

MackKaye Harbor Road Relocation Feasibility Study

Milepost 1.0 to Milepost 1.9, Lopez Island

Prepared For: San Juan County

June 2017

Prepared By:



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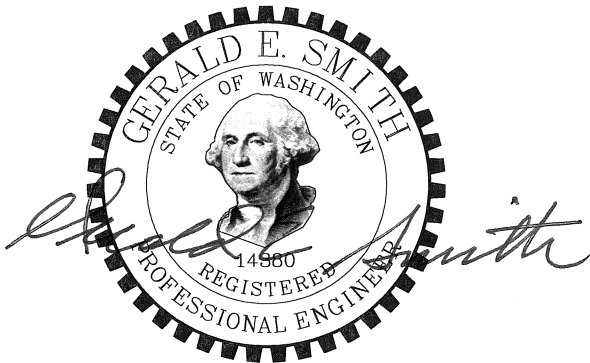
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PROJECT ENGINEER CERTIFICATION

MACKAYE HARBOR ROAD RELOCATION FEASIBILITY STUDY

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



Gerald E. Smith, PE
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Date: June 20, 2017

EXECUTIVE SUMMARY

The last mile of MacKaye Harbor Road, at the southern end of Lopez Island, provides the sole access to nearly 80 property owners, including tribal lands, a county park and a national monument. With continuing coastal erosion and projected increasing sea level elevations, portions of the road will be subject to inundation in the future. To plan for this situation, San Juan County was given a grant in January 2016, from the State Connecting Washington program, to develop a MacKaye Harbor Road Relocation Feasibility Study to evaluate a long term solution for the road by:

- Addressing projected sea level rise and continuing coastal erosion.
- Maintaining vehicular access to private properties, public and tribal lands.
- Providing parking provisions outside of the road travel way for visitors to the public lands.

The County reached out to the public to assist with the development of the Feasibility Study by convening a Feasibility Study Team that included full time residents from impacted neighborhoods, a team of specialty consultants, and County representatives from four disciplines.

The project study area is rich in diverse habitat, both marine and terrestrial, boasts stunning views across Barlow Bay and Outer Bay, and is located in a region with numerous Native American archaeological sites. Critical areas populate much of the landscape in the form of wetlands and eroding shorelines.

It was important to the study team to solicit comments from the community, but many of the residents in the study area do not reside on Lopez Island full time. To maximize the sharing of information, a combination of postal mailings and emails was used to reach property owners, in addition to posting materials on the County website. Two community meetings were held over the course of the 16-month study and status updates were sent out every other month. To solicit comments, an online open house was held for three weeks and a supplemental mailing was conducted requesting comments from property owners. The final result was that comments were received from 35% of the property owners in the study area and each of the impacted neighborhoods was represented.

Over the course of the Feasibility Study, four concepts emerged from the possibilities that were evaluated to meet the study goals, either singly or in combination. Essentially, concepts either included working with the road along the shoreline or moving the road inland. When asked to comment, the opinions of the community were divided between the desire to have the road remain along the shoreline or to be relocated inland in order to continue to provide long-term

access to the affected neighborhoods. There were many reasons given for the division of opinions and they served to illustrate the complexity of finding a solution within a diverse community.

After a thorough evaluation and consideration of all elements, the Inland Relocation concept was chosen as the ultimate long-term solution to meet the goals of the feasibility study. However, relocating a road is a lengthy process - it will be many years from the time funding is obtained and planning can be initiated until all the phases are complete and construction could be considered. In the meantime, coastal erosion continues to occur and the existing road needs to be protected. Therefore, in the interim, the County has committed to a number of near term actions to address issues with the current road, and implement safety measures.

Glossary

Berm¹: A low shelf or narrow terrace on the backshore of a beach formed of material thrown up and deposited by storm waves.

Beach Nourishment: The process of providing a beach with layers of additional gravel and sand. The gravel layer is used to build a beach berm and provide erosion control, while the sand layer is amenable to forage fish spawning.

Computer Aided Drafting (CAD): A software program that is used to create drawings and is commonly used by the engineering community. AutoCAD Civil 3D was the software used in this project and all references to CAD imply the use of the AutoCAD Civil 3D software.

Critical Areas: Include the following areas and ecosystems: (a) Wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas (Washington State Legislature RCW 36.70a.030(5)).

Datum: A reference point. There are many different reference points making it important to know which one is being used on a project. This project uses mean lower low water (MLLW) as the reference point for elevations which means all elevations presented in the report represent distance above/below MLLW.

Degradation: Deterioration of materials, construction, and/or natural features due to aging or exposure to external forces.

Erosion¹: The wearing away of land by the action of natural forces. Pertaining to a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or deflation (wind action) (opposite of accretion). Erosion may be separated into two categories: long-term erosion, which occurs over decadal or greater scales, and short-term erosion, which occurs at less than decadal scale due to individual storm events or seasonal variability.

Fetch¹: Open water distance over which a wind can blow unimpeded to form waves.

Forage Fish: A group of different species of fish which are a critical food source for many marine mammal, seabird, and fish species (NOAA Fisheries).

Geographic Information System (GIS): A system which captures and stores geographic information in order to provide a central location of information with which people can analyze and present said information.

¹ Coastal Geologic MacKaye Harbor Road Relocation Feasibility Study Coastal Analysis Report (2017) iii

GPS (Global Positioning System): A global system of U.S. navigational satellites developed to provide precise positional and velocity data and global time synchronization for air, sea, and land travel (Merriam-Webster).

Highest Observed Water Line (HOWL): The highest elevation of water that has been observed at a particular tidal station. This elevation corresponds with an extreme high tide plus storm surge.

King Tide: The king tide is the highest predicted high tide of the year at a coastal location. It is above the highest water level reached at high tide on an average day. King tides are also known as perigean spring tides (EPA).

LiDAR (Light Detection and Ranging): A survey technique that is used for mapping that uses a laser to detect the distance of a target from the source of the laser emission. This task is often performed by an unmanned aerial vehicle.

Mean Lower Low Water (MLLW): The average elevation of the lowest of the daily low tides. San Juan County experiences two low tides per day.

Mean Higher High Water (MHHW): The average elevation of the highest of the daily high tides. San Juan County experiences two high tides per day.

National Oceanic and Atmospheric Administration (NOAA)¹: An agency in the Department of Commerce that maps the oceans and conserves their living resources; predicts changes to the earth's environment; provides weather reports and forecasts floods and hurricanes and other information related to weather.

Net Shore-Drift¹: The long-term, net effect of sediment movement along a particular coast.

Ordinary high water mark (OHWM)¹: A legislated high tidal elevation. In Washington state: That mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or as it may change thereafter in accordance with permits issued by a local government or the department.

Palustrine: A wetland system that includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ‰. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5 ‰ (Cowardin).

¹ Coastal Geologic MacKaye Harbor Road Relocation Feasibility Study Coastal Analysis Report (2017) iv

Pocket Beach: A beach that is contained between two bedrock headlands that essentially functions as a closed system in terms of littoral sediment transport.

Revetment¹: A hard armor technique using stone placed on a sloping bank to protect against waves or currents.

Road Right-of-Way (ROW): An easement granted or reserved over land for transportation purposes.

Sea Level Rise (SLR): The increase in elevation of the sea. This can be caused by a multitude of sources including warming of sea water, melting of ice caps, and the addition of ocean ice from land sources.

Storm Surge: An abnormal rise in sea level accompanying a hurricane or other intense storm, whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic tide from the observed storm tide (NOAA).

Supratidal Zone: The area of a beach that is at an elevation greater than the average height of high tides. This area is usually dry; only being exposed to ocean/sea spray except for the rare case of extreme high tides that are associated with large storms.

¹ Coastal Geologic MacKaye Harbor Road Relocation Feasibility Study Coastal Analysis Report (2017) v

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Section 1: Introduction

MackKaye Harbor Road on Lopez Island in San Juan County, Washington, provides the only access to Agate Beach County Park (County Park), the San Juan Islands National Monument, Iceberg Point (National Monument), and more than 100 parcels in the study area which include the neighborhoods of Outer Bay (Agate Beach), Salmon Point, Barlow Bay, and Iceberg Point (Flint Road). The shoreline bluff along Outer Bay has been eroding from tidal and storm action for years. Today, bluff erosion has advanced to within a few inches of the road in some places near the County Park. This erosion will gradually shrink the width of MackKaye Harbor Road. Eventually, it is predicted that numerous sections of the road will be inundated or washed away if no action is taken.

MackKaye Harbor Road was relocated once in 1992 to avoid bluff erosion in the vicinity south of Agate Beach County Park. In the spring of 2017, the road was restricted to one-lane as a safety measure from continued bluff erosion along the County Park. Short term repair alternatives for the coastal erosion of MackKaye Harbor Road have been implemented in the past to keep the road operable in its current location. These solutions did not consider additional road damage from projected sea level rise as a result of climate change.

In January 2016, the Washington State Department of Transportation authorized funding through the State's Connecting Washington program to evaluate long-term solutions to protect the road from further erosion and to initiate measures to protect traffic in the interim. Connecting Washington is a funding package developed by the Governor and State Legislature to maintain critical infrastructure. The goals of the MackKaye Harbor Relocation Feasibility Study are to evaluate long-term solutions to protect MackKaye Harbor Road by:

- Addressing projected sea level rise and continuing coastal erosion.
- Maintaining vehicular access to private properties, public and tribal lands.
- Providing parking provisions outside of the road travel way for visitors to the public lands.

The study area includes MackKaye Harbor Road from milepost 1.0 to 1.9; encompassing both the Barlow Bay and Outer Bay areas of MackKaye Harbor (see Figure 1.1).

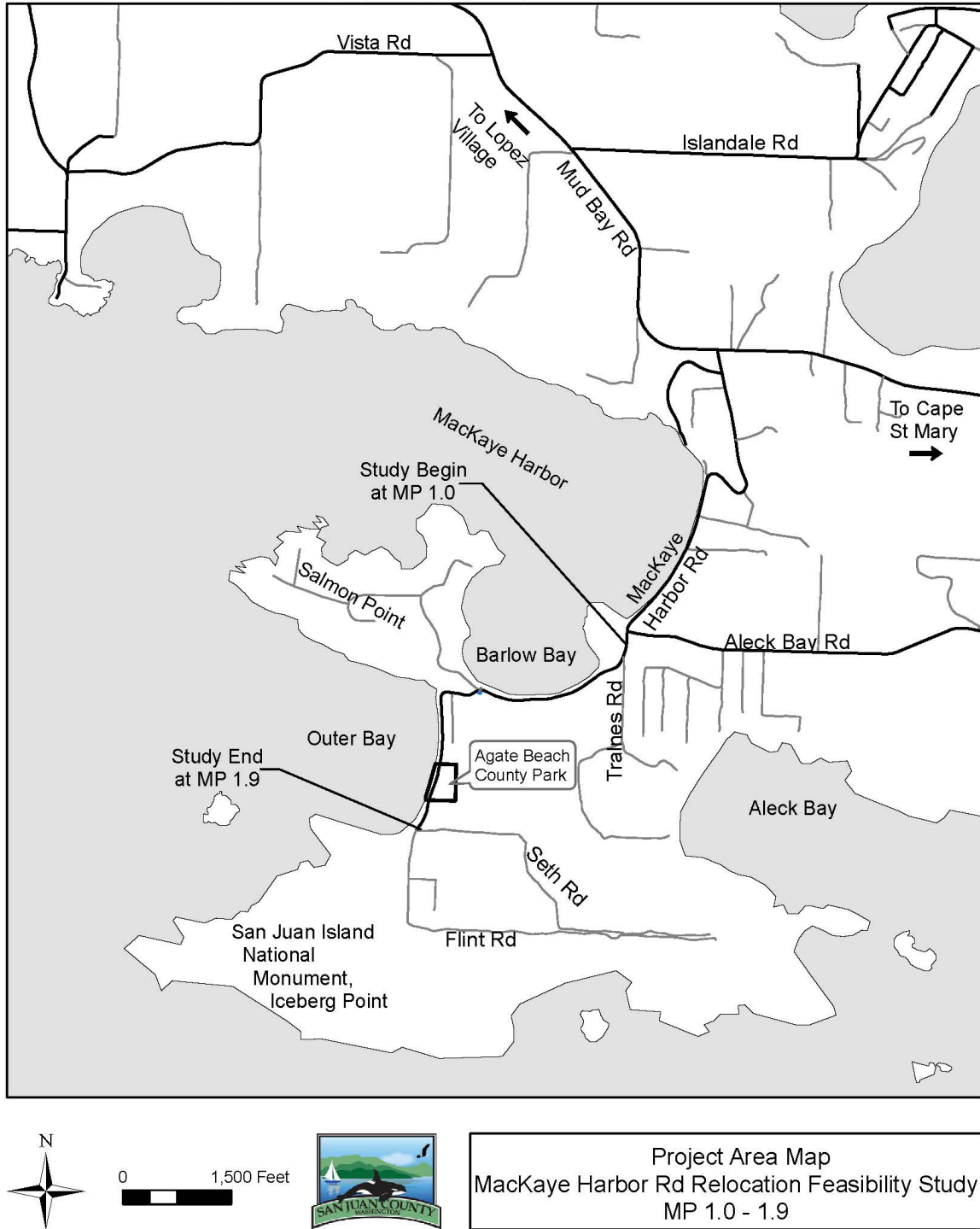


Figure 1.1 - Feasibility Study Location

1.1 Community Brainstorming and Scoping

San Juan County hosted a Community Brainstorming and Scoping Meeting on March 24, 2016 to gather the communities' input on identifying critical issues in the study area. The following is a synopsis of the community responses to the questions asked during the meeting (full responses can be found in Appendix 1A):



Community Brainstorming and Scoping Meeting March 24, 2016

1. *What is your experience that supports the need for this study?*

The overwhelming consensus was that there is visible erosion occurring along MackKaye Harbor Road, especially during a storm event.

2. *In a perfect world with a perfect solution, what are the outcomes that you would like to see or what are the good things that you can see coming out of this?*

Repeated themes:

- ✓ Road restoration
- ✓ Beach restoration
- ✓ Parking

Most residents indicated a preference for a solution where MackKaye Harbor Road remained in its current location. They wanted to restore the road and make adjustments that would provide better access for emergency vehicles.

Residents wanted to see the beach restored, including soft shore armoring techniques and greater access to the public beach, with provisions for handicap access.

Residents called for more parking. Currently, visitors to the County Park and National Monument exceed the capacity of the County Park parking lot. This creates a situation where visitors use private property to park their vehicles or park along the edge of the road which blocks portions of the travel lane.



Overflow Parking at Agate Beach County Park

Residents wanted a solution that would not negatively impact the current ecosystems. If possible, potential solutions would enhance/restore fish and wildlife habitats.

3. What issues or concerns should we be mindful of as we conduct this study?

The public wanted a long term solution that addressed sea level rise, the erosion of MacKaye Harbor Road, and the parking situation. However, they were concerned that potential solutions might take away from the natural feel of the location. Additionally, the public was sensitive to environmental issues. They were concerned about the potential to negatively impact native species with any proposed solution. They wanted impacts to current areas to be kept to a minimum.

1.2 Feasibility Study Team

With community feedback in hand, the County procured a Civil and Environmental Engineering firm with a demonstrated ability to establish a community process and solutions in a context sensitive manner. The definition of a context sensitive solution is:

Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions.

