

## **Project Report**

# **Coastal Flood Adaptation Strategies**

Scarborough, Maine

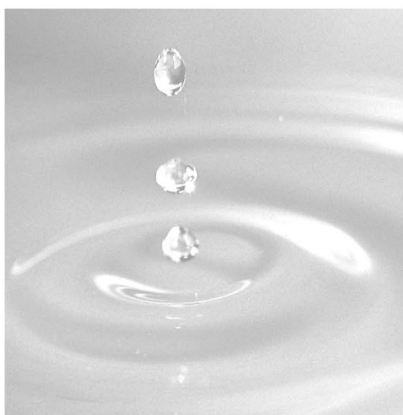
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Project No. 2403961



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# Table of Contents

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|           |                                                                  |           |
|-----------|------------------------------------------------------------------|-----------|
| <b>1.</b> | <b>Introduction.....</b>                                         | <b>1</b>  |
| 1.1.      | Adaptation Strategies Overview                                   | 1         |
| 1.1.1.    | Infrastructure-Based Adaptation Approaches                       | 1         |
| 1.1.2.    | Non-Structural Measures and Community Preparedness               | 1         |
| 1.1.3.    | Do-Nothing Approach                                              | 2         |
| <b>2.</b> | <b>Adaptation Strategies .....</b>                               | <b>3</b>  |
| 2.1.      | Roads                                                            | 3         |
| 2.2.      | Buildings                                                        | 5         |
| 2.2.1.    | Dry Floodproofing                                                | 5         |
| 2.2.2.    | Wet Floodproofing                                                | 6         |
| 2.2.3.    | Conversion of Lowest Floor                                       | 8         |
| 2.2.4.    | Elevation                                                        | 9         |
| 2.2.5.    | Retreat                                                          | 10        |
| 2.3.      | Pump Stations                                                    | 11        |
| 2.4.      | Coastal Ecosystems                                               | 12        |
| 2.4.1.    | Land Preservation                                                | 12        |
| 2.4.2.    | Dune Construction and Restoration                                | 12        |
| 2.4.3.    | Beach Scraping                                                   | 13        |
| 2.4.4.    | Beach Nourishment                                                | 13        |
| <b>3.</b> | <b>Community-Wide Non-Structural Adaptation Strategies .....</b> | <b>14</b> |
| 3.1.      | Water Level Monitoring and Alert System                          | 14        |
| 3.2.      | Road Barricades                                                  | 14        |
| 3.3.      | High-Water Rescue Vehicle                                        | 15        |
| 3.4.      | Emergency Planning and Community Outreach                        | 15        |
| 3.5.      | Policy Measures                                                  | 15        |
| <b>4.</b> | <b>Site-Specific Adaptation Recommendations .....</b>            | <b>16</b> |
| 4.1.      | Roads                                                            | 17        |
| 4.2.      | Pump Stations                                                    | 21        |
| 4.3.      | Additional Assets                                                | 22        |
| 4.4.      | Neighborhood-Scale Adaptation: Higgins Beach and Pine Point      | 23        |
| <b>5.</b> | <b>Cost of Doing Nothing.....</b>                                | <b>26</b> |
| <b>6.</b> | <b>Next Steps.....</b>                                           | <b>27</b> |
| <b>7.</b> | <b>Limitations .....</b>                                         | <b>29</b> |
| <b>8.</b> | <b>References .....</b>                                          | <b>30</b> |

## List of Tables

|                                                            |    |
|------------------------------------------------------------|----|
| Table 4-1. Relative Costs of Implementation                | 17 |
| Table 4-2. Adaptation Options for Select Roads             | 17 |
| Table 4-3. Adaptation Options for Select Pump Stations     | 21 |
| Table 4-4. Adaptation Options for Select Additional Assets | 22 |

## List of Figures

|                                                                                                    |    |
|----------------------------------------------------------------------------------------------------|----|
| Figure 2-1. Damage Along Bayview Avenue after January 2024 Storms                                  | 3  |
| Figure 2-2. Concept of Raised Roadways and a Roadway with a Concrete Floodwall                     | 4  |
| Figure 2-3. Concept of a Raised Roadway with a Sheet Pile Floodwall                                | 5  |
| Figure 2-4. Example of Wet Floodproofing Measures                                                  | 7  |
| Figure 2-5. Example of Retrofitting Lowest Flood with Flood Resistant Materials and Flood Openings | 8  |
| Figure 2-6. Example of Lowest Floor Conversion                                                     | 9  |
| Figure 2-7. Diagram of an Elevated Structure                                                       | 10 |

## Figures

Figure 1 Site Location

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# 1. Introduction

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GEI Consultants, Inc. has prepared this report to provide recommended adaptation strategies for select assets identified as vulnerable to coastal flooding as part of the flood vulnerability assessment for the Town of Scarborough, Cumberland County, Maine (the “Town”) (Figure 1). This work builds off the data review, flood vulnerability analysis, and risk-based prioritization efforts that were documented in previous memos provided to the Town (GEI, 2025a,b,c). The prior memos detail the data, methods, and results of the coastal flood exposure analysis for the Town.

This work is based on Task 5 of the proposal dated April 1, 2024. The purpose of this report is to present an overview of general adaptation strategies for broad asset categories—such as buildings, roadways, and pump stations—as well as more targeted recommendations for specific public assets that were identified as at risk in the coastal flood vulnerability analysis.

## 1.1. Adaptation Strategies Overview

Adaptation strategies to address flood risk can include both infrastructure-based (structural) and non-structural measures. This report provides an overview of both types of strategies that the Town may consider to increase the resilience of its infrastructure and community to flood inundation.

### 1.1.1. *Infrastructure-Based Adaptation Approaches*

Infrastructure-based adaptation strategies can include measures such as:

- **Protect** – Prevent floodwaters from reaching assets by constructing barriers such as seawalls or levees.
- **Accommodate** – Reduce the impact of flooding by elevating structures or implementing floodproofing techniques to minimize damage.
- **Retreat** – Relocate infrastructure away from areas at high risk of flooding.

Advancing infrastructure-based adaptation strategies would require additional phases of work before the recommendations can be implemented, such as site survey, preliminary design, permitting, and final design. The adaptation recommendations provided in this report are intended to serve as a starting point for further investigation and planning.

### 1.1.2. *Non-Structural Measures and Community Preparedness*

In addition to physical infrastructure improvements, non-structural measures can be used to reduce flood risk. Non-structural measures include:

- **Public Education** – Increase knowledge of flood risk and safety practices to reduce risk to life during periods of inundation.
- **Temporary Barriers** – Discourage and/or prevent travel through potentially unsafe areas.

- **Policy Measures** – Implement land use regulations or other policy measures through local ordinances.
- **Early Warning Systems and Emergency Alerts** – Alert community members to upcoming events that have potential to cause flood inundation to allow for planning and preparation. Public safety and emergency response agencies may also consider issuing evacuation or shelter-in-place advisories for areas of the Town.

The decisions around evacuation or shelter-in-place advisories should be made by public safety and emergency response agencies. This study does not intend to replace or override the authority of those agencies.

### ***1.1.3. Do-Nothing Approach***

The “Do-Nothing” alternative—leaving infrastructure and land uses unchanged—is a standard baseline for evaluating adaptation strategies. While it avoids upfront capital costs, it can carry long-term risks and expenses, including increased maintenance and repair costs, loss of economic activity, public safety risks, environmental degradation, and potential loss of life and property. More details on the costs related to “doing nothing” are provided in Section 5 of this report.

## 2. Adaptation Strategies

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### 2.1. Roads

Roadways can be adapted to reduce flood risk through a variety of measures, including elevation, relocation, abandonment, or protection using structural barriers such as seawalls. In general, road infrastructure is relatively resilient to damage from temporary stillwater flood inundation (i.e., without wave action). Once floodwater recedes, most roadways can be returned to service with minimal repair. However, as periods of inundation become longer and/or more frequent, roadways can be subject to surface material degradation and subgrade erosion, which can lead to cracking, potholes, and a general weakening of the integrity of the roadway surface. Beyond standing water, roadways located in coastal areas exposed to wave action (such as Bayview Avenue in the Higgins Beach neighborhood) are at an increased risk to infrastructure damage, as experienced in the January 2024 storm events. Wave impacts can compromise the integrity of the roadway itself or associated shoreline protection structures, such as revetments. Even without wave damage, flood events can deposit debris on road surfaces, which must be cleared to ensure safe passage.

**Figure 2-1. Damage Along Bayview Avenue after January 2024 Storms**



Source: WGME (2024)

Among the available adaptation options, road elevation is often a cost-effective solution. However, feasibility may be limited by site-specific constraints, including topography and regulatory requirements. In particular, coastal sand dune protection regulations may restrict elevation projects in sensitive areas

such as Pine Point and Higgins Beach. Road elevation typically requires the addition of fill which must be retained by walls or expanded side slopes, both of which can expand the footprint of construction. An increase in footprint can result in impacts to adjacent properties and/or habitat areas which can be important constraints to design of an elevated roadway section.

