

RESILIENT NJ: Township of Ocean, NJ

# Climate Change-Related Hazard Vulnerability Assessment (CCRHVA) & Resilience Action Plan

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PREPARED FOR

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Township of Ocean, New Jersey



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# SECTION 1: Introduction

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The Resilient NJ program is assisting the Township of Ocean in integrating climate change science into land use planning to strengthen its resilience to climate-related hazards. This section provides an overview of the study process behind this report.

## Program Overview

Resilient NJ is an assistance program to support local and regional climate resilience planning. In recognition of the critical need for climate science to inform land use planning, on February 4, 2021, Governor Murphy signed into law P.L. 2021, c6, amending NJ's Municipal Land Use Law (MLUL).<sup>1</sup> The Resilient NJ Program supports amendments to the MLUL requiring municipalities in NJ to incorporate a climate change-related hazard vulnerability assessment into any Master Plan Land Use Element. The Township of Ocean is one of the first municipalities to participate in the program and is receiving support to integrate climate change science into land use planning and decision-making.

This program aims to strengthen the Township's resilience to the effects of extreme heat, sea level rise, coastal storms, changing precipitation, and other climate-related hazards. The project team, led by Dewberry, has prepared a vulnerability assessment and menu of adaptation actions. This report includes the methods and findings from this effort, an examination of the impacts of climate change on the Township of Ocean, and a suite of potential action items that could improve the Township's resilience to climate change. This initial effort sets the stage for more comprehensive resilience planning and the further development and implementation of risk-mitigating actions.

# Township of Ocean

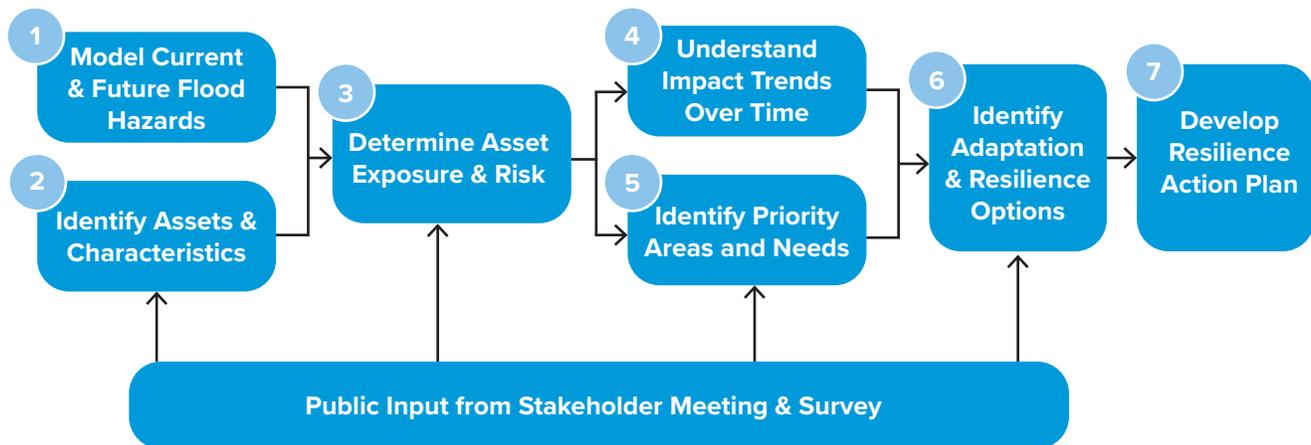
The Township of Ocean, Ocean County, is located on the eastern coast of New Jersey and has a population of 9,071 as of the 2020 census. The majority of development in the township is East of the Garden State Parkway, along the West coast of Barnegat Bay, and is protected by barrier islands on the East coast of the bay. Land in the Township West of the Garden State Parkway is within the Pinelands National Preserve and subject to the Pinelands Comprehensive Management Plan, a land use and development plan created by the New Jersey Pinelands Commission. Colloquially, the Township or parts of the Township are often referred to as “Waretown,” a term that generally encompasses the developed areas of the Township east of State Route 9.

