Strategic Salmon Recovery Planning in the San Juan Islands:

Nearshore Marine Habitat Restoration and Protection Project Prioritization.

PIAT II

October 2017

For the San Juan County Lead Entity for Salmon Recovery

By Friends of the San Juans

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Introduction

This project applied results from the county-wide shoreform and landscape scale strategic salmon planning effort completed in 2012 (Whitman et al. 2012 aka PIAT I) and identifies priority restoration and protection actions at the project and/or parcel scale, with the goal of improving both the efficiency and effectiveness of local salmon recovery efforts in WRIA 2 , the San Juan Islands, and support a more strategic approach to the identification, development and implementation of nearshore marine habitat projects. The project team included staff from SJC Salmon Recovery, Friends of the San Juans, Coastal Geologic Services and Confluence Environmental. Broad priorities for the work were informed by the San Juan County salmon recovery technical advisory group members as well as representatives from the Northwest Straits Foundation, Samish Tribe Natural Resources Department, the San Juan County Land Bank, Kwiaht and the San Juan Preservation Trust.

Background

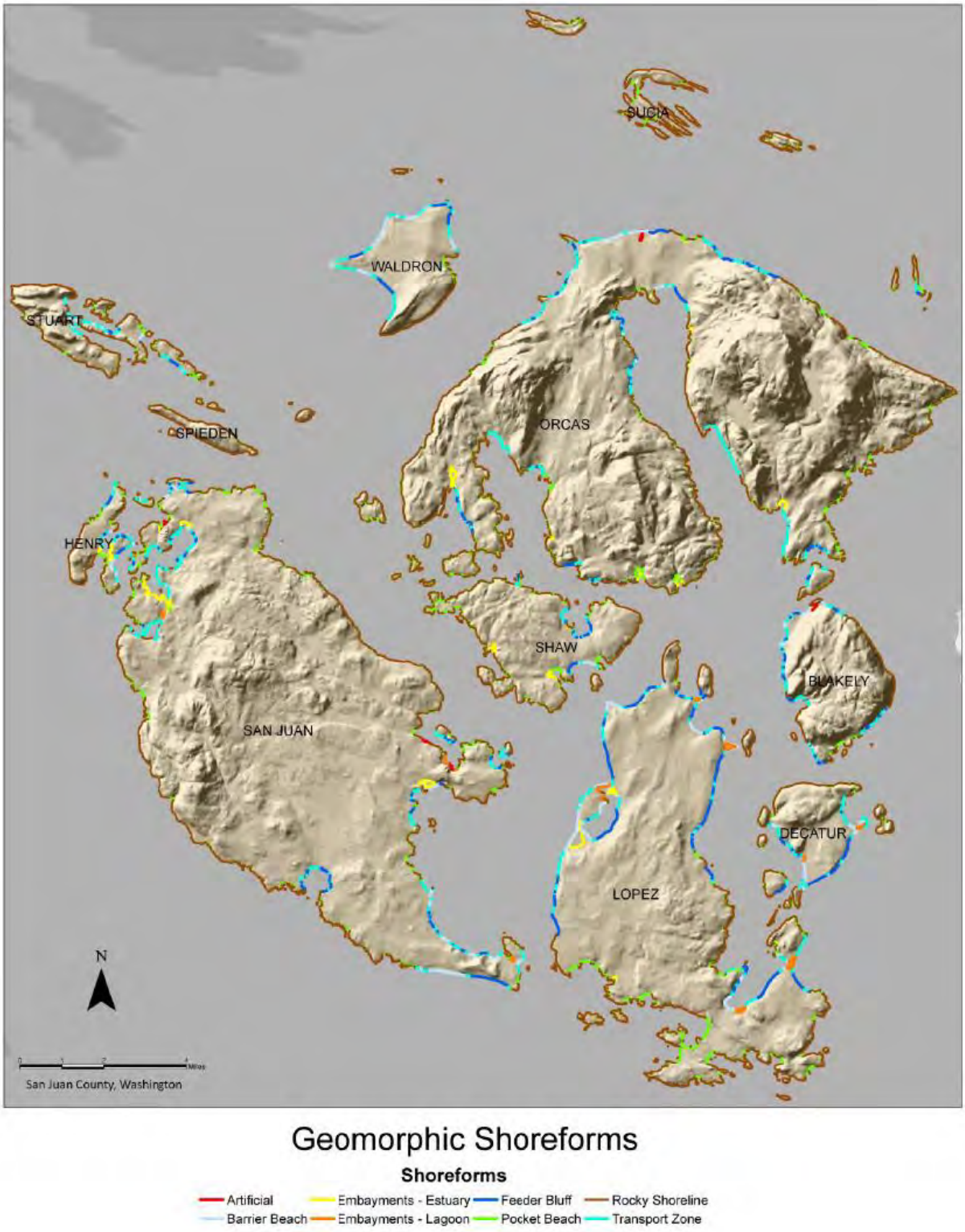
The project prioritization project applied a GIS based approach using existing spatially explicit data and best understanding of the relationships between coastal processes, habitats and stressors and their role in supporting ecological attributes key to the success of out-migrating juvenile salmon utilizing the nearshore marine environment of the San Juans for rearing, feeding and out-migrating. Prioritized project actions for both restoration and protection are included. Results will help protection and restoration entities identify strategic projects and will also inform the annual project ranking process.

Geographic Scope: The scope of the project included the marine shorelines of San Juan County, which are extensive, with over 400 linear miles, and diverse, including all geomorphic shoreform types found in the inland waters of Puget Sound except large river deltas (See Figure 1.). 5,003 waterfront tax parcels were included in the prioritization.

Table 1. Geomorphic Shoreforms of San Juan County.

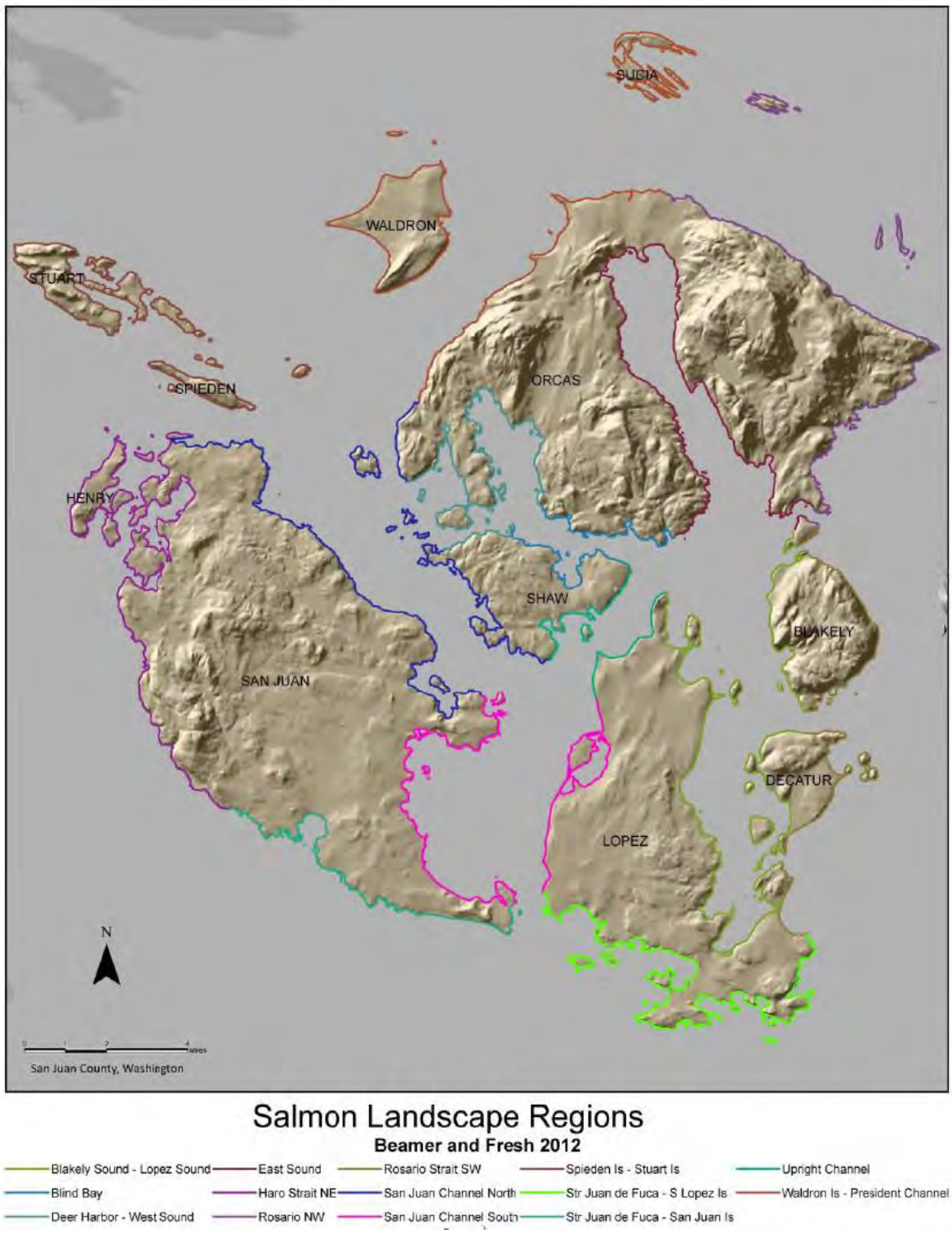
Shoreform	Count	% SJC Count	Length in Miles	% SJC Shore
Artificial	11	<1%	2.6	<1%
Barrier Beach	185	5%	25	6%
Transport Zone	404	13%	34	8%
Feeder Bluff	432	13%	30	7%
Embayment-estuary	38	1%	12	3%
Embayment-lagoon	16	<1%	5	1%
Pocket Beach	945	29%	48	12%
Rocky Shores	1,185	37%	250	61%
sum	3,216	100%	408 miles	100%

Figure 1. Geomorphic Shoreforms of San Juan County



Landscape regions utilized in the fish use geographic prioritization, and also in summary descriptions for restoration and protection prioritizations were adopted from the regions applied to the nearshore fish utilization study of the San Juans (Beamer and Fresh 2012) and also applied in PIAT I. See Figure 2.

Figure 2. Landscape Regions of San Juan County



Multiple meetings were held with the project's technical team, to review the shoreform and landscape scale salmon recovery planning work completed in 2012, set goals and objectives for the project scale prioritization, refine the scope and focus of the effort, and provide feedback on the relative importance of a wide range of potential factors for scoring consideration. The smaller project team of Friends of the San Juans, Coastal Geologic Services, SJC Salmon Recovery and Confluence Environmental considered technical team guidance and feedback in the development of the final prioritization framework.

The basic approach organized the prioritization effort into two primary categories- restoration actions and protection actions. Restoration project identification focused on known stressors to marine nearshore habitat process, structure and function identified as important in the PIAT I process completed in 2012, including shoreline armoring, coastal roads, tidal barriers, docks and groins. Due to the low likelihood of voluntary full removal of even a very limited number of docks, and the limited time and resources for this effort, docks were not included in the final restoration project scoring, although information on location, overwater structure area, material, and condition are available and could be analyzed in the future, should local priorities change.

The Pulling It All Together (PIAT I) salmon recovery strategic planning project adopted key ecological attributes and indicators for estuarine and marine habitats from work completed by the Puget Sound Chinook Salmon Regional Implementation Technical Team (RITT). Spatial data on shoreforms and stressors as well as conceptual and analytical frameworks from the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) were also adapted and applied. Primary hypotheses of the San Juan County and nearshore marine chapters of the Puget Sound Chinook salmon recovery plan were adopted as top priorities for this strategic planning process, including prioritization of out-migrating juvenile Chinook and forage fish. Foundational relationships between process, structure and function for juvenile salmon and previous assessment work from PIAT I process were applied to PIAT II, with some refinements, primarily to the fish use geographic prioritization.

Pacific Herring: While the importance of herring in the diets of juvenile salmon in the San Juans is known, technical understanding of the factors impacting the success of local herring populations and the steps that might be undertaken to protect and restore herring are limited. As a result, specific potential project actions in Pacific herring spawning grounds are addressed in a separate section of this document and the actions include research as well as potential restoration and protection actions. In addition, herring spawning grounds were added to the update of the fish use geographic prioritization of regions and shoreforms from the 2012 process; fish use priorities are key to both the restoration and protection prioritization frameworks and scoring.

Public Sites: Significant restoration actions exist at publicly managed infrastructure located in the county's marine shorelines, primarily associated with roads, including tidal barriers, armoring and groins. Public properties with priority restoration actions are also owned by local, state and federal entities including: San Juan County Public Works, San Juan County Parks and the San Juan County Land Bank, Washington State Parks, The U.S. Park Service and the U.S. Bureau of Land Management/National Monument. In the Appendices for each restoration project type: armor,

backshore roads, tidal barriers and groins, information on priority sites is organized by public, followed by private restoration actions. Protection priorities are provided for private waterfront parcels only, as the primary focus of protection actions for the purposes of this strategic planning process are permanent protection through a conservation easement or acquisition.

Project Prioritization Framework

Fish Use Geographic Prioritization: An early step in the project prioritization process was a review and refinement of the 'fish use' geographic prioritization completed in the 2012 PIAT I planning process at both the landscape region and shoreform scales. The 2012 approach applied three equally weighted factors including: rearing juvenile wild chinook presence probability; rearing forage fish presence probability (combined results for herring, surf smelt and sand lance); and beach spawning forage fish (surf smelt and sand lance). This approach did a good job capturing primary out-migrating regions and shoreforms important for rearing chinook and forage fish but was less successful at picking up priority forage fish spawning areas and underrepresented the significance of herring to chinook recovery by leaving herring spawning grounds out of the metrics. To better capture the individual forage fish species, and provide balance between chinook and forage fish factors, the fish use geographic prioritization was updated to address each forage fish species separately, linked with chinook and included:

- Rearing chinook, spawning sand lance and rearing sand lance;
- Rearing chinook, spawning herring and rearing herring; and
- Rearing chinook, spawning surf smelt and rearing surf smelt.

This modified approach resulted in the same four landscape regions as top priority for salmon recovery actions in the San Juans: Waldron/President's channel; Haro Strait NE; Rosario Strait SW; Strait of Juan de Fuca/S. Lopez. The four high landscape regions from the 2012 approach remained high in the revised approach: Eastsound, Rosario Strait NW, San Juan Channel N, Spieden/Stuart, Strait of Juan de Fuca/San Juan, and the regions of West Sound, San Juan Channel South and Blakely Sound/Lopez Sound moved from moderate ranking to high. Blind Bay and Upright Head regions remained moderate priority. In the 2012 fish use prioritization, a total of 8 miles were ranked as highest fish use shoreforms and 59 miles were ranked as high. In the refined approach, the length of highest priority shoreforms increased to 9.5 miles and the length ranked as high priority fish use shoreforms increased to 67 miles.

Priority fish use regions and shoreforms were then applied as a key ranking component to both the restoration and protection prioritization frameworks, ensuring that salmon recovery actions occur in those places most important for targeted species and life stages for project work.

Table 2. Priority fish use regions and shoreforms.

Highest Priority Fish Use Regions		
Waldron/President's channel; Haro Strait NE; Rosario Strait SW; Strait of Juan de Fuca/S. Lopez		
High Priority Fish Use Regions		
Eastsound, Rosario Strait NW, San Juan Channel N, Spieden/Stuart, Strait of Juan de Fuca/San Juan PLUS West Sound, San Juan Channel South, Blakely Sound/Lopez Sound.		
Moderate Priority Fish Use Regions		
Blind Bay, Upright Head		
Highest Priority Fish Use Shoreforms		
Shoreform	*Count*	*Length*
Pocket beach	112	8 miles
Feeder bluff	1	0.5 miles
Transport zone	3	0.76 miles
Barrier beach	1	0.21 miles
Embayment	0	-
Rocky	2	0.01 miles
Totals:	119	9.5 miles
High Priority Fish Use Shoreforms		
Shoreform	*Count*	*Length*
Pocket beach	601	30.2 miles
Feeder bluff	106	9.6 miles
Transport zone	121	14.6 miles
Barrier beach	54	8.5 miles
Embayment	2	.85 miles
Rocky	25	3.4 miles
Totals:	909	67 miles

Figure 3. Priority Fish Use Regions in San Juan County

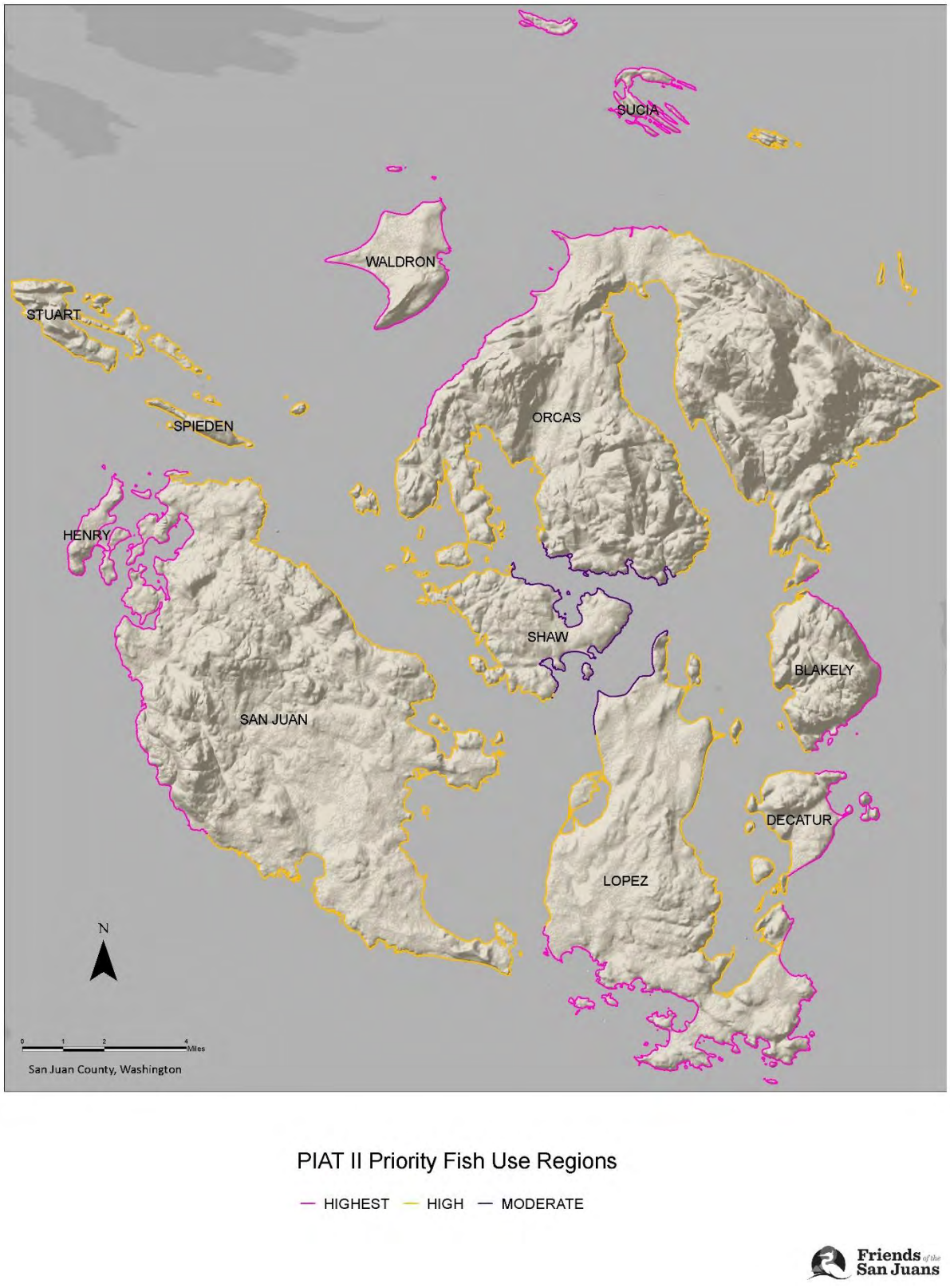
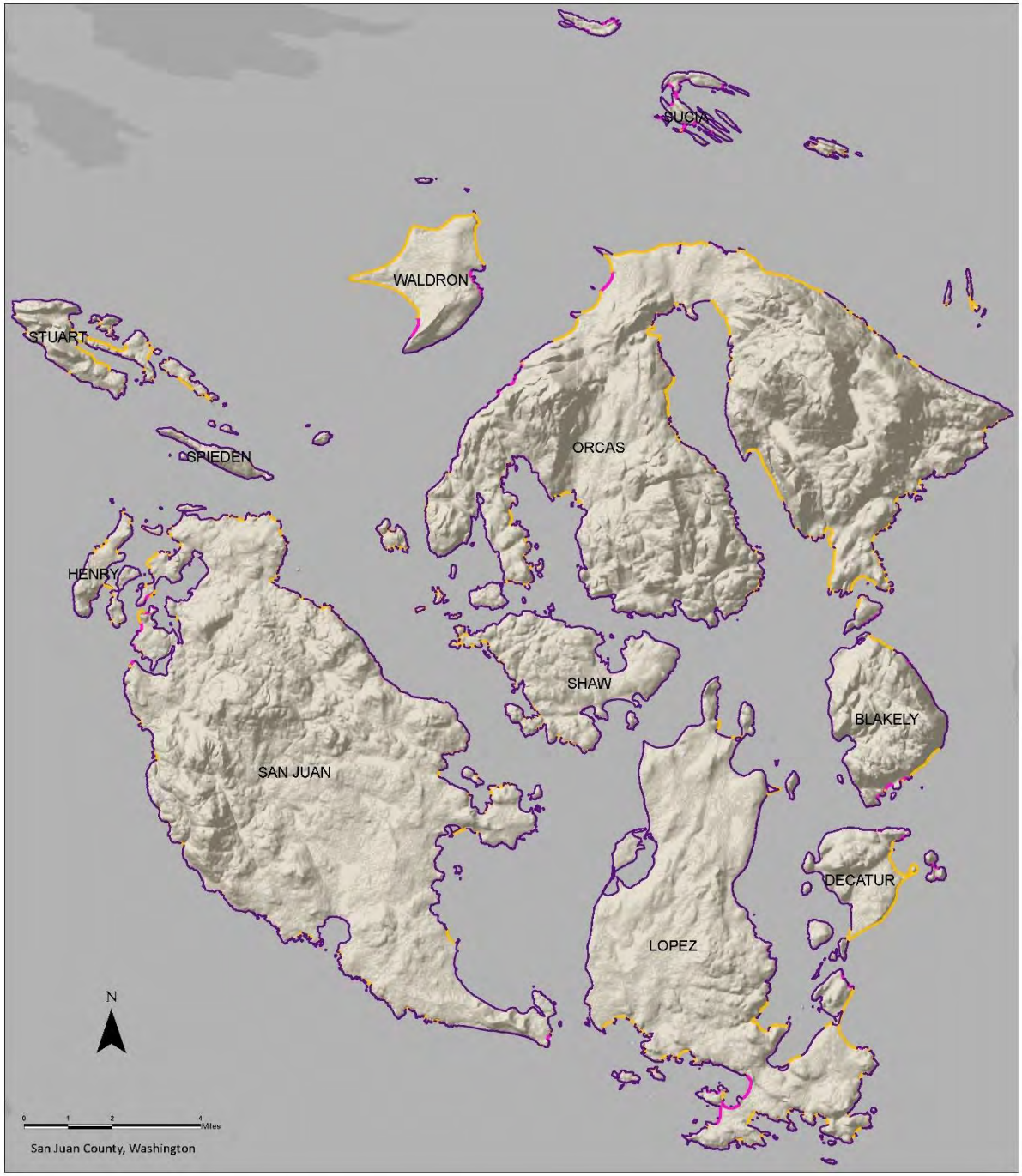


Figure 4. Priority Fish Use Shoreforms in San Juan County



RESTORATION RANKING

Shoreline Armoring

The armor dataset utilized is based on the 2009 Countywide Inventory of Shoreline Modifications completed by Friends (FSJ 2010) and linked to shoreforms in the Pulling It All Together (PIAT I) strategic salmon planning project (Whitman et al 2012). The armor data includes 925 records of shoreline armor, segmented by tax parcel and geomorphic shoreform.

