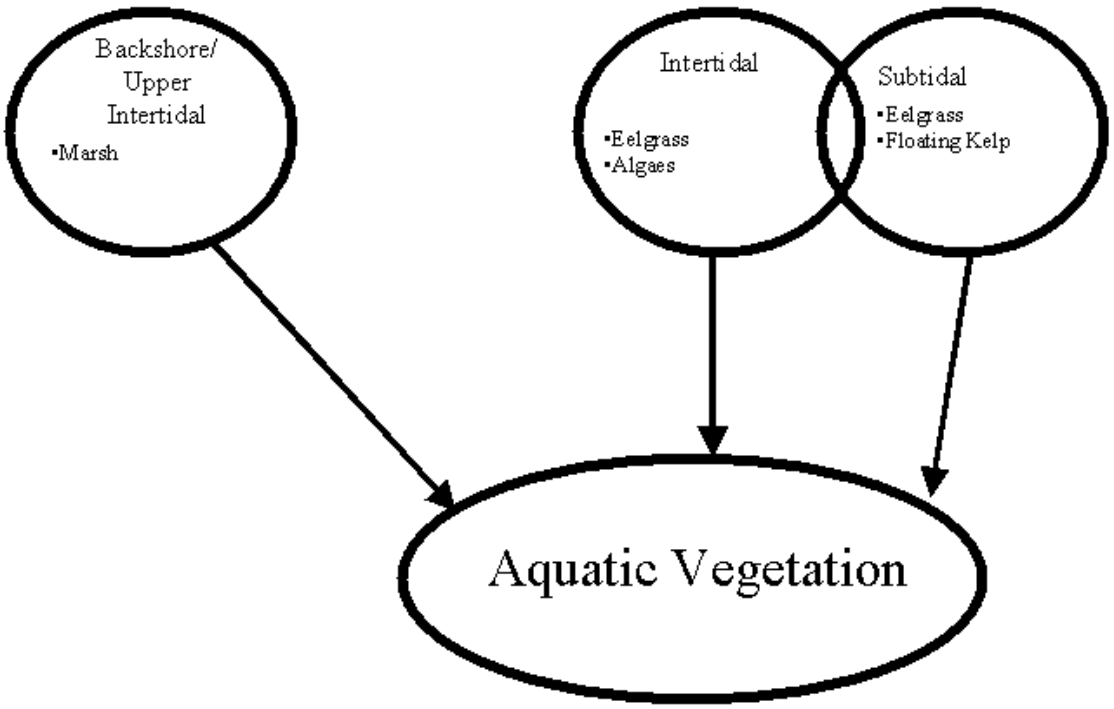


Figure 17: Causal model describing the relationship between shoreline characteristics and aquatic vegetation. Weight of arrows reflects assumed relative importance of those attributes for "success" in this particular model.

Eelgrass	Kelp	Brown Algae and Ulvoids	Marsh	Score
X	x	x	**x**	100
X	x		**x**	90
X		x	**x**	90
X			**x**	85
	x	x	**x**	70
	x		**x**	60
		x	**x**	60
X	x			50
X		x		50
X	x	x		60
			x	40
X				40
	x	x		30
	x			20
		x		20
				0

Habitat Impact	Habitat Quality Value	Score Justification
Invasive Plants		
Spartina	-30	Alters habitat Competes with native vegetation
Purple Loosestrife	-20	Competes with native vegetation
Sargassum	-10	Impacts of competition with native vegetation are unknown
Pollution/Nutrient Inputs		
Potentially Polluted Outfalls	-10	Altered nutrient supply impacts community composition Source of potential chemical contaminants
Structures		
Intertidal Structures	-20	Shades nearshore vegetation Affects nearshore hydrography
Shoreline Armoring	-10	Affect nearshore hydrography, occupies habitat

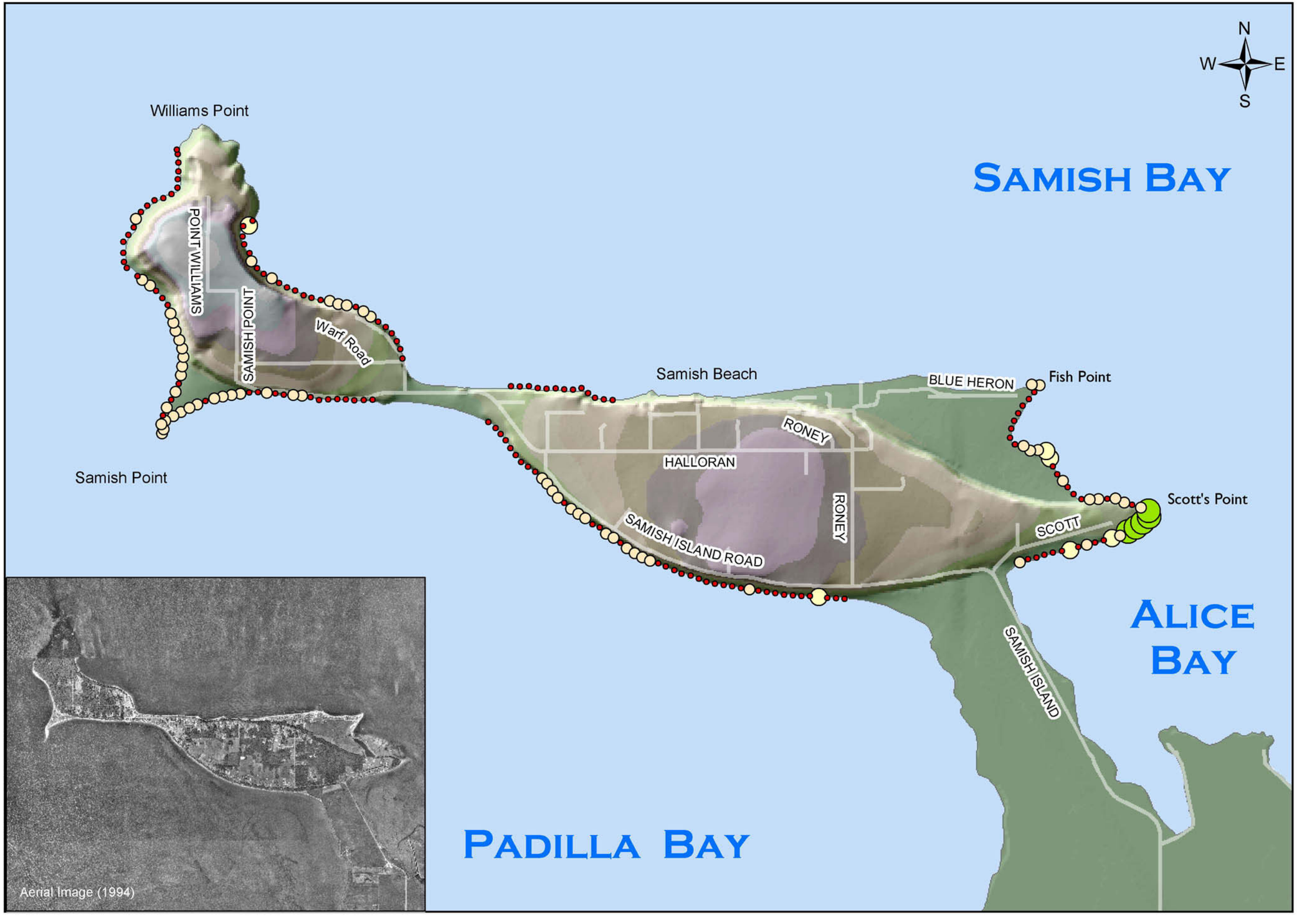
Table 4: Description of model scores and justification for aquatic vegetation model.

The conservation analysis reveals only one clear conservation priority for aquatic vegetation, at Scott's Point (Map 3A).

The restoration analysis reveals aquatic vegetation restoration priorities along Scott Road and northwest of Wharf Road (Map 3B). While one point on Samish Island Road scored in the top percentile, most of west Samish Beach scored in the middle range, suggesting that the latter might be the more clear priority. Again, the area between Fish Point and Scott's Point was probably historically a very important area for aquatic vegetation.

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 3A



CONSERVATION ANALYSIS

AQUATIC VEGETATION

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 90th to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

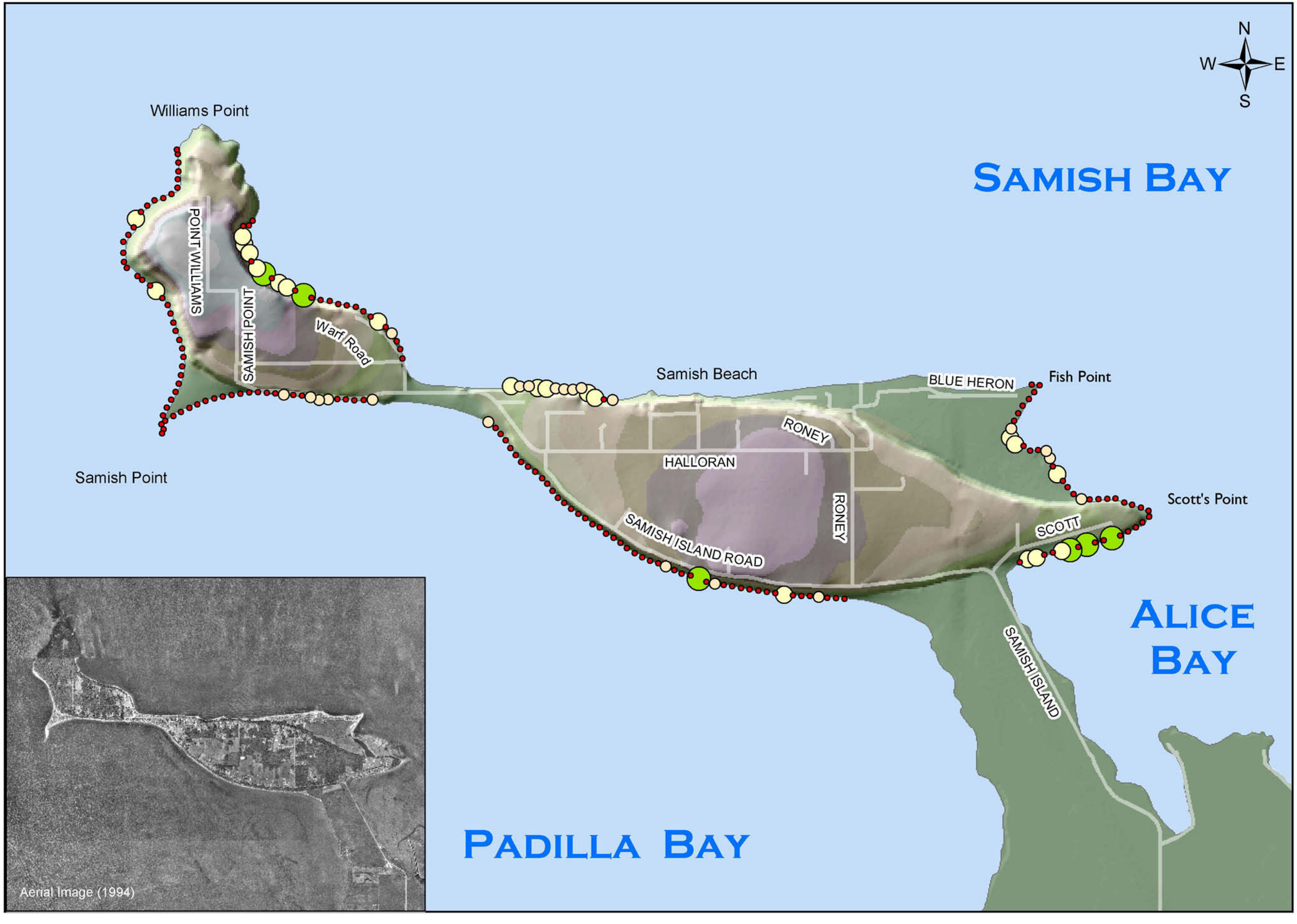
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 3B



RESTORATION ANALYSIS

AQUATIC VEGETATION

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Feeder Bluffs and Nearshore Hydrography Analysis

Puget Sound's shorelines are composed of hundreds of littoral cells that redistribute sediment along the shoreline. In the relatively protected waters of Puget Sound, the primary sources of sediment to the shoreline are alongshore and onshore transport, bluff erosion, and beach nourishment. Sediment is lost from the beach as a result of erosion and longshore transport or deposition on spits (Downing 1983). Shoreline development and armoring actively impact Puget Sound beaches by altering sediment supply and transport processes on shorelines and by directly modifying and occupying critical habitats (Shipman and Canning 1993, Shipman 1995).

In developing a causal model to assess the local functionality of the nearshore sediment budget, the results of other models that focus on the impacts of human activity on shoreline erosion were adapted (e.g. Lawrence 1994). The focus of this analysis is on identifying signs that the sediment budget is being filled by

looking for evidence of active erosion, in particular along bluff faces, and areas of deposition that are found at the end of drift cells such as tombolos and spits. The causal model and scoring for this model are described in Figure 18 and Table 5 respectively.

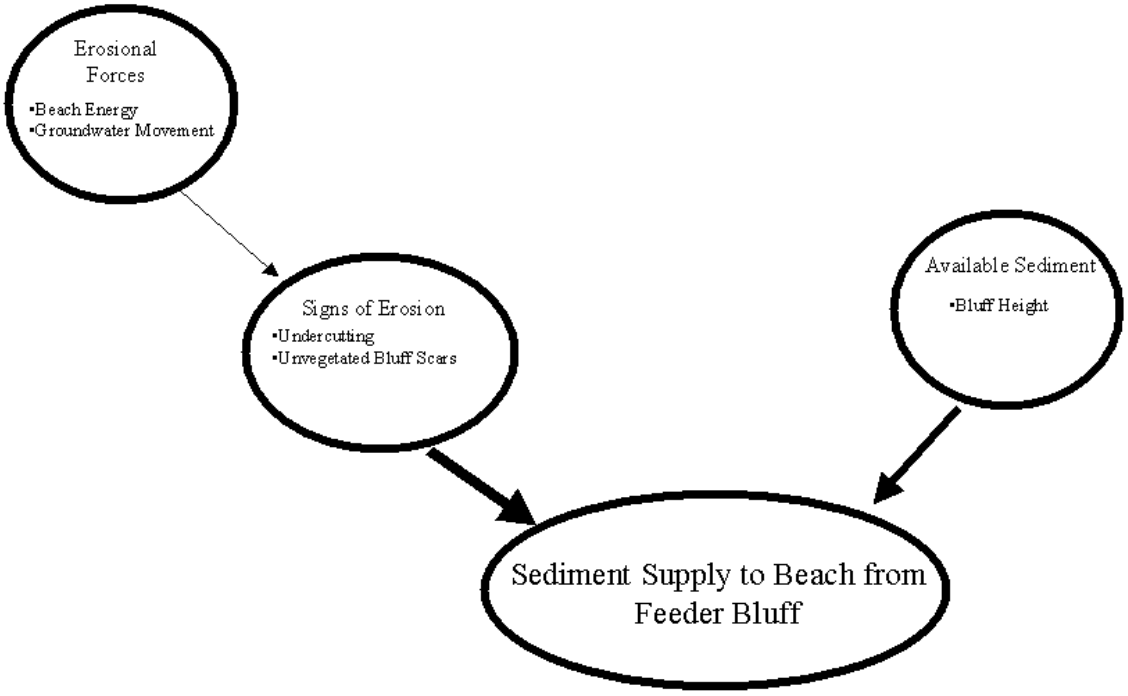


Figure 18: Causal model describing the relationship between shoreline characteristics and functional nearshore hydrography and feeder bluffs. Weight of arrows reflects assumed relative importance of those attributes for "success" in this particular model.

Habitat Attribute	Habitat Quality Value	Score Justification
Signs of Erosion		
Bluff Scars	10 to 15	Sign of active erosion
Bluff Undercutting	10 to 15	Sign of high beach energy and erosion potential
High Beach Energy	10	Cause of erosion
Sediment Supply		
Bluff Height	10 to 50	Sediment source potential
Stream or River	10	Sediment source potential
Sediment Deposition		
Tombolo, Spit, or Bar	10	Sediment Deposition Zone
Habitat Detractor	**Habitat Quality Value**	**Score Justification**
Shoreline Development		
Proportion of Shoreline Armored	-10 to -40	Shoreline armoring both exacerbates nearshore sediment loss and prevents sediment supply to the beach
Adverse Adjacent Land use	-20	Adjacent land use may act as a source of pollutants and developed land uses are likely to reduce sediment budget

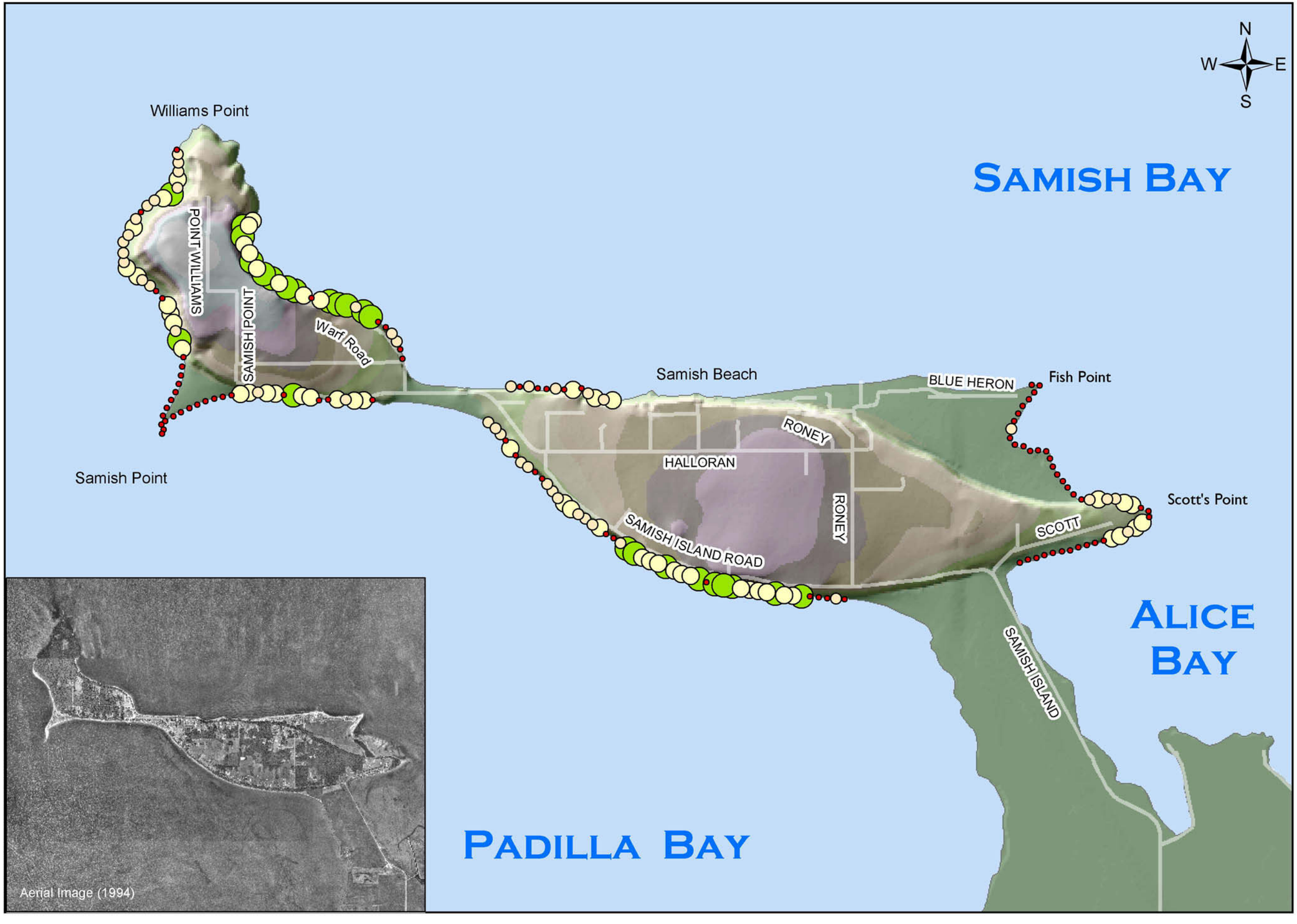
Table 5: Description of model scores and justification for functional nearshore hydrography and feeder bluff model.

The conservation analysis reveals nearshore hydrography conservation priorities northwest of Wharf Road, both north and east of Samish Point, and along Samish Island Road (Map 4A). Parts of Williams Point scored high because of the size of the bluffs there, but these are mostly rocky outcroppings and so probably not appropriate priorities. Samish Island contains many active feeder bluff areas, so a relatively large number of sections scored high in this analysis. Currently, the most active feeder bluff area is probably northwest of Wharf Road. It should be noted that Samish Point, while itself a large spit, was too large to be classified as a spit due to the scale of this survey.

The restoration analysis reveals nearshore hydrography restoration priorities west of Samish Point, at two spots along Samish Island Road, and along west Samish Beach (Map 4B). Only isolated sections scored high in this analysis; there is no stretch of beach that consistently scored well.

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 4A



CONSERVATION ANALYSIS

FEEDER BLUFFS AND NEARSHORE HYDROGRAPHY

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

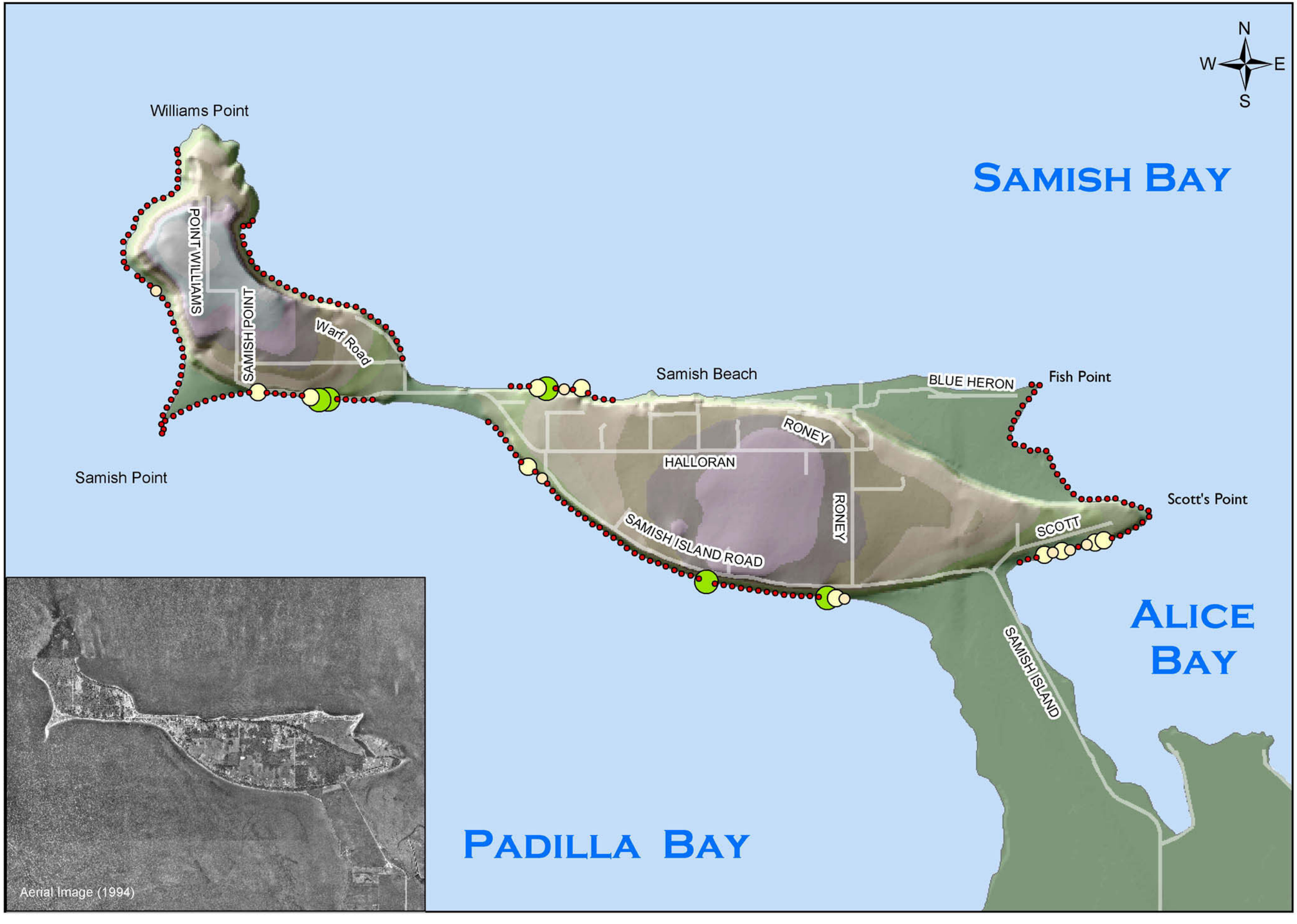
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 4B



RESTORATION ANALYSIS

FEEDER BLUFFS AND NEARSHORE HYDROGRAPHY

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 90th to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Marine Birds and Wildlife Habitat Analysis

A variety of terrestrial animals spend part or all of their lives within the nearshore environment and have a great impact on the composition and functioning of the nearshore ecosystem. An essential component of the nearshore ecosystem is marine birds. Marine birds are often the dominant predators along rocky as well as sandy beaches (Hori and Noda 2001). In addition to being a dominant consumer of animals, most birds are omnivores and therefore play a critical role in structuring assemblages of animals as well as vegetation in the nearshore ecosystem.

This analysis focuses on habitat components that contribute to the feeding, rearing, and resting of shoreline-dependent wildlife. This analysis looks at a variety of shoreline features that are beneficial for a variety of birds that depend on marine shorelines. It awards points for fine sediments where shorebirds forage, niche habitats where rivers and creeks meet salt water, and dunes where some shorebirds nest. It awards points for a variety of vegetation directly beneficial to marine waterfowl (such as brants) and indirectly beneficial to fish-eating birds (such as great blue herons and kingfishers). The causal model and scoring for this model are described in Figure 19 and Table 6 respectively.

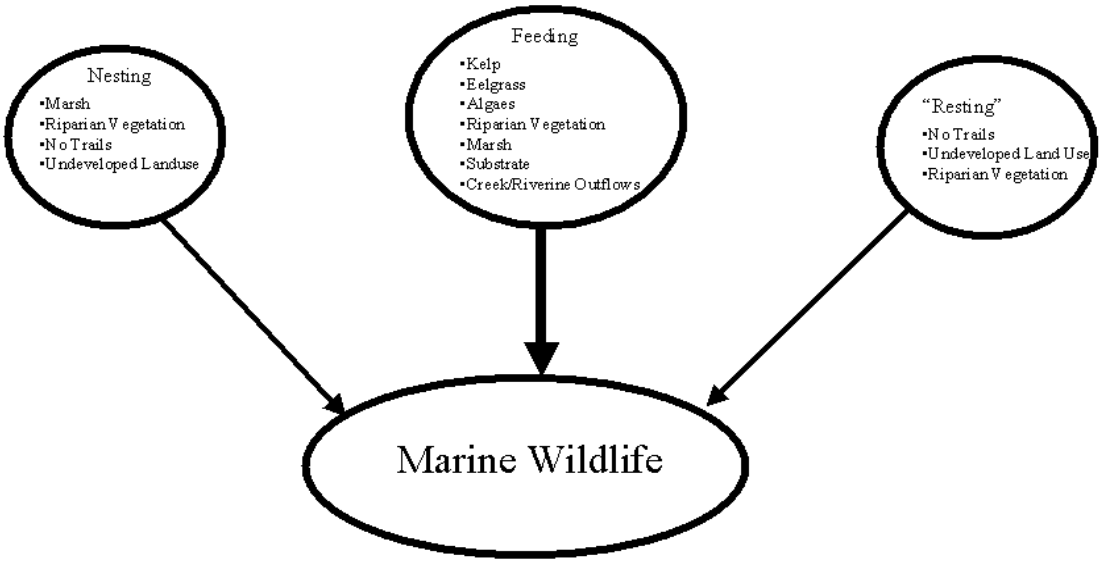


Figure 19: Causal model describing the relationship between shoreline characteristics and marine wildlife habitat. Weight of arrows reflects assumed relative importance of those attributes for "success" in this particular model.

Habitat Attribute	Habitat Quality Value	Score Justification
Geophysical Characteristic		
Intertidal Substrate	10 to 20	Shorebird habitat
Creek or River	5	Migration corridor Prey resource
Dune	15	Unique niche
Vegetation Characteristic		
Eelgrass (*Z. marina*)	10	Trophic productivity
Kelp	5	Trophic productivity
Marsh	10	Trophic productivity
Riparian Vegetation	5 to 25	Trophic productivity Resting/nesting
Bluff/Bank Vegetation	3 to 5	Trophic productivity Refuge/resting/nesting
Upland Land use		
Undeveloped Natural	5	Less Disturbance
Habitat Detractor	**Habitat Quality Value**	**Score Justification**
Upland Land use		
Developed Land use	-10 to –30	Potential pollutants Loss of habitat structure (refuge/resting/nesting)
Trail Access to Shoreline	-10 to –20	Disturbance
Structure		
Intertidal Structure	-30	Loss of habitat structure (refuge/resting/nesting)
Shoreline Armoring	-10 to –20	

Table 6: Description of model scores and justification for marine wildlife habitat.