The climate change-related hazard vulnerability assessment and related resilience action items presented in this report focus primarily on the coastal areas of the Township East of the Garden State Parkway, as this area currently experiences and is projected to experience significant exposure to climate-change related hazards. The majority of residents, businesses, and critical assets are located in this area.

The Township, State of New Jersey, and federal agencies have prioritized protecting and preserving sensitive ecosystems in the Township; as a result, the Township is almost entirely built-out in areas designated for development or redevelopment.

**FIGURE 1:** Map of the Township of Ocean showing notable geographic features and the Study Focus Area.





**FIGURE 2:** Vulnerability Assessment and Resilience and Adaptation Action Items Process

## Study Process

### Vulnerability Assessment

The Climate Change-Related Hazard Vulnerability Assessment (CCRHVA) examines how climate change affects the Township of Ocean. It focuses on sea level rise and coastal storms, the primary concern for the residents of Ocean, but also considers potential impacts related to increased temperatures, wildfire, and interior stormwater flooding. As part of this analysis, potential threats and vulnerabilities associated with critical facilities and future development are highlighted, setting the stage for the development of potential strategies to reduce or avoid risks. The process behind this vulnerability assessment can be broken down into the following steps (see Figure 2):

- **Model current and future flood hazards** – Mapped the flooding extents and depths associated with coastal flood events, projecting how floodplains will expand and deepen in the future.
- **Identify assets and characteristics** – Evaluated the location and

characteristics of critical facilities, community resources, and natural infrastructure within the Township.

- **Determine asset exposure and risk** – Examined exposure to flooding and other hazards across assets and time horizons, and quantified potential impacts and damages.
- **Understand impact trends over time** – Aggregated impact information across time horizons to measure how climate-related risks may increase in a no-action scenario.
- **Identify priority areas and needs** – Determined specific assets and areas that are in most need of projects and actions to mitigate risk.

The results and findings from this assessment are presented in **Section 2**. They led to the identification of adaptation and resilience options, and ultimately the development of a resilience action plan, as described below. This process also involves community input throughout—for the Vulnerability Assessment, this included a public survey and meeting to solicit feedback on community concerns and priorities.

## Resilience Options and Action Plan

Adaptation and resilience actions can come in many forms. As illustrated in Figure 3, they can be physical (design and construction strategies that actively change the built or natural environment) or policy-based (such as programs or regulations meant to influence the built environment over time). They can also be a combination of both physical and policy-based adaptations. Projects can be considered for their direct risk-mitigating benefits as well as secondary community benefits, such as supporting recreational opportunities, job creation and economic growth, and ecosystem services.

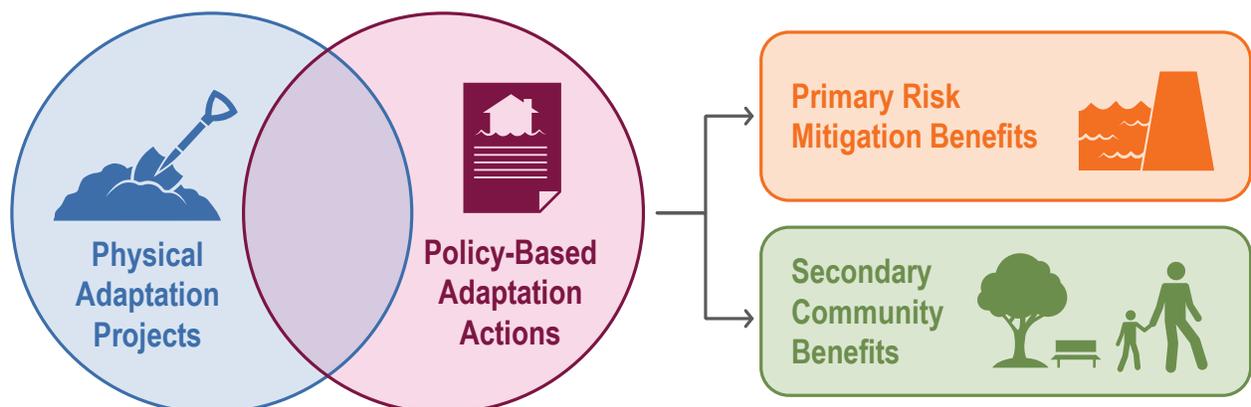
The process for researching and developing a responsive suite of action items was multi-faceted, including primary research and a community engagement component. The research included a review of successful resilience and adaptation actions from coastal communities across the country. These actions were then tailored to the study area to create a suite of suitable options and appropriate locations for the Township, presented in **Section 3**.

