

Salmon Habitat Protection Blueprint for San Juan County, Washington



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Acknowledgements

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Salmon Habitat Protection Blueprint

Background

With over 400 miles of shoreline, located at the confluence of Puget Sound, Georgia Strait and the Strait of Juan de Fuca, San Juan County shorelines provide critical habitat for salmon and salmon prey. All 22 Puget Sound salmon stocks as well as multiple Fraser River and Georgia Basin salmon stocks utilize the diverse shallow water habitats of the San Juan Archipelago for feeding, resting, and migration. Forage fish including Pacific sand lance and surf smelt spawn and incubate eggs in the upper intertidal portions of sand and gravel beaches. Pacific herring, another key prey item in marine food webs spawn in shallow subtidal waters, primarily on eelgrass. Nearly 200 species of fish, birds, marine mammals and squids rely on the marine food web supported by shoreline habitat in the San Juans.

With approximately 50% of shoreline parcels still undeveloped, nearshore habitat protection remains the most important salmon recovery strategy for San Juan County. As the vast majority of shoreline property in San Juan County is privately owned, voluntary participation by shoreline landowners is an essential part of protecting and restoring the marine ecosystem.

During the past two decades, San Juan County's population has grown by over 40%. This unprecedented growth has resulted in significant adverse impacts to our sensitive nearshore ecosystems, threatening some of the most pristine shorelines remaining in the Puget Sound. Because forage fish and juvenile salmon depend on beach and shallow water habitats for their survival, they are vulnerable to the impacts of shoreline development. Primary threats to the nearshore includes activities such as home and dock construction, bulkheads and other shoreline armoring, marina expansion, vegetation removal, sedimentation, failing septic systems and improperly designed moorings in eelgrass beds. Nearshore habitat protection is the top strategy identified for San Juan County in the Puget Sound Chinook Salmon Recovery Plan.

As the majority of shoreline development activity in San Juan County occurs through incremental single-family residential development and individual shoreline alterations, the magnitude of impacts may become evident only cumulatively. Development pressures on shorelines are outpacing regulatory solutions to protecting shoreline habitat, and significant habitat losses continue to occur. Strategic, long-term protection of remaining high quality shoreline habitat, through voluntary participation with shoreline landowners, provides an excellent opportunity to address a primary threat to the marine ecosystem in the San Juans.

Habitat Protection Toolbox

In San Juan County, a number of voluntary conservation options are available to interested landowners including: the donation of land, placement of a conservation easement, or placement of property into Washington State's Open Space tax incentive program.

Acquisition: A Fee-Simple Acquisition occurs when a conservation group or public entity buys the entire property and all associated property rights outright. Sometimes these properties are referred to as *Preserves*. The San Juan County Land Bank and the San Juan Preservation Trust are the primary land conservation entities that actively pursue acquisition of land in San Juan County. Additional entities may also engage in acquisition of shoreline property in San Juan County, including county, state or national parks and private conservation groups like the Nature Conservancy.

Conservation Easements: Conservation Easements are legal, recorded documents that provide a versatile way to protect the key natural features of a property while the property remains in private ownership. Through a Conservation Easement, the land conservation entity and a property owner develop an agreement with a set of restrictions that state the type of activities that are and are not allowed on the land. Because the property remains in private ownership, there is not public access unless the owner desires it. Conservation easements can be donated or purchased. The restrictions apply "in perpetuity," meaning they stay with the property forever. An easement agreement may carry with it eligibility for a federal income tax deduction if it applies to land which provides public benefit by permanently protecting important conservation resources such as salmon habitat. Conservation easements can be one of the most cost-effective ways to preserve land. They benefit both landowners and the community, while costing less than outright acquisitions. The San Juan County Land Bank and the San Juan Preservation Trust are the primary land conservation entities holding conservation easements in San Juan County.

Tax Incentive Programs: The Washington State Open Space Taxation Act, enacted in 1970, allows property owners to have their open space, farm and agricultural, and timberlands valued at their current use rather than their highest and best use. The existing Washington State Open Space Taxation Act and associated San Juan County Open Space Ordinance provides an opportunity to protect significant nearshore marine resources through existing programs. Improved understanding of the significance of nearshore marine habitat, as well as detailed information on habitat features and priorities, is needed to expand implementation in the nearshore marine context. Results of the San Juan County Nearshore Protection Blueprint will be shared with county planning staff and committee members to expand application of the program to protection of priority nearshore marine resources.

Improved Land Management: Better understanding of nearshore marine resources, their values and functions and protection priorities can help improve management of important sites. A wide range of public agencies own or manage shoreline lands in San Juan County, including county, state and national parks. Multiple private organizations with conservation interests also participate in land management in the county. In addition to the Preservation Trust noted above, additional organizations such as The Nature Conservancy, the University of Washington, Washington State Parks and the Department of Natural Resources have large shoreline land holdings. Project results will be shared with public entities and other ownerships with conservation management interests, for incorporation into long-term property and resource management plans.

Voluntary Protection

Voluntary protection is an essential element of salmon recovery for San Juan County. To protect critical nearshore habitat values on both public and private properties, land managers and shoreline landowners need guidance on expanding terrestrially focused conservation efforts to improve protection of marine resources. In addition, use of a scientifically-based prioritization of sites will maximize ecological and economic effectiveness.

To achieve the most efficient and effective use of limited conservation resources, it is imperative to have improved information on which properties provide the highest values toward achieving marine habitat protection goals. *FRIENDS Salmon Habitat Protection Blueprint* will help San Juan County's conservation efforts be more strategic and successful.

Voluntary habitat protection programs provide an effective way to protect critical habitat values on both public and private lands. This project is designed to utilize existing easement, acquisition and incentive programs in San Juan County to address threats to San Juan County's priority shoreline properties before shoreline modifications and losses of vital nearshore resources occur. Project results are expected to play a key role in local salmon recovery efforts, guiding implementation of the top recovery strategy- protection of high quality nearshore habitat.

Project Partners

Friends of the San Juans partnered with the San Juan County Land Bank (Land Bank) and the San Juan Preservation Trust (Preservation Trust) to complete the *Salmon Habitat Protection Blueprint*. Friends of the San Juans managed the project, collaborated on all educational project elements and conducted all database development and detailed habitat, land use and landowner willingness analysis. Land Bank and Preservation Trust staff provided assistance in determining the prioritization criteria used, co-sponsored the shoreline landowner survey, co-hosted shoreline landowner workshops held on Orcas, San Juan and Lopez Islands and conducted a follow-up mailing to those landowners who expressed interest in additional information on long-term protection strategies through the shoreline survey. Members of San Juan County's Open Space Advisory Program participated in landowner workshops and provided insight on ways that program could be improved to expand shoreline habitat protection. The Land Bank and the Preservation Trust are each applying *Salmon Habitat Protection Blueprint* results to current organizational strategic planning efforts as well as to project scale management decisions.

Salmon Habitat Protection Blueprint Methods

The *Salmon Habitat Protection Blueprint* took a multi-pronged approach to the task of targeting shoreline protection. Existing biological, physical and land use data were analyzed and mapped to objectively identify high quality habitat sites at-risk of future shoreline modification. In addition, shoreline landowners were engaged through informational mailings, a shoreline landowner survey and community workshops. Landowner willingness results from the shoreline landowner survey were analyzed spatially with landscape, physical and biological data sets to prioritize the most important sites for protection.

Landowner Willingness

To evaluate shoreline landowner interest in voluntary conservation strategies such as conservation easements, shoreline stewardship guides and a shoreline property owner survey were mailed to all shoreline property owners. Nearly 800 completed surveys were returned, a response rate of over 16%. In addition to assessing interest in long-term protection of shoreline habitat, the survey also collected basic information on the properties values and threats. Information provided by participating landowners included physical characteristics of the site, habitat changes the landowner has observed over time and interest in long-term protection of tideland and shoreline habitat. Survey results were compiled into searchable and spatially explicit ACCESS and ARCGIS databases that can be used by land conservation entities as they target specific sites for inclusion in voluntary protection programs.

In addition, landowner willingness survey results were used in the *Salmon Habitat Protection Blueprint* analysis to help prioritize parcels for protection. Over 130 individual landowners expressed high interest in learning more about long-term protection programs for 192 discrete shoreline properties, with another 169 landowners expressing moderate interest in shoreline conservation easements. In addition, over 150 landowners were interested in protecting their tidelands in perpetuity; over 200 tideland properties are represented by these landowners.

For a summary of Shoreline Landowner Survey Results, see Appendix G. Map 5 and Appendix H provide additional information on the location of shoreline and tideland parcels with landowners interested in long-term protection.

Physical and Biological Habitat Factors

A combination of factors were used to further refine identification and prioritization of shoreline sites for voluntary protection, including current development status, risk of future shoreline modification, landowner interest and nearshore habitat value. The highest value was assigned to those habitat features and processes most tightly linked by best available science to salmon recovery. Data applied to the prioritization of shoreline habitats included spatially explicit information on juvenile salmon presence, known forage fish spawning beaches, herring spawning grounds, eelgrass prairies, bull kelp beds, freshwater resources including coastal wetlands and streams and significant geologic features including class one, accretionary beaches and unstable, feeder, bluffs.

In addition, to further inform shoreline habitat protection efforts, information on additional nearshore dependant wildlife species and habitats were incorporated where county-wide data sets were available, including seal haulouts, eagle nests and seabird sites. Inclusion of these non-salmonid habitat features supports an ecosystem approach to shoreline habitat protection and provides the detailed, site specific information needed to ensure the most appropriate conservation and management measures are applied.

For details on the factors and ranking used to identify very high, high and moderate priority habitats in the Salmon Habitat Protection Blueprint project analysis, please see Appendices C through F.

Land Use Datasets

In addition to the extensive habitat datasets applied to the Salmon Habitat Protection Blueprint analysis, a variety of San Juan County and Friends of the San Juans land use datasets were also applied. These included, but were not limited to, information on shoreline parcel size, waterfront length, property value, developed status, presence of shoreline modifications, ownership, zoning designation and adjacency to currently protected shoreline sites. The combination of biological, physical, land use and social (landowner willingness) datasets greatly enhances the value of *the Salmon Habitat Protection Blueprint* prioritization process, identifying those sites that are at-risk, have the highest habitat value and have a high likelihood of successful long-term protection as a result of landowner interest in conservation of their shoreline habitat. The detailed, site specific data on land use, landowner interest and habitat value also provides the explicit information needed by land conservation organizations to effectively target and implement long-term habitat protection.

For details of the data sets and hierarchical modeling approach employed by the Salmon Habitat Protection Blueprint Project, please see Appendices L and M.

Hierarchical GIS Modeling Approach

To manage the large volume of underlying and intermediate datasets and individual and cumulative analyses involved in the *Salmon Habitat Protection Blueprint* identification and ranking of priority shoreline sites for long-term protection to enhance salmon recovery efforts, a hierarchical, modular modeling approach was employed, utilizing Arc GIS 9.2. The modular approach was used in part to address limitations of available geoprocessing tools, but also to support quality assurance at each project step, verification of results if questions arise in the future and to allow branching of the analytical process as necessary. In addition, each data layer along the hierarchy potentially provides useful information to organizations working to implement shoreline land conservation and salmon recovery efforts in the San Juan Archipelago.

Summary statistics and project maps can be determined for each individual model, as well as for the more complex, final prioritization that merges multiple previous analyses. For a detailed description of the project approach see Appendix K: GIS methodology and Appendix M: Hierarchical Analysis.

Salmon Habitat Protection Blueprint Results

At each level of the hierarchical, spatially explicit analysis conducted, summary statistics, maps and detailed parcel-specific information is available to inform shoreline habitat protection and salmon recovery efforts in the San Juan Archipelago. In addition, additional models build on previous analyses, providing increasing levels of refinement to the protection prioritization of habitat. The results incorporate physical, biological, landscape, land use and social data, providing an objective analysis of habitat protection priorities that directly supports ecologically effective and economically efficient implementation.