The 925 records of shoreline armor were prescreened to remove armor that would likely be infeasible to remove from the ranking framework. Criteria used to determine that removal would be infeasible included: all armor with structures set back less than 25 feet from the shoreline as well as all armor with structures set back between 25 and 50 feet and located at sites with fetch greater than 5 miles. This prescreening culled 235 armor records from the prioritization analysis, leaving 690 armor records that were included in the restoration prioritization framework.

The ranking process for armor sites included two basic steps, an assessment of the fish use geographic priorities at both the shoreform and landscape region scales, to ensure priority armor removal projects were located in the most important places for salmon recovery, as well as a secondary scoring process for each armor record that included multiple shoreform and structure specific factors. Ranking metrics included: armor length, armor toe elevation, sediment supply significance, proximity to forage fish spawning beaches, sea level rise resiliency and process degradation. Site scale factors (length, tidal elevation, sediment supply significance and proximity to forage fish spawning beaches) received more weight in the ranking than the shoreform scale factors (process degradation and sea level rise resiliency). Additional factors that were documented for each armor record but not scored (independent of other variables) included landscape region, shoreform type, and ownership (public, private, mixed).

Characteristics of the 690 armor records included in the ranking process included:

Priority Fish Use Regions: 143 highest, 363 high, and 184 moderate.

Priority Fish Use Shoreforms: 29 highest, 182 high, and 479 moderate.

Armor Length: 55 greater than 300 feet, 28 200- 300 feet, 72 100-200 feet, 242 less than 100 feet located on a feeder bluff or pocket beach, 293 less than 100 feet, not on a bluff or pocket beach. Note: 78% of all armor included in this project prioritization is less than 100 linear feet in length.

Armor Toe Elevation: 574 armor records below mean higher high water (MHHW), 116 above MHHW

Coincidence with documented forage fish spawning beaches: 62 armor records at documented forage fish spawning beaches.

Sediment supply significance: 84 armor records at priority bluffs, 50 at bluffs, 192 at pocket beaches, 175 elsewhere in drift cell (barrier beaches, transport zones and embayments), 189 in places with no appreciable drift (rocky or artificial).

Process Degradation (from PIAT I): 266 armor records in shoreforms with low process degradation (below 13%), 244 in shoreforms with moderate process degradation (13-38%), 184 in shoreforms with high process degradation (>38%).

Sea Level Rise Resiliency: 86 armor records in shoreforms with high sea level rise resiliency, 55 armor records in shoreforms with moderate sea level rise resiliency and 549 armor records in shoreforms with low sea level rise resiliency. Sea level rise resiliency was defined at the shoreform scale using a combination of sediment supply and sea level rise vulnerability metrics.

Landscape Regions (from Beamer and Fresh 2012 and PIAT I, see Figure 1): 68 armor records in West Sound/Deer Harbor; 42 in Waldron/President's Channel; 16 in Upright Head, 25 in Spieden/Stuart, 96 in San Juan Channel South, 80 in San Juan Channel North, 14 in Rosario Strait SW, 30 in Rosario Strait NW, 4 in Juan de Fuca/San Juan, 44 in Juan de Fuca S. Lopez, 79 in Haro Strait NE, 53 in Eastsound, 33 in Blind Bay, 106 in Blakely Sound/Lopez Sound landscape region.

Shoreform Type: armor records occurred at 106 transport zones, 183 rocky, 192 pocket beaches, 134 feeder bluffs, 21 embayments, 48 barrier beaches and 6 artificial.

Ownership: armor records occurred at 633 private, 24 mixed public/private, 33 public or quasi-public (Tribal, conservation entity, etc.) waterfront tax parcels.

Restoration Ranking:

Top armor removal priorities were identified for one third of the 690 scored armor records, with 18% of armor sites ranked as Tier 1 restoration actions and 15% of sites as Tier 2 restoration actions.

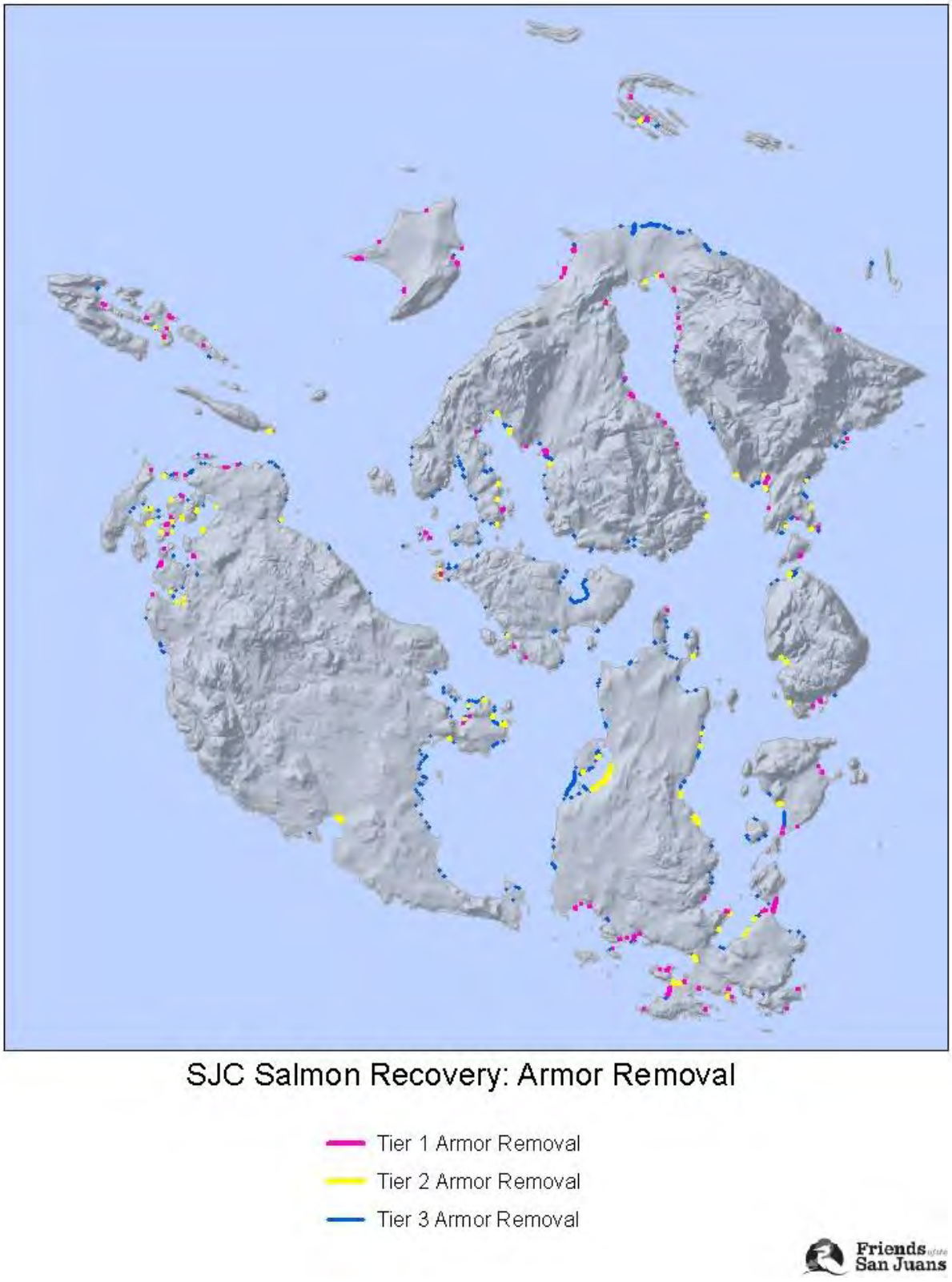
Prioritization Approach: Tier 1 armor removals included sites that were located at highest or high fish use regions *and* shoreforms (fish use combined score of 8 or greater) *and* also scored 16 or greater points in the armor ranking. A total of 123 armor records were identified as Tier 1 salmon recovery actions. No tier 1 armor removal sites were located in low fish use regions or shoreforms.

Tier 2 armor removals included those sites that scored 16 or greater in the armor ranking and were located at highest or high fish use regions *or* shoreforms (fish use combined scores of 5 to 7), as well as sites located at the highest or high fish use regions *and* shoreforms (fish use combined score of 8 or greater) but with armor scores below 16. A total of 104 armor records were identified as Tier 2 armor removals.

The remaining armor removal sites were classified as Tier 3 armor removal sites.

For details on restoration project scoring, please see the PIAT II project geodatabase README document.

Figure 5. Armor Removal Restoration Priorities for San Juan County



TIER 1 ARMOR RESULTS

Landscape and Shoreform Scale Factors

Landscape Regions: Tier 1 armor removal sites include project actions in the following landscape regions: Juan de Fuca/S. Lopez (25), Waldron/President's channel (21), Eastsound (17), Haro Strait NE (15), Rosario Strait SW (12), San Juan Channel North (10), Spieden/Stuart (9), and Blakely Sound/Lopez Sound (9).

Geomorphic Shoreforms: Tier 1 armor removal sites include pocket beaches (82), transport zones (21), feeder bluffs (11), barrier beaches (5), embayment estuaries (3), and rocky shorelines (1).

Fish Use: Seventy three percent (91) of Tier 1 armor removals are located in the highest fish use region, and seventeen percent (21) are located at the highest fish use region *and* highest fish use shoreform. The remainder of the Tier 1 armor removal sites are located in high fish use regions (53) and at high fish use shoreforms (102).

Process degradation: Thirty percent (37) of Tier 1 armor removals are located in shoreforms with low process degradation, fifty four percent (67) are located in shoreforms with moderate process degradation, and fifteen percent (19) are located in shoreforms with high process degradation. Note: process degradation levels were adopted from PIAT I (Whitman et al 2012) and include low (less than 13% shoreform length degraded), moderate (13% to 38% shoreform length degraded) and high (>38% shoreform length degraded).

Sea level rise resiliency: sea level rise resiliency was assessed based on intact sediment supply for drift cell systems and pocket beaches, as well as the location of structures (roads or houses) within projected future sea level rise inundation or erosion hazard zones. Twenty percent of tier 1 armor removal sites are located in shoreforms with high sea level rise resiliency, thirty percent are located in shoreforms with moderate sea level rise resiliency, and half are located in shoreforms with low sea level rise resiliency and represent an opportunity to increase resiliency by improving coastal sediment processes within the shoreform.

Site Specific Factors

Armor Elevation (structure toe): Eighty percent (99 of 124) of Tier 1 armor removals are located below MHHW.

Armor Length: Length distribution for Tier 1 armor removals includes 4 greater than 300 linear feet, 5 200-300 feet, 19 100 to 200 feet, 71 shorter than 100 feet and located at either a pocket beach or feeder bluff and 24 structures that are less than 100 feet located at a shoreform other than a pocket beach or a bluff.

Forage Fish Spawning: Eighteen Tier 1 armor removal sites are located on documented forage fish spawning beaches.

Sediment Supply: Eight Tier 1 armor removal sites are at bluffs ranked as top three restoration bluffs in their drift cell (CGS 2010).

Priority Public Sites: Numerous Tier 1 armor removal sites are located on publicly owned shoreline parcels including: WA State Parks (Echo and Mud Bay, Sucia and NE Orcas Island in Moran State Park); San Juan County Land Bank (Upright Head Preserve, Lopez and Judd Cove, Orcas), the U.S. Government (Westcott Bay, San Juan Island and Iceberg Point, Lopez) and San Juan County Parks (Agate Beach). Additional Tier 1 armor on private parcels but associated with county managed infrastructure such as roads includes: Cowlitz Bay, Waldron; Shoal Bight (Sperry Road), Lopez; Agate Beach Road, Lopez; and Crescent Beach Road, Orcas.

TIER 2 ARMOR RESULTS

Landscape and Shoreform Scale Factors

Landscape Regions: Tier 2 armor removal sites include project actions in the following landscape regions: San Juan Channel South (24), Blakely Sound/Lopez Sound (24), Haro Strait NE (21), Eastsound (12), Juan de Fuca/S. San Juan (7), Rosario Strait NW (4), Spieden/Stuart (4) and Waldron/President's channel (1).

Geomorphic Shoreforms: Tier 2 armor removal sites include pocket beaches (34), transport zones (16), feeder bluffs (40), barrier beaches (5), embayment estuaries (1), and rocky shorelines (8). Note: the rocky shoreline category includes small pocket beaches.

Fish Use: 23 armor sites located in highest fish use regions and 78 in high fish use regions. 3 armor sites located in highest and 37 located in high fish use shoreforms. And 64 low fish use shoreforms (in high region) and 3 low fish use regions (in high shoreform). No sites with low for both region and shoreform were included in tier 2 removal sites.

Process degradation: Twenty one percent (22) of Tier 2 armor removals are located in shoreforms with low process degradation, thirty five percent (36) are located in shoreforms with moderate process degradation, and forty four percent (46) are located in shoreforms with high process degradation. Note: process degradation levels were adopted from PIAT I (Whitman et al 2012) and include low (less than 13% shoreform length degraded), moderate (13% to 38% shoreform length degraded) and high (>38% shoreform length degraded).

Sea level rise resiliency: sea level rise resiliency was assessed based on intact sediment supply for drift cell systems and pocket beaches, as well as the location of structures (roads or houses) within projected future sea level rise inundation or erosion hazard zones. Twenty seven percent of Tier 2 armor removal sites are located in shoreforms with high sea level rise resiliency, two percent are located in shoreforms with moderate sea level rise resiliency, and seventy one percent are located in shoreforms with low sea level rise resiliency and represent an opportunity to increase resiliency by improving sediment supply.

Site Specific Factors

Armor Elevation (structure toe): Ninety three percent (97 of 104) of Tier 2 armor removals are located below MHHW.

Armor Length: Length distribution for Tier 2 armor removals includes 21 bulkheads greater than 300 linear feet, 5 structures 200-300 feet, 7 structures 100 to 200 feet, 52 structures shorter than 100 feet but located at either a pocket beach or feeder bluff and 19 structures that are less than 100 feet located at a shoreform other than a pocket beach or a bluff. Note: 78% of all armor included in the project prioritization is less than 100 linear feet in length.

Forage Fish Spawning: Sixteen Tier 2 armor removal sites are located on documented forage fish spawning beaches.

Sediment Supply: Thirty six Tier 2 armor removal sites are at bluffs ranked as one of top three restoration bluffs in their drift cell (CGS 2010).

Priority Public Sites: Numerous Tier 2 armor removal sites are located on publicly owned shoreline parcels including: San Juan County Public Works (Jackson's Beach, San Juan Island, N. MacKaye Harbor, Lopez); WA State Parks (Fossil Bay, Sucia); San Juan County Land Bank (NE Massacre Bay, Orcas); San Juan County Parks (SE Buck Bay, Orcas); U.S. Government (Westcott Bay, San Juan Island). In addition, multiple Tier 2 priority armor removal sites are located along County managed roads, including: Crescent Beach Road, Orcas; False Bay Road, San Juan; Cameron Road/Neck Point, Shaw; White Point Road, San Juan; Barlow Bay Road, Lopez; and Deer Harbor Road, Orcas.

For site specific images and details of top priority sites, please see Appendix A. Priority Public Armor Removal Sites and Appendix B. Priority Private Armor Removal Sites.

Tidal Barriers

28 tidal barriers were included in the restoration prioritization, including barriers applied in the PIAT I strategic planning process from the PSNERP dataset (Whitman et al 2012) and sites identified by Friends of the San Juans (FSJ 2006). Visual review of vertical and oblique aerial photographs and the Washington State T-sheets were used for quality assurance and to develop estimates of potential area. Scored attributes included fish use region, fish use shoreform, priority streams (top 9 identified by SJC Lead Entity), fish bearing streams, non-fish bearing streams, wetlands, and approximate area of restorable area (>10 acres, 5-10 acres, 2-5 acres, 1-2 acres, <1 acre). Additional information recorded for each record but not applied to the ranking included ownership, landscape region, shoreform type, if a road or armor was also present at the site, and process degradation (shoreform scale).

Summary statistics for the 28 tidal barriers included in the restoration ranking:

Landscape regions: tidal barriers included in the restoration prioritization were located in the following landscape regions: West Sound/Deer Harbor (4), Upright Head (4), San Juan Channel S. (3), San Juan Channel N. (2), Juan de Fuca S. Lopez (4), Haro Strait NE (2), Eastsound (5), Blakely Sound/Lopez Sound (2), Blind Bay (1), and Rosario NW (1).

Shoreforms: tidal barriers included in the restoration prioritization were located at the following geomorphic shoreline types: 10 embayments, 7 barrier beaches, 6 pocket beaches, 2 feeder bluffs, 2 transport zones and 1 rocky.

Fish Use Geographic Prioritization: three tidal barriers were located in the highest fish use region and at a highest fish use shoreform. An additional three tidal barriers were located in the highest fish use region, 17 in high fish use region and 5 in a moderate fish use region. In addition to the 3 sites in the highest fish use shoreform, 3 were located in high fish use shoreforms and 22 in moderate fish use shoreforms.

Freshwater Resources: 5 tidal barriers were located at top priority fish bearing streams, 8 at fish bearing streams and 15 at non fish bearing streams or wetlands.

Ownership: 1 public, 9 mixed public/private, 18 private. Note: many tidal barriers are associated with the public easement along County roadways, these are recorded as private as ownership was assigned to the shoreline tax parcel.

Size (approximate area of potentially re-connectable area): 6 > 10 acres, 4 5-10 acres, 5 2 to 5 acres, 7 1-2 acres and 6 <1 acre.

Modifications: 24 of 28 tidal barriers were associated with a backshore road and 13 were associated with shoreline armor (12 of the 13 also associated with roads).

Process Degradation: Two tidal barriers located in a shoreform with low process degradation (<13%), 16 in shoreforms with moderate process degradation (13-38%), 10 in shoreforms with high process degradation (>38%).

TIER 1 TIDAL HYDROLOGY RESTORATION SITES

The nine Tier 1 tidal barrier sites include the six sites located in the highest or high fish use region *and* shoreform (fish use score 8 or greater), as well as four additional tidal barriers with highest or high fish use region *or* fish use shoreform (fish use score 5-7) *and* location along a top priority fish bearing stream. No sites with low fish use region or shoreform were selected as Tier 1 tidal barrier removals.

Landscape regions: Tier 1 barriers are located in the following landscape regions: West Sound/Deer Harbor (2), San Juan Channel N. (1), Rosario NW (1), Juan de Fuca S. Lopez (3), Eastsound (1), and Blakely/Lopez Sounds (1).

Shoreforms: Tier 1 tidal barriers located at 4 pocket beaches, 3 embayment, 1 rocky and 1 barrier beach shoreforms.

Fish Use: 3 tidal barrier restoration priorities are located in the highest fish use region and highest fish use shoreform. Remaining barriers in high fish use region and high and low fish use shoreforms.