Figures 2-2 and 2-3 show high-level concepts of elevated roadways and roadways protected by seawalls. Adaptation recommendations for specific roadways in the Town are provided in Section 4.1.

**Figure 2-2. Concept of Raised Roadways and a Roadway with a Concrete Floodwall**

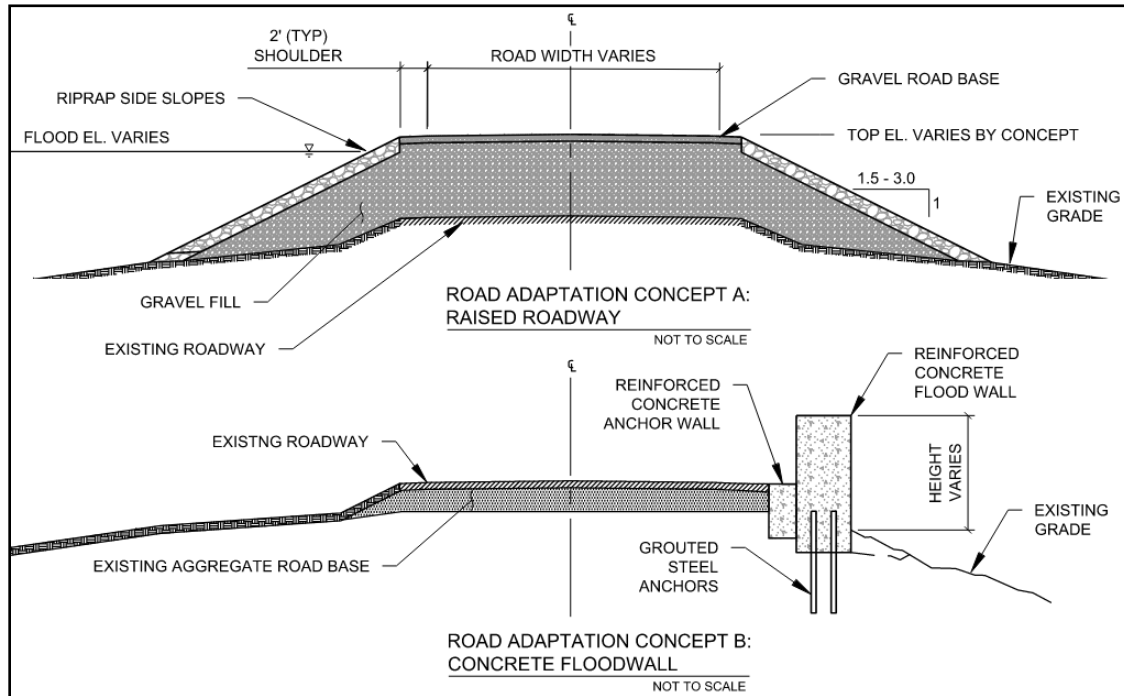
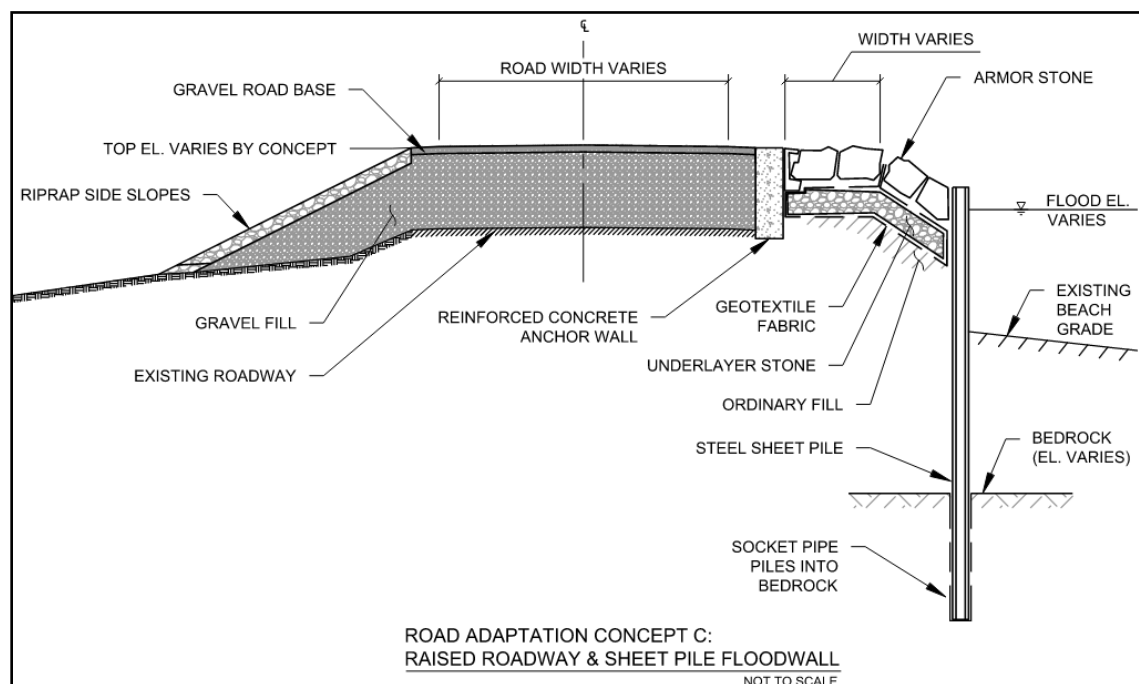


Figure 2-3. Concept of a Raised Roadway with a Sheet Pile Floodwall



## 2.2. Buildings

Adaptation strategies for buildings at risk of coastal flood inundation are provided below, including dry and wet floodproofing, conversion of the use of the first floor, elevation, and retreat.

### 2.2.1. Dry Floodproofing

Dry floodproofing is a structural adaptation technique designed to limit or prevent floodwaters from entering a building. This method involves reinforcing the building envelope and installing barriers to create a watertight seal around the structure.

Dry floodproofing measures can include:

- **Floodwalls or Levees:** Permanent or temporary barriers constructed around a building to block floodwaters.
- **Flood Barriers at Openings:** Installation of shields or panels over doors, windows, and other openings to prevent water intrusion.
- **Sealing the Building Envelope:** Application of waterproof coatings or membranes to exterior walls, typically up to the anticipated flood elevation, to prevent seepage.
- **Structural Reinforcement:** Buildings may require additional reinforcement to withstand the hydrostatic and hydrodynamic forces exerted by floodwaters.
- **Utility Modifications:** Installation of backflow prevention valves in sewer and drainage lines to stop floodwaters from entering through plumbing systems.

Dry floodproofing is generally more suitable for non-residential buildings, particularly those constructed with materials and designs that can support the necessary reinforcements. It is more likely to be effective in areas subject to shallow flooding and where floodwaters would not likely exceed three feet in depth.

### **2.2.2. *Wet Floodproofing***

Wet floodproofing involves the adaptation of a building to accommodate exposure to floodwater while minimizing risk of damage to the structure and its contents.