Community and stakeholder engagement throughout this project informed the inclusion of action items that reflect the needs and priorities of members of the community.

The initial list of potential strategies and actions was reviewed and refined in close coordination with Township staff and professionals and used to develop fifteen specific actions the Township is most interested in advancing. Those actions were further refined, prioritized, and aligned with potential funding sources as described in **Section 4** of this document.

The resulting action plan reflects the unique needs and circumstances of the community, and it provides a roadmap for building a more resilient future. However, the process of identifying potential actions to address climate change and other hazards should be ongoing and iterative. Moving forward, it is essential to continue engaging community members, monitoring changing conditions, and adapting strategies as needed to ensure that the Township of Ocean is prepared and resilient in the face of changing environmental hazards.

**FIGURE 3:** Adaptation action options and benefit types.



## Community Engagement

The perspectives and knowledge of community members are essential to understand what is important to the residents of Ocean and ultimately identify solutions that best meets the community's resilience needs and supports its long-term goals. To this end, community engagement occurred throughout the entire process, dedicating a public meeting for each task.

The public was notified about the meetings through Township emails, posts on social media, and through outreach to community organizations. The public involvement team developed a comprehensive database of organizations to notify to amplify outreach from the Township itself. The database included community groups, houses of worship, local sporting groups, and other organizations. Each organization was contacted by the public involvement team in advance of the public meetings to encourage participation.

By prioritizing community engagement and striving for equitable and inclusive participation, the program aims to develop strategies and solutions that reflect the needs and priorities of all members of the community.

### Meetings

The first meeting took place in person on July 14, 2022, to kick off the vulnerability assessment. The in-person meeting was held at the Waretown Volunteer Fire Company #1 at 117 Wells Mills Road in Waretown, New Jersey (see Figure 4). The venue was selected to ensure easy access for all participants. Approximately 30 residents attended the meeting. The meeting focused on community visioning and data collection. Specifically, the meeting included a project overview presentation, and then attendees moved

through table stations to discuss core topic areas:

- **Climate Concerns** – At this station, a team member facilitated discussions among participants by presenting maps and asking the following question(s): What are your climate resilience concerns? And what brought you to this meeting today?
- **Problem Areas** – At this station, a team member facilitated discussions among participants by asking them what assets are frequently impacted by selected hazards and to identify these locations on a map.
- **Community Assets** – At this station, a team member facilitated discussions among participants by asking them what community assets are important to them and to identify these locations on the map.
- **Resilience Visioning** – At this station, a team member facilitated discussions among participants by asking the following question(s): What does resilience mean to you? And what does a resilient community look like?

The second meeting took place on the evening of December 7, 2022, via Zoom, and focused on presenting and verifying results from the vulnerability assessment. Thirty-two participants joined the virtual meeting to learn more about the project and provide input. The project team gave a presentation that broke down steps and results from the assessment, and participants provided input by responding to polling questions posed during the presentation and through participation in the webinar chat. The meeting also included a component to introduce the next stage of the study process, asking residents to identify objectives and priorities to inform

**FIGURE 4:** Photos From the Initial Public Meeting



appropriate and relevant adaptation and resilience actions. Poll questions included:

- Does this information change the way you think about the future of your community? If so, how? *Open-ended.*
- How do you think this information should impact long-term planning in your community? *Open-ended.*
- Is there something here that surprised you? Are there additional vulnerabilities or risks that concern you that you did not see captured? *Open-ended.*
- What physical adaptation strategies would you most like to see in Ocean? *Multiple select.*
- What type of policy and planning adaptation actions would you most

like to see in Ocean? *Multiple select.*

- What hazard mitigation benefits would you like to see from resilience investments and efforts? *Multiple select.*
- What secondary community benefits would you like to see from resilience investments and efforts? *Multiple select.*

