

**Town of Guilford
Community Coastal Resilience Plan
Risk and Vulnerability Assessment Report**

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Prepared for

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Executive Summary

Utilizing The Nature Conservancy's web-based Coastal Resilience Tool, the Town of Guilford is undertaking The Nature Conservancy's Coastal Resilience Program. Coastal resilience is the ability to resist, absorb, recover from, or adapt to coastal hazards such as sea level rise, increased flooding, and more frequent and intense storm surges. The goal of the Coastal Resilience Program is to address the current and future social, economic and ecological resilience of the Town of Guilford to the impacts of sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. The four basic steps of the Coastal Resilience Program are:

1. Generate awareness of coastal risk (already underway and largely complete);
2. Assess coastal risks and opportunities (the current effort);
3. Identify options or choices for addressing priority risks and vulnerabilities (future effort); and
4. Develop and implement an action plan to put selected options or choices into place (future effort).

The Town has drafted the subject risk and vulnerability report as a step toward developing a Community Coastal Resilience Plan. This risk and vulnerability report has been funded through a grant from NOAA as part of the New England Municipal Resilience Initiative.

The Coastal Resilience decision support tool is the primary means of supporting the second step listed above. The tool is an interactive decision support instrument that explores future flooding scenarios caused by sea level rise with or without storm surges. The visual information is intended to inform development and conservation decisions. The broader Coastal Resilience program is not simply limited to the web-based decision support tool. However, the tool is valuable for community engagement. The coastal resilience tool can map potential flood scenarios for the decades of the 2020s, 2050s, and 2080s under three sets of conditions: no storm (in other words, only the impacts of sea level rise), Category 2 hurricane, and Category 3 hurricane. These three sets of conditions are further paired with three sets of relative or "downscaled" sea level rise projections: "high," "medium," and "conservative" which derived from modeling of three different emissions scenarios and seven global climate change models coupled with historic tide gauge data, subsidence rates, and several other variables.

In the context of hazards, risk is commonly defined as the product or the sum of vulnerability and frequency. Thus, if an event has (1) a low frequency and (2) very few people, structures, or infrastructure are vulnerable to the effects of that event, then the risk is low. If an event has a high frequency and many people, structures, or components of infrastructure are vulnerable to the effects of that event, then the risk is high. Either low frequency coupled with high vulnerability or high frequency coupled with low vulnerability will produce moderate risk. In the context of coastal hazards, risk will change over time because the frequency will increase. Coastal storms are believed to be increasing in frequency, and flooding will increase in frequency as sea level rises. Thus, even if coastal vulnerabilities in Guilford remain static, risks will increase. Therefore, Guilford is at a crossroads with regard to reducing risk. Vulnerabilities can remain static and risk can increase, or vulnerabilities can be reduced to hold risk at bay. If vulnerabilities can be reduced even further, than risks could be lowered in the face of rising sea level and increased coastal storms, leading to increased resilience.

Guilford faces several major categories of vulnerabilities to coastal hazards. The categories and some of the included vulnerabilities are as follows:

- ❑ Social – Residents, business community, and visitors.
- ❑ Economic – Residential Properties, commercial/industrial businesses, municipal resources, tourism, and future development.
- ❑ Infrastructure – Roads, bridges, railroads, stormwater, seawalls, tide gates, the marina, and municipal facilities.
- ❑ Utilities – Public and private water supplies, septic systems, telecommunications, and electricity.
- ❑ Emergency Services – Fire, police, medical, sheltering, evacuation/egress.
- ❑ Natural Systems – Tidal wetlands and other coastal landforms.

The relative importance of these vulnerabilities varies by location. Some of the notable geographic vulnerabilities are listed below:

- ❑ Branford Town Line to Island Bay – Old Quarry is already grappling with increased inundation of the main access to some 40 homes (Old Quarry Road). Sections of Route 146 are threatened.
- ❑ Island Bay to Trolley Road – Shell Beach Road and residential structures along the road are vulnerable to storm surges as well as future daily inundation. Homes located on Leetes Island are at risk of isolation. Marsh advancement is critical but may be challenging at the peripheries of Leetes Marsh, Great Harbor, and Lost Lake.
- ❑ Trolley Road to Vineyard Point – Some homes in the Trolley Road, Sachems Head, and Vineyard Point areas are vulnerable to inundation and storm surge.
- ❑ Vineyard Point to Tuttle Point – Indian Cove is increasingly vulnerable to a loss of egress at two key locations, and Tuttle Point Road is increasingly vulnerable to storm surges as well as future daily inundation.
- ❑ Tuttle Point to Guilford Point – Like Old Quarry Road, Chaffinch Island Road is already suffering from frequent flooding. Important facilities such as Brown’s Boat Yard, Guilford Boat Yard, and the Guilford Yacht Club are vulnerable to inundation and storm surge.
- ❑ Guilford Point to Madison Town Line – Jacob’s Beach is vulnerable to erosion whereas homes along Seaside Avenue are vulnerable to inundation and storm surges. The Town marina and the state’s East River Boat Launch are critical facilities that are highly vulnerable given their waterfront locations.
- ❑ Guilford Center and Town Center South – Several important economic areas are vulnerable such as commercial plazas along the Boston Post Road, the Soundview Road commercial/industrial area, and the Whitfield Street corridor.
- ❑ Upper East River – Although land is vulnerable to flooding, the East River estuary is a key area of interest for identifying future zones for marsh migration.

Future steps of this planning process will include the compilation of options and choices for coastal resilience and adaptation to sea level rise and the increased frequency and intensity of coastal storms; and the development of a community coastal resilience plan.

1.0 INTRODUCTION

1.1 Purpose

The Town of Guilford is working with The Nature Conservancy as a pilot community along Long Island Sound for instituting a coastal resilience planning process that will ultimately increase the Town's ability to accommodate coastal change in the future. According to the United States Department of Homeland Security, resiliency is "the ability of any system (infrastructure, government, business, and citizenry) to resist, absorb and recover from or successfully adapt to an adversity." Coastal resilience is therefore the ability to resist, absorb, recover from, or adapt to coastal hazards such as sea level rise, increased flooding, and more frequent and intense storm surges.

Utilizing The Nature Conservancy's web-based "Coastal Resilience Tool"

(www.coastalresilience.org) and the National Oceanic and Atmospheric Association (NOAA) Coastal Services Center's "Roadmap for Adapting to Coastal Risk" the Town of Guilford is undertaking The Nature Conservancy's "Coastal Resilience Program." The goal of this program is to comprehensively address the current and future social, economic and ecological resilience of the Town of Guilford to the impacts of sea level rise and to anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. This will better prepare the Town of Guilford and also serve to inform other communities in Connecticut, New England, and nationally. To accomplish this goal, Guilford has identified the following key strategies:

The four basic steps of the "Coastal Resilience Program" are:

- 1. Generate awareness of coastal risk (already underway and largely complete);**
- 2. Assess coastal risks and opportunities (the current effort);**
- 3. Identify choices for addressing priority risks and vulnerabilities (future effort); and**
- 4. Develop and implement an action plan to put selected choices into place (future effort).**

- ❑ Generating public awareness and understanding of coastal resilience issues and increasing support for Town action to address it;
- ❑ Assuring public safety;
- ❑ Identifying plans to compatibly protect, rehabilitate and/or relocate critical infrastructure;
- ❑ Amending Town coastal development policy to assure greater resilience of structures and natural resources;
- ❑ Adopting post-storm redevelopment which respects property rights and provides for greater coastal resilience; and
- ❑ Sustaining coastal habitats such as tidal marsh and barrier beaches through protection of adjoining upland areas and provision for the migration of these habitats.

The Coastal Resilience program for New York and Connecticut is a collaborative effort led by The Nature Conservancy in partnership with NOAA's Coastal Services Center, Association of State Floodplain Managers (ASFPM), Columbia University Earth Institute/NASA Goddard Institute for Space Studies, Pace University's Land Use Law Center, University of Southern Mississippi, and the University of California at Santa Barbara.

The Town has drafted the subject risk and vulnerability report as a step toward developing a Community Coastal Resilience Plan. This risk and vulnerability report has been funded through a grant from NOAA as part of the New England Municipal Resilience Initiative. The Town of Guilford is amongst an important initial cohort of municipalities from all the New England States.

1.2 Background

Sea levels have risen and are currently rising along the Atlantic coast. The Intergovernmental Panel on Climate Change (IPCC) concludes based on available data that there has been a global mean rise in sea level between 10 and 25 centimeters (cm) (approximately four to 10 inches) over the last 100 years (Neumann et al., 2000). Relative sea level rise at Boston and Woods Hole gauges over the same time period is estimated at 26 cm (10 inches) according to the United States Geological Survey.

In its landmark 2001 report, the IPCC projected that global sea level may rise nine to 88 centimeters during the 21st century. According to the February 2007 update report by the IPCC, these predictions have been somewhat refined using six global climate models to project a more narrow range of sea level rise of 28 to 43 cm (11 to 16.9 inches) in the 21st century.

Although erosion and shoreline change have long been recognized as coastal hazards nationwide, it is only recently that sea level rise has been viewed as a hazard to be considered while planning for resilience. Indeed, continued increases in the rate of sea level rise will increase the incidence, severity, and adverse effects of flooding, erosion, and shoreline change. Consider the following:

- ❑ A continued increase in the rate of rising sea levels will inundate low areas, increase erosion of beaches and tidal marshes, increase the incidence of flooding from storm surges, and enable saltwater to advance upstream and intrude further into estuaries and aquifers.
- ❑ Future sea level rise could result in the disappearance of a large percentage of Guilford's tidal wetlands unless they can advance as quickly as the rising level.
- ❑ Saltwater advancing upstream along estuaries can alter the point at which sedimentation leads to the creation of shoals and other features.
- ❑ FEMA's coastal base flood elevations will progressively rise along with sea level. This means that the 100-year and 500-year flood levels will affect lands and structures that are currently at unaffected elevations.
- ❑ As sea level rises, storm surges from hurricanes and nor'easters will reach further inland as they are starting from a higher base level.

- ❑ As sea level rises, drainage systems become less effective. Rainstorms will have the potential to cause greater flooding.

It has long been expected that the rate of sea level rise in Connecticut will be slightly higher than the global projections due to the effects of regional subsidence. However, more recent studies have asserted that changes in ocean circulation will increase the relative sea level rise along the Atlantic coast even more. The United State Geological Survey has demonstrated that sea levels along the mi-Atlantic and northeast coasts are already rising three to four times faster than the global average since 1990. This heightens the need for resilience planning in coastal Connecticut.

The Nature Conservancy has noted in recent years that "despite a growing awareness of sea level rise and coastal storm risks, communities and local decision makers still have limited access to the full suite of information needed to protect natural and human coastal communities from these conditions." The Nature Conservancy's Coastal Resilience project was developed from this need to provide tools and a process to effect comprehensive and more informed planning.

According to the Coastal Resilience web site, "Mounting evidence suggests that rising sea levels, coupled with related increases in storm surges, will increasingly put coastal populations at risk from inundation, storm damage, and saltwater intrusion. In order to adapt, decision-makers need access to information and tools that support choices for managing natural resources and protecting human communities. Without these resources, proactive solutions that reduce impacts and build resiliency for human and natural communities will remain elusive. Coastal Resilience aims to provide tools and information to better inform decision-making with a primary goal of identifying vulnerable human and natural communities and enabling adaptation solutions, emphasizing the important role of ecosystems."

As noted in Section 1.1, the coastal resilience framework includes four elements. The second element is the focus of this report:

- ❑ *Assess Risk: Assess risk and vulnerability to coastal hazards including alternative scenarios for current and future storms and sea level rise with community input.*

The Coastal Resilience decision support tool is the primary means of supporting this element. The tool is a unique interactive decision support instrument that explores future flooding scenarios caused by sea level rise with or without storm surge from major events. The visual information is intended to inform decisions in coastal development and conservation. The broader Coastal Resilience program is not simply limited to the web-based decision support tool. However, the tool has been valuable for community engagement.

The coastal resilience tool can map potential flood scenarios for the decades of the 2020s, 2050s, and 2080s under three sets of conditions: no storm (in other words, only the impacts of sea level rise), Category 2 hurricane, and Category 3 hurricane. These three sets of conditions are further paired with three sets of relative or "downscaled" sea level rise projections: "high,"

"medium," and "conservative" which derived from modeling of three different IPCC emissions scenarios and seven global climate change models coupled with historic tide gauge data, subsidence rates, and several other variables (Columbia/NASA). The result is a set of 27 different maps as listed below in Table 1. The scenarios are clarified in Table 2.

Table 1
Future Flood Scenarios Mapped by the Coastal Resilience Tool

Decade	Condition	Sea Level Rise Estimates*	Elevation (ft, NAVD)
2020s	No Storm	High	3.7
		Medium	3.3
		Conservative	3.3
	Category 2	High	9.8
		Medium	9.4
		Conservative	9.4
	Category 3	High	12.8
		Medium	12.4
		Conservative	12.4
2050s	No Storm	High	5.2
		Medium	3.8
		Conservative	3.9
	Category 2	High	11.3
		Medium	9.9
		Conservative	10.0
	Category 3	High	14.3
		Medium	12.9
		Conservative	13.0
2080s	No Storm	High	7.3
		Medium	4.7
		Conservative	4.5
	Category 2	High	13.4
		Medium	10.8
		Conservative	10.6
	Category 3	High	16.4
		Medium	13.8
		Conservative	13.6

*High = emissions scenario A2 + 3.28 feet (1 meter)

Medium = emissions scenario A2

Conservative = emissions scenario A1B

Table 1-2 provides relative or downscaled sea level rise projections for Long Island Sound that were generated under a contract between The Nature Conservancy and Columbia University's

Earth Institute/NASA Goddard Institute for Space Studies in 2010-2011. These projections are geospatially projected within the Coastal Resilience decision support tool.

Table 2
Downscaled Sea Level Rise Projections for Long Island Sound
Across Several Emission Scenarios

Scenarios	2020	2050	2080
Conservative	3.5 inches	10 inches	18.5 inches
Medium	3.5 inches	10 inches	20 inches
High	9 inches	26 inches	52 inches

While using the decision support tool in the past two years, The Nature Conservancy has noted that the Category 2 storm flooding, FEMA's Special Flood Hazard Area (SFHA) [the 1% annual chance flood event], and the 2080s sea level rise scenario (inundation) are approximately the same in lateral extent. Interestingly, Hurricane Irene (a tropical storm upon landfall) in August 2011 provided evidence both confirming and countering some previous observations and assumptions. Storm surges from Irene were about 4.7 feet above sea level in south-central Connecticut. Waves formed on the surge and together the surge and the waves caused extensive flooding. In some locations in Guilford, flooding appeared to be worse than that predicted by the surge mapping, whereas it was much less extensive in other locations. This demonstrates how important local causes such as wind can be when flooding occurs.

1.3 Relationship between Risk, Vulnerability, and Resilience

In the context of natural hazards such as flooding, risk is commonly defined as the product or the sum of vulnerability and frequency (risk = vulnerability X frequency or risk = vulnerability + frequency). Thus, if an event has (1) a low frequency and (2) very few people, structures, or infrastructure are vulnerable to the effects of that event, then the risk is assumed to be low. If an event has a high frequency and many people, structures, or components of infrastructure are vulnerable to the effects of that event, then the risk is assumed to be high. Either low frequency coupled with high vulnerability or high frequency coupled with low vulnerability will produce moderate risk.

In the context of coastal hazards and the need for developing coastal resilience, risk will change over time because the frequency will increase. Coastal storms are believed to be increasing in frequency, and flooding will increase in frequency as sea level rises. Thus, even if coastal vulnerabilities in Guilford remain static, risks will increase.

Therefore, Guilford is at a crossroads with regard to reducing risk. Vulnerabilities can remain static and risk can increase, or vulnerabilities can be reduced to hold risk at bay. If vulnerabilities can be reduced even further, than risks could be lowered in the face of rising sea level and increased coastal storms, leading to increased resilience.

The least desired combination of all would be the development of increased vulnerabilities while frequencies increase, because risks could rise faster than expected. An example of increased vulnerability would be the replacement of the Public Works facility (located in a coastal flood zones) with elderly housing units.

The Community and Regional Resilience Initiative (CARRI, 2011) uses a “Resilience Loss Recovery Curve” to illustrate the process of increasing or decreasing community resilience.

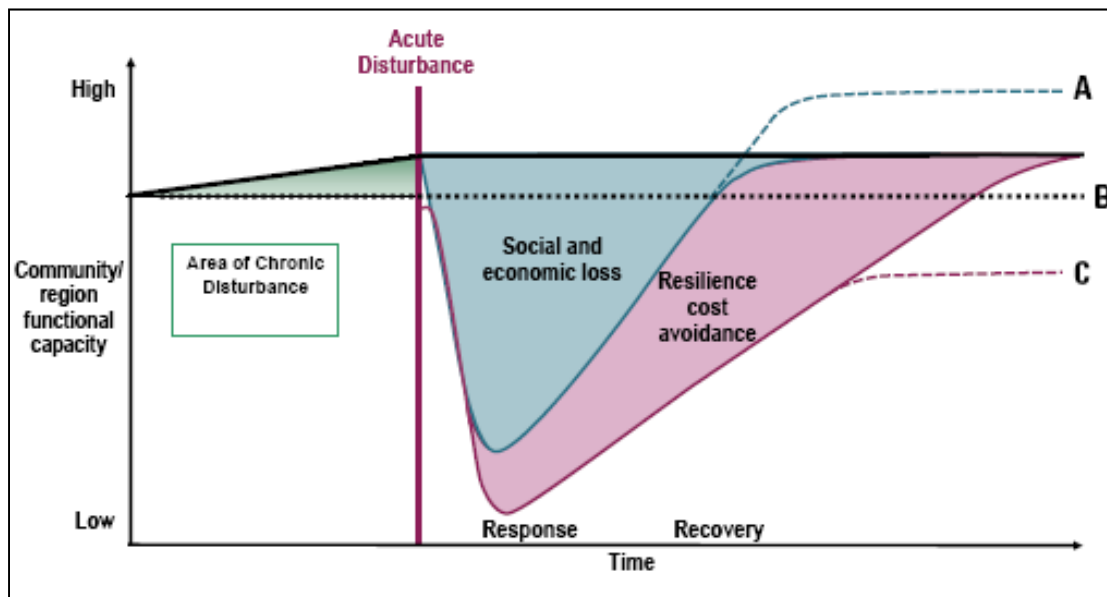


Figure 1 – Resilience Loss Recovery Curve

The Resilience Loss Recovery Curve helps explain how community function is affected by an acute disturbance such as an earthquake or hurricane, and depicts response and recovery curves. Community functions decline (blue and pink areas) as communities respond to a disaster. A more resilient community can more quickly restart local services (utilities, businesses, schools) and chart a path to a “new normal.” The more resilient community incurs some losses (blue) but avoids additional losses (pink), because it has taken informed measures (anticipating threats, developing disaster response plans and recovery strategies, longer-term land use policies) in advance to minimize the impact of the disturbance (i.e., planning and mitigation).

Resilient communities may find opportunities to transform themselves and grow. Thus, a resilient community’s “new normal” may be a higher level of function (Line A) or it may be able to return to a level of function existing before the disturbance (Line B). Ultimately, this cycle repeats itself both before and after each disturbance resulting in opportunities to incrementally increase resilience and comprehensively reduce losses over time.

1.4 Relationship to other planning efforts

The Town of Guilford and its residents have long valued the process of planning to guide the community. The results are evident by the numerous plans and reports available to the public. Many of these plans and reports address elements of coastal resilience.

Master Plan for Preservation and Scenic Conservation (1995)

The Master Plan for Preservation and Scenic Conservation was developed under the direction of the Guilford Preservation Alliance (GPA) in the 1980s and revised in 1995. Since the GPA is a private organization and not one of the Town's official boards or commissions, this plan is not an official document adopted by the Town.

