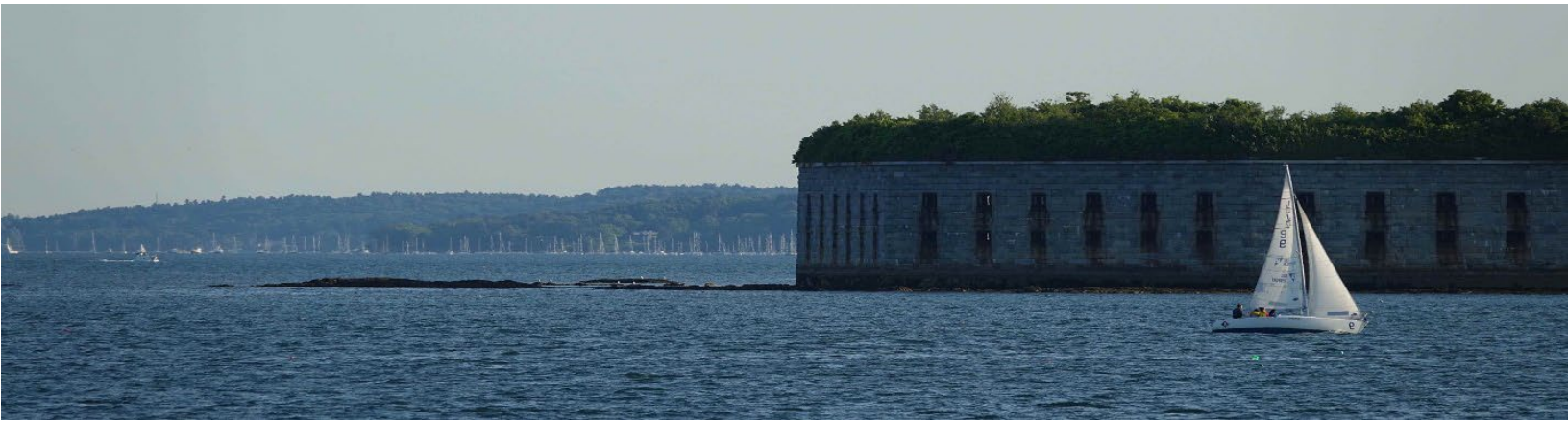
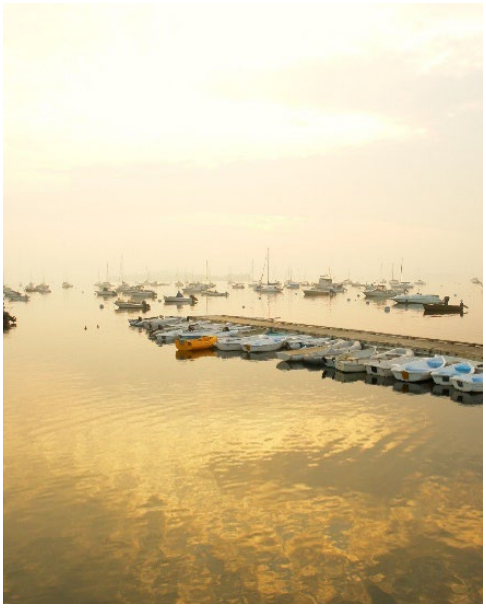
Climate Ready Casco Bay

Preparing Maine's Casco Bay communities for the impacts of climate change

April 2025





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About the Project

Casco Bay is an integral part of Maine's iconic coastline, and the economic engine for our region, offering an ecologically diverse geography for Mainers, tourists, and a variety of wildlife to enjoy. Protecting Casco Bay is both an important and time sensitive effort. The rate of sea level rise has nearly doubled in the past 30 years, and the Gulf of Maine is warming faster than 99% of the world's oceans. Significant climate mitigation and adaptation strategies are needed now as flooding and erosion impact our infrastructure, communities, and ecosystems.

Climate Ready Casco Bay engages community members who live, work, and play in Casco Bay, whose livelihoods are linked to the well-being of our coastline and will be greatly impacted by climate hazards.

This Climate Ready Casco Bay plan and the companion online portal was developed as part of a **National Fish and Wildlife Foundation** funded project to develop nature-based coastal resilience solutions across eleven Casco Bay communities. The project developed a comprehensive, regional assessment of resilience in the face of worsening climate risks across eleven communities in Casco Bay, Maine. The team used existing data to advance climate assessment efforts, identify and fill data gaps, seek public input, and develop nature-based concepts and strategies for protecting the region's coastline. It created an online platform that will serve as a resource and knowledge sharing site for future regional efforts.

The project provides a comprehensive, regional approach to climate resilience in preparation for climate risk and includes the work of multiple organizations and municipalities working on this issue in Casco Bay. This project — coordinated by **Greater Portland Council of Governments** and the **Gulf of Maine Research Institute** -- collaborated with community volunteers, municipal staff, elected officials and community leaders.

Map of communities participating in Climate Ready Casco Bay

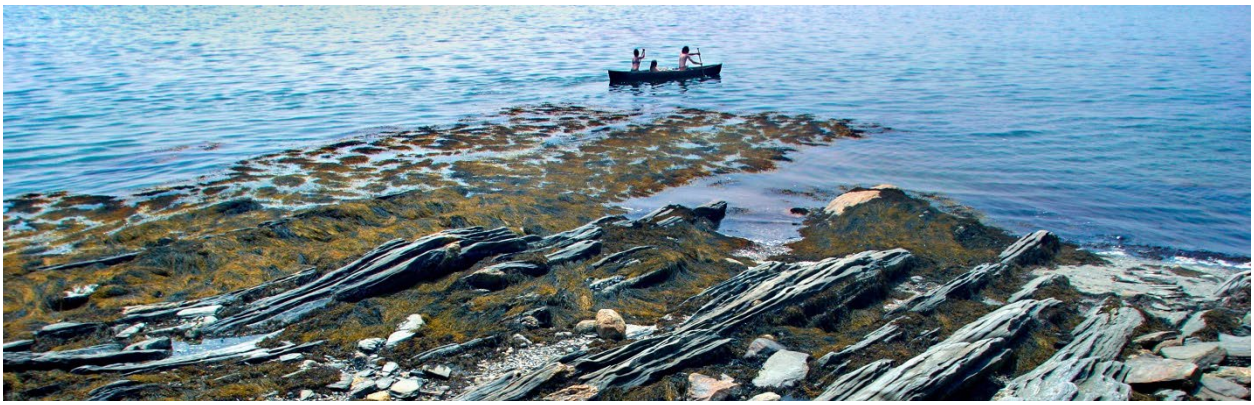


Photo credit: GPCOG

The project achieved the following outcomes:

- Increased municipal knowledge, capacity, and plans to protect coastal habitats and infrastructure from climate impacts. Multiple participating towns have advanced Climate Action Plans, Comprehensive Plans and other documents that identify hazards and actions for building resilience.
- Identification of high priority coastal areas for future resilience project, including 14 sites across the 11 communities.
- A regional resilience plan identifying community and ecosystem resilience needs, and actions and best practices to mitigate flood risks.
- An online portal supplementing the resilience plan, sharing data profiles, and creating an ongoing hub where information on project implementation, lessons learned, and developing resources can be shared.

The 11 participating communities are: Brunswick, Freeport, Yarmouth, Cumberland, Falmouth, Portland, South Portland, Cape Elizabeth, Scarborough, Chebeague Island and Long Island.

An advisory committee included partners from:

- Casco Bay Estuary Partnership
- Cumberland County Emergency Management
- Friends of Casco Bay
- Island Institute
- Maine Coast Heritage Trust
- Maine Geological Survey
- The Nature Conservancy
- National Association of Wetland Managers
- Southern Maine Planning and Development Commission

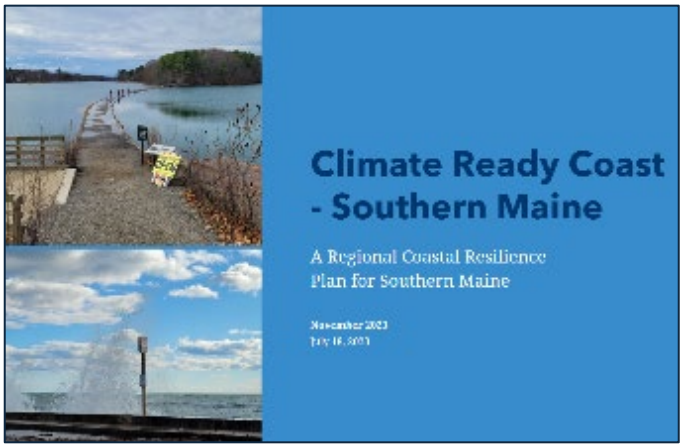
Building upon regional initiatives

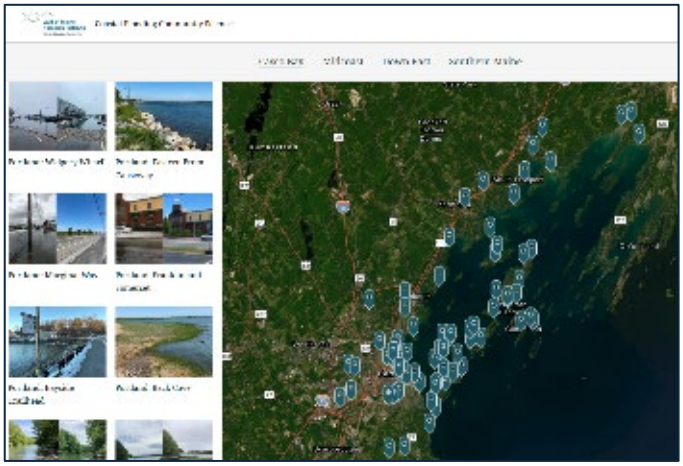
This project is not alone in working to support communities in building climate resilience. Many other organizations across the region and state are working together to ensure we can adapt to the changing climate.

In 2023, Southern Maine Planning and Development Commission (SMPDC) completed **Climate Ready Coast** – a similar project that advanced coastal adaptation and resilience strategies for ten municipalities in the southern Maine region. Climate Ready Casco Bay is using Climate Ready Coast as a guide and adding onto this project. The goal is for Climate Ready Casco Bay to expand many of their efforts to address the unique characteristics in the Casco Bay region. The Town of Scarborough also participated in Climate Ready Coast. Therefore, we pointed to information already provided by Climate Ready Coast rather than duplicate efforts.

This project was also guided by Gulf of Maine Research Institute's **Coastal Flooding Community Science Program**. The program provides guidance on how to contribute observations that will help pinpoint high-risk flooding areas in your community. Community members can identify the weather and water level conditions during flooding events, and describe how the flood impacts their community. All 11 Casco Bay communities are part of this program.

Finally, the **Community Intertidal Data Portal** is a resource that was created by Tidal Bay Consulting, Viewshed, and the Greater Portland Council of Governments to make intertidal data and information more accessible, foster connections between communities with an interest in the intertidal, and promote a more nuanced understanding of issues within the nearshore environment of Casco Bay. Most of the data used in the data profiles and for site assessment came from the Intertidal Data Portal.