Non-Impacted Sites

In the initial stages of identifying priority shoreline sites for protection using existing conservation strategies, analysis of shoreline parcels was conducted to identify intact sites. While many shoreline sites with existing structures also likely deserve attention, the focus of those efforts would be restoration, not protection. For the purposes of the *Salmon Habitat Protection Blueprint*, ‘non-impacted sites’ were defined as “all shoreline parcels without docks, bulkheads, improved boat ramps or structures within 200 ft of the shoreline and not in commercial or industrial zoning”.

All parcels without a major shoreline modification such as a dock, bulkhead, seawall, jetty, boat ramp or marine railway were identified and mapped. Of the 5,701 shoreline tax parcels in San Juan County, 3,009 (53% of parcels, representing 240 miles of shoreline) do not currently have a major shoreline modification and were classified as ‘non-impacted sites’ for the purposes of the *Salmon Habitat Protection Blueprint*. This large percentage of remaining, shoreline sites without structures highlights the significant protection opportunity that exists in San Juan County. Orcas Island has the largest percentage of non impacted sites county-wide (27% of non-impacted shoreline parcels are located on Orcas), and the outer islands have the largest percentage of parcels in non-impacted category, 60% of outer island parcels are currently without shoreline modifications.

See Table 1. for county-wide information on ‘non-impacted sites’. For a breakdown of ‘non-impacted sites’ by island, see Appendix B. For the location of ‘non-impacted’ shoreline parcels county-wide, see Map 1.

Protected Status

San Juan County has multiple active land conservation organizations and many shoreline properties are already in some form of shoreline protection. For the purposes of the *Salmon Habitat Protection Blueprint*, ‘protected shoreline sites’ were defined as “shoreline parcels in either: the San Juan County Open Open Space Tax Incentive Program; San Juan Islands Preservation Trust Easement or Ownership; San Juan County Land Bank Easement or Ownership; The Nature Conservancy Ownership or University of Washington ownership”. While other ownerships offering some shoreline habitat protection do exist, such as Parks, the multiple mandates of those land managers often result in sites with varying levels of shoreline habitat impact and thus they were not included as protected sites in this project.

Shoreline parcels already protected by conservation ownership, a conservation easement, or enrollment in the open space tax-incentive habitat protection program were identified and mapped. ‘Protected’ status was assigned to 254 shoreline parcels, representing 50 miles of shoreline, based on ownership by the University of Washington or The Nature Conservancy; ownership or easement with the Land Bank or Preservation Trust; or enrollment in the County’s open space tax incentive program. Four percent of shoreline tax parcels are currently protected. The highest percentage of protected shoreline parcels county-wide are located on Orcas (30%), followed by Lopez (22%), San Juan Island (20%), the Outer Islands (18%) and Shaw (10%).

See Table 1. for county-wide information on ‘*protected sites*. For a breakdown of ‘*protected sites*’ by island, see Appendix B. For the location of ‘*protected*’ shoreline parcels county-wide, see Map 2.

At-Risk Sites

To further refine analysis and prioritization of shoreline parcels for long-term protection, sites at-risk to future development were identified and used as the foundation of further detailed analysis. For this project, ‘*At-Risk Sites*’ were defined as *all of the non-impacted sites (see above) that are also not already protected (see above)*. Of the 5,701 shoreline tax parcels in San Juan County, 2,755, or 48% of all shoreline parcels, met the criteria of at-risk. The greatest percentage of at-risk shoreline parcels are located on the outer islands (27%), followed closely by Orcas (26%), Lopez (23%) and San Juan island (20%). Shaw Island made up a much smaller percentage of at-risk parcels by parcel number, with just 4% (103 parcels) of at-risk parcels in San Juan County. Total of shoreline waterfront length at-risk includes 202 miles.

Of the 2,755 at-risk shoreline tax parcels, just 8% (231) are parcels greater than 10 acres, with the remaining 92% (2,527) parcels less than 10 acres in size. To inform protection efforts and identify appropriate conservation tools (easement versus acquisition) at-risk sites were also categorized as developed and undeveloped. One third of at-risk shoreline sites (n=913) are located on developed properties and potential conservation easement opportunities. The remaining two-thirds of at-risk shoreline tax parcels (1,845) are located on undeveloped shoreline properties, providing conservation opportunities through a variety of existing protection tools, including easements, and tax incentive programs.

See Table 1. for county-wide information on ‘*at-risk*’ sites. For a breakdown of ‘*at-risk shoreline sites*’ by island, see Appendix B. For the location of ‘*at-risk*’ shoreline parcels county-wide, see Map 3.

Table 1. Shoreline Parcel Characteristics

Shoreline Parcel Characteristics	# shoreline parcels	% shoreline parcels	Shoreline miles
Shoreline Parcels in San Juan County	5,701	100%	400 + miles
Non-Impacted Shoreline Parcels (parcels without shoreline modifications)	3,009	53%	240 miles
Protected Shoreline Parcels (conservation ownership or easement)	254	0.4%	50 miles
At-Risk Shoreline Parcels (no shoreline modification, not protected)	2,755	48%	202 miles

Prioritization of At-Risk Sites

At-risk sites were then used as the foundation for extensive additional analysis and prioritization based on multiple factors including nearshore habitat value, physical condition, and landowner interest. Nearshore habitat value was broken into very high, high

and moderate priority categories, utilizing multiple combinations of presence of the following known important habitat features: forage fish spawning beaches, Pacific herring spawning grounds, eelgrass prairies, kelp beds, coastal wetlands, coastal streams, accretionary beaches, feeder bluffs, seal haulouts, eagle nests, seabird sites and juvenile salmonids (See Table 2 and Appendices C, D, E and F for details of priority habitat categorizations and parcel statistics; locations of Very High Priority Habitats are shown county-wide in Map 4.). Additional factors incorporated into analysis of at-risk sites with priority habitats included: parcel size, waterfront length, adjacency to existing protected sites, development status of parcel, parcel value and landowner interest in long-term protection of shoreline habitat based on survey results (see Appendices I and J).

Table 2. Priority Nearshore Habitat Categories

Very High Priority Habitat Categories	# of Parcels
Parcels with Forage Fish Spawning and Coastal Wetlands	119
Parcels with Juvenile Salmon and Coastal Wetlands	205
Parcels with Forage Fish Spawning Beaches, Coastal Wetlands and Juvenile Salmon	38
Parcels with Feeder Bluffs and Forage Fish Spawning Beaches	121
Parcels with Feeder Bluffs and Juvenile Salmon	305
Parcels with Forage Fish Spawning Beaches, Feeder Bluffs and Juvenile Salmon	33
Parcels with Eelgrass or Bull Kelp and Juvenile Salmon	1346
Parcels with Eelgrass or Bull Kelp and Forage Fish spawning beaches	488
Parcels with Eelgrass or Bull Kelp and Juvenile Salmon and Forage Fish Spawning Beaches	204
High Priority Habitat Categories	
Parcels with Forage Fish Spawning Beaches and Pacific Herring Spawning Grounds	945
Parcels with Juvenile Salmon (freshwater or marine)	2428
Parcels with Priority Aquatic Vegetation (eelgrass or bull kelp) and Priority Freshwater Habitats (coastal wetland or stream) and Priority Geologic Feature (accretionary beach or feeder bluff)	83
Parcels with Priority Aquatic Vegetation (eelgrass or bull kelp) and Priority Wildlife Habitat (seal haulouts or seabird sites or eagle nests)	392
Parcels with Priority Geologic Feature (accretionary beach or feeder bluff) and Priority Wildlife Habitat (seal haulouts or seabird sites or eagle nests)	45
Parcels with Priority Freshwater Habitats (coastal wetland or stream) and Priority Wildlife Habitat (seal haulouts or seabird sites or eagle nests)	33

Moderate Priority Habitat Categories	
Parcels with Priority Aquatic Vegetation (Eelgrass or Bull Kelp)	3375
Parcels with Priority Freshwater Habitats (Coastal Wetland or Stream)	406
Parcels with Priority Geologic Features (Class One, Accretionary Beach or Unstable, Feeder Bluffs)	699
Parcels with Priority Nearshore Bird Habitat (Seabird Site or Eagle Nest)	466
Shoreline Parcels with Seal Haulouts	131

Priority Shoreline Sites for Protection

Project results directly support strategic conservation efforts because of the detailed information they provide on species and habitats, site characteristics and landowner willingness. For example, the highest ranked shoreline sites for protection were defined as: at-risk parcels with very high priority nearshore habitat values, with a shoreline landowner who has expressed interested in long-term habitat protection. This highest level of protection priority includes just two parcels on Shaw Island and one on San Juan Island. Of these, one is greater than 10 acres, none have been developed with houses yet, all three have waterfront lengths of less than 1,000 feet and all three are adjacent to a shoreline parcel that is already protected (See Table 3, Appendices I and J and Map 6 for very high protection priorities).

The next layer of analysis identified at-risk sites with high priority habitat and landowners interested in long-term protection strategies. This high level of protection priority includes 119 shoreline parcels, five of which have waterfront lengths of over 1,000 feet and nine of which are greater than 10 acres. Ten of these high priority shoreline sites are located adjacent to shoreline parcels that are already protected. Of these high protection priority parcels, 73 have not yet been developed with houses (and as a result are candidates for acquisition or easement) and 43 have homes on the site but no shoreline structures and would be good candidates for voluntary long-term protection through a conservation easement or participation in the Open Space tax incentive program. (See Table 3, Appendices I and J and Map 6 for high protection priorities).

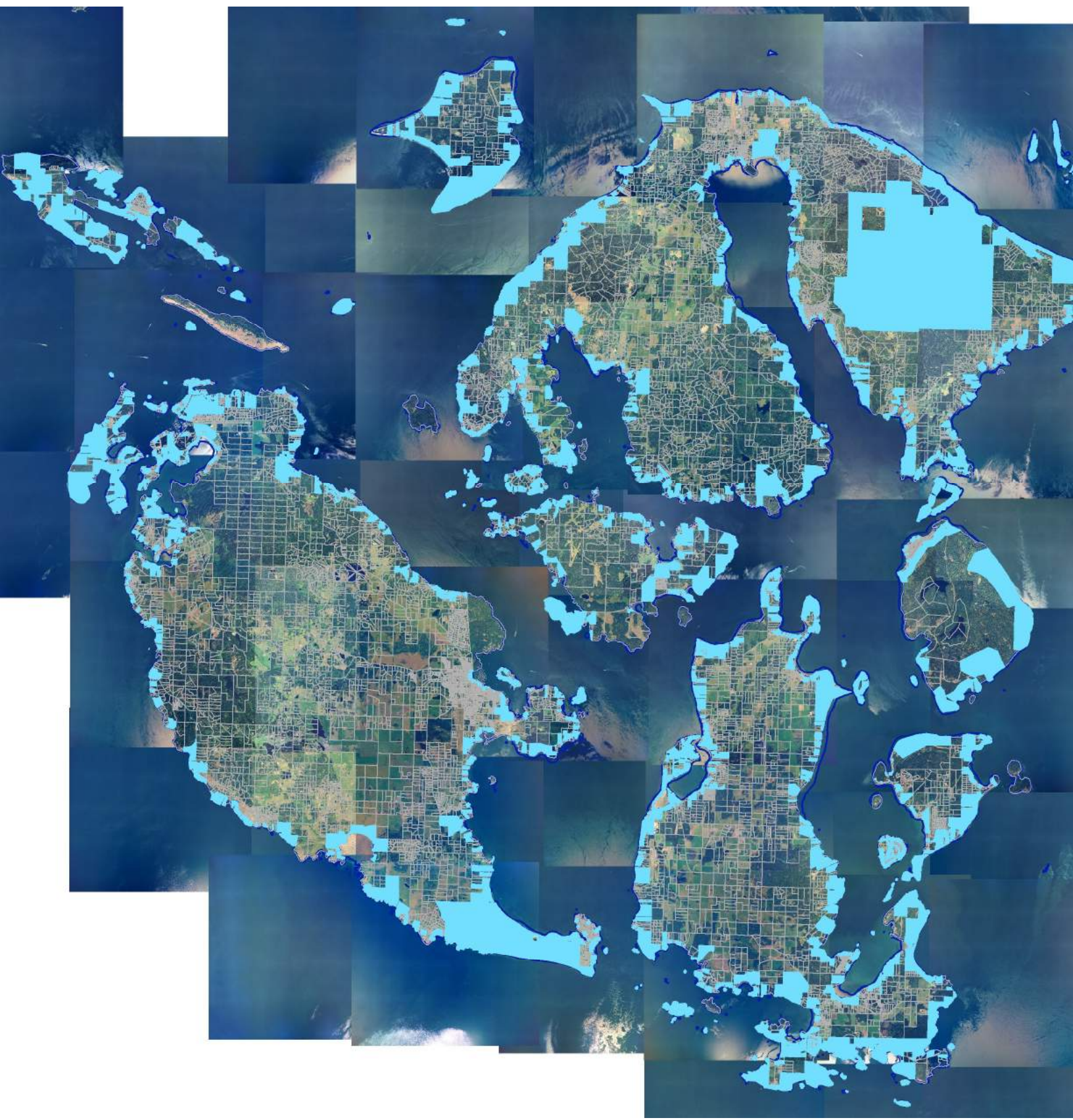
The final prioritization analysis identified at-risk sites with medium priority habitat and landowners interested in long-term protection strategies. This moderate level of protection priority includes 155 shoreline parcels, 6 of which have waterfront lengths of over 1,000 feet and 10 of which are greater than 10 acres. Seven of these moderate protection priority parcels are located adjacent to shoreline sites that are already protected. Of these moderate protection priority parcels, 91 have not yet been developed with houses (and as a result are candidates for acquisition or easement) and 64 have homes on the site but no shoreline structures and thus would be good candidates for voluntary long-term protection through a conservation easement or participation in the Open Space tax incentive program. (See Table 3, Appendices I and J and Map 6 for moderate protection priorities).