Freshwater Resources: Tier 1 barriers are located at the following top priority streams: West Sound-Crow Creek (2), Blakely Sound/Lopez Sound- Hummel Creek (1) and Rosario NW-Doe Creek (1).

Ownership: Numerous Tier 1 tidal hydrology restoration sites are located on publicly owned parcels or the barriers are associated with a county road, including: 3 sites along MacKaye Harbor Road on south Lopez, 1 site along Port Stanley road on Lopez, 1 site along Neck Point (Cameron rd.) on Shaw, bridges and associated roads at West Sound (Deer Harbor rd. and crow creek), Channel road in Deer Harbor, and upstream of a private tidal barrier, along Doe Bay Road, Orcas. Private Tier 1 tidal barrier restoration sites include Doe Bay Creek and Crow Valley Creeks on Orcas.

TIER 2 TIDAL HYDROLOGY RESTORATION SITES

Tier 2 tidal barrier sites included sites located in the highest or high fish use shoreform region *or* fish use shoreform (fish use score 5-7) *and* along a fish bearing stream (outside of the top 9) *or* located in the highest or high fish use shoreform region (fish use combined score of 5-7), located at a wetland or non-fish bearing stream that included >2 acres of potential new area. No sites with low fish use region and shoreform scores were selected as Tier 2 barriers. Tier 2 barriers included five sites with fish use combined scores of 5 to 7 and a fish bearing stream, as well as four additional sites with fish use score of 5 to 7, wetland or non-fish bearing stream, with >2 acres in size.

Landscape regions: Tier 2 tidal barrier restoration priorities were located in the following landscape regions: San Juan Channel S. (1), Juan de Fuca S. Lopez (1), Haro Strait NE (2), Eastsound (3) and Blakely/Lopez Sound (1).

Shoreforms: Tier 2 tidal barrier restoration priorities were located at 2 bluffs, 2 embayments and 4 barrier beach geomorphic shoreforms.

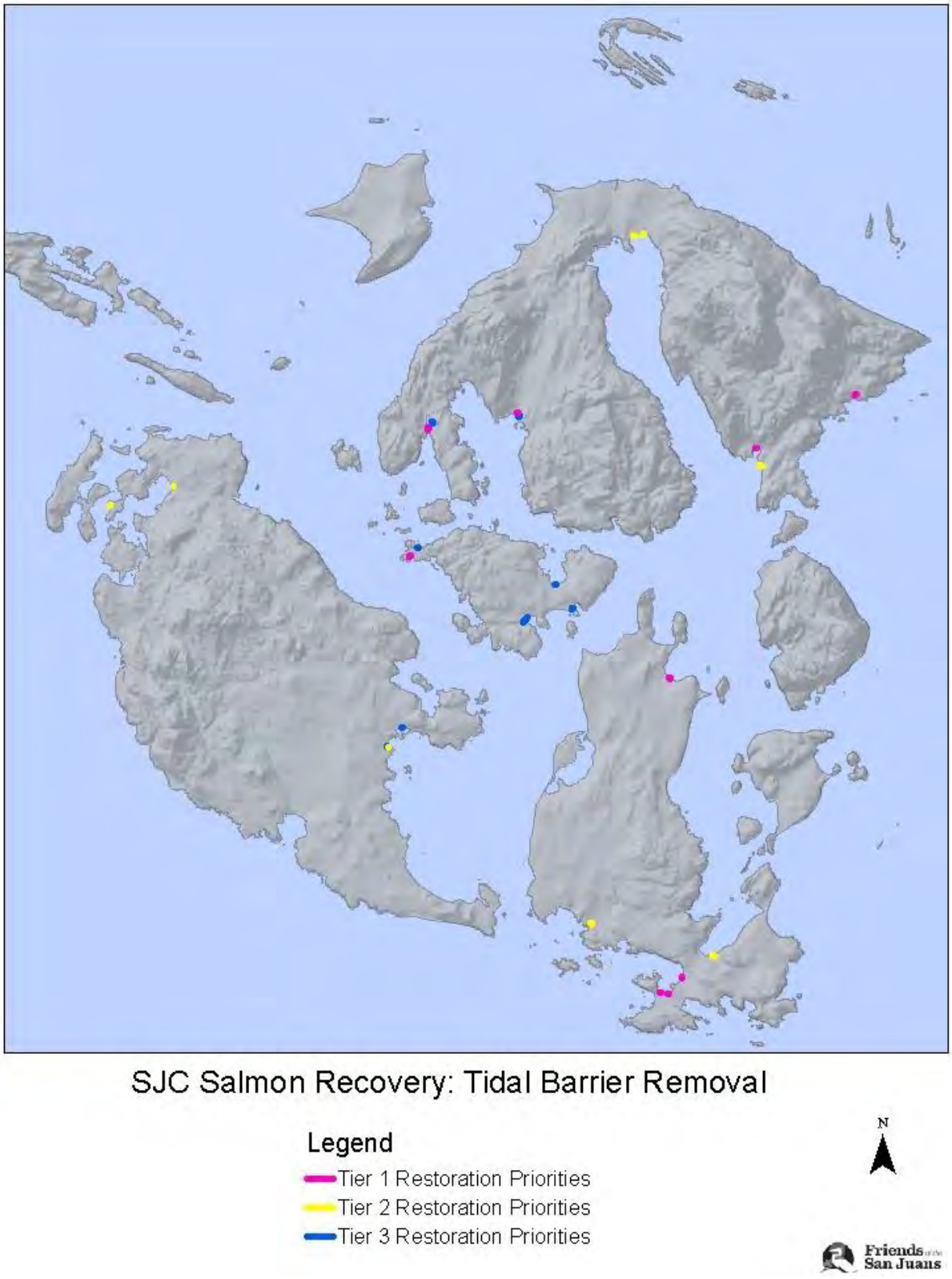
Freshwater resources: Tier 2 tidal barrier restoration priorities were located at 5 fish bearing streams and 3 wetlands or non-fish bearing streams.

Fish Use: Tier 2 tidal barrier sites were located within 3 highest and 5 high fish use priority regions. All Tier 2 tidal barrier restoration priority sites were located in low priority fish use shoreforms.

Ownership: Multiple Tier 2 tidal hydrology restoration sites are located on publicly owned parcels or the barriers are associated with a county road, including 2 sites along Crescent beach road, Orcas (public works-roadway and culverts) and Preserve parcels (SJC Land Bank) and 2 adjacent sites associated with Mill Street road on San Juan Island. Private Tier 2 tidal barrier restoration sites include 3 sites not associated with roads (Olga, Orcas, Westcott Bay, San Juan and Mud Bay, Lopez, as well as sites at private roads Seal Rock Lane, San Juan Island, Davis Bay, Lopez. Additional, unranked tidal barriers associated with county roads include multiple sites on Shaw including Blind Bay rd. (1), Squaw Bay rd. (2-3), Neck Point (1) and Indian Cove Rd. (1).

For images and details please see Appendix C. Tidal Barrier Public Restoration Priorities and Appendix D. Tidal Barrier Private Restoration Priorities.

Figure 6. Tidal Barrier Restoration Priorities for San Juan County



Groins

All 31 groins mapped in the 2009 SJC Inventory of Shoreline Modifications (FSJ 2010) were included in the restoration prioritization. Scored attributes included fish use region, fish use shoreform, sediment supply significance (priority bluff, bluff, pocket beach, elsewhere in drift cell (soft shore), rocky/artificial), proximity to documented forage fish spawning beaches, location in a drift cell with documented forage fish spawn. Additional information recorded for each record but not applied to the final ranking included ownership, landscape region, shoreform type, process degradation and sea level rise resiliency.

Characteristics of the 31 groins included in the restoration ranking:

Landscape regions: groins were located in the following landscape regions: West Sound/Deer Harbor (1), Waldron/President's Channel (1), Upright Head (1), Spieden/Stuart (1), San Juan Channel S. (5), San Juan Channel N. (3), Juan de Fuca S. Lopez (1), Haro Strait NE (5), Eastsound (2), Blind Bay (2) and Blakely Sound/Lopez Sound (8).

Shoreforms: groins were located at the following shoreform types: 12 feeder bluffs, 5 pocket beaches, 5 transport zones, 6 barrier beaches and 2 rocky.

Process Degradation: 5 groins located in shoreforms with low process degradation (<13%), 18 in shoreforms with moderate process degradation (13-38%) and 7 in shoreforms with high process degradation (>38%).

Sea level rise resiliency: 6 groins located in shoreforms with high sea level rise resiliency, 1 in shoreform with moderate sea level rise resiliency and 23 in shoreforms with low sea level rise resiliency.

Forage fish: 6 groins were located at documented forage fish spawning sites.

Sediment supply: 11 groins located at top priority restoration bluffs.

TIER 1 GROIN REMOVAL SITES

Eleven sites were identified as Tier 1 groin removal sites. These Tier 1 sites were located in the highest or high fish use region *and* shoreform (fish use score 8 or greater) *or* were located at a documented forage fish spawning site.

Landscape Regions: Tier 1 groin removal sites are located in the following landscape regions: Blakely Sound/Lopez Sound (4), Eastsound (2), San Juan Channel N (2), Spieden/Stuart (1), and Blind Bay (1).

Shoreforms: Tier 1 groin removal sites are located at 4 pocket beaches, 3 bluffs, 3 barrier beaches and 1 transport zone geomorphic shoreform.

Fish Use: Seven of the eleven Tier 1 groin removal sites are located in a highest or high fish use region *and* shoreform (fish use scores 8 or greater), 2 are located in a high fish use region and 1 site is located in a low fish use region and shoreform (note this 1 is at a documented forage fish spawning site).

Forage fish spawning: Six of the eleven Tier 1 groin removal sites are located at a documented forage fish spawning beach. All five sites located within a drift cell with documented spawn are located at documented spawn sites.

Sediment supply: Four Tier 1 groins are located at feeder bluffs (3 of 4 are top priority bluffs), 4 at pocket beaches, 3 at barrier beaches and 1 at a transport zone.

Ownership: One Tier 1 groin removal site is located on public property, owned and managed by San Juan County Public Works. The priority public groin removal site is at the Islandale boat ramp in E. MacKaye Harbor on Lopez, a site with multiple groins, as well as armor, a dock and a backshore road.

Process Degradation: 3 Tier 2 groin removal site are located in shoreforms with low process degradation (<13%), 5 in shoreforms with moderate degradation (13-38%) and 3 in shoreforms with high process degradation (>38%).

TIER 2 GROIN REMOVAL SITES

Nine sites were identified as Tier 2 groin removal sites. Tier 2 groin removal sites were located in the highest or high fish use region *and* shoreform (fish use score 5 to 7) and at a feeder bluff. All Tier 2 groin removal sites are located on private property.

Landscape Regions: Tier 2 groin removal sites are located in the following landscape regions: Waldron/President's Channel (1), Haro Strait NE (1), Blakely Sound/Lopez Sound (4), San Juan Channel South (2) and San Juan Channel North (1).

Shoreforms: Tier 2 groin removal sites are located at 7 bluffs, 1 rocky and 1 transport zone geomorphic shoreform.

Fish Use: 2 Tier 2 groin removal sites are located in the highest fish use region and 7 are located in high priority fish use regions. All Tier 2 groin removal priorities are located at low priority fish use shoreforms.

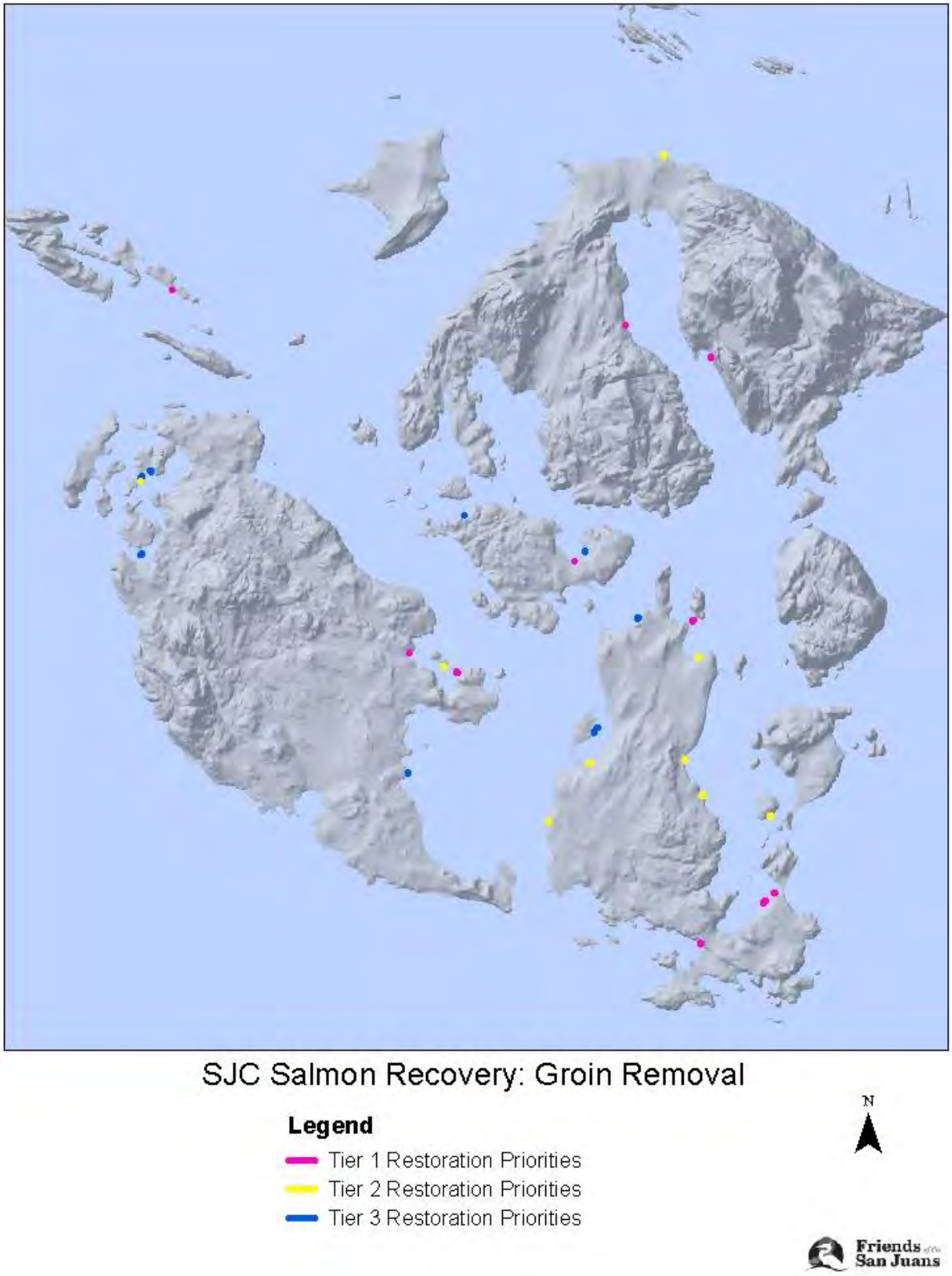
Forage Fish: No Tier 2 groin removal sites are located at documented spawning beaches.

Sediment Supply: 7 Tier 2 groin removal sites are located at top priority bluffs.

Ownership: All Tier 2 groins are located at private shoreline sites.

Process Degradation: 1 Tier 2 groin removal site is located in a shoreform with low process degradation (<13%), 5 in shoreforms with moderate degradation (13-38%) and 3 in shoreforms with high process degradation (>38%).

Figure 7. Groin Removal Restoration Priorities for San Juan County



Backshore Roads

Backshore roads included in the prioritization framework included both public and private mapped roads within 100 feet of the shoreline, and greater than 50 feet in length. Road segments set farther back from the shore, or less than 50 feet in length within the shore, were not included. 329 mapped road segments in the backshore were included in the final restoration ranking.

Scored attributes included fish use region, fish use shoreform, sediment supply significance (priority bluff, bluff, pocket beach, elsewhere in drift cell (soft shore), rocky/artificial), proximity to documented forage fish spawning beaches. Additional information recorded for each road segment but not applied to the final ranking included length, ownership, landscape region, shoreform type, process degradation and sea level rise resiliency. Ownership was recorded for the shoreline parcels, like with all other modifications in the analysis, but an additional ownership category was recorded, for the roads themselves- private, public or mixed.

Characteristics of the roads included in the restoration prioritization analysis:

Landscape regions: backshore roads included in the restoration prioritization were located in the following landscape regions: West Sound/Deer harbor (46), Waldron President's channel (16), Upright Head (12), Spieden/Stuart (17), San Juan Channel S. (31), San Juan Channel N. (33), Rosario trait SW (10), Rosario Strait NW (12), Juan de Fuca San Juan (6), Juan de Fuca S. Lopez (23), Haro Strait NE (33), Eastsound (27), Blakely Sound/Lopez Sound (36) and Blind Bay (27).

Shoreforms: backshore roads included in the restoration prioritization were located in the following geomorphic shoreforms: 93 pocket beaches, 68 rocky, 51 barrier beaches, 40 feeder bluffs, 37 transport zones, 21 embayments and 19 artificial.

Fish Use Geographic Priorities: 82, 208 and 39 backshore roads located in highest, high and moderate fish use regions, respectively. 13, 97 and 219 backshore roads were located in the highest, high and moderate fish use shoreforms, respectively.

Forage fish spawning: 36 backshore roads were located at documented forage fish spawning sites, 211 at potential, suitable spawning beaches, and 82 along unsuitable (rocky/artificial) shorelines.

Sediment supply: 10 backshore roads were located along top priority feeder bluffs.

Other Modifications: 21 backshore roads were also associated with a tidal barrier, and 72 segments were also associated with armoring.

Length: 25 backshore roads were > 1,000 linear feet, 34 were between 500 and 1,000 linear feet, 91 were between 200-500 linear feet, 98 were between 100 and 200 linear feet and 81 were less than 100 linear feet.

Backshore Road Restoration Ranking

Tier 1 BACKSHORE ROAD RESULTS

Tier 1 backshore road restoration sites included sites with highest or high fish use region *and* highest or high fish use shoreform (scores of 8 or greater) and the presence of one or more of the following: documented forage fish spawning beach; sediment supply bluff; association with a tidal barrier or armor. 21 backshore roads were identified as Tier 1 restoration priorities.

Landscape region: Tier 1 backshore roads were located in the following landscape regions: West Sound/Deer Harbor (6), Waldron/President' channel (1), Spieden/Stuart (1), San Juan Channel S. (2), Haro Strait NE (1), Eastsound (1), and Juan de Fuca S. Lopez (7).

Shoreforms: Tier 1 roads were located at 13 pocket beaches, 5 feeder bluffs and 3 transport zones.

Fish Use: 9 in highest fish use regions and highest fish use shoreform. Remaining 12 high fish use region and high fish use shoreform.

Process degradation: 5 Tier 1 backshore roads were located in shoreforms with low process degradation 5 in shoreforms with moderate process degradation and 11 with high process degradation.

14 public (county) and 7 private Tier 1 backshore roads were located at 5 public or mixed ownership parcels and 16 privately owned shoreline parcels.

Multiple road segments over 2,000 feet (over 6,500 total feet along MacKaye Harbor Road in MacKaye Harbor, Barlow Bay and Open bay). Minimum road length in Tier 1 restoration roads 72 feet.

Length: 4 Tier 1 backshore roads were > 1,000 linear feet, 2 were between 500 and 1,000 linear feet, 6 were between 200-500 linear feet, 5 were between 100 and 200 linear feet and 4 were less than 100 linear feet.

Forage fish spawning: 20 at documented spawning beaches. 1 potential spawning habitat.

Sediment supply: 1 top priority bluff, 4 bluffs.

Modifications: 3 also associated with a tidal barrier, 9 with shoreline armoring.

Tier 2 BACKSHORE ROAD RESULTS

Tier 2 backshore roads included remaining sites with highest or high fish use region and highest or high fish use shoreform (fish use scores of 8 or greater), as well as sites with (highest or high fish use region *or* shoreform (fish use scores of 5-7) *and* one or more of the following: documented forage fish spawning beach; sediment supply bluff; association with a tidal barrier or armor or sites with a fish use score below 4 *and* documented forage fish spawn or a top priority feeder bluff. 156 backshore road segments were ranked as Tier 2 restoration priorities.

Shoreforms: 23 transport zones, 6 rocky, 57 pocket beaches, 31 bluffs, 7 embayments, 27 barrier beaches, 5 artificial

Landscape Regions: 21 West Sound/Deer Harbor, 14 Waldron/President's channel, 7 Spieden/ Stuart, 17 San Juan Channel S., 11 San Juan Channel N., 10 Rosario SW, 8 Rosario NW, 3 Juan de Fuca San Juan, 14 Juan de Fuca S. Lopez, 9 Haro Strait NE, 20 Eastsound, 9 Blind Bay, 13 Blakely Sound/Lopez Sound.

Fish Use Geographic Priorities: 4 sites with highest fish use region and highest fish use shoreform, 34 with highest fish use region and high fish use shoreform, 51 high fish use region and high fish use shoreform, 9 highest fish use region and low fish use shoreform, 49 high fish use region and low fish use shoreform,, and 9 sites with low fish use region and low fish use shoreform (note these low fish use score sites are located along documented forage fish spawning beach OR a top priority restoration bluff.

Forage fish spawning: 16 tier 2 road segments are located along documented forage fish spawning sites, 130 at potential spawning beaches.

