

Chapter X – Climate Change & Sea Level Rise

Purpose

Much of Ogunquit’s identity, economy, and population are inextricably tied to, dependent on, and concentrated along its coastline, making coastal climate impacts of critical concern for the town. As such, this chapter will focus on sea level rise rather than climate change in general.

Community Opinion Survey Results

PLACEHOLDER

Overview

Climate change is already impacting Ogunquit and poses significant threats to the community, including its beaches, natural resources, historical and cultural resources, infrastructure, people, and economy. Warming air and ocean temperatures; shifting precipitation patterns; more frequent and intense storm events; sea level rise; increasing risk of drought; habitat loss; reduced biodiversity; and increasing prevalence of vector-borne diseases such as Lyme are just some of the climate hazards and impacts facing the town.

Climate change will not only exacerbate existing hazards and issues, but also cause new risks and challenges for Ogunquit. Intense precipitation events could cause more stormwater runoff, amplifying existing water quality problems. Increasing storm intensity and frequency will likely cause more power outages that last longer, disrupting the community’s normal activities, impairing public safety, and straining local resources. Shifting terrestrial habitat conditions and warming ocean temperatures could harbor the expansion of existing invasive species, like green crab and knotweed, and enable the arrival of new invasive species, jeopardizing traditional recreation and fishing activities like shellfish harvesting. Extreme heat and drought will threaten public health and natural resources.

While climate change will likely impact every facet of the community in some way, those impacts will not be felt evenly across the community and will not be uniformly distributed among population groups. Individuals who already have increased social vulnerability or have been traditionally marginalized and underrepresented will be disproportionately affected by climate hazards, as they generally have lower capacity to prepare for, respond to, and recover from hazard events and disruptions. Those populations include children and older adults, households with lower or moderate incomes, individuals with pre-existing health conditions, people of color, and those living alone. Ogunquit has a relatively high percentage of older individuals (65+) living alone, characteristics that contribute to elevated social vulnerability as they tend to be associated with social isolation and decreased ability to prepare for and respond to storms, flooding, and other natural disasters. As a result, the community as a whole likely has an elevated level of vulnerability to natural hazards and climate impacts.

Sea Level Rise Background

Sea level rise is a global phenomenon driven by two primary factors related to climate change: an increase in the volume of ocean water caused by the melting of land-based ice sheets and glaciers, and thermal expansion of seawater as it is warmed by increasing global temperatures. While sea level in Maine has been rising in the long-term, over the past few decades the rate of rise has accelerated. Nearly half of the documented sea level rise that has occurred locally over the past century has happened since 1993, representing a rapid increase in the rate of change. That rise is increasing the frequency of nuisance or high tide flooding, with southern Maine seeing four times as many nuisance flooding events over the last decade compared with the average of the past 100-years. According to a State 2020 study, under intermediate global greenhouse gas emissions scenarios there is a 67% probability that sea level will rise between 1.1 and 1.8 feet by 2050, and between 3.0 and 4.6 feet by the year 2100 relative to 2000 water levels, with higher sea level rise amounts possible. With that rate of sea level rise, not accounting for increased intensity and frequency of storms, Ogunquit can expect to see a 15-fold increase in coastal flooding by 2050. Those scenarios do not account for more intense rainfall that climate change is bringing to the region, which will exacerbate flooding.