The third meeting took place on February 27, 2023, also using a virtual format. This meeting was attended by 17 residents and focused on presenting adaptation and resilience strategies and soliciting feedback on the suitability and direction of strategies concerning community resilience goals. Like the second meeting, live poll questions were used to facilitate active participation and included::

- How likely are you to support the implementation of [this] type of strategy? *Multiple choice.*
- How can the township collaborate with stakeholders to build consensus around resilience efforts? *Open-ended.*
- How can we enhance the participation of vulnerable residents (age, income, mobility, etc.) in the resilience planning process and implementation? *Open-ended.*

These engagement efforts have helped to set the priorities and focus areas of the study team and document support or concerns in a way that is transferable to future communication and consensus-building efforts. In Tasks 1 and 3, engagement helped to identify and validate assets and areas to focus on during the vulnerability assessment. In later tasks, engagement has identified preferences for project types and benefits that the team plans to employ for the evaluation of action items and the development of a resilience action plan. The engagement is also documented in a way that will support broader planning efforts consistent with P.L. 2021, c. 6. Highlights of input collected through these meetings are presented alongside relevant content throughout the later chapters of this report.

## Survey

In addition to the public meetings, residents were encouraged to participate in the project and provide input through an online survey. The survey was accessible from the Township’s website and was publicized through emails and social media. The survey was launched before the initial public meeting and was primarily aligned with early-stage objectives of understanding community concerns and priorities. 56 residents responded to the

survey, answering the following set of questions:

- What concerns do you have about how climate change may affect the Township of Ocean? *Open-ended.*
- Based on your experience, what types of flooding have you witnessed in the Township of Ocean? *Multiple select.*
- What assets or places are important to the Township of Ocean? *Open-ended.*
- Why do you think these assets or places are important? *Open-ended.*
- Based on your experience, where are the Township of Ocean’s “problem areas”? Problem areas refer to locations that are known to have recurring issues with flooding or other hazards such as wildfires or extreme heat. *Open-ended.*
- What questions do you have about climate change and resilience? *Open-ended.*
- Resilience refers to the ability of social and ecological systems to absorb and adapt to shocks and stresses resulting from a changing climate. Based on this description, what does a resilient Township of Ocean look like to you? *Open-ended.*
- Imagine the year 2072, what do you hope to see in the Township of Ocean? *Open-ended.*
- Do you have any other comments, questions or concerns to share with us? *Open-ended.*

Highlights of responses collected from the survey are also presented alongside relevant content throughout the later chapters of this report.

## SECTION 2: Vulnerability Assessment

This section presents how natural hazards are projected to change over time with climate change and assesses the likely impacts these changes would have on the Township of Ocean's people and assets.

### Flood Assessment Methodology

Vulnerability is the extent to which people, places, systems, or things are prone to, or are unable to cope with, climate change's adverse impacts. Vulnerability to climate change can be broken down into the following three elements:

- **Exposure** – The degree to which a climate variation or change may affect people, places, or systems.
- **Sensitivity** – The degree to which people, places, or systems could be harmed by that exposure.
- **Adaptive Capacity** – The degree to which people, places, or systems could mitigate the potential for harm by taking action to reduce exposure or sensitivity.

A vulnerability assessment combines these three elements to evaluate how climate change will affect an identified population, place, or system. The primary focus of this assessment is on coastal flooding, relating

### Community Perspectives

In the online public survey residents were asked: "What concerns do you have about how climate change may affect the Township of Ocean?" The majority of respondents listed rising sea levels and flooding as their primary concern related to climate change and responses included:

*I believe we are seeing changes that are more dangerous to all of our communities. More frequent flooding, higher winds, more severe tornados and higher temperatures more frequently.*

*Drainage for flash flood waters.*

*I'm afraid of forest fires.*

*Ability to sustain current ecological environment including wet lands and forest areas.*

*Flooding big time. Water levels are rising.*



to both high tides and coastal storms, which will worsen over time with rising sea levels. Coastal flooding was the primary concern identified by community officials as well as residents who engaged in the planning process through meetings and surveys. Other climate-related hazards include extreme temperature, drought, wildfire, and inland stormwater flooding.

