

Shoring up Maine's working waterfronts: Understanding coastal hazard risks and planning for a more resilient future

In 2016 Maine Coastal Program (MCP) and several collaborators received funding from the National Oceanic and Atmospheric Administration (NOAA) for a vulnerability assessment and resilience planning project at ten working waterfront sites surrounding Penobscot Bay. Working waterfronts primarily support activities like commercial fishing and aquaculture, boat launching, boat building, marine construction, and passenger transportation, and they all depend on access to the water. For this study, project partners assessed the resilience of these sites against current and future storm surge, flooding, and sea level rise impacts, while helping the towns understand the range of adaptation options and associated costs for short-, medium-, and long-term improvements. This approach was designed to be relevant and transferrable to other working waterfront facilities along the Maine coast and beyond.

Wood Environmental & Infrastructure Solutions, Inc. (Wood) did the resilience analyses for the sites and provided recommendations for adaptation measures. In eight of the towns (Rockland, Camden, Lincolnville, Belfast, Searsport, Vinalhaven, Castine, and Stonington), Wood completed a baseline characterization and vulnerability assessment of the selected working waterfront facility. In the final towns (South Thomaston and North Haven), Wood completed alternative vulnerability assessments. These assessments and their recommendations are summarized below.

For additional information about this study, contact Melissa Britsch at Melissa.britsch@maine.gov.

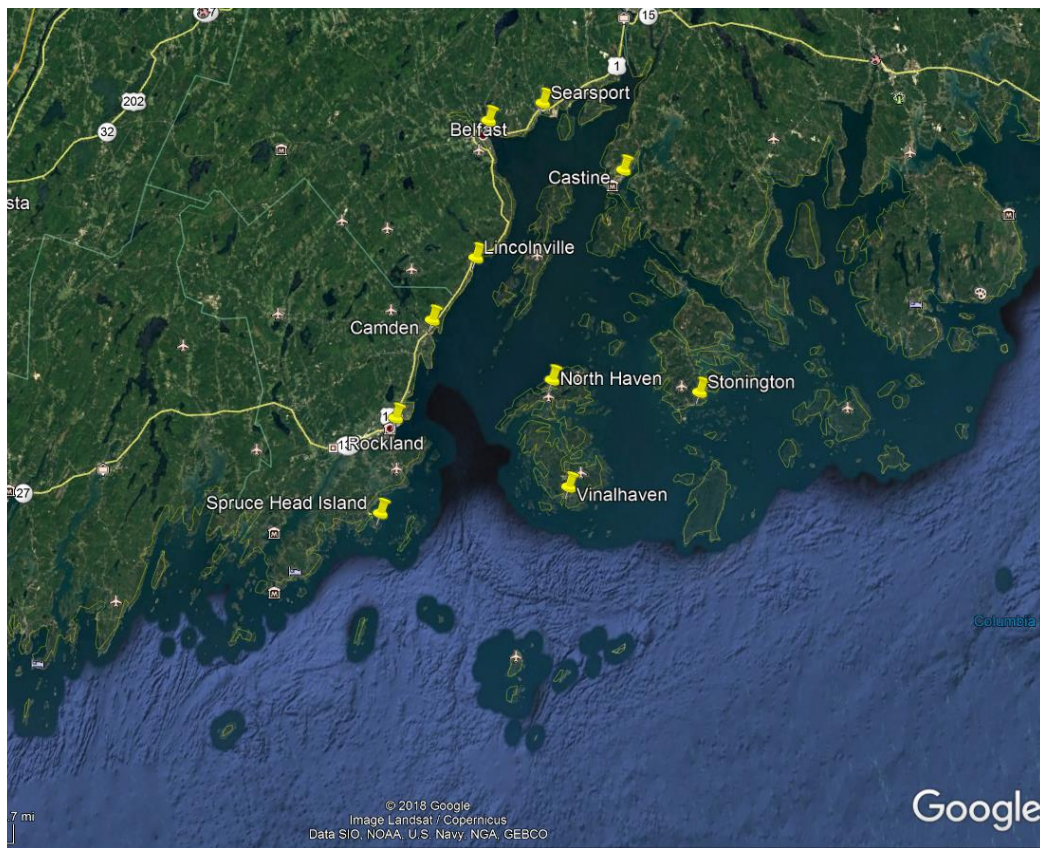


Figure 1: Project site locations

1. Study Sites:

Rockland: Middle Pier

Lincolntonville: Municipal Fishing Pier

Camden: Public Landing

Belfast: Public Landing

Searsport: Hamilton Wharf

Vinalhaven: Ferry Terminal

Castine: Town Dock

Stonington: Lobster Co-op

South Thomaston/Spruce Head Island: Island Road

North Haven: Pulpit Harbor, Izzy's Beach, the Town Waterfront, and Mullen Head

2. General Findings from the Baseline Characterization and Vulnerability Analysis

Wood reviewed documents, conducted interviews, analyzed site topography and elevation, and conducted an engineering analysis of study site structures. The vulnerability analysis also included modeling of tidal, storm surge, and wave-induced inundation under three SLR scenarios: 1 ft, 2 ft, and 4 ft. These scenarios represent potential sea level heights in 2030, 2050, and 2085. Wood provided information showing potential inundation risk and recommended strategies for adaptation, including issues to fix and estimated costs for different types of repairs and timelines.