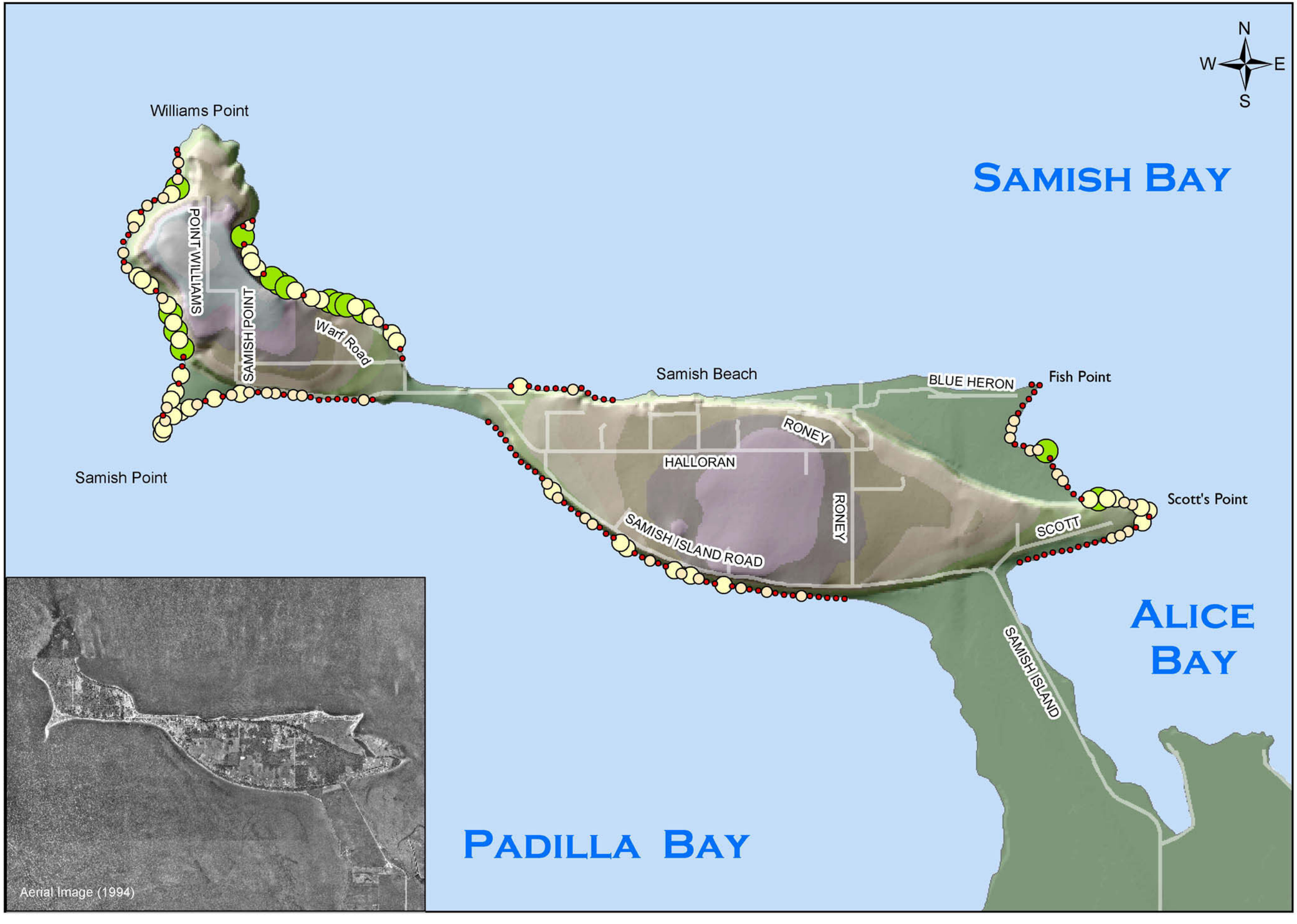
The conservation analysis reveals marine bird and wildlife conservation priorities in the vicinity of Samish Point, northwest of Wharf Road, and at Scott's Point (Map 5A).

The restoration analysis reveals marine bird and wildlife restoration priorities along Scott Road, on west Samish Beach, at in one area east of Samish Point (Map 5B).

This page is intentionally blank

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 5A



CONSERVATION ANALYSIS

MARINE BIRDS AND WILDLIFE

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

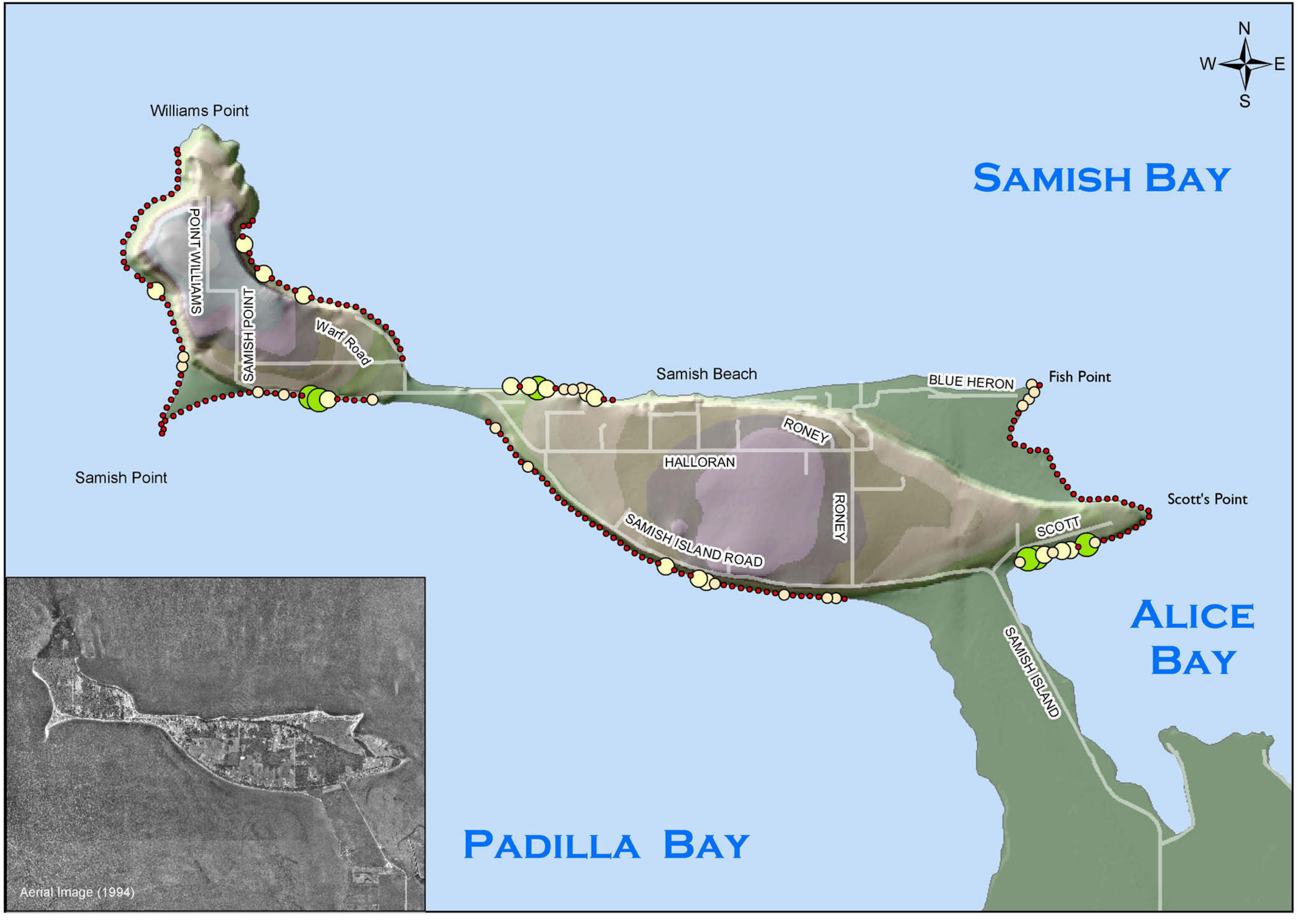
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 5B



RESTORATION ANALYSIS

MARINE BIRDS AND WILDLIFE

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 70th to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Conservation Focus Areas

To analyze the surveyed area for conservation potential, the conservation scores from the five models were summed and displayed (Map 6A). The areas that scored the highest for the combined conservation analysis were Scott's Point, northwest of Wharf Road, points north and east of Samish Point, and a string of points along Samish Island Road. Three general areas of focus for conservation are recommended based on these scores as well as a general knowledge of Samish Island and the surrounding areas. The focus areas are:

1) The Samish Point area;
2) The Wharf Road area, and;
3) The Scott's Point area.

The Samish Point area scored high on the salmon, feeder bluff, and marine bird analyses. The Wharf Road area scored high on the forage fish, salmon, feeder bluff, and marine bird analyses. The Scott's Point area scored high on the forage fish and vegetation analyses.

Each of these focus areas contain more than one RSI section that scored in the top decile on this combined analysis. These groupings of high-scoring sections present the most logical areas in which to assemble large conservation projects. This survey is not designed to produce the final word on specific site selection, nor were volunteers able to access all of the sections within these focus areas for survey, so these results need to be ground-truthed.

Samish Point scored lower that one might expect, probably because of the relatively fine scale of this analysis. For instance, a volunteer standing on the shore would not record the beach feature "spit," because it does not show up in that 150-foot section – even though Samish Point itself is a large sand spit. The

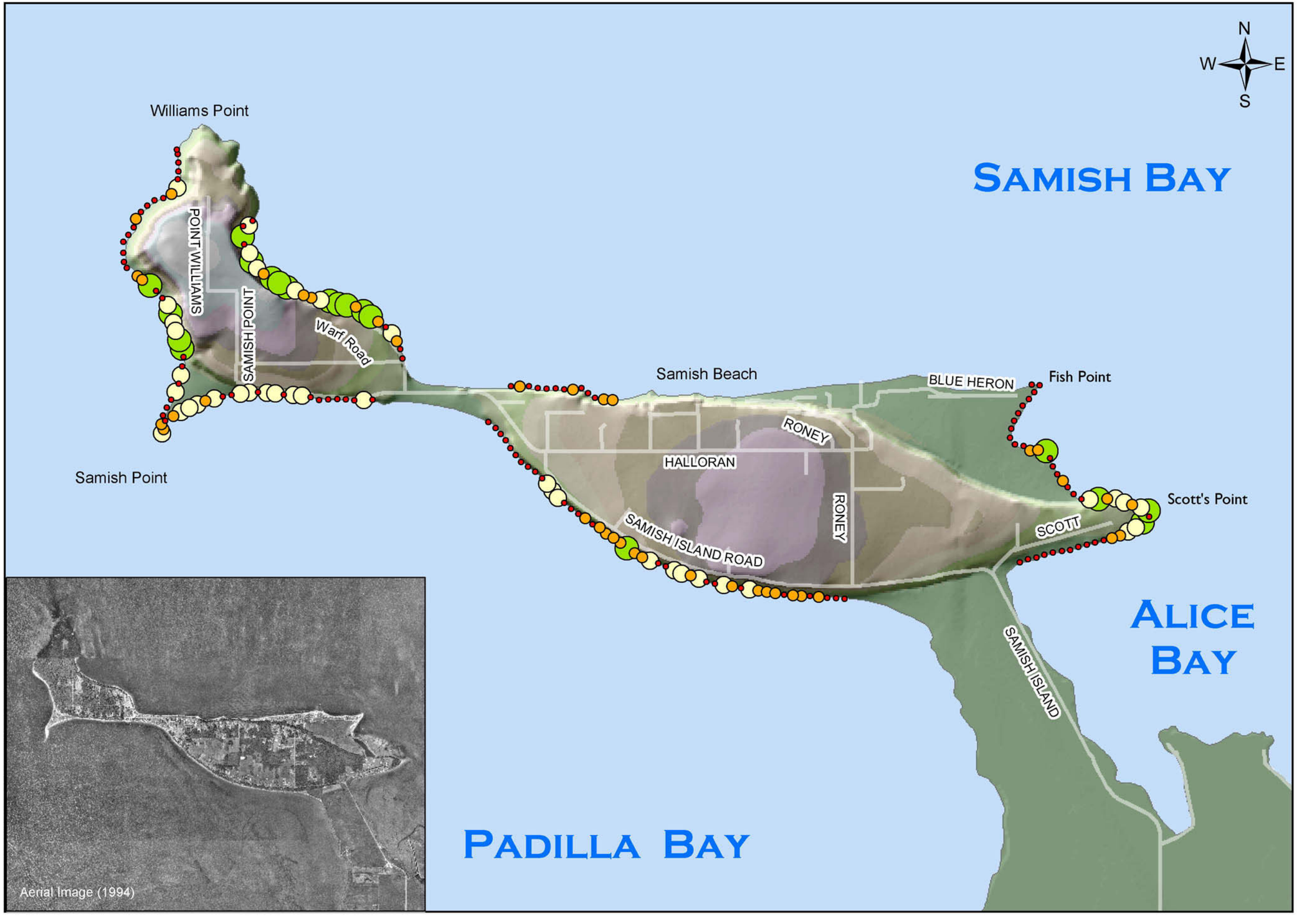
spit itself does not contain much overhanging vegetation – a somewhat natural condition that may have kept the conservation scores down. For these reasons, and because of the high groupings of scores to the north and east of Samish Point, the focus area includes the entire spit and environs.

Although there is no conservation focus recommended for Samish Island Road, it did score relatively high. Permanent protection for the vegetation buffer along that bank might be worth exploring. It is worth noting that this inventory covered only 5.7 miles within a 8.8 mile study area that was, on a whole, identified as an important conservation area by the Skagit County Marine Resource Committee. There may be other areas of the Island that that would be important to conserve for marine fish and wildlife.

These focus areas have not been ranked in order of priority. When considering projects for habitat conservation, it is customary to consider some factors that are not included in this study. These factors include size, adjacency to conserved areas, threat of habitat destruction, price, and landowner willingness. It should be noted that the owners of the parcels represented in this study granted permission to inventory their property, and so can be presumed to have an interest in the health of Puget Sound's marine shoreline or at least the status of their property.

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 6A



CONSERVATION ANALYSIS

OVERALL

Legend

Conservation Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Restoration Focus Areas

To analyze the surveyed area for restoration potential, the restoration scores from the five models were summed and displayed (Map 6B). The areas that scored the highest for the combined restoration analysis were Scott Road, west Samish Beach, points north and east of Samish Point, and a couple of points along Samish Island Road. Three general areas of focus for conservation are recommended based on these scores and a general knowledge of Samish Island and the surrounding areas. The focus areas are:

1) The Samish Point area;
2) The Wharf Road area, and;
3) The Scott Road area.

The Samish Point area scored high on all five sub-analyses. However, that area is large, and those scores are scattered in different portions of the focus area. The Wharf Road area scored highest on the forage fish and salmon analyses. The Scott Road area scored the highest on the forage fish, salmon, vegetation, and marine bird analyses.

If you look at the overall conservation and restoration analyses in combination, you begin to see how the three focus areas line up with each other. While Samish Point itself did not score high for restoration, distinct points north and west of the Point did. Areas on the north side of the spit scored relatively high, and restoration actions there such as trail management and bank re-vegetation might be very cost-effective to accomplish with high resource benefits.

While the area northwest of Wharf Road did not score particularly high for overall restoration, this was the largest conglomeration of high conservation

scores. The overlap of these areas suggests that this is a very good candidate for a combined conservation/restoration project.

Scott Road scored high for overall restoration, and is immediately adjacent the area of high conservation scores on Scott's Point. This area is also part of the Samish River Delta, and so might be more beneficial to restore in terms of the larger ecosystem.

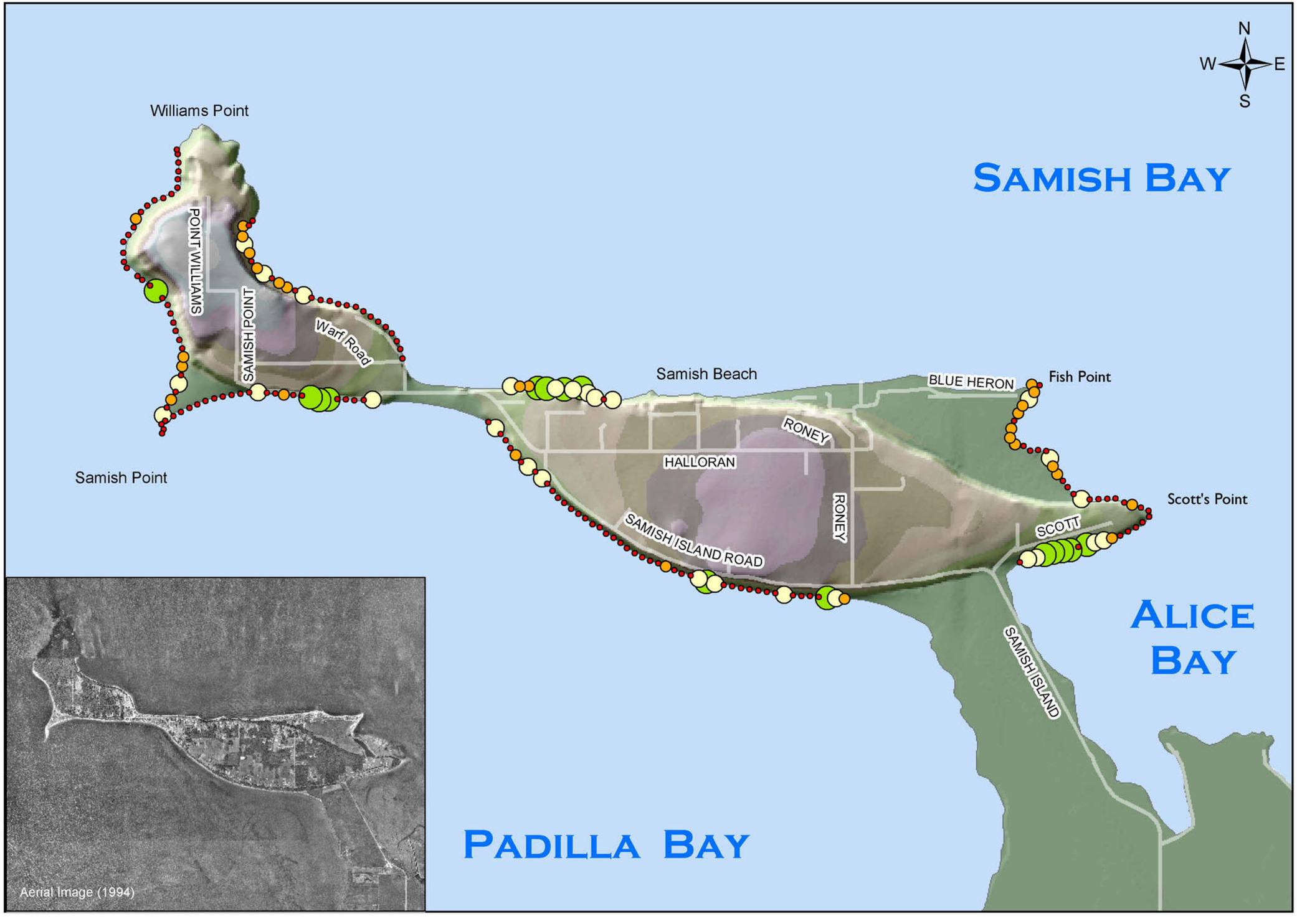
Both the west Samish Beach area and Scott Road scored high on this analysis, and both are heavily developed areas. While past analyses have produced restoration targets in good conservation areas with little damage, these scores were comprised of low conservation values and high damage. For this reason, and because west Samish Beach was not adjacent or coincident with a conservation area, there is no restoration focus recommended for that area.

In addition to these three focus areas, there were three individual sections that scored in the top decile for restoration:

1) In-between Fish Point and Scott's Point;
2) In the middle of the Samish Island Road surveyed area, and;
3) On the east end of the Samish Island Road surveyed area.

Samish Island Rapid Shoreline Inventory 2002 - Analysis

Map 6B



RESTORATION ANALYSIS

OVERALL

Legend

Restoration Rank

- 0 to 50th Percentile
- 51st to 70th Percentile
- 71st to 90th Percentile
- 91st to 100th Percentile

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Conclusion

Further ground investigation of the focus areas (Map 7) is recommended to assess their potential for voluntary conservation and restoration actions. The Scott Road area is highly developed, and so may be difficult to restore. Both Scott Point and Samish Point, being in single ownership, might be good conservation targets. Both would benefit greatly from vegetation management and enhancement. Samish Point would also benefit from better beach access management. Areas north and east of Samish Point need further assessment of their restoration potential. The relatively young age and good condition of bulkheads northwest of Wharf Road might make it a difficult area to restore, though a worthy focus area since it contains the largest single grouping of high conservation scores and the currently most active feeder bluffs.

This page is intentionally blank.

Samish Island Rapid Shoreline Inventory 2002 - Summary

Map 7

Restoration Focus Area Near Wharf Road

N
W E
S

Samish Bay

Williams Point

Wharf Road

Samish Point

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

Conservation Focus Area Scott's Point

Conservation Focus Area Samish Point

Alice Bay

Padilla Bay

SAMISH ISLAND

RESTORATION AND CONSERVATION

SUMMARY

Legend

Restoration and Conservation Focus Areas

Conservation Focus Areas

Restoration Focus Areas

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound - (Collected 06/22/02 - 06/26/02)

Project Partners:

Skagit MRC

People for Puget Sound
pugetsound.org

December 2002

References

Alsop, Fred J. III. 2001. Birds of North America. DK Publishing, New York, NY.

Bargmann, G. 1998. Forage fish management plan. Washington Department of Fish and Wildlife. Olympia, WA.

Bortleson, G. C., M. J. Chrzastowski, and A. K. Helgerson. 1980. Historical changes of shoreline and wetland at eleven major deltas in the Puget Sound region, Washington. Prepared in cooperation with the U.S. Department of Justice and the Bureau of Indian Affairs, Renton, Washington. U.S. Geological Survey, Hydrologic Investigations Atlas HA-617, Washington, D.C.

Cheney, D., R. Oestman, G. Volkhardt, and J. Getz. 1994. Creation of rocky intertidal and shallow subtidal habitats to mitigate for the construction of a large marina in Puget Sound, Washington. Bulletin of Marine Science 55 (2-3): 772-782.

Cordell et al. 2001. Biological monitoring at Duwamish River Coastal America restoration and reference sites: a seven-year retrospective. University of Washington School of Aquatic and Fishery Sciences. Seattle, WA.

Downing, J. 1983. The coast of Puget Sound: Its processes and development. Washington Sea Grant Program. University of Washington Press, Seattle, Washington. 126 pp.

Feist, B. 2002. Northwest Fisheries Science Center watershed program open house. March 19, Museum of History and Industry, Seattle.

Hori, M and T. Noda. 2001. Spatio-temporal variation of avian foraging in the rocky intertidal food web. Journal of Animal Ecology 70 (1): 122-137.

King County Department of Natural Resources. 2001. State of the nearshore ecosystem. Seattle, WA.

Koch, E.M. 2001. Beyond light: Physical, geological, and geochemical parameters as possible submersed aquatic vegetation habitat requirements. Estuaries 24 (1): 1-17.

Lawrence, P.L. 1994. Natural hazards of shoreline bluff erosion – A case-study of Horizon View, Lake Huron. Geomorphology 10 (1-4): 65-81.

Levings, C.D., K. Conlin, and B. Raymond. 1991. Intertidal habitats used by juvenile chinook salmon (Oncorhynchus Tshawytsch) reaing in the north arm of the Fraser-River Estuary. Marine Pollution Bulletin 22 (1): 20-26.

Levings, C.D. 1994. Feeding behavior of juvenile salmon and significance of habitat during estuary and early sea phase. Nordic Journal of Freshwater Research 69:7-16.

MacDonald, J.S., I.K. Birtwell, and G.M. Kruzynski. 1987. Food and habitat utilization by juvenile salmonids in the Campbell River Estuary. Canadian Journal of Fisheries and Aquatic Sciences 44: 1233-1246.

Mason, J.C. 1970. Behavioral ecology of chum salmon fry (*Oncorhynchus keta*) in a small estuary. Journal of Fisheries Research Board of Canada 31:83-92.

McClelland, JW, and I. Valiela. 1998. Changes in food web structure under the influence of increased anthropogenic nitrogen inputs to estuaries. Marine Ecology – Progress Series 168: 259-271.

Moore K.A., H.A. Neckles, and R.J. Orth. 1996. *Zostera marina* (eelgrass) growth and survival along a gradient of nutrients and turbidity in the lower Chesapeake Bay. Marine Ecology – Progress Series 142 (1-3): 247-259.

Shipman, H. and D. J. Canning. 1993. Cumulative environmental impacts of shoreline stabilization on Puget Sound. In: Proceedings, Coastal Zone 1993, Eighth Symposium on Coastal and Ocean Management. pp. 2233-2242. American Society of Civil Engineers, New York.

Shipman, H. 1995. The rate and character of shoreline erosion on Puget Sound. In: Proceedings of Puget Sound Research. 1995. pp. 77-83. Puget Sound Water Quality Authority, Olympia, Washington.

Penttila, D.E. 1995. Investigations of the spawning habitat of the Pacific sand lance *Ammodytes hexapterus*, in Puget Sound. In *Puget Sound Research '95 Conference Proceedings* (Robichaud, E., ed.), pp. 855-859. Olympia, WA: Puget Sound Water Quality Authority.

Penttila, D. Personal Communication between Philip Bloch, People For Puget Sound and Dan Penttila, Washington Department of Fish and Wildlife Service dated June 8, 2001.

People For Puget Sound. 2001. March Point rapid shoreline inventory. Seattle, WA.

Robards, M.D., J.F. Piatt, and G.A. Rose. 1999. Maturation, fecundity and intertidal spawning of Pacific sand lance in the northern Gulf of Alaska. Journal of Fish Biology 54: 1050-1068.

Ruiz, G.M., A.H. Hines, and M.H. Posey. 1993. Shallow-water as refuge habitat for fish and crustaceans in nonvegetated estuaries – An example from Chesapeake Bay. Marine Ecology – Progress Series 99 (1-2): 1-16.

Simenstad, C.A., K.L. Fresh, and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: An underappreciated function. In: V.S. Kennedy ed. Estuarine Comparisons. Pp. 343-365. Academic Press, Toronto.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6507. ManTech Environmental Research Services Corp., Corvallis, OR.

Thorpe, R.M., T.L. Parkwell, D.K. Shreffler, and K.B. MacDonald. 1994. Shoreline armoring effects on coastal ecology and biological resources in Puget Sound. Coastal Management Studies, Volume 7. Shorelands and Coastal Zone Management Program, WDOE, Olympia, WA.

Williams, G.D. and R.M. Thom. 2001. White Paper: Marine and Estuarine Shoreline Modification Issues. Battelle Marine Sciences laboratory. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation.

This page is intentionally blank.

Appendix A,

Samish Island 2002

Rapid Shoreline Inventory

Data Maps

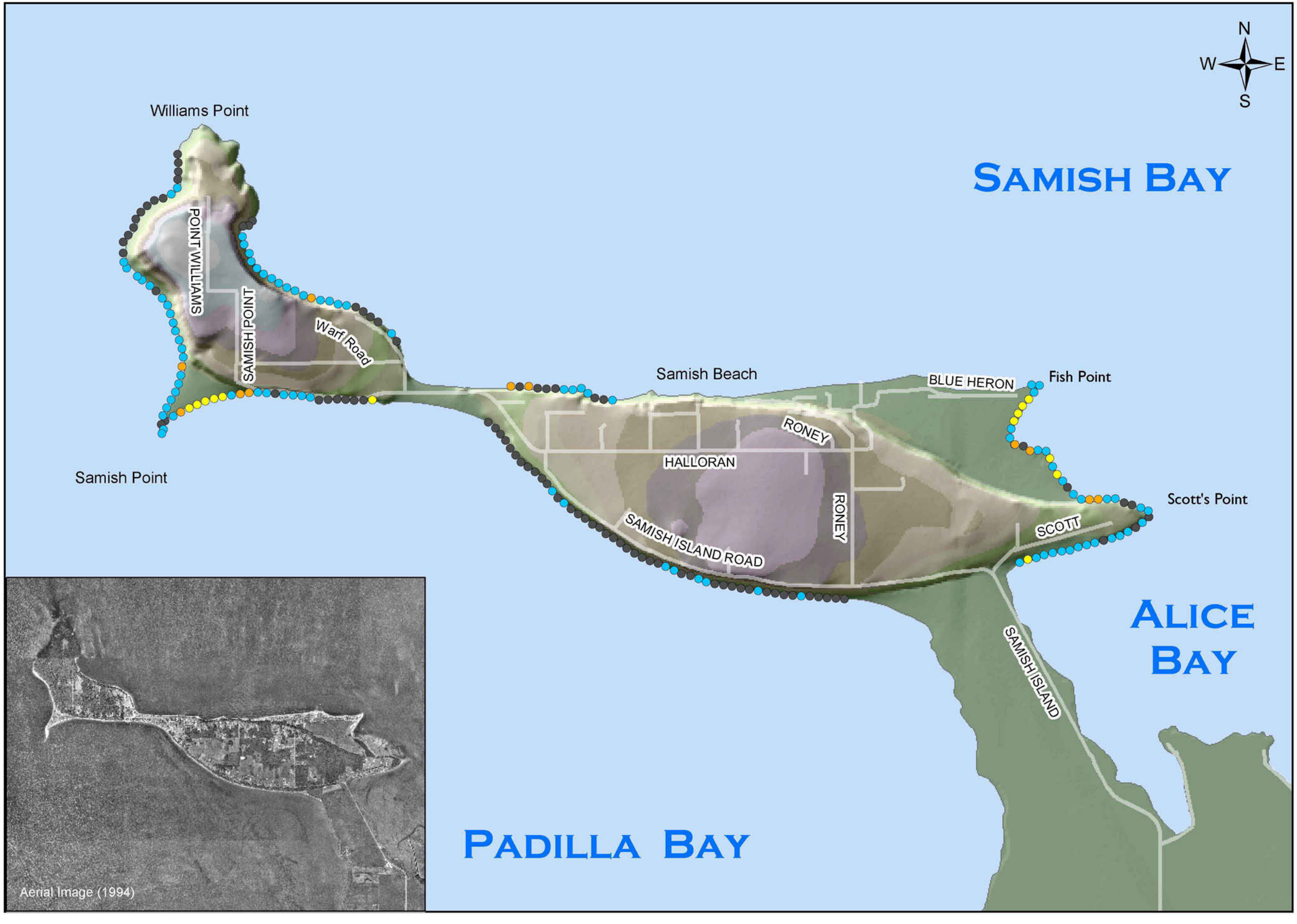
This page is intentionally blank

Map Table of Contents

Outflows (a.k.a. Streams, Outfalls and other Freshwater Discharges)

Shoreline Structures

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 1



INTERTIDAL ZONE

DOMINANT SUBSTRATE UPPER INTERTIDAL

Legend

Substrate - Upper Intertidal

- Hardpan
- Sand
- Gravel or Mixed Course
- Mud/Silt or Mixed Fine
- Cobble or Rock/Boulder

