

San Juan County Nearshore Impact Assessment



Documented surf smelt spawning beach, West Sound, Orcas Island

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Prepared by Friends of the San Juans



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Introduction

San Juan County government is directly responsible for extensive nearshore resources through ownership of shoreline parcels and management of shoreline infrastructure such as boat ramps, docks, roads and culverts. County departments with the most direct shoreline impacts and management responsibilities include Public Works, the Land Bank and County Parks. This report provides an overview of priority nearshore marine species and habitats and summarizes the County's direct impacts to nearshore marine species and habitats.

Shoreline Protection

A combination of local, state and federal policies and regulations recognize the importance of shoreline resources and in combination work to minimize damage from development activities. Washington State's Shoreline Management Act (SMA) was adopted by the public in a 1972 referendum to "prevent the inherent harm in an uncoordinated and piecemeal development of the states shorelines." Compliance with the SMA is implemented at the local level with guidance from the Department of Ecology. State Hydraulic Code rules and provisions of the Federal Clean Water Act also engage state and federal agencies (Washington Department of Fish and Wildlife, Army Corps of Engineers) in the permitting and review of shoreline development activities in San Juan County. Prohibited work times for projects on beaches are in place to protect spawning forage fish and out migrating juvenile salmon; pre-project sampling for egg presence may be required. The listing of multiple species of salmon, the marbled murrelet and the northern resident orca under state and federal Endangered Species Acts has elevated the importance of protecting critical habitat and food web linkages in counties throughout Puget Sound; resulting in additional agency involvement in shoreline policy and project guidance (United States Fish and Wildlife Service, National Marine Fisheries Service, National Oceanic and Atmospheric Administration).

Priority Species and Habitats

With over 400 miles of marine shoreline located at the confluence of Puget Sound, Georgia Strait and the Strait of Juan de Fuca, the nearshore marine habitats of San Juan County play an important role in regional salmon and orca recovery efforts.

Salmon

Local shorelines provide forage fish spawning sites, extensive eelgrass prairies and offer feeding, refuge and migration corridors for a range of salmon life history stages and species. Juvenile salmon move along the shallows of estuaries and nearshore areas during their outmigration to the sea, and may be found in these habitats throughout the year depending on species, stock, and life history stage. The waters of San Juan County are rich in nutrients and food for marine organisms. Maintaining the food web around the islands is a critical component of salmon recovery efforts (Shared Strategy 2005).

All twenty-two populations of Puget Sound Chinook salmon use the San Juans for feeding on their way out to sea and on their return (Kerwin 2002, Shared Strategy 2005). In addition to hosting significant resources for the nearshore dependant Chinook and coho salmon, the waters of the San Juans are also utilized by chum, sockeye and pink salmon during some portion of their life cycle. Salmonid use in San Juan County waters is concentrated in shallow-water nearshore marine environments as well as connected estuarine and lower freshwater habitats.

Emerging empirical evidence indicates that nearshore-associated freshwater habitats including pocket estuaries and streams offer juvenile salmon refuge from predation, increased food resources like insects and additional time to make the physiological transformation from freshwater to saltwater (Shared Strategy 2005). While quantitative studies are limited, a combination of historical and anecdotal reports describe salmonid use of multiple estuarine and freshwater habitats in San Juan County. Recent field research at lower stream habitat sites on Orcas Island documented the presence of salmonid species of multiple age classes and species, including coho, chum and sea run cutthroat (Washington Trout 2005).

Forage Fish

With the listing of many Puget Sound salmon stocks as threatened or endangered, the issue of maintaining forage fish stocks has been identified as a high priority (Shared Strategy 2005, Moulton and Penttila 2000). All the important forage fishes in our region (Pacific herring, surf smelt and Pacific sand lance) depend on nearshore marine habitats for spawning and rearing. Protection of nearshore habitats utilized as spawning and rearing areas for forage fish will be required if salmon recovery is to be successful. Forage fish are a significant part of the prey base for salmon, marine mammals, seabirds, and other predatory finfish populations in Washington State. Forage fish are a valuable indicator of the health and productivity of the marine environment.

Other priority fish and wildlife species in San Juan waters that depend on forage fish as critical prey resources include six stocks of Puget Sound rockfish; multiple species of seabirds, including the federally threatened marbled murrelet; and our resident marine mammal species. The same forage fish species and spawning habitat of interest in salmon recovery will also be vital for the protection and restoration of these additional key marine species.

Protection of existing high quality forage fish spawning habitat has been identified as a key conservation objective for the San Juans. Because forage fish and juvenile salmon depend on nearshore habitat for their survival, they are vulnerable to the impacts of shoreline development. Primary threats to forage fish habitat include: bulkheads, roads, boat ramps, docks, pollution and removal of shoreline and aquatic vegetation.

Just under 80 miles of potential forage fish spawning habitat were identified by Friends of the San Juans and the Washington Department of Fish and Wildlife in San Juan County during surveys

conducted from July 2001 through December of 2003, representing 20% of local shorelines (Friends 2004). Surf smelt spawn has been documented at 59 sites in San Juan County, while Pacific sand lance spawn activity has been documented at eight beaches (Friends 2004, Penttila 1999). Two stocks of spawning Pacific herring are recognized by Washington Department of Fish and Wildlife in San Juan County (Penttila 1999). One stock spawns in the Westcott Bay/ Roche Harbor Region, while the other spawns in the East portion of the county, including: Mud and Hunter Bays on Lopez Island, in West Sound and Eastsound on Orcas Island and in Blind Bay on Shaw Island.

Surf smelt spawn at the highest tides near the water's upper edge on coarse sand and pea gravel. Egg development is temperature dependent with marine riparian vegetation serving to maintain lower temperatures during the warmer summer months. Surf smelt are a significant part of the Puget Sound food web for larger predators. Spawning in northern Puget Sound occurs year round, while spawning in central and southern Puget Sound occurs in fall and winter. The limited extent of surf smelt spawning grounds makes them vulnerable to shoreline development and construction activities.

Pacific sand lance spawn at high tide in the upper intertidal area on sandy beach material. The fine sandy beach material coats the eggs and likely serves to assist in moisture retention when they are exposed during low tides. It also serves to conceal the eggs from predators. In Puget Sound, the spawning season is November 1 through February 15 with larvae commonly found between January and April in the Puget Sound area. Pacific sand lance are a significant dietary component of many economically important resources in Washington, such as juvenile salmon. It has been found that 35% of juvenile salmon diets are known to be Pacific sand lance. They are particularly important to juvenile Chinook with 60% of the juvenile Chinook diet represented by Pacific sand lance. Sand lance are also a key prey item for seabirds, including rhinoceros auklet and the threatened marbled murrelets. Their habit of spawning in upper intertidal zones of sand and gravel beaches makes them particularly vulnerable to the direct and cumulative effects of shoreline development.

Pacific herring typically utilize shallow subtidal habitats for spawning and juvenile rearing. Herring stocks in Puget Sound spawn at specific sites or 'grounds'. Herring spawn from the upper intertidal region to a depth of 40 feet, but most spawning is between 0 and -10 ft MLLW. Pacific herring spawning in the San Juans occurs from late January through early April. In San Juan County, spawning is generally on eelgrass (*Zostera marina*) or the fibrous red alga *Gracilariopsis*. The limited range of herring spawning areas and their location in nearshore marine environments make Pacific herring spawning grounds vulnerable to impacts from shoreline and upland development.

Pacific herring are an important prey item for many marine organisms including marine mammals, seabirds and fish. Pacific herring have been found to comprise from 30% to 70% of diets for the following fish species: Chinook salmon, coho salmon, Pacific cod, walleye pollock, lingcod and Pacific halibut. Pacific herring spawn sites play an important role in the life history characteristics

of scoters; with the eggs providing a critical energy source just before the birds make their annual journey to their Alaskan and Canadian breeding grounds.

Eelgrass

Nearshore, shallow-water beds of eelgrass provide food and shelter for over 70 species of fish and innumerable invertebrates. The native eelgrass (*Zostera marina*) is considered a “keystone” species in the Pacific Northwest, providing critical habitat for hundreds of important marine species, including juvenile salmon, Pacific herring, black brant, river otters and Dungeness crab (Dowty et al. 2005). Each blade of eelgrass is a small food factory. Diatoms, bacteria, and detritus (decaying plant and animal matter) gather on eelgrass leaves. This detritus provides food for many invertebrates; isopods, amphipods, polychaete worms, brittle stars, and some clams. The large number of invertebrates present makes eelgrass beds rich feeding areas for fish and marine birds. Eelgrass also provides structural complexity to the nearshore that functions as habitat, mitigates wave energy and traps fine sediments. Connectivity of eelgrass communities can play an important factor in habitat character, supporting salmon as they move through the nearshore. Comprehensive eelgrass mapping completed by Friends of the San Juans in partnership with the University of Washington and the Washington Department of Natural Resources in 2004 documented 140 miles of eelgrass in San Juan County, distributed along bays, beaches and offshore banks (Friends et al. 2004).

Marine Riparian

Shoreline vegetation plays an important role in the health of the nearshore marine environment (Brennan and Culverwell 2004, Rice 2006). Coastal forests provide shade to forage fish spawning habitat, protecting eggs from high summer temperatures. Marine riparian areas support marine food webs through detritus and prey items. Marine riparian areas also provide bank stability and water quality benefits and a source of large, woody debris which can help build backshore areas. Intact marine riparian forests help maintain natural beach slope which tends to maximize the shallow nearshore water areas critical for fish such as juvenile salmon. Diet studies have shown significant numbers of terrestrial insects in juvenile salmon stomachs, with higher numbers in samples collected in nearshore regions with intact marine riparian vegetation (Sobocinski 2003).

Research conducted by Washington Department of Fish and Wildlife across Puget Sound found that survival of incubating summer surf smelt eggs was significantly higher at beaches with good shade from intact marine riparian forests, suggesting that attention should be paid to protecting these habitats (Penttila 2001). A recent, more detailed study evaluated differences between natural and modified (shoreline armoring and reduced shoreline vegetation) beaches in terms of microclimate and surf smelt egg survival. The proportion of smelt eggs containing live embryos on the altered beach was approximately half that of the natural beach (Rice 2006). Comprehensive

information on current marine riparian habitat conditions- diversity, width, connectivity, etc. - is not available for San Juan County.

Nearshore Habitat Impacts

Protection of nearshore marine habitat has been identified as the most important salmon recovery strategy for the San Juan Archipelago at both the local and regional scale by Shared Strategy for Puget Sound, the Washington State Salmon Recovery Funding Board, the Puget Sound Action Team, and the San Juan County Marine Resources Committee. San Juan County has direct management responsibility for extensive nearshore marine habitat resources, through ownership of shoreline parcels as well as management of infrastructure such as boat ramps, docks, roads and culverts. A summary of these impacts is provided in the *Appendix* section of this document. Spatially explicit information is shown in the attached *Map Book* and map data layers are provided on the Geographic Information Systems *County Nearshore Impact Project* disk.

Shoreline Threats

Because forage fish and juvenile salmon depend on nearshore habitat for their survival, they are vulnerable to the impacts of shoreline development. Primary threats to forage fish, eelgrass and juvenile salmon habitat include bulkheads, roads, boat ramps and barge landings, docks, and culverts and environmental impacts including stormwater outfalls and removal of shoreline and aquatic vegetation.

Shoreline Armoring

The addition of structures or material along the shoreline to decrease the impact of waves and currents or to prevent the erosion of banks or bluffs – is one of the major contributors to loss of shoreline habitat across Puget Sound (Williams and Thom 2001, Zelo et al. 2000, Carrasquero et al. 2005). Primary sources of shoreline armoring in San Juan County include residential bulkheads and rip rap associated with infrastructure such as roads, boat ramps, docks and culverts.

Boat ramps impact nearshore habitat by physically covering the intertidal habitat, and can also impact sediment transport along beaches (Williams and Thom 2001). Boat ramps are often associated with damage to eelgrass, primarily through boat and prop scour waterward of the structure; this damage ranges widely in significance depending on the beach profile and boat and tidal use conditions. Both improved and unimproved boat ramps and barge landings used at inappropriate tidal elevations can damage plants directly through contact with the boat or prop scour (Nightingale and Simenstad 2001).