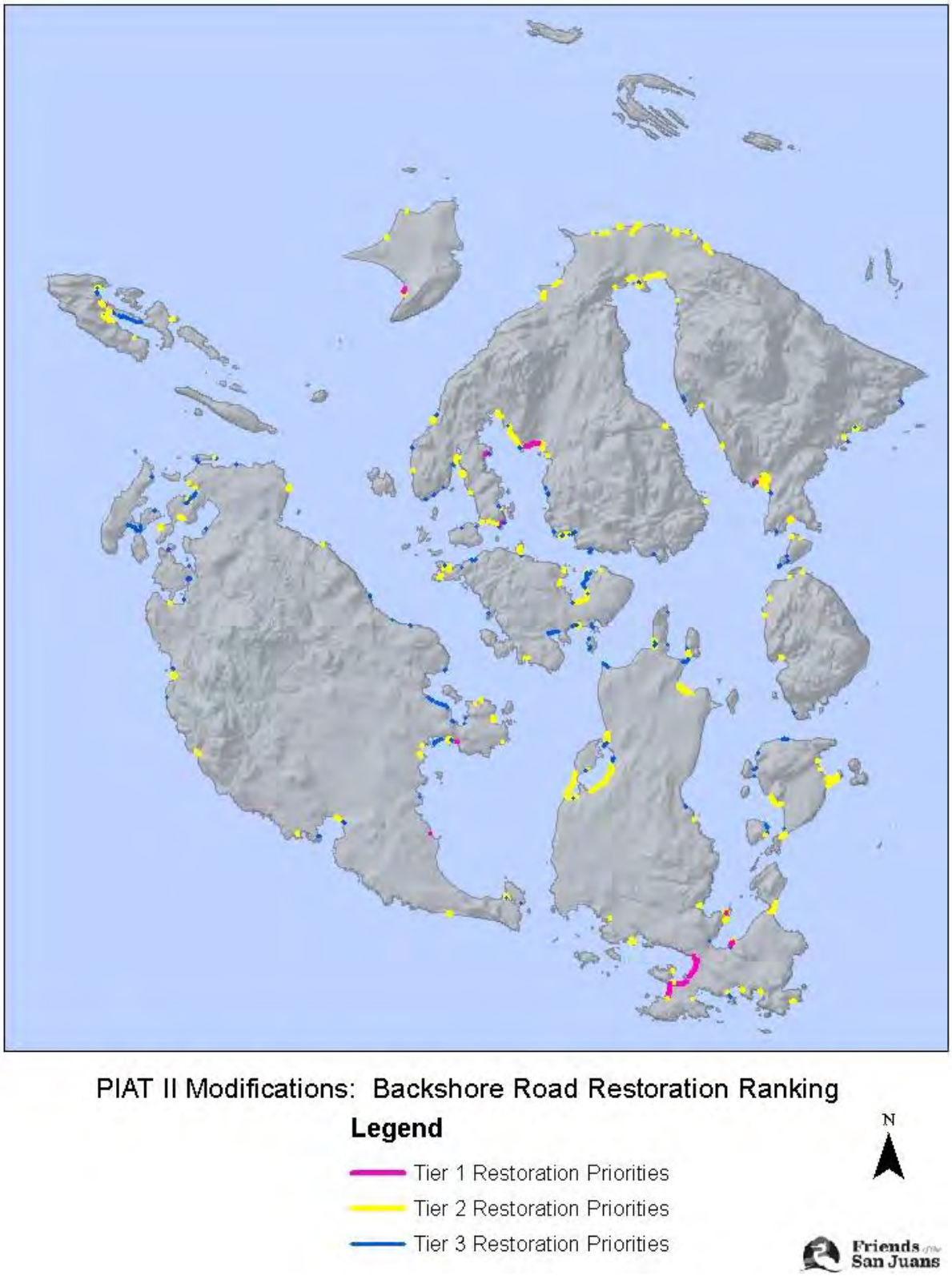
Sediment Supply: 9 located at top priority bluffs, 22 others at bluffs

Other stressors: 16 also associated with a tidal barrier, 52 also associated with armoring. Add percentages

Length: Minimum length 50 feet, maximum length 5,000 feet. 14 Tier 2 backshore roads were > 1,000 linear feet, 22 were between 500 and 1,000 linear feet, 31 were between 200-500 linear feet, 50 were between 100 and 200 linear feet and 39 were less than 100 linear feet.

Ownership: 66 public and 90 private roads, associated with 8 publicly owned shoreline parcels, 16 road segments with mixed public and private shoreline parcel ownership, and 132 private parcels.

Figure 8. Backshore Road Restoration Priorities for San Juan County



PROTECTION RANKING

Protection of remaining intact habitat at priority sites is the top salmon recovery strategy for San Juan County. A pre-screening process was conducted for the protection prioritization framework that removed all waterfront parcels already protected by ownership or easement, all parcels with low priority fish use region and low priority fish use shoreform rankings, and parcels less than 5 acres. The resulting 653 privately owned waterfront parcels not already protected, larger than 5 acres and located in the highest or high fish use region or shoreform were further prioritized using a suite of parcel and shoreform specific metrics. In addition to salmon technical team involvement, the pre-screening and ranking metrics were developed in consultation with the two land conservation entities located and working in WRIA 2, the San Juan Preservation Trust and the San Juan County Land Bank.

Parcel scale ranking factors that were scored included: development status (parcels with a building value less than $50,000 were categorized as undeveloped); waterfront length; building setback; landscape context (adjacency to parcels already protected by ownership or easement and undeveloped parcels); coincidence with documented forage fish spawning beaches and herring spawning grounds; proximity to priority freshwater resources (fish bearing streams, streams and wetlands); presence of shoreline modifications such as docks, armoring, roads, etc. and if the parcel was currently enrolled in the Open Open Space Public Benefit Rating System.

Shoreform scale ranking factors scored in the protection prioritization included: process degradation; sea level rise resiliency; fish use regions and shoreforms; high value riparian vegetation condition associated with documented forage fish spawning beaches, feeder bluffs and pocket beaches; and sediment supply (priority conservation bluffs countywide and in each drift scale as identified by CGS 2010).

Summary statistics for the 653 waterfront parcels included in the protection project ranking:

Fish Use Geographic Priorities: fish use regions and shoreforms throughout the county were prioritized based on a combination of rearing juvenile chinook, rearing forage fish and spawning forage fish factors. Parcels in the protection prioritization framework included 34 parcels located in the highest priority fish use region and at the highest priority fish use shoreform; 291 parcels are located in the highest fish use region; 435 parcels are located in high ranked fish use regions and 251 parcels ranked as high fish use shoreforms. No parcels ranked as low fish use region and low fish use shoreform were included in the protection prioritization framework.

Landscape Regions: Parcels included in the protection prioritization framework were located in the following landscape regions: West Sound/Deer Harbor (55), Waldron/President's Channel (65), Spieden/Stuart (47), San Juan Channel South (53), San Juan Channel North (65), Rosario Strait SW (37), Rosario Strait NW (49), Juan de Fuca San Juan (57), Juan de Fuca S. Lopez (57), Haro Strait NE (59), Eastsound (67) and Blakely Sound/Lopez Sound (83).

Shoreforms: Parcels included in the protection prioritization framework were located in the following geomorphic shoreform types: pocket beaches (242), rocky (215), feeder bluffs (99), barrier beaches (49), transport zones (39), and embayments (9).

Size: Minimum 5 acres, maximum 490 acres, mean 15 acres.

Waterfront Length: 162 parcels with greater than 1,000 feet of waterfront length, 191 parcels with 500 to 1,000 feet, 190 parcels 250 to 499 feet, and 110 parcels with less than 250 feet of waterfront.

Development Status: 220 undeveloped, 433 developed.

Setback: 310 parcels have structures set back more than 200 feet from the shoreline.

Open Open Space enrollment: 27 parcels in the protection prioritization are enrolled in the Open Open Space public benefit rating program.

Modifications: 462 of the waterfront parcels included in the protection prioritization have no shoreline modifications present.

Adjacency: 82 parcels are adjacent to a parcel already protected by ownership or conservation easement and 449 parcels are adjacent to an undeveloped parcel. Note: adjacency included waterfront and immediately inland parcels.

Process degradation: 249 parcels located in fully intact shoreforms with no shoreline modifications, 254 parcels located in shoreforms with low process degradation (less than 13%), 150 parcels located in shoreforms with moderate to high process degradation.

Sea level rise resiliency: 106 parcels located in shoreforms with high sea level rise resiliency and 169 located in parcels with moderate sea level rise resiliency.

Forage fish and overhanging vegetation: 22 parcels with documented forage fish spawn are located in shoreforms high 75-100% overhanging marine riparian vegetation and 7 parcels with documented forage fish spawn in shoreforms with 50-75% overhanging marine riparian.

Forage fish: 69 parcels are located at or adjacent to documented forage fish spawning, including surf smelt and sand lance spawning beach and pacific herring spawning grounds.

Feeder bluffs and riparian vegetation: 20 parcels are located at bluffs in shoreforms with 75-100% forested riparian buffers and 59 are located at bluffs with 50-75% forested riparian buffers.

Pocket beaches and marine riparian vegetation: 195 parcels are located at pocket beaches with 75-100 overhanging vegetation and 9 are located at pocket beaches with 50-75% overhanging vegetation. 95 parcels in the protection prioritization framework are located at pocket beaches with 75-100% forested buffer vegetation and 106 are located at pocket beaches with 50-75% forested buffer vegetation.

Sediment supply: 89 feeder bluffs are located at top priority bluffs (top 3 in each drift cell and among the top conservation bluffs) as identified by the 2010 feeder bluff mapping and assessment project (CGS 2010).

Freshwater resources: 31 parcels have a fish bearing stream and 79 parcels have a wetland. Note: none of the top 9 streams were located on parcels included in the protection prioritization framework (didn't make it through the pre-screening process).

PROTECTION PRIORITIZATION RESULTS

Waterfront parcels in the protection prioritization were scored and then organized into three bins, using natural breaks. 152 waterfront parcels were ranked as Tier 1 priorities for protection, 288 ranked as Tier 2 priorities and 213 as Tier 3 protection priorities. See Figure 9. Salmon Recovery Protection Priorities in San Juan County.

TIER 1 Protection Results

Landscape Regions Tier 1 Protection parcels were located in the following landscape regions: West Sound/Deer Harbor (14), Waldron/President's Channel (24), Spieden/Stuart (5), San Juan Channel South (5), San Juan Channel North (8), Rosario SW (20), Rosario NW (14), Juan de Fuca San Juan (3), Juan de Fuca Lopez (19), Haro Strait NE (10), Eastsound (16), and Blakely Sound/Lopez Sound (14).

Shoreforms: waterfront parcels identified as Tier 1 protection priorities were located at the following shoreforms: 84 pocket beaches, 38 feeder bluffs, 14 rocky shore, 8 transport zones, 7 barrier beaches and 2 embayments.

Fish Use: 73 highest, 79 high and no low fish use regions. 18 highest fish use shoreforms (also in highest fish use regions), 97 high fish use shoreforms and 37 low fish use shoreforms.

Size: minimum 5 acres, maximum 218 acres, mean 20 acres.

Waterfront length: 62 parcels greater than 1,000 feet of waterfront length, 38 parcels 500-1,000 feet of waterfront length, 34 parcels 250-499 feet, and 18 parcels with less than 250 waterfront feet.

Development status: 86 undeveloped and 66 developed parcels*.

Building Setback: 108 parcels with structures back greater than 200 ft. from the shoreline*.

*Note: developed criteria was a building value of 50,000 or greater, many parcels have setback barns or other low value structures.

Open Open Space Enrollment: 17 Tier 1 parcels in open open.

Modifications: 133 waterfront parcels identified as Tier 1 protection priorities have no shoreline modifications.

Context: 23 parcels adjacent to parcels already protected by ownership or conservation easement, 116 adjacent to undeveloped parcels. Note: adjacency included waterfront and immediately inland parcels.

Process degradation: 78 parcels in shoreforms with 0 process degradation (no stressors), 58 in shoreforms with low process degradation (below 13%), and 16 parcels in shoreforms with moderate to high process degradation.

Sea level rise resiliency: 46 parcels in shoreforms with high sea level rise resiliency and 75 parcels in shoreforms with medium sea level rise resiliency.

Forage fish sites and overhanging riparian: 7 parcels at documented forage fish spawning sites in shoreforms with 75-100% overhanging vegetation. 4 parcels at documented forage fish spawning sites in shoreforms with 50-75% overhanging vegetation

Forage fish spawning: 29 Tier 1 protection priority parcels located at or adjacent to documented forage fish (sand lance, smelt or herring) spawning sites.

Feeder bluffs and buffer vegetation: 14 Tier 1 parcels in feeder bluff shoreforms with 75-100% forested riparian buffer vegetation and 18 parcels in feeder bluff shoreforms with 50-75% forested riparian buffer vegetation

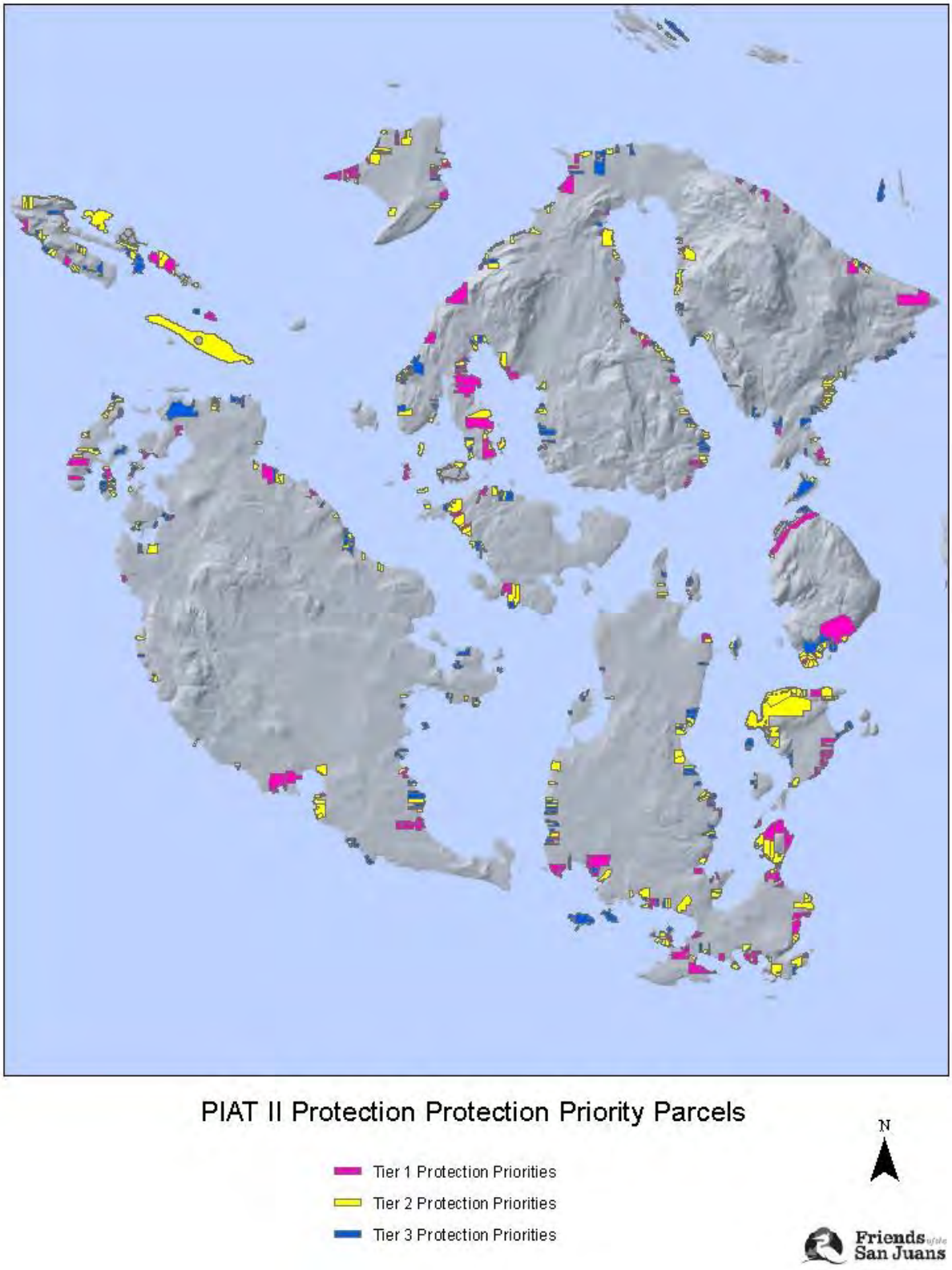
Pocket beaches and overhanging vegetation: 79 Tier 1 parcels at pocket beach shoreforms with 75-100% overhanging riparian vegetation and 1 with 50-75% overhanging.

Pocket beaches and buffer vegetation: 39 Tier 1 parcels in pocket beach shoreforms with 75-100% forested riparian buffer vegetation and 34 with 50-75% forested riparian buffer vegetation.

Sediment supply: 40 Tier 1 parcels at top priority conservation bluffs.

Freshwater resources: 14 parcels with fish bearing streams, 29 with streams or wetlands. Note: none of the top 9 streams were located on protection priority parcels.

Figure 9. Priority Parcels for Protection in San Juan County



Tier 2 Protection Priorities

Landscape region: Tier two protection priority parcels were located in the following landscape regions: West Sound/Deer Harbor (22), Waldron/President's Channel (30), Stuart/Spieden (31), San Juan Channel S. (18), San Juan Channel N. (30), Rosario SW (10), Rosario NW (18), Juan de Fuca San Juan (7), Juan de Fuca S. Lopez (25), Haro Strait HE (26) Eastsound (29) and Blakely Sound/Lopez Sound (42).

Shoreform: Tier 2 protection priori9ty parcels are located at the following geomorphic shoreform types: 103 pocket beaches, 104 rocky, 38 feeder bluffs, 20 transport zones, 20 barrier beaches and 3 embayments.

Fish Use: 91 Tier 2 protection priority parcels were located in the highest fish use regions, and 197 were in high fish use regions. No Tier two protection priorities were located in low fish use regions. 12 Tier 2 protection priority parcels with located in highest fish use shoreforms (also highest regions), 106 in high fish use shoreforms and 170 in low fish use shoreforms.

Size: maximum parcel size 490, minimum 5 acres, mean 15 acres.

Waterfront length: 70 parcels greater than 1,000 feet of waterfront length, 94 parcels 500-1,000 feet of waterfront length, 81 parcels 250-499 feet, and 43 parcels with less than 250 waterfront feet.

Development status: 119 undeveloped and 160 developed parcels*.

Building Setback: 156 Tier 2 protection parcels with structures back greater than 200 ft. from the shoreline*.

*Note: developed criteria was a building value of 50,000 or greater, many parcels have setback barns or other low value structures.

Open Open Space Enrollment: 11 Tier 2 parcels in open open.

Modifications: 211 waterfront parcels identified as Tier 2 protection priorities have no shoreline modifications.

Context: 35 Tier 2 protection parcels adjacent to parcels already protected by ownership or conservation easement, 195 adjacent to undeveloped parcels. Note: adjacency included waterfront and immediately inland parcels.

Process degradation: 124 Tier 2 protection parcels in shoreforms with 0 process degradation (no stressors), 106 in shoreforms with low process degradation (below 13%), and 58 parcels in shoreforms with moderate to high process degradation.

Sea level rise resiliency: 49 Tier 2 protection parcels in shoreforms with high sea level rise resiliency and 76 parcels in shoreforms with medium sea level rise resiliency.

Forage fish sites and overhanging riparian: 9 Tier 2 protection parcels at documented forage fish spawning sites in shoreforms with 75-100% overhanging vegetation. 3 parcels at documented forage fish spawning sites in shoreforms with 50-75% overhanging vegetation.

Forage fish spawning: 31 Tier 1 protection priority parcels located at or adjacent to documented forage fish (sand lance, smelt or herring) spawning sites.

Feeder bluffs and buffer vegetation: 5 Tier 2 parcels in feeder bluff shoreforms with 75-100% forested riparian buffer vegetation and 31 parcels in feeder bluff shoreforms with 50-75% forested riparian buffer vegetation.

Pocket beaches and overhanging vegetation: 88 Tier 1 parcels at pocket beach shoreforms with 75-100% overhanging riparian vegetation and 3 with 50-75% overhanging.

Pocket beaches and buffer vegetation: 40 Tier 1 parcels in pocket beach shoreforms with 75-100% forested riparian buffer vegetation and 48 with 50-75% forested riparian buffer vegetation.

Sediment supply: 35 Tier 2 protection parcels at top priority conservation bluffs.

Freshwater resources: 12 parcels with fish bearing streams, 38 with streams or wetlands. Note: none of the top 9 streams were located on protection priority parcels.

PACIFIC HERRRING

While the importance of Pacific herring in the diet of out-migrating juvenile salmon rearing in the San Juans is known, much less is understood about the specific factors impacting local herring populations and the submerged aquatic vegetation that supports spawning. Information that is available categorizes San Juan County's herring spawning populations as either 'disappeared' (NW San Juan Island stock- no evidence of spawning for multiple years) or 'depressed' (remaining interior San Juan County stock, 2% of 25 year historic mean) by the Washington Department of Fish and Wildlife (Stick et al 2014). Significant eelgrass declines within multiple herring spawning grounds have also been documented by researchers at Friends of the San Juans, the University of Washington and the Washington State Departments of Natural Resources and Fish and Wildlife (Stick et al 2014, WA DNR 2008).

For this project scale restoration and protection prioritization framework, fish use geographic priorities were refined to better capture Pacific herring rearing and spawning data in the landscape region and shoreform scale data applied to both restoration and protection prioritization frameworks. In addition, specific restoration and protection opportunities at Pacific herring spawning grounds were identified. Salmon technical advisory team member also support completion of additional research, specifically research that results in the identification of herring restoration or protection actions, as a remaining data gap for WRIA 2.