The plan included a review of early versions of the Comprehensive Plan of Development and Conservation (1978) and Open Space Plan (1984) existing at the time. The Master Plan for Preservation and Scenic Conservation called for purchase of tidal marshes north of the marina, portions of the East and West River estuaries, and portions of Joshua Cove. While these were recommended for reasons such as preservation of scenic areas, preservation of coastal areas will help achieve coastal resilience by retaining the capabilities of natural resources such as absorption and deflection of destructive wave energy and storage excess flood water from surface runoff and precipitation among others.

Plan of Conservation and Development (2002)

The Plan of Conservation and Development was updated in 2002 with contributions from local boards and commissions, citizens, and citizen groups. The purpose of the plan is to balance growth with maintaining the quality of life that citizens within the Town embrace. The plan does not directly address coastal resilience. However, the Town is in the final stages of updating the Plan of Conservation and Development and expects to include discussion of emerging issues such as resiliency from sea level rise and associated coastal hazards.

Transportation Plan (2003)

The Transportation Plan prepared by the Transportation Planning Committee is a review of existing transportation conditions and a proposal of long-term solutions to issues and/or problems identified by the committee. The plan takes into account ongoing growth and builds on various recommendations made in the 2002 Plan of Conservation and Development. Recommendations that are potentially related to coastal resilience include the following:

- 1.16. The Board of Selectmen should explore opportunities for creating a satellite public works facility north of the I-95 corridor to deploy a portion of the heavy duty equipment closer to areas of Town which it will serve. The relocation would enhance efficiency, reduce traffic in the Town's commercial center, and reduce pollution from vehicles.

Such site should be large enough to absorb the entire Public Works facility as a future contingency.

- 2.2. The committee believes that roads are desirable in order to improve public safety by facilitating the movement of emergency vehicles when time is critical and to allow better connections between various parts of Town. The Board of Selectmen should consider the following opportunities for constructing east/west road connections as Town development patterns warrant:
 - 2.2.1 Bullard Drive to Route 77 (contingent on developments of the middle school campus)
 - 2.2.2 Nut Plains West, to Route 77.
 - 2.2.3 Briarwood Road extension to Hahn Road and West Lake neighborhood.
 - 2.2.4 Connector Road from Little Meadow Road/Hoop Pole Road to Route 77 between Route 80 and Stepstone Road.
 - 2.2.5 Connector Road between Podunk Road and Goose Lane.
 - 2.2.6 New England Road extension to West Lake Avenue. In addition, numerous recommendations were offered to locally improve traffic movement in various areas of the Town.

Growth Management Plan (2004)

The Growth Management Strategies Plan was developed to address recommendations from the Plan of Conservation and Development. The Planning and Zoning Commission formed the Planning Committee, a group of Guilford residents and commission members to respond to the 2002 document. The committee both considered and incorporated, wherever appropriate, intentions within the Town's Plan of Conservation and Development, the Transportation Plan (2003), the Economic Development Strategic Plan (2004), and the draft Natural Resource Inventory and Assessment (2005, described below). In doing so, the report seeks to identify options that the Town can improve upon in order to promote sensible growth that improves the environment, the quality of life, and community character.

In several sections of the Growth Management Plan, the concept of subtracting floodplains from buildable areas is discussed. Elsewhere, the potential for zoning overlays over riverine systems is mentioned. These are potentially important concepts for coastal resilience because they would result in restriction of control or development in areas subject to coastal hazards.

Plan for Economic Development (2004)

In recognition of the increasing tax burden on Guilford's residential community and the lack of a balanced commercial tax base, the Economic Development Commission prepared a new Plan of Economic Development in 2004. This plan recognizes that Guilford's 2002 Plan of Conservation and Development states that "Developing and maintaining a strong local economy is essential to enhance the community's resources, foster its way of life, provide employment opportunities,

and support the provision of the broad amenities and services desired by Guilford's growing population." In order for Guilford to have economic development success in the future, the following factors are critical:

- ❑ Guilford must provide adequate sites on which businesses or other capital investment can locate that will generate net tax revenue to the Town.
- ❑ These sites must have reasonable zoning and necessary infrastructure.
- ❑ Guilford's permit and approval process must be reasonable, fair, uniformly applied, and rapid.

These needs may be viewed as in conflict with some aspects of the foregoing preservation- and conservation-oriented plans. Regardless, the desire for coastal resilience must consider the need for appropriately sited economic development, as a strong economy will facilitate recovery from disasters.

Natural Resources Inventory and Assessment (2005)

Produced by the Natural Resource Inventory Committee, the Natural Resources Inventory and Assessment establishes an information baseline toward enhancing the Town's ability to formulate sound land use decisions in regard to development, conservation, and natural resource management issues. In doing so, the report describes the natural resources within the Town. The document locates resources geographically, describes their importance to the community, lists any threats, and describes various approaches to protect these resources. As an inventory and assessment of natural resources, the Natural Resource Inventory describes many resources that are germane to coastal resilience such as coastal waters. The plan does not, however, directly address coastal hazards or resilience.

Emergency Operations Plan (2007)

The Town Emergency Operations Plan undertook a comprehensive update in 2007 although it is updated annually relative to pertinent information as it changes. Sections I and II of the Emergency Operations Plan provide its purpose and assumptions. The Emergency Operations Plan explains that residents are warned of disasters by Reverse 911, local media such as the public access television station, and drive-by announcements. Emergency medical response is provided by the Guilford Fire Department. The Emergency Operations Plan notes that resources for evacuation, sheltering, and emergency medical services are sufficient to cope with only "moderate" level situations.

Section III of the Emergency Operations Plan describes mitigation, increased readiness, emergency phase operations, and recovery phase operations. The Emergency Operations Plan lists snowfall, ice storms, blizzards, hazardous material incidents, aircraft accidents, hurricanes, electrical storms, fires, fuel shortages, water contamination, and highway accidents as hazards covered by the Emergency Operations Plan. Thus, coastal hazards are inherently included. Specific mitigation measures include the following:

1. Carry out hazard mitigation activities appropriate to the functions of departments, agencies, and offices
2. Restrict development in hazardous areas consistent with the degree of risk
3. Work with commerce and industry to improve hazardous materials storage, use, transport, and disposal
4. Encourage public safety at all levels
5. Maintain a stock of sandbags
6. Develop and maintain all-hazard shelter/mass care and evacuation reference guides with predesignated evacuation and shelter facilities
7. Maintain mutual aid agreements with neighboring communities
8. Promote professional development for emergency management and public safety personnel

Section IV of the Emergency Operations Plan sets and describes roles and responsibilities. The Emergency Management Director coordinates with the ARC and other agencies, the Superintendent of Schools, and the Parks and Recreation Director to commence shelter operations. Roles of the Fire Department, Police Department, Health Director, Public Works Department, and Communications Director are also described.

Section V of the Emergency Operations Plan describes administration and logistics. The Fire Department is specified to provide incident management. This section also describes the duties of the ARC and Salvation Army such as provision of food, clothing, and various types of assistance.

Land Acquisition Commission Report (2007)

The Plan for Open Space and Municipal Land Needs, developed by the Land Acquisition Commission in consultation with numerous residents of the Town, is intended to assist the Planning and Zoning Commission with future planning goals and assist the Town in identifying suitable properties for acquisition if and when those properties are put up for sale. The plan lists a number of strategies for open space conservation that are applicable to developing coastal resilience through protection of natural resources, especially where coastal flood hazard areas are discussed.

Town Center South Plan (2007)

Developed by the Town Center South Planning Committee, the Town Center South Plan seeks to create a mixed-use, transit-oriented, higher density neighborhood with the train station as its focal point. Most of this neighborhood lies within the coastal management area and is therefore potentially affected by coastal hazards. The draft plan seeks to effectively enhance, preserve, protect, and maintain the cultural and environmental aspects that the neighborhood currently holds. The use of public transit is both promoted and encouraged as a means of effectively balancing all public issues at hand.

The draft plan recognizes sea level rise and recommends deeper wetland and shoreline setbacks, adherence to environmentally sensitive building codes, reduction in impervious surfaces, elimination of industrial activities in the area, and allowance for coastal flooding. The draft plan recommends that new development and redevelopment in a Town Center South overlay zone be built at least one foot above FEMA base flood elevations (except in the V zone, where it would be two feet).

Relocation of the Public Works facility is another important theme of the draft plan. While the draft plan recognizes that the location of this facility in a flood zone is problematic, its recommendation for mixed-use development in its place should be evaluated against the recommendations of this HMP.

Municipal Coastal Program (2008)

Guilford's Municipal Coastal Program was initially adopted in 1982 to serve as a guide to development within the coastal boundary. The program established objectives for coastal zone use and development, articulated Town policies relative to the Connecticut Coastal Management Act, and formed the basis of the Planning and Zoning Commission's coastal site plan reviews. The Coastal Program was updated and revised in 2008. The updated Coastal Program includes a review of relevant federal, state, and local regulations and policies; a review of related state and local planning studies and documents; an overview of coastal management issues; discussions of existing land use and specific coastal issues in various coastal regions; and a presentation of recommendations.

While many of the issues and resulting recommendations were geographic in nature, it was recognized that many were broad and could affect the entire coastal management area. As a result, nine coastal management issues were selected to address within the coastal program update:

- ☐ Tidal Wetlands
- ☐ Zoning Map and Regulations
- ☐ Property Taxes and Teardowns
- ☐ Density, Views, and Zoning Requirements
- ☐ Buffers and Setbacks
- ☐ Low Impact Development
- ☐ Public Access
- ☐ Coastal Hazard Mitigation and Sea Level Planning
- ☐ Coastal Land Acquisitions

Recommendations associated with the nine issues were likewise grouped into eight "themes" of common recommendations. Each theme has one or more policy recommendations as well as several specific recommendations in some cases. Note that one of the nine issues was "coastal hazard mitigation and sea level rise planning." Recognizing the importance of coastal hazard

mitigation in Guilford, one of the recommendations of the Coastal Program was to pursue a planning grant via the PDM program to develop the hazard mitigation plan.

Harbor Management Plan (2011)

The Harbor Management Plan was developed as enabled by Connecticut General Statutes 22a-113m and is the Harbor Management Commission's summary of issues and recommendations to the increasing and competing demands for the use and development of Guilford Harbor and the associated shoreline. The plan identifies seven types of goals for the entire Town shoreline to focus its resources upon in an attempt to effectively manage the future of the harbor's landscape. These include shoreline erosion, harbor and shoreline usage growth, speed limits, shellfisheries, moorings, increased public access, and dock facilities. Various recommendations are presented for addressing erosion, increasing public access, managing docks, and managing navigation.

The Harbor Management Plan dovetails with the goals and objectives for coastal resilience in Guilford. Consider the following goals of the Harbor Management Plan:

- ❑ Managing uses within the coastal boundary through planning, zoning, and other local regulatory authority, giving highest priority and preference to water-dependent uses and facilities in shoreline areas.
- ❑ Promoting appropriate facilities for all types of recreational boating including marinas, rack storage, moorings for local and transient vessels, and trails and launch sites for small watercraft.
- ❑ Balancing the rights of private riparian/littoral property owners with public trust rights, assuring reasonable water access to riparian property owners while maximizing the use of public trust waters to the public.
- ❑ Preserving, protecting, and enhancing public access to the shoreline area including access by small watercraft including kayaks, canoes, and dinghies.
- ❑ Preserving, protecting, and enhancing shellfish resources and habitat wherever possible.
- ❑ Establishing reasonable access standards in sensitive resource areas including exposed headlands, beaches, and marshes. Reasonable access may include allowing launching of small watercraft in lieu of the construction of structural facilities.
- ❑ Preserving, protecting, and enhancing mooring opportunities accessible from small watercraft in order to avoid the construction of additional structural encroachments.
- ❑ Preserving, protecting, and encouraging the restoration of large intact expanses of tidal marshes by minimizing or eliminating fragmentation by docks and walkways, which traverse these resources.
- ❑ Minimizing or eliminating the encroachment of structures into public trust waters in order to avoid adverse impacts to critical resources and navigation.

Shoreline flood potential is discussed in Section 2.3 of the Harbor Management Plan, shoreline change is discussed in Section 5.1.2, and docks in high hazard areas are discussed in Section

5.6.2. Specific recommendations for constructing docks in high hazard areas are presented in Section 6.7.3 of the Harbor Management Plan.

Section 6.1 of the Harbor Management Plan states the following: *"Every reasonable, environmentally acceptable, and cost effective effort, consistent with the applicable policies and standards of the Connecticut Coastal Management Act and the CT DEEP-OLISP, should be made to reduce shoreline erosion within the boundaries of the entire Guilford shoreline."* Specific recommendations for combating shoreline erosion are provided in Section 7.1 of the Harbor Management Plan.

Hazard Mitigation Plan (2012)

Development of Guilford's Hazard Mitigation Plan was enabled by the Disaster Mitigation Act of 2000 and was required by FEMA in order to make the Town eligible for certain mitigation funding programs. The plan was developed from 2010 through 2011, approved by FEMA in spring 2012, and adopted in June 2012. The plan addresses all possible natural hazards in the town, from flooding to wildfires, but includes a detailed chapter dedicated to describing coastal hazards and sea level rise. The plan describes The Nature Conservancy's efforts related to coastal resilience in Guilford. Many of the recommendations of the hazard mitigation plan related to coastal resilience were culled from prior plans such as the Municipal Coastal Program.

With the adoption of the plan in June 2012, the Town also formed (by resolution) the Hazard Mitigation Planning Commission as a continuation of the Pre-Disaster Hazard Mitigation Committee. This new commission will be available to pursue recommendations related to increasing coastal resilience.

1.5 Relationship to other towns and regional planning

Coastal resilience planning has been underway in a number of other communities in Connecticut. A few examples are described below:

South Central Regional Council of Governments – The South Central Regional Council of Governments (SCRCOG) commenced its hazard mitigation planning effort in summer 2012. SCRCOG will develop a multi-jurisdiction hazard mitigation plan for ten of its municipalities from 2012 through late 2013. Three of the participating communities are adjacent to Guilford – Madison, Branford, and North Branford. Guilford anticipates that Branford and Madison will at least partially address coastal hazards and resilience in the hazard mitigation plan.

Old Saybrook – Like Guilford, specific coastal resilience planning with an emphasis on hazard mitigation is underway in Old Saybrook in connection with The Nature Conservancy's participation and funding from NOAA.

Stonington, Waterford, East Lyme, Old Lyme and the Greater Bridgeport Region – The Nature Conservancy and its partners have been conducting risk and vulnerability workshops in other Connecticut communities to promote coastal resilience planning.

Groton – The Town of Groton has been participating in an EPA-funded climate change planning process for several years. The process includes the Connecticut Department of Energy and Environmental Protection and has most recently resulted in the report “Preparing for Climate Change in Groton, Connecticut: A Model Process for Communities in the Northeast.” The Town will soon be incorporating some of the findings and recommendations in its Municipal Coastal Program and Plan of Conservation and Development, both of which are being updated in 2012-2013.

Greenwich – Through a NOAA grant for coastal resilience planning, the Town of Greenwich is assessing vulnerabilities to sea level rise and coastal flooding by creating a GIS database of properties that have been subject to FEMA elevation certificates. An elevation certificate is completed for all new or substantially improved structures that are located in flood hazard areas as delineated on the FIRM. An elevation certificate can also be required by a lender and is often the basis for flood insurance underwriting. These certificates specify the elevations of the base flood, the lowest floor, the next-highest floor, and the adjacent grade.

2.0 Existing Capabilities, Strengths, and Capacities

2.1 Municipal Codes and Regulations

Guilford's fundamental capacity for addressing coastal resilience lies within its Zoning Regulations, Inland Wetlands Regulations, Subdivision regulations, and Flood damage prevention section of the Town Code.

Flood Damage Prevention

Flood damage prevention is covered by Chapter 174 of the Code of the Town of Guilford. The Flood Damage Prevention Code is essentially the Town's local articulation of the National Flood Insurance Program (NFIP) Regulations. In all areas of special flood hazard (Zones A1-30, AE, and AH) where base flood elevation data has been provided, the following provisions are required:

- (1) New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated above the base flood elevation.
- (2) Nonresidential structures located in all A Zones may be floodproofed in lieu of being elevated, provided that, together with all attendant utilities and sanitary facilities, the areas of the structure below the required elevation are watertight, with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A registered professional engineer or architect shall review and/or develop the structural design, specifications, and plans for the construction and shall certify that the design and methods of construction are in accordance with acceptable standards of practice for meeting the provisions of this subsection.

Relative to coastal high hazard areas (Zones V1-30 and VE), the following provisions shall apply:

- A. All new construction or substantial improvement shall be located 25 feet landward of the reach of the mean high tide.
- B. All new construction or substantial improvement shall be elevated so that the bottom of the lowest supporting horizontal member (excluding pilings or columns) is located no lower than the base flood elevation level, with all space below the lowest supporting member open so as not to impede the flow of water.
- C. All new construction or substantial improvement shall be securely anchored on pilings or columns.
- D. All pilings and columns and the attached structures shall be anchored to resist flotation, collapse, and lateral movement due to the effect of wind and water loads acting simultaneously on all building components. The anchoring and support system shall be designed with wind and water loading values which equal or exceed the one-hundred-year mean recurrence interval (one-percent-annual-chance floods and winds).
- E. A registered professional engineer or architect shall review and/or develop structural design specifications and plans for the construction and shall certify that the design, specifications,

- and plans for construction are in accordance with acceptable standards and are in compliance with the provisions contained in Subsections B through D.
- F. There shall be no fill used as structural support. Noncompacted fill may be used around the perimeter of a building for landscaping/aesthetic purposes provided that the fill will wash out from storm surge (thereby rendering the building free of obstruction) prior to generating excessive loading forces, ramping effects, or wave deflection. The Town Engineer shall approve design plans for landscaping/aesthetic fill only after the applicant has provided an analysis by an engineer, architect, and/or soil scientist which demonstrates that the following factors have been fully considered:
- (1) The particle composition of the fill material does not have a tendency for excessive natural compaction.
 - (2) The volume and distribution of fill will not cause wave deflection to adjacent properties.
 - (3) The slope of fill will not cause wave run-up or ramping.
- G. There shall be no alteration of sand dunes which would increase potential flood damage.
- H. A nonsupporting breakaway wall, latticework, or mesh screening shall be allowed below the base flood elevation provided that it is not part of the structural support of the building and is designed so as to break away, under abnormally high tides or wave action, without damage to the structural integrity of the building on which it is to be used and provided that the following design specifications are met:
- (1) Design safe loading resistance of each wall shall not be less than 10 nor more than 20 pounds per square foot; or
 - (2) If more than 20 pounds per square foot, a registered professional engineer or architect shall certify that the design wall collapse would result from a water load less than that which would occur during the base flood event, and the elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components during the base flood event. Maximum wind and water loading values to be used in this determination shall each have a one-percent chance of being equaled or exceeded in any given year (one-hundred-year mean recurrence interval).
- I. If breakaway walls, latticework, or screening is utilized, the resulting enclosed space shall not be designed to be used for human habitation but shall be designed to be used only for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises.
- J. Prior to construction, plans for any structures that will have breakaway walls, latticework, or screening must be submitted to the Town Engineer for approval.
- K. Any alteration, repair, reconstruction, or improvement to a structure shall not enclose the space below the lowest floor except with breakaway walls, latticework, or screening as provided for in Subsections H and I.

Zoning Regulations

In Guilford, the Planning and Zoning Commission is charged with administering the Zoning Regulations. Zoning is covered by Chapter 273 of the Code of the Town of Guilford.

Floodplain District

The Floodplain District is described in Section 273-6 of the Zoning Regulations. The district is an overlay zone. Regulations for this district are provided in Section 273-89. The regulations are relatively brief and essentially articulate a permitting process for new or substantially improved structures in accordance with the standards provided in Chapter 174 (the Flood Damage Prevention code).

