



COUNTY OF SAN MATEO  
SOUTH COAST

**SEA LEVEL RISE  
VULNERABILITY  
ASSESSMENT  
&  
ADAPTATION  
REPORT**



**SEA CHANGE**  
SAN MATEO COUNTY



**integral**  
consulting inc.

# County of San Mateo South Coast

## Sea Level Rise Vulnerability Assessment and Adaptation Report



*Swan Dive Media, 2021*

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## EXECUTIVE SUMMARY

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Rising sea levels mean that the South Coast of San Mateo County, which extends from southern Half Moon Bay down to the south county line with Santa Cruz, will experience considerable challenges from the increased extent of storm wave flooding and from eroding beaches and cliffs, anticipated to significantly impact community assets.

This document includes an introduction and overview of sea level rise science, an overview of the South Coast's past and present social and geographic settings, including a summary of social vulnerability, a sea level rise vulnerability assessment, and an adaptation report. The vulnerability assessment provides projections of the extent of coastal hazards and of the physical and economic impacts to community assets like buildings, roads, farmland, and coastal access infrastructure. The adaptation report provides an overview of sea level rise adaptation strategies and provides an example adaptation pathway for an at-risk stretch of State Route 1.

This vulnerability assessment found significant sea level rise exposure in the agricultural community of Pescadero, which is intersected by two creeks influenced by the coastal environment, and at Martin's Beach, which sits directly on the coast. Also at risk to sea level rise impacts are the cultural areas and materials of Native Peoples, particularly in the areas of Pescadero, Año Nuevo, and Franklin Point. State Route 1, a critical corridor to the South Coast region, is already impacted by sea level rise hazards, but will be increasingly exposed to erosion and flood over time, with over four miles of roadway exposed by 4.9 feet of sea level rise. Increasing flood and erosion impacts to coastal trails and coastal access infrastructure like parking lots and restrooms will reduce public coastal access in the future. All the projected sea level rise could negatively impact communities if no adaptation measures are taken.

In response to the findings of the vulnerability assessment, the adaptation portion of the report provides an overview of adaptation measures that may be appropriate for the South Coast, as well as guidance for planning and implementing adaptation pathways in an equitable and community-oriented way. Government, communities, and other stakeholders may use this information as a reference document as they pursue site-specific adaptation measures. However, it is important to understand the limitations of this document.

All coastal hazard data used in this assessment are based on models which attempt to predict what will happen in the future using best available science, but which are unlikely to completely capture exact future conditions. For example, flood models used in this assessment do not account for riverine or stormwater flooding, nor do they account for how development changes or future adaptation measures may change flood extents. Likewise, erosion models do not consider local geologic conditions, which greatly influence erosion patterns. Because models provide only a best guess of what may happen in the future, this vulnerability assessment is meant to be used to help stakeholders understand areas that are susceptible to sea level rise impacts, prioritize areas for adaptation, and guide future site-specific assessments that can direct specific adaptation measures.

It is hoped that this vulnerability assessment and adaptation report will provide governments and South Coast communities with a valuable tool for pursuing responsive, evidence-based, and community-vetted adaptation solutions that reduce risk for all South Coast community members.

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## DISCLAIMER

This report is part of an ongoing process to understand and prepare for coastal hazards. The maps and associated analyses are intended as planning tools to illustrate projected hazard exposure to existing infrastructure, land use types, and other resources associated with a variety of future sea level rise and coastal hazard scenarios. The assessment has been conducted on a regional scale, and this level of precision should serve as a screening tool to identify areas that may require more detailed site-specific analysis. This report is advisory and not a regulatory or legal standard of review for actions that the County of San Mateo or any other regulatory agencies may take.

There are inherent uncertainties associated with modeling and projecting future hazards and their potential impacts. Maps produced for this report are based on model outputs and cannot account for all complex and dynamic ocean, terrestrial, and anthropogenic processes or for future adaptation approaches such as shoreline protection upgrades. In addition, these maps do not include projected flooding from riverine rainfall-runoff events or flooding precipitated by land use change or other factors. Flooding due to sea level rise and the various coastal hazards is possible in areas outside of those projected, and even the best projections cannot guarantee the safety of an individual or structure. The contributors and sponsors of this product do not assume liability for any injury, death, property damage, or other effects of flooding.

