March 2025

Four Shore Coastal Resiliency Plan

Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick

Patchogue River, Westbrook

How to Use This Document

This document is designed for optimal viewing in digital format. Digital access allows readers to enlarge maps and zoom in on specific areas, enhancing the viewing experience. While a printed version is available, please note that it may limit your ability to examine the finer points of the maps and graphics. For larger maps, see Appendix B.

This plan was prepared for the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick with funds provided through the National Fish and Wildlife Foundation's (NFWF) Long Island Sound Futures Fund (LISFF).

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Introduction

Longstanding Attraction vs. Risk

Coastal communities captivate with their waterfront beauty, but this allure comes with inherent risks. The same waters that draw people in also pose significant threats. Storms, wave action, and sea level rise expose these communities to potential flooding, property damage, and coastal erosion, creating a precarious balance between natural appeal and environmental vulnerability.

Coastal Environment & Economics

The coastal municipalities in this plan boast a unique appeal, attracting visitors, seasonal residents, and permanent residents. The area's natural beauty, characterized by its beaches, preserves, and trails, serves as a major draw for tourists. Additionally, local amenities such as marinas, shopping centers, and restaurants enhance the region's allure, contributing significantly to the local economy by drawing visitors.

Historic Storm & Path Forward

Superstorm Sandy struck the Long Island Sound coast in October 2012, bringing storm surges up to 10 feet in some areas. The storm's aftermath was devastating: widespread flooding, destroyed homes, loss of life, downed trees, and extended power outages. This Coastal Resiliency Plan, drawing lessons from Sandy and other past storms, represents a proactive approach to address the increasingly severe weather events anticipated in the future.

Federal & State Recognition

Both federal and state entities recognize the critical need for coastal resilience along the Long Island Sound. This recognition is evident through the support provided by the Federal Emergency Management Agency (FEMA) and the Connecticut Department of Energy & Environmental Protection (CT DEEP), which offer grant funding and extensive resources for coastal resilience planning and preparedness. As a testament to this commitment, this plan for the Towns of Clinton, Westbrook, and Old Saybrook, and the Borough of Fenwick was funded through the National Fish and Wildlife Foundation's (NFWF) Long Island Sound Futures Fund (LISFF).

Section 1: Planning Process

Project Purpose & Study Area

This coastal resiliency plan, known as the Four Shore Coastal Resiliency Plan (or the Plan), aims to assess and address future sea level rise risks for the Connecticut Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick. Its primary objective is to develop collaborative strategies to mitigate flood risks and adapt to sea level rise impacts while maintaining community quality of life.

The study area encompasses the southern coast of Middlesex County, Connecticut, covering 26 miles of water frontage along the Long Island Sound and the Connecticut River. This area is home to 30,629 residents across the four communities plus seasonal residents and commercial properties.

How this Plan was Developed

The Four Shore Coastal Resiliency Plan is the result of collaborative efforts between an Executive Committee of local government staff and community leaders from Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick. Public feedback and diverse stakeholder input shaped the Plan, ensuring it addresses regional concerns and goals. The planning process for this plan can be broken down into five categories:

1. Community asset mapping
2. Sea-level rise (SLR) scenarios
3. Vulnerability & risk assessment
4. Project identification & project development
5. Coastal resiliency plan development

Community Engagement & Education

To assist with the requirements of the Four Shore Coastal Resiliency Plan, the Town planning leads hired a consultant team to carry out the planning process and produce the Plan. Additionally, an Executive Committee was established consisting of local government staff and community leaders who bring diverse perspectives and experiences to help inform and guide the planning process. The Executive Committee met biweekly throughout of the planning process.

Various public engagement activities occurred throughout the planning process including:

- Key stakeholder interviews;
- Public meetings (7);
- Pop-ups at local events (3);
- Project website; and,
- Interactive mapping.

Executive Summary (cont.)

Section 2: State of the Coast

Existing Conditions

Category	Key Highlights
Land Cover	▪ The four-town coastal region is predominantly developed, with nearly half its area covered by impervious surfaces. These surfaces, unable to absorb or store stormwater, contribute to increased runoff. ▪ Natural landscapes span over most of the study area, with forests covering 45.2%, tidal wetlands 7.8%, and other wetland types 6.9%. The majority of forested areas are located north of I-95.
Land Use	▪ The coastline is primarily characterized by residential properties, often lacking adequate protection from high tides and storm surges. Parks and conservation areas, including marshes, comprise the second largest land use at nearly 12% of the total area. However, their flood mitigation potential is limited as most are located inland. ▪ Commercial zones primarily line Route 1 throughout the study area. Waterfront businesses, such as marinas, restaurants, and hotels, support the local tourism economy but are highly vulnerable to storm impacts and surges. This vulnerability poses a potential risk to the area's tourism industry.
Wetland Types	▪ Tidal wetlands, comprising estuarine and marine ecosystems, fringe the shoreline and extend along major rivers in the study area. These wetlands are the most prevalent ecosystem type in the region. Salt marshes, which largely overlap with these tidal areas, serve as critical habitats for various species.
FEMA Flood Zones	▪ Floodplains cover about 22% (6,746 acres) of the study area. These low-lying regions adjacent to water bodies—such as rivers, streams, and oceans—are prone to flooding. The area's flood zones range from Zone VE to Zone AO, placing much of the coastal region in high-risk or high-hazard categories. Buildings within these floodplains face more stringent regulations and review processes than those outside, including specific requirements for flood insurance.
Open Space	▪ The study area contains over 11,000 acres of protected open space, including forests, wildlife areas, preserves, and local parks. This encompasses both public lands and private conservation easements. These spaces are crucial for regional resilience, acting as natural flood buffers by absorbing excess water and reducing flood risk. ▪ The area features seven public beaches, which play a vital role in coastal protection by absorbing wave energy and controlling erosion. However, these beaches face threats from coastal erosion, increasing their vulnerability to flooding and storms. Beyond their protective function, beaches are also key to supporting local recreation and tourism.
Vulnerable Populations	▪ The Environmental Protection Agency (EPA) has identified five disadvantaged communities within the study area, spread across Clinton (one), Westbrook (two), and Old Saybrook (two). Four of these communities are located near water bodies or marshlands, increasing their vulnerability to environmental risks. ▪ Coastal manufactured home communities face particular resilience challenges due to their susceptibility to flooding and storm surges. Their proximity to water bodies exacerbates these risks, and some communities have limited evacuation options.
Critical Facilities	▪ If an evacuation becomes necessary, the State Everbridge System is utilized to send out an alert. Additionally, the municipalities within the study area have employed alternative methods to notify residents, such as driving through affected areas using public address announcements and conducting door-to-door distribution of informational pamphlets in case of an evacuation or impending emergency. ▪ Critical facilities include emergency response centers (police, fire stations, hospitals), buildings housing vulnerable populations (schools, nursing homes), and government operations buildings. These facilities are crucial for emergency response, protecting vulnerable populations, storing vital records and information, and providing temporary shelter or cooling/heating centers. The distribution of these facilities varies across the study area, with most municipalities having their own police and fire stations. Fenwick is an exception, relying on Old Saybrook for critical facilities.

Category	Key Highlights
Historic Places	▪ The study area encompasses ten historic districts recognized at local, state, or national levels. It also features 21 sites listed on the National Register of Historic Places, predominantly in Old Saybrook. Safeguarding these historic assets from coastal threats is crucial for preserving the region's character, identity, and economic vitality.
Road & Rail Infrastructure	▪ The study area contains over 300 miles of roads and 81 bridges, with 42 bridges in the 100-year floodplain. Several railroad underpasses are prone to flooding, compromising local traffic safety and reliability. ▪ The area includes 11.15 miles of Shore Line East rail and 2.6 miles of Amtrak Northeast Regional line, with 1.9 miles of total rail infrastructure within the floodplain.
Wastewater Management	▪ The study area relies entirely on septic systems, which are vulnerable to failures due to rising sea levels, elevated water tables, and increased flooding. This can lead to contamination of ground and surface waters. ▪ Frequent flooding occurs due to inundated marshes and high depth to groundwater in low lying areas where stormwater infrastructure is a challenge. Some catch basins drain directly into saturated marshes, while other catch basins fill naturally with the change in tides, exacerbating flooding issues. ▪ Westbrook and Old Saybrook have Water Pollution Control Authorities (WPCA) that are tasked with finding solutions to the identified impacts on the waters of the State by protecting the groundwater quality through wastewater treatment system upgrades, maintenance, and monitoring programs. Similarly, Clinton has a Water Pollution Control Commission (WPCC). The Town WPCA's or WPCC sewer avoidance programs are exploring on-site solutions as well as small community-based systems to address the needs of each municipality. ▪ Westbrook is exploring a centralized community septic system for its Town Center and has adopted a Sewer Avoidance Ordinance to effectuate septic upgrades. Clinton is considering wastewater treatment facilities for downtown and in vulnerable areas. Old Saybrook has upgraded on-site systems in low-lying areas. The Town is exploring options for small community wastewater treatment systems to implement a wastewater treatment system where on-site solutions are not practical or feasible in low-lying areas.
Stormwater Management	▪ Frequent flooding occurs due to inundated marshes and high depth to groundwater in low lying areas where stormwater infrastructure is a challenge. Some catch basins drain directly into saturated marshes or Long Island Sound. Many catch basins fill naturally with the change in tides exacerbating flooding issues. ▪ The Town health agencies regulate individual on-site septic systems. The CT River Area Health District (CRAHD) is the regional health district servicing Clinton, Old Saybrook, and Fenwick. The Town of Westbrook has its own health department.
Solid Waste Management	▪ All three towns (Clinton, Westbrook, and Old Saybrook) have closed their landfills and now use transfer stations located outside flood-prone areas. Waste is transported to regional facilities for disposal.
Utility Infrastructure	▪ Utilities in the study area are provided by Southern Connecticut Gas and Eversource. Power distribution relies on overhead lines and two substations in Old Saybrook. Gas service is limited to high-density areas and major thoroughfares. Connecticut Water supplies public water to parts of each municipality, while many residents use private wells. ▪ Key infrastructure challenges include the lack of public power generation facilities in Clinton, Westbrook and Fenwick ,and the location of some utility infrastructure in flood-prone coastal zones. Public water and gas services do not cover the entire area. Private water supplies vulnerable to saltwater intrusion due to rising sea levels.

Executive Summary (cont.)

Existing Planning Initiatives

Existing Planning Initiatives	
Clinton	Municipal Coastal Plan Revision
	Plan of Conservation and Development (2015-2025)
	Salt Marsh Advancement Zone Assessment
	Coastal Community Resilience Report
	Natural Hazard Mitigation Plan for MS4
	Harbor Management Plan Update
	Sustainable Connecticut Program Participant (Bronze Award)
	Plan of Conservation and Development Update
	Thriving Communities Program Participant
Westbrook	Harbor Management Plan
	Natural Hazard Mitigation Plan for MS4 Update
	Plan of Conservation and Development (2021-2031)
	Thriving Communities Program Participant
	Sustainable Connecticut Program Participant
	Local Natural Hazard Mitigation Plan
Old Saybrook	Harbor Management Plan
	Conservation and Open Space
	Stewardship Plan
	Invasive Species and Natural Habitat Management Plan
	Sea Level Rise Climate Adaptation Report of Findings
	Stormwater Management Plan
	Coastal Resilience and Adaptation Strategy
	Natural Hazard Mitigation Plan
	Plan of Conservation and Development (2023-2033)
	MS4 Annual Report
	Natural Hazard Mitigation Plan
	Thriving Communities Program Participant
	Sustainable Connecticut Program Participant (2024 Gold Award & Climate Leader)
Fenwick	Harbor Management Plan
	Plan of Conservation and Development (2017-2027)
	Natural Hazard Mitigation Plan

Existing Projects Underway

Since the 1970s, these three coastal towns have prioritized sewer avoidance strategies, establishing wastewater management districts in low-lying areas. Their approaches combine septic system maintenance, public education, and targeted infrastructure improvements.

Current Status:

- Clinton: Developing wastewater management plan, exploring downtown treatment facility
- Westbrook: Planning small-scale system for Town Center Business District, implementing septic upgrade program
- Old Saybrook: Investigating community septic system for coastal properties with limited individual options

All three municipalities are considering small community wastewater treatment facilities where individual septic solutions are impractical due to lot size or flood risks. Each town has invested significantly in research to identify scientifically sound, location-appropriate solutions.

Existing Local Policies

Each of the four municipalities in the study area has the following local policies:

- Floodplain Management
- Stormwater Management
- Wetland and Watercourse Protection
- Erosion and Sediment Control
- Open Space and Natural Resource Conservation
- Hazard Mitigation
- Environmental Review
- Architectural Design Controls
- Historic Preservation
- Harbor Management

The above policies and their corresponding documents have not been assessed for their merit or coordination with one another.

Section 3: Sea Level Rise & Vulnerability

The Sea Level Rise Scenario Models

Sea level rise (SLR) models, were created to simulate tidal and 100-year storm flooding conditions in the years 2050 and 2070 as well as the present-day conditions. The scenarios selected are in the intermediate range of projected sea level rise. These scenarios are consistent with recommendations published by the National Fish and Wildlife Foundation's grant that funded this project.

What is a Tidal Flooding Event? High tide flooding occurs when elevated sea levels combine with local factors to exceed normal high tide marks. This is sometimes called "sunny day flooding" and can inundate streets during full or new moons, or due to changes in prevailing winds and ocean currents. As a result, coastal areas increasingly face flood risks under otherwise benign weather conditions.

What is a 100-year storm event? It is a severe weather event with a 1% chance of occurring in any given year, not an event that happens once per century. These storms can happen in back-to-back years or even multiple times annually. They typically bring 8-10 inches of rainfall, 7-11 foot storm surges, and 74+ mph winds. These events threaten coastal infrastructure, natural barriers, utilities, and emergency routes. Superstorm Sandy exemplified this in 2012, causing extreme surge, widespread power outages, and severe beach erosion. As climate patterns shift, the frequency of these severe events may increase, challenging traditional probability assessments.

Tidal Simulation Model Results

The existing condition tidal model results match well with the NOAA tidal data, which confirms that the model was performing adequately. The model results showed that sea level rise may result in increased tidal flooding extents and depths along the project shoreline.

100-Year Storm Model Results

The existing condition 100-year storm surge model results match well with the USACE storm surge data, which confirms that the model was performing adequately. The model results showed that sea level rise may result in increased flooding extents and depths due to extreme storms along the project shoreline. See pages 70 through 80 for inundation and water level change mapping.

Vulnerability & Risk Assessment

A comprehensive risk assessment was conducted to identify areas and assets that are currently or will become highly vulnerable to the impacts of sea level rise, flooding, and erosion. This assessment provides an understanding of the locations and critical facilities most susceptible to these climate-related hazards. The findings from this analysis directly inform the recommended projects list and prioritization outlined in Section 4: Resiliency Recommendations.

To visualize the projected flooding extent, refer to the inundation mapping in Section 3. These maps offer a visual representation of potential flood scenarios, helping to illustrate the scope and scale of the future projected challenges.

Clinton

100-year Storm Event. The vulnerability and risk assessment for Clinton identified several high-risk areas prone to flooding during a 100-year storm event, including Cedar Island, Clinton Town Beach, commercial areas south of Riverside Drive, the Causeway and Groveway area, Shore Road, and various other residential neighborhoods. Current projections show significant inundation risks, with water depths ranging from 3 to 12 feet in some locations. Future projections for 2050 and 2070 indicate worsening flood conditions, with water depths increasing by up to 6 feet in some areas and flood zones expanding to new parts of town. The assessment highlights critical infrastructure at risk, including bridges, roads, and the railroad tracks north of Route 1. By 2070, over 21% of Clinton's buildings could be exposed to more than 6 inches of water during a 100-year storm event, emphasizing the growing flood risks and the need for proactive adaptation strategies. The Clinton Fire Department faces increasing flood risk, with projected water depths rising from current 2'4" to 2'10" (2050) and 3'8" (2070), compromising emergency operations. Facility relocation is recommended.

Executive Summary (cont.)

Tidal Event. The mean high water tidal inundation modeling for Clinton identifies several high-risk areas, including Cedar Island, Clinton Town Dock, Clinton Town Beach, Hammock River Marsh Wildlife Area, Hammonasset River marshes, the Causeway and Groveway area, Shore Road coastline, and Beach Park Road bridges. Under current conditions, Cedar Island faces severe flooding with depths up to 14’5”, while Clinton Town Dock and Beach experience inundation up to 4’5” and 6’3” respectively. Projections for 2050 and 2070 show worsening flood scenarios, with water depths increasing by up to 1’6” by 2050 and up to 8’ by 2070 in some areas. New flood-prone zones are expected to emerge, including the expansion of marsh areas behind residential communities. By 2070, 2.9% of Clinton’s buildings could be exposed to more than 6 inches of water during tidal events, a significant increase from 0.7% in 2023. This highlights the growing vulnerability of Clinton to sea level rise and the need for proactive adaptation strategies to address increasing tidal flood risks.

Westbrook

100-year Storm Event. The vulnerability and risk assessment for Westbrook identified several high-risk areas prone to flooding during a 100-year storm event, including Old Mail Trail, Coral Sands neighborhood, Salt Island Road, Pepperidge Avenue, Seaside Avenue, and areas along Route 1 and the Patchogue River. Current projections show significant inundation risks, with water depths ranging from 5 to 11 feet in some locations. Future projections for 2050 and 2070 indicate worsening flood conditions, with water depths increasing by up to 6 feet in some areas and flood zones expanding to new parts of town, particularly near Cold Spring Brook. The assessment highlights critical infrastructure at risk, including roads, businesses, and residential areas. By 2070, over 31% of Westbrook’s buildings could be exposed to more than 6 inches of water during a 100-year storm event, underscoring the growing flood risks and the need for proactive adaptation strategies. The flooding is projected to remain largely confined to areas south of Interstate 95, which appears to serve as a northern boundary for anticipated flooding through 2070.

Tidal Event. The mean high water tidal inundation modeling for Westbrook identifies several high-risk areas, including Old Mail Trail, marinas on the Menunketesuck and Patchogue Rivers, Salt Island Road, Little Stannard Beach Road, Pepperidge Avenue, Coral Sands Neighborhood, and Seaside Avenue. Current conditions show significant flooding in areas like Old Mail Trail, with water depths up to 5’10”. Projections for 2050 and 2070 indicate worsening flood scenarios, with water depths increasing by up to 6’ in some areas by 2070. The models show the expansion of flood-prone zones, particularly in marsh areas behind residential communities. By 2050, businesses and residences along the Patchogue River banks may face up to 4’ of water depth. By 2070, areas like Seaside Avenue could see inundation up to 3’2” above current grade, posing significant risks to homes caught between encroaching marsh waters and Long Island Sound. The percentage of Westbrook’s buildings exposed to more than 6 inches of water during tidal events is projected to increase from 1.3% in 2023 to 4.5% by 2070, underscoring the growing vulnerability to sea level rise and the need for adaptive strategies.

Old Saybrook

100-year Storm Event. The vulnerability and risk assessment for Old Saybrook identified extensive flood risks along the entire coastline during a 100-year storm event, affecting public beaches, private properties, critical infrastructure, and coastal ecosystems. Key high-risk areas include Chalker Beach, Indian Town Beach, Great Hammock Beach, Plum Bank areas of town, and sections of Main Street and College Street. Current projections show significant inundation risks, with water depths ranging from 3 to 12 feet in some locations. Future projections for 2050 and 2070 indicate worsening flood conditions, with water depths increasing by up to 8 feet in some areas and flood zones expanding inland. The assessment highlights critical vulnerabilities in local access and evacuation routes, particularly in the Saybrook Point area. By 2070, over 44% of Old Saybrook’s buildings could be exposed to more than 6 inches of water during a 100-year storm event, including several critical facilities such as schools and healthcare centers. This underscores the growing flood risks and the urgent need for comprehensive adaptation and mitigation strategies.

Tidal Event. The mean high water tidal inundation modeling for Old Saybrook identifies several high-risk areas, including Chalker Beach, Great Hammock Beach Area, Town Beach, Oyster River, and Cornfield Point. Current conditions show relatively minor impacts compared to future projections, with water depths ranging from 9" to 2'9" in coastal areas like Chalker Beach. By 2050, coastal inundation at Chalker Beach may reach 3'5" above the current grade. By 2070, the Oyster River mouth area could see water depth increases of up to 6', with some locations experiencing depths up to 6'9". The Town Beach area faces dual vulnerability from both the Back River marsh and Long Island Sound, with projected inundation up to 3'8" for homes and 2'7" for roads by 2070. The percentage of Old Saybrook's buildings exposed to more than 6" of water during tidal events is projected to increase from 1.1% in 2023 to 4.3% by 2070, highlighting the growing vulnerability to sea level rise and the urgent need for coastal adaptation measures.

Fenwick

100-year Storm Event. The vulnerability and risk assessment for the Borough of Fenwick, which is bordered by water on three sides, identified significant flood risks during a 100-year storm event. Key high-risk areas include eastern Sequassen Avenue, the Scum Beach area, and residential zones near Agawam Avenue and between Maple and Grove Avenues. Current projections show severe inundation risks, with water depths reaching up to 12 feet in some locations. Future projections for 2050 and 2070 indicate worsening flood conditions, with water depths increasing by up to 1.5 feet in most areas. Sequassen Avenue faces particularly severe risks, with projected water depths reaching nearly 14 feet by 2070. The assessment highlights the vulnerability of critical access routes and residential areas. By 2070, nearly 74% of Fenwick's buildings could be exposed to more than 6 inches of water during a 100-year storm event, a significant increase from 57% in 2023. This dramatic rise in vulnerability underscores the urgent need for robust flood mitigation and adaptation strategies in this coastal community.

Tidal Event. The tidal event model for the Borough of Fenwick identifies several high-risk areas, including Sequassen Avenue, the Crab Creek area, the area south of the eastern leg of Agawam Avenue, and the Scum Beach area. Under current conditions, the eastern section of Sequassen Avenue faces severe flood risk with water depths up to 4'6" above grade, while the Crab Creek area could see depths up to 3'4". Projections for 2050 and 2070 indicate worsening flood scenarios. By 2050, water depths could increase by up to 1'6" in some areas, with Sequassen Avenue potentially experiencing depths up to 4'8". By 2070, flood risks are projected to intensify further, with water depth changes of up to 3' compared to current conditions. Sequassen Avenue could face depths up to 5'8", while the Scum Beach area might see inundation up to 11'5". The percentage of Fenwick's buildings exposed to more than 6 inches of water during tidal events is projected to double from 7.9% in 2023 to 15.8% by 2070. This significant increase in vulnerability underscores the urgent need for adaptive strategies to address rising sea levels and increasing flood risks in this coastal community.

Executive Summary (cont.)

Section 4: Resiliency Recommendations

Projects and Implementation Strategy

	General Action / Strategy Recommendation	Timeframe	Estimated Cost
	Natural Shoreline Fortification		
1A	**Natural Shoreline Fortification**	4-10 years	Varies depending on application
1B	**Dune Management**	4-10 years	Initial year: $200-$500/LF Annual maintenance: $20-$50/LF
1C	**Beach Nourishment**	4-10 years	$15-$30/CY
2	**Structural Shoreline Fortification**	4-10 years	Varies depending on application
3	**Marsh & Wetland Management**	4-10 years	Varies depending on application
	Infrastructure Including Water Infrastructure		
4	**Elevate Roads**	10+ years	Varies depending on application
5	**Railroad Underpass Flooding**	Varies	Varies depending on application
6	**Stormwater Management**	1-3 years	Varies depending on application
7	**Install Backflow Preventers**	1-3 years	Varies depending on application
8	**Tide Gates**	10+ years	$1M/tide gate
9	**Dredging**	Varies	Varies depending on application
10	**Bury Utility Lines**	10+ years	Varies depending on application and complexity
11	**Investigate Long-Term Wastewater Management Solutions**	10+ years	To be determined based on size and scope of project
	Built Environment		
12	**Secure Plastic Septic Tanks**	1-3 years	$2K-$4K/system
13	**Elevate Structures**	1-10+ years	Varies depending on application
14	**Elevate Equipment**	1-3 years	$50K/home
	Policies & Programming		
15	**Land Use Regulations**	1-3 years	Varies depending on staff or consulting work
16	**Managed Retreat**	10+ years	$2M-$3M/acquisition
17	**Participate in the Community Rating System**	1-3 years	Municipality: $5K-$15K/year Consultant: $15K-$20K
18	**Offer Community Training & Education**	1-3 years	Varies depending on application

	Municipality-Specific Focus Areas	Location
19	Shore Road, Causeway, & Groveway	Clinton
20	Grove & Commerce Street Area, Town Dock, & Riverside Drive	Clinton
21	Clinton Policy & Practice	Clinton
22	Clinton Town Beach Nourishment & Fortification	Clinton
23	Meadow Road Area Improvements	Clinton
24	Town Center Area	Clinton
25	West Beach/Coral Sands/Pilots Point Area Improvements	Westbrook
26	Old Mail Trail Area Improvements	Westbrook
27	Middle Beach Area	Westbrook
28	Route 1 Between Wesley Avenue & Old Clinton Road Improvements	Westbrook
29	Cold Spring Brook & Chalker Beach Area Improvements	Old Saybrook/ Westbrook
30	Old Sea Lane & Hartford Avenue Outfall Repair	Old Saybrook
31	Existing Seawall Evaluation	Old Saybrook
32	Indian Town Area Improvements	Old Saybrook
33	Living Shoreline Feasibility	Old Saybrook
34/40	Dredging of South Cove	Old Saybrook / Fenwick
35	Sequassen Avenue Improvements	Fenwick
36	West End (Scum Beach & Seawalls)	Fenwick
37	Pettipaug Avenue Seawall	Fenwick
38	Folly Point Erosion	Fenwick
39	Breakwater Maintenance & Repair	Fenwick

Executive Summary (cont.)

Potential Funding Sources

The State and Federal Government offers programs for resiliency along with a number of grants. All funding requires detailed project scoping, benefit-cost analysis, and demonstrated community impact. Most programs require a municipal cost-share commitment. Below is a list of potential funding sources to consider for the recommendations in this plan:

- Community Investment Fund 2030 (CIF)
- Long Island Sound Community Impact Fund (LISCIF)
- Long Island Sound Futures Fund (LISFF)
- Connecticut Department of Energy and Environmental Protection (CT DEEP) Climate Resilience Fund
- Urban Forest Equity Grant Program
- Open Space & Watershed Land Acquisition Grant
- Urban Green & Community Garden Grant
- Connecticut Recreational Trails Grant Program
- Federal Clean Water Act §319 Non-Point Source Pollution Management Grant
- FEMA Flood Mitigation Assistance Program (FMA)
- Building Resilient Communities (BRIC)
- Hazard Mitigation Grant Program (HMGP) Urban Forest Equity Grant Program

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1 Planning Process

The Four Shore Coastal Resiliency Plan is a joint effort between the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick, to assess and prepare for coastal changes like flooding, erosion, and other climate-driven hazards.

This Plan assesses the risks and vulnerabilities of critical local systems -- from infrastructure and housing to natural resources and the economy -- to changing coastal conditions like flooding, sea level rise, and more frequent and severe storm events.

With these risks and vulnerabilities in mind, the Plan identifies projects and strategies to build resilience, to help us adjust how we live, work, and recreate, and to keep us all safe from the impacts of climate change now and into the future.

This introductory section focuses on the purpose of the planning effort, and the steps taken to develop this plan, and emphasizes the critical role of community participation in shaping the final document.

Project Purpose & Study Area

Project Purpose

This effort provides the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick with an understanding of future risks associated with sea level rise and to collaboratively identify strategies, policies, programs, and projects that will reduce flood risk and enable these communities to prepare for the impacts of climate change.

Study Area

The **study area** is displayed to the right in red shading. On the southern coast of Middlesex County, the study area encapsulates the four shore communities of Clinton, Westbrook, Old Saybrook, and Fenwick, located on the coast of the Long Island Sound in southern Connecticut. The Connecticut River defines the eastern edge of the study area boundary. With a total population of 30,629 people, the study area boasts approximately 26 miles of water frontage along the Long Island Sound and the Connecticut River.

This plan occasionally references the "**coastal area**" which is a boundary defined by the Connecticut Department of Energy & Environmental Protection (CT DEEP) and Connecticut General Statute C.G.S. 22a-94(a). The coastal area used for this Plan is displayed to the right in a red-striped pattern.

At times, this plan analyzes conditions in both the broader study area and the specific coastal zone, comparing the two to highlight the coastal area's increased vulnerability. This focused approach allows for a more detailed assessment of the region most at risk from sea level rise and coastal hazards. If the narrative does not directly reference the "coastal area," then it is referring to the greater study area.

Importance of a Multi-Jurisdictional Approach

Water does not stop at municipal boundaries. This plan's multi-jurisdictional approach enables collaboration between the participants and stakeholders. It identifies solutions that may have a broader benefit to the communities than the projects being pursued by individual property owners and beach associations with varying degrees of success. The proposed resilience and adaptation solutions are community-based and transferable amongst the participating communities and other communities in the region and state.

What is Resilience

Resilience is the ability of social and ecological systems to adapt to changing conditions and withstand—and rapidly recover from—disturbances and disasters. In other words, a resilient community can bounce back quickly after something bad happens. This ability to withstand disturbances, or bounce back, is a concept that applies to individuals, infrastructure, the environment, and communities large and small.

Coastal resilience is the ability of a community -- including the natural, social, economic, and infrastructure systems that define and support it -- to resist, absorb, recover from, and adapt to the effects of a natural hazard (e.g., sea level rise) in a timely and efficient manner. This is achieved through the preservation and restoration of essential structures and functions that provide a high quality of life for all residents and visitors.

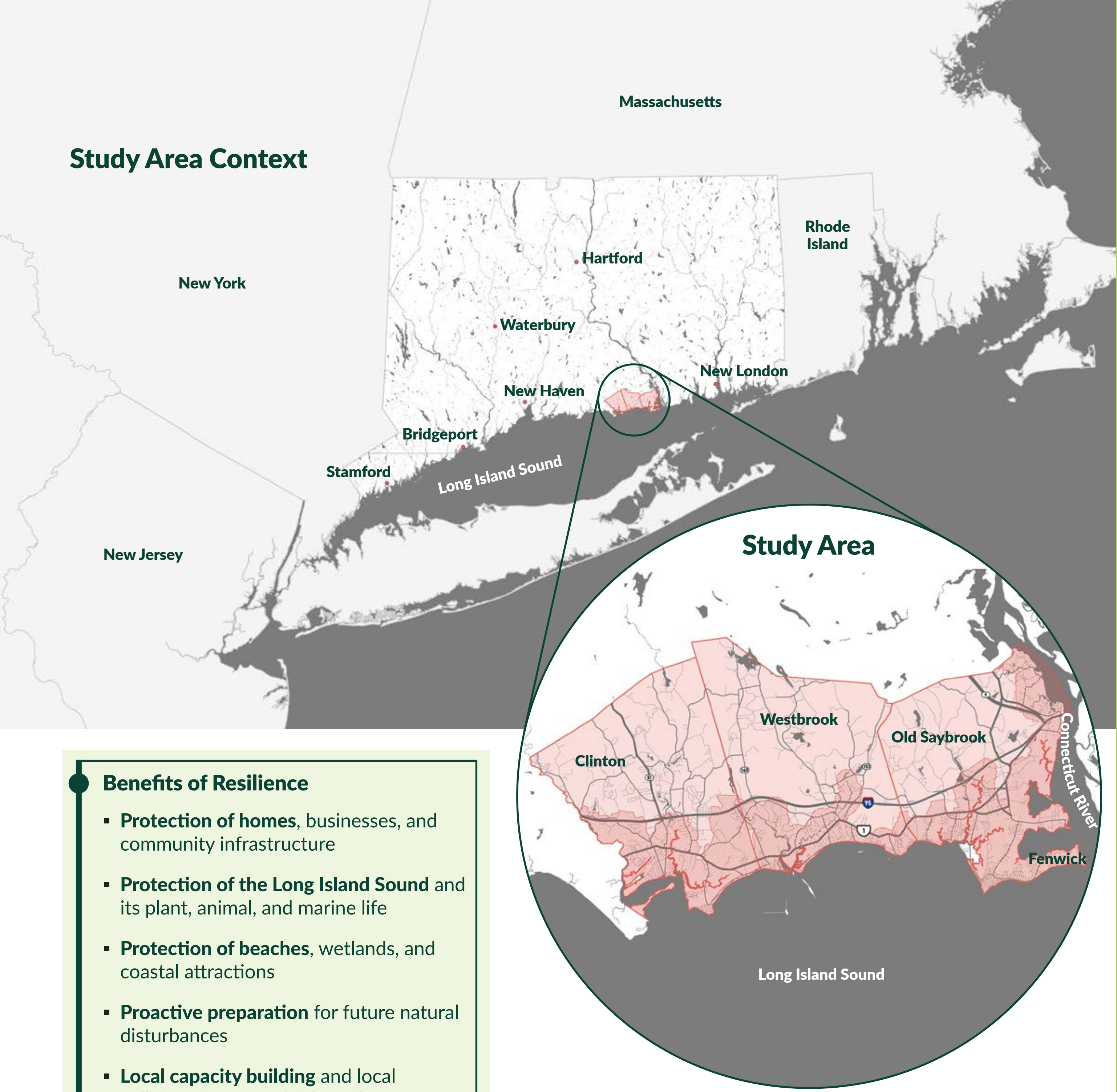
Why Resilience Matters

As communities surrounded by water, the four municipalities at the center of this effort are highly vulnerable to the risks associated with climate change, including rising sea levels, coastal storms, shoreline erosion, strong winds, and storm surges. In addition to their beautiful coastlines, several rivers run through the municipalities, draining into the Long Island Sound, along with extensive wetlands and salt marsh areas.

Vulnerable areas in each municipality are residential beach neighborhoods, marinas, bustling commercial corridors, and important town facilities including roads, fire departments, emergency services, schools, and other critical services.

The Four Shore Coastal Resiliency Plan will provide the municipalities with a deep understanding of the risks posed by climate change and rising sea levels. Based on this understanding of future risks, new policies, programs, and projects will be proactively identified to ensure the long-term sustainability and well-being of these communities and the surrounding region.

Study Area Context



Benefits of Resilience

- **Protection of homes**, businesses, and community infrastructure
- **Protection of the Long Island Sound** and its plant, animal, and marine life
- **Protection of beaches**, wetlands, and coastal attractions
- **Proactive preparation** for future natural disturbances
- **Local capacity building** and local collaboration at multiple scales

How this Plan was Developed

The Four Shore Coastal Resiliency Plan is the product of an extensive year-long, multi-step planning process that commenced in June 2023. Throughout its development, the project team benefited from the invaluable guidance of an Executive Committee, comprising local government staff and key community members from the participating Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick. The Plan's formulation was significantly enhanced by the considerable feedback and input received from a diverse array of stakeholders and community members, ensuring that it accurately reflects the region's collective concerns and aspirations.

This planning effort was made possible through funding from the National Fish and Wildlife Foundation's (NFWF) Long Island Sound Futures Fund (LISFF), a testament to the initiative's importance and the shared commitment to safeguarding the Long Island Sound's ecological integrity and coastal communities.

Through this collaborative and inclusive process, the Four Shore Coastal Resiliency Plan has emerged as a robust and locally grounded blueprint, poised to steer the region's efforts toward enhanced preparedness, adaptation, and resilience in the face of coastal hazards and the escalating impacts of climate change.

Summer 2023 | **Spring 2024** | **Summer 2024** | **Winter 2024/2025**

Project Start Up

A project kick-off meeting was held on June 15, 2023 with the Executive Committee and several stakeholders from each municipality. Throughout the summer, the project team conducted site visits and reviewed existing related plans and data to understand local issues and existing efforts to increase resilience.

Sea Level Rise (SLR) Scenarios

A hydrodynamic model of the Long Island Sound was developed to simulate sea level rise (SLR) and the corresponding inundation expected from a 100-year storm in the years 2030, 2050, and 2070.

Vulnerability & Risk Assessment

The community assets were overlaid with the SLR scenarios to identify the severity and likelihood that assets will be exposed to future flooding.

Community Asset Mapping

Community assets were identified and mapped based on existing data and feedback from the community.

Project Identification

Based on public feedback and the results of the risk assessment, a suite of projects were identified to reduce risks and increase resilience.

Project Development

Proposed projects were prioritized based on community feedback, and the highest priority projects were further developed, including renderings of the potential changes, cost estimates, and potential code changes.

Coastal Resiliency Plan Development

The Four Shore Coastal Resiliency Plan provides the participating municipalities with an action plan to move from planning to project implementation. The Plan includes the community asset inventory, key findings from the risk assessment, an overview of adaptation strategies, and a detailed description of potential projects to increase resilience.

Community Engagement

A series of public workshops and "pop-up" events were held throughout the planning process to collect feedback and information from the community.

The Planning Process

1 Community Asset Mapping

This task identified community assets using existing, publicly available information and by working collaboratively with municipalities and the public.

2 Sea Level Rise (SLR) Scenarios

This task resulted in the development of three different scenarios of sea level rise (SLR) and the associated flood inundation from a 100-year storm. Importantly, these scenarios help visualize the near-term and long-term flood impacts associated with climate change and SLR.

3 Vulnerability & Risk Assessment

By overlaying the community assets with the sea level rise scenarios, the project team identified vulnerable assets and systems, including assets vulnerable to sea level rise in the near-term and longer term. To ensure the accuracy of the flood model results, on-site validation was conducted.

4 Project Identification & Project Development

Based on the risk assessment, this task identified and prioritized projects to increase the region's coastal resilience. Several high priority projects were identified by the consultant team. An implementation action plan summarizes the following for each recommended project: project name and description, project lead and partners, planning level cost estimate, time frame, immediate next steps, and potential funding sources.

5 Coastal Resiliency Plan Development

The consultant team compiled a draft and final Coastal Resiliency Plan that integrates the key findings and recommendations from each preceding task.

Community Engagement

The Four Shore Coastal Resiliency Plan is underpinned by community input and feedback, which was used to help identify assets, issues, and opportunities. Community members were kept informed and engaged throughout the planning process via a series of public meetings, stakeholder interviews, public events, and the project website.

Community Engagement & Education

Executive Committee

The following individuals generously provided their time and expertise to guide the development of the Four Shore Coastal Resiliency Plan. Each of the four municipalities selected representatives to serve on the Executive Committee which met biweekly throughout the planning process and reviewed all deliverables to ensure they were consistent with the community's trajectory and needs. A kick-off meeting was held in Westbrook on June 15, 2023, to gather the Executive Committee and Consultant Team for a visioning session. Members of the Executive Committee include:

Clinton	
Abby Piersall	Town Planner
Carrie Allen	Town Council Chairman
Westbrook	
Peter Gillespie	Town Planner
Anthony Cozza	Chair WCRC
Marilyn Ozols	Vice Chair CRC, Planning Commission Representative
Old Saybrook	
Christina Costa	CZEO, CFM, Town Planner
Douglas McCracken	Planning Commission Vice Chairman
Fenwick	
Marilyn Ozols	ZEO/Land Use Administrator
Bruce Baird	Park Commission

Individual Town Committees

In addition to the Executive Committee, several Local Coastal Resiliency Committees from the Towns provided feedback and insight into the formation of this Resiliency Plan.

- **Clinton Coastal Resiliency Committee |** Carrie Allen, Nick Webb, Martin Jaffe, Kate Zadek, Robin Kohnke, Tom Welch, Zachary Plourde, Catherine Zamecnik
- **Westbrook Coastal Resiliency Committee |** Peter Gillespie, Anthony Cozza, Marilyn Ozols, Ron Botelho, Sid Holbrook, Evan Cusson, Mike Engels, Andy Calderoni, John Hall III
- **Old Saybrook |** Old Saybrook has had several committees over the past decade and the Planning Commission has taken this over with Doug McCracken as the liaison.

Stakeholder Focus Groups

Focused stakeholder interviews were held virtually with key stakeholders, partner organizations, and agencies to understand areas of concern and to walk through project elements in a more personalized environment. An interview was scheduled for each category below, six interviews in total. An abbreviated list of stakeholders involved in the development of this Plan is shown below:

Emergency Services
Local Police
State Police (Troop F)
Local Fire Chiefs
Fire Marshals
Public Services
Public Works Directors
Town Engineers
Floodplain Managers
Emergency Management Personnel
Local Government
Zoning Officers
Building Inspectors
Economic Development Personnel
Board and Commission Members
Key Business Owners
Chamber of Commerce Personnel
Local Marinas
Public Health
Health District Personnel
Water Pollution Control Authorities
Westbrook Health Department
State Organizations
Department of Energy & Environmental Protection (DEEP)
Department of Transportation (DOT)
Lower CT River Valley Council of Governments (RiverCOG)

Public Events

Public events were widely publicized through various channels, including fliers, notices on the project and community websites, social media pages, local businesses, community meetings, and email distributions.

Pop-up events occurred at planned community events and provided the opportunity to meet one-on-one with the Project Team and share feedback. These events were held in each municipality to ensure the entire study area was represented. Pop-up events were held on the following dates:

- **August 19, 2023 -** Westbrook Beach-side Tent
- **August 26, 2023 -** Clinton Summerfest
- **September 30, 2023 -** Old Saybrook Green

Community workshops included a presentation followed by an opportunity for the public to provide feedback to the Project Team. Community workshops were designed to be informative and engaging to the public. These events were held at various times and locations to reach a broad audience. Community workshops were held on the following dates:

- **September 13, 2023 -** Westbrook Town Hall
- **September 26, 2023 -** Virtual
- **October 2, 2023 -** Westbrook Council of Beaches Meeting
- **October 10, 2023 -** Old Saybrook Middle School Auditorium
- **February 24, 2025 -** Old Saybrook Middle School Auditorium
- **February 25, 2025 -** Westbrook Town Hall
- **February 26, 2025 -** Clinton Town Hall

Project Website

A project website for the Four Shore Coastal Resiliency Plan was created to provide community members and interested parties an opportunity to learn more about the project and provide input (www.4ShoreResiliency.com). The project website provides access to related project information, current community plans, meeting notifications and summaries, and draft project deliverables. The website also includes an online comment form allowing the public to submit comments at any time and a link to the interactive map.

Interactive Mapping

An online map was publicly available at the start of the project to help identify assets, issues, and opportunities within the study area. This map helped build out the Asset Inventory discussed in Chapter 2 and identify potential areas of risk for further exploration in the Risk Assessment presented in Chapter 3.

Public Meeting

Westbrook Town Beach Pop-up Event

2

State of the Coast

Within the Coastal Resiliency Framework, the "State of the Coast" serves as a comprehensive snapshot of the current coastal system within the study area. This assessment establishes an understanding of the underlying conditions, acting as a starting point for charting a path toward improved resilience. The needs along the coast are readily evident, owing to the mounting pressures of sea level rise, and the increasing frequency and intensity of coastal storms, which collectively create vulnerabilities in these coastal regions.

This section gives an overview of existing municipal planning efforts and initiatives, followed by an analysis of the prevailing physical, economic, and social conditions that impact the region. Community and municipal staff feedback on current assets and issues in the Study Area are featured at the end of this section. It is important to recognize the public as a valued contributor to this Coastal Resiliency Plan and to realize that their comments may reflect their personal context and not the full or major issues.

North Cove, Old Saybrook

Existing Conditions

This section offers an overview of the prevailing physical, socio-economic, infrastructure, and community resource conditions across the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick as they stand today.

The asset inventory takes an in-depth look at five areas that are critical to daily life in the involved municipalities: housing, infrastructure systems, health and social services, natural and cultural resources, and economic systems. These categories align with the Federal Emergency Management Agency's (FEMA) "Recovery Support Functions," which identify areas where communities should build resilience and capacity to accelerate the process of recovery after disasters.

Land Cover

Why this is Important.

Different types of land cover, such as wetlands and forests, provide crucial ecosystem services that mitigate flooding, control erosion, and support biodiversity. Maintaining and restoring appropriate land cover along the study area's coast and marshes can help adapt to sea level rise impacts and protect both natural and human communities.

Developed Land Cover

Developed land, which covers nearly 28% of the study area, is the second-most abundant land cover type. In the coastal area, developed land accounts for over 42% of the land cover. This means that almost half of the coastal area consists of impermeable surfaces, which cannot assist in the infiltration or storage of stormwater, and increase runoff.

Prioritizing new development north of Rte. 1, and preferably north of Interstate 95 (I-95), will help to ensure that no further flood storage capacity in the coastal area is lost to development. State and Federal regulations and priorities must be followed and considered when implementing sustainable land use practices, such as preserving or restoring wetlands, implementing green infrastructure solutions, and encouraging low-impact development (LID) techniques. LID is a land development approach that works with nature to manage stormwater by preserving natural landscape features and minimizing impervious surfaces to create functional drainage that treats stormwater as a resource rather than waste.

Natural Land Cover

The study area's most abundant natural land cover classes include forested land (45.2%), tidal wetlands (7.8%), and other wetlands (6.9%). Most of the forested land in the study area is North of I-95. Reducing these natural lands, particularly when replaced by developed lands, diminishes stormwater infiltration potential. The coastal area's natural land cover primarily consists of tidal wetlands (22.7%), forested land cover (17.2%), and turf/grass (8.6%). The majority of the forested land in the coastal area is located between Route 1 and I-95, away from the coastline. This inland flood storage is crucial for the gradual infiltration of floodwaters into groundwater.

Despite only accounting for 1.5% of the coastal area, beaches play a crucial role in the region's recreational activities and economy. In the majority of cases, residential and commercial development directly borders these beaches. The absence of natural vegetation between beaches and developed areas can exacerbate beach erosion. As sheet flow runs off roads and impervious surfaces directly onto the beaches without the opportunity to infiltrate, it can cause damage to the delicate soils found in coastal areas.

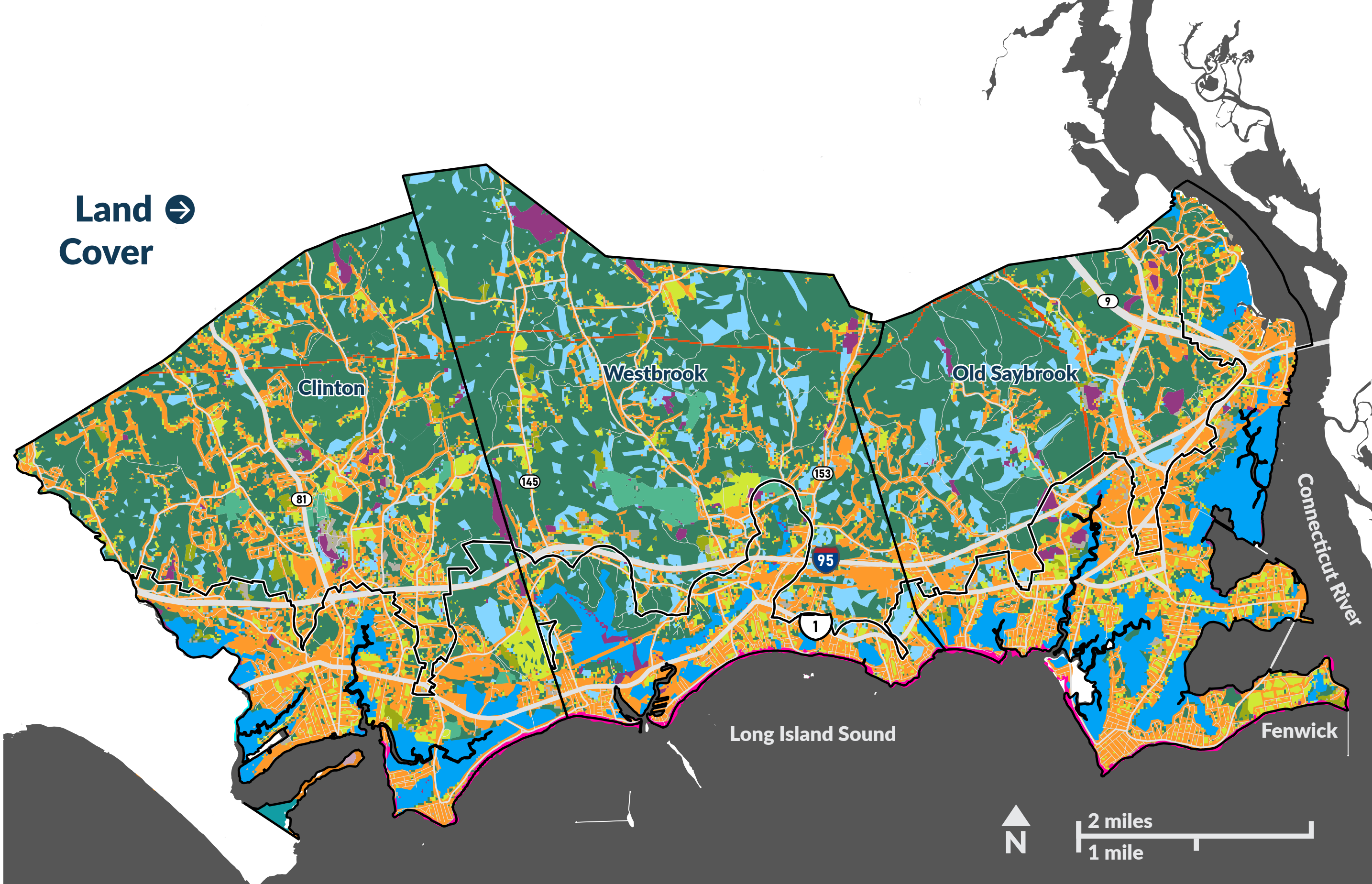
Coastal areas like Shore Road in Clinton, Old Mail Trail in Westbrook, the Great Hammock Beach neighborhood in Old Saybrook, and the Sequassen Ave neighborhood in Fenwick face a high risk of flooding due to their position between a marsh on one side and either the Long Island Sound or the lower Connecticut River on the other side. This condition makes them susceptible to storm surges from multiple directions. During flood events, the tidal wetlands act as natural water reservoirs, but once they reach their capacity, the excess water has no choice but to flow back toward the Sound or spread out into the developed areas, inundating the coastal communities in its path. While the wetlands may offer some protection for properties closer to Route 1 (Rte. 1), the developed coastal area becomes an island when the marshes and roads are submerged under floodwater.

Land Cover	Study Area	Coastal Area
Agriculture	1.1%	0.4%
Forest	45.2%	17.2%
Turf/Grass	6.3%	8.6%
Other Grass	1.2%	1.1%
Tidal Wetlands	7.8%	22.7%
Inland Wetlands	6.9%	2.6%
Beach	0.5%	1.5%
Freshwater	1.9%	2.0%
Developed	27.7%	42.6%
Utility ROW	0.5%	0.0%*
Barren	0.9%	1.2%

Total acreage is too small to round to the tenths place

Source: CT Eco Center for Land Use and Education Research (CLEAR)

Land Cover



Source: Connecticut Environmental Conditions Online (CT ECO) 2015

- Agriculture
- Forest
- Turf and Grass
- Other Turf and Grass
- Tidal Wetlands
- Inland Wetlands
- Beach
- Freshwater
- Developed
- Utility Right of Way
- Barren
- Coastal Area Boundary Line

Note: Land cover data was flown in 2015 at a National scale. For a more detailed look at the wetlands in this area, refer to page 17, Wetland Types.

Note: For this Coastal Resiliency Plan, the coastal area boundary was provided by the Connecticut Department of Energy & Environmental Protection (CT DEEP).

Note: That barren land is comprised of natural occurrences of soils, sand, or rocks where less than 10% of the area is vegetated. This could be areas of beaches, dunes, bedrock, and other accumulations of earthen material. For this Coastal Resiliency Plan, beaches and dunes have been extracted from barren as a separate land cover.

Land Use

Why this is Important.

By understanding how people are using the land, targeted, effective, and sustainable strategies for coastal resilience can be developed that balance human needs with the protection of coastal ecosystems.

From a coastal resilience perspective, the way land is utilized and the types of materials covering the land surface can significantly influence and be influenced by climate change impacts. The conversion of natural landscapes into human-centric developments, such as residential areas, transportation infrastructure, commercial centers, and impervious surfaces, disrupts the delicate balance between the land and its environment. This disruption can lead to downstream consequences for ecosystems and potentially exacerbate climate stressors, such as extreme temperatures and precipitation events.

Coastal resilience efforts must carefully consider land use patterns, land cover characteristics, and their intricate relationships with the environment. Striking a balance between development needs and conservation efforts is crucial to mitigating the impacts of climate change, safeguarding ecosystems, and ensuring the long-term viability of essential resources in these vulnerable coastal areas.

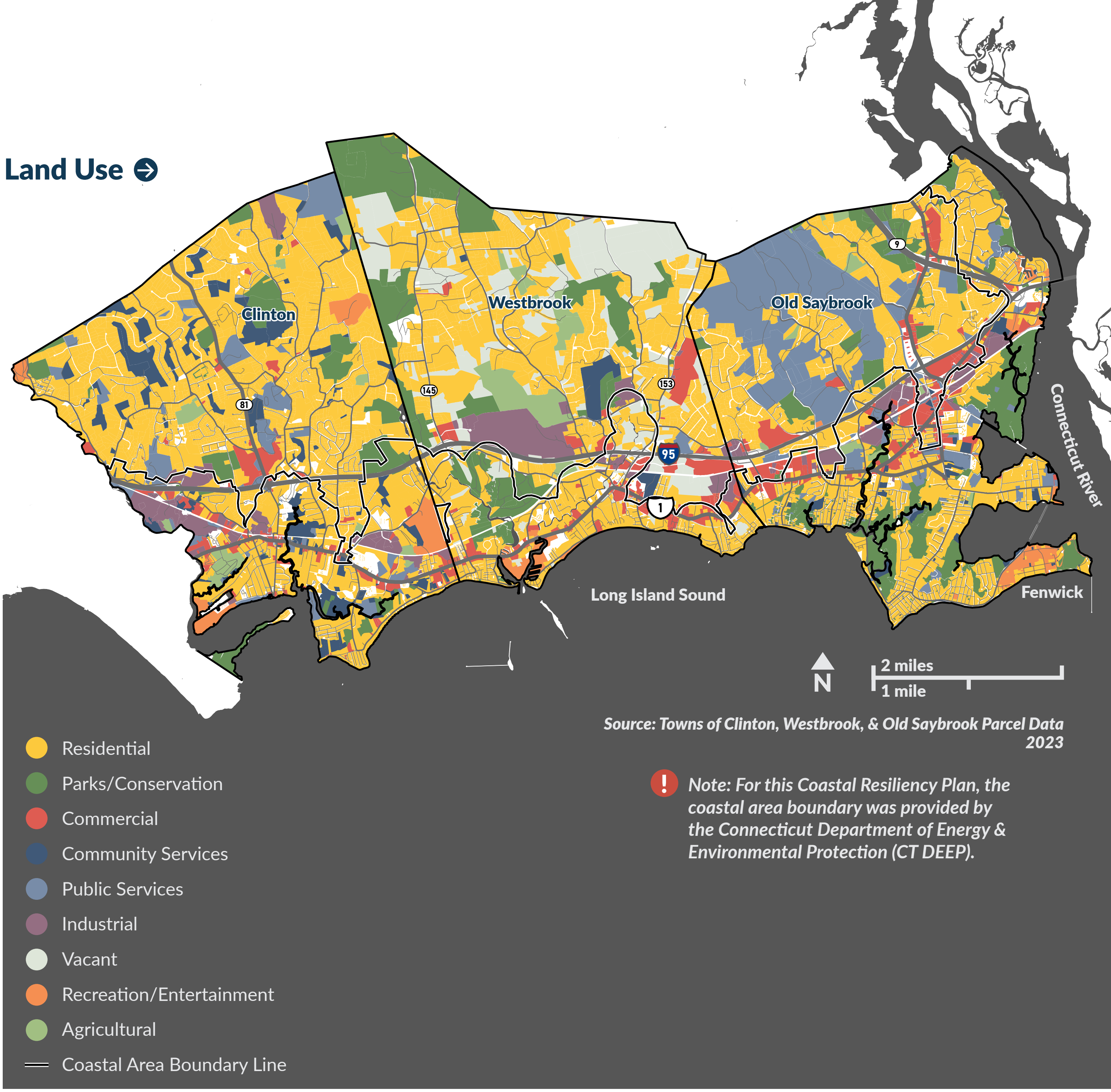
In several locations within the study area, industrial and commercial land uses are situated next to marshes. These land uses often involve significant vehicular traffic, including cars, tractor-trailers, and boat trailers. As a result, fuel, metals, and other chemicals can leach into nearby waterways in the wake of a storm or high tide, causing pollution in the adjacent marshes and water bodies.