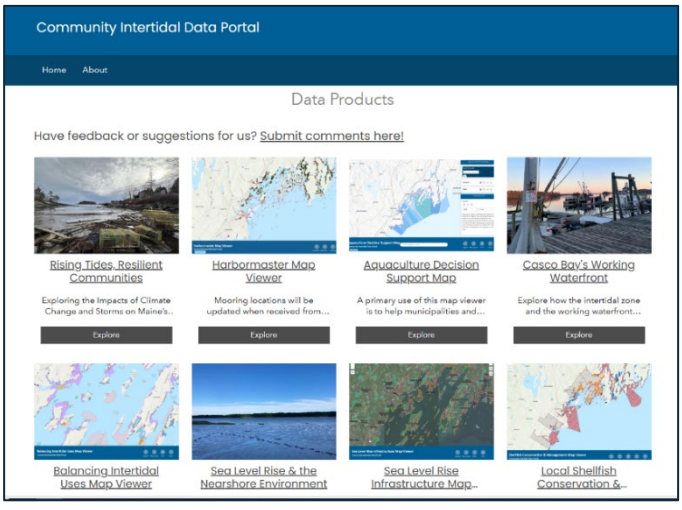


Photo credit: GPCOG

Workshops and Outreach

Gulf of Maine Research Institute (GMRI) led community engagement on the project and leveraged their "Planning Forward" workshops to engage stakeholders on long-term planning exercises that built capacity of municipal officials and local volunteers. GMRI enrolled each community in their Coastal Flooding Community Science program, which allows community members to support data collection and understand local flood risks. The monitoring sites identified by GMRI through this program were foundational to understanding regionally vulnerable sites.

GPCOG and GMRI held two "Planning Forward" workshops during the project with municipal staff and committee members designed to build knowledge about the at-risk locations and resources in the region, and the potential for nature-based solutions to mitigate impacts. Participants used scenario planning to envision a more sustainable future, and to facilitate dialog between committee members, municipal staff, and regional and state planning officials.

The project was highlighted in the *Portland Press Herald, News Center Maine*, and *Mainebiz*. The project team sent out four newsletters over the course of the project updating communities on the progress and process.

GPCOG also presented this project at:

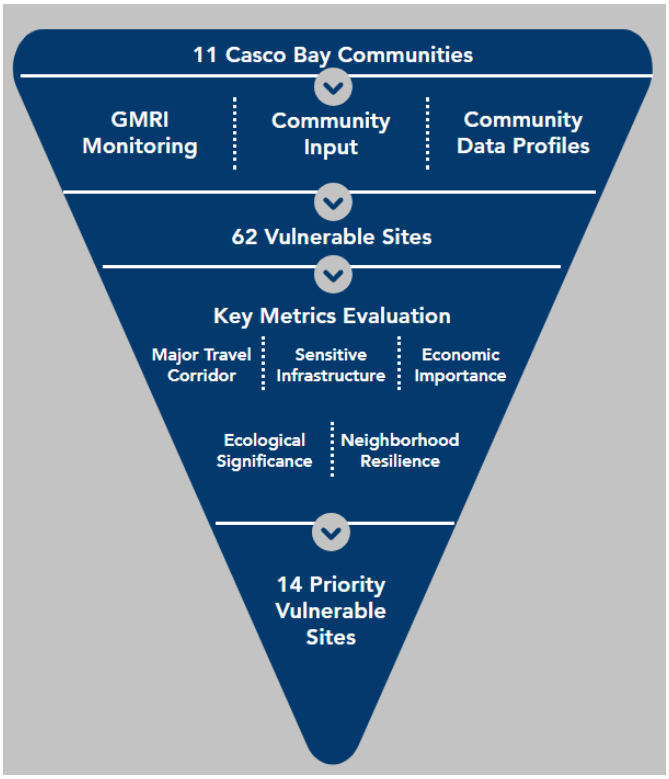
- Portland/South Portland Coffee and Climate – January 2023
- Prince Memorial Library – May 2024
- Piper Shores Retirement Community – November 2024
- National Coastal Resilience Fund Webinar – August 2024.
- GPCOG Regional Sustainability Roundtable – March 2025
- GPCOG Executive Committee—March 2023, November 2024, and January 2025

The final website contains links to these resources, including a recording of a presentation and example slides.

Regional Priorities

Across the **11 communities**, the project team used information developed from **(1) Gulf of Maine Research Institute's monitoring sites, (2) GIS based data profiles compiled for each community, and (3) staff input** through surveys, focus group discussions, and engagement workshops to identify an **initial database of 62 sites** across the region which are vulnerable to climate change.

Data profiles included sea level rise and flood impacts, erosion mapping, habitat identification, infrastructure, and existing social vulnerabilities to support identification of vulnerable hot spots.

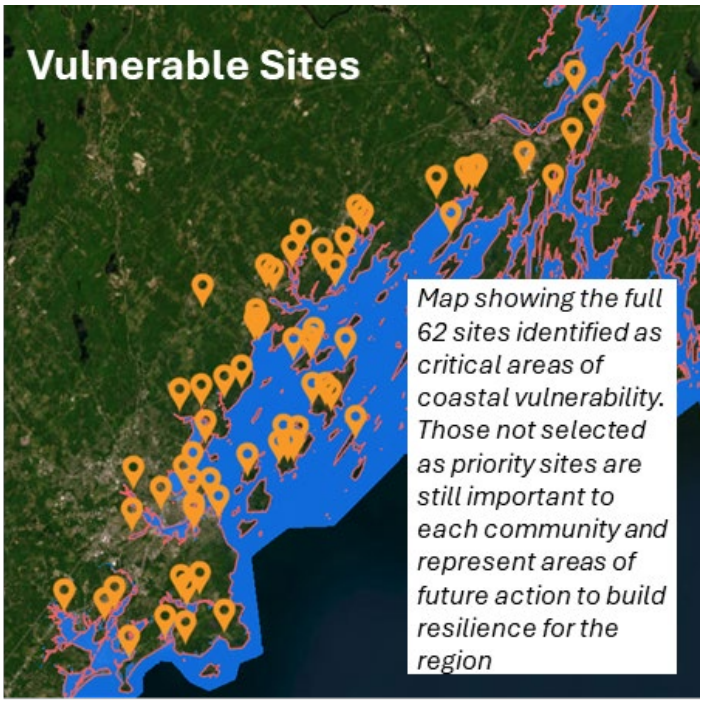


From the initial sites, the team evaluated the regional significance for each site using the following **key metrics**:

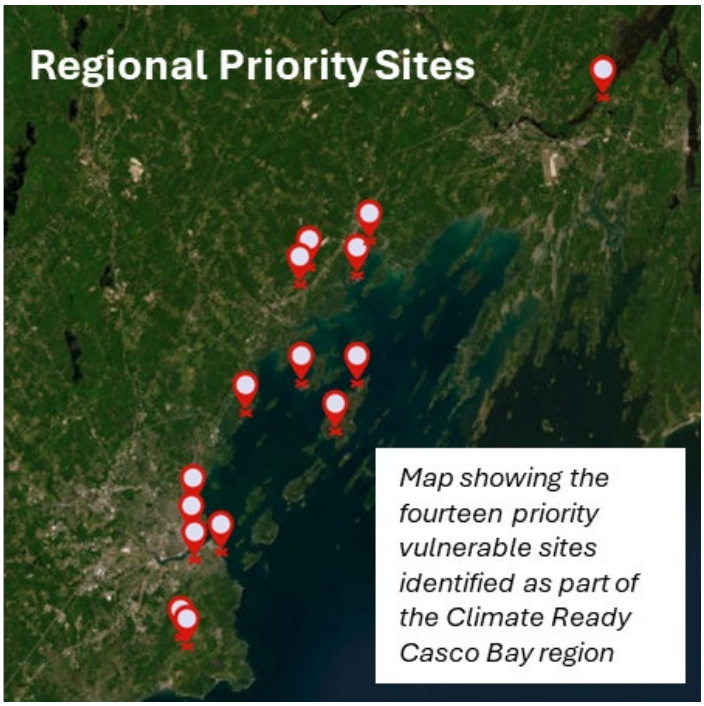
- Major travel corridor (e.g. Route 1, island access routes)
- Critical public infrastructure (e.g. wastewater treatment)
- Economic importance (e.g. working waterfront)
- Ecological significance (e.g. marsh, dunes)
- Neighborhood resilience (e.g. socially vulnerable populations)

Based on the evaluation, **14 priority vulnerable** sites were selected due to the potential for widespread negative impacts when the sites experience climate hazards. The website contains an interactive map along with site profile pages that details the reason for selection and potential adaptation strategies. See page 9 for a table highlighting these sites and links to the individual profile sheets.

Photo credit: GPCOG



Vulnerable sites interactive online map



Regional Priority Sites interactive online map

Spotlight: Data profiles

The data profiles are presented as a StoryMap, which is a web-based scrolling narrative that includes maps, data, and community-specific information. Each data profile is divided into 7 sections to present interactive maps and data which help assess the community's coastal vulnerabilities. The first five sections contain resource-specific data, such as flood risk, habitat changes, or infrastructure. The last two sections combine all the data to visualize overlapping impacts. The interactive maps allow users to navigate the data and explore each layer on their own, while narrative text explains the key takeaways and highlights from the data. The project team presented the profiles to each of the communities and used these, along with feedback provided by municipal staff, to establish vulnerable sites and develop key focus areas.

Full List of Vulnerable Sites across Casco Bay identified through the project. The 14 priority sites are highlighted in blue and include links to their detailed profile sheet. The priority site data profile sheets are available in **Appendix A**. Through SMPDC's Climate Ready Coast, several sites in Scarborough were selected as vulnerable hot spots. These sites are indicated with an asterisk (*). More information on these sites can be found on the Climate Ready Coast project page.

Priority Site location	Municipality	Climate Hazard	Vulnerability	Key Metrics for Evaluation					Critical Facility
				Travel Corridor	Sensitive Infrastructure	Economically Important	Ecological Significant	Neighborhood Resilience	
Brunswick Executive Airport	Brunswick	Flooding	Ecosystem: Salt Marsh Sparrow habitat Infrastructure: Culverts	x		x	x		Yes
Mere Point	Brunswick	Erosion, Flooding	Infrastructure: Roads and working waterfront Ecosystems: Dunes, bluffs, habitat	x		x	x		
Thomas Point Beach	Brunswick	Erosion	Ecosystem: Dunes and habitat People: Recreation area			x	x		
Bath Road	Brunswick	Flooding	Ecosystem: Tidal Marsh Infrastructure: Bridge, roads, Sunny Village culvert/dam replacement	x	x		x		
Bunganuc Coastal Bluffs	Brunswick	Erosion	Ecosystem: Habitat				x		
Gamble marsh	Brunswick	Erosion, Flooding	Ecosystem: Tidal Marsh				x		
Rossmore Road	Brunswick	Flooding	Infrastructure: Roads, culvert	x	x				
Wharton Point	Brunswick	Flooding	Infrastructure: Landing, boat launch		x	x			
Buttermilk Cove and Lower Coombs Island	Brunswick	Flooding	Ecosystem: Fish passage Infrastructure: Culverts		x		x		
Bay Bridge Estates and neighborhoods	Brunswick	Riverine Flooding	Ecosystem: Tidal marsh, habitat connectivity, fish passage, wetlands Infrastructure: Bridge, roads infrastructure, People: Socially vulnerable populations, open space, park	x	x		x	x	
Crescent Beach and Kettle Cove	Cape Elizabeth	Erosion, Flooding	Ecosystem: Habitat, People: Recreation, tourism			x	x	x	
Japanese Pond Road	Cape Elizabeth	Flooding	Ecosystem: Habitat Infrastructure: Roads	x	x		x		
Spurwink Ave over Spurwink River	Cape Elizabeth	Flooding, Erosion	Infrastructure: Homes, roads Ecosystem: Habitat and marsh migration	x	x		x		