Docks can have structural and biological impacts to nearshore marine environments, including shading of eelgrass and other light dependent species (Nightingale and Simenstad 2001). Piers and

floats block the sunlight that eelgrass requires to grow. Dock construction causes physical disturbances and noise impacts. Structural elements (e.g. pilings) can alter shallow water fish movement and use patterns. Depending on materials used and maintenance conditions, docks can also be polluters, acting as sources of creosote and Styrofoam.

Shoreline development activities have disrupted hydrologic and functional connections between freshwater systems such as estuarine wetlands and freshwater streams from the marine environment (Kerwin 2002, Shared Strategy 2005). This disconnect alters the transport of sediment and nutrients, affects water quantity and quality and is often a barrier to species movement between the two environments.

Non-Point Pollution

In San Juan County, non-point pollution sources such as failing septic systems and sediments and chemicals carried in stormwater are the primary contributor of pollution to beach habitats, while potential catastrophic events such as oil spills are also a threat. Stormwater can also alter beach habitat conditions and geologic processes through increased erosion, concentrated flows and impacts of the physical infrastructure (outfall pipes and associated rip rap).

Water quality conditions are critically important to the health of eelgrass and other submerged aquatic vegetation (Dowty et al. 2005). As fixed organisms, these plants are susceptible to changes in temperature, light, nutrient and chemical conditions. Threats to eelgrass include logging, stormwater and development activities that send sediments into bays and nearshore waters, limiting light and coating low flush areas with sediments. Dredging can directly destroy plants, and also add to water quality problems.

Summary

San Juan County government, residents and visitors share the unique benefits and responsibilities of over 400 miles of marine shoreline. Protection of nearshore habitat and marine food webs in San Juan County is an important component of salmon and orca recovery efforts. As a major shoreline property owner and manager of extensive coastal infrastructure, San Juan County has the ability to positively impact critical nearshore resources through its management decisions. The largest impact, and opportunity for improvement, is the county's road system and associated stormwater outfalls. Primary areas of county impact including Eastsound, West Sound, Blind Bay, Barlow Bay, Mackaye Harbor and Fisherman Bay, are also areas with significant environmental resources. As the land manager with the largest impact on local shorelines, San Juan County government must integrate the protection and restoration of nearshore marine resources into its daily operations and long-term management of shoreline infrastructure.

Appendix A. Bulkheads

Over 90 individual bulkheads were documented on sand/gravel beaches in San Juan County during forage fish spawning habitat assessments conducted between 2001 and 2003 (Friends 2004). The majority of bulkheads are located on private residential shoreline properties. San Juan County owns or manages 7 shoreline parcels with bulkheads. Five of the 7 county sites with bulkheads are known forage fish spawning beaches, with surf smelt activity documented at West Sound, Olga, Upright Head, Cowlitz Bay and Agate Beach (Penttila 1999, Friends 2004). The remaining two sites are potential forage fish spawning beaches (Moulton 2000). Six of seven county owned parcels with bulkheads also have eelgrass habitat (Friends et al. 2004). See Table 1. San Juan County Owned Parcels with Bulkheads.

Table 1. San Juan County Owned Parcels with Bulkheads

<i>County Parcels with Bulkhead</i>	<i>Region</i>	<i>Island</i>	<i>County Management</i>	<i>Priority Nearshore Habitat</i>
27145102000	Eastsound	Orcas	Public Works	Eelgrass, Pacific herring spawn
260434015000	West Sound	Orcas	Public Works	Eelgrass, Pacific herring and surf smelt spawn
160933002000	Olga	Orcas	Public Works	Eelgrass and surf smelt spawn
251852029000	Turn Point	San Juan	Public Works	Eelgrass
252811001000	Agate Beach	Lopez	Land Bank	Eelgrass and surf smelt spawn
263632009000	Upright Head	Lopez	Land Bank	Surf smelt spawn
372312002000	Cowlitz Bay	Waldron	Public Works	Eelgrass, surf smelt spawn

Appendix B. Roads in the Backshore

A major, existing impact to forage fish spawning habitat in San Juan County are roads located along shorelines. Road installation, long-term presence, and maintenance activities impact coastal processes and beach habitat through shoreline armoring, increased sedimentation and storm water runoff. Additional impacts of roads in nearshore habitat include a physical disconnection between marine and associated terrestrial habitats such as streams and wetlands.

Over ten miles of suitable forage fish spawning beaches were identified as having roads located along the backshore (Friends 2004). Approximately 20% of the road impact along beaches in San Juan County are private roads, with the majority of the impact, 80% (8.14 road miles) coming from County roadways. Over half of the county's shoreline impact from roads is concentrated in four general locations: West Sound (Orcas); Blind Bay (Shaw); and the Fisherman Bay and Barlow Bay/Mackaye Harbor regions of Lopez Island. All four of the county roadways with one mile or more of shoreline impact are documented forage fish spawning beaches (Penttila 1999, Friends 2004). Of the remaining 17 beach locations with county road impacts, 6 are documented forage fish spawning beaches (Penttila 1999, Friends 2004). All county roads located in the backshore are adjacent to beaches with eelgrass (Friends et al. 2004). See Table 2. County Roads Impacting Nearshore Marine Habitat.

Table 2. County Roads Impacting Nearshore Marine Habitat

<i>Shoreline Road Length (miles)</i>	<i>Region</i>	<i>Island</i>	<i>Priority Nearshore Habitat</i>
1.05	West Sound	Orcas	Eelgrass, surf smelt and Pacific herring spawn
0.5	Crescent Beach	Orcas	Eelgrass, sand lance and Pacific herring spawn
0.4	Buck Bay	Olga	Eelgrass
0.4	Deer Harbor	Orcas	Eelgrass
1	Blind Bay	Shaw	Eelgrass, Pacific herring and surf smelt spawn
.08	Neck Point	Shaw	Eelgrass
.07	Indian Cove	Shaw	Eelgrass
.04	Bell Point	Shaw	Eelgrass
0.2	Squaw Bay	Shaw	Eelgrass
0.2	False Bay	San Juan	Eelgrass, sand lance spawn
0.2	Jackson Beach	San Juan	Eelgrass, surf smelt and sand lance spawn
0.1	Westcott Bay	San Juan	Eelgrass, surf smelt and Pacific herring spawn
.07	SJ County Park	San Juan	Eelgrass
.06	Old Argyle	San Juan	Eelgrass
.05	Mitchell Bay	San Juan	Eelgrass, surf smelt spawn
1.69	Fisherman Bay	Lopez	Eelgrass
1.17	Barlow Bay/ Mackaye Harbor	Lopez	Eelgrass, surf smelt and sand lance spawn
0.2	Swifts Bay	Lopez	Eelgrass
.02	Hunter Bay	Lopez	Eelgrass, surf smelt and Pacific herring spawn
0.1	Mud Bay	Lopez	Eelgrass, surf smelt and Pacific herring spawn
0.1	Odlin	Lopez	Eelgrass, surf smelt spawn (1 egg site)

Appendix C. Stormwater Outfalls

Shoreline stormwater outfalls impact nearshore marine habitat in multiple ways. Culverts and stormwater infrastructure can disrupt geologic processes and alter beach substrate characteristics through concentrated flows, increased erosion and the physical structure itself, which is often secured with large rock. Stormwater is also a source of water quality problems, including increased sedimentation and pollutants. Water quality concerns are of particular importance in shallow water embayments with lower flushing. Many of the roads and stormwater systems in San Juan County are concentrated, with residential development, along these sensitive embayments.

San Juan County has 82 shoreline stormwater outfalls, defined here as road culverts within 50 feet of a beach, not associated with a stream. The majority of stormwater outfalls are located on Orcas (n=34), followed by Lopez (n=24), Shaw (n=13) and San Juan (n=11) Islands. Embayments with the largest stormwater outfall impact include Fisherman Bay (Lopez), Blind Bay (Shaw), Olga/Buck Bay (Orcas), West Sound (Orcas), Deer Harbor (Orcas) and Eastsound (Orcas). Eighty one of the county's 82 shoreline stormwater outfalls drain onto beaches with eelgrass communities (Friends et al. 2004). Fifty (61%) shoreline stormwater outfalls drain onto documented forage fish spawning beaches (Penttila 1999, Friends 2004). See Table 3. Shoreline Stormwater Outfalls.

Table 3. Shoreline Stormwater Outfalls

<i>Shoreline Outfalls</i>	<i>Region</i>	<i>Island</i>	<i>Priority Nearshore Habitat</i>
3	Eastsound	Orcas	Eelgrass, Pacific herring spawn
2	Crescent Beach	Orcas	Eelgrass, Pacific herring and sand lance spawn
2	North Beach	Orcas	Eelgrass
6	Deer Harbor	Orcas	Eelgrass
2	Massacre Bay	Orcas	Eelgrass, Pacific herring spawn
7	West Sound	Orcas	Eelgrass, Pacific herring and surf smelt spawn
3	Orcas Bay	Orcas	Eelgrass, sand lance spawn
8	Olga/Buck Bay	Orcas	Eelgrass, surf smelt spawn
10	Blind Bay	Shaw	Eelgrass, Pacific herring and surf smelt spawn
3	Squaw Bay	Shaw	Eelgrass
4	Westcott Bay	San Juan	Eelgrass, Pacific herring and surf smelt spawn
1	Smugglers Cove	San Juan	Eelgrass
2	County Park	San Juan	Eelgrass
2	False Bay	San Juan	Eelgrass, sand lance spawn
1	Old Argyle	San Juan	Eelgrass
1	Limestone Point	San Juan	Kelp
2	Odlin	Lopez	Eelgrass
1	Shoal Bay	Lopez	Eelgrass, surf smelt spawn
3	Swifts Bay	Lopez	Eelgrass
4	Barlow Bay/ Mackaye Harbor	Lopez	Eelgrass, surf smelt and sand lance spawn
3	Outer Bay/ Agate Beach	Lopez	Eelgrass, surf smelt spawn
10	Fisherman Bay	Lopez	Eelgrass
1	Mud Bay	Lopez	Eelgrass, Pacific herring and surf smelt spawn

Appendix D. Infrastructure Impacts to Coastal Streams and Wetlands

Culverts and roads in proximity to coastal streams and wetlands primarily impact freshwater habitat by disrupting physical or functional connections between marine, estuarine and freshwater habitats. As anadromous fish research and management traditionally focused on protection of natal freshwater streams, the significance of San Juan County's freshwater systems (estuarine wetlands, salt marshes, pocket estuaries and streams) is not reflected in current policy. As a result, most culverts in San Juan County are designed to transport water from the upland to the marine environment, and not concerned with the two-way movement of salmonids of multiple species and life history stages now known to utilize connected freshwater systems. In addition, the significance of maintaining tidal exchange of water and nutrients for a host of species and ecosystem processes has often been overlooked.

For this analysis, county infrastructure impacts to nearshore associated freshwater habitats was defined as 'roads or culverts located within 100 feet of mean high water and within 100 feet of a mapped wetland or stream'. As the county's best available spatially explicit 'streams' layer is imperfect, impact assessments for this factor are likely conservative. An overview of the regions where county infrastructure is impacting coastal streams and wetlands is provided below in Table 4. County Infrastructure Impacts to Coastal Streams and Wetlands.

Table 4. County Infrastructure Impacts to Coastal Streams and Wetlands

<i>Island</i>	<i>Region</i>	<i>Freshwater Habitat Type</i>
Orcas	Crescent Beach	Wetland
	Rosario	Stream
	Buck Bay	Stream
	Orcas	Stream/Wetland
	West Sound	Stream
	Deer Harbor	Wetland/Estuary
Shaw	Neck Point	Wetland
	Squaw Bay	Wetland
	Blind Bay	Wetland
San Juan	Old Argyle	Stream/Wetland
	Argyle Lagoon	Stream
	Mitchell Bay	Wetland
	Beaverton Creek	Stream
Lopez	Fisherman Bay	Wetland
	Davis Bay	Stream
	Barlow Bay/Mackaye Harbor	Wetland
	Mud Bay	Wetland/Estuary
	Shoal Bight	Wetland

Appendix E. Docks

There are at least 504 shoreline parcels with docks in San Juan County, the vast majority of which are privately owned and managed. San Juan County is responsible for 8 docks, primarily located within County Parks and managed by the Public Works Department. Four of San Juan County's docks are located on beaches with documented forage fish spawning activity, and all 8 of San Juan County's docks are located in areas of eelgrass communities (Penttila 1999, Friends 2004, Friends et al. 2004). See Table 5. County Parcels with Docks.