Pacific Herring Spawning Habitat Restoration Opportunities

In addition to restoration opportunities prioritized at the county scale, for a range of juvenile chinook, forage fish, process and habitat factors, that focused on armor, groins, tidal barriers and backshore roads, existing in-water modifications located in herring spawning grounds were identified and are outlined below in Table 3 (see Maps in Appendix H). While these structures might not rise to the priority level in the county-wide analysis, they should be considered if and when other work is occurring in those areas of if relevant landowners are particularly interested in taking action.

Table 3. In-Water Modifications in documented Pacific Herring Spawning Grounds in San Juan County
Source: SJC Inventory of Shoreline Modifications (FSJ 2010).

SJC Herring Spawning Grounds	Docks	Pilings	Mooring Buoys	Total In-water modifications in herring spawning grounds
N. Eastsound, Orcas	1	1	16	18
West Sound, Orcas	26	2	41	69
Mud/Hunter Bays, Lopez	10	1	69	80
Blind Bay, Shaw	4	1	32	37
Westcott & Garrison Bays, San Juan	25	6	85	116
Totals:	*66*	*11*	*243*	320

Pacific Herring Spawning Habitat Protection Opportunities

One method of permanently protecting known Pacific herring spawning grounds is through the acquisition or easement of tideland parcels that support spawn as well as through protection of adjacent shoreline properties. Nearly 363 tideland acres in herring spawning grounds are publicly owned by the State of Washington Department of Natural Resources, across 77 individual tax parcels. An additional 401 tideland acres in herring spawning grounds are in private ownership, across 145 discrete tax parcels. See Table 4 below as well as Appendix I. These private tideland holdings represent a significant opportunity to secure priority tideland parcels for protection from future development (such as aquaculture or in water structures), as well as the potential for experimental restoration actions, such as eelgrass replanting. Note: proximity to herring spawning grounds was also included as a scored factor in the protection prioritization framework applied to waterfront tax parcels, see related text section above.

Table 4. Tideland Ownership in Known Pacific Herring Spawning Grounds
Source: WDFW herring spawning ground data, WA DNR tideland parcel data

Known Herring Spawn Site	Public Tideland Ownership Parcel Count	Public Tideland Ownership Acres	Private Tideland Ownership Parcel Count	Private Tideland Ownership Acres	No Tideland Ownership Attribute Parcel Count (Acres)	Total count & (acres)
Eastsound, Orcas	6	20.5	28	96	1 (6)	35 parcels 122.5 acres
West Sound, Orcas	18	68	37	69	4 (6)	59 parcels 143 acres
Mud/Hunter Bays, Lopez	9	99	16	78	-	25 parcels 177 acres
Blind Bay, Shaw	9	26	7	18	-	16 parcels 44 acres
Westcott & Garrison Bays, San Juan	35	149	57	140	2 (23)	94 parcels 312 acres
	77 public tideland parcels	**362.5** public tideland acres	**145** private tideland parcels	**401** private tideland acres	**7** unknown parcels (35 acres)	**229 parcels 799 acres**

Conclusions

The combination of the geographic and shoreform specific process degradation assessment completed in PIAT I (Whitman et al 2012) and this latest effort (PIAT II), that apply both the conceptual framework and results of PIAT I to the identification and ranking of specific project actions, can greatly improve strategic salmon recovery efforts in San Juan County. In addition to the report and its maps and images of top tier restoration and protection actions, PIAT II results include spatially explicit information available to future users in ARC GIS, ARC Reader and Excel formats on the suite of shoreform and parcel scale factors included in the prioritization framework.

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Appendix A. San Juan County Armor Removal – Priority Public Restoration Sites

Waldron Center Rd., Cowlitz Bay, Waldron. County road. Private shoreline parcel. Highest priority fish use region and shoreform. Documented forage fish spawning beach.

Crescent Beach Road, Eastsound, Orcas. County road. SJC Land Bank and private shoreline ownership. High priority fish use region and shoreform. Documented forage fish spawning beach.

Cameron Rd., Neck Point, Shaw. County road. Private shoreline ownership. High priority fish use region and shoreform. Also a tidal barrier. Relatively large length.

MacKaye Harbor Rd., Agate Beach S. Lopez County road. SJC County Park shoreline ownership. Highest priority fish use region and shoreform. Documented forage fish spawning beach downdrift of bluff. Extensive length.

MacKaye Harbor Rd., S. Lopez County road. Private shoreline ownership. Highest priority fish use region and shoreform. Documented forage fish spawning beach downdrift of bluff. Extensive length.

MacKaye Harbor Rd., S. Lopez County road. Highest priority fish use region and shoreform. Documented forage fish spawning beach downdrift of bluff. Extensive length. S. of County Park.

Sperry Rd., Shoal Bight, Lopez County and private road. Highest priority fish use region and high fish use shoreform. Extensive length.

Judd Cove, Orcas. San Juan County Land Bank ownership. High fish use region and shoreform.

Upright Head, Lopez. San Juan County Land Bank ownership. High fish use region and shoreform. Documented forage fish spawning site.

Mud Bay, Sucia. WA State Parks Note: preliminary design for full removal completed in 2017 by FSJ and WA State Parks. Implementation funds pending. Armor, tidal barrier and road.

Deer Harbor Rd., NE West Sound, Orcas County road. San Juan County Land Bank shoreline ownership. High fish use region and shoreform. Extensive length and intertidal coverage.

Deer Harbor Rd., NE West Sound, Orcas. County road. Private shoreline ownership. High fish use region and shoreform. Extensive length and intertidal coverage.

Deer Harbor Rd.., NE West Sound, Orcas. County Road, private shoreline ownership. Extensive length and intertidal coverage.

MacKaye Harbor Rd. Barlow Bay, Lopez. County Road, private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

MacKaye Harbor Rd. Barlow Bay, Lopez. County Road, Tulalip Tribes and private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

MacKaye Harbor Rd. Barlow Bay, Lopez. County road, private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

MacKaye Harbor Rd. Barlow Bay, Lopez. County road, private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

MacKaye Harbor Rd. Barlow Bay, Lopez. County road, private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

MacKaye Harbor Rd. Barlow Bay, Lopez County road, private shoreline ownership. Documented forage fish spawning site. Extensive length. Also a tidal barrier in multiple locations.

Islandale, MacKaye Harbor, Lopez. San Juan County Public Works Ownership. Dock, boat ramp, a shoreline road and multiple groins as well as armoring. Highest priority fish use region and high fish use shoreform.

Islandale, MacKaye Harbor, Lopez. San Juan County Public Works Ownership. Dock, boat ramp, a shoreline road and multiple groins as well as armoring. Highest priority fish use region and high fish use shoreform.

Islandale, MacKaye Harbor, Lopez. San Juan County Public Works and private ownership. Dock, boat ramp, a shoreline road and multiple groins as well as armor. Highest priority fish use region and high fish use shoreform.

Small Pox Bay, San Juan County Park, San Juan. High fish use region and shoreform. Pocket Beach. Close proximity, low lying structure and road.

Jackson's Beach, San Juan. San Juan County Public Works ownership. High fish use region and shoreform. Documented forage fish spawning site. Extensive length and intertidal coverage.

Jackson's Beach, San Juan. San Juan County Public Works ownership. High fish use region and shoreform. Documented forage fish spawning site. Extensive length and intertidal coverage.

Hunter Bay, Lopez. High fish use region and shoreform. Documented forage fish spawning beach. Pocket beach. Multiple armor sites in close proximity. San Juan County dock and ramp.

Iceberg Point, Lopez U.S. BLM/National Monument Highest priority fish use region and shoreform.

South False Bay Road, San Juan. County road and private shoreline ownership. High priority fish use region and shoreform. Documented forage fish spawning beach. Relatively long length and extensive intertidal coverage. Image: CGS 2014

Central False Bay Road, San Juan. County road, private shoreline ownership. Documented forage fish spawning beach. Relatively long length and extensive intertidal coverage. Image: CGS 2014

N End False Bay Road, San Juan. County road, private shoreline ownership. Documented forage fish spawning beach. Relatively long length and extensive intertidal coverage. Image: CGS 2014

Westcott Bay, San Juan National Park Service ownership. High priority fish use region and shoreform. Documented forage fish spawning site.

Westcott Bay, San Juan National Park Service ownership. High priority fish use region and shoreform. Documented forage fish spawning site.

Westcott Bay, San Juan National Park Service ownership. Highest priority fish use region and shoreform. Documented forage fish spawning site.

Echo Bay, Sucia. WA State Parks. Highest fish use region and shoreform.

Georgia Strait, Orcas. WA State Parks (Moran). Highest fish use region and high fish use shoreform. Note: armor associated with a historic lime kiln.

Fossil Bay, Sucia WA State Parks (note: FSJ 2014 photo). Highest fish use region and shoreform. Adjacent beach is a documented forage fish spawning site. Extensive length and intertidal coverage. Note: historic shoreform type is bedrock, not soft shore, and current shoreline result of historic quarry activities.

Appendix B. San Juan County Armor Removal – priority private restoration sites

Cowlitz Bay, Waldron. County road, private shoreline ownership. Documented forage fish spawning beach, bluff. Highest priority fish use region and shoreform.

Agate Beach, Lopez. County road, private shoreline ownership. Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Agate Beach, Lopez. County road, private shoreline ownership. Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Agate Beach, Lopez. County road, private shoreline ownership. Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Salmon Point, Lopez. Private shoreline ownership. Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Salmon Point, Lopez. Private shoreline ownership (community beach). Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Salmon Point, Lopez. Private shoreline ownership (community beach). Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Yacht Haven, San Juan Island. Documented forage fish spawning beach, pocket beach. Highest priority fish use region and shoreform.

Yacht Haven, San Juan Island. Highest priority fish use region and shoreform. Pocket beach. Documented forage fish spawn.

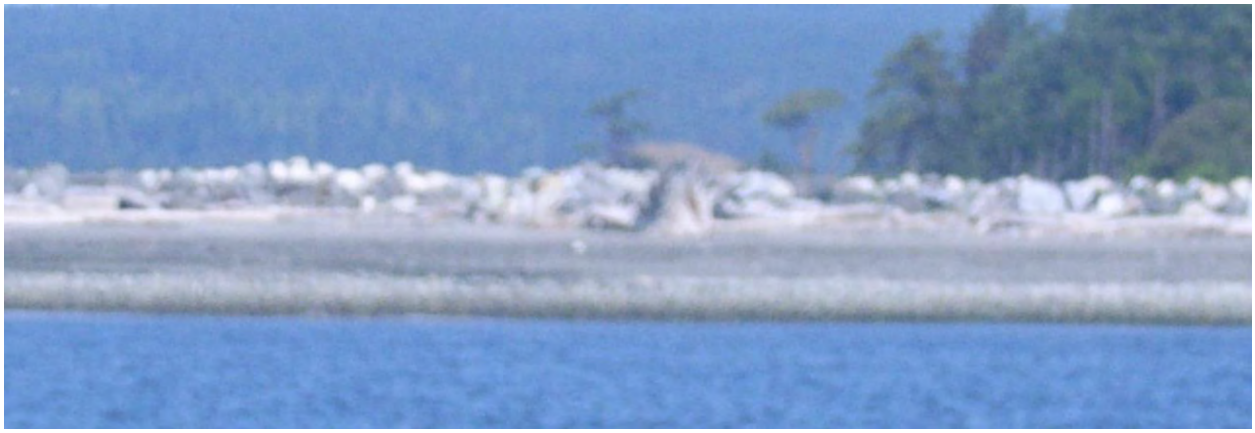
Mud Bay, Lopez. High fish use region and shoreform. Documented forage fish spawning site.

President's channel, Orcas. Priority bluff, highest priority fish use region and high fish use shoreform.

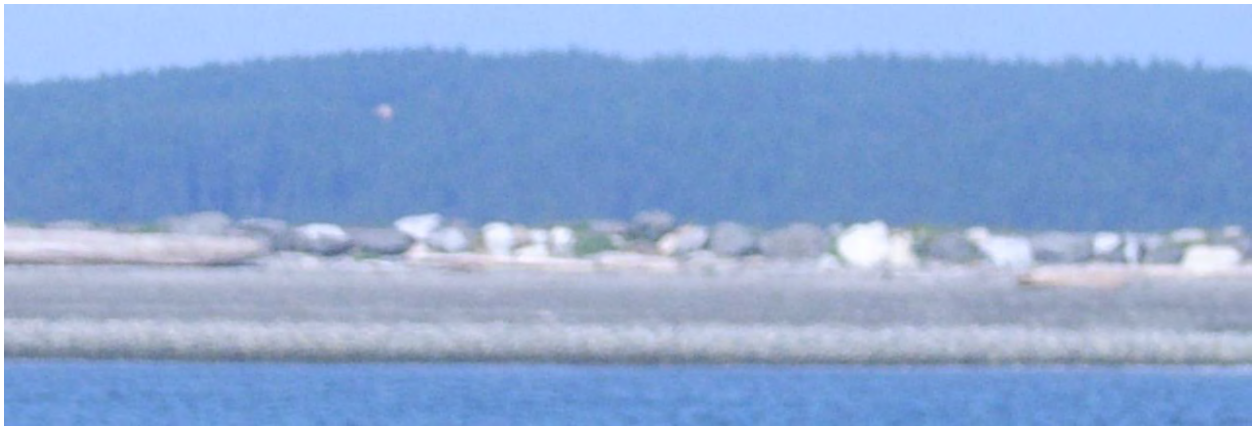
President's channel, Orcas Highest priority fish use region and high fish use shoreform.

Presidents' channel, Orcas Highest priority fish use region and high fish use shoreform.

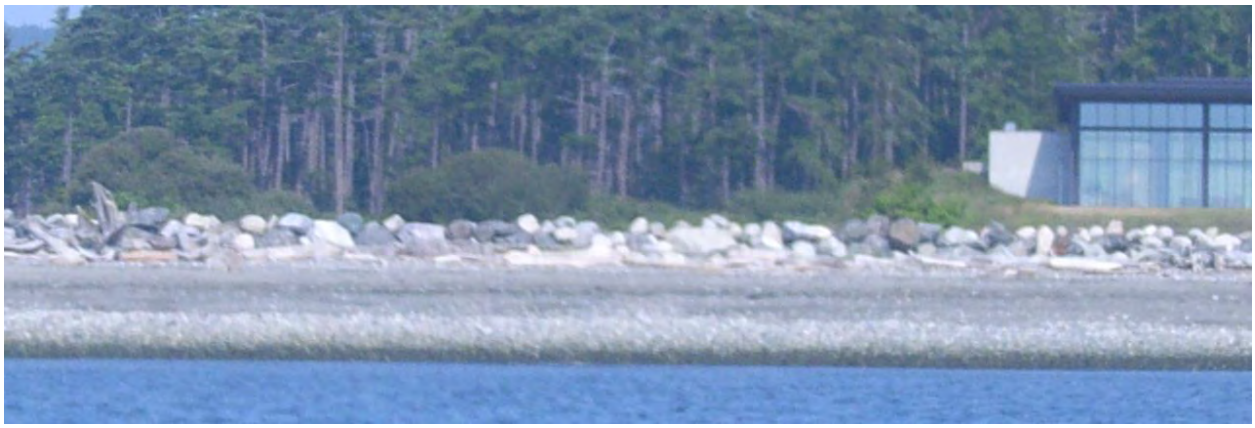
NE Eastsound, Orcas High fish use region and shoreform. Documented forage fish spawn and priority bluff.



Shoal Bight Lopez. Highest fish use region and high fish use shoreform. Large length. County and private road. Private parcel.

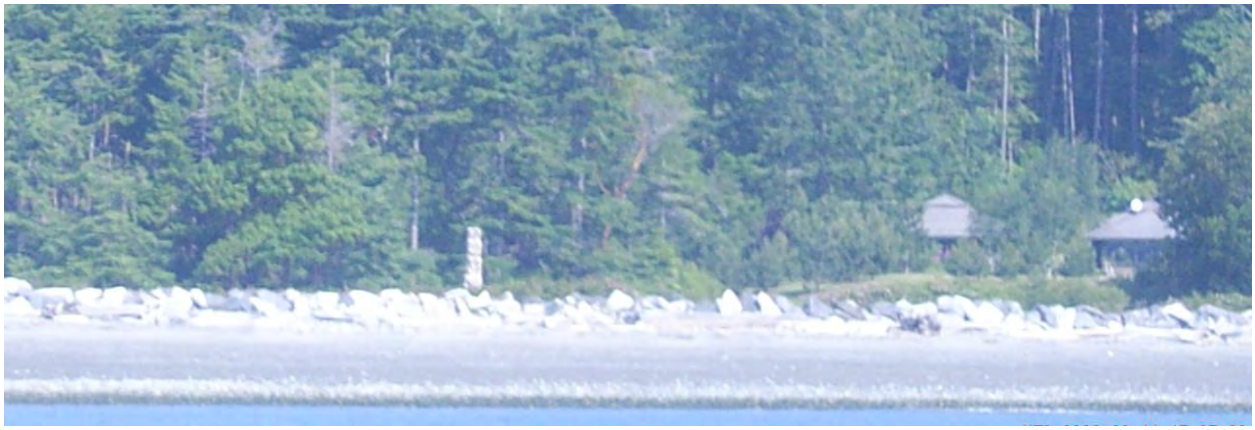


Shoal Bight, Lopez. Highest fish use region and high fish use shoreform. Large length. Private road.



Shoal Bight, Lopez. Highest fish use region and high fish use shoreform. Large length. Private parcel.

Shoal bight, Lopez. Highest fish use region and high fish use shoreform. Large length. County and private road.



Shoal Bight Lopez. Highest fish use region and high fish use shoreform. Large length. County and private road.

SE Buck Bay, Orcas High fish use region and shoreform. Priority bluff.

SE Buck Bay, Orcas High fish use region and shoreform.

N. Waldron, Highest fish use region and high fish use shoreform.

SE Blakely Island. Highest fish use region and shoreform. Pocket beach, relatively long structure. Note: unpermitted structure and additional, newer unpermitted armor to the south (left in photo). Active land use case with San Juan County.

Yacht Haven, San Juan Highest fish use region and shoreform. Relatively long structure.

Stuart. High fish use region and shoreform. Pocket Beach.

Mail Bay, Waldron Highest fish use region and shoreform. Pocket Beach. Armor associated with dock and boat ramp.

Mail Bay, Waldron Highest fish use region and shoreform. Pocket Beach. Armor associated with dock and boat ramp.

S. of Mail Bay, Waldron. Highest fish use region and shoreform. Pocket Beach.

MacKaye Harbor Road, Agate Beach, Lopez. Highest fish use region and shoreform. Pocket beach/bluff. Forage fish spawning down drift. County road and private shoreline ownership.

MacKaye Harbor Road, Agate Beach, Lopez. Highest fish use region and shoreform. Pocket beach/bluff. Forage fish spawning down drift. County road, County Park and private shoreline ownership.

NW West Sound, Orcas. High fish use region and shoreform. Documented forage fish spawning and pocket beach.

SW West Sound, Orcas. High fish use region and shoreform. Documented forage fish spawning and pocket beach. Armor and boat ramp.

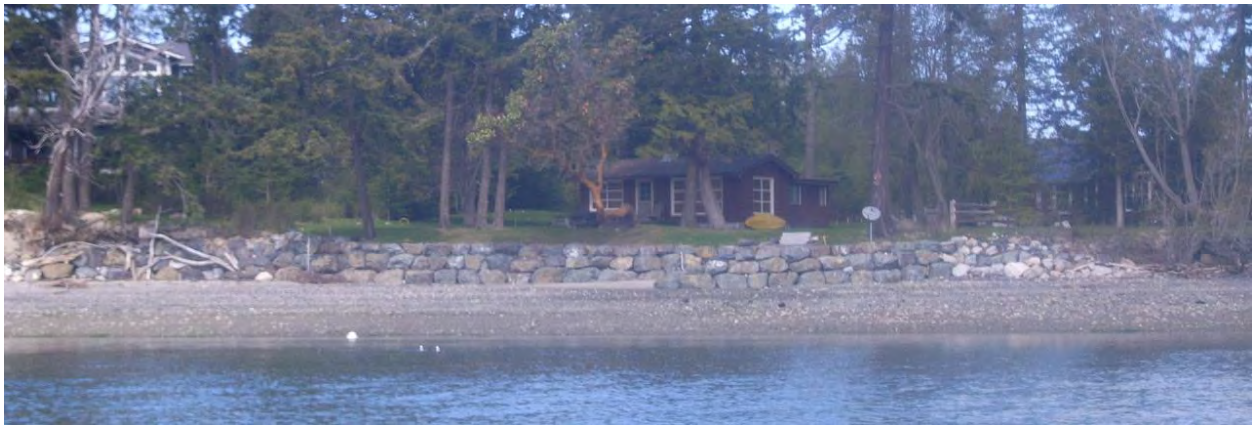
Crescent Beach Rd., Eastsound, Orcas. High fish use region and shoreform. Documented forage fish spawning site. County road. San Juan County Land Bank and private shoreline ownership.

Hunter Bay, Lopez. High fish use region and shoreform. Documented forage fish spawning beach. Pocket beach. Multiple armor sites in close proximity. Private shoreline ownership.

Hunter Bay, Lopez. High fish use region and shoreform. Documented forage fish spawning beach. Pocket beach. Multiple armor sites in close proximity. Private shoreline ownership.

Hunter Bay, Lopez. High fish use region and shoreform. Documented forage fish spawning beach. Pocket beach. Multiple armor sites in close proximity. San Juan County dock and ramp. Private shoreline ownership.