Priority Site location	Municipality	Climate Hazard	Vulnerability	Key Metrics for Evaluation					Critical Facility
				Travel Corridor	Sensitive Infrastructure	Economically Important	Ecological Significant	Neighborhood Resilience	
Sawyer Road	Cape Elizabeth/ Scarborough	Flooding, Erosion	Infrastructure: Roads, homes Ecosystem: Marsh, habitat	x	x		x		
The Hook	Chebeague Island	Erosion	Infrastructure: Roads Ecosystem: Habitat	x			x		
Colman Cove	Chebeague Island	Flooding, Erosion	Infrastructure: Working waterfront, buildings, roads, riprap defenses	x	x	x		x	
South Shore Drive	Chebeague Island	Flooding, Erosion	Infrastructure: Roads	x					
Stone Wharf Landing and Road	Chebeague Island	Flooding	Infrastructure: Working waterfront, roads	x		x		x	Yes
Inland culverts	Cumberland	Flooding	Infrastructure: Roads, service disruption	x	x				
Broad Cove	Cumberland	Flooding, Erosion	Ecosystem: Dunes, bluffs Infrastructure: Riprap and coastal armoring People: Recreation			x	x	x	
Foreside Road near Falmouth boarder	Cumberland	Flooding, Erosion	Infrastructure: Private infrastructure, homes, riprap and coastal armoring		x				
Eelgrass habitat	Cumberland	Warming Waters	Ecosystem: Habitat				x		
Town Landing	Falmouth	Flooding	Infrastructure: Working waterfront, roads, parking	x		x		x	Yes
Mackworth Island bridge and Route 1 bridge	Falmouth	Flooding	Infrastructure: Bridge and roads, neighborhoods, service disruption, riprap	x	x				
Presumpscot Outlet	Falmouth	Flooding, Erosion	Ecosystem: Marsh, habitat Infrastructure: Homes		x		x		
Foreside Road	Falmouth	Flooding, Erosion	Infrastructure: Waste water infrastructure, neighborhoods, roads	x	x				
Allen Ave extension	Falmouth	Flooding	Infrastructure: Roads, service disruption, buildings	x	x				
Bartol Island Road	Freeport	Flooding, Erosion	Infrastructure: Riprap, roads	x					
Town Wharf - South Freeport	Freeport	Flooding	Infrastructure: Marina, working waterfront, road, parking, homes, service access People: Recreation	x	x	x		x	Yes

Priority Site location	Municipality	Climate Hazard	Vulnerability	Key Metrics for Evaluation					Critical Facility
				Travel Corridor	Sensitive Infrastructure	Economically Important	Ecological Significant	Neighborhood Resilience	
Various at-risk culverts	Freeport	Flooding	Infrastructure: roads, homes, People: Service access	x	x	x		x	
Winslow Park	Freeport	Flooding	Ecosystem: Tidal marsh People: Recreation and tourism			x	x	x	
Porter's Landing and boat launch	Freeport	Flooding	Infrastructure: Roads, working waterfront, homes Ecosystem: Tidal marsh People: Recreation	x		x	x	x	Yes
Fowler Beach	Long Island	Erosion	Infrastructure: Roads Ecosystem: Dunes, habitat	x			x		
Dam on Fern Ave	Long Island	Flooding	Infrastructure: roads, dam	x	x				
Town Landing	Long Island	Flooding	Infrastructure: Roads, working waterfront, riprap	x		x			
Fern Ave, Beach Avenue, and Jerry Point Road,	Long Island	Flooding, Erosion	Infrastructure: Roads, homes	x					
South Beach	Long Island	Flooding	People: Isolation in storms					x	
Island coastal risks	Portland	erosion	Infrastructure: Ferry infrastructure, roads, buildings Ecosystem: Dunes, Bluffs	x		x	x		
Bayside neighborhood	Portland	Flooding	Infrastructure: Buildings, service disruption, infrastructure Ecosystem: Habitat	x	x	x	x		
Water Treatment Plant and I-295	Portland	Flooding	Infrastructure: Essential infrastructure, service disruption, roads, combined wastewater overflow	x	x	x			Yes
Commercial Street Wharves	Portland	Flooding	Infrastructure: Working waterfront infrastructure. roads, parking, service disruption	x	x	x			Yes
West End	Portland	Flooding	Infrastructure: Mercy Hospital		x	x			Yes
Casco Bay Islands Docks	Portland	Flooding	Infrastructure: Working waterfront, People: Recreation			x		x	yes

Priority Site location	Municipality	Climate Hazard	Vulnerability	Key Metrics for Evaluation					Critical Facility
				Travel Corridor	Sensitive Infrastructure	Economically Important	Ecological Significant	Neighborhood Resilience	
Stroudwater and Capisic Street Dams	Portland	Flooding	Infrastructure: Buildings, service disruption, culverts, dams Ecosystem: Habitat		x		x		
Route 77 Bridge over Spurwink Salt Marsh*	Scarborough	Flooding	Infrastructure: Road, access to services Ecosystem: Habitat, marsh migration	x	x		x		
Higgins Beach*	Scarborough	Flooding	Infrastructure: Road, buildings People: Recreation, tourism	x	x	x		x	
Prouts Neck - Black Point Road*	Scarborough	Flooding	Infrastructure: Roads, buildings Ecosystem: Habitat People: Recreation	x	x	x	x	x	
Nonesuch River - Black Point Road*	Scarborough	Flooding	Infrastructure: Roads, access to services, buildings Ecosystem: Marsh migration	x	x		x		
Route 1*	Scarborough	Flooding	Infrastructure: Roads, access to services	x	x				Yes
Winnocks Neck Road*	Scarborough	Flooding	Infrastructure: Roads, buildings, trail	x					
Willard Beach	South Portland	Flooding, Erosion	Infrastructure: Roads, wastewater infrastructure, homes Ecosystem: Dunes, habitat People: Recreation	x	x		x	x	
Bug Light	South Portland	Flooding	Infrastructure: Roads, brownfield Ecosystem: Habitat People: Recreation, open space		x		x	x	Yes
Knightsville and Mill Creek	South Portland	Flooding	Infrastructure: Roads, service disruption, buildings People: Social vulnerable populations	x	x			X	
Trout Brook	South Portland	Flooding	Infrastructure: Culverts		x				
Clarks Pond and Long Creek	South Portland	Flooding	Infrastructure: Airport, roads, buildings	x	x				
Route 1 and I-295 along Yarmouth/Freeport border	Yarmouth/ Freeport	Flooding, Erosion	Ecosystem: Tidal marsh, Salt Marsh Sparrow habitat Infrastructure: Roads	x		x	x		

Priority Site location	Municipality	Climate Hazard	Vulnerability	Key Metrics for Evaluation					Critical Facility
				Travel Corridor	Sensitive Infrastructure	Economically Important	Ecological Significant	Neighborhood Resilience	
Royal River dams - Bridge St and Elm St	Yarmouth	Flooding	Infrastructure: Roads, service disruption, dams Ecosystem: Fish habitat	x	x	x	x		Yes
Royal River outlet	Yarmouth	Flooding	Infrastructure: Buildings, culvert, working waterfront infrastructure Ecosystem: Tidal marsh	x	x	x		x	
Wyman Power Station	Yarmouth	Flooding	Infrastructure: Power, brownfield, roads Ecosystem: Eelgrass	x	x	x	x	x	Yes
Talbot Road to Little John Island	Yarmouth	Flooding	Infrastructure: Roads, service disruption	x	x				Yes
Chebeague Island Ferry terminal	Yarmouth	Flooding	Infrastructure: Ferry, working waterfront, roads, parking	x		x			Yes

Regional Topics

Community and stakeholder engagement identified three critical issues that need to be addressed by multiple communities: managing septic systems, addressing coastal bluff erosion, and preserving working waterfronts. The regional nature of the issues requires coordination across municipal borders.

While these issues were outside of the scope of this project, joint action to address them is essential to building resilience in the region. For some areas, there are nature-based solutions that could be deployed to build resilience to these regional risks, others need a mix of policy and gray infrastructure, or in other cases moving development away from the coastline may need to be considered. Detailed pages on each of these topics are included in **Appendix B**.

Photo credit: GPCOG

Septic Systems

Many homes in close proximity to Casco Bay rely on private septic systems to manage wastewater. Proper management of these systems is necessary to protect water quality and marine habitats. However, rising sea levels, increased flooding, and nutrient pollution can threaten the effectiveness of these systems and lead to contamination of nearby waters.

- **Climate Hazards:** Sea level rise, warming temperatures, and heavy precipitation cause these systems to become less effective.
- **Impacts:** Declining water quality impacts aquatic life and public health. In addition, the closure of shellfish areas due to pollution harms the local economy.
- **Strategies:** Communities can site new septic systems using climate projections and ensure consistent maintenance and monitoring of existing systems and fund upgrades where possible.

Coastal Bluff Erosion

Coastal bluffs in the region face accelerated erosion from wave action, storms, and rising sea levels, threatening critical infrastructure and property values. These erosion patterns disrupt natural sediment dynamics essential for maintaining beaches and marshes, and shellfish habitat, potentially destabilizing the region's coastal ecosystems. The economic ramifications of bluff vulnerability extend beyond direct property damage, impacting tourism and recreation.

- **Climate Hazards:** Sea level rise and frequent and intense storms accelerate erosion of coastal bluffs. More frequent freeze-thaw cycles and increased rainfall can further destabilize bluffs and increase the risk of landslides.
- **Impacts:** Coastal bluff erosion threatens homes, roads, bridges, utilities, and sewer systems, requiring costly repairs or relocations. Bluff erosion also destabilizes working waterfronts, disrupts navigation, and increases the need for costly dredging.
- **Strategies:** Updated coastal bluff data is needed to understand the full extent of risk. Monitoring vulnerable areas and implementing nature-based control measures can help reduce risk. Managing the coastline as a whole is key and requires understanding the implications of rip rap and other hard infrastructure on nearby sites.

Photo credit: GPCOG

Working Waterfronts

Working waterfronts serve as vital economic and cultural resources and are uniquely exposed to climate impacts. Maine's working waterfronts provide irreplaceable access points for multiple industries from commercial fishing and aquaculture to marine transport and tourism. These access points feature concentrated infrastructure (wharves, processing facilities, fuel stations) in the exact coastal locations most susceptible to sea level rise, storms, and other climate threats.

- **Climate Hazards:** Rising seas threaten to submerge piers; frequent and intense storms damage vessels, gear, and facilities; warming water temperatures disrupt marine ecosystems and create conditions for harmful algal blooms and invasive species.
- **Impacts:** Damaged infrastructure increases costs to Maine's fishing communities. Business disruptions threaten jobs, incomes, and the economic stability of many communities.
- **Strategies:** Communities and businesses can adapt infrastructure and operations to get out of harm's way or develop nature-based solutions to mitigate impacts. Another strategy is to develop emergency preparedness or transition plans to ensure working waterfronts are resilient to climate change.