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

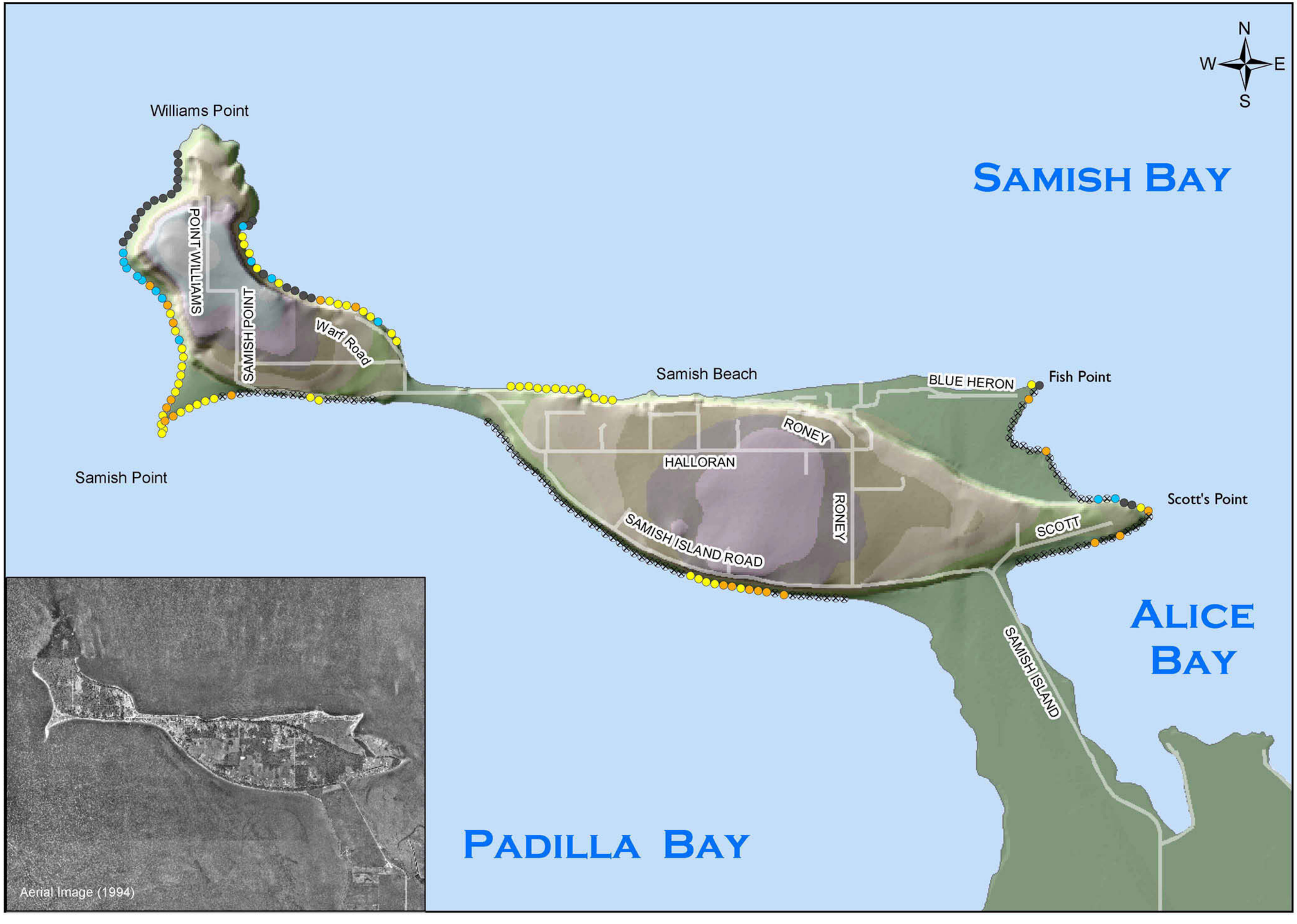
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 2



INTERTIDAL ZONE

DOMINANT SUBSTRATE LOWER INTERTIDAL

Legend

Substrate - Lower Intertidal

- Mud/Silt or Mixed Fine
- Sand
- Gravel or Mixed Coarse
- Cobble or Rock/Boulder
- ⊗ No Data/Not Visible

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 3

N
W E
S

Williams Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Samish Point

Scott's Point

SCOTT

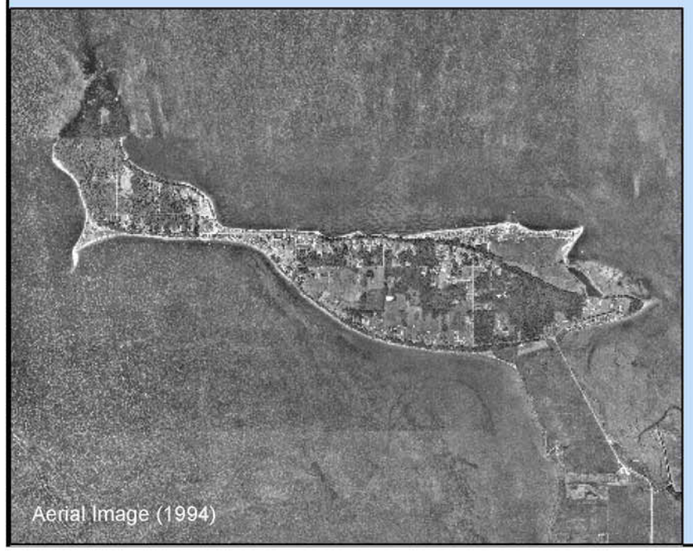
SAMISH ISLAND ROAD

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INTERTIDAL ZONE

SAND OR MIXED FINE SEDIMENT AT WATERLINE

Legend

Sand and/or Mixed Fines

- Continuous
- Patchy
- Not dominant
- Not visible/accessible

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 4

N
W E
S

Williams Point

SAMISH BAY

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Samish Point

Scott's Point

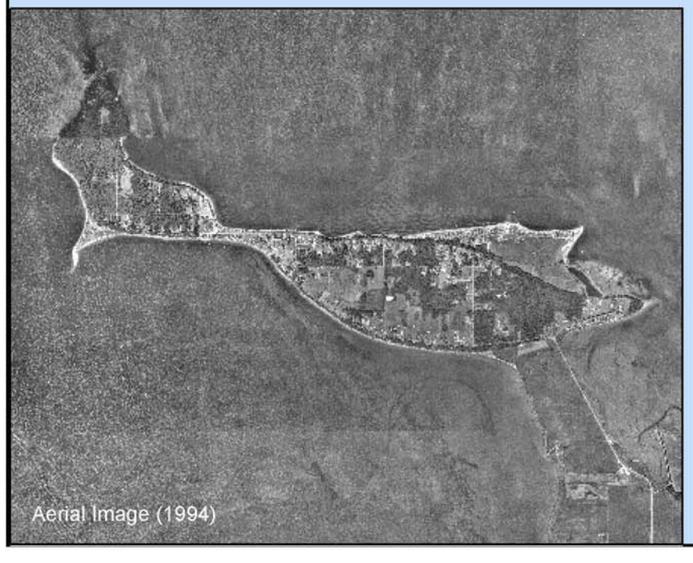
SCOTT

SAMISH ISLAND ROAD

SAMISH ISLAND

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INTERTIDAL ZONE

EELGRASS COVERAGE

Legend

Eelgrass Coverage

- Continuous
- Patchy
- None
- Not Accessible

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 5

N
W E
S

Williams Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Point

SAMISH BAY

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

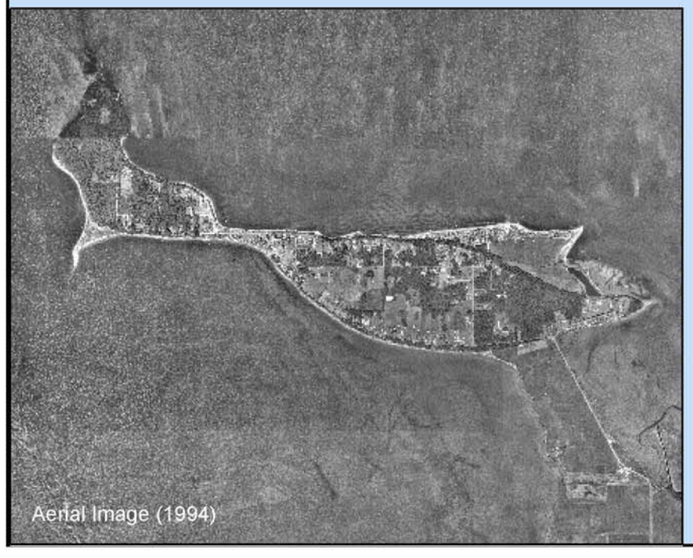
Scott's Point

SCOTT

SAMISH ISLAND

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INTERTIDAL ZONE

EELGRASS SPECIES

Legend

Eelgrass Observations

- Z. marina and Z. japonica
- Zostera marina
- Zostera japonica
- No Eelgrass
- Not Assessed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND

pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 6

N
W E
S

Williams Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Scott's Point

SCOTT

SAMISH ISLAND ROAD

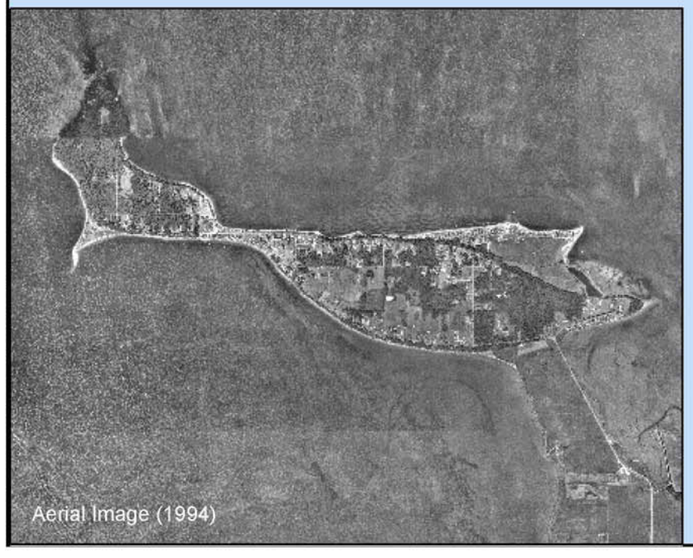
SAMISH ISLAND

Samish Point

SAMISH BAY

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INTERTIDAL ZONE

KELP FLOATING OFFSHORE

Legend

Kelp Floating Offshore

- Yes
- Not visible/acc
- None Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

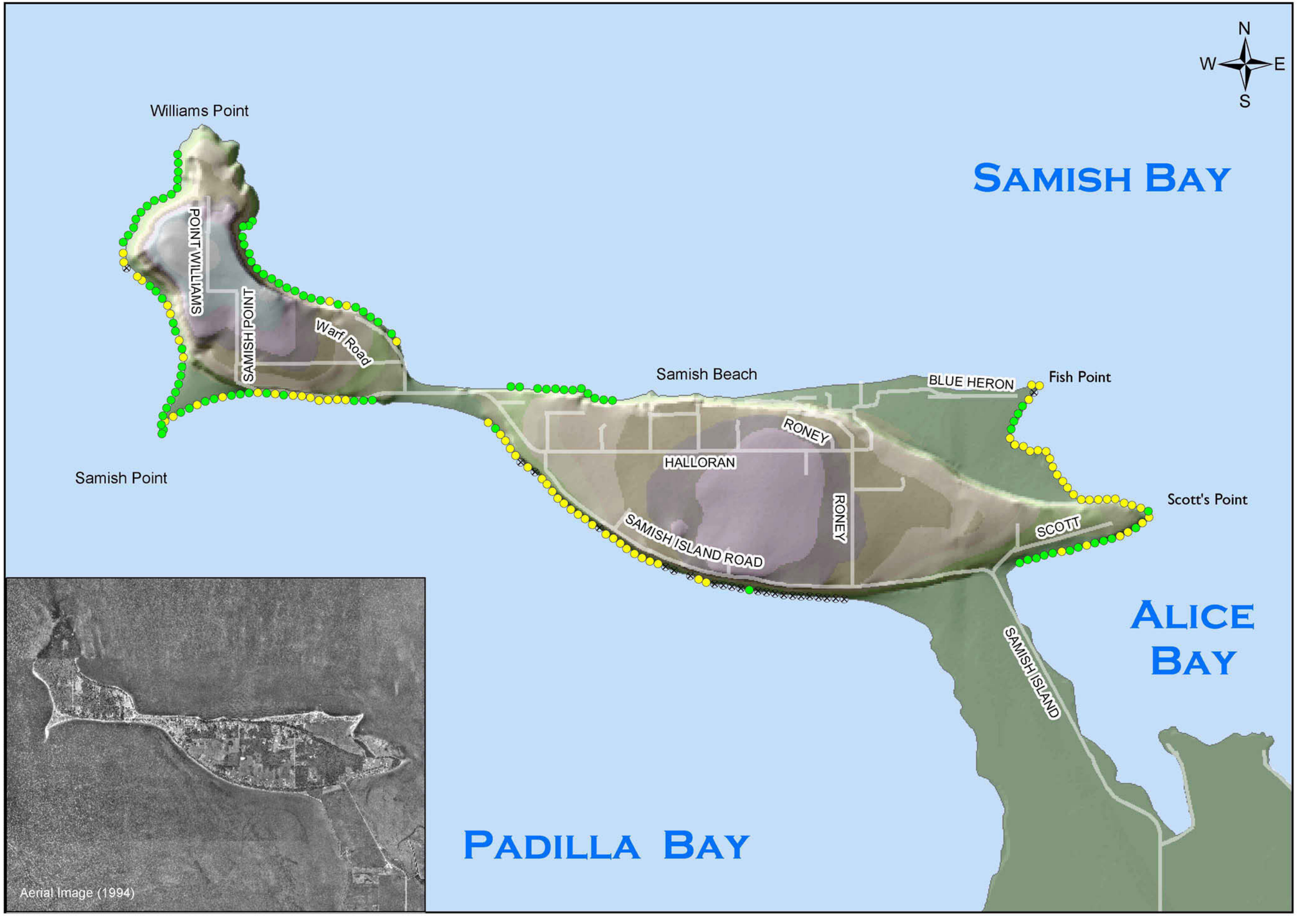
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 7



INTERTIDAL ZONE

ALGAE COVERAGE

Legend

Algae Coverage

- Continuous
- Patchy
- None

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

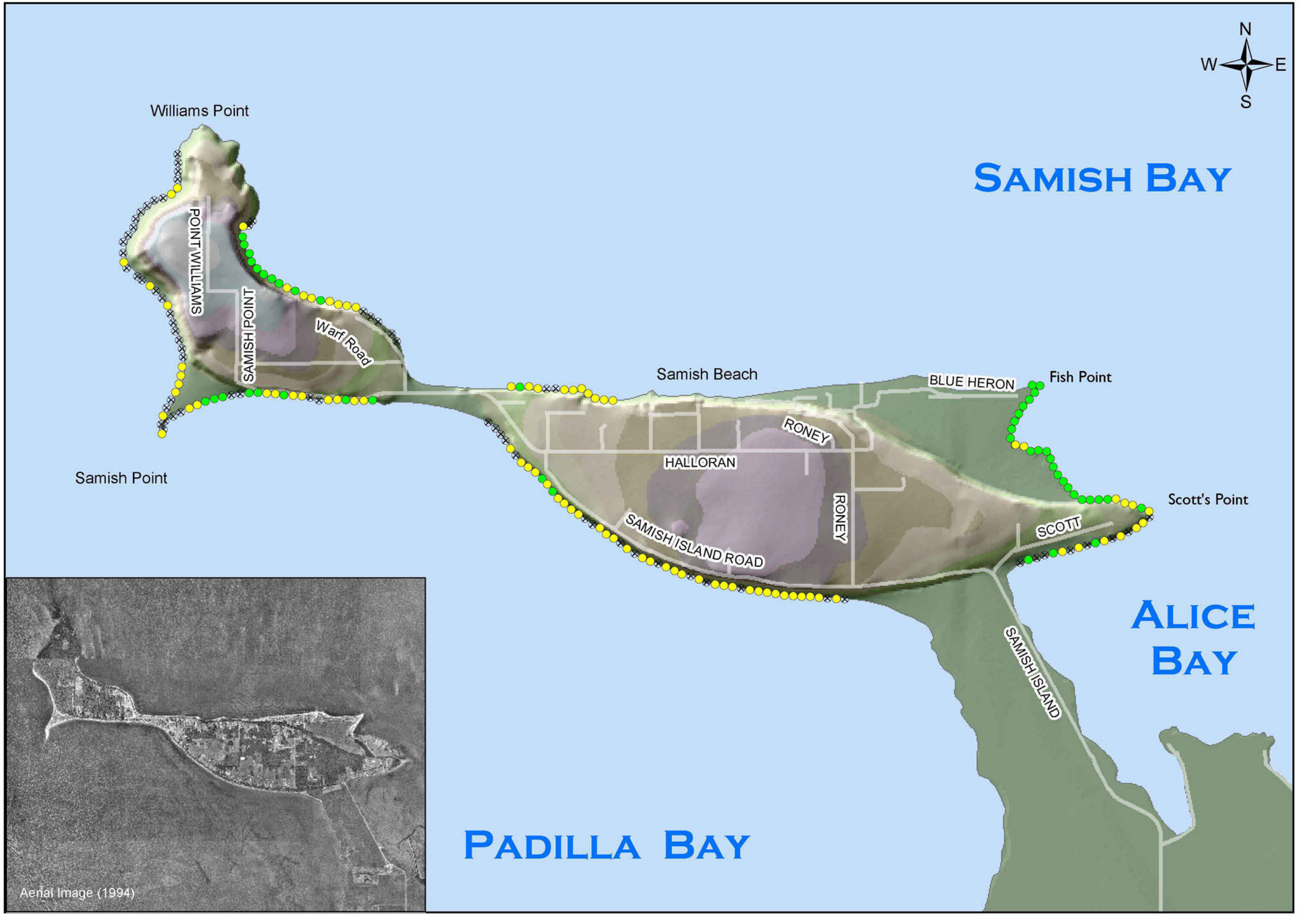
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 8



INTERTIDAL ZONE

PRESENCE OF SAND OR GRAVEL AT BACKSHORE BREAK

Legend

Sand or Gravel Patches

- Continuous
- Patchy
- ⊗ Not Dominant

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

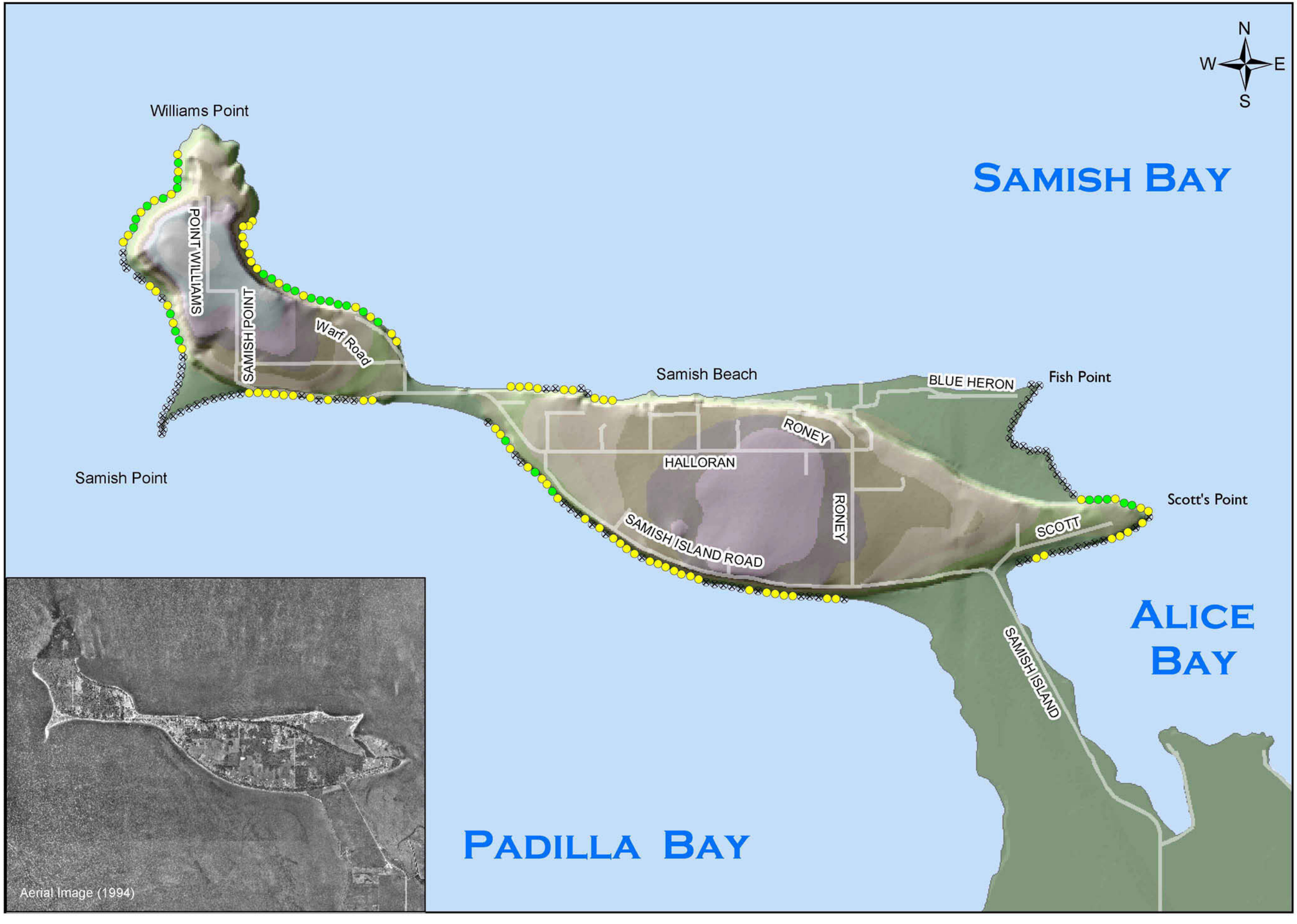
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 9



INTERTIDAL ZONE

VEGETATION OVERHANGING INTERTIDAL ZONE

Legend

Overhanging Vegetation

- Continuous
- Patchy
- None

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

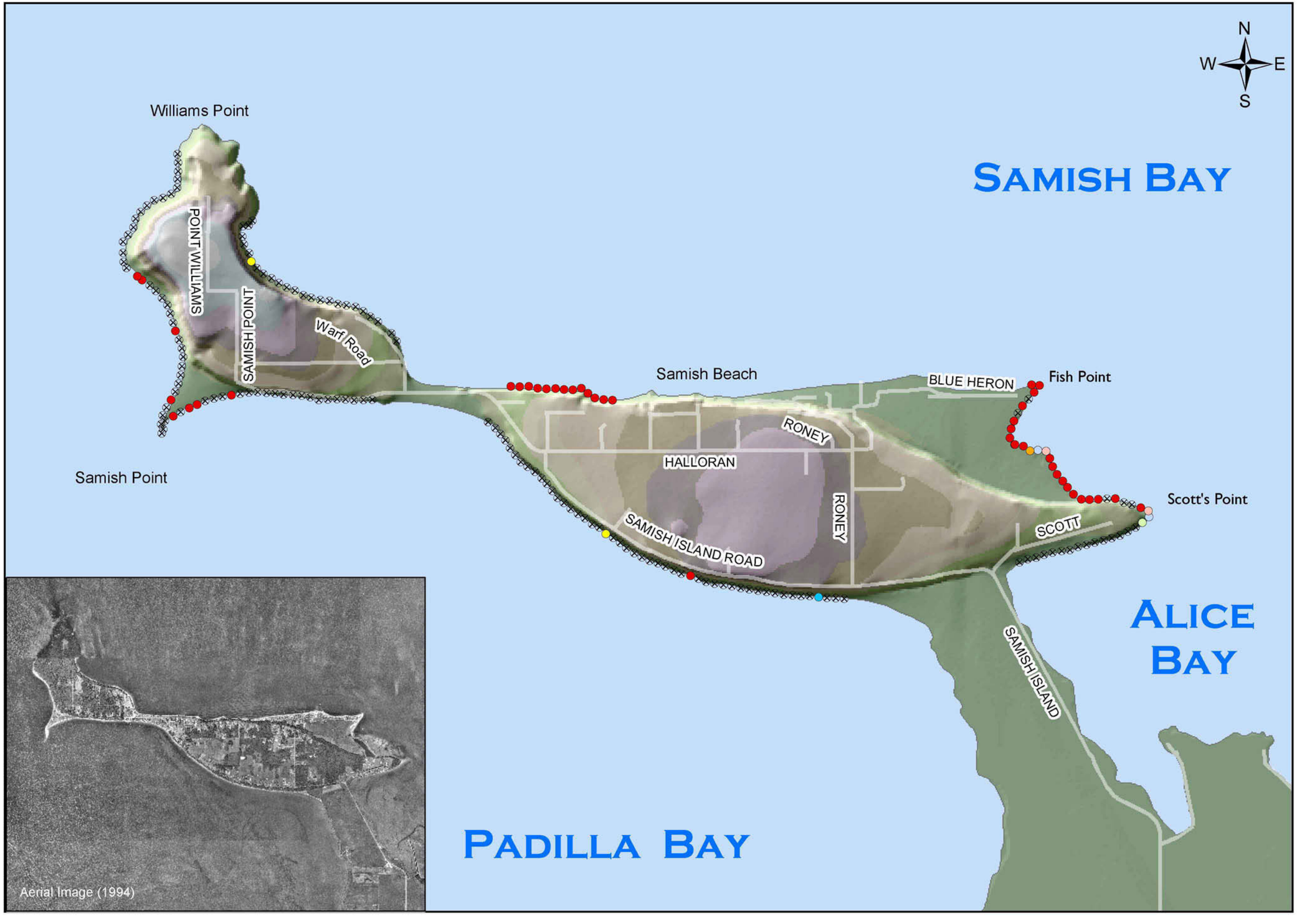
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 10



INTERTIDAL ZONE

BEACH FEATURES

Legend

Beach Features

- Beach Spit
- Beach Bar
- Intertidal Marsh
- Beach Spit and Beach Bar
- Beach Spit and Intertidal Marsh
- Beach Bar and Intertidal Marsh
- Beach Spit, Beach Bar and Intertidal Marsh
- No Beach Features

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

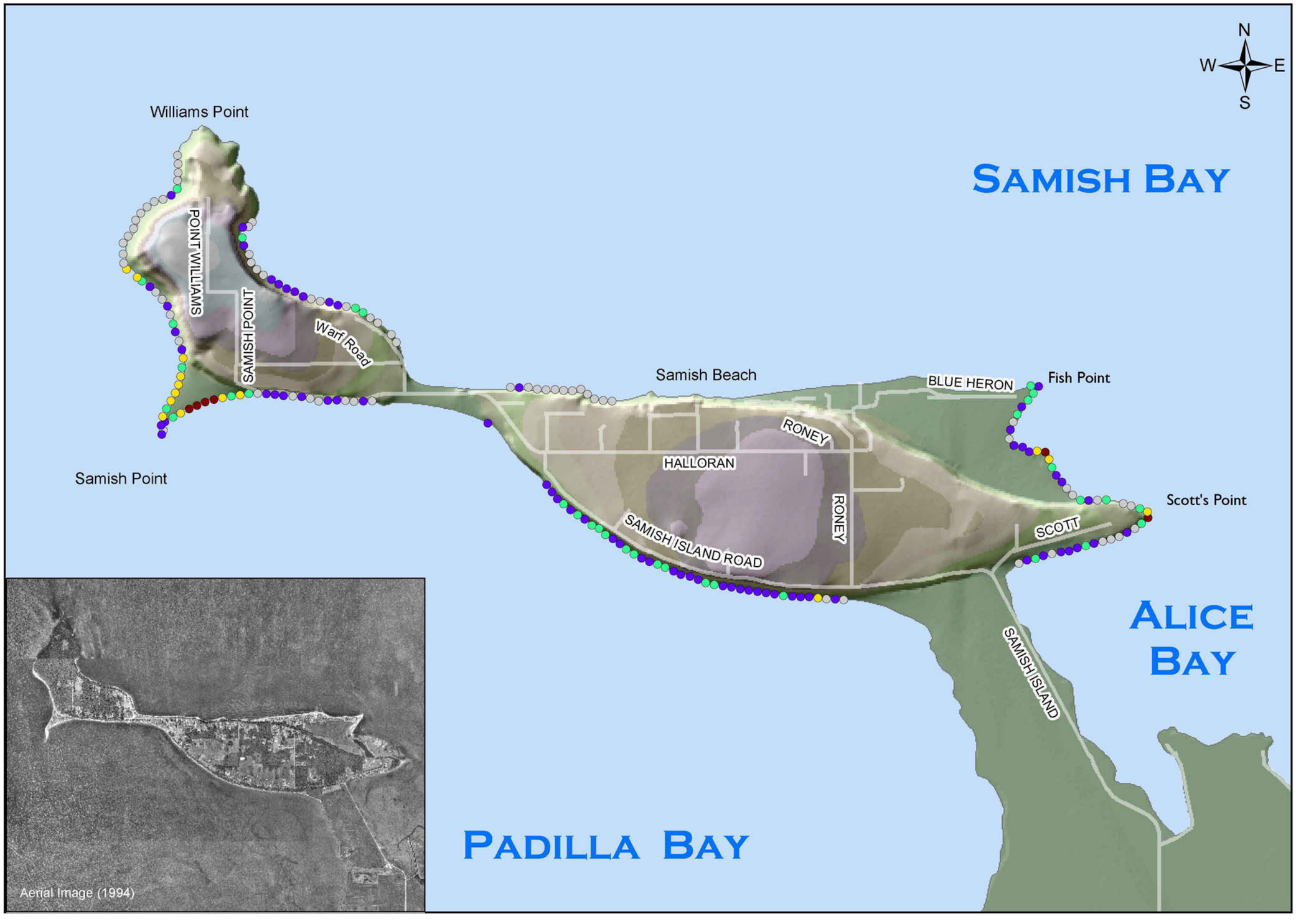
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 11