Table 5. County Parcels with Docks

<i>County Parcel with Dock</i>	<i>Region</i>	<i>Island</i>	<i>County Management</i>	<i>Priority Nearshore Habitat</i>
271460066000	Eastsound	Orcas	Public Works	Eelgrass, Pacific herring spawn
161650110000	Obstruction Pass	Orcas	Public Works	Eelgrass
260434015000	West Sound	Orcas	Public Works	Eelgrass, Pacific herring spawn, surf smelt spawn
141880005000	Barlow Bay/ Mackaye Harbor	Lopez	Public Works	Eelgrass, surf smelt spawn and sand lance spawn
252221010000	Fisherman Bay	Lopez	Land Bank	Eelgrass
250251001000	Odlin	Lopez	Public Works	Eelgrass
372312002000	Cowlitz Bay	Waldron	Public Works	Eelgrass, surf smelt spawn
	Prevost Harbor	Stuart	Public Works	Eelgrass

Appendix F. Improved Boat Ramps

There are at least 34 improved boat ramps located in the sand/gravel nearshore marine habitats of San Juan County, 7 of which are owned and/or managed by San Juan County. Three of the county's improved boat ramps are located on documented forage fish spawning beaches, with the remaining located in suitable forage fish spawning habitat (Penttila 1999, Moulton 2000, Friends 2004). All 7 of San Juan County's boat ramps are located on sites with eelgrass (Friends et al. 2004). See Table 6. County Parcels with Improved Boat Ramps.

Table 6. County Parcels with Improved Boat Ramps

<i>County Parcel with Improved Boat Ramp</i>	<i>Region</i>	<i>Island</i>	<i>County Management</i>	<i>Priority Nearshore Habitat</i>
161650110000	Obstruction Pass	Orcas	Public Works	Eelgrass
263431001000	South Beach	Shaw	Public Works	Eelgrass
451131001000	SJ County Park	San Juan	Public Works	Eelgrass
141880005000	Barlow Bay/ Mackaye Harbor	Lopez	Public Works	Eelgrass, surf smelt and sand lance spawn
Road ending	Hunter Bay	Lopez	Public Works	Eelgrass, Pacific herring and surf smelt spawn
250251001000	Odlin	Lopez	Public Works	Eelgrass
372312002000	Cowlitz Bay	Waldron	Public Works	Eelgrass, surf smelt spawn

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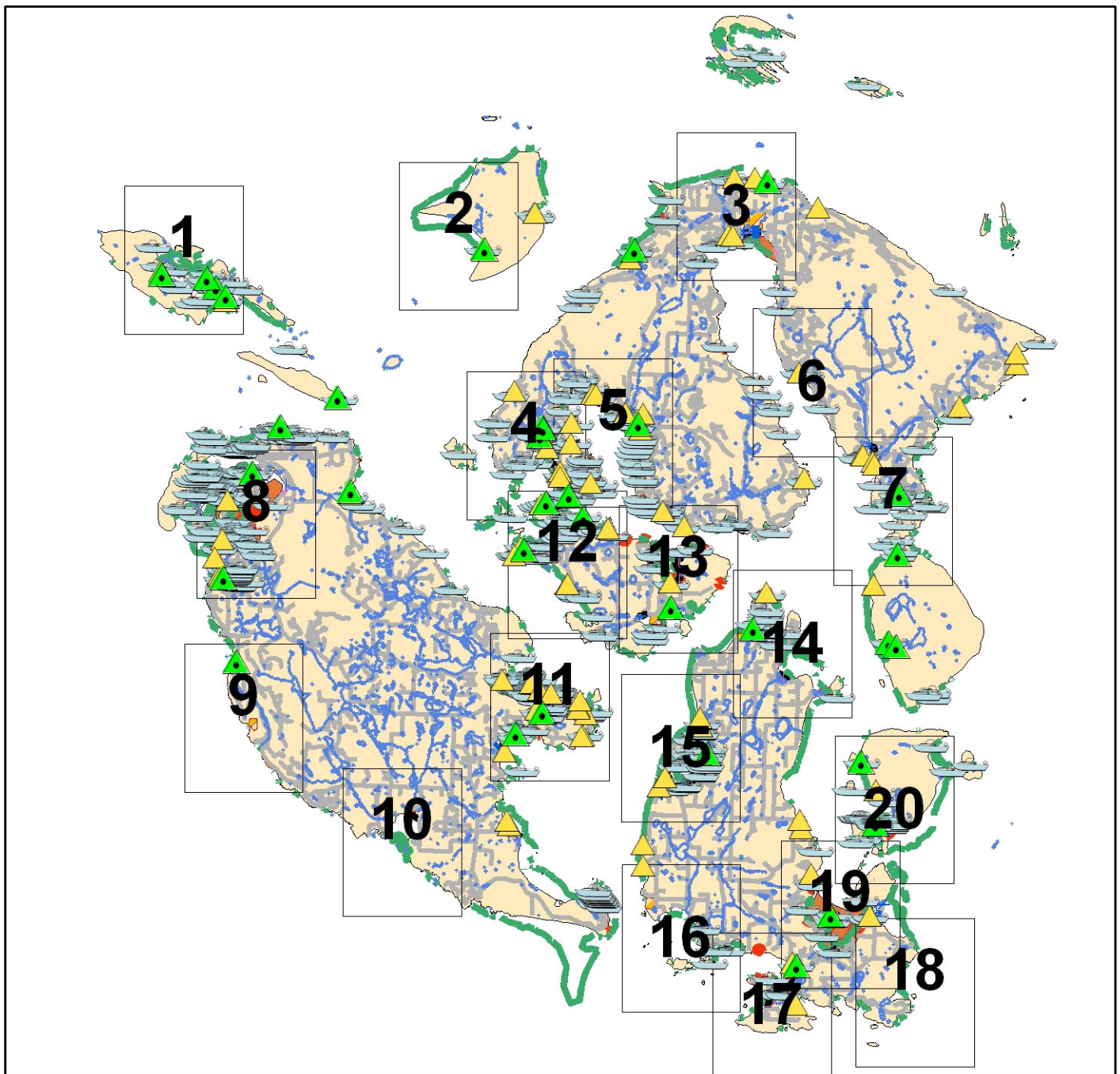
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San Juan County Nearshore Impact Assessment

Map Book

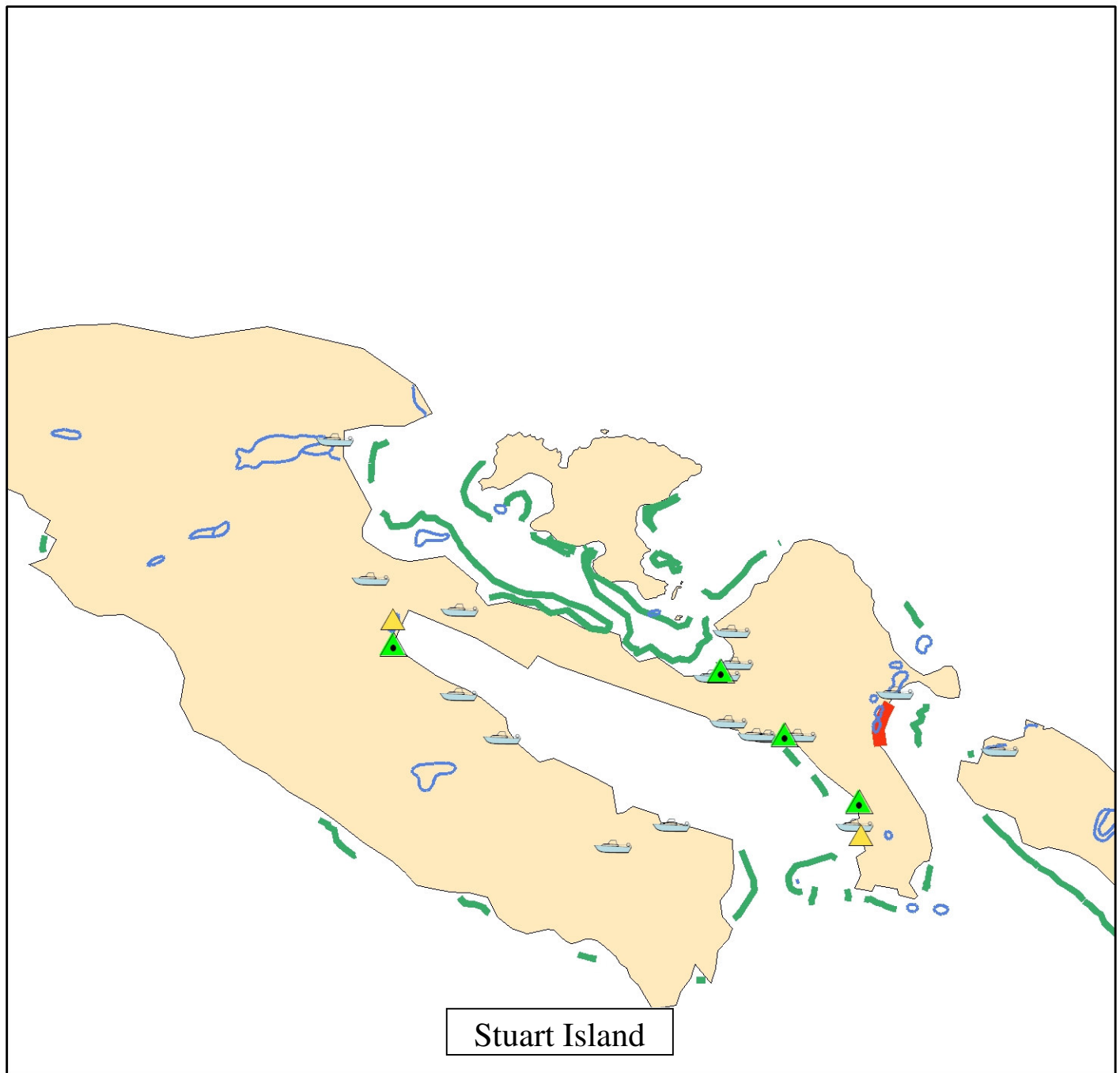


Legend

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|---|------------------------------|
| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |

San Juan County Nearshore Impact Assessment

Map 1



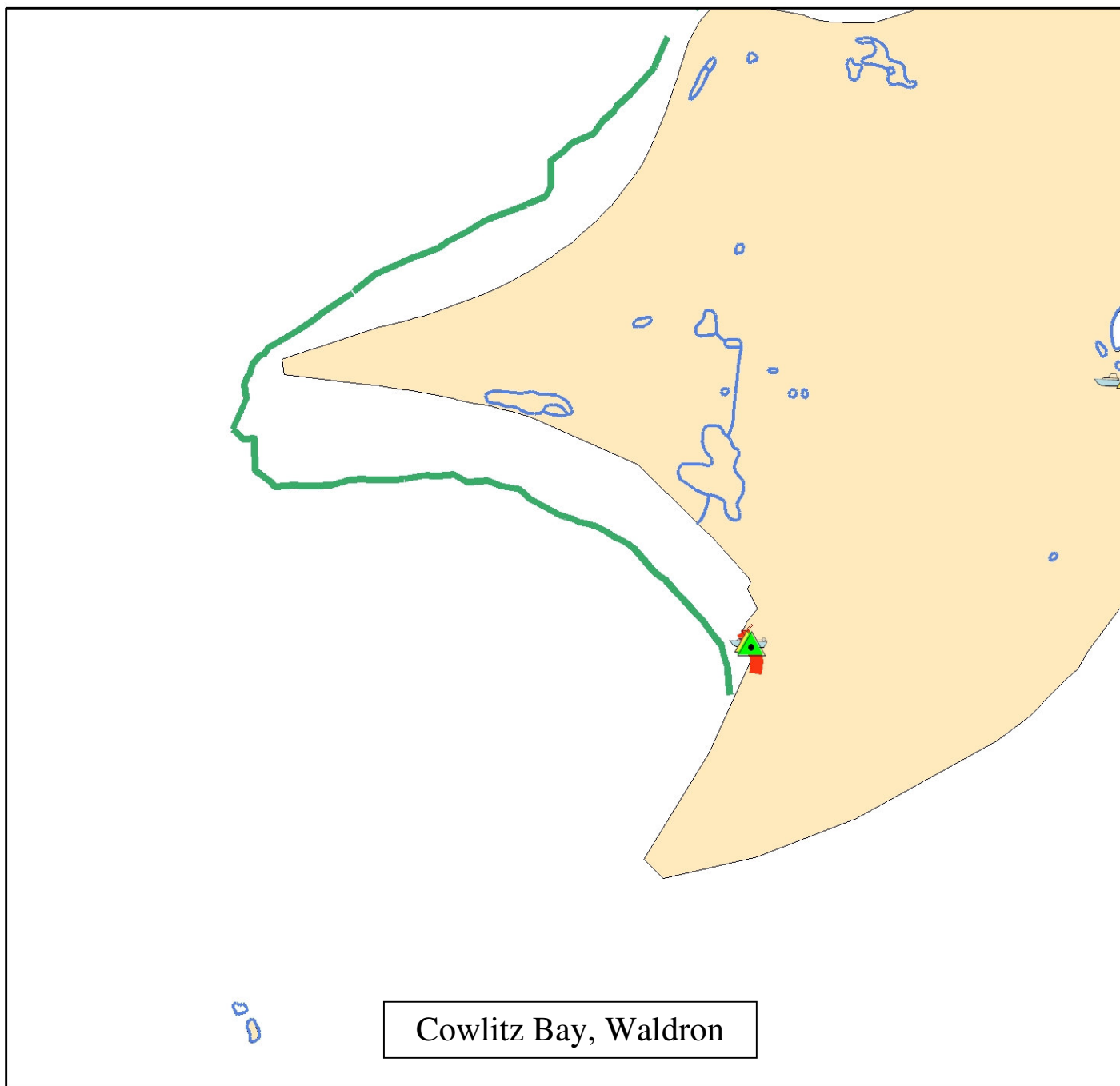
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |















San Juan County Nearshore Impact Assessment

Map 2



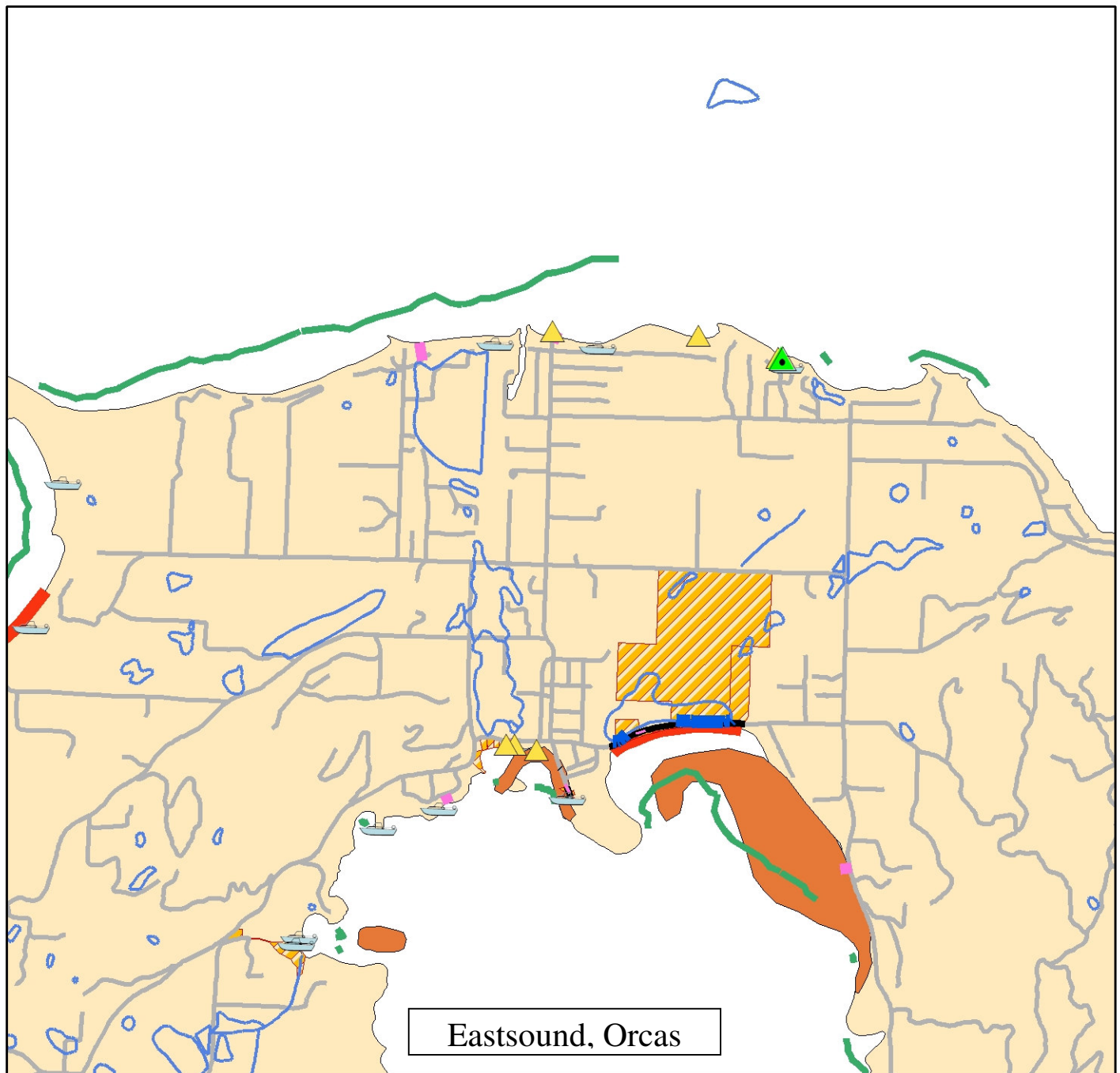
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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 3



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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 4



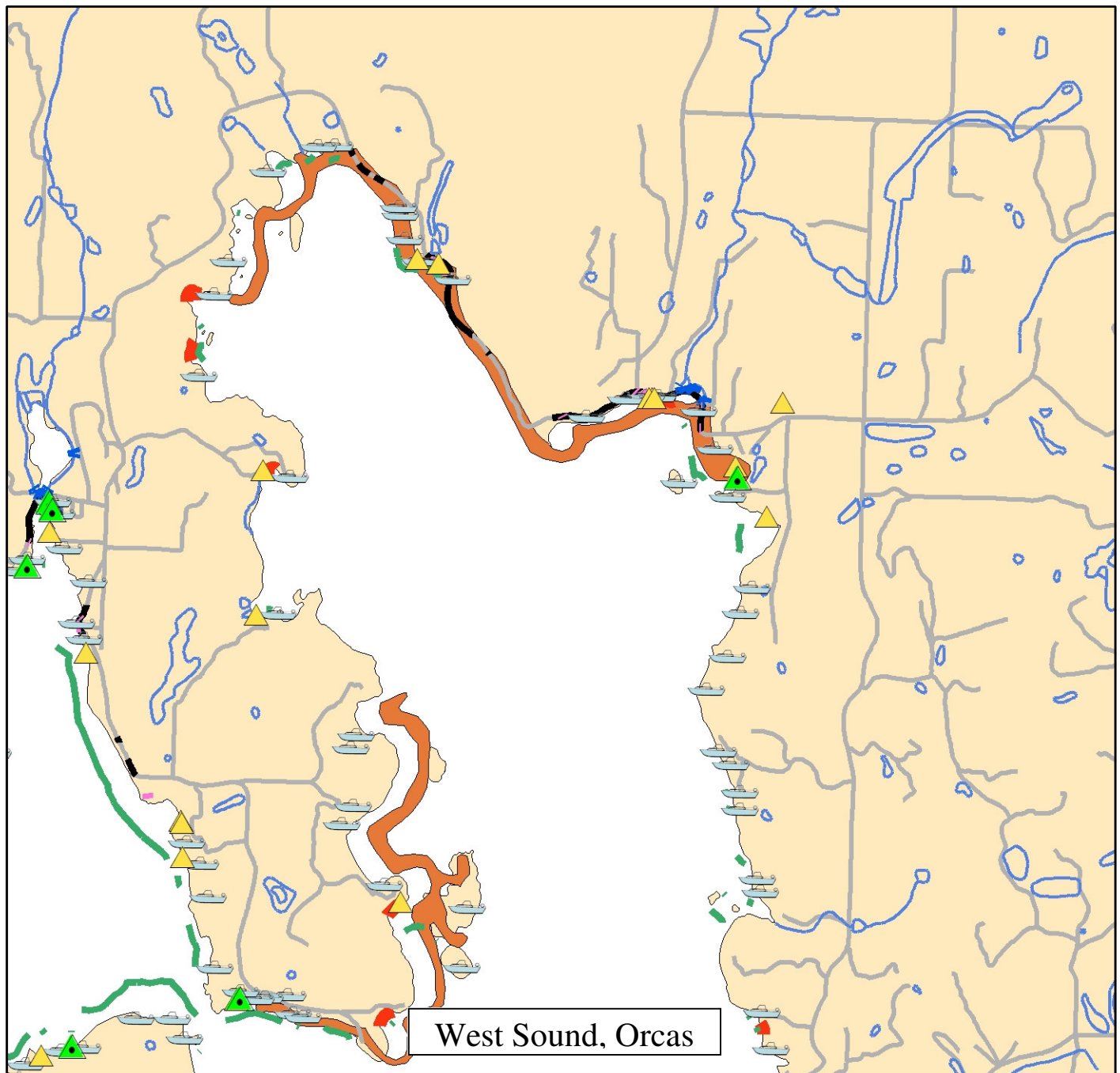
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 5



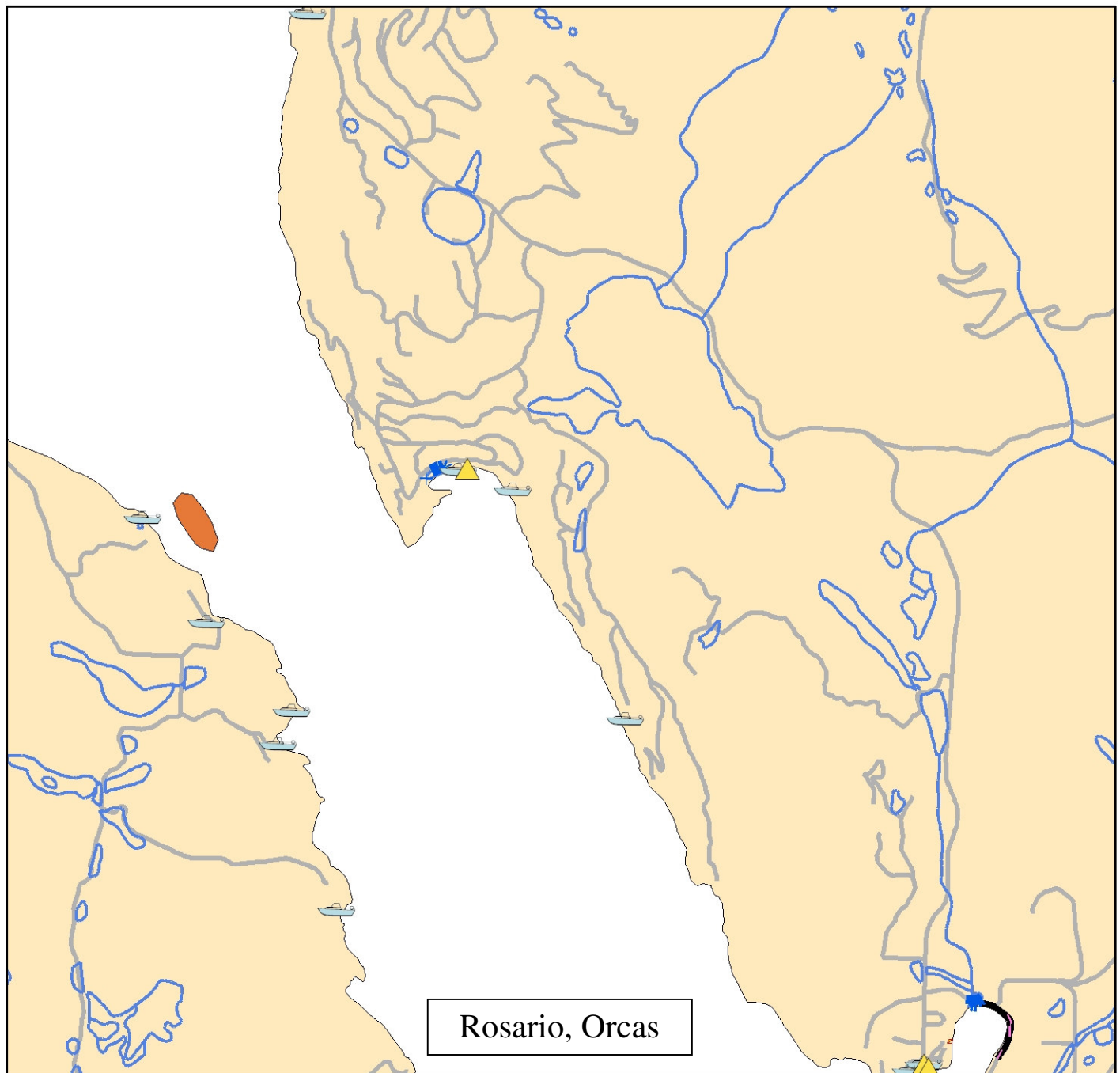
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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 6