Community Pages

The communities across Casco Bay have diverse coastline features and a range of vulnerable infrastructure, ecosystems, and populations. All these communities are at different stages of climate action planning. For each community, the project team created a community page that features:

1. **Priority focus areas** – identifies key risks the community could focus on to build resilience. This includes areas that might be at high risk of erosion or flooding, or where access is threatened during flooding events. The focus areas were developed through review and analysis of the data profiles in partnership with the Gulf of Maine Research Institute.
2. **Vulnerable sites** – list of all vulnerable sites identified through the project process. The table also describes the infrastructure, ecosystem, and demographic vulnerabilities of each site.
3. **Data Profile** –the profile presents technical data on coastal hazards and community resources, including habitat, infrastructure, and socio-economic conditions. Mapping of this data helps to visualize vulnerabilities and impacts. These profiles helped to identify the priorities and vulnerable sites listed above and are intended to help guide municipal staff in future planning.
4. **Projects** – list of current or completed projects within the community that are addressing coastal vulnerabilities and building resilience. This can include example nature-based solutions, planning and zoning work, or infrastructure projects.
5. **Resource List** – provides links to municipal departments, committees, and previous plans which address climate or coastal resilience.

Photo credit: GPCOG

Photo credit: GPCOG

Adaptation Strategies

Building coastal resilience requires multiple strategies to address coastal hazards and vulnerabilities. Each strategy has barriers and risks, including cost, effectiveness, permitting restrictions, and lifespan. Some options will be 'quick wins' which can be implemented in the near term, while others require significant planning across decades. The goal of this part of the project was to provide communities with a broad range of potential adaptation options to guide selection of the best strategy for the project area.

Adaptation strategies fall into four categories:

Protect
Protect land and buildings from erosion and flooding with new infrastructure. This approach generally prevents or minimizes inundation due to flooding.

Accommodate
Instead of preventing inundation, erosion, or flooding, coping strategies are developed that enable use of the land to coexist with repeated impacts.

Avoid
Prevent new development in areas most vulnerable to flooding or erosion. This is primarily a proactive and policy-driven approach.

Get Out of Harm's Way
Move people and structures in areas most vulnerable to flooding or erosion out of harm's way.

AND

Within each of these four categories, specific solutions can be selected based on a range of criteria including geography, scale, cost, and future maintenance. To implement these strategies, communities can use various approaches:

Nature-Based
Uses green or natural infrastructure to protect against climate hazards.

Hardscape
Uses materials such as stone, concrete, or asphalt to create structures or barriers to protect against climate hazards.

Policy/Program
Sets standards for adaptation measures.

Nature-Based Solutions in Action

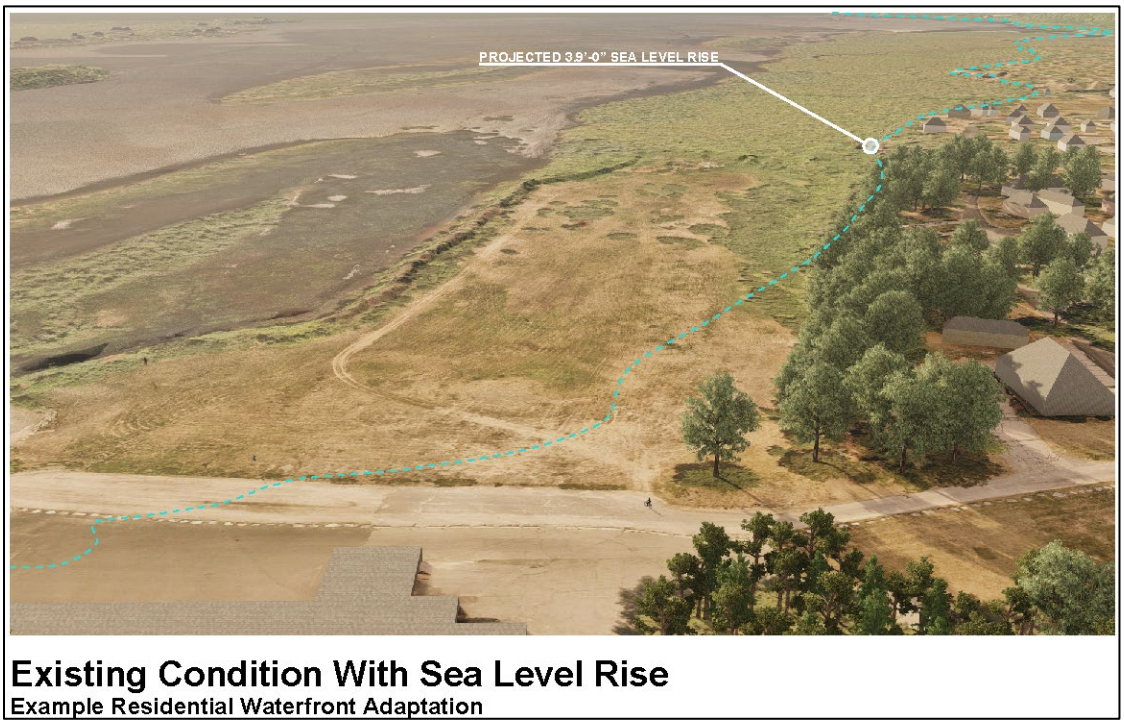
SMPDC, as part of their Climate Ready Coast project, with support from consultant SWCA, developed an extensive matrix of adaptation and resilience strategies with explanations of type, limitations, permitting needs, and cost. This matrix provides a great overview of potential strategies municipalities can use, allowing decision-makers to evaluate the benefits and challenges to implementation, along with permitting requirements, and degree of maintenance. The hope is for municipalities to review the matrix to best select a strategy applicable to their site as they consider resilience building options.

As part of Climate Ready Casco Bay, the project team worked with consultant SWCA to develop three conceptual site renderings that showcase some of these potential resilience strategies. The site types were selected as representative models for how adaptation strategies could be implemented in residential, working waterfront, and critical infrastructure areas. Although the sites are based on three priority vulnerable sites selected as part of the project, the renderings are conceptual and are intended to showcase best practices and are not proposed for design or implementation.

The full-scale renderings showing before and after images can be found on the project website and **Appendix C**.

SMPDC Climate Ready Coast Resilience Strategies Matrix Index	
Adaptation Strategy	Specific adaptation strategy, such as dune restoration, coastal resilience overlay zone, or greenways, and detailed description of the strategy.
Type	Conservation, restoration, infrastructure, policy, zoning/land use, structural stabilization
Nature-Based Solution	Yes, No, or Hybrid
Category	Protect, Accommodate, Retreat
Hazard(s) Addressed	Sea Level Rise, Erosion, Storm Surge and Flooding
Site Conditions Appropriate for Strategy	Are there specific conditions that need to met for the strategy to work. For example, needs to be located in a wetland or sand dune.
Appropriate Spatial Scale	Site, Neighborhood, Community, Regional
Intended Lifespan	Short (<5 years), Medium (5-10 years), Long (>10 years), Permanent
Co-Benefits	Recreation and Tourism, Habitat, Water Quality, Carbon Sequestration
Limitations	Description of potential limitations for implementing the strategy, such as cost, additional impacts, or indirect impacts.
Potential Paired Strategies	Additional adaptation strategies that could provide similar benefits or supplement the listed strategy
Implementation Cost	No Cost, Low ($<50K), Medium ($50K-$150K), High (>$150K)
Potential State and Federal Permits	Example permits that could be required to implement the strategy.
Maintenance Requirements	Description of potential maintenance tasks over the lifespan of the project
Maintenance Cost	No Cost, Low ($<50K), Medium ($50K-$150K), High (>$150K)
Implementation Example	Example cases from around the country that have implemented the listed strategy

Residential: Many residential neighborhoods along the coast are at risk of flooding from sea level rise and increasing storm. Communities can implement different adaptation strategies to not only protect residents from flooding, but also to enhance livability, provide stormwater runoff mitigation and benefits, and support natural habitat.



Existing Condition With Sea Level Rise
Example Residential Waterfront Adaptation

Potential Condition With Sea Level Rise
Example Residential Waterfront Adaptation

- This site models the creation of a floodable parkway that allows for continued residential use of amenities while utilizing natural filtration and wave dissipation systems, creating a diverse mix of habitats.

Working Waterfront: Working waterfronts in the Casco Bay region support a wide range of uses and infrastructure. Rising sea levels threaten these important economic centers for the community. A range of adaptation strategies, both in the water and on land, can protect the coastline and infrastructure of the working waterfront. Implementing innovative strategies will allow these complex areas to thrive in the changing environment.

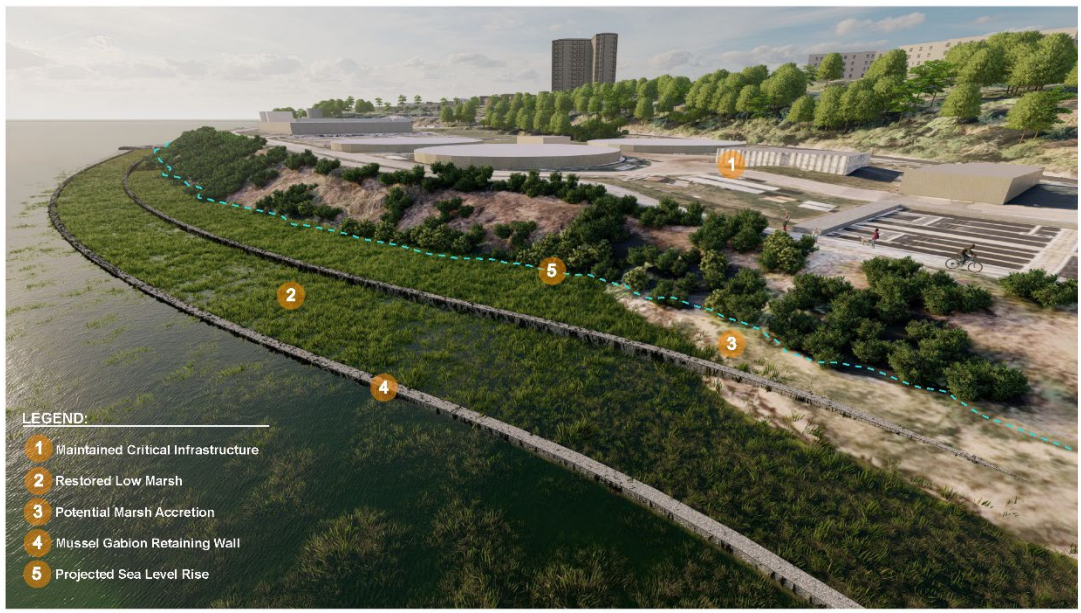
Existing Condition With Sea Level Rise
Example Working Waterfront Adaptation

Potential Condition With Sea Level Rise
Example Working Waterfront Adaptation

- This site models the creation of a working waterfront with consolidated built assets, increased precipitation uptake capabilities, wave action reduction, restored habitats, and an adjustable floating dock.

Critical Infrastructure: Several communities have critical infrastructure, such as wastewater treatment plants, situated along the coastline. Sea level rise and coastal erosion threaten to impact these important services and impact the surrounding habitat. Use of nature-based solutions, such as living shorelines, provides natural protection against flooding. This can help prevent erosion and preserve critical infrastructure.