Coastal Area Overlay District

The Coastal Area Overlay District is coincident with the Coastal Area Management Boundary. Revisions to Section 273-91 of the Zoning Regulations, the Coastal Site Plan Review, and the Coastal Area Overlay District were approved on December 16, 2009 and became effective on December 25, 2009. These revisions were promulgated as a result of the adoption of the Municipal Coastal Program in 2009. One of the objectives of revising the section of the regulations was to strengthen resiliency from coastal hazards.

In determining the acceptability of potential adverse impacts of the proposed activity described in the Coastal Site Plan on both coastal resources and future water-dependent development opportunities, the Planning and Zoning Commission shall "consider the characteristics of the site, including the location and condition of any of the coastal resources defined in Connecticut General Statutes Section 22a-93" and "consider the potential effects, both beneficial and adverse, of the proposed activity on coastal resources and future water-dependent development opportunities."

The following uses wholly or partially within the Coastal Area Overlay District, if permitted in the underlying district, shall require a Special Permit: (1) all nonresidential uses, including the expansion of existing nonresidential uses, except retail stores, offices, financial institutions, personal service establishments, and restaurants located more than 250 feet from a critical coastal resource; and (2) multifamily uses greater than two-family dwellings.

Because certain uses are found by the commission to pose an unacceptable risk of negative impacts on coastal resources, these uses are not be permitted within the Coastal Area Overlay District regardless of whether such uses may otherwise be permitted in the underlying district: foundries, painting shops except when accessory to boat repair or to other permitted uses and when constructed in accordance with applicable state and federal requirements, machine shops except as accessory to a permitted principal use, sheet metal shops except as accessory to a permitted principal use, welding shops except as accessory to a permitted principal use, tire recapping shops, bulky waste transfer or processing operations, motor vehicle washing establishments, and oil storage and propane filling stations except as accessory to a water-dependent principal use (any legally existing oil and propane filling stations in existence as of 12/25/2009 may be continued).

In addition to all required front, side, and rear yard setbacks, the following minimum setbacks between a proposed structure or impervious surface and any critical coastal resources shall be required for all uses within the Coastal Area Overlay District:

Minimum Setbacks from Coastal Resources

Development Depth ¹	<50 feet	50-100 feet	100-200 feet	>200 feet
<i>Minimum Setback² From:</i>				
Tidal Wetland and Intertidal Flats	25 feet	35 feet	50 feet	100 feet
Coastal Bluffs and Escarpments	25 feet	35 feet	50 feet	50 feet
Beaches or Dunes	25 feet	35 feet	50 feet	50 feet
Rocky Shorefronts	25 feet	25 feet	35 feet	50 feet

1. Development Depth – Distance between the critical coastal resource and an existing structure or impervious surface or, if the lot is unimproved, the front building line of the lot.
2. Minimum Setback – Required minimum distance between a proposed structure or impervious surface and the critical coastal resource.

Setbacks from critical coastal resources may be increased when the commission finds that the rate of erosion of the critical coastal resource or the rate of encroachment of coastal waters is likely to require a larger setback in order to protect the critical coastal resource.

Subdivision Regulations

Subdivision of land is defined in Chapter 272 of the Town of Guilford Code. In Guilford, the Planning and Zoning Commission is charged with administering Subdivision Regulations. Components of the regulations that directly or indirectly address coastal resilience (flooding, public safety, etc.) are listed below:

- ❑ Section 272-13, Part H, Flood Hazard Assurances: When the subdivision includes land within a special flood hazard area, written assurances with attendant drainage maps and calculations shall be presented as follows... that the flood-carrying capacity of any altered or relocated watercourse in the special flood hazard area will be maintained; and that any encroachment on the regulated floodway by construction of improvements or excavation, grading, or depositing of materials will not result in any increase in flood levels in the Town during the occurrence of the base flood discharge.
- ❑ Section 272-32, Part B, Street Planning: Proposed streets and rights-of-way shall be planned in such a manner as to provide safe and convenient access....(additional design standards are provided)
- ❑ Section 272-49, Special Flood Hazard Areas and Floodways: When the subdivision includes land in a special flood hazard area or regulated floodway, the lots, streets, drainage, and

other improvements shall be reasonably safe from flood damage and shall conform to the following: (A) The lots shall be consistent with the need to minimize flood damage within the special flood hazard area and shall be capable of use without danger from flooding or flood-related damages; (B) All utilities and facilities such as sanitary sewer systems, water supply systems, and electric and gas systems shall be located and constructed to minimize or eliminate flood damage; (C) the storm drainage required under Section 272-33 shall be designed to reduce exposure to flood hazards; and (D) Streets shall be of such elevation or shall be suitably protected as to allow reasonable emergency access during flood conditions.

Inland Wetland and Watercourses Regulations

In Guilford, the Inland Wetlands Commission is charged with administering the Inland Wetland and Watercourses Regulations. In Connecticut, wetlands are identified as related to flood hazard mitigation within the state enabling regulations, and this is often stated as such in the title section of local regulations. The same is true in the Guilford Inland Wetland and Watercourses Regulations (with underlines added for emphasis):

"The wetlands and watercourses are an interrelated web of nature essential to an adequate supply of surface and underground water; to hydrological stability and control of flooding and erosion; to the recharging and purification of groundwater; and to the existence of many forms of animal, aquatic, and plant life."

Furthermore, a "significant impact activity" is defined as an activity "which substantially diminishes the natural capacity of an inland wetland or watercourse to: support desirable fisheries, wildlife, or other biological life; prevent flooding; supply water; assimilate waste; facilitate drainage; provide recreation or open space; or perform other functions."

If a proposed activity involves a significant activity as determined by the commission and defined in Section 271-6 of these regulations, additional information based on the nature and anticipated effects of the activity, including but not limited to the following is required...

"Management practices and other measures designed to mitigate the impact of the proposed activity. Such measures include, but are not limited to, plans or actions which avoid destruction or diminution of wetland or watercourse functions, recreational uses, and natural habitats or re-vegetation which prevent flooding, degradation of water quality, erosion and sedimentation, and obstruction of drainage, or which otherwise safeguard water resources."

2.2 Boards, Commissions, and Departments

Guilford's capacity for addressing coastal resilience will depend on the participation of the various boards, commissions, and departments that will need to carry out the goals and objectives of the coastal resilience plan. The following subsections describe general departmental responsibilities, and duties related to coastal resilience.

Board of Selectmen

The Town is managed by a Board of Selectmen. The Board of Selectmen oversees many of the municipal departments, commissions, and boards and is directly responsible for appointing members of many commissions and boards.

Public Works Department and Commission

This Public Works Department is under the general supervision of the First Selectman. The department is responsible for planning, organizing, and administering the public works operations as well as managing the public works staff and budget. As is common throughout the shoreline of Connecticut, the Public Works Department is often charged with numerous tasks that are related to coastal hazards. Specifically, roadway/infrastructure maintenance and complaint logging/tracking are duties of the Public Works Department. For example, the Public Works Department tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure.

The Public Works Department is often the de facto first responder during emergencies. The Public Works Department must maintain access for the Police and Fire Departments to respond to emergencies.

The Public Works Commission is appointed by the Board of Selectmen. This commission is charged with the following:

- ❑ Management and oversight of the Public Works Department;
- ❑ Development of a proposed budget estimating anticipated expenditures and revenues for the operations of the Public Works Commission for each fiscal year;
- ❑ Review of the Town's needs with respect to public works and making such recommendations to the Board of Selectmen and other Town agencies and departments as it deems appropriate;
- ❑ Establishment of regulations for the effective operation of the Public Works Department including the duties of the department and its superintendent or director with respect to construction and maintenance of Town buildings, highways, sidewalks, sewers and drains;
- ❑ Review and approval of the department's maintenance and care of school buildings; and
- ❑ Review and approval of the department's maintenance and care of beaches and parks on request of the Parks and Recreation Commission.

Building and Engineering Department

The Building Official administers the Town's building inspection program adhering to and enforcing all code requirements of the State of Connecticut relating to building construction.

The Town Engineer plans, directs, and coordinates engineering contracts and construction projects, including bridges, sanitary, and marine development. This official provides technical

consultation to Town boards and commissions and serves as Town liaison with various state agencies. As such, the Town Engineer will often need to review issues related to drainage, flood conveyance, and flood mitigation. The Town Engineer has a unique responsibility when it comes to coastal resilience as he or she is responsible for overseeing codes related to coastal flood damage prevention. For example, the Engineering Department enforces A- and V-zone standards for floodproof construction and building elevations.

Fire Department and Emergency Management Agency

The Fire Department is the primary agency involved with the social aspects of coastal resilience through emergency services and public education. The mission of the Guilford Fire Department is "to provide the highest quality fire protection, emergency medical services, fire prevention, safety education, community services, and mitigation of emergency and non-emergency incidents for the citizens and visitors to the town of Guilford."

Chapter 27 of the Town of Guilford Code establishes a Civil Preparedness Agency. The Director of Civil Preparedness shall be a staff person reporting directly to the Board of Selectmen of the Town of Guilford and shall be primarily responsible for the planning and coordination of disaster emergency operations. According to the Town Code, the director's duties may include but will not necessarily be limited to the following:

- ❑ Planning for specific and general emergencies that involve one or more town departments or agencies and/or that overload normal resources
- ❑ Recruiting and/or training volunteers and town employees to operate within the context of civil preparedness
- ❑ Coordination with the State Office of Civil Preparedness on all matters pertaining to civil preparedness
- ❑ Procurement and/or coordination of such facilities, equipment, and supplies as are required
- ❑ Preparation of required reports, procedures, and other necessary paperwork to ensure that the town receives all possible funding, equipment, assistance, and other benefits available to the town through state and federal civil preparedness agencies

In the event of disaster as declared by the Governor of the State of Connecticut or the President of the United States, the acting Chief Executive Officer or the Board of Selectmen, as available, may assume complete command of all local government functions and facilities, including public schools and personnel.

The Town implements the provisions of Chapter 27 of the code through the Emergency Management Agency. The Fire Chief is the director of the Emergency Management Agency. The Emergency Operations Plan articulates the composition of the Emergency Management Agency as follows: Director (appointed by First Selectman), First Selectman, Health Director, Police Chief, Superintendent of Schools, Public Works Director, Town Engineer, Communications Supervisor, and Director of Parks and Recreation.

The Emergency Management Agency meets as needed. For example, the agency met in September 2010 before Hurricane Earl's anticipated landfall. At that time, the agency issued the following statement via the Town website (refer to Appendix E for a copy):

"Currently our area is under a tropical storm warning. Listen to local television or radio stations for the latest updates. Our Emergency Departments are on standby and ready to go into action if necessary. If an emergency shelter is required, the community center will be open. If evacuations become necessary and you have pets, contact the Animal Shelter at 453-8083. As a precaution have at least two days of necessary supplies stockpiled."

Police Department

Day-to-day duties of the Police Department include crime prevention, criminal investigations, traffic enforcement, motor vehicle accident investigations, and patrols. Duties related to coastal resilience include planning and coordination of personnel, equipment, shelters, and other resources necessary during a coastal emergency.

Planning Department

The Town Planner is managed by the Office of the First Selectman. The Town Planner is responsible for managing the Planning and Zoning and Inland/Wetlands staff. The planning office provides assistance to the Health Department and Building and Engineering Departments and is responsible for housing and economic development planning. The Zoning Enforcement Officer/Inland Wetlands Enforcement Officer enforces the zoning regulations and is the administrator of the inland wetlands regulations and coastal site plan decisions on issues of zoning compliance.

Because the Planning Department assists the applicable commissions with administration of the Zoning Regulations, Subdivision Regulations, and Inland Wetland Regulations, the department is responsible for numerous elements of coastal resilience.

Commissions Related to Coastal Resilience

Numerous commissions are involved with coastal resilience:

- ❑ Conservation Commission – Charged with the development, conservation, supervision, and regulation of natural resources and water resources.
- ❑ Harbor Management Commission – Charged with the duty and purpose of developing a Harbor and Waterways Management Plan for Guilford.
- ❑ Inland Wetlands and Watercourses Commission – Charged with implementing and enforcing all provisions of the Connecticut General Statutes as regards the Inland Wetlands and Watercourses Act. Like many Connecticut municipalities, the Town is enabled to appoint a Flood and Erosion Control Board. The duties of the Flood and Erosion Control Board are carried out by the Inland Wetlands Commission.

- ❑ Land Acquisition Commission – Charged with determining and recommending to the Board of Selectmen the feasibility of acquiring land, development rights, and conservation easements and prioritizing properties for acquisition by the Town.
- ❑ Marina Commission – Charged with the control, development, management, operation, and maintenance of the Town marina.
- ❑ Planning and Zoning Commission – Charged with establishing, implementing, and overseeing planning and zoning regulations as provided by the Connecticut General Statutes.
- ❑ Hazard Mitigation Commission – Formed to implement recommendations of the hazard mitigation plan and to maintain and update the plan as required by FEMA.

3.0 Vulnerabilities by Type

In general, the areas of Guilford that are vulnerable to sea level rise are similar to those vulnerable to coastal hazards. Specifically, the developed areas of Guilford that are most vulnerable to sea level rise include those at low elevations and those characterized by a lack of near-surface competent bedrock. A quick view of the coastal floodplain maps reveals the areas that are most vulnerable to sea level rise. These include at-grade roads, certain neighborhoods, and larger areas adjacent to marshes.

With regard to undeveloped areas, all of the tidal marshes are vulnerable to sea level rise. They will continue to erode as marshes spend more time inundated and as other contributors to marsh die-off continue. The "collapse" of the Leete's marsh and the die-off of eel grass and other species leaves only mud flats in many areas that previously were marshes including Hidden Lake above the railroad bridge at the head of Great Harbor. The marshes will continue to be "squeezed" where they cannot migrate inland and, even where sufficient land is available for migration (such as within and along the East River corridor), sea level rise could be too fast for migration to occur. The following subsections explore individual types of vulnerability in more detail.

3.1 Social

Social vulnerabilities to coastal hazards are focused mainly on three groups of people: residents, the business community, and visitors. These social vulnerabilities are directly linked to economic vulnerabilities, described in the next section.

Residents

Residents of Guilford comprise the greatest group of people with vulnerability to coastal hazards and thus increased risk as sea level rises. More frequent coastal storms, storm surges, and flooding can cause a wide range of outcomes from minor property damage to injury and loss of life. Even the indirect outcomes of increased flooding can cause a range of problems from the slight inconvenience of waiting for low tide to traverse a key intersection, to being unable to mobilize an ambulance to the home of a person in need of medical attention.

Business Community

Social vulnerabilities to coastal hazards in Guilford are not limited to residents. Social vulnerabilities can be found among the business community. Many people who do not live in Guilford are employed in town or own a business in town. As such, they have significant fiscal or emotional investment in Guilford. Increased coastal hazard risks could cause interruptions in employment, leading to loss of income and insurance; or interruptions in business continuity, leading to failure of businesses and loss of services that were provided by shuttered or failed businesses. These are all significant social issues, leading to distress for business owners and employees as well as residents.

Visitors

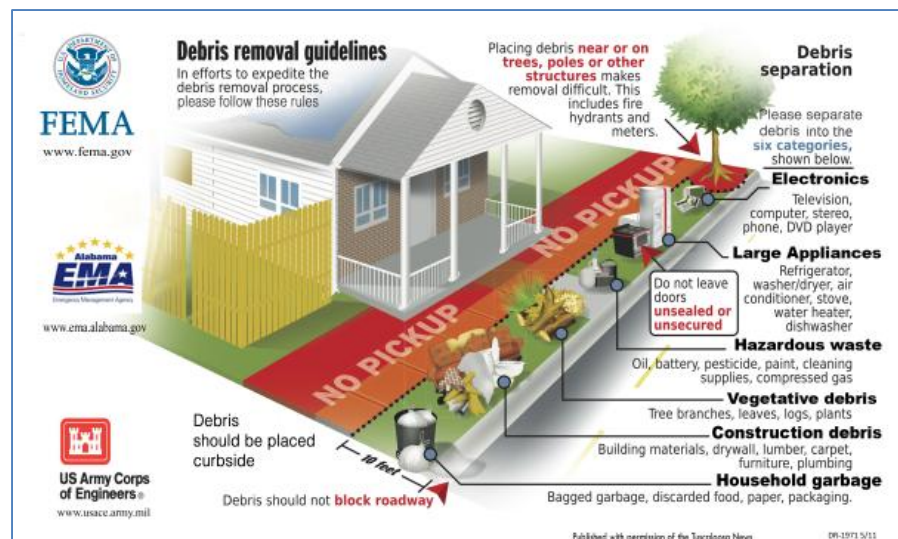
Many people who neither live nor work in Guilford have a great love of the community and visit often, from boaters and kayakers to hikers and cyclists. People visit Guilford to dine at their favorite restaurants and visit their favorite shops, stroll on the green, or simply take a leisurely drive through town. More frequent coastal storms, storm surges, and flooding can adversely impact the amenities and natural resources that draw these visitors from out of town, leaving them with fewer options for recreation in Guilford. Examples range from a flooded restaurant that can no longer be visited by patrons, to an eroded beach that can no longer accommodate the level of visitors that it previously supported.

3.2 Economic

Residential Properties

Residential properties are directly vulnerable to coastal hazards with regard to flooding and wave action. Waves can destroy a residential structure in very little time. Floodwaters cause massive damage to the lower levels of homes, destroying heating and other equipment, furniture, important papers, and possessions. Wet and damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Gasoline, pesticides, sewage, and other aqueous pollutants can be carried into areas and buildings by floodwaters and soak into soil, building components, and furniture.

The costs to clean up a home after flooding can range from less than \$10,000 to more than \$100,000 depending on the damage. The amount of debris produced by flooding can be staggering. The graphic to the right (courtesy of FEMA) demonstrates the types of debris that can be generated, all requiring disposal and replacement.



The land surrounding homes is also vulnerable to coastal hazards. Vehicles, pools, landscaping, and outbuildings can be washed away or destroyed. Erosion can alter the ground surface.

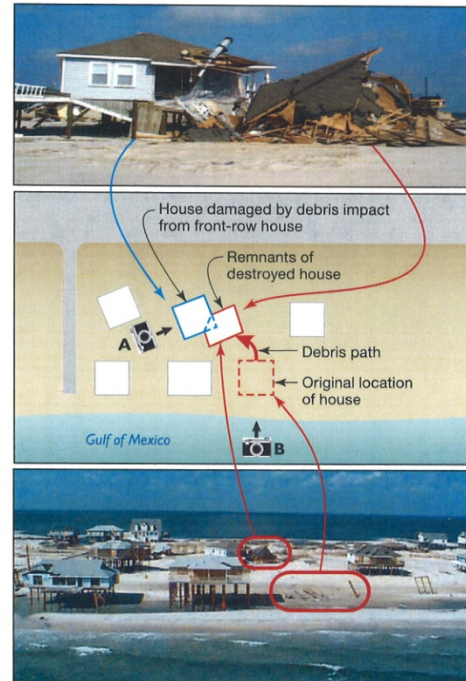
Animals can be forced out of their natural habitats and into closer contact with people. Wells and septic systems can be damaged or rendered useless as discussed in Section 3.4 below.

The graphic to the right (courtesy of FEMA) illustrates another type of vulnerability. Debris from a damaged home can be moved by floodwaters or a storm surge and damage a nearby home.

The indirect vulnerabilities to residential properties can be as bad as the direct vulnerabilities. Floodwaters can prevent emergency egress by blocking streets, deteriorating municipal drainage systems, and diverting municipal staff and resources. This can leave a home vulnerable to fire or other damage, leading to further economic losses. Figure 2 depicts this type of vulnerability; although the home may be situated above current and future flood elevations, access to the home may be increasingly cut off by flood waters associated with storms or even from normal high tides.