In areas south of Rte. 1, residential housing is frequently situated between the Long Island Sound to the south and marshlands to the north. This positioning leaves these homes highly vulnerable to high tides and storm surges. During flooding events, entire neighborhoods can become isolated like islands when roads become inundated, making it challenging to provide aid or conduct recovery efforts.

Coastal Area Land Use

The coastal area boundary line primarily lies south of Interstate 95, with residential properties, both seasonal and year-round, comprising over half of the acreage within this boundary. Nearly the entire coast consists of residential properties, often lacking sufficient buffers from high tides and storm surges. Parks and conservation land, including marshes, make up the second most abundant land use, accounting for nearly 12% of the total acreage. However, the majority of these park lands are situated outside the coastal area, which limits their potential for flood storage. Commercial land uses are generally concentrated along Rte. 1 throughout the study area. Other commercial land uses, such as marinas, are situated along the waterfront and play a vital role in supporting the boating and tourism activities in the study area. These waterfront commercial zones are more susceptible to storm impacts and storm surges, which could ultimately affect the local tourism industry. Commercial properties often feature a high proportion of impermeable surfaces, such as parking lots and large buildings. These characteristics contribute to reduced stormwater infiltration, potentially exacerbating and prolonging flood events.

Land Use



Land Use	Description	Example
Residential	Used for human habitation. Living accommodations such as hotels, motels, and apartments are in the Commercial category	single-family home, duplex, triplex, seasonal residences
Parks/Conservation	Reforested lands and preserves	public parks, wetlands
Commercial	Used for the sale of goods and/or services	hotel, apartments, restaurant, parking lot, retail, office space
Community Services	Used for the well being of the community	school, library, church, municipal building, police and fire protection
Public Services	Used to provide services to the general public	water supply, electric, gas, communication, bridges
Industrial	Used for the production and fabrication of man-made goods	manufacturing
Vacant	Not in use, is in temporary use, or lacks permanent improvement	shell building, vacant lots
Recreation/ Entertainment	Used by groups for recreation, amusement, or entertainment	marina, golf course, movie theater, playground
Agricultural	Used for the production of crops or livestock	farm, vineyard, nursery

Natural Resources

Why this is Important.

Wetlands play a vital role in coastal resilience by acting as natural sponges that absorb and gradually release water during storm events, reducing the impact of flooding and erosion on nearby communities and ecosystems.

Wetlands

The study area encompasses roughly 2,900 acres of freshwater wetlands, which fall under the jurisdiction of the State's Inland Wetland and Watercourses Act (IWWA). These wetlands, consisting of marshes, bogs, meadows, and other areas saturated by surface or groundwater, serve as vital habitats for a diverse array of flora and fauna. Moreover, these wetlands play a crucial role in enhancing resilience by absorbing floodwater and runoff, thereby mitigating the erosion of upland soil. As such, these wetlands are not only ecologically significant but also serve as a valuable tool in promoting the region's overall resilience to environmental challenges.

Tidal Wetlands

Tidal wetlands, found where rivers meet the sea, are characterized by brackish water and tidal influences. In the study area, these wetlands take the form of marshes. Marine wetlands, unlike estuarine wetlands, are coastal wetlands directly exposed to the open ocean, with salinity levels similar to seawater. In the study area, they appear as tidal flats that provide critical habitats for various marine species and offer essential ecosystem services, including coastal protection and nutrient cycling. These wetlands provide essential flood storage during high tides and storm events.

Inland Wetlands

Several categories of inland wetlands exist in the study area. Emergent inland wetlands serve as the transitional zone between permanently wet and dry land. The term "emergent" refers to both the land that "emerges" from the water to meet the forest and the plants that "emerge" from the water to grow in this unique environment.

Forested inland wetlands are areas where the soil is saturated or flooded for at least part of the growing season, and the vegetation, primarily consisting of trees, is adapted to withstand these flooded conditions. These wetlands experience temporary flooding and provide valuable flood storage in upland areas, which helps to alleviate flooding downstream.

Riverine wetlands are found in floodplains along the sides of non-tidal streams and are heavily influenced by the flow and fluctuations of the adjacent water body. Small crossings or bridges often stretch over these wetlands. It is crucial to maintain the integrity of these crossings. If the streams swell with water and the crossings are closed, routes can be disrupted.

Lakes and Ponds

Lakes and ponds are scattered throughout the study area, with some having dams to control water flow. Maintaining these dams in good condition is imperative to ensure the safety of the downstream populations, as a failure could pose significant threats.

Critical Habitat Area

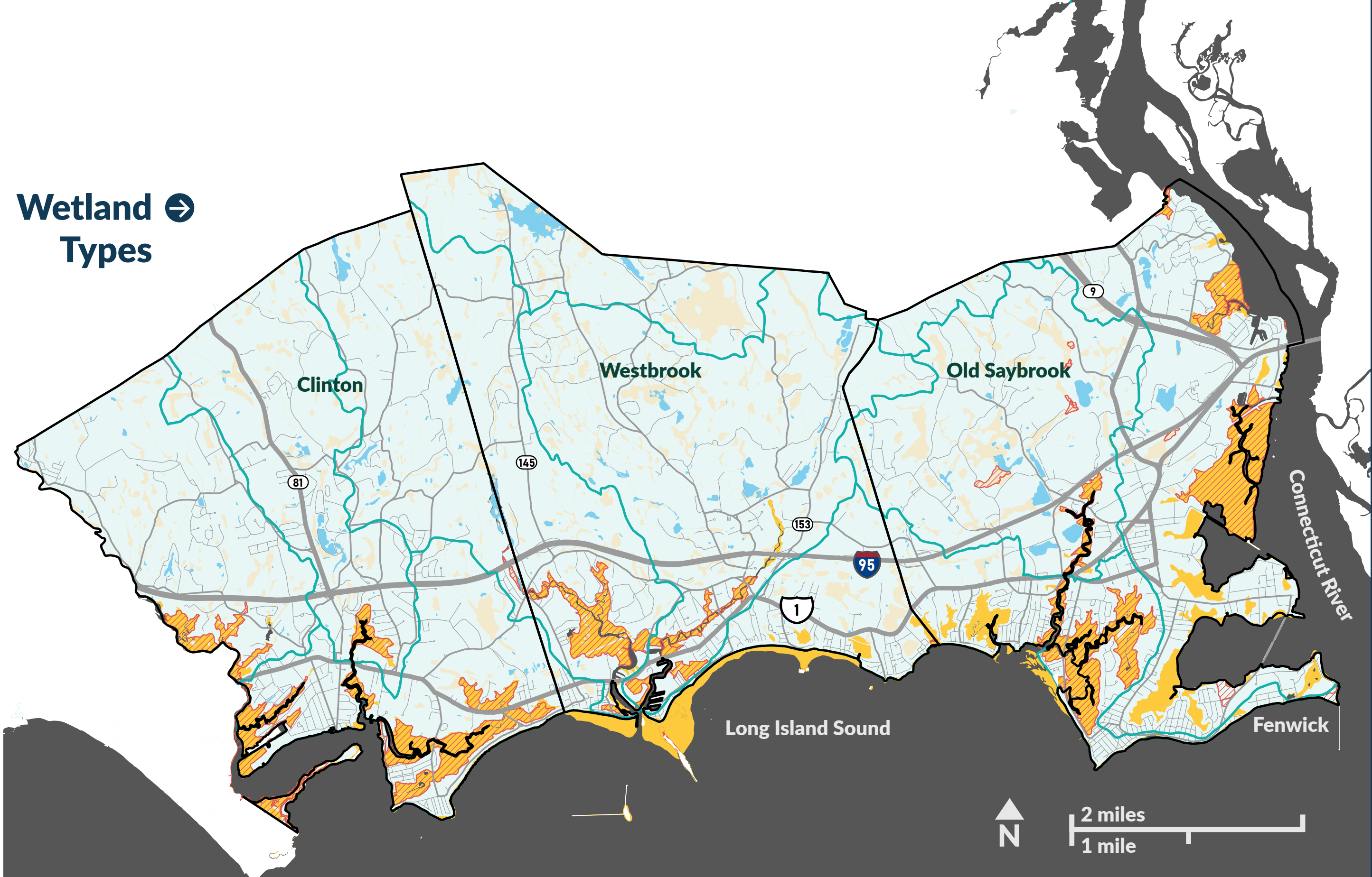
Critical habitats contain features or areas essential for the conservation and recovery of species listed under the Endangered Species Act. In the study area, critical habitat generally aligns with the estuarine and marine wetlands which are marshes. The Natural Diversity Data Base (NDDB) gathers and consolidates State and Federal Listed Species information from various sources. The exact locations of species are not disclosed, but generalized buffer zones are shown.

Watershed

Understanding the 12 subregional watersheds in the study area is crucial. These systems influence water quality, flooding, pollution, and ecosystems, linking inland areas to the coast. This knowledge informs resource management and adaptation strategies while highlighting the need for collaboration across jurisdictions to effectively address coastal challenges.

Watersheds extend beyond municipal boundaries, and as a result, some recommendations may necessitate collaboration between municipalities to secure project funding and address shared challenges.

Wetland ➔ Types



- Tidal Wetland
- Inland Wetland
- Lake / Pond
- Critical Habitat Area
- Subregional Watersheds
- Roads

Source: Connecticut Department of Energy & Environmental Protection (CT DEEP) 2024 *(Critical Habitat Areas);*
National Wetland Inventory (NWI) 2023;
Connecticut Environmental Conditions Online (CT ECO) 2023 *(Subregional Watersheds)*

Note: The Connecticut Department of Energy & Environmental Protection (CT DEEP) has specific legal definitions for tidal and inland wetlands that differ from the federal definitions used in the National Wetland Inventory (NWI), which informs the wetland map above. For this planning effort, NWI data is sufficient to inform proposed recommendations. However, should a project recommended in this plan move forward to design and implementation, further investigation into the presence of wetlands should be conducted.

Why this is Important.

FEMA flood zones indicate areas at high risk of flooding. Understanding which areas fall within different flood zones helps inform decisions about land use, building regulations, insurance requirements, and adaptation strategies to minimize flood damage and ensure public safety.

Floodplains

Approximately 22% of the study area's land area (or 6,746 acres) is located in a designated floodplain, or flat area of land next to a water system like a river, stream, or ocean. Floodplain areas can be found along the Long Island Sound, the Connecticut River, and inland rivers and streams.

Flood Insurance

The entirety of the study area is voluntarily enrolled in the National Flood Insurance Program (NFIP) which provides insurance to reduce the socio-economic impact of floods. The NFIP program requires participating communities to adopt the Flood Insurance Rate Map (FIRM) and a floodplain management ordinance or zoning regulations that meet or exceed the minimum NFIP criteria.

The Federal Emergency Management Agency (FEMA) updates FIRMs periodically to reflect changes in flood risks, as these risks are not static. As a result, flood zone designations can change over time, which may impact insurance requirements and development regulations for properties within the affected areas. Structures located in the floodplain have a 26% chance of flooding over the life of a 30-year mortgage. Mandatory flood insurance is only required for properties with a federally backed loan. Properties that do not have a mortgage are not required to have flood insurance but can still purchase federal flood insurance due to community participation in the NFIP. Flood insurance is strongly encouraged for all structures within, and close to, mapped floodplains or with a prior history of flooding.

Flood Hazard Areas

FEMA issues Flood Insurance Rate Maps that identify flood hazards as Special Flood Hazard Areas (SFHA). An SFHA is an area that will be inundated by the flood event having a 1% chance (referred to as a 100-year flood) of being equaled or exceeded in any given year. Structures located in floodplains are subject to stricter review and regulations compared to those situated outside of flood-prone areas.

High Hazard Zone V / VE

High Hazard Area Zones are marked as V or VE on FEMA flood maps. These coastal SFHAs have wave heights exceeding 3 feet and fast-moving water during the base flood event. "Zone VE" indicates a detailed study was conducted, and Base Flood Elevations (BFEs) were calculated. Flood zone VE areas have a 1% or greater annual flood risk and additional hazards from storm waves and high-velocity water. VE Zone floodplain construction standards are applied to development.

High Risk Zone AE

Flood zone AE is the FEMA designation for areas with a 1% annual chance of flooding. FEMA has performed detailed analyses of these riverine and coastal floodplains that result in BFEs.

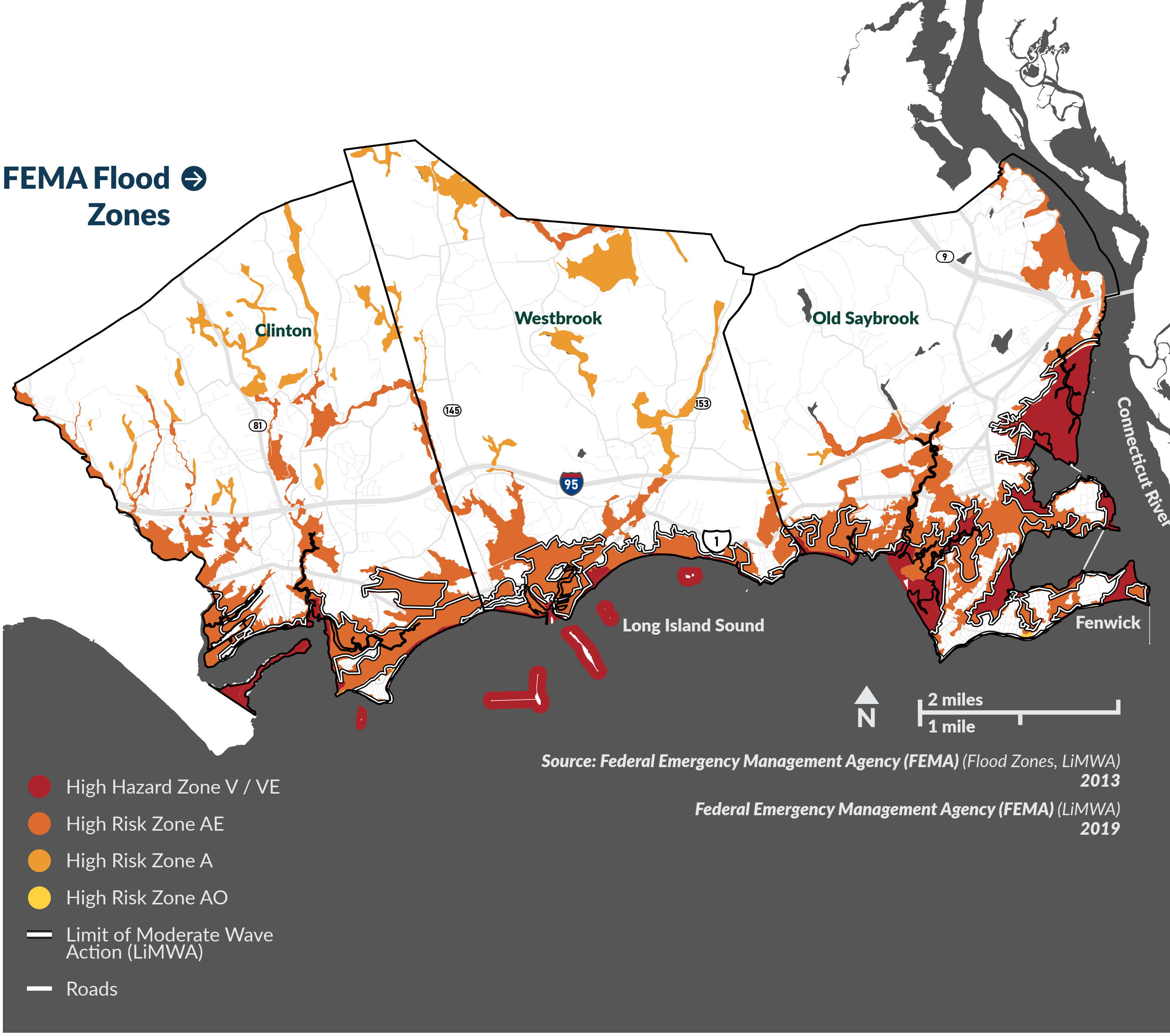
High Risk Zone A

Flood zone A is the FEMA designation for areas with a 1% annual chance of flooding. Because detailed analyses are not performed for these areas, no depths or BFEs are shown within these zones. Flood zone A areas are also called "un-numbered A zones" as they do not have a BFE calculated by FEMA. Development in these areas would require the calculation of a BFE by the property owner.

High Risk Zone AO

Zone AO indicates areas at risk of 1 to 3 feet deep flooding during the base flood, often due to wave over-topping. In these zones, waves wash over the crest of a dune or bluff and flow into the area beyond. Flood depth is expressed as a height above natural ground. Structures in AO zones remain vulnerable to wave flooding, even if located on higher ground or behind a wall.

FEMA Flood Zones



Source: Federal Emergency Management Agency (FEMA) *(Flood Zones, LiMWA)* ***2013***

Federal Emergency Management Agency (FEMA) *(LiMWA)* ***2019***

Limit of Moderate Wave Action (LiMWA)

Flood zone Coastal AE indicates the portion of the CHHA with wave heights between 1.5 feet and 3.0 feet bounded by the Limit of Moderate Wave Action (LiMWA) line on an FIRM and has a 1% or greater chance of flooding. For Coastal Zone AE, detailed analyses have been performed and BFEs have been calculated. A LiMWA line marks the inland extent of potentially damaging 1.5-foot breaking waves during a 100-year storm. It is a crucial tool for coastal flood risk assessment, mapping, and management, guiding development and planning strategies. Per the Connecticut State Building Code requirements, VE Zone floodplain construction standards are applied to the development of Coastal AE Zones.

Natural Resources (cont.)

> **Why this is Important.**
>
> Open space is essential for stormwater and flood storage especially when it is positioned adjacent to a waterway. Upland flood storage manages water in upstream areas to reduce downstream flooding. Natural water retention areas, like wetlands and forests, absorb and store excess water during heavy rainfall. This reduces peak water flow and minimizes flooding in low-lying areas.

Open Space

The study area boasts over 11,000 acres of protected open space, encompassing a diverse range of natural environments such as forests, wildlife management areas, preserves, and local parks. The open space displayed to the right is not all public open space. It also includes conservation easements over public and private land. These open spaces play a vital role in enhancing the region's resilience by serving as natural flood storage areas, absorbing excess water during heavy rainfall events, reducing flood risk, and facilitating water infiltration. By preserving and maintaining these critical components of the landscape, the study area can bolster its resilience to climate change and other environmental challenges, while simultaneously promoting the well-being of the community. These parks and open spaces are important and should be protected from development as much as possible, as they represent large areas of land that are actively mitigating the impacts of climate change.

Trails

Walking and biking trails, especially those along the coast, offer numerous benefits. They improve public health by providing opportunities for physical activity and encouraging tourism and recreation, which can boost the local economy. When designing these trails, it is crucial to consider the protection of sensitive areas, such as wetlands and marshlands, which are easily harmed by human impact. The study area features a network of trails that are maintained through the efforts of both public and private organizations.

Public Beaches

The study area has seven public beaches, listed below from west to east.

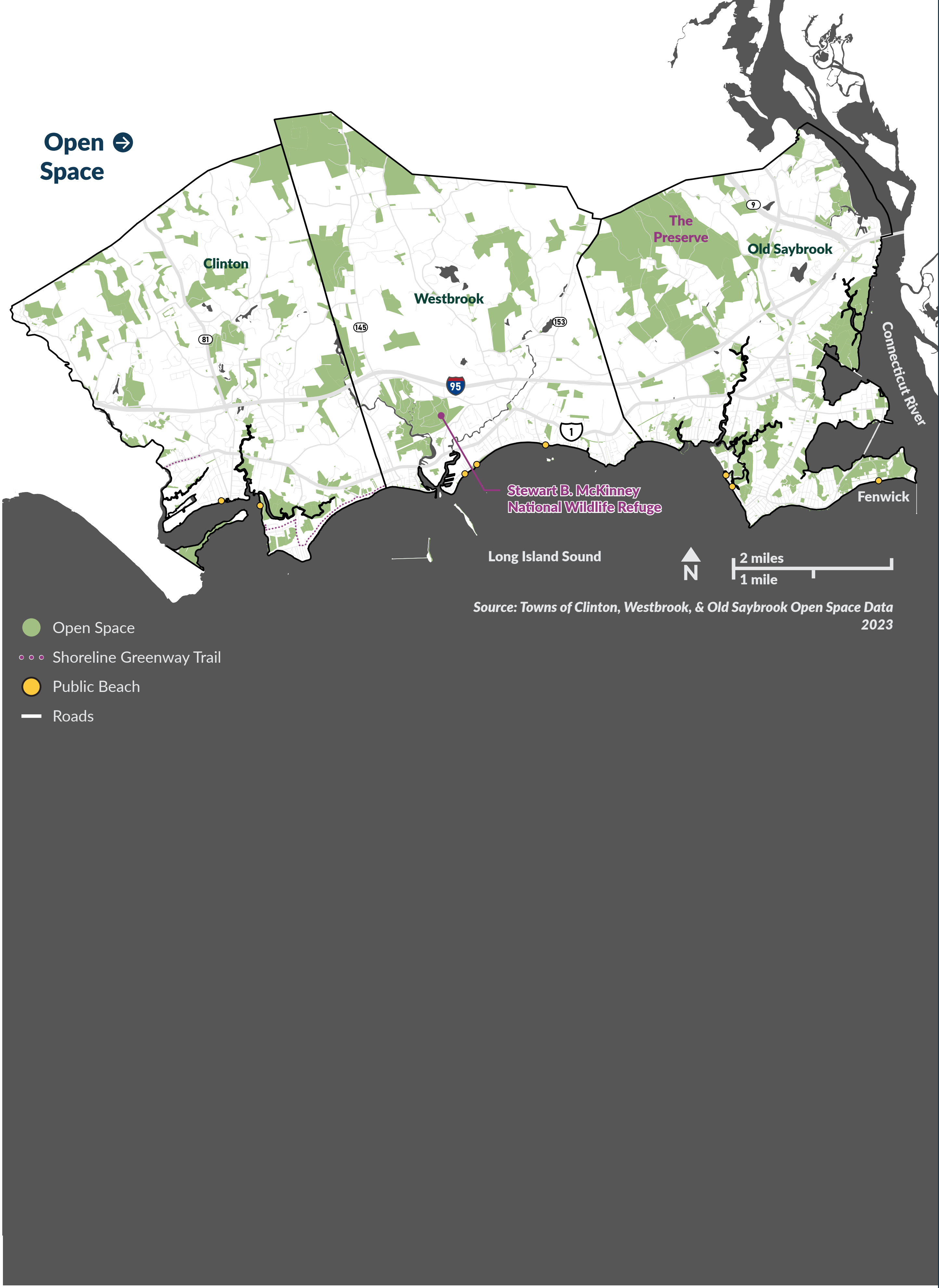
Town	Beach
Clinton	Esposito Beach
	Clinton Town Beach
Westbrook	Coral Sands Beach
	West Beach
	Middle Beach
Old Saybrook	Harvey's Beach
	Town Beach
Fenwick	Fenwick Ave Beach

Coastal erosion endangers beaches, increasing their vulnerability to flooding and storms. Beaches are essential for coastal resilience, absorbing wave energy, controlling erosion, providing flood protection, and supporting recreation and tourism. Sustainable beach management is necessary to maintain beaches' crucial role in safeguarding coastal communities and ecosystems against environmental challenges. In certain locations, dunes that serve the essential purpose of providing natural coastal protection against storm surges and high wave action are being unlawfully removed. This practice is often driven by the desire to enhance water views in these areas, prioritizing aesthetic considerations over the critical ecological function and protective benefits offered by the dunes.

Beach Associations

Clinton has 7 beach associations, 5 of which are also special tax districts. Westbrook has 17 beach associations and a Council of Beaches consisting of one delegate from each association. Old Saybrook has 11 beach associations plus Fenwick, some of which are also taxing districts. The Borough of Fenwick is a full coastal municipality within the Town of Old Saybrook.

Open Space


The Preserve
Old Saybrook
Clinton
Westbrook
Connecticut River
95
9
81
145
153
1
Stewart B. McKinney National Wildlife Refuge
Fenwick
Long Island Sound
N
2 miles
1 mile
Source: Towns of Clinton, Westbrook, & Old Saybrook Open Space Data 2023
Open Space
Shoreline Greenway Trail
Public Beach
Roads

Demographics

Why this is Important.

Understanding local demographics and statewide projections is crucial for municipalities to prioritize resources, design targeted interventions, and plan for future changes in population size, age structure, and diversity that impact housing, transportation, education, healthcare, and other essential services.

Note: The demographic information provided does not include seasonal or intermittent residents who answered the census from their primary home in a different location.

Note: Data sources include Fenwick in the Old Saybrook data.

Population

The combined population of the study area, which includes Clinton, Westbrook, Old Saybrook, and Fenwick has remained relatively stable since the 2010 Decennial Census, which was 30,452. The 2021 American Community Survey (ACS) reported a combined population of 30,629 representing a growth of 0.1% over the 10 years. In contrast, the State of Connecticut saw a similar population increase of 0.1% during the same period. The 2020 ACS reveals a much older population resides in the study area, which has a median age of 52.7 years compared to Connecticut's median age of 41 years. This data highlights the study area is growing at a rate consistent with the State's growth. The study area experiences an influx in population during the summer months due to seasonal residents.

Ethnicity	Percentage
White	86.1%
Hispanic / Latino	7.0%
American Indian / Alaskan Native / Other	4.9%
Asian	1.6%
Black / African American	0.4%

***Source:** 2021 American Community Survey (ACS)*

Municipality	Population	Coastal Population*
Clinton	13,283	5,835
Westbrook	6,800	3,608
Old Saybrook / Fenwick	10,546	5,756

***Source:** 2021 American Community Survey (ACS)*

**Coastal populations were calculated based on available census tracts (6101, 6102, 6801.02, and 6702)*

Commuting Patterns

In 2021, the study area had a total of 14,881 commuting workers, a majority of which drove alone (77.8%), while only 5% carpooled. Nearly 2% of commuters took public transportation to work, while 3.2% walked and 1.1% took other means of transportation such as a taxi, bicycle, etc. The average commute time was estimated at 26 minutes in 2021. It should be noted that nearly 11% of the working population in the study area worked from home.

Income and Employment

In 2021, the study area's median household income was $94,206. The poverty rate in the study area was 4.2% for individuals and 2.7% for families and the unemployment rate was 3.5%. The table outlines the 2022 Asset Limited, Income Constrained, Employed (ALICE) report findings in the study area.

Town	Poverty	ALICE	Above ALICE
Clinton	298	1,240	3,886
Westbrook	133	1,227	2,009
Old Saybrook	287	984	3,389

***Poverty:** households with an income below the Federal Poverty Level*

***ALICE (Asset Limited, Income Constrained, Employed):** households with an income above the Federal Poverty Level but below what is needed to afford the cost of basic expenses*

***Above ALICE:** households with an income above the cost of basic expenses*

Property Values and Homeownership

In 2021, the study area contained 16,680 housing units, with 65.1% being owner-occupied, 15% being renter-occupied, and 19.9% being vacant housing. The United States Census Bureau categorizes vacant housing units into several distinct categories. Seasonal housing is considered a type of vacant housing, but it's specifically classified as "Vacant - For seasonal, recreational, or occasional use." Of the nearly 20% of vacant housing units in the study area, 79% of them are categorized as "Vacant - For seasonal, recreational, or occasional use." This suggests a substantial presence of summer residents who own property within the study area. Short-term rentals in the study area primarily consist of academic housing catering to visiting scholars and students, as well as vacation rentals used by tourists and temporary visitors.

In 2021, the study area's median owner-occupied home value was $353,200. Housing costs for homeowners with a mortgage averaged $2,253 per month. In contrast, the median rent has increased by over 23% over 11 years to $1,365 per month.

Age of Housing

The median year that houses in the study area were built was 1969. Most older homes don't meet current building codes due to their age. As these homes age and require ongoing maintenance or upgrades, homeowners may face the risk of triggering significant improvement requirements to ensure the continued integrity of their properties. For instance, a home built in 1972 may require a new roof to maintain its functionality and value. Substantially damaged or substantially improved homes (50% of pre-disaster or pre-improvement value) in the Special Flood Hazard Area (SFHA) must comply with local zoning and flood ordinances during repairs.

Demographic Snapshot, Study Area

Source: U.S. Census Bureau, American Community Survey (ACS) 2021

Population
30,629

Median Age
52.7

Households Age 65+
40.47%

Median Household Income
$94,206

Median Owner-Occupied Home Value
$353,200

Source: United States Census Bureau

Year-Round Owner-Occupied Housing Units
65.1%

Renter-Occupied Housing Units
15%

Vacant Housing Units
19.9%

79% Vacant - For seasonal, recreational, or occasional use

Source: ESRI Business Analyst Community Profile and Demographic/Income Profile

Median Year Housing Units Built
1969

Unemployment Rate
3.5%

Total Daily Work Commuters
14,881

Vulnerable Populations

Why this is Important.

Identifying vulnerable populations is necessary to ensure that the needs of these groups are addressed. Planners can use this information to develop strategies that reduce environmental burdens, increase resilience, and promote equitable access to resources, creating a more just community.

Disadvantaged Communities

The Environmental Protection Agency (EPA) defines disadvantaged communities based on a combination of environmental, health, and socioeconomic factors. These communities typically experience one or more of the following: low income, high unemployment, linguistic isolation, low educational attainment, disproportionate environmental burdens, health vulnerabilities, housing cost burdens, limited transportation access, and lack of access to essential resources. Refer to page 23 for Asset Limited, Income Constrained, Employed (ALICE) report findings in the study area.

The EPA has identified five disadvantaged communities within the study area, see table below. These are distributed across three towns: one in Clinton, two in Westbrook, and two in Old Saybrook. Notably, four out of these five communities are located near a FEMA-designated flood zone. Based on the 2050 and 2070 projections, areas 2,3 and 5 are expected to experience significant inundation. See pages 70-79 for detailed mapping.

	Population*	% Non-English Speaking Household	% Low Income	% Minority
Clinton				
1	959	8%	11%	25%
Westbrook				
2	841	18%	26%	13%
3	1,476	18%	21%	38%
Old Saybrook				
4	1,518	8%	20%	7%
5	770	8%	28%	6%

Source: Environmental Protection Agency (EPA) Disadvantaged Communities and Climate Justice Program

Manufactured Home Communities

Manufactured homes in coastal areas face significant challenges related to resilience, particularly due to their vulnerability to flooding and storm surges. Several such communities are situated near waterbodies, making them more susceptible to flooding. Evacuation options are also limited for some communities. Some communities have a single entry/exit point, which poses a significant risk during flooding events. If this access becomes blocked by high water levels, emergency personnel may be forced to reach these areas on foot from adjacent streets, potentially delaying critical response times.

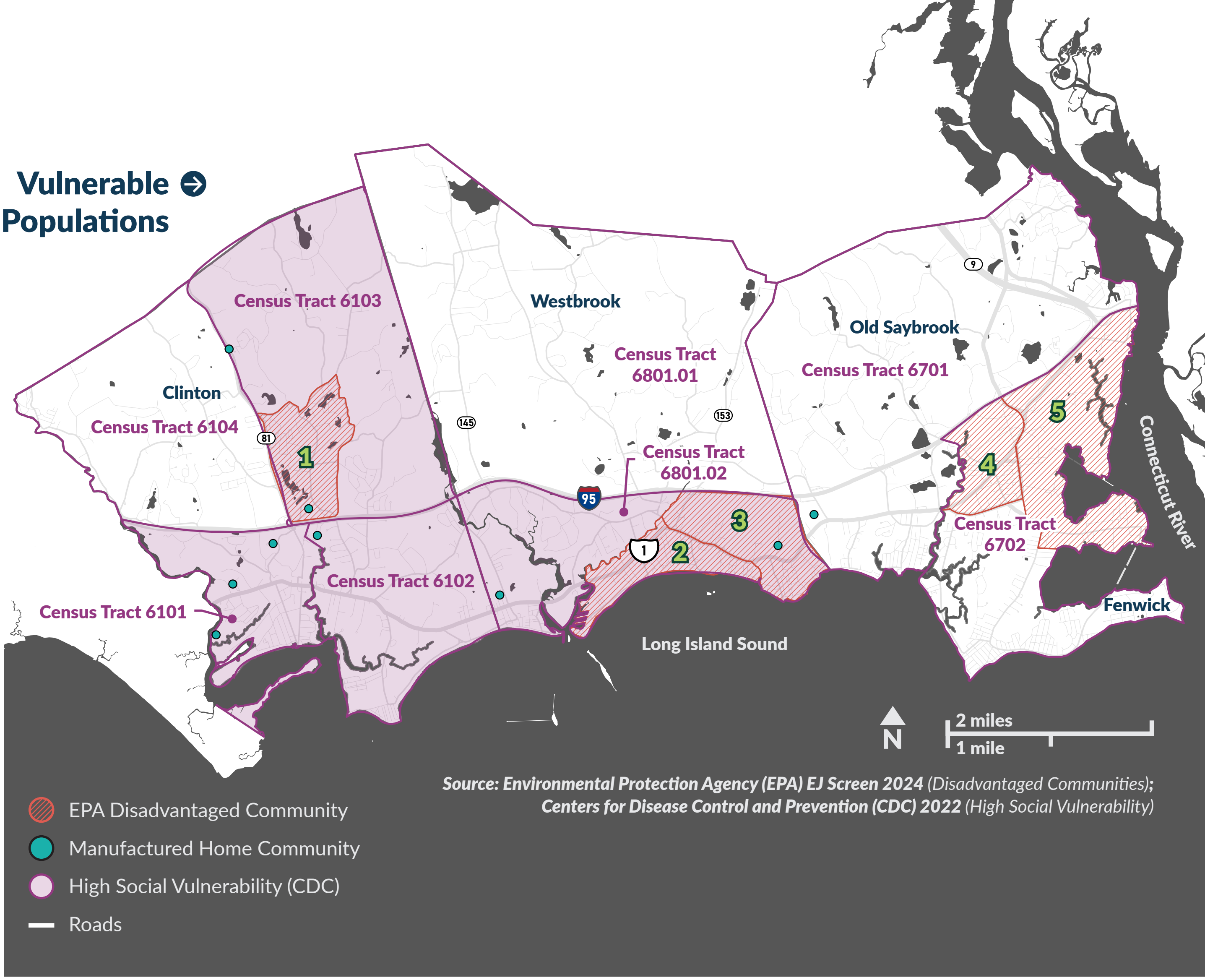
Given these factors, enhancing coastal resilience for manufactured home communities requires targeted strategies like improved building codes, safeguarding evacuation routes, providing housing alternatives in lower-risk areas, and offering financial assistance for mitigation and recovery efforts.

Community	Capacity
Clinton	
Cedar Grove	50 lots S. location, 10 lots N. location
Evergreen Springs	103 lots
Singh Estates	9 lots
Singh Meadows	7 lots
Old Mill Road	40 lots
Westbrook	
New England Village	139 lots
Green Acres	71 lots
Old Saybrook	
Yankee Village	24 lots

Socially Vulnerable Populations

The Centers for Disease Control and Prevention (CDC) uses a Social Vulnerability Index (SVI) to identify populations who may be at increased risk of hazardous events, including natural and climate disasters, because of socioeconomic or demographic conditions. In the study area, four census tracts (6101, 09130610200, 6103, 6801.02), are considered Socially Vulnerable Areas. Of the almost 12,000 residents who live in these areas, 11% are minorities, nearly 2% of households do not have access to a vehicle, and 11.5% are below the federal poverty level.

Vulnerable Populations



***Source: Environmental Protection Agency (EPA) EJ Screen 2024** (Disadvantaged Communities); **Centers for Disease Control and Prevention (CDC) 2022** (High Social Vulnerability)*

It is important to note that there can be significant overlap between socially vulnerable communities and environmental justice communities, as marginalized populations often face a combination of social and environmental challenges. However, not all socially vulnerable communities face disproportionate environmental burdens, and not all environmental justice communities experience the same level of social vulnerability.

Beach Communities

Properties along residential streets extending from the shoreline present complex engineering challenges based on their foundation conditions. Shorefront structures often sit on barrier beach sand, while those on connecting streets may rest on fill material. These varying subsurface conditions affect flood depths, drainage patterns, and evacuation routes.

While water service extends throughout these areas, they lack sewer infrastructure, relying instead on septic systems installed in either beach sand or fill material. Though some neighborhoods warrant preservation for their community value, this consideration may not apply uniformly to all structures within them.

The coastal location of properties in the study area presents a complex insurance challenge, with significantly elevated home and flood insurance premiums creating substantial financial pressure. This cost burden frequently leads to underinsurance, as many residents are forced to reduce coverage levels to manage premium costs. The combination of inadequate insurance coverage and the area's vulnerability to severe weather events leaves properties exposed to potentially devastating financial losses. Addressing insurance affordability is therefore essential to protecting both individual homeowners and the broader coastal community.

Economy

> **Why this is Important.**
>
> Understanding local and state economic projections helps guide resource allocation, anticipate future development, and assess risks. By incorporating economic projections into the planning process, the involved communities can develop financially feasible and sustainable strategies that are responsive to the changing populations and needs of the coastal region.

In 2022, the study area contained 13,328 jobs across all industries according to the Connecticut Department of Labor Annual Averages of Employment & Wages by Industry ("QCEW") data. However, from 2017 and 2022, the number of jobs within the study area decreased by 1,332 jobs, or 9%.

Industry Sectors

Land use describes the physical way property is utilized (such as residential, commercial, industrial, or agricultural), while industry sectors categorize economic activities and businesses by their type of work or output (such as manufacturing, healthcare, retail, or technology). The top five largest industry sectors by employment in the study area in 2022 were:

- **Education, Healthcare & Social Assistance:** 4,434 jobs (25.8% of total)
- **Retail Trade:** 2,357 (13.7% of total)
- **Professional, Scientific, Management, Administrative & Waste Management Services:** 2,105 jobs (12.3% of total)
- **Arts, Entertainment, Recreation, Accommodation, & Food Services:** 1,843 jobs (10.7% of total)
- **Manufacturing:** 1,711 jobs (10% of total)

Historic Growth Trends

In 2017, the two largest industries were retail trade with 26.9% of jobs and accommodations and food services with 13.6% of jobs. The healthcare and social assistance industry had 11.4% of jobs in the study area while government jobs comprised 10.8% of jobs. Manufacturing jobs rounded out the top five industries in 2017 with 4.3% of jobs. The data above demonstrates that although the total combined jobs in the study area have decreased in the past five years, the major industries providing those jobs have remained relatively stable.

The Lower Connecticut River Valley's workforce has roughly 100,000 positions across private, self-employed, and government sectors. While the region has rebounded from the COVID-19 downturn, employment remains below its 2016 peak of 101,000 jobs. As of 2021, the employment landscape was divided among private payroll positions (62%), self-employed workers (27%), and government jobs (10%). The area continues to demonstrate economic vitality, albeit at a more measured pace than previous years. Since 2014, the region has gained nearly 2,000 self-employed workers and approximately 800 payroll-based businesses, reflecting sustained but moderate growth.

While the Lower Connecticut River Valley's unemployment trends generally track with statewide patterns, the region consistently maintains lower unemployment rates than Connecticut overall. The area achieved its lowest unemployment rate shortly before the COVID-19 pandemic. During the pandemic's peak, the region demonstrated its economic resilience, with unemployment rates running three percentage points below the state average—a testament to the area's diverse industry mix and robust economic foundation.

Economic Connection to Resilience

This plan's protection of local assets aligns with the Lower Connecticut River Valley Comprehensive Economic Development Strategy (CEDS) by promoting equitable growth and fostering sustainable, resilient communities. These measures are crucial for the region's long-term economic vitality and adaptability.

Tourism and hospitality form a vital economic pillar in the region, anchored by its coastal amenities. The area's economic vitality depends on protecting key assets including waterfront parks, beaches, and marinas, along with its hospitality infrastructure of restaurants and hotels. Premium retail destinations and upscale experiences further strengthen this sector, making the preservation of these interconnected tourism assets essential for the region's long-term economic success.

While predominantly residential in land use, the study area's economy is significantly bolstered by seasonal tourism. The influx of day visitors, short-term renters, and seasonal residents creates a multiplier effect throughout the local economy. Though precise economic impact figures are not available, the relationship between coastal amenities and economic health is clear: any degradation of natural assets like beaches due to flooding would reduce visitor traffic, creating ripple effects across all sectors of the local economy, from retail to hospitality services.

Clinton Premium Outlets
Photo Credit: https://ctvisit.com/listings/clinton-crossing-premium-outlets

Economy (cont.)

Why this is Important.

Safeguarding businesses from coastal hazards is crucial for maintaining the local economy and ensuring that essential and critical businesses can support community recovery efforts following flooding or storm events.

Businesses

The study area is home to thousands of businesses, with marinas, tourist accommodations, restaurants, local shops, and small businesses serving as a significant economic driver. However, these businesses face an increased risk of inundation due to their locations. If compromised, the local economy would suffer from decreased revenue and coastal tourism. This potential for instability in the event of a disaster could subsequently impact the workforce.

Some coastal stressors that can have significant impacts on local businesses and the economy include:

- **Sea-level rise:** As sea levels continue to rise, coastal businesses may face increased flooding, erosion, saltwater intrusion, and damage to infrastructure, leading to higher operating costs and potential relocations.
- **Coastal storms and hurricanes:** Intense storms can cause severe damage to coastal businesses, disrupt supply chains, and lead to prolonged closures, resulting in economic losses.
- **Beach erosion:** As beaches erode, coastal businesses that depend on tourism, such as hotels, restaurants, and recreational activities, may experience a decline in visitors and revenue.
- **Coastal development:** Over-development of coastal areas can lead to the degradation of natural buffers, such as wetlands and dunes, making coastal businesses more vulnerable to flooding and erosion.
- **Pollution and water quality issues:** Coastal pollution from sources such as stormwater runoff, sewage discharges, and industrial activities can impact water quality, harming marine life and affecting businesses that depend on clean coastal waters.
- **Wastewater Treatment:** Damage to wastewater treatment infrastructure, like septic systems, can disrupt business operations and cause local economic impacts.

Coastal stressors can lead to increased costs for businesses in terms of damage repairs, insurance premiums, and adaptation measures, as well as decreased revenue due to business interruptions, reduced tourism, and declining natural resources. To minimize these economic impacts, businesses and communities must invest in resilience strategies.

If businesses need to rebuild after damage, they may face significant regulatory requirements under FEMA's 50% rule. This regulation stipulates that if repair costs exceed 50% of a structure's market value, the entire building must be brought up to current floodplain standards. For affected businesses, this could mean either elevating their buildings above base flood elevation or reducing their structural footprint. These requirements extend beyond mere physical reconstruction to affect fundamental business operations and viability.

Critical Businesses

Critical businesses refer to businesses that are considered most useful in a community's short-term recovery after a natural disaster. These businesses may be given priority in terms of resources, support, or access during emergencies. Some critical businesses include:

- Utilities and support services
- Hotels and motels
- Educational services
- Restaurants and food services
- Religious organizations
- Construction
- Wholesale and retail merchants

Essential Businesses

Essential businesses typically refer to businesses and services that are deemed necessary to maintain the health, safety, and welfare of the public during and after an emergency. These businesses are allowed to continue operating even during lockdowns or stay-at-home orders. Examples of essential businesses include:

- Healthcare and related services
- Pharmacies
- Gas stations
- Grocery stores

Essential businesses located in flood zones must have adequate backup systems to ensure food safety, preserve perishable goods, and maintain operations during power outages.

Town	Critical	Essential
Clinton	316 businesses	68 businesses
Westbrook	183 businesses	35 businesses
Old Saybrook	399 businesses	123 businesses

The information presented in the table above is derived from the 2023 LCRV COG Business Resiliency and Recovery Plan.

Resilience Practices to Consider

- Develop pre-permitting systems to speed up the rebuilding process. Pre-permitting certain kinds of emergency infrastructure could reduce downtime.
- Collaboration between neighboring municipalities can lead to pooled resources, shared equipment (e.g., mobile generators) and coordinated recovery strategies.

By integrating these elements into a recovery and resilience strategy, communities can better weather the impact and ensure that essential businesses and services continue to operate during and after such flood events.

Health & Social Services

> **Why this is Important.**
>
> Critical facilities maintain community health, safety, and welfare. Safeguarding these facilities from flooding is crucial to ensure that emergency services can run recovery efforts and schools can remain in session. If these facilities are located in vulnerable areas, it is imperative to either relocate them or plan for storm events. The community needs to minimize disruptions to the well-being of the population.

Critical Facilities

Critical facilities include police and fire stations, hospitals, government operations buildings, schools, and nursing homes among others. These facilities are either critical to emergency response (i.e., police and fire stations and hospitals), may house large concentrations of vulnerable populations (i.e., nursing homes and schools), or hold vital statistics and property information among other important documents. Critical facilities like schools and government buildings may also function as temporary heating/cooling centers or short-term shelters during emergencies. The distribution of critical facilities in the study area varies. Police and fire stations are located in every municipality with Fenwick relying on Old Saybrook's resources for all critical facilities.

Each municipality in the study area has a Hazard Mitigation Plan that identifies and assesses vulnerabilities of critical facilities and outlines actionable strategies to reduce or eliminate long-term risks to people and property through coordinated resources, programs, and activities.

Emergency Response Plans and Evacuation Routes

Emergency response plans are developed by local municipalities to prepare for potential emergencies, like floods, hurricanes, chemical releases, and other life-threatening disasters. Emergency response plans improve response times and effectiveness and reduce negative effects by determining how to deploy resources and assign responsibilities to responding agencies ahead of time.

In the study area, if an evacuation becomes necessary, the State Everbridge System is utilized to send out an alert. Everbridge is a system that enables officials to directly communicate crucial information to individuals during emergencies. These alerts are delivered through various channels, including text messages, emails, and phone calls to cell phones, home phones, or work phones. The alerts guide on evacuation destinations, necessary actions, and how to stay informed throughout the emergency. Additionally, the municipalities within the study area have employed alternative methods to notify residents, such as driving through affected areas using public address announcements and conducting door-to-door distribution of informational pamphlets in case of an evacuation or impending emergency.

During an emergency, Emergency Managers assess the situation and determine the appropriate evacuation needs. Based on the nature and severity of the emergency, they may need to modify the designated evacuation routes to ensure the safety of the public.

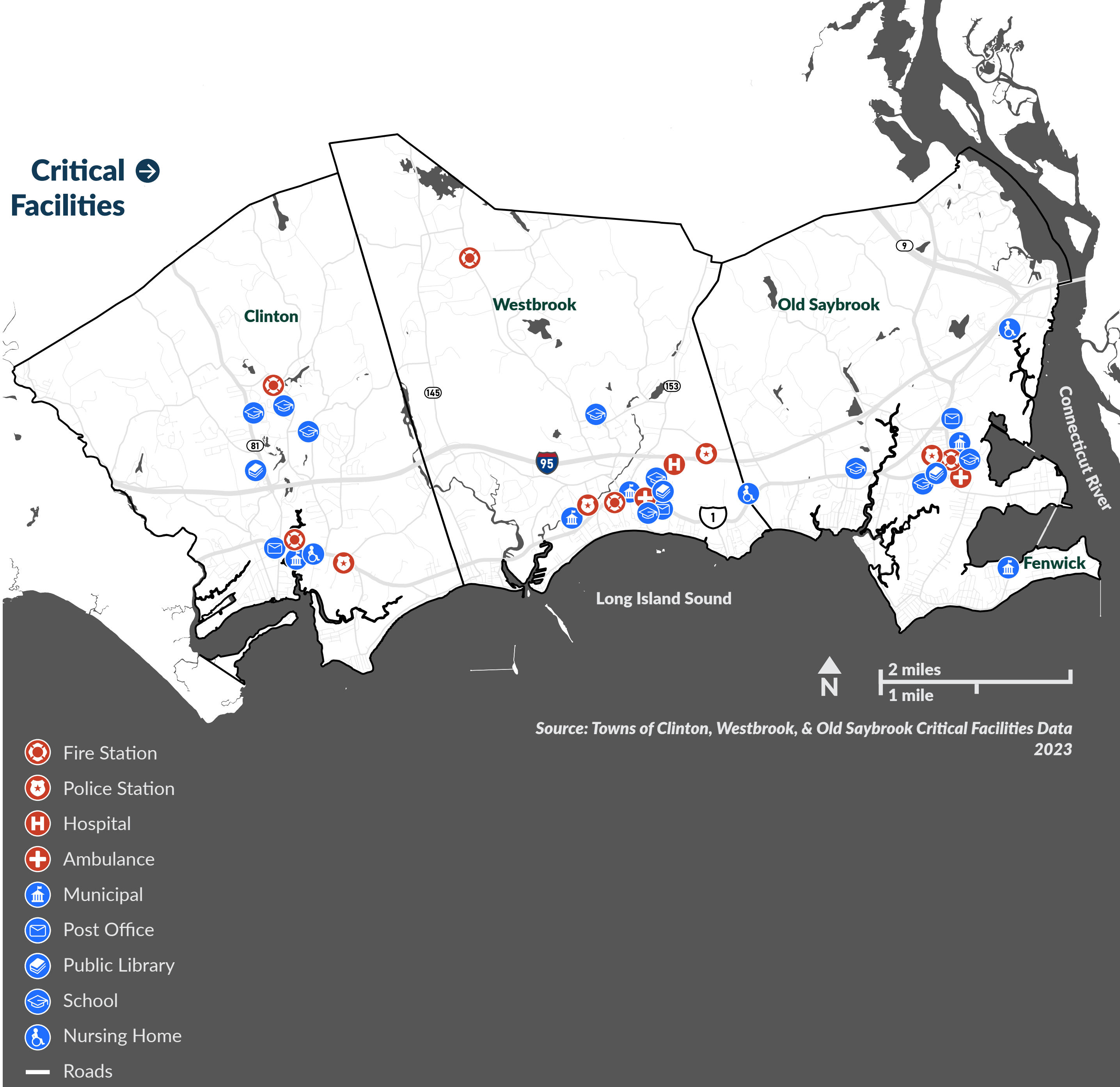
Evacuation signs have been installed at several locations south of Rte. 1 to assist in directing people away from the water in case of an emergency. However, it should be noted that the information displayed on these signs may need to be updated and may not reflect the most up-to-date evacuation procedures, routes, or flood elevations.

Communications

Maintaining communication systems is crucial during disasters for broadcasting emergency messages and facilitating communication among first responders and the public.

However, sea level rise and flooding threaten communications infrastructure, with Clinton's southern cellular tower and Westbrook's paging transmission tower located in the floodplain. Many medical professionals rely on pagers, emphasizing the need to maintain paging infrastructure during events.

Critical Facilities



Source: Towns of Clinton, Westbrook, & Old Saybrook Critical Facilities Data 2023

Cultural Resources

Why this is Important

Protecting the study area's Historic Districts from coastal threats preserves the character, identity, and economic vitality of the coastal region.

National Historic Districts

Being listed as a National Historic District is a prestigious recognition that opens up opportunities for federal, state, and local economic incentives to support rehabilitation efforts. However, properties within a National Historic District are not protected against alteration or demolition, nor are they subject to review by a local historic preservation commission, unless additional local protections are in place. The study area is home to seven National Historic Districts, each with portions located within the 100-year floodplain. These districts are listed in the table to the right, providing a comprehensive overview of the historically significant areas potentially vulnerable to flooding.

State Historic Districts

State Historic Districts are designated by the State Historic Preservation Office and provide a moderate level of protection and oversight for historic properties. While not as stringent as Local Historic Districts, they offer some incentives for rehabilitation projects, such as tax credits, grants, or loans, to encourage preservation efforts. Old Saybrook has two State Historic Districts both of which have portions in the 100-year floodplain.

Local Historic Districts

Local Historic Districts, designated by local governments and regulated by historic district commissions, offer the strongest protection for historic properties. They often require approval for exterior changes and have design guidelines that vary by municipality. Clinton, Old Saybrook, and Fenwick have designated Local Historic Districts within their municipal boundaries. Old Saybrook's and Fenwick's Local Historic District includes areas that fall within the 100-year floodplain, making them potentially vulnerable to flooding events.

Historic Districts

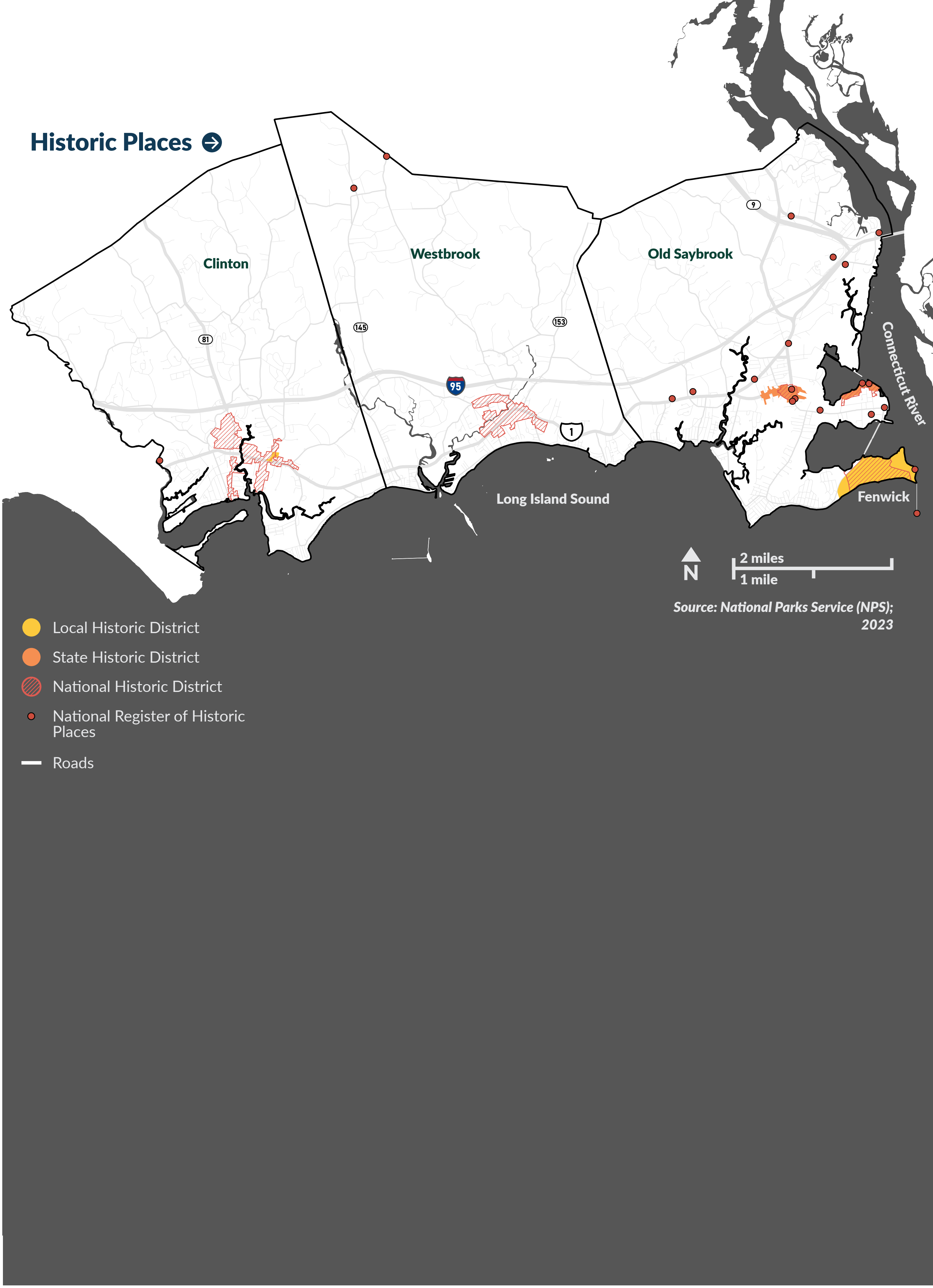
	Classification	District Name
Clinton	Local Register	Liberty Green Historic District
	National Register	Clinton High Street Historic District
	National Register	Clinton Village Historic District
	National Register	Commerce Street Historic District
Westbrook	National Register	Westbrook Town Center Historic District
Old Saybrook	State Register	Old Saybrook South Green
	National / State / Local Register	North Cove Historic District
	National Register	Old Saybrook South Green
Fenwick	Local Register	Borough of Fenwick Historic District
	National Register	Fenwick Historic District

National Register of Historic Places Points

Clinton	William Stevens House
Westbrook	Lay-Pritchett House
	Doane's Sawmill/Deep River Manufacturing Company
Old Saybrook	Elisha Bushnell House
	Bushnell Dickinson House
	Old Saybrook Town Hall and Theater
	Ambrose Whittlesey House
	Parker House
	Jedidiah Dudley House
	John Whittlesey Jr House
	Humphrey Pratt Tavern
	General William Hart House
	James Pharmacy
	Samuel Eliot House
	William Tully House
	Black Horse Tavern
	Cypress Cemetery
	Shoreline Electric Railway Powerhouse
	Connecticut Valley Railroad Roundhouse and Turntable Site
Fenwick	Lynde Point Lighthouse
	Saybrook Breakwater Lighthouse

The table above may not include every point in each municipality.