Table 3. Priority Shoreline Sites for Protection

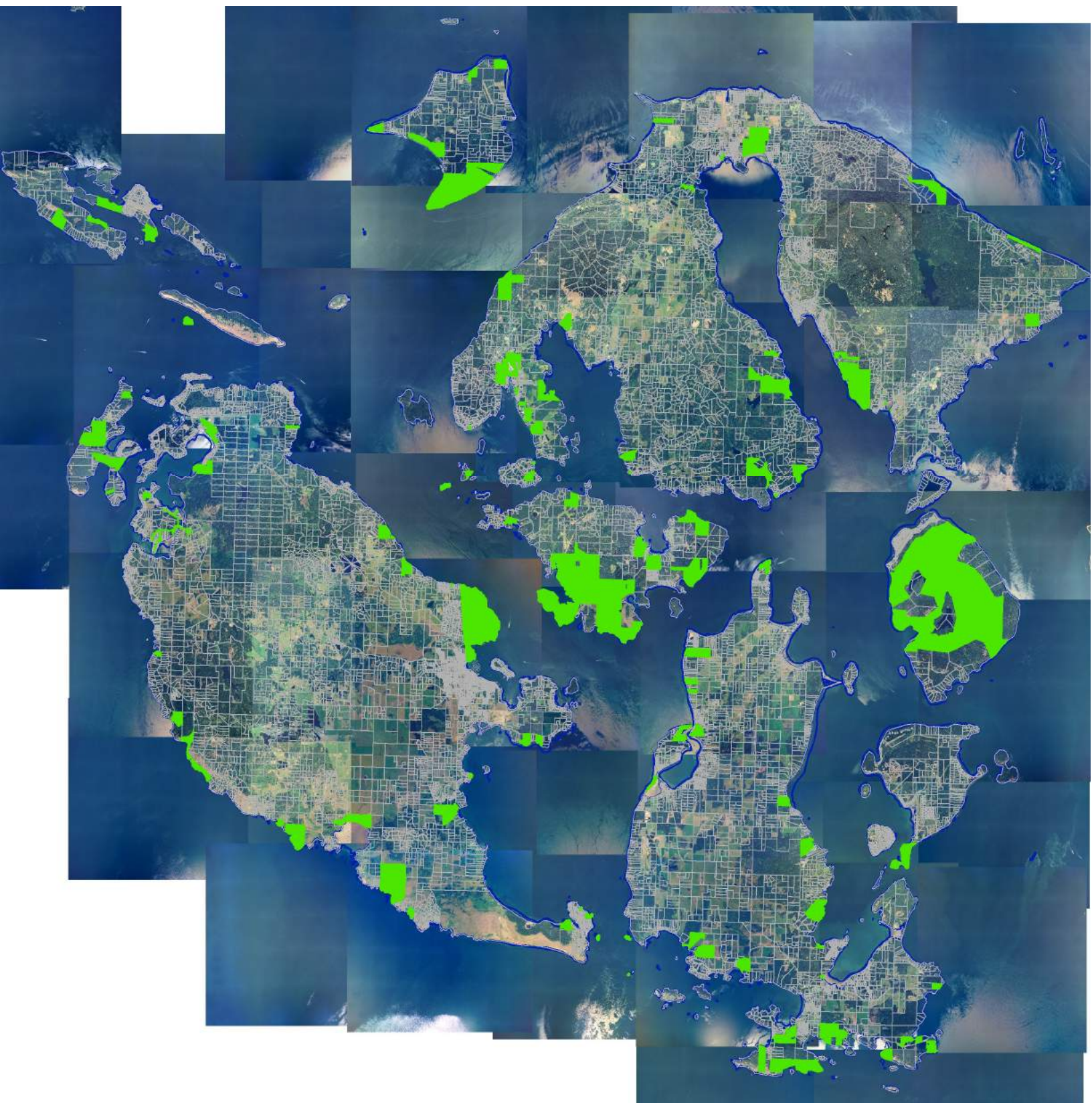
<i>Priority Shoreline Sites for Protection</i>	<i># shoreline parcels</i>	<i>% of shoreline parcels county-wide</i>
At-risk shoreline parcels with <i>very high</i> priority habitat and landowners interested in long-term conservation.	3	< 1%
At-risk shoreline parcels with <i>high</i> priority habitat and landowners interested in long-term conservation.	119	2%
At-risk shoreline parcels with <i>moderate</i> priority habitat and landowners interested in long-term conservation.	155	3%
<i>total</i>	<i>277</i>	<i>5%</i>

Next Steps

The ability to objectively focus efforts from the thousands of potential shoreline protection sites allows limited marine protection resources to be focused on those sites that have the highest habitat values and the highest likelihood of successful long-term protection. *Salmon Habitat Protection Blueprint* results can also be used to monitor effectiveness of protection efforts over time as the computer modeling approach used allows analyses to be updated as new information becomes available. Species and habitat specific information supports development of management plans and easements that focus on the most important elements of that individual site. The Land Bank and the Preservation Trust are both applying results to internal planning processes and the *Salmon Habitat Protection Blueprint Project* will help them, and other conservation entities, become more strategic in their shoreline protection efforts. Local salmon recovery efforts can use project results to leverage landowner and funding support for implementation of the top salmon recovery strategy for San Juan County: protection of remaining, high quality nearshore habitat.

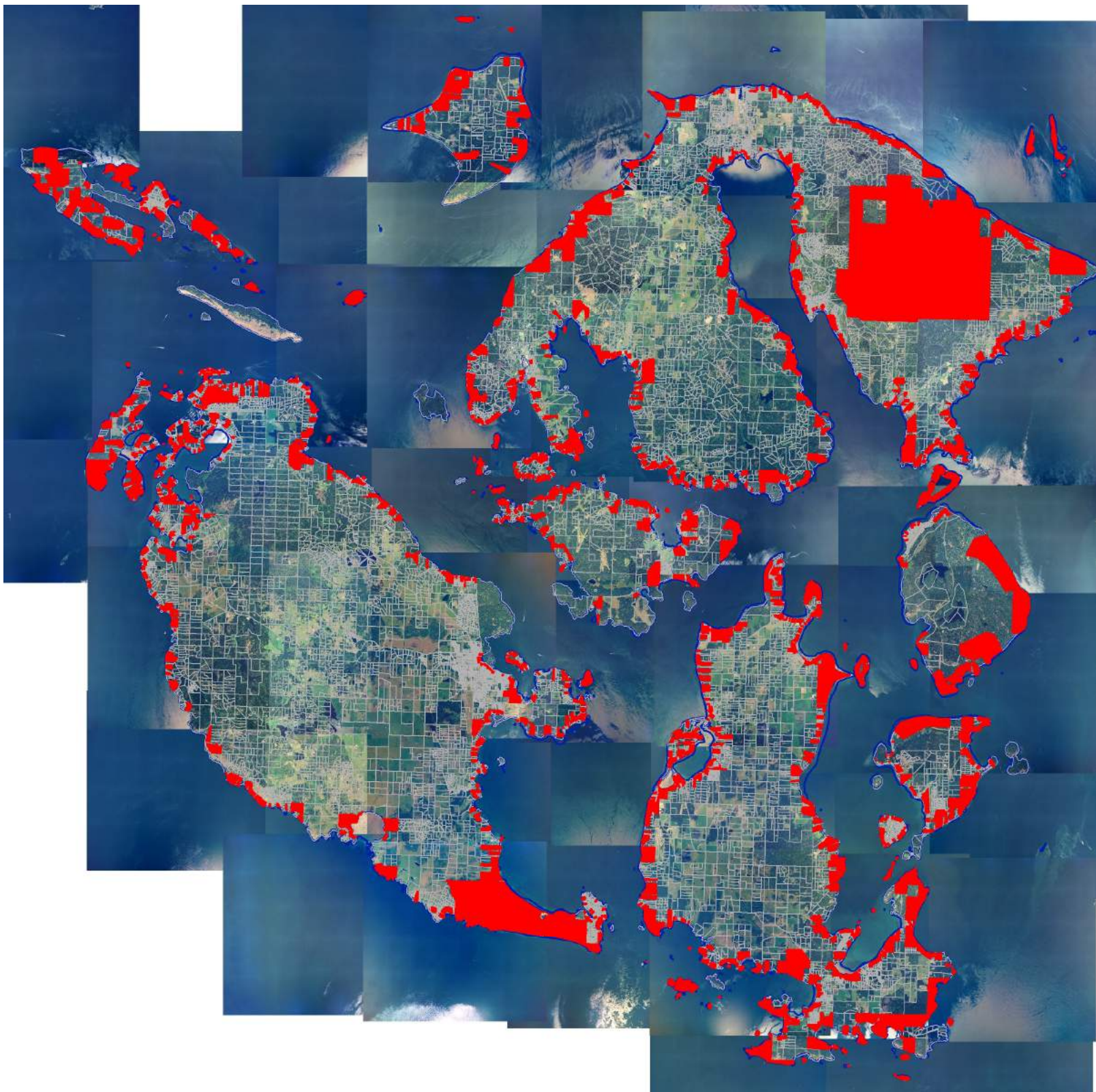


Map 1. Non-Impacted Shoreline Sites.
Shoreline parcels with no docks, bulkheads or boat ramps.