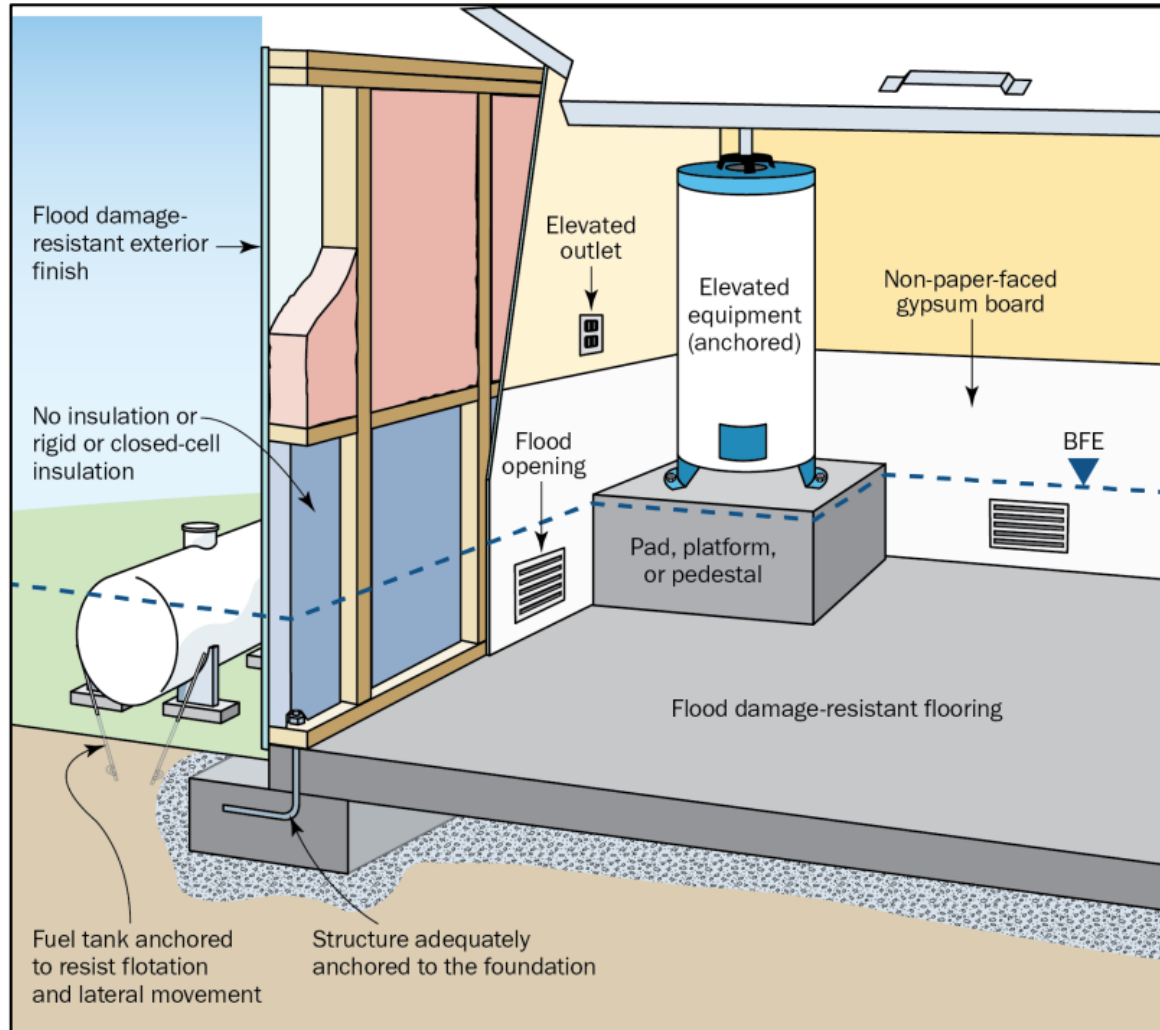
Key wet floodproofing measures include:

- **Flood Openings:** Installing engineered openings in foundation or enclosure walls to allow water to flow freely into and out of the structure.
- **Elevation of Utilities:** Raising electrical panels, HVAC systems, and other mechanical equipment above the elevation of anticipated flooding to prevent water damage and maintain functionality.
- **Use of Flood-Resistant Materials:** Incorporating materials such as concrete, tile, or pressure-treated wood in floors, walls, and finishes that could likely withstand direct contact with water and would be easy to clean and dry. Minimizing/eliminating the use of drywall, fiberglass insulation, or other materials that would be highly prone to damage by flood exposure.
- **Elevation of Contents:** Storing valuable or sensitive items above the anticipated flood level to reduce the risk of loss or damage. Securing items with potential to become buoyant during a flood event to reduce the potential for floating debris.

While wet floodproofing could reduce repair costs following a flood, it would allow water to enter the structure, which could temporarily affect the building's serviceability and operability. Therefore, this method is typically recommended for non-residential or accessory structures, or in cases where dry floodproofing or elevation would not be feasible.

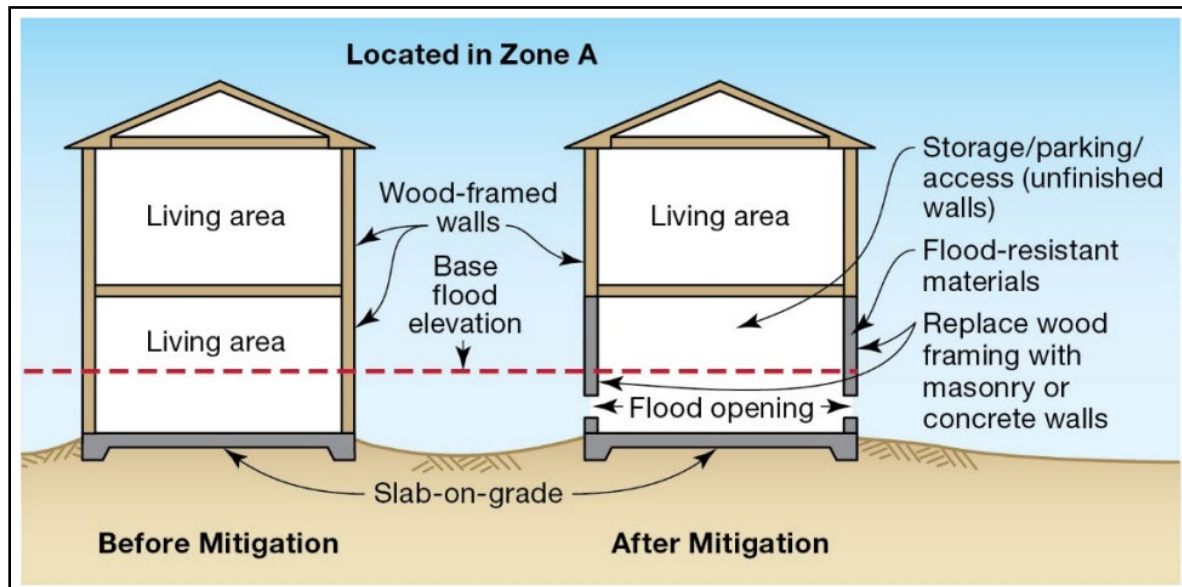
Refer to Figures 2-4 and 2-5 for visual examples of wet floodproofing applications.

Figure 2-4. Example of Wet Floodproofing Measures



Source: FEMA (2022)

Figure 2-5. Example of Retrofitting Lowest Flood with Flood Resistant Materials and Flood Openings



Source: FEMA (2019)

### 2.2.3. Conversion of Lowest Floor

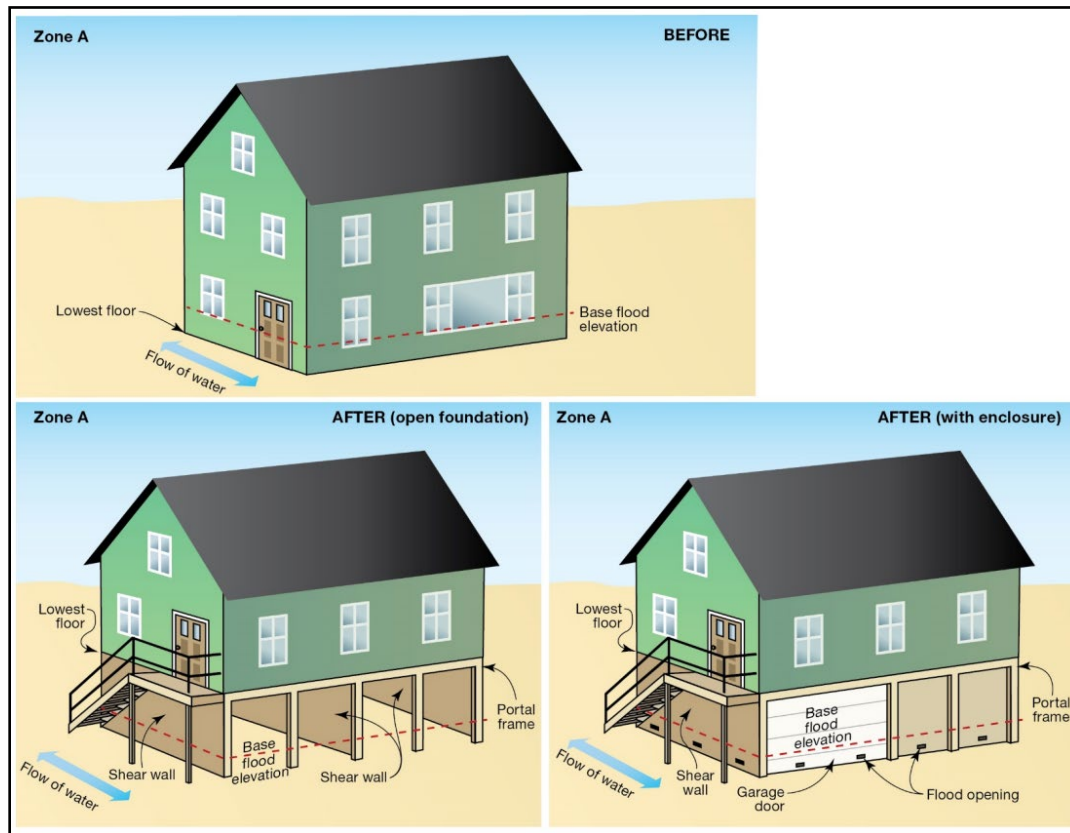
Converting the lowest floor of a building from enclosed, occupied space to open, unoccupied space is another flood risk reduction strategy for buildings. This approach, illustrated in Figure 2-6, involves modifying the ground level to allow water to flow through freely during flood events, thereby reducing hydrostatic pressure on the structure and minimizing potential damage.