Yacht Haven, San Juan Highest fish use region and shoreform. Pocket beach



White Point, San Juan Island. Highest fish use region and shoreform. Pocket beach

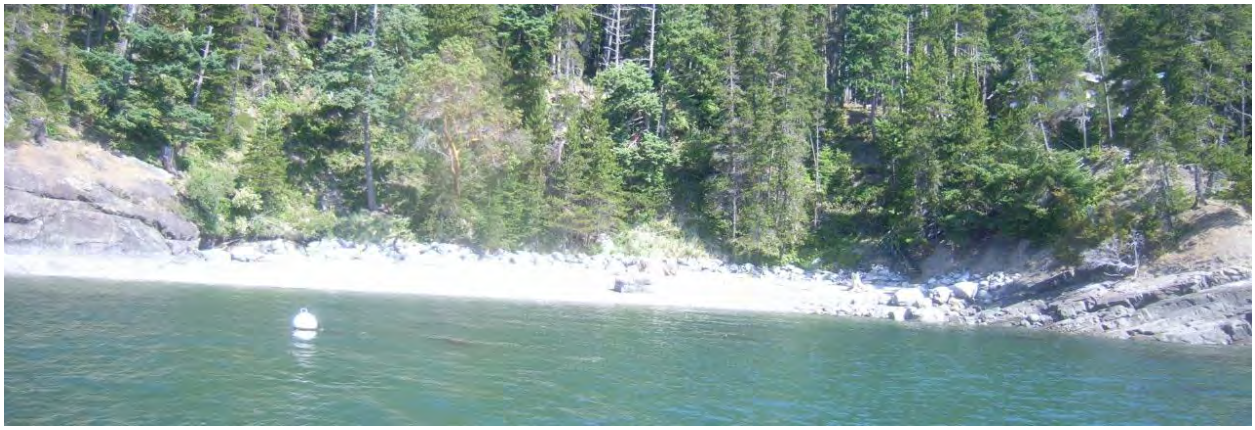
Decatur. High fish use region and shoreform. Documented forage fish spawn site. Low elevation armor.

Cowlitz Bay, Waldron. Highest fish use region and high fish use shoreform. High sea level rise resiliency (ad this factor to others)

Cowlitz Bay, Waldron. Highest fish use region and high fish use shoreform. High sea level rise resiliency

Cowlitz Bay, Waldron. Highest fish use region and high fish use shoreform. High sea level rise resiliency

Cowlitz Bay, Waldron. Highest fish use region and high fish use shoreform. High sea level rise resiliency



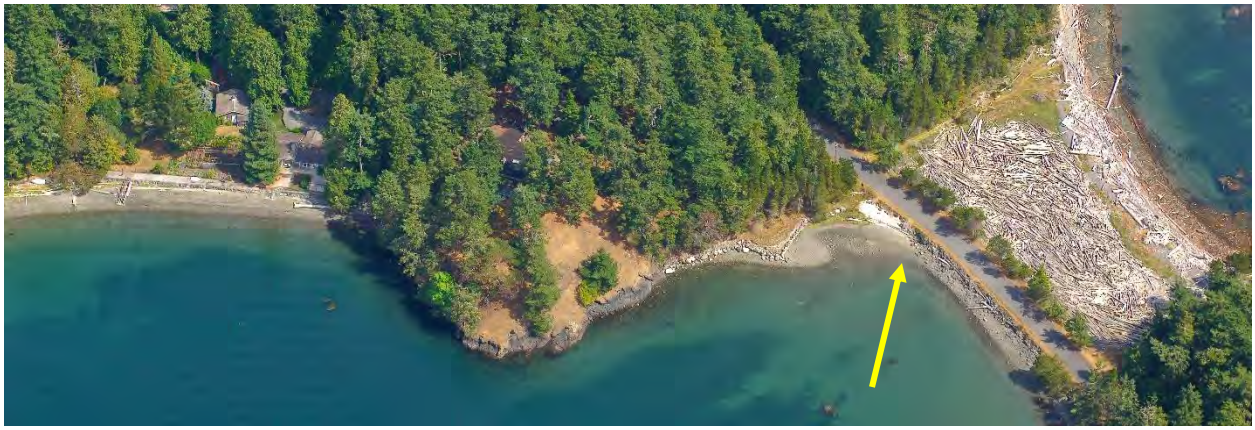
Obstruction. Highest fish use region and shoreform. Pocket beach. Relatively long length.

Appendix C. Tidal Barriers- Priority Public Restoration Sites

Tier 1. MacKaye Harbor Road, Barlow Bay Lopez. Highest priority fish use region *and* shoreform. Tide gates associated with county road. Tulalip Tribe parcel ownership at one of two sites.

Tier 1. MacKaye Harbor Road, MacKaye Harbor Lopez. Highest priority fish use region *and* shoreform. Culvert(s?) associated with county road.

Tier 1. Port Stanley Road, Swift's Bay, Lopez. High priority fish use region and top priority stream. Tide gate associated with county road.



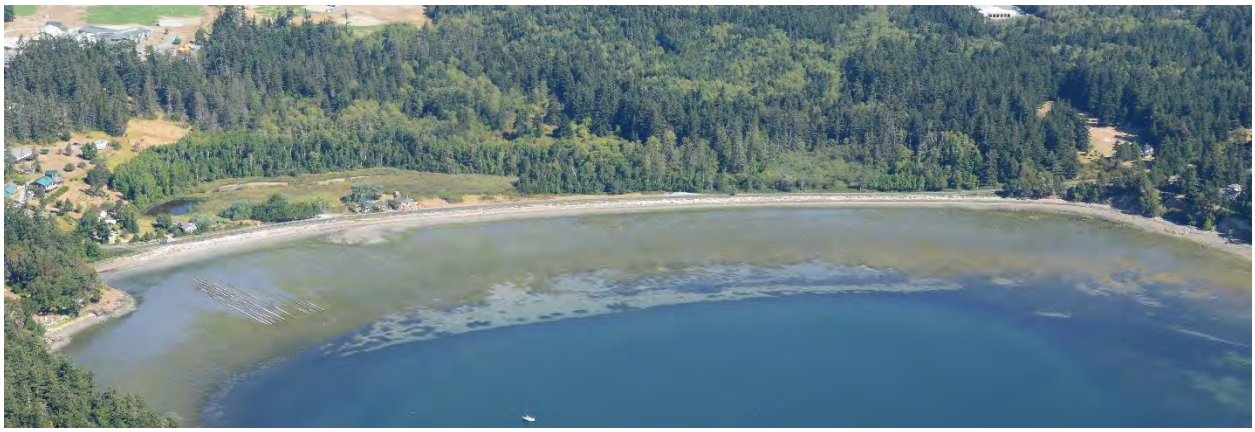
Tier 1. Cameron Road, Neck Point, Shaw. High priority fish use region *and* shoreform. Culvert associated with county road. Conceptual design complete. Additional research in progress.

Tier 1. Olga road, Buck Bay Orcas High fish use region *and* shoreform and top priority stream. County road/bridge. Note: bridge installed recently to replace armor/fill/perched culverts and improve tidal hydrology.

Tier 1. Deer Harbor Road, West Sound Orcas. High priority fish use region and fish bearing stream. County road/bridge, plus private barrier upland.

Tier 1. Channel Road, Deer Harbor, Orcas High priority fish use region and priority region. County road/bridge. Note: larger span bridge installed in 2016 that improved tidal hydrology.

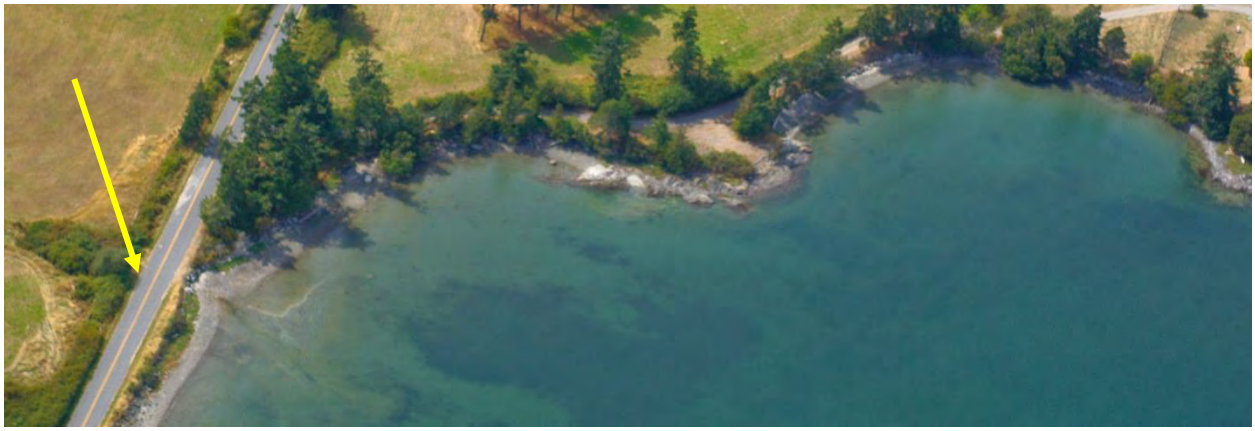
Tier 2. Mill Creek Road, Griffin Bay, San Juan Island High fish use region and fish bearing stream. Culverts associated with a county road.



Tier 2. Crescent Beach Road, Eastsound, Orcas. High fish use region and large area. Culverts associated with a county road. San Juan County Land Bank shoreline ownership.

Remaining Tidal Barriers- Public Sites

Squaw Bay Road, Squaw Bay, Shaw. Fish bearing stream. Culverts associated with a county road.



Blind Bay Road, Blind Bay, Shaw. Culvert associated with a county road.

Appendix D. Tidal Barriers- Private Restoration Priorities

Tier 1. Doe Bay, Orcas. High priority fish use region, top priority stream
Note: additional upstream barrier (culvert) at Doe Bay County Road.

Tier 2. Westcott Bay, San Juan Island. Highest fish use region and fish bearing stream.
Note: Additional barrier at a County Road crossing (culvert) upstream of private barrier.

Tier 2. White Point, San Juan Island Highest priority fish use region. Barrier associated with private road.

Tier 2. Davis Bay, Lopez Island. Highest priority fish use region and large area. Tide gate associated with a private road. Note: additional barrier from a county road at upper edge of wetland complex. SJC Land Bank and Preservation Trust easements in area.

Tier 2. SE Eastsound, Orcas. High priority fish use region and fish bearing stream.

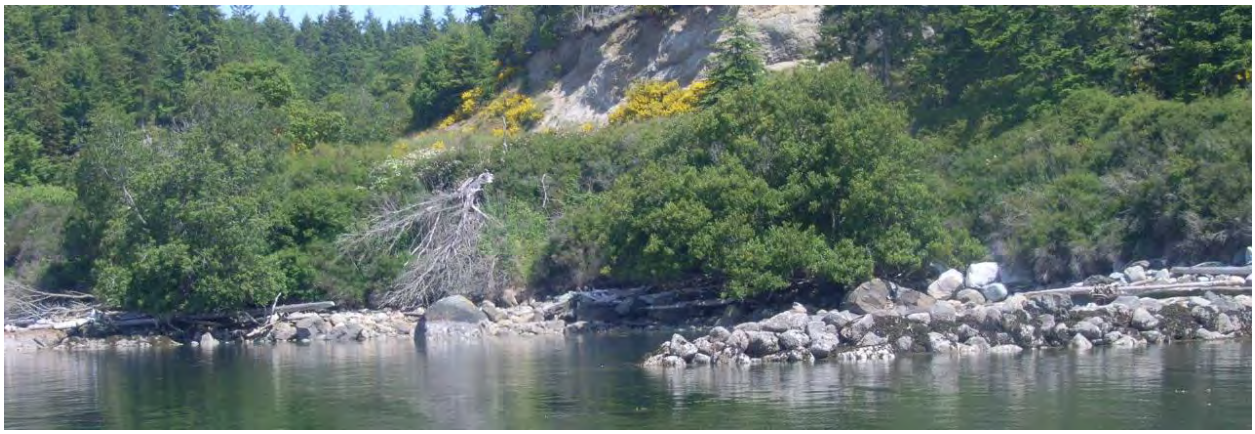
Tier 2. Mud Bay, Lopez. High fish use region and large size. Partial barrier (rocks in channel).

Indian Cove Road, Shaw Barrier associated with a private road.

Neck Point, Shaw. High fish use region and shoreform.
Note: half of wetland located to the west (right) of the armor and dock reconnected ten years ago.

Appendix E. Groin Removal- Priority Restoration at Public Sites

Tier 1. Groin Removal Islandale, MacKaye Harbor, Lopez. San Juan County Public Works shoreline parcel (includes shoreline road, armor, dock, ramp, multiple groins). Highest priority fish use region and high priority fish use shoreform.



Tier 1. Groin Removal Islandale, MacKaye Harbor, Lopez. San Juan County Public Works shoreline parcel (includes shoreline road, armor, dock, ramp, multiple groins. Highest priority fish use region and high priority fish use shoreform.

Appendix F. Groin Removal- priority restoration at private sites

Tier 1. Groin removal Mud Bay Lopez High fish use region and shoreform. Documented forage fish spawning site. Priority bluff.

Tier 1. Groin removal Mud Bay Lopez High fish use region and shoreform. Documented forage fish spawning site.

Tier 1. Groin Removal, Shoal Bay, Lopez High fish use region and shoreform. Documented forage fish spawning beach.

Tier 1 Groin Removal, John's Island. High priority fish use region and shoreform.

Tier 1 Groin Removal, Eastsound, Orcas. High priority fish use region and shoreform.

Tier 1. Groin Removal, Blind Bay, Shaw. Moderate fish use region and shoreform. Documented forage fish spawning beach.

Tier 1 Groin Removal, Turn Point, San Juan High fish use region and shoreform.

Groin Removal, Brown Island High fish use region and moderate fish use shoreform.

Groin Removal, Westcott Bay, San Juan. Highest fish use region and moderate fish use shoreform.

Groin Removal, Westcott Bay, San Juan. Highest priority fish use region and high shoreform.

Groin Removal, N. Orcas. Highest priority fish use region and high fish use shoreform.

Groin Removal, Lopez Sound. High fish use region.

Groin Removal, Lopez Sound. High fish use region.

Groin removal Center Island High fish use region.

Groin removal, SW Lopez. High fish use region.

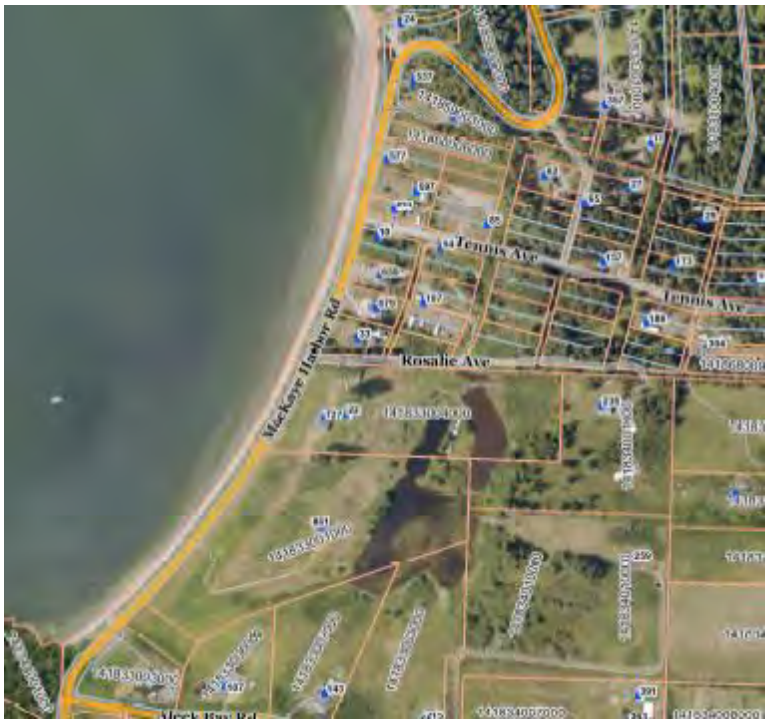
Groin removal Fisherman Bay Lopez High fish use region.

Appendix G. Backshore Roads- Priority Restoration Sites

Note: combined public and private sites. Images from San Juan County Polaris web site. See related armor and tidal barrier images for profile and oblique images

MacKaye Harbor Rd. MacKaye, Barlow and Open Bays, S. Lopez County Road
Highest fish use region and shoreform.

MacKaye Harbor Rd. MacKaye, Barlow and Open Bays, S. Lopez. County Road
Highest fish use region and shoreform.



MacKaye Harbor Rd. MacKaye, Barlow and Open Bays, S. Lopez
County Road. Agate Beach County Park. Highest fish use region and shoreform.

Cowlitz Bay Waldron, County road to landing facility
Highest fish use region and shoreform and documented forage fish spawning site.

Deer Harbor Road, West Sound, Orcas. High fish use region and shoreform and documented forage fish spawning site.

Point Lawrence and EJ Young Rds., Buck Bay Orcas
County Road and private road. High fish use region and shoreform.

Mud Bay Dock Rd., Lopez. County road end. High fish use region. Documented forage fish spawning.

Hunter Bay Dock, County road end, dock and ramp. High fish use region and shoreform. Documented forage fish spawning site.

Cameron Rd., Neck Point, Shaw. County Road. High fish use region and shoreform.

Sperry Rd., Shoal Bight Lopez. County and private road
Highest fish use region and high shoreform.

Decatur Head Drive, E. Decatur. County and private road.
Highest fish use region and high shoreform.

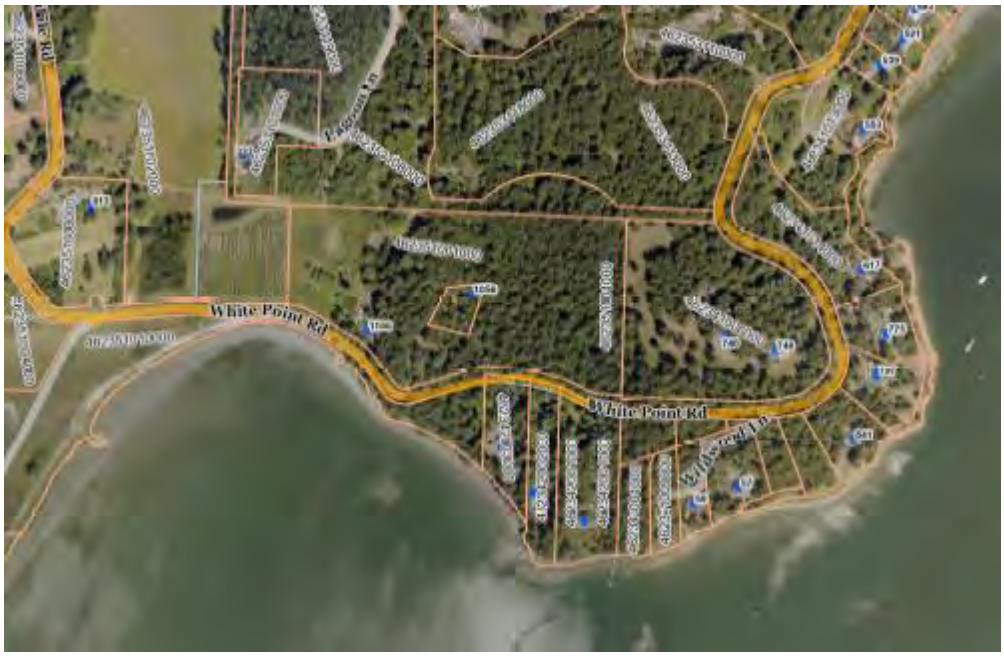
False Bay Drive, San Juan County road. High fish use region and shoreform.
Documented forage fish spawning site, priority bluff.

Jackson's Beach, San Juan. High priority fish use region and shoreform. Documented forage fish spawning.

Bayshore Rd, Lopez High fish use region and shoreform.

Fisherman Bay Rd., Lopez

Crescent Beach Rd., Eastsound, Orcas High priority region and shoreform, documented forage fish spawning.



White Point Rd., San Juan Highest priority region and high priority shoreform.

Reed Bay Rd, Decatur. High priority fish use region and shoreform. Priority bluffs. County and private roads.

Swift's bay, Lopez High priority fish use region and shoreform. Priority stream.

Thatcher Pass rd., Decatur. High priority fish use region and shoreform.