- [Results of Joint AASHTO / FHWA Context Sensitive Solutions Strategic Planning Process, Summary Report, March 2007](#)

The responses and comments from the brainstorming and scoping meeting clearly pointed to the need to develop a context sensitive solution for the project which required a collaborative, interdisciplinary approach that involved all stakeholders in providing a transportation facility that fits its setting. The interdisciplinary approach includes a team of individuals with technical skills and stakeholders willing to collaborate toward a successful outcome. Stakeholders include San Juan County staff and citizens living in the area. Combined with the engineering firm, this group makes up the Feasibility Study Team.

Citizen stakeholders are an important part of the Feasibility Study Team because they know the community and understand the issues. Their diversity of ideas helps to shape the study to meet or address the varied community expectations. Full time residents from three of the more populated neighborhoods impacted by the potential loss of MackKaye Harbor Road agreed to serve on the team.

A complete list of Feasibility Study Team participants is included in Appendix 1B.

1.3 Feasibility Study Scope

To meet the goals of the funding program and evaluate the issues initially raised by the community, the scope of the MackKaye Harbor Road Relocation Feasibility Study included the following objectives:

- Develop/select design standards in keeping with a 'local road' designation.
- Identify the components of the shoreline environment, such as sea level rise elevation, and sensitive critical areas.
- Provide options for beach armor/nourishment alternatives, as appropriate for selected concepts.

- Work with the Feasibility Study Team to identify potential road corridor alternatives and develop a preferred concept that meets the project goals.
- Provide an environmental review of road corridors and consider potential mitigation concepts, including existing tide gate modifications.
- Complete a visual cultural resource analysis report to identify sensitive areas.
- Complete a cursory soils analysis to identify challenging conditions.
- Contact resource agencies to gather feedback.
- Present the feasible road corridor concepts to the public.
- Consult with Tribal Natural Resource and Cultural Resource representatives.

Section 2: Existing Conditions

The area defined by Barlow Bay and Outer Bay was inhabited by the Central Coast Salish – Northern Straits Native Americans thousands of years ago. After the area was surveyed in the 1870s and settlers migrated in, roads began to appear. MackKaye Harbor Road right-of-way was deeded to the County at the turn of the century and chip sealed in the early 1960s. Since that time, there have been a number of events requiring responses by the County to protect the road along the shoreline. Figure 2.1 (next page) presents a timeline of events related to MackKaye Harbor Road.

Since the 1970s, there have been reported incidents of erosion which suggest that erosion has been, and still is, a concern for the continued operation of MackKaye Harbor Road. Local property owners report sand and beach debris littering the road during storm events.

2.1 Existing Road Conditions

MackKaye Harbor Road is a two lane, low volume road with a current average daily traffic of less than 200 vehicles in the winter and increasing to nearly 350 vehicles in the summer season. The current road width is generally 18 to 20 feet with no shoulders although there is a high level of pedestrian and bicycle travel. Bicycle touring companies frequently use Agate Beach County Park as a meeting place.

Parking at Agate Beach County Park is provided by an onsite parking lot. During peak season, the parking spots in the lot are quickly filled. Because of the limited parking area, visitors park along the road fronting park property and spill over onto private property. The cars parked along the road block a portion of the travel lane and force pedestrians and bikes toward the center of the road. Parking along the narrow road in some areas is dangerous, particularly in front of the park near the eroding bluff. The County is currently planning to add a parking area off of the road in the park.

The National Monument at Iceberg Point currently has no parking of its own and access is via private property south of Agate Beach County Park. Visitors to the National Monument often park at the County Park, exacerbating the demand for parking spaces. The Bureau of Land Management (BLM) is currently preparing a Resource Management Plan which discusses options for parking and access at the National Monument. The BLM will not be able to take action on any items until the Resource Management Plan is completed. A draft will be available for review in 2017. In the meantime, BLM is providing funding to County Parks for the maintenance of park facilities impacted by visitors to the National Monument.

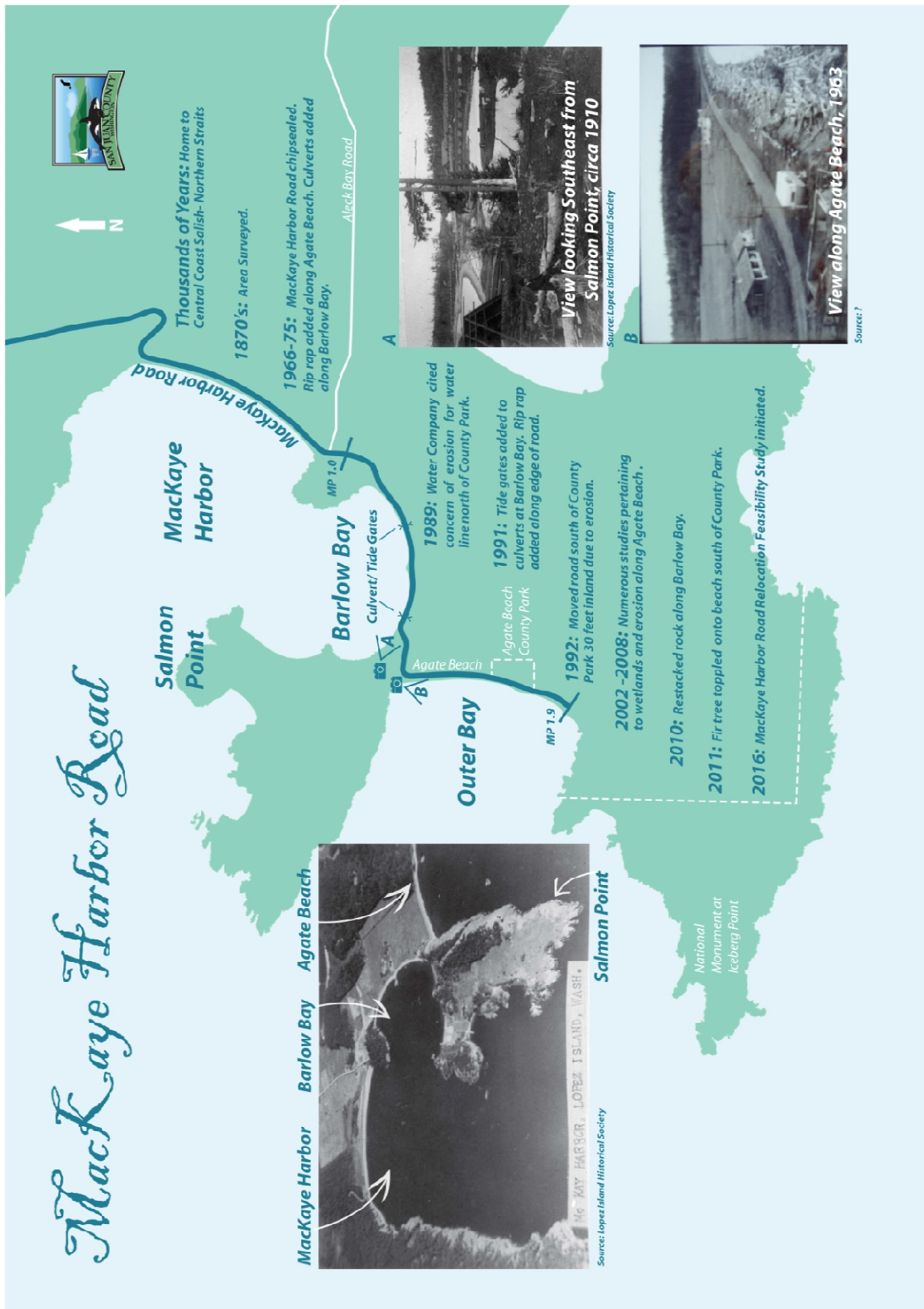


Figure 2.1 - MackKaye Harbor Timeline (Source: San Juan County)

MackKaye Harbor Road right-of-way in the study area is 30 feet wide with the exception of the first 1000 feet and the portion south of the Agate Beach County Park. In those areas, the road right-of-way is 60 feet wide.

Two tide gates are located along MackKaye Harbor Road that control back-flooding of culverts that discharge to Barlow Bay. One tide gate is located at the west end of Barlow Bay and one towards the east end. Based on LiDAR mapping, the invert elevation of the west tide gate is approximately 5.1 feet at the outlet. The invert elevation of the east tide gate is approximately 4.7 feet at the outlet. The tide gates manage the water level of the natural salt water marsh to prevent flooding of properties on the south side of MackKaye Harbor Road.

2.2 Utilities

Orcas Power & Light Co-op (OPALCO) and MackKaye Harbor Water District serve their customers with facilities under or along MackKaye Harbor Road. The water main along Agate Beach is in the seaward side of MackKaye Harbor Road and is in poor condition. There is concern that it is vulnerable to erosion which was highlighted by a water main break a few years ago at the north end of Agate Beach. OPALCO's power lines run overhead down Agate Beach Lane, and then continue along MackKaye Harbor Road. OPALCO also hosts telecommunications on these poles. A utility map is presented in Appendix 2A.

2.3 Geology, Beach Characteristics, and Habitats

Igneous and metamorphic bedrock is exposed in headlands bounding the beaches of Barlow and Outer Bays. This makes them *pocket beaches* with no appreciable net shore-drift, where very little sediment is exchanged with neighboring coasts. Beach sediment at Outer Bay is mostly gravel, with some sand in the backshore and generally finer materials in the north. The Barlow Bay beach is mostly sand, with some pebble and shell hash. Most of the banks are stable, except the southern bank of Outer Bay which is actively eroding. A band of large woody debris (drift logs) approximately 25 feet in width is usually present on the northern portions of the Outer Bay shore, sheltering backshore vegetation areas that vary by year and season.

2.3.1 Coastal Armor Structures

Along both bays, most of the backshore areas have armor stone revetments for erosion protection. The revetment along Barlow Bay is intact structurally throughout almost the entirety of the north-facing shores as a result of a 2011 habitat restoration project initiated by Friends of the San Juans. The armor stone revetment along Outer Bay has failed in a number of areas and the rocks are on the beach. Shore armoring has an impact on the ecological functioning of nearshore coastal systems and often causes beach degradation. The proliferation

of armor stone revetments has been viewed as one of the greatest threats to the ecological functioning of coastal systems (Puget Sound Action team 2003).

2.3.2 Historical Shore Change

Maps, LiDAR, aerial photographs, and field GPS mapping were used in shore change analysis to determine historical erosion rates. The highest erosion rate was on the northernmost stretch of Agate Beach at about six inches/year, where the shore receded approximately 15.5 feet in 32 years. The south-central and far southern portions of the Outer Bay shore, south of the County Park stairway, is eroding at a lower rate. Analyses of aerial photos spanning 40 years show bank recession (erosion) has been measured at an average of 1½ inches/year along Outer Bay and an average of 2 inches/year along Barlow Bay (2016, Coastal Geologic Services, Inc., *Coastal Analysis Report*). Figure 2.2 (below) is just one example of the severity of the erosion. Note the distance between the edge of the grass and the edge of MackKaye Harbor Road.



2002

LOOKING NORTH ALONG AGATE BEACH



2017

Figure 2.2 - Recent Erosion Comparisons Along Agate Beach

A detailed analysis of the historical shore change evaluation can be found in *MackKaye Harbor Road Relocation Feasibility Study Coastal Analysis Report – Final, 2017, CGS*, in Appendix 3A.

2.3.3 Existing Sea Level Conditions

The lowest elevation in MackKaye Harbor Road fronting Barlow Bay is 11 feet. With a mean higher high water (MHHW) of 7 feet 2 inches and typical wave heights of 2 feet with a strong north wind, the water is often close to the edge of the road. When the storm surge or king tides are added, which can be up to 3 feet, then the water can actually top the road at the lowest point. Early in 2017, spray was photographed overtopping the road during the wind storm although it was not an exceptionally high tide.

At Outer Bay the low point of MacKaye Harbor Road is about 13.5 feet at the mid-point of the Agate Beach neighborhood homes. Wave heights at Agate Beach are estimated at 4 to 5 feet because there is up to 54 miles of open waters (fetch) to the west allowing significant wave formation by a westerly wind (CGS, 2017). Waves of 5 feet and a storm surge of 3 feet means that seawater overtops the road at its lowest point during king tides. Neighbors have related stories of both water spray and debris on the road during storm events. Erosion at Outer Bay is more severe than at Barlow Bay because of the more exposed location and increased wave energy.

There are no tidal monitoring stations in the immediate study area. It was determined that the National Oceanic and Atmospheric Administration's (NOAA) data from the current tidal monitoring station at Friday Harbor on San Juan Island, used in conjunction with tidal epoch data from the station previously located at Richardson on Lopez Island, provides the most accurate tidal information for this study location. The combined data results in a current MHHW elevation of 7.17 feet above MLLW.

2.3.4 Eelgrass Beds and Forage Fish Spawning Habitat

Eelgrass beds exist in both of the subtidal areas of the study area. Eelgrass is found approximately 500 feet waterward of Outer Bay and approximately 200 feet waterward of Barlow Bay.

Forage fish spawning occurs throughout the study area. The northernmost portion of Agate Beach harbors surf smelt spawning. Sand lance spawning habitat is found on Barlow Bay beach near the rocky tombolo.

2.4 Critical Areas

Critical areas, defined in the San Juan County Critical Area Ordinance, were mapped using a variety of sources. The San Juan County GIS (Polaris) combined with previous wetland delineations done by Rozewood Environmental Services, Inc., FEMA's latest draft Flood Insurance Rate Maps (2016), Coastal Geologic Services "MacKaye Harbor Shoreline Restoration Project (2009)" and field work conducted in 2016 by Skillings Connolly were all used to verify previous wetland delineations and critical areas. Critical areas are shown in the map in Appendix 2C. Wetlands are present on the Wetlands Map (Appendix 2B). The 2017 *MacKaye Harbor Road Critical Areas Report* provides more details (Appendix 3D).

Wetlands represent the most expansive critical area within the vicinity of MacKaye Harbor Road. Non-tidal and tidal influenced wetlands and shorelines are prevalent throughout the study area. Wetlands were previously delineated along MacKaye Harbor Road in both the Agate Beach and Barlow Bay areas. A large wetland, not previously delineated, was identified along

the eastern portion of the study area adjacent to Aleck Bay. In general, the wetland areas consist of very poor soils. Near Aleck Bay, soils are comprised of peat- like materials. Figure 2.3 displays the numerous wetlands within the study area.