This assessment relies upon the best available data to evaluate vulnerable assets in the Township, with refinements to priority areas informed by feedback from Township residents and officials.

### Sea Level Rise Scenarios

The perspectives and knowledge of sea level rise scenarios for this effort were aligned with guidance from the New Jersey Department of Environmental Protection (DEP), “Sea-Level Rise Guidance for New Jersey.”<sup>2</sup> The DEP guidance recommends using a moderate greenhouse gas emissions scenario to plan for climate change. More specifically, to ensure adequate protection against the worst of the likely range of sea level rise impacts, DEP recommends using the upper end of the likely range of NJ sea level rise projections provided by the 2019 Science and Technical Advisory Panel (STAP)

for residential, commercial, and most infrastructure activities.

As excerpted from the guidance: *“The upper end of the likely range sea level rise projection reflects a 17% chance of being met or exceeded. These activities include those that the damage or loss of which would adversely affect household or community stability; would result in significant investment loss; adversely impact sensitive or socially vulnerable populations; with limited flexibility for adaptation; or have other large social, environmental, or economic impacts. Examples of these types of activities include most activities including single and multi-family residential structures, commercial developments, most energy transmission and water treatment infrastructure, evacuation routes and bridges, hospitals, or public transit facilities.”*

The 17% chance values for the moderate scenario were retrieved from the report and are shown below. Some further adjustments were required prior to implementing these values for the flood analysis. Tidal datum epoch adjustments were developed to align the water level elevations with current conditions, and the projected sea level rise values with the water level data. Further

**TABLE 1:** SLR scenario values implemented with the water level elevations to capture existing and future condition coastal flooding

SCENARIO	EXISTING CONDITIONS	FUTURE CONDITIONS			
	2022	2030	2050	2070	2100
SLR Scenario Value	0	1.1	2.1	3.1	5.1
Epoch Adjustment:	0.47	0.12	0.12	0.12	0.12
<b>Water Level Adjustment for Condition:</b>	<b>0.47</b>	<b>1.22</b>	<b>2.22</b>	<b>3.22</b>	<b>5.22</b>

details on the adjustment methodology can be found in **Appendix A: Sea Level Rise and Flood Modeling Methodology**. These adjustments and the final values applied across the study geography to the water level data for each scenario are shown in Table 1.

As shown in Table 1, the baseline water level is projected to rise by one to two feet in each future conditions time frame, exposing more land area and population in Ocean to flooding as time progresses.