Historic Places



Infrastructure Systems

Why this is Important

The infrastructure system is a critical lifeline during disasters for facilitating evacuation, service provision, and relief delivery. Maintaining public routes and transportation during recurring flood events is crucial for community members who rely on these services daily. Assessing the condition of dams and bridges can inform a priority-driven maintenance and replacement plan to ensure the lasting function of the infrastructure.

Roads and Bridges

The study area encompasses over 300 miles of roadways and 81 bridges. These bridges, identified by the Connecticut Department of Transportation (CTDOT), include both those listed in the National Bridge Inventory (NBI) and those not part of the NBI and are under either State or Town jurisdiction. These infrastructure assets are in varying conditions. Smaller waterway crossings, like culverts, are not included in the total bridge count. Among the bridges, 42 are located within the 100-year floodplain. CTDOT has plans to address the deficiencies in the Singing Bridge deck, which carries US Route 1 over the Patchogue River in Westbrook, Connecticut. The repairs are anticipated to begin in Spring 2027.

The two major roads in the area are Interstate 95 (I-95) and State Route 1 (Rte. 1), which run parallel to the Long Island Sound. The Average Annual Daily Traffic (AADT) for I-95 is roughly 50,000 vehicles, while Rte. 1 has an AADT of roughly 9,500 vehicles.

Port Authority

Connecticut's three deep-water ports (Bridgeport, New Haven, and New London), are not located within the study area. However, a Port Authority office is situated on Boston Post Road in Old Saybrook, which is currently out of the floodplain. Despite the building being outside the floodplain, building access following a storm event is crucial to ensure that daily shipping operations remain uninterrupted.

Dams

Several dams in the study area have an Emergency Action Plan (EAP) in place should the dam fail. EAPs are intended to reduce the potential for property and loss of life in an area affected by a dam failure or large flood. The hazard potential classification, which indicates potential downstream hazards if a dam fails or an operational mishap occurs, ranges from low to high. Other private and public dams also require investigation. Communities should continue to assess the potential impacts of both public and private dams, as well as evaluate their hazard risks. All dams are subject to oversight by the DEEP Dam Safety Bureau.

Railways

The CTrail Shore Line East is a commuter rail service that operates along the Connecticut coastline, connecting New Haven and New London. Within the study area, spanning Clinton, Westbrook, and Old Saybrook, the Shore Line East rail network extends for 11.15 miles.

Clinton, Westbrook, and Old Saybrook each have a dedicated train station along the Shore Line East route. Additionally, the Old Saybrook train station serves as a stop for Amtrak's Northeast Regional line, which runs between Boston and Virginia. Approximately 2.6 miles of this route's infrastructure runs through Old Saybrook, providing a vital connection for regional and long-distance rail travel.

This rail infrastructure facilitates commuter mobility and connects to major metropolitan centers. It is also susceptible to the impacts of sea-level rise and storm surge, highlighting the need for proactive resilience measures to safeguard this resource. Of the total rail infrastructure in the study area, 1.9 miles are located within the 100-year floodplain.

Several railroad underpasses in the study area flood, often presenting unsafe and unreliable routes for local traffic. For more information regarding flooding at railroad underpasses, see the Community Assets & Issues breakdown at the end of this section.

Public Transit

The study area is served by the public bus system of River Valley Transit (RVT). Their buses operate on five routes that cover the study area as well as extend to the surrounding region. In addition to these bus routes, RVT offers a range of comprehensive transit options accessible to all members of the public, regardless of age or disability status. These supplementary services include Dial-A-Ride, ADA Paratransit, and XtraMile.

Road & Rail Infrastructure ➔

***Source: River Valley Transit 2023** (Bus Route);*
***Connecticut DOT GIS Open Data 2021** (Bridges, CT Port Authority, Train Station);*
***Connecticut DEEP GIS Open Data 2023** (Railroad and Underpasses);*
***National Inventory of Dams 2023** (Dams);*
***Towns of Clinton, Westbrook, & Old Saybrook Road Data 2023** (Routes)*

- Bridge
- CT Port Authority
- Dam
- Train Station
- Railroad Underpass
- Railroad
- River Valley Transit Bus Route
- Interstate Route
- US Route
- State Route
- Local Roads

Infrastructure Systems (cont.)

Why this is Important

Understanding the condition and location of stormwater management structures is essential for comprehending stormwater movement within the study area. Optimizing the infrastructure system's efficiency will minimize standing water caused by clogged pipes or saturation.

Wastewater Management

All properties within the study area have septic systems. Rising sea levels, elevated water tables, and increased flooding events can lead to system failures, overflows, and contamination of groundwater and surface waters with untreated sewage. Additionally, the higher water tables and poorly draining soils common in many coastal areas make it challenging to properly treat and disperse septic effluent, posing risks to public and environmental health.

In areas with poorly draining soils, tidal fluctuations, and intense rainfall, septic systems cannot always properly treat the effluent allowing the potential for partially untreated waste to seep into nearby bodies of water like the Long Island Sound.

Parts of the study area have unsuitable soils or inadequate lot areas for the installation of code-compliant septic systems because lots are typically small and may have been created by filling marsh in low-lying areas.

It is common for replacement systems or repairs to existing septic systems to require the bottom of the leaching system to be 24" to groundwater.

To partially address the risks and constraints associated with individual septic systems, Clinton, Westbrook, and Old Saybrook are all exploring new technology and the possibility of installing smaller community systems to accommodate wastewater treatment for problematic areas.

Stormwater Management

All Towns in the study area are required and have active General Permits for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit). The MS4 program in Connecticut began over twenty years ago as a response to Environmental Protection Agency (EPA) Stormwater Phase II rules adopted in 1999. The MS4 General Permit requires municipalities to take proactive measures to prevent pollutants from entering storm sewer systems and then discharging into water bodies.

The study area experiences frequent high tide and storm surge flooding due to various factors, including the inundation of marshes and the failure of stormwater management infrastructure to be able to correctly function due to high depth to groundwater.

When the catch basins reach capacity, there is nowhere for them to outlet because the marshes and poorly drained soils in these low-lying areas are already saturated. In some neighborhoods, basement sump pumps and footing drains discharge excess water into yards or streets, further impacting the stormwater system This adds to the frequency of road flooding, potential ice hazards, and environmental risks. Rising sea levels will intensify these issues.

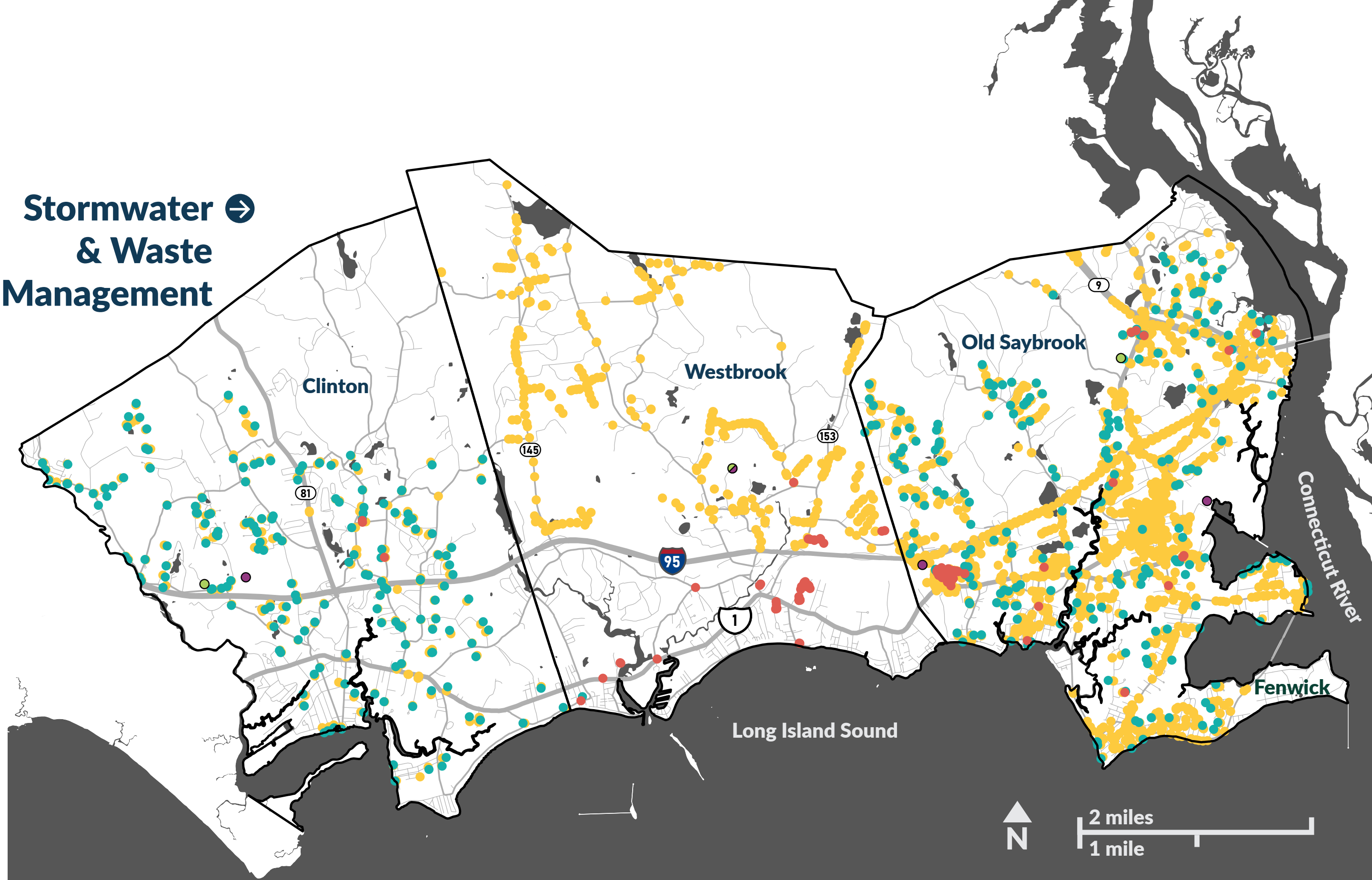
Solid Waste Management

Clinton, Westbrook, and Old Saybrook have closed and capped their landfill sites and they are no longer in use. The former landfills are routinely monitored to ensure they remain in compliance with CT DEEP's environmental standards.

Currently, all three towns have transfer stations situated beyond the reach of 100 and 500-year floods that are then transported to a regional waste management facility. Fenwick uses Old Saybrook's facility.

Keeping solid waste facilities outside of floodplains is essential for protecting the environment, public health, and infrastructure, and ensuring compliance with regulations while promoting the long-term sustainability of waste management systems.

Stormwater & Waste Management



Source: Towns of Clinton, Westbrook, & Old Saybrook GIS Data 2023

- Transfer Station
- Former Solid Waste Landfill
- Stormwater Catch Basin
- Stormwater Manhole
- Stormwater Outfall
- Roads

Note: Data on stormwater management infrastructure varies among the municipalities within the study area. To gain a comprehensive understanding of the existing systems, it is advisable to conduct a thorough survey of the entire region. This survey will help identify strengths, weaknesses, and gaps in the current infrastructure, enabling better planning for future stormwater management strategies.

Infrastructure Systems (cont.)

Why this is Important

Securing gas and electric utilities out of harm's way to ensure public safety is important. A healthy water supply is also essential to maintain, as it is a key component of overall community resilience.

Gas and Electric Distribution

Southern Connecticut Gas and Eversource provide utilities to the study area. Power distribution relies on overhead lines and two substations in Old Saybrook (Bokum Road and Elm Street). Clinton, Westbrook, and Fenwick lack public power generation facilities. Gas service primarily covers high-density areas and major thoroughfares, not the entire region. Some utility infrastructure is located in coastal and flood-prone zones, posing potential risks. To ensure continuity during emergencies, all critical facilities should be equipped with backup generators positioned above the base flood elevation.

Water

The study area is part of the Connecticut Water Company's Guilford System. This system relies on the Kelseytown Reservoir treatment plant, which processes and distributes water from multiple sources. The system interconnects with the Regional Water Authority at North Branford, providing system redundancy and resilience.

While many residents in the study area use private wells, these face saltwater intrusion risks from rising sea levels. As the exclusive service provider, Connecticut Water Company can extend water service to areas with failed wells, though costs must be reimbursed. This arrangement, combined with the company's existing service to many shore-front properties, enhances community resilience through potential system expansion and multiple water sources.

Additional Utilities

Additional utilities in the study area include cable television and communications services. Comcast of Connecticut, Inc. provides cable television coverage throughout the entire study area. Multiple communication companies service the region, including Verizon Wireless and AT&T, which offer coverage across the entire study area. Crown Castle Fiber and GoNetspeed provide service specifically to Clinton, Westbrook, and Old Saybrook. In addition to cable television, Comcast of Connecticut also offers communication services to Fenwick.

Utility Infrastructure Purpose & Users

Cellular Tower
Purpose: Transmits and receives cellular phone signals and mobile data
Users: Mobile phone companies, their customers, and emergency services

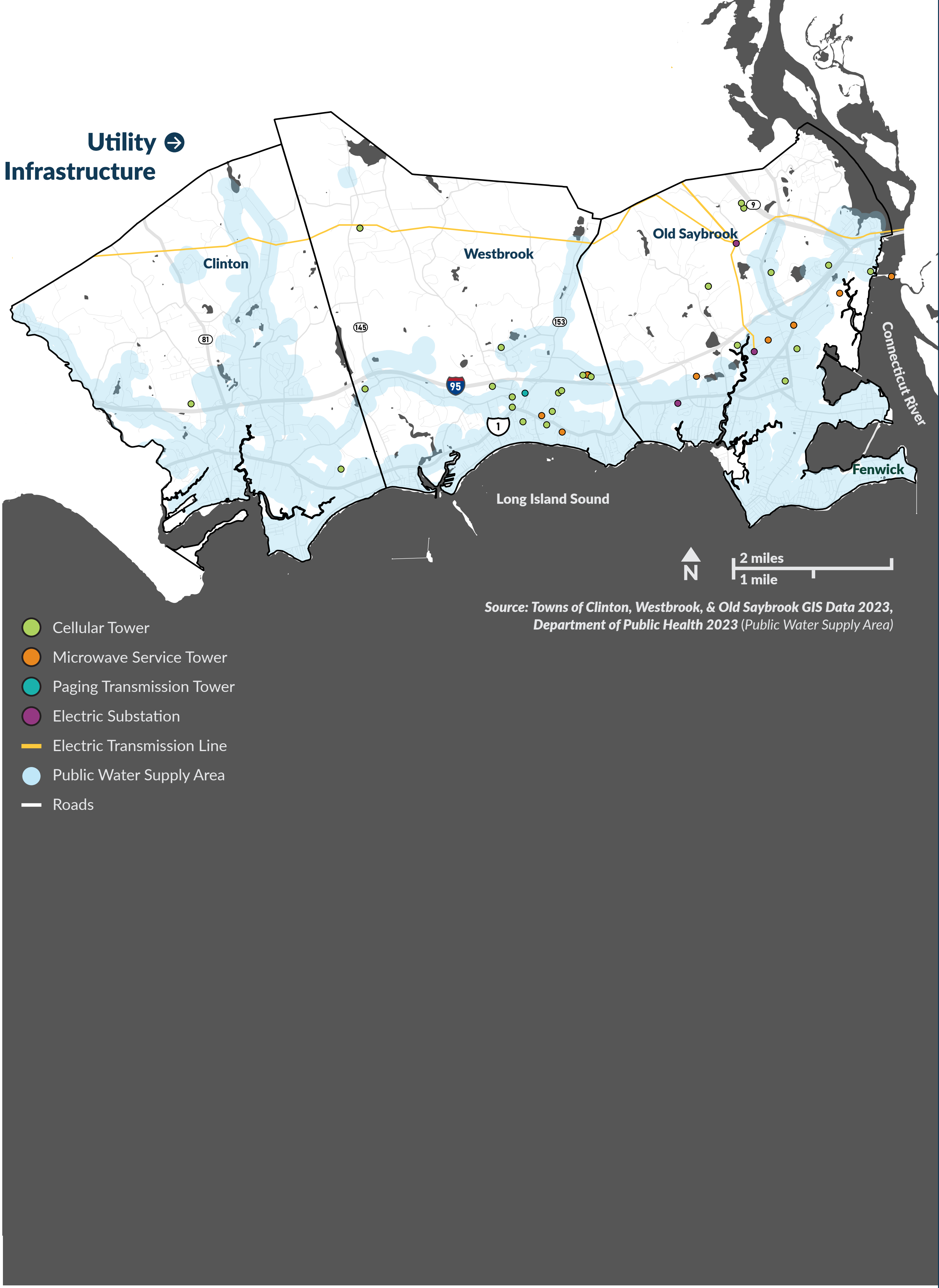
Microwave Service Tower
Purpose: Point-to-point transmission of high-frequency radio waves for communications and data transfer
Users: Telecommunications companies, TV/radio broadcasters, utilities, and emergency services

Paging Tower
Purpose: Transmits one-way messages to paging devices
Users: Primarily hospitals, emergency responders, and some businesses that still rely on pager systems

Electric Substation
Purpose: Transforms voltage levels in electrical power distribution, either stepping voltage up for transmission or down for local distribution
Users: Electric utilities and all electricity consumers in the service area

Electric Transmission Line
Purpose: High-voltage power lines that carry electricity long distances from generation sources to local distribution networks
Users: Electric utilities and indirectly all electricity consumers in the region

Utility ➔ Infrastructure



Source: Towns of Clinton, Westbrook, & Old Saybrook GIS Data 2023, Department of Public Health 2023 *(Public Water Supply Area)*

Salt Island Road, Westbrook
December 2022

Existing Planning Initiatives

Coastal resilience-related plans and policies are crucial to building community capacity to promote resilience and encourage effective recovery and enhancement measures.

This section highlights the Four Shore Communities' existing planning initiatives, local policies, and upcoming projects as they relate to coastal resiliency.


STOP

Existing Planning Initiatives

Why this is Important

The four municipalities in the study area have laid an excellent foundation and put a lot of work into other local plans to build this coastal resiliency plan. Supplemental plans provide additional support, guidance, and strategies to address specific aspects of coastal management and resilience. These plans complement this planning effort by focusing on particular areas of concern or opportunity, ensuring a more comprehensive and effective approach.

Clinton

2005

- Municipal Coastal Plan Revision

2015

- Plan of Conservation and Development *(2015-2025)*
- Salt Marsh Advancement Zone Assessment

2022

- Coastal Community Resilience Report
- Natural Hazard Mitigation Plan for MS4 *(included as an annex to the Lower Connecticut Valley Hazard Mitigation Plan)*

2023

- Harbor Management Plan Update
- Sustainable Connecticut Program Participant Bronze Award

2024

- Plan of Conservation and Development Update
- Thriving Communities Program Participant

Westbrook

2014

- Harbor Management Plan

2019

- Natural Hazard Mitigation Plan for MS4 Update

2021

- Plan of Conservation and Development (2021-2031)

2024

- Thriving Communities Program Participant
- Sustainable Connecticut Program Participant
- Local Natural Hazard Mitigation Plan Update

Fenwick

2005

- Harbor Management Plan

2017

- Plan of Conservation and Development *(2017-2027)*

2024

- Natural Hazard Mitigation Plan

Old Saybrook

2003
- Harbor Management Plan
- Conservation and Open Space

2006
- Stewardship Plan

2010
- Invasive Species and Natural Habitat Management Plan

2014
- Hazard Mitigation Plan

2015
- Sea Level Rise Climate Adaptation Report of Findings

2017
- Stormwater Management Plan

2018
- Coastal Resilience & Adaptation Study

2019
- Natural Hazard Mitigation Plan

2023
- Plan of Conservation and Development *(2023-2033)*
- MS4 Annual Report

2024
- Natural Hazard Mitigation Plan
- Thriving Communities Program Participant
- Sustainable Connecticut Program Participant *(2024 Gold Award & Climate Leader)*

Regional

2021
- Lower Connecticut Valley Hazard Mitigation Plan
- Regional Plan of Conservation and Development

2023
- Lower Connecticut River Valley Comprehensive Economic Development Strategy

State

2011
- Connecticut Climate Change Preparedness Plan

2017
- Plan of Conservation and Development (2017-2027)

2019
- CT Rises: Planning for Long-Term Disaster Recovery

2021
- Taking Action on Climate Change and Building a More Resilient Connecticut for All: GC3 Phase 1 Report Near-Term Actions

2022
- CIRCA's expansion of the Resilient Connecticut Program

National

2022
- National Oceanic and Atmospheric Administration (NOAA) Sea Level Rise Technical Report

Existing Policies, Plans & Regulations

Why this is Important

Taking an inventory of local policies helps to identify gaps, opportunities, and strengths within the communities. These local policies have established a solid foundation upon which further coastal resilience recommendations can be built and implemented.

Wastewater Management Planning

The Clinton, Westbrook, and Old Saybrook Water Pollution Control Authorities have been working on waste management planning since the 1970s with a focus on sewer avoidance. All three towns have identified low-lying areas in their communities and some have established wastewater management districts.

Within these districts or identified areas, programs to improve groundwater quality have been implemented such as programs to repair/replace septic systems, tank pump-out programs, and public education.

Each Town has specific goals for its communities and has made significant time and financial investments to research the best scientifically and technologically based sewer avoidance solutions to address their needs. Small community wastewater treatment facilities are a consideration of all three Towns in areas where individual on-site solutions may not be a possibility on small lots in flood-prone areas.

Clinton

Clinton has been working on a draft wastewater management plan and has explored some preliminary concepts based on the plan's findings. These concepts include initial investigations into the possibility of a downtown wastewater treatment facility. The draft plan tentatively suggests coastal areas where sewer systems might be appropriate and identifies a potential site for wastewater treatment. The plan and its recommendations are currently being further developed and explored.

Westbrook

Westbrook is considering a small-scale community wastewater system for the Town Center Business District. Preliminary plans and cost estimates have been put together, and the next steps will involve further testing and detailed design work. Westbrook has also adopted a sewer-avoidance plan that focuses on improving and upgrading existing septic systems.

Old Saybrook

As part of our sewer-avoidance program, Old Saybrook is exploring options for a small-scale community septic system to accommodate properties in coastal areas where the replacement of individual on-site septic systems is not feasible.

Local Policies

Each of the four municipalities in the study area has the following local policies:

- Floodplain Management
- Stormwater Management
- Wetland and Watercourse Protection
- Erosion and Sediment Control
- Open Space and Natural Resource Conservation
- Hazard Mitigation
- Environmental Review
- Architectural Design Controls
- Historic Preservation
- Harbor Management

The above policies and their corresponding documents have not been assessed for their merit or coordination with one another.

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Crab Creek
Sequassen Avenue, Fenwick
January 2024

Crowd-Sourced Assets & Issues

This section highlights assets and issues that are present in the study area. The comments were gathered from discussions with municipal representatives, local organizations, and the public. Through an online interactive map, and in-person and virtual feedback, an understanding of problem areas and important community facilities were recorded and mapped in the following section.

LOAD LIMIT

Crowd-Sourced Community Assets & Issues

Receiving Local Feedback

Over four months, community members actively shared insights and experiences regarding local flooding and erosion through an online interactive mapping tool and in-person engagement at events and meetings. Over 250 comments were collected during this process. The consistent themes in the feedback emphasized the pressing need for a transformative approach to flood management and maintenance practices to address public concerns and enhance the resilience of affected areas.

The public shared valuable insights into recurring issues, including severe and frequent flooding in residential areas, inefficient or absent drainage systems, beach erosion, concerns about being trapped during flooding, deteriorating sea walls, and the need for dredging waterways. These common themes highlight the multifaceted challenges faced by communities and emphasize the need for comprehensive solutions to address flooding, erosion, and infrastructure maintenance. Accounts of these experiences are provided in the following section.

In addition to the comments collected from community members, local municipal representatives, local organizations, and project stakeholders shared their input. The remainder of this section is a record of the feedback received from each community.

What is an Asset?

An asset is a useful or valuable facility, system, person, or place that supports a high quality of life for residents and visitors. For the Coastal Resiliency Plan, an asset could be a town beach, a fire department, a residential neighborhood, a local business, a salt marsh, or anything else that provides an important service to the community and/or contributes to the area's quality of life and appeal.

What is an Issue?

An issue is an unwelcome occurrence that needs to be overcome. For the Coastal Resiliency Plan, an issue could be flooding roads, damaged sea walls, erosion, clogged drain inlets, or anything else that impairs daily life in the community and/or contributes negatively to coastal resiliency.

Public Feedback on Assets & Issues

The assets and issues described in the Public Feedback sections of this plan are a collection of comments from participating members of the public that have been consolidated and summarized in no particular order. The public feedback reflects individual perceptions of the issue. Please note that the accuracy of these comments has not been verified. While this feedback is an important part of the broader discussion, it is not exhaustive, and the process of gathering input remains ongoing. Town officials recognize that other issues within the community may not be captured here, and the feedback presented is based solely on public participation.

Causeway and Groveway Intersection - Clinton

Shoreline Town Beach Erosion - Clinton

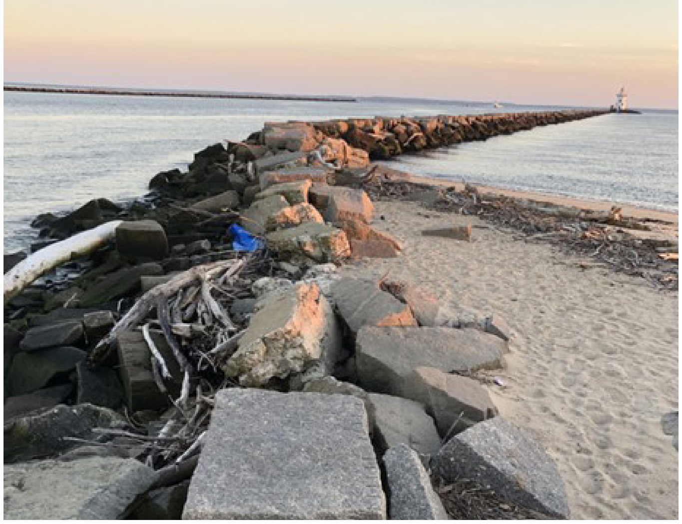
Debris at the Cornfield Point Sea Wall - Old Saybrook

Hagar Creek Flooding from Chalker Beach - Old Saybrook

Flooding on Pepperidge Avenue - Westbrook

Flooding Along Old Mail Trail - Westbrook

Breakwater to Old Saybrook Lighthouse - Fenwick



Crab Creek at Sequassen Avenue - Fenwick

Clinton

Assets

Marinas

Clinton Town Marina and private marinas are drivers of tourism and the local coastal economy. Marinas support recreational and commercial activities beyond private boating including charter fishing, and cruising tours, and provide land-based amenities like swimming and restaurants. Marinas also play an important role in transient lodging, as visitors use their boats for overnight accommodations during the summer months. Besides offering convenient launching facilities, marinas serve as hubs for socializing, sightseeing, and contributing to the town's coastal identity.

Waterfront Communities

Coastal neighborhoods are an important part of the local economy and tax base. These neighborhoods include amenities like private beachfront access and areas like Waterside Lane include historic homes. The aesthetic charm of these areas attracts residents and visitors. This leads to both increased property values and a greater reliance on the tax revenue generated from these homes to fund public services, infrastructure, and other community needs.

Marsh

Marshes offer numerous environmental benefits including water filtration and flood storage capacity, while also providing recreational opportunities and economic value through tourism. The diverse array of beautiful birds and other species that call these marshes home add to the beauty and ecological importance of these wetland ecosystems, making them vital for both nature and the local community.

Issues

Road Flooding

Flooding and debris make it difficult for emergency services to reach affected communities, especially in the aftermath of severe storms. Residents commented that roads including River Road, Glenwood Road, Causeway, Shore Road, and Riverside Drive are critical for both local movement and emergency services. When these roads are flooded, it cuts off access to communities, preventing people from leaving or receiving aid. This also happens at the end of Hammock Road, Meadow Road, and Old Mill Road, where residents get stranded for hours. Runoff from 1-95 floods Cow Hill Rd and Liberty St. Flooding at the railroad bridge underpasses cuts the town off when they are flooded.

There are areas outside of the coastal area that experience flooding that interrupts access to neighborhoods. Evergreen Street is frequently cut off due to flooding when the bridge becomes submerged, which can occur multiple times a year. In these instances, the rear gate can be used as an alternative route, though it also becomes inaccessible during extreme flooding. Residents who are cut off from evacuation routes are left vulnerable, especially if they need medical assistance or access to supplies.

Tidal Concerns

High tides and storm surges are becoming increasingly problematic, with residents expressing concerns, especially along Grove, Shore, Causeway, Hammock, and West Roads. Residents report seeing water near the tops of sea walls during high tide on calm days, noting that the risk of flooding is rising, especially during storms. These frequent flooding events are causing concern about flooding on private property. Roads becoming impassable could indicate a need for more urgent action or planning.

Septic Failure

Sea level rise and extreme weather events, such as major storms, have posed serious risks to septic systems in low-lying areas. As the water table rises and storm surges inundate the soil, septic systems can become overwhelmed or even fail. This can lead to several serious problems, including system malfunction which can cause sewage to surface, soil erosion causing the systems to dislodge, public health risks due to the release of harmful pathogens, and environmental damage to coastal ecosystems such as marshes, wetlands, and estuaries.

Route 1

The lack of sidewalks and bike lanes along Route 1, combined with the town's flood-prone infrastructure, exacerbates the challenges to both resilience and mobility. After storms or floods, when car traffic might be impeded or roads damaged, bike lanes and pedestrian paths could be essential for providing people with safe, alternative mobility options. Without them, residents would face even greater difficulties accessing emergency services, supplies, or shelter. Given that Route 1 and other key buildings, such as the fire department may flood due to the Indian River, extreme weather events are a risk to both daily operations and emergency responses.

Flooding from events like Superstorm Sandy and Irene have already shown that storm events impact critical infrastructure. A damaged culvert or bridge and damaged roadways isolate neighborhoods and hinder recovery efforts. The town could be physically disconnected if a major storm or flood event damages Route 1, limiting evacuation routes, access for first responders, and the transport of goods and services.

Beach Erosion & Coastal Structures

Coastal erosion is a major threat to infrastructure and resources. Much of Clinton's coastline is privately owned, and erosion is a threat to private properties along the shoreline. Private property owners and beach associations maintain seawalls, bulkheads, groins, and jetties as well as beaches. Design, permitting, and construction associated with maintaining coastal structures can be challenging and costly. Maintaining beaches and structures in the face of storms and sea level rise is also a challenge. Private beaches provide recreational opportunities and value for residents with access.

Clinton Town Beach is located at the mouth of the Hammock River and is experiencing multiple challenges due to rising seas, flooding from storms, and erosion. The Waterside Lane bridge is the only point of public access from land to the Town Beach. The road approaching the bridge floods during storm events, eliminating access. Tidal currents have significantly eroded the marsh and land adjacent to the bridge. There are areas along the Town Beach that have been experiencing accelerated rates of erosion. One area, north of the swimming area, was significantly compromised when a section of bluff and beach washed out in a winter storm. Vegetation in this area was damaged, and there is concern that erosion will continue without root systems to hold soil in place. In the long term, this erosion could compromise public access, the park space, and trails.

River & Stream Flooding

Impervious surfaces prevent rainwater from naturally soaking into the ground. This leads to higher volumes of water running off these surfaces, carrying pollutants into Rivers and the Long Island Sound. These pollutants can degrade water quality, harming aquatic ecosystems and affecting human activities like fishing and recreational use. When storms occur, they exacerbate this issue. Improving stormwater management systems to better handle and treat runoff is crucial for mitigating flood risks and enhancing environmental sustainability.

Hammock Road Flooding - Clinton, January 2024

Commerce and Grove Ave Flooding - Clinton, January 2024

Westbrook

Assets

Marinas

Dick's, Harry's, Marshview, Safe Harbor (Pilot's Point), and the other marinas play a vital role in enriching the town's economy, environment, and sense of community. Westbrook has over 2,000 boat slips. They not only attract visitors and support local businesses but also help preserve the area's coastal charm and promote a vibrant, water-oriented lifestyle.

Dunes

The Town Beach's dunes play a vital role in protecting homes from the Sound by acting as natural barriers against waves, storm surges, and coastal erosion.

Stewart B McKinney National Wildlife Preserve

The refuge encompasses over 1,000 acres of forest, shrubland, barrier beach, tidal wetland, and fragile island habitats. It provides important resting, feeding, and nesting habitats for numerous species of birds. Visitors explore the diverse habitats of the refuge through approved recreational activities.

Patchogue & Menunketesuck Rivers

These rivers and waterways play a key role in the local economy as a source of tourism and recreation and commercial maritime activities. A significant portion of Westbrook's economy flows through the Patchogue and Menunketesuck Rivers.

Beach Neighborhoods

To each homeowner, their home is the most valuable asset. There are more than 1000 homes within 100 yards of the Long Island Sound. The value of those properties is influenced by their proximity to the water, scenic views, and access to the Sound, which makes them highly desirable.

Westbrook Public Library

The library is an invaluable community asset, offering resources like books, internet access, and educational programs for children and adults. It connects people to information and other people. The library provides after-school homework help, games, book clubs, and computer classes, allowing older adults to stay engaged in a digital world. The library is vital in fostering a stronger, more resilient community.

Town Dock

The Westbrook Town Dock, which has served as an access point for boat-to-shore transfers of passengers and cargo while supporting recreational fishing, now faces operational challenges due to frequent tidal flooding. These flooding events occur during peak high tides.

Tidal Wetlands

There are several hundred acres of Tidal Wetlands in Westbrook primarily associated with the Menunketesuck and Patchogue Rivers. These areas provide significant recreational and biological benefits for the community.

Town Hall

Town Hall is an important community facility located in a vulnerable area along the bank of the Patchogue River. During past storm events vehicles and equipment were relocated to safer locations.

East-West Duck Island Breakwater

This breakwater has experienced deterioration over the past few decades as storms have displaced portions of the structure reducing the effectiveness of the protection provided by the breakwater.

Businesses

Businesses in the Marina District provide jobs and tax revenue that are a vital part of the local economy. Retail, service, and restaurants such as Bill's Seafood are experiencing flooding due to sea level rise.

Issues

High Tide Waters

The Marshview Marine parking lot is an example of a parking lot that floods regularly at high tide, with large storms causing marsh water to approach Route 1 near the Singing Bridge. Streets like Salt Island Rd, Pepperidge Avenue, Seaside Ave, and Old Mail Trail, which are at lower elevations, frequently lose access during full moon high tides. McVeagh Rd, east of the high school, also floods with rain and runoff, often leaving only one route through town.

Street Flooding

Old Mail Trail has long been susceptible to flooding, but recent years have seen worsening conditions, with deeper water levels. Limited drainage causes floodwaters to linger for hours, causing the Grove Beach area to flood 6-8 times per month. Chronic street flooding at Tarpon, Striper, and Dolphin Avenues frequently makes this area impassable and can extend to Seaside Avenue blocking access to Pilot's Point. Salt Island Road and Pepperidge Avenue experience chronic sunny day flooding both from rising sea level/wave action and brook/stormwater drainage outfalls that cannot function properly during high tides. The railroad underpass (a school bus route) and Pond Meadow Road underpass also flood regularly. Storm surges from the marshes further exacerbate flooding, impacting waterfront homes.

Public Education

Another important aspect of street flooding is that locals who are familiar with the area likely have strategies for dealing with floods, but visitors, especially in tourist-heavy areas, may be caught off guard. When floods occur, they may not know the best routes to avoid, where to find higher ground, or how to access emergency services.

Dunes

Illegal tree and vegetation cutting on the dunes has occurred multiple times, weakening the dune structure and increasing the risk of storms breaching them. Gaps in the dunes allow water to flow through, compromising their effectiveness as a natural barrier.

Debris Removal

The town frequently faces the issue of sand and debris accumulation along beaches, particularly between the town beach and the Elks Lodge, as well as on the eastern edge of Old Mail Trail. This requires regular removal to maintain aesthetics and safety. The costs of such cleanup efforts include labor, equipment, and disposal fees, which can strain municipal budgets.

Seawalls & Breakwater

The private seawall along Old Kelsey Point Rd is collapsing and boulders from the East-West breakwater on Duck Island are falling away. The breakwaters form a vital, natural safe anchorage for boats. The damage to this seawall and breakwater and others threatens both the local shoreline and the safety of vessels relying on this protected area. Immediate attention is needed to prevent further erosion and safeguard the anchorage.

Rock Jetty at Money Point

The erosion or structural failure of the rock jetty is reducing the shoreline's defense against wave action, further exacerbating coastal erosion in the area and risk to the local sea walls.

Stormwater Infrastructure

Kingfisher and Magna Lanes lack proper storm drains, which, combined with increasing rainfall and rising sea levels, heighten the risk of flooding and septic system issues. Additionally, underground pipes and streams from Route 1 currently discharge onto the beach, contributing to erosion. Uncovered pipes pose a public safety hazard, particularly for small children who could become trapped. Duck valves require maintenance and get clogged with sand and debris.

Chronic street flooding at Tarpon, Striper, and Dolphin Avenues is causing catch basin outfalls to clog, disrupting vehicle access. On Old Kelsey Point Rd., a catch basin with an insufficient dry well contributes to flooding, with water levels reaching over 12 inches. Furthermore, catch basins near Westbrook Town Beach drain into marshes, worsening marsh flooding and catch basin outfalls at Middle Beach cannot function during high tides and/or become clogged with sand during flood events. Stormwater and storm surges are causing backflow through outfalls, further exacerbating the issue.

Westbrook (cont.)

Tidal Wetland Filling

While expanding backyard areas or developing waterfront properties is a common desire, it is important to consider that the long-term environmental costs of filling tidal wetlands may outweigh the potential benefits. Protecting these areas is crucial for maintaining the health of coastal ecosystems, safeguarding property, and reducing flood risks.

Flooding from Tidal Marshes

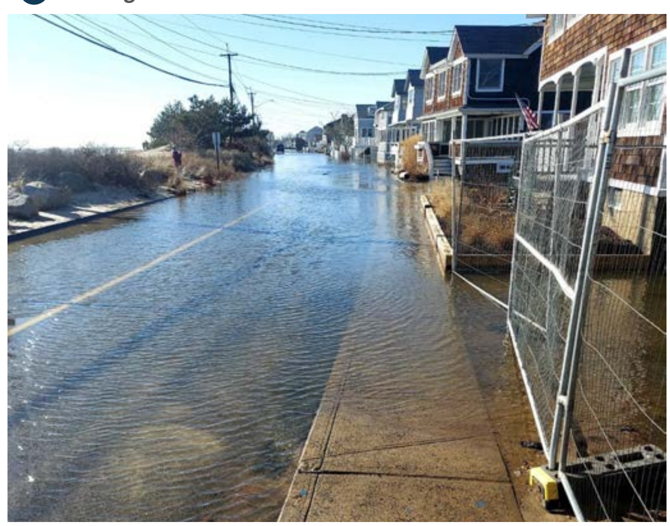
Neighborhoods, including the east end of Old Mail Trail, Seaside Avenue, and Coral Sands regularly flood during high tides and storms due to overflow from the nearby salt marshes and occasionally from the Sound.

Marsh and Beach Erosion

There is significant beach erosion on the eastern end of Old Mail Trail. Improvements to the remaining groins could potentially improve conditions. There has been dramatic erosion over the years to the mouth of Cold Spring Brook. Eroding beaches in scattered locations along the Sound reduce protection from flooding and impact the tourist economy.

Old Mail Trail Flooding - Westbrook

Looking West Down Seaside Ave - Westbrook



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Old Saybrook and Fenwick

Assets

Tree Canopy

Healthy tree cover and reduction in impervious surface cover can reduce stormwater runoff and peak flows in local waterways, resulting in substantial savings on drainage infrastructure, water treatment costs, and the need for flood controls.

The Preserve

A 963-acre coastal forest situated between Long Island Sound and the mouth of the Connecticut River.

Neighborhood Clubhouses

Provide a gathering space for residents to facilitate social interaction, and access to recreational activities while playing a crucial role in promoting resilience during coastal storms and other emergencies by providing a safe meeting point that conforms to FEMA requirements and support services.

Tourist Attractions

Saybrook Point Marina and Resort, The Kate, Fenwick Golf Course, and mini-golf generate revenue through visitor spending, provide employment opportunities, and stimulate the development of local businesses and cultural experiences.

Coastal Marshes

Marshes like South Cove can significantly mitigate flooding by acting as a natural buffer, absorbing excess water from storm surges and waves, slowing down water flow, and reducing wave energy.

Issues

Sea Walls

The integrity of many sea walls has deteriorated due to wear and tear, with gaps and structural weaknesses compromising their effectiveness. Most of these walls are not of sufficient height to fully prevent flooding or protect against property damage. The continued vulnerability of sea walls to high tides and strong wave action exacerbates this issue. Sea walls of concern include Barnes Road, Plum Bank, Knollwood, Fenwood, and Ferry Point in Old Saybrook and Pettipaug Avenue and the Scum Beach area in Fenwick.

Additionally, large debris such as rocks, logs, and tree trunks contribute to further erosion and degradation as they are driven into the walls by powerful waves, particularly during storm events. Post-disaster FEMA will not provide funding to repair or replace any non-engineered public beaches or seawalls. Urgent funding is needed for repairs and upgrades to ensure these vital structures can provide adequate protection.

Road Flooding

Flooding during major storms significantly disrupts evacuation routes, with road flooding, downed trees, and overhead power lines creating barriers to safe passage. A particular concern is the Elm Street railroad underpass, which serves as a school transportation route.

Given its location between the Long Island Sound and the Back River marsh, Plum Bank/Great Hammock is prone to frequent road closures during storms. This thoroughfare is crucial for both local and emergency traffic.

Additionally, high tide flooding obstructs access to and from neighborhoods, especially the Chalker Beach, Saybrook Manor, Indian Town, Saybrook Point, and Fenwick areas severely limiting entry and exit to these areas that could hinder evacuation efforts and emergency services. Interior to Fenwick, Sequassen Ave starting at the Crab Creek Bridge is frequently under water during high tides. Raising vulnerable low areas and regular infrastructure improvements such as reinforcing embankments or installing flood barriers could help reduce the number of closures.

South Cove

Silt build-up in South Cove on both sides of the causeway threatens the ecosystem, water quality, and recreational activities. This accumulation of silt can harm aquatic life, disrupt the balance of the local environment, impact the overall enjoyment and health of the waterway, and impact the flushing of the Soutch Cove salt marsh. Due to the blockage of water flow from the causeway, from Saybrook Point to Fenwick which has only three channels under it, the South Cove is becoming a mud flat with one channel that is entirely silted in.

Septic Concerns

Neighborhoods prone to tidal flooding face significant challenges in maintaining effective onsite wastewater management systems. Limited lot sizes, elevated groundwater levels, and poor soils, coupled with frequent flooding, severely restrict homeowners' options for installing or upgrading septic systems and exacerbate the risk of system failure, particularly in areas subject to tidal surges. These conditions hinder the ability to implement traditional septic solutions, which rely on sufficient soil depth for filtration and absorption. As a result, there is a need for innovative wastewater management solutions that address both the spatial constraints of these properties and the environmental impacts of flooding. The town has overseen septic system replacement for 1,200 properties with another 750 remaining.

Beach Erosion

Coastal erosion, exacerbated by rising sea levels, storm surges, and boat wakes presents serious challenges. It leads to the loss of beach and dune areas, property damage along coastlines, the destruction of natural habitats, and disruption of recreational activities.

Additionally, it has significant economic impacts, particularly on tourism industries. The erosion also undermines the protective role of beaches and dunes, which are essential for safeguarding neighboring properties, supporting local plant and wildlife habitats, and providing spaces for recreation. All the beaches in Old Saybrook and Fenwick have been affected, especially Fenwood and Knollwood beaches in Old Saybrook, and the Scum Beach area and Folly Point in Fenwick.

Marsh Flooding

Chalker Beach tide gate needs to be investigated to improve its functionality into the marsh to minimize storm surges and in particular allow surface runoff from the large commercially developed contributing watershed area to drain from the marsh. During precipitation events, runoff ponds within the marsh due to the restricted outflow created by the tide gate, this restriction elevates the marsh resulting in flooding of residential properties and public roadways within the Chalker Beach residential area, often taking days for the water to recede to normal levels. Hagar Creek Marsh has been flooding over at an increased frequency at high tide with water coming from underneath the Indian Town Bridge.

The Scum Beach area marsh in Fenwick experiences increased flooding both from deluge rainfall and tidal flooding through the gaps in the seawalls threatening the residential structures on Wilson Avenue and Old Fenwick Road. Additionally, the deposit of material and the intrusion of salt water into the freshwater marsh threaten the natural habitat and ecosystem.

Breakwaters

Deteriorating breakwaters both offshore and connecting to the outer lighthouse reduces their effectiveness.

Utilities

More frequent storms and wind events cause repeated disruption to aboveground utility service.

Barnes Road Flooding Over Sea Walls - Old Saybrook

Old Fenwick Inland Wetland Full After Rain - Fenwick

3 Sea Level Rise & Vulnerability

The Connecticut coastline is a dynamic landscape, where natural systems are vulnerable to hazards such as floods, storms, and storm surges. These hazards are exacerbated by dynamic coastal environments including shifting habitats, erosion caused by changes in sediment supply, rising sea levels, and unpredictable weather patterns driven by climate change.

To effectively plan for coastal resiliency needs, the Project Team developed models to understand the potential future scenarios of landscape changes and storm surges resulting from sea level rise. The data and knowledge gained from these models are crucial for understanding the current and future vulnerabilities of the study area's coastline and for developing solutions to enhance resiliency against these vulnerabilities.

This section outlines sea level rise scenarios for the years 2050 and 2070, providing projections of the anticipated changes over time. Additionally, a comprehensive Risk Assessment was conducted to identify areas and assets within the study area that are at high risk from the impacts of climate change. Town-specific maps highlight projected inundation during a 100-year storm and tidal event. See Appendix B for enlargements of these maps.

This study offers valuable insights into coastal flooding but represents only part of a complex picture. The modeled effects may be amplified by factors not fully captured, such as inland flooding and drainage issues where coastal and riverine flooding intersect. Future research integrating multiple flooding pathways will be crucial for a comprehensive understanding of coastal flood risks.

Seaside Avenue, Westbrook
January 2024

Sea Level Rise Scenarios

To proactively address the inevitable natural changes to the study area, sea level rise models simulating conditions in 2050 and 2070 were developed. These models provide insights into potential future scenarios, encompassing landscape transformations and storm surges resulting from rising sea levels.

The models' data and insights are essential for understanding the study area's current and future coastal vulnerabilities and developing effective resilience strategies.

Wave & Hydrodynamic Modeling

Wave & Hydrodynamic Modeling

This section describes the wave and hydrodynamic modeling that was performed to support the development of the Four Shore Coastal Resiliency Plan. The primary goal of the coastal modeling analysis was to evaluate potential future flood elevations due to sea level rise (SLR) and the associated flooding inundation extents and depths along the project coastline in Clinton, Westbrook, Old Saybrook, and Fenwick, Connecticut to inform the vulnerability and risk assessments for the project. The coastal modeling analysis was performed using a two-dimensional (2-D) coupled hydrodynamic and wave model to simulate nearshore wave and hydrodynamic conditions under a variety of meteorological conditions and sea level rise scenarios ranging from typical tidal conditions to an extreme storm event (i.e., 100-year return interval storm surge).

Model Description

The Delft3D Flexible Mesh Suite was the numerical model selected for the coastal modeling analysis. The model was developed and supported by Deltares and validated for use in riverine, estuarine, and open-coast hydrodynamic systems. Delft3D is widely used to evaluate coastal flooding conditions and was selected for this analysis to simulate the effects of sea level rise on flood elevations.

Wave growth and transformation modeling were performed with the 2-D Delft3D-WAVE (WAVE) model. The WAVE model is based on the Simulating Waves Nearshore (SWAN) model. The SWAN model was developed by the University of Delft and includes all relevant wave processes, such as refraction, shoaling, diffraction approximated by directional spreading of the phase-averaged waves, and wave breaking. The SWAN model computes wave heights and wave periods throughout the model domain. The hydrodynamic modeling was performed with the 2-D version of the Delft3D-FLOW Flexible Mesh (FLOW) model which computes water levels, water depths, and current velocities throughout the model domain.

Model Grids

A series of site-specific WAVE model grid domains were developed for the coastal modeling analysis. The WAVE model grids cover the Long Island Sound and the project coastline. The WAVE grid with the largest extent (see Figure 3-1 in red) has the coarsest resolution of 400 meters by 400 meters (approximately 1,300 feet by 1,300 feet) and the series of WAVE model grids with smaller extents and higher model grid resolution are nested within the larger grid (see Figure 3-1 in green). The highest resolution WAVE grid has a cell size of 25 meters by 25 meters (approximately 80 feet by 80 feet) and covers the entire project coastline (see figure 3-1 in blue). This resolution is considered sufficient to represent key features of the study area while maintaining computational efficiency. Figure 3-1 shows the WAVE model grid extents and resolutions. A site-specific FLOW model grid was developed and covered Long Island Sound and the project coastline. The resolution of the FLOW model grid is spatially variable with resolutions matching the resolutions of the nested wave grids. The spatially variable model grid resolution increases computational efficiency. Figure 3-2 shows the FLOW model grid extents. The WAVE and FLOW grids were setup as coupled domains such that the interaction between waves and currents computed by each domain is conveyed back and forth between the two models.

What does this mean?

An industry-standard coastal model was used to evaluate how sea level rise may affect flooding extents and depths along the project shoreline. The model grids were developed with resolutions that balanced capturing key features along the project shoreline and helped the model run efficiently. The model results were used to inform the risk and vulnerability assessments for the project.

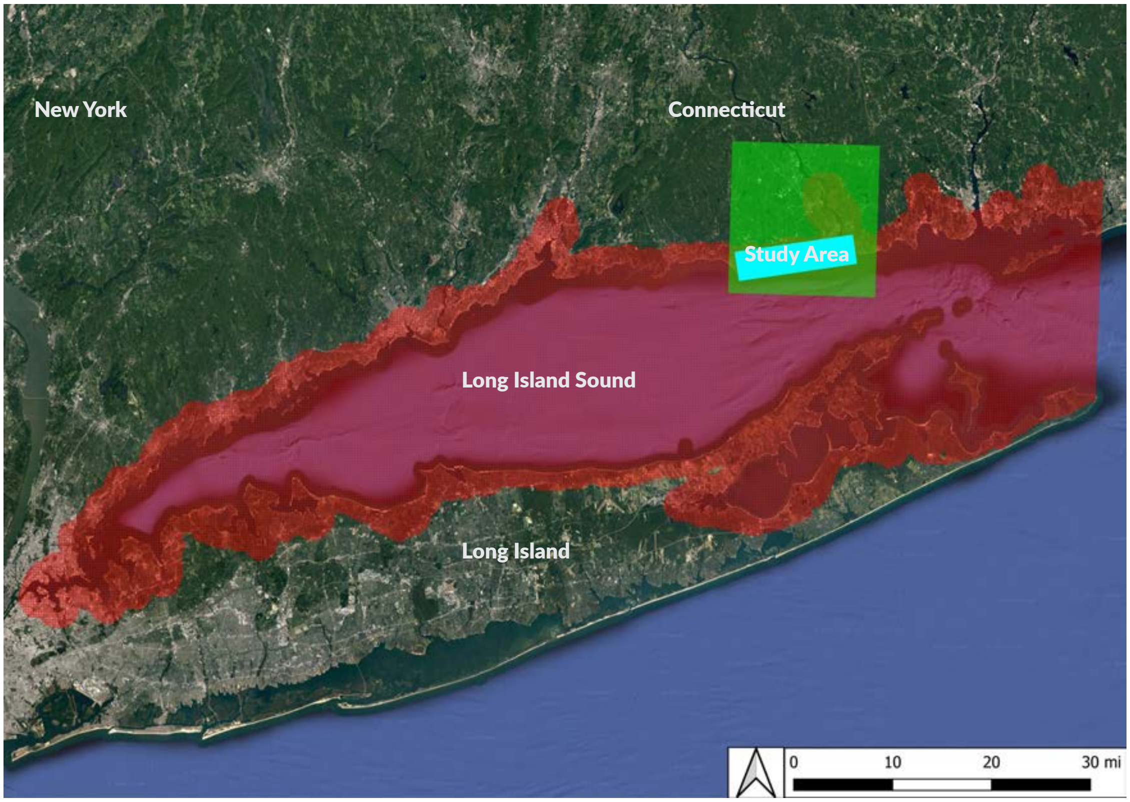


Figure 3-1: WAVE Model Grid Extents

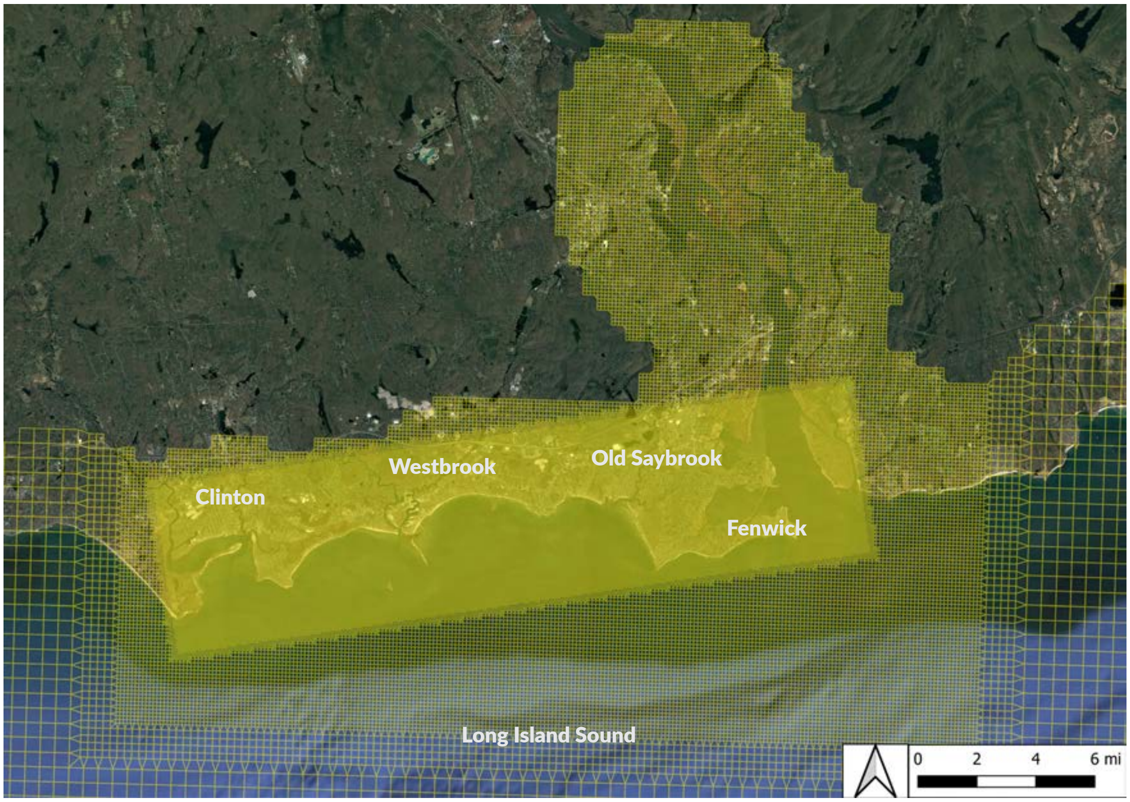


Figure 3-2: FLOW Model Grid Extents

Wave & Hydrodynamic Modeling (cont.)