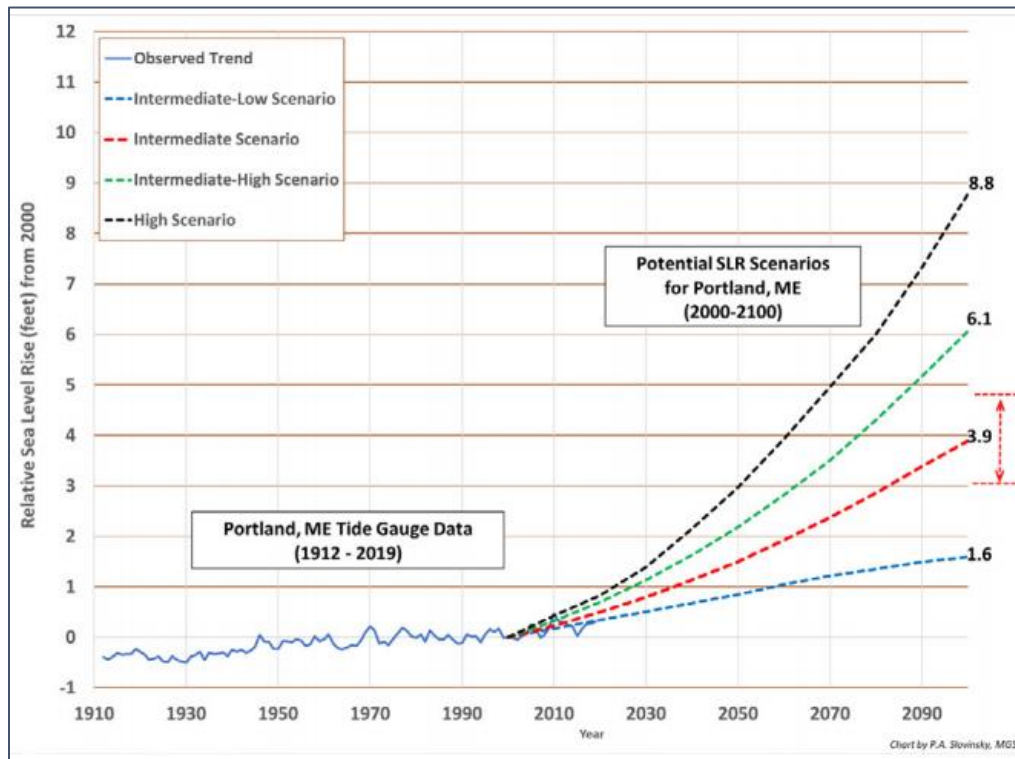


Figure 1 Graph illustrating historical sea level rise in Portland (solid blue line) and scenarios from 2000-2100 with central estimates (50% probability of being met or exceeded) for low-intermediate to high sea level rise scenarios. The likely range of 3.0 to 4.6 feet (67% probability of sea level rise falling between these values) for the intermediate scenario is shown as a dashed red arrow and red lines on the right side of the figure. Values are presented in tenths of a foot and relate to a year 2000 starting point. Scenario data from the U.S. Army Corps of Engineers Sea Level Change Calculator based on sea level rise scenarios developed for the 4th U.S. National Climate Assessment. (Source: Scientific Assessment of Climate Change and Its Effects in Maine prepared by the Maine Climate Council Scientific and Technical Subcommittee. Chart by P. Slovinsky, Maine Geological Society)

Historically, coastal flooding has been the most common type of weather-related disaster in coastal southern Maine, causing an average of \$800,000 in property damage annually across the region since the mid-1990s. As sea level rises in the future, normal high tides will be higher and storms, and accompanying storm surge (the abnormal rise in ocean water level above the normal predicted astronomical tide during a storm event), will be more impactful, causing extensive coastal flooding to roads, homes, and businesses. Storm surge can cause extreme flooding in coastal areas, especially when storm surge coincides with normal high tide, as was the case during a late December 2022 coastal storm when Ogunquit experienced a roughly 2.5-foot surge that hit at high tide causing significant and damaging tidal flooding leading to road closures and extensive power outages. The December 2022 storm highlighted how increasing storm intensity and frequency coupled with sea level rise will impact the community. Of local concern is how the impact of power outages from future storms on Ogunquit's relatively large population of vulnerable older residents who rely on medical services and equipment that require electricity. While future sea level rise will occur gradually over time, extreme storm events can cause damaging flooding episodically in the short-term.



Figure 2 Flooding in Perkins Cove during a storm event.