Although every effort was made to review all resource sector and infrastructure data received from other sources, neither the County of San Mateo nor its consultant, Integral Consulting Inc., can verify the completeness of all spatial data. For this reason, we do not accept responsibility for any errors, omissions, or positional inaccuracies. Users of the data displayed in the maps are strongly cautioned to verify all information.

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## PROJECT OVERVIEW

Rising sea levels mean that the South Coast of San Mateo County, which extends from southern Half Moon Bay down to the south county line with Santa Cruz, will experience considerable challenges from the increased extent of storm wave flooding and from eroding beaches and cliffs (OPC, 2018). As sea levels rise in the future, threats from coastal hazards will create a multitude of impacts on communities, economies, and natural habitats in the region unless adaptation measures are put into place.

This report documents the projected extents of coastal hazards, projected impacts to assets, and economic impacts to different resource sectors, then begins to identify feasible adaptation strategies and approaches that may reduce sea level rise risk over time. Key findings are described in Table 1-2.

### Background

In 2015, under the leadership of Supervisor Dave Pine and Supervisor Don Horsley, the County of San Mateo Office of Sustainability (OOS) launched the SeaChange SMC Initiative with the purpose of increasing the resilience of the County's economy, environment, and communities through collaborative planning and projects. In 2018, the County finalized a Sea Level Rise Vulnerability Assessment for the northern open coast and the bayside portion of the county in coordination with cities, agencies, businesses, community groups, and others. However, due to a lack of suitable coastal hazard modeling data, the southern open coast of the county, known as the South Coast, was not included. This assessment focuses on the South Coast region of the county, from the southern end of Half Moon Bay down to Año Nuevo State Park, filling the data gap of the original assessment.

### Vulnerability Assessment Goals

This assessment contributes to resilience planning in the South Coast area through achieving the following goals:

- Map assets and future risk scenarios
- Identify exposed assets
- Identify feasible adaptation strategies
- Build community awareness
- Facilitate collaboration

The results of the report are intended to help county and city officials, community-based organizations, community members, and other stakeholders understand what is at risk, prioritize areas for adaptation actions, understand the tradeoffs between different strategies, and present a roadmap for future actions.



## Outreach and Engagement

To maintain an inclusive stakeholder process, input from numerous community groups, government agencies and departments, and community members helped guide the assessment. OOS, along with project consultants Integral Consulting Inc. and the San Mateo Resource Conservation District, conducted the following outreach and engagement activities:

- Focus Group 1—County of San Mateo Departments (April 2021)
- Focus Group 2—Caltrans and State Parks (May 2021)
- Interviews with Local Growers and Agricultural Landowners (April–May 2021)
- Pescadero Roundtable (May 2021)
- Outreach Video Launched (June 2021)
- Community Meeting 1 (June 2021)
- Sustainable Pescadero (August 2021)
- Coastside Land Trust Educational Web Series (September 2021)
- Meeting with the City of Half Moon Bay (September 2021)
- Meeting with Caltrans (October 2021)
- Community Meeting 2 (March 2022)

## Vulnerability Assessment

This study, focused on the South Coast of San Mateo County bordering the Pacific Ocean, completes the sea level rise vulnerability assessment for all of San Mateo County and provides detailed information on the projected exposures of different community and resource sectors to coastal hazards and associated economic impacts. The study area includes all areas between southern Half Moon Bay and the south county line that are exposed to sea level rise and coastal hazards with 4.9 feet of sea level rise and a 1% annual chance storm.

This study used the best available scientific projections of coastal hazards and sea level rise along with the most spatially accurate locations of important land uses, development, and key infrastructure to identify what could potentially be impacted now and in the future. The vulnerability assessment carefully considers modeled projections of existing and future coastal extents of cliff and dune erosion, storm wave impacts, tidal flooding, and estuary-related flooding for four different sea level rise scenarios: a baseline scenario without sea level rise and a 1% annual chance storm, 0.8 feet of sea level rise and a 1% annual chance storm, 1.6 feet and a 1% annual chance storm, and 4.9 feet and a 1% annual chance storm. The latter three scenarios represent the short-term (~year 2030), mid-term (~year 2050), and long-term (~year 2100), respectively.