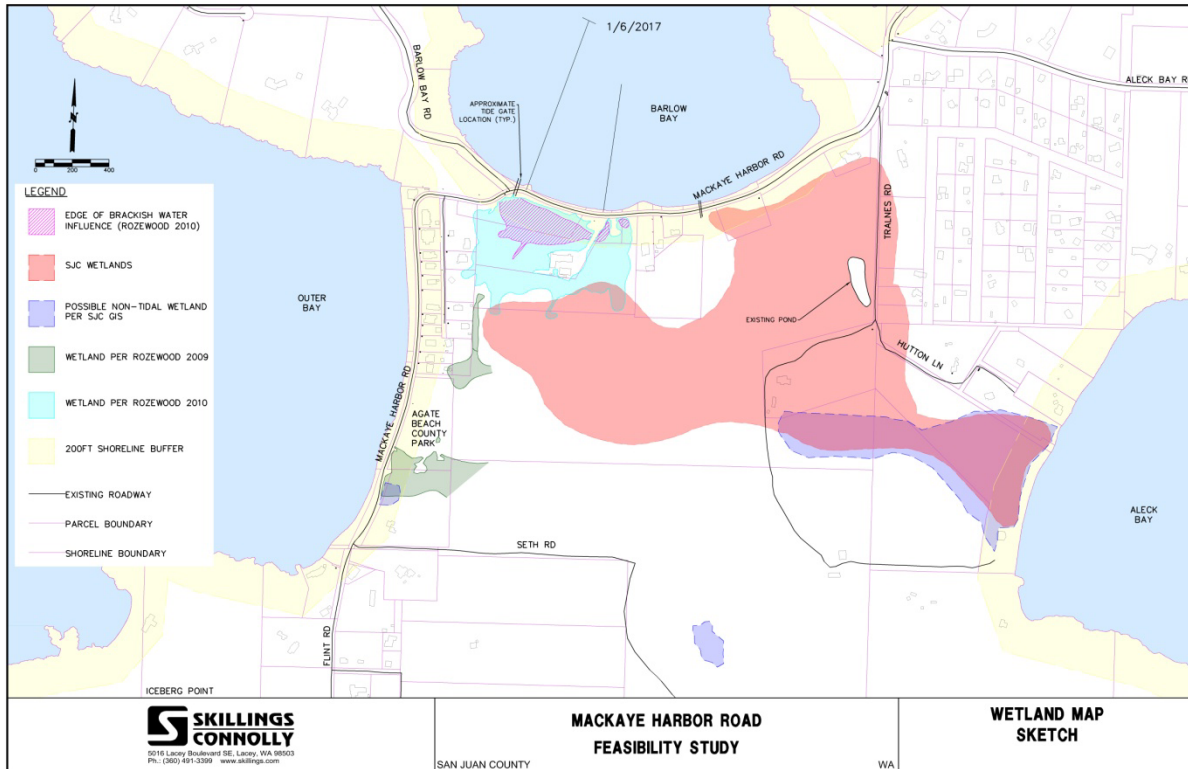


Figure 2.3 - Wetlands Map (see Appendix 2B for larger image)

Upland forested areas located in the southerly reaches of the study area could be considered essential critical habitat for nesting Bald Eagles. Both Washington State and the Federal Government have listed Golden Paintbrush, a national heritage plant, as “threatened.” Golden paintbrush may be found in the area around Aleck Bay. To see the extent of the critical areas, refer to Appendix 2C.

The Federal Emergency Management Agency (FEMA), in their draft 2016 Flood Hazard maps, show the wetland areas south of Barlow Bay and extending westerly to Agate Beach as flood zone areas. The flood zone area delineated encompasses more area than was previously shown in FEMA’s 1977 Flood Hazard maps. Bedrock areas exist in the study area. Many of the County’s aquifers are located in bedrock and are at high risk from direct surface contamination. San Juan County aquifers are considered to be sole source aquifers that are recharged by local rainfall only.

2.5 Critical Slopes

Slope stability is an area of concern along the southern portion of Agate Beach south of the County Park stairway. The unstable bluff has been identified as a critical area by both San Juan County and the Department of Ecology. The stone revetment has collapsed in areas and is not functioning to control erosion. In the spring of 2017, San Juan County reduced a portion of MackKaye Harbor Road in front of the County Park to one lane to safeguard users of the road from the steep bank encroaching up to the road edge.

2.6 Topography

The topographic map was created from the County's existing LiDAR information. Within the study area topography varies considerably. Table 2.1 (below) provides approximate elevations and mile post positions of select features along MackKaye Harbor Road within the study area.

Location	Elevation	Mile Post
Intersection of MacKaye Harbor Road and Tralnes Road	41' MLLW	1.03
Low Point of MacKaye Harbor Road along Barlow Bay	11' MLLW	1.31
Intersection of MacKaye Harbor Road and Barlow Bay Road	11.5' MLLW	1.45
High Point Between Barlow Bay and Outer Bay	22' MLLW	1.54
MacKaye Harbor Road at Beginning of Outer Bay	18.5' MLLW	1.56
Low Point of MacKaye Harbor Road along Outer Bay	13.5' MLLW	1.63
MacKaye Harbor Road at South End of Agate Beach County Park	26' MLLW	1.83

Table 2.1 – Elevations of Key Locations Along MacKaye Harbor Road Between Mile Posts 1.0 and 1.9

The majority of the wetlands in the study area are north of an imaginary horizontal line drawn between the south end of Agate Beach County Park and Aleck Bay. This area is also where runoff water is collected. This area is not forested, and is relatively flat compared to the rest of the island (the majority of the section being sloped flatter than 40H:1V). South of this line, elevations increase and contain upland forested areas. This part of the island is more steeply sloped. The southernmost portions of Flint Road have elevations that vary from approximately 85 feet to 130 feet above MLLW.

The LiDAR data was shot in the NGVD29 vertical datum. This data was turned into a surface and a datum shift was performed to change the datum from NGVD29 to the tidal datum where MLLW=0.0; used for all sea level predictions in this study to allow sea level rise projections to be consistent with national predictions. Appendix 2E shows the calculations performed in the datum shift.

Section 3: Environmental Analyses

The MacKaye Harbor Road Relocation Feasibility Study Team evaluated both the environmental impacts of implementing shoreline improvements and the impacts of the road concepts developed in Section 4. Maps of the existing wetlands and critical areas were created and used as a base for the evaluation. National soils classification mapping were used to determine if soils were suitable for road construction. Current Washington State Department of Archaeology and Historic Preservation records were the basis for the cultural resource investigation.

All existing information was verified in the field by visual observation, taken when walking or driving the site; no soil disturbance occurred during this study

3.1 Coastal Analysis (see Appendix 3A for complete report)

Coastal Geologic Services, Inc. (CGS) prepared the coastal analysis report. The report described the existing shoreline conditions and the historical change of the shoreline from coastal erosion along Barlow Bay and Outer Bay as described in Section 2. The report also presented options for beach nourishment/beach armoring along both Barlow Bay and Outer Bay, an estimate of the cost to construct those options, and a detailed analysis and estimate of sea level rise by the year 2100.

Concepts for protecting MacKaye Harbor Road in its current location require coastal improvements along the shoreline to delay the effects of coastal erosion. However, due to the combination of the increasing occurrence of high water events and the projected sea level rise, it is not considered feasible to protect the road from inundation beyond an estimated twenty to forty years, or approximately mid-century. Feasible coastal techniques differ for Outer and Barlow Bays due to the different wave climate, nearshore habitats, and topography. All coastal improvements will require maintenance of beach nourishment materials (approximately 20% every 20 years) and repair of revetment sections periodically.

- Outer Bay

At the lowest, the elevation of MacKaye Harbor Road along Outer Bay is +13.5 feet MLLW. Until mid-century, the road may be preserved with a combination of armor stone revetment and multilayer gravel beach nourishment. At the southern end of Outer Bay, there is currently no shore armor, but the addition of a revetment could protect the bluff from continued erosion. Extending to the north, the shoreline has existing shore armor in various states of disrepair to approximately 100 feet north of the County Park. These areas of existing shore armor could potentially be augmented and rebuilt to protect the shore from continued erosion.

Beginning at the north boundary of the County Park and extending northward, the beach area is considered to be forage fish spawning habitat. Due to many years of beach erosion and the nature of the area having a limited source for coastal drift, sediment nourishment will be required as part of shoreline mitigation efforts to help restore ecological functions in the area. Coastal improvements along this stretch would include layers of beach nourishment and vegetation enhancement. Beach nourishment consists of layers of gravel for beach building topped with fine gravel for forage fish spawning. Vegetation enhancement could include native dunegrass and other native, salt-tolerant plants that can enhance the berm's longevity and provide a habitat benefit.

- Barlow Bay

At the lowest, the road is +11 feet MLLW, so it can presently be overtopped by waves during high tides with strong north winds. Until mid-century, this stretch of road, along with the eelgrass beds and forage fish spawning habitat, may be protected with a two layer beach nourishment section which may also help restore the ecological functions in the area. A layer of coarse gravel would be used to build a new beach berm and provide erosion control with a finer grain upper layer added to support forage fish spawning and the addition of vegetation. The resultant coastal improvements would create a beach berm up to +12 feet MLLW and preserve habitat while helping to dissipate wave energy. However, forage fish habitat makes the solution more complex. If beach nourishment construction should move the ideal spawning habitat off shore into deeper water, then the benefit to the road may be reduced because of the potential environmental impact to sand lance spawning.

Eelgrass beds exist in the tidal zones and will need to be assessed to ensure that mitigation efforts and conceptual designs do not compromise the health of these ecological systems.

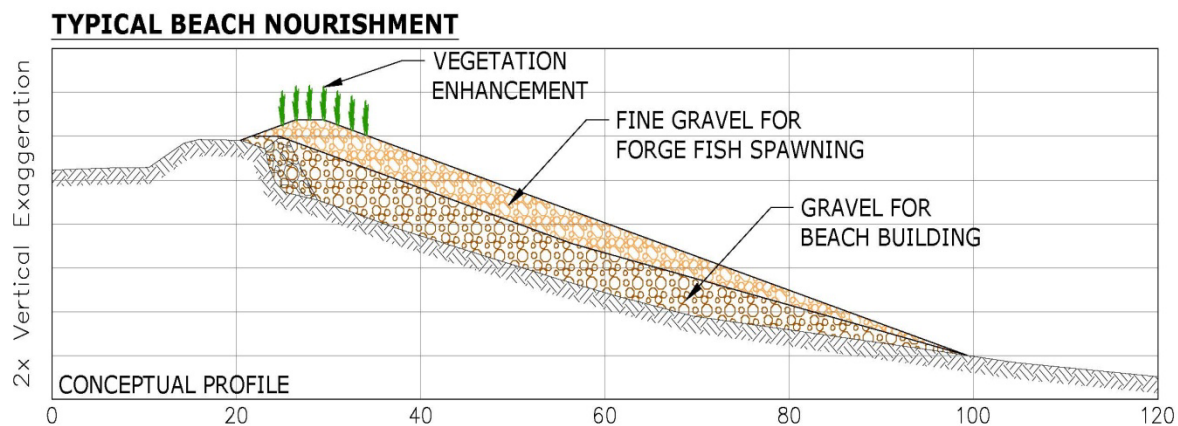


Figure 3.1- Typical Beach Nourishment Profile

3.2 Geotechnical Analysis (see Appendix 3B for complete report)

Plateau Geosciences Group LLC evaluated the study area in the field to determine the soil characteristics that could impact the development of feasible road concepts. Based on visual observations, the soils encountered along the existing road and the proposed relocation concepts are projected to be suitable for road construction when the existing vegetative matter is removed, with the exception of the following areas:

- Any road concept that proposes to cross the supratidal zone of the wetland extension of Aleck Bay will encounter a zone consisting of peat deposits which are expected to be low density soils unsuitable for road foundations. This area is anticipated to be tidally influenced and saturated seasonally or potentially year-round. Unsuitable foundation soil could be expected to be 5 to 15 feet in depth, meaning that large volumes of over excavation would be required during road construction. The recommendation was that any road in this area should be avoided.
- Any concept that traverses the undeveloped land at the west end of the Aleck Bay extension may encounter possible wetland conditions that have not been mapped as evidenced by ditch seepage. Over excavation of potentially unsuitable foundation soils could be required for any road constructed in this area.
- These conditions are also true for any road concept that is located at the east edge of the Agate Beach County Park. Any concept here will cross a seasonally inundated wetland that is likely to contain organic soil.
- Potential parking areas installed along the eastern and southern borders of Agate Beach County Park may encounter wetlands with seasonal saturation or inundation, and likely contain low density, highly organic soil that would be unsuitable for road construction. Providing parking intermittently within the trees could maximize the use of suitable areas for parking by providing parking “pads” in the driest areas.

3.3 Cultural Resource Assessment (see Appendix 3C for complete report)

Tierra Right of Way Services, Ltd. (Tierra) conducted a cultural resources assessment for the MackKaye Harbor Road Relocation Feasibility Study. The assessment consisted of a background review and a pedestrian walkthrough of the area. No shovel probes were conducted.

To date, forty cultural/historical surveys have been conducted with thirty archaeological sites, six historic properties, and four Historic Register-listed properties recorded within a 1.0-mile radius of the study area. Three archaeological sites and no Historic Property Inventory forms

have been previously recorded within the study area. Background review determined that the study area is located in an area with a high potential for precontact or historic deposits.

Two archaeological sites are located along MacKaye Harbor Road's current corridor, indicating that any concepts involving work on the shoreline or the road in its current location could impact historical/cultural resources. This area has very complex soil distribution with eight soil types present along MacKaye Harbor Road. Almost all are glacially derived soils and sediments. Due to the amount of water that appears to be present in areas where these soil types are located, most of these soils likely would allow for good preservation of cultural materials. There is evidence of use of the vicinity in the precontact era as well as evidence that the landscape was utilized by Native and non-Native peoples during the contact and postcontact periods.

The Washington State Department of Archaeology and Historic Preservation (DAHP) predictive model probability calculations (indicating a high risk for the study area) are based on known environmental factors and/or information derived from archaeological research. The proximity of the study area to the harbor, historic roads/homesteads, and marshy areas to the east and southeast increases the possibility of precontact cultural deposits, as these types of natural and cultural features increase the likelihood of human use in the past. Taking all of these factors into account, the likelihood that any road concept would affect historic properties is very high. This is evidenced by the location and recording of a new archaeological site during the pedestrian survey for this study.

A full cultural resources field survey will be required for the development of any road concept due to the proximity to precontact and historic era cultural locations, as well as natural resources that would have been utilized by humans in the past.

It is likely that any road concepts along the shoreline will yield additional archaeological materials during testing due to the presence of two recorded archaeological sites and the very close proximity of the beach. Depending on the extent of archaeological features underneath the existing road bed, more extensive archaeological work, possibly including full data recovery, may be required by the DAHP in order to pursue any road concepts along the shoreline.

Road concepts located inland from the shoreline have the least contact with shorelines and are, therefore, less likely to come into contact with extensive archaeological deposits.

3.4 Critical Areas Analysis and Potential Mitigations in the Study Area (see Appendix 3D for complete report)

The critical areas analysis for the MacKaye Harbor Road Relocation Feasibility Study was provided by Skillings Connolly staff scientists. This section analyses the impact to critical areas

and the potential mitigations required for concepts that would maintain or modify the road along the shoreline or relocate the road inland. See Appendix 2B and 2C for Critical Areas Maps.

3.4.1 Wetlands

Critical areas consist of non-tidal and tidal influenced wetlands and shorelines along Outer Bay, Barlow Bay, and Aleck Bay. Wetlands are concentrated between Seth Road and MacKaye Harbor Road. Wetlands in this area are estuarine (tidally influenced) and palustrine (non-tidal). Wetlands represent the most expansive critical area within the vicinity of MacKaye Harbor Road. Each of the road concepts has the potential to impact vicinity wetlands. To perform a qualitative analysis of potential impacts to vicinity wetlands, the entire project area was evaluated to determine the location, extent, and quality of wetlands that could be affected by the improvements to, and/or relocation of, MacKaye Harbor Road. For details see Appendix 2B Wetlands Map.