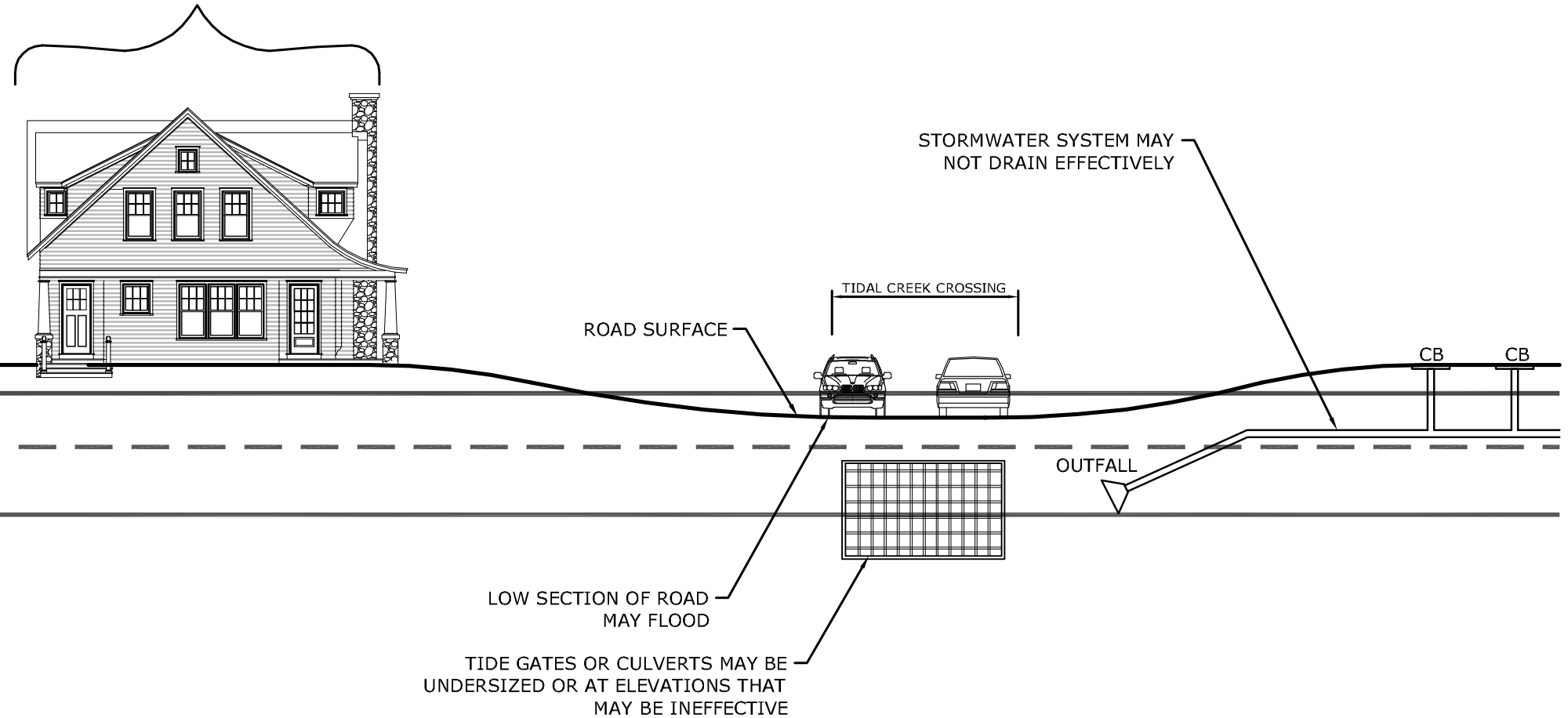
Guilford's overall tax base is heavily dependent on residential properties, and coastal properties make up a very large percentage of the residential tax base. The loss of a home leads directly to the loss of the taxes collected from the property.

In general, many of the homes in the near-shore densely populated areas such as Old Quarry, Little Harbor, Leete's Island, Sachems Head, Vineyard Point, Indian Cove, Mulberry Point, Tuttle's Point, and Rock Point are not at high risk to inundation due to sea level rise, but they are at risk to coastal hazards such as waves and winds, increased damage from storms as sea level rises, and increased frequency of isolation as roads are flooded. On the other hand, homes located along Shell Beach Road, Trolley Road, Seaside Avenue, Meadow Street, South Fair Street, High Street, Halleck Street, Norton Street, Rosemary Lane, Chimney Corner/Prospect Avenue, and Summer Street may need to address the actual encroachment of sea water under non-storm conditions. Geographic differences are examined in Chapter 4 of this report.



RESIDENTIAL, ROADWAY, AND DRAINAGE VULNERABILITIES

NEIGHBORHOODS MAY BECOME ISOLATED
MORE FREQUENTLY



LEGEND

- CURRENT MHW WATER ELEVATION
- - - FUTURE MHW WATER ELEVATION
- FUTURE FLOOD

FIGURE 2

Commercial/Industrial Businesses

Non-residential commercial and industrial properties are directly vulnerable to coastal hazards with regard to flooding and wave action just as the residential properties described above. Waves can destroy a structure and floodwaters can cause damage. Figure 3 depicts several types of vulnerability to commercial and industrial properties. Increased flood frequency and increased flood elevations can inundate assets, equipment, and vital records such as products/merchandise and IT systems on the lower levels of a building; and damage HVAC equipment such as air conditioning units, boilers, furnaces, etc. Wells and septic systems can be damaged or rendered useless as discussed in Section 3.4 below.

A review of FEMA payments to small businesses after federal disaster declarations is quite revealing. Millions of dollars are funneled toward getting businesses back on their feet after floods.

The Soundview Road corridor is an important area of commercial/industrial vulnerability in Guilford. Approximately 13 businesses are located along Soundview Road and Shoreline Drive, and all of them are presently in hurricane surge zones. Therefore, risks will increase over time. Some of these businesses can be easily relocated while some cannot be easily moved. The tax base and employment provided by the Soundview Road businesses are important to the Town of Guilford and therefore reducing risk will be important.

Hazardous materials, fuels, and products are stored and used at some of the businesses along Soundview Road, making them more vulnerable to damage on-site as well as increasing vulnerability for surrounding properties that may be exposed to fire or pollution in the event of a release. The economic implications could include the need to repair damaged facilities as well as the costs of responding to hazardous materials incidents and the aftermath.

Businesses along the Boston Post Road near River Street are at risk to coastal storms during several of the future scenarios (2020s/Category 2 and upward) although daily inundation risks in future scenarios are only moderate. These businesses include the Mulberry Plaza and the gasoline service station at River Street and the Boston Post Road (currently a Mobil). Similarly, a number of businesses along the south side of the Boston Post Road between Village Walk and Goose Lane are at risk to coastal storms during several of the future scenarios (2020s/Category 2 and upward) although daily inundation risks in future scenarios are only moderate.

As with the Soundview Road businesses, the tax base and employment provided by businesses along the Boston Post Road and other busy thoroughfares are very important to the Town of Guilford. Perhaps more imperative, these businesses provide vital services that support residents, business owners, employees, and visitors of Guilford on a daily basis.

COMMERCIAL/INDUSTRIAL, WATER SUPPLY WELL, AND SEPTIC SYSTEM VULNERABILITIES

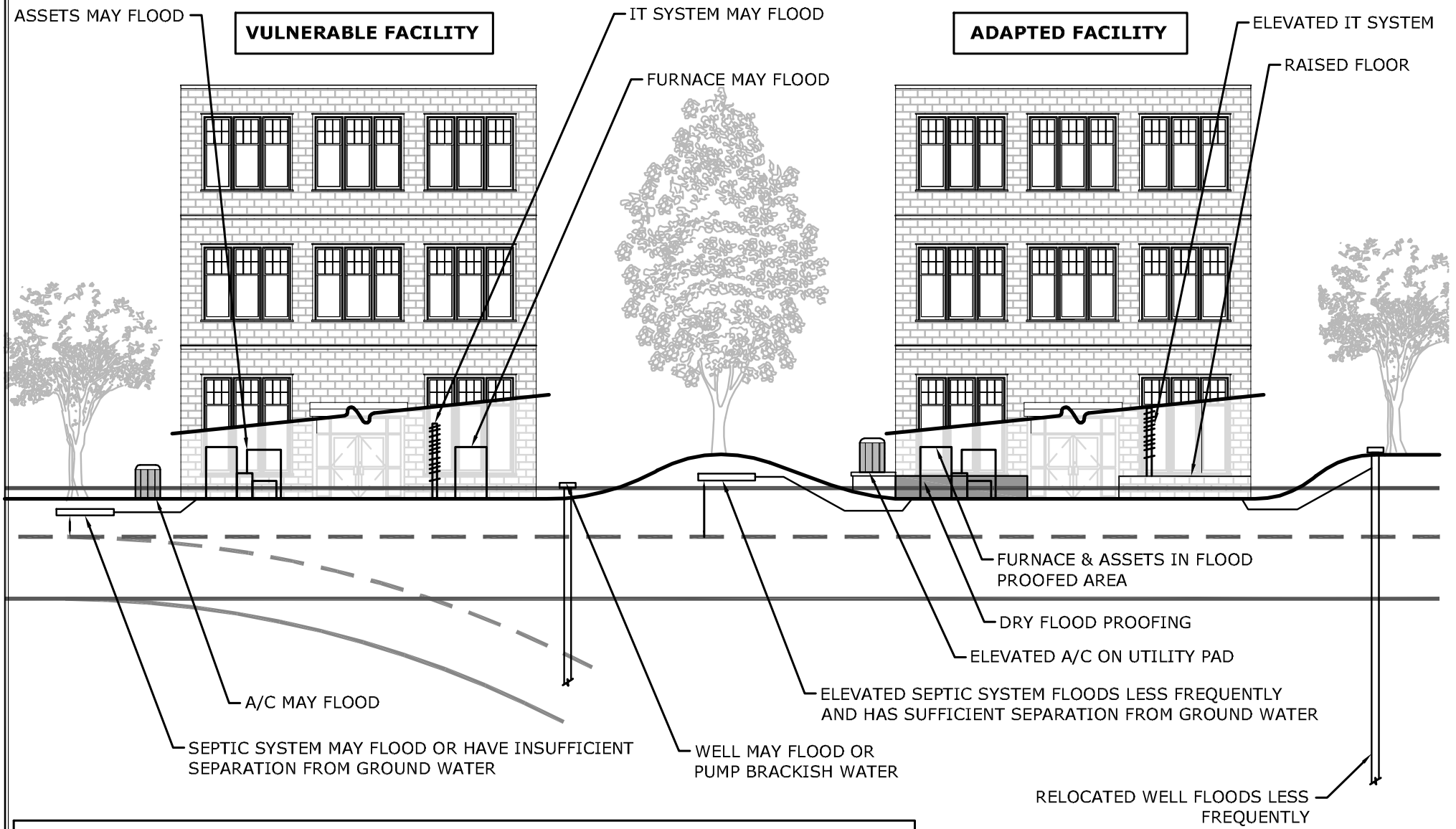


FIGURE 3

Water-Dependent Commercial/Industrial Businesses

Water-dependent businesses in Guilford include Guilford Boat Yard, Brown's Boat Yard, Guilford Yacht Club, and Sachems Head Yacht Club. The clubs are considered businesses in this report because they employ people. These businesses will have vulnerabilities that are similar to the commercial and industrial properties described above, but may have higher overall risk by virtue of the fact that they are typically located at the water's edge. Guilford Boat Yard and Brown's Boat Yard are considered by the Town to be critical facilities because they can assist before coastal storms, and as such, risk reduction is very important for these businesses. Though few in numbers, the water-dependent businesses have an important positive economic impact in the Town.

Municipal/Institutional Resources

The Guilford Public Works facility off Old Whitfield Street is presently in a hurricane surge zone and coastal flood zone, is highly vulnerable to coastal hazards, and will experience increasing risk under all scenarios of sea level rise and coastal storms as discussed below in Section 3.3. The economic impacts of coastal hazards affecting the Public Works facility are far-reaching. A loss of equipment at the facility due to a flood could cost the Town thousands of dollars to replace. If access to and from the facility is impaired, then the Town may not be able to respond appropriately to coastal hazards elsewhere, leading to road closures that could shut down businesses and impede commerce.

The Guilford Marina (town-owned) and the East River State Boat Launch (state-owned) are both considered critical facilities because of their importance in clearing the harbor before coastal storms and providing access immediately following storms. The economic benefit of these facilities is that they directly support recreational and non-recreational boating and the associated mooring fees and ancillary businesses such as restaurants, boat yards, and yacht clubs. Because these facilities will always be located in high-risk areas at the water's edge, reducing risks can only be accomplished through reducing vulnerabilities.

As explained in Section 3.5, three fire stations are located in areas of risk. Any loss of equipment at the firehouses would have a significant financial impact to the community, and any loss of response time during a fire or coastal storm could have dire economic impacts in Guilford.

Tourism

Section 3.1 described the social vulnerabilities associated with visitors of the Town of Guilford, many of whom are supporting the tourism industry. More frequent coastal storms, storm surges, and flooding can adversely impact the amenities and natural resources that draw these visitors from out of town, leaving them with fewer options for recreation in Guilford. Examples range from a flooded restaurant (such as the Stone House) that can no longer be visited by patrons, to an eroded beach (Jacob's Beach, Shell Beach, etc.) that can no longer accommodate the level of visitors that it previously supported. The economic impact of tourism in Guilford is

believed to be significant and closely linked to the positive economic impacts associated with the marina, East River boat launch, businesses along the Boston Post Road, and other support services.

Future Development

Targeted economic development zones include the Soundview Road area, Town Center South area, parcels north and south of I-95 just east of exit 58 (between State Street and Goose Lane), parcels at the northeast corner of Long Hill Road and I-95 (Hubbard Road), and properties east and west of the Boston Post Road on the north side of I-95 at exit 57. Some of these areas are already developed, such as Soundview Road, while others include significant vacant land.

The parcels between State Street and Goose Lane and the parcels at the northeast corner of Long Hill Road and I-95 (Hubbard Road) are at minimal risk under all future scenarios. The Hubbard Road parcels have similar risk as the Police Department and Fire headquarters (Section 3.5 below), with only the “rear” of the parcels nominally affected by high water during the 2080s/Category 3 scenario. The properties east and west of the Boston Post Road on the north side of I-95 at exit 57 have no risk under future scenarios.

The future development areas at highest risk to coastal hazards are the Town Center South and Soundview Road areas. In both cases, various parcels are already in coastal flood zones and hurricane surge zones. Adjacent parcels will be increasingly at risk to future coastal hazard scenarios. The key for Town Center South and Soundview Road will be to ensure that future development is resilient by reducing risks through constructing buildings with very low vulnerabilities.

3.3 Infrastructure

State Roads and Bridges

Significant sections of State roads are vulnerable under a range of future scenarios, including:

- ☐ Route 146 at Old Quarry Road
- ☐ Two sections of Route 146 in the Lost Lake/Great Harbor area
- ☐ The intersection of Route 146, Sachems Head Road, and Sam Hill Road
- ☐ Two short sections of Route 146 between Wild Rose Avenue and Jacobs Lane
- ☐ Route 146 at West River (a wide section from Whitfield Street to Guilford Boat Yard)
- ☐ Route 146 just west of Goose Lane
- ☐ The Boston Post Road (Route 1) at West River
- ☐ The Boston Post Road at East River

Bridges and culverts are located at East River, West River, Lost Lake, Great Harbor, Hoadley Creek, and unnamed watercourses that are tributary to West River and Sluice Creek.

Figure 2 depicts a variety of vulnerabilities that occur at low roadways. They may become flooded or inundated more frequently, drainage systems in the roads may become ineffective, and culverts may become ineffective due to poor capacity or because they are situated at an improper elevation relative to rising sea level.

Town Roads and Bridges

Significant sections of Town roads are vulnerable under a range of future scenarios, including:

- ☐ Old Quarry Road
- ☐ Shell Beach Road
- ☐ Trolley Road
- ☐ Prospect Avenue
- ☐ Chimney Corner Circle
- ☐ Vineyard Point Road
- ☐ Sachems Head Road and Sam Hill Road and their intersection with Route 146
- ☐ Three Mile Course
- ☐ Indian Cove Road at the head of the cove
- ☐ Tuttle's Point Road
- ☐ Chaffinch Island Road and
- ☐ River Street
- ☐ The lower part of Long Hill Road
- ☐ Mill Road
- ☐ Howard Drive
- ☐ Meadow Street
- ☐ South Fair Street, High Street, Halleck Street, Norton Avenue, Frances Street, and Rosemary Lane
- ☐ Hunter Drive and Rollwood Drive
- ☐ Lovers Lane, Stone House Landing, and Sawpit Road
- ☐ Seaview Terrace and East Avenue
- ☐ Whitfield Street and Old Whitfield Street
- ☐ Seaside Avenue
- ☐ Soundview Road and Shoreline Drive

Small bridges and culverts are located at many locations.

Railroads

In general, the railroad line through Guilford has not historically flooded and the potential for it to flood is limited based on the future scenarios. This is because the grade is elevated above the adjacent tidal marshes and other low areas.

Stormwater and Drainage

As sea level rises, drainage systems become less effective. Rainstorms will have the potential to cause greater flooding because the stormwater will not as easily be collected and conveyed elsewhere. Figure 2 depicts the outfall of a drainage system and shows how it will be below water level in the future, limiting its effectiveness.

Guilford reportedly experiences increased problems with inadequate storm drainage south of the Town center and along Whitfield Street and several coastal areas. As sea level rises, these areas will likely experience decreased drainage capacity and increased risk of flooding.

Tide Gates

Tide gates are somewhat sensitive to elevation and are therefore vulnerable to sea level rise and coastal hazards. Figure 2 depicts a tide gate structure below a road. The risk of coastal flooding upstream of a tide gate is directly related to the functionality of a tide gate. Therefore it can be difficult to quantify the overall risks associated with a tide gate that will not function as needed during future coastal hazard events or simply as sea level rises.

Seawalls and Bulkheads

The effectiveness of seawalls and bulkheads is directly related to their elevations and construction. Seawalls and bulkheads will become more vulnerable to coastal storms over time as sea level rises. In turn, the properties and structures protected by seawalls and bulkheads will become more vulnerable. The increased vulnerability and increased frequency of storms will cause risk of failure and risk to protected properties to increase over time.

Marinas, Docks, and Boat Ramps

The Guilford Marina (town-owned) and the East River State Boat Launch (state-owned) are both considered critical facilities because of their importance in removing watercraft from the harbor before coastal storms and providing access immediately following storms. The marina is located at the head of Guilford Harbor in a 100-year coastal flood zone with wave velocity hazards and the state boat launch is located on the East River estuary in a 100-year coastal flood zone. As such, limited availability should be expected during disasters. Because these facilities will always be located in high-risk areas at the water's edge, reducing risks can only be accomplished through reducing vulnerabilities. The low point in the marina parking lot is already floodprone and may be inundated on a daily basis in the future scenarios.

Other Municipal and Institutional Facilities

The Guilford Public Works facility off Old Whitfield Street is presently located in a coastal flood zone and Category 1 hurricane surge zone associated with the Sluice Creek estuary. It is highly vulnerable to coastal hazards, and will experience increasing risk under all scenarios of sea level

rise and coastal storms. The facility is considered critical and risk reduction is so important for the Public Works facility that various planning studies have discussed complete relocation to remove it from an area of risk. The Guilford Transportation Plan discusses the exploration of opportunities for creating a satellite Public Works facility north of the I-95 corridor to deploy a portion of the heavy duty equipment closer to the areas of Town that it will serve. The Town Center South Plan discusses the relocation of the Public Works facility to a more appropriate area outside a flood zone, and the Hazard Mitigation Plan recommends relocation of the Public Works facility.

The Guilford Post office at 42 Water Street is located in hurricane surge zone and will experience increasing risk under all scenarios of sea level rise and coastal storms. Similarly, the Guilford/Madison post office facility on Shoreline Drive (off Soundview Road) will have increasing risks that are common to the many businesses on Soundview Road.