It should be noted that model outputs cannot account for all complex and dynamic ocean, terrestrial, and anthropogenic processes or for future adaptation approaches such as shoreline protection upgrades, and that this model does not account for projected flooding from riverine rainfall-runoff events or flooding precipitated by land use change or other factors. Because there are inherent uncertainties associated with modeling and projecting future hazards and their potential impacts, this hazard data and resulting asset exposure analyses are not intended to be

used for site-specific decisions, but rather to identify areas at risk of exposure that may require more detailed analyses.

The resource sectors considered in this vulnerability assessment include: Land Use and Structures; Agriculture, Roads and Parking; Parks, Recreation, and Coastal Access; and Significant Facilities.

Data for these resource sectors were provided primarily by the County and other publicly available sources.

The vulnerability assessment was based on a geospatial analysis that analyzed the exposure of each resource sector with each coastal hazard type over different sea level rise scenarios. Social, structural, and environmental sensitivities are discussed where they have been identified. Economic analyses were based on reported information from the County Assessor’s office and relevant reports from various county, state, and federal agencies that were publicly available. The project team verified findings through focus group engagement and targeted communication with land and business owners and managers.

Table 0-1. Feasibility of Adaptation Strategies

<b>Feasibility of Adaptation Strategies</b>		
<b>Strategy</b>	<b>Overall Regulatory Viability</b>	<b>Feasibility (Considering Cost, Benefits, and Regulatory Constraints)</b>
Revetments	<b>Yes</b>	<b>High</b>
Seawalls	<b>Yes</b>	<b>Low</b>
Soil Nail Tie-back Walls	<b>Yes</b>	<b>Low</b>
Horizontal Flood Control Levees	<b>Yes</b>	<b>Low</b>
Artificial Reefs	<b>No</b>	<b>No</b>
Groins (Sheet-Pile, Concrete, Rubble)	<b>No</b>	<b>No</b>
Offshore Breakwaters	<b>No</b>	<b>No</b>
Sand Nourishment	<b>No</b>	<b>Low</b>
Dune Restoration	<b>Yes</b>	<b>High</b>
Cobble Berms	<b>Yes</b>	<b>High</b>
Setbacks	<b>Yes</b>	<b>High</b>
Elevate	<b>Yes</b>	<b>High</b>
Realignment of State Route 1	<b>Yes</b>	<b>Medium</b>
Causeway	<b>Yes</b>	<b>Medium</b>

*Note: This table is distilled from Table 5-3 in the Adaptation Planning Section. Assumptions of a particular strategy’s regulatory viability and feasibility are based on local knowledge and professional opinion.*

## Adaptation Planning

The vulnerability assessment can help inform the development of an adaptation framework for the South Coast region that reduces hazard risks to local communities and visitors while continuing to support existing agricultural activities, providing new economic opportunities, and being socially acceptable to the community. Community engagement to date indicates a strong community preference for nature-based solutions that maintain access to the coast and transportation connectivity. The high interest and engagement of South Coast residents reiterates the importance of vetting any proposed adaptation solution with the community.

The adaptation section provides a summary of a wide range of potential adaptation strategies, considerations of secondary consequences, and a narrowed range of strategies that the study team has evaluated as most ecologically, financially, and regulatorily feasible, though site-specific studies will be necessary to assess feasibility and effectiveness of each strategy. Table 0-1 outlines some of the adaptation strategies that may be feasible for the South Coast. Considerations not included in Table 0-1 include how long each feasible strategy would remain effective in reducing risk, lead time to plan, design, permit, finance, and construct.

## Key Findings

The South Coast study area encompasses 2,288 acres of land. Within the study area are 1,970 parcel-owned acres and 123 primary structures, including 109 residences, as well as numerous significant community facilities including a fire station, a gas station, a hotel, and a lighthouse. There are 13 state, county, and city parks located in this area, as well as a multitude of public and private beaches that are popular destinations for locals and tourists alike.