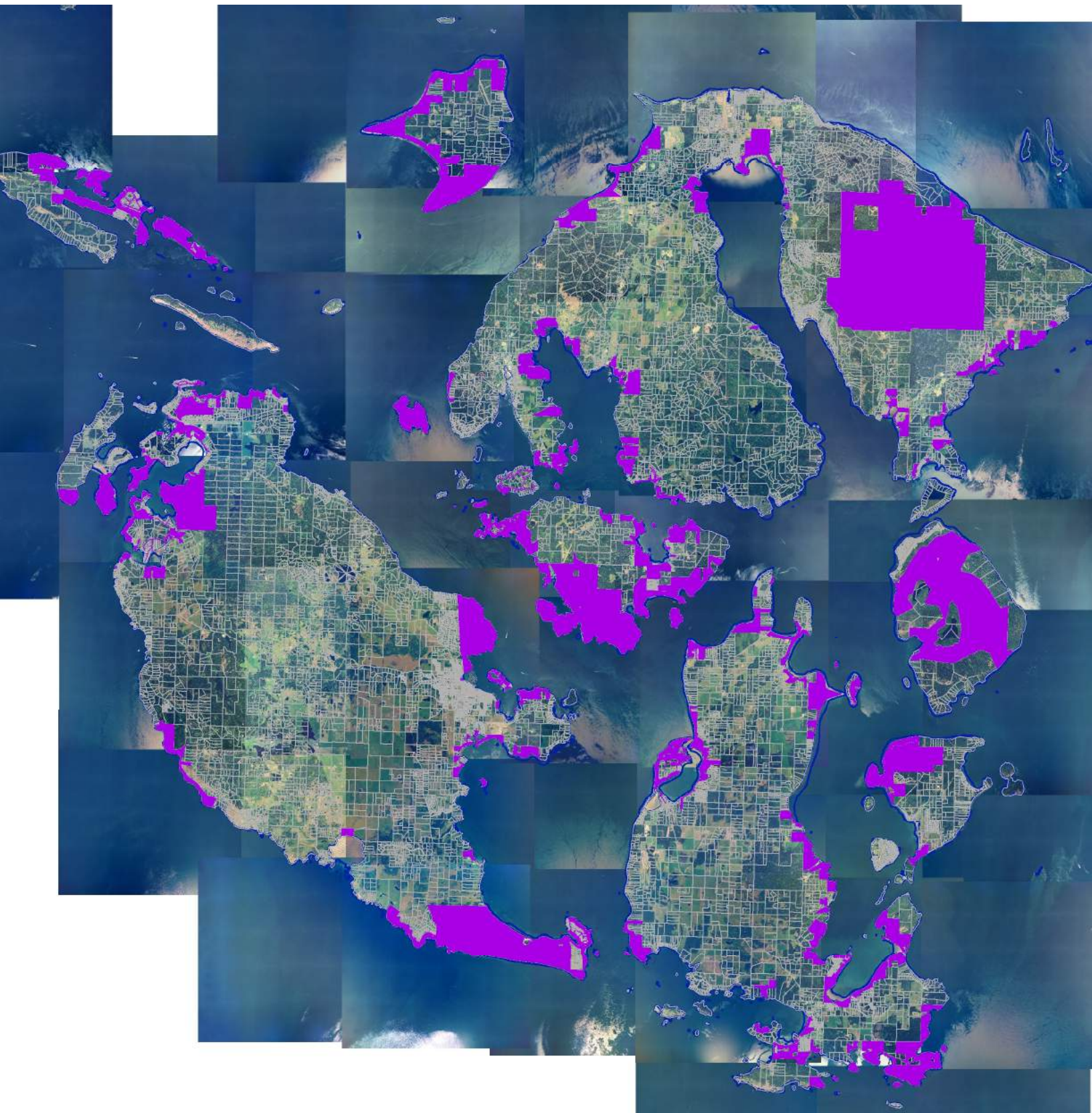


Map 2. Protected Sites.

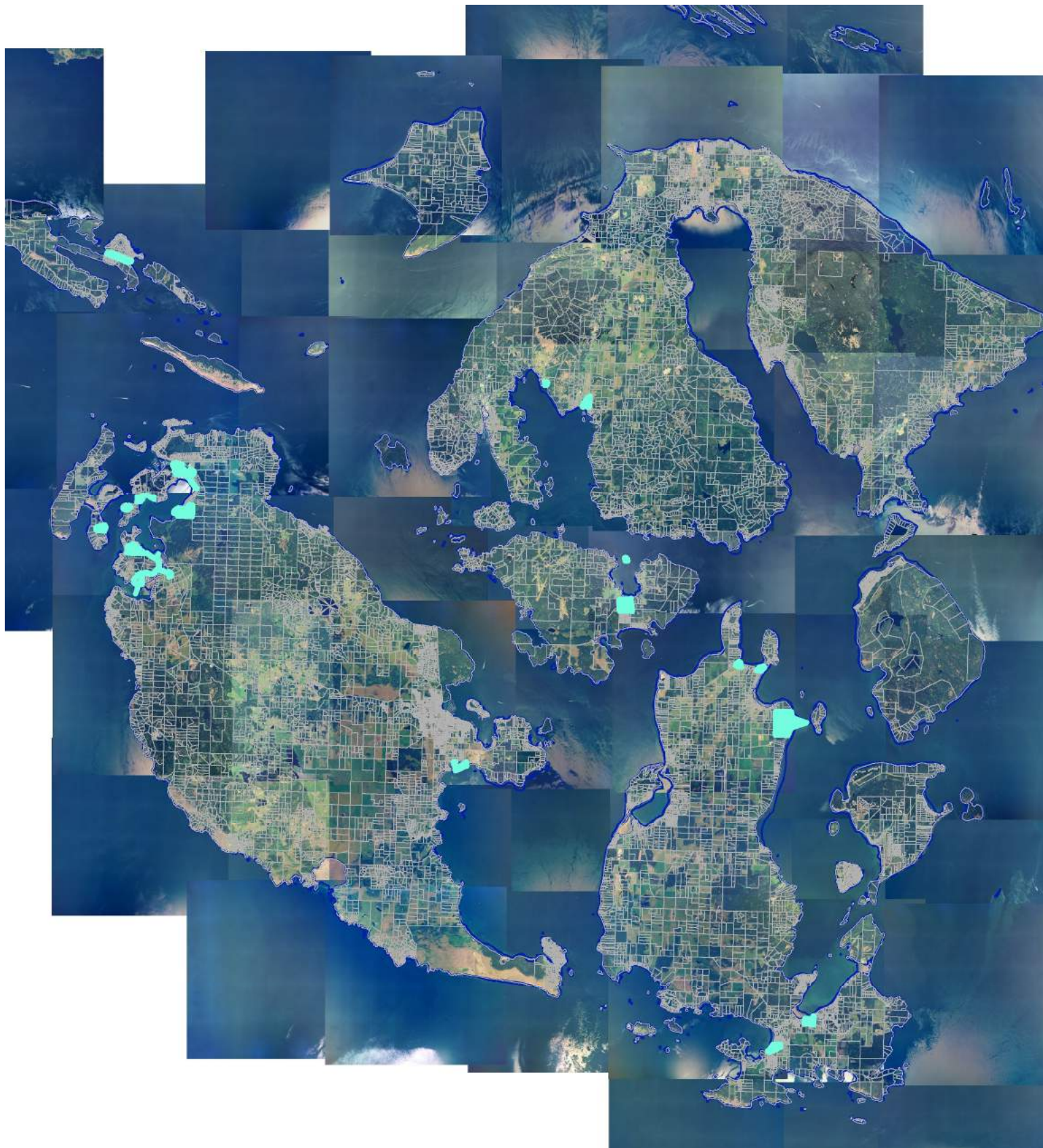
Shoreline parcels currently protected by ownership, easement or Washington State's Open Space tax incentive program.



Map 3. At-Risk Sites.
Shoreline parcels with no shoreline modifications,
not protected by ownership or easement.

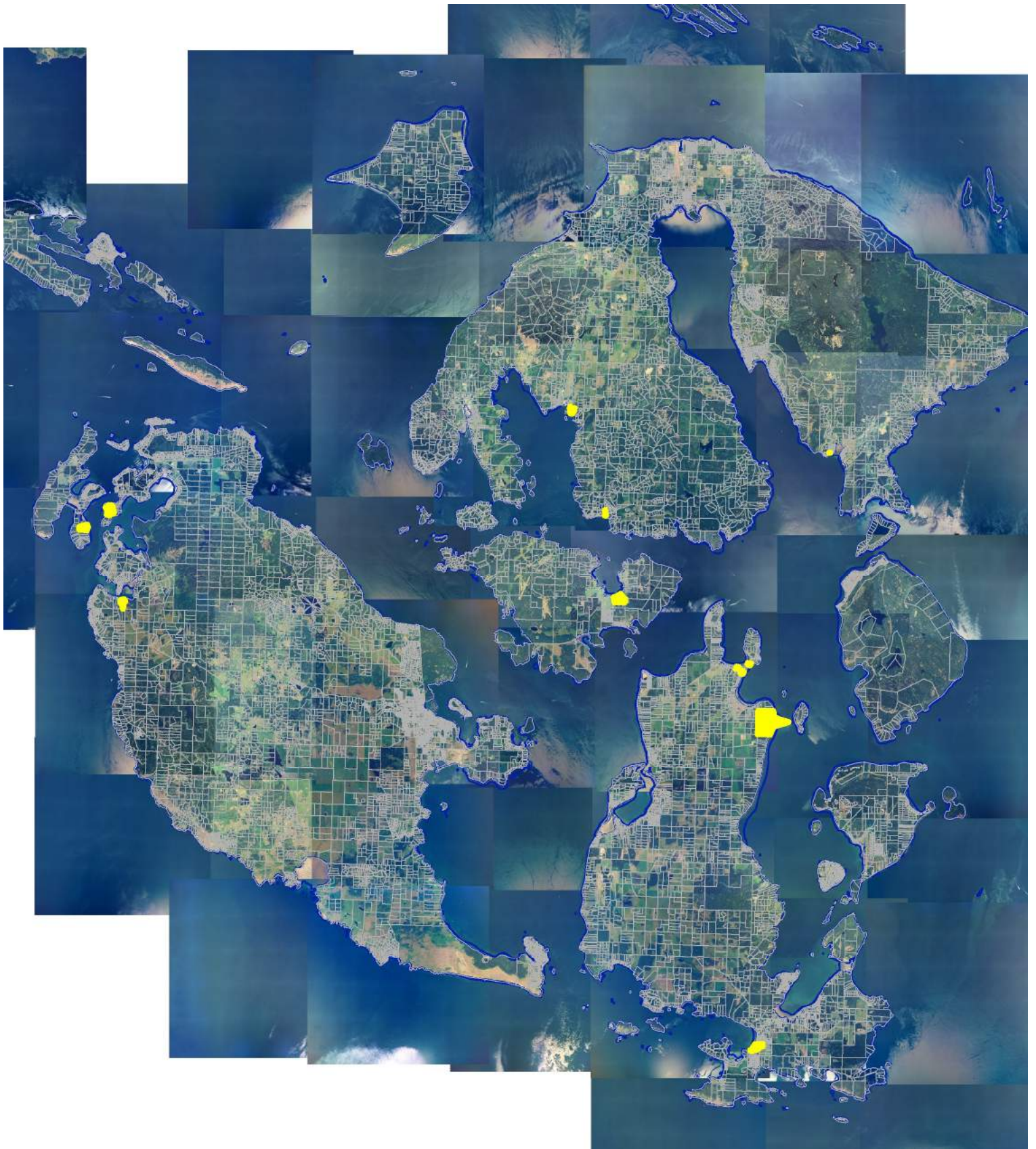


Map 4. Shoreline Parcels with Very High Priority Habitat.