Health Care, Assisted Living, and Senior Living Facilities

Apple Rehabilitation is currently located in a coastal flood zone and hurricane surge zone. Although daily inundation from sea level rise is not likely under future scenarios, hurricane surge flood risks will increase over time as sea level rises.

Similar to Apple Rehabilitation, the Boston Terrace public housing complex is currently located in a coastal flood zone and hurricane surge zone. Although daily inundation from sea level rise is not likely under future scenarios, hurricane surge flood risks will increase over time as sea level rises.

3.4 Utilities

Public Water Systems

Public water supply in Guilford is supplied by the Connecticut Water Company's "Guilford System." Sources of supply include the Guilford Well in southern Guilford, the Pinewood Well in central Guilford, surface water supplies, and an interconnection with the Regional Water Authority system. Most of these sources are not located in coastal flood hazard or hurricane surge zones; therefore coastal hazard risks are low.

The Guilford Well is located east of Long Hill Road and south of Interstate 95 near the Town Millpond. Although the wellhead is above the base flood elevation¹, it is presently in a mapped surge zone and coastal hazard risk will increase over time.

Although many coastal neighborhoods in Guilford are still served by individual private wells, portions of the distribution system extend into Sachems Head, Vineyard Point, and the Whitfield Avenue/marina area. It is conceivable that portions of the system installed in some coastal

¹ Correspondence with The Connecticut Water Company, 2012

neighborhoods are close to sea level. The positive pressure maintained in a water system will prevent salt water from entering pipes. However, it is possible that salt water intrusion to fresh groundwater – or into areas that are currently above the groundwater table – could lead to corrosion of pipes. Vulnerability is likely low, but risk could increase over time as sea level rises.

In addition, the Town has been working for many years to extend the Guilford System into the Indian Cove, Tuttles Point, and Mulberry Point neighborhoods. When funding is available, it is expected that water mains will be installed in these areas. Logistical concerns have largely centered on high bedrock and the need for blasting or ripping, so brackish groundwater is not a main concern. However, there may be a few areas where pipes may cross below sea level in unconsolidated sediments such as Daniel Avenue and Tuttles Point Road. Because the pipes will be installed for the first time, opportunities to reduce vulnerabilities will be available.

Private Water Supplies

Individual private wells are vulnerable to sea level rise and coastal hazards in two important ways:

- ❑ Increased flooding and inundation can contaminate a well by allowing surface water to enter the wellhead or travel downward along the casing, rendering the well unusable until it can be disinfected and flushed.
- ❑ Rising sea levels can shift the fresh groundwater/salt water interface inland where it can intersect with wellbores that are currently landward of the interface.

Figure 3 depicts these two types of vulnerabilities to individual private wells. If private wells are not relocated inland and elevated, or replaced by public water systems, then risks will increase over time.

Subsurface Sewage Disposal Systems (septic systems)

Like many shoreline communities in Connecticut, Guilford relies mainly on subsurface sewage disposal systems (septic systems) for sanitary wastewater treatment. Public sewers are not present in the town. These systems are vulnerable to sea level rise and coastal hazards in two important ways:

- ❑ Increased flooding and inundation can flood a system and render it unusable, filling the septic tank and galleries and making it impossible for waste to drain away from a home or business. The system can break out and cause contamination at the ground surface.
- ❑ Rising sea levels can decrease the vertical separation between the top of the groundwater table and the bottom of the septic system, decreasing the travel time for pathogens and the adsorptive capacity of the unsaturated zone, causing increased groundwater pollution.

Figure 3 depicts these two types of vulnerabilities to septic systems. If systems are not relocated inland and elevated, or replaced by sanitary sewers, then risks will increase over time.

Electricity

The greatest threats to the electrical grid associated with increased coastal hazards are wind-related. These are not directly addressed in this report. However, increased incidence and duration of flooding can reduce the capability of CL&P to respond to outages caused by downed wires and blown transformers. For example, a utility crew could have difficulty traversing a flooded intersection to reach a coastal neighborhood where downed wires have caused a loss of power. Risks will increase over time, as the vulnerability of overhead power lines is unlikely to decrease without a concerted effort to bury electrical lines.

In addition, it is possible that increased flooding and sea level rise can affect low-lying or buried electrical lines directly. Locations of buried utilities are not documented in a manner that allows for a rapid assessment of vulnerabilities to flooding.

Telecommunications

Wired telecommunications systems such as cable television and internet will have vulnerabilities and risks that are identical to those described above for electricity. Wireless telecommunications systems are dependent on towers, antennas, and satellites and therefore lack any direct vulnerability to coastal hazards (except for winds). However, the loss of electricity and a reduced capacity for CL&P to respond due to flooding could impact wireless telecommunications systems that require electricity to operate.

3.5 Emergency Services

Fire and Police Department Facilities

The fire headquarters is located at 390 Church Street. Outlying fire stations are located at 10 Graves Avenue, 120 Whitfield Street, 51 Water Street, and 3087 Durham Road.

The Police Department is located next to the fire headquarters on Church Street. Both buildings are located close to Interstate 95, presently outside flood or surge zones. During the 2080s/Category 3 scenario, only the rear of the two facilities is nominally affected by high water, but the buildings remain unaffected. Long-term risk is therefore believed to be low.

Three of the fire stations are located in hurricane surge zones and will experience increasing risk under all scenarios of sea level rise and coastal storms. Any loss of response time during a coastal storm could have dire consequences in Guilford.

Shelters and Evacuation Routes

Emergency shelters are considered to be an important subset of critical facilities as they are needed in emergency situations. Town officials have designated the community center as the primary shelter and the high school as the secondary shelter. The community center building at 32 Church Street appears to be outside any future flood scenario, but a portion of the community center property may be flooded during the 2080s/Category 3 scenario. Because the building remains unaffected, overall risk is low, but the Town may consider methods of further reducing sheltering risk in the future. The high school is outside any future risk areas.

The Town has developed a map entitled "Guilford Flood Zones & Emergency Evacuation Routes to Shelters." The map highlights the evacuation routes out of Guilford, the route to the Community Center as the primary shelter, the route to Guilford High School as the secondary shelter, and an alternative route if the designated route to the high school is closed. Evacuation routes include roads that can become flooded during coastal storms, such as Route 146.

It has long been recognized that several coastal areas of Guilford may become isolated from the mainland during coastal storms. These areas include Sachems Head, Vineyard Point, Leetes Island, Tuttle's Point, Indian Cove, and Mulberry Point as well as smaller unnamed areas adjacent to these. Residents choosing to evacuate after a storm has caused flooding will not be able to reach the community center or the high school. This is an important secondary risk in the context of sheltering.

3.6 Natural Systems

Tidal Wetlands

Guilford's tidal marshes, more broadly known as tidal wetlands, are undergoing a transformation as sea level rise, erosion, altered tidal flushing, invasive species, and "sudden marsh dieback" collectively work toward degrading the marshes from all sides. These issues are often interrelated, but this report focuses on the loss of marshes due to sea level rise and increased coastal hazards.

Some of the notable tidal wetland systems in Guilford include Leete's marsh, Great Harbor salt marsh, Long Cove, the Chaffinch Island marshes, the West River complex, Sluice Creek, Grass Island, the East River complex, and the Sanctuary in the upper East River area. Numerous pockets of marshes are located throughout Little Harbor, Sachems Head, Vineyard Point, Tuttle's Point, Mulberry Point, and near the marina. Significant erosion is already occurring around Grass Island, east and west of the mouth of the West River, and near Trolley Road and Great Harbor. Additionally, the marshes are sinking/collapsing in many locations, most notably the Leete's marsh north of Shell Beach Road.

Subsidence or drowning of tidal wetlands will occur as a result of sea level rise because they can no longer accumulate peat fast enough to stay above sea level. In Connecticut, the effect

depends on location. Sea level rise appears to be altering the zonation of plant communities in southeastern Connecticut, where the tidal range averages 0.75 meters (approximately two feet). Studies have documented that at least two marsh systems are currently not keeping up with sea level rise. On Connecticut's western shore, with a tidal range of up to two meters (approximately six feet), extensive areas of low marsh vegetation have been drowned (e.g., Five-Mile River, Norwalk). It is believed by many that a loss of peat has caused the subsidence in Leete's marsh.

One effect of sea level rise is the tendency for marsh systems to migrate landward where they are able to do so. In developed areas where seawalls, lawns, and other structures are at the existing edge of the marsh, landward movement will be limited. The basic assumption is that some high marshes will become low marshes. Many marshes will be submerged by the 2020s. In the 2050s scenarios, uplands will be wet. In the 2080s, water will have moved past marshes. Although it is believed that some marshes will be able to advance, a net loss is anticipated. In some cases, marshes may advance into town-owned and private property.

The coastal resilience tool maps the potential marsh advancement areas for the years 2020, 2050, and 2080. The three planning horizons were viewed within the web tool, and the areas of marsh advancement were noted as follows:

2020s

- ☐ Along Old Quarry Road
- ☐ End of Shell Beach Road between Birch Grove and Pump Lane (Leetes Island)
- ☐ On both sides of Pump Lane (Leetes Island)
- ☐ North side of 146 near Great Harbor
- ☐ Along Sachems Head Road south of 146
- ☐ North of 146 along the Indian Cove valley
- ☐ East of West Lane near Vineyard Point Road
- ☐ Between Prospect Avenue and Chimney Corner Circle
- ☐ West of Frances Road and Rosemary Lane
- ☐ Along Meadow Street
- ☐ Along Sluice Creek
- ☐ Along Field Road
- ☐ Both sides of Seaside Avenue
- ☐ East of East Creek Circle
- ☐ Along Soundview Road
- ☐ Between Mill Road and Long Hill Road

2050s

- ☐ More land along Old Quarry Road
- ☐ More land along Shell Beach Road
- ☐ End of Shell Beach Road between Birch Grove and Pump Lane (Leetes Island)
- ☐ On both sides of Pump Lane (Leetes Island)
- ☐ North side of 146 near Great Harbor

- ☐ Along Sachems Head Road south of 146
- ☐ North of 146 along the Indian Cove valley
- ☐ East of West Lane near Vineyard Point Road
- ☐ Areas along Trolley Road
- ☐ Between Prospect Avenue and Chimney Corner Circle, but extending further east and west
- ☐ Along Daniel Avenue
- ☐ West of Frances Road and Rosemary Lane
- ☐ Overtaking Meadow Street
- ☐ Additional land along Sluice Creek, affecting Stone House Road
- ☐ Along Field Road, overtaking portions of the road
- ☐ Both sides of Seaside Avenue, overtaking portions of the road
- ☐ East of East Creek Circle
- ☐ Along Soundview Road, overtaking portions of the road
- ☐ Between Mill Road and Long Hill Road, and extending west of Long Hill Road
- ☐ Along eastern portion of Mulberry Farms Road, overtaking portions of the road
- ☐ Along Pinewood Road near Mulberry Farms Road
- ☐ Along Jacobs Lane
- ☐ Along River Street
- ☐ Extending upstream (northwest) of Three Mile Course
- ☐ Intersection of Norton Avenue and Halleck Street
- ☐ Jacob's Beach
- ☐ Large area south of the end of Soundview Road, from the road to the railroad tracks
- ☐ Past the end of Lucy Lane
- ☐ Northern end of East Avenue

2080s

- ☐ More land along Old Quarry Road
- ☐ Along Harrison Point Road
- ☐ Along Andrews Road and Little Harbor Road
- ☐ More land along Shell Beach Road
- ☐ End of Shell Beach Road between Birch Grove and Pump Lane
- ☐ Along Joshua Point Road
- ☐ On both sides of Pump Lane
- ☐ North side of 146 near Great Harbor
- ☐ Along Sachems Head Road south of 146, overtaking portions of the road
- ☐ North of 146 along the Indian Cove valley
- ☐ Overtaking portions of West Lane near Vineyard Point Road
- ☐ Overtaking Trolley Road
- ☐ Overtaking portions of Prospect Avenue and Chimney Corner Circle
- ☐ Crossing West Uncas Point Road
- ☐ Along Colonial Road
- ☐ Overtaking Vineyard Place
- ☐ Along Sachems Avenue
- ☐ Along Falcon Road

- ☐ Along Daniel Avenue
- ☐ Southern part of Rock Lane
- ☐ Along parts of Tuttle Point Road
- ☐ Along Deepwood Drive
- ☐ Along Chaffinch Island Road
- ☐ Overtaking portions of Frances Road and Rosemary Lane
- ☐ Overtaking Meadow Street
- ☐ Additional land along Sluice Creek, affecting Stone House Road and extending to Wheaton Avenue
- ☐ Overtaking Field Road
- ☐ Overtaking Seaside Avenue
- ☐ East of East Creek Circle
- ☐ Overtaking Soundview Road
- ☐ Entire area between Mill Road and Long Hill Road, and extending west of Long Hill Road
- ☐ Overtaking the eastern portion of Mulberry Farms Road
- ☐ Overtaking Pinewood Road near Mulberry Farms Road
- ☐ Overtaking Jacobs Lane
- ☐ Overtaking River Street and crossing toward Fair Street
- ☐ Extending upstream (northwest) of Three Mile Course
- ☐ Overtaking the intersection of Norton Avenue and Halleck Street
- ☐ Overtaking Summer Street
- ☐ Up to Whitfield Street
- ☐ Overtaking Jacob's Beach
- ☐ Large area south of the end of Soundview Road, from the road to the railroad tracks
- ☐ A larger area past the end of Lucy Lane
- ☐ Overtaking East Avenue
- ☐ Overtaking parts of East River Road

Figures 4 through 8 depict potential marsh advancement for various locales in Guilford. Green shading depicts future marshes whereas red shading represents land that is developed or otherwise unavailable for advancing marshes.

Other Coastal Landforms

Several of Connecticut's coastal landforms are found in Guilford and are vulnerable to coastal hazards in different ways.

- ☐ *Rocky Shorefronts* are shorefronts composed of bedrock, boulders and cobbles that are highly erosion resistant and are an insignificant source of sediments for other coastal landforms. Guilford has many rocky shorefronts, and these landforms are already resilient to coastal hazards. Homes that sit atop rocky shorefronts are seldom subject to coastal wave action and will not be subject to daily inundation due to sea level rise. However, many of these homes have vulnerable wells and septic systems, and residents are vulnerable to isolation.

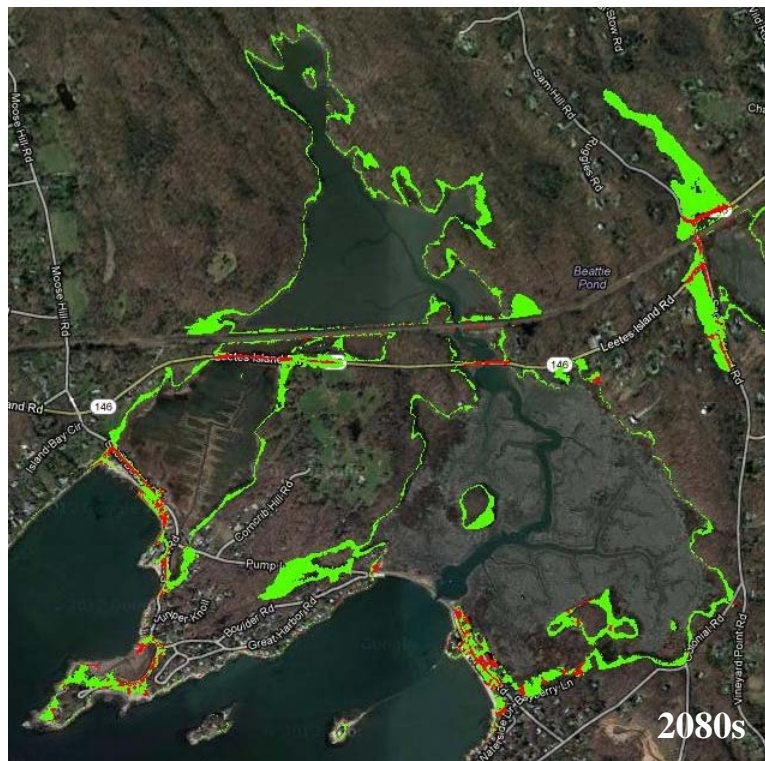
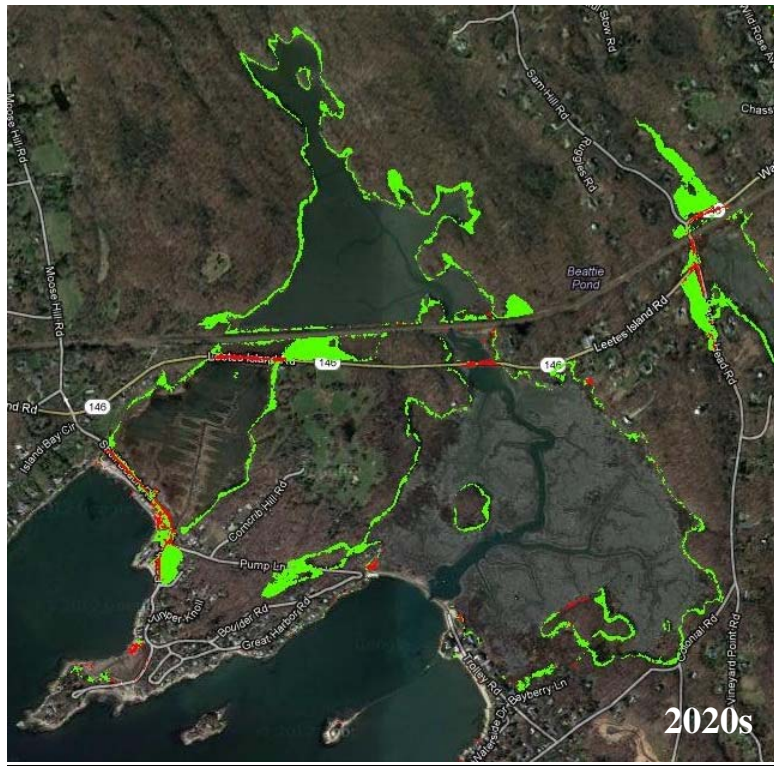