The key findings in Tables 0-2 and 0-3 describe assets that will be exposed to hazards at different sea level rise horizons (0.0, 0.8, 1.6, and 4.9 feet of sea level rise with a 1% annual chance storm), which can be associated with current, near-, mid-, and long-term planning ranges, respectively. Readers should note that many assets are exposed to multiple hazards and may be impacted by multiple coastal hazards at one time.

Notable assets projected to be impacted by sea level rise-related hazards include State Route 1, which is a key access route for the region, and crucial for the local agricultural and tourism economies, the communities of Martin's Beach and Pescadero, oceanfront homes west of State Route 1, State Park and agricultural lands, and several significant facilities, including the CAL FIRE Station, Gazos Gas Station, and Pescadero County Corporation Yard.

Table 0-2. South Coast Vulnerability Snapshot

South Coast Vulnerability Snapshot		
What Is at Risk?	What Is Exposed by the Long-term Sea Level Rise Horizon?	Potential Impacts and Consequences
Sections of the State Route 1 Corridor	<ul style="list-style-type: none"> <li>• 4.5 miles of highway</li> </ul>	<ul style="list-style-type: none"> <li>• Disruptions in emergency service</li> <li>• Disruptions to the primary transportation network</li> <li>• Reroutes increase vehicle miles traveled</li> </ul>
Coastal Access and Recreation	<ul style="list-style-type: none"> <li>• Park and open space land</li> <li>• Trails</li> <li>• Coastal access locations</li> </ul>	<ul style="list-style-type: none"> <li>• Permanent loss of pocket beaches</li> <li>• Loss of coastal marsh habitats</li> <li>• Potential loss in intertidal habitat</li> <li>• Rerouting of trails</li> </ul>
Cultural Resources	<ul style="list-style-type: none"> <li>• Año Nuevo State Park</li> <li>• Pigeon Point Light Station</li> <li>• State Historic Park</li> </ul>	<ul style="list-style-type: none"> <li>• Potential loss of cultural heritage, maritime history, and areas of anthropological interest</li> </ul>
Residential Communities	Homes, in the communities of: <ul style="list-style-type: none"> <li>• Martin’s Beach</li> <li>• Pescadero</li> <li>• Cliffside areas west of Hwy 1 between Pescadero Point and Bean Hollow</li> </ul>	<ul style="list-style-type: none"> <li>• Estuarine flooding may make interior conditions unsuitable for habitation</li> <li>• Coastal erosion and storm wave impacts may damage homes</li> </ul>
Significant Facilities	Five facilities: <ul style="list-style-type: none"> <li>• Gazos Creek Alliance Gas Station</li> <li>• Pigeon Point Lighthouse</li> <li>• Pescadero CAL FIRE Station</li> <li>• Pescadero County Corporation Yard</li> <li>• Ritz-Carlton Hotel and Half Moon Bay Golf Links</li> </ul>	<ul style="list-style-type: none"> <li>• Disruptions in emergency service</li> <li>• Loss of culturally significant facilities</li> <li>• Loss in tax revenue</li> </ul>

### Key Areas of Concern and Trigger Points

The list below outlines some of the key areas in the South Coast that are vulnerable to sea level rise. Note, this analysis is for screening purposes only, and more site-specific analysis should be conducted.

#### Current Vulnerabilities

- Box culvert under State Route 1 at Bean Hollow Beach (also known as Arroyo de Los Frijoles Beach) poses a safety issue due to sand and debris buildup blocking the culvert.

- Flooding of Pescadero Creek and Butano Creek can lead to interrupted transportation service along Pescadero Creek Road and threaten the community of Pescadero. This flooding can also impact access for the Pescadero Corporation Yard and the CAL FIRE Station on Pescadero Creek Road.