BACKSHORE ZONE

BACKSHORE WIDTH

Legend

Backshore Width

- No Backshore
- 1 - 10 Feet
- 11 - 25 Feet
- 26 - 75 Feet
- 76 - 150 Feet

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 12

N
W E
S

Williams Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Point

SAMISH BAY

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

SCOTT

SAMISH ISLAND

ALICE BAY

PADILLA BAY

BACKSHORE ZONE

BACKSHORE SUBSTRATE

Legend

Backshore Substrate

- No Backshore
- Mixed fine
- Sand
- Mixed coarse
- Gravel
- Cobble

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

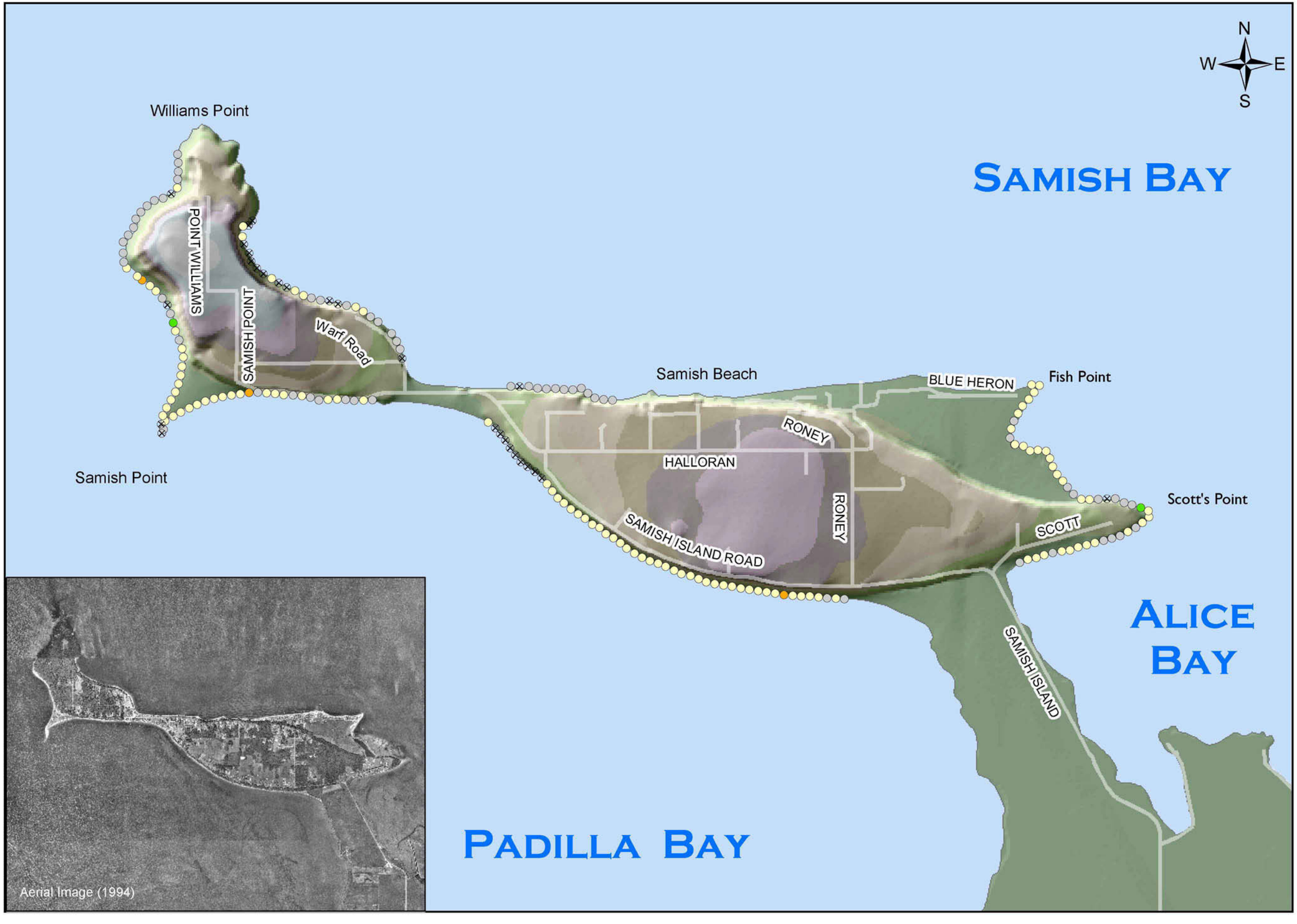
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 13



BACKSHORE ZONE

DOMINANT VEGETATION

Legend

Dominant Vegetation Type

- No Backshore
- None
- Grasses/herbs
- Shrubs
- Trees

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

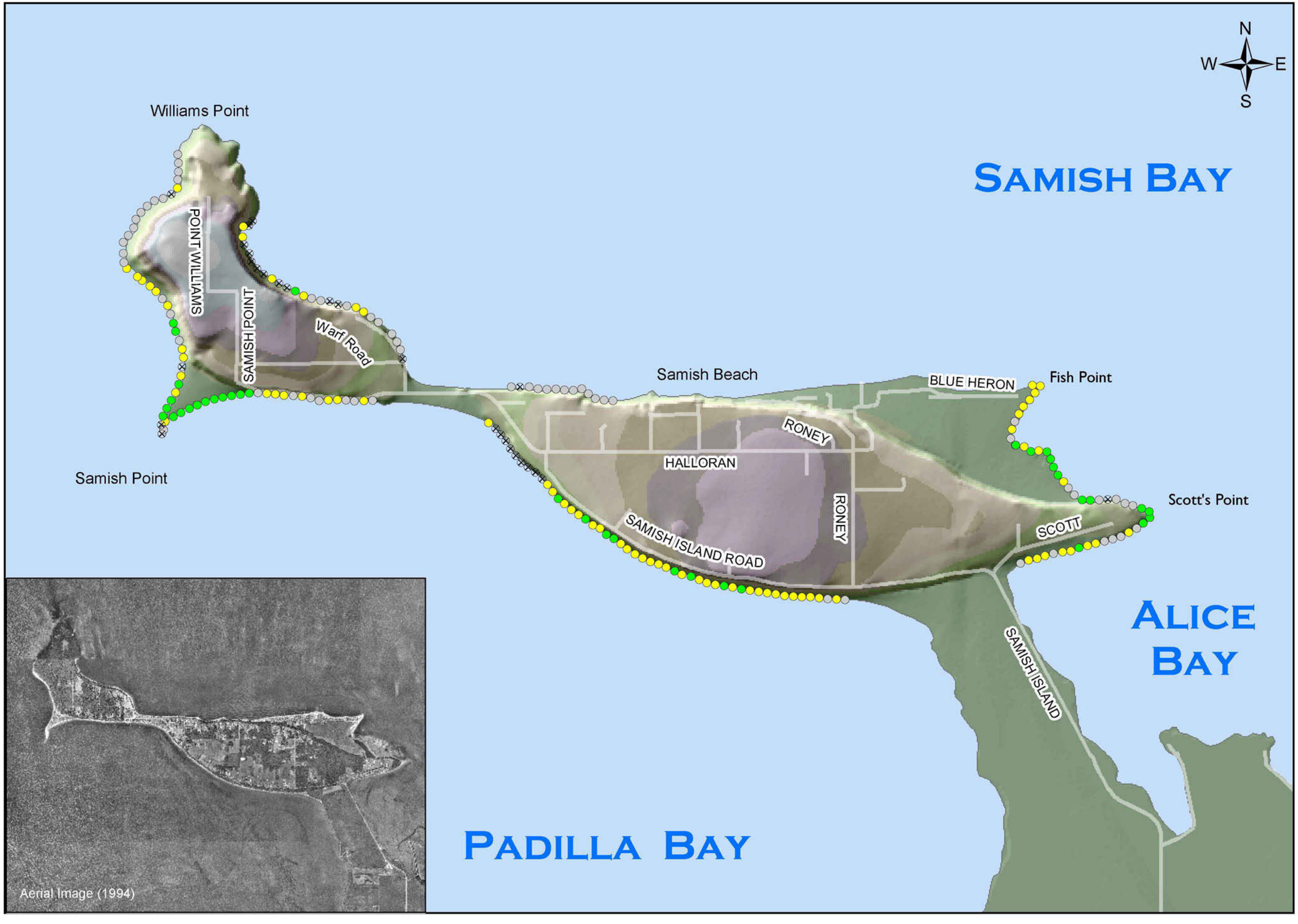
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 14



BACKSHORE ZONE

VEGETATION COVERAGE

Legend

Vegetation Coverage

- Continuous
- Patchy
- None
- No Backshore

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

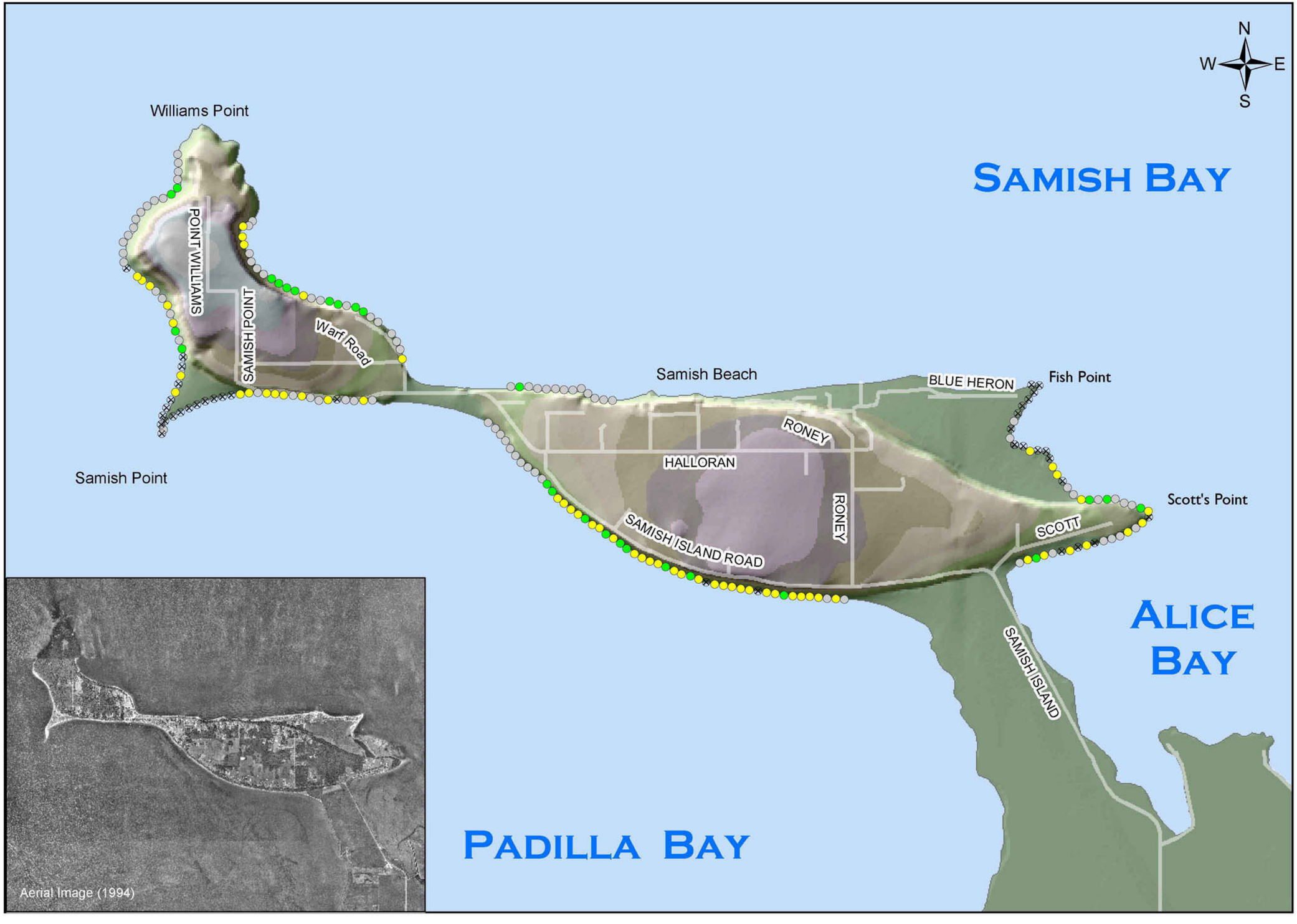
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 15



BACKSHORE ZONE

VEGETATION OVERHANGING BACKSHORE

Legend

Overhanging Vegetation

- Continuous
- Patchy
- None
- No Backshore

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

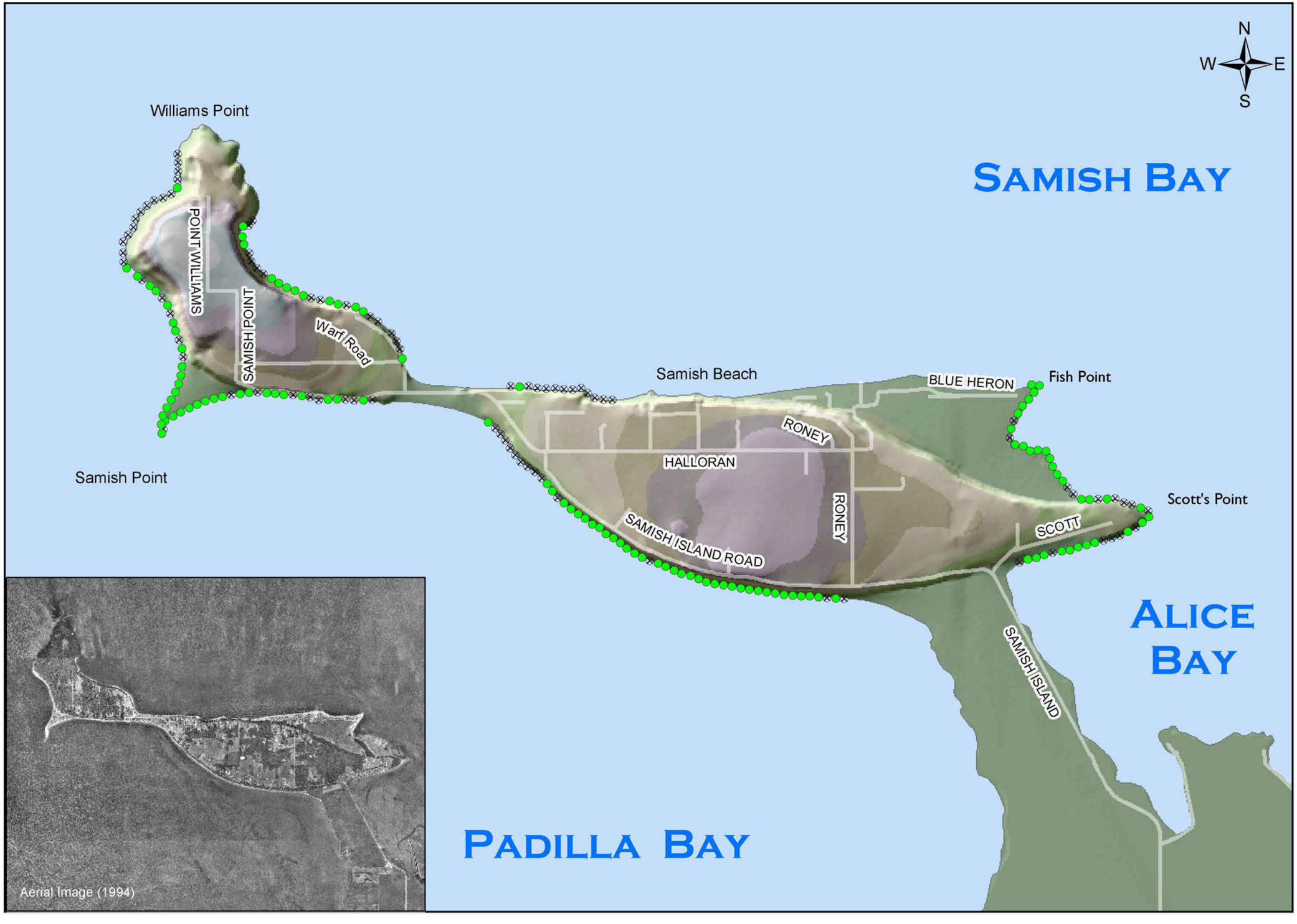
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 16



BACKSHORE ZONE

BACKSHORE FEATURES

Legend

Backshore Features Observed

- ⊗ No Marsh, Dune or Driftwood
- Driftwood
- Driftwood and Marsh
- Driftwood, Marsh and Dune

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

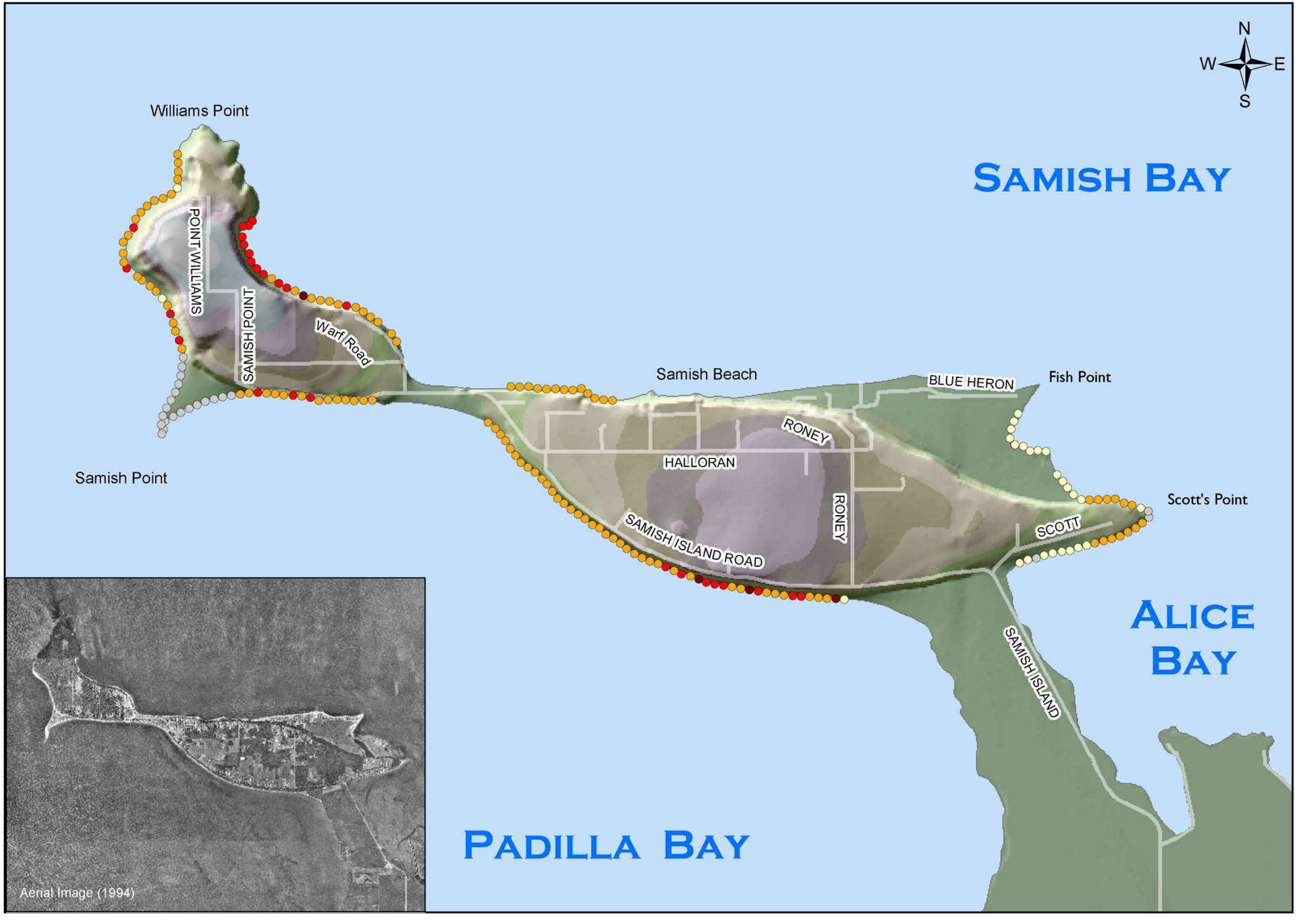
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 17



BLUFF/BANK ZONE

BLUFF/BANK HEIGHT

Legend

Bluff/Bank Height

- No Bluff/Bank
- 1 - 10 Feet
- 11 - 50 Feet
- 51 - 150 Feet
- 151 - 300 Feet

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

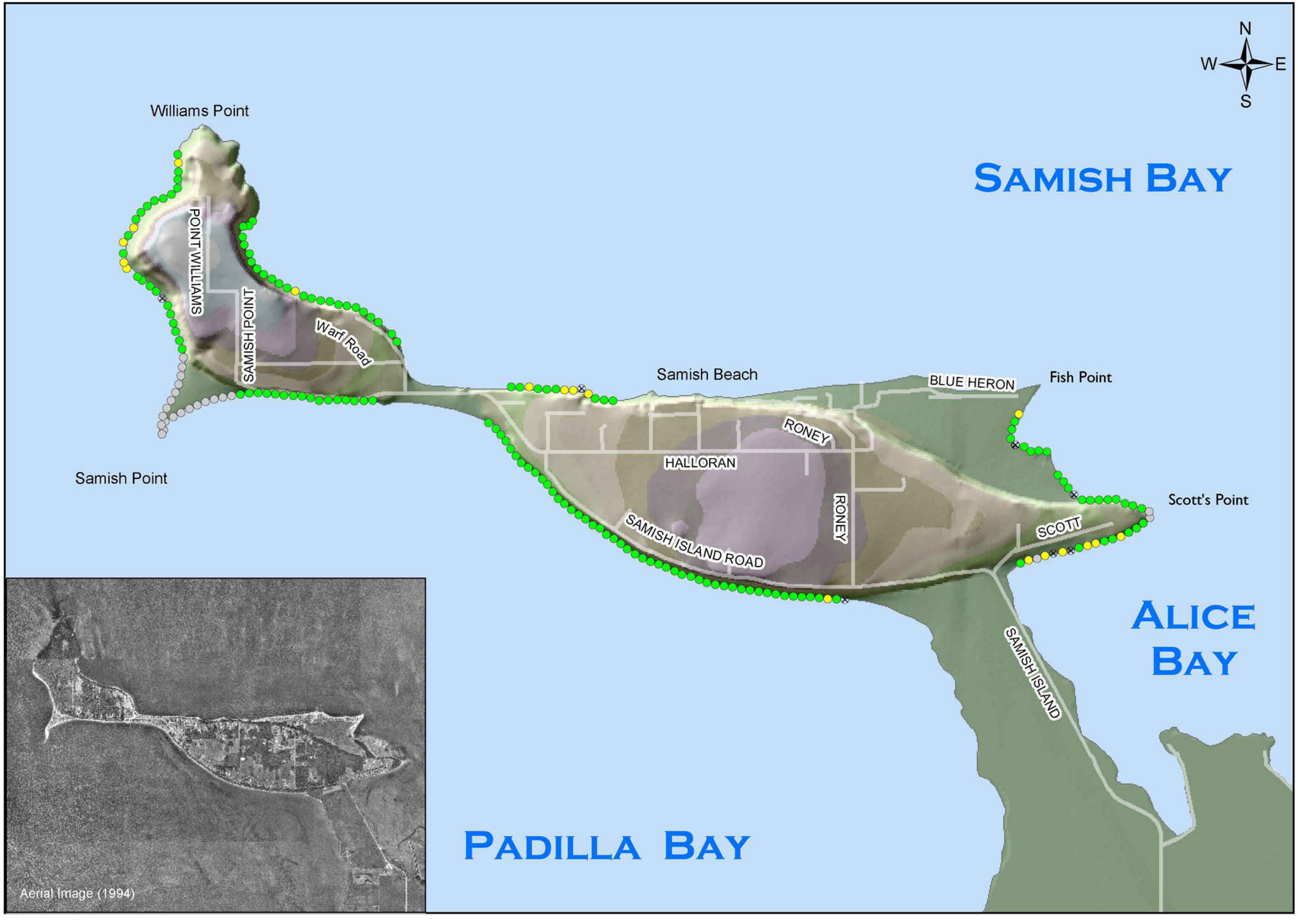
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 18



BLUFF/BANK ZONE

VEGETATION COVERAGE

Legend

Vegetation Coverage

- No Bluff
- Continuous
- Patchy
- None

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

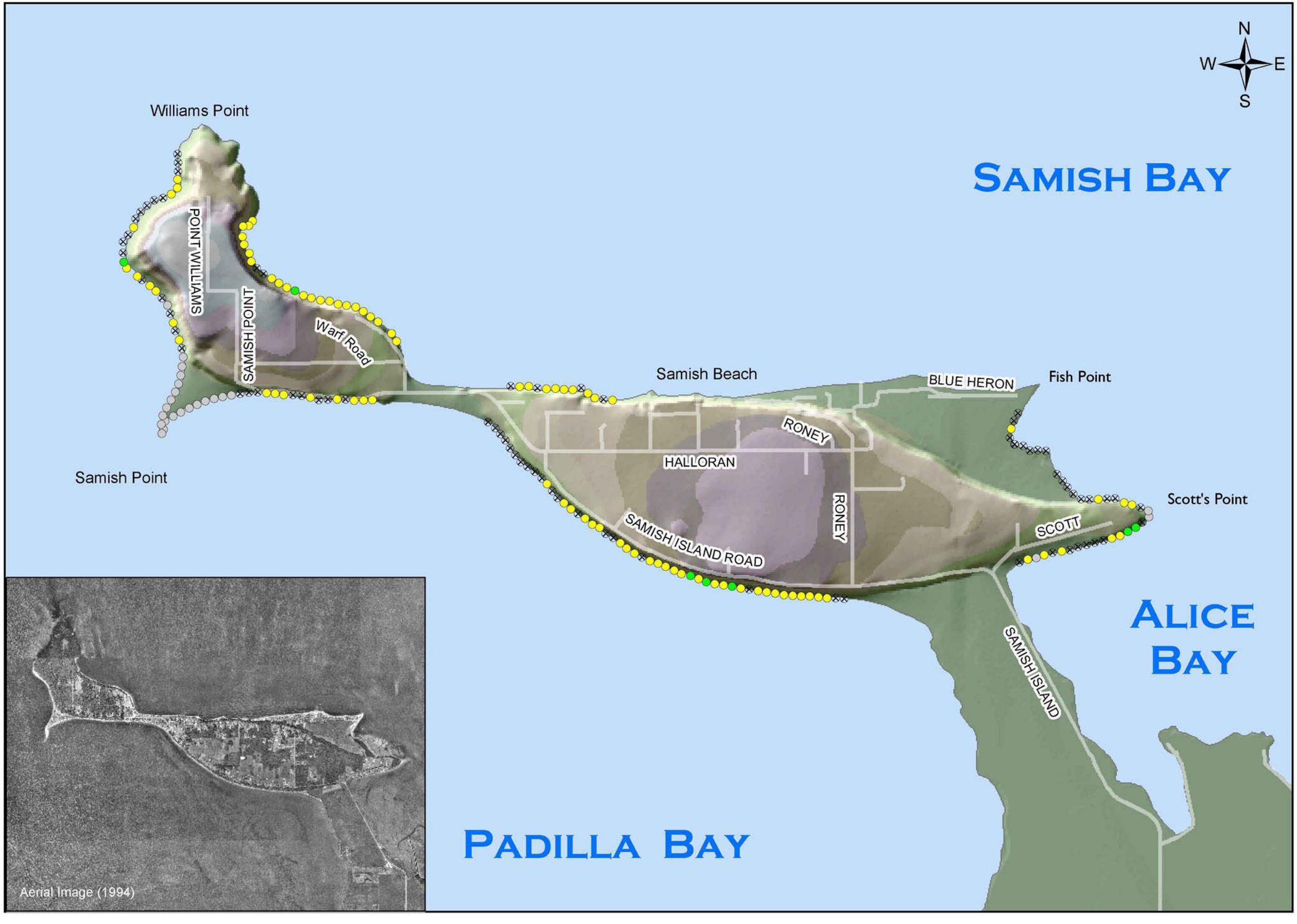
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 19



BLUFF/BANK ZONE

UNVEGETATED SLIDE SCARS

Legend

Unvegetated Scars

- No Bluff/Bank
- Continuous
- Patchy
- None

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

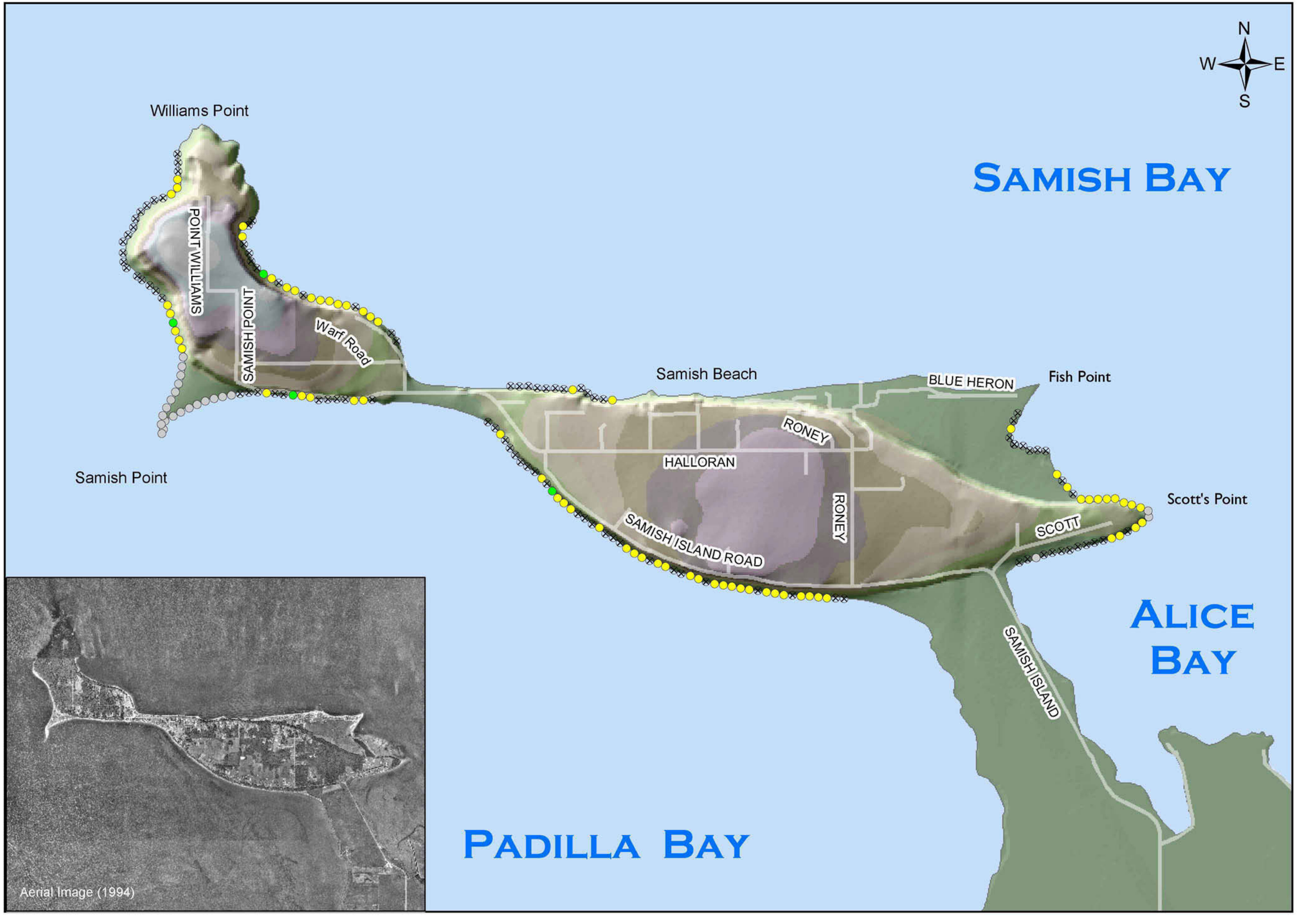
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 20



BLUFF/BANK ZONE

BLUFF UNDERCUTTING

Legend

Bluff Undercuts

- No Bluff/Bank
- Continuous
- Patchy
- None

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 21

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

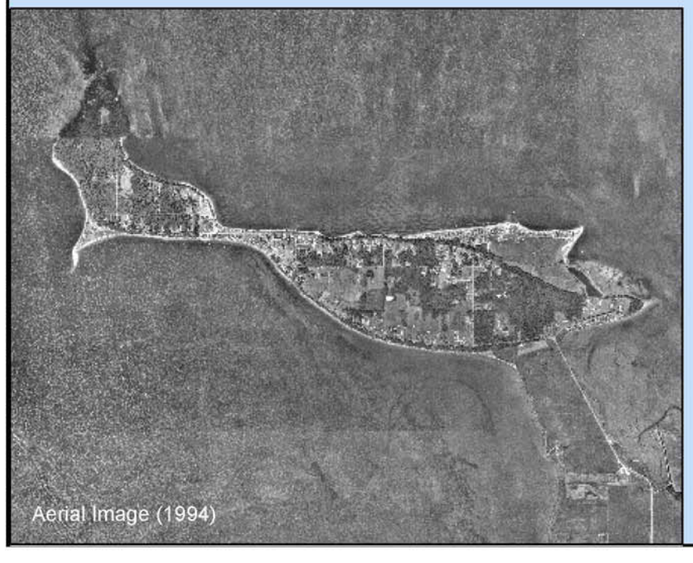
SCOTT

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INVASIVE SPECIES

SARGASSUM

Legend

Sargassum

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 22

N
W E
S

Williams Point

SAMISH BAY

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Samish Point

Scott's Point

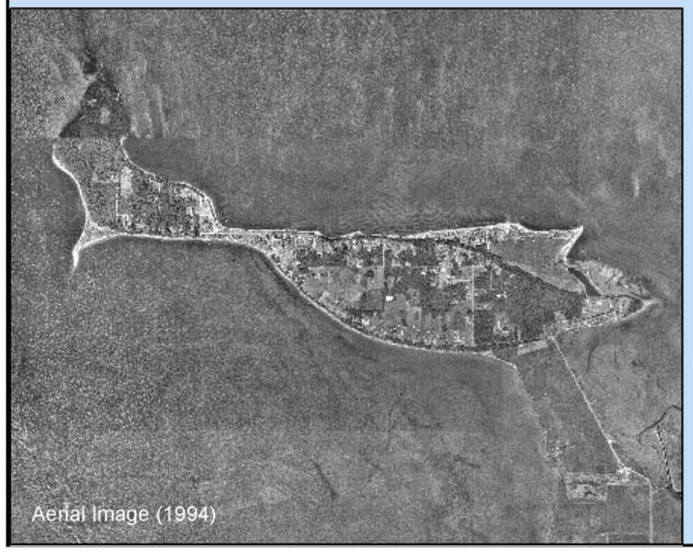
SAMISH ISLAND ROAD

SCOTT

SAMISH ISLAND

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INVASIVE SPECIES

SPARTINA SPP.