In addition to rising seas, storm surge, and more nuisance flooding events, southern Maine is experiencing more frequent and intense precipitation events. As noted above, the intensity and frequency of precipitation is expected to increase in the future with climate change. Stormwater runoff from intense rainfall events combined with storm surge and future sea level rise will lead to more extensive flooding, potentially increasing pollution and intensifying water quality issues in town. That threat is further exacerbated by development pressure throughout the Ogunquit River and Josias River Watersheds and increasing impervious coverage within the region. Precipitation events can cause widespread flooding and damage, especially when coupled with elevated ocean water levels.

Sea Level Rise Impacts in Ogunquit

Sea level rise is projected to cause regular inundation of low-lying coastal areas during high tide; contamination of groundwater and drinking water wells from saltwater intrusion; septic system failure from flooding and elevated groundwater levels; and increased erosion of the coastline, including sandy beaches, dunes, and salt marshes. In Ogunquit, beaches, marshes, beach parking areas, cultural and historic resources, coastal roads, water and sewer infrastructure, and the wastewater treatment plant are at risk of flooding. The concentration of residential and commercial development in coastal areas, tourism-based economy, and proximity of significant community resources, like the Marginal Way and Perkins Cove, to the coastline make Ogunquit particularly vulnerable to sea level rise. The Town has

undertaken efforts to improve its understanding of flood risks of and vulnerabilities to sea level rise by participating in several regional sea level rise and coastal resilience planning projects.

Ogunquit's beaches are vital economic, recreation, and cultural resources for the town. As storms and rising seas erode beaches and damage beach-dune systems, some of the natural and recreational services that beaches provide will disappear, resulting in tangible losses to the local economy. There is already a minimal dry beach around the southern end of Main Beach during regular high tide. Shoreline data collected annually by the Maine Geological Survey (MGS) through the Maine Beach Mapping Program show that overall, Ogunquit's beach and dune areas are not experiencing erosion from year to year, but rather are accreting or growing slightly. According to MGS, from 2017 to 2021, Ogunquit saw strong positive trends in dune and beach change, while the mean dry beach width stayed about the same. From 2020-2021, dry beach width decreased near the river, but increased along most of the beach. Despite the current positive trends, sea level rise is expected to accelerate the rate of erosion and cause more beach areas to be inundated during tidal cycles. An assessment by the MGS reveals that 1.6 feet of sea level rise will reduce Ogunquit's dry beach area by 42%, which could happen by 2050 or earlier depending on the rate of sea level rise and natural sand supplies. That finding has serious implications for Ogunquit's economy, as well as to the overall community, its residents, and local businesses that rely on having healthy beaches to support tourism and recreation.

In addition to the beaches themselves, beach parking areas are critical assets for the town. The Main Beach parking lot, Footbridge Beach parking lot, North Beach parking lot, and the Lower Lot are vulnerable to sea level rise, as are road access to the lots and footpath access from the lots to the beaches. Flooding of those areas could result in costly damage to pavement and parking lot infrastructure and lead to partial or entire closures of parking lots for extended periods of time. Depending on when these closures occur (during the tourist season or off-season), they could result in decreased parking revenue and beach visitation. Municipal data show that the Town's public beach lots brought in over \$2 million annually during the fiscal years ending in 2018-2020. That revenue makes up over 20% of Ogunquit's municipal budget. Therefore, loss of beach parking during and after coastal storms is a serious risk to Ogunquit's fiscal health. Additionally, access to parking is a key determinant of beach visitation. If future sea levels rise and coastal storms decrease the availability of beach parking, beach visitation and beach-centered tourism in Ogunquit could change as well.