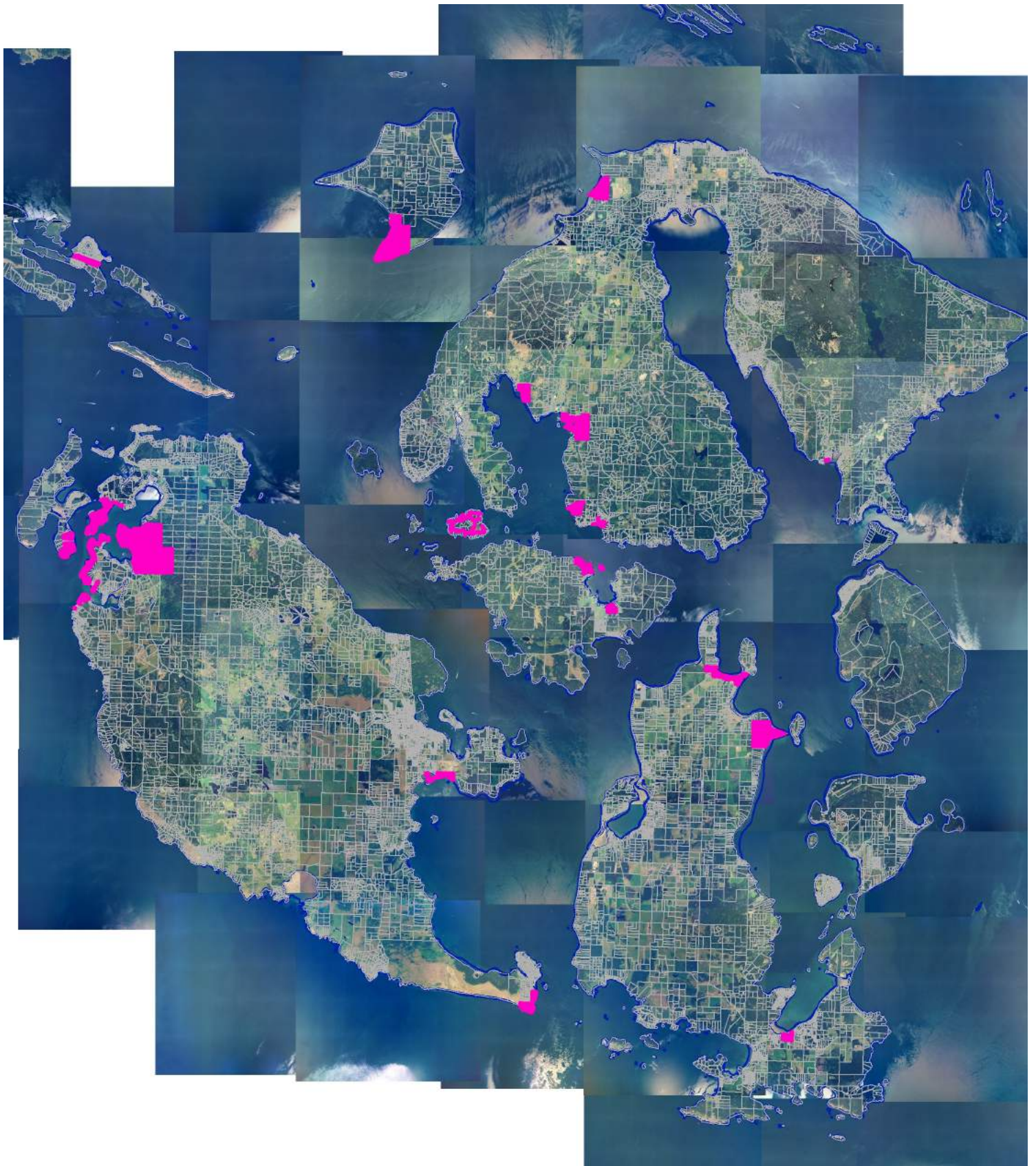
Map 4a. Very High Priority Habitat

- Shoreline parcels in proximity to forage fish spawn habitat, juvenile salmon and wetlands.



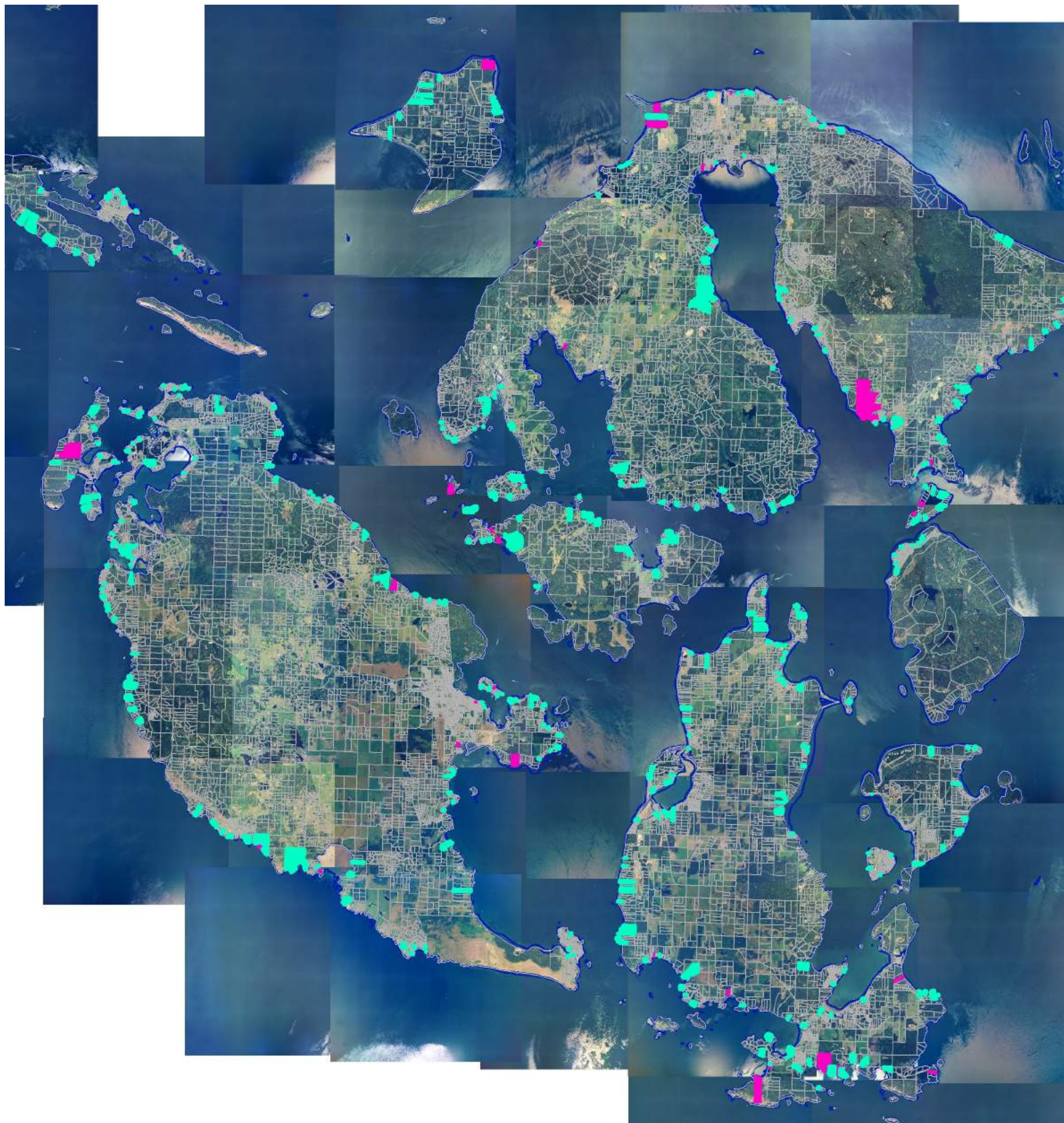
Map 4b. Very High Priority Habitat

- Shoreline parcels in proximity to forage fish spawn habitat, juvenile salmon and unstable bluffs.



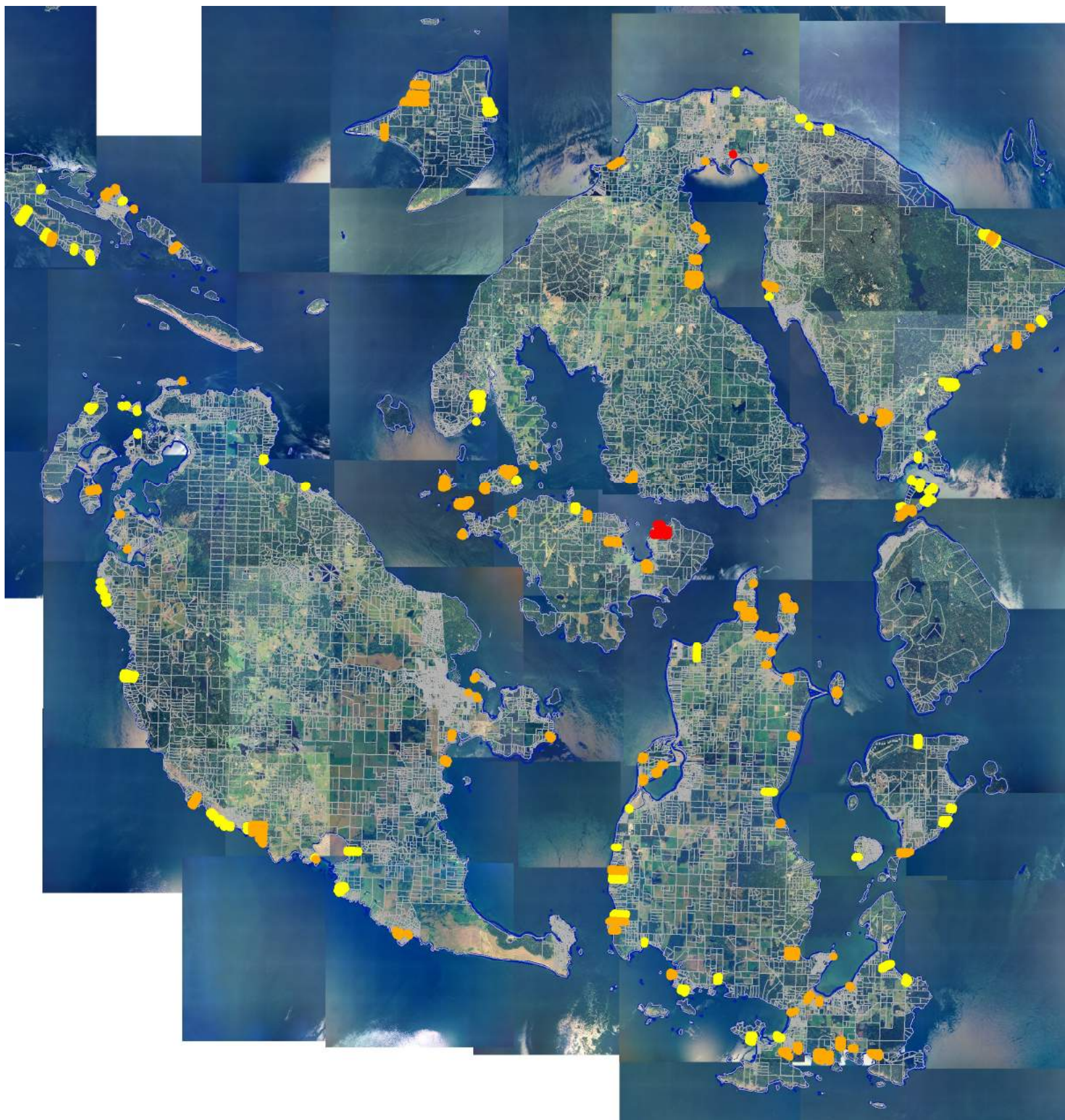
Map 4c. Very High Priority Habitat

- Shoreline parcels in proximity to forage fish spawn habitat, juvenile salmon and eelgrass or bull kelp.



Map 5. Landowner Willingness.

- Landowners interested in long-term protection of shoreline property.
- Landowners interested in long-term protection of tideland property.



Map 6. Protection Priorities.

- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term protection.
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term protection.
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term protection.