Model Elevation Data

Detailed elevation data were incorporated into the model to represent the bathymetry (the measurement of water depth in waterbodies) and topography within the model grid extents and to distinguish local bathymetry near the study area and more accurately predict flooding and wave transformation near the site. The elevation data were projected horizontally to the North American Datum of 1983, 2011 (NAD83/2011) Connecticut State Plane Coordinate System, and vertically to the North American Vertical Datum of 1988 (NAVD88).

The model bathymetry was constructed primarily using the Long Island Sound Bathymetric Contours published by the Connecticut Department of Energy and Environment Protection (CT DEEP; CT DEEP 2019) and supplemented with electronic navigation chart soundings published by the National Oceanic and Atmospheric Administration (NOAA; NOAA 2023a). Figure 3-3 shows the extent of the Long Island Sound bathymetric contours obtained from CT DEEP (2019). Model grid topography was constructed using the 2016 Capital Region Council of Governments (CRCOG) Lidar Digital Elevation Model (DEM) Connecticut Statewide (CRCOG 2017) and United States Geological Survey (USGS) 3D Elevation Program (3DEP) 1 arc second tile data in study area published from 2021 to 2023 (USGS 2023).

What does this mean?

The latest publicly available elevation data was used in the model to represent the bathymetric elevations within Long Island Sound and the topographic elevations along the project shoreline.

Modeling Approach

Wave models, such as WAVE, are driven by forcing conditions applied at the boundaries of the model grid, such as wind speed, wind direction, and water level. These inputs were applied to the model grid to simulate storm flood elevations and localized wind-wave generation along the project coastline for existing conditions and simulations that incorporate sea level rise. Two types of simulations were performed to simulate a range of nearshore wave and hydrodynamic conditions at the site: (1) typical tidal conditions with FLOW model to simulate "tide only" conditions (i.e., no wind or storm inputs), (2) an extreme storm event equivalent to a 100-year return interval storm with the coupled WAVE and FLOW model.

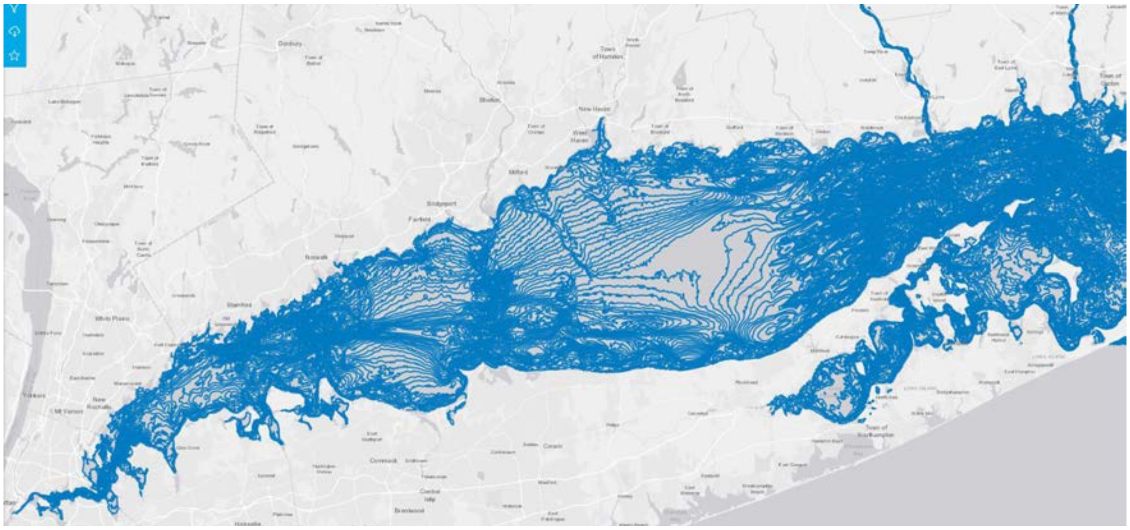
The purpose of the tidal condition simulations was to evaluate flood inundation extents and depths under typical tidal conditions (i.e., non-storm or "sunny day") that peaked around the mean higher high water (MHHW) elevation and impacted the site frequently and to evaluate changes in flood elevations, extents, and depths due to SLR. The tidal simulations used water level data from December 14 and 15, 2023 at NOAA station 8510560 at Montauk, New York near the model eastern model boundary (NOAA 2023b). These were run as "tide only" simulations (i.e., FLOW model only) with a time series of water levels, but no wind or storm inputs. Figure 3-4 shows the time series of water levels used for the existing conditions tidal simulation.

The purpose of the extreme storm simulations was to evaluate flood inundation extents and depths under an extreme storm event with a storm surge that peaked around the 100-year stillwater elevation in the study area published by the Federal Emergency Management Agency (FEMA; FEMA 2013) and to evaluate changes in flood elevations, extents, and depths due to SLR. The FEMA 100-year Stillwater elevation in the study area equaled 9.2 feet NAVD88 which includes effects of astronomical tide and storm surge. The Stillwater elevation is different from the Base Flood Elevations (BFEs) shown on the Flood Insurance Rate Maps (FIRMs) for the study area because BFEs also include effects of waves that result in higher elevations. Using the Stillwater elevation for storm selection was considered appropriate because the coupled WAVE and FLOW models will compute storm waves and the increased flood elevations for the selected storm.

Data from the U.S. Army Corps of Engineers (USACE) Coastal Hazards System North Atlantic Coast Comprehensive Study (NACCS) was used for the coastal modeling analysis. As part of NACCS, the USACE simulated a range of tropical storm conditions and outputs parameters such as water levels and wave heights to data-save stations throughout the study area. Data from NACCS station 8238 located centrally along the project coastline was evaluated for selecting a 100-year storm event. Figure 3-5 shows NACCS stations located near the project site as well as NACCS station 9134 located near the eastern boundary of the WAVE and FLOW model grids.

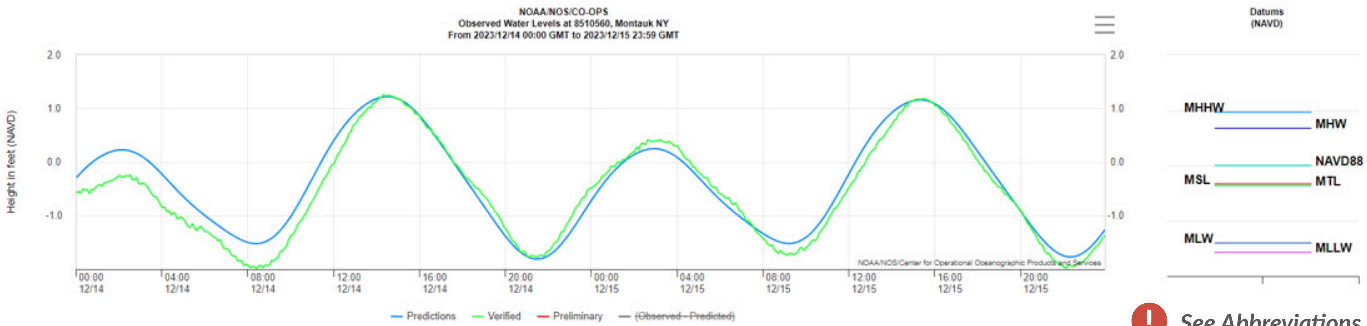
What does this mean?

The model was used to evaluate a range of coastal conditions, including typical tides and a 100-year storm. This approach allowed us to evaluate how sea level rise may affect both tidal flooding and storm-induced flooding. The model inputs were based on data published by FEMA, NOAA, and the USACE.



1-foot contour

Figure 3-3: Digital Bathymetric Contours in Long Island Sound from CT DEEP (2019)



See Abbreviations list

Figure 3-4: Typical Tidal Condition Simulation Water Levels

Figure 3-5: USACE NACCS Stations Near Project Site

Wave & Hydrodynamic Modeling (cont.)

Modeling Approach (cont.)

The water level data at NACCS station 8238 was evaluated to select a storm with a track through Long Island Sound and resulted in a peak storm surge equal to the FEMA 100-year Stillwater elevation in the study area. Figure 3-6 shows two storm tracks through Long Island that were evaluated for water levels.

Figure 3-7 shows the time series of water level for storms along Track 13 compared to the FEMA 100-year Stillwater elevation. As shown in the figure, the peak water level at NACCS Station 8238 from Storm 374 was approximately equal to the FEMA 100-year Stillwater elevation at the study area. Storm 374 was selected as the 100-year storm event for the coastal modeling analysis. The time series data of wind and water level for Storm 374 at NACCS station 9134 near the model boundary were used as the extreme storm model inputs.

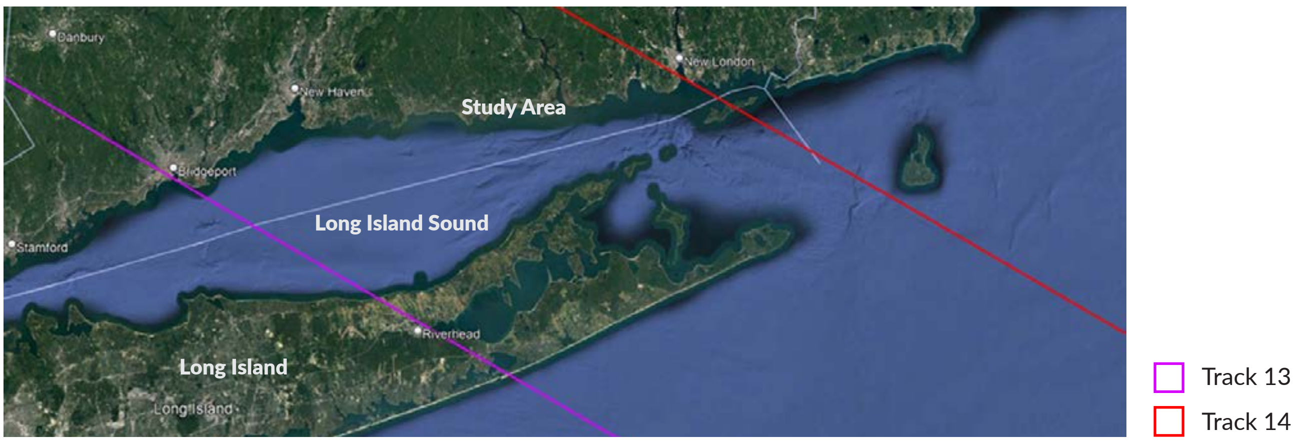


Figure 3-6: Storm Tracks Evaluated for Water Levels

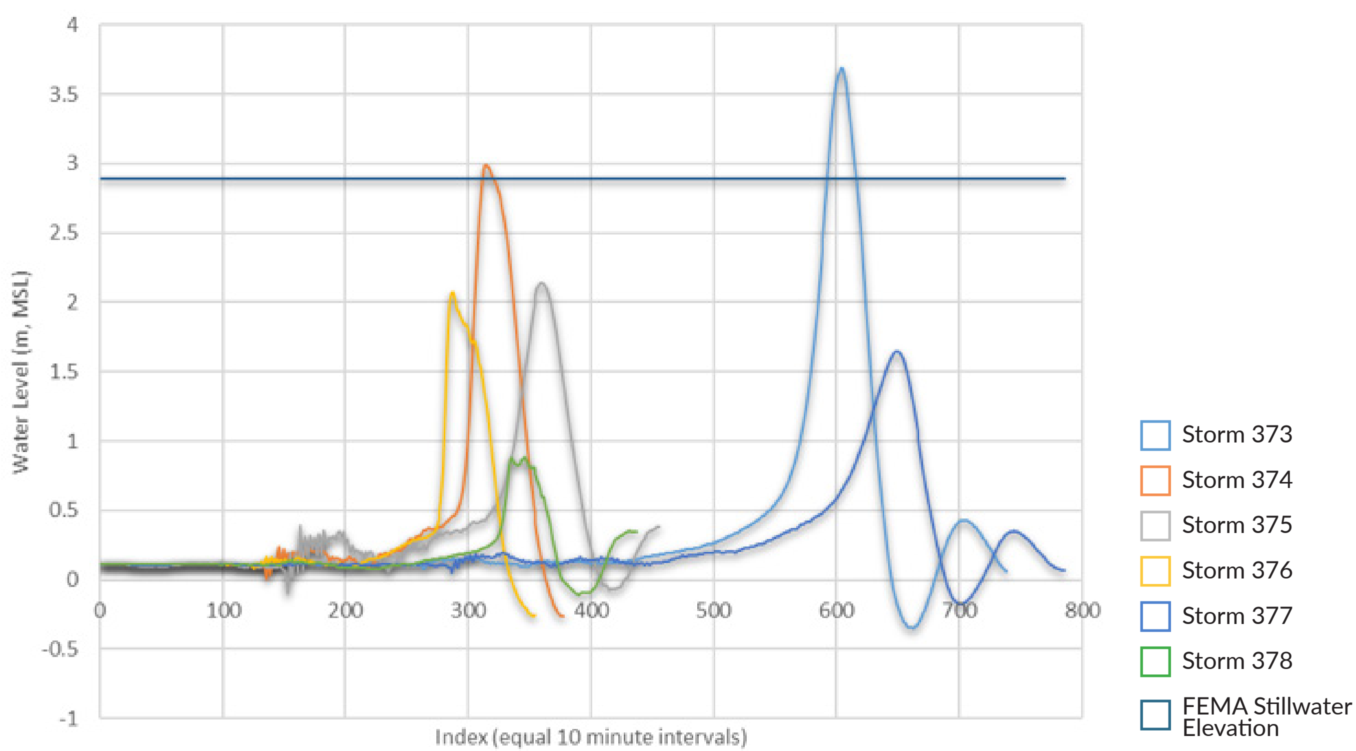


Figure 3-7: Track 13 Storm Water Levels

Sea Level Rise

Two references were reviewed to determine the most appropriate SLR scenarios for the Connecticut shoreline along Long Island Sound. The first was the Connecticut Department of Energy and Environmental Protection's (DEEP's) website Sea Level Rise in Connecticut (DEEP 2020). The second was Sea Level Rise in Connecticut (O'Donnell 2018), prepared by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA).

As described by DEEP (2020), Connecticut General Statutes (CGS) Section 25-68o(b) requires the DEEP to publish the sea level change scenario for the state. DEEP and CIRCA held a public hearing on October 2, 2018, on the recommended sea level change scenario for Connecticut. Also under the statute, DEEP published, on December 26, 2018, a notice signed by DEEP's Commissioner adopting the sea level change scenario.

This sea level change scenario is meant to guide municipalities and the state in preparing the following documents:

- Municipal evacuation or hazard mitigation plans
- The state's civil preparedness plan and program
- Municipal conservation and development plans
- Revisions to the state's conservation and development plan

The SLR scenario selected by DEEP was based on a review of several projections (see Figure 3-8). These SLR projections are based on guidance on the magnitude of potential changes in global mean sea level described in the National Oceanic and Atmospheric Administration (NOAA) Technical Report OAR CPO-1 (Parris et al., 2012), modified to provide more local guidance to include the effects of local oceanographic conditions, more recent data and models, and local land motion.

The different SLR projections shown in Figure 3-8 are based on local tide gauge observations (Low; blue line), the Intergovernmental Panel on Climate Change IPCC (2013) RPC 4.5 model simulations near Long Island Sound (Intermediate Low; yellow line), and the semi-empirical models (Intermediate High; orange line) and ice budgets (High; magenta line) in Parris et al., 2012. O'Donnell (2018) notes that the differences between the projections are not large until after mid-century. Therefore, a SLR of 0.5 m in 2050 in Long Island Sound was recommended for planning in Connecticut (shown in Figure 3-8 as the Planning Threshold). O'Donnell (2018) also recommends alerting the public with properties in elevations that may be affected if a 1.0 m increase in mean sea level were to occur (shown in Figure 3-8 as the Alert Threshold).

Based on State of Connecticut guidance, these two SLR scenarios are recommended for the study:

- **Scenario 1: 0.5 m (1 foot 8 inches) in Long Island Sound by 2050.** This scenario is consistent with the State of Connecticut guidance and is 26 years in the future. O'Donnell (2018) notes that a common and useful planning outlook in many applications (e.g., home mortgages) is 30 years, so the 2050 time horizon would be consistent with the recommendation. Because 0.5 m is the mid-point of the projections for 2050, it was determined by CT DEEP to provide a reasonable and prudent guideline for planning purposes.
- **Scenario 2: 0.75 m (2 feet 6 inches) in Long Island Sound by 2070.** This scenario is 46 years in the future and coincides with the Intermediate Low and Intermediate High SLR projections in 2070. A time horizon of approximately 50 years is recommended because 50 years is the practical design life of typical municipal civil works projects. As shown in Figure 3-8, this scenario would be also equal to the High SLR projection in the Year 2055.

What does this mean?

Two sea level rise scenarios are used in the coastal modeling analysis to look at potential flooding in 2050 and 2070. The scenarios selected are in the intermediate range of projected sea level rise. These scenarios are consistent with recommendations published by the National Fish and Wildlife Foundation's grant that is funding this project.

Wave & Hydrodynamic Modeling (cont.)

Sea Level Rise (cont.)

The SLR values at 2050 and 2070 from the "Intermediate Low" curve shown in Figure 3-8 were used in the coastal modeling analysis. This curve's values were approximately equal to the recommended SLR values and were considered an appropriate balance for municipal planning purposes since it does include an acceleration in long-term SLR compared to the linear historical trends, but is not the worst-case scenario projection. The 2050 and 2070 time horizons to evaluate SLR are also consistent with the National Fish and Wildlife Foundation's (NFWF's) Long Island Sound Futures Fund grant that supports the Four Shores Coastal Resiliency Plan.

It should be noted that the SLR projections recommended by the State of Connecticut were based on SLR increases from Year 2000. For the Four Shore Coastal Resiliency Plan, the increases in sea level were based on the difference in water levels in 2023 and the projections in Years 2050 and 2070. Figure 3-8 calls out the SLR values relative to the 2023 value on the "Intermediate Low" curve.

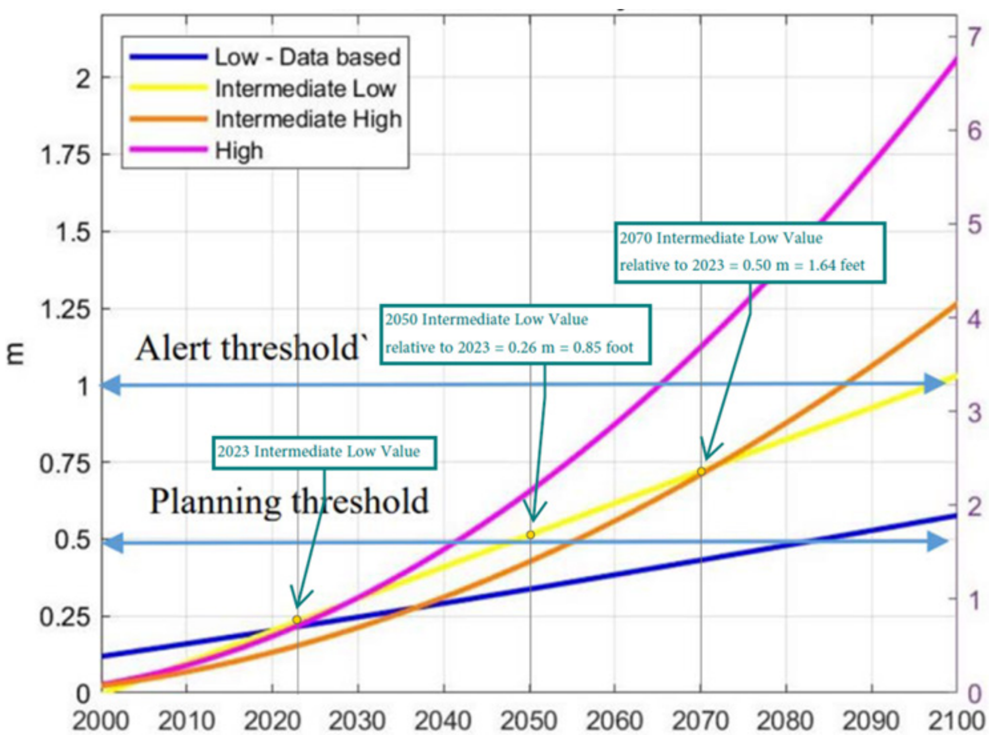


Figure 3-8: Connecticut Sea Level Rise Projections

Alert Threshold: Recommended threshold for alerting the public with property in elevations that may be affected if a 1 meter (3' - 3") increase in mean sea level were to occur.

Planning Threshold: the adopted sea level change scenario for Connecticut is a 0.5 meter (1' - 8") increase in sea level in the Long Island Sound by 2050.

What is a Tidal Flooding Event? High tide flooding occurs when elevated sea levels combine with local factors to exceed normal high tide marks. This is sometimes called "sunny day flooding" and can inundate streets during full or new moons, or due to changes in prevailing winds and ocean currents. As a result, coastal areas increasingly face flood risks under otherwise benign weather conditions.

What is a 100-Year Storm Event? It is a severe weather event with a 1% chance of occurring in any given year, not an event that happens once per century. These storms can happen in back-to-back years or even multiple times annually. As climate patterns shift, the frequency of these severe events may increase, challenging traditional probability assessments.

Tidal Simulations Model Results

Model Results

The simulation results from the FLOW model for each tidal simulation were compared at the location of the NOAA station in Bridgeport, Connecticut located approximately 34 miles west of the study area. Figure 3-9 shows the comparison of the water level data from the guage for the December 2023 simulation period and the existing conditions, 2050 SLR, and 2070 SLR simulation water level results. As shown in the figure, the existing condition model results matched well with the NOAA guage data. The 2050 SLR and 2070 SLR results showed increases in tidal elevations (e.g., MHHW) compared to existing conditions due to SLR.

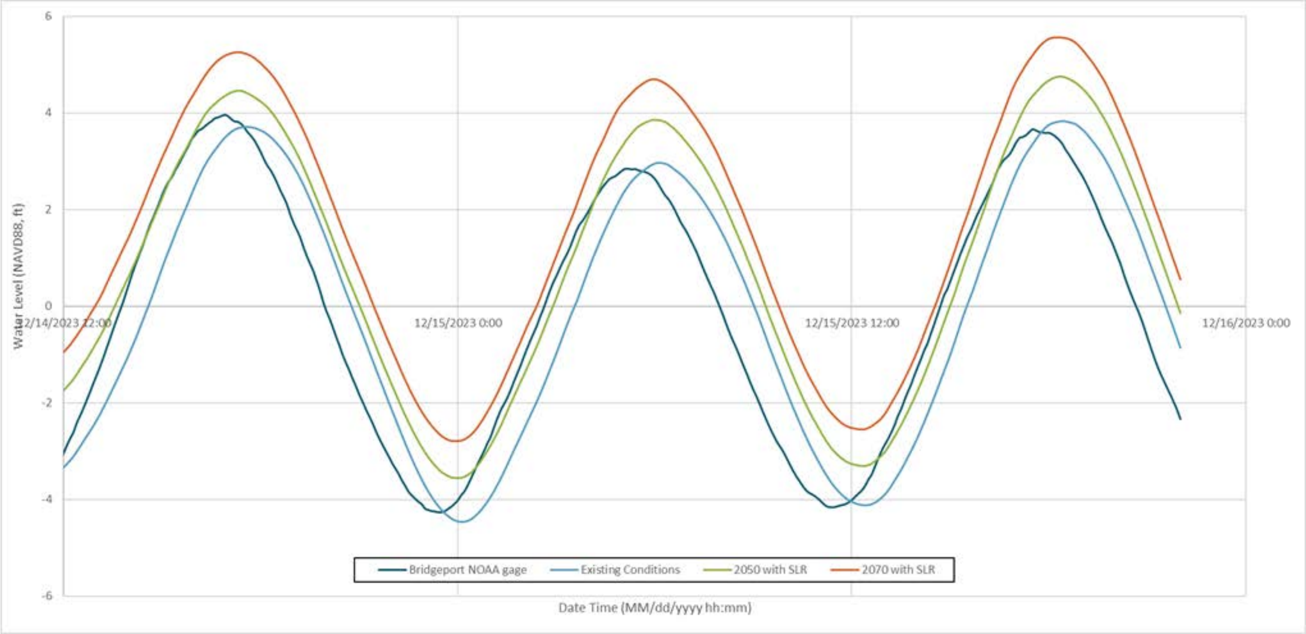


Figure 3-9: Tidal Simulation Water Level Results Comparison

Figures 3-10 through 3-15 show the water level and water depth results for the tidal simulations. As shown in the figures, the water levels increased in the 2050 SLR and 2070 SLR results compared to existing conditions. The results indicate that under typical tidal conditions (i.e., non-storm or "sunny day" conditions), the extents and depths of inundation are expanded and increased compared to existing conditions due to SLR, which means that areas that do not currently get inundated under typical tidal conditions may become inundated in the future under typical tidal conditions.

What does this mean?

The existing condition tidal model results matched well with the NOAA tidal data, which confirmed that the model was performing adequately. The model results showed that sea level rise may result in increased tidal flooding extents and depths along the project shoreline.

Tidal Simulations: Existing Condition

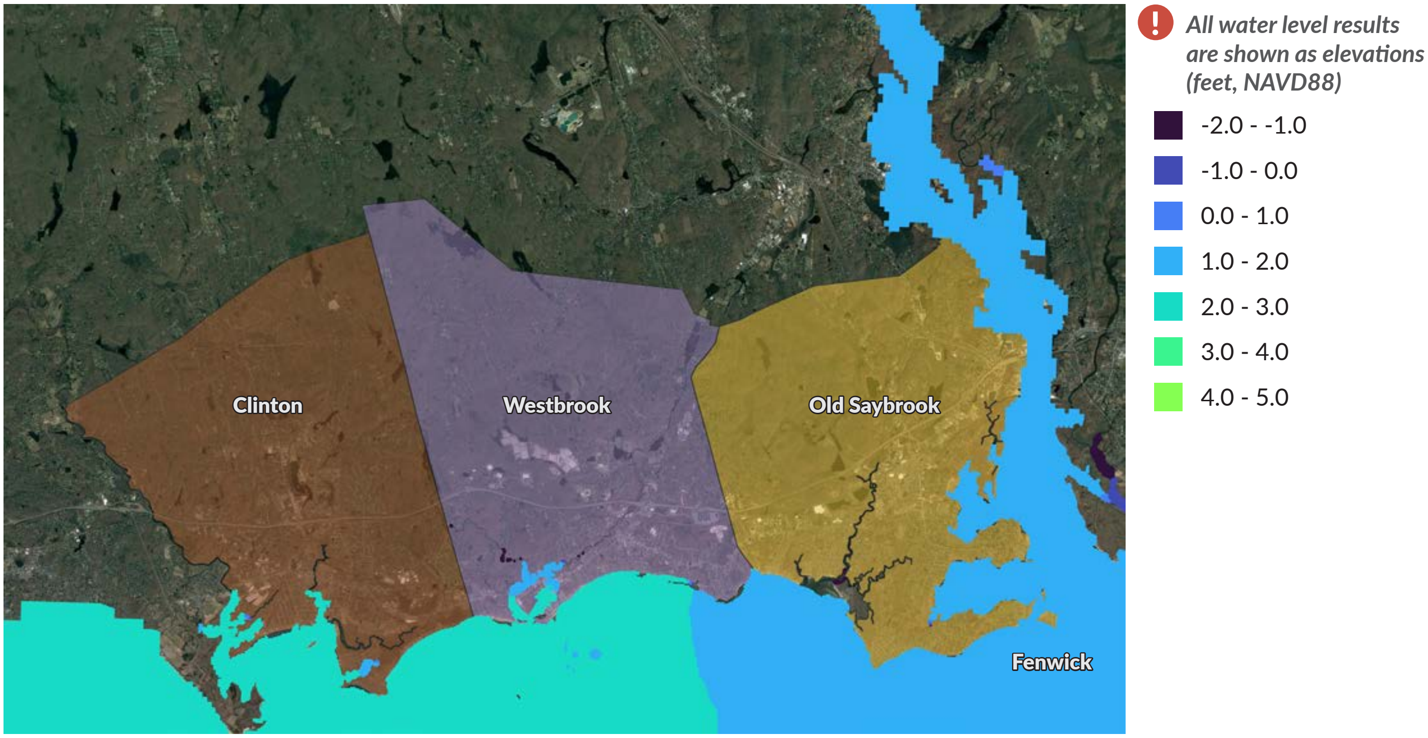


Figure 3-10: Tidal Simulation Water Level (Existing Condition)

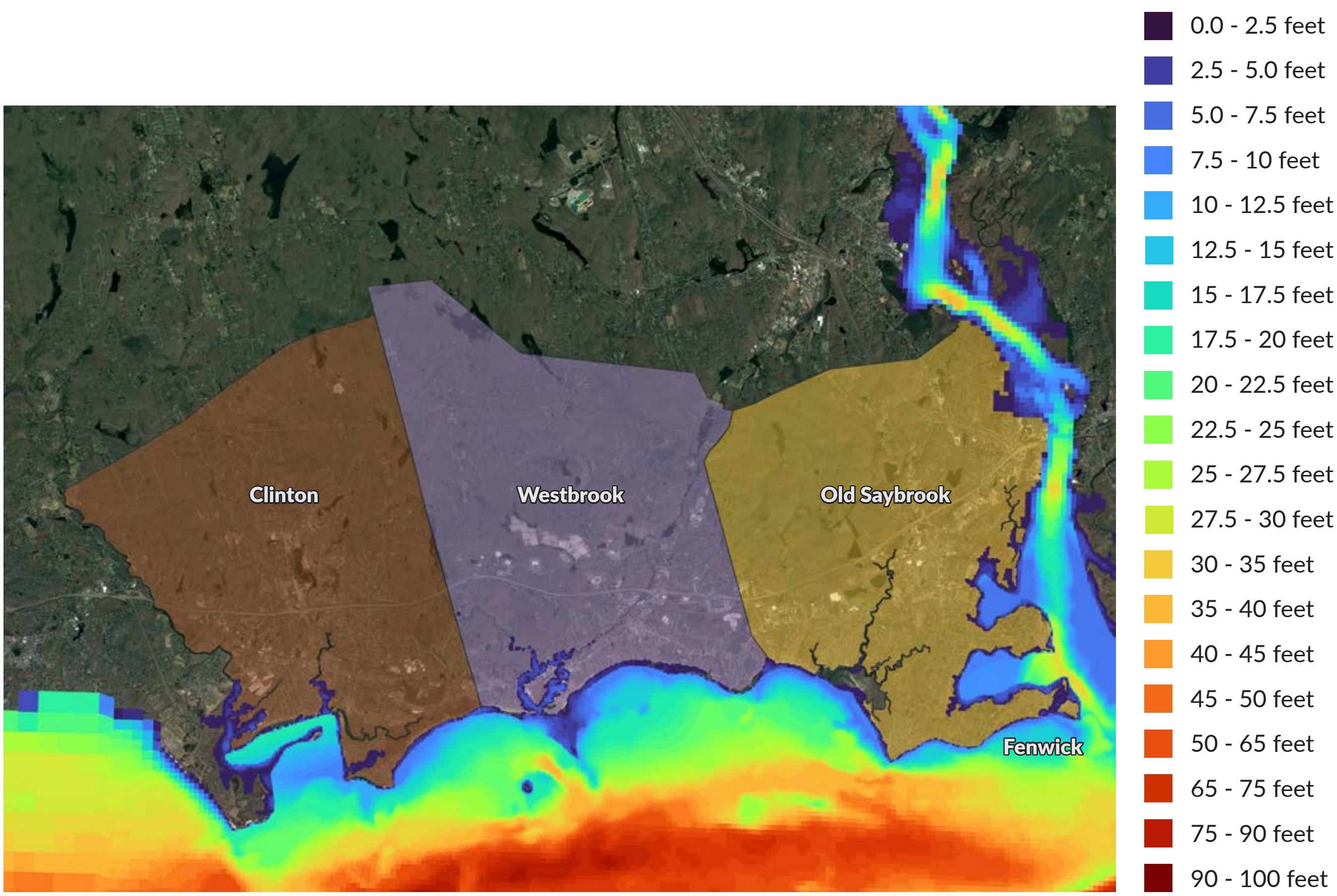
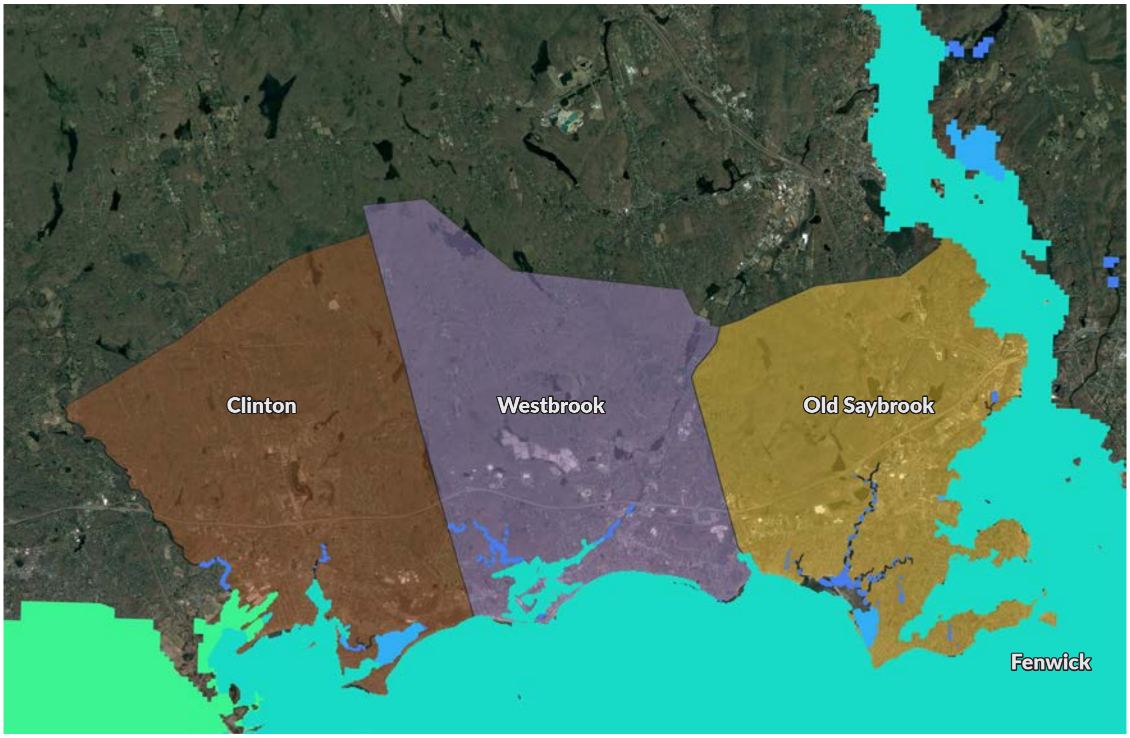


Figure 3-11: Tidal Simulation Water Depth (Existing Condition)

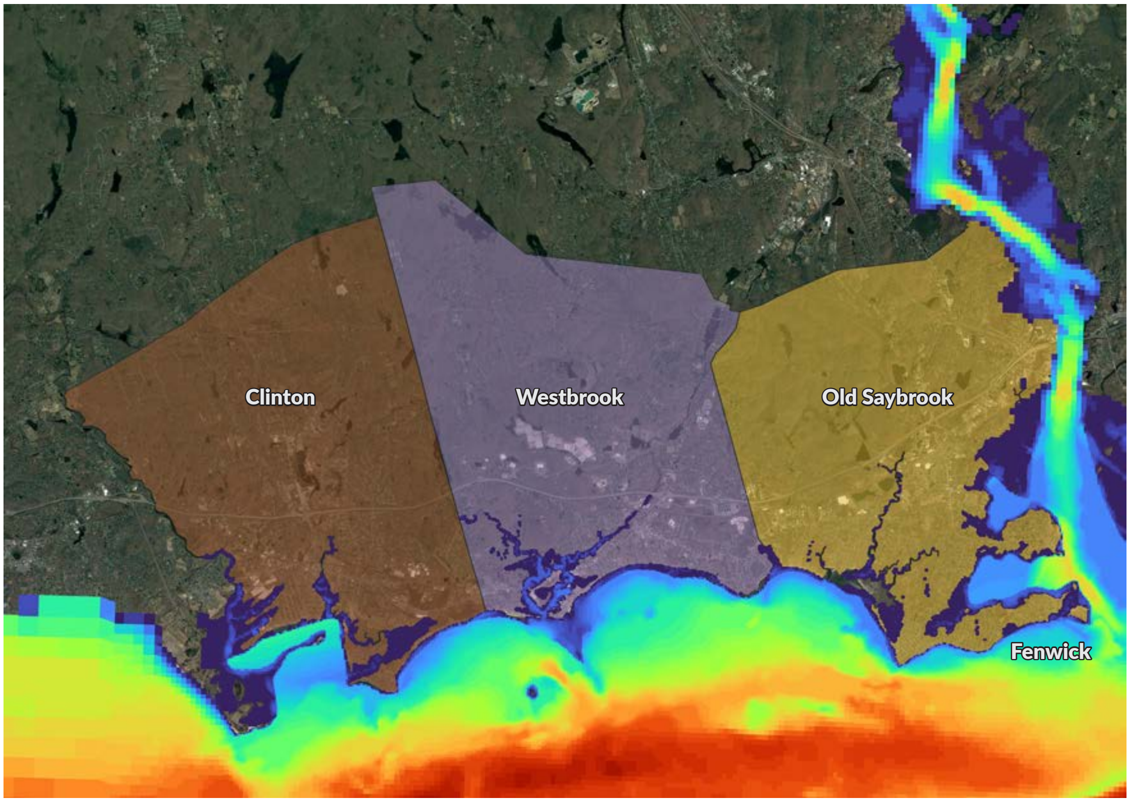
Tidal Simulations: 2050 with Sea Level Rise Condition



All water level results are shown as elevations (feet, NAVD88)

- -2.0 - -1.0
- -1.0 - 0.0
- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0

Figure 3-12: Tidal Simulation Water Level (2050 with Sea Level Rise Condition)



- 0.0 - 2.5 feet
- 2.5 - 5.0 feet
- 5.0 - 7.5 feet
- 7.5 - 10 feet
- 10 - 12.5 feet
- 12.5 - 15 feet
- 15 - 17.5 feet
- 17.5 - 20 feet
- 20 - 22.5 feet
- 22.5 - 25 feet
- 25 - 27.5 feet
- 27.5 - 30 feet
- 30 - 35 feet
- 35 - 40 feet
- 40 - 45 feet
- 45 - 50 feet
- 50 - 65 feet
- 65 - 75 feet
- 75 - 90 feet
- 90 - 100 feet

Figure 3-13: Tidal Simulation Water Depth (2050 with Sea Level Rise Condition)

Tidal Simulations: 2070 with Sea Level Rise Condition

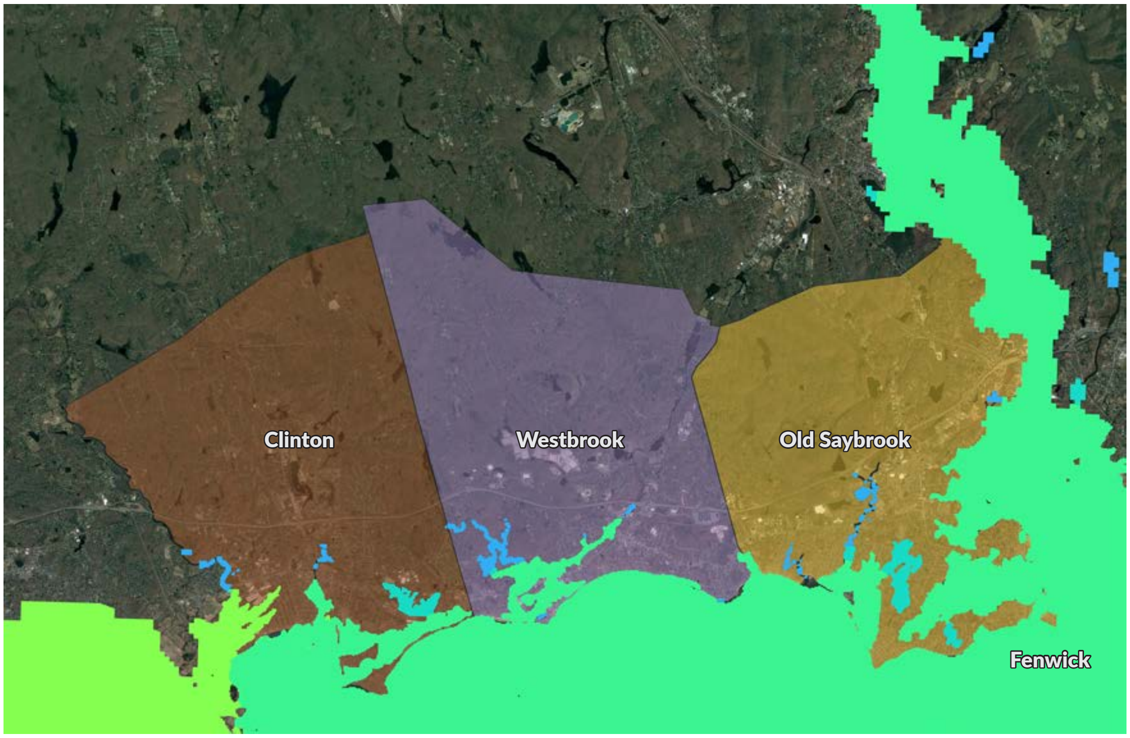


Figure 3-14: Tidal Simulation Water Level (2070 with Sea Level Rise Condition)

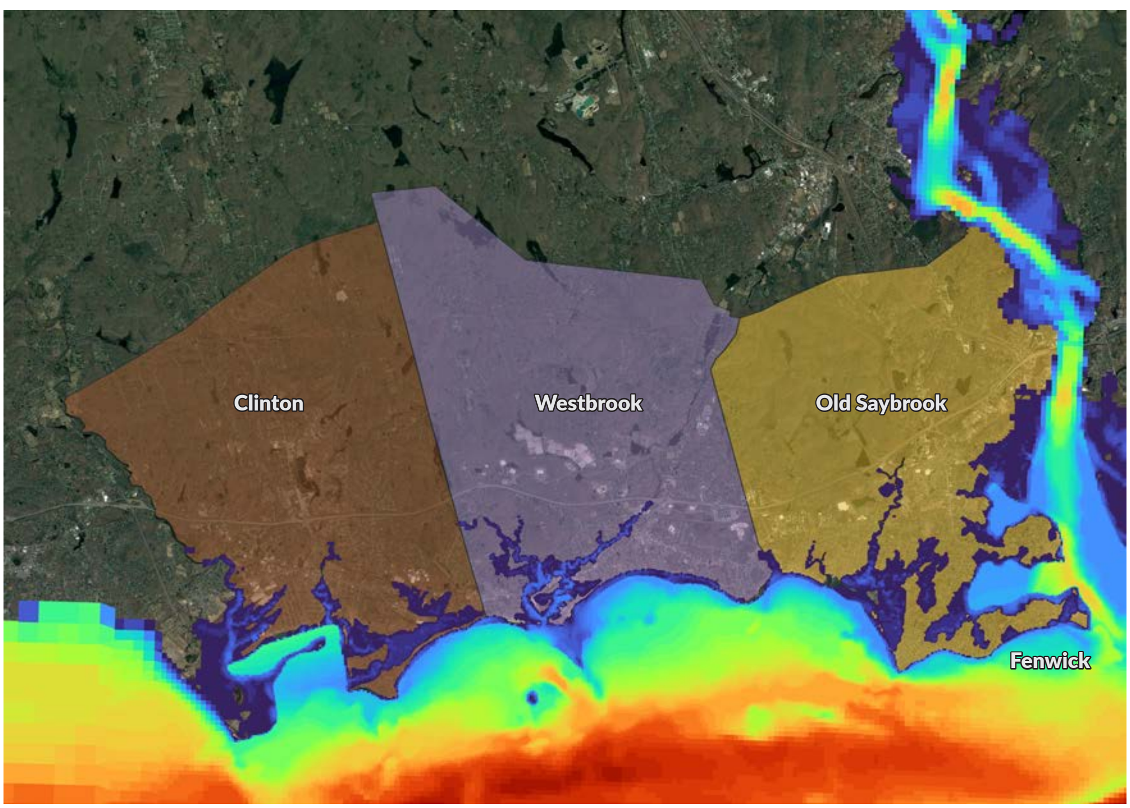


Figure 3-15: Tidal Simulation Water Depth (2070 with Sea Level Rise Condition)

Tidal Simulations: Water Depth Differential

Model Results (cont.)

To further compare the water depth results, Figures 3-16 and 3-17 show the difference between the existing conditions' water depth results and the 2050 SLR and 2070 SLR water depth results, respectively. The comparisons were made by computing the difference between the water depth results for each SLR case and the existing conditions' water depth results. The figures further illustrate the expanded and increased inundation extents and depths.

Figure 3-16: Tidal Simulation Water Depth Difference Between 2050 Sea Level Rise and Existing Conditions

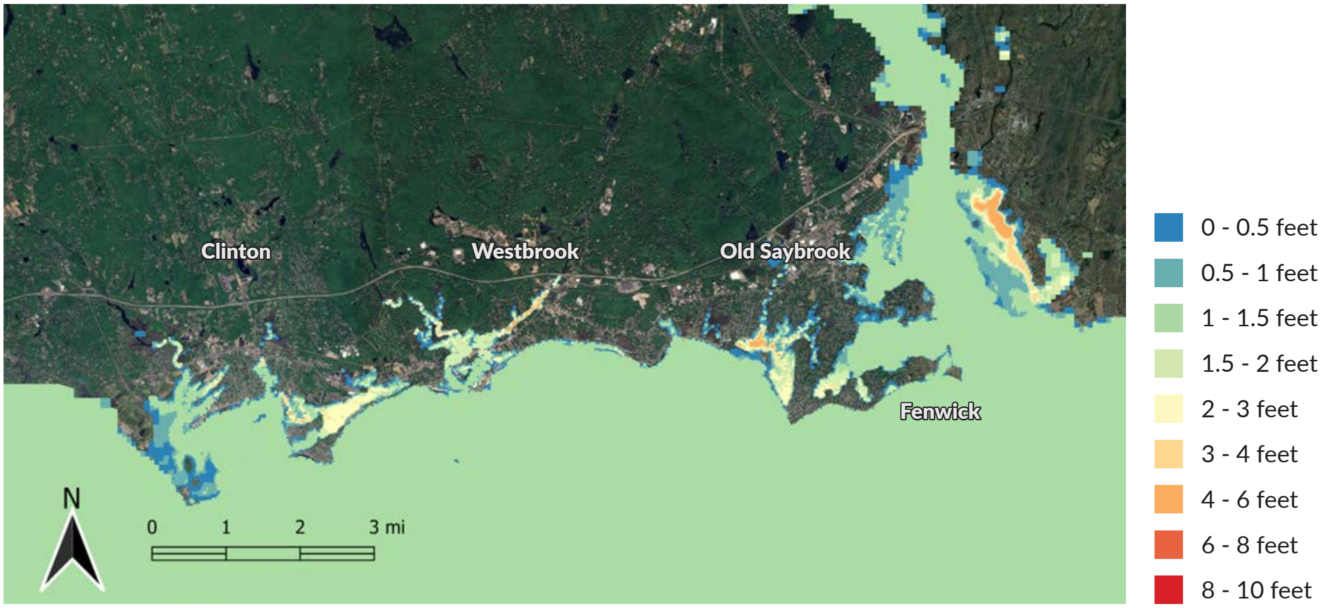


Figure 3-17: Tidal Simulation Water Depth Difference Between 2070 Sea Level Rise and Existing Conditions

100-Year Storm Simulations Model Results

Model Results

The simulation results from the FLOW model for each extreme storm simulation were compared at NACCS Station 8238 located near the study area. Figure 3-18 shows the comparison of the water level data from the NACCS station for Storm 374 (see yellow box below) and the existing conditions, 2050 SLR, and 2070 SLR simulation water level results. As shown in the figure, the existing condition model results matched well with the NACCS station data. The 2050 SLR and 2070 SLR results showed increases in storm surge elevations compared to existing conditions due to SLR.

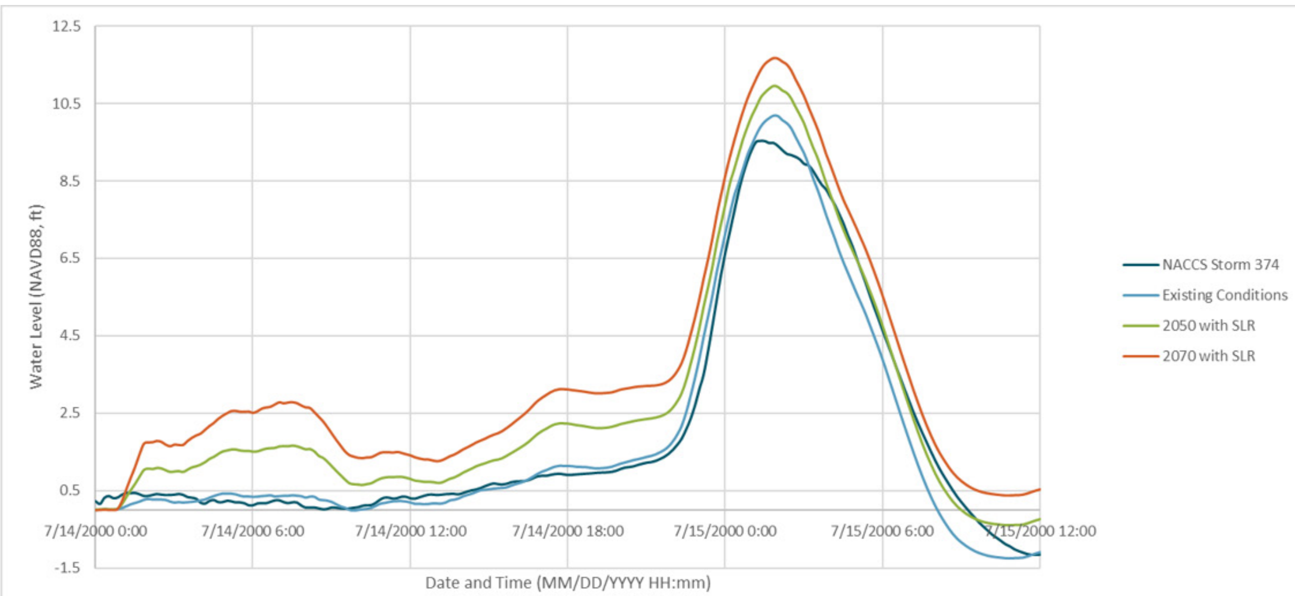


Figure 3-18: Extreme Storm Simulation Water Level Results Comparison

Figures 3-19 through 3-24 show the water level and water depth results for the extreme storm event simulations. As shown in the figures, the extent and depth of inundation are increased during extreme storm events compared to typical tidal conditions. In addition, the storm surge elevations are increased in the 2050 SLR and 2070 SLR results compared to existing conditions. The results show expanded and increased extents and depths of inundation compared to existing conditions due to SLR, which means that areas that do not currently get inundated from storm surges during extreme events may become inundated in the future.

What does this mean?

The existing condition 100-year storm surge model results matched well with the USACE storm surge data, which confirmed that the model was performing adequately. The model results showed that sea level rise may result in increased flooding extents and depths due to extreme storms along the project shoreline.

What is Storm 374?

Storm 374 was a computer-generated tropical storm scenario created by USACE for their North Atlantic Coast Comprehensive Study (NACCS), not a historical event. It was one of many synthetic storms modeled using historical hurricane data to analyze potential impacts on the North Atlantic Coast. The July 2000 dates in Figure 3-18 are modeling reference dates unrelated to actual storms.