### Flood Hazard Extents

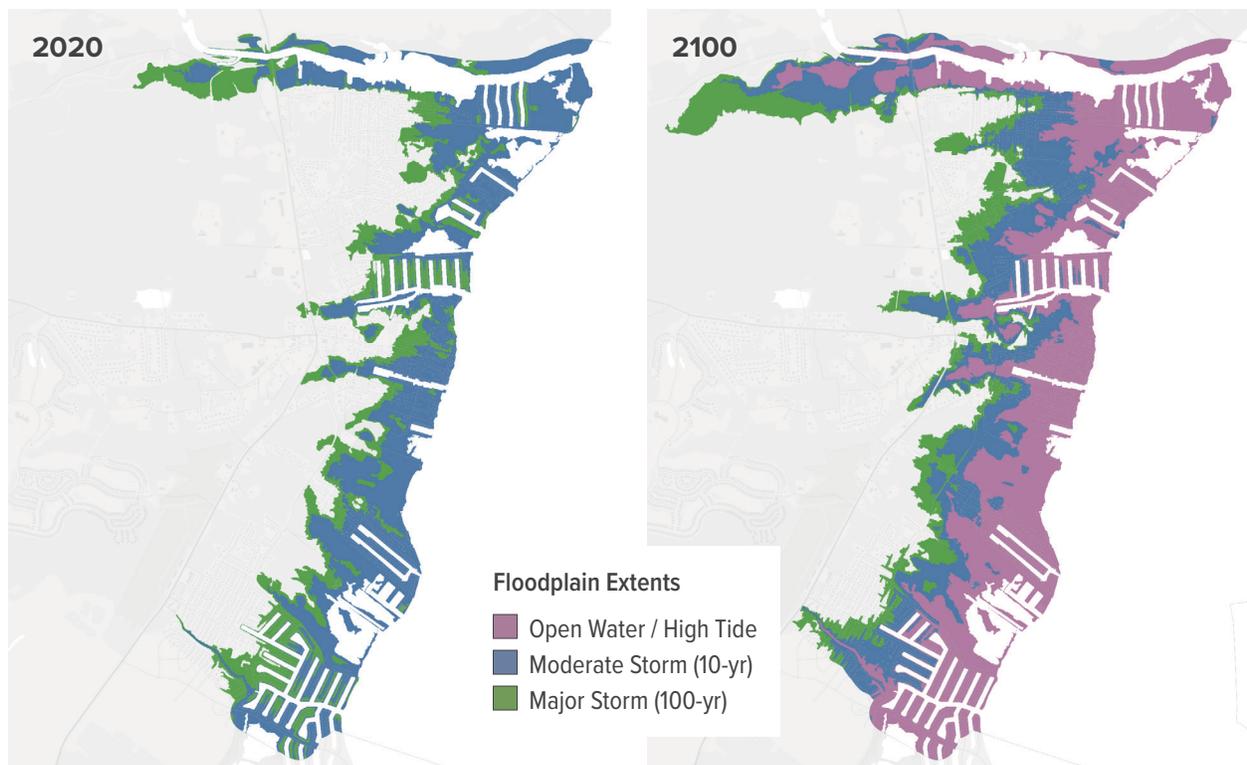
To understand how sea level rise will affect Ocean and identify effective resilience strategies, it is critical first to understand how and when flood hazards will change. As an initial step in the vulnerability assessment, the study team assessed flood hazard scenarios based on two dimensions: event type and time frame. The study considers three reference flood conditions: high tide, moderate storm, and major storm, as shown in Table 2, and modeled how they would change across five reference time frames: 2020, 2030, 2050, 2070, and 2100. This analysis relied on publicly available science and datasets for sea level rise projections and topographic information.<sup>2</sup>

As sea levels rise, the magnitude of a given flood event type will increase—the floodplain it covers will expand, and the water depth will be deeper. As floodplains expand, the likelihood that areas and assets will experience flooding in any given year will increase. And as floodwaters deepen, flood events will become more dangerous and damaging. As a result, coastal flooding impacts will become more frequent and costly over time. Without mitigating action, some wetlands and normally dry land will become permanently inundated and effectively lost to open water. Land inundation has already occurred in Ocean, as the area in the mapped FEMA floodplain will decrease with the most recent floodplain maps due to the reclassification of portions of land as open water, as stated in the most recent Municipal Self-Assessment.

Figure 5 illustrates the modeled flood scenarios for the three reference events in 2020 (baseline conditions) and 2100 (extreme conditions). The spatial extents represent areas projected to be inundated during high tide, a moderate flood (10% annual chance flood), or a major flood (1% annual chance flood), assuming no mitigation actions or changes to the physical landscape take place.