Existing Condition With Sea Level Rise
Example Critical Infrastructure Waterfront Adaptation



Potential Condition With Sea Level Rise
Example Critical Infrastructure Waterfront Adaptation

- This site models salt marsh restoration combined with a living shoreline that will filter and reduce wave action while limiting material loss during extreme storm events.

Moving Forward

The Climate Ready Casco Bay plan identifies at risk sites across the region and can help support development of projects that build resilience. GPCOG will be using the data, the knowledge of vulnerable sites and issues, and the lessons learned on nature-based solutions, to pursue funding for coastal resilience projects in partnership with municipalities.

Additionally, the website will live as a dynamic regional resource hub for coastal resilience planning and project implementation, and to foster regional collaboration. The website can serve as a resource for municipalities looking to move projects along from concepts, to planning, and onward to implementation.

Anticipated future website updates include:

- A filterable table of adaptation strategies that allow users to easily find potential solutions based on project information such as site scale, maintenance, cost, permitting, etc. The goal is to expand on SMPDC's solution matrix to make it in a searchable format.
- A comprehensive project list that showcases new municipal coastal resilience projects, including the adaptation strategies employed.

Photo credit: GPCOG

Appendix A: Priority Site Profile Pages

REGIONAL PRIORITY SITES

Location

Coleman Cove, Chebeague Island

SCALE

Site | Neighborhood | Community | Regional

South Shore Drive & adjacent residents on Coleman Cove.

DESCRIPTION

Coleman Cove is located on the southeastern shore of Chebeague Island. The cove provides critical shore access for fisherman and the public via a conservation area upland from the cove protecting historic farmland, field, and meadows. South Shore Drive is the only access point by land for the coastal island residents and emergency services. The cove also hosts emergent wetlands, shellfish habitat, tidal waterfowl and wading bird habitat, and eelgrass habitat

CRITICAL ROADS

South Shore Road, the primary access to the residential homes located on Coleman Cove, is vulnerable to flooding and overtopping from extreme storm surge. This could result in safety hazards and costly repairs.

HABITAT

The cove contains vulnerable coastal habitat, including dune and bluffs, emergent wetlands, waterfowl and wading bird, shellfish, and eelgrass. Sea level rise and storm surge could greatly impact these important natural resources.

ECONOMY

The cove provides critical shore access for traditional uses by local fisherman, recreation, and tourism. Disruption of this access could strain these industries. Additionally, the coastal hazards associated with climate change could impact home and property prices on South Shore Drive.

COASTAL HAZARDS

Erosion | Storm Surge | Sea Level Rise

VULNERABILITIES

Working Waterfront | Travel Corridors | Residential Housing | Habitat

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Coleman Cove was selected as a priority site because it is a critical economic resource as a working waterfront and public access for recreation. Additionally, the area is adjacent to a coastal island neighborhood that is highly vulnerable to flooding and erosion with limited access points for emergency services.

STRATEGIES

- Living Shorelines to prevent erosion of critical habitat, including dune and bluff systems.
- Continued conservation of open space.
- Implementation of shoreland zoning ordinance that increases buffer setbacks for future development.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

Location

Stone Wharf Landing, Chebeague Island

SCALE

Site | Neighborhood | Community | Regional

Aerial image of Stone Wharf and access to island via Stone Wharf Road

DESCRIPTION

Stone Wharf Landing is located on the northwest shore of Chebeague Island. For 130 years, the granite block wharf has been a multi-use municipal waterfront serving residents, commercial fishermen, passenger ferries, water taxis, and island visitors. Various modifications have been made to the pier structure and use since the original construction, with additions of wave breaks, grouting, and replacement of infill.

TRAVEL CORRIDORS & INFRASTRUCTURE

The wharf landing, one of the main access points to and from the island, is within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise.

SOCIAL DEMOGRAPHIC

Based on the Maine Social Vulnerability Index, certain populations that reside on the island are particularly vulnerable to climate change. 48% of the population is 65 years or older and 29% are civilians with a disability.

ECONOMY

The wharf provides critical shore access for traditional uses by local fisherman, recreation, and tourism. Disruption of this access could strain these industries. Additionally, the coastal hazards associated with sea level rise could impact businesses located on Stone Wharf Road.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Working Waterfront | Travel Corridors | Coastal Infrastructure | Social Demographic

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Coleman Cove was selected as a priority site because it is a critical economic resource as a working waterfront and one of the main public access points for the island. The Town of Chebeague has completed various assessments to evaluate structure stability and future use and assess the impact of Sea Level Rise on the wharf. Based on the analysis, in 50 years (2070) the wharf could experience overtopping of 3.7 feet that would render the facility unusable and unsafe on a frequent basis.

STRATEGIES

- Modular-docking and elevated decking systems for continued access to fishing, recreation, and transportation.
- Continued conservation of open space.
- Implementation of shoreland zoning ordinance that increases buffer setbacks for future. development.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

Location

Town Landing, Falmouth

SCALE

Site | Neighborhood | Community | Regional

Aerial image of Falmouth Town Landing from Zillow.com.

DESCRIPTION

The Town Landing is located at the end of Town Landing Road on the coast of Falmouth. It is the largest recreational anchorage/mooring field north of Marblehead, Massachusetts. The landing also hosts residential/public parking, beach, and boat launch. Additionally, the coast surrounding the landing is host to shellfish and tidal waterfowl & wading bird habitats.

WHY IS THIS A PRIORITY SITE?

The Town Landing in Falmouth was selected as a priority site because it is a local economic hub tied to recreation, tourism, and a working waterfront. It is the largest recreational anchorage/mooring field north of Marblehead, Massachusetts.

TRAVEL CORRIDORS & INFRASTRUCTURE

The Town landing is within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise. This includes the lower portion of Town Landing Road, the wharf, parking lot, boat launch, beach, and coastal defenses.

ECONOMY

The landing provides critical shore access for traditional uses by local fisherman, recreation, boating facilities, and tourism. Disruption of this access could strain these industries.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Working Waterfront | Travel Corridors | Coastal Infrastructure

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

STRATEGIES

- Elevate the existing infrastructure, including Town Landing Road, the wharf, parking lot, and boat launch, to protect against 1.5 feet of projected sea level rise.
- Develop a phased relocation plan for critical facilities to higher ground.
- Construct a nature-based seawall with strategic fill to mitigate storm surge.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

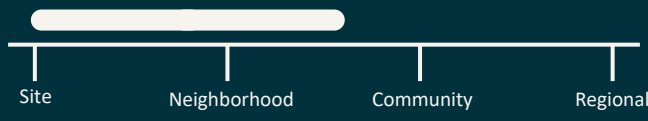
CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

Location

Bay Bridge Estates & Neighborhoods, Brunswick

SCALE



Aerial image of Bay Bridge Estates from company website.

DESCRIPTION

Bay Bridge Estates is a mobile home community located on the Androscoggin River. This community and surrounding neighborhoods on Bay Bridge Road are at risk of riverine flooding due to climate change. This location is host to non-tidal wetlands, tidal waterfowl and wading bird habitat, and in proximity to at-risk species freshwater mussel habitat.

TRAVEL CORRIDORS & RESIDENTIAL HOUSING

The mobile home community, surrounding neighborhoods, public water access point, and connecting travel corridors are in proximity to the FEMA floodplain and vulnerable to flooding from 3.9 feet of sea level rise.

SOCIAL DEMOGRAPHIC

Based on the Maine Social Vulnerability Index, this priority site is ranked as most vulnerable. The measures that were high include social economic status (19% below poverty), household composition and disability status (29% civilians with a disability), minority status (10%), and housing status (71% mobile homes).

HABITAT

Sea level rise will force marsh migration towards Bay Bridge Estates and surrounding development. Additionally, the priority is adjacent to a large wetland complex, tidal waterfowl and wading bird habitat, and in proximity to at-risk species freshwater mussel habitat.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Residential Housing | Habitat | Travel Corridors | Social Demographic

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Bay Bridge Estates and surrounding neighborhoods were selected as a priority site due to the vulnerable populations located in the area, potential infrastructure impacts, and significant potential for future marsh habitat from marsh migration associated with sea level rise.

STRATEGIES

- Develop resilient stormwater parks and greenways to mitigate flooding risks and create natural buffers for the vulnerable mobile home community.
- Create a nature-based habitat corridor that allows for marsh migration while providing protective infrastructure for the surrounding residential areas and critical ecosystems.
- Implement managed retreat and relocation assistance programs for residents.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Porter's Landing & Boat Launch, Freeport

SCALE

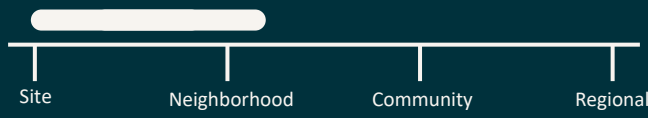


Image of Porter's Landing from Ned O'Connor.

DESCRIPTION

Porter Landing is a historically-significant neighborhood located on the western shore of the Harraseeket River, a tidally influenced tributary of Casco Bay. Originally the Town's port, the public boat launch is for hand carried watercraft. Not only is this location popular for recreation and local fishermen, the site is host to tidal marsh habitat, shellfish habitat, and tidal waterfowl and wading bird habitat.

TRAVEL CORRIDORS & INFRASTRUCTURE

The boat launch, a popular public access location, is within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise. Additionally, both Cove Road and Freeport Road could have limited access due to flooding.

ECONOMY

The landing provides critical shore access for traditional uses by local fisherman, recreation, boating facilities, and tourism. Disruption of this access could strain these industries. Additionally, adjacent waterfront businesses could be susceptible to service disruptions from flooding.

HABITAT

Sea level rise will force marsh migration towards Porter landing. Additionally, the priority site is adjacent tidal waterfowl and wading bird habitat and shellfish habitat.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Residential Housing | Habitat | Travel Corridors | Working Waterfront

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Porter Landing, both the neighborhood and public boat launch, were chosen as a priority site due to vulnerable populations in the area, potential infrastructure impacts, and significant potential for future marsh habitat from marsh migration associated with sea level rise.

STRATEGIES

- Elevate the public boat launch and adjacent parking area with strategic seawall construction to protect against 1.5 feet of projected sea level rise.
- Develop a comprehensive relocation plan for the boat launch and critical infrastructure.
- Create a nature-based habitat corridor that allows for marsh migration while protecting the historically significant neighborhood and its economic resources.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

Location

Commercial Street Wharves, Portland

SCALE

Site | Neighborhood | Community | Regional

Aerial image of Commercial Street from Alex MacLean.

DESCRIPTION

TThe commercial street wharves in Portland, Maine are a series of historic piers stretching along the city's working waterfront. These wooden structures, some dating back to the 19th century, still serve as active hubs for the fishing industry and other maritime businesses, while also hosting restaurants and shops that cater to tourists.

TRAVEL CORRIDORS & INFRASTRUCTURE

The Commercial Street wharves are primarily within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise. At 3.9 feet of Sea Level Rise, a large portion of Commercial Street and connected access roads could be flooded.

ESSENTIAL SERVICES

Essential services like electricity, water supply, and telecommunications may face disruptions due to flooded equipment or damaged underground infrastructure. More intense rainfall events could overwhelm stormwater and wastewater systems, potentially leading to decreased water quality.