As shown in Section 2, there are multiple wetlands in the vicinity of MacKaye Harbor Road between Barlow Bay and Outer Bay. Both of the beaches along Barlow Bay and Outer Bay have wetlands classified as estuarine and marine systems with unconsolidated shores that are regularly flooded by saltwater. Saltwater intrusion into the estuarine wetlands along Barlow Bay is controlled by two tide gates. Property owners residing near the tide gates want them to continue operating to prevent saltwater intrusion, although as sea level rise increases, they will become inundated themselves and inoperable unless they are replaced at a higher elevation. If the road is raised, the design of the tide gates and the condition of the existing culverts will need to be evaluated. At the least, the culverts would need to be extended and the tide gates relocated to the new culvert ends. Replacing the culvert and tide gates at a higher elevation will raise the wetland elevation south of MacKaye Harbor Road equally.

A larger palustrine system extends roughly from the intersection of Tralnes and MacKaye Harbor Roads southwesterly to the vicinity of the easterly boundary of Agate Beach Park and borders the forested area to the south. This palustrine system is composed of different vegetation types, including emergent vegetation and scrub-shrub vegetation. The central portion of this wetland, mostly hayfields, has been identified as seasonally flooded. The eastern portion of the palustrine wetland (the inland wetland extension of Aleck Bay) is also characterized by emergent vegetation, but is considered semi-permanently flooded due to being impounded. A small portion of the palustrine system is forested wetland that is seasonally flooded and represented by the area west of Tralnes Road and north of Aleck Bay extension. These wetlands have not been formally delineated.

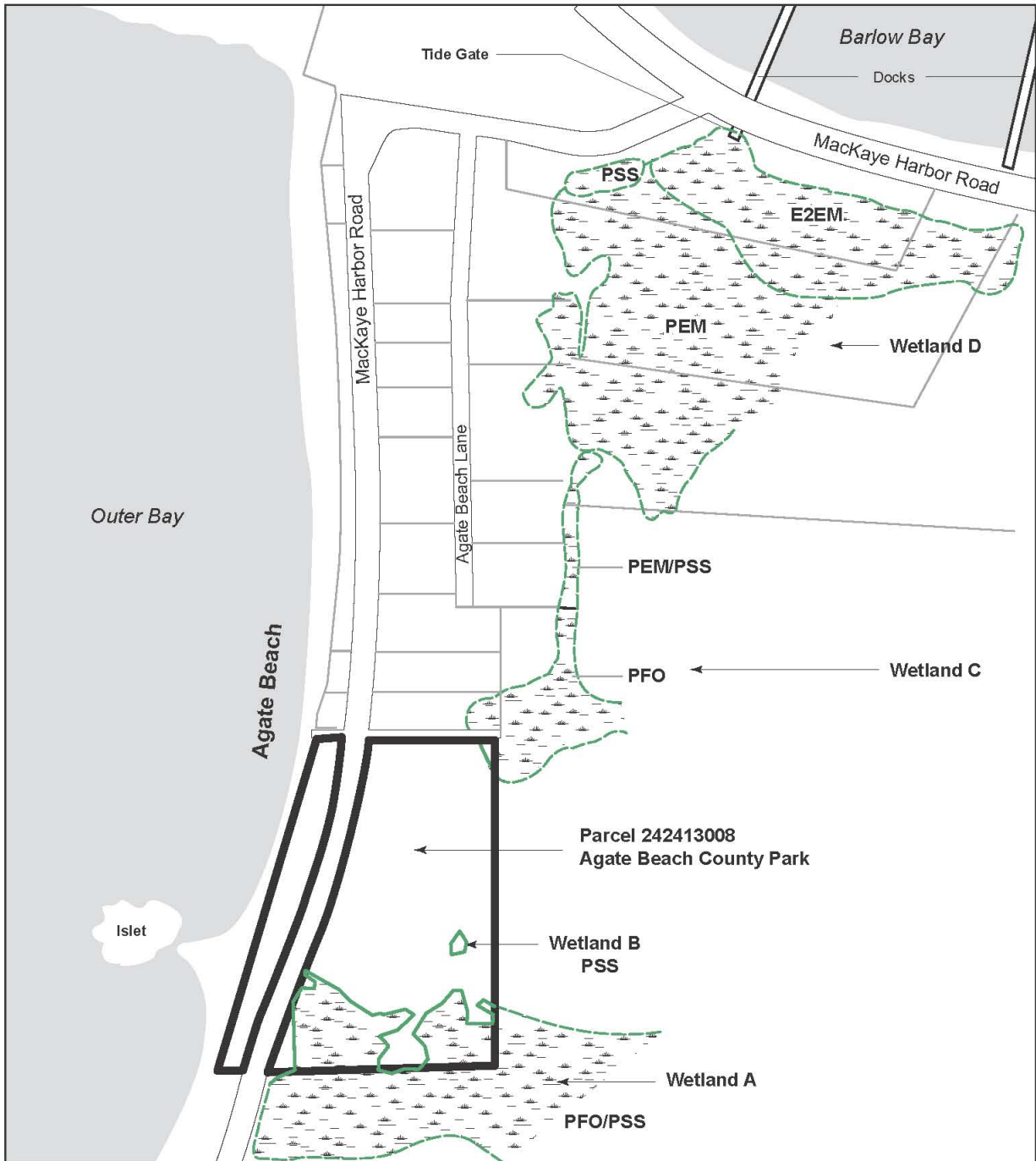
Rozewood Environmental Services (Rozewood) delineated wetlands along MacKaye Harbor Road in previous studies and identified four wetlands, categorized as II, III and IV, along the

corridor adjacent to the Agate Beach neighborhood and Barlow Bay shoreline. These wetlands would be impacted to various degrees by the proposed road concepts. Rozewood's delineated wetlands are detailed in Figure 3.2. Critical areas affected by both shoreline and relocation road concepts will require mitigation measures. Based on the visual field surveys and evaluation of existing documents, the potential wetland mitigation measures required for each of the road concepts are discussed here. Associated costs are included in Section 4 – Development of Feasible Road Concepts.

Mitigation for wetlands and their buffers are clearly defined by the Army Corps of Engineers and can be selected as: Re-establishment or Creation, Rehabilitation Only, Re-establishment or Creation (R/C) and Rehabilitation (RH), Re-establishment or Creation (R/C) and Enhancement (E) and Enhancement Only (E/O). Whether the road remains along the shoreline or is relocated, a combination of these wetland and buffer definitions may apply. There are many opportunities to mitigate for these classifications. Mitigation ratios and the selection of options presented will incur a range of costs associated with each approach. Estimates were provided in the cost development of road concepts in Section 4.

Examples for possible mitigation in the study area include shoreline restoration in the form of beach nourishment, vegetation enhancement and modification or removal of man-made structures (i.e. two tide gates located along the northern extent of MacKaye Harbor Road at Barlow Bay). The tide gates are a good example of gaining maximum credits in any given situation due to the extent of improvements. Elimination of man-made structures is favorable with The Army Corps of Engineers, Department of Fish & Wildlife and the Department of Ecology. In addition, this example would restore wetlands on the southern extent of MacKaye Harbor Road to estuarine functions which is a programmatic goal of regulatory agencies. This activity allows for the most productive form of mitigation ratio credits, which in turn could lower overall mitigation costs. However, this activity would also impact private properties and would need to be thoroughly assessed; property owners have expressed concern about the impacts of saltwater marsh potentially being reestablished on their property.

The Washington State Department of Ecology considers this type of mitigation as Rehabilitation. Rehabilitation of the wetland to historic conditions will provide mitigation at either a 3:1 or 4:1 ratio. This means that every three to four acres of wetland rehabilitated will mitigate for one acre of wetland impacted. Formal delineation of the existing wetland and surface water modeling will be necessary to determine the amount of rehabilitated wetland that can be achieved through this opportunity. The level of mitigation ratio is dependent on the category of wetland impacted. The ratio can increase to 6:1 if higher quality wetlands (Category I and II) are impacted, which depends on the road concept selected.





<p>Figure 2</p>	<p>E2EM Estuarine, intertidal emergent wetland PEM Palustrine emergent wetland PSS Palustrine scrub-shrub wetland PFO Palustrine forested wetland --- Wetland boundary, dashed where approx.</p>	<p style="text-align: center;">   1 Inch = 200 Feet (scale approx.) </p>
<p>Wetland Reconnaissance Map</p>	<p>MackKaye Harbor Road Relocation at Agate Beach</p>	<p>Rozewood Environmental Services, Inc. February 9, 2009</p>

Figure 3.2 - Rozewood Delineated Wetlands

The mitigation strategy to remove the tide gates is applicable to any of the road concepts; however, removal of the tide gate will change the hydroperiod of the existing wetlands along Barlow Bay. This means that saturated soils and standing water will potentially increase under tidal inundation. The consequences to private properties with this mitigation would need to be evaluated and factored into any discussion.

3.4.2 Flood Hazard Zones

FEMA has prepared draft flood hazard mapping for San Juan County. They are preliminary and are currently undergoing a public vetting process. These new maps have been available since November 2016. Any concept that impacts wetlands will impact the flood hazard zone as well. The area south of MackKaye Harbor Road along Barlow Bay is in the flood hazard zone and is also identified as wetlands. The November 2016 flood hazard zones are shown on the Critical Areas Sketch, Appendix 2C.

3.4.3 National Heritage Plants and Endangered Species

Critical areas include essential critical habitat for listed and endangered species. The Washington Department of Fish and Wildlife, Priority Habitats and Species (PHS) listing and the Information for Planning and Conservation (IPaC) Map, developed by the U.S. Fish & Wildlife Service was referenced to assess all listed and endangered species that potentially reside within the proposed study area. Federal listings include marbled murrelet, streaked horned lark, yellow-billed cuckoo, bull trout, and golden paintbrush. The critical habitat for chinook salmon and killer whale (orca) overlap. Washington State listings include bald eagle and golden eagle (breeding area listed on PHS list), pinto abalone, red sea urchin, and surf smelt (breeding area on PHS list).

Upland forested areas located in the southern portion of the study area could be considered essential critical habitat for nesting bald eagles. Both Washington State and the Federal Government have Golden Paintbrush listed as “threatened.” Golden paintbrush may be found in the area around Aleck Bay shown on the Critical Areas Sketch as existing National heritage Plants. The area containing golden paintbrush is best avoided in any concept as the soils in the area are not suitable for road construction.

Inland relocation options that would remove trees will need to take eagles into account when developing the biological assessment as part of the environmental documentation process.

3.4.4 Steep Slopes

The eroding bluff along the southern portion of Agate Beach, south of the Agate Beach Park stairway, has been identified as a critical area by both San Juan County and the Department of

Ecology. A stone revetment has been in place acting as coastal armor for the Agate Beach bluff. The revetment has collapsed in areas and may need to be repaired and modified to maintain the integrity of the road unless the road concepts include removal of the road in the impacted area. In that case, the rock could potentially be removed to restore beach habitat and allow the natural progression of the bluff erosion.

A short revetment also exists along Barlow Bay. It is built of smaller rocks that have recently been restacked. Slope stability is not as tenuous here; however, the As-Is Maintenance concept will require a one to one and one-half foot beach nourishment berm adjacent to the existing roadway.

3.4.5 Soils, bedrock and critical aquifer recharge areas

If MacKaye Harbor Road were to be relocated, bedrock areas, and therefore aquifer recharge areas, could potentially be impacted. Roads permitted in such areas would need to be located, designed, and constructed to ensure minimal environmental impacts. Existing soils that are poor for road construction were identified in many of the wetland areas. A program of soil borings would be required for any road relocation concept to identify the extent of poor soils and bedrock prior to determining the location of any relocated road. Road drainage would need to be designed to take surface water away from any aquifer recharge area. Since the whole of Lopez Island is considered a critical aquifer recharge area, stormwater design would incorporate a comprehensive treatment program of best management practices.

3.5 Project Permitting

Due to the sensitive nature of critical areas within the study limits, a multitude of environmental permitting and application requirements would need to be met once an improvement project or relocation concept was selected. A meeting was held during the study with representatives from each of the state and federal agencies, as well as tribal representatives, to discuss potential permitting requirements for various road concepts. In general, the representatives discussed common themes when considering permit requirements:

- Allowing shorelines to reach equilibrium
- Restoring salt water marshes to provide long term transitional habitats
- Requiring full cultural resources survey for any concepts
- Minimizing impacts to waters of the state and wetlands
- Discouraging additional revetments along the shoreline

Given that there are Waters of the US, wetlands, critical aquifers, shorelines of the state and listed and endangered species present, permit applications to the various agencies will need to

be considered for moving forward with any road concept (see the Critical Areas Report in Appendix 3D for details).

Permits required for all concepts will include:

- ✓ Clean Water Act Section 401 and 404 certification – US Army Corps of Engineers (USACE) and Washington Department of Ecology (DOE), including wetland delineations
- ✓ Biological Assessment – USACE, DOE, Washington Department of Fish and Wildlife (WDFW)
- ✓ Section 7A Consultation – Endangered Species Act
- ✓ Mitigation Planning Document – USACE
- ✓ State Environmental Policy Act (SEPA) – San Juan County
- ✓ National Environmental Policy Act – Federal Highway Administration if federal money used
- ✓ National Historic Preservation Act Cultural Resources Survey – Washington State Department of Archaeology and Historic Preservation (DAHP) (Executive Order 05-05)
- ✓ Land Use/Critical Areas Permit - San Juan County
- ✓ NPDES Construction Permit – DOE

Additional permits required for shoreline road improvements and coastal improvements:

- ✓ Hydraulic Project Approval – WDFW, includes forage fish habitat and eelgrass mitigation
- ✓ Shoreline Substantial Development Permit - San Juan County

Additional permits required for inland relocation concepts:

- ✓ Heritage Tree Survey - San Juan County
- ✓ Environmental Impact Statement – either SEPA or NEPA requirement

Section 4: Development of Feasible Road Concepts

Road concepts for the MacKaye Harbor Road Relocation Feasibility Study were developed by a Feasibility Study Team consisting of San Juan County staff and neighborhood representatives assisted by a consultant team of engineering and environmental experts. Over the course of the study, the Feasibility Study Team collaborated for more than 30 hours in meetings and conference calls to brainstorm concepts, evaluate issues, and develop concept level details for public presentations and to develop the appropriate message for the public outreach venues. The Principles of Context Sensitive Solutions, as discussed in Section 1, were incorporated to develop concepts that fit the study goals and acknowledged the input from the community.

4.1 Feasibility Study Assumptions

Concept development for each of the conceptual road alignments, including costs and environmental impacts, was based on these study assumptions:

1. MacKaye Harbor Road is a low volume road with a current average daily traffic totaling less than 200 vehicles in the winter and approximately 350 vehicles in the summer.

Roads are considered low volume when the average daily traffic is less than 400 vehicles per day. This classification of road is also known as a Local Access Road. The low volume designation impacts the design standards that can be applied and the funding opportunities for development.

2. Two lanes are expected to provide adequate capacity for traffic for at least 75-80 years. Therefore, concepts for road improvements or relocation must survive to the year 2100.