Legend

Spartina

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND

pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 23

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

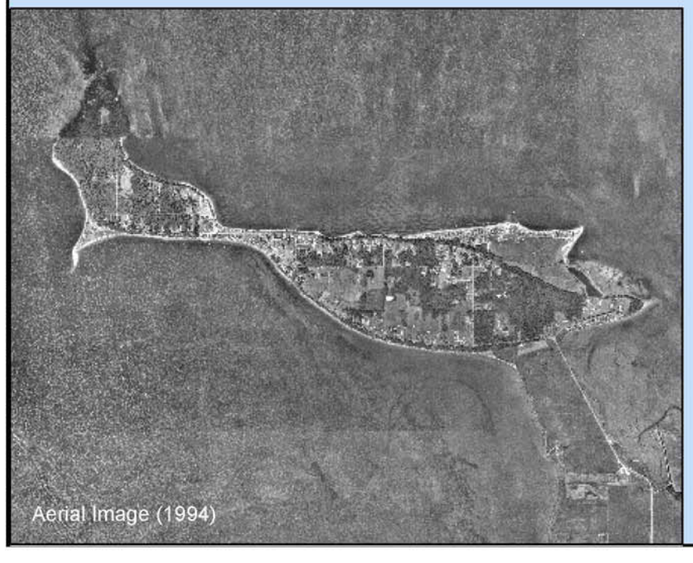
SCOTT

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



INVASIVE SPECIES

ENGLISH IVY

Legend

English Ivy

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

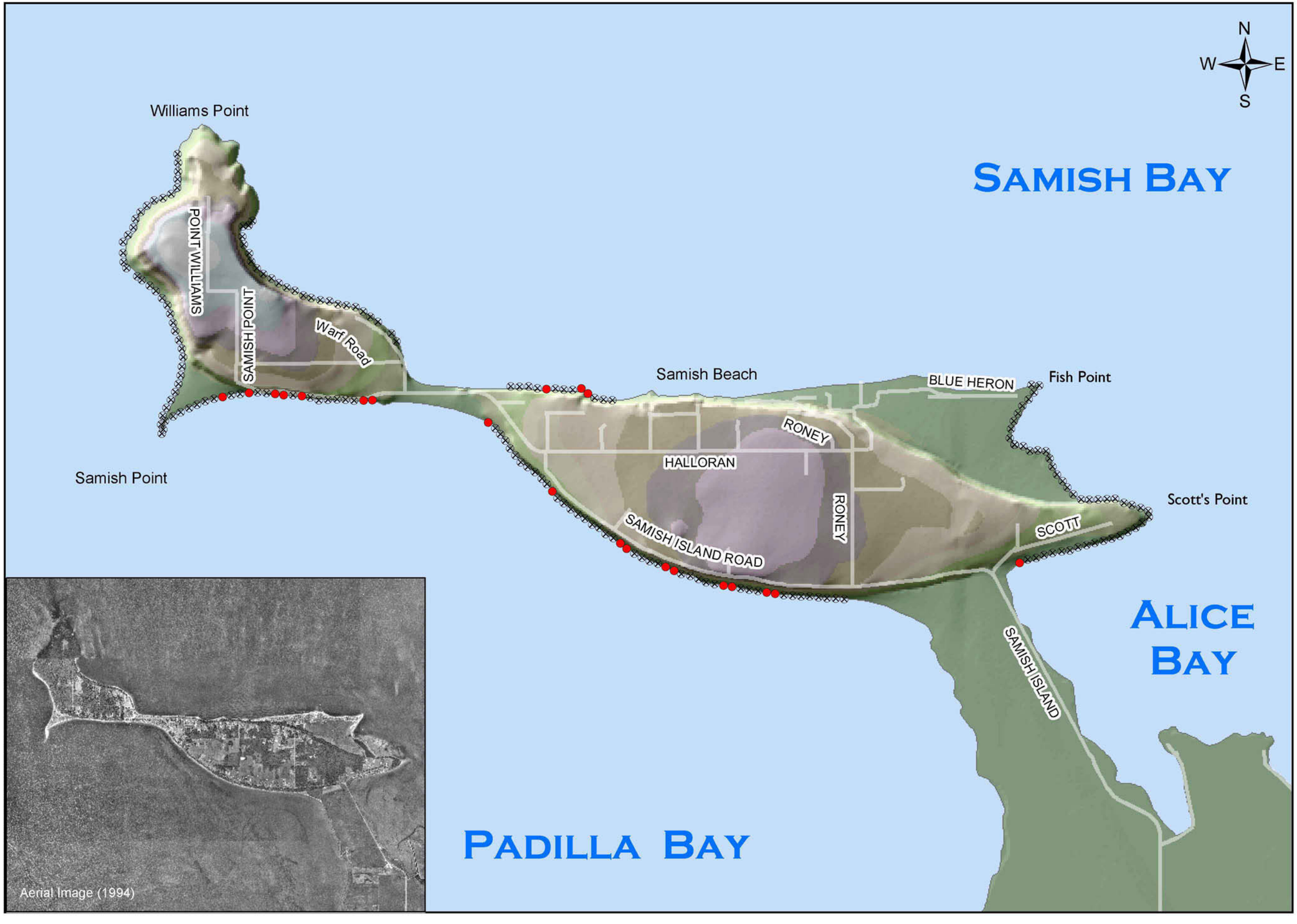
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 24



INVASIVE SPECIES

HEDGE BINDWEED

Legend

Hedge Bindweed

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 25

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

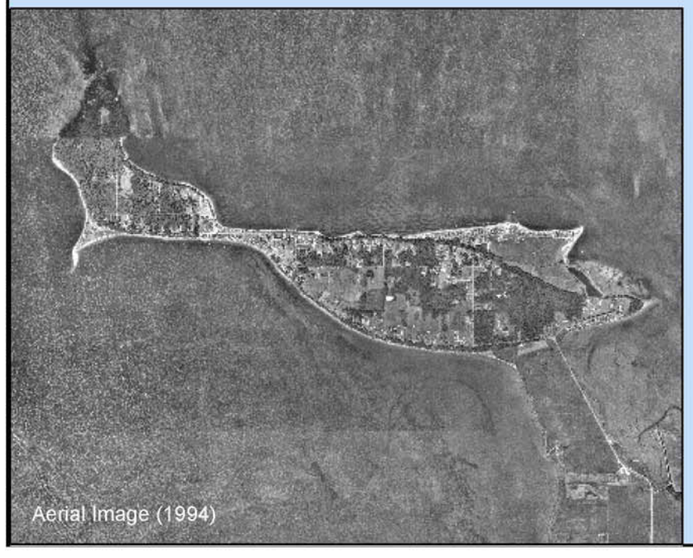
SCOTT

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



INVASIVE SPECIES

HIMILAYAN BLACKBERRY

Legend

Himalayan Blackberry

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 26

N
W E
S

Williams Point

SAMISH BAY

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Samish Point

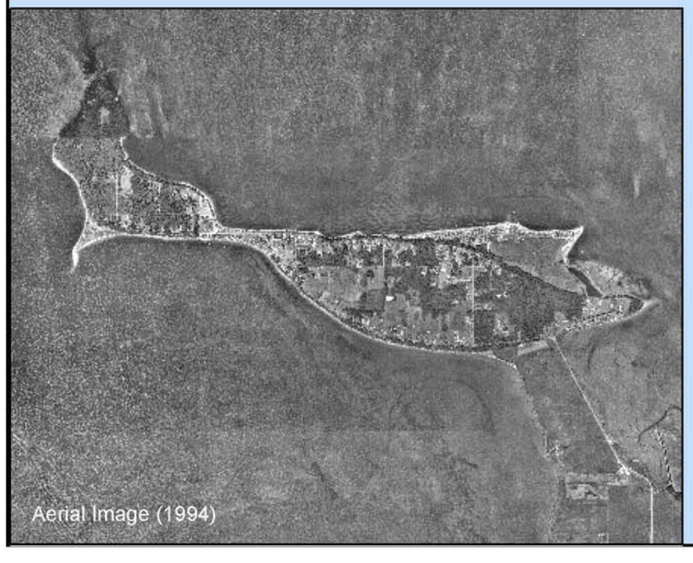
Scott's Point

SCOTT

SAMISH ISLAND

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INVASIVE SPECIES

JAPANESE KNOTWEED

Legend

Japanese Knotweed

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 27

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Scott's Point

SCOTT

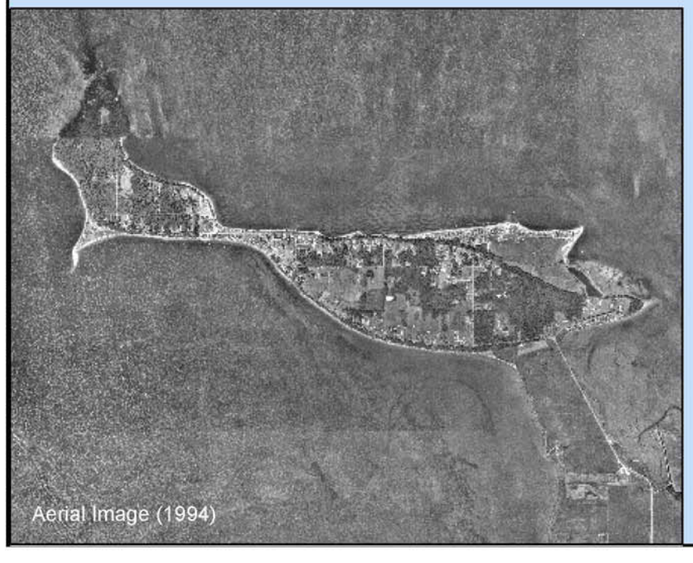
SAMISH ISLAND ROAD

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



Aerial Image (1994)

INVASIVE SPECIES

Scot's Broom

Legend

Scot's Broom

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features

Map 28

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Scott's Point

SCOTT

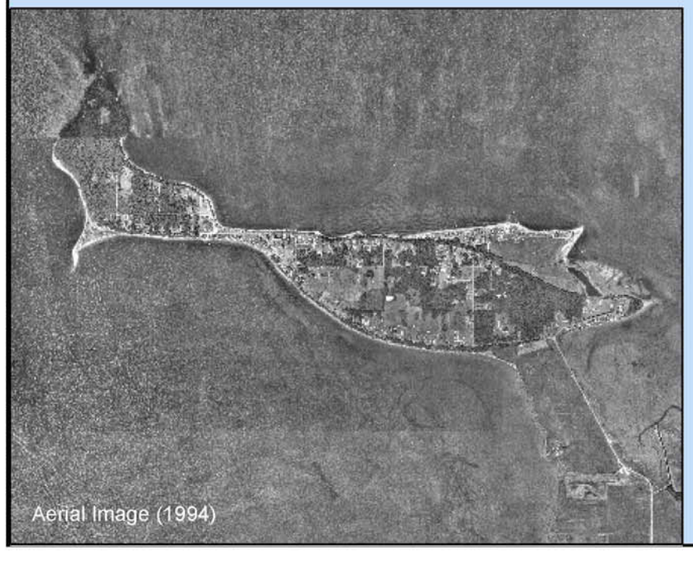
SAMISH ISLAND ROAD

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



ADJACENT LAND USE

NUMBER OF TRAILS

Legend

# of Access Points

- None
- One
- Two
- Three to Six

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

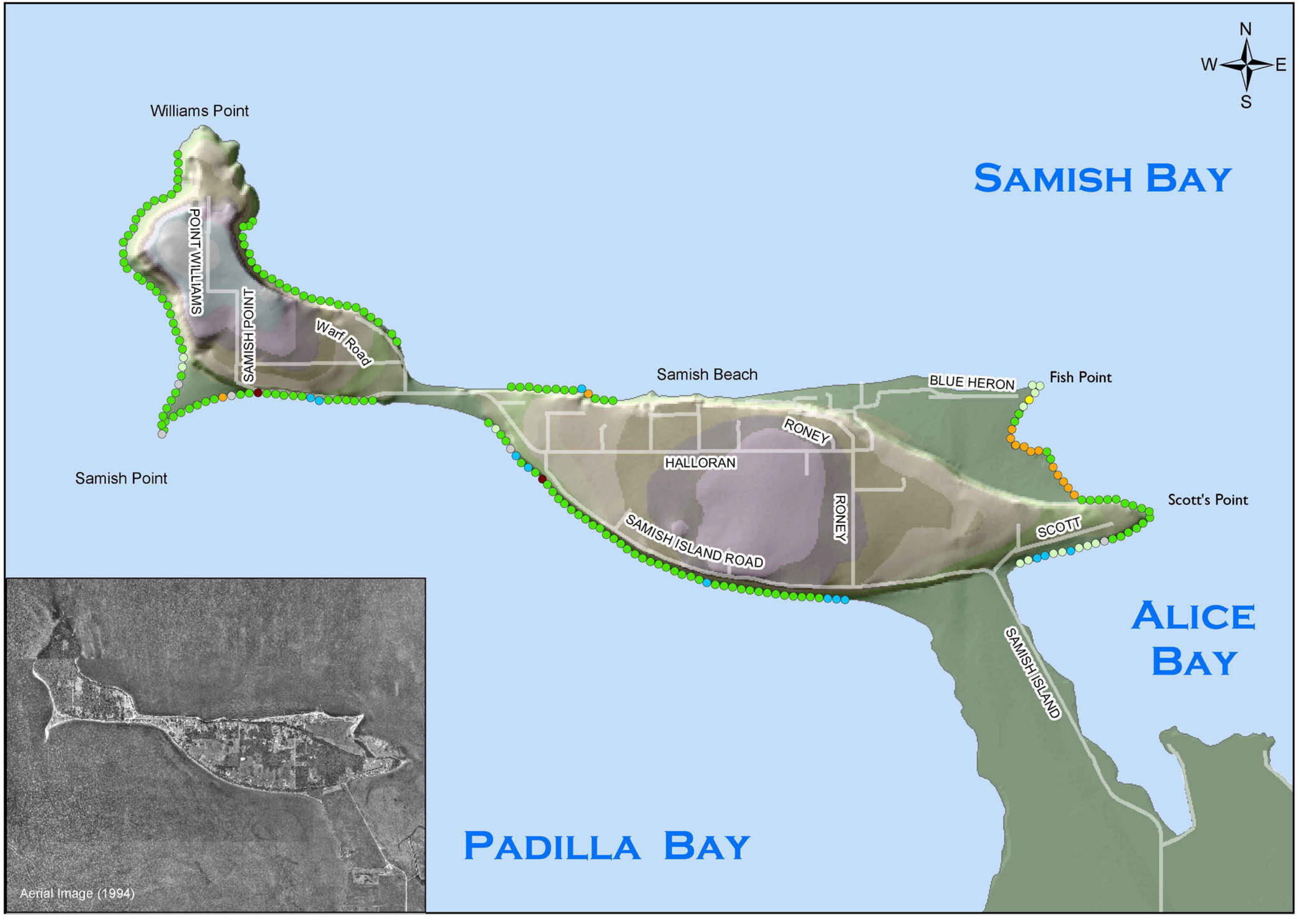
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Features Map 29



ADJACENT LAND USE

LAND USE TYPE

Adjacent Land Use

Legend

- Commercial
- Industrial
- Lawn
- No data
- Not Assessed
- Paved Road/Path/Lot
- Residential
- Undeveloped Natural
- Unpaved Road/Path/Lot

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Outflows

Map 30

N
W E
S

Williams Point

Samish Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

Scott's Point

SCOTT

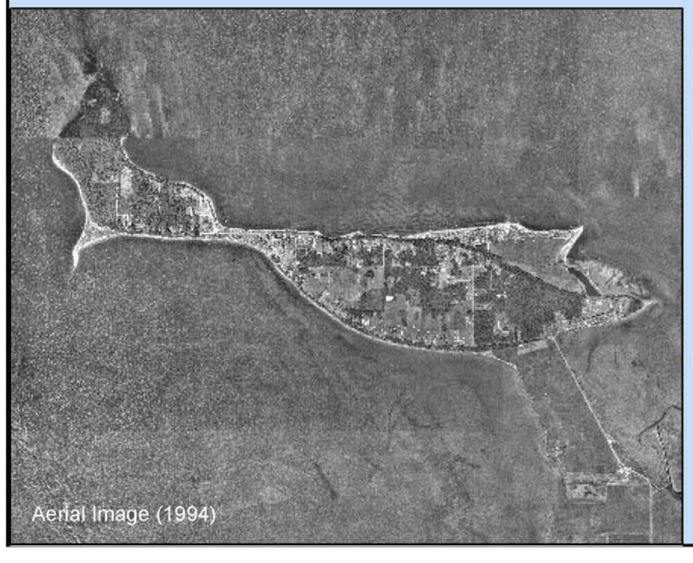
SAMISH ISLAND ROAD

SAMISH ISLAND

SAMISH BAY

ALICE BAY

PADILLA BAY



OUTFLOWS

NUMBER OF OUTFLOWS

Legend

Number of Outflows

- None
- 1
- 2 to 5
- 6 to 15
- 16 to 40

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

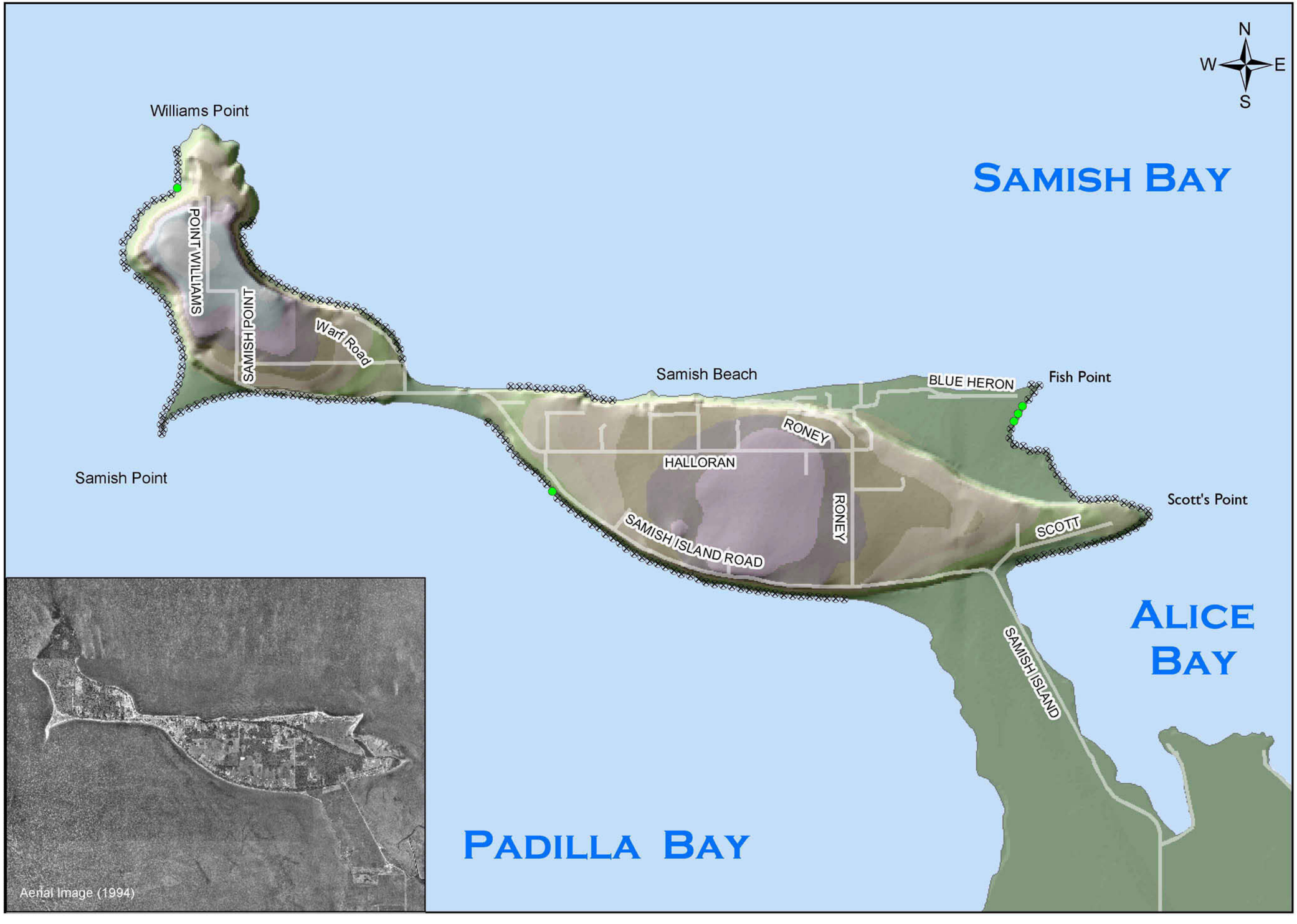
PEOPLE FOR PUGET SOUND

pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Outflows

Map 31



OUTFLOWS

CREEKS/DITCHES

Legend

Creek or Ditch at Shoreline

- Creek or Ditch Present
- No Creek or Ditch Present

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

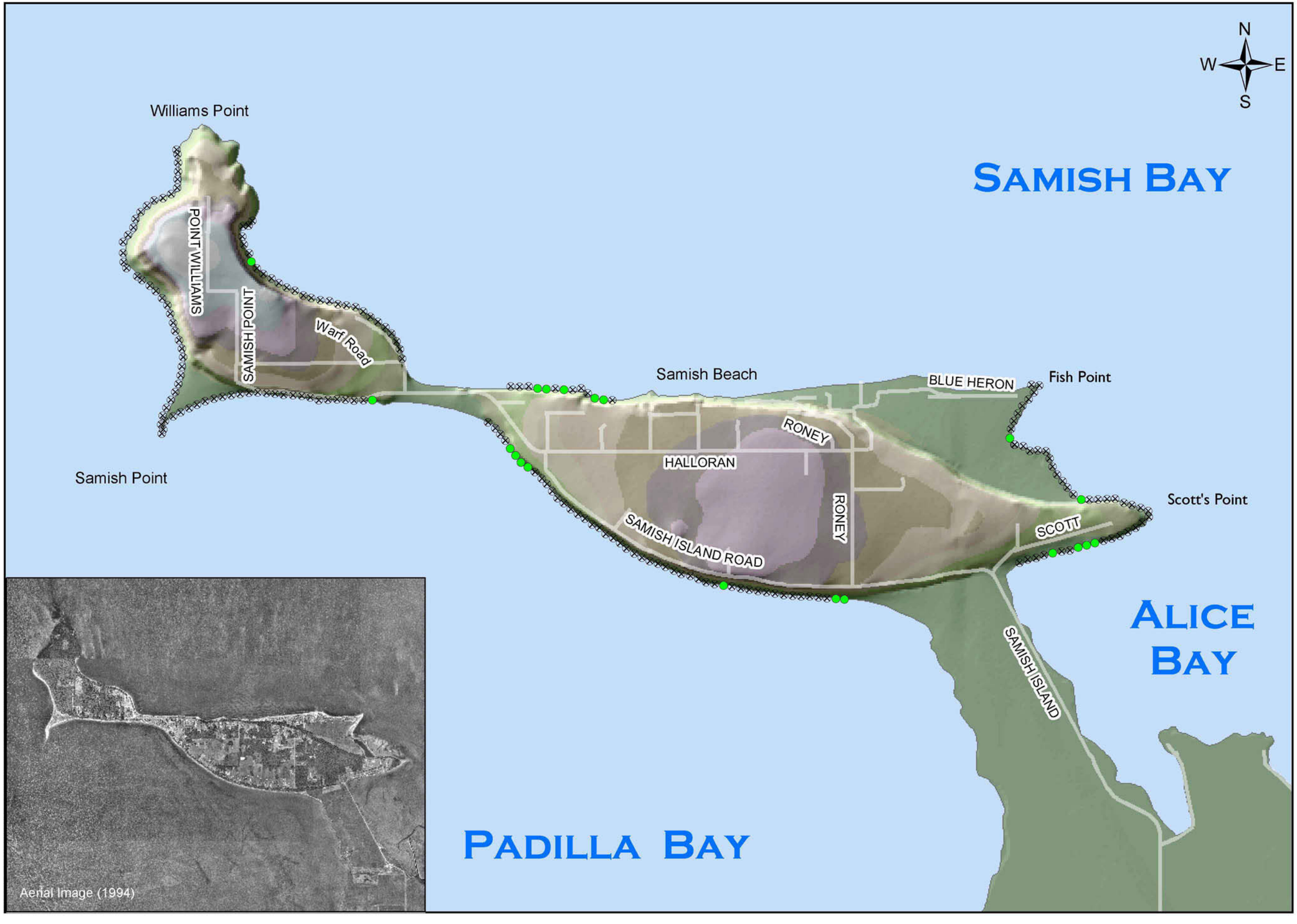
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Outflows

Map 32



OUTFLOWS

PIPES

Legend

Pipe at Shoreline

- ⊗ No Pipe Present
- ● Pipe Present

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Outflows

Map 33

N
W E
S

Williams Point

POINT WILLIAMS

SAMISH POINT

Warf Road

Samish Point

SAMISH BAY

Samish Beach

BLUE HERON

Fish Point

RONEY

HALLORAN

RONEY

SAMISH ISLAND ROAD

Scott's Point

SCOTT

SAMISH ISLAND

ALICE BAY

PADILLA BAY

Aerial Image (1994)

OUTFLOWS

SEEPS

Legend

Seeps at Shoreline

- Seep Present
- No Seep Present

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

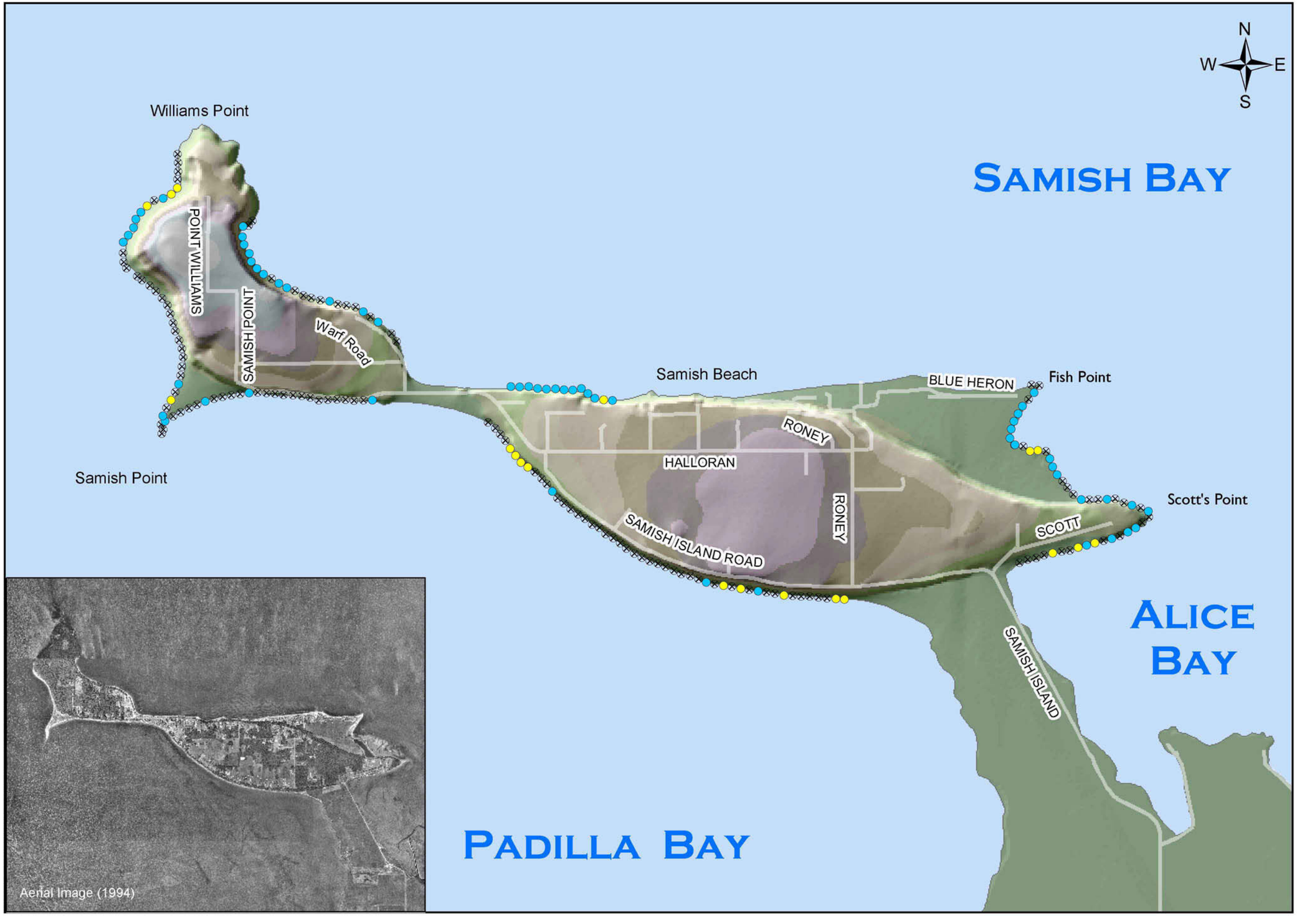
PEOPLE FOR PUGET SOUND

pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Outflows

Map 34



OUTFLOWS

FLOW

Legend

Flow

- Flow Observed
- No Outflow Present
- No Flow Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