ECONOMY

Sea level rise and storm surge could cause regular flooding on Commercial Street, disrupting important infrastructure supporting the marine-industrial industry and the Casco Bay Lines terminal, the major transportation hub for the Casco Bay islands.

COASTAL HAZARDS

Storm Surge

Sea Level Rise

VULNERABILITIES

Working Waterfront

Travel Corridors

Coastal Infrastructure

STRATEGY TYPE

Policy/Program

Nature-based

Hardscape

WHY IS THIS A PRIORITY SITE?

The Commercial Street wharves were identified as a priority site because its a local and regional economic hub tied to recreation, tourism, and a working waterfront. The area also provides critical access to the islands that are located in Casco Bay.

STRATEGIES

- Elevate critical infrastructure and historic wooden structures to protect against 1.5 feet of projected sea level rise and potential flooding.
- Construct and enhance robust seawalls with advanced flood protection technologies to prevent inundation of Commercial Street and connected access roads.
- Develop comprehensive drainage improvements and long-term retreat strategies to ensure continued functionality of maritime businesses and essential services.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

Location

Sawyer Road, Scarborough & Cape Elizabeth

SCALE

Site | Neighborhood | Community | Regional

Storm surge across Sawyer Road. Photo by PPH.

DESCRIPTION

Sawyer Road crosses the Spurwink River in tidal areas of the Spurwink Marsh and connects the towns of Cape Elizabeth and Scarborough. The structure was built in 1997 and passes an overage of 1080 daily vehicular trips. The road is overtopped and flooded during certain high tides, in which the road is closed and traffic is rerouted. The crossing infrastructure has localized erosion due to tidal conveyance inadequacies, which impacts the marsh habitat.

WHY IS THIS A PRIORITY SITE?

Sawyer Road has been evaluated by both municipalities and could potentially showcase an example of retreat as a strategy to the hazards of climate change. There is also significant potential for future marsh habitat from marsh migration associated with sea level rise.

TRAVEL CORRIDORS & INFRASTRUCTURE

The road and associated infrastructure is within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise.

HABITAT

Sea level rise will force marsh migration towards Sawyer Road and surrounding development. The site also hosts habitat for tidal waterfowl and wading birds.

COASTAL HAZARDS

Storm Surge | **Sea Level Rise**

VULNERABILITIES

Coastal Infrastructure | **Habitat** | **Travel Corridors**

STRATEGY TYPE

Policy/Program | **Nature-based** | Hardscape

STRATEGIES

- Remove the road and restore the marsh to enhance flood resilience, support marsh migration, and protect vital coastal habitats.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Willard Beach, South Portland

SCALE

Site | Neighborhood | Community | Regional

Storm surge at Willard Beach.

DESCRIPTION

Willard Beach is a 4-acre sand and pebble crescent-shaped beach in Simonton Cove between Fisherman's Point and the campus of Southern Maine Community College. The beach is popular amongst locals for recreation, dog-walking designated hours, and convenient beach facilities (snack shack, bathhouse, and playground).

WHY IS THIS A PRIORITY SITE?

Willard beach was chosen as a priority site due to its vulnerability from flooding and increased storm intensity, important natural habitat, as well as community importance and economic value from tourism and recreation.

TRAVEL CORRIDORS & INFRASTRUCTURE

The beach, adjacent residential property, and certain road segments are within the FEMA floodplain and vulnerable to flooding from 1.5 feet of sea level rise.

HABITAT

The beach and its sand dunes are at risk of erosion as sea levels rise. There is limited potential for marsh migration due to the surrounding development. Eelgrass habitat and wading bird and waterfowl habitat could also be impacted.

COASTAL HAZARDS

Erosion | Storm Surge | Sea Level Rise

VULNERABILITIES

Residential Housing | Habitat | Travel Corridors | Essential Infrastructure

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

STRATEGIES

- Implement dune restoration and beach nourishment to reduce erosion and enhance natural coastal resilience.
- Elevate or retrofit vulnerable infrastructure to mitigate flood risk.

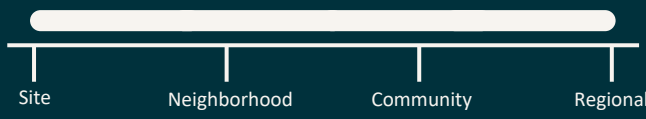
This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Wyman Power Station, Yarmouth

SCALE



Aerial image of Wyman Power Station by The Portland Press Herald.

DESCRIPTION

The Wyman Power Station is an oil-fired power station owned by NextEra Energy in Yarmouth, Maine. Found on Cousins Island, the facility has four steam turbine units. The plant has been used mostly as a peaking power plant, only used when another big plant goes offline or when extreme weather temperatures spike the regions demand for energy.

TRAVEL CORRIDORS & INFRASTRUCTURE

The plant is used when another plant goes down or when the region is in high demand, and the flooding may not make it a reliable backup. If the roads surrounding the plant flood, accessing it will become a challenge.

SOCIAL DEMOGRAPHIC

Historically, the Wyman Power Station was an economic center for the community, employing a large workforce beginning in the late 1950s. Although employment has decreased, it continues to represent an opportunity for growth for Yarmouth.

ECONOMY

Wyman Power Plant is Yarmouth's largest property taxpayer, contributing around $2 million annually. The plant provides many employment opportunities and supports local community organizations. Additionally, it has the largest battery storage project in New England, helping to provide grid stability.

COASTAL HAZARDS

Erosion | Storm Surge | Sea Level Rise

VULNERABILITIES

Coastal Infrastructure | Economic Importance | Travel Corridors | Social Demographic | Essential Infrastructure

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Rip-rap protects soil from erosion, and therefore protects the coastline surrounding the Wyman Power Plant from extreme damage. If the rip-rap experiences extreme destruction, the shoreline will no longer be stabilized and stormwater can not be controlled.

STRATEGIES

- Monitor plans for the Wyman Power Station going forward to ensure the productive and beneficial reuse of the property that maintains or improves the local economy.
- Preserve the habitat around the Wyman Power Station
- Converse with NextEra Energy regarding reducing its carbon footprint and increasing its use of renewable energy

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Route 1 & Interstate 295, Yarmouth & Freeport

SCALE

Site | Neighborhood | Community | Regional

Image of US 1 bridge across Cousins River. Photo by PPH.

DESCRIPTION

Route 1 and Interstate 295 between Yarmouth and Freeport connects major commercial districts that are home to several large retail stores, restaurants, and other businesses. The area is extremely well trafficked, and has potential for the expansion of commercial development utilizing the existing public infrastructure which also connects easy access to other transportation routes.

TRAVEL CORRIDORS & INFRASTRUCTURE

If the roads and surrounding bridges were to experience extreme flooding, it would prevent individuals from traveling to critical locations, causing serious problems and traffic jams. Dangerous shut downs like this could increase the need for hospital access, which is much more difficult if these roads can not be used.

ESSENTIAL INFRASTRUCTURE

Residents may use these roads to access major hospitals, grocery stores, and more. Neighborhoods farther inland who rely on these routes may be cut off from normal access points because of flooding and the limited road network.

ECONOMY

Extreme damage to roads and bridges results in economic loss for Maine. Maine already struggles with funding transportation infrastructure needs, and unexpected shut down of major routes is extremely expensive.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Economic Importance | Habitat | Travel Corridors

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

The flooding of this infrastructure could prohibit access to critical infrastructure relied on in times of crisis. Additionally, the Salt Marsh Sparrows in this area are at risk since their nests are in low tidal marshes, and are flooded easily by high tides.

STRATEGIES

- Elevate and reinforce critical bridge infrastructure along Route 1 and Interstate 295 to prevent flooding-related transportation disruptions.
- Develop alternative routing and emergency access plans to maintain connectivity during potential flood events.
- Implement comprehensive flood mitigation measures that protect both transportation infrastructure and sensitive ecological habitats like Salt Marsh Sparrow nesting areas.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Knightville & Mill Creek, South Portland

SCALE

Site | Neighborhood | Community | Regional

Aerial image of Knightville neighborhood by Homes.com.

DESCRIPTION

The Knightville and Mill Creek neighborhood is a concentrated area of South Portland that is home to beloved parks, social services, grocery stores, small businesses, municipal offices, affordable housing, a public transit hub, and the wastewater treatment plant

TRAVEL CORRIDORS & INFRASTRUCTURE

The Knightville and Mill Creek neighborhood has vulnerable roads, buildings, oil and fuel tanks, and a brownfield site that will be prone to future flooding. Threatened buildings include the Coast Guard facility, which could be important in any disaster response.

ESSENTIAL INFRASTRUCTURE

With sea level rise and significant storms bringing flooding, much of the services and homes in this region could be inaccessible. Lower elevation neighborhoods will need to prepare for increased flooding by flood proofing their basements, elevating essential equipment such as boilers and heat pumps, and have a pre-established action plan when high tides and storms are forecasted.

ECONOMY

With busy streets and concentrated areas needing to shut down, local businesses struggle and residents face challenges getting to work outside of the region.

COASTAL HAZARDS

Storm Surge

Sea Level Rise

VULNERABILITIES

Residential Housing

Economic Importance

Travel Corridors

Social Demographic

STRATEGY TYPE

Policy/Program

Nature-based

Hardscape

WHY IS THIS A PRIORITY SITE?

The hazards faced by the Knightville and Mill Creak neighborhood will impact the city's ecosystems, economy, and infrastructure. It will also affect residents' access to resources, health, and well-being.

STRATEGIES

- Elevate essential equipment, retrofit buildings, and implement floodproofing measures to protect homes, businesses, and municipal services.
- Develop adaptive strategies for businesses, including emergency response plans and alternative transportation routes, to minimize economic disruptions.
- Invest in nature-based solutions such as expanded green spaces and shoreline restoration to absorb floodwaters and reduce storm surge impacts.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

East End Wastewater Treatment Plant, Portland

SCALE

Site | Neighborhood | Community | Regional

Aerial image of the East End Wastewater Treatment Facility.

DESCRIPTION

The East End wastewater treatment facility is located on the coast of Portland, adjacent to Portland's East End Beach, Tukey's Bridge, and Back Cove. The treatment facility is the largest in Maine, serving 60,000 customers and treating 19.8 million gallons per day.

COASTAL HAZARDS

Erosion | Storm Surge | Sea Level Rise

VULNERABILITIES

Travel Corridors | Essential Infrastructure | Habitat | Social Demographic

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

The East End wastewater treatment facility was chosen as a priority site due to the essential functions the facility provides and vulnerability to flooding based on sea level rise and increased rainfall.

TRAVEL CORRIDORS & INFRASTRUCTURE

The East End wastewater treatment facility protects the Casco Bay watershed and keeps the water clean and safe. Flooding within the facility can compromise essential functions resulting in major complications.

SOCIAL DEMOGRAPHIC

Upgrades in the facility improve water quality in Back Cove, making East End Beach officially safe for recreational swimming and boating. With the complications of flooding, damage to the facility could result in negative health impacts especially to already vulnerable individuals.

ECONOMY

The facility has been expanded and modified since it first opened in 1979 in order to handle more wastewater and protect Casco Bay. In 2023, the Maine DEP and Maine Municipal Bond Bank approved a $5 million upgrade to the facility's secondary clarifier and primary sludge gallery.