When the County improves an existing road, relocates a road, or constructs a new road, it must be designed to last for 75-80 years to ensure that the facility is economical and sustainable.

3. Current San Juan County Road Standards for a Local Access Road are for a roadway width of 11' lanes with 2' shoulders.

Currently, MacKaye Harbor Road has 9 ft to 10 ft lanes with essentially no shoulders.

4. Design speed is 25 mph.

The current speed limit on MacKaye Harbor Road is 25 mph. Any improvements to the road would be based on maintaining the existing speed limit.

5. Required right-of-way (ROW) width is assumed as 60 feet, which translates to 30 feet on either side of the road centerline, with an understanding that final design may require more width for higher cuts and fills when a final project is selected.

As stated in Section 2, currently the ROW width of the road in the study area is essentially 30 feet wide. For any improvements, the County will need to procure additional ROW for a minimum total ROW width of 60 feet for a two lane road.

6. Best design practices from the American Association of Highway and Transportation Officials (AASHTO) and Washington State Department of Transportation (WSDOT) will be utilized, in addition to accepted standards typical of County road projects.

Since MackKaye Harbor Road is located within 200 ft of the shoreline for its entire length within the study area, the provisions of the County's Shoreline Master Program and Critical Areas Ordinance must also be taken into consideration with any concepts developed along the shoreline.

4.2 Initial Brainstorming and Site Visit

The initial Feasibility Study Team meeting included discussions of the historic perspective of the area, the meaning of "Context Sensitive Solutions", and the draft goals and objectives, as well as the themes that emerged from the previous Community Brainstorming and Scoping meeting, see Section 1.

A site walkthrough was also conducted to review and discuss various site issues, including:

1. Existing road, existing bank armor condition, and beach and bank erosion
2. Road design concerns
3. Utility issues - underground water and overhead power
4. Geological issues
5. Environmental challenges
6. Photo documentation
7. Property and right-of-way issues/challenges



Feasibility Study Team members on Agate Beach during low tide

Following initial discussions and the site visit, team members brainstormed potential concepts with the intention of including any possible variation of a road concept that could meet the study goals.

4.3 Sea Level Rise Elevation Determination

Rising sea levels are visibly affecting communities in western Washington and this was one of the issues to be addressed and defined early on in the Feasibility Study. Scientific studies have projected that sea level will continue to rise into the future. The first issue the Feasibility Study Team needed to agree on was the expected elevation of sea level rise by the year 2100.

The level of sea level rise was estimated at the end of the century using the best available sciences. The references for this project were the San Juan County Shoreline Master Plan, San Juan County “Best Available Science Synthesis (2011),” and the National Research Council (2012) adapted Intergovernmental Panel on Climate Change (IPCC) projections of global sea level rise to the Puget Sound region. Using IPCC model A1FI (“high”), the local sea level rise is

projected to be 1.57 ft by 2050 and 4.69 ft by the year 2100. This is similar, but greater than, the projections used in the San Juan County Shoreline Master Program numbers with a high local sea level rise of 4.19 feet by the end of the century. Adding this 4.69ft to the current MHHW of 7 feet, 2 inches, the projected MHHW by 2100 is estimated to be essentially 12 feet above MLLW.

The recent information on sea level rise published in the National Oceanic and Atmospheric Administration's *Global and Regional Sea Level Rise Scenarios for the United States, January 2017*, indicates sea level rise projections have steadily become higher with new data. Minor flooding that used to be an annual event now happens eight times a year. This means that the sea level rise projections made in this study could be realized before the year 2100.

The scientific method for calculating sea level rise uses the elevation the water can reach when a king tide and storm surge occur at the same time – an elevation defined as highest observed water level (HOWL). The current HOWL is 10.30 feet; therefore, the HOWL in 2100 will be nominally 15 feet ($10.30 + 4.69 = 14.99$). This means that during a HOWL event, the road surface will get wet, but it is an intermittent event and raising the road even higher is not cost effective. The road surface elevation needs to be at an elevation of at least 15 feet to limit water inundation in a HOWL event. Even then there is the possibility of waves over the road and debris blown onto the road at least occasionally. This study used the road surface elevation of 15 feet in estimating road construction costs. Additionally, the HOWL for this area ranges from about 130% to 150% of MHHW. Assuming this to be approximately true in the future, the 2100 MHHW is confirmed to be essentially 12 feet above MLLW.

4.4 Refinement of Concepts

Sea level rise elevations and preliminary cost estimates were applied to the road concepts developed in the initial brainstorming session. After the initial analysis, a number of concepts were considered to be infeasible and eliminated from subsequent evaluations. Examples of the concepts eliminated in the first round included the following:

1. The “Do Nothing” or “No Action” concept was rejected. The Feasibility Study Team decided that doing nothing was not a viable option because it did not provide a solution which responds to the problem of sea level rise or coastal erosion and could not ultimately provide continued access to the Salmon Point, Agate Beach, Barlow Bay and Iceberg Point neighborhoods.
2. A road in the Aleck Bay neighborhood was rejected because it would route traffic through a developed residential neighborhood which was not located in the study area.

3. A bridge or causeway to replace MackKaye Harbor Road was considered not feasible because it would impact the local view aesthetics, would be more problematic for permitting than some of the other options through wetlands, and the cost would be significant, on the order of \$150 per square foot.
4. Sea walls along Barlow Bay were rejected because in order for a sea wall to work, it would need to 20'+ below ground and 15' high, resulting in a 35ft total structure. Such a structure would be extremely expensive and difficult to permit.
5. A new marine facility near Agate Beach County Park for providing ferry service was eliminated because it would not provide access to the Salmon Point, Barlow Bay, or portions of the Agate Beach neighborhoods and would restrict access for emergency services.

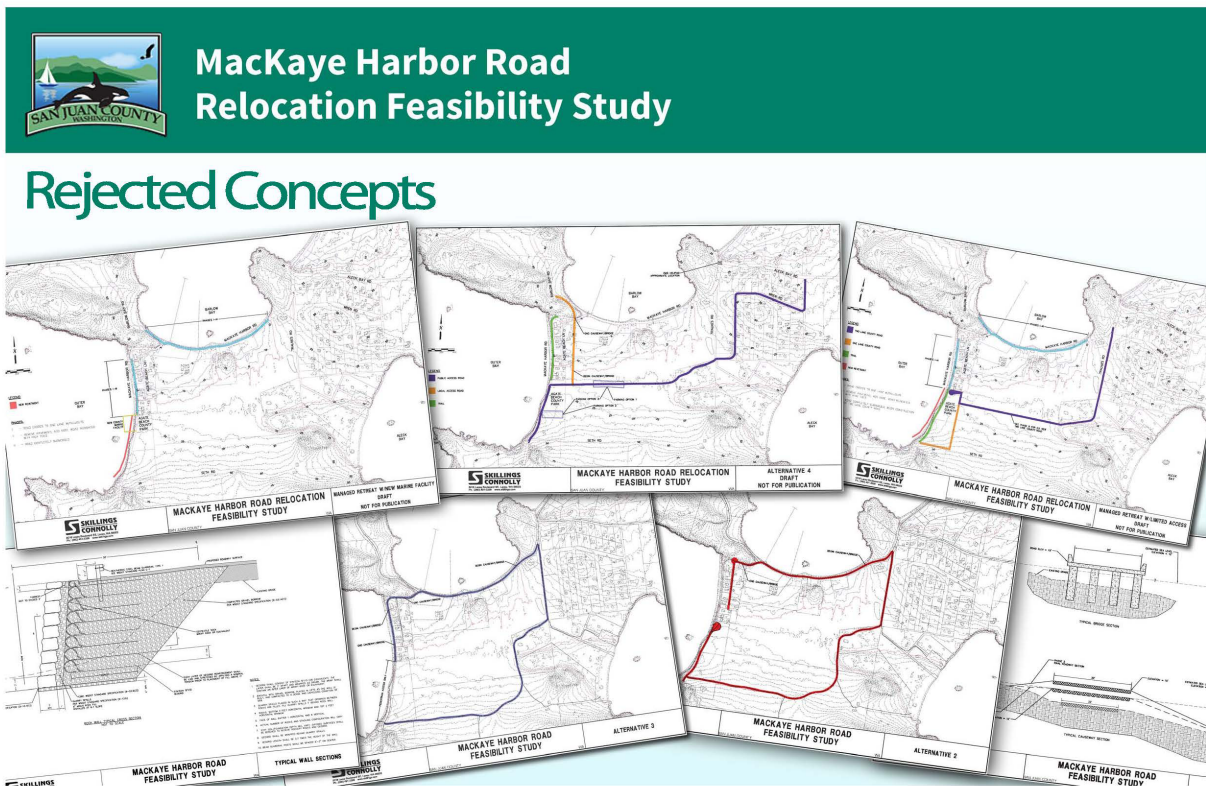


Figure 4.1 – Concepts Rejected by the Feasibility Study Team

Once the first cut of road concepts had been made, additional elements were applied to fine tune the concept viability, which included order of magnitude construction costs, property impacts, and environmental impacts.

4.5 Final Feasible Road Concepts

After narrowing the list of potential road corridor concepts, subsequent meetings were spent further refining the concepts, developing a pro/con matrix to easily compare concepts, discussing concept phases, parking concepts, and the use of MacKaye Harbor Road as a trail.

Concept phases became a discussion item as it was determined that some of the road corridor concepts were not able to meet the study goals to the end of the century.

Parking concepts were added to reflect the goal of the study which required interim parking concepts to be incorporated to provide capacity for access to public spaces, i.e. Agate Beach County Park and the National Monument. Any final solution would need to address long-term parking for public spaces.

When considering relocation concepts, it was agreed that MacKaye Harbor Road would stay in place until no longer passable. Initially, the road would be reduced to one lane, then to a one lane gravel surface, then to a pedestrian/bicycle trail as it continued to degrade from erosion and rising seas.

The four general concepts that emerged from the comprehensive evaluation process were:

1. As-Is Maintenance
2. Raise the Road
3. Inland Relocation
4. Flint Road Relocation

In some instances, combinations of these concepts were required to meet the Feasibility Study goal of long-term solutions, i.e. to the year 2100. Concept drawings are provided below as Figures 4.2, 4.3, 4.4, and 4.5. These figures are also provided in Appendix 4A in a larger size.

4.5.1 Concept 1: As-Is Maintenance/Inland Relocation

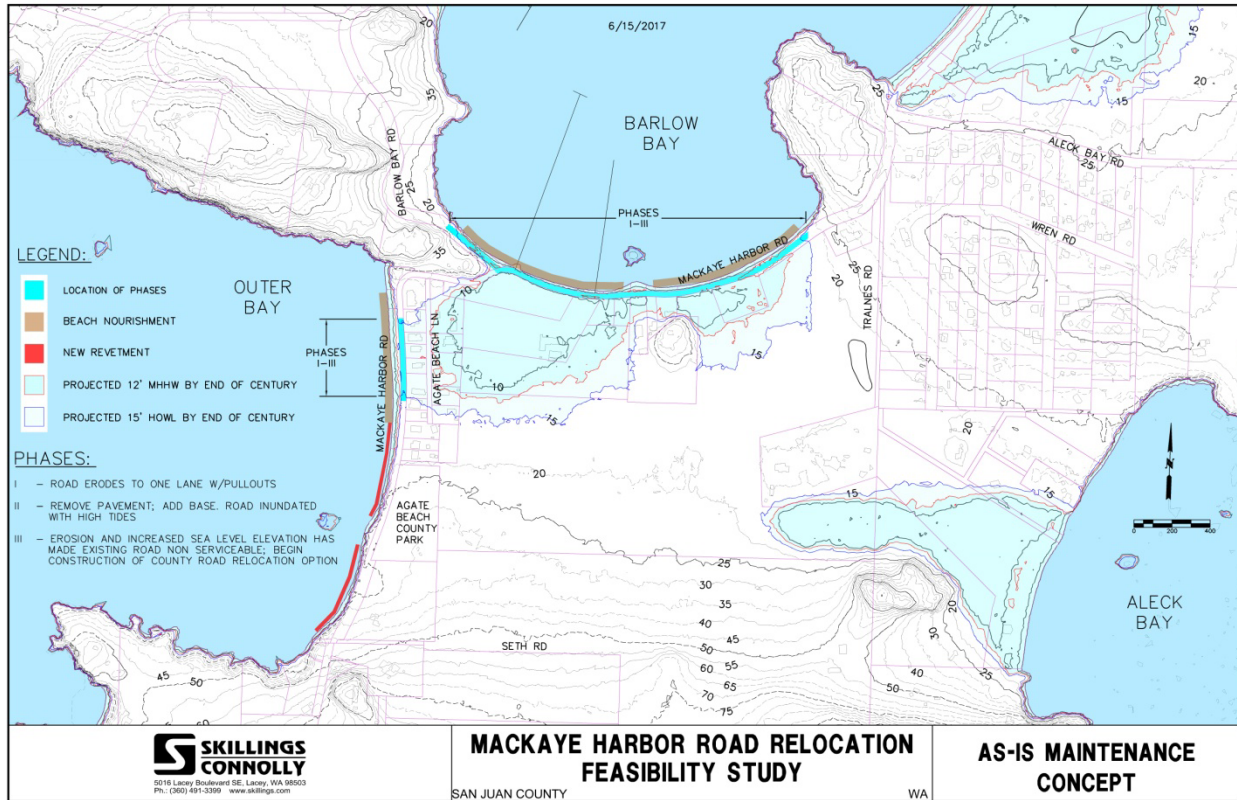


Figure 4.2 - As-Is Maintenance

The As-Is Maintenance/Inland Relocation concept is to protect MacKaye Harbor Road for as long as possible, and then to relocate the road once it becomes necessary.

To protect MacKaye Harbor Road from continuing erosion, combinations of beach nourishment and/or revetments would be needed as described in Coastal Geologic Services analysis (Appendix 3). The revetments at Outer Bay will be raised and/or strengthened; beach nourishment of gravel and sand will be added to both beaches to restore eroded areas and protect the road. Both revetments and beach nourishment will be subject to extensive permitting efforts and archaeological review. This concept is estimated to be viable until mid-century when rising sea levels are expected to inundate the low lying portions of MacKaye Harbor Road, no matter the improvements constructed. Additional easements on the shore side of the road and an aquatic lease from the DNR would likely be required.

Ultimately, road relocation would be required. The relocation process should be started well before road safety becomes compromised because obtaining funding, planning, designing, permitting, acquiring easements, and constructing a new road can take many years. This option will impact the shoreline of both Outer Bay and Barlow Bay, which are spawning grounds for forage fish and surf smelt.