FIGURE 4
Tidal Wetland Advancement – 2020s and 2080s

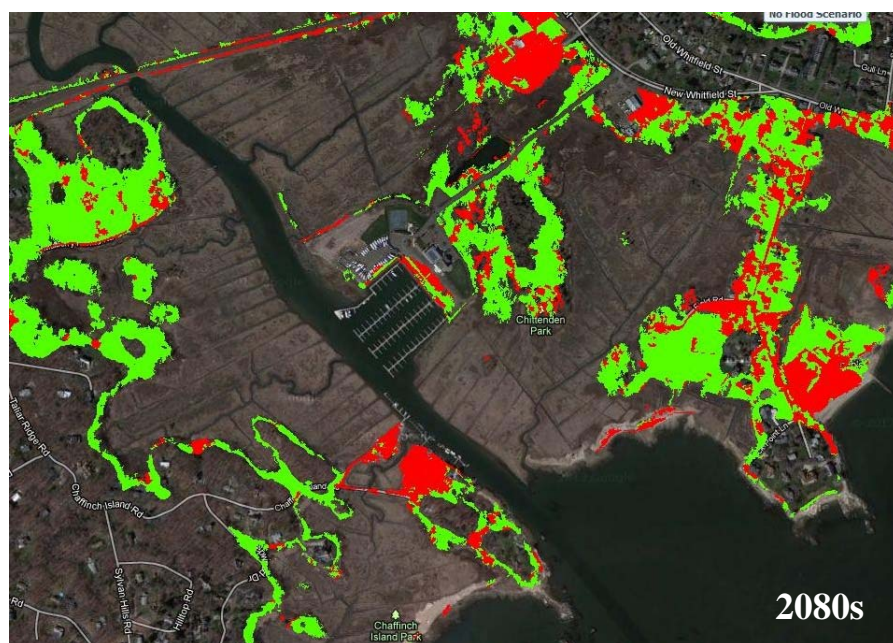


FIGURE 5
Tidal Wetland Advancement – 2020s and 2080s

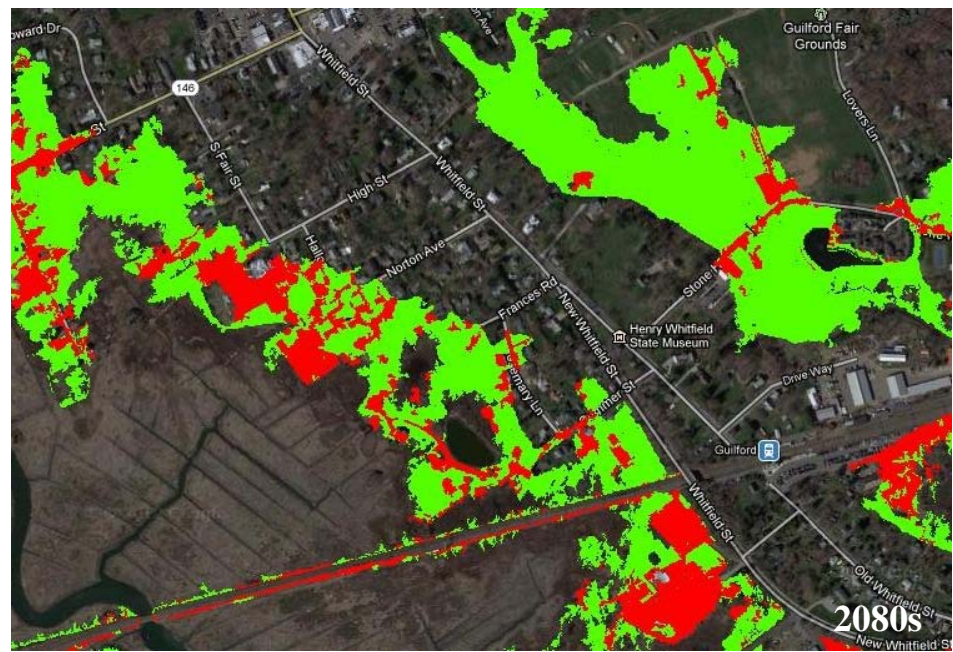


FIGURE 6
Tidal Wetland Advancement – 2020s and 2080s

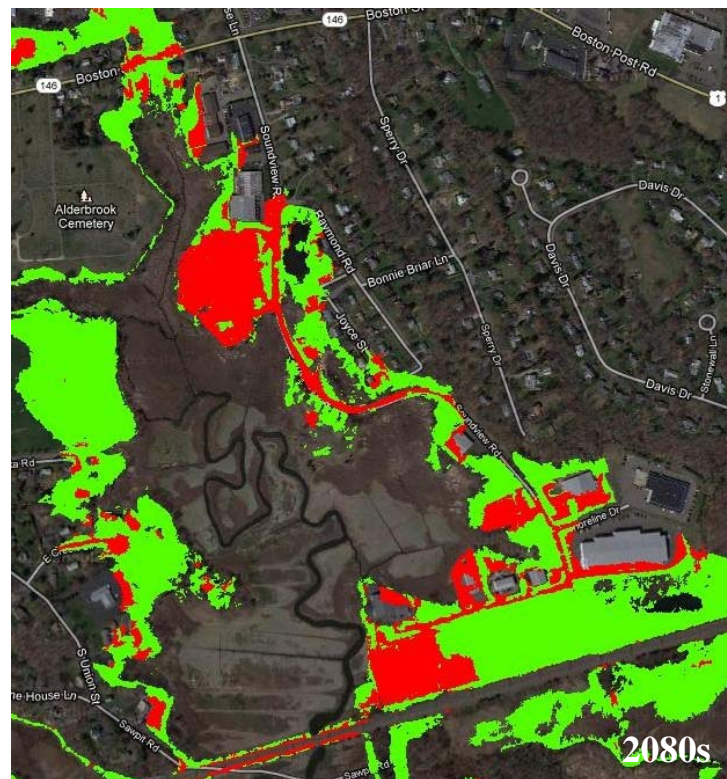
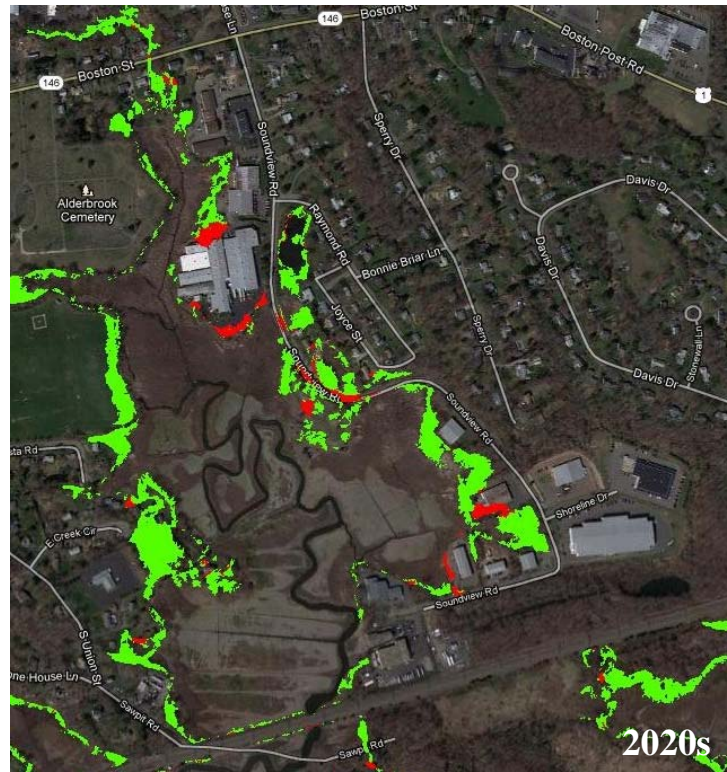


FIGURE 7
Tidal Wetland Advancement – 2020s and 2080s

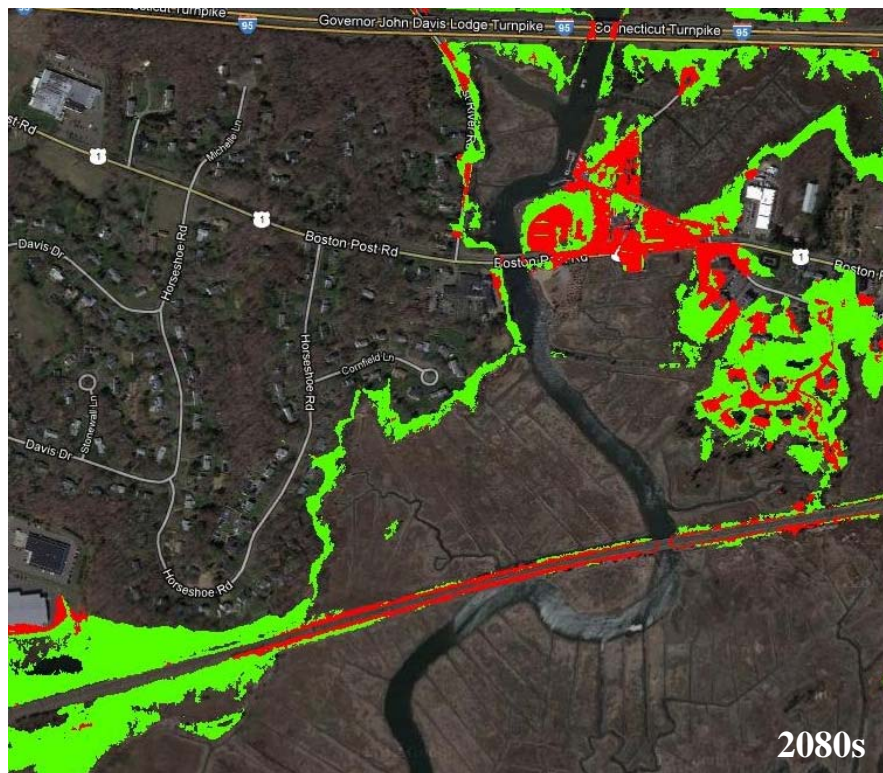
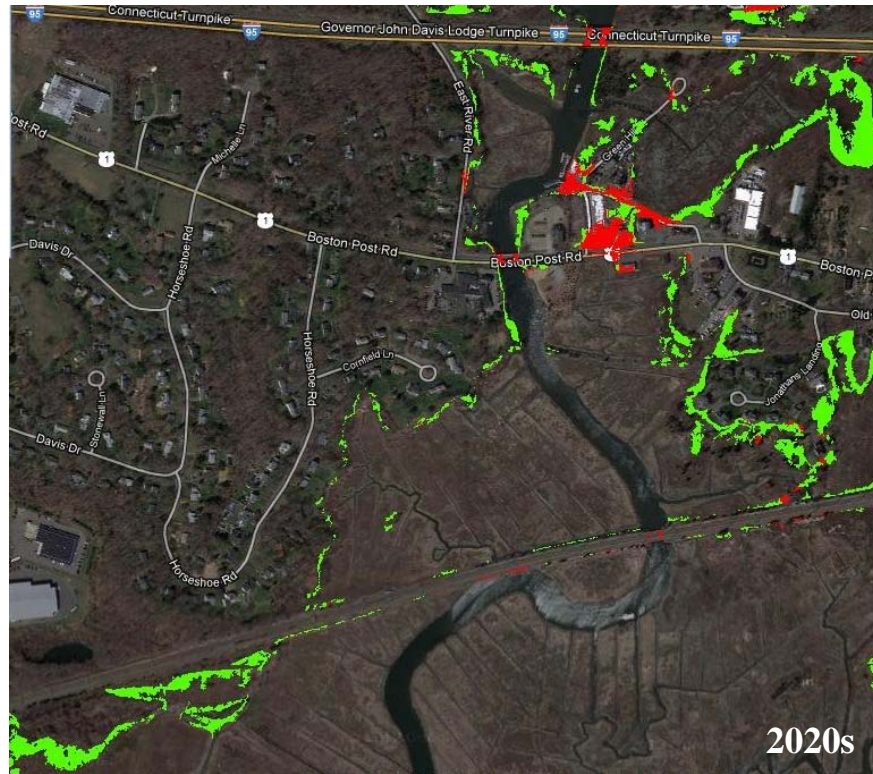


FIGURE 8
Tidal Wetland Advancement – 2020s and 2080s

- ❑ *Beaches and Dunes* are beach systems including barrier beach spits and tombolos, barrier beaches, pocket beaches, land contact beaches and related dunes and sandflats. In general, beaches are dynamic areas abutting coastal waters that are characterized by sand, gravel or cobbles. These areas are vulnerable to coastal hazards and sea level rise, and the risks of erosion and loss of beaches and dunes will increase over time. This is true for the small natural beaches and the larger maintained beaches such as Jacobs Beach.
- ❑ *Intertidal Flats* are very gently sloping or flat areas located between high and low tides composed of muddy, silty and fine sandy sediments and generally devoid of vegetation. Guilford's intertidal flats are sensitive to the tidal cycle and tidewater elevations, and therefore are vulnerable to coastal hazards and sea level rise. Although the risk of losing these flats will increase over time, new flats will likely form where beaches and tidal wetlands were once located.
- ❑ *Estuarine Embayments* are a protected coastal body of water with an open connection to the sea in which saline sea water is measurably diluted by fresh water including tidal rivers, bays, lagoons, and coves. The West River, East River, and Sluice Creek estuaries are important resources in Guilford. The East River estuary, in particular, supports a very extensive and diverse ecosystem and includes the Town's East River preserve. Guilford's estuaries are sensitive to the tidal cycle and tidewater elevations, and therefore are vulnerable to coastal hazards and sea level rise. Like the tidal wetlands lining these estuaries, the estuaries will need to migrate inland to keep up with rising sea level. Much of this migration will not be readily visible, because the salt water/freshwater mixing zone will simply move upstream into the rivers.

4.0 Vulnerabilities by Region

Chapter 4 of this report identifies vulnerabilities and risks by geographic area within the Town of Guilford and including its borders with Branford to the west and Madison to the east. For ease of organization, the shoreline of Guilford is divided the same way that it is organized in the Municipal Coastal Program, from west to east.

4.1 Branford Town Line to Island Bay

This area includes the Old Quarry and Little Harbor neighborhoods.

Old Quarry Road is already prone to flooding. Coastal hazards risks (flooding and daily inundation) will increase from the present time going forward. Route 146 is also vulnerable to flooding in the vicinity of the Quarry Road intersection, further reducing access to this area during coastal storms.

Specifically, in the 2020s scenario, daily inundation may affect Old Quarry Road, a section of Route 146, and the Andrews Road/Little Harbor Road intersection. Refer to Figure 9. By the 2080s, the inundation will be more extensive. Present-day Category 2 storm flooding mainly affects the same areas. Interestingly, the surge during Tropical Storm Irene flooded Old Quarry Road as far north as Andrews Road. Furthermore, according to local officials, the extent of Irene's still water appeared to be similar to the 2050s non-storm inundation. At the other extreme, 2080s/Category 3 flooding affects most of the length of Old Quarry Road and a longer section of Andrews Road.

According to members of the Town's Hazard Mitigation Commission, Old Quarry is illustrative of the social and economic challenges posed by older, well established shoreline communities. Socially, road improvements are critical for safety, evacuation and access to important natural resources. Economically, these properties are among the highest valued real estate in the Town. In Old Quarry there are 44 properties with a combined assessed value of over \$66 Million. The average assessed value of over \$1.6 Million is over four times the value of overall average for properties in Town. If safe and regular access is not provided, the property values will decline causing a serious revenue problem for the Town.

Although the homes in the Old Quarry neighborhood are located relatively high on rocky shorefronts, a few of them may be vulnerable in the future. The homes at the north end of Old Quarry Road are at the lowest elevation and will be affected by storms in the 2020s and onward, but not by non-storm inundation. Homes at the far south end of Old Quarry are also likely to be flooded slightly by Category 2 and 3 storms in the 2020s and 2050s, with increasing risk through the 2080s. Homes along Little Harbor Road are higher and are at low risk from coastal hazards, although all homes share the loss of egress that will occur through most of the future scenarios.

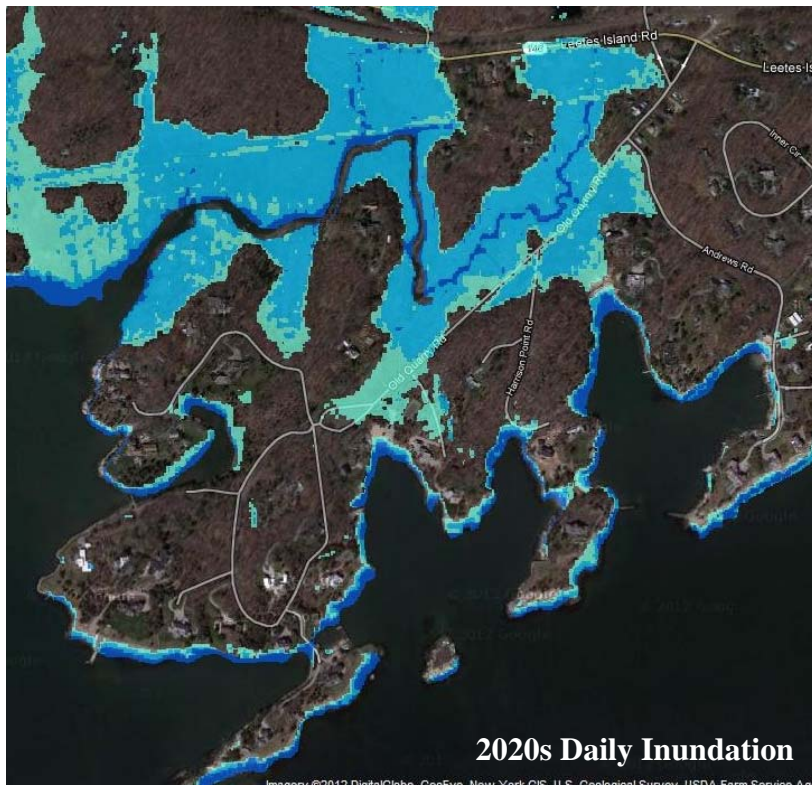


FIGURE 9
Old Quarry

Also of note, wells and septic systems may lie at lower elevations than homes. They are vulnerable to sea level rise and the associated changes in salt water interface and rising groundwater levels.

4.2 Island Bay to Trolley Road

This area includes Shell Beach, Leetes Island, and the adjacent tidal wetlands (Great Harbor, Lost Lake, and Leetes Marsh).

Shell Beach Road is already flooded by storm surges, and risks will only increase over time. With regard to daily inundation due to sea level rise, partial inundation is anticipated by the 2020s and more extensive inundation is anticipated in the 2050s and 2080s. Refer to Figure 10. As such, Shell Beach Road is one of the most vulnerable roads in Guilford. Some of the houses along the road (fronting Island Bay) are already elevated above the base flood level and therefore have some resilience, but wells and septic systems are still below grade and quite vulnerable.

Shell Beach Road is the access for the homes on Leetes Island. Access will be cut off as noted above for the future surges and daily inundation affecting the road. Pump Lane (in the interior of Leetes Island) is also vulnerable under all future scenarios, due to its very low elevation. Pump Lane provides additional egress for homes in the area.

Many of the Leetes Island homes along Great Harbor Road and Joshua Point Road are at “intermediate” elevations such that they are not affected by flooding at the present time, and structures are at low risk for inundation from sea level rise, but they are already on the cusp of being affected by storm surges. Risks from future storm surges will increase, and flooding of structures is anticipated. Because wells and septic systems may lie at lower elevations than the homes, they are vulnerable to sea level rise and the associated changes in salt water interface and rising groundwater levels.

Route 146 is vulnerable to flooding and inundation at two sections (Leetes Marsh and Great Harbor). These are critical connections, although it is plausible that Leetes Island and Shell Beach Road residents may evacuate to the west if necessary, facing low spots in the road elsewhere.

The Leetes Marsh, Great Harbor, and Lost Lake areas are obviously vulnerable in all future scenarios due to their elevation at sea level, and all are at great risk for marsh die-back. Advancement is critical around these natural resources. Advancement of marshes may occur, but large areas have already been inundated or collapsed. Tidal flows under Route 146 between Great Harbor and upstream areas have reportedly been increasing as sea level rises, and the culverts may be undersized. Overall, there may not be sufficient space for marsh advancement.

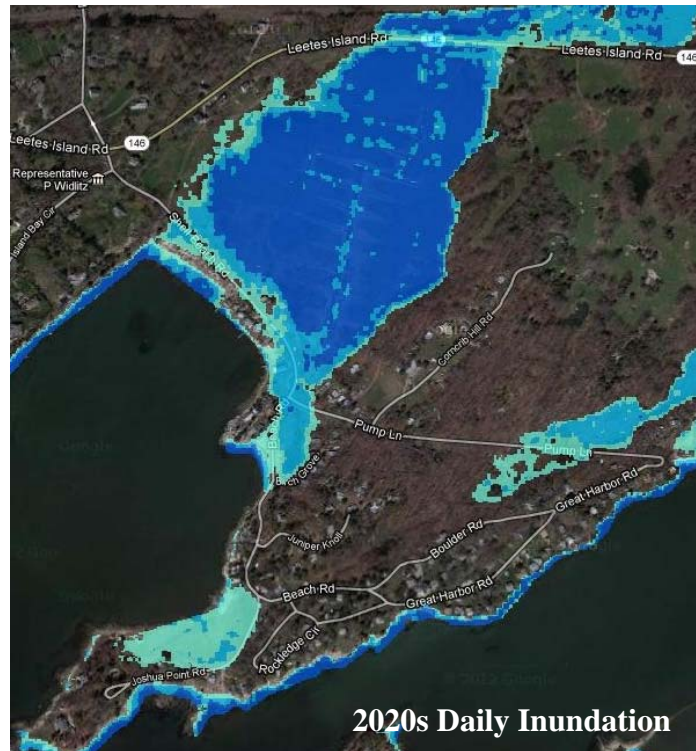


FIGURE 10
Shell Beach and Leetes Island

In summary, homes along Shell Beach Road and homes located on Leetes Island are at risk of isolation and many are at risk for flooding and inundation. The number of people affected is higher than the number of people affected in the Old Quarry and Little Harbor areas. Marsh advancement is critical but may be challenging at the peripheries of Leetes Marsh, Great Harbor, and Lost Lake.