***Near-Term Vulnerabilities, between 0-0.8 feet of sea level rise + 1% annual chance storm (Present to 2030)***

- Dune erosion through Pescadero Beach dunes is a threat to State Route 1 and will likely affect Pescadero Marsh North Pond habitat.
- Cultural materials and heritage at Franklin Point and Año Nuevo Point are threatened by dune erosion. Potential losses include cultural areas and materials with importance to Native Peoples and the burial grounds of shipwrecked sailors.
- Coastal wave flooding is a threat to the front row of homes at the community of Martin's Beach.
- The Pigeon Point Light Station and Interpretive Center could become threatened by cliff erosion. Note that site-specific analysis suggests the Light Station is likely out of the hazard zone in this horizon.

***Mid-Term Vulnerabilities, between 0.8-1.6 feet of sea level rise + 1% annual chance storm (2030 to 2060)***

- Coastal wave flooding and coastal erosion could threaten the entire community of Martin's Beach.
- Cliff erosion between Bean Hollow and Pescadero Bridge is projected to threaten State Route 1.
- Cliff erosion between the county line and Elliot Creek could threaten State Route 1.
- Loss or interruptions to State Route 1 could pose a significant access and business operations issue for both locals and tourists. This would have substantial impacts on emergency service access, as well as impacts to the shipping of agricultural produce to distribution centers in Monterey County.
- The Pigeon Point Light Station Hostel buildings could become threatened by cliff erosion, though more site-specific analysis is needed to fully understand when impacts are likely to occur.

***Long-Term Vulnerabilities, between 1.6-4.9 feet of sea level rise + 1% annual chance storm (2060 to 2100+)***

- The Ritz-Carlton Hotel and Half Moon Bay Golf Links could be threatened by cliff erosion.

Table 0-3. A highlight of areas exposed to coastal hazards by level of sea level rise

A Highlight of Most Vulnerable Areas			Likelihood and Severity by Sea Level Rise Horizon			
Category	Hazard Exposure	Adaptive Capacity	Current	0.8 ft	1.6 ft	4.9 ft
<b>Communities</b>						
1) Martin’s Beach Community	Coastal Erosion, Storm Wave Flooding	MED	Yellow	Red	Dark Red	Dark Red
2) Cliffside Homes between Bolsa Point and Pescadero Pt	Coastal Erosion, Storm Wave Flooding	LOW	Green	Yellow	Red	Dark Red
3) Pescadero—Vicinity of Water Lane	Estuary Flooding	MED	Yellow	Yellow	Yellow	Yellow
<b>Farms</b>						
4) Farms at Pescadero Creek Road and Water Lane	Estuary Flooding	HIGH	Yellow	Yellow	Yellow	Red
5) Northern Section Cliffside Farms and Ranches	Coastal Erosion	HIGH	Green	Yellow	Yellow	Yellow
6) Southern Section Cliffside Farms and Ranches	Coastal Erosion	HIGH	Green	Green	Yellow	Yellow
<b>Transportation</b>						
7) Pescadero Creek Road	Estuary Flooding	MED	Yellow	Yellow	Yellow	Yellow
8) State Route 1 at County Line	Cliff Erosion	LOW	Green	Yellow	Red	Dark Red
9) State Route 1 between Bean Hollow and Pescadero Point	Coastal Erosion, Storm Wave Flooding	MED	Yellow	Red	Dark Red	Dark Red
10) State Route 1 between Pescadero Point and Pescadero bridge	Cliff Erosion	MED	Green	Yellow	Red	Dark Red
11) State Route 1 at Pescadero Beach	Dune Erosion, Estuary Flooding, Storm Wave Flooding	LOW	Yellow	Red	Dark Red	Dark Red
12) State Route 1 between Pomponio State Beach and San Gregorio State Beach	Dune or Cliff Erosion, Storm Wave Flooding	MED	Yellow	Red	Dark Red	Dark Red