In this method, the original first floor is repurposed for non-habitable uses such as parking, storage, or access, while the second floor becomes the lowest occupied level. The modified ground level typically features open or flow-through construction, such as breakaway walls or piers, to accommodate floodwaters.

To ensure structural integrity, the building may require reinforcement of the foundation and support elements to withstand flood forces, and replacement or retrofitting of materials with flood-resistant alternatives in areas expected to be exposed to water.

While this strategy is generally less invasive and could be more cost-effective than elevating the entire building, it does result in a reduction of usable, occupied space. Therefore, it is more appropriate for buildings where the loss of lower-level occupancy is acceptable or where zoning and building codes permit such modifications.

Figure 2-6. Example of Lowest Floor Conversion



Source: FEMA (2019)

## 2.2.4. Elevation

Elevating structures above projected flood levels could be an effective strategy for reducing flood risk. By raising a building above anticipated flood elevations, including those associated with storm surge and future sea level rise, the risk of structural damage and loss of function during flood events would likely be reduced.

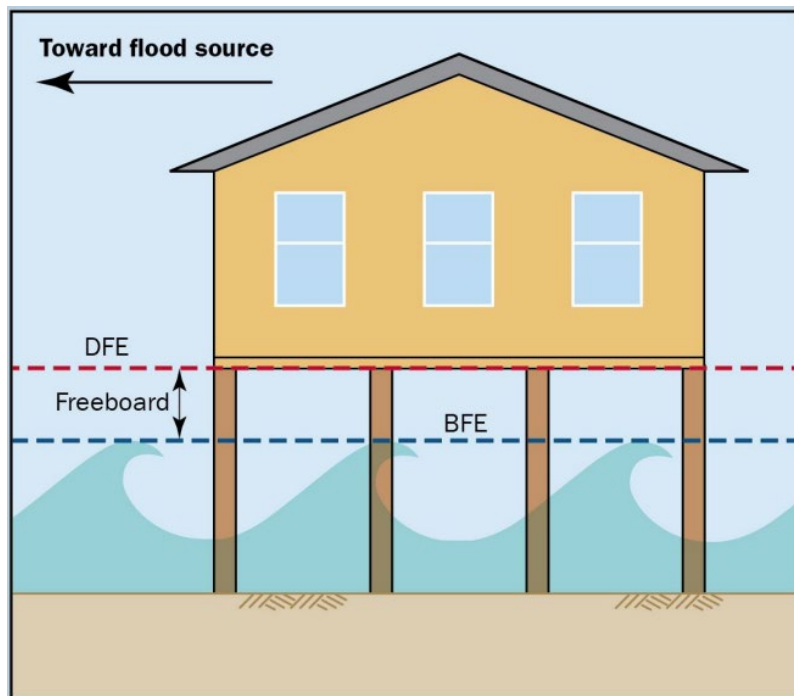
The target elevation for a structure is typically determined by:

- Minimum code and regulatory requirements, such as the local building code and the floodplain management regulations of the authority having jurisdiction. The Federal Emergency Management Agency (FEMA) Base Flood Elevation (BFE) is typically the basis for the design flood elevation, in the absence of more refined analysis, and is combined with any additional specified freeboard.
- Owner risk tolerance, which may justify incorporating additional freeboard—an extra margin of height above the minimum required elevation—to account for future sea levels, an increase in intensity of storm events, and other uncertainties in flood projections.

See Figure 2-7 for a diagram of an elevated structure that incorporates additional freeboard above the BFE.

This approach is particularly effective in areas subject to frequent or severe flooding and can be a prerequisite for compliance with floodplain management regulations and eligibility for flood insurance. Where owners are eligible for flood insurance under the National Flood Insurance Program, the amount of freeboard that a structure has above the minimum required elevation can influence insurance rates for the property.

**Figure 2-7. Diagram of an Elevated Structure**



Source: FEMA (2025).

Note: BFE stands for “Base Flood Elevation,” and DFE stands for “Design Flood Elevation,” which can include additional freeboard above the BFE.

### **2.2.5. Retreat**

In certain situations, managed retreat, or “getting out of harm’s way,” could be an appropriate strategy for reducing flood risk. With rising sea levels, some properties may become uninhabitable, or inaccessible, despite protective or adaptive measures. This approach involves relocating structures away from high-risk flood zones, particularly when:

- The risk of flood exposure is severe or expected to increase significantly over time.
- The cost of adaptation (e.g., elevation or floodproofing) is prohibitively high.
- The function of the structure does not require a waterfront or flood-prone location.

For properties with sufficient land outside the floodplain, retreat may involve relocating buildings to higher ground on the same parcel, often in combination with elevation to meet flood protection standards. In other cases, retreat may involve removing structures entirely from flood-prone areas.

Vacated properties can be restored to natural or open space, such as wetlands, dunes, or vegetated buffers. These naturalized areas provide ecological benefits and could serve as resilient flood buffers, likely absorbing and dissipating floodwaters more effectively than developed land.

Managed retreat is a long-term resilience strategy that could likely reduce future risk and maintenance costs while enhancing environmental sustainability. Managed retreat programs allow property owners to relocate proactively, reducing the financial, physical, and emotional toll of forced displacement. These programs could also support the restoration of flood-prone areas to natural open space, enhancing flood resilience and ecological value.

## 2.3. Pump Stations

Similar to buildings, pump stations should be protected from flood-related damage and performance disruptions through floodproofing measures. These strategies aim to either prevent water intrusion (dry floodproofing) or allow controlled water entry while minimizing damage (wet floodproofing).

- **Dry Floodproofing**, which involves sealing openings and reinforcing structures to prevent water from entering. For pump stations, this may include:
  - **Watertight hatches** over dry well vaults to prevent inundation.
  - **Sealed doors** on above-ground facilities to block floodwater entry.
  - **Floodproofed manhole covers** to prevent water from entering the sewer system.
- **Wet Floodproofing**, which allows water to enter the structure but relies on the use of flood-resistant materials and elevated or sealed internal components to limit or prevent damage. This approach is less common for pump stations but may be considered in specific design contexts.
- **Perimeter Flood Barriers**. In addition to component-specific measures, temporary or permanent flood barriers could be installed around pump stations to provide broader protection. These systems may require internal drainage or sump pumps to manage rainwater or seepage that accumulates within the protected area during a storm.
- **Elevating**. Elevating pump station features could reduce damage potential from flood inundation. Electrical panels and controls are likely at risk of being damaged if installed near ground surface and have the potential to be inundated by storm surge or sea level rise. Elevating sensitive infrastructure helps to reduce risk. Other features that would benefit from elevating above flood risk levels include pump station can openings, electrical and communications wiring, vent pipes, and fill pipes for fuel tanks. For pump stations housed in structures, the structure could be elevated above the design flood elevation to reduce flood risk.

Floodproofing manholes in conjunction with pump stations would likely reduce overall flood risk to the sewer system. If manholes remain vulnerable to inundation, coastal floodwaters could infiltrate the sewer network and compromise the pump stations.

## **2.4. Coastal Ecosystems**

Coastal ecosystems such as wetlands, beaches, and sand dunes can play a critical role in flood mitigation, shoreline stability, and ecological health of a community. As sea levels rise, allowing these systems to migrate and adapt naturally would promote continued ecological benefit from these resources. The following adaptation strategies support the long-term resilience of these natural features.

### **2.4.1. Land Preservation**

Preserving undeveloped land upland of existing wetlands, beaches, and dunes allows these systems to migrate inland in response to sea level rise. Without adequate space, natural features could become trapped between rising waters and built infrastructure, leading to their degradation or loss.

For wetlands, land preservation supports marsh migration, helping maintain their flood-buffering capacity. For dunes, it enables inland movement, preserving their ability to absorb wave energy and storm surge.

Key land preservation strategies include:

- Updating zoning and ordinances to restrict development in migration corridors.
- Acquiring land or securing conservation easements.
- Coordinating with land trusts and conservation partners.

In addition to preserving physical space, maintaining tidal transparency—the unobstructed movement of tidal waters through the landscape—promotes ongoing wetland health. Infrastructure such as undersized culverts can restrict tidal flow, impairing wetland function and resilience. Enhancing tidal connectivity through infrastructure improvements will help sustain wetland ecosystems and their flood-mitigating benefits.

These preservation efforts will likely reduce flood risk while also enhancing opportunities for recreation, tourism, and ecological restoration.

### **2.4.2. Dune Construction and Restoration**

Where dunes have been degraded or lost, they could be constructed or restored using upland sand sources or sand that is beneficially reused from dredging projects. Stabilization techniques may include:

- Jute matting or coir logs.
- Recycled holiday trees.
- Enhanced dune fencing.
- Native vegetation plantings.

These methods help trap sand and promote natural dune growth. However, added sand should be considered sacrificial, as seasonal erosion and accretion will continue to reshape the dune system.