STRATEGIES

- Implement structural reinforcements and elevate critical equipment to prevent flood damage and ensure continuous wastewater treatment operations.
- Enhance coastal buffers and restore natural habitats around the facility to absorb storm surge and mitigate erosion risks.
- Invest in long-term facility upgrades, including improved drainage and backup systems, to safeguard water quality and public health.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

Location

Route 77 Bridge Crossing, Scarborough

SCALE

Site | Neighborhood | Community | Regional

Spurwink Road bridge at low tide. Photo by Maine DOT.

DESCRIPTION

The Spurwink Road Bridge on Route 77 in Scarborough, Maine, spans the tidal Spurwink River, connecting the towns of Scarborough and Cape Elizabeth. This small but vital bridge provides a scenic crossing near Higgins Beach, offering views of salt marshes and coastal wildlife. It serves as a key route for local traffic and visitors traveling along the coastal corridor.

TRAVEL CORRIDORS & INFRASTRUCTURE

Route 77 restricts tidal flow, preventing the culvert from allowing sufficient water to pass through. This not only increases the risk of extreme flooding but also disrupts the natural function of the surrounding marsh. The road is highly susceptible to severe flooding, posing risks to critical infrastructure access and resident safety. During flood events, many residents already take a minor detour, though some have concerns about how a permanent closure could impact traffic.

HABITAT

Salt marshes are critical ecosystems because of their abilities to buffer in storms and surges by absorbing water, reducing damage while filtering runoff. They provide food and shelter for over 75% of fisheries species, as well as birds like the waterfowl, Eastern black rail, wood stork, and salt marsh sparrow.

COASTAL HAZARDS

Storm Surge

Sea Level Rise

VULNERABILITIES

Essential Infrastructure

Habitat

Travel Corridors

STRATEGY TYPE

Policy/Program

Nature-based

Hardscape

WHY IS THIS A PRIORITY SITE?

The Spurwink Road Bridge is a priority site for addressing coastal hazards due to its vulnerability to tidal flooding, storm surges, and sea level rise, which threaten its structural integrity and the resilience of this critical transportation link.

STRATEGIES

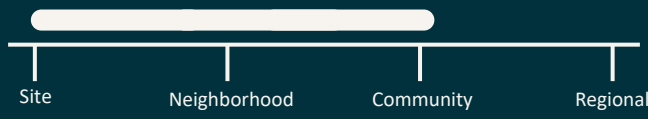
- Redesign the Route 77 bridge and culvert system to improve tidal flow and reduce flood risks while maintaining critical transportation infrastructure.
- Implement adaptive engineering solutions that enhance the bridge's resilience to storm surges and projected sea level rise.
- Develop a comprehensive flood mitigation plan that balances infrastructure protection with preservation of the surrounding sensitive salt marsh ecosystem.

This project is made possible through a grant from the National Fish and Wildlife Foundation, with support from Gulf of Maine Research Institute, The Builders Initiative, and Jane's Trust Foundation.

CLIMATE READY CASCO BAY

REGIONAL PRIORITY SITES

SCALE



Location

Freeport Town Landing, South Freeport

Aeriel image of Freeport Town Landing taken by Marinas.com

DESCRIPTION

Freeport Town Landing is a working dock located on the Harraseeket River. It is conveniently positioned across from Wolfes Neck, downriver to Winslow Park, and nearby downtown Freeport. The harbor is locally known as one of the most sheltered and welcoming harbors along Maine's coast. The landing is also home to many native species.

ESSENTIAL INFRASTRUCTURE

Rip-rap, buildings, marina infrastructure, and parking at the landing may be vulnerable to flooding from sea level rise and storm surge. These marinas are already under pressure from crowding and overuse. There are limited all tide access points in Freeport for marinas.

HABITAT

Seasonally, the area is home to Barrow's goldeneyes, long-tailed ducks, red-breasted mergansers, and Common Eiders. Additionally, existing marsh along the nearby coast will need to expand and migrate as sea levels rise.

ECONOMY

The landing provides critical shore access for traditional uses by local fisherman, recreation, boating facilities, and tourism. Disruption of this access could strain these industries. Many livelihoods and the local economy depend on a clean, sustainable aquaculture industry. Aquaculture sits and leases at the landing could be negatively impacted by climate change.

COASTAL HAZARDS

Storm Surge | Sea Level Rise

VULNERABILITIES

Residential Housing | Habitat | Travel Corridors | Working Waterfront

STRATEGY TYPE

Policy/Program | Nature-based | Hardscape

WHY IS THIS A PRIORITY SITE?

Freeport Town Landing has vulnerable infrastructure, ecological significance, and economic importance. Rising sea levels threaten the marina, surrounding neighborhoods, and aquaculture. The area provides crucial habitat for various waterfowl and supports marsh migration as sea levels rise.

STRATEGIES

- Elevate and reinforce marina infrastructure, including rip-rap, buildings, and parking areas.
- Develop a comprehensive habitat migration plan that allows for marsh expansion while preserving critical infrastructure and aquaculture resources.
- Create adaptive shore access solutions that maintain economic viability for local fishermen, recreational boating, and tourism in the face of changing coastal conditions.

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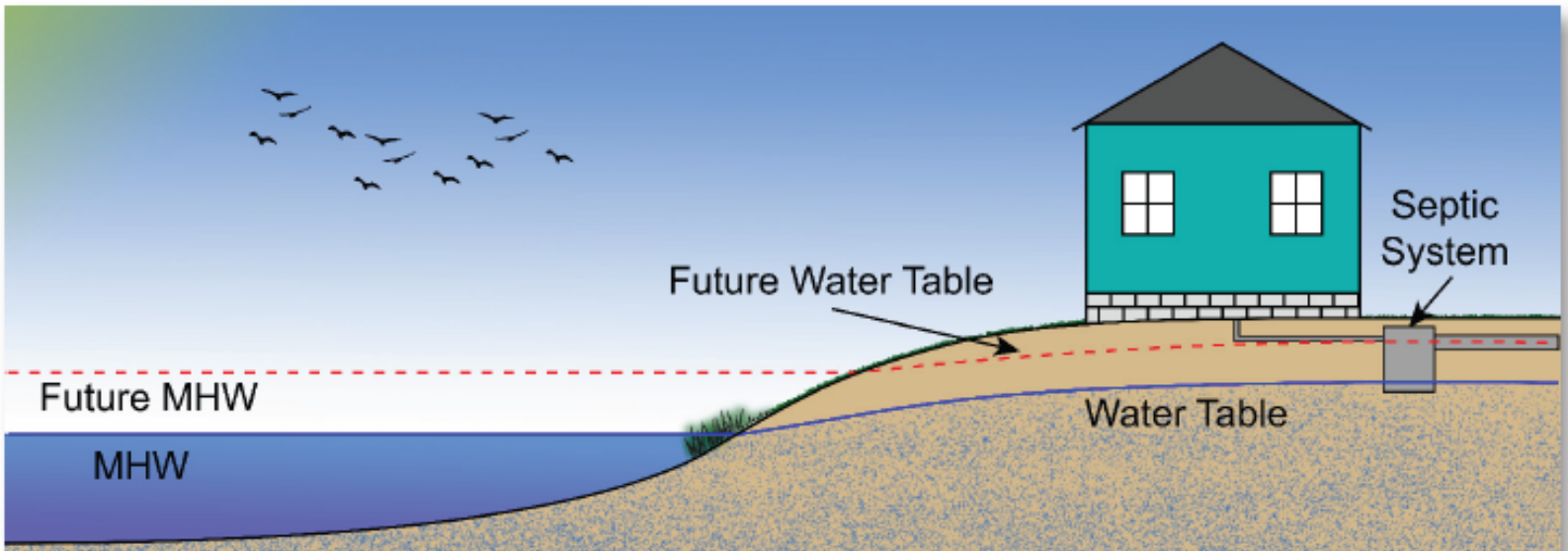
CLIMATE READY CASCO BAY

Appendix B: Regional Topics

SEPTIC SYSTEMS



HAZARD TYPE

SEA LEVEL RISE

Rising sea levels push saltwater inland and underground, forcing groundwater to rise. This reduces the amount of dry soil beneath septic system leachfields, which normally act as natural filters for wastewater. With less dry soil available, these systems become less effective at cleaning wastewater and removing harmful bacteria.

INCREASED HEAVY PRECIPITATION

More frequent, heavy rainstorms saturate the ground as water seeps downward. This extra water fills up underground water supplies, pushing the groundwater level higher. During intense rain periods, groundwater in coastal areas can rise dramaticaly - up to an additional food beyond sea level rise projections.

TEMPERATURE CHANGE

Rising temperatures due to climate change makes soil bacteria require more oxygen to survive and function properly. When this bacteria doesn't get enough oxygen, it cannot effectively break down pollutants and organic matter in the soil. This disrupts the soil's natural ability to filter and clean water as it passes through, potentially leading to contaminated groundwater and declining coastal water quality.

STRATEGIES

- Incorporate future seasonal high water table projections when siting septic systems.
- Implement a septic system maintenance ordinance.
- Perform a septic system vulnerability assessment.

WHY IS THIS A REGIONAL PRIORITY?

Septic systems in Casco Bay play a vital role in managing wastewater for coastal communities, such as Brunswick, Freeport, Yarmouth, & the Islands. Given the bay's unique ecological significance and heavy recreational use, proper management of these systems is crucial to protect water quality and marine habitats.

However, the area faces challenges such as rising sea levels, increased flooding, and nutrient pollution, which can threaten the effectiveness of these systems and lead to contamination of nearby waters.

IMPACTS

AQUATIC LIFE & PUBLIC HEALTH

High water quality is essential for organism and human health, with Maine recommending specific parameters for dissolved oxygen, temperature, and chemical composition. Pristine waters not only support public health, but also provide recreational opportunities.

SHELLFISH AREA CLOSURES

Shellfish harvesting areas must meet state water quality standards, particularly regarding fecal coliform bacteria levels which indicate the presence of fecal contamination. If bacteria levels exceed state thresholds, the shellfishing area must close according to region-specific regulations.

LOCAL ECONOMY

Shellfishing area closures negatively impact the local economy, affecting both harvesters and the tourism industry.

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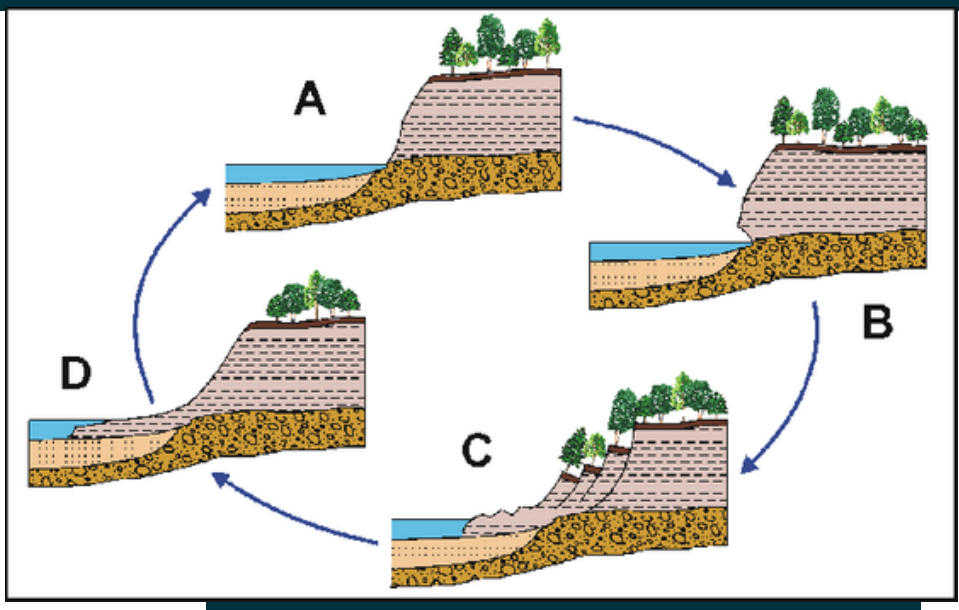
COASTAL BLUFFS



HAZARD TYPE

SEA LEVEL RISE

Sea level rise along Maine's coast allows waves to increasingly erode beaches and flats at the base of coastal bluffs, destabilizing them over time. This ongoing cycle of erosion removes supportive sediment, leading to landslides that temporarily restore equilibrium until wave action, driven by continually rising seas, restarts the process.