Historic and cultural assets that are significant drivers of tourism, including Perkins Cove and the Marginal Way, are also vulnerable to sea level rise. Sea level rise modeling shows that the Marginal Way itself is not projected to be directly impacted by flooding from 1.6 or 3.0 feet of sea level rise combined with storm surge. However, the path already experiences significant erosion damage during storm events from pounding waves and high-water levels. Sea level rise will cause elevated base water levels that will likely cause higher storm tide water levels and worsening erosion from more intense and direct wave action potentially resulting in loss of integrity to the path and safety concerns.



Figure 3 The Marginal Way was closed to walkers due to flood risk during Nor'easter on March 3, 2018. Photo: Joan Griswold

In addition to impacts to the tourism economy, sea level rise, and climate change in general, pose risks to municipal fiscal health. Like other coastal communities in Maine, Ogunquit's municipal budget is highly dependent on revenue from local property taxes and coastal development provides a substantial portion of the municipal tax base, generating vital funds that sustain community operations, services, and programs. However, it is that same development that is most susceptible to coastal flooding, placing residents, visitors, and municipal tax revenue at greatest risk. Studies have shown that coastal hazards and climate change diminish the value of impacted properties. A [2022 study](#) by SMPDC found that coastal properties totaling approximately \$98.9 million in assessed value are exposed to flooding from 1.6 feet of sea level rise combined with storm surge. That figure increases to \$112.2 million with 3.0 feet of sea level rise combined with storm surge, representing 10% of the Town's FY21 municipal budget. Municipal fiscal health could be affected as coastal properties, which generate a large portion of local tax revenue, are increasingly exposed to flooding and potentially decrease in value due to the increasing flood risk. Most of the properties at direct risk of flooding in Ogunquit are designated as uses other than residential single-family homes, amplifying potential negative impacts to the local economy.

Ogunquit has 0.7 miles of road vulnerable to 1.6 feet of sea level rise plus storm surge, almost 0.5 miles of which are local roads. Road flooding poses risks to public health, safety, and wellbeing as it disrupts local travel, the provision of emergency services, and access to emergency evacuation routes in town. Additionally, flooding can cause costly damage to road infrastructure. Roads that are vulnerable to flooding from sea level rise include Beach Plum Lane, River Road, Ocean Street, Riverbank Road, Beach Street, Bridge Street, Lower Lot Road, and Perkins Cove Road.

The Ogunquit Sewer District's (District) wastewater treatment plant, access to it via Ocean Avenue in Wells, and pump station are extremely vulnerable to sea level rise. The plant, which is located in a coastal sand dune system, is projected to experience significant inundation in the 1.6-foot scenario and is entirely inundated by the 3.0-foot scenario. It has experienced significant flooding in the past,

particularly during the Patriot's Day Storm in 2007. Both the Sewer District and the Town have undertaken or been involved with studies to examine the impacts of sea level rise, storm surge, and flooding at the plant. Considerable measures are being investigated and implemented by the District to reduce the critical facility's vulnerability to flooding by relocating it inland to an area of lower flood risk. The District purchased land outside of the designated regulatory floodplain to eventually relocate the treatment plant as necessary. The District has also moved existing electrical equipment out of the flood-prone basement of the plant, installed flood gates on entry doors, and is planning to elevate other critical equipment to mitigate flood impacts.

While sea level rise and coastal flooding threaten both commercial and recreational fishing activity through direct impacts to harbor infrastructure at Perkins Cove and access to that infrastructure, there are additional climate-related impacts to the marine environment. Water quality issues negatively impact coastal wildlife, including commercially harvested species. Additionally, climate change causes both warming and acidification of marine waters. The Gulf of Maine is warming faster than 99% of the world's oceans. Ocean acidity levels have already risen 30% and will continue rising alongside growing greenhouse gas levels. Ocean acidification has already impacted some shellfish harvesting operations statewide and will increasingly affect marine organisms that produce calcium carbonate to build shells, such as oysters, scallops, clams, mussels, and sea urchins. These combined climate impacts will lead to some marine species migrating northward to colder water and disappearing from traditional fishing grounds. This is expected to reduce catches and associated revenue for local fishermen and could detrimentally impact Ogunquit's recreational fishing activity.