**TABLE 2:** Modeled Flood Reference Events

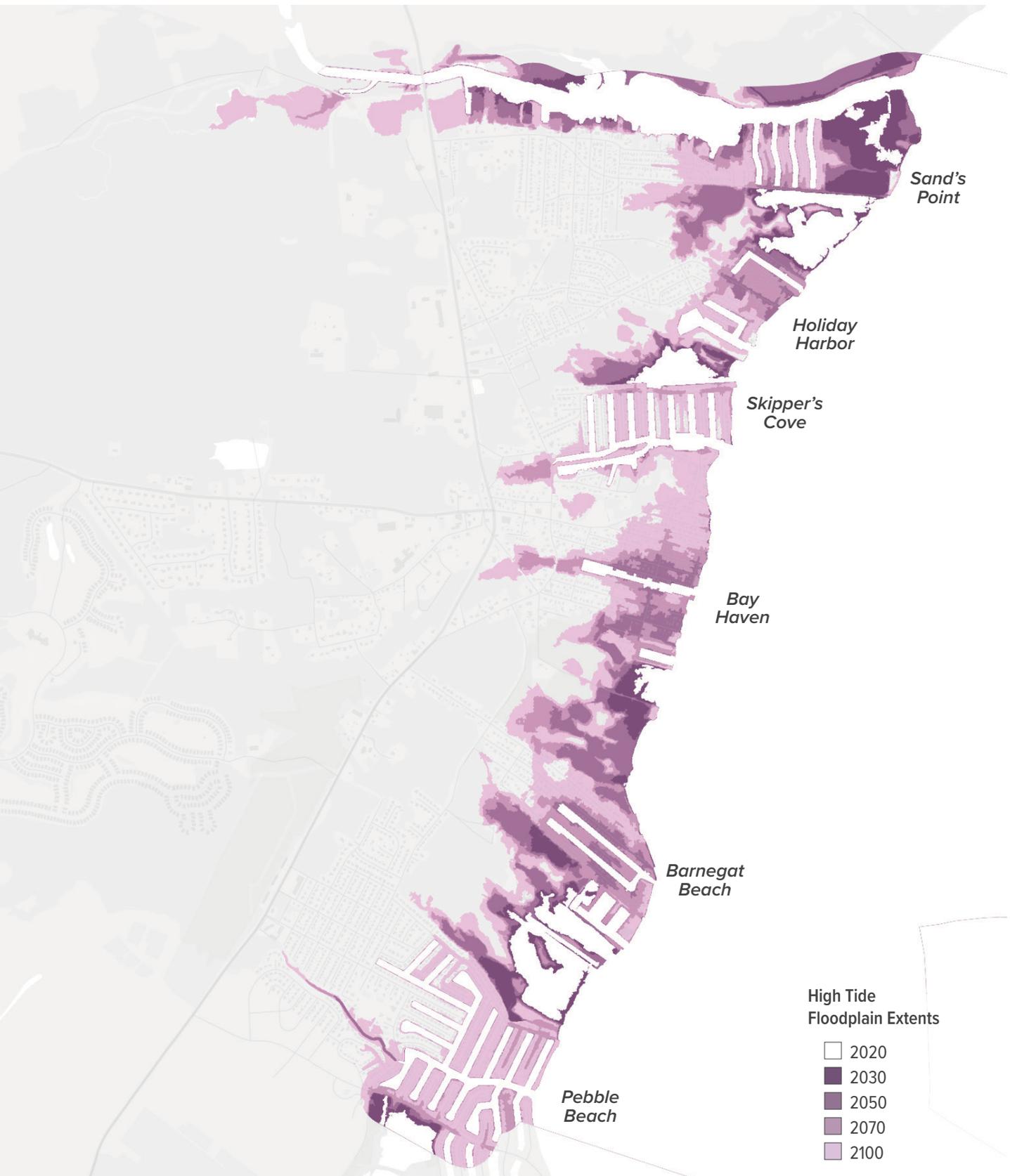
REFERENCE FLOOD	TYPICAL EVENT	AVERAGE RETURN INTERVAL (FREQUENCY)	LIKELIHOOD OF OCCURRING IN...	
			A GIVEN YEAR	A 30-YEAR PERIOD
Tidal	Daily High Tide	< 1 day	100%	100%
Moderate	Tropical Storm	10 years	10%	96%
Major	Hurricane	100 years	1%	26%