A Highlight of Most Vulnerable Areas			Likelihood and Severity by Sea Level Rise Horizon			
Category	Hazard Exposure	Adaptive Capacity	Current	0.8 ft	1.6 ft	4.9 ft
13) State Route 1 at Gazos Creek State Beach	Dune Erosion, Storm Wave Flooding	MED	Green	Green	Green	Yellow
14) State Park Formal Parking Areas	Coastal Erosion, Storm Wave Flooding	HIGH	Yellow	Red	Red	Red
<b>Parks and Recreation</b>						
15) Gazos Creek State Beach	Coastal Erosion, Storm Wave Flooding	MED	Green	Green	Yellow	Red
16) Bean Hollow State Beach at Arroyo de los Frijoles	Coastal Erosion, Storm Wave Flooding	LOW	Yellow	Yellow	Red	Red
17) Bean Hollow State Beach at Pebble Beach	Coastal Erosion, Storm Wave Flooding	LOW	Yellow	Yellow	Red	Red
18) Pescadero State Beach	Coastal Erosion, Storm Wave Flooding	HIGH	Green	Green	Yellow	Red
<b>Significant Facilities</b>						
19) CAL FIRE San Mateo Unit	Estuary Flooding	MED	Yellow	Yellow	Yellow	Yellow
20) Pescadero Corporation Yard	Estuary Flooding	MED	Green	Green	Green	Yellow
21) Ritz-Carlton Half Moon Bay and Half Moon Bay Golf Links	Cliff Erosion	Hotel: LOW Golf Course: HIGH	Green	Yellow	Red	Red
22) Gazos Creek Alliance Gas Station	Coastal Erosion, Storm Wave Flooding	MED	Green	Yellow	Red	Red
<b>Cultural and Historical</b>						
23) Cultural Areas and Materials at Año Nuevo State Park	Coastal Erosion, Storm Wave Flooding	VERY LOW	Red	Red	Red	Red
24) Pigeon Point Light Station	Cliff Erosion	LOW – MED	Green	Yellow	Red	Red

A Highlight of Most Vulnerable Areas			Likelihood and Severity by Sea Level Rise Horizon			
Category	Hazard Exposure	Adaptive Capacity	Current	0.8 ft	1.6 ft	4.9 ft
<b>Habitat</b>						
25) Año Nuevo Seal Haul-Out Areas	Coastal Erosion, Storm Wave Flooding	HIGH	Green	Yellow	Red	Dark Red
26) North Pond	Coastal Erosion, Storm Wave Flooding, Estuary Flooding	LOW - MED	Green	Green	Yellow	Dark Red
27) Pescadero Marsh	Coastal Erosion, Storm Wave Flooding, Estuary Flooding	MED - HIGH	Green	Green	Yellow	Dark Red