Impacts to Marshes

Maine's State shoreland zoning regulations define *coastal wetlands* as all tidal and subtidal lands which have salt water tolerant vegetation present and any marsh, bog, swamp, beach flat or lowland that is subject to tidal action during the highest tide level. These coastal wetlands can also include portions of the coastal sand dunes. Ogunquit is protected by coastal wetlands which can also include portions of the coastal sand dunes. Ogunquit is protected by coastal wetlands called marshes. *Low marsh* is defined as intertidal marsh: it is exposed and covered by the tide each day. *High marsh* is defined as the area of salt marsh that is sporadically only covered by water.

Marshes are important to the ecosystem. They provide pollution filtering, slow and buffer water during coastal flood events and provide a wildlife habitat. They are also important in slowing erosion in areas. As in many Maine communities, marsh migration can be an issue for Ogunquit. Flooding from sea level rise poses a threat to Ogunquit's coastal wetlands at risk of flooding in Ogunquit.

Small amounts of sea level rise have the potential to cause extensive changes to marshland such as the inland migration of marshes. When sea level rise increase, *high marsh* environments cannot survive the increase inundation. This leaves only *low marsh* environments. This decreases the diversity of saltwater marsh as a whole and diminishes its ability to buffer the shoreline from erosion. If the sea level rises too rapidly or abruptly, it can drown the low marsh, leaving the shoreland unprotected waves. Marshes can migrate landward to keep pace with sea level rise when there are no physical barriers (e.g., houses, roads, rock walls, etc.) hindering their migration.

Storms and Potential Hurricanes

Storms are more intense than in earlier decades, due to climate change with heavier rainfall and higher winds. Because of Maine's tidal variation, the potential combination of astronomical tide and storms is concerning.

Potential hurricane inundation mapping has been done in Maine through a FEMA grant to Maine's Food plan Management Office along with consultation with the National Hurricane Partnership representatives on tool development, proposed process and techniques. Modeling potential hurricanes inundation scenarios can assist towns with investigating potential impacts to critical infrastructure, emergency management, community outreach and education.

Lastly, flooding from sea level rise poses a threat to Ogunquit's coastal wetlands and the vital services they provide (e.g., wildlife habitat, water filtration, flood mitigation, and absorption of wave energy), as it can drown saltmarsh vegetation. According to a [2013 study](#) of climate adaptation in the northeast, there are 97 acres of coastal wetland at risk of flooding in Ogunquit.

Climate change poses an existential threat to Ogunquit. The rise of sea level is of particular concern for the town, as it threatens the coastal community's character, economy, public safety, infrastructure, and natural resources. Ogunquit is already taking action to plan for climate change by participating as a founding member in the Southern Maine Regional Sustainability and Resilience Program; enrolling in the State's Community Resilience Partnership program; undertaking watershed studies and stormwater management improvements; conserving important natural areas; participating in regional coastal resilience planning projects; converting streetlights to LEDs; pursuing funding to install solar panels on the Dunaway Center; converting portions of the municipal fleet to electric vehicles (EVs); and installing EV charging stations in municipal parking lots. Continued commitment to climate action will be critical in the future to ensure the sustainability and resilience of the community.