### ***2.4.3. Beach Scraping***

Beach scraping involves redistributing sand from lower beach areas to reinforce vulnerable dune sections. While this method does not introduce new sediment into the system, it can provide short-term protection while more permanent solutions are developed. Scraping should be carefully managed to minimize ecological impacts and comply with regulatory requirements.

### ***2.4.4. Beach Nourishment***

Beach nourishment increases the width and elevation of the dry beach by placing sand along the shoreline, often sourced from dredged navigation channels. This strategy can be paired with dune restoration to enhance coastal protection.

Nourishment projects can be conducted in partnership with the U.S. Army Corps of Engineers (USACE) if conducted in cooperation with a federal dredge or may be undertaken as part of a private or municipal dredge project. These projects require environmental permitting and long-term maintenance planning for both the dredging and beach nourishment activities.

### 3. Community-Wide Non-Structural Adaptation Strategies

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Non-structural adaptation measures play an important role in reducing the impacts of flood events on people and property. While these strategies do not necessarily prevent flooding, they can improve public safety, emergency response, and community resilience. Many of these measures could be implemented in the near term and could address both current and future flood risks.

#### 3.1. Water Level Monitoring and Alert System

Installing water level monitoring and alert systems in flood-prone areas could provide real-time data and early warnings to residents. These systems can trigger alerts through community emergency notification platforms when water levels exceed thresholds that may result in flooding.

Vendors such as Hohonu and Divirod offer water level monitoring services tailored for municipalities. Hohonu currently operates a sensor at the mouth of the Scarborough River in Pine Point. The Hohonu monitoring station could be set up with an alert system to notify the community when water levels exceed a specific threshold. Divirod offers similar services, including real-time dashboards and customizable alerts. The Town may also explore other reliable providers.

In addition to real-time monitoring, the Town could implement an alert system based on predicted astronomical high tides. NOAA's *Monthly High Tide Flooding Outlook* (NOAA, 2025) provides tide forecasts up to one year in advance, including data for the Portland, Maine tide gauge. Prior to predicted high tide events, the Town could issue public advisories encouraging residents to:

- Prepare to shelter in place with adequate supplies.
- Avoid driving through flooded areas.
- Relocate temporarily if they require uninterrupted access to medical care.

#### 3.2. Road Barricades

The Town of Scarborough should continue maintaining pre-positioned road barricades near frequently flooded roadways and be prepared to implement additional barriers along roadways that may see additional flooding in the future. The Town could consider installing a gate system that could be operated remotely along roadways that frequently experience flooding. During anticipated high-water events, Town staff should deploy these barricades to prevent vehicles from entering flooded areas.

Driving through floodwaters is hazardous and can be life threatening due to reduced visibility of road conditions, potential for vehicle stalling or entrapment, or potential for vehicle to be swept away with the floodwater. The Town should consider implementing a public education campaign to raise awareness about the dangers of driving through flooded roads and encourage compliance with barricade placements.

### **3.3. High-Water Rescue Vehicle**

To ensure emergency access during flood events, the Town should consider acquiring or partnering with regional agencies to operate a high-water rescue vehicle. These vehicles are designed to navigate inundated roadways and can be used to evacuate residents experiencing medical emergencies or other urgent needs during flood conditions.

### **3.4. Emergency Planning and Community Outreach**

The Town should review and update its emergency response and evacuation plans, with a focus on high-risk neighborhoods such as Higgins Beach, Pine Point, and Prouts Neck. Key planning actions include:

- Temporarily closing roads like Ocean Avenue and Pine Point Road to non-local traffic during flood events.
- Pre-positioning emergency response equipment (e.g., fire trucks) in areas that may become isolated.
- Implementing targeted alert systems (e.g., phone, text, email, or door-to-door notifications) to encourage timely evacuation.

Community engagement is an important part of the success of emergency planning. The Scarborough Emergency Management Agency (EMA) currently hosts biannual outreach events at the Public Library and Public Safety Building. The Town should expand these efforts by conducting neighborhood-specific outreach in at-risk areas to increase participation and preparedness.

### **3.5. Policy Measures**

Policy tools, such as local ordinances, can have a role in enhancing the resilience of coastal communities. Municipal ordinances can be used to implement and support a wide range of adaptation strategies.

Examples of ordinance-based resilience measures include:

- Establishing buffer zones around coastal ecosystems to allow for inland migration in response to sea level rise.
- Requiring resilient building practices that promote flood-resistant design and limit development in high-risk areas.
- Creating coastal overlay districts that apply design standards and land use restrictions based on site-specific flood risk.

As part of this project, GEI conducted a review of selected Scarborough Town Ordinances to identify opportunities for strengthening local policy in support of climate adaptation and flood resilience. Recommendations for ordinance revisions and additions have been provided in a separate memorandum as part of this project (GEI, 2025).

## 4. Site-Specific Adaptation Recommendations

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We have developed high-level, site-specific adaptation recommendations for various assets and areas across Scarborough. These include priority roadway segments; flood-vulnerable pump stations; additional municipal assets such as trails, parking lots, and public buildings; and neighborhood-scale strategies for areas with concentrated coastal flood risk.

These recommendations are intended to serve as guidance for potential adaptation actions. Decisions regarding which assets to adapt—and how—should be informed by a range of factors, including site-specific flood risk, community priorities and public support, funding availability, coordination with nearby infrastructure projects, and regulatory and environmental considerations. Further investigation into these strategies is required to understand feasibility in terms of right of way access, site topography, and permitting constraints.

We have provided recommendations in the following sections that could likely be implemented to reduce flood risk by 2050, or through Flood Scenario 7. Adaptation options that reduce flood risk for the 2100 timeframe (Flood Scenarios 8-10) will require longer-term planning and policy changes. There is more uncertainty around sea level rise projections for the 2100 timeframe. We will have a better understanding of adaptation design strategies and elevations to reduce flood risk as we approach that timeframe.

To support planning, we have included relative cost estimates for the recommendations using a dollar sign scale:

- **\$** – Low-cost measures likely feasible within a single fiscal year using existing Town funds.
- **\$\$** – Moderate-cost measures requiring capital improvement planning, but potentially achievable within one budget cycle.
- **\$\$\$** – High-cost measures requiring substantial funding or a multi-year implementation approach.
- **\$\$\$\$** – Very high-cost measures likely requiring multiple funding sources and long-term planning.

These cost indicators are intended for preliminary planning purposes only. More detailed cost estimates will need to be developed during future phases of design, engineering, and permitting. For planning purposes, we have included a range of possible costs for the relative costs estimates, which have been summarized in Table 4-1. The costs provided in the table represent relative dollar costs to implement, but do not account for economic gains or losses from implementing the adaptation strategies.

A more thorough cost benefit analysis will provide a better understanding of total costs, including economic impacts, particularly for “do nothing” approaches. In many cases, we have provided a range of relative costs for the “do nothing” approach, since it could also depend on the condition of current infrastructure and likelihood of damage.

**Table 4-1. Relative Costs of Implementation**

| Symbol   | Cost                    |
|----------|-------------------------|
| \$       | < \$100,000             |
| \$\$     | \$100,000 - \$500,000   |
| \$\$\$   | \$500,000 - \$5,000,000 |
| \$\$\$\$ | > \$5,000,000           |

## 4.1. Roads

We have provided adaptation options for 17 of the top 30 ranked roads identified in the road prioritization study (GEI, 2025c). The remaining 13 roads from the top 30 list are located in the Higgins Beach or Pine Point neighborhoods, and in these areas, coastal flood risk is a neighborhood-scale issue and therefore we have provided adaptation options for the neighborhood as opposed to individual road segments. However, key collector and arterial roads critical for access to these neighborhoods, like Ocean Avenue and Pine Point Road, are addressed on an individual basis.

The adaptation recommendations provided in the table below are based on the permitting rules and regulatory zones (FEMA flood zones and Maine Coastal Sand Dune zones) as of the date of this report. For example, the current Maine Sand Dune Rules may limit road elevation within the limits of a sand dune. These rules could be subject to change, and it is recommended to review permitting constraints when designing adaptation options for roadways and other infrastructure.

The suggested adaptation options for individual road segments are provided in Table 4-2. Assets in the table are listed alphabetically for ease of reference. The order of presentation does not imply prioritization or recommended sequencing for implementation.