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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 7



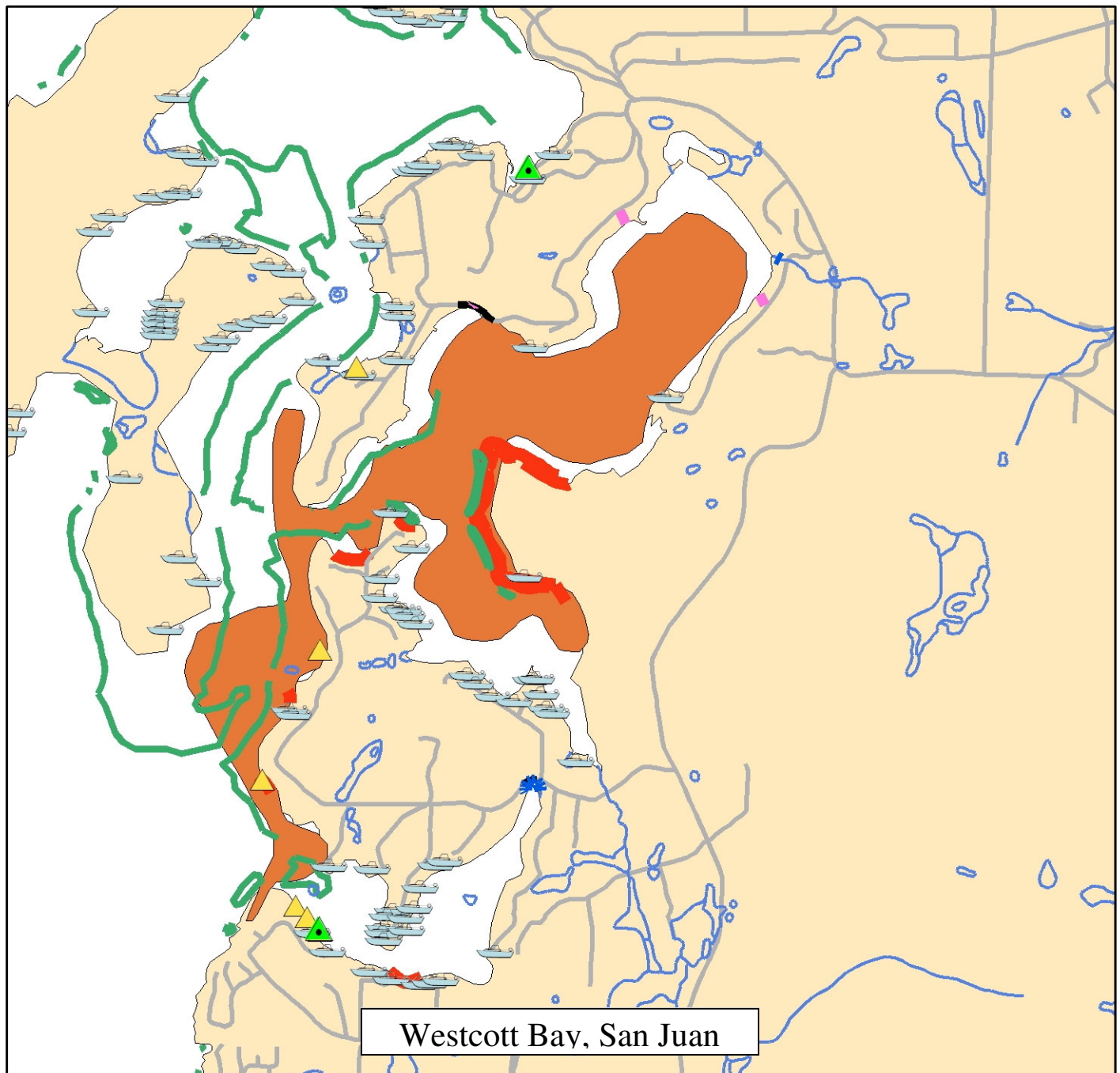
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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 8



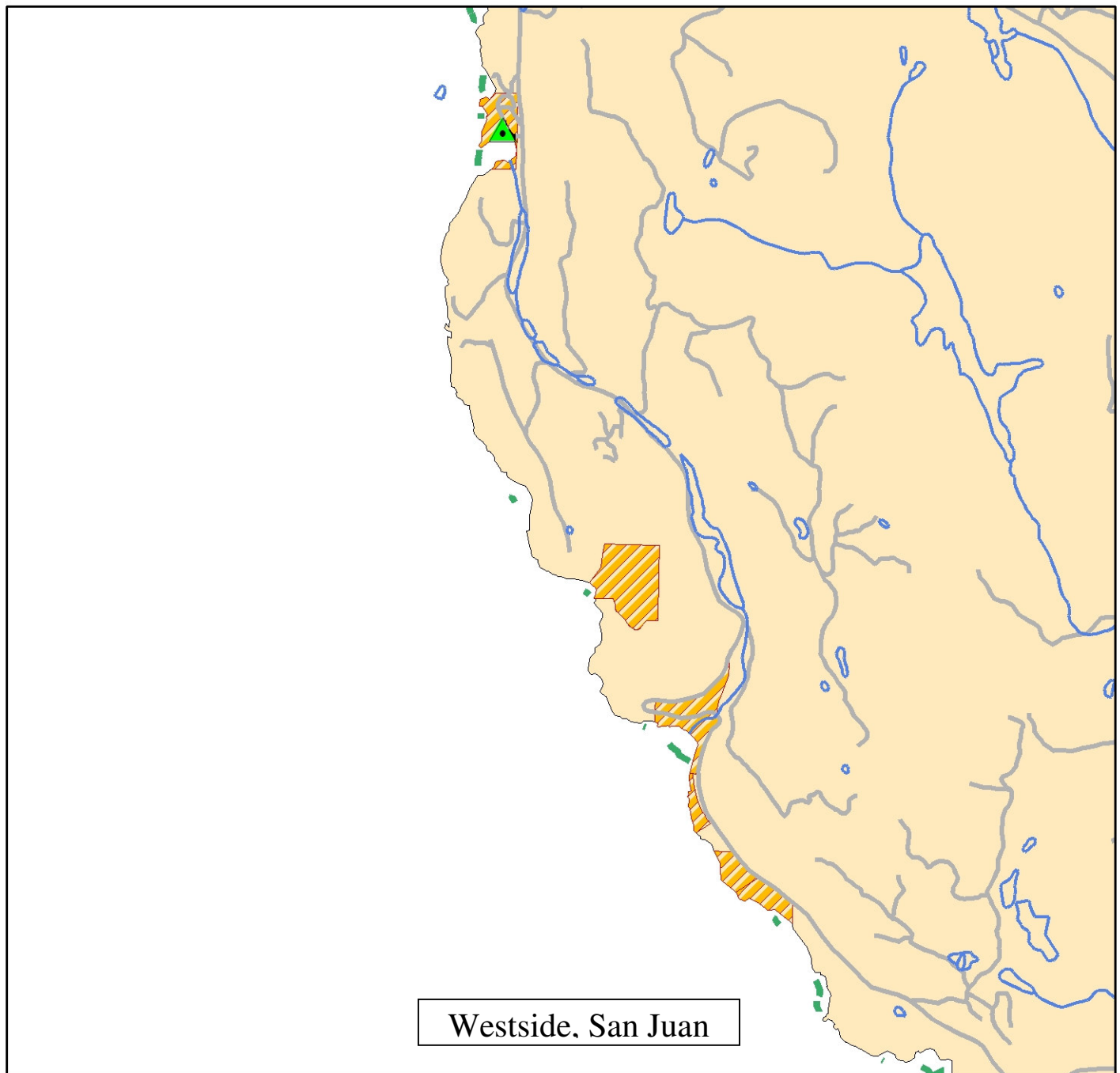
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 9



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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 10



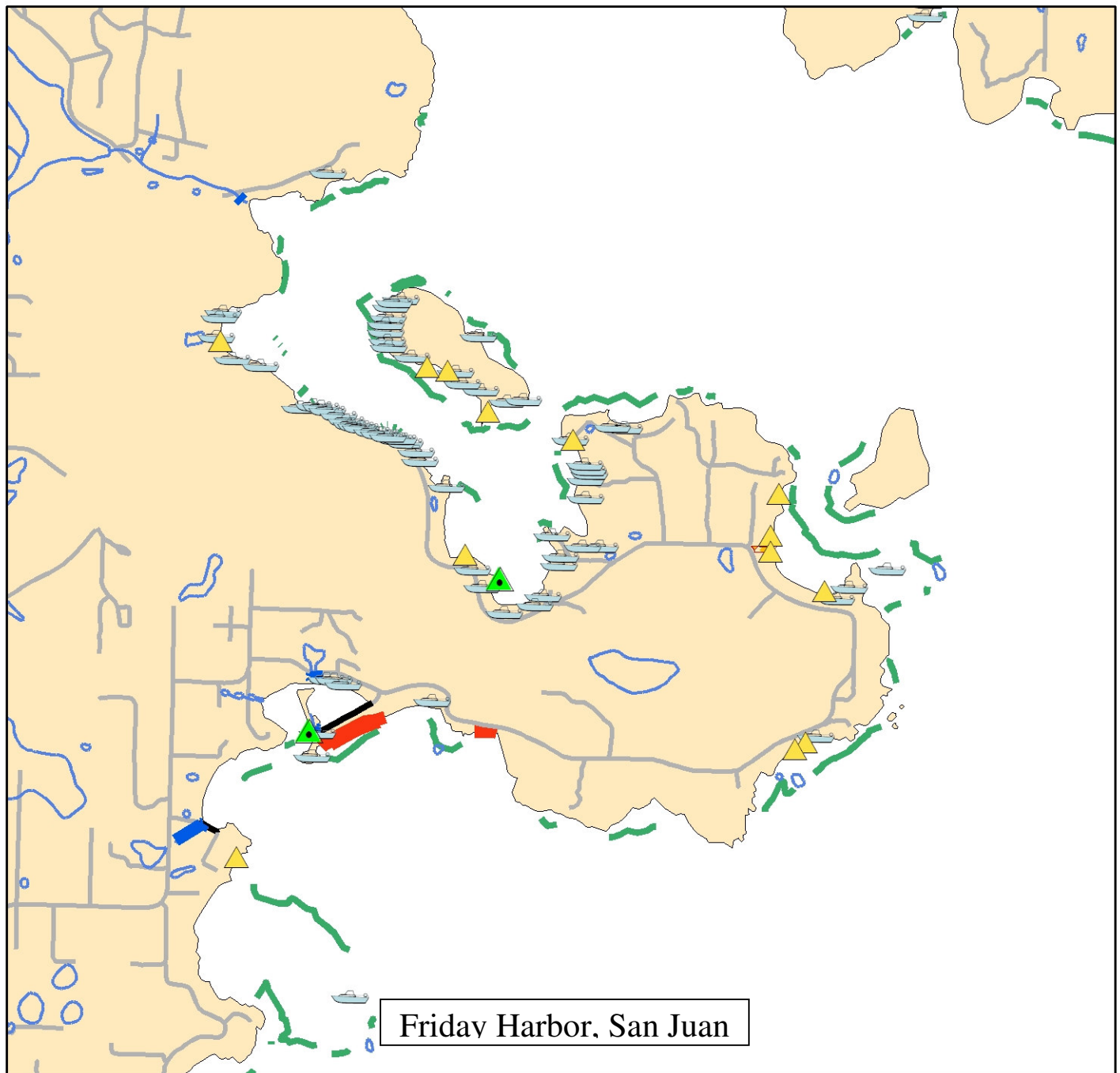
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|  Docks |  County Roads along Backshore |
|  Bulkheads |  County Roads |
|  Improved Boat Ramps |  Outer Edge of Eelgrass |
|  Shoreline Streams/Wetlands with Roads or Culverts |  Forage Fish Spawn Sites |
|  Stormwater Outfalls |  Herring Spawn Area |
|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 11