Town of Ogunquit Comprehensive Plan

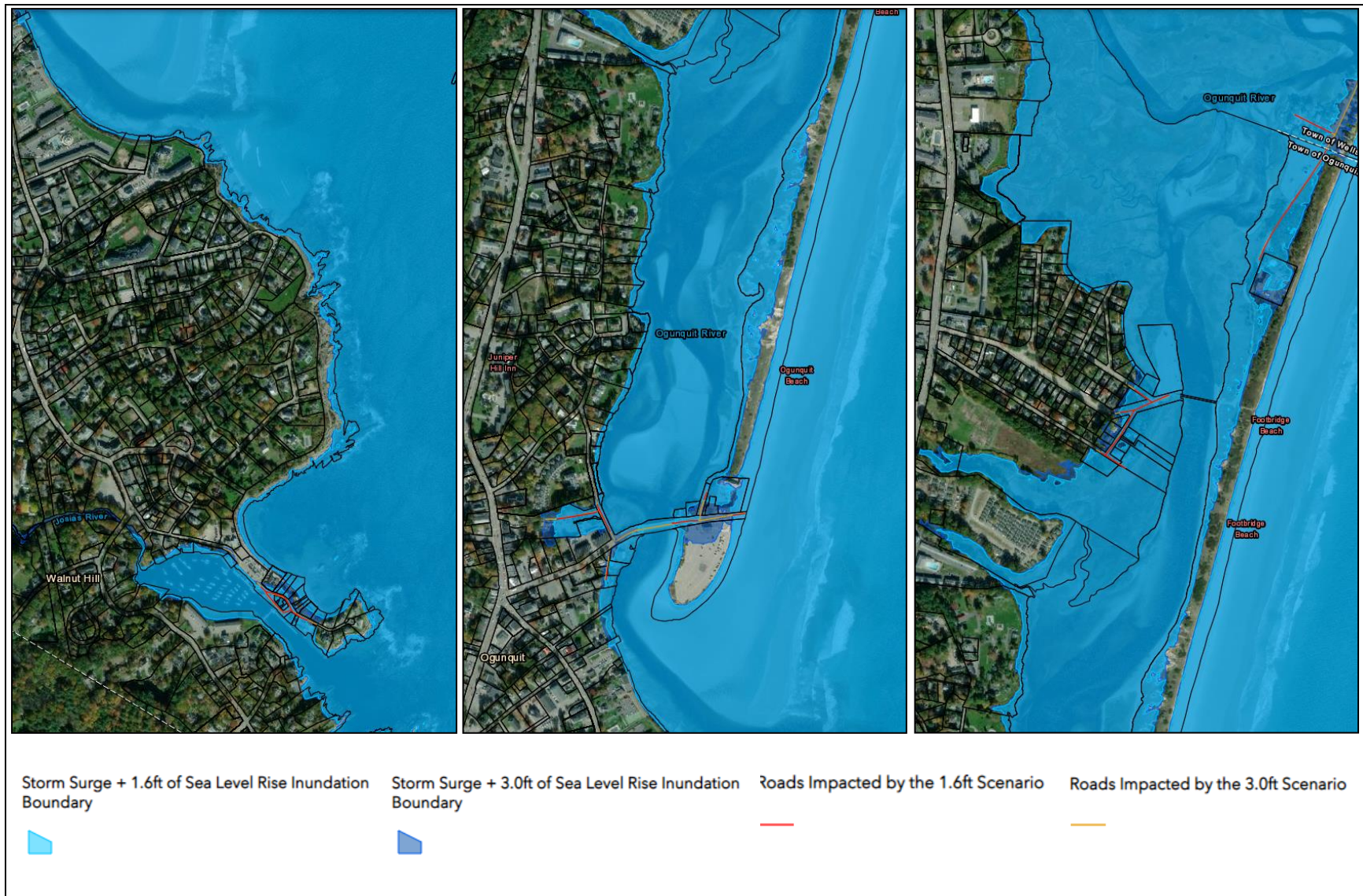


Figure 4 Projected inundation from 1.6 and 3.9 feet of sea level rise combined with storm surge from the 1% annual chance event overlaid with Ogunquit parcels. Impacted roads account for bridge elevation, as LiDAR was used to confirm whether a bridge would be overtopped based on bridge deck elevations and the water surface elevations of the inundation scenario. If the inundation boundary appears to ‘cover’ a bridge, the bridge is only projected to be inundated by water if it is shown as red or orange on the map. (Source: SMPDC. 2022. Economic Resilience Assessment and Plan for Coastal York County).