**Table 4-2. Adaptation Options for Select Roads**

| Road Name      | Option 1                                                                                                                                                                                                 | Cost 1 | Option 2                                                                                                                                                                                           | Cost 2 | Option 3                                                                                                                                   | Cost 3   |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Bayview Avenue | Raise existing revetment 2'; Construct shoreline stabilization between Pearl Street and Ashton Street through revetment or dune reconstruction; Elevate road between Morning Street and Champion Street. | \$\$\$ | Abandon road between Ocean Avenue and Morning Street; reconstruct dune; install wastewater pumps at southern ends of perpendicular roads. Elevate road between Morning Street and Champion Street. | \$\$\$ | "Do nothing," i.e., continue maintaining roadway. Estimated costs assumes over \$2M in storm damage for a given major coastal storm event. | \$\$\$\$ |

| Road Name        | Option 1                                                                                                                            | Cost 1   | Option 2                                                                                                                                                                                                                                                                                                                                                                                                        | Cost 2                     | Option 3                                                                                                                                                     | Cost 3           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Black Point Road | Elevate road at Libby & Nonesuch River crossings; enlarge tidal crossings.                                                          | \$\$\$\$ | Elevate road near Winnocks Neck; Abandon other low-lying road segments; utilize Highland Avenue, Fogg Road, and Spurwink Road for access.                                                                                                                                                                                                                                                                       | \$\$\$ <sup>1</sup>        | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses. | \$ -<br>\$\$\$\$ |
| Clay Pits Road   | Elevate road; elevate boat ramp and parking in current location.                                                                    | \$\$\$   | Abandon road beyond boat ramp.                                                                                                                                                                                                                                                                                                                                                                                  | \$-<br>\$\$\$ <sup>1</sup> | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.                                | \$ -<br>\$\$\$\$ |
| E Grand Avenue   | Elevate roadway.                                                                                                                    | \$\$\$\$ | Install deployable flood barrier along sections of northern side of roadway (Blaine Avenue to Old Orchard Beach Town line, between Dover Street and Beach Street, between Pine Point Road and Oak Street). Assumes inundation would be prevented via elevation or flood barrier along Pine Point Road near E Grand Avenue. Require evacuation of residences accessed along the northern side of E Grand Avenue. | \$\$                       | “Do nothing” – barrier inundated sections of roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.          | \$ -<br>\$\$\$\$ |
| Ferry Road       | Elevate western end of roadway. Elevating the parking lot may face permitting difficulties and would require further investigation. | \$\$\$   | Abandon end of road; move parking lot inland or create a satellite parking lot; allow for beach and dune migration inland.                                                                                                                                                                                                                                                                                      | \$\$\$                     | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.                                | \$ -<br>\$\$\$\$ |
| Milliken Road    | Elevate southern end of road to tie into elevated Route 1 <sup>2</sup> .                                                            | \$\$     | Abandon southern end of roadway; access road from Payne Road.                                                                                                                                                                                                                                                                                                                                                   | \$-<br>\$\$\$ <sup>1</sup> | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.                                | \$ -<br>\$\$\$\$ |

| Road Name                          | Option 1                                                                | Cost 1   | Option 2                                                                                                                                                                                            | Cost 2              | Option 3                                                                                                                                                                                                                                                          | Cost 3           |
|------------------------------------|-------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Ocean Avenue                       | Elevate road; enlarge tidal crossing                                    | \$\$\$   | Abandon northern end of road, north of Higgins Creek Road; construct new road stemming from between Higgins Creek Road and Oceanwood Drive that connects to Spurwink Road across from Dorado Drive. | \$\$\$              | “Do nothing” – barrier roadway during storm events. Collaborate with Piper Shores to use Greenwood Avenue and Piper Road for access during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses. | \$ -<br>\$\$\$\$ |
| Old Neck Road                      | Elevate                                                                 | \$\$\$   | Deployable flood barrier along marsh side of roadway; residents on marsh side of flood barrier would be encouraged to evacuate during storm events                                                  | \$                  | “Do nothing” - barrier roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.                                                                                                                                     | \$ -<br>\$\$\$\$ |
| Payne Road                         | Elevate; enlarge tidal crossings                                        | \$\$\$\$ | Abandon between Milliken Road and Beech Ridge Road; provide alternative access to Sargent Road                                                                                                      | \$\$\$ <sup>1</sup> | “Do nothing” - barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses.                                                                                                      | \$ -<br>\$\$\$\$ |
| Pine Point Road (near Jones creek) | Elevate; enlarge crossing to increase tidal transparency to Jones Creek | \$\$\$\$ | “Do nothing” - barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses.                                        | \$ -<br>\$\$\$\$    |                                                                                                                                                                                                                                                                   |                  |
| Route 1 <sup>2</sup>               | Elevate; increase crossing opening size for tidal transparency          | \$\$\$\$ | “Do nothing” - barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses.                                        | \$ -<br>\$\$\$\$    |                                                                                                                                                                                                                                                                   |                  |

| Road Name                                        | Option 1                                                                  | Cost 1   | Option 2                                                                                                                                                     | Cost 2              | Option 3                                                                                                                                                     | Cost 3           |
|--------------------------------------------------|---------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Route 9 <sup>2</sup><br>near<br>Cascade<br>Brook | Elevate; increase crossing opening for tidal transparency                 | \$\$\$\$ | Abandon road; restore marsh; utilize Old Blue Point Road to access southern portion of Pine Point Road.                                                      | \$\$\$ <sup>1</sup> | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses. | \$ -<br>\$\$\$\$ |
| Sawyer Street <sup>3</sup>                       | Elevate; increase crossing opening for tidal transparency                 | \$\$\$\$ | Abandon road segment; restore marsh.                                                                                                                         | \$\$\$              | “Do nothing” – barrier roadway during storm events. Estimated cost assumes existing culvert would need to be replaced.                                       | \$\$\$\$         |
| Snow Canning Road                                | Elevate; increase crossing opening for tidal transparency                 | \$\$\$\$ | Abandon road; relocate facilities; restore marsh area                                                                                                        | \$\$\$              | “Do nothing” – barrier roadway during storm events. Estimated cost assumes existing culvert would remain through 2050.                                       | \$ -<br>\$\$\$\$ |
| Spurwink Road                                    | Elevate near Birch Lane; increase crossing opening for tidal transparency | \$\$\$   | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses. | \$ -<br>\$\$\$\$    |                                                                                                                                                              |                  |
| Winnocks Neck Road                               | Elevate                                                                   | \$\$\$   | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate, need for culvert replacement, and economic losses. | \$ -<br>\$\$\$\$    |                                                                                                                                                              |                  |
| Winnocks Neck to Plummer Island                  | Elevate via bridge over existing railroad tracks                          | \$\$\$\$ | “Do nothing” – barrier roadway during storm events. Estimated costs depend on roadway deterioration rate and economic losses.                                | \$ -<br>\$\$\$\$    |                                                                                                                                                              |                  |

Notes:

1. The cost of abandonment could range depending on if a “do nothing” approach is used (i.e., road is blocked off during storms and the road naturally deteriorates over time) or if the road is actively removed (i.e., marsh restoration efforts are pursued and/or impacted properties compensated).
2. The Maine DOT is currently underway on a road elevation adaptation project for U.S. Route 1 and U.S. Route 9.
3. The Town is currently planning to abandon and remove Sawyer Street and conduct marsh restoration.

## 4.2. Pump Stations

Table 4-3 summarizes adaptation options for the 14 pump stations identified as at-risk of coastal flooding, as detailed in the Results Memo (GEI, 2025b). Assets in the table are listed alphabetically for ease of reference. The order of presentation does not imply prioritization or recommended sequencing for implementation.

**Table 4-3. Adaptation Options for Select Pump Stations**

| Station Name                        | Option 1                                                | Cost 1      | Option 2                                                                              | Cost 2    | Option 3               | Cost 3 |
|-------------------------------------|---------------------------------------------------------|-------------|---------------------------------------------------------------------------------------|-----------|------------------------|--------|
| Public 1: Pine Point                | Elevate can lid and electrical equipment                | \$\$        | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$\$ | Seal interior conduits | \$     |
| Public 2: Pine Point, Eastern Trail | Elevate structure                                       | \$\$-\$\$\$ | Install watertight door and seal ingresses                                            | \$        |                        |        |
| Public 3: Wild Duck - Dunstan       | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 6: Old Neck                  | Elevate structures, wet wells, and electrical equipment | \$\$\$      | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   |                        |        |
| Public 7: Higgins Beach             | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 8: Prouts Neck               | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 9: Fogg Road                 | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 10: Clay Pits Road           | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 11: Old County Road          | Elevate structure and electrical equipment              | \$\$\$      | Install watertight door and seal conduits and ingresses                               | \$        |                        |        |
| Public 12: Libby Road               | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 13: Tall Pines Road          | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |
| Public 14: Industrial Park          | Elevate can lid and electrical equipment                | \$          | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$   | Seal interior conduits | \$     |

| Station Name              | Option 1                                 | Cost 1 | Option 2                                                                              | Cost 2  | Option 3                                                | Cost 3 |
|---------------------------|------------------------------------------|--------|---------------------------------------------------------------------------------------|---------|---------------------------------------------------------|--------|
| Public 15: Partridge Lane | Elevate can lid and electrical equipment | \$     | Temporary or permanent flood barrier around station; interior drainage pumping system | \$-\$\$ | Seal interior conduits                                  | \$     |
| Public 16: River          | Elevate structure and can lid            | \$\$   | Flood barrier around can                                                              | \$\$    | Install watertight door and seal conduits and ingresses | \$     |
| Public 21: Pleasant Hill  | Elevate can lid and electrical equipment | \$     | Seal conduits                                                                         | \$      |                                                         |        |

### 4.3. Additional Assets

Table 4-4 summarizes adaptation options for seven additional assets at-risk of coastal flooding.