INCREASED STORM INTENSITY

More frequent and intense storms amplify wave energy and storm surge, accelerating erosion at the base of Maine's coastal bluffs. These intensified storms also increase rainfall, which can oversaturate bluff materials and enhance groundwater pressure, further destabilizing bluffs and making them more susceptible to landslides.

TEMPERATURE CHANGE

More frequent freeze-thaw cycles caused by increasingly variable winter temperatures can physically weather bluff materials through frost action, creating cracks and fissures that weaken the overall structure of the bluff and make it more susceptible to erosion and failure.

STRATEGIES

- Mapping and monitoring of vulnerable areas
- Implementation of erosion control measures
- Land use planning and building restrictions
- Public education about bluff stability and management

Nature-based solutions, such as restoring native vegetation and creating living shorelines, work with natural processes to stabilize coastal bluffs, reducing erosion while preserving habitats and biodiversity. Unlike hard armoring, which can disrupt natural coastal dynamics and lead to increased erosion elsewhere, these solutions are adaptable and more sustainable over time, protecting both the environment and local communities.res to protect coastal communities.

WHY IS THIS A REGIONAL PRIORITY?

Coastal bluffs in the Casco Bay region face accelerated erosion from wave action, storms, and rising sea levels, threatening critical infrastructure and property values along the shoreline. These erosion patterns disrupt natural sediment dynamics essential for maintaining beaches and marshes, potentially destabilizing the region's coastal ecosystems.

The economic ramifications of bluff vulnerability extend beyond direct property damage, impacting tourism, recreation, and will require substantial investment in monitoring and stabilization measures to protect coastal communities.

IMPACTS

PROPERTY & INFRASTRUCTURE

Coastal bluff erosion in Casco Bay threatens homes, roads, bridges, and utility lines, potentially causing sudden failures or requiring costly relocations. Water and sewer systems are especially vulnerable, as erosion can expose and rupture pipes, while residential buildings face foundation damage or complete loss as bluffs become unstable.

WORKING WATERFRONT

Coastal bluff erosion can destabilize the land around working waterfronts, threatening docks, piers, and essential infrastructure crucial for fishing and marine trade. As erosion progresses, sediment runoff can accumulate in harbors, disrupting navigation and increasing dredging needs, which are costly and time-intensive. Additionally, erosion-related flooding risks can lead to business disruptions, impacting the livelihoods of those who depend on the waterfront economy.

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WORKING WATERFRONT

HAZARD TYPE

SEA LEVEL RISE

Rising seas in Maine threaten to submerge piers and working waterfronts that are vital to the fishing and lobstering industries, potentially forcing expensive adaptations or relocations of these critical coastal infrastructure assets. Higher water levels can also reduce clearance under docks during high tides, making it harder for boats to access and tie up at working waterfront facilities that have served Maine's maritime communities for generations.

Damage in Harpswell during January Storm. Shawn Patrick Ouellette/PPH Staff Photographer

INCREASED STORM INTENSITY

More frequent and intense storms amplify wave energy and storm surge causes damage to vessels, gear, and shoreside facilities while creating longer periods when this infrastructure cannot operate safely. The increased storm activity leads to higher maintenance costs and more frequent repairs for waterfront businesses, as powerful storm surge and wave action accelerate wear and tear on piers, docks, and protective structures.

WARMING WATERS

Rising water temperatures in Casco Bay are disrupting traditional marine ecosystems, causing valuable cold-water species like cod and lobster to shift their territories while creating conditions for harmful algal blooms that can shut down shellfish harvesting. These warming waters are also enabling southern and invasive species to move into the bay, fundamentally altering the marine environment that the local fishing industry has depended on for generations.

STRATEGIES

- Elevating or relocating critical infrastructure like piers and processing facilities to higher ground.
- Using nature-based solutions like living shorelines with native vegetation to attenuate waves and mitigate coastal erosion.
- Hardening existing infrastructure to better withstand waves and storm surge.
- Developing early warning systems and emergency preparedness plans for extreme weather.
- Transitioning to aquaculture species and operations better suited for warming conditions.
- Leveraging marine-based tourism opportunities that highlight the region's natural coastal assets and biodiversity

WHY IS THIS A REGIONAL PRIORITY?

The working waterfront represents a significant regional vulnerability for Maine's climate resilience because it serves as a vital economic and cultural backbone while being uniquely exposed to climate impacts. Maine's working waterfronts provide irreplaceable access points for multiple industries - from commercial fishing and aquaculture to marine transport and tourism - while also featuring concentrated infrastructure (wharves, processing facilities, fuel stations) in the exact coastal locations most susceptible to sea level rise, storms, and other climate threats.

IMPACTS

COASTAL INFRASTRUCTURE

Maine's coastal infrastructure faces a double threat from climate change: rising seas and stronger storms will damage or destroy critical facilities like wharves, piers, boat launches, and processing plants that were built for historically stable conditions. The concentration of essential maritime infrastructure in vulnerable shoreline locations, combined with the high costs of adaptation measures like raising structures or building protective barriers, creates a particularly challenging scenario for Maine's fishing communities and working waterfront businesses.

LOCAL ECONOMY

The working waterfront is the backbone of Maine's coastal economies, supporting vital industries like commercial fishing, aquaculture, and maritime tourism. Disruptions to waterfront infrastructure and operations from climate impacts like sea level rise and storms will threaten jobs, incomes, and the economic stability of many Maine coastal communities.

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CLIMATE READY CASCO BAY

Appendix C: Conceptual Renderings

Existing Condition With Sea Level Rise

Example Residential Waterfront Adaptation

Potential Condition With Sea Level Rise

Example Residential Waterfront Adaptation

- This site models the creation of a floodable parkway that allows for continued residential use of amenities while utilizing natural filtration and wave dissipation systems, creating a diverse mix of habitats.

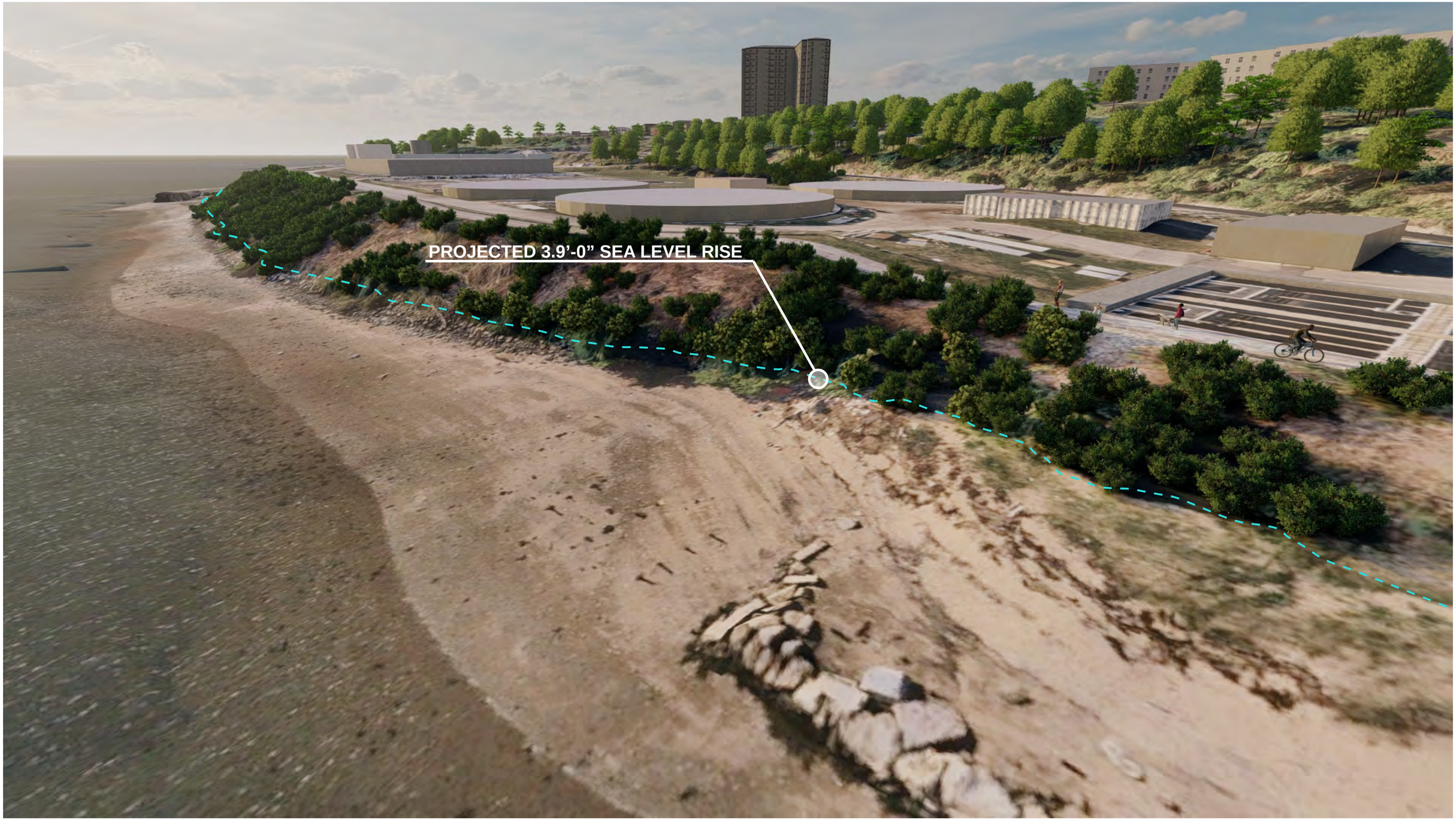
Existing Condition With Sea Level Rise

Example Working Waterfront Adaptation

Potential Condition With Sea Level Rise

Example Working Waterfront Adaptation

- This site models the creation of a working waterfront with consolidated built assets, increased precipitation uptake capabilities, wave action reduction, restored habitats, and an adjustable floating dock.



Existing Condition With Sea Level Rise

Example Critical Infrastructure Waterfront Adaptation

Potential Condition With Sea Level Rise

Example Critical Infrastructure Waterfront Adaptation

- This site models salt marsh restoration combined with a living shoreline that will filter and reduce wave action while limiting material loss during extreme storm events.