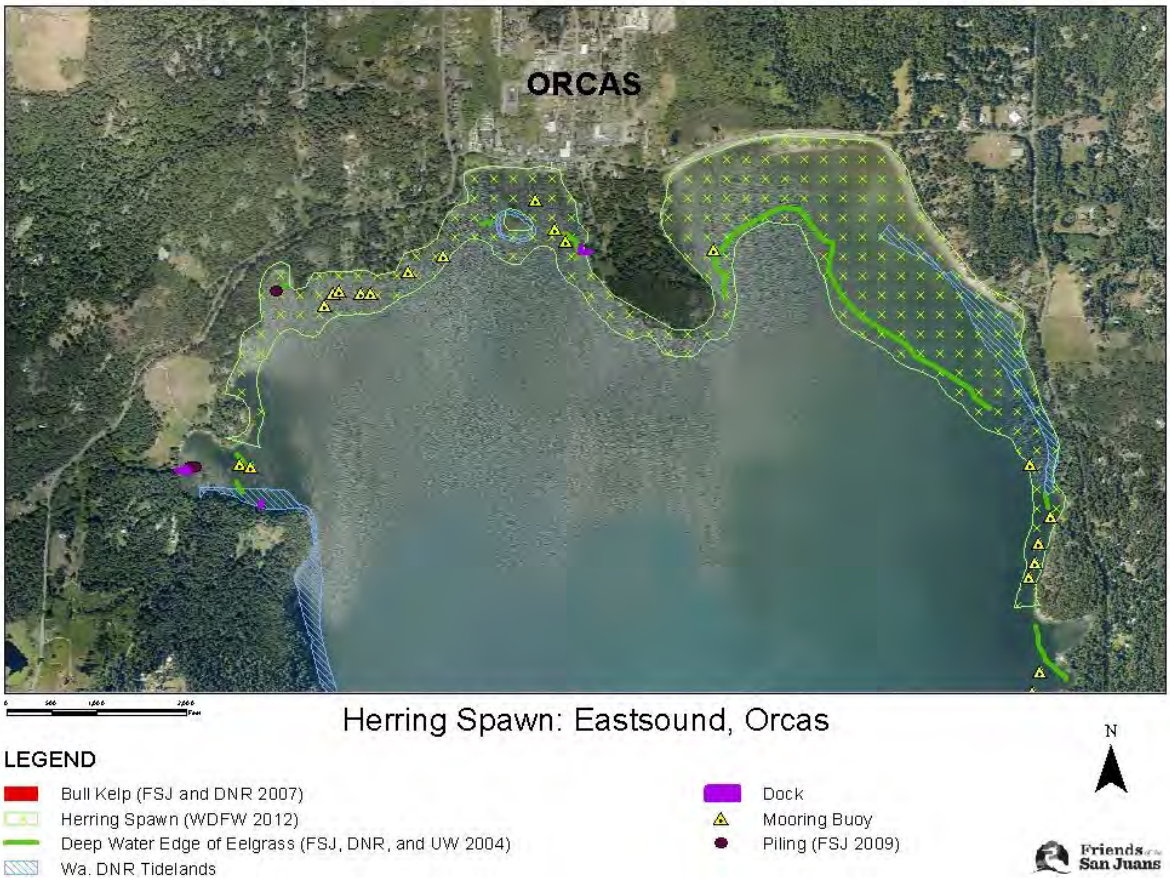
Watmough Head rd., McArdle Bay Lopez. Highest priority fish use region and shoreform.

Blind Bay, Shaw County road. Documented forage fish spawning, feeder bluffs.

Squaw Bay Rd., Shaw

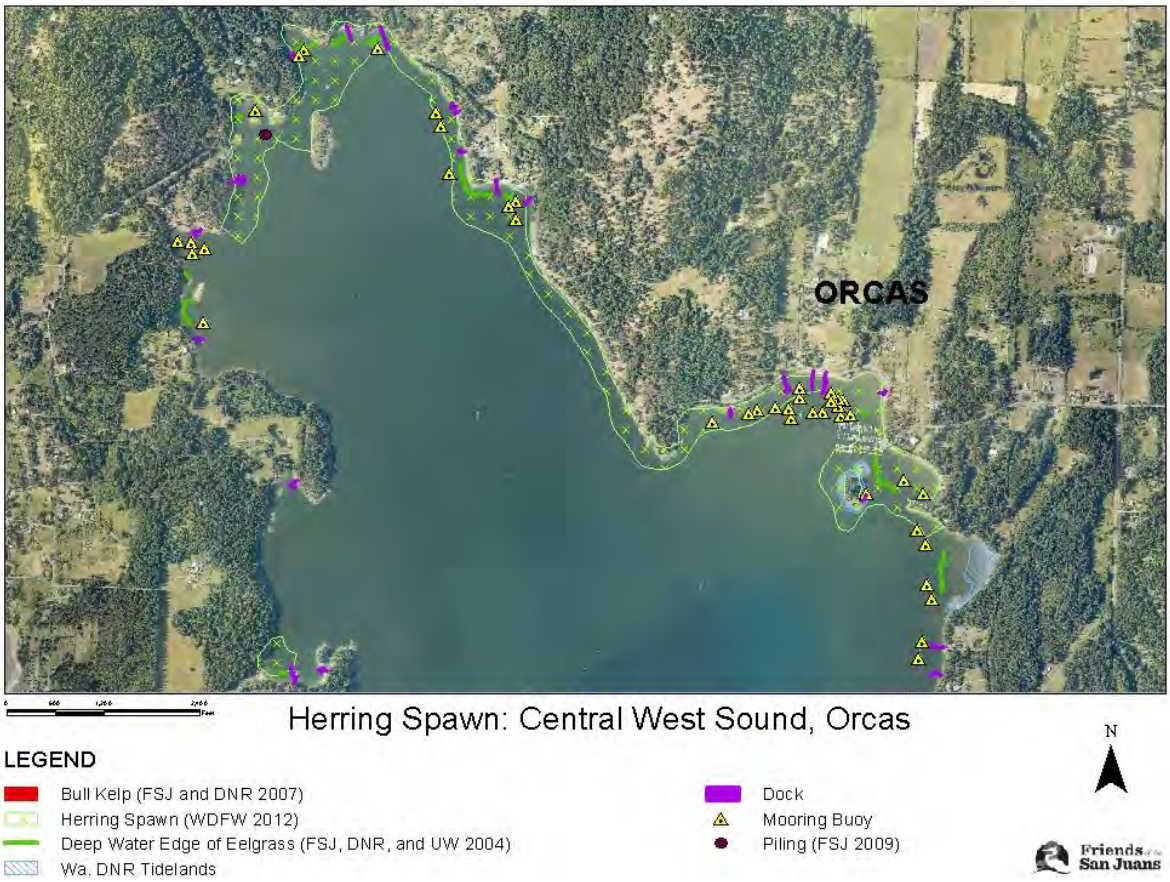
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

Eastsound, Orcas



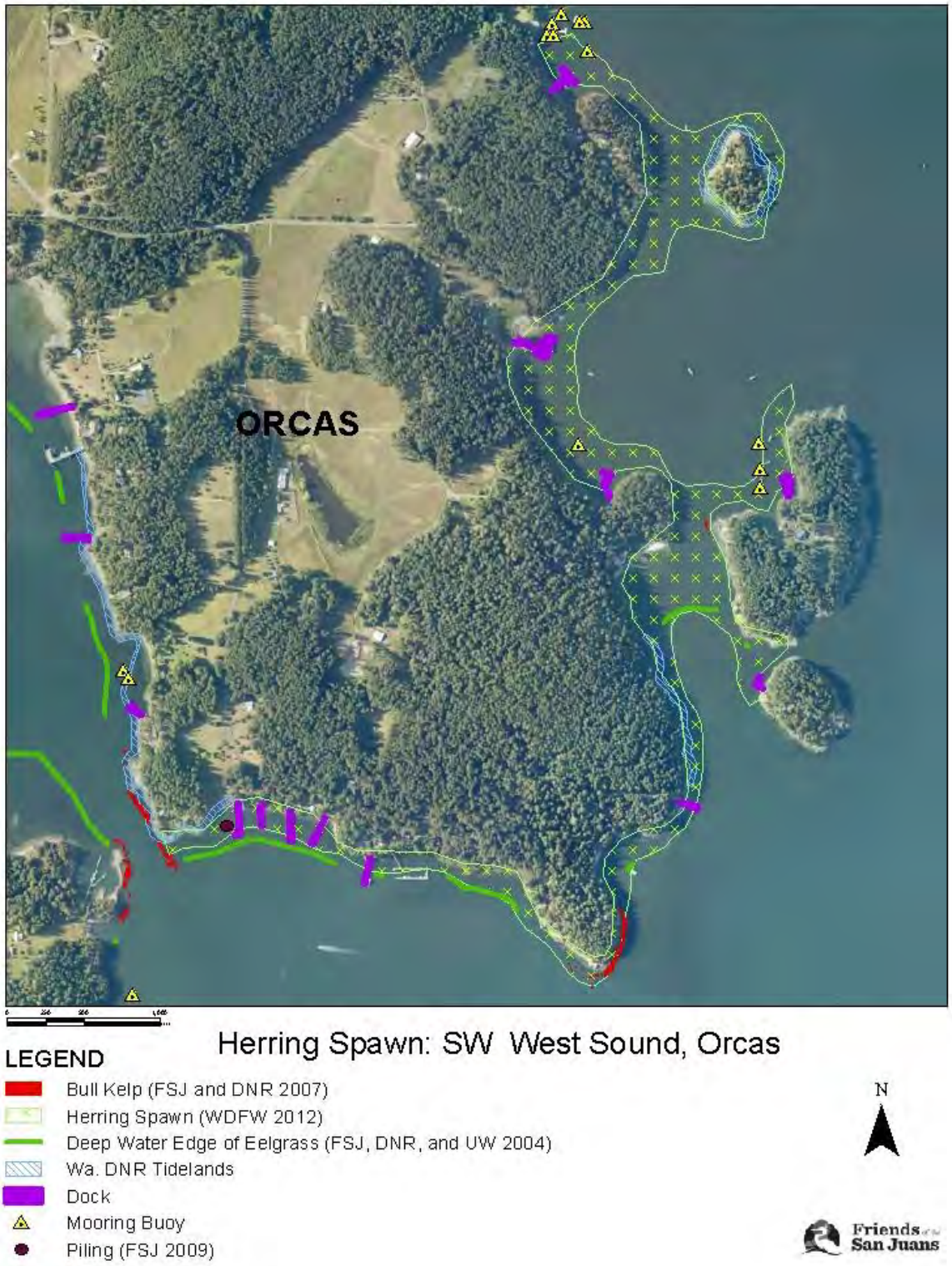
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

West Sound, Orcas



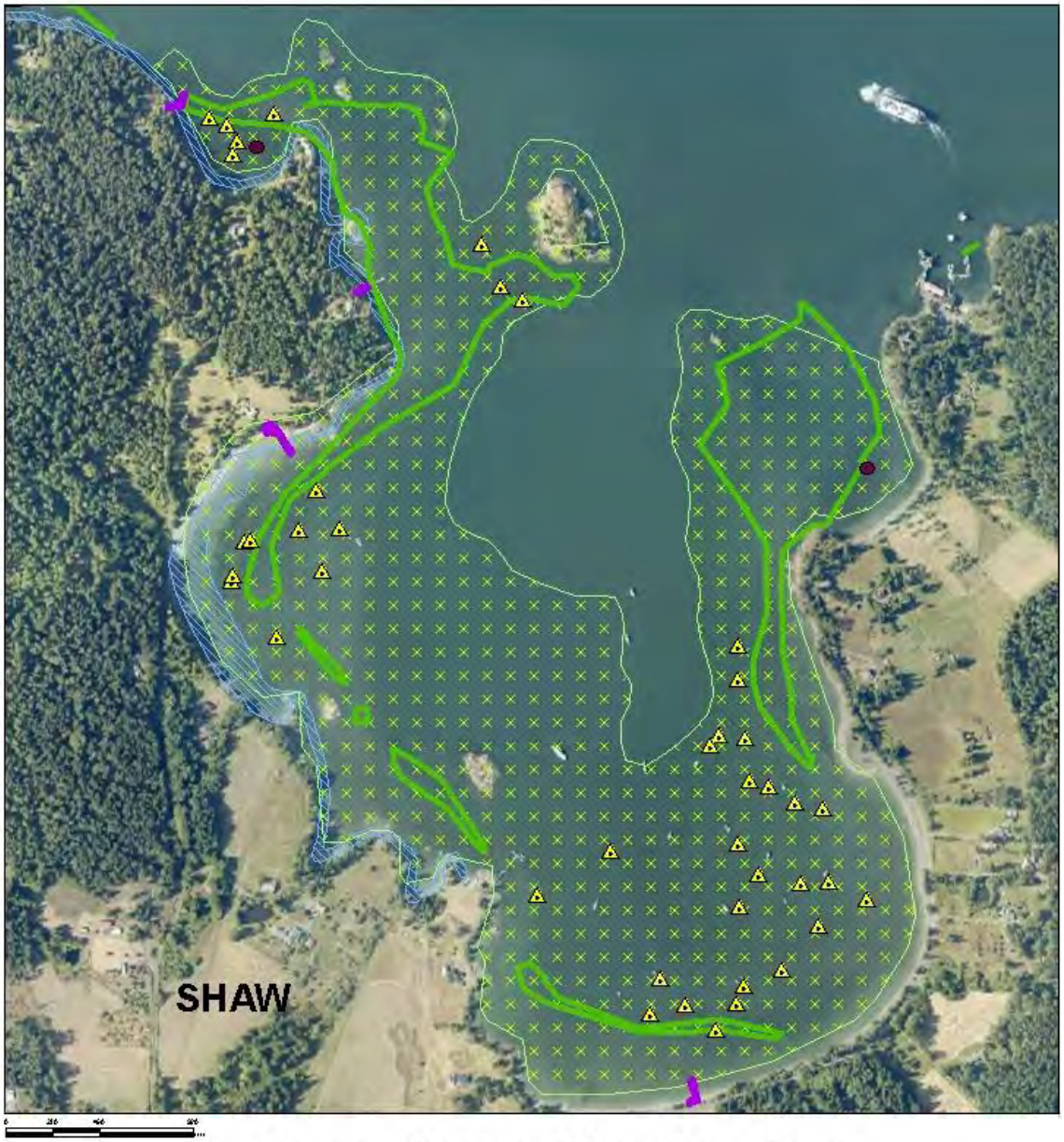
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

West Sound, Orcas



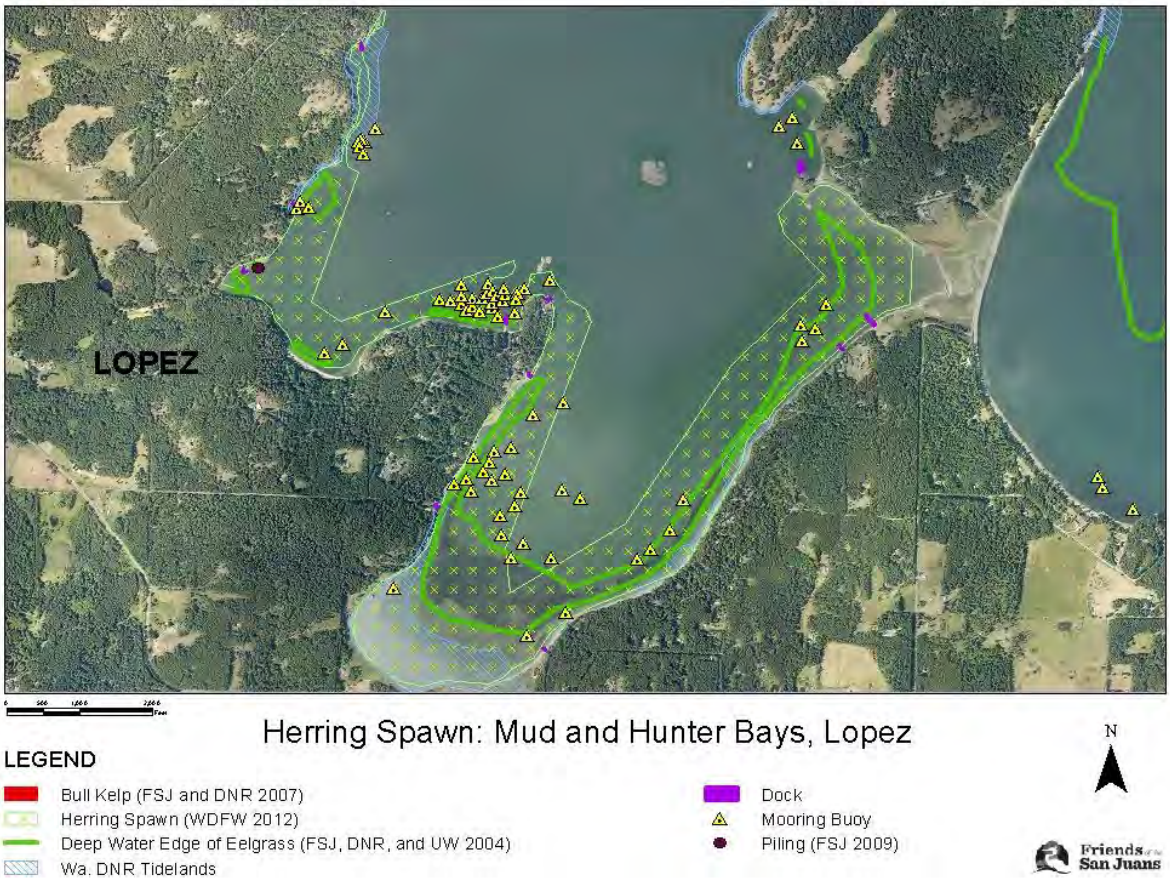
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

Blind Bay, Shaw



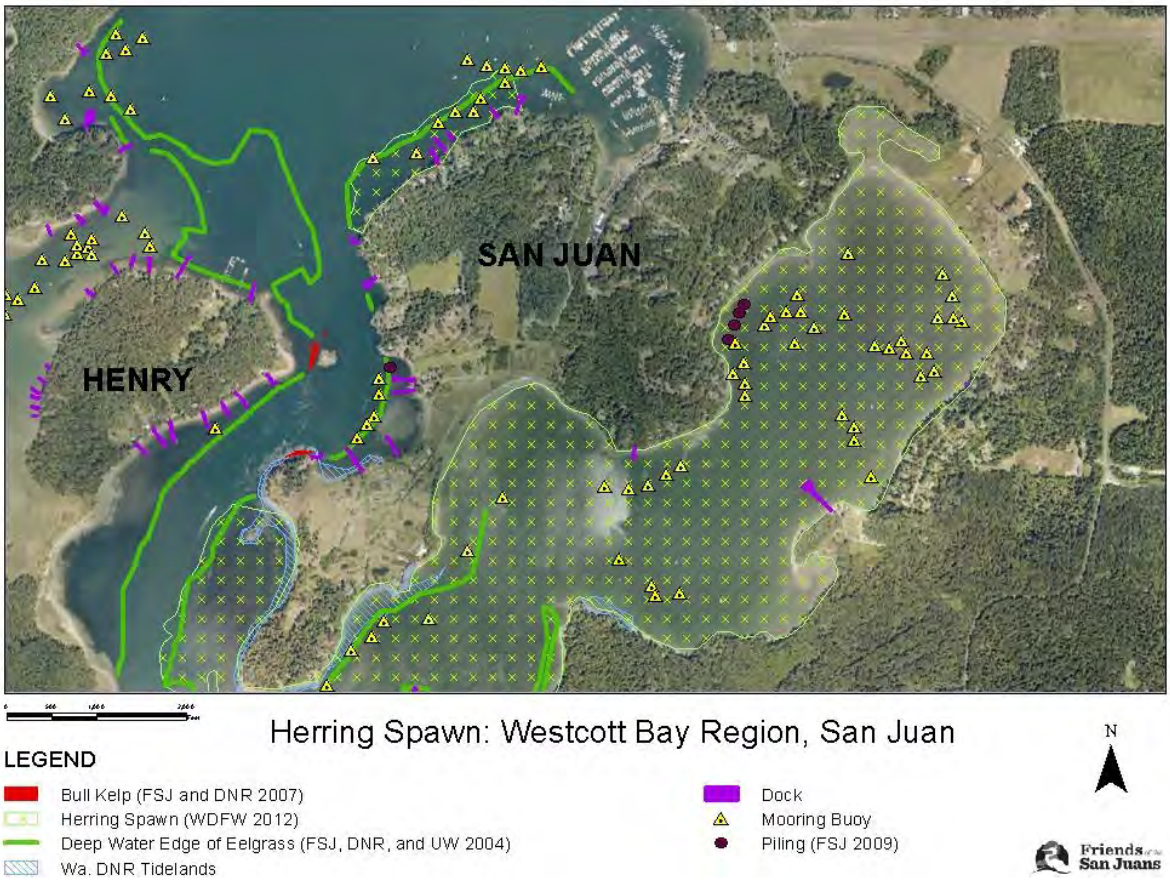
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

Mud and Hunter Bays, Lopez



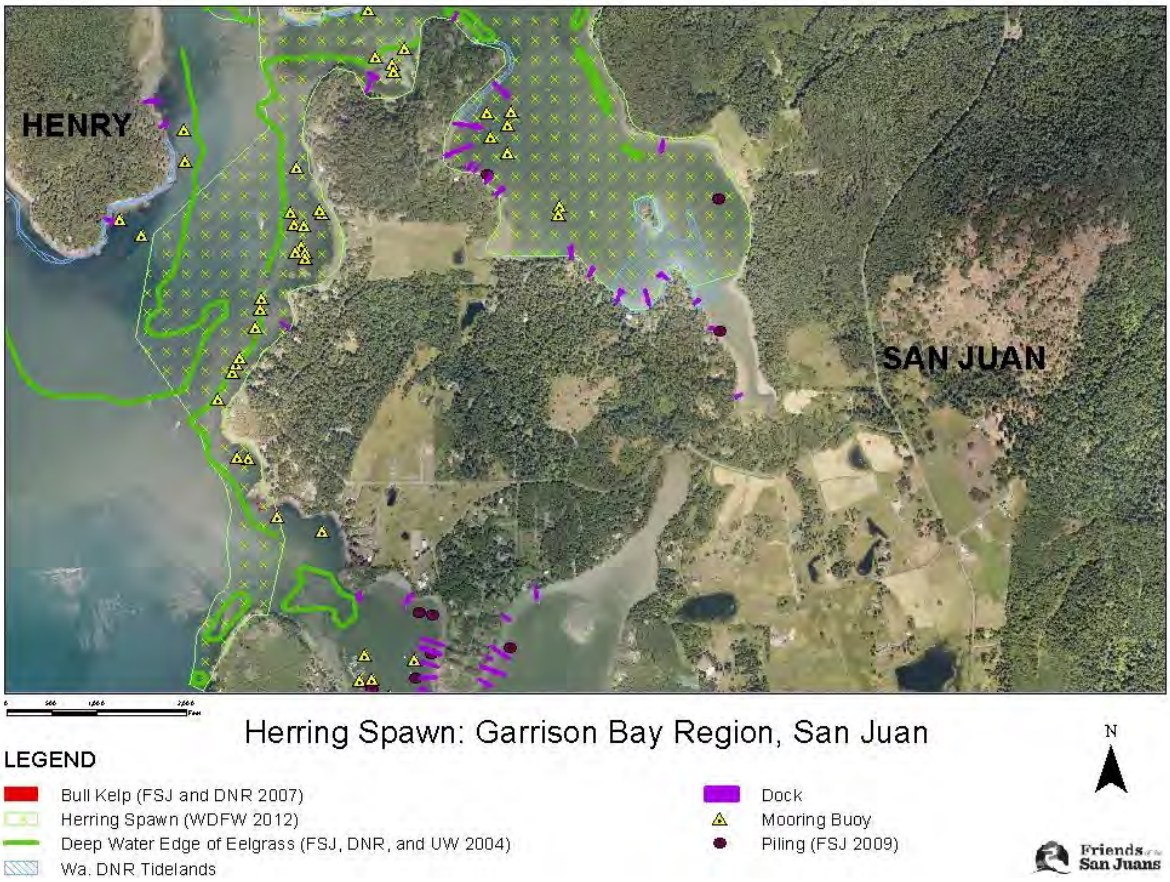
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