Appendix A. San Juan County Shoreline Parcels

Shoreline Parcels, San Juan County

San Juan County Shoreline Parcels	# shoreline parcels	% of shoreline parcels county-wide
San Juan Island	1470	26%
Shaw	239	4%
Orcas	1483	26%
Lopez	1192	21%
Outer Islands	1317	23%
Total Shoreline Parcels	5701	100%

Appendix B. Shoreline Parcel Characteristics: non-impacted, protected and at-risk

Non-impacted Shoreline Parcels

Location	# non-impacted shoreline parcels	% of non impacted shoreline parcels by island	% of non-impacted shoreline parcels county-wide	% of total shoreline parcels county-wide
San Juan Island	602	41%	20%	11%
Shaw Island	116	49%	4%	2%
Orcas	803	54%	27%	14%
Lopez	694	58%	23%	12%
Outer Islands	794	60%	26%	14%
All San Juan County	3009	-	100%	53%

Protected Shoreline Parcels

Location	# protected shoreline parcels	% of protected shoreline parcels by island	% of protected shoreline parcels county-wide	% of total shoreline parcels county-wide
San Juan Island	52	3.5%	20%	.9%
Shaw Island	25	11%	10%	.4%
Orcas	70	5%	28%	1.3%
Lopez	53	4.6%	21%	.9%
Outer Islands	54	4.2%	21%	.9%
All San Juan County	254	-	100%	5%

At Risk Shoreline Parcels

Location	# at risk shoreline parcels	% of at risk shoreline parcels by island	% of at risk shoreline parcels	% of total shoreline parcels
San Juan Island	555	38%	20%	9%
Shaw Island	103	43%	4%	2%
Orcas	726	49%	26%	13%
Lopez	635	53%	23%	11%
Outer Islands	736	56%	27%	13%
All San Juan County	2755	-	100%	48%

Appendix C. Shoreline Parcels with Priority Habitats

Shoreline Parcels with Forage Fish Spawning Beaches (within 100 ft. of documented surf smelt and/or Pacific sand lance spawn habitat)

Location	# shoreline parcels with forage fish spawning beaches	% of shoreline parcels with forage fish spawning beaches	% of total shoreline parcels
San Juan Island	47	14%	.9
Shaw Island	40	11%	.8
Orcas	50	14%	.9
Lopez	199	56%	3.4%
Outer Islands	16	5%	.03
All San Juan County	352	100%	6%

Shoreline Parcels in Proximity to Pacific Herring Spawning Grounds (within 1,000 ft.)

Location	# of shoreline parcels with Pacific herring spawn	% of shoreline parcels with Pacific herring spawn	% of total shoreline parcels
San Juan Island	256	32%	4%
Shaw Island	54	7%	.9
Orcas	274	34%	5%
Lopez	196	24%	3%
Outer Islands	32	3%	.6%
All San Juan County	812	100%	13.5%

Shoreline Parcels with Eelgrass (within 100 ft.)

Location	# of shoreline parcels with eelgrass	% of shoreline parcels with eelgrass	% of total shoreline parcels
San Juan Island	683	24%	12%
Shaw Island	177	6%	3%
Orcas	495	17%	17%
Lopez	749	26%	13%
Outer Islands	770	27%	13%
All San Juan County	2874	100%	58%

Appendix C. Shoreline Parcels with Priority Habitats

Shoreline Parcels with Bull Kelp (within 100 ft.)

Location	# of shoreline parcels with kelp	% of shoreline parcels with kelp	% of total shoreline parcels
San Juan Island	239	32%	4%
Shaw Island	20	3%	.03%
Orcas	153	21%	3%
Lopez	89	12%	1.5%
Outer Islands	238	32%	4%
All San Juan County	739	100%	12.5%

Shoreline Parcels with Coastal Wetland (on parcel)

Location	# of shoreline parcels with wetlands	% of shoreline parcels with wetlands	% of total shoreline parcels
San Juan Island	40	13%	.07%
Shaw Island	33	11%	.05%
Orcas	52	17%	.09%
Lopez	124	42%	.2%
Outer Islands	50	17%	.08%
All San Juan County	299	100%	5%

Shoreline Parcels with Coastal Stream (on parcel)

Location	# of shoreline parcels with streams	% of shoreline parcels with streams	% of total shoreline parcels
San Juan Island	69	20%	1%
Shaw Island	32	8%	.05%
Orcas	70	20%	1%
Lopez	110	31%	2%
Outer Islands	75	21%	1%
All San Juan County	356	100%	6%

Appendix C. Shoreline Parcels with Priority Habitats

Shoreline Parcels with Class One, Accretionary, Beaches (within 20 ft.)

Location	# of shoreline parcels with class one beach	% of shoreline parcels with Class one beach	% of total shoreline parcels
San Juan Island	21	10%	.04%
Shaw Island	35	19%	.06%
Orcas	6	3%	.01%
Lopez	79	40%	1.3%
Outer Islands	55	28%	1%
All San Juan County	196	100%	3.4%

Shoreline Parcels with Unstable, Feeder, Bluffs (on parcel)

Location	# of shoreline parcels with unstable bluffs	% of shoreline parcels with Unstable bluffs	% of total shoreline parcels
San Juan Island	72	14%	1%
Shaw Island	20	3%	.4%
Orcas	88	17%	1%
Lopez	283	55%	5%
Outer Islands	55	11%	1%
All San Juan County	518	100%	9%

Shoreline Parcels with Seal Haulouts (within 500 ft.)

Location	# of shoreline parcels with Seal Haulouts	% of shoreline parcels with Seal Haulouts	% of total shoreline parcels
San Juan Island	33	25%	.5%
Shaw Island	6	5%	.01%
Orcas	12	10%	.02%
Lopez	7	5%	.01%
Outer Islands	73	55%	1%
All San Juan County	131	100%	2%

Appendix C. Shoreline Parcels with Priority Habitats

Shoreline Parcels with Eagle Nests (within 400 ft.)

Location	# of shoreline parcels with Eagle Nest	% of shoreline parcels with Eagle Nest	% of total shoreline parcels
San Juan Island	111	26%	2%
Shaw Island	20	5%	.3%
Orcas	76	18%	1.3%
Lopez	84	20%	1.5%
Outer Islands	128	31%	2%
All San Juan County	419	100%	7%

Shoreline Parcels with Seabird Sites (within 500 ft.)

Location	# of shoreline parcels with Seabird Sites	% of shoreline parcels with Seabird Sites	% of total shoreline parcels
San Juan Island	5	9%	.008
Shaw Island	0	0	0
Orcas	0	0	0
Lopez	7	12%	.002
Outer Islands	46	79%	.08%
All San Juan County	58	100%	1%

Shoreline Parcels in Proximity to Juvenile Salmon - Marine (within 5,000 ft. of salmon documented in nearshore marine habitat)

Location	# of shoreline parcels with Juvenile Salmon-marine	% of shoreline parcels with Juvenile Salmon-marine	% of total shoreline parcels
San Juan Island	765	36%	13%
Shaw Island	128	6%	2%
Orcas	295	14%	5%
Lopez	576	27%	10%
Outer Islands	367	17%	7%
All San Juan County	2131	100%	37%

Appendix C. Shoreline Parcels with Priority Habitats

**Shoreline Parcels in Proximity to Juvenile Salmon - Freshwater
(within 5,000 ft. of salmon documented in freshwater habitat)**

Location	# of shoreline parcels with Juvenile Salmon-freshwater	% of shoreline parcels with Juvenile Salmon-freshwater	% of total shoreline parcels
San Juan Island	146	30%	3%
Shaw Island	8	1.6%	.01%
Orcas	331	67%	5%
Lopez	0	0	0
Outer Islands	7	1.4%	.01%
All San Juan County	492	100%	8%

Appendix D. Shoreline Parcels with Very High Priority Habitat

VHP #1: Shoreline Parcels in Proximity to Forage Fish, Coastal Wetlands and Juvenile Salmon

Location	# shoreline parcels	% of VHP 1 parcels	% of total shoreline parcels county-wide
San Juan Island	11	29%	< 1%
Shaw Island	1	2%	< 1%
Orcas	9	24%	< 1%
Lopez	12	32%	< 1%
Outer Islands	5	13%	< 1%
All San Juan County	38	100%	< 1%

VHP # 2: Parcels in Proximity to Juvenile Salmon and Coastal Wetlands

Location	# shoreline parcels	% of VHP 2 parcels	% of total shoreline parcels county-wide
San Juan Island	56	27%	< 1%
Shaw Island	30	15%	< 1%
Orcas	27	13%	< 1%
Lopez	64	31%	< 1%
Outer Islands	28	14%	< 1%
All San Juan County	205	100%	3%

VHP # 3: Shoreline Parcels in Proximity to Forage Fish Spawn Habitat and Coastal Wetlands

Location	# shoreline parcels	% of VHP 3 parcels	% of shoreline parcels county-wide
San Juan Island	16	14%	< 1%
Shaw Island	4	3%	< 1%
Orcas	32	27%	< 1%
Lopez	56	47%	< 1%
Outer Islands	11	9%	< 1%
All San Juan County	119	100%	2%

Appendix D. Shoreline Parcels with Very High Priority Habitat

VHP # 4: Shoreline Parcels in Proximity to Forage Fish, Juvenile Salmon and Feeder Bluffs

Location	# shoreline parcels	% of VHP 4 parcels	% of shoreline parcels county-wide
San Juan Island	5	15%	< 1%
Shaw Island	6	18%	< 1%
Orcas	9	27%	< 1%
Lopez	10	30%	< 1%
Outer Islands	3	10%	< 1%
All San Juan County	33	100%	< 1%

VHP # 5: Shoreline Parcels in Proximity to Juvenile Salmon and Feeder Bluffs

Location	# shoreline parcels	% of VHP 5 parcels	% of shoreline parcels county-wide
San Juan Island	32	10%	< 1%
Shaw Island	45	15%	< 1%
Orcas	36	12%	< 1%
Lopez	165	54%	2%
Outer Islands	27	9%	< 1%
All San Juan County	305	100%	5%

VHP # 6: Shoreline Parcels in Proximity to Forage Fish Spawning Habitat and Feeder Bluffs

Location	# shoreline parcels	% of VHP 6 parcels	% of shoreline parcels county-wide
San Juan Island	8	7%	< 1%
Shaw Island	12	10%	< 1%
Orcas	16	13%	< 1%
Lopez	79	65%	1%
Outer Islands	6	5%	< 1%
All San Juan County	121	100%	2%

Appendix D. Shoreline Parcels with Very High Priority Habitat

VHP # 7: Shoreline Parcels in Proximity to Forage Fish, Juvenile Salmon and Eelgrass or Bull Kelp

Location	# shoreline parcels	% of VHP 7 parcels	% of shoreline parcels county-wide
San Juan Island	101	49%	< 1%
Shaw Island	12	6%	< 1%
Orcas	32	16%	< 1%
Lopez	37	18%	< 1%
Outer Islands	22	11%	< 1%
All San Juan County	204	100%	< 1%

VHP # 8: Shoreline Parcels in Proximity to Juvenile Salmon and Eelgrass or Kelp

Location	# shoreline parcels	% of VHP 8 parcels	% of shoreline parcels county-wide
San Juan Island	368	27%	6%
Shaw Island	118	9%	2%
Orcas	215	16%	4%
Lopez	360	27%	6%
Outer Islands	285	21%	5%
All San Juan County	1346	100%	23%

VHP # 9: Shoreline Parcels in Proximity to Forage Fish Spawning Beaches and Eelgrass or Kelp

Location	# shoreline parcels	% of VHP 9 parcels	% of shoreline parcels county-wide
San Juan Island	110	22.5%	2%
Shaw Island	49	10%	< 1%
Orcas	110	22.5%	2%
Lopez	180	37%	3%
Outer Islands	39	8%	< 1%
All San Juan County	488	100%	8%

Appendix E. Shoreline Parcels with High Priority Habitats

HP # 1: Shoreline Parcels in Proximity to Forage Fish Spawning Beaches and Pacific Herring Spawning Grounds