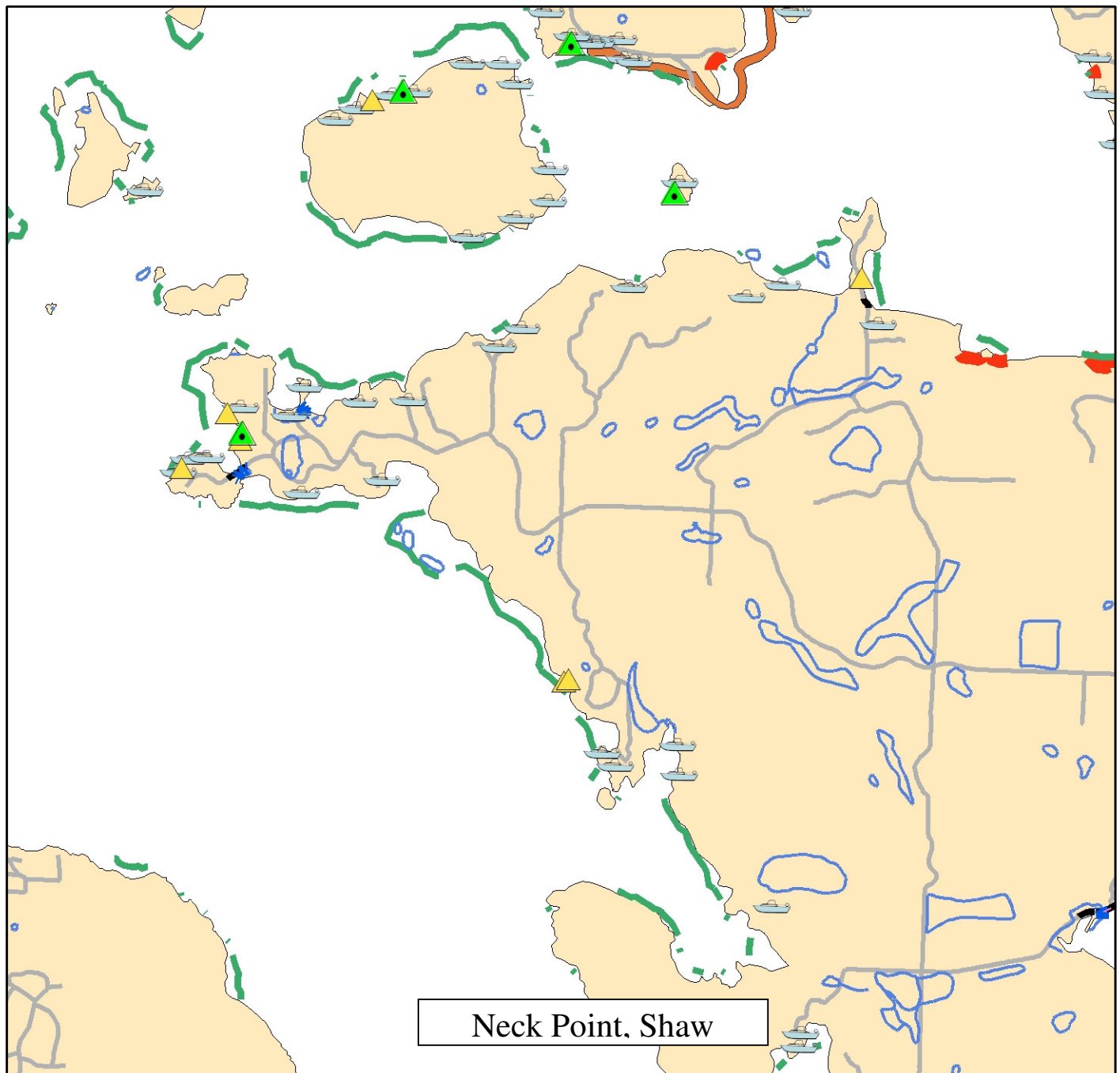
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 12



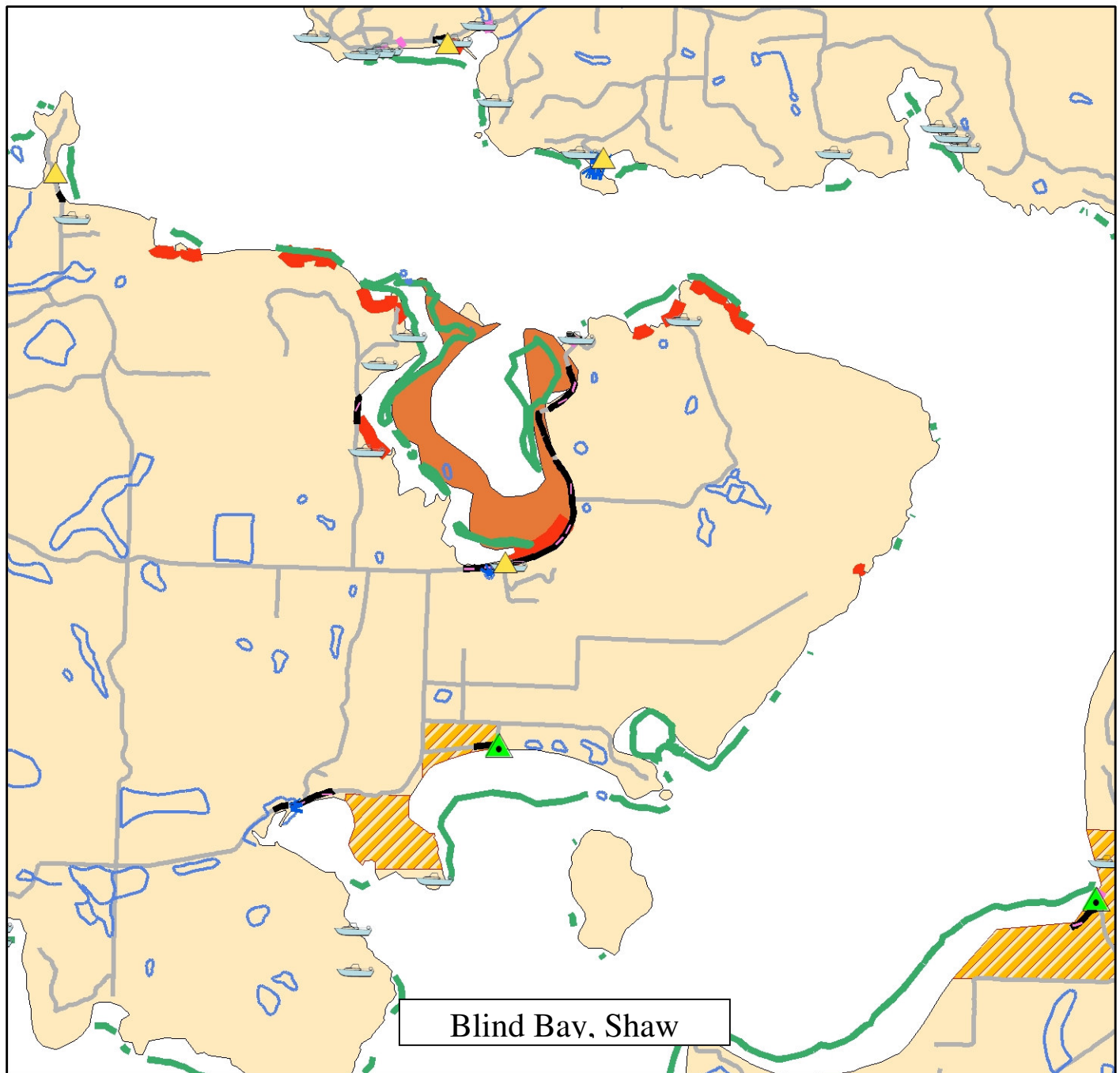
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 13



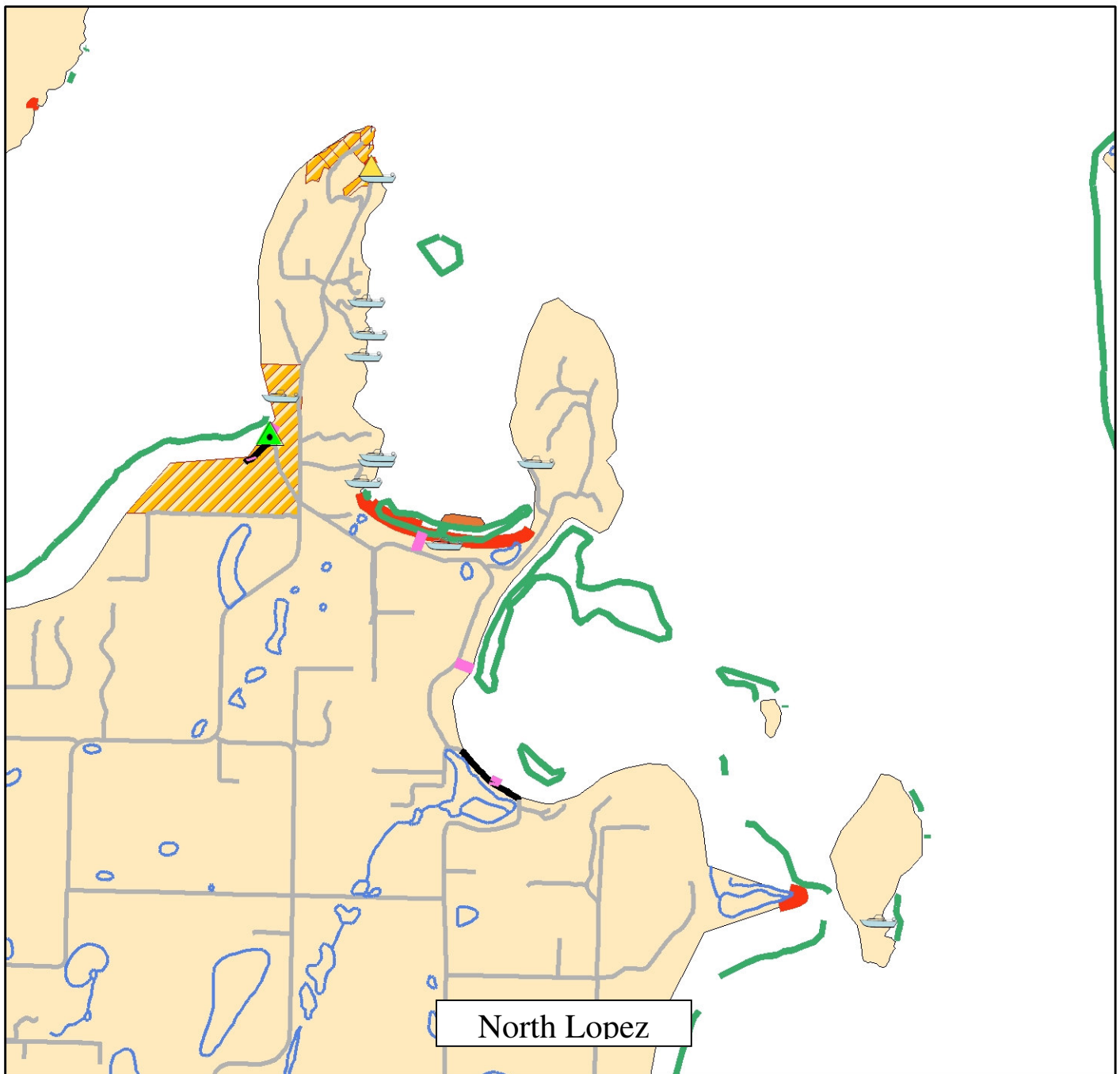
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 14