NW San Juan Island



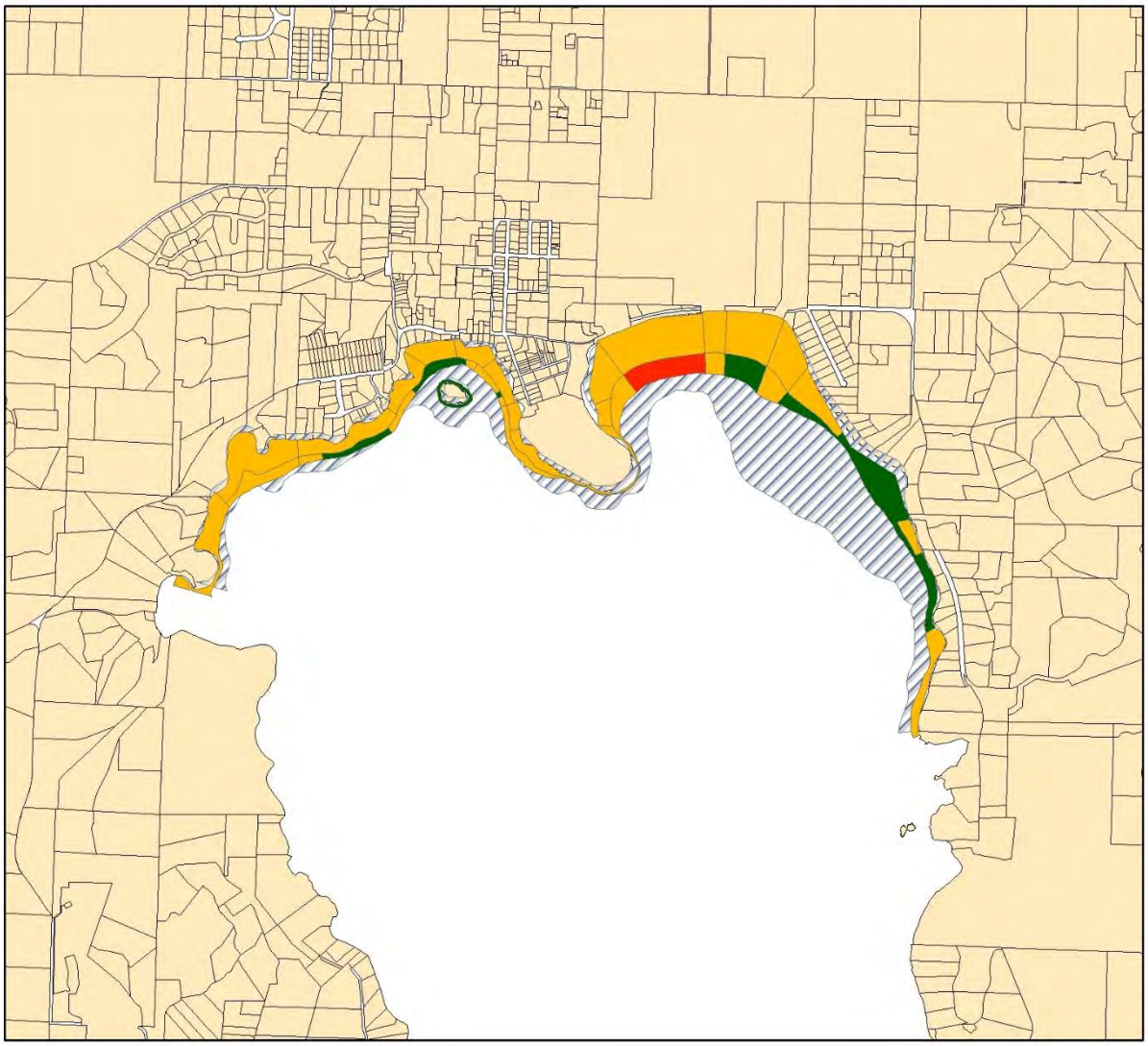
Appendix H. Restoration Opportunities- Pacific Herring Spawning Grounds

NW San Juan Island



Appendix I. Tideland Protection Opportunities- Pacific Herring Spawning Grounds

Eastsound, Orcas



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- STATE OF WASHINGTON
- UNDETERMINED
- DocHerringSpawningGround2012
- Parcel_Link

Document Path: C:\files\FOSJ\herring\HerringOwners2017\HerringOwners2017.mxd

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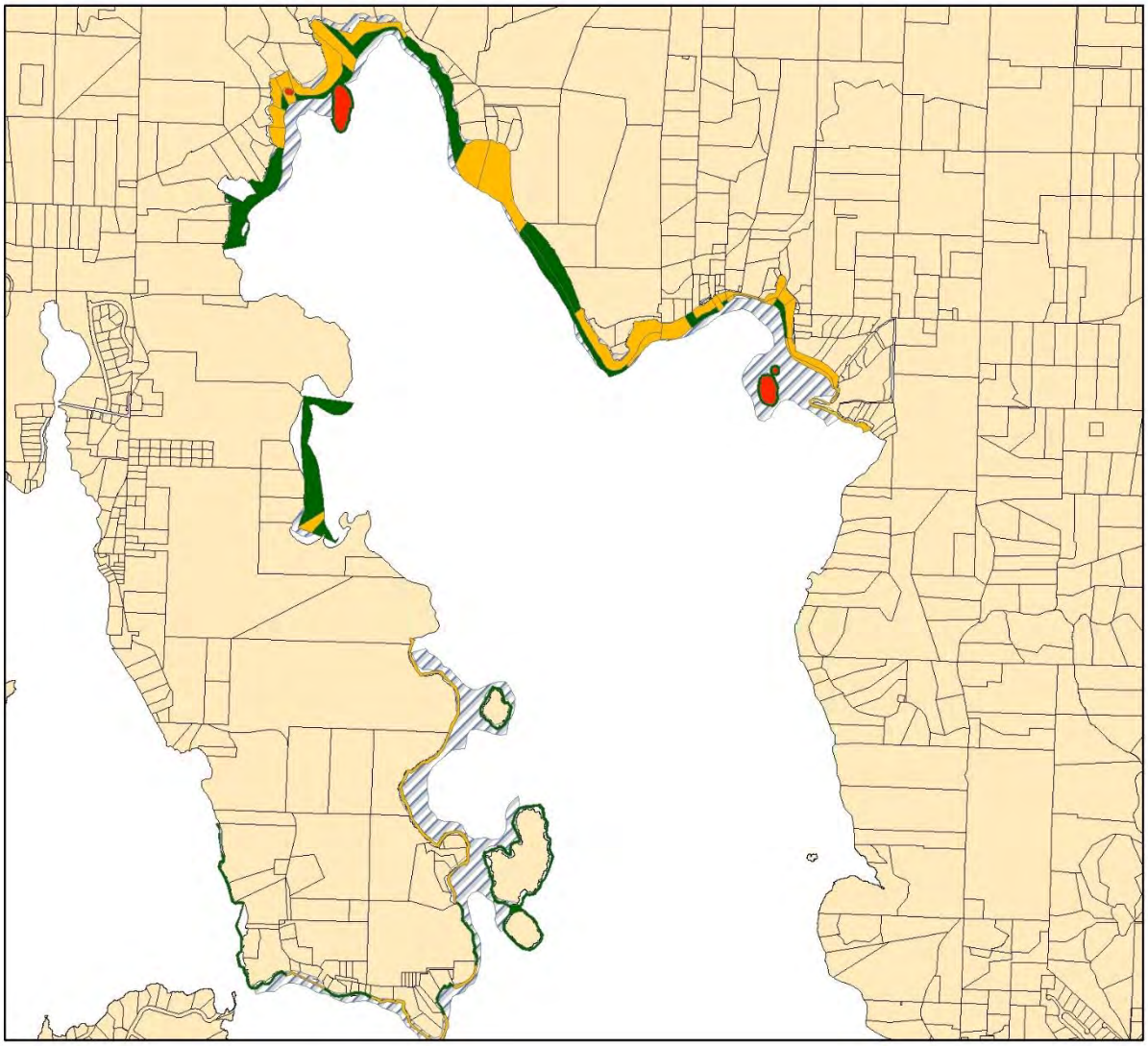
Appendix I. Tideland Protection Opportunities- Pacific Herring Spawning Grounds

West Sound, Orcas



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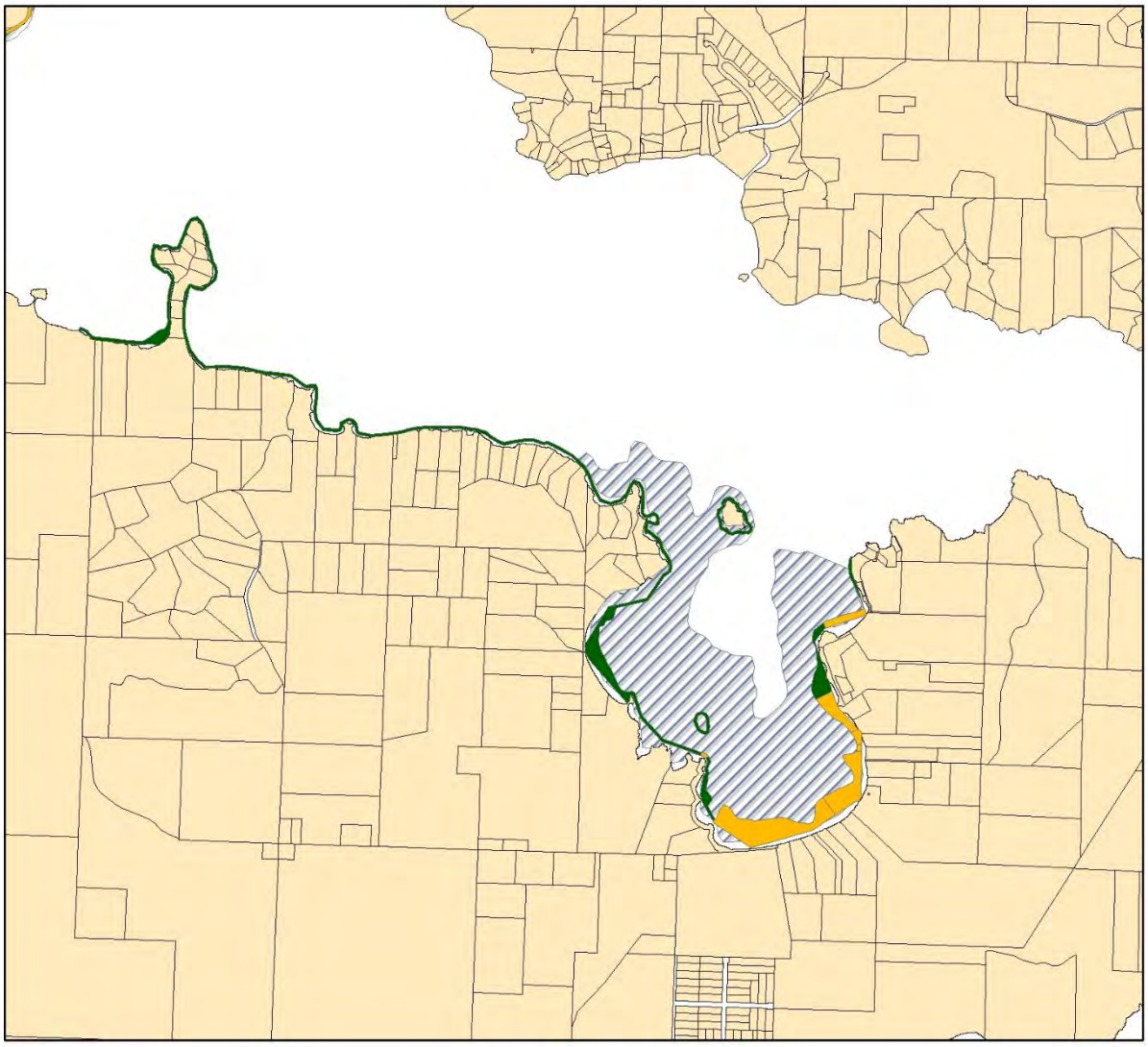
Appendix I. Tideland Protection Opportunities- Pacific Herring Spawning Grounds

Blind Bay, Shaw



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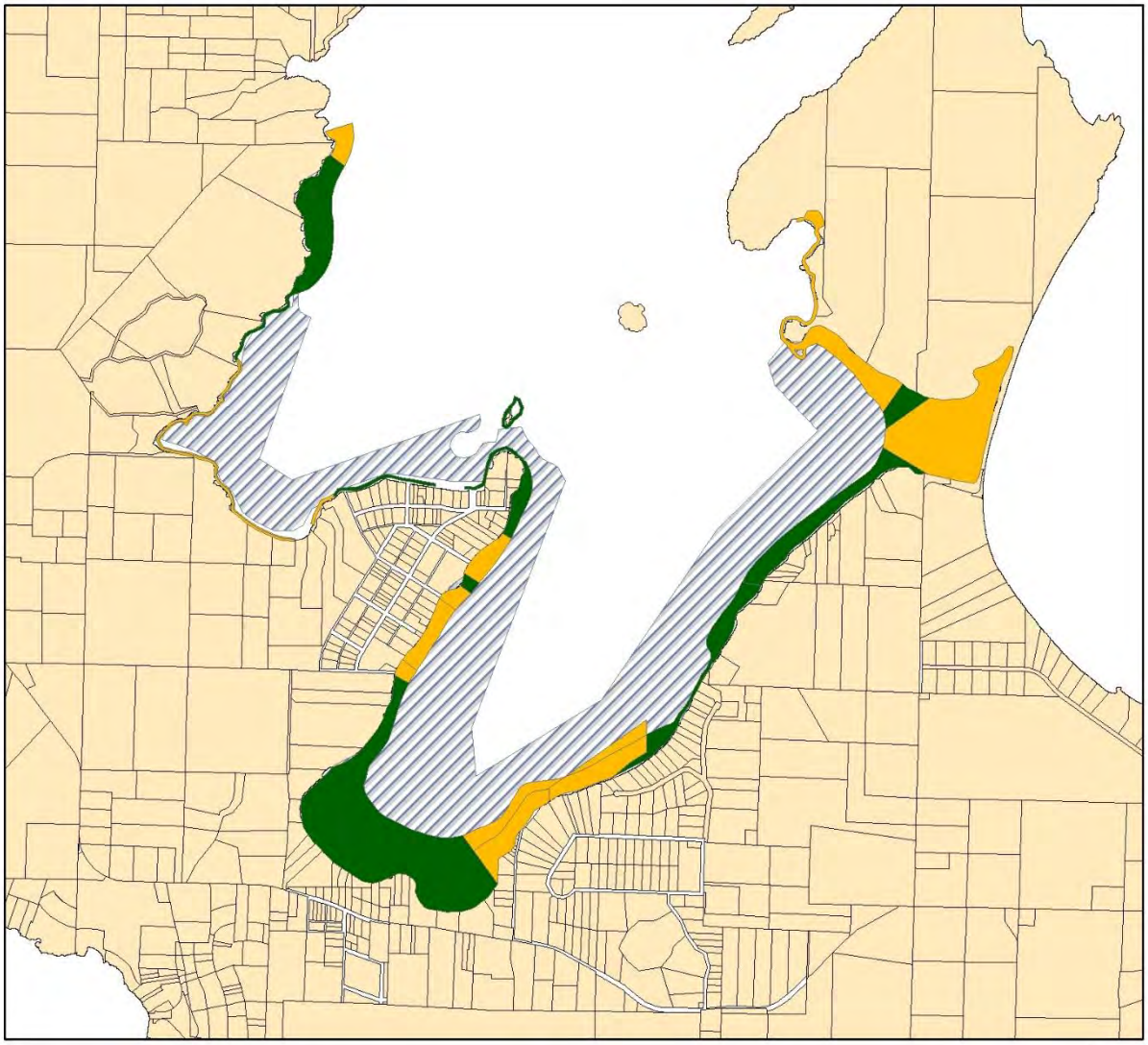
Appendix I. Tideland Protection Opportunities- Pacific Herring Spawning Grounds
Mud and Hunter Bays, Lopez



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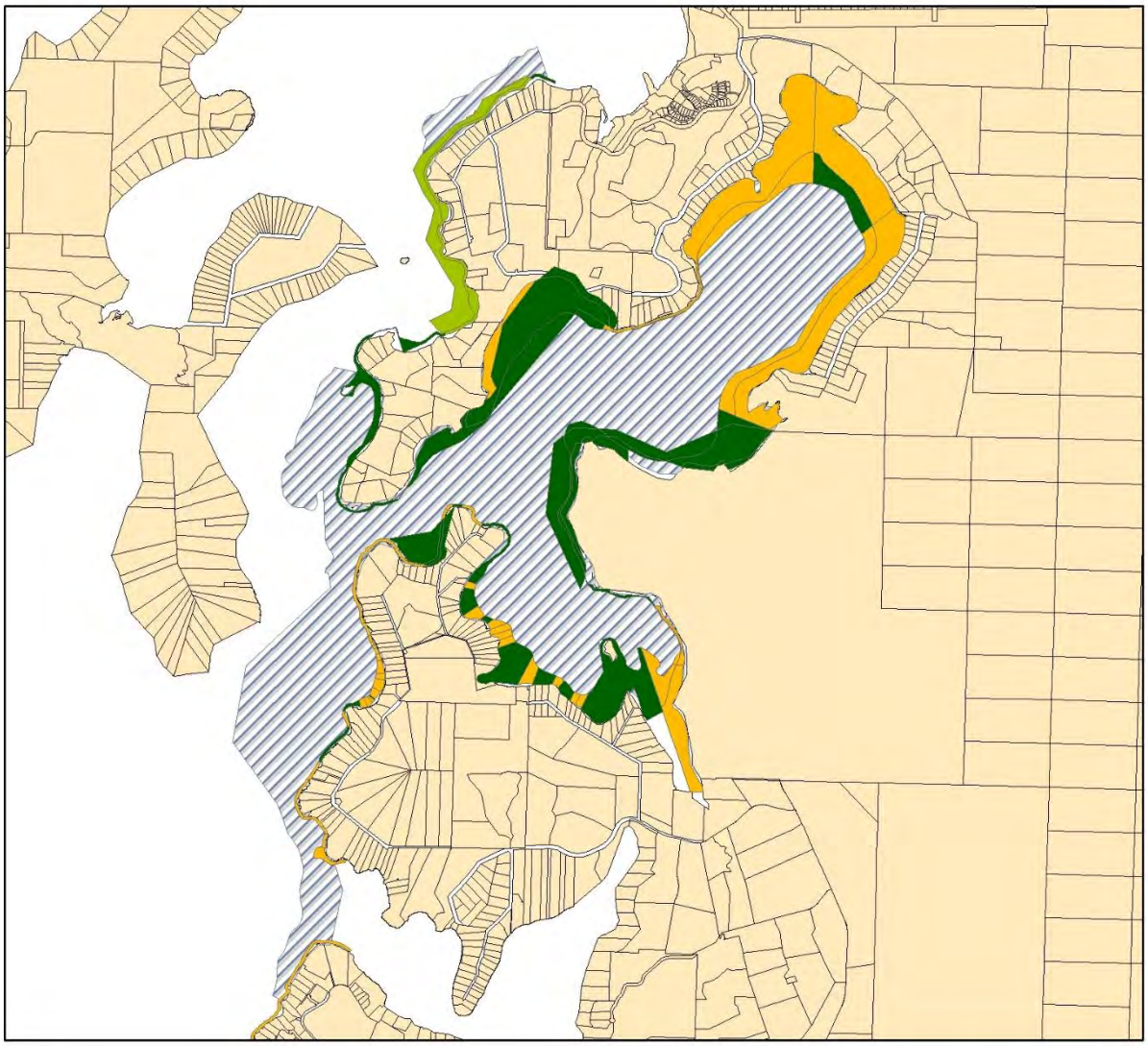
Appendix I. Tideland Protection Opportunities- Pacific Herring Spawning Grounds

NW San Juan Island



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