Location	# shoreline parcels	% of HP 1 parcels	% of shoreline parcels county-wide
San Juan Island	276	29%	5%
Shaw Island	71	8%	1%
Orcas	288	30%	6%
Lopez	262	28%	4%
Outer Islands	48	5%	< 1%
All San Juan County	945	100%	17%

HP # 2: Shoreline parcels in Proximity to Juvenile Salmon- freshwater or marine

Location	# shoreline parcels	% of HP 2 parcels	% of shoreline parcels county-wide
San Juan Island	827	34%	15%
Shaw Island	136	6%	2%
Orcas	520	21%	9%
Lopez	576	24%	10%
Outer Islands	369	15%	6%
All San Juan County	2428	100%	42%

HP # 3: Shoreline parcels in Proximity to Priority Aquatic Vegetation (Bull Kelp or Eelgrass) and Priority Freshwater Resources (Coastal Wetland or Stream) and Priority Geologic Features (Class One, Accretionary Beach or Unstable, Feeder, Bluff)

Location	# shoreline parcels	% of HP 3 parcels	% of shoreline parcels county-wide
San Juan Island	6	7%	< 1%
Shaw Island	21	25%	< 1%
Orcas	7	8%	< 1%
Lopez	27	33%	< 1%
Outer Islands	22	27%	< 1%
All San Juan County	83	100%	1.5%

Appendix E. Shoreline Parcels with High Priority Habitats

HP # 4: Shoreline parcels with Priority Aquatic Vegetation (Bull Kelp or Eelgrass) and Priority Wildlife Habitat (Seal Haulout or Seabird Site or Eagle Nest)

Location	# shoreline parcels	% of HP 4 parcels	% of shoreline parcels county-wide
San Juan Island	101	26%	2%
Shaw Island	22	6%	< 1%
Orcas	36	9%	< 1%
Lopez	68	17%	1 %
Outer Islands	165	42%	3%
All San Juan County	392	100%	7%

HP # 5: Shoreline parcels with Priority Geologic Feature (Class One, Accretionary Beach or Unstable, Feeder Bluff) and Priority Wildlife Habitat (Seal Haulout or Seabird Site or Eagle Nest)

Location	# shoreline parcels	% of HP 5 parcels	% of shoreline parcels county-wide
San Juan Island	14	31%	< 1%
Shaw Island	4	9%	< 1%
Orcas	5	11%	< 1%
Lopez	14	31%	< 1%
Outer Islands	8	18%	< 1%
All San Juan County	45	100%	< 1%

HP # 6: Shoreline parcels with Priority Freshwater Resources (Coastal Wetlands or Streams) and Priority Wildlife Habitat (Seal Haulout or Seabird Site or Eagle Nest)

Location	# shoreline parcels	% of HP 6 parcels	% of shoreline parcels county-wide
San Juan Island	12	37%	< 1%
Shaw Island	3	9%	< 1%
Orcas	1	3%	< 1%
Lopez	4	12%	< 1%
Outer Islands	13	39%	< 1%
All San Juan County	33	100%	< 1%

Appendix F. Shoreline Parcels in Proximity to Moderate Priority Habitats

MP # 1: Shoreline Parcels with Priority Aquatic Vegetation (Eelgrass or Bull Kelp)

Location	# shoreline parcels	% of MP 1 parcels	% of shoreline parcels county-wide
San Juan Island	821	24%	14%
Shaw Island	185	5%	5%
Orcas	624	19%	11%
Lopez	803	24%	14%
Outer Islands	942	28%	28%
All San Juan County	3375	100%	59%

**MP # 2: Shoreline Parcels with Priority Freshwater Resources
(Coastal Wetland or Coastal Stream)**

Location	# shoreline parcels	% of MP 2 parcels	% of shoreline parcels county-wide
San Juan Island	72	18%	1%
Shaw Island	37	9%	<1%
Orcas	72	18%	1%
Lopez	149	36%	3%
Outer Islands	76	19%	1%
All San Juan County	406	100%	7%

**MP # 3: Shoreline Parcels with Priority Geologic Features
(Class One, Accretionary Beach or an Unstable, Feeder Bluff)**

Location	# shoreline parcels	% of MP 3 parcels	% of shoreline parcels county-wide
San Juan Island	92	13%	1.5%
Shaw Island	54	8%	<1%
Orcas	94	13%	1.6%
Lopez	356	51%	6%
Outer Islands	103	15%	2%
All San Juan County	699	100%	12%

Appendix F. Shoreline Parcels in Proximity to Moderate Priority Habitats

MP # 4: Shoreline Parcels with Priority Bird Habitat (Seabird Site or Eagle Nest)

Location	# shoreline parcels	% of MP 4 parcels	% of shoreline parcels county-wide
San Juan Island	116	25%	2%
Shaw Island	20	4%	<1%
Orcas	76	16%	1%
Lopez	89	19%	1%
Outer Islands	165	36%	3%
All San Juan County	466	100%	8%

MP # 5: Shoreline Parcels with Seal Haulouts

Location	# shoreline parcels	% of MP 5 parcels	% of shoreline parcels county-wide
San Juan Island	33	25%	<1%
Shaw Island	6	5%	<1%
Orcas	12	9%	<1%
Lopez	7	5%	<1%
Outer Islands	73	56%	1%
All San Juan County	131	100%	2%

Appendix G. Shoreline Landowner Survey Results

Bank Type

Bank Character	Number of Question Respondents	Percent of Survey Respondents
High Bank Shoreline	169	23%
Medium Bank Shoreline	379	51%
Low Bank Shoreline	179	24%
No Bank Shoreline	77	10%

Shoreline Vegetation Condition- trees

Shoreline Vegetation Condition	Number of Question Respondents	Percent of Survey Respondents
No trees	84	11%
Single row of trees	315	42%
Up to 50 ft. width of trees	124	16%
Greater than 50 ft. width of trees	214	29%

Shoreline Vegetation Condition- shrubs

Shoreline Vegetation Condition	Number of Question Respondents	Percent of Survey Respondents
No shrubs	81	11%
Single row of shrubs	254	34%
Up to 50 ft. width of shrubs	156	21%
Greater than 50 ft. width of shrubs	175	23%

Length of Ownership

Ownership	Number of Question Respondents	Percent of Survey Respondents
Less than 5 years	94	13%
5-10 years	116	16%
11-20 years	171	23%
Over 20 years	359	48%

Appendix G. Shoreline Landowner Survey Results

Observed Changes in Shoreline

Have You Noticed Changes in Your Shoreline?	Number of Question Respondents	Percent of Survey Respondents
Yes	348	47%
No	376	50%

Primary Concerns about Shoreline

Concerns you have about your shoreline property	Number of Question Respondents	Percent of Survey Respondents
Erosion	244	33%
Vegetation Management Issues	103	14%
Hydrology/Stormwater Issues	57	8%
Freshwater Issues	56	7%
Less Wildlife	107	14%
Marine Debris/Trash	180	24%
Water Pollution	76	10%
Sea Level Rise	85	11%
Other	66	9%

Shoreline Structures

Built Shoreline Features on Your Property	Number of Respondents	Percent of Survey Respondents
Erosion Control Bulkhead	61	8%
Dock	72	10%
Mooring Buoy	129	17%
Other	71	10%

Appendix G. Shoreline Landowner Survey Results

Planned Site Changes

Improvements planned for the next 5 years	Number of Question Respondents	Percent of Survey Respondents
New Residence Construction	53	7%
New Shoreline Structure (dock, erosion control bulkhead)	28	4%
Repair of Existing Bulkhead	23	3%
Land Division or Boundary Line Modification	8	1%
Do not know at this Time	148	20%
No, not in the next 5 years	402	54%

Interest in Long-term, Voluntary Conservation Programs

Interest in Voluntary Conservation/Protection Program	Number of Question Respondents	Percent of Survey Respondents
No, I already have a conservation easement	67	9%
Yes, please send more information on voluntary conservation	169	23%
Yes, I am interested in attending a workshop to learn more about priority species and habitats and opportunities to protect my shoreline in perpetuity	61	8%
Moderate interest, I do not need additional information	270	36%
No interest	154	21%

Tideland Ownership

Tideland Ownership	Number of Question Respondents	Percent of Survey Respondents
Own Tidelands	248	33%
Lease Tidelands	7	<1%
Unsure	196	26%
Do not own tidelands	253	34%

Appendix G. Shoreline Landowner Survey Results

Interest in Long-term, Voluntary Tideland Protection

If you own tidelands, are you interested in protecting them in perpetuity?	Number of Question Respondents	Percent of Respondents Who Own Tidelands
Yes, please send more information on tideland conservation	121	49%
Moderate interest, I do not need additional information	122	49%
No interest	82	33%

Interest in Site Visit

Would you be interested in an expert site visit?	Number of Question Respondents	Percent of Survey Respondents
Yes, I am interested in a site visit to help me improve shoreline management	135	18%
Moderate interest, I will contact you if I want more information	232	31%
No interest in site visit	321	43%

Appendix H. Landowner Interest in Long term Shoreline Protection Programs

Shoreline Parcels with Landowners Interested in Long Term Conservation Programs

Location	# Parcels with Landowners with High Interest	# Parcels with Landowners with Moderate Interest
San Juan	45	69
Shaw	10	11
Orcas	50	64
Lopez	53	65
Outer Islands	34	61
All San Juan County	192	270

Tideland Landowners Interested in Protecting their Tideland Habitats in Perpetuity

Location	# Landowners with High Interest	# Landowners with Moderate Interest
San Juan	30	35
Shaw	7	2
Orcas	31	30
Lopez	32	31
Outer Islands	21	24
All San Juan County	121	122

Appendix I. Priority Shoreline Parcels for Protection

At-risk shoreline parcels with very high priority habitat and landowners interested in long-term protection.

Location	# shoreline parcels	% of highest protection priority parcels	% of shoreline parcels county-wide
Shaw	2	67%	<1%
Orcas	1	33%	<1%
San Juan County	3	100%	<1%

At-risk shoreline parcels with high priority habitat and landowners interested in long-term protection.

Location	# shoreline parcels	% of high protection priority parcels	% of shoreline parcels county-wide
San Juan	14	12%	<1%
Shaw	8	6%	<1%
Orcas	28	24%	<1%
Lopez	45	38%	<1%
Outer Islands	24	20%	<1%
San Juan County	119	100%	2%

At-risk shoreline parcels with medium priority habitat and landowners interested in long-term protection.

Location	# shoreline parcels	% of medium protection priority parcels	% of shoreline parcels county-wide
San Juan	27	17%	<1%
Shaw	9	6%	<1%
Orcas	26	17%	<1%
Lopez	46	30%	<1%
Outer Islands	47	30%	<1%
San Juan County	155	100%	3%

Appendix J: Priority Shoreline Parcels for Protection

At-risk shoreline parcels with very high priority habitat and landowners interested in long-term protection.

Location	# Shoreline Parcels	# parcels greater than 10 acres	# parcels less than 10 acres	# parcels with a structure value less than \$50,000k	# parcels with a structure value greater than \$50,000	# parcels with a waterfront length less than 1,000 ft.	# parcels with a waterfront length greater than 1,000 ft.	# parcels adjacent to a protected site
Shaw	2	1	1	2	0	2	0	2
Orcas	1	0	1	1	0	1	0	1
San Juan County	3	1	2	3	0	3	0	3

At-risk shoreline parcels with high priority habitat and landowners interested in long-term protection.

Location	# Shoreline Parcels	# parcels greater than 10 acres	# parcels less than 10 acres	# parcels with a structure value less than \$50,000k	# parcels with a structure value greater than \$50,000	# parcels with a waterfront length less than 1,000 ft.	# parcels with a waterfront length greater than 1,000 ft.	# parcels adjacent to a protected site
San Juan	14	1	13	8	6	9	1	2
Shaw	8	1	7	6	2	7	0	2
Orcas	28	1	27	16	12	22	1	2
Lopez	45	2	43	28	17	41	0	2
Outer Islands	24	4	20	15	9	19	3	2
San Juan County	119	9	110	73	46	98	5	10

Appendix J: Priority Shoreline Parcels for Protection

At-risk shoreline parcels with medium priority habitat and landowners interested in long-term protection.