4.5.2 Concept 2: Raise the Road/Inland Relocation

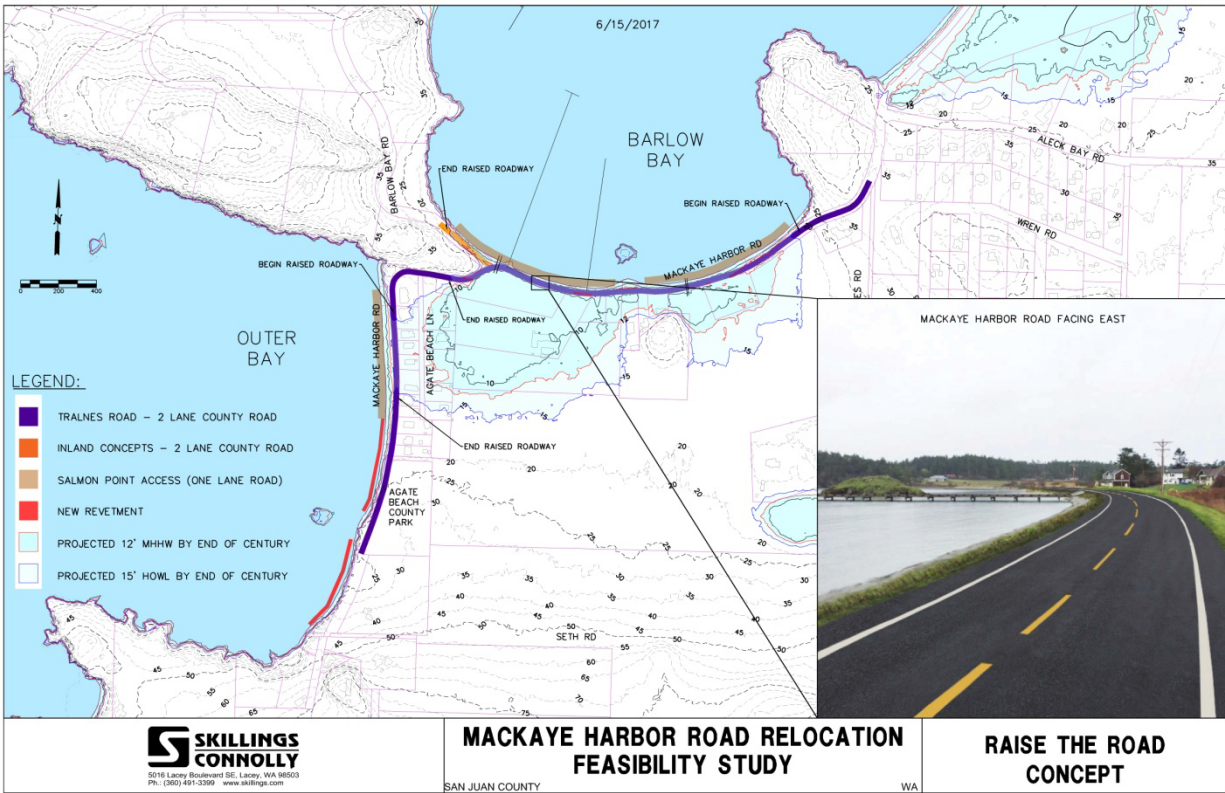


Figure 4.3 - Raise the Road

This concept is similar to As-Is Maintenance in the sense that the purpose of this concept is to protect MacKaye Harbor Road for as long as possible, raise the road as needed, and then to relocate the road once it becomes necessary. This is a concept that can be done in stages. As the sea level rises, the County would raise the elevation of the road up to 15 feet elevation to accommodate coastal erosion and/or sea level rise. This would be possible until around mid-century when coastal erosion is expected to scour away the base of MacKaye Harbor Road no matter the improvements constructed. This is due to the expected continuation of an increase in frequency and severity of storms as well as a rising sea level.

The photo in Figure 4.3 is an artist's rendering of how the road would appear after being raised. Note the steps leading down to the dock and the additional fill on the south side of the road, depicted by green grass.

There are some limitations and complications with this concept. The fill slopes on both sides of the road will reach their limits; the seaward side is limited by the close proximity of the road to the shoreline and the landward side is limited by the amount of right-of-way that would need to be acquired. A one foot increase in road elevation results in two foot outwardly fills from

both sides of the road, assuming steep side slopes are acceptable. Therefore, additional right-of-way will be required to construct the raised road and shoreline improvements.

Ultimately, road relocation would be required to meet the projected sea level rise elevation prior to the end of the century. The relocation process should be started well before road safety becomes compromised because obtaining funding, planning, designing, permitting, acquiring easements, and constructing a new road can take many years. As with concept 1, this option will impact the fish spawning grounds along Barlow Bay and Outer Bay.

4.5.3 Concept 3: Inland Relocation

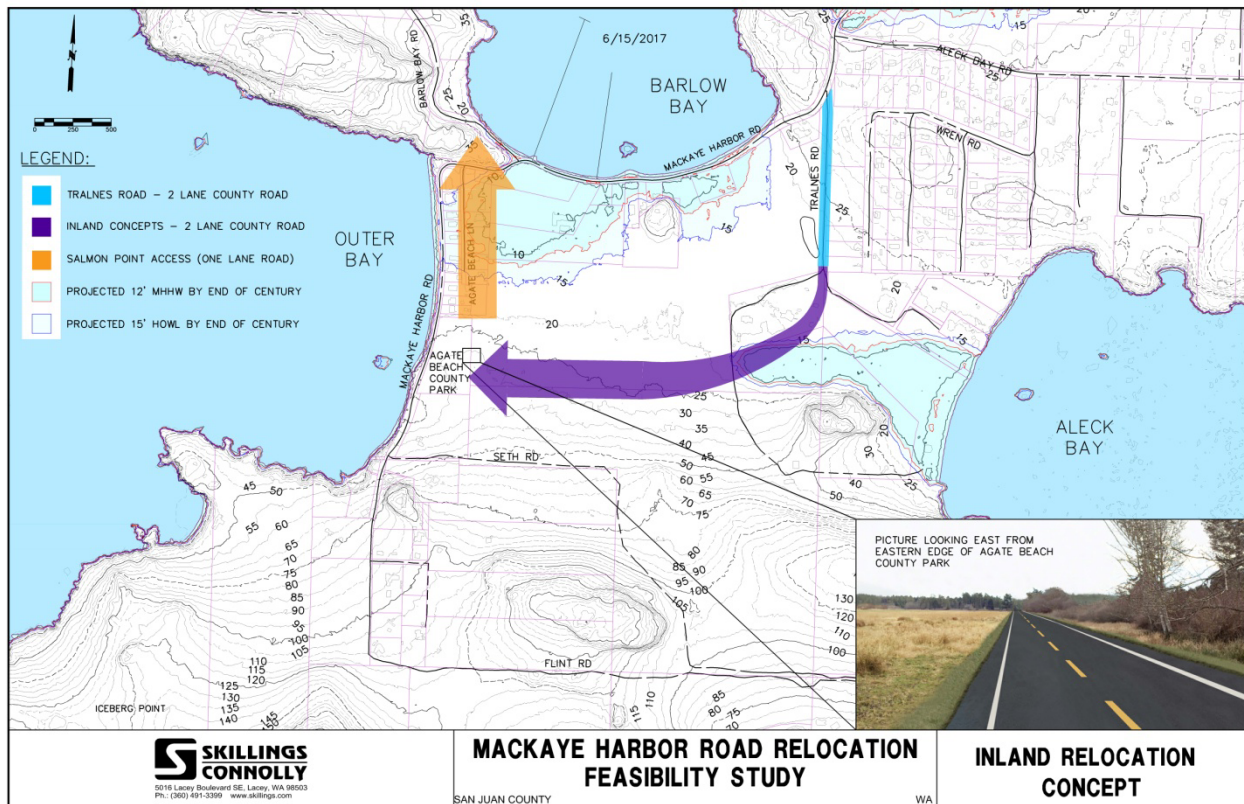


Figure 4.4 - Inland Relocation

The Inland Relocation concept would begin by heading generally south on Tralnes Road where it intersects with MackKaye Harbor Road. This private road would be upgraded to meet County standards. At some point north of the Aleck Bay wetland, the new road would extend west across the field/forested area at a ground elevation of 20 feet or higher to a point anywhere between the eastern boundary of Agate Beach County Park and Seth Road, and tie into the beginning of Flint Road. At this conceptual stage, the precise route of the road would be determined in future phases. Provisions for parking in the vicinity of the County Park are available with the Inland Relocation concept. To access the Agate Beach and Salmon Point

communities, an additional road would be required. This additional access road is discussed in Section 4.5.5.

The existing MacKaye Harbor Road would be used for local access and a non-motorized trail for as long as feasible.

The photo in Figure 4.4 is an artist's rendering of the potential road looking eastward from the back of the Agate Beach County Park toward Aleck Bay.

Inland Relocation is the least expensive of the options because it does not include any coastal restoration, but allows shoreline changes to progress naturally although the existing road would need to be maintained until the relocated road was completed. This concept is viable for 75-80 years, making it an economical, long-term solution.

While this option has many benefits, it also has inherent problems. This option will require the County to purchase road easements from community members that currently are not in favor of the road concept. Additionally, there will be significant wetland impacts that would need to be mitigated.

4.5.4 Concept 4: Flint Road Relocation

Like the Inland Relocation concept, the Flint Road Relocation concept travels generally south along Tralnes Road. Then, instead of heading west, the road continues south while skirting the Aleck Bay wetland and then climbs the heavily forested hillside to Flint Road. This concept was created to resemble the County's original grant proposal to the state legislature. While this concept may provide the most access to areas of the island, it is the longest and will be the most costly. The vast majority of the land required is private and the County would need to negotiate and purchase road easements.

As with the previous concept, access to the Agate Beach and Salmon Point communities would be via a new one lane County road, see Section 4.5.5. In addition, the existing MacKaye Road would continue to be used for local access and a non-motorized trail for as long as is feasible.

In the artist's rendering in Figure 4.5 (next page), the road is depicted in the forest with representative parking spaces on either side.

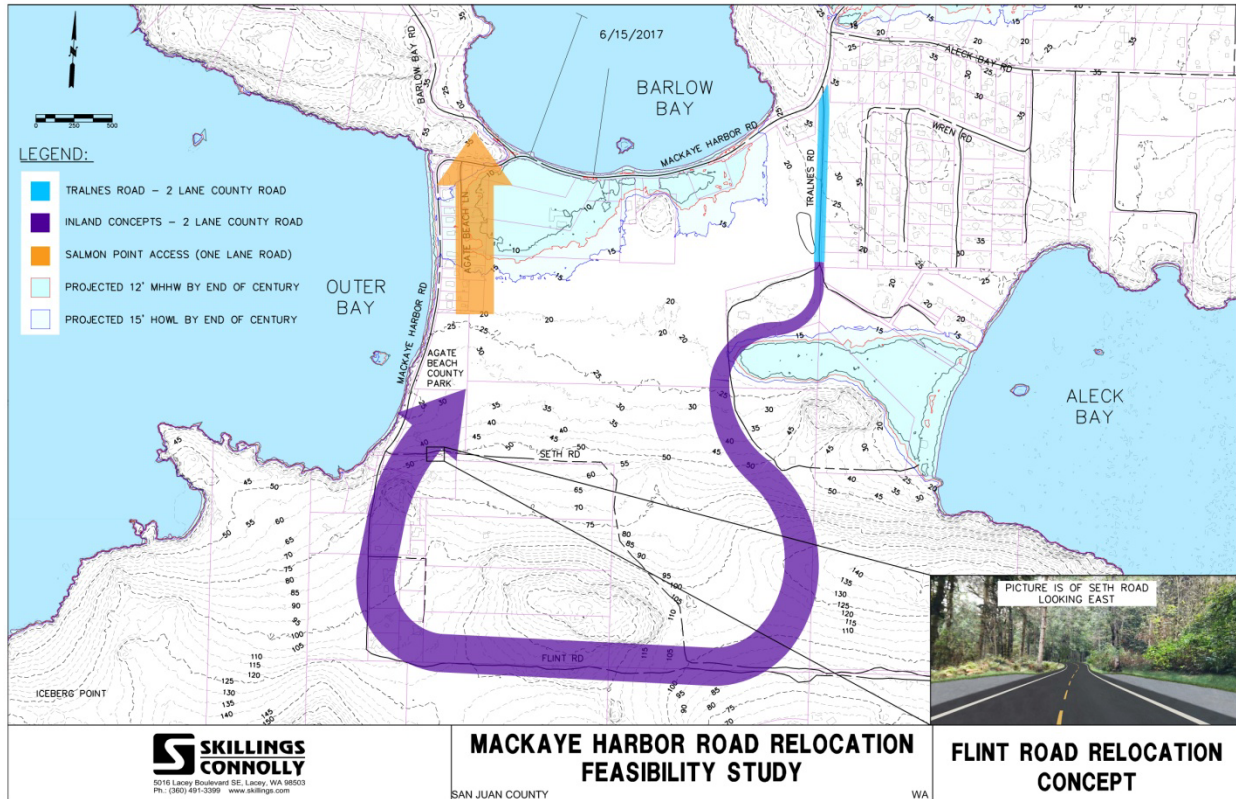


Figure 4.5 - Flint Road Relocation

4.5.5 Salmon Point Access

While both the Inland Relocation and the Flint Road Relocation concepts provide access to the neighborhoods along Flint Road and the County Park, they also require building a roadway for access to and from the Agate Beach and Salmon Point neighborhoods. Two options were discussed to provide access to Salmon Point. Both options start from the northern boundary of Agate Beach County Park, head north and connect to Barlow Bay Road. These options are depicted in Figures 4.4 and 4.5 as the orange arrow. Each option would be constructed as a one lane access road since access to public areas would not be required. Option 1 would connect Agate Beach County Park to the existing MacKaye Harbor Road and on to Barlow Bay Road via the existing private Agate Beach Lane. Option 2 would create a new road from the northeastern corner of Agate Beach County Park to the north along the eastern edge of the properties along Agate Beach Lane. This option would then connect to a raised MacKaye Harbor Road and Barlow Bay Road like Option 1. Either option would need to be raised to the 15 foot MLLW elevation for a distance of approximately 300 feet.

Option 2 would have impacts to wetlands (Category II and Category III) to the east of the Agate Beach neighborhood and encounter poor soils during construction. Option 1 would impact less

critical areas, but it could be challenging to provide driveway access to some of the properties from the raised road. Additional traffic on Agate Beach Lane would also be a neighborhood concern with both options. Private property is impacted with both options and would require negotiations to obtain the necessary road easements.

4.5.6 Barlow Bay Property Connections

Currently, MacKaye Harbor Road accesses the front of properties along Barlow Bay. When MacKaye Harbor Road is no longer passable, there would need to be a new way to provide access to these properties and the existing marine docks. As MacKaye Harbor Road erodes and is reduced to a narrow one lane, it could provide driveway access for these properties only until the road is continually inundated. Alternatively, providing driveways to these properties from the south from an inland relocated road or east from the Salmon Point access road is possible, but would have wetland impacts and require access easements across potentially both private properties and tribal lands.

As with any of the lower lying properties, eventually properties may need to be abandoned once the sea level rises to an elevation that septic systems become flooded and inoperable. Until that time, access to all properties will be included in any of the inland relocation options.

4.5.7 Parking Options

General concepts for additional parking to accommodate visitors to Agate Beach County Park and the National Monument were evaluated (Figure 4.6 next page). With the road concepts located along the shoreline, no additional areas were identified for long-term parking other than along the boundaries of the County Park. The Relocation concepts could potentially include parking spaced among the trees along the relocated road near the County Park. If a private road easement could be combined with the public land at the County Park, additional parking capacity could be provided.

As discussed earlier, additional parking for visitors to the public areas is required to eliminate the current overflow parking situation. Bike touring company vans with trailers are no longer allowed to park in the County Park parking lot in July or August. Those lengthy vehicles must use the County-owned MacKaye Harbor marine facility parking lot located two miles away.