100-Year Storm: Existing Condition

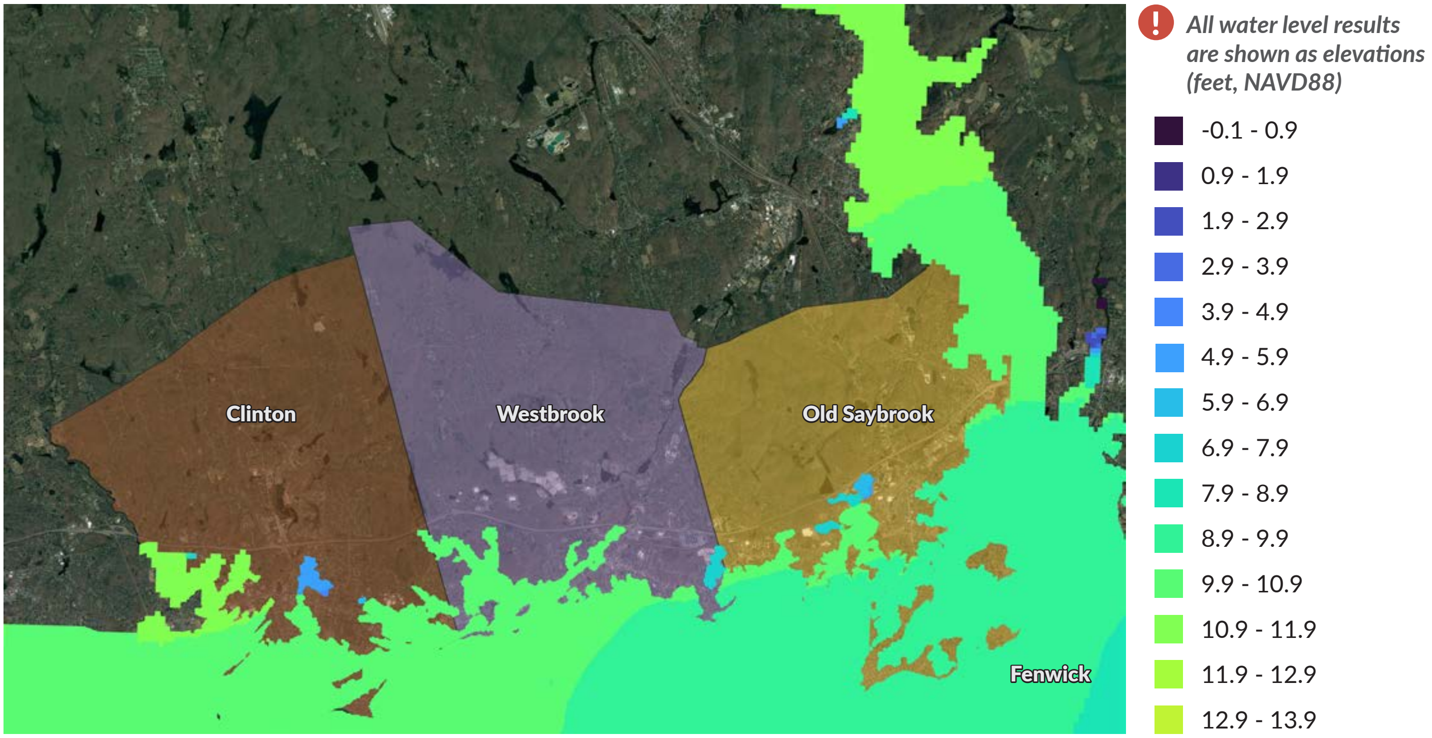


Figure 3-19: 100-Year Storm Water Level (Existing Condition)

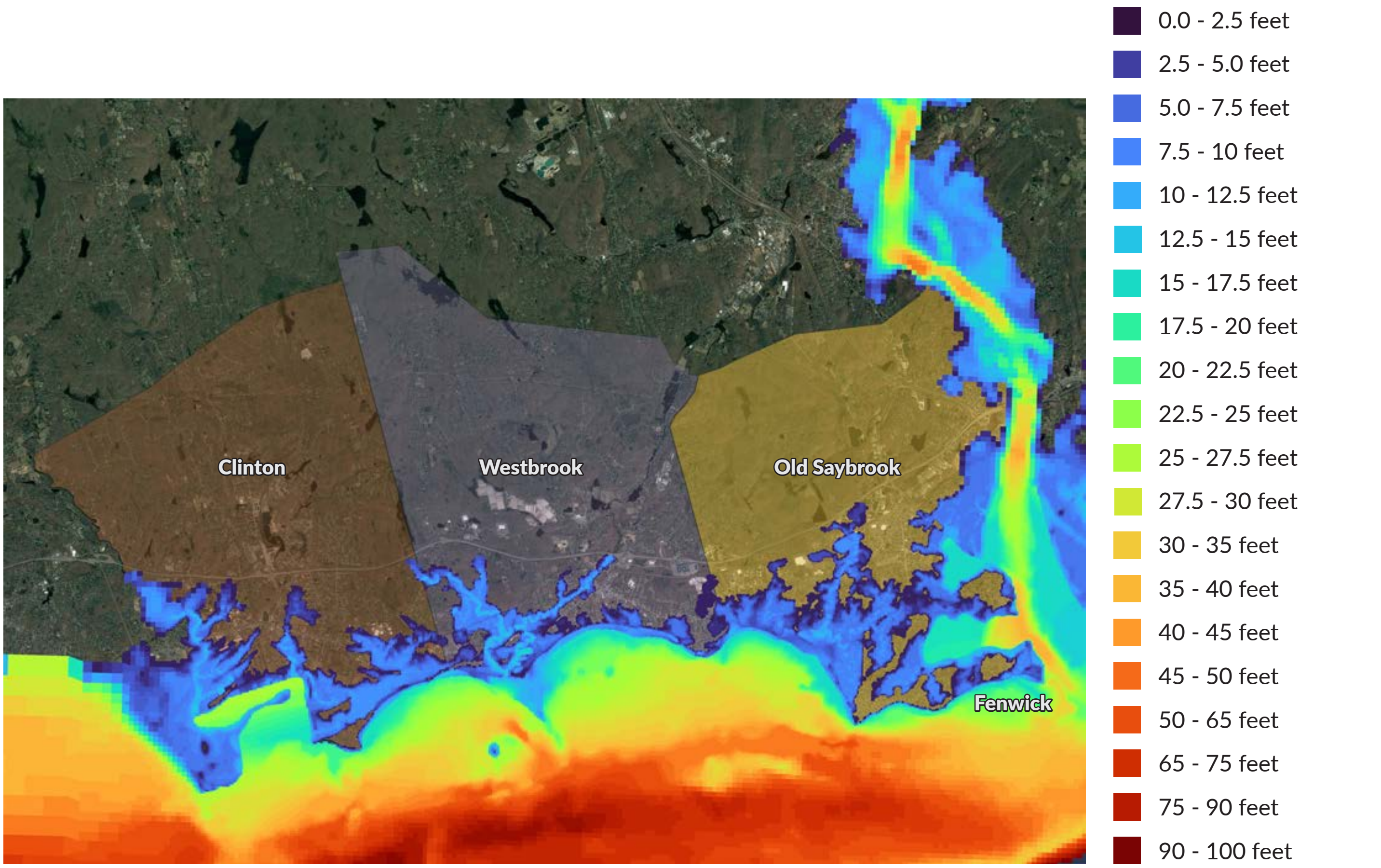


Figure 3-20: 100-Year Storm Water Depth (Existing Condition)

100-Year Storm: 2050 with Sea Level Rise Condition

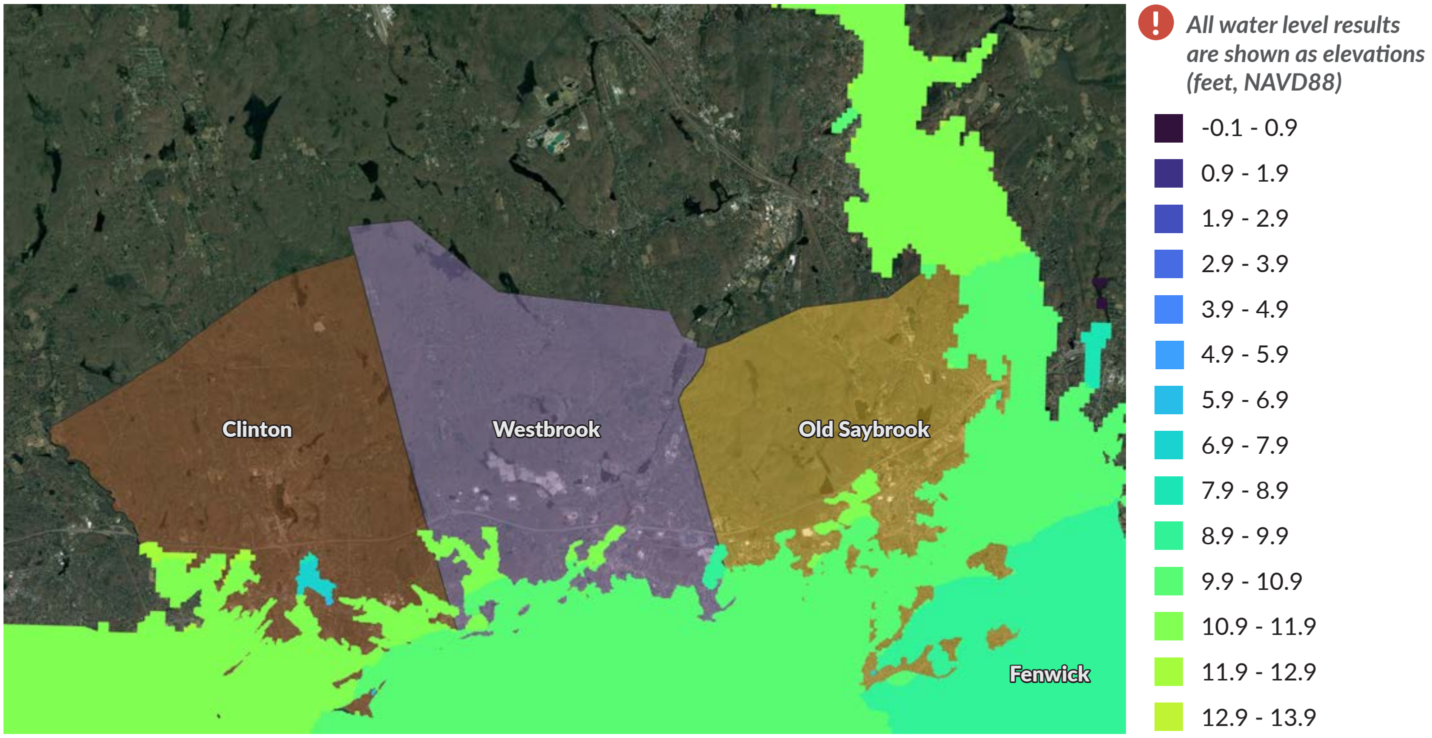


Figure 3-21: 100-Year Storm Water Level (2050 with Sea Level Rise Condition)

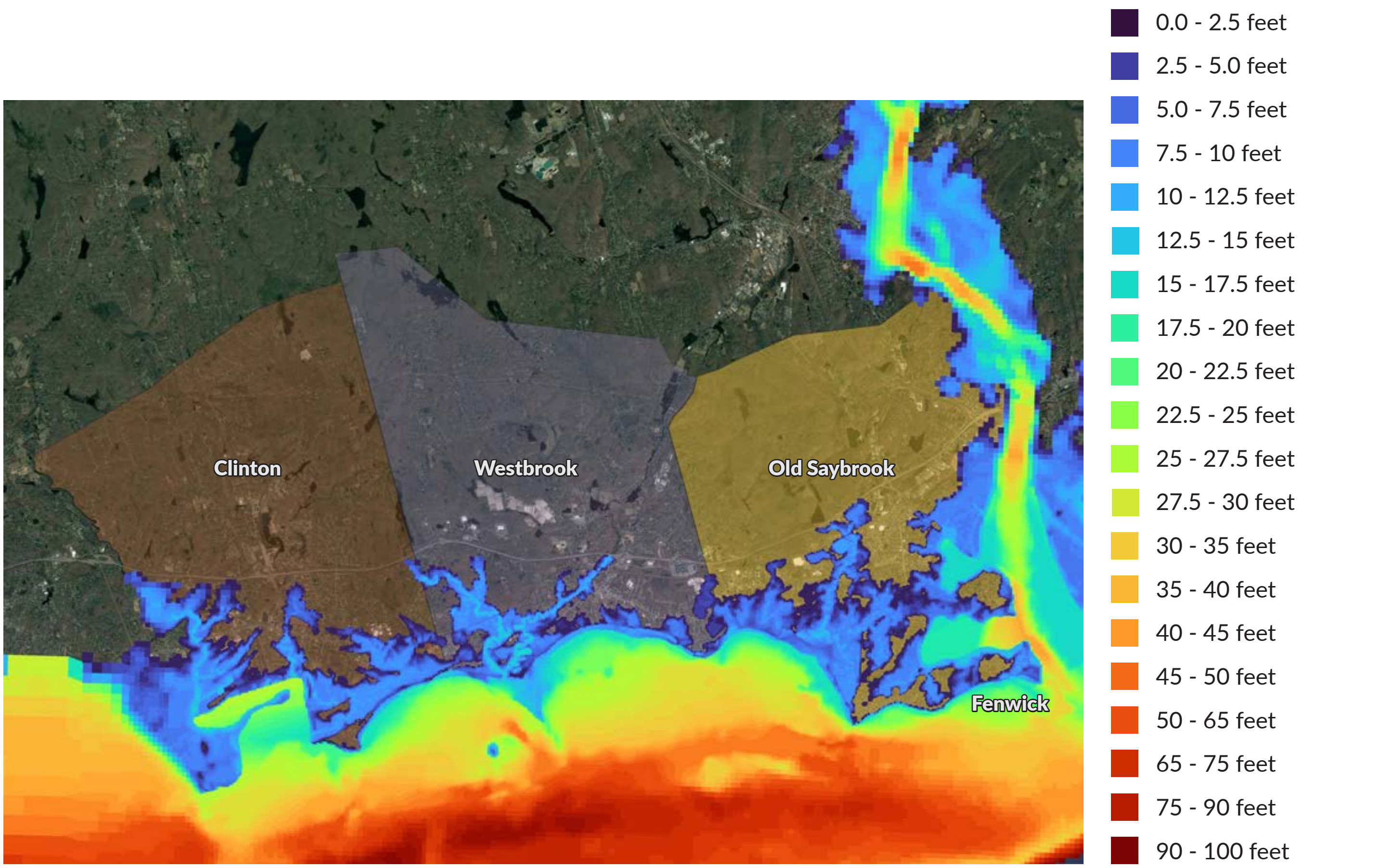
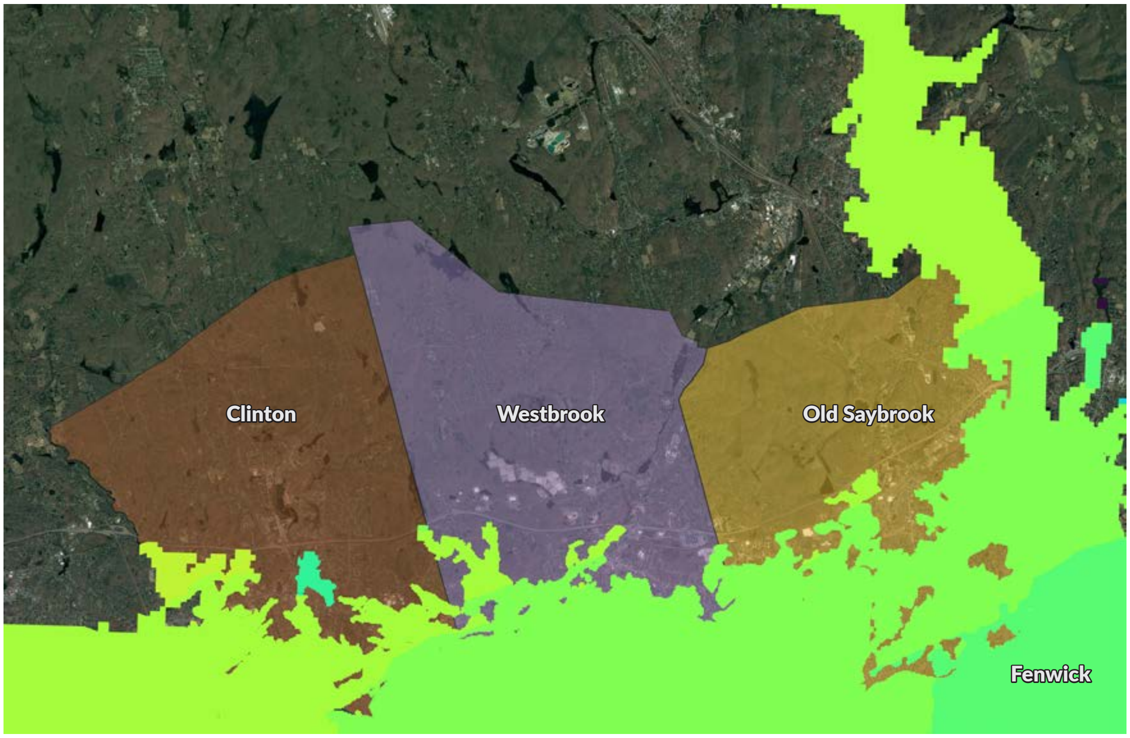


Figure 3-22: 100-Year Storm Water Depth (2050 with Sea Level Rise Condition)

100-Year Storm: 2070 with Sea Level Rise Condition



All water level results are shown as elevations (feet, NAVD88)

- -0.1 - 0.9
- 0.9 - 1.9
- 1.9 - 2.9
- 2.9 - 3.9
- 3.9 - 4.9
- 4.9 - 5.9
- 5.9 - 6.9
- 6.9 - 7.9
- 7.9 - 8.9
- 8.9 - 9.9
- 9.9 - 10.9
- 10.9 - 11.9
- 11.9 - 12.9
- 12.9 - 13.9

Figure 3-23: 100-Year Storm Water Level (2070 with Sea Level Rise Condition)

- 0.0 - 2.5 feet
- 2.5 - 5.0 feet
- 5.0 - 7.5 feet
- 7.5 - 10 feet
- 10 - 12.5 feet
- 12.5 - 15 feet
- 15 - 17.5 feet
- 17.5 - 20 feet
- 20 - 22.5 feet
- 22.5 - 25 feet
- 25 - 27.5 feet
- 27.5 - 30 feet
- 30 - 35 feet
- 35 - 40 feet
- 40 - 45 feet
- 45 - 50 feet
- 50 - 65 feet
- 65 - 75 feet
- 75 - 90 feet
- 90 - 100 feet

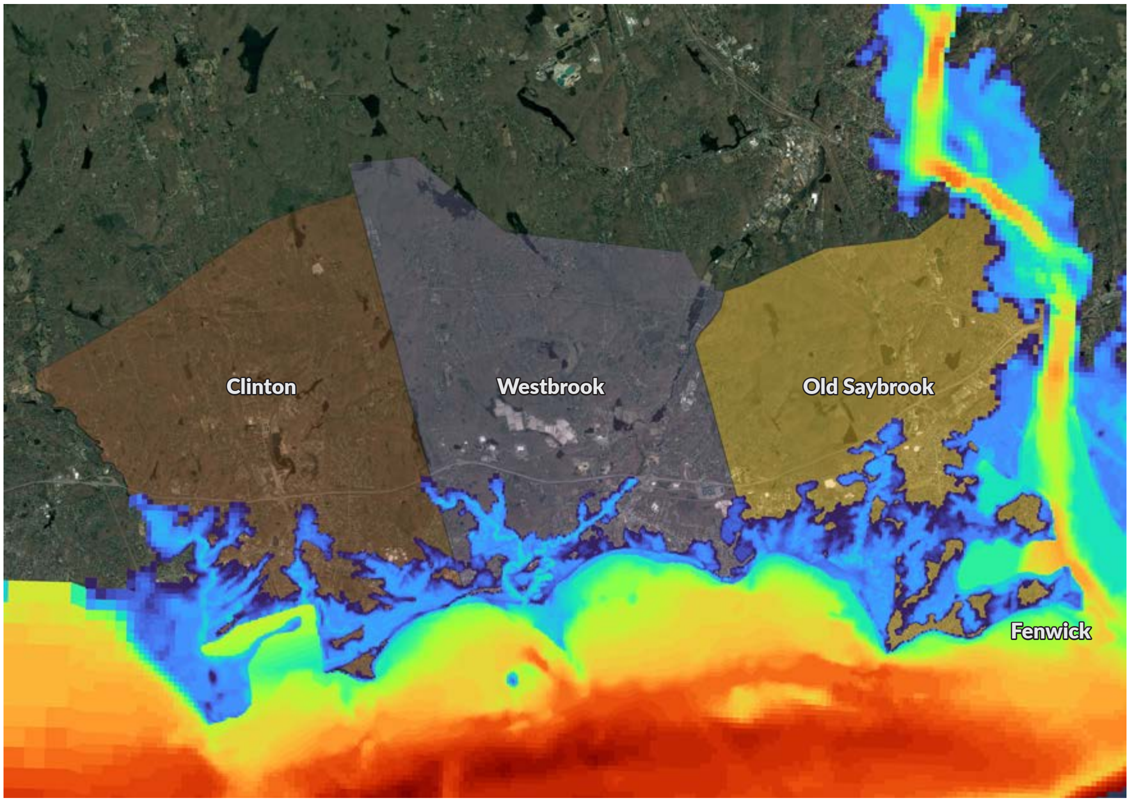


Figure 3-24: 100-Year Storm Water Depth (2070 with Sea Level Rise Condition)

100-Year Storm Model Results: Water Depth Differential

Model Results (cont.)

To further compare the water depth results, Figures 3-25 and 3-26 show the difference between the existing conditions' water depth results and the 2050 SLR and 2070 SLR water depth results, respectively. The comparisons were made by computing the difference between the water depth results for each SLR case and the existing conditions' water depth results. The figures further illustrate the expanded and increased inundation extents and depths.

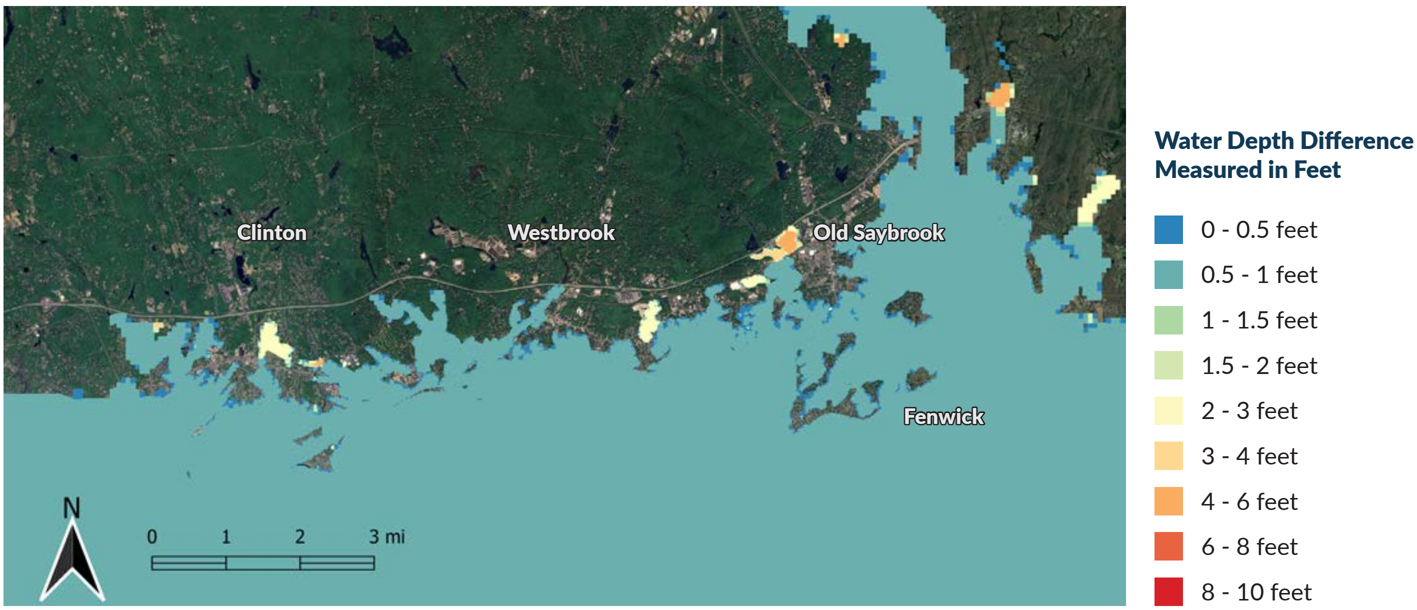


Figure 3-25: Water Depth Difference between 2050 SLR and Existing Conditions – Extreme Event

Figure 3-26: Water Depth Difference between 2070 SLR and Existing Conditions – Extreme Event

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Salt Island Road, Westbrook
December 2022

Vulnerability & Risk Assessment

This section presents the results of a risk assessment conducted to pinpoint areas and assets highly vulnerable to the effects of rising sea levels, flooding, and erosion. The assessment provides an understanding of the locations and infrastructure most susceptible to these hazards. The findings inform the recommended projects list and prioritization in Section 4: Resiliency Recommendations.

Each flood projection timeframe shows progressively worsening conditions. Areas experiencing flooding in the present day will see deeper water levels in 2050, with further increased depths by 2070. The impacts are cumulative, with each scenario building upon the flooding extents and depths of the previous period.


STOP

Clinton Vulnerability & Risk Assessment

100-Year Storm Scenario

See page 85 for a map of the 100-year storm inundation greater than 6" water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 75-80 for detailed visuals of the 100-year storm scenario in 2023, 2050, and 2070.

The 100-year storm inundation modeling has identified several high-risk areas in Clinton, in addition to the critical facilities listed on page 113. The Clinton shoreline faces flood risk, with both private properties and public amenities vulnerable to inundation. The notable exception is Loop Road, which benefits from its higher elevation. The following list highlights the areas at greatest risk:

- Cedar Island
- Clinton Town Beach
- The intersection of Commerce Street and Grove Street
- Commercial and Town Facilities south of Riverside Drive
- The Causeway and Groveway area
- The Harborview Neighborhood
- Homes along the eastern section of Shore Road
- The Hammocks Residential Community
- The neighborhood between Buell Court and Maplewood Drive
- North of Rte. 1 between Meadowview Road and Old Post Road
- Indian River north of Rte. 1
- Shore Road near Kelsey Point

100-Year Storm Existing Condition

Under current conditions, Cedar Island faces complete inundation, with water depths up to 11' above grade in some areas. Without an egress road, island access is limited to boats, creating significant risks during severe weather. Seasonal home occupants must rely on watercraft for transportation, which could become treacherous or impossible during large storms. The lack of safe evacuation options presents substantial safety concerns for residents during extreme weather events.

Under current conditions, Clinton Town Beach is expected to experience between 5' to 12' of inundation. The Waterside Lane Bridge access to the Town Beach is projected to experience anywhere from 7' to 11' water depths above the existing grade. Flood waters overtaking the bridge would result in a temporary loss of recreational assets. The Rte. 1 bridge over the Indian River is expected to experience up to 5' of water depth above the existing grade. Rte. 1 is a major corridor in Clinton and would impact the circulation of local traffic as well as the Fire Department and Town Hall traffic whose buildings are located adjacent to the Rte. 1 bridge.

The 100-year storm model predicts significant flooding for commercial and Town facilities south of Riverside Drive and near the Commerce Street and Grove Street intersection, with water depths ranging from 3' to 10'. This area, containing marinas, restaurants, the Town boat launch, dock, and Esposito Beach, faces substantial inundation risk. The potential impact highlights the vulnerability of this Clinton waterfront section during extreme weather events.

In the current condition 100-year storm model, the Causeway faces severe flooding, with water depths ranging from 3'-9" to 9'-9", increasing toward Long Island Sound. This inundation renders the Causeway impassable, potentially isolating the Shore Road community. Their only alternative route, Beach Park Road to the west, is also projected to be under 9'-8" of water in some areas.

The Kelsey Point and Hammock Point neighborhoods risk becoming completely cut off. This isolation is concerning for the area between Sols Point Road and Loop Road. While many residences there may not experience direct flooding, they could face limited access to emergency services and delayed recovery efforts due to impassable surrounding roads.

100-Year Storm 2050 Projection

The 2050 sea level rise projection intensifies flooding risks identified in current conditions. Water depth increases range from 0' to 6' across affected areas.

By 2050, the 100-year storm model projects significant changes for the Hammocks community off Beach Park Road. While this area was not affected in the 2023 model, projections now show it becoming inundated with flood waters. The anticipated flooding in this location is expected to reach approximately 2' in depth.

By 2050, the neighborhood between Buell Court and Maplewood Road is projected to experience new flooding. However, this inundation will be relatively mild compared to other areas, with water depths generally less than 10”.

The most significant change in water depth is observed north of Rte. 1, in the area between Meadowview Road and Old Post Road. Here, the 100-year storm model projects water levels reaching up to 6’ in some locations. This depth is particularly concerning due to the railroad tracks running through this zone. If these tracks become submerged and impassable, it would severely impact commuter mobility, potentially disrupting rail transportation in the region. This scenario highlights the vulnerability of critical transportation infrastructure to extreme flooding events in this area.

100-Year Storm 2070 Projection

The 2070 sea level rise model for Clinton depicts a worsening flood scenario. It shows intensified flooding in all previously affected areas from the 2023 and 2050 simulations. Moreover, the model forecasts an expansion of flood-prone zones into new parts of town. This trend indicates a steady increase in flood risk across Clinton over the coming decades, highlighting the growing challenges the town may face due to climate change and rising sea levels.

By 2070, the area around the Indian River north of Rte. 1 is projected to experience significant changes in flood risk. Water depths here could increase by approximately 6’ compared to 2023 levels. The flood zone is expected to expand, potentially affecting the Mill Road manufactured home community and reaching the rear of some neighborhoods off Liberty Street. While these areas do not typically flood currently, the model projects future inundation. However, the projected water depths in these newly affected zones are relatively moderate, ranging from 1’ to 4’ depths, which is less severe than in other flood-prone areas of Clinton.

The 2070 sea level rise model highlights a critical flood risk where Shore Road nears Kelsey Point. In this area, water depths may increase by almost 8’ compared to current levels. This substantial change is probably due to a localized topographical depression, creating a potential flood “hotspot.” While limited in area, this projection underscores the importance of identifying and addressing such vulnerable locations in long-term flood management strategies.

100-Year Storm Building Inundation

Protecting critical facilities, businesses, and homes is crucial in Clinton, given their importance as community assets and the area’s vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes.

The table below shows how many building footprints in Clinton could experience water depths greater than 6” against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6” of water where the first floor is above the 6” of water on the property.

Year	Total Number of Buildings in Clinton in More Than 6” of Water (100-Year Storm)
2023	1,224 buildings *(16.5% of the buildings in Clinton)*
2050	1,334 buildings *(17.9% of the buildings in Clinton)*
2070	1,565 buildings *(21.0% of the buildings in Clinton)*

Clinton Buildings in More than 6” of Water During a 100-Year Storm

See Appendix B for enlarged map

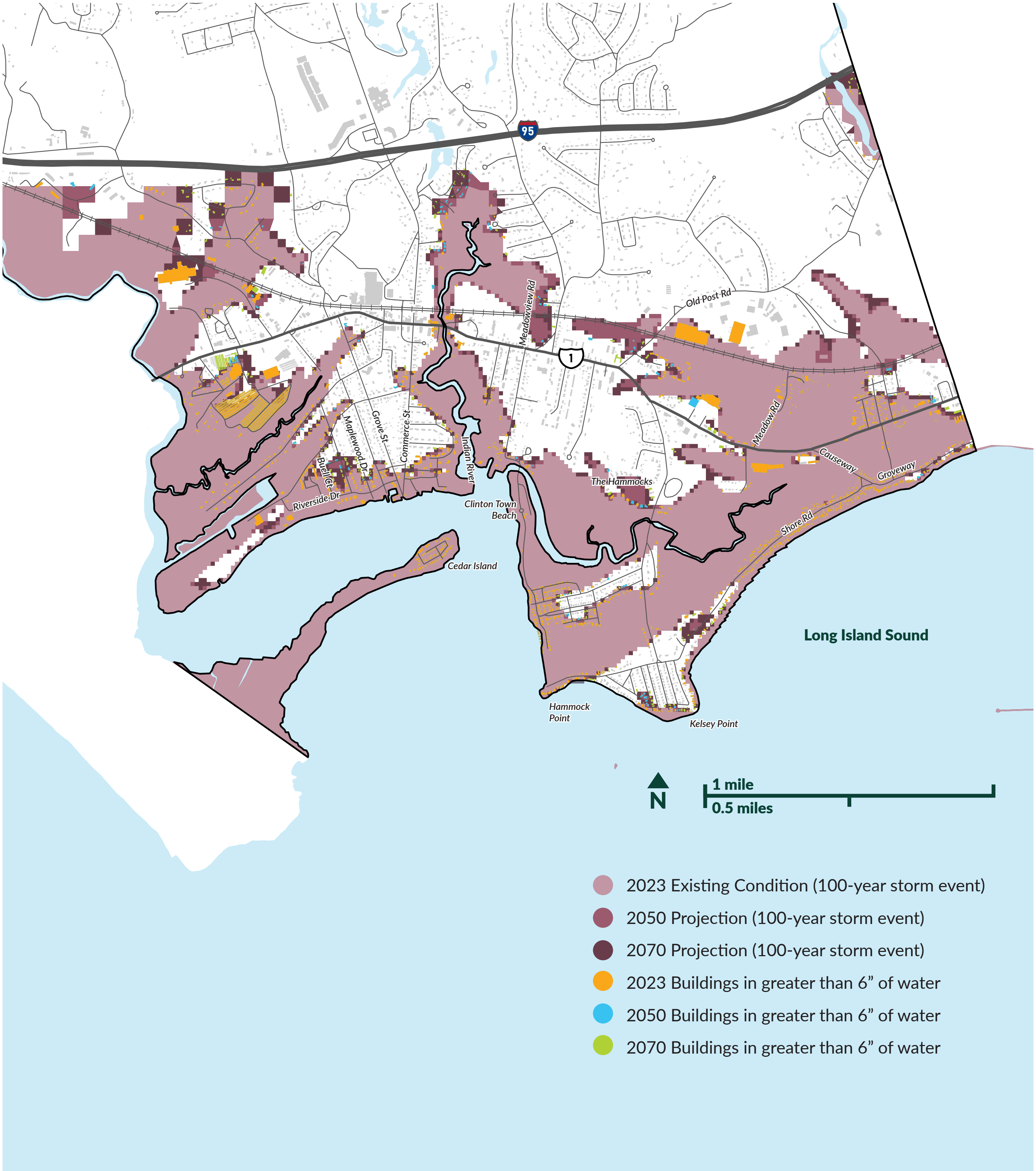


Figure 3-27: **Clinton** *- Buildings in more than 6” of water during a 100-year storm*

Clinton Buildings in More than 6" of Water During a Tidal Event

See Appendix B for enlarged map

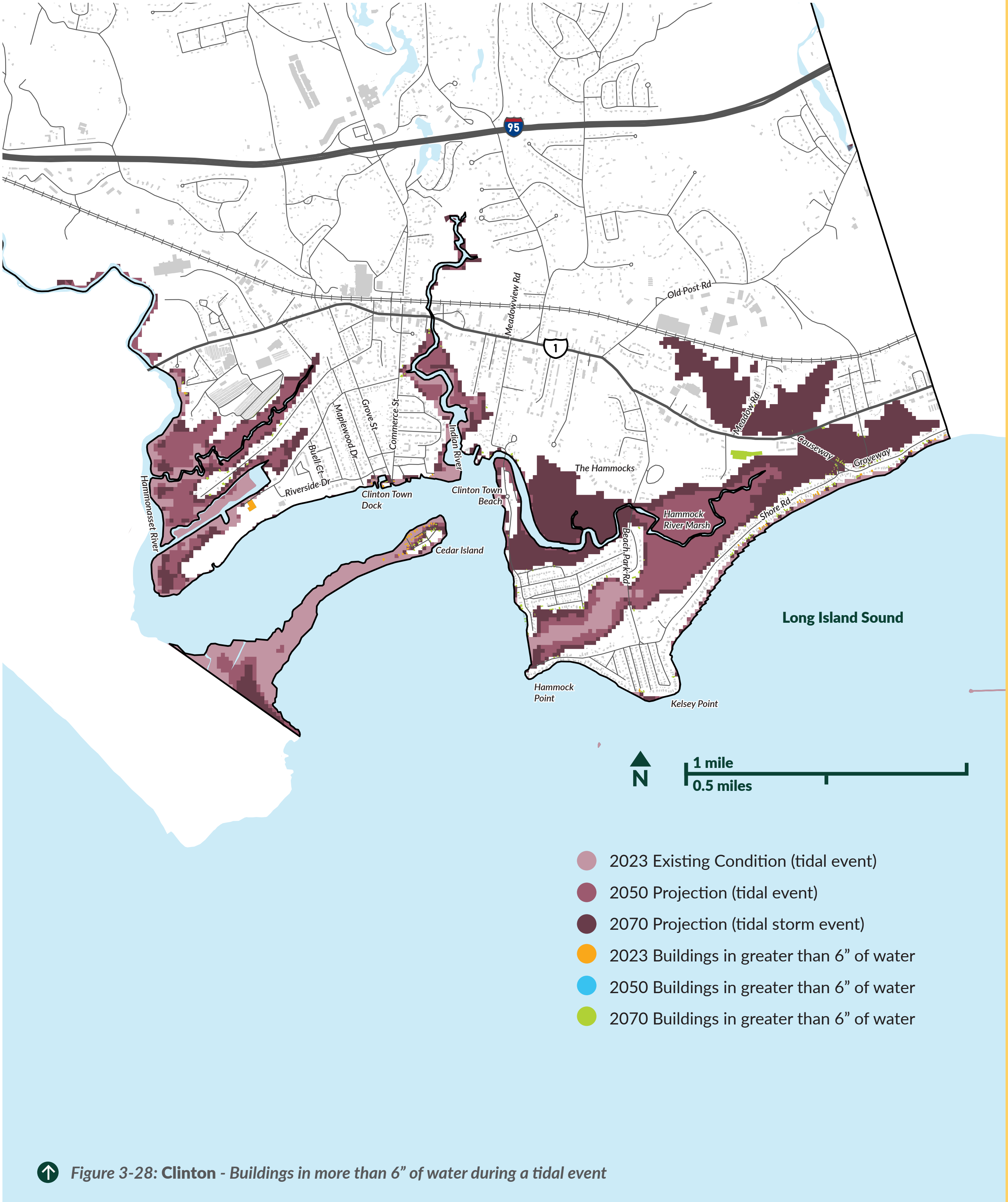


Figure 3-28: **Clinton** *- Buildings in more than 6" of water during a tidal event*

Clinton Vulnerability & Risk Assessment

Tidal Event Scenario

See page 86 for a map of the tidal event inundation greater than 6" water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 70-74 for detailed projections for a tidal event in 2023, 2050, and 2070.

Based on the mean high water tidal inundation modeling, the most high-risk areas in Clinton during a tidal event include:

- Cedar Island
- Clinton Town Dock
- Clinton Town Beach
- Hammock River Marsh Wildlife Area
- Hammonasset River marshes
- The Causeway and Groveway area
- Shore Road Coastline
- Beach Park Road Bridges

Tidal Event Existing Condition

The mean high water tidal simulation shows Cedar Island facing water depths up to 14'5" in some areas. With no egress road, residents rely solely on boats for access. This poses significant risks during severe weather, as the short trip to the mainland could become dangerous or impossible, hindering evacuation efforts and raising substantial safety concerns for residents.

Concentrated flooding is anticipated at Clinton Town Dock off Riverside Drive, according to the model. Under current conditions, water depths in this area are expected to vary from 4" to 4'5".

During a mean high water tidal event, Clinton Town Beach could experience inundation up to 6'3" under current conditions. Such frequent flooding may cause coastal erosion and redistribute sand along the beach, potentially affecting the local aquatic ecosystem.

Tidal Event 2050 Projection

The 2050 projection intensifies flooding risks identified in current conditions. Water depth increases range from 6" to 1'6" across affected areas. New zones facing significant inundation by 2050 include the Hammock River Marsh Wildlife Area and the Hammonasset River marshes.

The 2050 tidal event model shows major changes for the Hammock River Marsh Wildlife Area. Unlike the 2023 model, new projections indicate flooding up to 3'2" deep. Located behind residential areas, this marsh could pose a flood risk as waters recede after initial inundation and surge events.

The Hammonasset River marshes could face inundation up to 5'6", extending into the Hammonasset Yacht Club marina. Regular tidal flooding may impair marina operations due to high water levels or facility damage, potentially causing economic and social impacts in Clinton.

Tidal Event 2070 Projection

The 2070 sea level rise model for Clinton depicts a worsening flood scenario with water depths anywhere from 6" to 8' deeper than in 2023. It shows intensified flooding in all previously affected areas from the 2023 and 2050 simulations.

The 2070 mean high water tidal event model predicts extensive flooding of the Hammock River Marsh, extending to the Causeway. Water depths on the Causeway are forecast to reach up to 2'5", making it impassable and potentially cutting off the Shore Road community. The alternative route via Beach Park Road to the west is also expected to flood, with water depths up to 3'3" in some areas, particularly at bridge locations.

The model also shows the Hammock River Marsh expanding behind the Shore Road, Kelsey Point, and Hammock Point communities. These areas become isolated when both the Causeway and Beach Park Road are inaccessible due to flooding.

By 2070, homes along the Shore Road coastline are projected to face inundation levels ranging from 2" to 3'4". However, Shore Road itself is expected to remain unaffected by this inundation.

Tidal Event Building Inundation

Clinton's vulnerability to coastal flooding necessitates the protection of essential facilities, businesses, and residences. These structures are vital community assets. Many people will face challenges leaving their properties due to flood waters reaching their properties.

The table below shows how many building footprints in Clinton could experience water depths greater than 6" against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a tidal event scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6" of water where the first floor is above the 6" of water on the property.

Year	Total Number of Buildings in Clinton in More Than 6" of Water (Tidal Event)
2023	59 buildings *(0.7% of the buildings in Clinton)*
2050	59 buildings *(0.7% of the buildings in Clinton)*
2070	214 buildings *(2.9% of the buildings in Clinton)*

Clinton Vulnerability & Risk Assessment (cont.)

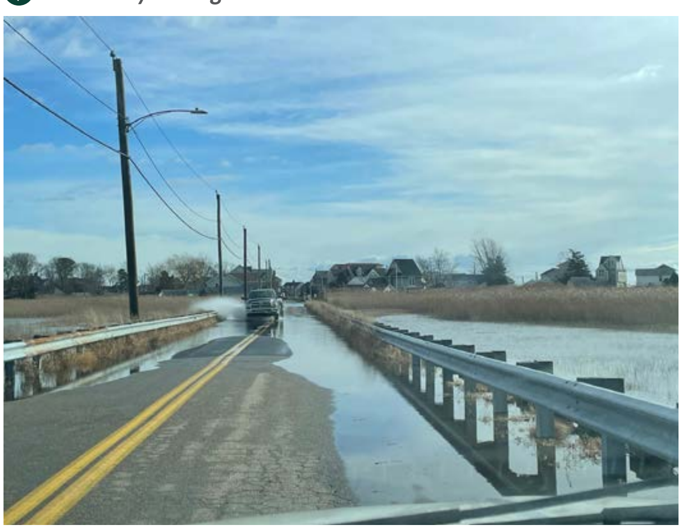
Meadow Road Flooding - Clinton

Waterside Lane and Bridge to Town Beach Flooding - Clinton

Intersection of Commerce and Grove - Clinton

Intersection of Causeway and Groveway - Clinton

Causeway During Flood Event - Clinton



Hammock Rd Flooding - Clinton

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Westbrook Vulnerability & Risk Assessment

100-Year Storm Scenario

See page 93 for a map of the 100-year storm inundation greater than 6” water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 75-80 for detailed visuals of the 100-year storm scenario in 2023, 2050, and 2070.

The 100-year storm inundation modeling has identified several high-risk areas in Westbrook, in addition to the critical facilities listed on page 113. The entire Westbrook shoreline is exposed to significant flood risk, threatening both private properties and public infrastructure. Key high-risk areas include:

- Old Mail Trail
- Coral Sands Neighborhood
- Salt Island Road, Pepperidge Avenue, and Little Stannard Beach Road
- Seaside Avenue
- Pointina Road and 2nd Avenue
- Rte. 1 between Wesley Avenue and Old Clinton Road
- Rte. 1 between Duck Island Landing and Post Avenue
- Patchogue River near the Town Hall and the Police Station
- Cold Spring Brook, between Green Acres Park Drive and Rte. 1
- Apogee Lane

100-Year Storm Existing Condition

The 100-year storm model for current conditions shows Old Mail Trail facing severe flood risk. Water depths could reach nearly 7’6”’ above grade in some areas. This street’s location, positioned between the Long Island Sound and the inland marsh, makes it particularly vulnerable to inundation. The combination of coastal and marsh flooding contributes to the area’s high susceptibility during extreme weather events.

The model projects significant flooding for Tarpon, Dolphin, and Striper Avenues in the Coral Sands neighborhood, with water depths ranging from 5’ to 8’8”. These residential streets face reported drainage issues, exacerbating their vulnerability. The combination of existing drainage problems and projected flood risks makes these areas highly susceptible to future flooding and its impacts.

Salt Island Road and Little Stannard Beach Road encircle a salt marsh, with homes on its perimeter. The 100-year storm model projects average flood depths of 6’, reaching up to 9’-4” in some areas.

The shallow beaches in these neighborhoods provide insufficient buffer against flooding, leaving these roads and surrounding homes highly vulnerable to inundation during extreme weather events.

Seaside Avenue and the neighborhoods along it, situated between the Long Island Sound and a salt marsh, face significant flood risk during a 100-year storm. Projections show potential water depths reaching 7’ in some areas, with the road potentially submerged under 5’ of water. Inundated areas along Seaside Avenue include the Town Beach which could experience anywhere from 3’6” to 9’10” water depths. Seaside Avenue is the only public access route to several neighborhoods in Pilot’s Point. Its vulnerability to flooding poses concerns for emergency access.

Pointina Road and 2nd Avenue are bisected by a channel connecting the Long Island Sound to a salt marsh. During a 100-year storm, the marsh behind these residential streets threatens to inundate the area between Cedar Lane and Old Salt Works Road with up to 9’ of water above grade. The shallow beaches in this area offer minimal protection, failing to provide an adequate buffer against flood waters. This combination of factors heightens the flood risk for residents in this area.

100-Year Storm 2050 Projection

The 2050 sea level rise projection shows an intensification of flooding risks compared to current conditions. While the increase in inundation extent is relatively limited and mild compared to other parts of the study area, some locations face notable changes. In areas like Apogee Lane and the area between Duck Island Landing and Post Avenue, water depth increases range from 0’ to 3’, indicating a gradual but significant rise in flood vulnerability over the next few decades.

The 100-year storm model shows severe flooding on Rte. 1 between Wesley Avenue and Old Clinton Road, with water depths reaching up to 6'-7". This flooding stems from the Patchogue River to the northwest. The proximity of this affected section to the Westbrook Fire Department is particularly concerning, as an impassable Rte. 1 could significantly hinder emergency response and recovery efforts during and after a major flooding event.

The 2050 model shows the Patchogue River's flood extent expanding toward Town Hall and the Police Station. This encroachment puts multiple critical facilities and businesses along this corridor at risk. As water depths are projected to increase over the coming decades, these essential services and commercial areas face growing vulnerability to flooding events.

100-Year Storm 2070 Projection

The 2070 sea level rise model for Westbrook shows a significantly worsening flood scenario. It predicts intensified flooding in all areas previously affected in the 2023 and 2050 simulations. Additionally, the model projects an expansion of flood-prone zones into new parts of town. This trend indicates a progressive increase in flood risk across Westbrook over the next few decades, underscoring the mounting challenges the town will likely face due to climate change and rising sea levels.

The 2050 projections show water depth changes from current conditions ranging from 0' to 6' above grade. The most significant increase occurs near Cold Spring Brook, between Green Acres Park Drive and Rte. 1. This area, spanning roughly 62 acres, is anticipated to see average flood water depths of 2' to 6'. This large flood-prone zone sits adjacent to the Green Acres manufactured home community, potentially putting this residential area at increased risk.

The projected flood extents in Westbrook remain confined to areas south of Interstate 95 (I-95). This highway appears to serve as a northern boundary for the anticipated flooding, suggesting that areas north of I-95 may be at lower risk from sea level rise and storm surge impacts through 2070.

Segments of Rte. 1 are expected to see additional inundation based on the 2070 model. These areas include between the Patchogue River and Eckford Avenue and between Hammock Road and the Menunketesuck River bridge.

100-Year Storm Building Inundation

Protecting critical facilities, businesses, and homes is crucial in Westbrook, given their importance as community assets and the area's vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes.

The table below shows how many building footprints in Westbrook could experience water depths greater than 6" against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6" of water where the first floor is above the 6" of water on the property.

Year	Total Number of Buildings in Westbrook in More Than 6" of Water (100-Year Storm)
2023	2,631 buildings *(25.9% of the buildings in Westbrook)*
2050	2,854 buildings *(28.1% of the buildings in Westbrook)*
2070	3,159 buildings *(31.1% of the buildings in Westbrook)*

Westbrook Buildings in More than 6" of Water During a 100-Year Storm

See Appendix B for enlarged map

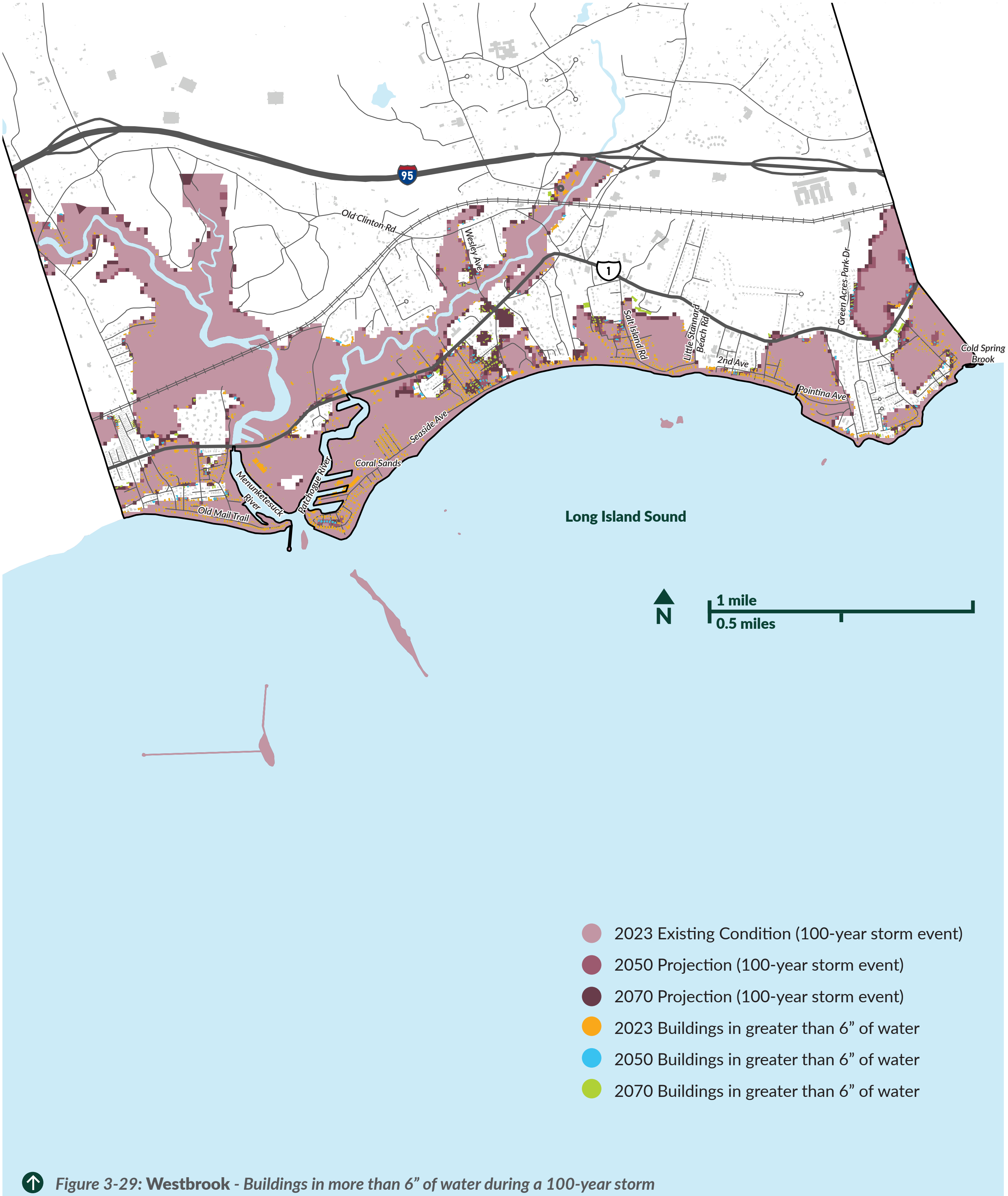

Figure 3-29: **Westbrook** *- Buildings in more than 6" of water during a 100-year storm*

Westbrook Buildings in More than 6" of Water During a Tidal Event

See Appendix B for enlarged map

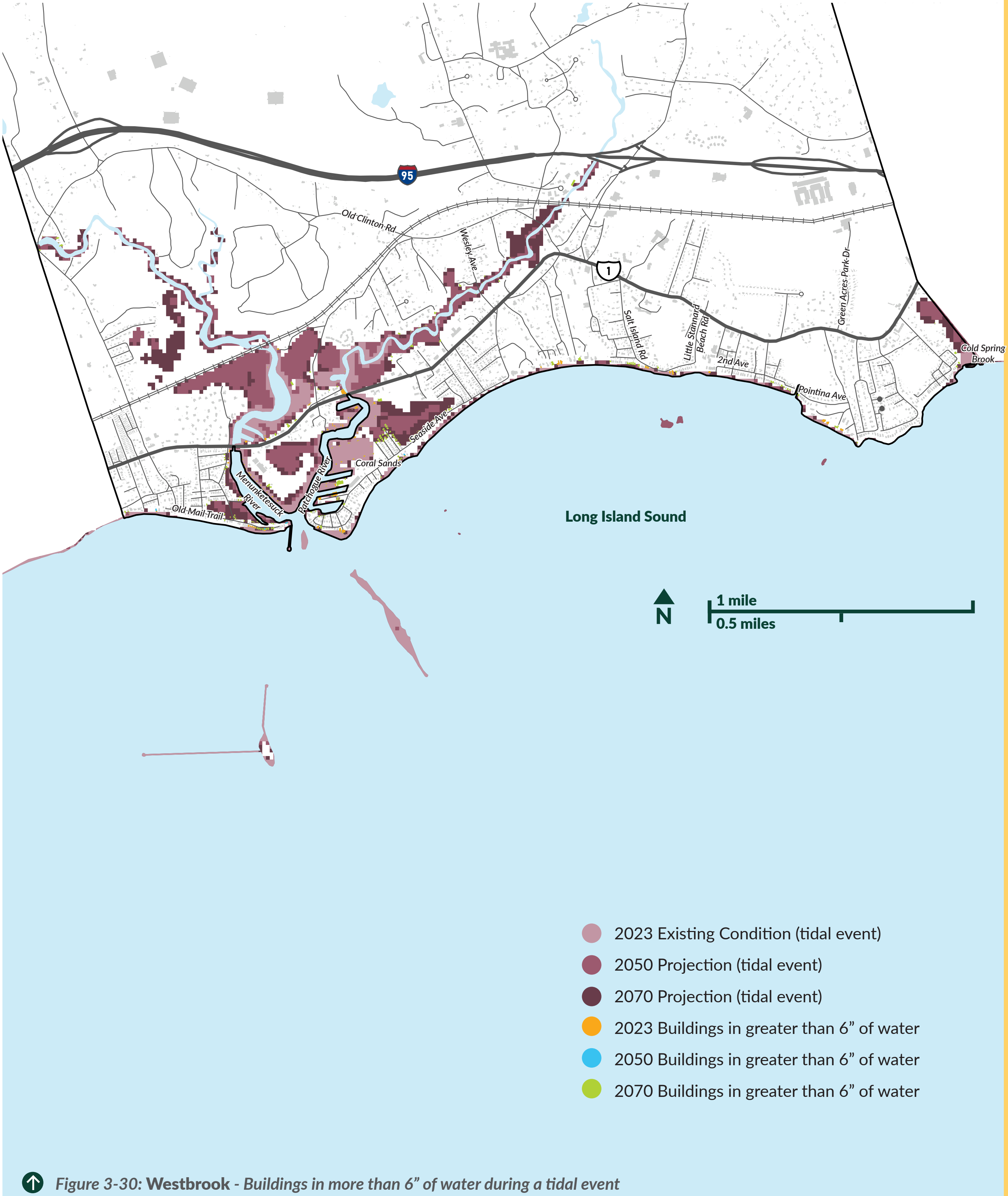

Figure 3-30: **Westbrook** *- Buildings in more than 6" of water during a tidal event*

Westbrook Vulnerability & Risk Assessment
Tidal Event Scenario

See page 94 for a map of the tidal event inundation greater than 6” water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 70-74 for detailed projections for a tidal event in 2023, 2050, and 2070.

Based on the mean high water tidal inundation modeling, the most high-risk areas in Westbrook during a tidal event include:

- Old Mail Trail
- Marinas on the Menunketesuck River
- Marinas on the Patchogue River
- Salt Island Road, Pepperidge Avenue, and Little Stannard Beach Road
- Coral Sands Neighborhood
- Seaside Avenue
- Hammock Road and Rte. 1

Projections for Cold Spring Brook indicate an increase in inundation coverage by 2070. However, the anticipated water depths do not present a high-risk scenario. The projected depths range from 7” to 1’4” and are not expected to reach nearby structures.

Tidal Event Existing Condition

Current tidal event modeling indicates Old Mail Trail is at risk of significant flooding. Projected water depths range from 9” to 5’ 10” above the existing grade, with some areas potentially experiencing depths of nearly 10 feet. The street’s location, situated between Long Island Sound and an inland marsh, renders it especially vulnerable to inundation. This positioning exposes the area to both coastal and marsh flooding, dramatically increasing its susceptibility during severe weather events.

The Menunketesuck River flood model indicates potential inundation of marinas on the east bank. Water levels are projected to reach 6’2” above the current ground level near some dock areas. This degree of flooding could pose a significant risk to marina operations, potentially damaging docks and boats. Similarly, the marinas on the Patchogue River could experience 6’6” water depths in areas.

Salt Island Road and Little Stannard Beach Road form a perimeter around a salt marsh, with residential properties situated along their edges. Tidal event modeling predicts average flood depths of up to 3’4” in coastal areas. The region’s shallow beaches offer inadequate protection against flooding, leaving these roadways and nearby homes highly susceptible to inundation during severe weather events.

The Coral Sands neighborhood experiences inundation in the present day with water levels up to 2’2” along the coast.

Tidal Event 2050 Projection

The tidal inundation projection for 2050 indicates an escalation in flooding risks relative to present-day conditions. Water depths are anticipated to increase anywhere from 6” to 6’ beyond current levels.

Projections for 2050 suggest Old Mail Trail may face 5’ water depths along the coastline. The jetty at the mouth of the Patchogue River is expected to be under 5’4” to 9’ of water during a tidal event.

Tidal events are projected to cause increased swelling of the Patchogue River over time. This puts the businesses, and residences located on the marsh banks between Hammock Road and Rte. 1 at elevated risk. Areas along these banks may experience up to 4’ water depths.

Projections for 2050 indicate an increase in flood risk for Salt Island Road, Little Stannard Beach neighborhood, and Middle Beach neighborhood. Water depths along these roads are expected to rise by approximately 6”, potentially reaching up to 4’ during tidal events.

In the case of Cold Spring Brook, the model predicts water depths of up to 4’3”. However, it’s worth noting that the flooding in this area is anticipated to be largely contained within the marshland. While this may limit direct impacts on developed areas, it could still have significant ecological consequences and potentially affect nearby infrastructure.