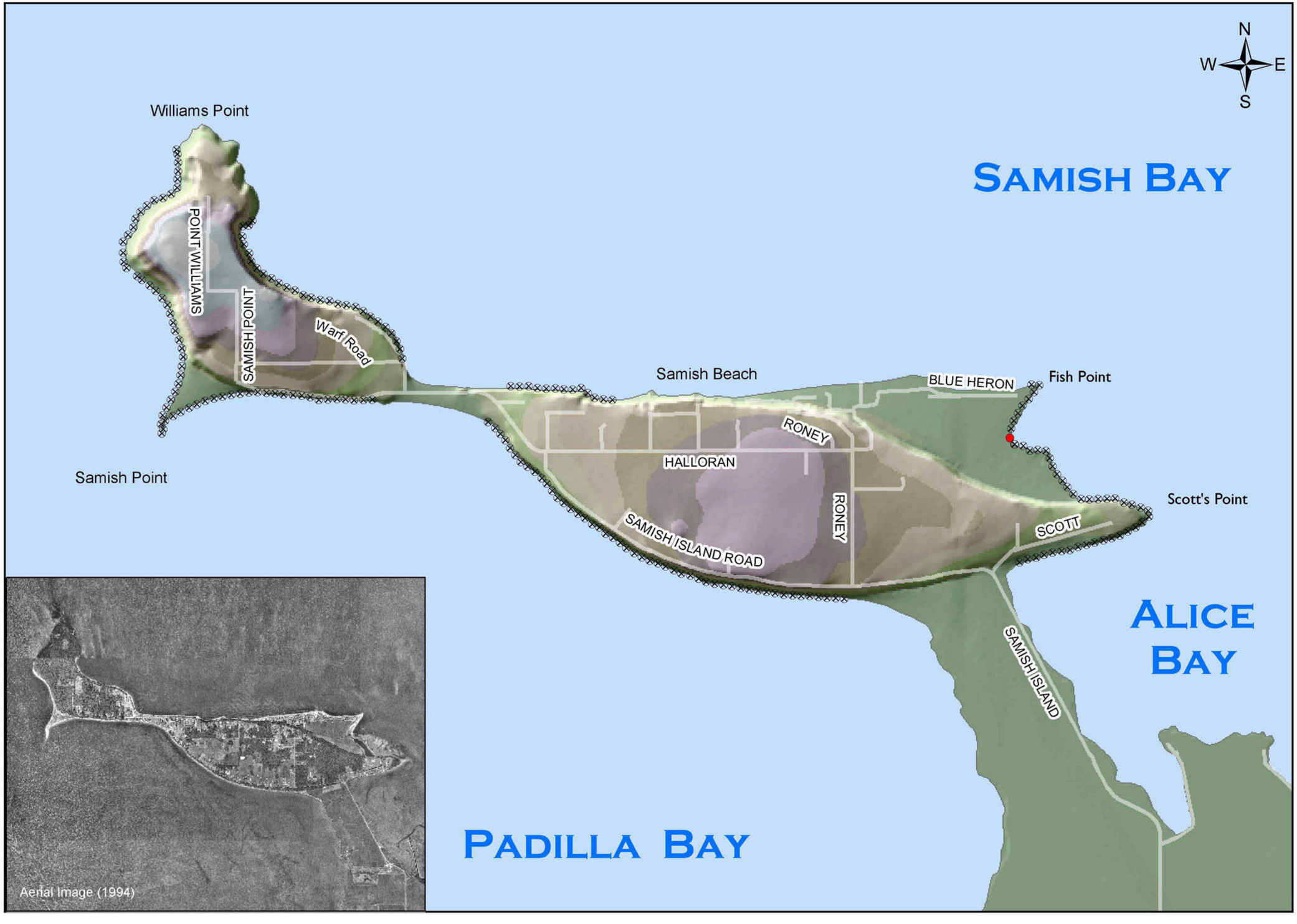
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 35



SIGNS OF POLLUTION AT OUTFLOWS

DISCOLORATION OF WATER

Legend

Discoloration of Water

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

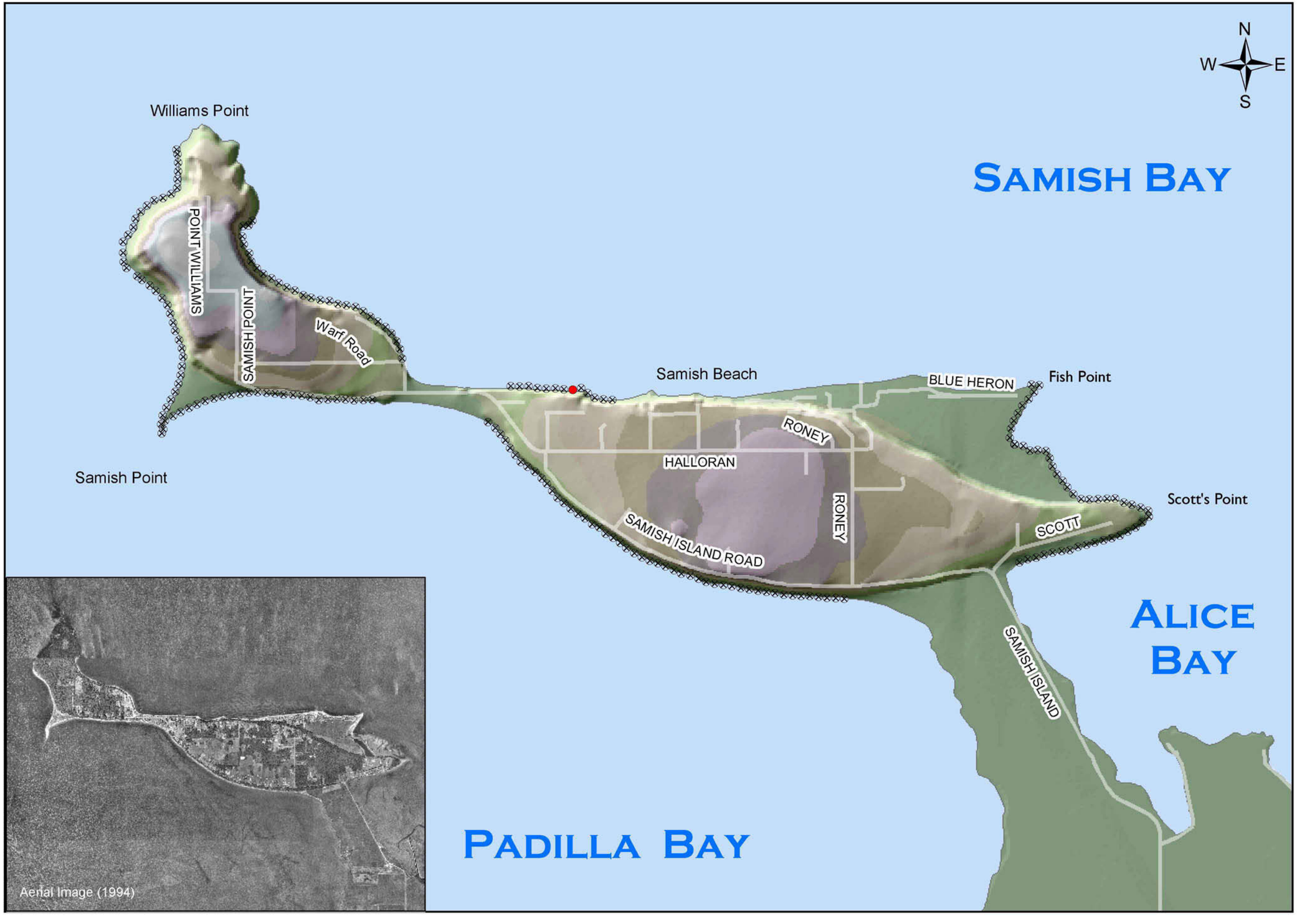
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 36



SIGNS OF POLLUTION AT OUTFLOWS

ASSOCIATED ODOR

Legend

Associated Odor

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

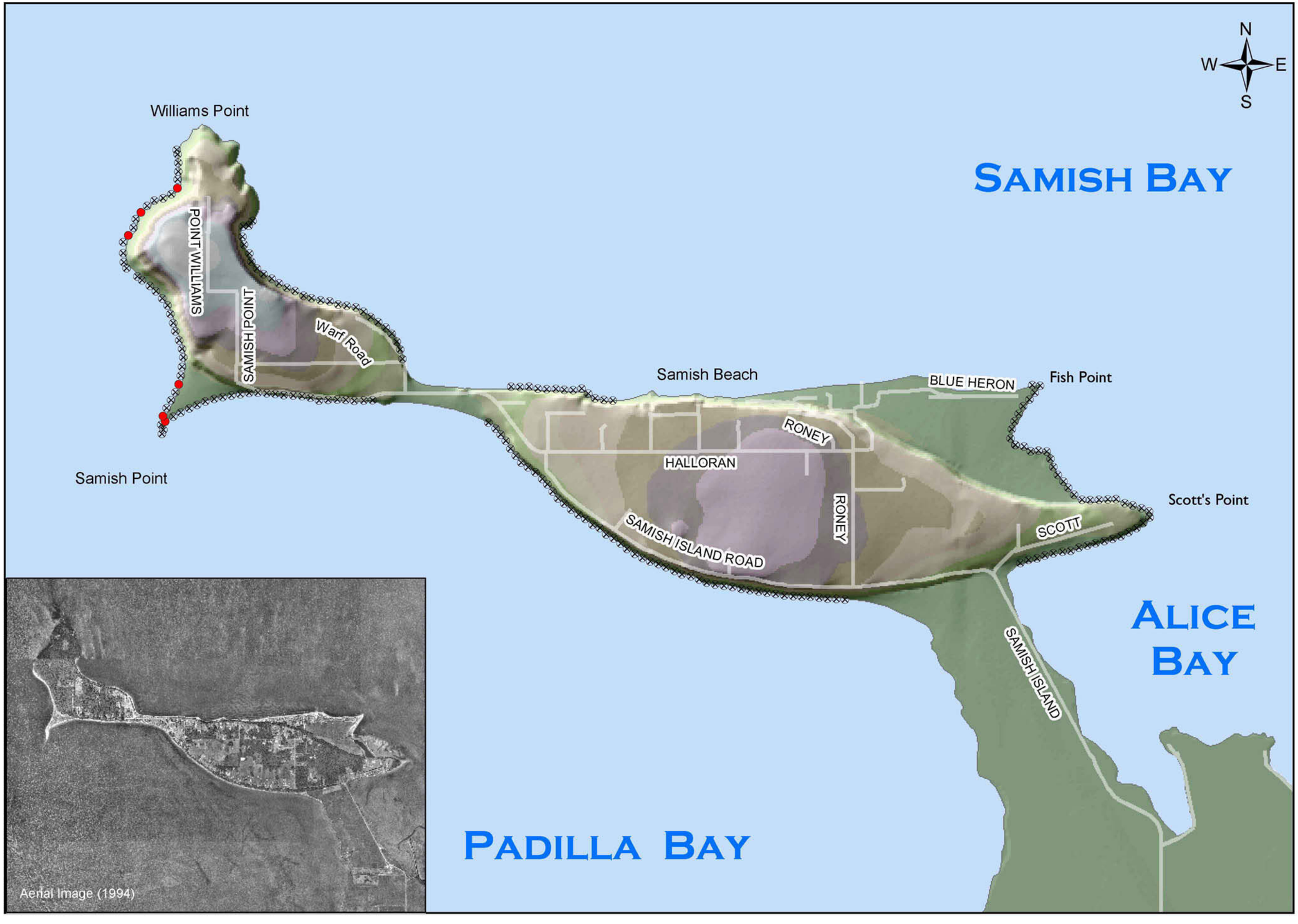
PEOPLE FOR PUGET SOUND

pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 37



SIGNS OF POLLUTION AT OUTFLOWS

EROSION

Legend

Erosion

- Observed
- ⊗ Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

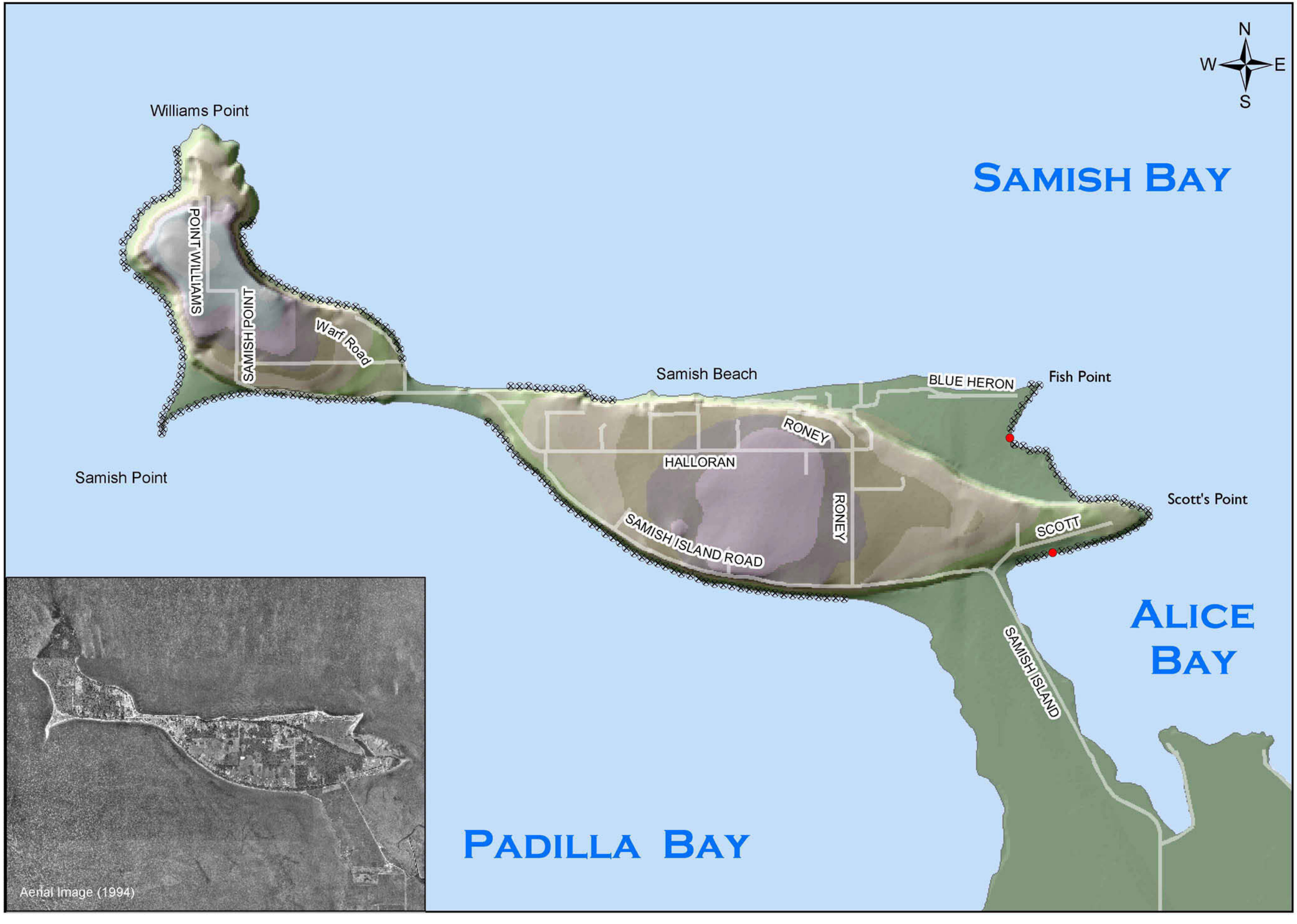
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 38



SIGNS OF POLLUTION AT OUTFLOWS

DARKENED SEDIMENT

Legend

Darkened Sediment

- Observed
- ⊗ Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

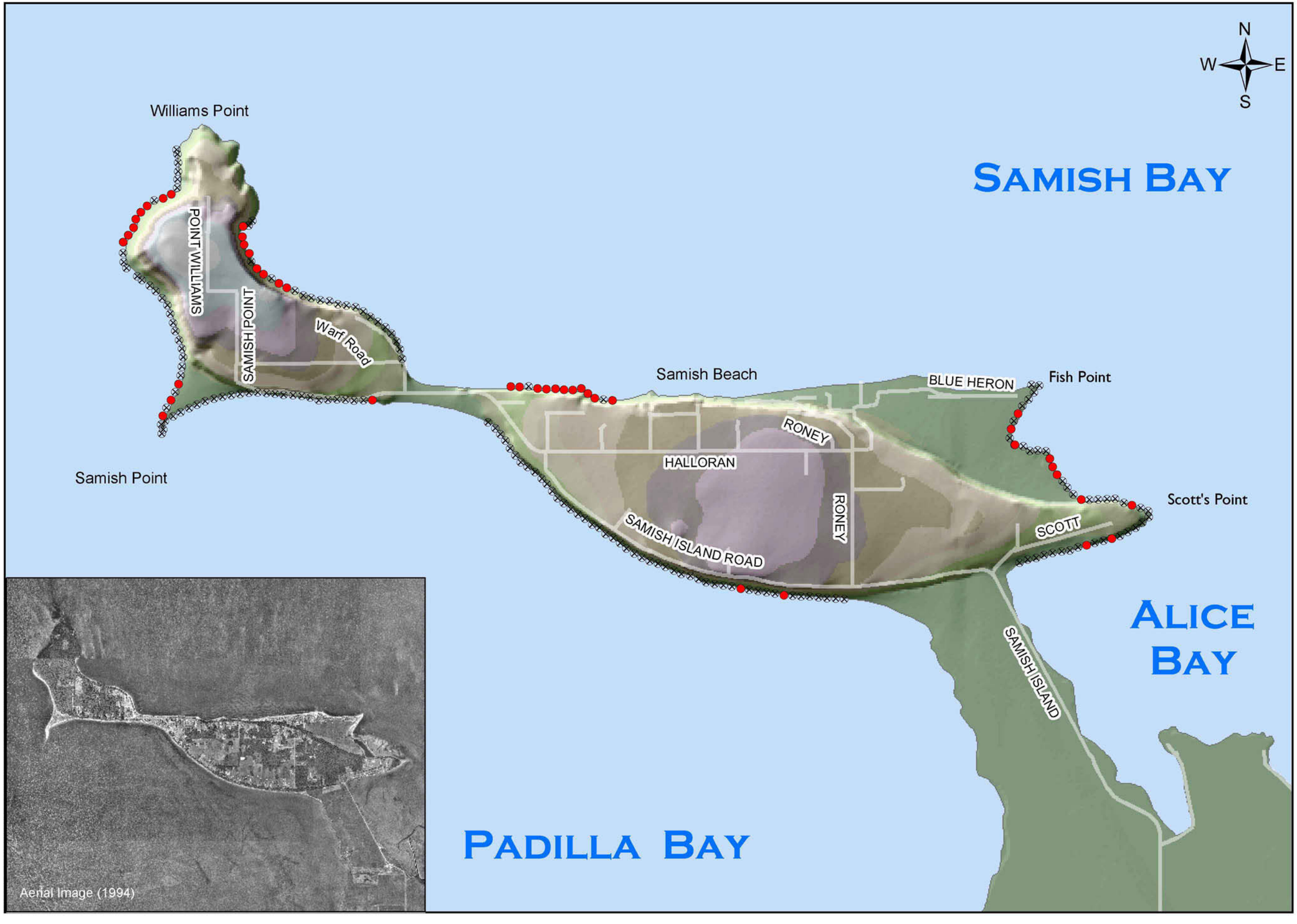
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 39



SIGNS OF POLLUTION AT OUTFLOWS

EXCESSIVE ALGAE

Legend

Excessive Algae

- Observed
- Not Observed

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

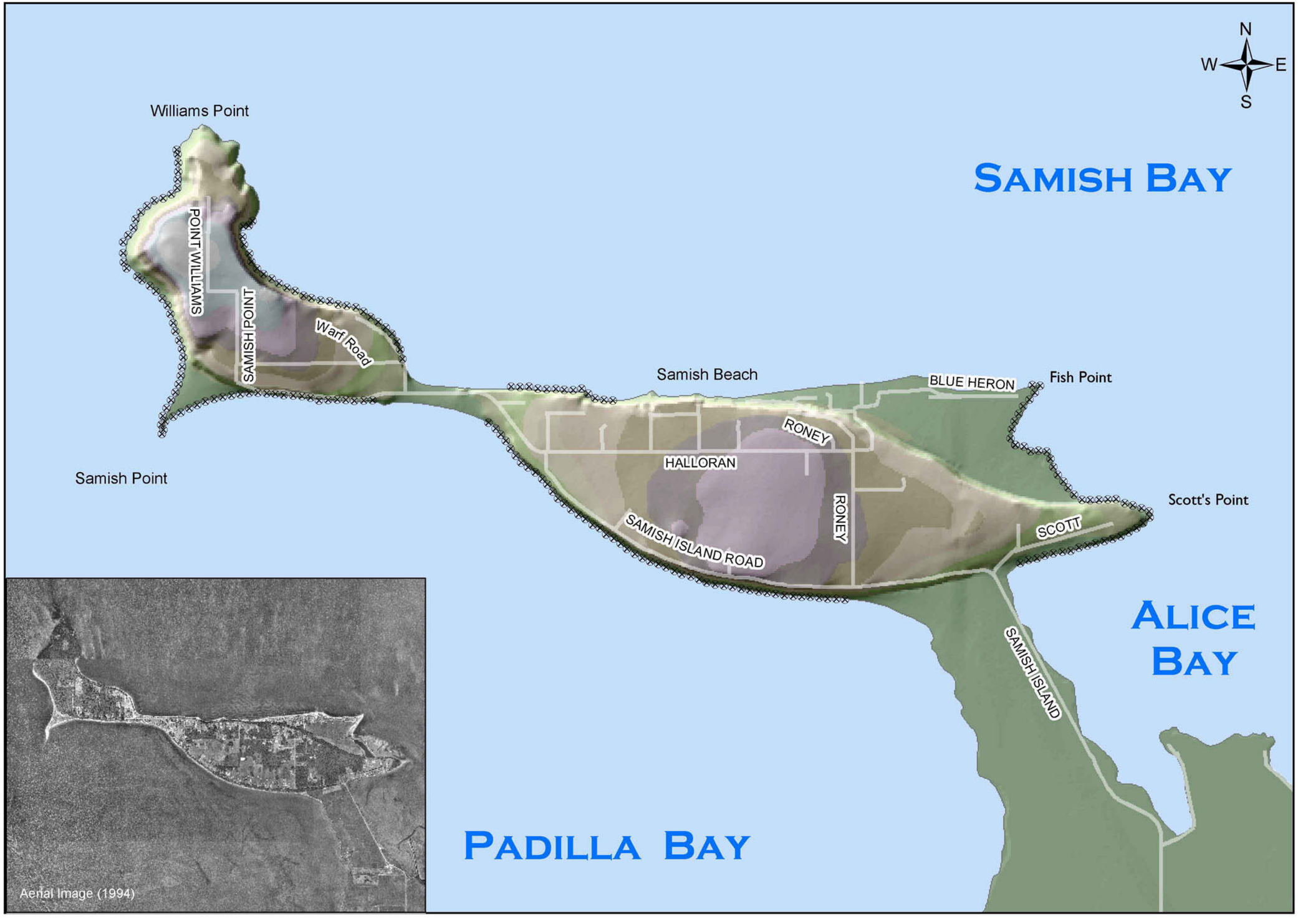
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 40



SIGNS OF POLLUTION AT OUTFLOWS

DEBRIS

Legend

Debris

- ● Observed
- ⊗ Not Observed

* Note no debris associated with outflows was observed.

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

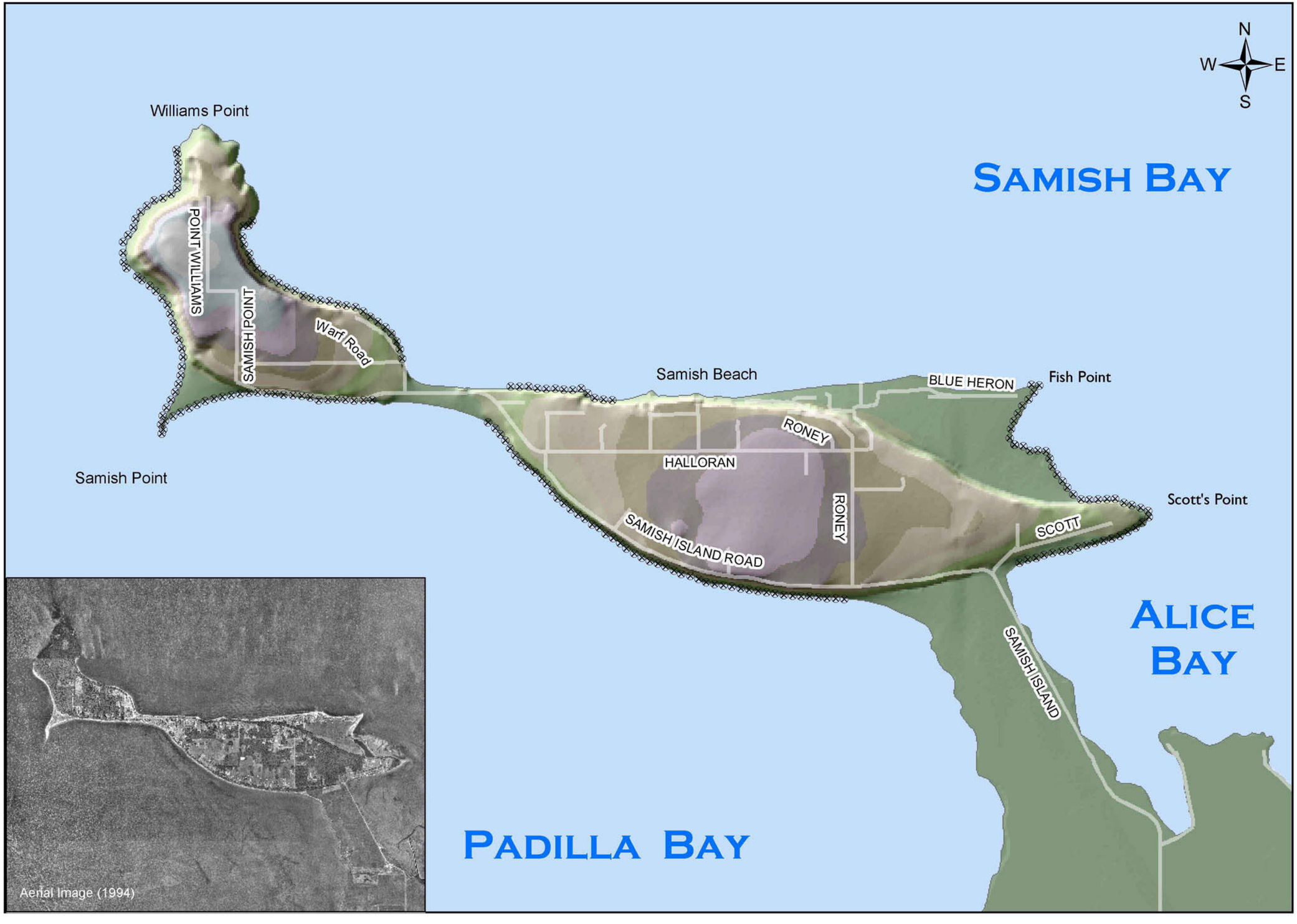
Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Signs of Pollution

Map 41



SIGNS OF POLLUTION AT OUTFLOWS

OIL SLICK OR SHEEN

Legend

Oil Slick or Sheen

- ● Observed
- ⊗ Not Observed

* Note no oil slicks or sheens with outflows were observed.