**Table 4-4. Adaptation Options for Select Additional Assets**

| Asset Name              | Option 1                                                                                                                            | Cost 1   | Option 2                                                                                                                              | Cost 2          | Option 3                                                                                                                                          | Cost 3          |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Eastern Trail           | Elevate                                                                                                                             | \$\$\$\$ | Construct nature-based shoreline solutions to protect shoreline from erosion                                                          | \$\$            | “Do nothing” – barrier trail during storm events. Estimated costs depend on trail deterioration rates, economic losses, and the choice to repair. | \$-<br>\$\$\$\$ |
| Ferry Beach Parking Lot | Relocate inland of current location                                                                                                 | \$\$\$   | Elevate the parking lot. This option may face permitting difficulties and would require additional investigation.                     | \$\$\$          | “Do nothing” – barrier parking lot during storm events. Estimated costs depend on parking lot deterioration rates and economic losses.            | \$-<br>\$\$\$\$ |
| Hurd Park               | Elevate the portion of the parking lot in the Back Sand Dune. Leave the rest of the parking lot as is, or convert to a dune system. | \$\$\$   | Do nothing” – barrier parking lot during storm events. Estimated costs depend on parking lot deterioration rates and economic losses. | \$-<br>\$\$\$\$ |                                                                                                                                                   |                 |
| Manholes                | Floodproof manhole covers                                                                                                           | \$\$     | “Do nothing” – Estimated costs depend on rate of damage to pump station and economic losses.                                          | \$-<br>\$\$\$\$ |                                                                                                                                                   |                 |

| Asset Name                              | Option 1                                                                                                         | Cost 1 | Option 2                                                   | Cost 2 | Option 3                                                                 | Cost 3    |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------|--------|------------------------------------------------------------|--------|--------------------------------------------------------------------------|-----------|
| Pine Point Fire Station                 | Floodproof first floor of building using flood panels/flood barriers. Elevate sensitive systems within building. | \$     | Deployable flood barrier around north side of building.    | \$     | "Do nothing" Estimated costs depend on flood damage and economic losses. | \$-<br>\$ |
| Public Works Facility <sup>1</sup>      | Construct a levee or barrier around parking lot                                                                  | \$     | Fill eligible area to elevate lot and flood proof building | \$     | "Do nothing" Estimated costs depend on flood damage and economic losses. | \$-<br>\$ |
| Wastewater Treatment Plant <sup>1</sup> | Construct a levee or barrier around facility                                                                     | \$     | Floodproof (interior drainage systems, seal conduits)      | \$     | "Do nothing" Estimated costs depend on flood damage and economic losses. | \$-<br>\$ |

Notes:

1. The buildings on site for the Public Works Facility and the Wastewater Treatment Plant would not likely experience flood inundation until 2100.

#### 4.4. Neighborhood-Scale Adaptation: Higgins Beach and Pine Point

The Higgins Beach and Pine Point neighborhoods are particularly vulnerable to coastal flooding and should be considered for neighborhood-scale adaptation planning, rather than isolated interventions at the level of individual streets, structures, or facilities. Both neighborhoods are located within a mapped Maine Coastal Sand Dune System and include areas designated as FEMA AE and VE flood zones, which impose regulatory constraints on certain adaptation measures.

For example, adaptation strategies such as elevating land using fill or constructing new seawalls or hardened barriers are unlikely to be permitted within some areas of these neighborhoods under current state and federal regulations. The recommendations below focus on life safety, infrastructure protection, and long-term resilience planning.

##### Recommended Adaptation Strategies:

- Establish Evacuation Routes:
  - *Higgins Beach*: Coordinate with Piper Shores to formalize an evacuation route using Greenwood Avenue and Piper Road during flood events that inundate Ocean Avenue for the near-term until Ocean Avenue can be adapted through elevation or re-routing. Consider elevating Ocean Avenue, or rerouting (see Table 4-2) to maintain access.
  - *Pine Point*: Prioritize elevating the segment of Pine Point Road that crosses Jones Creek and East Grand Avenue for emergency access and evacuation purposes during storm events. Pine Point Road should be the priority; elevating East Grand Avenue could still cause vehicles to be stranded once they cross over into the Town of Old Orchard Beach, unless the Town of Old Orchard Beach also adapts their infrastructure.

Consider coordinating with the Town of Old Orchard Beach to fund a regional infrastructure adaptation initiative.

- Consider long-term plans for road elevation:
  - *Higgins Beach*: Elevating Bayview Avenue between Morning Street and Champion Street, elevating Vesper Street from Bayview Avenue North, and elevating Champion Street would increase emergency evacuation and access to critical infrastructure located in inundated areas of Higgins Beach during coastal storm events. Morning Street could also be elevated to increase access to homes located along Morning Street. Flood inundation of the buildings would still be likely unless the buildings were elevated by the owners. Additionally, elevating these roads would require coordination of interior drainage, which may involve installation of pump systems. Elevating roads in this area could face significant challenges in terms of right of way access, interior drainage strategies, and permitting. We have included it for a long-term adaptation consideration for this neighborhood; however, further investigation may indicate that this strategy would not be feasible.
  - *Pine Point*: Consider connecting River Sands Drive to King Street and elevating Jones Creek Drive, King Street, and the western end of River Sands Drive. This would increase the network of roadways available for use during storm events and the elevated road network would likely reduce flood inundation along Tasker Avenue, the Avenues, and Driftwood Lane. Elevating this road network would require coordination of interior drainage, which may involve installation of pump systems. Additionally, flood inundation of buildings would still be likely unless the buildings were elevated by the owners. This strategy would likely face significant challenges in terms of right of way access, interior drainage strategies, and permitting. We have included it for a long-term adaptation consideration for this neighborhood; however, further investigation may indicate that this strategy would not be feasible.
- Designate Emergency Shelters
  - *Pine Point*: Utilize the second floor of the Pine Point Fire Station as a temporary shelter during periods of inundation.
- Implement a Neighborhood Flood Alert System
  - Develop a localized flood alert system to notify residents of impending storm events. Consider integrating an audible alarm or siren system to prompt evacuation during immediate flood threats. A siren would ensure that seasonal renters and houseguests, who may not be subscribed to communication channels, get alerted to flood danger. A siren would also alert residents when floodwater rises during night hours when other alerts may be missed.
- Streamline Dune Restoration Efforts
  - Establish a streamlined and recurring dune restoration program—such as the annual placement of recycled holiday trees—to reinforce dune systems and reduce erosion and storm damage to inland infrastructure.

- Deploy Temporary Flood Barriers
  - Consider installing seasonal flood barriers around vulnerable areas of the neighborhoods for up to seven months per year to reduce exposure to coastal storm impacts.
- Enhance Public Education and Outreach
  - Continue neighborhood education efforts around flood risk, including targeted education for renters and seasonal residents on flood risks, shelter locations, and evacuation procedures to improve preparedness and response.
- Develop an Adaptation Roadmap
  - Create a guidance document outlining feasible approaches to floodproofing or elevating structures within the constraints of current permitting regulations.
- Plan for Long-Term Managed Retreat
  - Evaluate the feasibility of voluntary managed retreat in areas projected to experience regular tidal flooding by 2050 and beyond. This may include property buyouts or land use transitions to open space or natural buffers.

## 5. Cost of Doing Nothing

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Adapting to coastal flood risk, especially through infrastructure improvements, requires investment. However, choosing not to act, or “doing nothing,” also comes at a cost. As sea levels rise and coastal storms become more intense, the risk of damage to roads, utilities, and private property will likely increase. Without proactive adaptation, the Town will likely face increasing expenses for emergency response, repairs, and economic disruption.

While a full cost analysis of inaction was outside the scope of this project, recent events provide clear examples of the financial impact:

- The Scarborough Sanitary District spent \$72,000 to repair damage to Pump Station Public 7 in Higgins Beach after the January 2024 storms.
- The Town of Scarborough spent approximately \$2.75 million on storm response, debris removal, and road and bridge repairs following the same event. As of July 15, 2025, approximately \$253,000 of that amount has been reimbursed by FEMA.

In addition to these direct costs, inaction can lead to other economic and other losses such as:

- Lost revenue from beach parking and tourism due to erosion and storm damage. Between the years 2021 to 2024, the Town profited an average annual amount of approximately \$128,800 from beach fees. Losses to these revenue sources may occur if parking and beach access is not adapted for coastal flooding.
- Unquantified damage to homes and businesses.
- Increased risk to public safety and long-term community resilience.

National data also supports the value of proactive investment. According to the U.S. Chamber of Commerce (2024), every \$1 spent on resilience and disaster preparedness can save \$6 in direct damages—and up to \$13 when broader economic impacts are included.