Tidal Event 2070 Projection

The 2070 sea level rise model for Westbrook shows a significantly worsening flood scenario. The model projects an expansion of flood-prone zones into new parts of town mostly due to marshes swelling when inundated. Overall, Westbrook will potentially experience water depths anywhere from 3” to 6’ greater than the present day.

Projections for 2070 indicate a significant increase in tidal inundation risks. The mean high water is expected to extend to the marsh behind Seaside Avenue, with water depths potentially reaching 3’2” above the current grade. This scenario places the homes along Seaside Avenue in a particularly vulnerable position, as they are positioned between the encroaching marsh waters and Long Island Sound. The dual threat of flooding from both sides substantially elevates the risk to these residential properties, potentially impacting their long-term viability and safety.

Projections for Seaside Avenue and its surrounding area indicate an increase in inundation coverage by 2070. However, the anticipated water depths do not present a high-risk scenario for Seaside Avenue itself. The road is projected to experience up to 7” of water on its surface. Several structures positioned between the Long Island Sound and the marsh are at risk of flood waters touching the structure with a maximum projected depth of 8”.

According to projections, flooding in Westbrook is expected to be largely limited to areas south of Interstate 95 (I-95) through 2070. The Menunketesuck River’s flood zone is anticipated to extend northward, nearly reaching I-95, while the Patchogue River’s inundation is projected to stretch up to the railroad line. I-95 seems to act as a natural northern boundary for the predicted flooding. This suggests that regions north of the interstate may face a lower risk from the impacts of sea level rise and storm surges over the next five decades.
This pattern of flooding indicates that while coastal and low-lying areas south of I-95 may face increasing challenges, the highway could serve as a critical line of demarcation for flood risk assessment and management strategies in Westbrook through 2070.

Tidal Event Building Inundation

Westbrook’s vulnerability to coastal flooding necessitates the protection of essential facilities, businesses, and residences. These structures are vital community assets. Many people will face challenges leaving their properties due to flood waters reaching their properties.

The table below shows how many building footprints in Westbrook could experience water depths greater than 6” against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a tidal event scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6” of water where the first floor is above the 6” of water on the property.

Year	Total Number of Buildings in Westbrook in More Than 6” of Water (Tidal Event)
2023	135 buildings *(1.3% of the buildings in Westbrook)*
2050	144 buildings *(1.4% of the buildings in Westbrook)*
2070	457 buildings *(4.5% of the buildings in Westbrook)*

Westbrook Vulnerability & Risk Assessment (cont.)

Old Mail Trail Flooding - Westbrook

Marina Parking Lot Under Water - Westbrook

Pier 76 Marina - Westbrook

Grove Beach Point Marshland Erosion - Westbrook

Salt Island Rd - Westbrook

Tarpon Ave - Westbrook

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Old Saybrook Vulnerability & Risk Assessment

100-Year Storm Scenario

See page 105 for a map of the 100-year storm inundation greater than 6" water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 75-80 for detailed visuals of the 100-year storm scenario in 2023, 2050, and 2070.

Old Saybrook's entire coastline faces substantial flood risk during a 100-year storm event. This inundation threat endangers public beaches, private properties, critical infrastructure, and coastal ecosystems. Based on the inundation modeling, the most high-risk areas in Old Saybrook during a 100-year storm in addition to those noted on page 113 include:

- Chalker Beach
- Indian Town Beach
- Great Hammock Beach
- Town Beach
- Main Street/College Street between Maple Ave and Willard Avenue
- The intersection of Nehantic Trail and Old Post Road
- Research Parkway, between the railroad and I-95
- Oyster River Marsh between the railroad and I-95
- Plum Bank Road
- North area of South Cove
- Where Rte. 1 crosses Oyster River

100-Year Storm Existing Condition

The Chalker Beach area water depths are projected to range from 3'9" to 9'5" in various locations. Beach Road W, Beach Road E, and Bel Aire Manor are especially vulnerable due to their position between the Long Island Sound and the Hagar Creek and Chalker Beach marshes. This geographical setting exposes the area to both coastal and marsh flooding, substantially increasing its susceptibility during extreme weather events.

Indian Town Beach's residential area between Nehantic Trail and Owaneco Trail could see water depths of 3 to 8 feet, highlighting flood risks in this community.

The Great Hammock Beach area faces severe flood risk during a 100-year storm, with projected water depths ranging from 4'6" to 12'. This residential zone is particularly vulnerable due to its location, bordered by marshlands on three sides and Long Island Sound on the fourth. Its positioning makes it extremely susceptible to both flooding and storm surges, underscoring the area's high risk during extreme weather events.

The Town Beach area, located south of Great Hammock Beach along Plum Bank Road, faces significant flood risk. Residences here are situated between Long Island Sound and a large marsh fed by the Back River and Plum Bank Creek. This positioning makes the area highly vulnerable to flooding from both coastal and inland water sources. Harvey's Beach, one of Old Saybrook's two public beaches, located on Plum Bank Road, is more exposed to these flood risks.

The 100-year storm model projects significant flooding on Main Street/College Street between Maple Avenue and Willard Avenue. This narrow corridor, positioned between North Cove and South Cove, could potentially be covered by 1' to 5' depth of water. If this stretch of road becomes impassable, Saybrook Point, located at the eastern terminus of College Street, would only be accessible via the Causeway, which is also known to flood frequently. If the Causeway were to become impassable, Saybrook Point becomes an island and impacts access to Fenwick. This situation highlights a critical vulnerability in local access and evacuation routes during severe flooding events. Saybrook Point is currently vulnerable to flooding with potential water depths ranging from 1'8" to 6'3". This popular destination for tourism and marine recreation faces significant risks from a 100-year storm event, which could severely impact its facilities and activities.

The Elm Street railroad underpass frequently floods, disrupting traffic flow for school buses, commuters, and residents. This recurring issue significantly impacts connectivity in the area. Action is needed to address and resolve this problem before the inundation worsens over time.

100-Year Storm 2050 Projection

The 2050 sea level rise projection for Old Saybrook indicates a worsening flood scenario. All previously described flood-prone areas are expected to experience more severe inundation. Additionally, flooding is anticipated to spread into new locations across the town. The change in water depth from current conditions to 2050 is projected to range from 6” to 6’, depending on the area. This broad range of increased flood depths underscores the growing vulnerability of Old Saybrook to sea level rise over the next few decades.

The 2050 model shows new flooding around the intersection of Nehantic Trail and Old Post Road. However, this area is projected to experience relatively mild inundation, with water depths less than 1’6”. This level of flooding is significantly less severe compared to the other flood-prone areas previously mentioned.

The 2050 projection model reveals significant flooding on Research Parkway, between the railroad and I-95. This large inundated area includes self-storage units and several businesses. The flooding is particularly severe near the business park entry on Elm Street, where water depths could reach up to 8’9”. This forecast highlights a potential risk to commercial and industrial operations and infrastructure in this previously less vulnerable area.

100-Year Storm 2070 Projection

The 2070 sea level rise projection for Old Saybrook shows a significantly worsening flood scenario. All previously identified flood-prone areas are expected to face more severe inundation. The model also predicts flooding will expand into new locations across town. Water depth changes from current conditions to 2070 are projected to range from 6” to 8’ depending on the location. Notably, the Oyster River Marsh between the railroad and I-95 is expected to see an 8’ increase in water depth compared to the present day. This range of increased flood depths highlights Old Saybrook’s growing vulnerability to sea level rise in the coming decades.

The 2070 model for a 100-year storm event reveals dramatic flooding in the Back River Marsh area. Plum Bank Road is projected to be under up to 12’ depth of water in some areas, effectively islanding the severely flooded homes near Harvey’s Beach and Town Beach. Properties bordering the Back River Marsh and Plum Bank Marsh could experience flooding ranging from 1’ to nearly 11’ deep. This scenario indicates a significant increase in flood risk for coastal and marsh-adjacent properties, potentially isolating entire neighborhoods and causing extensive damage.

The 2070 model predicts significant flooding around South Cove. Residential areas on the north end of the cove, particularly those off College Street, could face inundation ranging from 1’6” to 8’8” on their properties. The northern section of Maple Avenue, situated between Back River Marsh and South Cove faces severe flood risk. This area is expected to experience significant inundation with water depths reaching up to 8’.

At the point where Rte. 1 crosses Oyster River, the 2070 model projects a significant increase in water levels. This rise threatens to overtop the bridge, potentially causing severe connectivity issues. The possible breach of this critical transportation link highlights the growing vulnerability of key infrastructure to future flooding events.

100-Year Storm Building Inundation

Protecting critical facilities, businesses, and homes is crucial in Old Saybrook, given their importance as community assets and the area’s vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes.

The table below shows how many building footprints in Old Saybrook could experience water depths greater than 6” against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including

Old Saybrook Vulnerability & Risk Assessment (cont.)
100-Year Storm Scenario

building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6” of water where the first floor is above the 6” of water on the property.

Year	Total Number of Buildings in Old Saybrook in More Than 6” of Water (100-Year Storm)
2023	2,642 buildings *(34.8% of the buildings in Old Saybrook)*
2050	2,916 buildings *(38.4% of the buildings in Old Saybrook)*
2070	3,350 buildings *(44.1% of the buildings in Old Saybrook)*

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Fenwick Vulnerability & Risk Assessment
100-Year Storm Scenario

See page 105 for a map of the 100-year storm inundation greater than 6" water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 75-80 for detailed visuals of the 100-year storm scenario in 2023, 2050, and 2070.

The Borough of Fenwick, bordered by water on three sides, faces a high risk of inundation. Its entire shoreline is currently vulnerable to flooding. The 100-year storm model identifies several high-risk areas in Fenwick, expanding on those noted on page 113. These additional high-risk locations include:

- Eastern Sequassen Avenue
- Scum Beach Area
- The area south of the eastern leg of Agawam Avenue
- The residential area between the west end of Pettipaug Avenue and Grove Avenue

100-Year Storm Existing Condition

The eastern section of Sequassen Avenue, between the Connecticut River and Crab Creek Marsh, faces severe flood risk. Projections show water depths of 6' to 12' in this narrow corridor, potentially isolating residences beyond the road. The Crab Creek bridge, already prone to tidal flooding, would be completely submerged. During a 100-year storm event, flood waters would likely block the roadway east of Neponset Avenue, cutting off access to the area.

The Scum Beach area faces significant flood risk in the 100-year storm scenario. The marsh behind it is projected to have water depths exceeding 8'. The Scum Beach area itself could experience flood inundation ranging from 1' to 12', indicating a wide variation in vulnerability across the location. This severe flooding potential highlights the area's exposure to both coastal and inland water sources during extreme weather events.

Crab Creek's path over and behind the residential driveway south of the eastern leg of Agawam Avenue significantly increases the area's flood risk. During a 100-year storm event, this location could potentially experience water depths up to 10'3". This projection underscores the vulnerability of properties in this area to severe flooding from the creek, Hepburn Pond, and potential storm surges.

100-Year Storm 2050 Projection

The 2050 sea level rise projection for Fenwick indicates a worsening flood scenario. All previously described flood-prone areas are expected to experience more severe inundation. Flooding is anticipated to spread into new locations across the borough. The change in water depth from current conditions to 2050 is projected to range from 6" to 1', depending on the area. This range of increased flood depths underscores the growing vulnerability of Fenwick to sea level rise over the next few decades.

The residential area between the west end of Pettipaug Avenue and Grove Avenue is projected to see up to 6' of flood waters above grade. The central higher elevation area of Fenwick is anticipated to have little to no flood inundation in the year 2050.

The 100-year storm model projects significant flooding of 1' to 5' depths of water on Main Street/College Street between Maple Avenue and Willard Avenue. The Causeway's frequent flooding presents a serious access challenge for Fenwick. When flooded, alternative routes are also likely to be impassable, effectively cutting off Fenwick from mainland access. This situation highlights a critical vulnerability in local access and evacuation routes during severe flooding events.

100-Year Storm 2070 Projection

The 2070 sea level rise projection for Fenwick indicates a deteriorating flood situation. Previously identified flood-prone areas are expected to experience more intense inundation, while flooding is predicted to spread to new locations across the borough. Water depth changes from current conditions to 2070 are projected to vary between 6" and 1'6", depending on the specific area. This forecast underscores Fenwick's increasing vulnerability to sea level rise over the coming decades.

Sequassen Avenue faces particularly severe flood risk, with projected water depths reaching up to nearly 14' in some areas during a 100-year storm event. This extreme level of inundation poses significant dangers to residents, property, and infrastructure highlighting it as a critical area for flood mitigation efforts.

100-Year Storm Building Inundation

Protecting critical facilities and homes is crucial in Fenwick, given the area's vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes or surrounding roads.

The table to the right shows how many building footprints in Fenwick could experience water depths greater than 6" against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6" of water where the first floor is above the 6" of water on the property.

Year	Total Number of Buildings in Fenwick in More Than 6" of Water (100-Year Storm)
2023	65 buildings *(57.0% of the buildings in Fenwick)*
2050	73 buildings *(64.0% of the buildings in Fenwick)*
2070	84 buildings *(73.7% of the buildings in Fenwick)*

Old Saybrook + Fenwick Buildings in More than 6” of Water During a 100-Year Storm

See Appendix B for enlarged map

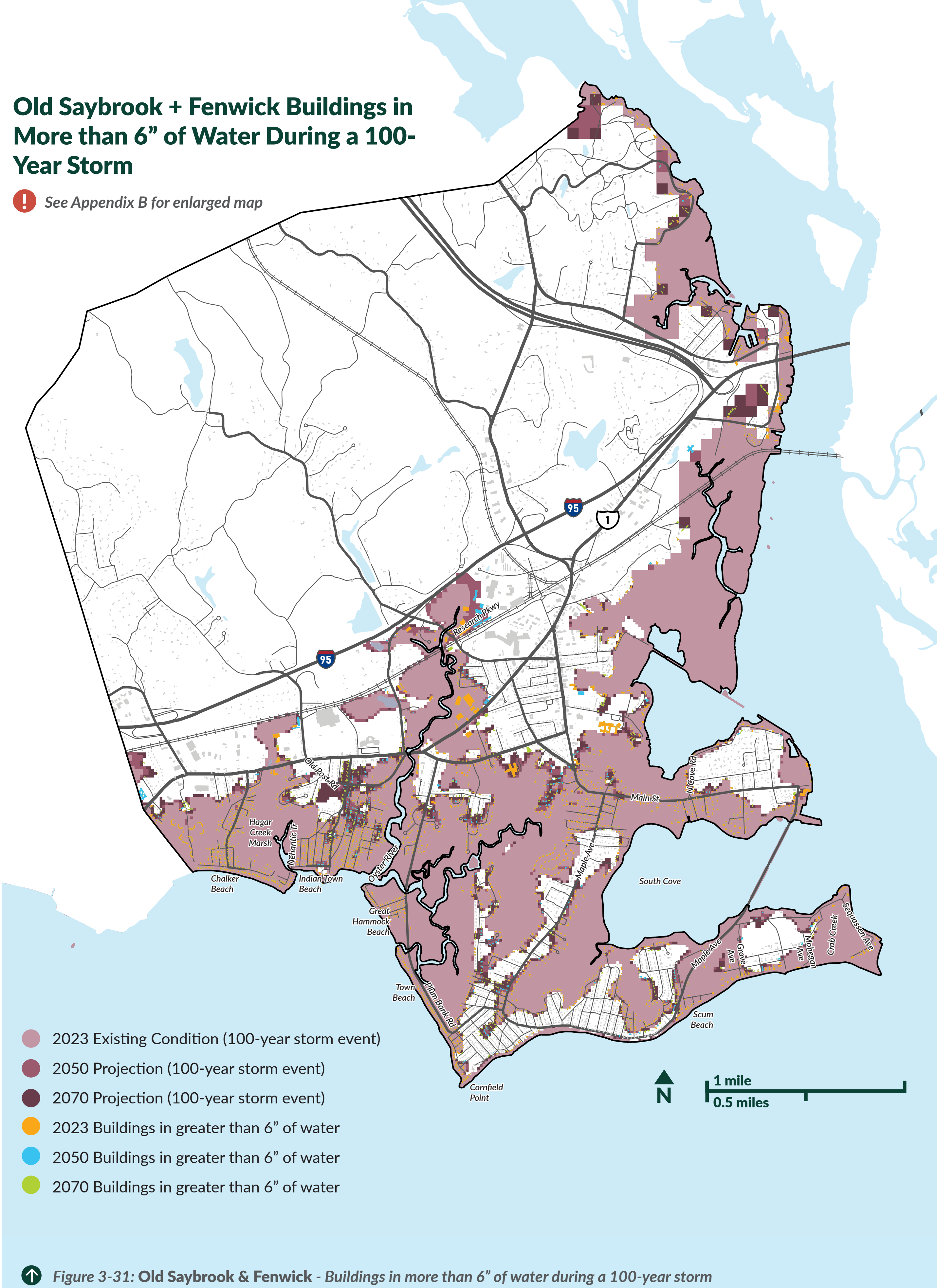


Figure 3-31: **Old Saybrook & Fenwick** - *Buildings in more than 6” of water during a 100-year storm*

Old Saybrook + Fenwick Buildings in More than 6” of Water During a Tidal Event

See Appendix B for enlarged map

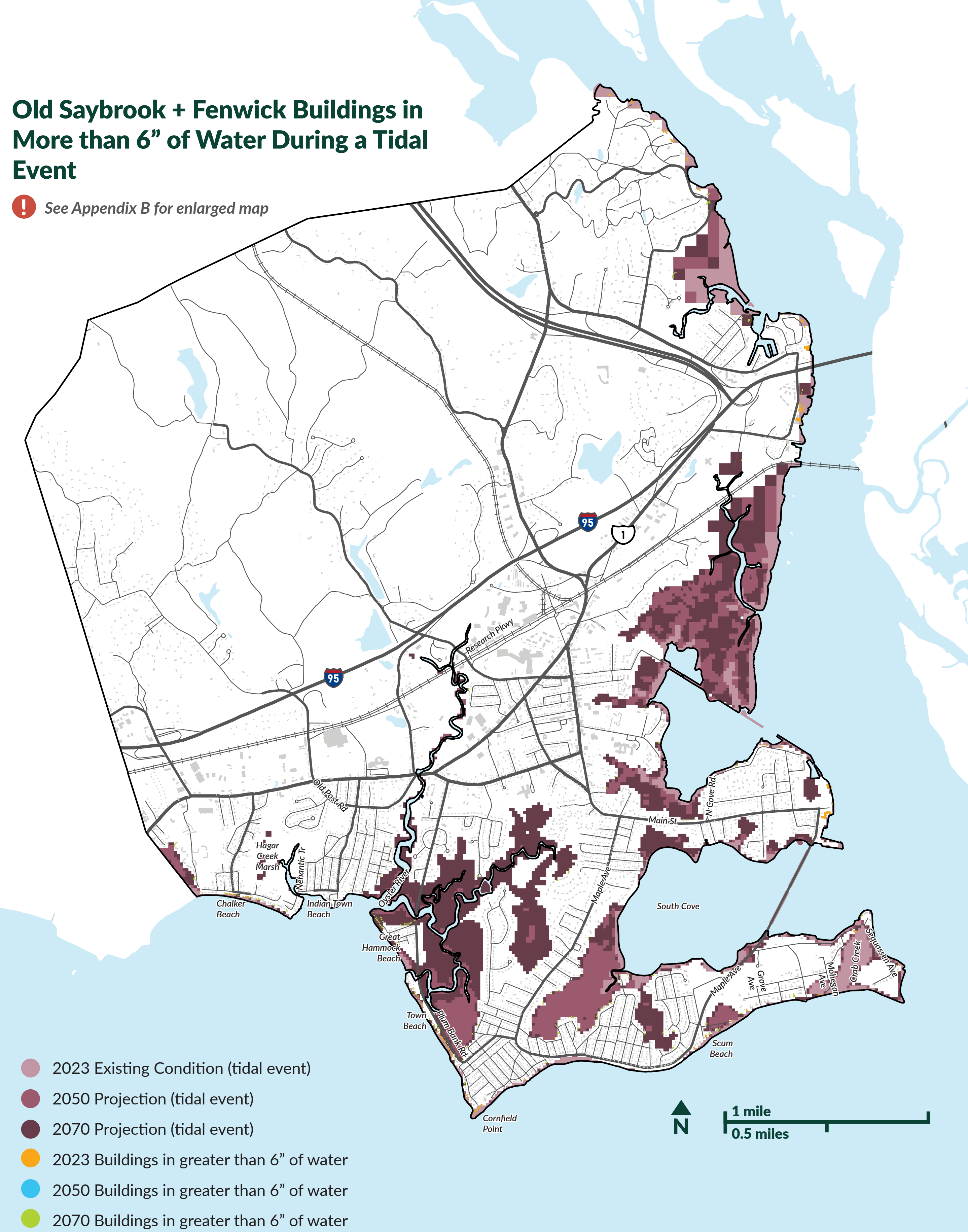


Figure 3-32: **Old Saybrook & Fenwick** *- Buildings in more than 6” of water during a tidal event*

Old Saybrook Vulnerability & Risk Assessment

Tidal Event Scenario

See page 106 for a map of the tidal event inundation greater than 6” water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 70-74 for detailed projections for a tidal event in 2023, 2050, and 2070.

The mean high water tidal event model reveals significant flood risks across several coastal areas in Old Saybrook. While all beaches in Old Saybrook face an elevated risk of inundation, the modeling indicates certain zones are particularly vulnerable during tidal events. The areas identified as having a higher risk of flooding include:

- Chalker Beach
- Great Hammock Beach Area
- Town Beach
- Oyster River

Tidal Event Existing Condition

Current tidal inundation models for mean high water events show relatively minor impacts compared to projected future scenarios. The model shows the marsh areas currently experience little to no inundation, which is beneficial for the facilities, businesses, and residences located on or near these wetlands.

In the Chalker Beach area, current tidal inundation varies significantly along the coastline, with water depths ranging from 9” to 2’9” above grade. Several residential properties are already affected by these tidal events, with some locations experiencing water levels up to 2’4” above the existing ground elevation.

Tidal Event 2050 Projection

The 2050 sea level rise projection for Old Saybrook indicates a worsening flood scenario. All previously described flood-prone areas are expected to experience more severe inundation. Additionally, flooding is anticipated to spread into new locations across the town. The change in water depth from current conditions to 2050 is projected to range from 6” to 2’, depending on the area.

Projections for 2050 indicate that Chalker Beach may see coastal inundation reaching 3’5” above the current grade. This rise is likely to affect both the shoreline and nearby homes, potentially contributing to beach regression.

By 2050, projections for Cornfield Point indicate that while the area affected by inundation is not expected to expand significantly, the depth of water in already impacted areas is likely to increase by up to 5”.

Tidal Event 2070 Projection

Projections for 2070 indicate significant changes in water depth at the Oyster River mouth, with increases of up to 6’ compared to current levels. This represents the most substantial depth change in Old Saybrook over the next five decades. The Indian Town and Great Hammock Beach neighborhoods are expected to be particularly affected. In some locations, water depths could reach 6’ 9”, with certain residences potentially experiencing water levels 5’5” above the existing ground level.

The Town Beach area faces dual vulnerability, bordered by the Back River Marsh and Long Island Sound. By 2070, projections indicate that during tidal events, homes in this area could be inundated by up to 3’8” of water. Roads may be submerged under as much as 2’7” of water, potentially severing access to the Great Hammock Beach neighborhood.

By 2070, the Chalker Beach area is projected to face tidal inundation up to 4’6” above current ground level. This significant increase emphasizes the urgent need for coastal adaptation measures in the region to protect properties and infrastructure from rising sea levels and increased flooding risks.

Projections for Cornfield Point show that the geographical extent of inundation is not expected to expand significantly. However, the severity of flooding in already affected areas is anticipated to worsen, with water depths projected to increase by 2’.

Tidal Event Building Inundation

Protecting critical facilities, businesses, and homes is crucial in Old Saybrook, given their importance as community assets and the area's vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes.

The table to the right shows how many building footprints in Old Saybrook could experience water depths greater than 6" against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6" of water where the first floor is above the 6" of water on the property.

Year	Total Number of Buildings in Old Saybrook in More Than 6" of Water (Tidal Event)
2023	83 buildings *(1.1% of the buildings in Old Saybrook)*
2050	83 buildings *(1.1% of the buildings in Old Saybrook)*
2070	241 buildings *(4.3% of the buildings in Old Saybrook)*

Fenwick Vulnerability & Risk Assessment
Tidal Event Scenario

See page 106 for a map of the tidal event inundation greater than 6” water depth above the existing grade. Note that the inundated areas are at heightened risk of septic system failures.

See pages 70-74 for detailed projections for a tidal event in 2023, 2050, and 2070.

With the Borough of Fenwick being surrounded on three sides by water, its vulnerability to inundation is high. The tidal event model reveals the most high-risk areas in Fenwick during a mean high water tidal event include:

- Sequassen Avenue
- Crab Creek area
- The area south of the eastern leg of Agawam Avenue
- Scum Beach area
- Maple Avenue between Nibang Avenue and the Borough of Fenwick Offices

Tidal Event Existing Condition

The eastern section of Sequassen Avenue, between the Connecticut River and Crab Creek Marsh, faces severe flood risk. Projections show water depths up to 4’6” above grade, potentially isolating residences. During mean high water tides, the segment between Mohegan and Neponset Avenues could be inundated up to 4’ above grade.

Crab Creek’s path over and behind the area south of the eastern leg of Agawam Avenue increases flood risk. A tidal event could bring water depths up to 3’4”, with depths up to 2’7” in residential areas south of the eastern leg of Agawam Avenue. The Crab Creek bridge is expected to experience 1’ of inundation above grade during such an event.

The Scum Beach area faces heightened flood risk in the mean high water tidal scenario. Although the marsh behind it is not projected to have inundation, the Scum Beach area itself could experience flood inundation ranging from 6” to 5’8” on the coast, indicating a wide variation in vulnerability across the location.

Tidal Event 2050 Projection

Fenwick’s 2050 sea level rise projection shows worsening flood conditions. Water depth increases from current levels to 2070 are expected to range from 6” to 1’6”, varying by area.

In 2050, the eastern section of Sequassen Avenue is projecting water depths up to 4’6” above the existing grade. Between Mohegan Avenue and Neponset Avenue up to 4’8” water depth above the existing grade is anticipated in a tidal event.

Crab Creek is projected to see inundation up to 5’ with 1’8” water depth at the Crab Creek bridge. The residential area south of the eastern leg of Agawam Avenue could experience up to 3’10” water depths above grade.

The marsh behind Scum Beach is projecting water depths between 3” and 1’8” water depths. Scum Beach could experience 8’3” of tidal inundation putting the residences off of Wilson Avenue in a vulnerable position between the Long Island Sound to their front and the marsh to their rear.

Tidal Event 2070 Projection

The 2070 sea level rise projection for Fenwick indicates an elevated flood situation. Water depth changes from current conditions to 2070 are projected between 3” and 3’.

By 2070, Sequassen Ave faces flood risks projected up to 5’5” water depths in a tidal event on the east side and up to 5’8” between Mohegan Avenue and Neponset Avenue. Crab Creek is slated to experience up to 4’9” water depths and up to 4’10” water depths in the residential area. By 2070, the marsh behind Scum Beach is projected to have up to 2’6” of inundation with up to 11’5” of inundation at the beach itself.

As inundation areas increase, Maple Avenue between Nibang Avenue and the Borough of Fenwick Offices is projected to experience up to 3’ of inundation.

Tidal Event Building Inundation

Protecting critical facilities and homes is crucial in Fenwick, given the area's vulnerability to coastal flooding. Many residents already face mobility challenges due to flood waters reaching their homes or surrounding roads.

The table below shows how many building footprints in Fenwick could experience water depths greater than 6" against their exterior walls. The data only indicates where flood water may contact building exteriors; exterior water contact does not automatically mean interior flooding will occur. The likelihood of water entering a building depends on several factors including building material type (brick, wood, concrete, etc.), overall structural condition, presence of cracks or gaps, foundation type and condition, and existing waterproofing measures. A detailed structural assessment of each building is needed to determine its actual vulnerability to interior flooding when exposed to these water depths.

The building totals presented in the table are derived from a 100-year storm scenario that also accounts for projected sea level rise in three time intervals. Building footprint data was obtained from each municipality, with each dataset representing different collection years. As a result, some building footprints may not reflect current conditions. The building totals represent all building types including residential, accessory structures, businesses, institutional, government, and critical facilities. The totals may include FEMA-compliant structures that may not get the 6" of water where the first floor is above the 6" of water on the property.

Year	Total Number of Buildings in Fenwick in More Than 6" of Water (Tidal Event)
2023	9 buildings *(7.9% of the buildings in Fenwick)*
2050	9 buildings *(7.9% of the buildings in Fenwick)*
2070	18 buildings *(15.8% of the buildings in Fenwick)*

Old Saybrook / Fenwick Vulnerability & Risk Assessment (cont.)

Sequassen Ave During Storm - Fenwick

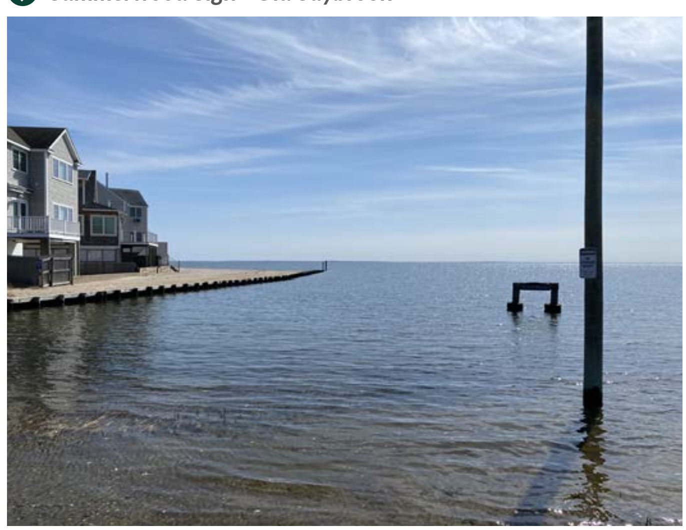
Scum Beach Seawall Gaps - Fenwick

Sand Displacement and Erosion - Fenwick

Barnes Rd Flooding - Old Saybrook

Barnes Rd Flooding - Old Saybrook

Summerwood Sign - Old Saybrook



Great Hammock Rd Flooding - Old Saybrook

Plum Bank Rd Flooding - Old Saybrook

Nehantic Trail Flooding January 2024 - Old Saybrook

Saye Street Flooding December 2022 - Old Saybrook

100-Year Storm Water Depth Projection at Critical Facilities

Critical facilities are structures that are essential for community functioning and disaster response, while critical businesses are private sector entities whose operations are essential for community function, economic stability, or supply chain continuity. Refer to page 32 for the Critical Facilities map.

The information below is derived from a 100-year storm scenario that accounts for projected sea level rise in three time intervals (2024, 2050, and 2070). These estimates serve as a conservative baseline to guide future coastal resilience planning initiatives.

No Water on the Parcel

The following critical facilities are not projected to experience flood waters within their parcels in a 100-year storm scenario in any of the three time increments:

Clinton

- Fire Department - Station 2
- Police Department
- Lewin G. Joel Elementary School
- Jared Eliot Middle School
- Morgan High School
- Ocean Meadow Senior Living
- Henry Carter Hull Public Library
- Post Office

Westbrook

- Fire Department - Station 2
- State Police Department
- Shoreline Medical Center
- Ambulance Association
- Daisy Ingraham Elementary School
- Middle/High School
- Public Library
- Post Office

Old Saybrook & Fenwick

- Fire Department
- Police Department
- Post Office

Water on the Parcel

The following critical facilities are projected to experience flood waters within their parcels but the water will not rise to touch the building facade in a 100-year storm scenario in any of the three time increments:

Westbrook

- Westbrook Fire Department - Station 1
- Police Department/Town Hall
- John P. Riggio Municipal Building

While the Route 1 parking lot entrance will maintain access to the Westbrook Fire Department and John P. Riggio Municipal Building, predicted flooding on South Main Street poses critical access challenges for emergency vehicles. Of particular concern, projections indicate that by 2070, fire truck garages will experience 5” of standing water at their exits, potentially compromising emergency response capabilities during flood events.

The Westbrook Police Department and Town Hall building is not projected to experience inundation, but the rear parking area will become inaccessible by 2070 with water depths ranging from 11” to 2’6” in areas. By 2050, the rear parking lot could experience 4” water depths.

Old Saybrook & Fenwick

- Town Hall
- High School
- Acton Public Library
- Gladeview Healthcare Center

The Old Saybrook Town Hall is expected to remain fully operational and accessible, as projected flood waters will reach only the outer edges of the property without affecting the building or parking facilities.

While Old Saybrook High School’s main facilities—including buildings, parking lots, and athletic fields—are projected to remain safe from flooding, minor access challenges may emerge by 2070. At that time, the Route 1 entrance is expected to experience one inch of flooding, though the Donnelley Road entrance will remain fully accessible.

While the Acton Public Library building itself is projected to stay dry, flooding already threatens access to the facility. Current models show 3" of water affecting both the parking area and main entrance. Conditions are expected to worsen by 2070 when up to 12" of flooding could render the parking area completely inaccessible.

While Gladeview Healthcare Center's flood projections show escalating impacts over time on the parcel, access to the building and parking areas will see relatively minimal impacts by 2070 with water depths projected to be less than 6".

Water on the Parcel and Touching the Building

The list of critical facilities below may experience flood contact with their building perimeters during a 100-year storm event. Note: This analysis only identifies potential exterior flood exposure and does not assess interior water penetration.

Clinton

- Fire Department - Station 1
- Town Hall

Water levels around the Clinton Fire Department on Route 1 are projected to rise steadily. Current models show flooding depths of 2'4" in the parking lot and building perimeter. By 2050, these waters could deepen to 2'10", and may reach 3'8" by 2070. This inundation will compromise emergency response capabilities during flood events. Facility relocation is recommended.

Flood projections for the Clinton Town Hall show increasing impacts over time. The southwest corner of the building and parking area currently faces water depths of 1'10". These depths are expected to increase significantly - reaching 2'4" by 2050. The rear parking area will become inaccessible by 2070 due to the 3'4" flood depth.

Westbrook

- Oxford Academy

By 2070, while Oxford Academy will maintain overall accessibility, its southernmost building is projected to experience flood depths up to 1'3" on both its west and east sides. Some of the grounds will be affected by flooding, though most buildings and parking areas will remain accessible.

Old Saybrook & Fenwick

- Apple Rehab Nursing Home
- Kathleen E. Goodwin Elementary School
- Middle School
- Ambulance Association
- Fenwick Municipal Building

By 2070, Apple Rehab Nursing Home could face up to 9" of flooding at its entrance and parts of its exterior. While dry until then, these projected water levels could complicate emergency operations at the facility.

Kathleen E. Goodwin Elementary School faces increasing flood risks over time. Currently, while parking areas experience minor flooding up to 2", the building itself remains dry. Flooding is projected to expand across most parking areas in the coming decades. By 2070, both the building and parking areas are expected to be fully inundated with water depths up to 1'6".

Access to Old Saybrook Middle School could be compromised by 2070, despite the campus itself remaining accessible. While the school grounds will stay usable, flood waters up to 6 inches deep on Sheffield Road may restrict the ability to reach the facility. The far east parking area's flooding is projected to worsen from 3" currently to 1'9" by 2070, with similar depths expected along the building's southern end. While on-site parking will remain accessible, flood depths up to 6" on Sheffield Road could impair access to the facility.

Flood impacts at the Old Saybrook Ambulance Association are projected to worsen significantly over time. Currently, the facility faces up to 3" of flooding, which affects building access. By 2050, water depths are expected to increase to 9" with more extensive parking lot flooding. The situation becomes more severe by 2070, when the parking lot is projected to be completely flooded and water depths up to 1'-11" could accumulate against the building's facade.

The Fenwick municipal office building faces the most severe flood risk among critical facilities in the study area. Despite recent efforts to elevate the parking areas and building, its location makes flooding inevitable. Models show the entire parcel underwater in all timeframes, with depths increasing from 2'6" currently to 3' by 2050, and reaching 4'1" by 2070. The site remains inaccessible throughout all projected periods.

Tidal Event Water Depth Projection at Critical Facilities

Critical facilities are structures that are essential for community functioning and disaster response, while critical businesses are private sector entities whose operations are essential for community function, economic stability, or supply chain continuity. Refer to page 32 for the Critical Facilities map.

The information below is derived from a tidal event scenario that accounts for projected sea level rise in three time intervals (2024, 2050, and 2070). These estimates serve as a conservative baseline to guide future coastal resilience planning initiatives.

No Water on the Parcel

The following critical facilities are not projected to experience flood waters within their parcels in a tidal event scenario in any of the three time increments:

Clinton

- Fire Department - Station 2
- Police Department
- Lewin G. Joel Elementary School
- Jared Eliot Middle School
- Morgan High School
- Ocean Meadow Senior Living
- Henry Carter Hull Public Library
- Post Office

Westbrook

- Westbrook Fire Department - Station 1
- Fire Department - Station 2
- Police Department/Town Hall
- John P. Riggio Municipal Building
- State Police Department
- Shoreline Medical Center
- Ambulance Association
- Daisy Ingraham Elementary School
- Middle/High School
- Public Library
- Post Office
- Police Department/Town Hall
- John P. Riggio Municipal Building
- Oxford Academy

Old Saybrook & Fenwick

- Fire Department
- Police Department
- Post Office
- Town Hall
- High School
- Acton Public Library
- Ambulance Association
- Apple Rehab Nursing Home
- Gladeview Healthcare Center
- Kathleen E. Goodwin Elementary School

Water on the Parcel

The following critical facilities are projected to experience flood waters within their parcels but the water will not rise to touch the building facade above in a 100-year storm scenario in any of the three time increments:

Clinton

- Town Hall

The 2070 model anticipates tidal waters to enter the Clinton Town Hall parcel on the western edge, reaching depths up to 2', but not impacting circulation or operations.

Old Saybrook & Fenwick

- Middle School
- Fenwick Municipal Building

The Old Saybrook Middle School is projected to experience tidal flooding in the 2070 projection on the southern edge of the property. Water depths could potentially reach 1'4", although access and operations would likely not be impacted.

The Fenwick municipal building is not projected to see inundation in the 2070 projection. The northern edge of the property adjacent to South Cove could experience 2'11" of inundation, though it is not anticipated that it would reach the parking area or inhibit circulation.

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4 Resiliency Recommendations

This section outlines options that could be applied to the study area to enhance coastal resilience including preservation, adaptation and avoidance measures.

Preservation is the protection and maintenance of existing natural coastal features and ecosystems to retain their protective functions and ecological value.

Adaptation refers to modifying human systems, infrastructure, and practices to better withstand and function amid coastal hazards and changing environmental conditions.

Avoidance is the strategic reduction of exposure to coastal risks through planned retreat and careful land use decisions that limit development in vulnerable areas.

From this array of options, highlighted projects for Clinton, Westbrook, Old Saybrook, and Fenwick are identified and include concept level details. For each of these highlighted projects, the section explains the underlying need, the recommended actions necessary for implementation, and the potential benefits they offer.

This section provides planning-level cost estimates, potential partners, and funding sources for each project. The project profiles are designed to be readily utilized as part of grant applications by lead agencies, facilitating the acquisition of funding for project implementation.

The adaptation options and prioritized project list have been developed by drawing upon the assets and issues identified, the Risk Assessment findings, and invaluable feedback from stakeholders and the community. This collaborative approach ensures that the proposed solutions are tailored to address the specific vulnerabilities and needs of the study area.

Causeway & Groveway , Clinton
January 2024

Projects & Implementation Strategy

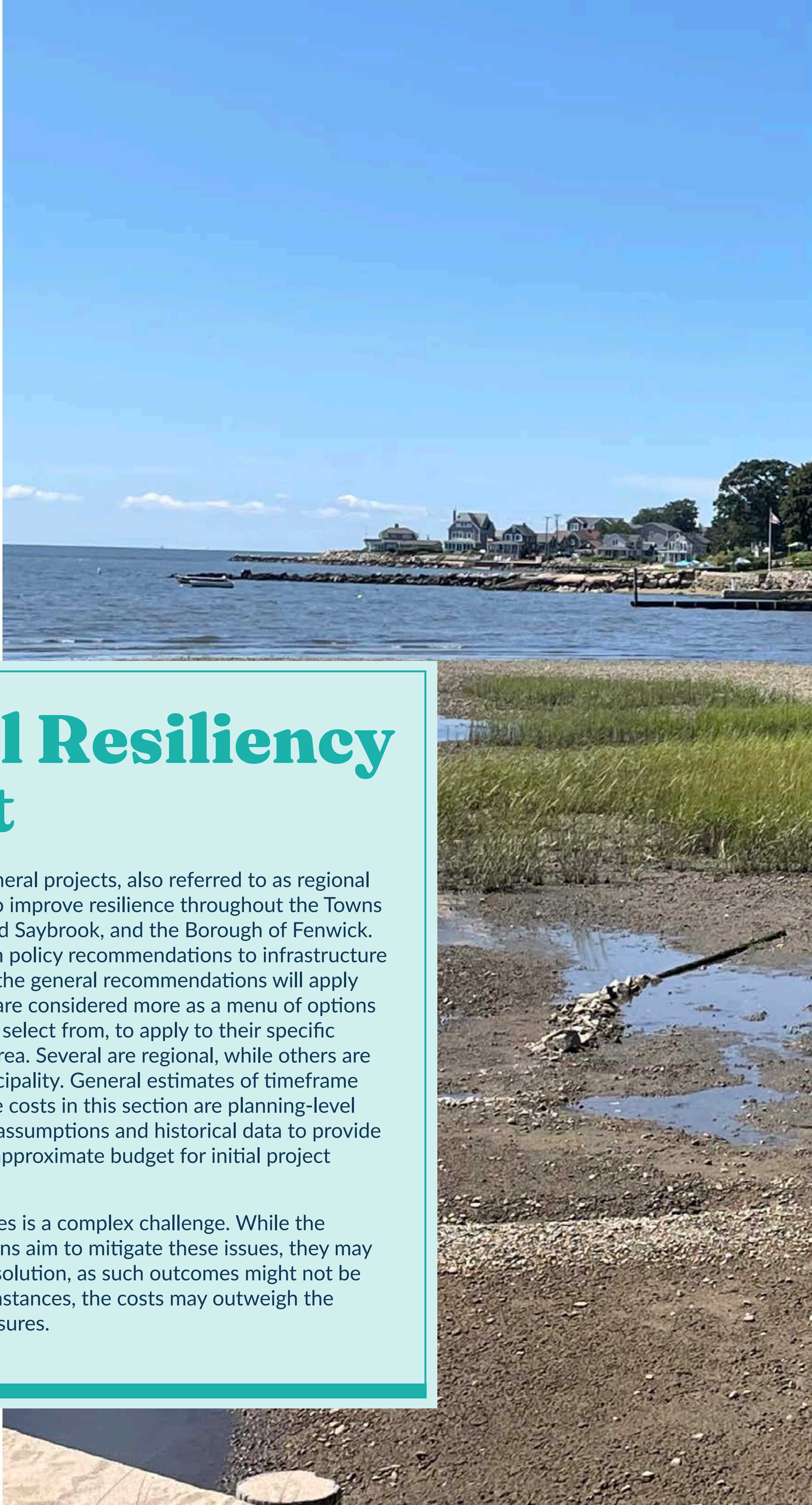
This section presents recommended projects derived from research findings, the vulnerability and risk assessment results, and input from the community and Executive Committee. An implementation strategy is included to organize priorities and future efforts. The project list addresses the risks identified in Section 3: Sea Level Rise & Vulnerability.


STOP

Coastal Resiliency Toolkit

	General Action / Strategy Recommendation	Timeframe	Estimated Cost
Natural Shoreline Fortification			
1A	Natural Shoreline Fortification	4-10 years	Varies depending on application
1B	Dune Management	4-10 years	Initial year: $200-$500/LF Annual maintenance: $20-$50/LF
1C	Beach Nourishment	4-10 years	$15-$30/CY
2	Structural Shoreline Fortification	4-10 years	Varies depending on application
3	Marsh & Wetland Management	4-10 years	Varies depending on application
Infrastructure Including Water Infrastructure			
4	Elevate Roads	10+ years	Varies depending on application
5	Railroad Underpass Flooding	Varies	Varies depending on application
6	Stormwater Management	1-3 years	Varies depending on application
7	Install Backflow Preventers	1-3 years	Varies depending on application
8	Tide Gates	10+ years	$1M/tide gate
9	Dredging	Varies	Varies depending on application
10	Bury Utility Lines	10+ years	Varies depending on application and complexity
11	Investigate Long-Term Wastewater Management Solutions	10+ years	To be determined based on size and scope of project
Built Environment			
12	Secure Plastic Septic Tanks	1-3 years	$2K-$4K/system
13	Elevate Structures	1-10+ years	Varies depending on application
14	Elevate Equipment	1-3 years	$50K/home
Policies & Programming			
15	Land Use Regulations	1-3 years	Varies depending on staff or consulting work
16	Managed Retreat	10+ years	$2M-$3M/acquisition
17	Participate in the Community Rating System	1-3 years	Municipality: $5K-$15K/year Consultant: $15K-$20K
18	Offer Community Training & Education	1-3 years	Varies depending on application

	Municipality-Specific Focus Areas	Location
19	Shore Road, Causeway, & Groveway	Clinton
20	Grove & Commerce Street Area, Town Dock, & Riverside Drive	Clinton
21	Clinton Policy & Practice	Clinton
22	Clinton Town Beach Nourishment & Fortification	Clinton
23	Meadow Road Area Improvements	Clinton
24	Town Center Area	Clinton
25	West Beach/Coral Sands/Pilots Point Area Improvements	Westbrook
26	Old Mail Trail Area Improvements	Westbrook
27	Middle Beach Area	Westbrook
28	Route 1 Between Wesley Avenue & Old Clinton Road Improvements	Westbrook
29	Cold Spring Brook & Chalker Beach Area Improvements	Old Saybrook/ Westbrook
30	Old Sea Lane & Hartford Avenue Outfall Repair	Old Saybrook
31	Existing Seawall Evaluation	Old Saybrook
32	Indian Town Area Improvements	Old Saybrook
33	Living Shoreline Feasibility	Old Saybrook
34/40	Dredging of South Cove	Old Saybrook / Fenwick
35	Sequassen Avenue Improvements	Fenwick
36	West End (Scum Beach & Seawalls)	Fenwick
37	Pettipaug Avenue Seawall	Fenwick
38	Folly Point Erosion	Fenwick
39	Breakwater Maintenance & Repair	Fenwick



Cold Spring Brook Outlet, Westbrook / Old Saybrook August 2023

Coastal Resiliency Toolkit

This section describes general projects, also referred to as regional projects, recommended to improve resilience throughout the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick. These projects range from policy recommendations to infrastructure improvements. Not all of the general recommendations will apply to each municipality, but are considered more as a menu of options that the communities can select from, to apply to their specific application or challenge area. Several are regional, while others are site-specific in each municipality. General estimates of timeframe and cost are included. The costs in this section are planning-level estimates that use broad assumptions and historical data to provide decision-makers with an approximate budget for initial project evaluation.

Addressing resiliency issues is a complex challenge. While the proposed recommendations aim to mitigate these issues, they may not lead to a complete resolution, as such outcomes might not be fully attainable. In some instances, the costs may outweigh the benefits of resiliency measures.


SUMMERWOOD

Recommendation #1 Shoreline Fortification

Natural Shoreline Fortification

Shoreline fortification strategies work best when combined to create multiple layers of coastal protection. Under the broader category of shoreline fortification, there are three key interrelated approaches: natural shoreline fortification, dune management, and beach nourishment. These strategies complement and reinforce each other.

Natural Shoreline Fortification | Recommendation #1A

Estimated Cost: Varies, see page 126 **Timeframe:** 4 - 10 years **Location:** Study Area

Project Description: Natural shoreline fortification encompasses both living shorelines and broader natural approaches such as vegetated beaches and dune systems to help protect coastlines from erosion and moderate wave action. This approach frequently requires offshore attenuating structures such as rock sills and involves planting native coastal vegetation and strategically placing rocks or logs. The Hepburn living shoreline is a local example of natural shoreline fortification. While these methods help reduce erosion and buffer against normal wave energy, it's important to note they are ineffective protection against storm surges when water levels are significantly elevated, such as during major coastal storms. The continued erosion from storm events weakens these natural buffers, making them less effective in stabilizing the coastline over time. These natural fortifications can only reduce wave heights by a small amount, typically measured in inches rather than feet. However, they still provide valuable benefits: they are often less damaging to surrounding ecological resources than hard structures like seawalls, they can adapt to changing conditions, they are typically more cost-effective in the long term, and they maintain the aesthetic and recreational value of the coastline. Regardless of the method chosen, shoreline fortification is necessary to reduce the risk of the nourished sand from being washed away by regular wave action and tidal events. Prioritize project locations based on cost-benefit analysis and performance projections. Focus on areas that offer the highest potential impact and sustainability while considering investment timeframes and alignment with strategic goals.

Dune Management | Recommendation #1B

Estimated Cost: Initial year: $200-$500/LF and Annual maintenance: $20-$50/LF **Timeframe:** 4 - 10 years
Location: Study Area

Project Description: Dunes provide natural coastal protection against storm surges and high waves, preventing or reducing coastal flooding and structural damage, as well as providing important ecological habitats. The natural approach to reconstructing a dune involves the placement of compatible sediment on an existing dune, or the creation of an artificial dune by building up a mound of sediment at the back of the beach. New dunes can be created in areas where they did not previously exist, providing an additional layer of protection. However, the success of this approach depends on several factors, including the specific environmental conditions, the type of terrain, and the local storm patterns. Without clear guidance or detailed modeling on where these new dunes would be most effective, it is difficult to determine whether they would be viable in certain locations or under certain conditions. This may be a component of a beach nourishment effort or a standalone project. CT DEEP does not permit the use of a hard structure core in dunes. Dune projects may be appropriate for areas with dry beaches at high tide and sufficient space to maintain dry beaches even after the new dune sediments are added to the site. It is important to plant native coastal vegetation (like beach grass, shrubs, and groundcovers) on dunes to anchor sand with their root systems, which helps reduce erosion, trap additional sand, and maintain dune structure against wind and wave action.

Beach Nourishment | Recommendation #1C

Estimated Cost: $15-$30/CY **Timeframe:** 4 - 10 years **Location:** Study Area

Project Description: Beach nourishment adds sand to eroding beaches, creating a buffer against waves and flooding while improving recreational value. This process widens the beach and moves the shoreline seaward, enhancing natural protection against storms. Projects typically last 3-10 years, depending on site conditions and storm intensity. Structural shoreline fortification is necessary to reduce the risk of the nourished sand from being washed away by a single storm or tidal event. Beach management and erosion control involve maintaining and protecting coastal areas from erosion, ensuring beach stability, and enhancing environmental quality. Beach Associations often play a key role in these efforts, working alongside local authorities and stakeholders. Coordinated beach nourishment—such as nourishing sand—is an effective strategy, but it's important to consider the potential impact on neighboring properties, as sediment movement can affect adjacent shorelines. Proper planning and collaboration are essential to balance protection and minimize negative consequences.

Anticipated Benefits

- **Natural Shoreline Fortification:** Reduces erosion and storm damage by creating natural buffers that absorb wave energy; Supports coastal biodiversity and water quality by providing habitat and natural filtration; Adapts to changing conditions and self-repairs after storms
- **Dune Management:** Coastal protection against storms and erosion; Sand storage for beach nourishment
- **Beach Nourishment:** Provides a buffer against wave action, flooding, and erosion; Protects destructive waves from reaching dunes and upland developments

Potential Challenges

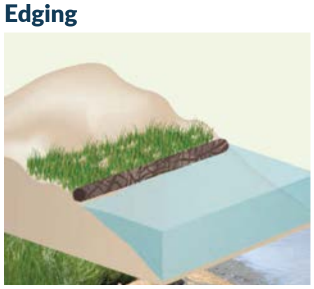
- **Natural Shoreline Fortification:** Lowered effectiveness where much of the shoreline is already hardened; More challenging to design and install than more traditional structural shoreline fortification
- **Dune Management:** Continued erosion; Pedestrian access to the beach
- **Beach Nourishment:** Uncertain longevity; Legalities of property lines; High expense; Permitting

Natural Shoreline Fortification

Vegetation Only

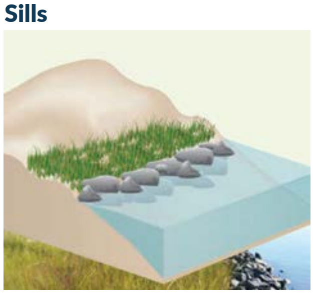
Construction: up to $1K/LF

Edging



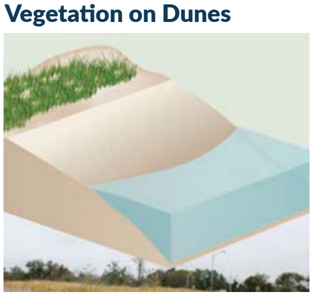
Construction: $1K-$2K/LF

Sills



Construction: $1K-$2K/LF

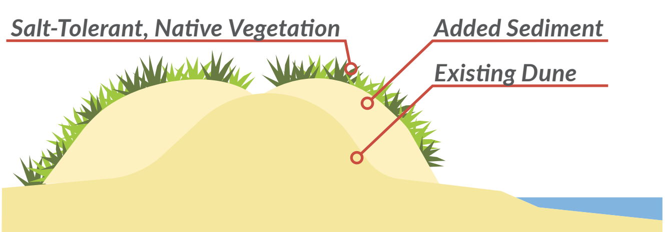
Vegetation on Dunes



Construction: $2K-$5K/LF

Image Credit: Guidance for Considering the Use of Living Shorelines | NOAA

Dune Management



Responsible Party and Key Partners

- **Natural Shoreline Fortification:** Property owner (local municipality or a private owner), United States Army Corp of Engineers (USACE)/CT DEEP (Permitting), The Nature Conservancy (TNC)/Connecticut Institute for Resilience & Climate Adaptation (CIRCA) (Design/Execution), The State of Connecticut (State of CT)
- **Dune Management:** Property owner, USACE/CT DEEP (Permitting), State of CT
- **Beach Nourishment:** Property owner, USACE/CT DEEP (Permitting), beach associations (Coordination), State of CT

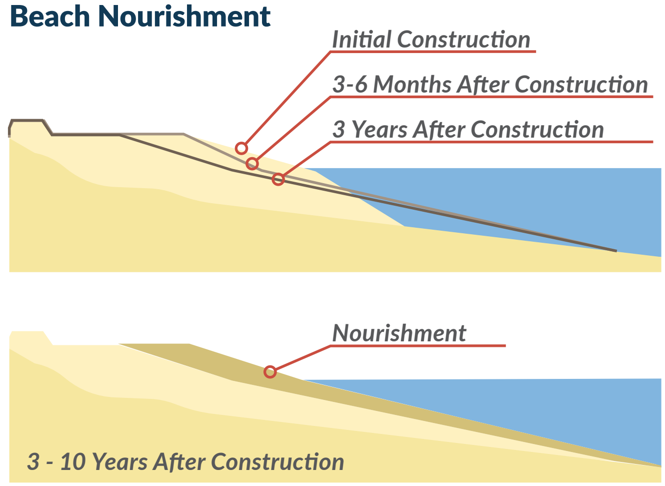
Pre-Development Actions

- **Natural Shoreline Fortification:** Perform a site analysis to determine whether living shoreline stabilization is appropriate in a particular area. Ensure compliance with all federal, state, and local laws, regulations, and permits.
- **Dune Management:** Evaluate the current condition of the local dune system, determine the appropriate dune height, width, and slope based on local conditions, obtain necessary permits from local, state, and federal agencies.
- **Beach Nourishment:** Undergo an existing condition and environmental analysis, consult coastal engineers for future sand movement projections and appropriate dune heights and offshore slopes, identify a sand source.