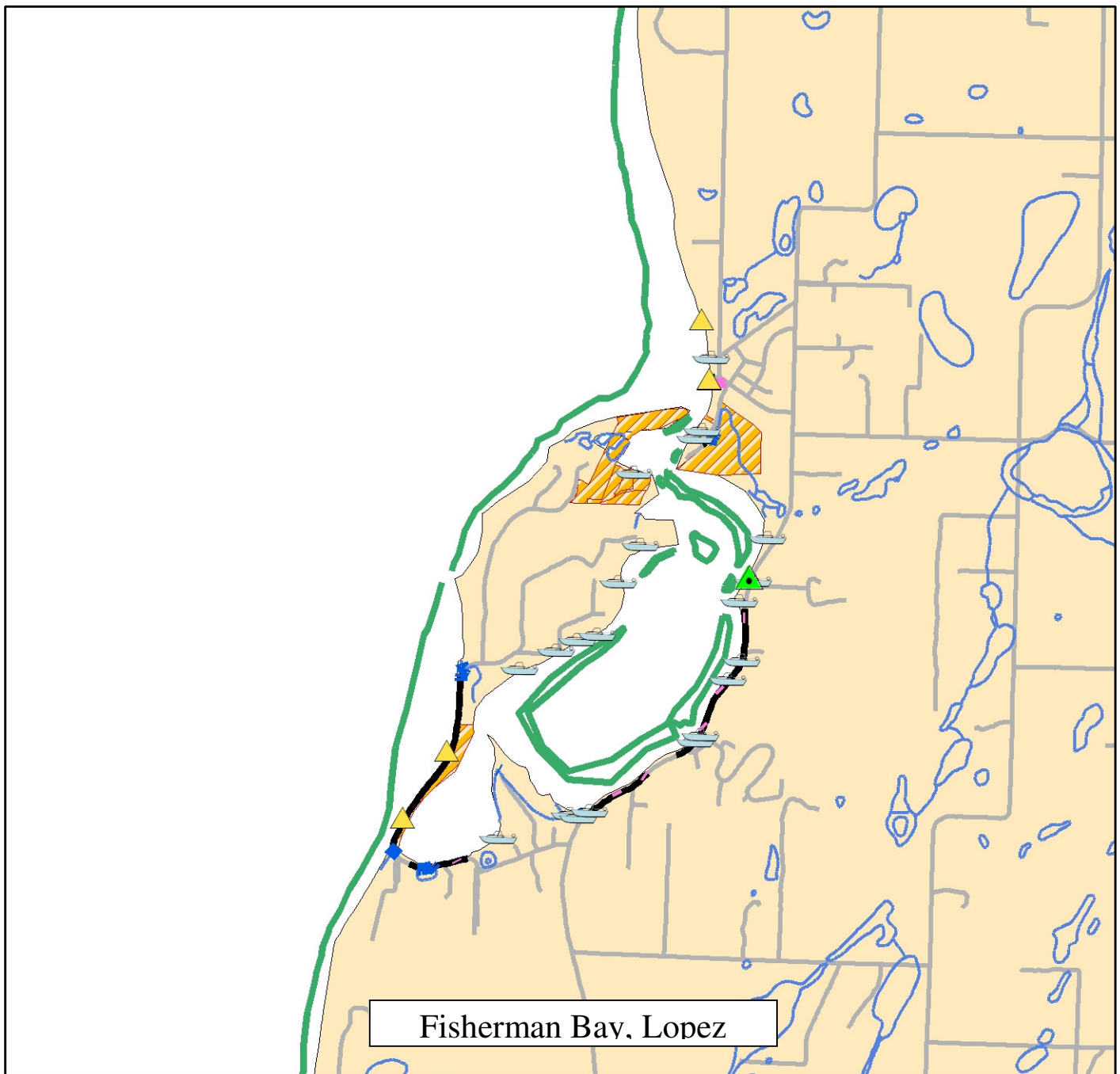
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 15



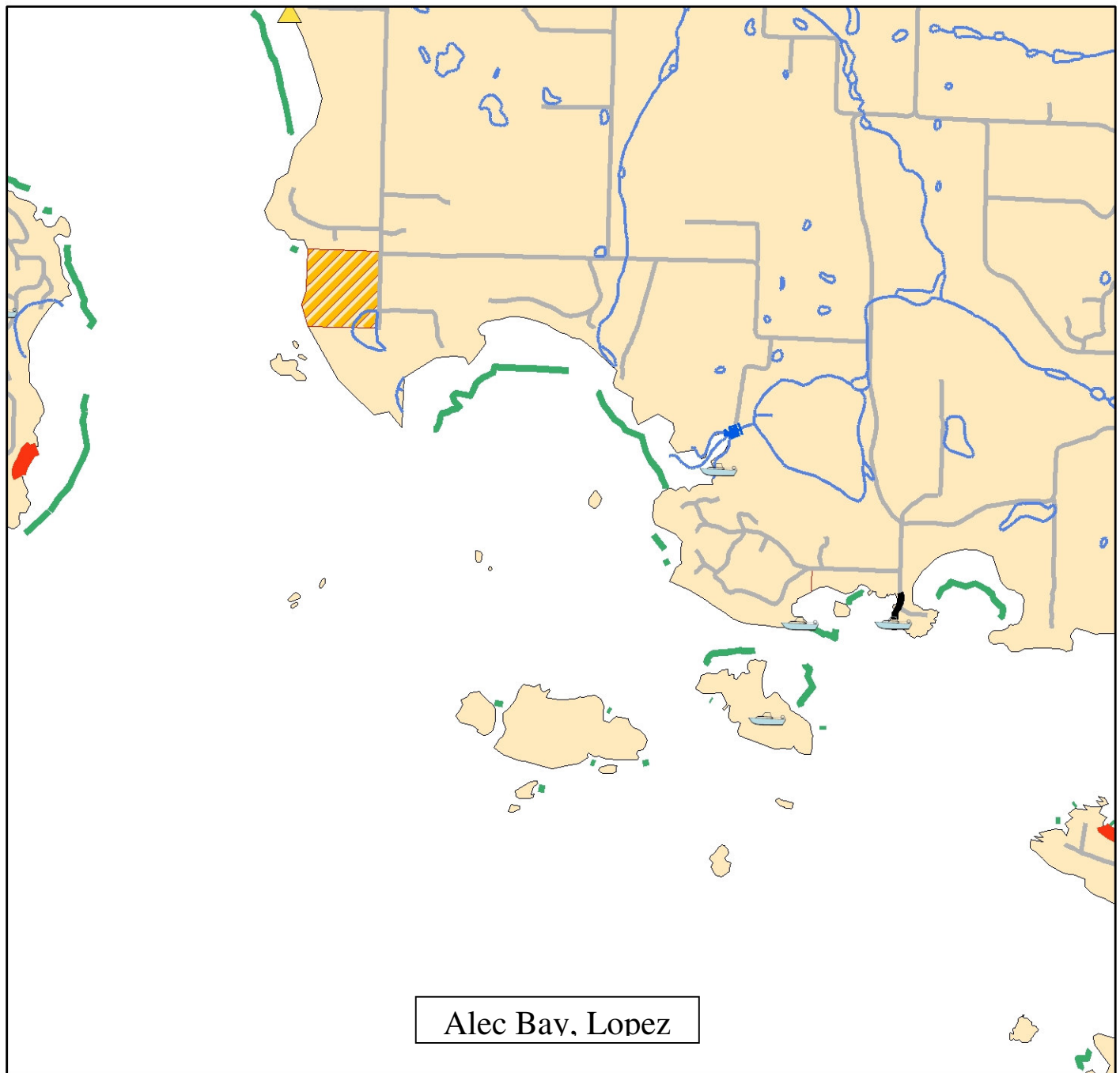
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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 16



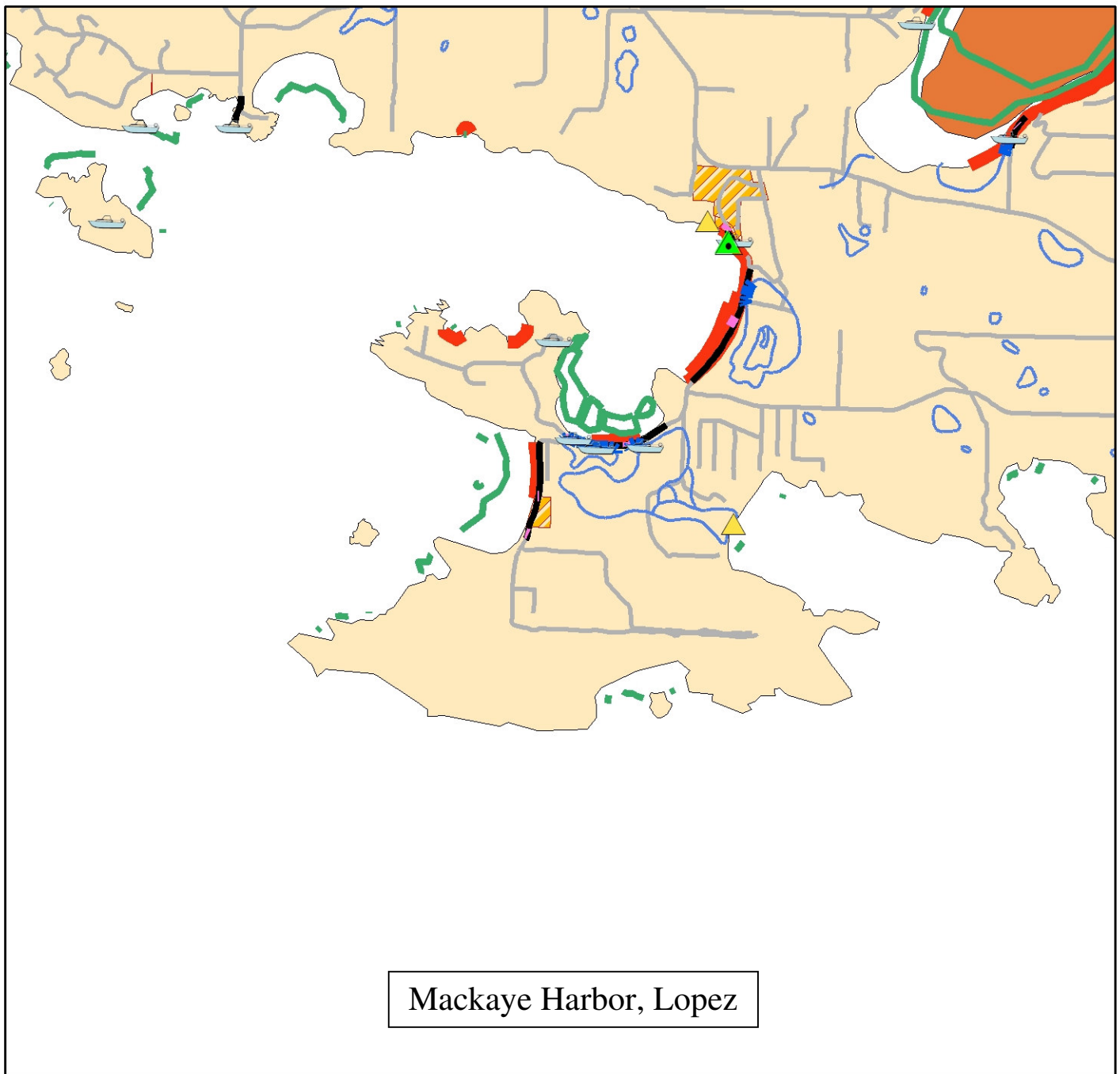
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|  Docks |  County Roads along Backshore |
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|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 17