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

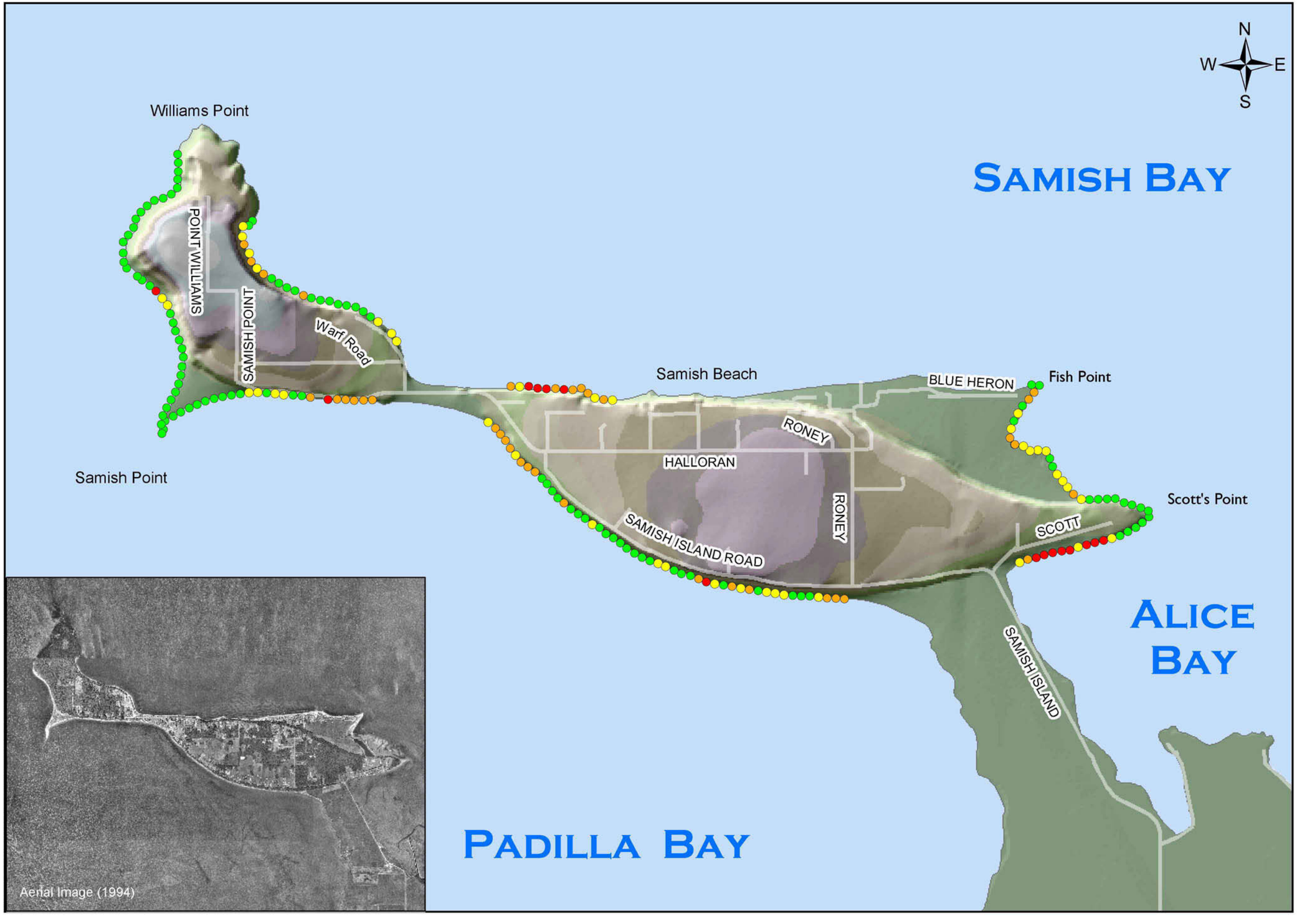
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Structures Map 42



SHORELINE STRUCTURES

NUMBER OF STRUCTURES

Legend

Number of Structures

- No Structures
- 1
- 2 - 3
- 4 - 6

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

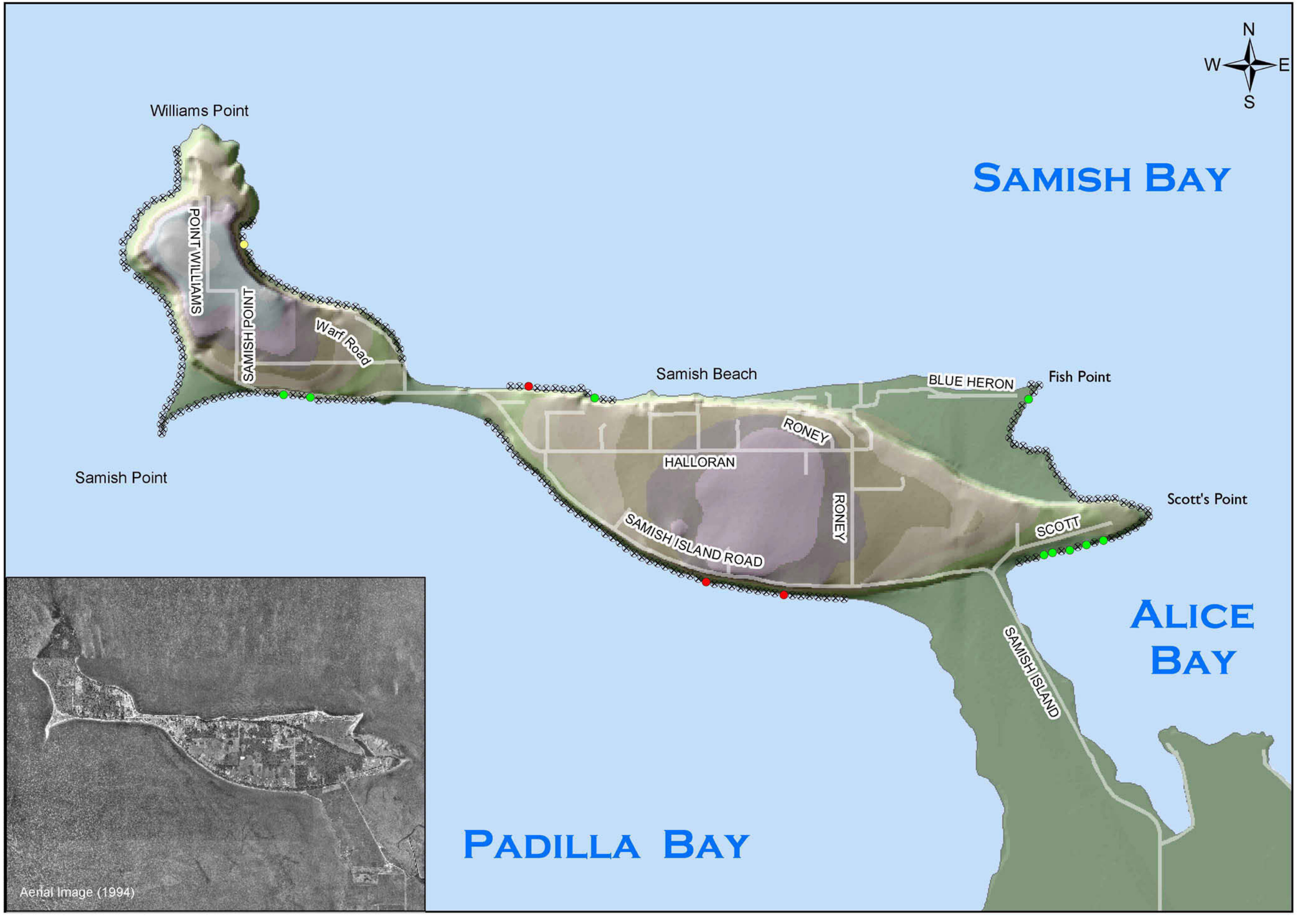
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Structures Map 43



SHORELINE STRUCTURES

PIERS AND DOCKS

Legend

Pier/Dock Condition

- Excellent
- Good
- Poor
- No Pier/Dock

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

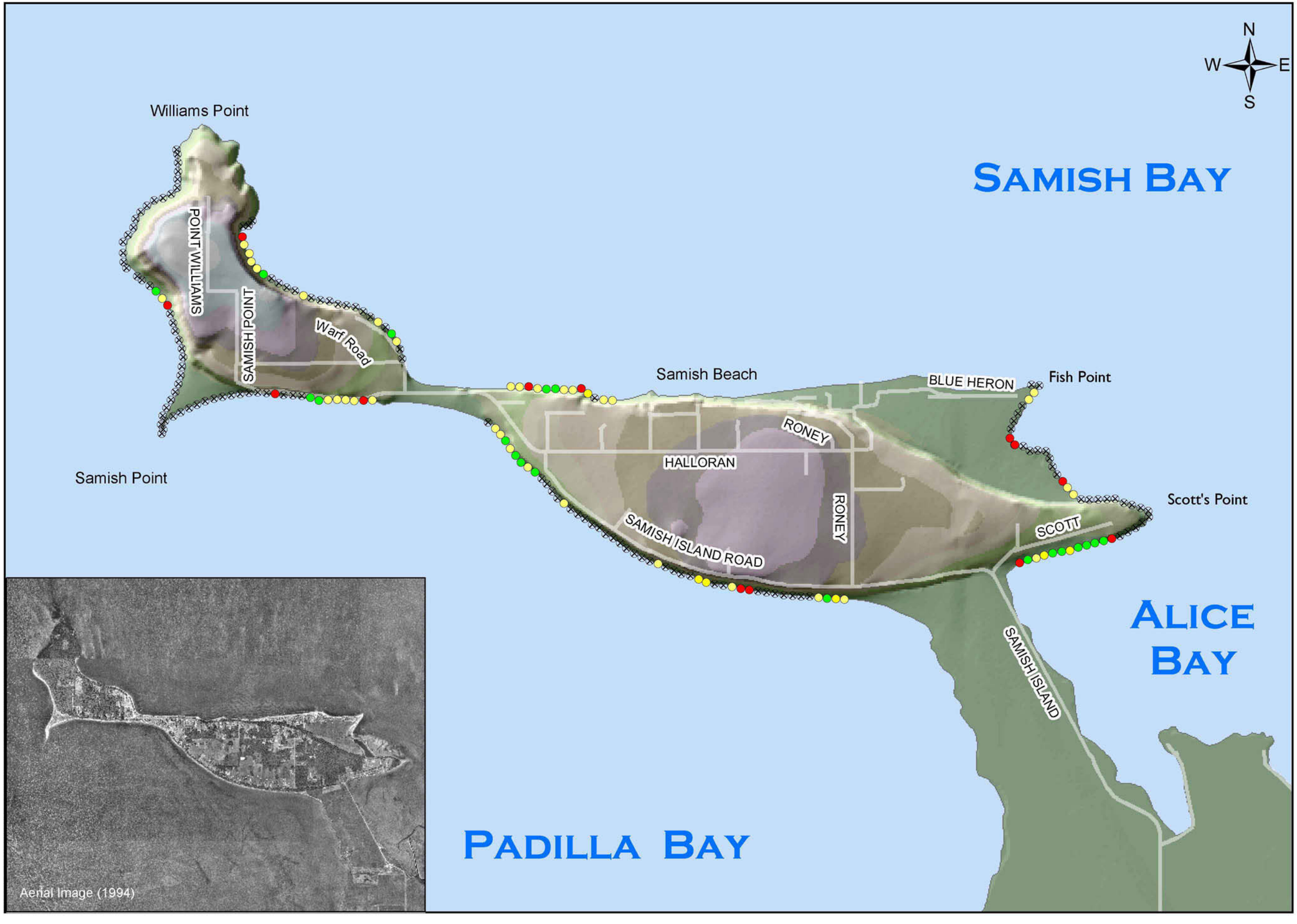
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Structures Map 44



SHORELINE STRUCTURES

BULKHEADS AND SEAWALLS

Legend

Bulkhead and Seawall Condition

- Excellent
- Good
- Poor
- No Bulkhead/Seawall

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

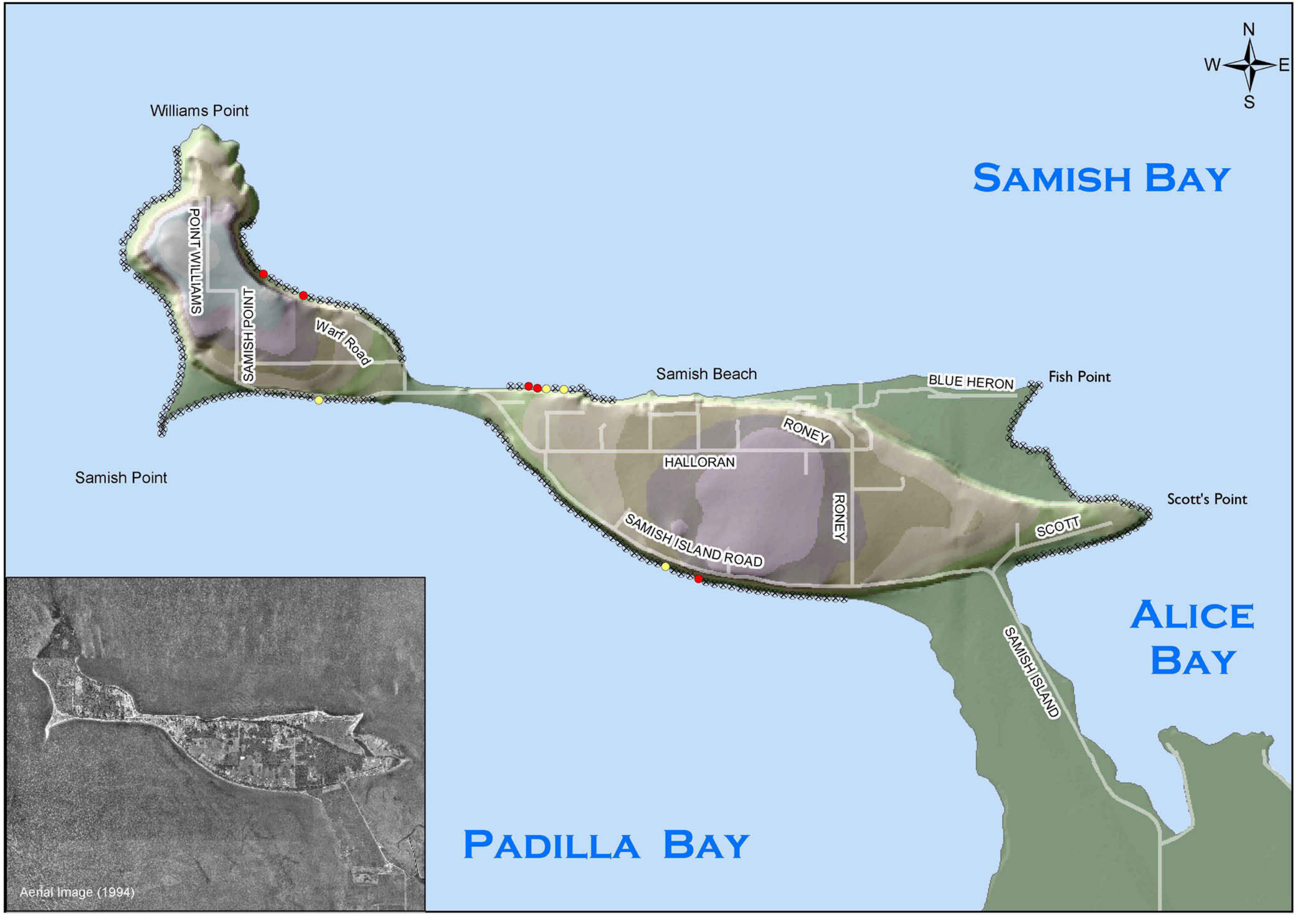
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Structures Map 45



SHORELINE STRUCTURES

JETTIES AND GROINS

Legend

Jetty and Groin Condition

- Excellent
- Good
- Poor
- No Jetty/Groin

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

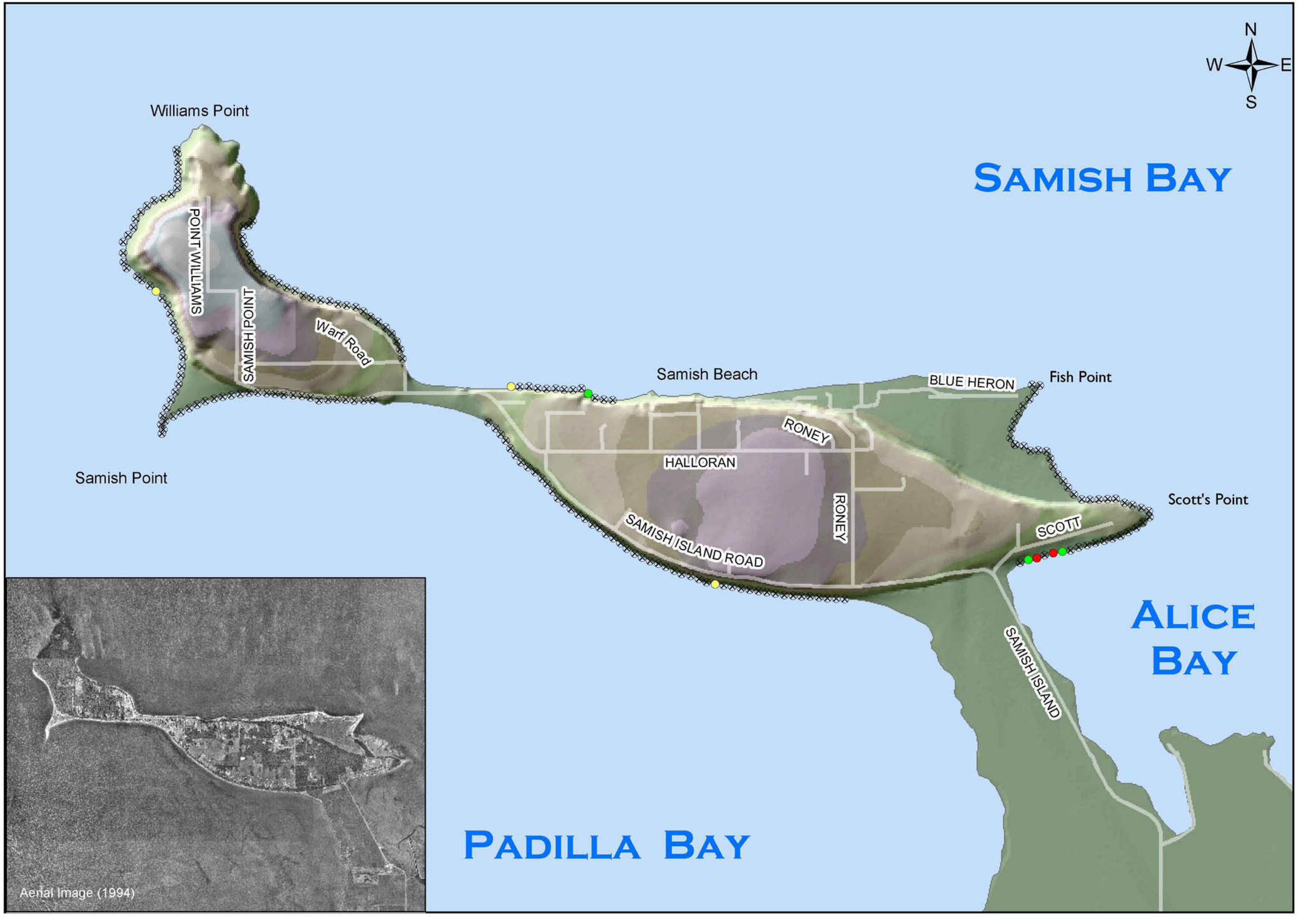
PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Samish Island Rapid Shoreline Inventory 2002 - Shoreline Structures Map 46



SHORELINE STRUCTURES

LAUNCHES AND RAMPS

Legend

Launch and Ramp Condition

- Excellent
- Good
- Poor
- No Launch/Ramp

0 0.25 0.5

Miles

Base Data: Washington DNR
Elevation Data: USGS
Survey Data: People for Puget Sound
- (Collected 06/22/02 - 06/26/02)

PROJECT PARTNERS:

Skagit MRC

PEOPLE FOR PUGET SOUND
pugetsound.org

DECEMBER 2002

Appendix B,

Samish Island 2002

Rapid Shoreline Inventory

Species Lists

This page is intentionally blank

Table 1: Wildlife species Observations from 2002 Samish Island Rapid Shoreline Inventory.

Species Name	Location					
	Backshore	In flight	In/On the water	Intertidal	Upland	Unknown
Abarenicola spp.				6		
Acorn Barnacle (Balanus glandula)				19		1
American Robin (Turdus migratorius)	3			2		
Amphipod, Unidentified				10		1
Ant, Unidentified	1					1
Bald Eagle (Haliaeetus leucocephalus)	1	4	1			
Barn Swallow (Hirundo rustica)	1	2		1	1	1
Barnacle, Unidentified			2	123		19
Battilaria attramentaria				74		4
Beach Hopper (Orchestia spp.)				12		1
Bee, Unidentified		1				
Belted Kingfisher (Ceryle alcyon)		9				3
Bird, Unidentified		2				
Bittium reticulatum				1		
Blackbird, Unidentified		1		1		
Black-Headed Grosbeak (Pheucticus melanocephalus)				1		
Blue Mussel (Mytilus edulis)			1	9		
Butter Clam (Saxidomus giganteus)				3		1
Butterfly, Unidentified	3	6		1	1	
Chiton, Unidentified				4		
Clam, Unidentified				41		8
Cliff Swallow (Hirundo pyrrhonota)						1
Cockle, Unidentified				2		1
Crab, Unidentified			4	28		1
Cricket, Unidentified				1		
Dragonfly, Unidentified		2	1	2		
Duck, Unidentified			2			
Dunce-cap limpet				3		
Dungeness Crab (Cancer magister)			3	3		
Eagle, Unidentified		3				
Eel, Unidentified				2		
European Starling (Sturnus vulgaris)		2		1		
Finch (Carpodacus spp.)		2				
Fish, Unidentified			2			1
Flat Worm, Unidentified				2		1
Flathead Clingfish (Gobiesox maeandricus)				2		
Fly, Unidentified				1		
Frog, Unidentified			1			
Geoduck (Panopea generosa)				1		
Ghost Shrimp (Callianassa californiensis)			1	15		1
Giant Acorn Barnacle (Balanus nubilus)				5		
Great Blue Heron (Ardea herodias)		17		1		2
Gull, Unidentified		11	3	19		4

Species Name	Location					
	Backshore	In flight	In/On the water	Intertidal	Upland	Unknown
Gunnel, Unidentified			1			
Hairy Shore Crab (Hemigrapsus oregonensis)			2	7		1
Hermit Crab, Unidentified			2	16		3
Heron, Unidentified		3				
Horse Mussel (Modiolus modiolus)				9		
Hummingbird, Unidentified		1			1	
Japanese Oyster (Crassostrea gigas)				13		1
Keyhole Limpet (Diodora aspera)				1		
Ladybug, Unidentified	1			1		
Limpet, Unidentified				44		4
Littleneck Clam (Protothaca tenerrima)				1		
Littorina spp.				1		
Mossy Chiton (Mopalia muscosa)				1		
Mouse (Mus spp.)					1	
Mussel, Unidentified				10		1
Northwestern Crow (Corvus caurinus)	1	3		1		1
Olympia Oyster (Ostrea lurida)				1		
Osprey (Pandion haliaetus)				1		
Oyster, Unidentified				38		5
Pacfic Razor Clam (Siliqua patula)				2		
Pacific Herring (Clupea pallasii)				1		
Periwinkle, Unidentified				26		2
Pigeon Guillemot (Cepphus columba)						1
Pisaster ochraceus				7		
Polychaete, Unidentified				1		1
Purple Shore Crab (Hemigrapsus nudus)				7		1
Red Rock Crab (Cancer antennarius)			1	9		1
Sand Dollar (Dendraster excentricus)			1	1		1
Sculpin, Unidentified			4	1		1
Sea Anemone, Unidentified				17		4
Sea Cucumber, Unidentified				5		
Sea Pork				1		
Sea Pork (Aplidium spp.)				1		
Sea Slug, Unidentified				2		
Sea Star, Unidentified			2	21		3
Segmented Worm (Nereis spp.)				5		1
Segmented Worm, Unidentified				21		2
Shore Bird, Unidentified						1
Shore Crab, Unidentified				57		4
Shrimp, Unidentified				1		
Smelt (Hypomesus spp.)			2			
Snail, Unidentified				37		2

Species Name	Location					
	Backshore	In flight	In/On the water	Intertidal	Upland	Unknown
Sunflower Star (Pycnopodia helianthoides)				2		
Swallow, Unidentified		6		1		
Thrush, Unidentified					1	
Tube Worm, Unidentified				15		2
Whelk, Unidentified				26		3
Winter Wren (Trogolodytes trgolodytes)				1		
Worm, Unidentified				1		

** Observations reflect the number of 150-foot sections where species were observed.*

Table 2: Vegetation Species Observations from 2002 Samish Island Rapid Shoreline Inventory.

Species Name	Location	
	Backshore	Intertidal
Algae, Unidentified	3	7
Aspen (Populus tremuloides)	3	
Beach Pea (Lathyrus japonicus)	10	
Beach Sagewort (Artemisia pyncnocephala)	17	
Big Leaf Maple (Acer macrophyllum)	10	
Bitter Cherry (Prunus emarginata)	2	1
Black nightshade (Solanum americanum)	1	
Blackberry, Unidentified	4	
Bracken Fern (Pteridium aquilinum)	1	
Brown Algae, Unidentified	1	6
Bull Kelp (Nereocystis luetkeana)		15
Cedar, Unidentified	9	
Clover (Trifolium spp.)	2	
Common Juniper (Juniperus communis)	1	
Common Red Paintbrush (Castilleja miniata)	3	
Daisy, Unidentified	3	
Dandelion (Taraxacum officinale)	5	
Diatom, Unidentified	5	
Douglas Fir (Pseudotsuga menziesii)	69	1
Dunegrass (Elymus mollis)	48	1
Eelgrass (Zostera japonica)		89
Eelgrass (Zostera marina)		101
Eelgrass, Unidentified	2	2
English Ivy (Hedera helix)	32	
Feather Boa (Egregia menziesii)	1	
Fern, Unidentified	2	
Fir, Unidentified	27	
Fireweed (Epilobium angustifolium)	1	
Flower, Unidentified	6	1
Foxglove (Digitalis purpurea)	1	
Grass, Unidentified	30	1
Green Algae (Cladomorhpa columbiana)		2
Green Algae, Enteromorpha spp.	1	89
Green Algae, Unidentified		2
Gumweed (Grindelia integrifolia)	5	
Hedge Bindweed (Convolvulus arvensis)	21	
Himalayan Blackberry (Rubus discolor)	65	
Holly	3	
Hooker's Willow (Salix hookeriana)	2	
Horsetail (Equisetum spp.)	5	
Huckleberry (Vaccinium spp.)	2	
Lichen, Unidentified	2	
Lilly (Lillium spp.)	1	
Lodgepole Pine (Pinus contorta var. latifolia)	2	
Lodgepole Pine (Pinus ponderosa)	1	
Madrone (Arbutus Menziesii)	39	
Mountain Ash (Sorbus sitchensis)	2	
Nootka Rose (Rosa nutkana)	15	
Oak, Unidentified	11	

Species Name	Location	
	Backshore	Intertidal
Ocean Spray (Holodiscus discolor)	71	1
Oregon Grape (Mahonia nervosa)	10	
Ornamental Plants	1	
Pacific Silverweed (Potentilla anserina ssp. pacifica)	1	
Paper Birch (Betula papyrifera)	1	
Pickleweed (Salicornia virginica)	3	16
Pine, Unidentified	3	10
Poison Hemlock (Conium Maculatum)	2	
Poplar (Populus spp.)	1	
Queen Anne's Lace (Daucus carota)	5	
Red Alder (Alnus rubra)	38	1
Red Algae (Porhyra spp.)		6
Red Algae, Corraline Spp.		9
Red Algae, Porphyra spp.		10
Red Algae, Unidentified		3
Red Elderberry (Sambucus racemosa)	4	
Red-Flowering Currant (Ribes sanguineum)	2	
Reed Canary Grass (Phalaris arundinacea)	2	
Rhododendron, Unidentified (Rhododendron spp.)	1	
Rock Weed (Fucus distichus)	2	63
Rose (Rosa rugosa)	2	
Rose, Unidentified	54	
Ryegrass (Lolium spp.)	4	
Salal (Gaultheria shallon)	2	
Salmonberry (Rubus spectabilis)	6	
Sargassum muticum		26
Scrub Oak (Quercus ilicifoliate)	1	
Scot's Broom (Cytisus scoparius+A35)	14	
Sea Lettuce (Ulva fenestrata)	2	120
Seaweed, Unidentified		1
Serviceberry (Amelanchier alnifolia)	7	
Shore Pine (Pinus contorta var. contorta)	2	
Shrub, Unidentified	1	
Small Bedstraw (Galium trifidum)	1	
Small Bedstraw (Gallium spp.)	1	
Snowberry (Symphoricarpos albus)	12	
Spearscale (Atriplex patula)	22	1
Spruce, Unidentified	2	
Stinging Nettle (Urtica dioica)	3	
Sugar Wrack (Laminaria saccharina)		30
Sword Fern (Polystichum munitum)	2	
Thimbleberry (Rubus parviflorus)	34	1
Thistle (Crisium arvense)	9	
Trailing Blackberry (Rubus ursinus)	1	1
Turkish Towel (Chondracanthus exasperatus)		2
Unknown	1	
Vetch (Vicia spp.)	1	
Vine Maple (Acer circinatum)	3	
Western Hemlock (Tsuga heterophylla)	4	
Western Red Cedar (Thuja plicata)	2	

Species Name	Location	
	Backshore	Intertidal
Western Trumpet Honeysuckle (Lonicera ciliosa)	5	1
Wild Carrot	1	
Wild Pea	2	
Willow, Unidentified	58	1
Yarrow (Achillea millefolium)	12	

** Observations reflect the number of 150-foot sections where species were observed.*

Appendix C,

Rapid Shoreline Inventory Protocol

This page is intentionally blank

Rapid Shoreline Inventory Program Protocol

DRAFT JULY 2001
This protocol is under review.
For the most current copy, please see www.pugetsound.org

PROBLEM STATEMENT

In 1994, a marine science panel made up of experts from Washington state and the Canadian province of British Columbia issued a joint report which outlined the environmental problems facing the shared waters of Puget Sound, the Strait of Juan de Fuca, and the Georgia Straits. This report identified the permanent loss of nearshore marine and estuarine habitat as the most threatening environmental problem facing the region.

After conducting an assessment of the information available on habitat loss throughout Puget Sound (*The Loss of Habitat in Puget Sound*, March 1997), People For Puget Sound found that very little information was available about the extent and current rate of nearshore habitat loss around the Sound.

Even more troubling than the lack of reliable information on the fate of nearshore habitat is the lack of understanding about the relationship between shoreline development and natural resources that rely on healthy beach environments for survival. We know, for example, that shellfish require sand and gravel substrate, and that salmon feed on the forage fish that spawn on sand and gravel beaches. It has been documented that shoreline development often results in the loss of these important sand and gravel habitats. However, a lack of clear and documented information about the effects of shoreline development has led to a historic lack of protection for Puget Sound shoreline habitats.

In response to these findings, People For Puget Sound and Adopt a Beach developed the Citizens Shoreline Inventory (CSI) program in 1997. This program recruited and trained volunteer stewards to collect detailed information about the shoreline of Puget Sound. After implementing this program for three years, People for Puget Sound identified several aspects of the CSI program that were in need of adjustment. These areas include:

- Geographically dispersed data: Since one of the goals of CSI was to educate citizens about the importance of Puget Sound shoreline habitats, many of the volunteers were shoreline homeowners implementing the inventory on their own property. While the data was statistically interesting, this system provided no means of focusing the inventory on areas of high interests.

- Consistent data accuracy/quality issues: CSI volunteers received approximately four hours of training prior to implementing the program on their selected section(s) of shoreline. This amount of training was not adequate to cover the complexity of the data collection system. Since volunteers were working without supervision, this system gave no opportunity for volunteers to increase their data collection skills over time. These two factors were generating continual problems with data accuracy and quality.