All sites had deficiencies that increased their vulnerability to future damage. Common issues included corrosion of metal fasteners and dock attachments, deterioration of wood pilings and other support structures, sediment settling or washing out around structures, insufficient structural support of piers, insufficient attachment of floating docks, utilities lacking weatherproof containers, and parking lot and access road deterioration.

Potential repairs to increase resilience include:

- *Wharves and piers:* Confirming that attachments are secure, replacing corroded metal, further structural analyses, and design improvements to account for higher water levels and waves.
- *Floating docks:* Independent moorings, cleaning and replacement of damaged hardware, and gangways and decks could be raised to accommodate higher tides.
- *Buildings:* Buildings are vulnerable to flooding and should be reconstructed, raised, or relocated.
- *Utilities:* Utilities should be secured to resist wind and water or relocated higher above the flood elevation. Fuel tanks should be assessed relative to hydrostatic loading from flooding and be repaired or replaced as needed.
- *Boat ramps:* Need to be raised and regraded to accommodate rising sea levels and remain functional.
- *Shoreline protection:* Current protection should be improved to accommodate rising water levels and increased wave heights, and future efforts should also account for these factors.

Camden, Belfast, Searsport, and Castine are most at risk of inundation because the wharves are shorter and closer to the current high tide line. Rockland, Lincolntonville, Vinalhaven, and Stonington have

higher wharves and are at lower risk of inundation. However, all wharves/piers will be inundated under 1% Base Flood Elevation (BFE). The 1% BFE is often referred to as a “100-year flood” and is the highest water level – including waves – expected during a storm that has a 1-in-100 chance of happening or being exceeded in any given year (for more information, see: <https://www.mass.gov/service-details/1-annual-chance-flood>).

While all of the sites were vulnerable to future damage from sea level rise, the resilience measures mentioned in the report could reduce the impact of storms or extreme high tide events and will help the towns budget and plan for repairs in the near-term and over a longer timeframe.

3. Additional Findings:

The municipalities of South Thomaston and North Haven analyzed working waterfront site vulnerability in different ways.

a. Road inundation evaluation for South Thomaston

Wood completed a road inundation evaluation for South Thomaston because the only road connecting Spruce Head Island to the mainland has two low-lying areas that are at risk of winter icing and storm inundation. Road closures could create safety hazards and also limit access to valuable working waterfront sites on the island. This study evaluated the vulnerability of the road to storm and tidal flooding and provided recommendations for improving its resilience. Wood reviewed info about the road and modeled potential inundation from storm surge, waves, and tides under three sea level rise scenarios: 1 ft, 2 ft, and 4 ft. These represent potential sea level heights in 2030, 2050, and 2085.

South Thomaston received a grant to raise the low-lying part of Island Road and stabilize the shoreline. The analysis from the Working Waterfront Resilience study was designed to help the road improvement project account for sea level rise.

The reconstruction effort should consider:

- Conducting geotechnical assessments to evaluate potential road settling.
- Repairing or replacing culverts to improve drainage and water flow.
- Raising the road between 1-2 feet.
- Stabilizing the road base to prevent washout during flooding.
- Consider geocomposite drains to prevent instability after flooding.
- Design shore protection measures like riprap that account for inundation and wave modeling data for future conditions.

These solutions could increase road resilience for the next ten years, allowing time for the town to consider other, long-term solutions for the road and access to Spruce Head Island.

b. Site evaluation for working waterfront access

The Town of North Haven evaluated alternative waterfront access sites in light of climate challenges. North Haven was planning to expand commercial and recreational use of its harbors and wanted four potential sites analyzed (Pulpit Harbor, Izzy’s Beach, the Town Waterfront, and Mullen Head). The four sites were evaluated and ranked based on their favorability for access, size, harbor

congestion, storm vulnerability, environmental impact, and relative cost. Recommendations for improving waterfront access for commercial and recreational boating were provided to the town.

The Pulpit Harbor Town Dock was identified as the best site, but it would need increased parking, a boat ramp, and utilities. None of the sites were ideal, and a multi-site solution that provided slight and unique improvements to three of the four sites might be the most cost-effective way to collectively meet the town's needs.

Potential improvements for a multi-site solution would include:

- *Pulpit Harbor*: Improving the parking lot, exploring options for expanded parking, adding water and electrical utilities, expanding the pier, and implementing a mooring layout plan.
- *Town Pier and Dock*: Expanding the dock, adding water and electrical utilities to support commercial fishing, adding a power lift, and expanding or adding additional floating docks.
- *Mullen Head*: Building a public boat ramp, road repairs, and water and electrical utilities.