Potential Funding Sources

- **Natural Shoreline Fortification:** Urban Green & Community Garden Grant, Connecticut Sea Grant, National Oceanic and Atmospheric Administration (NOAA), National Fish and Wildlife Foundation (NFWF)
- **Dune Management:** Long Island Sound Futures Fund
- **Beach Nourishment:** Long Island Sound Futures Fund

Beach Nourishment



After the beach nourishment project is constructed, gradual changes to the beach are anticipated as it evolves into a more natural form over time

Recommendation #2 Shoreline Fortification

Structural Shoreline Fortification

Structural shoreline fortification involves building engineered barriers to protect coastal areas from erosion and flooding. These hardened structures are designed to withstand wave action and storm surge while stabilizing the shoreline. They often require significant investment and ongoing maintenance. Effective shoreline protection integrates structural and natural approaches to maximize resilience while maintaining ecosystem functions, using site-specific conditions and coastal dynamics to guide adaptive management strategies. However, efforts to integrate natural designs with structures like groins and revetments often encounter difficulties in coordinating different approaches. There are also concerns regarding the impact on local habitats, as well as the complexity of replacing or repairing existing structures. Effective project communication and implementation require consensus among multiple stakeholders, including landowners and agencies. Detailed modeling can illustrate the impact of different locations and types of additional shoreline fortifications.

Groins

Estimated Cost: $2K-$5K/LF **Timeframe:** 4-10 years **Location:** Study Area

Project Description: A groin is a hard structural barrier built perpendicular to the shoreline that extends into the water to trap sand and reduce beach erosion by interrupting longshore sediment transport. Best used in areas with significant lateral sand movement, groins are typically constructed of rock, concrete, or steel with a lifespan of 30-50 years depending on materials and conditions. While they effectively build up beach width on their updrift side, groins can starve downdrift beaches of sand, potentially accelerating erosion in neighboring areas. Their high cost, aesthetic impact, and potential effects on access and coastal ecosystems must be weighed against their beach stabilization benefits. Groins extend from the backshore to just beyond low tide line (at 2-3 feet water depth), not exceeding the normal surf zone. The crest height tapers from 2-3 feet above beach level at the landward end to below mean low water at the seaward end, reducing wave reflection and scour. Spacing between groins should be 2-3 times their length.

Breakwaters

Estimated Cost: $5K-$10K/LF **Timeframe:** 4-10 years **Location:** Study Area

Project Description: A breakwater is an offshore barrier structure built parallel to the shoreline that reduces wave energy reaching the coast, creating a calmer zone that promotes sediment deposition and beach formation. Best used in high-energy wave environments where shoreline protection and beach stabilization are needed, breakwaters are typically constructed of large rock or concrete armor units with a lifespan of 50+ years with proper maintenance. While effective at reducing erosion and creating stable beach areas, breakwaters are expensive to construct, can impact natural sediment transport patterns, may affect water quality in the sheltered area, and can pose navigational hazards. Like other hard structures, they also require consideration of sea level rise in their design and may have significant environmental impacts on marine habitats. Breakwaters have a 5-15 degree angle to accommodate wave direction and littoral drift, with gaps between segments of 0.8-1.2 times structure length. Placement should be 1.5-2.5 times the design wave length from mean low water line (200-300 feet offshore for tidal ranges under 2 feet; 300-500 feet for ranges 2-13 feet), with final parameters adjusted for local wave climate, tides, and sediment conditions.

Bulkheads & Seawalls

Estimated Cost: $2K-$5K/LF & $5K-$10K/LF **Timeframe:** 4-10 years **Location:** Study Area

Project Description: Bulkheads and seawalls are vertical or near-vertical walls built parallel to the shoreline to protect upland areas from erosion and wave action, with seawalls typically being more robust structures designed for higher wave energy environments. These structures, made of concrete, steel, or timber, have lifespans ranging from 20-50 years depending on materials and conditions, and are best used in developed areas where property protection is critical. While effective at preventing upland erosion and providing flood protection, they can cause increased erosion at their base (scour), reflect wave energy that may affect adjacent properties, and often eliminate natural beach habitat. Additionally, they require regular maintenance, are expensive to construct, and may need modifications to address future sea level rise.

Anticipated Benefits

- **Groins:** Help build and stabilize beaches; Dissipate wave energy while maintaining natural beach
- **Breakwaters:** Reduce wave energy at the shoreline; Comprehensive protection against wave action; Reduce coastal erosion while maintaining aesthetics
- **Bulkheads & Seawalls:** Direct protection against wave action; Can have stairs to maintain waterfront access; Effective at preventing land loss

Potential Challenges

- **Groins:** Can cause increased erosion on the downdrift side; Can interrupt recreational beach use; Often built in a series; Permitting
- **Breakwaters:** Expensive to construct and maintain; Can impact water quality at the shoreline; Require careful placement to avoid creating hazards for vessels; Permitting
- **Bulkheads & Seawalls:** Expensive to construct and maintain; Increased erosion at the toe of the structure; Negative visual impact and potential loss of ecosystems; Permitting

Responsible Party and Key Partners

Property owner (local municipality or a private owner), beach associations, Harbor Management Commissions, State of CT

Pre-Development Actions

Evaluate the repairs needed for existing shoreline structures, which are in varying conditions and require thorough assessment. Identify gap areas for shoreline fortification implementation based on historic impacts of flooding, Flood Insurance Rate Maps (FIRM) maps, climate projections, and shoreline studies, determine the appropriate fortification application based on local conditions, obtain necessary permits from local, state, and federal agencies.

Potential Funding Sources

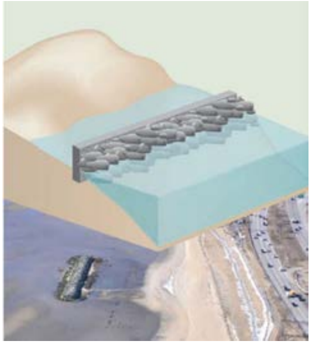
NOAA National Coastal Resilience Fund

Structural Shoreline Fortification Applications

Groin

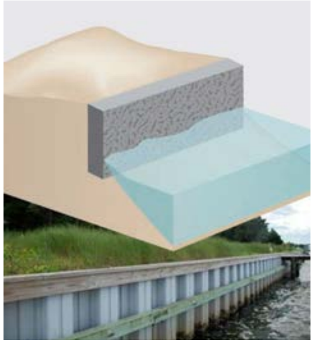
Construction: $2K-$5K/LF

Breakwater



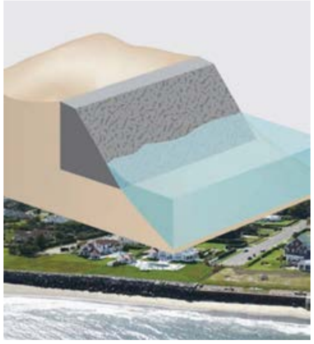
Construction: $5K-$10K/LF

Bulkhead



Construction: $2K-$5K/LF

Seawall



Construction: $5K-$10K/LF

Different structural shoreline fortification methods like groins, breakwaters, seawalls, and bulkheads, each provide varying levels of protection and durability. Selection between these engineered solutions depends on site conditions, wave exposure, and desired longevity, with each method offering distinct advantages in specific applications.

Image Credit: Guidance for Considering the Use of Living Shorelines | NOAA

Erosion at west return of the 43 Pettipaug Avenue seawall. Hightide breach allows ocean access to Old Fenwick inland wetland.

Recommendation #3 Shoreline Fortification

Marsh & Wetland Management

Estimated Cost: Varies depending on application*

Basic management: $2K/ac annually

Moderate Restoration: $5K-$25K/ac and additional $1K-$4K/ac/annually for ongoing maintenance

Complex Restoration: $30K-$200K/ac and additional $2K-$8K/ac/annually for ongoing maintenance

*The cost for marsh and wetland management will vary depending on site accessibility, type and extent of degradation, permitting requirements, wetland type, level of engineering required, etc. These costs are preliminary planning estimates only; detailed construction cost estimates must be calculated by a professional engineer or wetland specialist.

Timeframe: 4-10 years

Location: Study Area

Anticipated Benefits

- Improved water quality through natural filtration of pollutants and sediments
- Carbon sequestration, contributing to climate change mitigation

Potential Challenges

- Coastal marshes and wetlands face ongoing threats from rising sea levels and erosion, making long-term preservation difficult

Wetland management and restoration play a vital role in enhancing coastal resilience against natural disasters. Restored tidal wetlands serve as natural buffers, absorbing storm surge energy and reducing wave heights during severe storms. Restored inland wetlands enhance flood protection by acting as natural sponges, storing excess water during rainfall events and releasing it to reduce downstream flooding to help maintain groundwater levels. The ability to trap sediment also reduces erosion and improves water quality. When restored, brackish wetlands help maintain shoreline stability and provide protection against both storm surge and rainfall-induced flooding. Their complex root systems help prevent erosion, while their ability to adapt to changing salinity levels makes them especially valuable in areas experiencing sea level rise.

Restored wetlands provide ongoing protection against smaller but more frequent flooding events, reducing insurance costs and infrastructure damage while requiring less maintenance than hard engineering solutions like seawalls or levees.

Successful wetland and marsh management depends on restoring natural hydrology, maintaining proper soil conditions, establishing native vegetation, and controlling invasive species while considering the site context and climate change impacts. Climate change considerations must factor into planning, as shifting precipitation patterns and sea level rise can significantly impact wetland sustainability, and success ultimately depends on strong collaboration between scientists, engineers, local communities, and regulatory agencies.

Sea level rise threatens wetlands through "coastal squeeze," where rising waters push wetlands inland but they cannot migrate due to development or natural barriers. Healthy wetlands naturally adapt through vertical accretion and marsh migration into upland areas, but this process fails when there is no available space. This is when traditional management strategies become futile, leading to marsh loss regardless of restoration efforts. This creates a critical decision point for coastal managers: either acquire and/or protect upland areas for future marsh migration or accept the eventual loss of wetland ecosystems in areas where migration is impossible.

Constructed wetlands can absorb and store water through careful engineering of depressions, soil conditions, and water control structures. Success depends on incorporating gradual slopes (5:1 to 10:1), establishing appropriate native vegetation, and including both shallow and deep zones to handle varying water levels. Proper inlet and outlet structures are essential to control water flow and maintain desired water levels throughout the seasons.

Each of the four Towns should consider this measure for a group of tidal marshes throughout the study area.

Responsible Party and Key Partners

Local municipality, TNC, USACE, CT DEEP, Audubon Society, State of CT

Pre-Development Actions

Conduct a comprehensive assessment of existing wetlands and potential restoration sites. Identify areas of wetland that will no longer be wetlands due to future inundation. Develop a prioritization framework for restoration projects based on ecological value and flood protection potential. Engage with local communities, environmental organizations, and relevant stakeholders to build support and gather input. Secure necessary permits and funding sources, including potential grants for wetland restoration projects.

Potential Funding Sources

TNC, NOAA, NFWF, National Coastal Resilience Fund (NCRF), Audubon Society, Long Island Sound Futures Fund (LISFF), CT DEEP Climate Resilience Fund

Indian River marsh along in Clinton, CT at the Clinton Town Hall

Recommendation #4 Infrastructure Including Water Infrastructure

Elevate Roads

Estimated Cost: Varies depending on application*

+1 foot of elevation: $145/LF

+2 foot of elevation: $315/LF

+3 foot of elevation: $690/LF

+4 foot of elevation: $955/LF

*The cost for road elevation will vary depending on vertical change, road width, existing utilities, mitigating impacts to wetlands and surrounding properties, etc. These costs are preliminary planning estimates only and based on a 24-foot wide road; detailed construction cost estimates must be calculated by a professional engineer.

Timeframe: 10+ years

Location: Study Area

Anticipated Benefits

- Maintain critical transportation routes
- Maintain community connectivity to critical and essential businesses and institutions
- Reduced roadway maintenance costs to repair erosion, potholes, and structural weakening

Potential Challenges

- Elevating a road to keep the road free of flooding without accommodating flood flows could create a barrier to flood flows and increase neighboring damages due to pooling water. In cases of saturated water tables, temporary standing water may occur on nearby properties
- Existing stormwater systems will likely require modifications, including raising drainage structures and extending collection networks to accommodate new elevation changes and maintain proper water management
- Transition areas will be required at driveway aprons and connecting roads, gradually adjusting the grade to achieve a safe and drivable slope

Project Description

Road elevation serves as a critical adaptation strategy for maintaining transportation access during flood events, whether caused by nuisance flooding or severe storms. This approach can be implemented through two distinct strategies, each serving a different timeline and protection goals.

The **moderate elevation strategy**, raising roads less than two feet, aims to restore historical road functionality by counteracting sea level rise. This approach improves flood tolerance while accepting occasional inundation, allowing for easier vehicle passage during minor flood events. While serving as an interim solution for communities requiring immediate action, it remains more cost-effective than the enhanced elevation strategy but will require future reassessment as flood risks increase.

In contrast, the **enhanced elevation strategy** raises roads more than two feet to eliminate sunny day flooding concerns and maintain critical access during 10-year and 25-year flood events. This approach provides long-term resilience against projected flood scenarios, serving as a potential solution for critical transportation corridors. Though it requires greater initial investment, it offers extended protection for vital infrastructure.

Road elevation in residential areas presents unique challenges due to the frequent driveway connections and private property interfaces that must be reconstructed to match new road heights. These modifications significantly increase project costs and complexity compared to commercial areas, which generally have larger lots with enhanced drainage methods. While road elevation may still be appropriate for residential streets that serve as critical evacuation routes or in areas with limited access alternatives, communities should carefully consider other flood mitigation strategies like enhanced stormwater systems or property-level protection measures that may be more suitable for residential settings. Success depends on detailed flood modeling beyond the preliminary assessments provided in Section 3. The process requires phased implementation based on critical access priorities, community resources, construction logistics, and advanced hydraulic analysis.

For optimal outcomes, road elevation should be integrated within a comprehensive flood management framework, complementing other resilience measures such as drainage improvements, green infrastructure, and coastal protection strategies. This multi-faceted approach creates a more robust and adaptable infrastructure system capable of meeting both current and future flood challenges.

Responsible Party and Key Partners

Local municipality, Department of Public Works, beach associations, owners of privately-owned roads, CTDOT (State Roads), USACE (Permitting), Council of Governments (Local Transportation Capital Improvement Program (LOTCIP) coordination), State of CT

Pre-Development Actions

Identify all roads with existing flooding of 6" or greater in tidal and/or 100-year storm flooding scenarios. Establish a priority list for implementation. Coordinate with CTDOT as they expand the road vulnerability assessment. Coordinate with the CT Division of Emergency Management and Homeland Security for their coastal road evacuation study.

Potential Funding Sources

FEMA Building Resilient Coastal Communities, FEMA Hazard Mitigation Grant Program (HMGP), CT DEEP Climate Resiliency Fund (DCRF), CIRCA Resilient Connecticut, CT Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT), CTDOT, LOTCIP, Municipality

Before Road Profile Elevation

Road and driveways are underwater, meaning access to and from the properties is restricted.

After Road Profile Elevation

Enhanced elevation raised road stays above flood level, ensuring access.

Moderate elevation raised road elevates vehicles from flood waters but still may experience standing water on roads.

Recommendation #5 Infrastructure Including Water Infrastructure

Railroad Underpass Flooding

Estimated Cost: Varies depending on application*

Manual gate: $10,000/gate
Automated gate: $70K-$150K/gate
Temporary pump: $150K/pump
Permanent pump: $1-2M/pump

Timeframe: Varies

Gate or temporary pump: 1-3 years
Permanent pump: 4-10 years

Location: Study Area

Project Description

Railroad underpasses on Hull Street and N. High Street and the pedestrian underpass at Post Office Square in Clinton, Pond Meadow Road in Westbrook, and Elm Street in Old Saybrook regularly flood, disrupting traffic and emergency routes.

In the short term, to prevent vehicles from becoming stranded during flooding, manual or automated gates can be installed at underpasses with temporary access restrictions during high water events. This system would be coordinated between emergency management and Public Works departments, supported by strategic warning signage and community notifications. Alternatively, marking alternate routes and installing temporary pumps ($150K each) that require staffing during floods could also be beneficial.

A mid-term solution involves installing a permanent automatic pump system, requiring a $1-2M investment for hydrologic and hydraulic (H&H) study, design, and construction, excluding land acquisition and maintenance costs. A key challenge is identifying suitable discharge locations that won't worsen flooding elsewhere. If initial pump routing appears feasible, an H&H study should evaluate optimal discharge locations for various flooding scenarios.

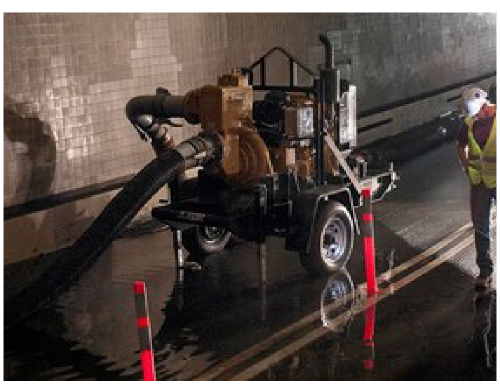
A temporary underpass flood water pump should be converted to a permanent fixture when it's being deployed more than 3-4 times per year or when the annual costs of temporary deployment exceed 15-20% of permanent installation costs. This decision should also strongly consider safety factors, particularly if the underpass is a critical route for emergency vehicles or has a history of stranded vehicles requiring rescue operations.

Anticipated Benefits

- Enhanced public safety due to improved access for emergency vehicles and residents during flood events
- Improved traffic flow during heavy rain events
- Increased resilience of critical transportation infrastructure
- Potential minimization of disruptions to local businesses and commuters

Potential Challenges

- Potentially cost-prohibitive
- Closing the underpass gates before vehicles enter the flooded area
- Identifying suitable discharge locations for flood waters



Pumps installed in tunnels to reduce flooding impacts

Image Credit: The Pumps That Are Saving New York | The Wall Street Journal (2012.).

Responsible Party and Key Partners

CT DEEP, CT DOT, Amtrak, Shoreline East, State of CT

Pre-Development Actions

Pilot short-term solutions to evaluate effectiveness. Assess the condition of current drainage systems in the area. Conduct a comprehensive hydrological study of the area to understand water flow patterns and water pump feasibility. Update Hazard Mitigation Plans in more detail to include alternate routing and procedures during underpass flooding.

Potential Funding Sources

DCRF, CIRCA

Recommendation #6 Infrastructure Including Water Infrastructure

Stormwater Management

Estimated Cost: Varies depending on application*

*Regulations vs. retrofits

Timeframe: Regulations: 1-3 years; Retrofits: 1-5 years and ongoing

Location: Study Area

Anticipated Benefits

- Improved stormwater management can help address current and future flooding issues by infiltrating water before it overwhelms existing infrastructure
- Water quality improvement through reduced runoff and treatment

Potential Challenges

- Possible concern about project costs and long-term maintenance costs depending on the type of stormwater system proposed

Responsible Party and Key Partners

Local municipality, UConn Center for Land Use Education and Research (CLEAR), beach associations, private property owners, State of CT

Pre-Development Actions

Conduct a comprehensive assessment of local hydrology and existing gray infrastructure to identify prime locations for blue-green interventions. Develop a detailed inventory of potential blue-green infrastructure sites, including public spaces, rights-of-way, and private properties. Review and update local zoning laws, building codes, and development regulations to facilitate and incentivize blue-green infrastructure implementation.

Potential Funding Sources

Urban Green & Community Garden Grant, DCRF, LISFF

Project Description

Municipalities should evaluate both regulatory requirements and best practices related to stormwater management. Targeted infrastructure upgrades to treat and infiltrate stormwater can reduce flood impacts and help protect receiving wetlands and waterbodies.

Local regulations—including Zoning, Inland Wetlands, and Subdivision Regulations—should be evaluated and updated to include requirements for Low Impact Development (LID), see page 13, design and green infrastructure in new projects and redevelopment. Requirements should, at a minimum, meet stormwater quality standards in the most recent CT Stormwater Quality Manual. Municipalities should consider incentives for projects that address future conditions, such as more frequent and heavy rainfall or exacerbated flooding in coastal areas. Municipalities should also evaluate zoning standards for impervious ground coverage and landscaping to determine if reductions in coverage limits are possible.

Municipal projects should be identified and prioritized to disconnect impervious areas and create or restore buffers adjacent to waterways and wetlands. Blue-green infrastructure integrates natural systems to manage stormwater while providing environmental benefits. Priority projects may include disconnecting impervious areas where flooding occurs, creating vegetated buffers along waterways, and incorporating permeable pavement. Long-range projects should include evaluations of stormwater treatment locations and implementation plans. Municipalities should dedicate funds and explore grants to support these projects.

Municipalities should evaluate their current Municipal Separate Storm Sewer System (MS4) plans and address necessary actions. Municipalities should prioritize accurate and complete stormwater system mapping including mapping the locations of catch basins and outfalls. Municipalities should evaluate their inspection programs for catch basin maintenance and outfall inspections. Illicit Discharge Detection and Elimination (IDDE) programs and public education and outreach programs should be evaluated for potential expansion.

Wherever possible, municipalities should document and use successful local LID designs as examples for public outreach and education initiatives. Developing an inter-municipal stormwater collaborative to share best practices and educational materials may benefit municipalities.

Recommendation #7 Infrastructure Including Water Infrastructure

Install Backflow Preventers

Estimated Cost: Varies depending on application*

Municipal: $30K/outfall
Household: $2K-$5K installation
Business: $5K-$15K installation

*The cost for backflow preventers will vary depending on depth and accessibility of the outfall pipe, the type and size of valve required, etc. These costs are preliminary planning estimates only; detailed construction cost estimates must be calculated by a professional engineer.

Timeframe: 1-3 years

Location: Study Area

Anticipated Benefits

- Features built-in monitoring through test ports and gauges
- Provides safety features for continuous protection
- Allows systematic testing and verification of water safety

Potential Challenges

- High installation costs
- Requires specialized technicians for maintenance and testing
- Complex troubleshooting due to multiple components
- Installation in flood-prone areas

Responsible Party and Key Partners

Local municipality, homeowner, business owner, beach associations, CT DEEP (Permitting), USACE, State of CT

Pre-Development Actions

Identify all outfalls and drainage locations requiring, where suitable, a backflow preventer. Educate homeowners and business owners about the need to install backflow preventers and installation resources.

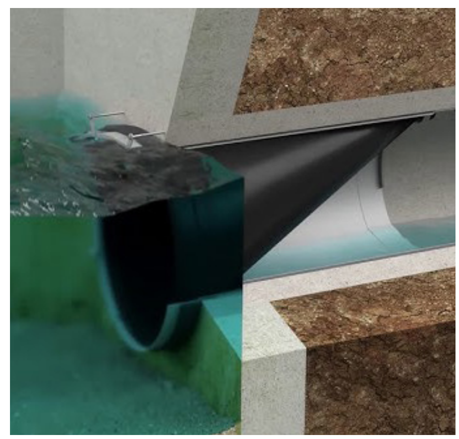
Potential Funding Sources

Local municipality, private sources, State of Connecticut

Project Description

A backflow preventer is an infrastructure device installed in stormwater systems to prevent tidal waters and storm surge from flowing backwards through municipal outfall pipes. During flood events, rising water levels can force water to reverse through the drainage system, causing flooding from street-level storm drains before water overtops coastal defenses. These one-way valves allow stormwater to discharge during normal conditions while automatically closing when water levels rise, making them essential for coastal communities where tidal influence, storm surge, or king tides can push water backwards through the system. They are particularly important in low-lying areas and communities with outfalls below the high tide line, where drainage system backflow can cause regular flooding. Regular maintenance is crucial as debris can prevent proper closure during flood events, compromising their effectiveness as a flood control measure.

Check valve releasing storm water at an outfall at low water level



Check valve preventing storm water from entering an outfall at high water level

Image Credit: WaStop® Inline Check valve. (n.d.).

Recommendation #8 Infrastructure Including Water Infrastructure

Tide Gates

Estimated Cost: $1M/tide gate

Timeframe: 10+ years

Location: Study Area

Anticipated Benefits

- Prevents saltwater intrusion into upstream freshwater systems
- Enables passive flood control during high tides while allowing natural drainage during low tides
- Protects coastal infrastructure and properties from tidal flooding without constant active management

Potential Challenges

- High installation and maintenance costs, requires regular inspection and debris removal
- Can disrupt natural ecosystem processes (fish migration, sediment transport, etc.)
- Prone to mechanical failures from corrosion, sediment buildup, and storm damage, potentially leading to flooding when most needed
- Private property owner agreements including buy-in
- Operations and maintenance responsibility

Responsible Party and Key Partners

Local municipality, private property owners, CT DEEP, beach associations, State of CT

Pre-Development Actions

Conduct a study of the viability of the existing tide gate and potential future tide gate installations, repairs or removals. Engage with local communities, environmental groups, and relevant stakeholders to gather input and address concerns. Develop detailed design and cost estimates. Initiate the permitting process with local, state, and federal agencies, including environmental regulatory agencies.

Project Description

A tide gate is a one-way valve that allows freshwater to flow downstream during low tide but closes automatically when the tide rises to prevent saltwater from moving upstream. Tide gates work best where coastal waters meet freshwater systems in low-lying areas, particularly to protect infrastructure and land from saltwater intrusion while allowing freshwater drainage during low tides. Ideal locations include estuaries, coastal wetlands, or river mouths where natural drainage channels or engineered waterways intersect with tidal waters, and where there's a significant enough tidal range to make the passive operation of the gates effective.

Tide gates present significant challenges despite their utility. High installation and maintenance costs, coupled with environmental impacts like disrupted ecosystems and sediment buildup, often make them impractical. Their effectiveness can be compromised by operational issues including clogging, mechanical failures, and complex permitting requirements. Regular monitoring and maintenance are essential but add to the overall cost and complexity of these systems.

Tide gates should be inspected monthly for debris accumulation, corrosion, and proper hinge operation, with more frequent checks after major storms or flooding events. The typical lifespan is 20-30 years, though this varies based on material (aluminum tends to last longer than steel), environmental conditions, and maintenance quality - replacement should be planned when significant corrosion, seal deterioration, or mechanical issues are observed that can't be addressed through regular maintenance.

Potential Funding Sources

LISFF

Trash Rack Associated with the Chalker Beach Tide Gate

Inside of the Chalker Beach Tide Gate

Recommendation #9 Infrastructure Including Water Infrastructure

Dredging

Estimated Cost: Varies depending on application*

Mechanical

Basic project: $15-$30/CY

Moderate project: $30-$75/CY

Complex project: $75-$150+/CY

Hydraulic

Basic project: $10-$25/CY

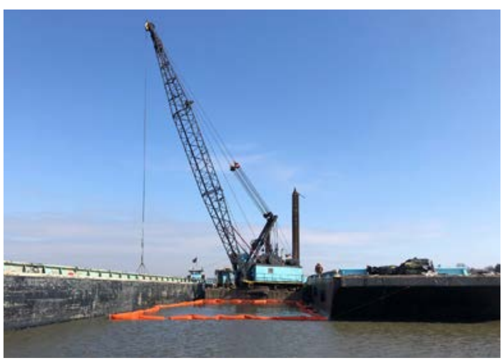
Moderate project: $25-$50/CY

Complex project: $50-$100+/CY

*The complexity of dredging projects means that pricing is based on several factors: engineering and permitting; mobilization; depth and type of sediment; allowable run-times; transport distance; disposal; and water management. Detailed cost estimates must be calculated by a professional engineer on a case-by-case basis.

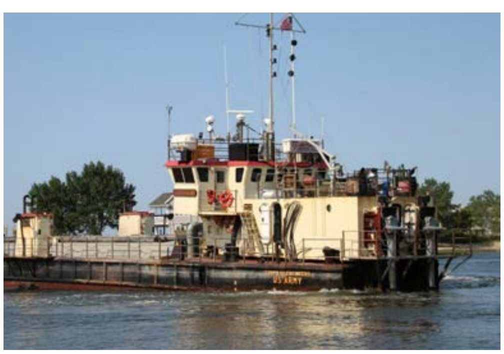
Timeframe: 1-3 years

Location: Study Area



Dredging of North Cove, Old Saybrook, 2018

Image Credit: USACE (2018).



Dredging of Patchogue River, Westbrook, 2022

Image Credit: Patchogue River Dredging Nears End | Dredging Today (2022).

Project Description

Dredging is the process of removing accumulated sediment, debris, and other materials from the bottom of waterways, harbors, and coastal channels to maintain or increase water depth for navigation and flood control. In Connecticut, dredging plays a crucial role in maintaining working waterfronts, ferry channels, recreational boating access, and the overall health of coastal ecosystems by removing built-up sediment that can restrict water flow and impact marine habitats.

Dredging is best suited for areas with natural sediment accumulation patterns, such as river mouths, harbors, and tidal inlets where sand and silt naturally deposit over time. In Connecticut, it helps with coastal resilience by maintaining proper water depths that allow for better tidal flushing, which can reduce flooding during storm events. In some cases, dredged material can be reused for beach nourishment, marsh restoration, and other coastal adaptation projects pending testing for the material's suitability. Dredging projects must be carefully planned and timed to minimize environmental impacts on marine life, water quality, and sensitive habitats, typically occurring during winter months when ecological impacts are reduced. The process requires extensive permitting through state and federal agencies to ensure environmental protection and proper material disposal or reuse.

Anticipated Benefits

- Removing sediment to deepen and widen channels allows improved navigation
- Improves water flow and tidal flushing to reduce flood risks

Potential Challenges

- Complex permitting process involving multiple agencies
- Regular maintenance is required as sediment naturally accumulates

Responsible Party and Key Partners

Local municipality, USACE, CT DEEP, private property owners including marinas, State of CT

Pre-Development Actions

Evaluate the potential effects on local ecosystems, water quality, and wildlife. Complete a hydrographic survey to map the underwater bathymetry of the area to be dredged.

Potential Funding Sources

Local municipalities, USACE

Recommendation #10 Infrastructure Including Water Infrastructure

Bury Utility Lines

Estimated Cost: Varies depending on application and complexity*

$1.2M - $16.8M/mile

Customer cost: $10K-$30K/property

*The cost of burying utility lines will vary depending on environmental factors, regulatory requirements, density of service area, rights of way, existing underground utilities, etc. These costs are preliminary planning estimates only; detailed construction cost estimates must be calculated by a professional engineer in conjunction with the utility companies.

Timeframe: 10+ years

Location: Study Area

Anticipated Benefits

- More reliable service during extreme weather
- Enhanced aesthetics that allow for fuller tree canopies and unobstructed views

Potential Challenges

- High installation costs due to trenching, specialized equipment, and materials needed for underground conduits and waterproofing
- Difficult and time-consuming repairs

Responsible Party and Key Partners

Local municipality, Eversource, other utility companies, State of CT

Pre-Development Actions

Conduct a vulnerability assessment to identify priority locations for underground power line installation. Engage with Eversource and other relevant utility companies to discuss feasibility, costs, and potential partnerships. Perform a cost-benefit analysis comparing underground installation to long-term maintenance of overhead lines. Adjust local regulations to require burying utility lines for all new development and re-development of existing utilities.

Potential Funding Sources

FEMA HMGP, Eversource

Project Description

Burying even a portion of a town's utility lines can significantly reduce hurricane and storm impacts while decreasing power outage risks from high winds and falling trees. This approach offers improved storm resilience, enhanced aesthetics, and reduced long-term maintenance needs in flood-prone coastal communities. However, challenges include saltwater corrosion, potential water ingress, higher initial costs, difficult repairs, and environmental concerns. Engineers address these issues using watertight conduits, corrosion-resistant materials, elevated vaults, strategic line placement, and regular inspections.

In addition to these considerations, underground utility installation faces complex challenges when crossing railroads, requiring specialized boring techniques and extensive permitting to prevent settlement or disruption of rail operations. Wetland crossings demand careful environmental assessment, specialized equipment for unstable soils, and often horizontal directional drilling to minimize ecological impact while existing infrastructure like other utilities, foundations, or rock formations necessitates precise mapping, careful route planning, and sometimes expensive rerouting or specialized crossing methods.

Burying utility lines allows for more extensive tree canopy since it eliminates aerial conflicts, preventing both the need for tree pruning and the risk of power outages from falling branches during storms. This approach supports healthier tree growth and more sustainable forestry practices.

Before and after burying overhead utilities

Image Credit: Undergrounding: The Hidden Helper of Disaster Prep | Kimley Horn (2022.).

Recommendation #11 Infrastructure Including Water Infrastructure

Investigate Long-Term Wastewater Management Solutions

Estimated Cost: To be determined based on size and scope of project*

*The cost for a small-scale community treatment plant will vary depending on site conditions, treatment level, local regulations and permitting requirements, etc. These costs are preliminary planning estimates only; detailed cost estimates must be calculated by a professional on a case-by-case basis.

Timeframe: 10+ years

Location: Study Area

Project Description

Currently, properties within the study area utilize on-site septic systems to handle waste. Municipalities should continue to investigate long-term wastewater management solutions that are designed to be resilient by making some accommodations for projections for future sea level rise. These solutions will most likely be through small-scale community treatment plants or advanced treatment systems. The Water Pollution Control Commission (WPCC) has performed preliminary work concerning wastewater issues, and coordination with the WPCC, the Connecticut River Area Health District, the Department of Public Health, and CT DEEP should be a priority.

For relevant information on wastewater see pages 29, 37, and 45.

Anticipated Benefits

- Improvement of water quality by reducing potential discharge of untreated effluent and stormwater runoff into groundwater and water bodies
- Protection of public and environmental health

Potential Challenges

- Potentially cost-prohibitive
- Environmental and regulatory requirements (permitting, environmental impact studies, code compliance) can add complexity, time, and cost to the project, and may require specialized expertise

Responsible Party and Key Partners

Property owner (local municipality or a private owner), CT DEEP, Department of Public Health, Water Pollution Control Authorities (WPCA), WPCC in Clinton, State of CT

Recommendation #12 Built Environment

Secure Plastic Septic Tanks

Estimated Cost: $2K-$4K/system*

*The cost to secure a plastic septic tank will vary depending on tank size, anchoring system, soil condition, water table, etc. These costs are preliminary planning estimates only; detailed cost estimates must be calculated by a professional on a case-by-case basis.

Timeframe: 1-3 years

Location: Study Area

Project Description

Typically, 9 out of 10 ten tanks installed are made of concrete. However, there are times when a licensed installer chooses to install a plastic septic tank. If used, it is recommended that plastic septic tanks in coastal flood-prone areas be anchored due to several critical factors. During floods, saturated ground can cause tanks to become buoyant, potentially floating or shifting position, especially if they're empty or partially filled. This movement, combined with soil erosion around the tank, can compromise its structural integrity, leading to tilting or rising out of the ground. Septic tank displacement not only damages the tank and connected pipes but also risks sewage leaks, which can contaminate floodwater and pose health and environmental hazards. Anchoring methods typically involve using concrete slabs, earthen anchors, or other robust tethering systems to keep the tank securely in place even under flood conditions.

Securing a plastic septic tank with straps

Image Credit: Methods to Prevent Septic Tank Flotation | OnSite Installer (2019.).

Anticipated Benefits

- Reduced risk of septic tanks floating or becoming displaced when the subgrade is saturated
- Increased durability of the septic tank to prevent leaks and environmental contamination
- Continued functionality of the wastewater treatment system, even under challenging coastal conditions

Potential Challenges

- Higher cost

Responsible Party and Key Partners

Property owner (local municipality or a private owner), Health Department, State of CT

Pre-Development Actions

A comprehensive survey of existing septic systems is recommended to understand the current condition of tanks throughout the community.

Potential Funding Source

Private funding

Recommendation #13 Built Environment

Elevate Structures

Estimated Cost: Varies depending on application

Home elevation costs are determined by foundation type, home size, soil composition, flood zone location, and required lift height. Detailed design and cost estimates must be calculated by a professional engineer.

Timeframe: 1-10+ years

Location: Study Area

Project Description

It is recommended that all structures located in a FEMA-designated special flood hazard area, particularly those experiencing repetitive loss or frequent flood damage be elevated either through self-funded measures or through the help of FEMA funding. Self-funded elevations can be accomplished consistent with the State Building Code and local flood regulations. FEMA-funded elevations need to be set two feet above the 500-year flood elevation. For example, if the BFE is 13 feet and FEMA funds are used, then the design elevation is therefore 13 feet x 1.25 + 2 feet, which is 18.25. FEMA funding may result in significant municipal investment including additional staffing.

The benefits of higher flood compliance in coastal areas are significant - elevating structures above base flood elevation and implementing proper drainage systems typically results in lower insurance premiums while providing enhanced flood protection and potential property value increases.

Several factors determine the complexity of structural elevation, including the presence of basements, building age, size, and existing structural reinforcement. Each property requires individual assessment to weigh the potential risks and benefits of elevation.

Common elevation methods include raising buildings on piles, modifying site topography, or abandoning the first floor. These approaches protect against wave action and flooding while often reducing insurance premiums. The space below elevated structures can be repurposed for parking, storage, or entryways, providing practical benefits alongside risk mitigation.

A comprehensive plan is needed to address forced elevation to ensure homeowners are informed and prepared for potential changes.

Anticipated Benefits

- Reduced risk of flood damage to structure and utilities
- Reduced flood insurance costs
- Additional parking and storage space under the first floor

Potential Challenges

- Potentially cost-prohibitive and adversely affect access to the structure and visual appearance
- Elevation may not be feasible for some structures
- Navigating land use regulations

Responsible Party and Key Partners

Property owner (local municipality or a private owner), State of CT

Pre-Development Actions

Complete structural surveys of homes considered for elevation to ensure their suitability for elevation. Review the local zoning and building codes regarding building heights, setbacks, and elevation requirements.

Potential Funding Sources

Private property owners, FEMA HMGP, FEMA Flood Mitigation Assistance Grant (FMA)

Elevated structures on Beach Road W, Old Saybrook

Recommendation #14 Built Environment

Elevate Equipment

Estimated Cost: Varies depending on application

Timeframe: 1-3 years

Location: Study Area

Anticipated Benefits

- Improve building functionality and reduce downtime during and after flood events
- Decrease the risk of costly damage to essential systems
- Enhance safety for building occupants by maintaining critical services during emergencies
- Potential reduction in insurance premiums and increased compliance with flood regulations

Potential Challenges

- Equipment elevation may interact with fire code
- Large commercial retrofits may need structural reinforcements for heavy equipment

Responsible Party and Key Partners

Property owner (local municipality or a private owner), building officials, State of CT

Pre-Development Actions

Conduct a comprehensive inventory and risk assessment of existing critical equipment in flood-prone areas. Develop preliminary design guidelines and cost estimates for typical equipment elevation scenarios. Establish a prioritization framework to identify high-risk buildings and critical infrastructure for immediate action.

Potential Funding Sources

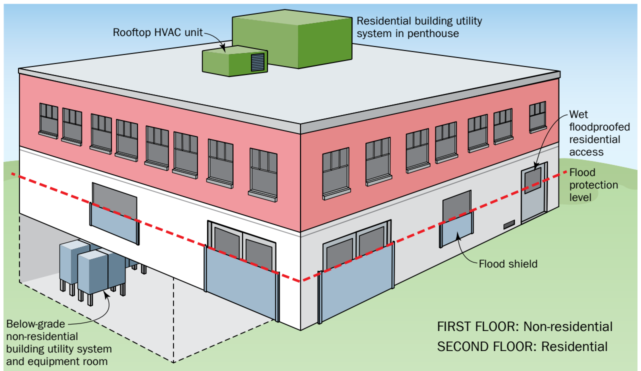
Community Investment Fund 2030, FEMA HMGP, FEMA FMA

Project Description

With increasing coastal flooding from extreme weather events, the elevation or relocation of critical equipment such as electrical boxes, HVAC equipment, and communications systems from flood-prone areas is crucial for building resilience. Equipment should be moved to upper floors or rooftops. When relocation isn't feasible, equipment must be elevated above the design flood elevation (DFE), which combines the base flood elevation (BFE) and required freeboard. Freeboard is the additional height that a structure is protected from flood waters above the BFE.

Critical facilities in the 500-year flood zone should elevate essential equipment and utilities at least 3 feet above the 500-year flood elevation or at least 2 feet above the BFE plus freeboard requirements to ensure continued operation during extreme flood events.

NFIP compliance requires properties within coastal flood zones (AE, Coastal AE, and VE) elevate equipment above BFE for new construction and substantial improvements/damage. Local regulations mandate utility elevation for all structures, with new equipment installations requiring elevation in flood zones. Properties in areas identified as currently experiencing or projected to experience future inundation (detailed on pages 79 through 112) should prioritize elevating their critical equipment.



Elevated mechanical infrastructure on a mixed-use building

Image Credit: Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings | FEMA (2021)

Elevated equipment

Image Credit: FEMA, Liz Roll

Recommendation #15 Policies & Programming

Land Use Regulations

Estimated Cost: Varies depending on staff or consulting work

Timeframe: 1-3 years

Location: Study Area

Project Description

It is recommended that each municipality review current land use regulations, ordinances, and plans and re-evaluate current standards and policies relating to coastal development and flood-impacted neighborhoods. These measures should be designed to help communities better withstand and recover from coastal flooding, improve resiliency, and limit the potential impact of coastal flooding and erosion patterns in vulnerable neighborhoods. At a minimum, regulations and plans should include the review of current Zoning Regulations, Standards for Public Improvements, Subdivision Regulations, Coastal Area Management, Flood Plain Regulations, Plans of Conservation & Development, and Natural Hazard Mitigation Plans. These evaluations should consider ideas to make the permitting process more efficient and incorporate higher resiliency standards.

Anticipated Benefits

- A higher base flood elevation reduces the risk of flood damage to structures and their contents
- Buildings elevated above flood levels typically qualify for reduced flood insurance rates due to lower risk
- Reduced risk of life and property from coastal risks

Responsible Party and Key Partners

Local municipality boards and commissions, State of CT

Potential Funding Source

Municipal operating and capital budgets

Suggested regulations and plan amendments could include:

Adopting FEMA's higher standards in local Zoning Regulations or Flood Plain Management Ordinances by adding freeboard (FEMA Base Flood Elevation [BFE] plus 3 feet for new construction or elevations) to create a new Design Flood Elevation (DFE) and enhance resiliency for the community.

Adopting new Zoning Regulations that incorporate more flexibility and allow for the elevation of non-conforming residential structures in flood-prone areas through administrative permits, without requiring variances for bulk standard regulations such as height and setbacks. The regulations allow for Building Code-required stairs, landings, and utility platforms of minimum size within setbacks and in circumstances where the structure exceeds building/structure coverage requirements. This encourages voluntary building elevations and expedites permitting. Consider extending these provisions to areas that are projected to experience future flood risk from sea level rise, and include disaster recovery provisions that expedite post-emergency reconstruction permitting.

Evaluating the zoning rules regarding how building height is measured in the floodplain. Establish design standards to mitigate the visual impact of increased building heights that result in exposed piers, piles, and open spaces beneath structures.

Creating an overlay zone for structures within Special Flood Hazard Areas to limit the expansion of residential structures and reduce loss of life and property during flood events. Write the regulation to limit building/structure coverage and gross floor area to less than the current maximums allowed, or reduce these maximums. Consider prohibiting variances to prevent the Zoning Board of Appeals from granting exceptions.

Requiring all new construction and substantial improvements in Special Flood Hazard Areas to utilize either wet floodproofing (allowing floodwaters to enter and exit a structure through flood vents/openings) for residential structures, or dry floodproofing (making the structure watertight below base flood elevation) for non-residential buildings.

Amending all Town Regulations, Ordinances, and Plans to encourage and require low-impact development designs, such as green infrastructure or permeable materials for driveways, walkways, and patios. The purpose is to better manage stormwater and encourage more permeable surfaces, particularly in Special Flood Hazard Areas where water infiltration and drainage are issues.

Recommendation #16 Policies & Programming

Managed Retreat

Estimated Cost: $2M - $3M/ acquisition*

*The cost for managed retreat varies depending on the value of the acquired property, land acquisition costs, etc. These costs are preliminary planning estimates only and include the real estate acquisition, building demolition, and removal of utilities and roads; detailed cost estimates must be calculated by a professional.

Timeframe: 10+ years

Location: Study Area

Anticipated Benefits

- Reduced private and government expenditures for emergency response, clean-up, and rehabilitation
- Natural area expansion and restoration
- Reduced risk of life and property from coastal risks

Potential Challenges

- Limited access to suitable land for land swaps
- Public hesitation or loss of tax-base
- Funding land acquisitions

Responsible Party and Key Partners

Local municipality. Council of Governments, CT DOH, CT DEMHS, NOAA, local land trusts, State of CT

Pre-Development Actions

Identify priority areas for voluntary buyouts and land acquisition. Locate public uplands suitable for exchange with flood-prone private properties. Develop an incentive program that can be implemented by the municipality. Consider creating a regional or shoreline-wide program.

Potential Funding Sources

FEMA HMGP, FEMA Pre-Disaster Mitigation, CT Community Development Block Grant, USDA Natural Resources Conservation Service (NRCS), Open Space & Watershed Land Acquisition Grant

Project Description

Managed retreat is a voluntary, proactive strategy that relocates residents, structures, and assets from flood-vulnerable areas to safer locations. This approach requires community support and provides financial and technical assistance to help residents move to lower-risk areas. Although this may not be the most desirable alternative, there may come a time when locations are inundated for extended periods making them uninhabitable. Implementing a managed retreat plan prepares communities for areas that may become uninhabitable due to repetitive flooding. The strategy typically includes home buyout programs and targeted land acquisition. This approach not only protects lives and property but also prevents significant public and private losses while restoring natural flood retention capabilities of shoreline areas, enhancing overall community resilience.

Key considerations for managed retreat include:

Thresholds: Towns must define clear thresholds for when retreats or buyouts should be implemented, balancing the costs of relocation with the benefits of preserving community safety.

Land Options and Density: Since the municipalities are already built out, options for relocating communities within existing areas should be explored with possibly planning for increased density in less vulnerable areas with suitable soils.

Tax Base and Community Loss: Relocating or losing homes could significantly impact local economies, as houses contribute to the tax base. Developing strategies for maintaining or replacing revenue is essential.

Population Shifts: Municipalities should plan for the shifting of populations, ensuring that new areas for relocation are capable of accommodating displaced residents and businesses.

Horizon Planning and Funding: Long-term planning should be tied to a clear horizon for when retreats or buyouts are necessary. Funding mechanisms for these strategies are expected to evolve, so towns need to anticipate changes in available financial support for relocation efforts.

Following Superstorm Irene and Superstorm Sandy in 2013, West Haven, Connecticut initiated a federal buyout program in the Old Field Creek neighborhood. The project demolished 25 homes initially, with plans for 39 more, to restore the area to its pre-1920s wetland state. This managed retreat aims to improve flood mitigation by creating drainage basins and redirecting water flow away from remaining residential areas.

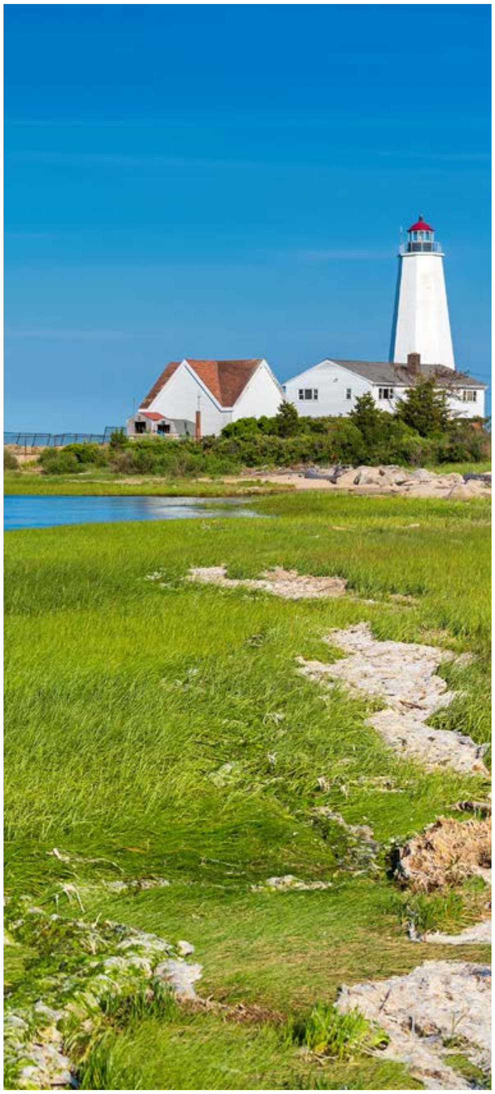
Recommendation #17 Policies & Programming

Participate in the Community Rating System

Estimated Cost:
Municipality: $5K-$15K/year
Consultant: $15K-$20K

Timeframe: 1-3 years

Location: Study Area



Marshland by the Lynde Point Lighthouse, Fenwick

Project Description

The Community Rating System (CRS) is a voluntary incentive program through FEMA that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program (NFIP). In CRS communities, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community's efforts. Upgrading participation is a way to ensure flood insurance rates remain affordable to property owners. CRS communities receive flood insurance premium discounts from 5% to 45%, in 5% increments. Class 10 communities don't participate and get no discount. Discounts increase from 5% for Class 9 to 45% for Class 1 communities.

Over 1,500 communities participate nationwide. 13 communities in Connecticut, none of which are in the study area, participate in the program ranging from class 7 to class 9. Within those 13 communities, there are 9,882 policies in force with $11.6M in premiums. It is realistic in Connecticut to be in the class 7 to class 9 range meaning discounts will not exceed 15% within the study area.

Anticipated Benefits

- Discounts on flood insurance may enable some community members to purchase flood insurance who have not in the past
- Participation slightly elevates the function of floodplain managers and requires an annual review of policies and practices to maintain program status

Potential Challenges

- Adopting stricter building standards, such as increased freeboard or lower thresholds for substantial improvements, may face pushback due to higher up-front costs for developers and property owners
- Participation in this program is time-consuming, requires considerable staffing, and is costly for municipalities

Responsible Party and Key Partners

Local municipality, CT DEEP, FEMA, State of CT

Pre-Development Actions

Notify the FEMA Regional Office of your community's interest. Submit a CRS application with documentation of implemented activities for which credit is requested. Complete a site verification visit. Annually verify the continuation of credited activities through re-verification submissions.

Potential Funding Sources

Lower CT River Valley Council of Government

Recommendation #18 Policies & Programming

Offer Community Training & Education

Estimated Cost: Varies depending on application*

Resident education: up to $100K annually

Professional education: up to $25K/ training

*The cost for training and education will vary depending on the number of trainings, materials provided, available resources, etc. These costs are preliminary planning estimates only; detailed cost estimates must be calculated on a case-by-case basis.

Timeframe: 1-3 years

Location: Study Area

Project Description

Educate residents and property owners about the steps they can take to reduce their risks to climate impacts to protect life and property. Existing and future programs should be accessible through public engagement. This includes offering training sessions, workshops, walking tours, and resources, such as grant information and guidance online and in person. Programs should include easily understandable educational materials, complemented by training and support services. Key topics should cover home retrofitting for climate resilience, installation of green infrastructure on private properties, costs and processes involved in structure and critical equipment elevation, and emergency preparedness including critical resources for individuals isolated due to flooding. By fostering community awareness and empowering individuals with knowledge and resources, these programs aim to build broad community resilience against climate-related challenges.

Building business resilience is crucial to maintaining the area's economic stability. Business owners need comprehensive education about protective measures and continuity planning. Critical to this effort is ensuring businesses understand and can access available financial resources—including grants, low-interest loans, and appropriate insurance coverage—to help them prepare for, survive, and recover from severe weather events.

Collaboration with local emergency management teams is essential to align resiliency training with disaster preparedness plans, ensuring a coordinated response during crises. The goal is to enhance disaster preparedness and resource management at the community level.

A key component of this approach is the implementation of targeted resilience training programs for contractors and municipal officials, who play crucial roles in implementing resilience measures at the community level. These educational initiatives should focus on best practices for resilient design, construction techniques, and effective policy-making. By equipping these key stakeholders with essential knowledge and skills, communities can more effectively promote resilience, ultimately reducing risks to life and property.

Anticipated Benefits

- **Resident:** Increased individual awareness and preparedness for climate-related events; Reduced potential damage to private property from climate impacts; Reduced government and private expenditures for clean-up, rehabilitation, and emergency response; Empowerment of residents to take proactive measures in protecting their homes and families
- **Professional:** Enhanced decision-making capabilities for community planning and development; Improved understanding and integration of climate risks and adaptation strategies in local projects; Improved coordination between different sectors and departments in addressing climate challenges; Potential cost savings through early integration of resilience measures in projects

Responsible Party and Key Partners

Local municipality, CT DEEP, regional planning councils, academic institutions, Connecticut Sea Grant, beach associations, State of CT

Pre-Development Actions

- **Resident:** Conduct a community needs assessment to identify knowledge gaps and specific local climate risks. Develop a comprehensive curriculum covering key resilience topics tailored to the local context. Identify and engage local experts and partner organizations for program development and delivery. Secure funding and resources for creating educational materials and implementing the program.
- **Professional:** Develop a comprehensive curriculum covering relevant resilience strategies and best practices. Partner with local and state agencies and other organizations to host trainings and workshops. Secure funding and resources for the training program, including potential grants or partnerships. Establish evaluation metrics to measure the program's effectiveness and impact on local resilience efforts.

Potential Funding Sources

Long Island Sound Community Impact Fund, Connecticut Sea Grant

Educational walking tour through the study area

Connecticut Community Resilience Building Workshop

Image Credit: Community Resilience Building | The Nature Conservancy (2025).

Beach Road West, Old Saybrook
August 2011

Project Profiles

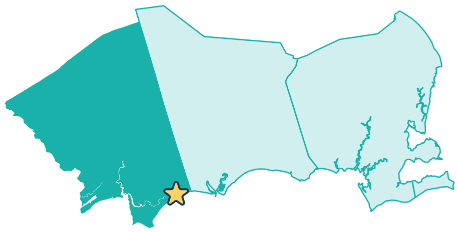
Municipality-Specific Focus Areas

This section describes site-specific projects in each municipality recommended to improve resilience throughout the Towns of Clinton, Westbrook, Old Saybrook, and the Borough of Fenwick. Of the 21 total recommended projects, 8 are considered a priority and have accompanying project profiles describing the concepts in greater detail. Each project is designed to address identified needs from the community, the Executive Committee, and the vulnerability and risk assessment. General estimates of time frame and cost are included.

Clinton **Project #19**

Shore Road, Causeway, & Groveway

Location:



Existing Challenges: Rising tides increasingly threaten the Causeway and surrounding coastal areas. During high tides, water levels approach the seawalls protecting Grove Beach and Groveway's lower-lying properties, with storms causing frequent overtopping and property flooding. The situation has grown more severe over time, with accelerating beach erosion undermining coastal defenses. Coastal conditions have begun to compromise local septic systems, challenged by both surface flooding and elevated groundwater levels from sea level rise. During storms, road flooding disrupts local traffic patterns and emergency access. These challenges affect multiple beach associations throughout the Shore Road area.

Resiliency Measures to Consider

1 Natural Shoreline Fortification. Natural shoreline protection through vegetated dunes could protect unfortified beachfront properties. Limited lot sizes and narrow shorelines pose implementation challenges. A robust dune system would offer multiple benefits - dissipating waves, reducing floods, trapping sediment, and adapting to sea level rise. This approach requires careful study of beach nourishment needs and substantial coordination between property owners The municipality could potentially support the initiative through design and permitting assistance. The coordination between public and private entities is a complex arrangement. See pages 125-126.

2 Structural Shoreline Fortification. Strengthening coastal defenses in this area would involve several key structural improvements like elevating existing seawalls and addressing gaps in the current barrier system. The challenge of closing seawall gaps is twofold: obtaining permits for new wall sections where none currently exist, and establishing a uniform elevation height that satisfies all property owners. Given that beach access remains a vital amenity for coastal residents, any new seawall construction or shoreline fortification must be carefully designed to maintain convenient beach access while providing effective flood protection. See pages 127-128.

3 Marsh & Wetland Management. Thin layer deposition to raise tidal marshes is a new/emerging field in CT, with one pilot project beginning. This should be made clear- that while it may be an option, the Town may want to consider it as a more regional measure for discussion with the other towns. See page 129-130.

4 Elevate Road. The 2070 tidal model projects water depths of 2'5" on the Causeway. Consider a 3-foot elevation to maintain access during future tidal events. This presents minimal technical challenges due to the absence of driveway connections. See pages 131-132.