In addition, the upcoming maintenance of the County Park parking lot is planned to increase the number of parking spaces available by better defining the parking area boundaries, rerouting traffic in one direction only and by adding curb stops to delineate parking spaces.

Until long-term parking can be resolved, San Juan County Public Works will be installing interim parking spaces along the western boundary of the County Park later in 2017.

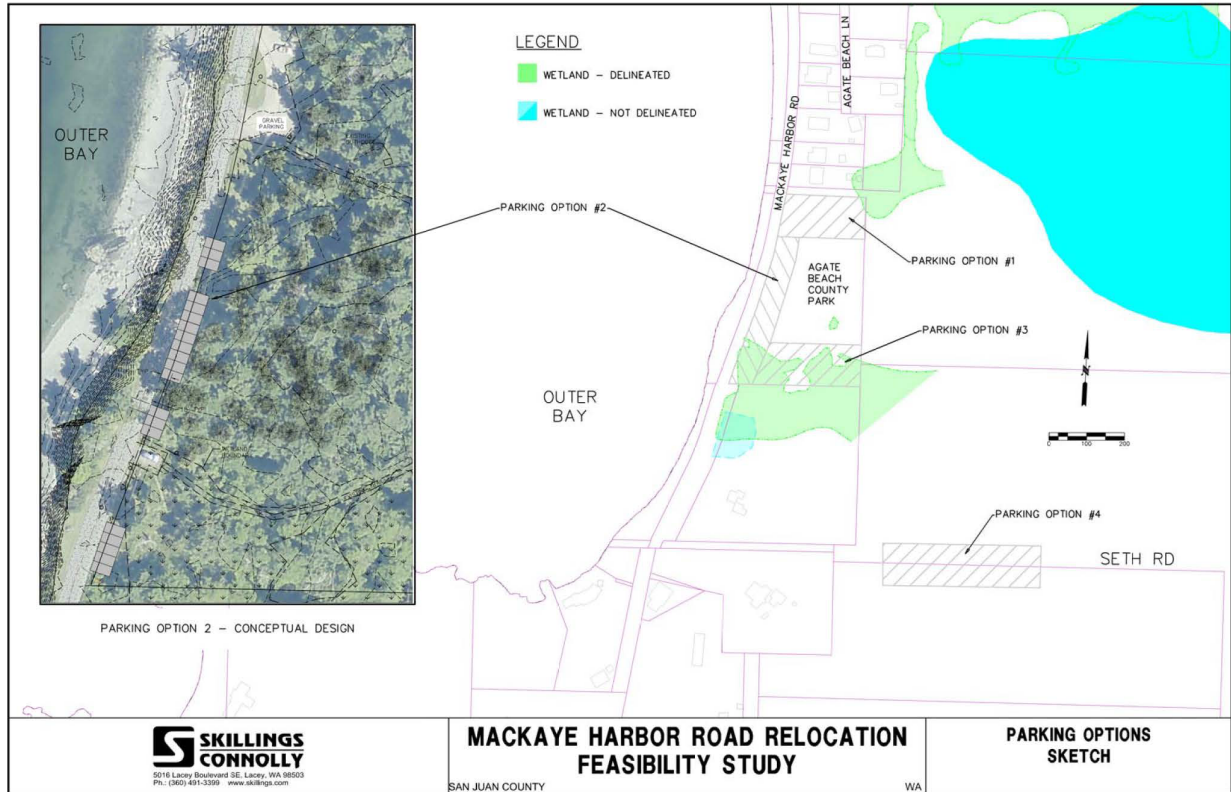


Figure 4.6 - Parking Options

4.6 Cost and Environmental Impacts Estimation

To compare the concepts selected as potential solutions meeting the project goals, costs were compiled for each concept. Cost elements included estimation of road construction, coastal improvements, right-of-way, and environmental impacts and mitigations costs on a planning level for this study.

Table 4.1 presents the estimated capital costs for each concept, as well as an estimation of the impacted areas noted.

To estimate the capital cost of road construction, the general alignment for each concept was drawn on the topographic base map with a vertical alignment that fit the contour of the land and a right-of-way width of thirty feet each side of centerline (sixty feet total). Approximate earthwork quantities were calculated. Construction cost estimates were based on historical values of road construction within the County. All estimates are order of magnitude at this level of development and will be further defined in future phases.

**MackKaye Harbor Road Feasibility Study
Capital Cost, Right of Way, Environmental, and Cultural Impacts**

CONCEPT	COASTAL IMPROVEMENTS Millions of Dollars*	CAPITAL COST Millions of Dollars	RIGHT OF WAY Millions of Dollars	WETLAND MITIGATION Millions of Dollars	TOTAL COST Millions of Dollars	RIGHT OF WAY Acres	WETLANDS Acres	TREES Acres	CRITICAL AREAS Acres	CULTURAL RESOURCES
AS-IS MAINTENANCE [†] INLAND RELOCATION	\$3.4	\$1.9	\$0.70	\$0.45	\$6.5	Inland Relocation see box below	Inland Relocation see box below	Inland Relocation see box below	Inland Relocation see box below	Registered archaeological sites within the corridor. High probability of affecting historic properties.
RAISE THE ROAD [†] INLAND RELOCATION	\$3.1	\$5.3	\$1.3	\$0.50	\$10.8	Raise the Road - 5.6 acres. Many parcels have homes. Inland Relocation see box below	Raise the Road 0.5 acres Category I/II tidally influenced, more difficult to mitigate Inland Relocation see box below	Inland Relocation see box below	Raise the Road 5.9 acres forage fish spawning, wetlands, unstable bluffs Inland Relocation see box below	Registered archaeological sites within the corridor. High probability of affecting historic properties.
INLAND RELOCATION [^]		\$1.9	\$0.7	\$0.45	\$3.1	9.4 acres Mostly open forest and pastures, few homes	2.3 acres Category III/IV wetlands may be mitigated or designed to miss	3.2 acres design to minimize tree impact	0.8 acres Nat'l heritage plants, priority habitat and species, flood plain	No registered archaeological sites within the corridor. High probability of affecting historic properties.
FLINT ROAD RELOCATION [^]		\$9.7	\$1.15	\$0.55	\$11.4	16.5 acres Mostly forested, some homes depending on exact route	2.1 acres High impact to peat area, difficult construction, high mitigation need.	10.2 acres design to minimize tree impact	8.8 acres Nat'l heritage plants, priority habitat and species, flood plain	No registered archaeological sites within the corridor. High probability of affecting historic properties.

* - this concept is only feasible through mid-century because of bank erosion, then relocation will be required.

† - includes \$0.5-\$0.8M for beach nourishment replacement required after 20 years

^ - this concept is feasible to the end of the century

Table 4.1 - Capital Cost, Right-of-way, Environmental, and Cultural Impacts

Coastal improvements, revetment and beach nourishment, were based on similar work at other locations. No costs are included at this level for eelgrass mitigation. Beach nourishment maintenance was included for one 20-year cycle to reach the mid-century projection assuming that MackKaye Harbor Road would no longer be viable for access by then.

Areas for trees and critical areas impacted within the right-of-way were estimated based on current county maps. Wetland mitigation cost estimates were estimated from recent County experience developing wetland mitigation sites on other projects.

Right-of-way costs were estimated based on a review of nearly every parcel in the area and the current assessor valuation to meet the need for a total right-of-way width of 60 feet. An order of magnitude value per acre was estimated for several areas and that value multiplied by the needed acres. No appraisals or provisions for the impact of individual landowner negotiations were considered at this level of evaluation.

In addition to the costs and impacted areas delineated in Table 4.1, a pro/con matrix was developed for each concept and used in the comparison analysis of the concepts (see Appendix 4B). A typical example of the roadway construction cost estimate is included in Appendix 4C.

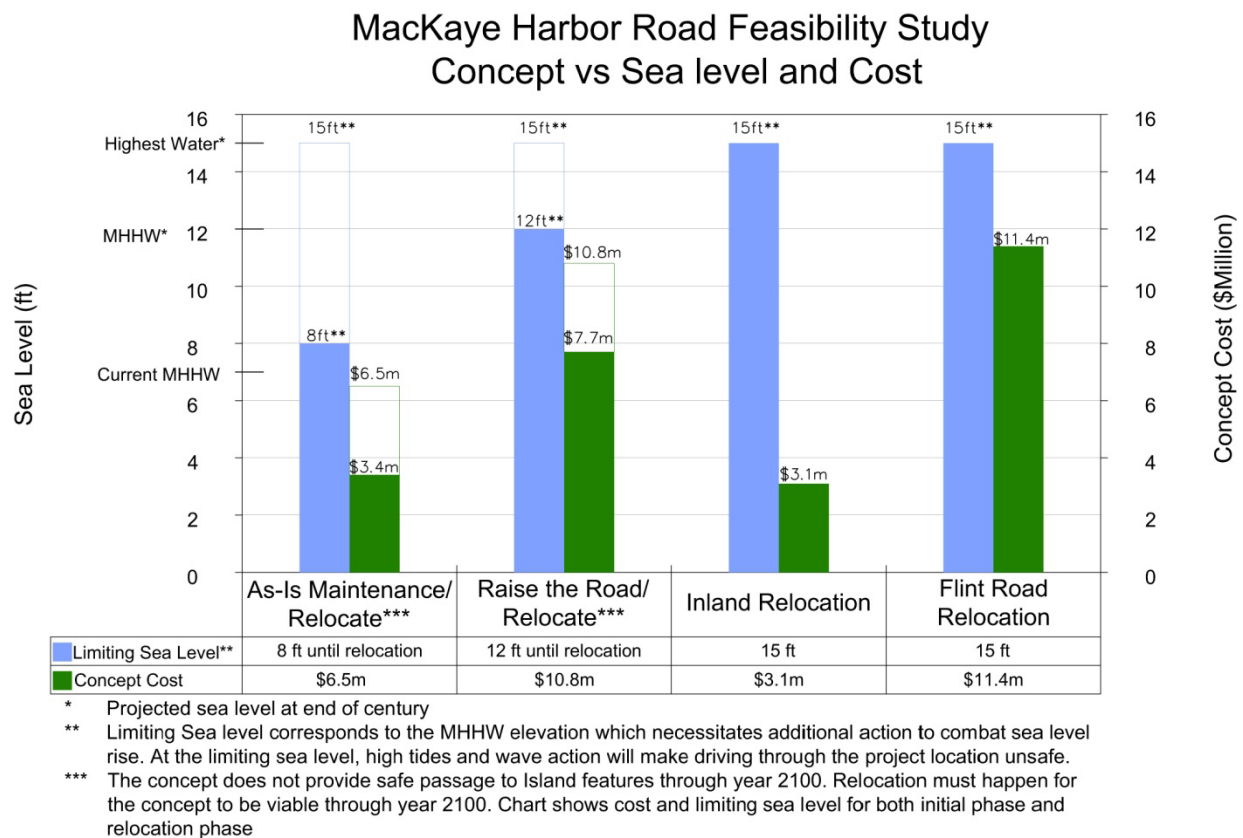


Figure 4.7 - Comparison of Sea Level Rise and Cost/Concept

The bar chart in Figure 4.7 portrays the ability of each concept, or combination of concepts, to meet the ultimate road surface requirement of 15 foot minimum elevation in response to projected sea level rise elevations. An estimate of total concept development costs for each concept, or combination of concepts, is shown with the green set of bars.

The solid bars in Figure 4.7 correspond to the first phase of each concept. As-Is maintenance and Raise the Road require a second phase, relocation. This second phase of the project is shown by the outlined bar. This is to show the difference between the initial and completed concept cost and limiting sea level of the As-Is Maintenance and Raise the Road concepts.

4.7 Achieving the Project Goals

In the Introduction to the MacKaye Harbor Road Relocation Feasibility Study, the project goals were listed as:

- Addressing projected sea level rise and continuing coastal erosion.
- Maintaining vehicular access to private properties, public and tribal lands.
- Providing parking provisions outside of the road travel way for visitors to the public lands.

Figure 4.7 demonstrates that all of the concepts, or combinations of concepts, are capable of meeting the first goal of addressing sea level rise. The two concepts that remain along the shore are unable to meet the stated time period on their own (to the end of the century) and would be viewed as concepts that allow a wait-and-see attitude for the occurrence and magnitude of sea level rise. To meet the time frame, a relocation concept would need to be added. Both the Inland Relocation and Flint Road Relocation concepts could be an immediate response to future sea level issues.

Each of the concepts were developed with the premise of maintaining vehicular access to private properties, public and tribal lands. The issue of continued access to the properties fronting MacKaye Harbor Road along Barlow Bay is challenging because of the need to develop access across private lands for a handful of parcels. It can be done, but will require thoughtful negotiations.

General concepts for additional parking to accommodate visitors to Agate Beach County Park and the National Monument were addressed with the Relocation concepts. Until those concepts are implemented and long-term parking can be included, interim measures must be instigated to relieve the existing peak season parking congestion. The County is currently designing additional parking areas along the western boundary of the park and applying for the required permits. Continued bluff erosion in the area of the County Park precludes anything more than interim solutions at this time.

Section 5: Public Outreach

The MacKaye Harbor Road Relocation Feasibility Study was developed using the tenets of Context Sensitive Solutions which require both public participation on the Feasibility Study Team and continuous public information and involvement. Public involvement in the study began before the Feasibility Study Team was formed. San Juan County Public Works hosted a Community Brainstorming and Scoping Meeting in March 2016, to gather initial thoughts and ideas for the study. See Section 1, Introduction, for more details.

One challenge with the Public Outreach for this Feasibility Study was to reach as many of the property owners as possible in the study area. Many of the residents do not reside on Lopez Island full-time. Part-time residents may come to Lopez Island on weekends only or seasonally. Others may rent their homes out for a portion of the year. This made the dissemination of information problematic. To maximize the availability of information, four approaches were employed:

- Mailings based on assessor address records for parcels within the study area
- Emailing when online addresses were shared
- Posting materials on the County website
- Advertisement of meetings and materials on LopezRocks, a local website

With these approaches, there were a number of opportunities to share information with the community and collect comments in return:

- March 2016 Community Brainstorming and Scoping meeting, see Section 1
- Bi-monthly status updates
- January-February 2017 Online Open House
- January 2017 Community Meeting
- March 2017 Supplemental Mailing
- Posting of the draft Feasibility Study online and in the local library

5.1 Bi-Monthly Status Updates

The County issued bi-monthly status updates which described the current progress of the MacKaye Harbor Road Relocation Feasibility Study. It was possible to receive this status update in two ways. The first was to sign up to a direct distribution program by providing the County with a valid email address. Community members were encouraged to sign up for this method whenever they contacted the County. Alternatively, the status updates were posted on the San

Juan County Public Works website for public viewing. Status updates were published in June, August, October, and December 2016, and February, April, and June 2017.

The status updates are included in Appendix 5A.

5.2 Online Open House

EnviroIssues, the public involvement professional, created an online open house which was available from January 23 through February 14, 2017, for public review and comment. This venue was included so that even those property owners not living on the island or not able to attend the subsequent community meeting, would be able to review the materials and provide comments. The online open house had seven sections: Purpose and Goals, Study Background, Community Input, Proposed Concepts, Concept Details, Share Your Thoughts, and What's Next.