- Slow data turnaround: The CSI process necessitated data passing through numerous hands from the time it was collected by volunteers to the time it was presented on People for Puget Sound's website. Consequently, it often took many months to present the results of data collection.

During the third year of the CSI program, the Washington Department of Natural Resources (WADNR) released its *Shorezone* database, the most comprehensive compilation of Puget Sound shoreline habitat data to date. Given the difficulties with the CSI program and the new resource provided by *Shorezone*, People for Puget Sound took this opportunity to create the Rapid Shoreline Inventory program (RSI). RSI actively engages data end users from the outset by working with resource managers to identify shoreline areas for inventory and select goals for the data. RSI data can be used to identify areas for protection and/or restoration, or can provide a baseline against future resource damages. RSI provides a fine-screen view of the shoreline that complement and nests within *Shorezone* and provides resource managers with the information necessary to make good management decisions to protect shoreline habitat.

PROGRAM SUMMARY

The Rapid Shoreline Inventory is designed to collect accurate, comprehensive data on contiguous sections of Puget Sound shoreline, and to present the results in a timely fashion. In developing this program, great consideration was given to ensure that the data being collected:

1. Complements rather than duplicates existing data sets. The scale at which the RSI program is implemented allows for a more refined collection of data than is currently available in existing data sets. Resource managers can use the *Shorezone* data set to identify broad shoreline areas of interest or under their jurisdiction, select areas for which they would like additional on-the-ground data, and implement RSI to collect this more detailed information. In turn, this detailed information may indicate to resource managers the need for even more meticulous, targeted data collection to be undertaken by specialized professionals.

2. Can be accurately collected by trained volunteers. People For Puget Sound recognizes that volunteers can be a valuable asset in gathering information that would be cost-prohibitive for agency personnel to collect. However, it is also recognized that collection of certain types of data (such as biological data to the species level), may be best accomplished by professional staff. The data sets presented in the RSI program are those for which volunteers have proven to be successful in absorbing the requisite training and in implementing the collection of accurate data.

3. Provides data geared toward answering specific resource questions: Each type of data within RSI has been selected for its direct applicability to shoreline resource management. While there is a tremendous amount of information that would be 'good to know', RSI is designed to provide resource managers with data that can be utilized directly for making resource management decisions. For example, RSI data can provide the baseline information to identify specific shoreline areas that are high priority areas for conservation or for habitat restoration.

The process is divided into three activity areas (See Attachment A for the RSI Program Checklist):

- Planning: A target area of shoreline is identified, inventory date(s) are set in conjunction with the lowest possible daytime tides, and the appropriate combination of staff and volunteers are determined. If new volunteers will be involved in the inventory, a three-session training schedule is set such that the training is completed just prior to the first inventory date.

- Training/setup: All volunteers new to the RSI program will complete a three-session training series, comprised of two classroom sessions and one field training session. On the day preceding the inventory day(s), the target shoreline is measured and flagged into 150-foot sections with GPS readings taken for each section. Once the number of sections has been determined, the appropriate number of data forms is generated and adequate materials and supplies collected.

- Implementation: People For Puget Sound staff and/or staff from local partner organizations will accompany, assist, and manage volunteers on inventory days. On the inventory day, staff and volunteers are assigned roles of data collectors,

quality control staff, and field marshals. The field marshal will assign data collectors and quality control staff specific sections of shoreline. Each staff member can be expected to supervise three to five volunteers on the beach. As data collectors complete each section, they wait in that section for staff to have that data form checked for completeness, corrected/adjusted if necessary, and signed off. At the end of the day, staff bring those forms to the field marshal, who will assure that each assigned section was inventoried and that each form was quality checked.

- Data processing/analysis/presentation: Once all shoreline sections have been inventoried, People For Puget Sound staff bring the completed, checked data forms to the office for data processing and analysis. Staff train and supervise volunteers to enter the data into the database, and staff review data entry on every 20th form. Once the data is entered, the Data Analysts transfers the data to a Geographic Information System and review the data for gaps and anomalies. Field staff review the data forms and data entry to resolve questions about the data. The Data Analysts then creates standard and customized displays of the data, in consultation with the resource managers, and staff generate a project report based on the original data goals for the project.

PROGRAM DETAIL

Planning

Shoreline selection: People for Puget Sound works with resource managers to use existing data sources, such as *Shorezone* and information on natural resource distributions, to identify and select target shorelines. Priority can be given to high resource shoreline areas, such as those with intact critical habitat (i.e., eelgrass beds, known/potential forage fish spawning substrate, etc.), or those with high potential for restoration (i.e., public shoreline areas). Areas can be targeted to look for conservation targets adjacent already protected areas, to provide baselines for shoreline scheduled for a significant change in land use, or for other social reason. Or areas can be targeted to produce a baseline against which to assess future damages such as from an oil spill or un-permitted land use. People For Puget Sound can assist shoreline selection by producing statistical models from existing data sets that increase the likelihood of finding habitat for specific species or sets of species.

Selection of target shorelines must be the first step in implementing the RSI process, as the amount of shoreline inventoried is limited by the program budget, the number of staff/volunteers needed, and number of inventory days (daytime sub-zero tides) required to complete the data collection process. Starting and ending boundaries of target shoreline areas must be clearly delineated during the planning process, and access point located.

In many cases, permission will be needed to access the shoreline. The importance of gaining shoreline access early in the planning process cannot be underestimated, and must be included as a factor in the selection of target shorelines (and in the project

budget). The responsibility for securing shoreline access should be agreed upon by the parties involved in an RSI inventory early in the planning process, and a date for access established after which the project would automatically be postponed to the following data season. In some cases it may make sense to create a "study area" within which a select amount of data would be gathered, either in contiguous sets or randomly to provide statistical samples.

Staffing needs: To address the differing needs and limitations of resource managers, we have developed three data collection scenarios for RSI. Each has advantages and disadvantages, and is designed to allow resource managers to select the scenario that best fits their particular situation. In all scenarios, People for Puget Sound staff assumes responsibility for training (if necessary), quality control, and data processing/analysis/reporting.

It would be possible to mix and match the three scenarios with any given project in order to best meet the needs of local resource mangers or project sponsors. People For Puget Sound is willing to train staff from agencies or organizations to carry out this program. However, People For Puget Sound retains all rights to this program and protocol. At the very least, agencies or organizations must agree in writing to follow the training and Q/A procedures, to process and analyze the data in a timely fashion, to make the data available to the public, and to deliver the data to People For Puget Sound.

Staffing Scenario	**Advantages**	**Disadvantages**
1. Data collected by People for Puget Sound Staff	⇨Least expensive ⇨Most flexible with regard to scheduling ⇨Quickest turnaround time ⇨Eliminates need for training	⇨Does not educate and engage citizen volunteers
2. Data collected by volunteers drawn from pool of previously trained citizens	⇨Engages citizen volunteers ⇨Eliminates need for full training sessions ⇨Moderate turnaround time from planning to implementation ⇨Some flexibility with regard to scheduling	⇨Does not necessarily engage local citizens ⇨Limited opportunity for collaboration with local groups
3. Data collected by newly recruited and trained local volunteers	⇨Engages and educates citizen volunteers ⇨Opportunity for collaboration with local groups/organizations ⇨Adds to the regional pool of trained RSI volunteers	⇨Most time-consuming ⇨Least flexible with regard to scheduling

Inventory dates: Once the target shoreline and the staffing scenario have been selected, training and inventory dates must be set. Depending upon the staffing scenario selected, several factors may need to be taken into account when setting inventory dates, including:

- Daytime, sub-zero tides
- Holiday weekends
- Proximity of inventory dates to available training dates

RSI inventories must occur during sub-zero tide (USGS Tide Tables and Charts, MLLW = 0), and preferably lower than –1 food (these tides usually occur from May to August). Ideally, the lowest possible daytime tide should be uses, with the inventory scheduled to span 1.5 hours prior to and 1.5 hours following the low tide.

The number of inventory days necessary to complete data collection on target shorelines will be affected by the length of target shoreline, the complexity of access and type of shoreline (i.e., easily accessible contiguous shoreline versus difficult terrain such as rocky headlands), and the number of staff/volunteers available. This will be addressed on a case-by-case basis. In good conditions, you can expect an experienced volunteer to complete data for one section every half hour. Thus, a one-day, one-mile survey would require an absolute minimum of six volunteers (six sections each for a total of 36) supervised by two staff.

Training schedule (if necessary): Staffing Scenario #3 includes a three-session training series that must be completed prior to the inventory dates. It should be made quite clear to volunteers as they pre-register that none of the training sessions are optional. Volunteers should also know that graduates will be asked to participate in a minimum of one data gathering sessions, or perhaps more depending on the size of the project.

The training schedule is designed to ensure that volunteers have adequate time to absorb the information presented, yet to immediately and intensively apply their knowledge in implementing RSI data collection. This process helps volunteers to quickly become familiar with and proficient in the RSI data collection process, and to internalize this knowledge so that they may draw on it for future RSI inventories. The training series is comprised of two, three-hour classroom sessions, one week apart, followed by a three-hour field training session. The field training session occurs as soon as possible after the second classroom session and must occur at no higher than a zero-foot tide. The first inventory day occurs one week following the field training session. A sample schedule would be:

- First classroom session — June 7 (Wednesday)
- Second classroom session — June 14 (Wednesday)
- Field training session — June 16 (Saturday)
- First Inventory day — June 23 (Saturday)
- Second Inventory day — June 24 (Sunday)

Training/setup

Local partner involvement/volunteer recruitment: Staffing Scenario #3 may involve collaboration with local citizen groups or governments to recruit and manage citizen volunteers. Local partners may be responsible for:

- Recruiting local citizen volunteers, paying special attention to the need for volunteers to commit to both the training regime and the inventory process.
- Arranging for training location and logistics (audio visual equipment, refreshments, etc.).
- Acting as primary point of contact for volunteers regarding training/inventory schedules and locations.
- Assisting with quality control of data during inventory days.

People For Puget Sound may also recruit and manage citizen volunteers for RSI. In this case, and in the case of drawing from the pool of trained RSI volunteers, People For Puget Sound will assume responsibility for communication and organization of those volunteers.

Creation of forms/gathering supplies: Once the target shoreline and staffing scenario, data forms should be created and inventory supplies gathered. Staff should create a master form for each inventory day by filling in the beach name, county, date and extreme low tide/time for that date. In most cases, resource managers will want all of the data represented on the form, but in some cases a sub-set of the data may be desired. In this case, simply cross out the "parts" of the form that are not wanted before duplicating the form.

Training implementation: All volunteers participating in RSI must complete a three-session training series, conducted by People For Puget Sound staff (and/or other qualified staff) and guest presenters. It is important that parts of the training focus on topics of local interest, ecology unique to the region, and/or areas of interest to the resource manager. The first classroom session is broadly informational/educational, and useful even if volunteers decide not to commit to the subsequent training sessions. A set of standard training materials has been developed, to be augmented with materials specific to local interest and/or interest to the resource manager (see Attachment D for list of standard training materials). The training format is as follows:

1. First classroom session:
    - Program description. Includes RSI program background, description of RSI inventory process and inventory days, and discussion of the commitment necessary to be an RSI volunteer.
    - Presentation on the Puget Sound ecosystem and threats to nearshore and estuary habitat.
    - Basics of Puget Sound shoreline ecology, including the vocabulary necessary to conduct the inventory.
    - Presentation on special interest topic. Varies based on local interest/resource issues. Examples include slide presentations on common alga/invertebrates or hands-on examination of samples of invasive plant species.

2. Second classroom session:
    - Thorough, interactive part-by-part examination of the data form, including areas of possible confusion, allowable and unallowable data choices, and what-if scenarios. Volunteers are encouraged to voice any and all questions and concerns, and to participate in extensive discussion of these issues. Measurement techniques and tools are demonstrated.
    - Logistics of field training session.

The field training session provides volunteers the opportunity to practice RSI data collection in a leisurely way (unlike the actual inventory days). This session should be conducted on the target shoreline area, and scheduled with the same considerations as actual inventory days (spanning 1.5 hours prior to and 1.5 hours following the lowest possible tide). Should the data collected during the field training session prove to be accurate and complete, it will processed as valid data collected for that target shoreline area; People for Puget Sound staff will make this determination immediately following the field training session.

3. Field training session:
    - Brief review of the data form.
    - Demonstration of measurement techniques and determination of necessary shoreline distinctions (i.e., break between backshore and intertidal zones, how to estimate bank/bluff height).
    - Group data collection of one 150-foot section.
    - Individual data collection of at least one 150-foot section per volunteer, including Q/A.

Once volunteers have completed the training series, they are considered 'certified' and qualified to implement RSI inventories on Puget Sound shorelines. To maintain certified status, volunteers must complete at least one of the following options:

- Completion of annual three-hour refresher training session (preferably the field session), or,
- Completion of at least two RSI inventory days per calendar year.

Shoreline setup: On the day preceding the inventory day (or the morning of the inventory day, if scheduling permits), staff set up the target shoreline for inventory implementation. The setup process includes:

- Section delineation: The target shoreline is measured in 150-foot sections, each marked with red flags for the starting and ending points. The mid-point of each section is marked with a yellow flag bearing a unique (for that inventory) section number.
- GPS readings: As the shoreline is divided into sections, GPS readings are taken of each mid-point. In addition, GPS coordinates are taken of stationary shoreline characteristics, such as trails/access points, outfalls, and structures including bulkheads, seawalls, docks, piers, and boat launches. To ensure maximum accuracy of GPS readings, a GPS unit with a margin of error no greater than three meters is required. People For Puget Sound uses a Trimble GeoExplorer III with the PDOP mask set to six. See Appendix E for GPS/GIS standards and practices.

Safety procedures: People For Puget Sound has developed a set of safety guidelines designed to avoid potentially hazardous situations and to be able to react to any accidents or injuries that may occur.

- At least two first aid kits will be on the beach at all times, one with the field marshal and one at the deployment point. When possible, additional first aid kits should be carried by all staff.
- Directions/maps to the nearest hospital, and driving directions to guide emergency personnel to the site will be carried by all staff. See Appendix F for the standard Emergency Plan form.
- At least two cell phones will be on the beach at all times, preferably by staff at opposite ends of the day's targeted survey. All staff and volunteers are encouraged to carry additional cell phones if possible. In addition, each staff member should carry a two-mile-range or better two-way radio.
- At least two staff will be certified in basic first aid/first responder.
- Everyone participating in RSI inventories are instructed to bring the following items onto the beach in a day pack:
  - Plenty of water
  - Snacks/lunch
  - Sunscreen
  - Hat
  - Sunglasses
  - Appropriate footwear for navigating slippery, wet, and muddy terrain

Implementation

Assign roles. On inventory day, staff/volunteers gather on the target shoreline and each are assigned roles:

- *Field marshal:* Depending on the length and configuration of shoreline, one or two staff are assigned as field marshals. The field marshals are responsible for:

  - Assignment of shoreline sections to data collectors and quality control staff. Each quality control staff is assigned a contiguous set of sections and a group of volunteers, no less than three and no more than five. Since good data takes about half an hour to collect, this initial assignment should include no more than six sections per volunteer. These assignments should be completed at least half an hour prior to the opening of the three-hour data window, so as to give volunteers and staff time to walk or shuttle to remote beach sections.
  - Tracking of data collection to ensure that all assigned sections are covered, and to assign additional sections if data gathering is going quickly or if some groups need assistance with their initial assignment.
  - Ensuring that each data form has received a quality control check. Staff should gather after the day's data is collection to complete Q/C on forms they missed.
  - Carrying a first aid kit, two-way radio, cell phone, and extra food and water.

The field marshal can perform quality control, but should be positioned in the middle of the survey so as to have maximum radio contact with other staff.

- *Quality control staff:* People For Puget Sound staff and/or staff from local partner organizations are assigned as quality control staff. Most staff can be expected to easily supervise three volunteers, and many will be able to supervise five — though staff should be warned that this requires quickly walking back and forth across 750 feet of beach continually for three straight hours. Quality control staff are responsible for:
  - Carefully reviewing each data form for the data collectors assigned to them by the field marshal. Quality control staff will complete this process by actually looking at the shoreline section with the volunteer present in that section to answer questions, clarify handwriting, and/or complete missing parts.

- *A quality control check includes:*
  - Ensuring that the data form is complete with no areas left blank.
  - Ensuring that only allowable entries are listed for each data question.
  - Identifying and clarifying any areas of discrepancy or questionable data.
  - Initialing each data form as a signal to the field marshal that the form has received a quality control check
  - Answering questions and clarifying any areas of confusion for data collectors.
  - Carrying a first aid kit and radio.

The two quality control staff assigned to each end of the day's survey assume the "sweep" positions, by physically maintaining a position at the end of the line of data collectors as they are spread out along the shoreline. As the sweep completes their assigned sections and moves toward the center of the survey, they will pick up section flags and make sure that no volunteers are left behind.

- *Data collectors:* The majority of staff/volunteers participating in an RSI inventory are data collectors. Data collectors are responsible for:

  - Completing data collection for their assigned sections.
  - Clarifying with staff any areas of uncertainty or confusion regarding their assigned sections.
  - Assisting neighbor data collectors with measurements or species identification, if necessary.
  - Ensuring that each of their data forms receives a quality control check while they are standing in that section.

<u>Distribute supplies and give instructions.</u> On inventory day, staff will distribute a set of materials to each data collector:

- Clipboard
- Data forms (enough for assigned number of segments, plus two extras)
- Pencils (minimum of two)
- One-hundred foot measuring tape
- Metal stake for use in taking measurements (to secure the end of the tape)

Quality control staff and field marshals will carry extra supplies during the inventory as space allows. Supplies will be returned to staff upon completion of the inventory day.

For each inventory day, there are several determinations that need to be made by staff and communicated to volunteers:

- Identification of break between backshore and intertidal zone. This distinction can be complicated by the presence of summer/winter berms or recently washed up algae/wrack lines. To minimize confusion and/or variability in data collected, staff will make a determination of how best to distinguish the break for the survey area, and ensure during the quality control process that the proper zone division between the backshore and intertidal area is used.
- Decisions regarding width measurements for intertidal/backshore zones. On occasion, the intertidal or backshore zone will be very wide. When these zones exceed 200 feet in width, data collectors will be instructed to indicate the width as "200+" on their data forms. This reduces the amount of time that data collectors must spend in walking the entire width of these zones, while still providing the valuable information that indicates that these zones are quite wide.

Some useful reminders to data collectors include:

- Take measurements from the mid-point of the section.
- Do not take the intertidal measurement or the lower intertidal data if soft mud prevents easy walking. However, DO carefully test the mud for each section to see if the lower intertidal is accessible.
- Take biological data by walking a transect at the mid-point of the section (observing a five-foot swath), NOT by walking all over the section. This instruction limits the amount of time that data collectors spend on what could be a very time consuming part of the inventory.
- To be sure that width measurements are taken from the break between the intertidal and backshore zones, NOT the placement of the mid-point flag. Flags are not necessarily placed at the backshore/intertidal break, and often are placed well above the break.
- To move with alacrity while not rushing data collection. It is important that all participating in RSI inventories understand the constraints of the low-tide timeframe and the need to take as much as advantage as possible of the time we are on the beach.

Complete inventory. Each inventory day includes an hour for orientation and deployment, and no more than three hours to complete data forms. This ensures that a maximum amount of data can be collected, while not risking data quality problems that could occur with tired data collectors or tides that are less than optimal. However, the amount of time spent collecting data may be adjusted due to the low tide window of availability or the complexity of the target shoreline. Only two hours of data should be collected on a zero tide, while four hours are allowed on tides that are –3.0 or better. If the target shoreline is complex, such as those with many shoreline structures or a great diversity of biology, data collection may take longer per section than it would on a

more basic area of shoreline. This may cause the low tide window to close prior to completion of all shoreline sections. In this case, staff should halt data collection prior to completion of the target shoreline rather than extend the data collection past the low tide window.

If the window is short or volunteers few, the volunteers can be instructed to collect the intertidal data for a series of section sections PRIOR to collecting any backshore/upland data. This will mean that volunteers must visit each of their sections twice. Staff will need to take a good look at the lower intertidal before the window closes so they can accurately assess the quality of the data (a good idea for either scenario).

It is not recommended that inventories take place during inclement weather (steady rain or thundershowers). The attention paid to data quality will suffer if data collectors are trying to complete inventories while battling the elements.

Perform quality control check. People For Puget Sound and/or partner staff will perform quality control checks on all data forms. As each data collector completes each data form, they will whistle or waive to the quality control staff that has been assigned to them and present their data form for review. While standing in the section of shoreline represented by the data form with the volunteer, staff will review the form to:

- Ensure that the data form is complete with no areas left blank.
- Ensure that only allowable entries are listed for each data question.
- Identify and resolve any areas of discrepancy or questionable data.

When the review is complete and any discrepancies corrected, the quality control staff will initial the data form, attach it to his/her own clipboard, and assign a new section to the volunteer.

Data processing, analysis and presentation

All data gathered using this protocol is public and easily available. At a minimum, any agencies, businesses, or organizations who use this protocol must agree in writing to follow the training and Q/C procedures, to process and analyze the data in a timely fashion, to make the data available to the public, and to deliver the data to People For Puget Sound.

Data entry. Once the inventory has been completed, People For Puget Sound will take possession of the data forms for entry into the RSI database (unless other arrangements for data entry have already been made). The RSI database uses Microsoft Access as the base software to ensure optimal compatibility with ArcView and ArcInfo GIS software. People For Puget Sound staff and/or volunteers enter all data into the RSI database.

Perform quality control. Volunteers should be instructed to review each form against its computer record to ensure that the record accurately reflects the information collected on the data form. Staff review data entry for each volunteer's first five forms, and then for every 20th form.

Analyze/present data. Data is transferred into People For Puget Sound's GIS system for analysis and presentation. The type of analysis and reporting will vary based on the needs of the resource manager involved in a particular inventory. At a minimum, People For Puget Sound will generate maps presenting the following data sets:

- Eelgrass coverage
- Algae coverage
- Invasive species presence/absence
- Shoreline structure presence/absence
- Outfall presence/absence
- Potential surf smelt and/or sand lance spawning areas

These maps will be provided to the resource manager and presented on People For Puget Sound's web site (www.pugetsound.org). People For Puget Sound will also provide a CD-ROM with the full data set to the resource manager. Others can receive a full data set on CD-ROM for a processing fee of $50.

In addition, People For Puget Sound will provide a summary report of findings and recommendations based on the original data goals. This will provide resource managers a baseline from which to utilize the RSI data in active management of their shorelines.

This page is intentionally blank.

Appendix D,

Rapid Shoreline Inventory Data Form

This page is intentionally blank

BEACH name:

COUNTY:

Rapid Shoreline Inventory™

6-29-2001 • People For Puget Sound • www.pugetsound.org

Form CHECKED BY:

Month __ __	Day __ __	Year __ __		
Tide LEVEL _____ ft	Tide TIME __ __ : __ __	❑ AM ❑ PM		
STEWARD name:				

SECTION number:	
START time for this section:	__ __ : __ __ ❑ AM ❑ PM
END time for this section:	__ __ : __ __ ❑ AM ❑ PM

1. Intertidal Zone

AT MID POINT

Dominant substrate in the UPPER intertidal. • Measure 30 feet DOWN the beach from the intertidal/backshore break, turn around. Look. • Check one.	❑ Mud/Silt ❑ Mixed fine ❑ Sand ❑ Mixed coarse ❑ Gravel ❑ Cobble ❑ Rock/boulder ❑ Shells ❑ Hardpan
WIDTH of intertidal.	_____ feet
TIME of measurement.	❑ am ❑ pm __ __ : __ __
Dominant substrate in the LOWER intertidal. • Measure 30 feet UP the beach from the water line, turn around. Look. • Check one.	❑ Mud/Silt ❑ Mixed fine ❑ Sand ❑ Mixed coarse ❑ Gravel ❑ Cobble ❑ Rock/boulder ❑ Shells ❑ Hardpan ❑ Not accessible

ENTIRE SECTION

Are SAND and/or MIXED FINES dominant anywhere along the water line? • Check one.	❑ Not dominant ❑ Patchy ❑ Continuous ❑ Not accessible
EELGRASS coverage. • Check one.	❑ None ❑ Patchy ❑ Continuous ❑ Not accessible
Eelgrass SPECIES. • **Check all that apply.**	◯ None ◯ Marina ◯ Japonica ◯ Unknown ◯ Not accessible
Is KELP floating offshore? • Check one.	❑ Yes ❑ No ❑ Not accessible
ALGAE coverage. • Check one.	❑ None ❑ Patchy ❑ Continuous
Are SAND and/or PEA GRAVEL dominant anywhere just below the top of the intertidal? • Check one.	(Maximum size of pea gravel) → ◯ ❑ Not dominant ❑ Patchy ❑ Continuous
Vegetation OVERHANGING the intertidal zone. • Check one.	❑ None ❑ Patchy ❑ Continuous
Are any of these features present? • Check yes or no for each.	Spit ❑ Yes ❑ No; Bar ❑ Yes ❑ No; Tombolo ❑ Yes ❑ No; Marsh ❑ Yes ❑ No

2. Backshore Zone

If this section does not have a backshore at the mid point, please write "n/a" for the "width of the backshore zone" and move on to Part 3.

AT MID POINT

WIDTH of the backshore zone.	_____ feet
Dominant substrate in the BACKSHORE. • Along the mid-point transect. • Check one.	❑ Mud/Silt ❑ Mixed fine ❑ Sand ❑ Mixed coarse ❑ Gravel ❑ Cobble ❑ Rock/boulder ❑ Shells ❑ Hardpan

ENTIRE SECTION

Dominant ATTACHED vegetation. • Check one.	❑ None ❑ Grasses/herbs ❑ Shrubs ❑ Trees
Vegetation COVERAGE. • Check one.	❑ None ❑ Patchy ❑ Continuous
Vegetation OVER-HANGING the backshore. • Check one.	❑ None ❑ Patchy ❑ Continuous
Are any of these features present? • Check yes or no for each.	Marsh ❑ Yes ❑ No; Dunes ❑ Yes ❑ No; Driftwood ❑ Yes ❑ No

3. Bluff / Bank

If there is no bluff or bank in this section, please check "no" for "Bluff or bank present" and move on to Part 4.

ENTIRE SECTION

Is BLUFF or BANK present? • Check one.	❑ Yes ❑ No
Maximum HEIGHT of bluff or bank. In section.	_____ feet
Vegetation ON the bluff or bank. • Check one.	❑ None ❑ Patchy ❑ Continuous
Unvegetated SCARS. • Check one.	❑ None ❑ Patchy ❑ Continuous
Bottom of bluff UNDERCUT. • Check one.	❑ None ❑ Patchy ❑ Continuous

4. Invasive Species

ENTIRE SECTION

Are INVASIVE species present? • Check yes or no for each.

European green crab	❑ Yes	❑ No
Sargassum	❑ Yes	❑ No
Spartina	❑ Yes	❑ No
English ivy	❑ Yes	❑ No
Hedge bindweed	❑ Yes	❑ No
Himalayan blackberry	❑ Yes	❑ No
Japanese knotweed	❑ Yes	❑ No
Purple loosestrife	❑ Yes	❑ No
Scot's broom	❑ Yes	❑ No

5. Adjacent Land Use - entire section

Are there TRAILS or paths leading to this section? • Check one.

❑ Number _____
❑ None

DOMINANT ADJACENT land use? • Please indicate the ONE dominant type of land use you observe that is immediately adjacent to the backshore or the beach. • Check one.

❑ Not visible
❑ Industrial structure
❑ Commercial structure
❑ Residential structure
❑ Paved road, path or lot
❑ Unpaved road, path or lot
❑ Railroad
❑ Pasture
❑ Crops
❑ Lawn
❑ Golf course
❑ Undeveloped/natural

6. Streams, Outfalls, and other Discharges — entire section

❑ Number _____
❑ None

Number of OUTFALLS. • Check one. • If there are no outfalls in this section, please check "none" and move on to Part 7.
Please provide details for UP TO THREE of the MOST ACTIVE outfalls:

	Outfall 1	Outfall 2	Outfall 3
• Check one.	❑ Creek ❑ Seep ❑ Ditch ❑ River ❑ Pipe	❑ Creek ❑ Seep ❑ Ditch ❑ River ❑ Pipe	❑ Creek ❑ Seep ❑ Ditch ❑ River ❑ Pipe
Outfall diameter	_____ inches	_____ inches	_____ inches
Check yes or no for each:			
Flow	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Discoloration of water	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Associated odor	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Erosion	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Dead animals	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Darkened sediment	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Algae growth	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Debris/trash	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No
Oil slicks/sheens	❑ Yes ❑ No	❑ Yes ❑ No	❑ Yes ❑ No

7. Shoreline Structures — entire section

❑ Number _____
❑ None

Number of STRUCTURES. • Check one.
• If there are no structures, check "none" and move on to Part 8.
Please provide details for UP TO FOUR of the LARGEST structures:

	Structure 1	Structure 2	Structure 3	Structure 4
• Check one.	❑ Pier/dock ❑ Bulkhead/seawall ❑ Jetty/groin ❑ Dike/levee ❑ Launch/ramp ❑ Other:_____	❑ Pier/dock ❑ Bulkhead/seawall ❑ Jetty/groin ❑ Dike/levee ❑ Launch/ramp ❑ Other:_____	❑ Pier/dock ❑ Bulkhead/seawall ❑ Jetty/groin ❑ Dike/levee ❑ Launch/ramp ❑ Other:_____	❑ Pier/dock ❑ Bulkhead/seawall ❑ Jetty/groin ❑ Dike/levee ❑ Launch/ramp ❑ Other:_____
Made from:	_____	_____	_____	_____
Height:	_____ feet	_____ feet	_____ feet	_____ feet
Width:	_____ feet	_____ feet	_____ feet	_____ feet
Length:	_____ feet	_____ feet	_____ feet	_____ feet
CONDITION. • Check one.	❑ Poor ❑ Good ❑ Excellent	❑ Poor ❑ Good ❑ Excellent	❑ Poor ❑ Good ❑ Excellent	❑ Poor ❑ Good ❑ Excellent

8. Wildlife Identification — along the mid point transect

SPECIES • Common names okay	COUNT • Check one: 1	2-5	>5	LOCATION • In the water, on the water, intertidal, backshore, upland, in flight, etc.
1	❑	❑	❑	
2	❑	❑	❑	
3	❑	❑	❑	
4	❑	❑	❑	
5	❑	❑	❑	
6	❑	❑	❑	
7	❑	❑	❑	
8	❑	❑	❑	
9	❑	❑	❑	
10	❑	❑	❑	

9. Vegetation Identification — along the mid point transect

BACKSHORE/UPLAND species • Common names okay	INTERTIDAL species • Common names okay
1	1
2	2
3	3
4	4
5	5
6	6