4.3 Trolley Road to Vineyard Point

This area includes Trolley Road, Sachems Head, and Vineyard Point.

Homes along Trolley Road are vulnerable to coastal storms and are at increasing risk for all storm surge scenarios beginning at the present time. Trolley Road has a number of elevated homes and these will have greater resilience. Risks from inundation caused by sea level rise are not apparent (for structures) until the 2080s, at which time non-elevated structures may experience inundation. However, risks to the wells and septic systems that serve these homes may materialize much sooner.

Homes in Sachems Head have a range of vulnerabilities due to the range of elevations at residential properties. At least two houses are low and vulnerable on the north side of Uncas Point causeway. Chimney Corner has a low spot of vulnerability with two homes at risk. The west end of Prospect Avenue is also vulnerable. The 2080s/Category 3 storm highlights significantly increased vulnerabilities in Sachems Head and Vineyard Point, as water can reach further toward homes.

Public water supply is available to many properties in Sachems Head, reducing overall risk to water supplies. However, wells are still present in some areas, and all homes are served by septic systems that may be vulnerable before the structures are at risk.

As articulated by the Town's Hazard Mitigation Commission, adequate and safe access is a significant issue at Chimney Corner Circle, Vineyard Point Road, West Lane, and Route 146 where it meets Sachems Head Road. The risk of daily inundation at Route 146 and Sachems Head Road will be increasing from the 2020s and onward, and the railroad line at the kink in Route 146 may limit the State's ability to elevate Route 146. A risk of daily inundation at West Lane (which affects Indian Cove, discussed below) will begin in the 2020s but won't manifest until the 2050s. Of course, storm surge risks for all these roads are already high and will increase.

4.4 Vineyard Point to Tuttle Point

This area includes the densely populated Indian Cove, Mulberry Point, and Tuttle Point neighborhoods.

Indian Cove has many high homes except for a few on Daniel Avenue near the Lower Road intersection (near the beach). These higher homes are at low risk for surge flooding and

inundation associated with sea level rise. Many of the properties in Indian Cove are sufficiently high that wells and septic systems have relatively unchanging vulnerability going forward, although it must be noted that the Town desires public water supply in this area to address *existing* water quality and yield problems.

For Indian Cove, the main vulnerability is a severe lack of egress during coastal storms. As noted above, a risk of daily inundation at West Lane will begin in the 2020s and will jeopardize access to the west through Sachems Head. Likewise, a risk of daily inundation at Daniel Avenue along the beach will begin in the 2050s and will jeopardize access to the east to Mulberry Point Road. Refer to Figure 11.

Access to Mulberry Point from the north is relatively resilient except for a small segment of the road near the Daniel Avenue intersection, although it must be noted that Route 146 is vulnerable east and west of its intersection with Mulberry Point Road. Access between Mulberry Point and Tuttle Point is cut off easily along Tuttle Point Road for non-storm inundation scenarios beginning as early as the 2020s. As such, all future scenarios for storm surges and sea level rise demonstrate significant vulnerability at Tuttle Road. Refer to Figures 12 and 13. Sections of Marshall Avenue and Rock Lane are vulnerable for the storm surge scenarios beginning in the 2020s with risk increasing through the 2080s.

Homes in Tuttle Point and Mulberry Point lie at lower elevations than those in Indian Cove, and structures along the streets listed above (Mulberry Point Road, Tuttle Road, Marshall Avenue, and Rock Lane) are at varying degrees of risk for the future storm scenarios. Daily inundation due to sea level rise appears to be a low risk for homes in these neighborhoods. However, wells and septic systems are at risk for the reasons discussed previously.

4.5 Tuttle Point to Guilford Point

This area includes Chaffinch Island, the West River estuary, Chittenden Beach, critical facilities such as Brown's Boat Yard and Guilford Boat Yard, and the Guilford Yacht Club.

Chaffinch Island Road, the two boat yards, and Guilford Yacht Club all demonstrate vulnerability due to sea level rise and may experience inundation as early as the 2020s or perhaps by the 2050s. Storm surge vulnerabilities are already high, and Chaffinch Island Road is already flooded easily by very high tides. This cuts off access to Brown's Boat Yard and Chaffinch Island. Residents are not directly affected as homes are not located on Chaffinch Island, but recreation is affected. Guilford Yacht Club's access causeway will be flooded by storm surges beginning sometime between the 2050s and 2080s. The wells and septic systems for all the above-mentioned facilities are vulnerable and may be at risk for failure in the near future.

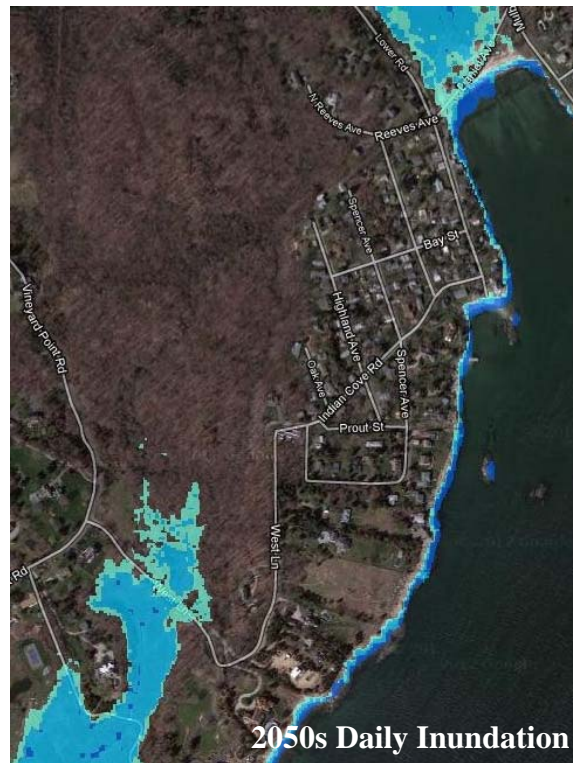


FIGURE 11
Indian Cove

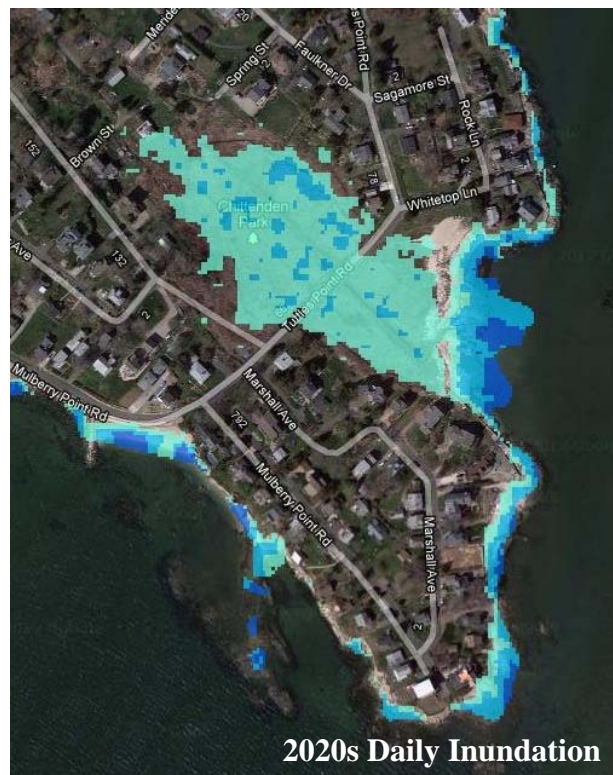
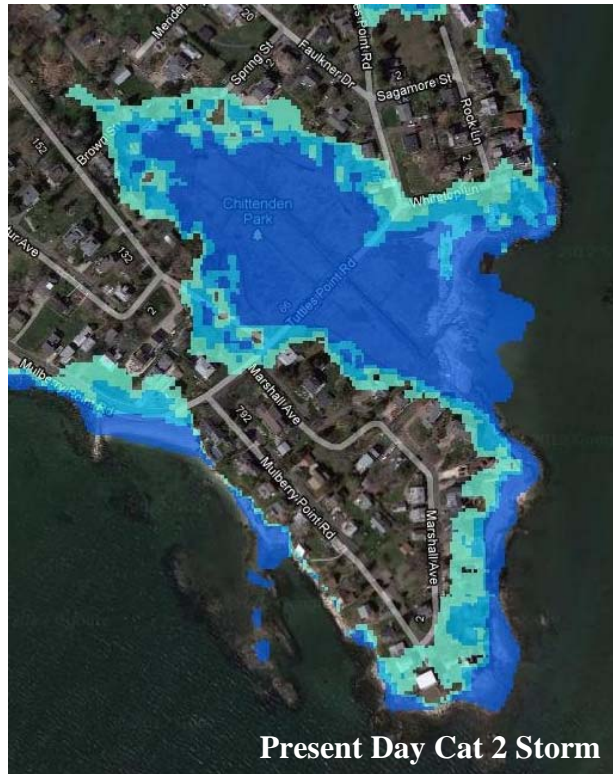


FIGURE 12

Mulberry Point and Tuttle's Point



FIGURE 13
Tuttles Point Road

The West River estuary is home to vast expanses of tidal marshes. The marshes at the water's edge are already experiencing rapid erosion, with hundreds of feet lost over the last few decades according to Town volunteers and officials. This is a part of Guilford where advancement toward the southwest and northeast will be critical. However, advancement to the northeast will be constrained by infrastructure such as Whitfield Street and private properties.

4.6 Guilford Point to Madison Town Line

This area includes Jacob's Beach, Seaside Avenue, the Town's marina, Grass Island, and the state's East River Boat Launch. Refer to Figures 14 and 15.

Seaside Avenue is a common bellwether in Guilford. The road flooded during Tropical Storm Irene as it has during many nor'easters and coastal storms. Daily inundation from sea level rise appears to approach the road in the 2020s but does not cross the road until the 2050s. However, all current and future storm surge scenarios are shown to flood the road and the 20 to 25 homes along the road. A few homes are elevated and therefore resilient, but many are not. All septic systems are already vulnerable and risks will only increase. Public water supply is available and wells are not believed present. Access to the higher homes on Rock Point Lane will be cut off for many future scenarios. Guilford officials believe that it may take a decade of planning to address coastal resilience along Seaside Avenue. The road is also important access to Jacob's Beach.

As noted in Section 3.5, the Marina is considered a critical facility. The marina is located at the head of Guilford Harbor in a 100-year coastal flood zone with wave velocity hazards. The low point in the marina parking lot is already floodprone and may be inundated on a daily basis in the future scenarios. Because the marina will always be located in a high-risk area at the water's edge, reducing risks can only be accomplished through reducing vulnerabilities.

Circle Beach and Grass Island are home to six seasonal houses and their septic systems, the "Little Red Shack," and the state boat launch. Vast areas of Grass Island will begin experiencing inundation as early as the 2020s and continuing to increase into the 2080s, but the houses are less vulnerable to inundation from sea level rise. On the other hand, all future storm surge scenarios flood the island and homes.

As noted for the West River and Great Harbor/Leetes March, this is a part of Guilford where marsh advancement will be critical. However, advancement to the north may be constrained by infrastructure and private properties.

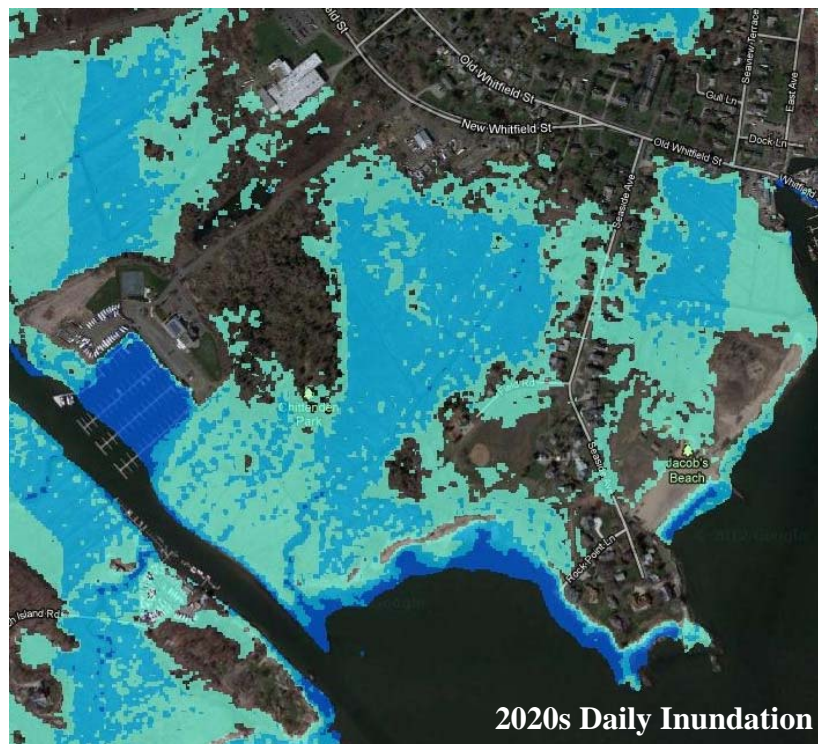
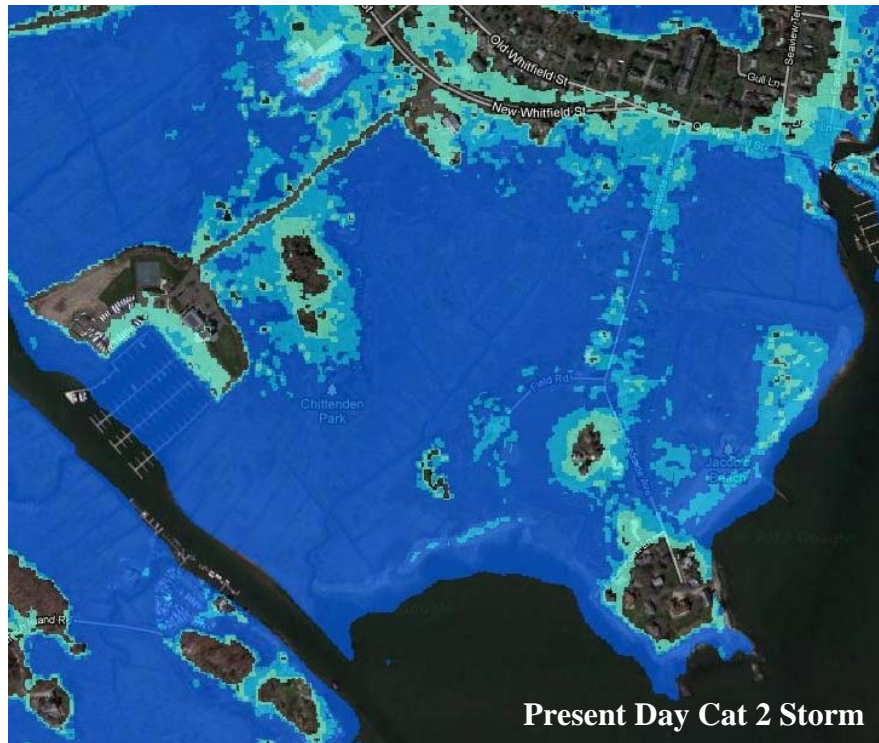


FIGURE 14
West River and Seaside Avenue

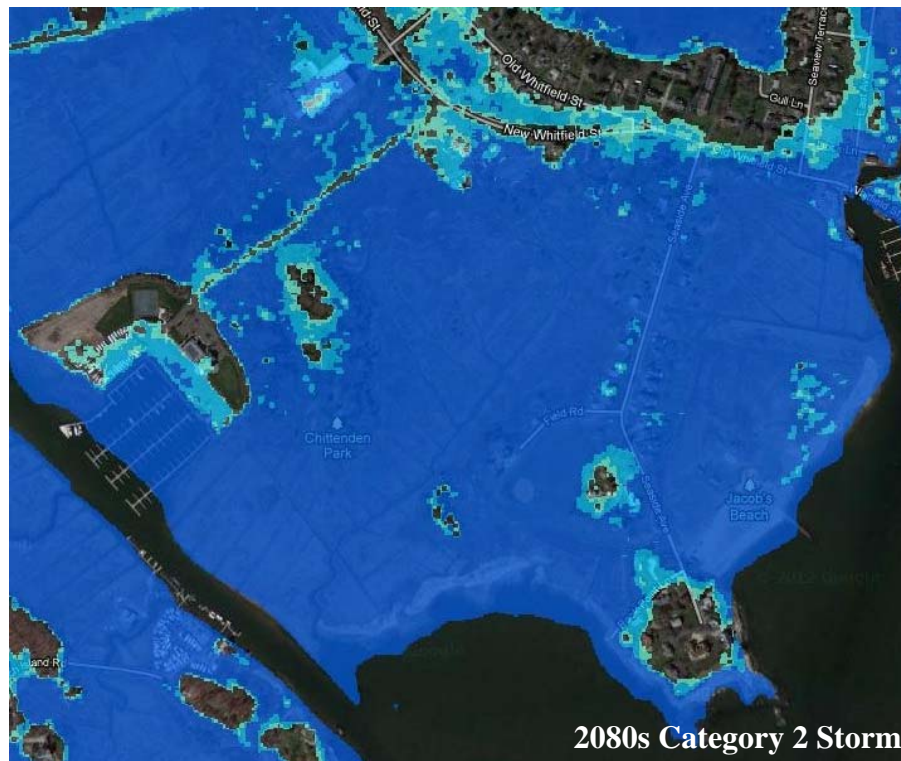
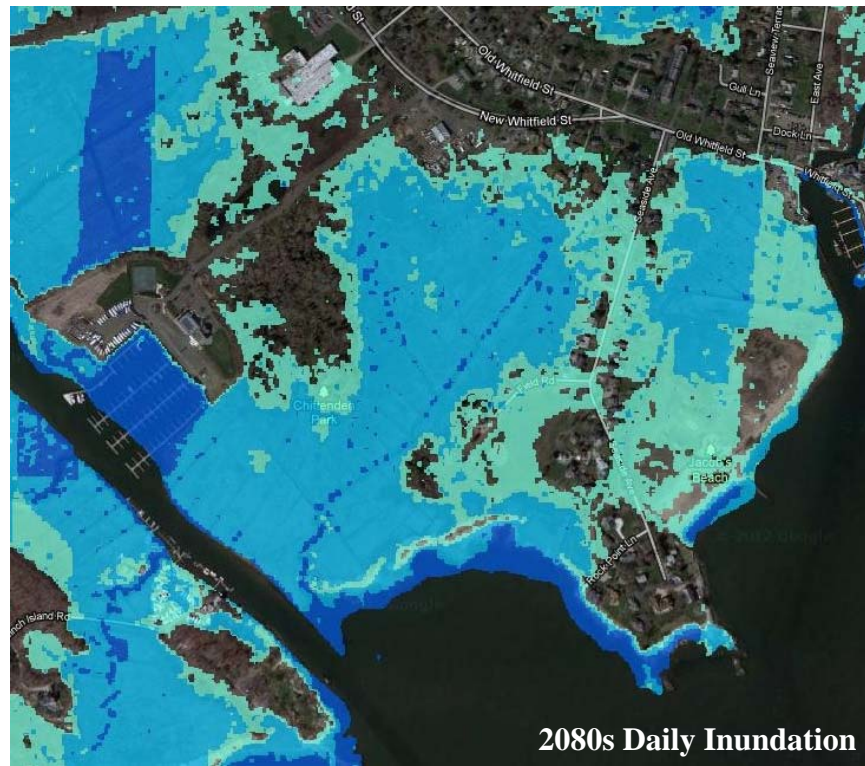


FIGURE 15
West River and Seaside Avenue

4.7 Guilford Center and Town Center South

Guilford Center and Town Center South include many of the municipal and critical facilities described in Chapter 3 of this report, along with numerous residential, commercial, and industrial properties. Given that the 2080s/Category 3 scenario may extend flooding all the way to the Town Green, there are hundreds of individual vulnerabilities in this region. A selection of the more notable issues (some repeated from Chapter 3) includes:

- ❑ Boston Terrace public housing complex – daily inundation from sea level rise is not likely under future scenarios, but hurricane surge flood risks will increase over time as sea level rises.
- ❑ Condominiums on Rollwood Drive and Paddock Lane – Similar to Boston Terrace, daily inundation from sea level rise is not likely under future scenarios, but hurricane surge flood risks will increase over time as sea level rises.
- ❑ Seaview Terrace and East Avenue – Daily inundation from sea level rise is not likely under future scenarios, but hurricane surge flood risks for these homes and condominiums will increase over time as sea level rises.
- ❑ Soundview Road corridor – approximately 13 businesses are located along Soundview Road and Shoreline Drive, and all of them are presently in hurricane surge zones. Therefore, risks will increase over time. Refer to Figures 16 and 17. Non-storm inundation may occur in spots along the road as early as the 2020s, whereas longer sections of the road could be inundated on a daily basis by the 2050s and 2080s. Hazardous materials, fuels, and products are stored and used at some of the businesses along Soundview Road, making them more vulnerable to damage on-site as well as increasing vulnerability for surrounding properties that may be exposed to fire or pollution in the event of a release.
- ❑ Businesses along the Boston Post Road near River Street – at risk to coastal storms during several of the future scenarios (2020s/Category 2 and upward) although daily inundation risks in future scenarios are only moderate. These businesses include the Mulberry Plaza and the gasoline service station at River Street and the Boston Post Road. Refer to Figure 18.
- ❑ South side of the Boston Post Road between Village Walk and Goose Lane - businesses are at risk to coastal storms during several of the future scenarios (2020s/Category 2 and upward) although daily inundation risks in future scenarios are only moderate.
- ❑ Three fire stations – located in hurricane surge zones and will experience increasing risk under all scenarios of sea level rise and coastal storms. Daily inundation from sea level rise is not anticipated.