These examples highlight the importance of planning ahead. Investing in adaptation now could help avoid much higher costs in the future.

## 6. Next Steps

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This report presents adaptation options for coastal flood risk in the Town of Scarborough. This was a high-level, planning-based study. In general, next steps for adaptation involve more detailed feasibility analysis for each of the selected adaptation options. Given the timeline for planning, design, permitting, construction, and funding allocation, adaptation projects could take years to fully implement and may involve multiple phases that could align with grant funding rounds.

We have provided a summary of recommended next steps in order for the Town to advance infrastructure-related adaptation to coastal flood risk:

- **Decide on adaptation projects to pursue.** This decision should be based on the risk of exposure to flooding as well as the impacts (i.e., consequences) that would likely occur if the area or infrastructure becomes inundated. The Town should consider their tolerance to “living with water” when making decisions. Infrastructure-based adaptation methods (i.e., elevating a roadway) could be supplemented with non-infrastructure-based adaptation methods (i.e., alert systems or road barriers) to increase the overall resiliency to flood risk.
- **Pursue relevant funding options.** This could include a funding package that leverages grant awards as a match requirement for a separate grant award. The Town should continue to explore grant opportunities focused on implementation of flood adaptation measures. Adapting a single piece of infrastructure through construction may require support from multiple grants, over multiple funding cycles, to complete.
- **Contract with a consultant to develop preliminary and final designs, procure the necessary permits, and oversee construction.** Once assets have been identified for adaptation and funding has been received, we recommend contracting with one or more consultants to develop adaptation designs for the selected infrastructure and oversee construction. The consultant(s) should be responsible for several tasks. These tasks could be part of separate contracts, funded through various grant programs, and take several years to complete. The tasks that the consultant(s) could be responsible for include:
  - **Conducting field investigations.** This would include scope items such as coordinating surveys of areas, performing wetland delineation, and carrying out a geotechnical investigation, as applicable.
  - **Refining flood risk through a coastal and/or hydrologic and hydraulic analysis.** We recommend performing a site-specific coastal flood modeling analysis to understand wave conditions, such as wave runup heights, for assets that would likely be exposed to wave action. For infrastructure such as roadways with culverts, culverts themselves, or other drainage features, we recommend performing a hydrologic and hydraulic analysis to understand opening sizes that could adequately convey design flows following guidance from Maine DOT, the Federal Highway Administration, the CoastWise approach (Maine Coastal Program, 2023), or other applicable agencies and guidance manuals.

- **Develop preliminary and final designs.** The adaptation measures identified would need to be advanced through preliminary and final phases of design development.
- **Procure permits.** The consultant would help prepare and submit regulatory permit applications required for the selected design. We note that the selection of an adaptation approach should consider regulatory constraints which may influence the feasibility of various options.
- **Prepare construction bid documents.** The consultant could help prepare construction plans and bid documents and assist in the selection of a contractor for the construction of the project.
- **Oversee construction.** The consultant could oversee the construction of the project.

Beyond infrastructure projects, it is imperative that the Town continue to develop, enhance, and execute a plan for emergency preparedness around flooding. This might include, for example, developing forecasting methods and an emergency alert system, operating procedures for deploying road barricades in advance of major storm events, a program to educate the public about the dangers of flooding, and procedures for local emergency organizations to respond to emergencies during periods of inundation.

Emergency responders and public works officials should closely follow weather forecasts and extreme tides, separately and combined, and plan for road closures during significant events that pose a risk to roads. Residents who rely on stretches of road to travel to and from their home that are likely to inundate will need to be mindful of high tides and weather forecasts of significant events when planning for travel outside their home. Vulnerable populations who rely on emergency services may want to consider temporarily moving to a more accessible location during anticipated coastal storm events. Addressing inundation will require education by the Town, warnings about advancing storm events, and the development of, for example, emergency alert systems such as the Maine Citizen Alert System.

## 7. Limitations

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This report summarizes our work for the Town of Scarborough. The project relied on readily available online information, limited field investigations, published references, and our professional judgement. The purpose of this report was to provide high-level adaptation options for infrastructure at-risk of coastal flooding and relative costs for implementation.

This study does not include an evaluation of the structural integrity of roadways, culverts, bridges, dams, and other appurtenances.

Advancing infrastructure-based adaptation strategies will require additional phases of work before the recommendations can be implemented, such as site survey, preliminary design, permitting, and final design. The adaptation recommendations provided in this report constitute a high-level assessment of risk and an introduction to adaptation options. This report should be used as a guidance, but further investigation will be needed to advance engineering designs.

Reuse of this report for any purpose, in part or in whole, is at the sole risk of the user.

## 8. References

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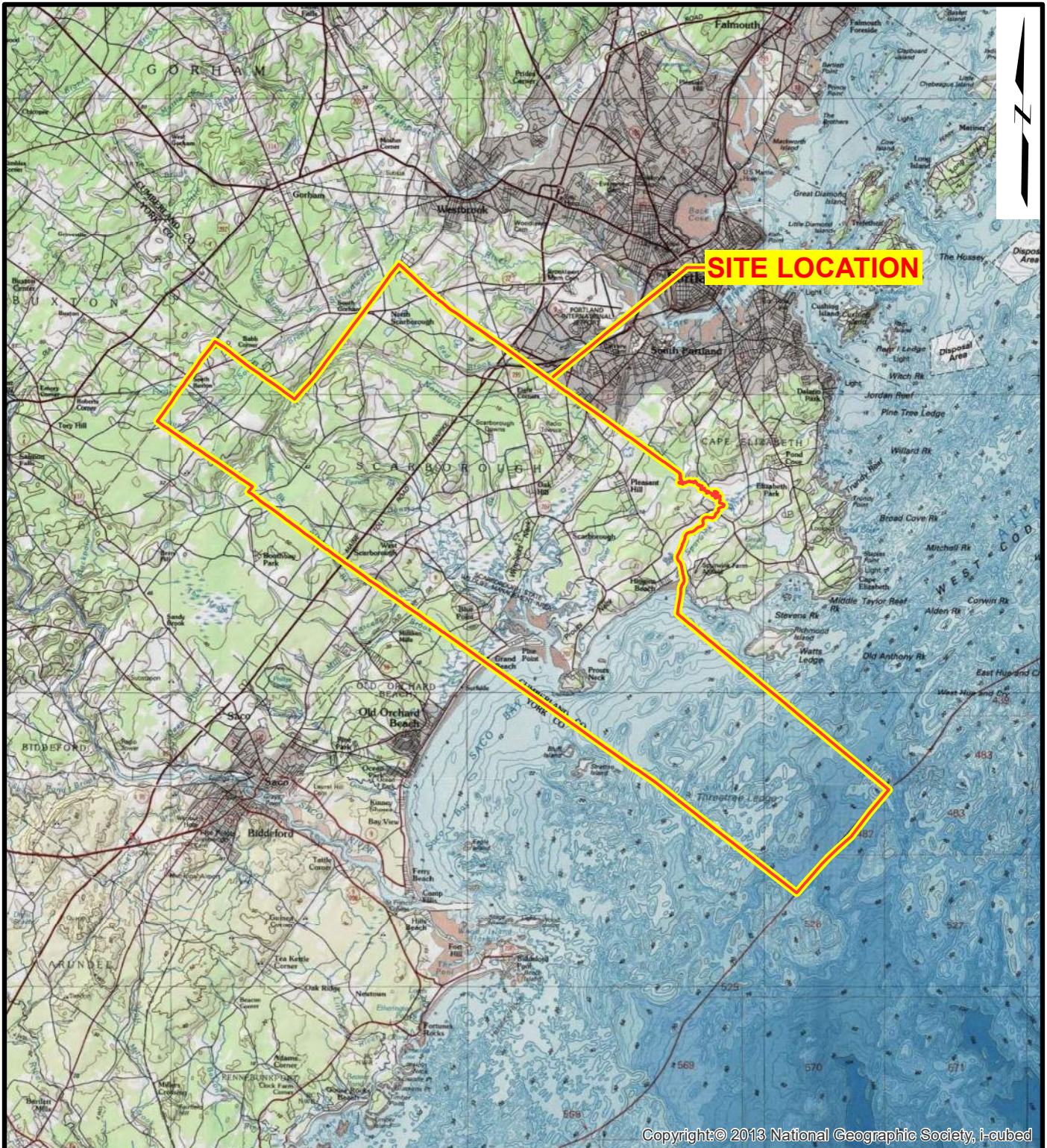
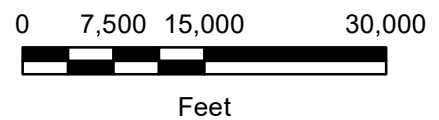
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## Figures

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### Figure 1 Site Location



Coastal Flood Adaptation Strategies  
Scarborough, Maine

Town of Scarborough  
Scarborough, Maine



Project 2403961

SITE LOCATION

October 2025

Fig. 1