Location	# Shoreline Parcels	# parcels greater than 10 acres	# parcels less than 10 acres	# parcels with a structure value less than \$50,000k	# parcels with a structure value greater than \$50,000	# parcels with a waterfront length less than 1,000 ft.	# parcels with a waterfront length greater than 1,000 ft.	# parcels adjacent to a protected site
San Juan	27	3	24	12	15	26	1	1
Shaw	9	1	8	6	3	9	0	2
Orcas	26	0	26	14	12	25	1	2
Lopez	46	2	44	29	17	46	0	0
Outer Islands	47	4	43	30	17	43	4	2
San Juan County	155	10	145	91	64	149	6	7

Appendix K. GIS Methodology

Geographic scope of analysis

The geographic scope of the *Salmon Habitat Protection Blueprint* analysis is all shoreline parcels within San Juan County. Shoreline parcels are those parcels that lie wholly or partially within the jurisdiction of the Shoreline Master Program which is everything seaward of a line located 200' horizontally inland of the Ordinary High Water Mark.

Base data layers assembled

1. Four categories of data assembled:
 - General (20 layers)
 - Nearshore Resources (17 layers)
 - Protected Sites (4 layers)
 - Impacted Sites (21 layers)

Base relationships assembled

1. Connecting assessors parcel valuation and use code data to the parcel map using parcel numbers.
2. Connecting land use (zone) and density data to the parcel map.
3. Combining Land Bank and San Juan Preservation Trust ownership and easement data to form part of a protected sites assemblage.
4. Selecting shoreline parcels based on their spatial relationship to the Nearshore Resource data layers

Overall modeling approach

The initial approach was to assemble a robust and verifiable monolithic model that would work against the base data layers to generate the output layers. This approach proved unworkable for a variety of reasons. The reasons ranged from unstable behavior of the geo-processing tools available to vagaries in base data that required unavoidable preprocessing. While working on resolving the issues involved in the monolithic approach a modular approach was suggested (Burke 2007) that resolved the issues arising from the monolithic approach. The modular approach was adopted and the early work performed while attempting the monolithic model was reconstructed to use the modular approach. In essence the modular approach uses simple models to perform a step in the overall work flow. These models use long meaningful model names and the resultant data layers use long meaningful layer names. The resultant data layers are retained to allow verification of results if later questions arise and to allow branching of the analytical process as necessary. In all there are 150 individual models and resultant data layers that comprise the workflow of the blueprint analytical process. All analyses and modeling performed for the Blueprint project were performed using ESRI © ArcINFO 9.2 sp3.

Hierarchical usage of models

For each question in the *Salmon Habitat Protection Blueprint* analysis individual models were used to assemble the basic data relationships and then additional individual models were used sequentially up the analytical chain to get to the specific answers. In every case every model and every intermediate dataset were saved. The models can be found in the SalmonModel.mxd document in the toolboxes named Salmon Models, Salmon Models

Appendix K. GIS Methodology

Priority Habitat Analysis, and Salmon Survey Models. All resultant data layers and summary statistic tables can be found in the SalmonFinal.mdb geodatabase.

Merging of intermediate results

In some cases the analytical process required merging of certain resultant datasets. Because all analyses in this project use parcel boundaries from the basic San Juan County parcel layer merging layers often results in duplicate parcels "stacking" on top of each other. This duplicate parcel problem will skew summary statistics substantially even though it is not ascertainable by viewing the map. Deleting duplicate data where all graphic and attribute data except the object identification are identical is not a native tool in ArcINFO. The commercial Arc extension Type Convert (Hronusov and Barsky 2007) was used to identify and delete duplicate parcels in merged layers wherever they existed.

Quality assurance and uncertainty

The Salmon Habitat Protection Blueprint is a complex product. As such quality assurance is both important and difficult. There is no easy way to ascertain that the results are accurate. In order to overcome the problem of quality assuring at the end of the project quality assurance was performed at each individual step of the process. Data layers were visually surveyed by myself to assure that the model performed as expected and the same layers were visually surveyed by Tina Whitman whose extensive knowledge of the conditions on the ground allow her to know by looking that the required model parameters had been met. This quality assurance process revealed the unstable behavior of certain geo-processing tools referenced above. In all cases of unstable behavior suitable workarounds were identified and implemented. For those who might be inclined to use these models on newer data or in different processes the unstable behaviors were located in situations requiring "select by location" on polygons.

All complex GIS analyses contain some level of uncertainty. The Salmon Habitat Protection Blueprint uncertainty is a direct function of the quality of the base data. The base data, while the best available, is dated and of varying resolution. The analytical approach, once the selection behavior vagaries were identified, does not substantially exacerbate the uncertainty of the base data.

Summary statistics

The data layers that address the Salmon Habitat Protection Blueprint analysis have summary statistics for variables such as unimproved parcel value (minimum, maximum, average, sum) and waterfront length (minimum, maximum, average). These summary statistics are broken out by ferry served island. All summary statistics tables are named for their related data layer and are located in the SalmonModel.mxd arc map document.

Maps

The entire Salmon Habitat Protection Blueprint project, including each hierarchical modeling layer, is contained in an ARC 9.2 geodatabase. As such, all project results are spatially explicit and maps can be created for any base layer or analytical result. Each data layer is linked back to the San Juan County parcel database, linking individual ownership attributes with the results of each model query and category.

Appendix L. Base Data Layers

General

Parcels with Structures within 200ft of shoreline
Waterfront Parcels
Parcels with Docks
Parcels
Watersheds
Watersheds Merge
High Low Tide Line
Elevation and Bathymetry
Survey Respondents
Parcel Developed Value
Land Use Designation

Nearshore Resources

Salmon Streams
Bull Kelp
Documented surf smelt and Pacific sand lance Spawn Habitat
Potential surf smelt and Pacific sand lance Spawn Habitat
All juvenile salmon (freshwater and marine)
Herring Spawn
Class One Beaches
Seabird Sites
Streams
Seal Haulouts
Unstable Bluffs
Eagle Nests
Wetlands
Outer Line Eelgrass
Coastal Lagoons

Protected Sites

Land Bank Ownership
Land Bank Easement
Preservation Trust Ownership
Preservation Trust Easement
University of Washington Ownership
The Nature Conservancy Ownership
Shoreline Parcels in Open Open Space Program

Impacted Sites

Parcels with Docks
Parcels with Structures within 200ft of shoreline
Parcels with Bulkheads
Beach Access
Boat Ramps

Appendix M. Hierarchical Analysis

GIS Model Queries

Non-impacted sites

All shoreline parcels with no: docks, bulkheads, improved boat ramps, structures within 200 feet of the shoreline and not in commercial or industrial land use zoning.

Protected sites

All shoreline parcels in San Juan County Open Open Space Program, Preservation Trust Easement or Ownership, Land Bank Easement or Ownership, University of Washington Ownership or The Nature Conservancy Ownership.

At-risk sites

All shoreline parcels that are: non-impacted (above) and also not protected (inverse of above).

Priority habitat sites

All shoreline parcels with documented surf smelt or Pacific sand lance spawn, Pacific herring spawn, eelgrass, bull kelp, coastal wetland, stream, class one beach, unstable bluff, seal haulout, eagle nest, seabird site or documented juvenile salmon (freshwater or marine).

Very high priority habitat sites

- Shoreline parcels with documented forage fish spawn habitat and wetlands and juvenile salmon.
- Shoreline parcels with documented forage fish spawn habitat and wetlands.
- Shoreline parcels with documented juvenile salmon and wetlands.
- Shoreline parcels with documented forage fish spawn habitat and unstable bluffs and juvenile salmon.
- Shoreline parcels with juvenile salmon and unstable bluffs and class one beaches.
- Shoreline parcels with documented forage fish spawn habitat and unstable bluffs and class one beaches.
- Shoreline parcels with juvenile salmon and eelgrass or bull kelp and documented forage fish spawn habitat.
- Shoreline parcels with juvenile salmon and eelgrass or bull kelp.
- Shoreline parcels with documented forage fish spawn and eelgrass or bull kelp.

High priority habitat sites

- Shoreline parcels with documented surf smelt or Pacific sand lance or Pacific herring spawn.
- Shoreline parcels with juvenile salmon (freshwater or marine).
- Shoreline parcels with eelgrass or bull kelp and coastal wetland or stream.
- Shoreline parcels with eelgrass or bull kelp and class one beach or unstable bluff.

Appendix M. Hierarchical Analysis

- Shoreline parcels with eelgrass or bull kelp and seal haulout or eagle nest or seabird site.
- Shoreline parcels with class one beach or unstable bluff and seal haulout or eagle nest or seabird site.
- Shoreline parcels with coastal wetland or stream and seal haulout or eagle nest or seabird site.

Moderate priority habitat sites

- Shoreline parcels with eelgrass or kelp.
- Shoreline parcels with coastal wetland or stream.
- Shoreline parcels with class one beach or unstable bluff.
- Shoreline parcels with seal haulouts.
- Shoreline parcels with eagle nest or seabird site.

Landowner willingness sites

Shoreline parcels with landowners interested in long-term conservation programs.

- At-risk shoreline parcels with landowners interested in long-term conservation programs.
- At-risk shoreline parcels with priority habitat (VH, H and M) and landowners interested in long-term conservation programs.
- At-risk shoreline parcels with priority habitat (VH, H and M) and landowners interested in long-term conservation programs.

Highest Priority Salmon Protection Blueprint Project Sites

At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program.

- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program adjacent to protected shoreline property.
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program greater than 10 acres.
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program less than 10 acres.
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program on undeveloped parcels (acquisition or easement or Open Space program potential).
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program on developed parcels (easement or Open Space Program potential).
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program with greater than 1,000 feet of marine shoreline.
- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program with less than 1,000 feet of marine shoreline.

High Priority Salmon Protection Blueprint Project Sites

At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program.

- At-risk shoreline parcels with very high priority habitat and landowners interested in long-term conservation program adjacent to protected shoreline property.
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program greater than 10 acres.
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program less than 10 acres.
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program on undeveloped parcels (acquisition or easement or Open Space program potential).
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program on developed parcels (easement or Open Space Program potential).
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program with greater than 1,000 feet of marine shoreline.
- At-risk shoreline parcels with high priority habitat and landowners interested in long-term conservation program with less than 1,000 feet of marine shoreline.

Moderate Priority Salmon Protection Blueprint Project Sites

At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program.

- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program adjacent to protected shoreline property.
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program greater than 10 acres.
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program less than 10 acres.
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program on undeveloped parcels (acquisition or easement or Open Space program potential).
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program on developed parcels (easement or Open Space Program potential).
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program with greater than 1,000 feet of marine shoreline.
- At-risk shoreline parcels with moderate priority habitat and landowners interested in long-term conservation program with less than 1,000 feet of marine shoreline.

Appendix N. Landowner Survey Database

Shoreline Landowner Survey ACCESS Database

The 2007 shoreline survey database was created to house the information returned from the shoreline property owner surveys in a user friendly manner that can be easily accessed in the future by project partners including Friends of the San Juans, Land Bank and Preservation Trust personnel. The database has three tables linked by a common primary key. The tables are “landowner” where there is a unique record for every individual property owner who returned a survey; “surveymain” where the records contain fields to accommodate the yes/no responses to the survey; and a ‘comments’ table which stores all comment from the returned survey forms. These three tables are linked in the order above via their parcel number. This provides for reports consisting of lists of owners with duplicates removed. A simple menu system provides pre-designed reports for select survey questions, access to the data for viewing and easy links to printing mailing labels. All survey results are also housed in the spatially explicit, Salmon Habitat Protection Blueprint Arc 9.2 geodatabase.