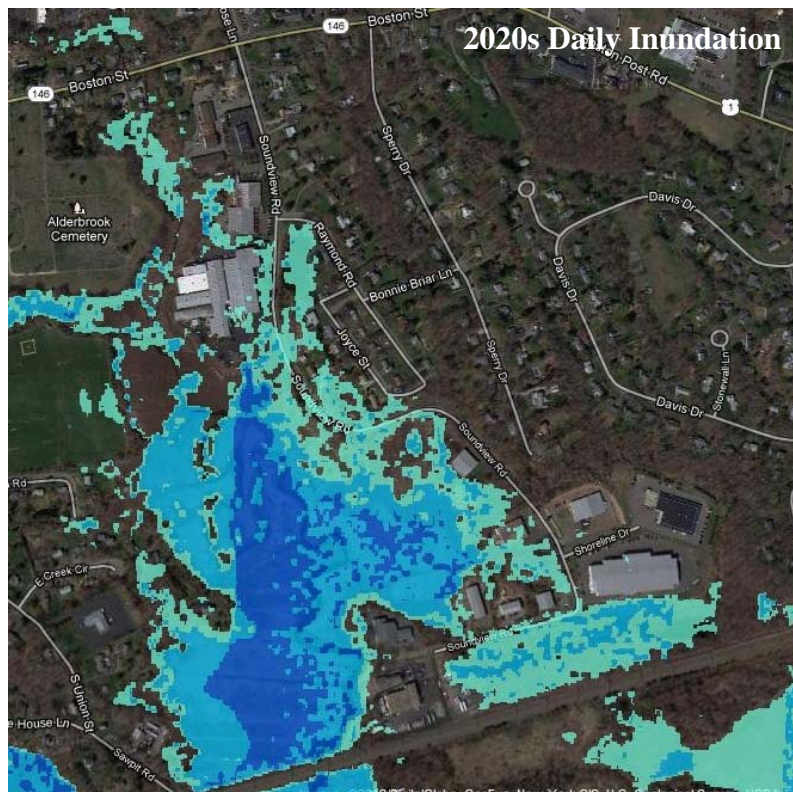
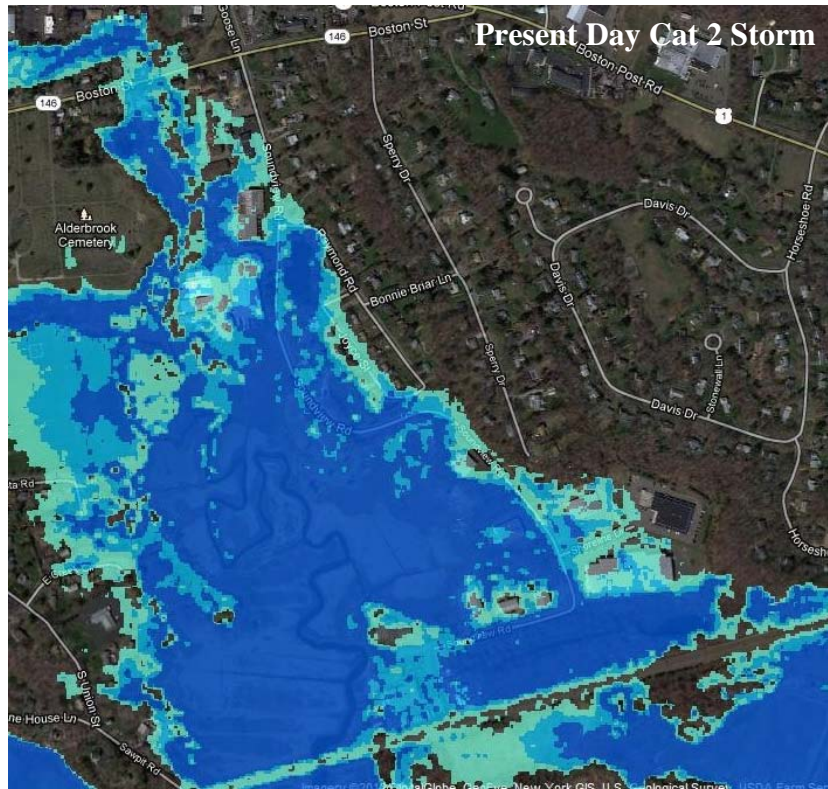


FIGURE 16
Soundview Road

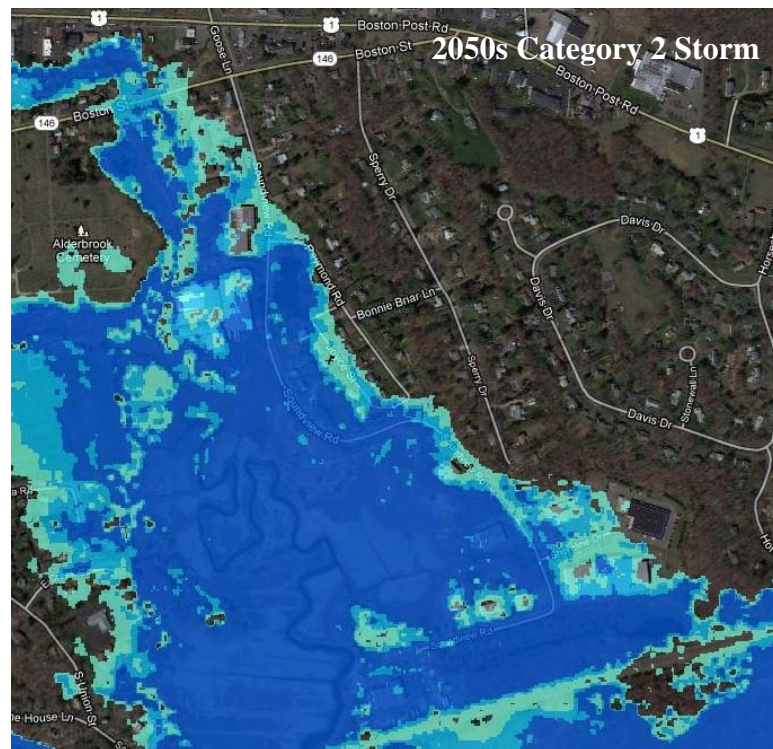
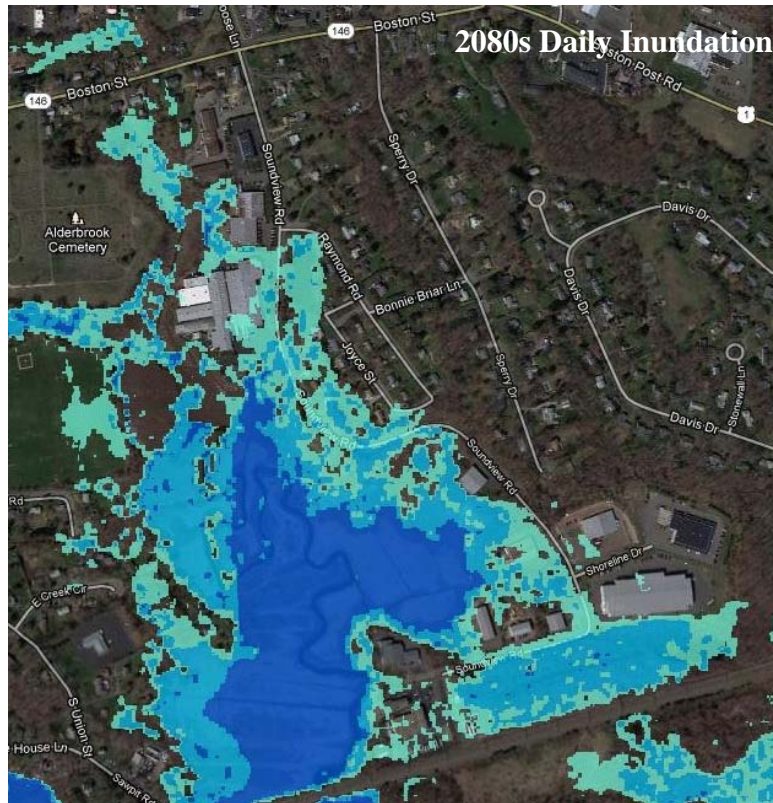


FIGURE 17
Soundview Road

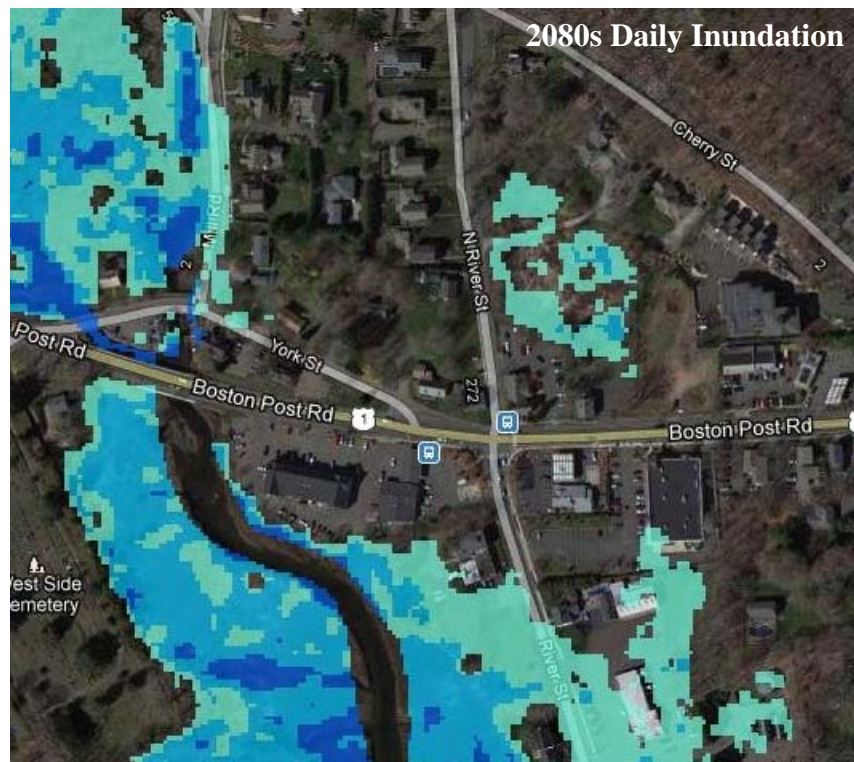


FIGURE 18
Boston Post Road and River Street

- ❑ Whitfield Street storm drainage – Guilford experiences increased problems with inadequate storm drainage south of the Town center and along Whitfield Street and several coastal areas. As sea level rises, these areas will likely experience decreased drainage capacity and increased risk of flooding.
- ❑ Public Works facility – located in a coastal flood zone and Category 1 hurricane surge zone associated with the Sluice Creek estuary, it is highly vulnerable to coastal hazards and will experience increasing risk under all scenarios of sea level rise combined with coastal storms. Daily inundation from sea level rise is not anticipated.
- ❑ United States Postal Service – the Guilford Post office at 42 Water Street is located in hurricane surge zone and will experience increasing risk under all scenarios of sea level rise and coastal storms. Similarly, the Guilford/Madison post office facility on Shoreline Drive (off Soundview Road) will have increasing risks that are common to the many businesses on Soundview Road.
- ❑ Future development areas – the Soundview Road and Town Center South areas are considered key regions for future economic development in Guilford. Both are vulnerable to coastal hazards and risks will need to be minimized as development occurs.

One of the more important areas of vulnerability lies along the margin of tidal marshes adjacent to South Fair Street, Halleck Street, Rosemary Lane, High Street, Norton Avenue, and Summer Street. Hundreds of private residential properties are located along this margin, and water may be extending toward them on a daily basis with the tide cycle as early as the 2020s. A few homes may be at risk by the 2050s, and a few more may be at risk by the 2080s. Refer to Figure 19. These are all non-storm scenarios. During storm surges, the neighborhoods are already at risk. By the 2080s, storm surges may flood the entire area up to (and past) Whitfield Street. This area is also interesting because marsh advancement may occur here, although many private properties would be affected.

4.8 Upper East River

East River Road is at low risk for inundation through all future sea level rise scenarios, but sections of the road are already in surge zones and risks will increase in the future. Only a small number of homes along the road appear to be vulnerable to flooding, but risks for these homes will increase over time as they will for the road. Further upstream, Clapboard Hill Road is at risk for flooding during current and future storms.

As noted in Section 3.3, Apple Rehabilitation is currently located in a coastal flood zone and hurricane surge zone. Although daily inundation from sea level rise is not likely under future scenarios, hurricane surge flood risks will increase over time as sea level rises.

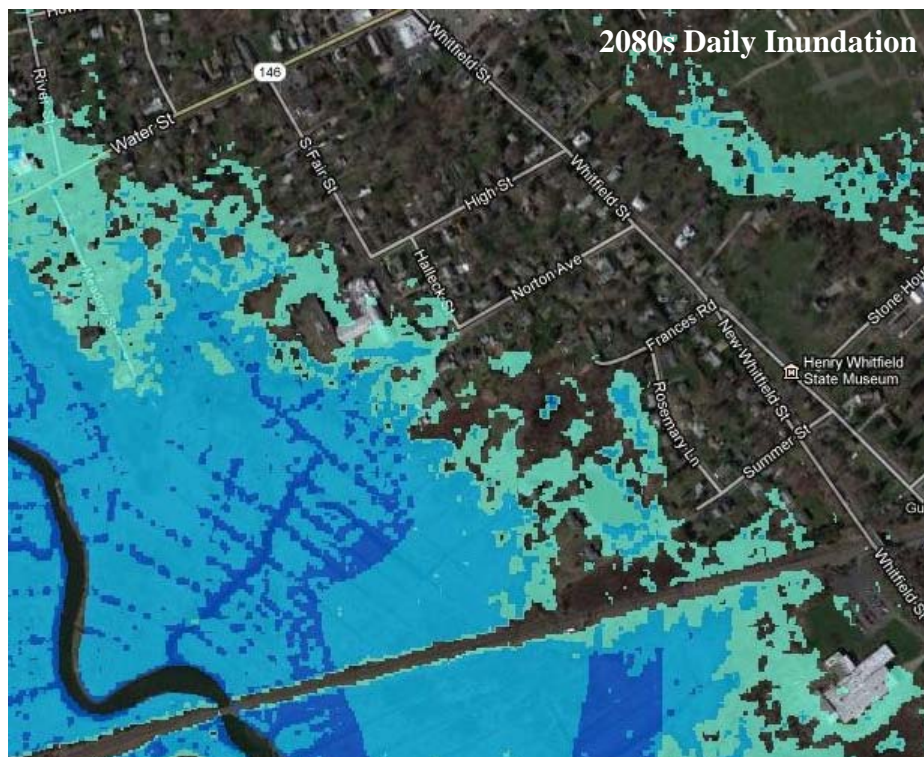
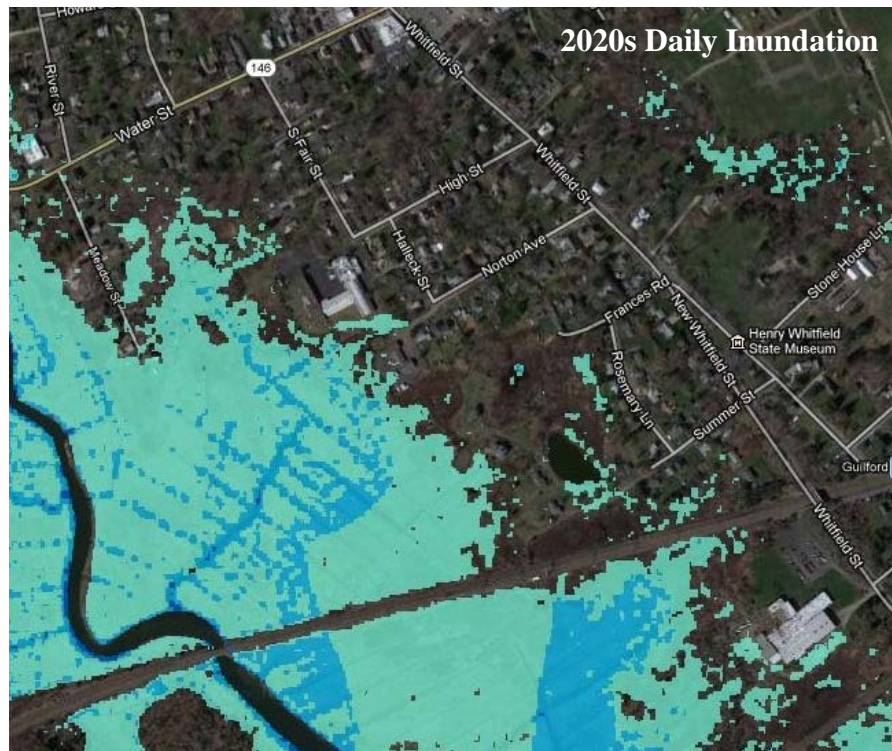


FIGURE 19
West of Whitfield Street

Homes along Cornfield Lane and Horseshoe Road are not at risk for inundation cause by sea level rise (although portions of private properties will be inundated), but they are at risk for storm surge flooding beginning in the 2020s. Septic systems may be at risk for failure due to rising groundwater.

Perhaps more than any other part of Guilford, opportunities for marsh advancement may be relatively abundant along the East River. The variation of low marsh and high marsh that is already present may also facilitate the conversion of high marsh to low marsh. These opportunities will require much planning in the coming years.