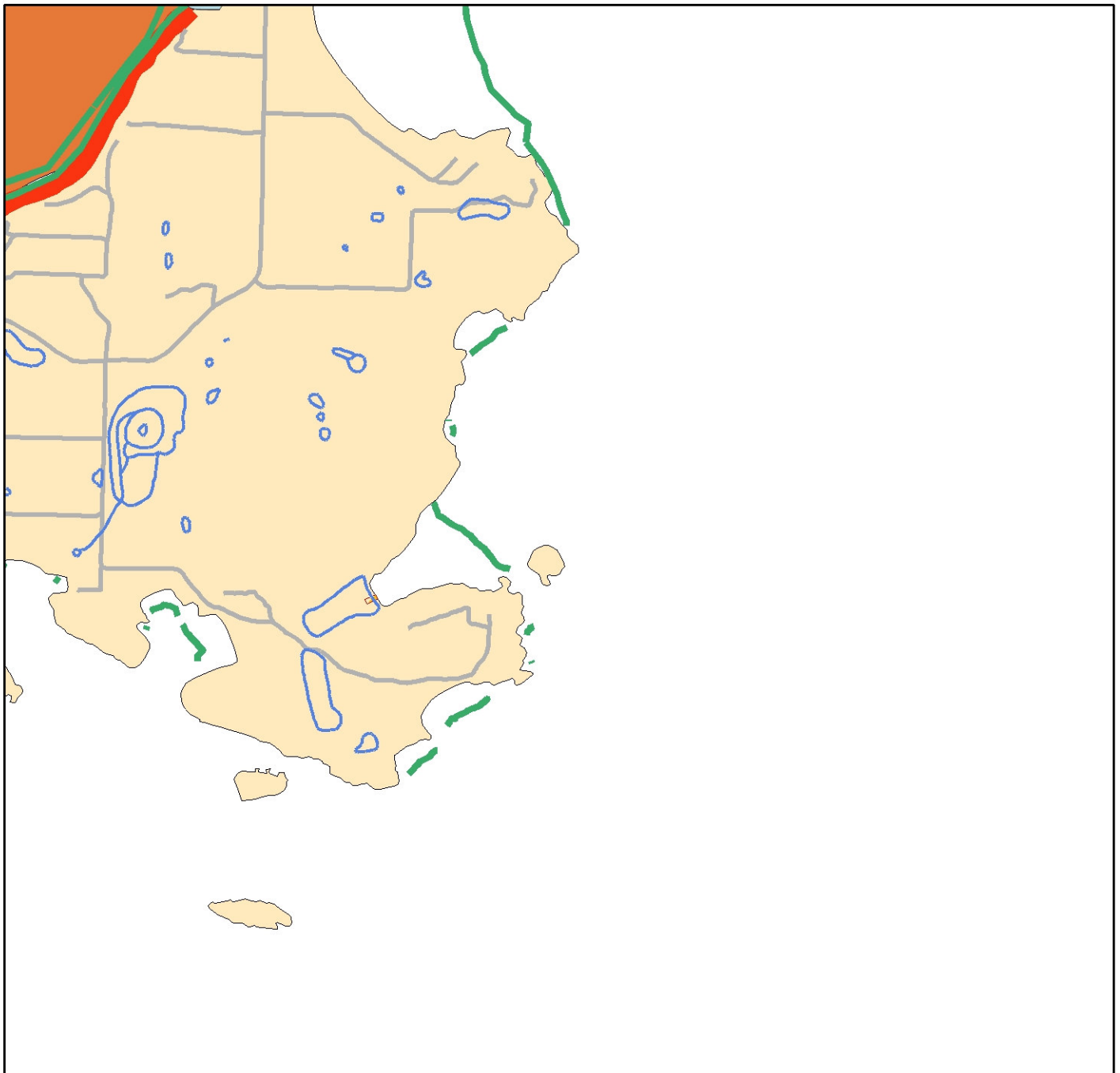
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|  Docks |  County Roads along Backshore |
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|  Streams/Wetlands |  County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 18



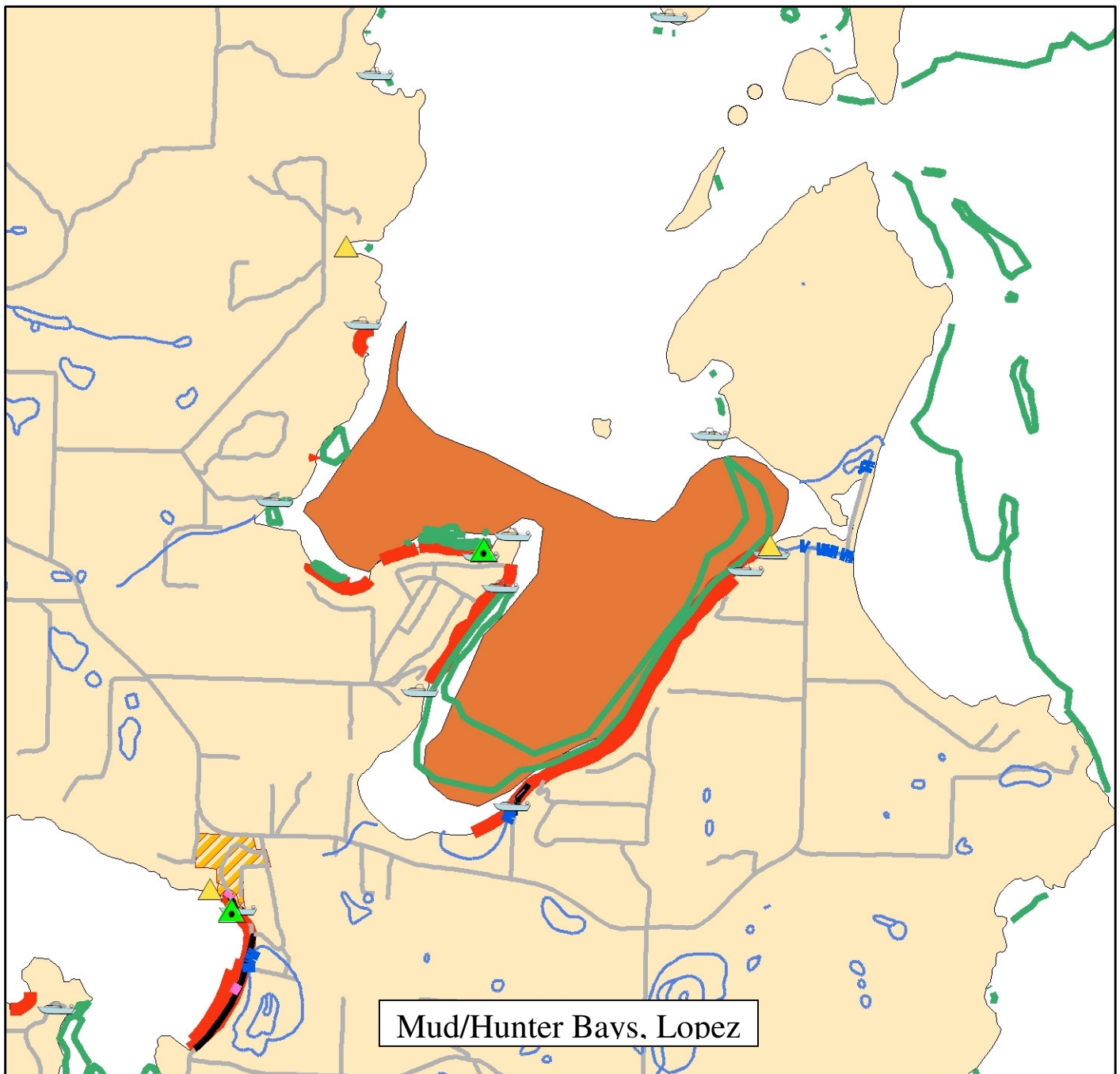
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|  Docks |  County Roads along Backshore |
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San Juan County Nearshore Impact Assessment

Map 19



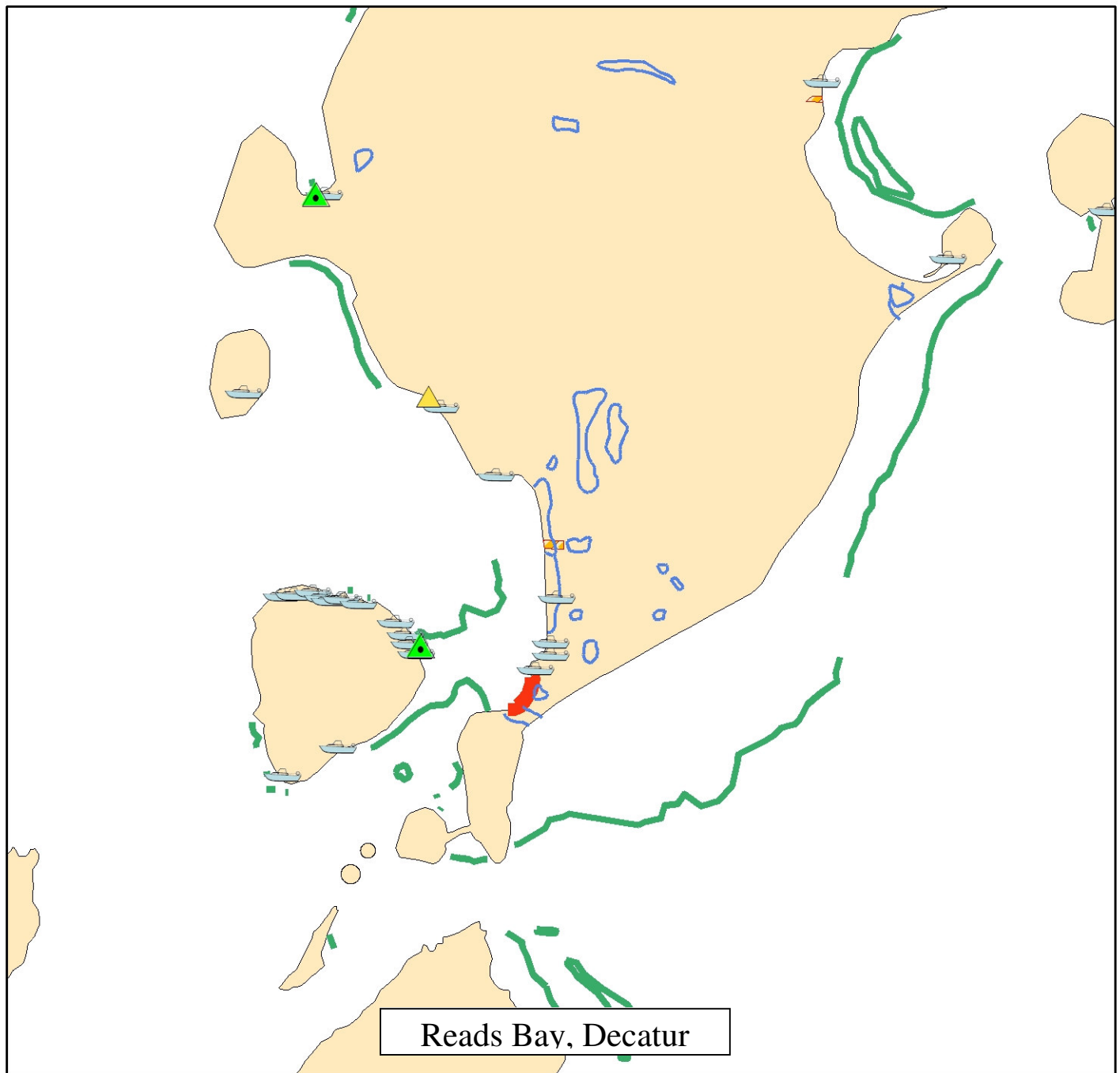
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| Stormwater Outfalls | Herring Spawn Area |
| Streams/Wetlands | County Shoreline Ownership |



San Juan County Nearshore Impact Assessment

Map 20



Legend

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| Docks | County Roads along Backshore |
| Bulkheads | County Roads |
| Improved Boat Ramps | Outer Edge of Eelgrass |
| Shoreline Streams/Wetlands with Roads or Culverts | Forage Fish Spawn Sites |
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