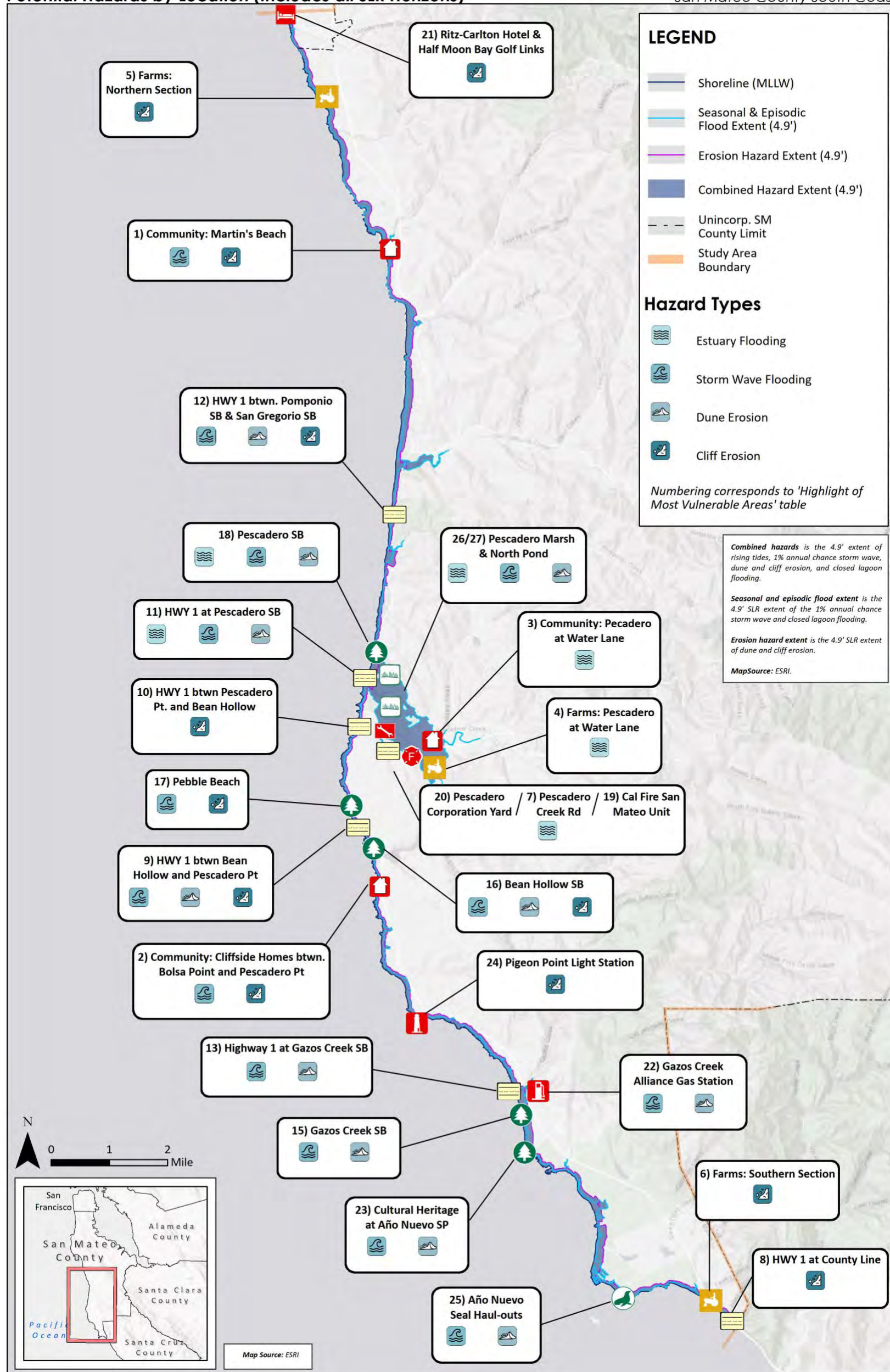
**Green**—Minimal to no projected impacts due to sea level rise.  
**Yellow**—The chance for disruptions or damages is moderate.  
**Red**—The chance for disruptions or damages is significant.  
**Dark Red**—The chance for disruptions or damages is very high.



# San Mateo South Coast: Vulnerability Highlights

Potential Hazards by Location (Includes all SLR Horizons)

Section:  
San Mateo County South Coast



Map 1. A highlight of areas most exposed to sea level rise-related hazards, according to this study's screening

## Data Gaps and Recommended Next Steps

### Data Gaps

The South Coast is dependent on water for its agricultural sector and for general development. Geospatial data on the surface water reservoirs and their respective water rights is currently lacking.

Sea level rise impacts on potable water supply are an ongoing concern for many residents of Pescadero, though it is uncertain exactly how saltwater intrusion to groundwater may occur with rising seas. Because of limited access to data on water supply (largely wells), wastewater (largely septic), and groundwater modeling data, these assets could not be evaluated. The County is aware that this issue needs to be studied.

Reporting for the analysis is largely quantitative, based on numbers, area, and value of features affected. Many of these features and areas may hold significant cultural and social value, and wherever possible, this was described qualitatively.

### Recommendations for Next Steps

Chapter 7 provides an expanded overview of the next four steps that the County should take to best act upon the findings of this assessment. In addition, step 5 outlines several areas for additional research or analysis that the County or another stakeholder may carry out in the future to support adaptation work.

Step 1. Develop Project Concepts and Adaptation Plans

Step 2. Acquire Funding to Implement Projects

Step 3. Continue Community Engagement, Outreach and Education around Sea Level Rise

Step 4. Update Policies to Facilitate Adaptation and Resilience

Step 5. Conduct or Support Additional Studies and Research