The online open house allowed community members to view the issues and challenges facing the ongoing and future operation of MackKaye Harbor Road, review the concepts the Feasibility Study Team developed, compare the concepts via the provided conceptual costs, right-of-way needs, and environmental impacts; and learn what the next steps could be once the feasibility study was completed. The website allowed community members to look at the materials and prepare for the community meeting so they could ask questions and make comments. If they could not attend the upcoming community meeting, viewers had the opportunity to submit their comments online.

The online open house displays are available in Appendix 5B.

There were 194 individual reviewers of the online open house during 292 sessions. The average session duration was over eight minutes. The online open house resulted in comments from twenty individuals, although less than half of those were property owners in the study area. Those comments are available in Appendix 5C and the County's responses to the community comments are available in Appendix 5D. The stated preference was for Concept 1, As-Is Maintenance, with Concept 3, Inland Relocation as a close second.

5.3 Community Meeting

A community meeting took place at Woodmen Hall on January 31, 2017. The community meeting featured a one hour open house followed by presentations from members of the Feasibility Study Team.

The open house portion of the meeting consisted of ten different stations, each hosted by members of the Feasibility Study Team. Each station included one or more of the display boards from the online open house, see Appendix 5B. Community members were encouraged to visit each station and talk to and ask questions of the members of the Feasibility Study Team to

better understand the issues and challenges, the concepts that had been developed to address the issues, the pros/cons of each concept, and what would happen after the feasibility study was completed.

The subsequent presentations included additional information on sea level rise expectations, concept development, and the next steps.



Community Meeting: January 31, 2017

After the presentation, a question and answer (Q&A) session took place. During this Q&A session, the community was able to interact with the presenters. There were comments about Feasibility Study Team neighborhood representation and private property impacts. Both questions and responses are included in the online open house comment responses, see Appendix 5C.

5.4 Supplemental Property Owner Mailing

It was determined that before a conclusion could be reached on the preferred concept, from both a technical view as well as the community's view, additional feedback from the property owners in the study area was required since little more than 10% of the property owners

responded during the Online Open House or Community Meeting. A supplemental mailing was made to each of the eighty plus study area property owners (representing approximately 100 parcels) asking them to review the online open house material on the County website and comment on:

- The four concepts presented as a means to meet the goals of the study.
- Their most important issues.
- Any other issues the study team needed to be aware of or take into consideration.

This additional request for comments resulted in 25 property owners responding; comments are included in Appendix 5C. With the comments received from the supplemental mailing, in addition to the comments from the earlier online open house, more than one-third of the property owners in the study area were represented. In addition, numerous comments were received from each of the impacted neighborhoods. Therefore, it is believed that the Feasibility Study Team has received a representative sampling of comments for the concept evaluation required to conclude the study.

These supplemental mailing comments trend quite similarly to those received during the Community Meeting and Online Open House where nearly half of the responders would like the County to maintain the existing scenic road enjoyed by pedestrians, bicyclists, and drivers. Responders feel that a 'wait and see' attitude about sea level rise is warranted before spending additional funds, while continuing to maintain and protect MackKaye Harbor Road from continued coastal erosion.

The other half of responders would like the County to pursue the Inland Relocation concept. Reasons cited were that it was a long term solution, appeared to be economical and provided for additional parking.

While the County did not specifically respond to the comments from the supplemental mailing, the previous responses to the Online Open House and Community Meeting in Appendix 5D were generally applicable to the additional property owner comments.

In addition to the community responses on preferred concepts, a number of comments were made on various issue of importance to the community. A sampling of those issues is listed below and the complete list can be found in Appendix 5C.

Issues of importance include:

- Protecting the beauty and accessibility of Agate Beach and Iceberg Point.
- Protecting the access to existing homes.
- Resolving the parking problem generated by the public spaces.

Other issues that cited as needing to be considered:

- If MacKaye Harbor Road becomes a foot, path parking spaces need to be developed and assigned to residents lots required to use the foot path.
- There should be more parking at the Agate Beach parking lot or somewhere else appropriate if a new road is developed.
- There needs to be a plan to replace the steps down to Agate Beach as it is badly eroded and people are making their own path.
- Cutting a few trees in the park would be acceptable to provide more parking.

5.5 Draft Feasibility Study

The draft Feasibility Study was posted on the County's website on May 4, 2017. At the same time, two copies of the Feasibility Study were placed at the Lopez Island Library for public viewing. Three comment letters were received on the draft Feasibility Study and have been summarized in Appendix 5F.

A presentation was made to the County Council on May 9, and a supplemental discussion was held on June 5. As a result, the County Council chose to develop a Council Commentary to be submitted with the final study when it was sent to WSDOT.

Section 6: Next Steps

The goals of the MacKaye Harbor Road Relocation Feasibility Study are to evaluate long-term solutions for the road by:

- Addressing projected sea level rise and continuing coastal erosion.
- Maintaining vehicular access to private properties, public and tribal lands.
- Providing parking provisions outside of the road travel way for visitors to the public lands.

After considering many possibilities, four concepts (two shoreline and two inland) were evaluated as long term solutions for this feasibility study. After a thorough analysis of the concepts and the various elements associated with them, Inland Relocation was selected as the long-term concept that best met all of the goals of the study.

6.1 Preferred Long-Term Concept: Inland Road Relocation

The premise of the Relocation concepts is to move MacKaye Harbor Road inland, where it fronts Barlow Bay and Outer Bay, to at least an approximate elevation of 20 feet which is well above the projected sea level rise elevation by the end of the century. By doing so, the road will remain a viable public road accessing public lands, and can be modified or supplemented to provide access to the neighborhoods that currently depend on the County road.

Of the two concepts, the Inland Relocation was the most cost effective concept with an estimated capital cost of \$3.1 million. Wetland mitigation will be an environmental consideration based on the currently identified Category III and IV wetlands in the area. Inland locations are anticipated to have less likelihood of encountering archaeological sites than any of the shoreline location concepts.

Flint Road Relocation was deemed significantly more expensive since it is more than twice as long as the Inland Relocation concept, would have similar wetland impacts, and additionally would have significant impacts to trees in the forested route. **Therefore, the Inland Relocation concept was chosen as the preferred long-term solution.**

The existing location of MacKaye Harbor Road along the bays would be maintained as long as possible (see item G in Section 6.4) to provide continued local and non-motorized access. Eventually, continued erosion and rising seas would render portions of the existing road impassable.

Based on input from the community, proponents of this concept believe it is prudent to relocate the road sooner rather than later for the following reasons:

1. The most economical use of public funds.
2. Immediately achieves the goal of protecting against sea level rise and provides a long-term solution.
3. Allows the most flexibility to meet long-term public access and parking needs.

6.2 Shoreline Concepts

Much of the community was in favor of the County investing funds in As-Is Maintenance and Raise the Road concepts that were expected to be viable only until roughly mid-century. Estimated capital costs for the shoreline concepts ranged from \$3.4 million to \$7.7 million. Eventually, an additional \$3.1 million would be required to relocate the road inland to provide continued access. In the end, these concepts would cost the County two to three times as much as the initial inland relocation concept with the same final results.

Based on input from the community, proponents of the shoreline concepts believe the road should be maintained in its current location for as long as possible citing the following reasons:

1. Wait and see if the projected sea level rise actually does occur; in the meantime, address the erosion issue immediately.
2. Maintains the scenic views.
3. Protects the homes along the shore.
4. Safeguards the water line in MacKaye Harbor Road until it can be replaced and relocated.

6.3 Implementation Challenges

All of the concepts face implementation challenges, including availability of funding, permitting, acquisition of road easements and other impacts to private property. There are currently limited funds available for planning, design, permitting, or construction for any of the road concepts. Since sea level rise is a worldwide phenomenon which is being addressed at the national level, it is difficult to predict future funding availability. With the major population centers along the coasts being impacted, these cities will likely receive first priority for funding.

Some private property owners have clearly voiced their objection to the road relocation concept because of the location of potential road corridors. New road easements would potentially divide properties and result in loss of privacy with increased traffic. The County recognizes that a critical challenge will be to address the impacts to private properties balanced with the need to purchase road easements.

6.4 Near Term and Future Actions

There have been requests to wait to begin the planning phase to relocate the road until road failure is imminent; however, by then it is too late. The steps necessary to relocate a road require a long lead time of many years from the time funding is obtained, planning is initiated, additional studies are undertaken, design is completed, permits are secured, road easements are acquired, and construction can commence. Therefore, the County will begin the process now of seeking funding for the road relocation concept. At the same time, the County intends to implement a number of near term maintenance and safety measures to address issues with the current shoreline road.

- A. This MacKaye Harbor Road Relocation Feasibility Study will be submitted to the Washington State Department of Transportation (WSDOT), as required by the Connecting Washington grant, in June 2017.
- B. The County recently reduced MacKaye Harbor Road at Agate Beach County Park to one lane in May 2017 to keep traffic away from the eroding bluff.
- C. In additional response to the eroding bluff, the County will begin planning for relocation of the road to the inside eastern boundary of Agate Beach County Park as the first step in the Inland Relocation concept. The project will be added to the Six Year Transportation Improvement Plan. Wetland mitigation will be a crucial element to resolve to ensure success of the project.
- D. Interim parking spaces will be installed along the western boundary of Agate Beach County Park later in 2017, contingent upon receiving a shoreline permit and funding.
- E. In the next season or two, maintenance of the parking lot at the County Park will include modifying the traffic circulation within the parking lot to one direction and delineating spaces with curb stops to maximize the number of vehicles that can efficiently fit within the parking lot.
- F. The County will be actively seeking funds to begin planning for the relocation of MacKaye Harbor Road. Road relocation planning will include choosing and designing an acceptable route and preparing the environmental documentation required with appropriate environmental mitigation and permitting defined. An integral element of this will be the ability to negotiate and purchase road right-of-way.

- G. Funding for shoreline improvements as a combination of revetments and/or beach nourishment along both bays will continue to be explored, as appropriate, to maintain and protect MackKaye Harbor Road from continued coastal erosion for the immediate future.

Property issues are a complicating factor for coastal improvements along Agate Beach, north of the County Park, and the beach at Barlow Bay since most of the shoreline areas are privately owned. Beach front property owners will need to be involved in any coastal improvement planning. Public funds often cannot be used to improve private properties without the granting of easements. Some environmental funding sources can be applied to private property, but continued access to state and federal environmental funds are currently unknown.

Before any work is undertaken along the shoreline, a full cultural resources survey will be required to determine the extent of any existing archaeological resources.

Figure 6.1 (next page) presents a relative time frame for the various near term and future actions proposed in the MackKaye Harbor Road study area.

6.5 Policies

This relocation feasibility study is the first of its kind in San Juan County. Public Works is responsible for the maintenance of approximately 16 miles of public roads along shorelines throughout the County. Many of those roads are experiencing issues related to erosion, and more severe storms, and additional studies may be authorized to evaluate road options at other locations.

In developing this study, a number of policy questions were broached which do not immediately have answers available. When it comes to issues related to rising sea levels and flooding, there are national discussions taking place to determine policy direction. Some of the ongoing policy discussions include the following:

- What is the County's responsibility to continue to provide access in areas with rising sea level – to what extent should public resources be committed to options with a limited life?
- How does the County respond to loss of property values when access is compromised?
- How does the County respond when properties become uninhabitable with flooding septic systems as a result of sea level rise?
- What is the County's policy regarding the installation and maintenance of tide gates?

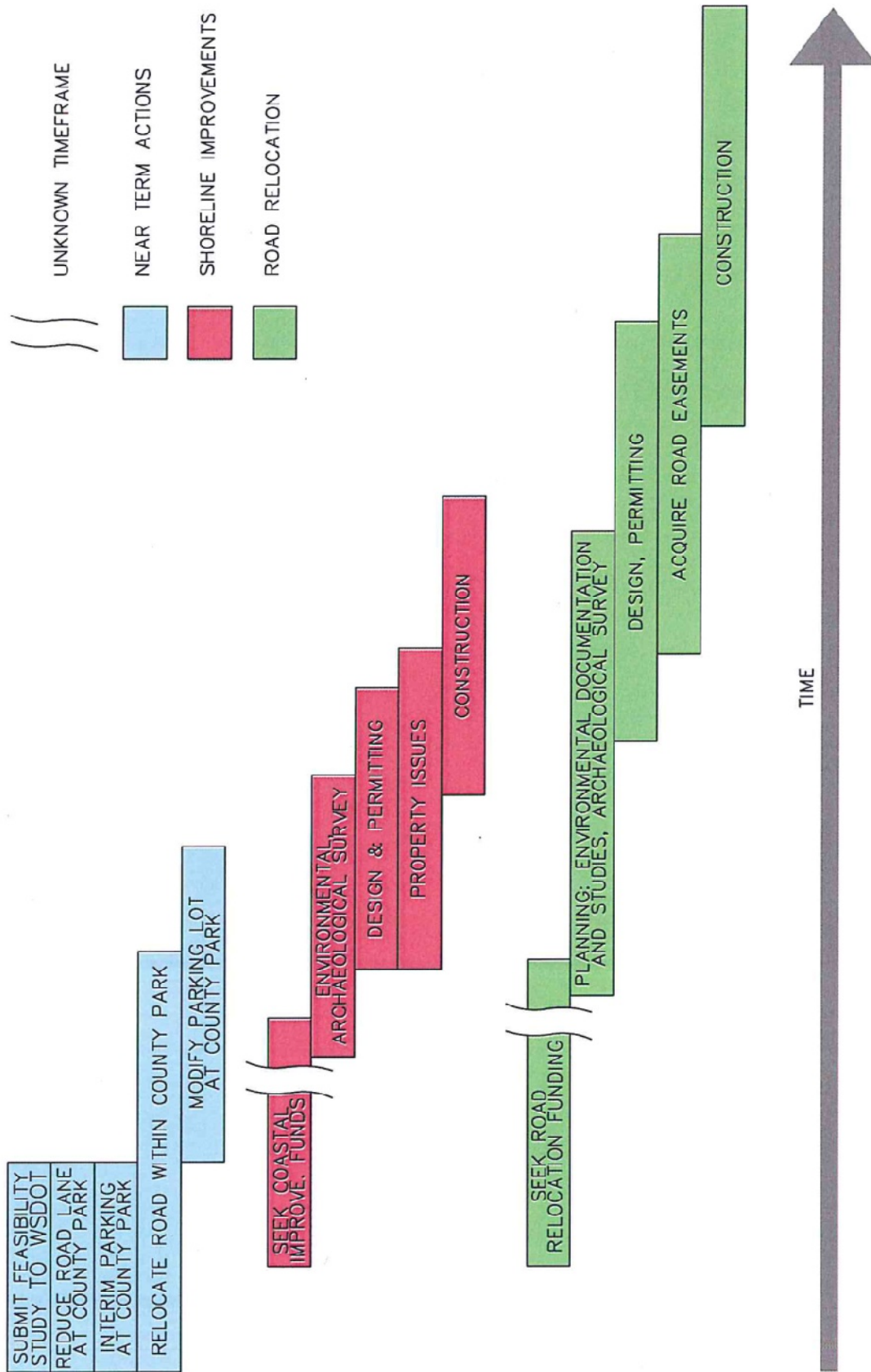


Figure 6.1 - Next Steps Timeline

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