5 Stormwater Management. Implement rain gardens and other vegetated buffers along roads and at residences to improve water infiltration and absorption. Stormwater management is a good tool but not a major driver of resiliency in this neighborhood. See page 134.

6 Secure Plastic Septic Tanks. All flotation-prone items should be secured or relocated to prevent displacement during flood events. This is particularly critical for septic tanks, which can become buoyant and cause severe environmental and health hazards if dislodged. Proper anchoring systems should be installed for these essential infrastructure components. See page 140.

7 Elevate Structures and Equipment. Consider elevating homes on Shore Road and Groveway that experience routine flooding and property damage. This would mostly be through private investment. It is encouraged that the Town provide public education/ outreach to encourage voluntary action and incentives to exceed minimum elevations for future resiliency. In areas that experience routine flooding relocate any electrical or other critical equipment to the second floor of a structure or elevate to a minimum of +2 feet BFE, also known as the design flood elevation (DFE). See pages 141-142.

8 Land Use Regulations. Implementing a coastal overlay district would provide a comprehensive framework for managing development in this barrier beach setting, helping mitigate future flood impacts and wastewater management challenges. Such an overlay could establish consistent standards for building elevation while incorporating ground coverage limitations that align with floor area ratio provisions. The overlay district could also include incentive-based measures to encourage reduced impervious coverage, enhancing the area's resilience to coastal hazards. See pages 143-144.

Resiliency Measures Key Map

Areas of Particular Interest

The Causeway

Intersection of Causeway, Groveway and Shore Road

Measures Not Shown

6 7 8

Grove & Commerce Street Area, Town Dock, & Riverside Drive

Location:

Existing Challenges: This area includes one of the Town's primary areas for water-dependent uses, and public access. These uses have unique adaptation issues because they must be located at the edge of the water. This area is at the heart of the Town's harbor and economy and is a cornerstone of tourism and municipal identity. The Clinton Town Dock area faces regular flooding, exacerbated by a nearby filled-in historic marsh. During flood events, Riverside Drive and the intersection of Commerce Street and Grove Street often become impassable, limiting emergency access. Local marshlands are diminishing due to sedimentation, reducing the area's natural flood storage capacity. Over time, the marshes have been altered to accommodate marina activities.

Resiliency Measures to Consider

1 Structural Shoreline Fortification. Bulkheads should be elevated/heightened as needed to keep up with rising mean high high water (or other design criteria), but they will not offer flood protection unless they are incorporated into a comprehensive system of walls without gaps and disjointed sections. See pages 127-128.

2 Marsh & Wetland Management. Thin layer deposition to raise tidal marshes is a new/emerging field in CT, with one pilot project beginning. This should be made clear- that while it may be an option, the Town may want to consider it as a more regional measure for discussion with the other towns. The FEMA SFHA covers most of this area and would continue covering the area whether more space or less spaces was created for marshes. See pages 129-130.

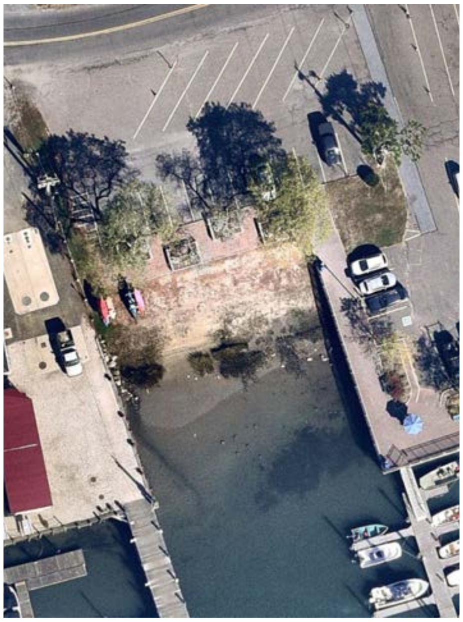
3 Install Backflow Preventers. Install backflow preventers to stromwater pipes and public outfall pipes to avoid stormwater backflow into structures and streets like the Grove and Commerce Street intersection. See page 135.

4 Secure Plastic Septic Tanks. All flotation-prone items should be secured or relocated to prevent displacement during flood events. This is particularly critical for septic tanks, which can become buoyant and cause severe environmental and health hazards if dislodged. Proper anchoring systems should be installed for these essential infrastructure components. See page 140.

5 Elevate Structures & Equipment. Consider elevating business structures that receive repetitive inundation to meet the BFE regulations for elevating structures. A decision process is recommended for evaluating structure elevation as opposed to floodproofing for businesses. In areas that experience routine flooding relocate any electrical or other critical equipment to the second floor of a structure or elevate to a minimum of +2 feet BFE, also known as the design flood elevation (DFE). See pages 141-142.

Resiliency Measures Key Map

Areas of Particular Interest



Espacito Beach

Town Boat Launch

Intersection of Grove Street and Commerce Street

Measures Not Shown

4 5

Additional Clinton Focus Areas

Project #21 Clinton Policy & Practice

It is recommended that all capital and regulatory decisions must include formal resilience assessments and discussions. Establish clear communication protocols between public and private stakeholders for coordinated project planning, approvals, and resource allocation. Define roles, timelines, and approval processes upfront.

Project #22 Clinton Town Beach Nourishment & Fortification

Clinton Town Beach is a defining local feature and community asset that contributes to the desirable amenities Clinton offers. Clinton is currently pursuing two projects that will have resiliency implications. The first is the preliminary analysis by RACE Coastal Engineers to address erosion in the area south of the main beach. The second is the future reconstruction of the Waterside Lane bridge, which will affect the mouth of the Hammock River. Clinton Town Beach has been subjected to severe erosion, with the effects becoming increasingly pronounced as one moves further out onto the point. The situation recently escalated when a portion of the bluff collapsed, causing significant land loss. The remaining strip of land is narrow with Clinton Harbor on one side and the Hammock River marsh on the other.

Natural Shoreline Fortification Provide clarification about basic design criteria of a living shoreline that would be appropriate in this area (width, type of vegetation, sills or no sills, etc.). To address long term erosion, it is recommended that a living shoreline of native, salt-tolerant plants be constructed on the southern edge of Clinton Town Beach to stabilize the shoreline against wave action and storm impacts. Consider incorporating a 10-20 foot marsh fringe, a 15-30 foot sill or breakwater zone, and buffer space for upland vegetation. See page 125-126.

Dune Management & Beach Nourishment It is recommended that Clinton Town Beach implement beach nourishment to replace the displaced sand. At a minimum, evaluate the sediment needs for beach nourishment and analyze the feasibility of potentially using materials already in the harbor. To minimize the loss of the newly nourished sand, assess the existing condition and ability of the groins to retain the sand. Repair any deteriorating groins. Construct a vegetated dune system behind the beach. A sufficient coastal beach and dune system can dissipate wave energy, trap sediments, and be adapted to rising sea levels. This approach provides multiple benefits including improved resiliency, recreation, and habitat. See pages 125-126.

Structural Shoreline Fortification Consider constructing offshore segmented breakwaters to attenuate wave energy and reduce erosive forces acting on the shoreline. The design of offshore breakwaters would have to include navigation considerations given the proximity of the site to a navigation channel. See page 127-128.

Project #23 Meadow Road Area Improvements

Meadow Road has several industrial facilities and residences that require continuous access during tidal flood events. While the road currently does not experience tidal flooding, models project that by 2070, portions of Meadow Road could be inundated with water depths up to 1’9” during such events.

Natural Shoreline Fortification Evaluate the feasibility of constructing earthen berms along the eastern edge of the Hammock River at the west end of Elm Street, Walnut Street, and Chestnut Street to reduce inundation during high tides and the Hammock River swell. This approach would improve the resiliency of the neighborhood under rising sea levels and is a natural feature that can be integrated with the surrounding existing wetlands. These features could help to reduce flooding of properties adjacent to the existing wetland. See page 125-126.

Elevate Road To address road future flooding on Meadow Road, consider raising the segment between Route 1 and 41 Meadow Road from its current 2-foot elevation to 4 feet. This 2-foot increase would improve the road’s resilience to tidal nuisance flooding. This specific section is ideal for elevation because it lacks residential properties, eliminating common challenges such as matching driveway grades or managing water displacement. The proposed change would enhance road safety and accessibility during flood events without disrupting existing property access. See pages 131-132.

Widen Culvert Evaluate the expansion of the Hammock River culvert beneath Meadow Road, specifically in the section between Route 1 and 14 Meadow Road. Increasing the culvert’s capacity would enhance water flow underneath the road, potentially reducing surface water accumulation and overflow onto the roadway during heavy rainfall or flood events.

Project #24 Town Center Area

Where East Main Street crosses the Indian River, the culvert fills completely, leaving no excess capacity for flood waters. This poses a significant risk to critical facilities in the area, specifically the Clinton Fire Department and Town Hall, which are vulnerable to flooding from the Indian River. The lack of additional drainage capacity threatens these essential municipal services during high water events. Clinton’s Town Hall parking lot and Fire Department are located within the 100-year floodplain. While the Town Hall building itself is outside the floodplain and has avoided direct flooding, its parking lot has a history of inundation. The Town Hall features a popular public access point to the Indian River, valued by the community. The Fire Department has developed a proactive approach to flooding, relocating equipment before anticipated flood events to maintain emergency response capabilities if the firehouse becomes inaccessible. If/when Amtrak undertakes rail line improvements or its own resiliency projects, local plans for Downtown and resiliency projects will be impacted. Early coordination is needed with Amtrak and DOT for projects in the Town Center area.

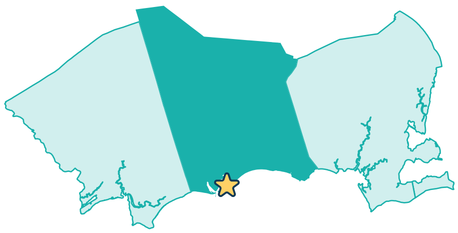
Elevate Road To improve water flow under the Indian River bridge on East Main Street, consider raising the road segment between Snow Lane and Cemetery Road from its current 8-foot elevation to 11 feet. While the road currently experiences up to 4 feet of inundation during a 100-year storm event, this projected 3-foot increase would result in approximately 1 foot of standing water on the road. However, even this reduced depth approaches the upper limit of what most standard emergency vehicles can safely navigate. Emergency responders would need to exercise extreme caution when accessing this area during flood conditions. The plan would require grading road segments east and west of the bridge to meet the new elevation, as well as adjusting entrances to parking areas to align with the raised road grade. This approach would boost the area’s flood management capabilities. Coordination with CT DOT is important, especially as CT DOT advances its own vulnerability study of State roads. See pages 131-132.

Managed Retreat Continue to evaluate opportunities to relocate the fire department outside the 100-year floodplain. The new site should prioritize quick access to major roads for fast emergency response, reliable utility connections, and space for future expansion to meet growing community needs. Consider redeveloping the current Fire Department property into a floodplain park designed to store excess water during flood events. See page 145.

Westbrook **Project #25**

West Beach/Coral Sands/Pilots Point Area Improvements

Location:



Existing Challenges: The neighborhood faces several interconnected drainage and flooding issues. Several catch basins in this area experience backflow. Storm drains along Seaside Avenue frequently clog with sand and sediment, significantly impeding stormwater removal. This problem is compounded during high tides and storms, when Tarpon, Dolphin, and Striper Avenues experience flooding from the northern creek, resulting in damage to homes and vehicles. The situation is exacerbated by the low-lying outfall at the end of Striper Avenue. Access to Pilots Point Drive is often compromised due to flooding of storm drains at its entry point. Environmental factors contribute to these issues, with areas of dune vegetation removal weakening the dunes' structural integrity. Seaside Avenue faces additional flooding challenges, primarily from the marsh located north of the residential properties. During high tide conditions and storms, surge overtops West Beach and Coral Sands.

Resiliency Measures to Consider

1 Dune Management. Maintain the protective profile of the West Beach dunes through regular monitoring and management, while preserving and enhancing their native salt-tolerant vegetation cover. Healthy dune vegetation is essential for stabilizing sand and preventing erosion. See pages 125-126.

2 Structural Shoreline Fortification. Existing bulkheads should be elevated as needed to keep up with the rising mean high high water (MHHW) line. However, this recommendation will only provide effective flood protection if the bulkheads are part of a comprehensive, continuous wall system. Several practical challenges exist in achieving this continuity - particularly where homes are built up to street ends and require driveway access. Additionally, since boat and dock access is an important amenity along the shoreline, especially in Pilot's Point, any bulkhead elevation will need to be coordinated with modifications to docks and pier structures to maintain water access. Beyond these shoreline structures, the Town should continue to maintain the West Beach Jetty system. See pages 127-128.

3 Elevate Roads. To enhance flood resilience a 2-foot elevation increase is recommended for Tarpon, Dolphin, and Striper Avenues. This recommendation presents technical challenges for driveway connections. Properties with shorter driveways require attention, as they must be regraded to meet the new road elevation. To address these constraints, engineering solutions and innovative design should be evaluated on a case-by-case basis. See pages 131-132.

4 Stormwater Management. Install storm drain inlet protection bags along Tarpon, Dolphin, and Striper Avenues, at the Marina District entrances, and along Seaside Avenue. Remove and clean the inlet protection bags once they are 50% full or after a storm event. See page 134.

5 Install Backflow Preventers. Install backflow preventers to stromwater pipes and public outfall pipes to avoid stormwater backflow into structures and streets. See page 135.

6 Tide Gate. Consider conducting a study to determine if a tide gate is feasible at the bridge to the Safe Harbor Marina/Pilots Point North Yard. See page 136.

7 Secure Plastic Septic Tanks. Secure or relocate all flotation-prone items to prevent displacement during flood events. This is critical for septic tanks, which can become buoyant and cause severe environmental and health hazards if dislodged. Proper anchoring systems should be installed for these essential infrastructure components. See page 140.

8 Elevate Structures. Elevating structures is often feasible and cost-effective, particularly for homes on Tarpon, Dolphin, Striper, and Seaside Avenues that experience routine property damage. Homeowners should take the steps to elevate their homes independently when feasible. The Town may consider helping a private homeowner through FEMA Hazard Mitigation Assistance (HMA) grant funding if the property has documented repetitive flood losses, is in a high-risk flood zone, fits within the community mitigation strategy, and the property owner participates in the cost-sharing requirements. Many homes in this area have been elevated. See page 141.

9 Elevate Equipment. Relocate any electrical or other equipment to the second floor of a structure or elevate to a minimum of +2 feet BFE). See page 142.

Resiliency Measures Key Map

Conceptual Images

The above images represent where coastal resiliency measures could be considered in a general sense.

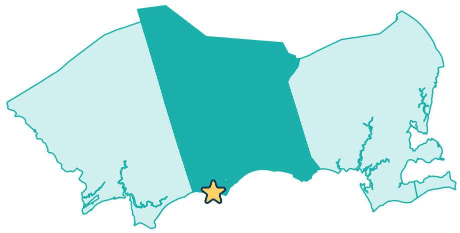
Measures Not Shown

7 6

Westbrook **Project #26**

Old Mail Trail Area Improvements

Location:



Existing Challenges: Old Mail Trail, situated between the Long Island Sound and the Menunketesuck River salt marsh, experiences frequent disruptions due to sunny day flooding, nuisance flooding during high tides and flooding from minor rain events, both affecting road navigability. Shoreline erosion has led to loss of land, with high tides reaching halfway up seawalls, causing waves to crash against walls and spill over houses into the street. Similarly, repetitive wave action has resulted in beach sand deposition into Old Mail Trail. The Menunketesuck River is experiencing increased sediment settling, resulting in decreased navigability of the waterway and reduced access to marinas. East of Menunketesuck Road, the absence of adequate storm water drainage infrastructure causes water pooling on the road, creating impassable conditions and stranding residents.

Resiliency Measures to Consider

1 Natural Shoreline Fortification. Introduce vegetation along the back of the beach to create a natural buffer and help absorb wave energy, reducing shoreline erosion. Implement vegetated sills along the shoreline. Sand from the beaches in this area have been washed out into the Long Island Sound. Consider beach nourishment along Old Mail Trail. See pages 125-126.

2 Structural Shoreline Fortification. Groins along the Long Island Sound have deteriorated over time and no longer function efficiently. Rebuild and maintain the groins to decrease erosion and sand displacement. Repair the Duck Island Breakwater as needed. Inspect the breakwater annually to identify necessary maintenance. Repair existing seawalls to protect properties. See pages 127-128.

3 Elevate Road. The eastern section of Old Mail Trail sits at an elevation of approximately 4 feet. To enhance flood resilience, particularly against tidal nuisance flooding and sunny day flooding, a 2-foot elevation increase is recommended. While this adjustment offers moderate protection benefits, it presents technical challenges for driveway connections. Properties with shorter driveways will require particular attention, as they must be regraded to meet the new road elevation. To address these constraints, a combination of engineering solutions and innovative design approaches should be evaluated on a case-by-case basis. See pages 131-132.

4 Stormwater Management. Install storm drain inlet protection to the drain inlets along Old Mail Trail. Clear and reset the inlet protection after major flooding events and as needed. See page 134.

5 Dredging. Remove sediment from the Menunketesuck River outlet that has settled over time to allow for better water navigability. Evaluate the use of dredged sediment material for filling marsh sills to build them up to protect properties in the Old Mail Trail area. See page 137.

6 Secure Plastic Septic Tanks. All flotation-prone items should be secured or relocated to prevent displacement during flood events. This is particularly critical for septic tanks, which can become buoyant and cause severe environmental and health hazards if dislodged. Proper anchoring systems should be installed for these essential infrastructure components. See page 140.

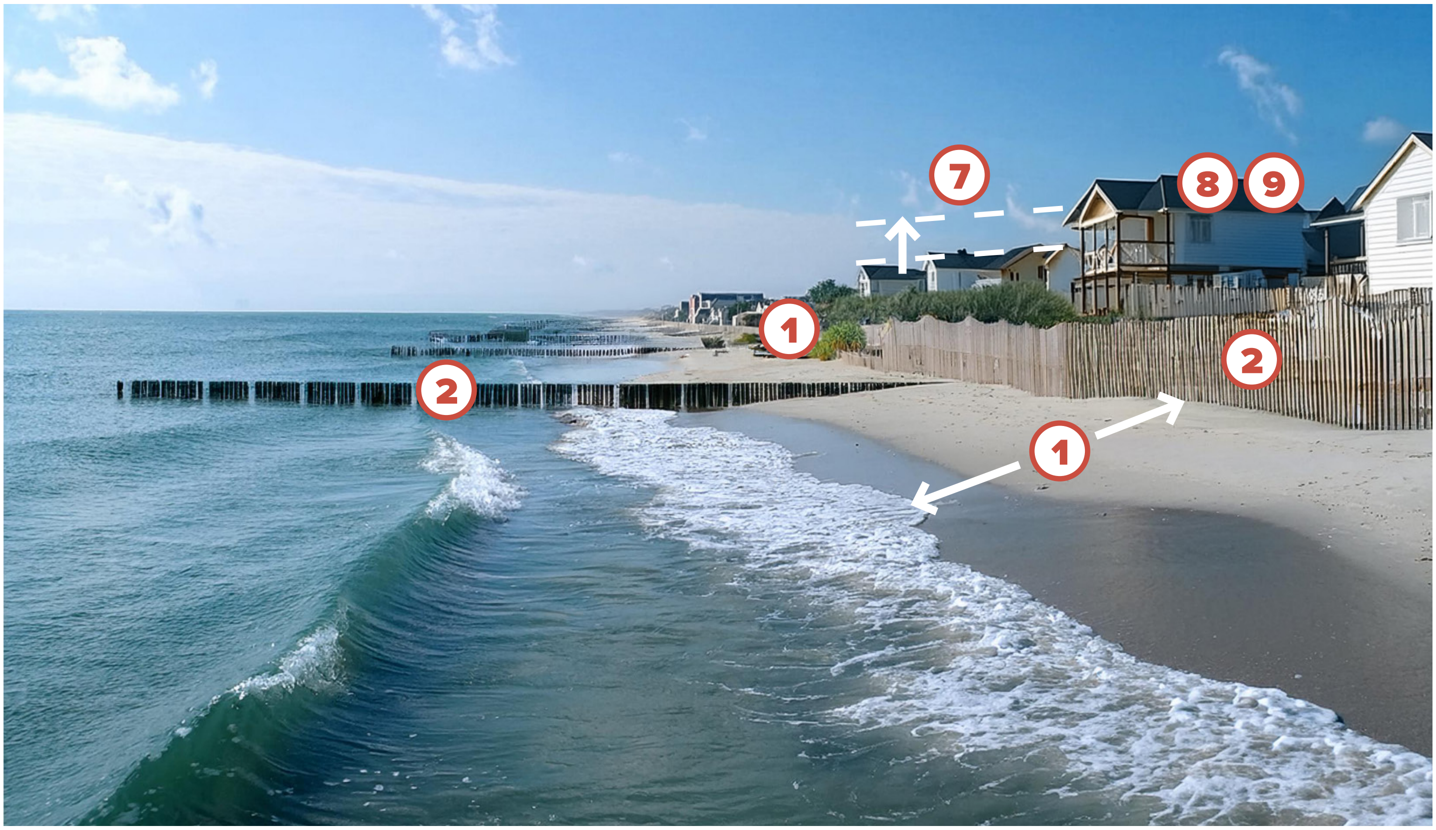
7 Elevate Structures. Elevating structures is often feasible and cost-effective, particularly for homes on the eastern end of Old Mail Trail that experience routine property damage. It is encouraged that homeowners take the steps to elevate their homes independently when feasible. The Town may consider helping to elevate a private homeowner's house through FEMA Hazard Mitigation Assistance (HMA) grant funding if the property has documented repetitive flood losses, is located in a high-risk flood zone, fits within a broader community mitigation strategy, and the property owner agrees to participate in the cost-sharing requirements, all of which demonstrates a clear public benefit in reducing future disaster costs. Many homes in this area have already been elevated. See page 141.

8 Elevate Equipment. Relocate any electrical or other equipment to the second floor of a structure or be elevated a minimum of +2 feet BFE, also known as the design flood elevation (DFE). See page 142.

9 Land Use Regulations. Consider a coastal overlay to provide uniform guidance and allowances for elevating buildings and accessory structures. If the Town wishes to incentivize reducing impervious surfaces, consider implementing a coastal site plan review process. See pages 143-144.

Resiliency Measures Key Map

Conceptual Image



The image above presents a conceptual visualization of potential resiliency measures for consideration in the areas south of Old Mail Trail. It's important to note that this rendering is not an existing conditions photo of the Old Mail Trail area. Instead, it serves as a representative illustration of the types of conditions and interventions that could be implemented in this area to enhance coastal resilience.

Measures Not Shown

4 6

Additional Westbrook Focus Areas

Project #27 Middle Beach Area

The Middle Beach area suffers from frequent flooding during high tides and storms, including sunny day flooding. Salt Island Road and Pepperidge Avenue often become impassable due to water coverage, hindering access to Middle Beach, a public town beach in addition to hindered access to the residential properties in the area.

Beach Nourishment In conjunction with structural groin improvements, beach nourishment (adding new sand) is recommended for Middle Beach. Private beach owners adjacent to Middle Beach who wish to pursue their own beach nourishment projects must fund these independently from the Middle Beach nourishment effort. To limit sand erosion and drift, consider adding a groin to the western end of Middle Beach. See pages 125-126.

Structural Shoreline Fortification Consider modifying or augmenting the existing groins along the shoreline. This strategy aims to capture sediment, but its effectiveness would depend on its compatibility with the natural sediment transport characteristics of the site. Alternatively, offshore segmented breakwaters could effectively reduce shoreline erosion by attenuating wave energy. Finally, consider repairing damaged seawalls to increase their efficiency. If seawall modifications like extensions, increasing heights, or filling in gaps are being considered, the project needs to balance engineering requirements (ensuring proper foundation and wave resistance), environmental impacts (considering erosion patterns and marine habitat), and regulatory compliance (obtaining necessary permits from local to federal levels). The project must also account for access to the waterfront and long-term maintenance costs. Consider whether alternative approaches like living shorelines or improved drainage systems might be more effective either alone or in combination with seawall modifications in these areas.

Each of these options offers potential benefits for coastal protection, but they require thorough evaluation to ensure they align with the specific environmental conditions and regulatory requirements of the area. See pages 127-128.

Elevate Road To enhance flood resilience, a 2-foot elevation increase on Salt Island Road and Little Stannard Beach Road is recommended. While this adjustment offers moderate protection benefits, it presents technical challenges for driveway connections. Properties with shorter driveways will require particular attention, as they must be regraded to meet the new road elevation. To address these constraints, a combination of engineering solutions and innovative design approaches should be evaluated on a case-by-case basis. See pages 131-132.

Stormwater Management Coordinate with Public Works to assess Middle Beach's stormwater system by conducting a detailed study of outfalls and drain inlets to evaluate their condition, efficiency, and maintenance needs. Consider installing grates or barriers on outfalls to prevent wildlife and human entry into pipes, addressing safety concerns. Adding headwalls to the outfall pipes will prevent sand from washing out underneath, reducing erosion. See page 134.

Elevate Structures Elevating structures is often feasible and cost-effective, particularly for homes that experience routine property damage. It is encouraged that homeowners take the steps to elevate their homes independently when feasible. The Town may consider helping to elevate a private homeowner's house through FEMA Hazard Mitigation Assistance (HMA) grant funding if the property has documented repetitive flood losses, is located in a high-risk flood zone, fits within a broader community mitigation strategy, and the property owner agrees to participate in the cost-sharing requirements, all of which demonstrates a clear public benefit in reducing future disaster costs. Many homes in this area have already been elevated. See page 141.

Project #28 Route 1 Between Wesley Avenue & Old Clinton Road Improvements

While not currently problematic, the 100-year storm model for 2050 predicts severe flooding Patchogue River and marsh on Route 1 between Wesley Avenue and Old Clinton Road, with water depths up to 6'-7" from the Patchogue River. While not as threatening, this flooding extends to South Main Street near the Westbrook Fire Department and could critically impair emergency response during and after major floods by making Route 1 impassable. Segments of Route 1 are expected to see additional inundation based on the 2070 model. These areas include between the Patchogue River and Eckford Avenue and between Hammock Road and the Menunketesuck River bridge. See pages 92 and 113.

Natural Shoreline Fortification Along Route 1's northern right-of-way, several segments have adequate space to construct vegetated earthen berms, which would help mitigate flooding from high tides and the Patchogue River. However, this solution excludes the section directly adjacent to tidal wetlands. A key consideration is that while berms would provide flood protection, they would also restrict stormwater drainage from the road into the tidal marsh and river. Since Route 1 falls under state jurisdiction, any flood mitigation measures require collaboration with the CT DOT and should align with their road vulnerability assessment. Despite these challenges, implementing a berm system offers significant advantages. The nature-based approach would enhance protection against sea level rise while naturally integrating with existing wetland ecosystems. Additionally, this solution would help reduce flood risk for properties bordering the wetlands, providing both infrastructure resilience and environmental benefits while protecting nearby properties. This natural shoreline protection strategy could be replicated in other vulnerable sections along Route 1 that share similar topographic conditions and space constraints, creating a comprehensive approach to coastal resilience. See pages 125-126.

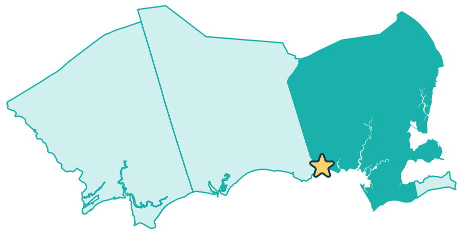
Elevate Road The section of Route 1 between North Main Street and 1121 Boston Post Road presents an opportunity for flood mitigation through a 3-foot road elevation increase. This location is particularly suitable because it has minimal driveway connections, and the few existing driveways are sufficiently long to accommodate gradual regrading to meet the new road height. However, this elevation strategy creates potential complications with water displacement. The raised road segment would effectively create low points at key intersections, particularly at Route 1 and Old Clinton Road, near the Fire Department. This poses a significant concern, as concentrated flooding at these locations could impede emergency response capabilities and create access challenges during critical situations. The design must carefully consider drainage solutions to prevent the unintended consequence of redirecting flood waters to these vital access points. See pages 131-132.

Widen Culvert Assess enlarging the culvert under Route 1 between 1062 and 1119 Boston-Post Road. Increased capacity would improve water flow, potentially reducing road flooding during heavy rains and protecting nearby infrastructure.

Old Saybrook/Westbrook **Project #29**

Cold Spring Brook & Chalker Beach Area Improvements

Location:



Existing Challenges: Historically, large storms like Superstorm Sandy and Superstorm Irene have eroded Cold Spring Brook, leading to the deposition of sediment creating changes to the coastline. The Chalker Beach Tide Gate's limited capacity has caused persistent flooding in the community. The gate serves a watershed of several hundred acres, including commercial areas along Boston Post Road and Spencer Plains Road, plus residential zones. The marsh functions as a detention basin, controlled by 24-inch inlet and outlet pipes. Climate change-driven rainfall intensity has worsened flooding impacts on local properties and roads, both in extent and duration.

Resiliency Measures to Consider

1 Natural Shoreline Fortification. Consider constructing a living shoreline at the mouth of Cold Spring Brook, incorporating nearshore sills to dissipate wave energy. This natural infrastructure approach would provide both erosion protection and habitat benefits. See pages 125-126.

2 Stormwater Management. Investigate the possibility of connecting a drainage pipe from Brooke Street to Saye Street. Note that the existing pipe elevation affects drainage capability from the Saye Street catch basin to the Chalker Beach marsh. See page 134.

3 Tide Gates. A comprehensive study conducted in 2000 modeled the marsh drainage and proposed a box culvert solution to achieve drainage within one tidal cycle, in conjunction with a tide gate to mitigate flooding from coastal storms and extreme tidal events. Given the study's age, CT DEEP has indicated that an updated comprehensive analysis would be required before any tide gate modifications could be considered. While the town actively pursues grant funding opportunities for this analysis, estimated to cost several hundred thousand dollars, an interim solution is being developed. This temporary measure involves reducing the elevation of land between Chalker Beach Marsh and Long Island Sound to create a high-level overflow, as the full process of securing funding, conducting studies, obtaining environmental permits, and constructing a permanent solution is projected to take several years. The Town of Old Saybrook was awarded a planning grant in December of 2024 to restore the Chalker and Chapman Beach marshes and mitigate marsh-associated flooding from Chapman Beach to Indian Town. The Town will continue to peruse grant funding opportunities for implementation of long-term solutions. See page 136.

4 Elevate Structures and Equipment. All critical equipment is required to elevate to +2 feet BFE, also known as the design flood elevation (DFE). See pages 141-142.

5 Land Use Regulations. Due to the small, fully developed lots in Chalker Beach and existing regulatory constraints from zoning, wetlands, and health codes, further development restrictions would have minimal impact. While future redevelopment projects could incorporate more permeable surfaces for driveways and patios, the area's poor soil conditions significantly limit the effectiveness of any infiltration measures. See page 143.

Resiliency Measures Key Map

The image above presents a conceptual visualization of potential resiliency measures for consideration. It is important to note that this rendering is not an existing conditions photo of the Chalker Beach area. Instead, it serves as a representative illustration of the types of conditions and interventions that could be implemented in this area to enhance coastal resilience.

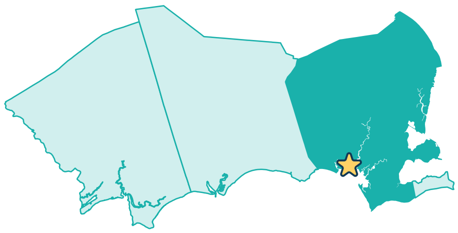
Measures Not Shown

5

Old Saybrook **Project #30**

Old Sea Lane & Hartford Avenue Outfall Repairs

Location:



Existing Challenges: This project addresses two stormwater outfalls, with one located at the end of Old Sea Lane and a second positioned between Old Sea Lane and Hartford Avenue. Both outfall pipes are currently situated at an excessive depth in the ground, preventing them from functioning as originally designed. This improper elevation allows sediment to back up into the pipes. While tidal action sometimes flushes out the accumulated sediment, this natural clearing process is inconsistent and depends entirely on the specific tidal conditions.

Resiliency Measures to Consider

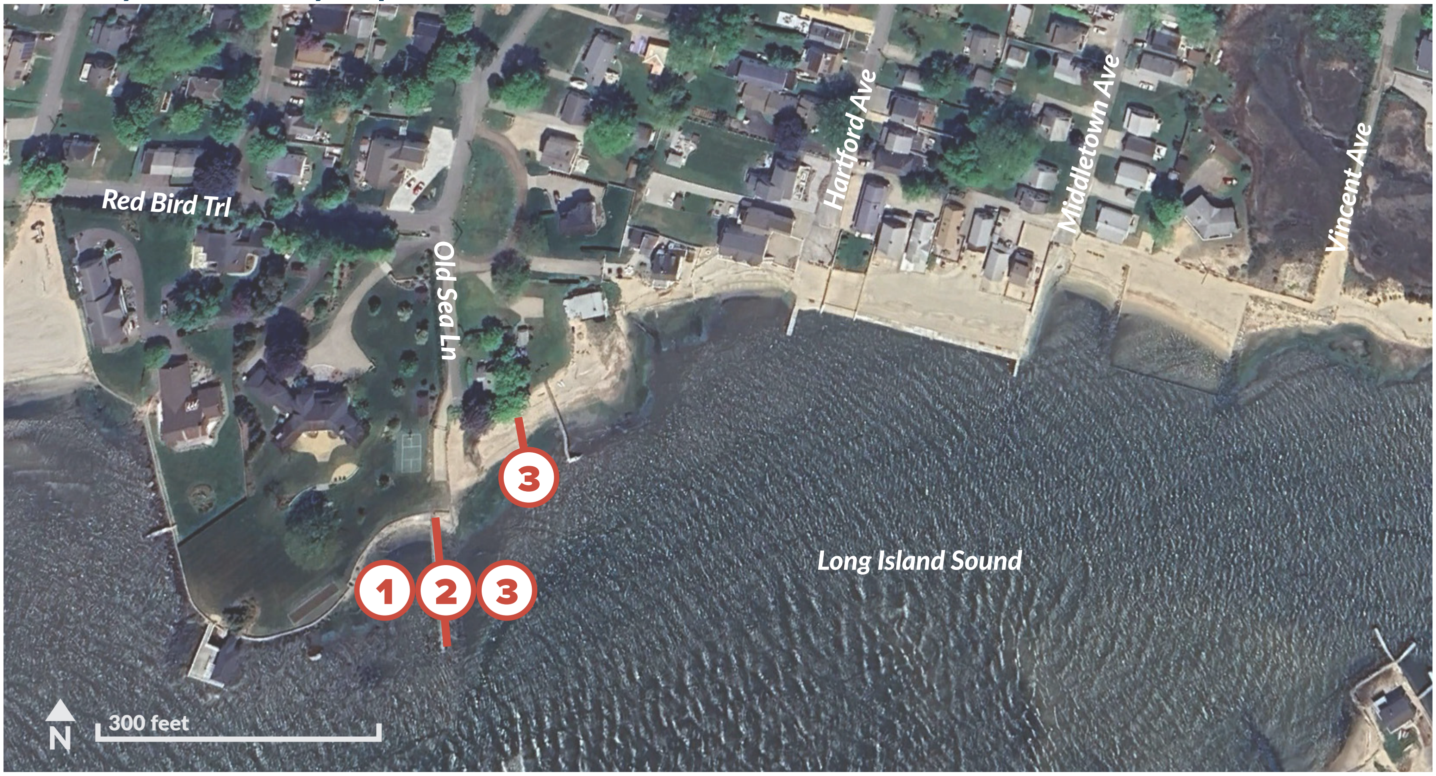
1 Structural Shoreline Fortification. Investigate the feasibility of adding a headwall to the outfall pipes to prevent sand from washing out underneath, thereby reducing erosion. Additionally, construction of offshore segmented breakwaters would serve to attenuate wave energy and diminish the erosive forces acting on the shoreline. Each of these options offers potential benefits for coastal protection, but they require thorough evaluation to ensure they align with the specific environmental conditions and regulatory requirements of the area. See page 124.

2 Install Backflow Preventers. Investigate installing a backflow preventor on the outfall positioned between Old Sea Lane and Hartford Avenue. The backflow preventor will help prevent sediment from entering and accumulating in the pipe during high tide events by allowing stormwater to discharge while blocking the tidal water from pushing sediment back into the pipe system. See page 135.

The outfall pipe located between Old Sea Lane and Hartford Avenue requires investigation of two potential solutions: extending the outfall pipe seaward or adjusting its elevation. This particular outfall presents a significant challenge due to its northward alignment that crosses multiple private properties. Implementation of any elevation modifications will be complicated by the need to obtain consent from these property owners.

3 Outfall Pipe Extension. At both outfall pipes, investigate the feasibility of a seaward extension to relocate its discharge point, where increased wave action and tidal forces can naturally prevent sediment accumulation by dispersing materials that would otherwise block the pipe system.

Resiliency Measures Key Map



Representative Imagery

Existing condition of the outfall between Old Sea Lane and Hartford Avenue.

Existing condition of the outfall at Old Sea Lane.

Additional Old Saybrook Focus Areas

Project #31 Existing Seawall Evaluation

A comprehensive assessment of seawalls throughout Old Saybrook is needed to identify structures that are inadequate or already compromised, with the Barnes Road seawall serving as a notable example of deterioration. These seawalls play a vital role in protecting municipal and private properties, along with state, town, and private roadways from coastal flooding. The assessment must be conducted in parallel with a thorough evaluation of road conditions in flood-prone areas, particularly Route 154, as the integrity of both seawalls and roadways are interconnected in managing flood risks. This coordinated evaluation approach will provide a complete understanding of the town's coastal infrastructure vulnerabilities and inform effective flood protection strategies.

Project #32 Indian Town Area Improvements

Indian Town, an area with a higher concentration of full-time residents compared to nearby neighborhoods, faces regular flooding challenges. The marsh frequently inundates several roads during high tide, particularly Mohican Trail, Nehantic Trail, and Shetucket Trail. The flooding of Shetucket Trail poses a particular risk as it can isolate the Waterhaven Condos and the southern section of Nehantic Trail between the bridge and the Long Island Sound, effectively turning them into an island during severe events. The situation is further complicated by Indian Town harbor water backflowing into road catch basins, affecting streets like Nehantic and Mohican Trail. Several infrastructure issues compound these flooding problems: suspected compromised underground drainage pipes between the Harbor and catch basins, aging catch basins that need replacement or repair, and frequent siltation at the Marina at Indian Town Beach due to sediment carried by Mud Creek. These combined factors create ongoing challenges for both flood management and marine access in the area.

Natural Shoreline Fortification Investigate the construct of an earthen berm along the eastern edge of Hagar Creek along the west end of Nehantic Trail. This approach would improve the resiliency of the neighborhood under rising sea levels and is a natural feature that can be integrated with the surrounding existing wetlands. These features could help to reduce flooding of properties adjacent to the existing wetland. See pages 125-126.

Elevate Roads Past efforts to mitigate flooding by raising Nehantic Trail to 1 foot above sea level have proven insufficient, as the road continues to flood despite modifications to driveway aprons and changes in water displacement patterns. The situation is even more severe on Mohican Trail, which floods approximately twice a month from marsh overflow. To address this, the Town is evaluating a more ambitious proposal to elevate Mohican Trail by 2 feet. However, this potential solution presents numerous challenges: extensive grading requirements, necessary adjustments to driveway aprons, complications with raised septic systems, and the likelihood of water displacement onto private properties. The project's success would also depend heavily on obtaining approval from affected property owners. These multiple layers of technical and social challenges highlight the complexity of implementing effective flood mitigation strategies in this area. See page 131-132.

Stormwater Management To effectively address flooding in the Indian Town Beach Area, a comprehensive infrastructure improvement project is recommended that simultaneously addresses all drainage components: catch basins, underground pipes, and the drainage pipe to Indian Town Harbor. This coordinated approach should include evaluation and repairs of the underground pipe network, replacement or rehabilitation of failing catch basins, and modifications to the harbor drainage pipe. Implementing these improvements as a single coordinated project, rather than piecemeal repairs, is essential for achieving successful flood mitigation in this coastal community. See page 134.

Tide Gate The drainage pipe that discharges into Indian Town Harbor requires further investigation to evaluate the potential of installing a tide gate at its outlet. This solution could help improve drainage performance. See page 136.

Project #33 Living Shoreline Feasibility

Shoreline Fortification Explore the implementation of extensive living shoreline areas to safeguard waterfront properties throughout the entire Town. Focus areas should include: the stretch between Cold Spring Brook and Oyster River as the primary site, and the area from Oyster River to Cornfield Point as a secondary option. Assess these locations for their potential to support natural coastal defense systems that can enhance both ecological value and property protection. See pages 125-126.

Project #34 Dredging of South Cove

The causeway is restricting water flow into South Cove, leading to silt accumulation and invasive plant growth. This blockage threatens the ecosystem, water quality, and recreational activities. If left unchecked, the silt buildup west of the causeway could transform South Cove into a mud flat further impacting water flowing in/out of the South Cove salt marsh to the west.

Dredging Dredge accumulated sediment on both sides of the Causeway to prevent South Cove's transformation into a mud flat and create additional channels for water flow under the Causeway. This targeted dredging will maintain the cove's ecological character while enhancing its hydrological function. Investigate whether the dredged material can be used to augment marsh sills within the study area, bolstering their height and protective capacity for nearby properties. This approach addresses both environmental preservation and flood mitigation concerns, improving water circulation and strengthening natural defenses against inundation and erosion. See page 137.

Widen Culvert Assess enlarging or routinely clearing the openings beneath the Causeway. Increased capacity would improve water flow, potentially reducing road flooding during heavy rains and protecting nearby infrastructure.

Fenwick **Project #35**

Sequassen Avenue Improvements

Location:

Existing Challenges: Sequassen Avenue experiences nuisance and storm high tide flooding which prohibits access to and from the homes in the neighborhood especially after Crab Creek bridge. The road often washes out in large storms and severely erodes properties in the area known as Folly Point. At the mouth of the Connecticut River in Old Saybrook, CT, shoreline erosion poses a significant threat, endangering existing dune and marsh habitats. Additionally, it's jeopardizing Sequassen Avenue, which serves as a vital emergency escape route for residents during storms and flooding events. This erosion not only impacts the natural environment but also compromises public safety, highlighting the urgent need for effective shoreline management in this coastal community. Sequassen Avenue experiences frequent power outages during storms.

Resiliency Measures to Consider

1 Natural Shoreline Fortification. Along Sequassen Avenue, a potential nature-based approach to reduce flooding would be to construct vegetated earthen berms along the west side of the roadway to reduce inundation. This approach would improve the resiliency of the road under rising sea levels and is a natural feature consistent with the existing wetlands surrounding the road. A potential nature-based solution for this area is an integrated beach and vegetated dune system around the peninsula's perimeter. This approach aligns with existing shoreline characteristics and offers multiple benefits: dissipating wave energy, trapping sediment, and adapting to rising sea levels. It improves resilience while enhancing recreation and habitat quality. As dynamic systems, beaches and dunes require designs that work with natural processes, including ongoing monitoring and management. This approach provides effective coastal protection while maintaining ecological integrity. A living shoreline could be investigated on the eastern coast of Fenwick following Sequassen Avenue. See pages 125-126.

2 Structural Shoreline Fortification. Perform annual inspections of all Fenwick breakwater structures, documenting their condition, clearing debris, making repairs for minor damage, and reporting major issues. See page 127-128.

3 Marsh & Wetland Management. Extend the existing marsh north along the shoreline. It may become necessary to raise the elevation of the tidal marsh areas to reduce flooding and inundation, adapt to rising sea levels, maintain a healthy marsh, and improve the resiliency of the marsh and adjacent areas including Sequassen Avenue. See pages 129-130.

4 Elevate Road. Evaluate elevating the Sequassen Avenue segment east of Crab Creek bridge by 2 feet to enhance resilience against tidal nuisance flooding. This section is ideal for raising as it lacks driveway connections, eliminating the need for apron adjustments. To maximize effectiveness, consider combining this road elevation with natural shoreline fortification measures. See pages 131-132.

5 Bury Utility Lines. Bury the power lines along Sequassen Avenue to protect the utility from wind and wave damage during storms, improve the visual aesthetic of the historic area, and reduce maintenance of the utility. Because Sequassen Avenue is flood prone, measures will have to be taken to ensure the safety and resilience of the underground utility. See page 138.

6 Elevate Equipment. Any electrical or other critical equipment should be relocated to the second floor of a structure or be elevated a minimum of +2 feet BFE, also known as the design flood elevation (DFE). See page 142.

7 Expand the No-Wake Zone. Extend the existing State No-Wake Zone south on the Connecticut River to include the areas east of South Cove and the eastern end of Fenwick. This expansion aims to protect sensitive shorelines from erosion by limiting boat speed. Reduced wave action from slower watercraft would decrease erosive effects, thereby preserving the natural coastline and enhancing the long-term resilience of these vulnerable coastal areas.

Resiliency Measures Key Map

Measures Not Shown

5 6

Fenwick **Project #36**

West End (Scum Beach & Seawalls)

Location:

Existing Challenges: Gaps in the existing seawall system present areas of concern, leading to erosion and flooding issues that need to be addressed while considering the surrounding structures. Just north of Wilson Avenue lies an inland wetland that swells with rainwater and storm surge during severe weather events. The primary challenge in this area is not the influx of water, but rather the damage and erosion caused by its rapid outflow back into the Long Island Sound. When flooding occurs, saltwater enters the inland wetlands, creating a tidal or brackish wetland where there was formerly an inland (freshwater) wetland. Saltwater intrusion disrupts wetland ecosystems by increasing salinity, which kills salt-sensitive vegetation, alters soil chemistry, and forces freshwater species to migrate or perish.

Resiliency Measures to Consider

1 Natural Shoreline Fortification. Conduct a study to determine the feasibility of constructing vegetated earthen berms to reduce inundation along the property boundaries adjacent to the wetland. This approach would improve the resiliency of the properties under rising sea levels and is a natural feature consistent that can be integrated with the existing surrounding wetlands. A potential nature-based approach for this area may be to construct an integrated beach and vegetated dune system. Consider conducting a study to determine the effectiveness of this approach. Since there is already a beach along this shoreline, this approach is consistent with the existing characteristics of the area. A sufficient coastal beach and dune system can dissipate wave energy, reduce inundation risk, trap sediments, and can be adapted to rising sea levels. This approach provides multiple benefits including improved resiliency, recreation, and habitat. Beaches and dunes are dynamic systems and their design must work with the natural processes of the area and should include monitoring and management requirements and strategies. The feasibility and effectiveness of filling seawall gaps with natural fortification depends on multiple factors including topography, wave action, salinity, and the condition of the surrounding seawalls. This implementation should be considered on a case-by-case basis. Natural fortification of seawall gaps is most feasible during low-energy seasons when wave action is minimal and vegetation can establish itself. The process works best in sheltered areas with gradual slopes and adequate sediment supply to support plant growth. Success depends on selecting native species adapted to local conditions and implementing during favorable growing seasons. See pages 125-126.

2 Structural Shoreline Fortification. Structural fortification in this area may include raising the elevations of existing seawalls along the coast, closing any gaps between seawalls that exist, or constructing an integrated rock revetment along the coast including in front of existing seawalls. Consider conducting a study to determine the effectiveness of this approach. See pages 127-128.

3 Marsh & Wetland Management. One option could be to assess the flooding and hydrodynamics of the area to evaluate the potential to provide a connection between the wetland and Long Island Sound. This would include dredging. Salinity changes can alter existing wetland ecosystems and affect native species, but can also create new habitats supporting different biodiversity. Higher tidal exchange improves flood control and sediment transport but risks erosion and habitat loss. Salt water intrusion may impact groundwater and upstream freshwater systems, while providing natural flood defenses and carbon sequestration benefits. Success requires careful hydrological modeling, gradual transition periods, and ongoing monitoring of ecosystem responses. Design should incorporate features like sills or weirs to control tidal exchange rates and buffer zones to protect sensitive areas. It may become necessary to raise the elevation of the marsh areas to reduce flooding/inundation, adapt to rising sea levels, maintain a healthy marsh, and improve the resiliency of the marsh and adjacent areas. See pages 129-130.

Resiliency Measures Key Map

Additional Fenwick Focus Areas

Project #37 Pettipaug Avenue Seawall

The Pettipaug Avenue Seawall is experiencing significant erosion along its full length. On the east end, erosion extends from the seawall to Fenwick beach, while the west end sees erosion stretching into the Scum Beach area. During high water events, waves overtop the seawall, causing scouring of the land behind it, further compromising the structure's effectiveness and the stability of the surrounding shoreline.

Structural Shoreline Fortification Several alternatives exist to improve the effectiveness of the Pettipaug Avenue Seawall, requiring coordination among private wall owners for success. Key improvements include: extending the eastern end to the beach/pier for continuous residential protection; modifying the western end to connect with Scum Beach area seawalls; redesigning the entire structure with a uniform, wave-deflecting design; and increasing height to account for rising sea levels. These measures would significantly enhance the seawall's effectiveness in protecting the coastline and properties. To inform the strategy, a seawall existing conditions analysis and localized coastal analysis should be performed, ensuring a comprehensive and effective approach to long-term coastal resilience. See pages 127-128.

Project #38 Folly Point Erosion

Folly Point has experienced extreme erosion, resulting in the loss of up to 100 feet of beach. This severe coastal degradation has led to exposed septic systems, disconnected docks from the land, and even the forced relocation of at least one house. These impacts underscore the urgent need for erosion mitigation measures in the area.

Expand the No Wake Zone Expanding the existing State No-Wake Zone southward on the Connecticut River to include the areas east of South Cove and the eastern end of Fenwick. This expansion aims to protect sensitive shorelines from erosion by limiting boat speed. Reduced wave action from slower watercraft would decrease erosive effects, thereby preserving the natural coastline and enhancing the long-term resilience of these vulnerable coastal areas.

Project #39 Breakwater Maintenance & Repair

The offshore and lighthouse breakwater structures play a crucial role in minimizing flooding and erosion along the shoreline. Improving their condition would enhance protection for the coastal area against the impacts of severe weather and tidal forces.

Structural Shoreline Fortification A comprehensive evaluation should assess the offshore and lighthouse breakwaters' current condition. Based on this assessment, structural repairs can be implemented to restore their effectiveness in deflecting and attenuating wave action, protecting the shoreline from erosion, and preserving historic structures. Analysis of the breakwaters' wave attenuation effectiveness will inform whether design modifications could enhance coastal protection against severe weather and tidal forces. See pages 127-128.

Project #40 Dredging of South Cove

The causeway is restricting water flow into South Cove, leading to silt accumulation and invasive plant growth. This blockage threatens the ecosystem, water quality, and recreational activities. If left unchecked, the silt buildup west of the causeway could transform South Cove into a mud flat further impacting water flowing in/out of the South Cove salt marsh to the west.

Dredging Dredge accumulated sediment on both sides of the Causeway to prevent South Cove's transformation into a mud flat and create additional channels for water flow under the Causeway. This targeted dredging will maintain the cove's ecological character while enhancing its hydrological function. Investigate whether the dredged material can be used to augment marsh sills within the study area, bolstering their height and protective capacity for nearby properties. This approach addresses both environmental preservation and flood mitigation concerns, improving water circulation and strengthening natural defenses against inundation and erosion. See page 137.

Widen Culvert Assess enlarging or routinely clearing the openings beneath the Causeway. Increased capacity would improve water flow, potentially reducing road flooding during heavy rains and protecting nearby infrastructure.

Old Mail Trail, Westbrook
May 2021

Potential Funding Sources

This section identifies potential funding sources for the recommended projects outlined in the previous section. The funding sources provided include various Federal, State, and Local organizations that may offer grants, loans, or other financial support for implementing these projects. By exploring these diverse funding opportunities, the communities can work toward securing the necessary resources to carry out the proposed resilience and adaptation measures.

As funding priorities change at the Federal and other levels, or as insurance programs evolve (or disappear) implementing recommended measures may fall increasingly to local and private entities. Communities should be prepared to potentially integrate adaptation strategies into their municipal funding and capital planning processes.

Potential Funding Sources

This is a point in time identification of potential funding sources. It is recommended that towns continue to monitor and identify additional funding sources as they become available in the years to come.

Funding Source + Description	Eligible / Relevant Activities	Award
Community Investment Fund 2030 (CIF)		
Fosters economic development in historically under-served communities across the state. Provides funds for capital improvement programs, small business capital programs, and planning for capital projects	Municipalities, Non-profit Organizations and Community Development Corporations in Public Investment Communities and/or Alliance Districts (currently 55 municipalities)	$175 million a year; no match required
Long Island Sound Community Impact Fund (LISCIF)		
Funds projects in environmental justice communities to address environmental issues and improve the quality and accessibility to the Long Island Sound. Provides technical assistance for capacity building	Non-profit organizations, Tribes, state, county, local governments, and their subdivisions, and academic institutions. Projects funded under LISCIF must be completed in the LIS geographic region.	$5,000 - $100,000 per project; no match required
Long Island Sound Futures Fund (LISFF)		
Funds water quality, habitat restoration, species conservation, resilience, environmental education and stewardship projects	501(c), local/state government, educational institutions	$50,000 - $1.5 million grant range; 50% match required of requested amount
Connecticut Department of Energy and Environmental Protection (CT DEEP) Climate Resilience Fund		
Climate resilience planning and project advancement. Future to include municipal match funding	Municipalities	$50,000 - $100,000; no match required
Urban Forest Equity Grant Program		
Urban forestry projects that will benefit disadvantaged communities. This could include tree planting, stewardship, planning, invasive control, education, and urban wood utilization	State and local government, federally recognized tribes, non-profit organizations, public institutions of higher education. Projects MUST demonstrate direct benefit to disadvantaged communities as defined by the Climate and Economic Justice Screening Tool	Over $2 million; no match required
Open Space & Watershed Land Acquisition Grant		
Funds the purchase of permanent interests in land	Municipalities, non-profit conservation organizations & water companies	Funding is based on appraisal of property; up to 75% of fair market value price covered depending on location
Urban Green & Community Garden Grant		
Funds the creation, enhancement or restoration of urban green space: green infrastructure, community gardens,passive recreational trails, etc.	Distressed municipality or targeted investment community, but current legislation may change that	No upper limit on request, but can only be 20% of yearly grants from OSWA/UGCG pool of funding; 50% match required

Funding Source + Description	Eligible / Relevant Activities	Award
Connecticut Recreational Trails Grant Program		
Funds planning, design and construction of new trails; maintenance and restoration of existing trails; acquisition of land or easements for a trail, or for trail corridors; and educational programs	Nonprofits, Municipalities, COGs, Tribal Gov.	$10 million; 20% match required
Federal Clean Water Act §319 Non-Point Source Pollution Management Grant		
Funds both planning and implementation projects that address non-point source water pollution	Municipal, state, and regional governments, quasi-state agencies, schools and universities, nonprofit organizations, community groups. Recipients must be registered with the CT Secretary of State	$1.2 million annually for project funding; 40% match requirement for each awarded grant, match may be waived in certain circumstances
FEMA Flood Mitigation Assistance Program (FMA)		
Funds to reduce or eliminate the risk of repetitive flood damage to buildings	States, federally recognized Tribal governments, U.S. territories, and local governments. Recipients must be insured by the National Flood Insurance Program (NFIP)/be located in an NFIP community	$800 million annually for project funding; 40% match requirement for each awarded grant, match may be waived in certain circumstances
Building Resilient Communities (BRIC)		
Provides funds for projects which reduce the overall risk to population and structures from future hazard events, while also reducing the reliance on federal funding from future disasters	State and Local Government Agencies, federally recognized Tribal governments, some eligible non-profit organizations.	The maximum allocation for a state is $2 million and the maximum total allocation for tribal is $25 million to carry out eligible building code adoption and enforcement activities
Hazard Mitigation Grant Program (HMGP)		
Provides funds for projects which reduce the overall risk to population and structures from future hazard events, while also reducing the reliance on federal funding from future disasters	State Government and Tribal Governments are eligible to apply directly to FEMA. Local Governments, Tribal Nations, and private or non-profit organizations may apply through the State as sub-applicants	Available funding is based on the percentage of funds spent on Public and Individual Assistance for each Presidentially declared disaster. 25% match requirement for each awarded grant

4 Shore
Coastal Resiliency Plan