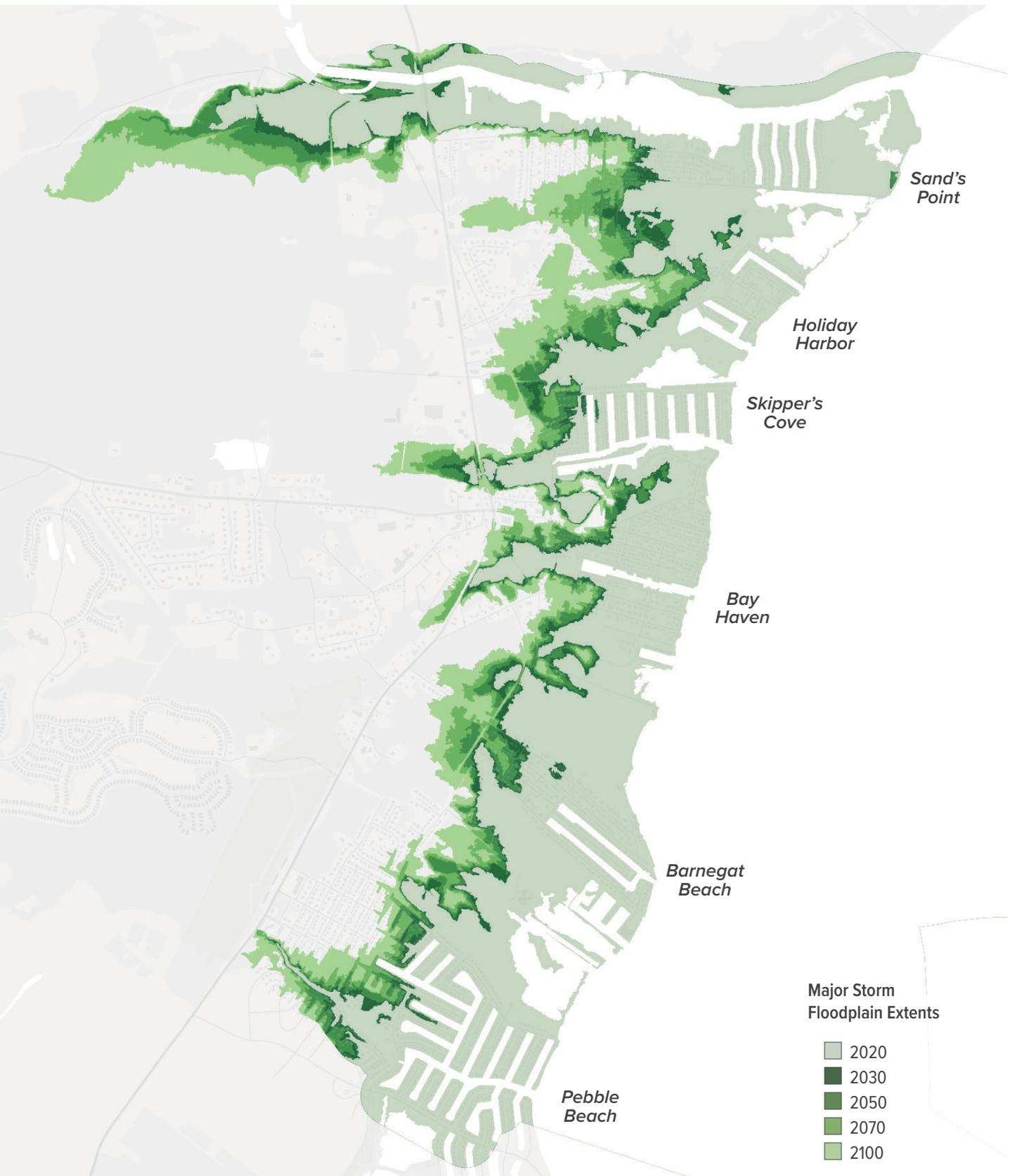
**FIGURE 5:** Flood Scenarios in 2020 (left) and 2100 (right)

The following full-page maps show how floodplain extents are projected to (or anticipated to) change from 2020 through 2100. Figure 6 shows inundation areas during high tide. This map tells the story of a changing shoreline, highlighting areas currently considered dry that are projected to be inundated during high tide in the future and potentially converted to open water.

Figure 7 illustrates how inundation from a major food is likely to expand over time. This is particularly notable as the 100-year floodplain is the primary reference that floodplain management regulations and flood insurance requirements are tied to.



**FIGURE 6:** Growing Inundation Areas during High Tide (Mean High Water)



**FIGURE 7:** Growing Inundation Areas of Major Storm Events (1% Annual Chance Storm)

## Asset Identification

Figure 8, the map to the right, shows buildings, critical infrastructure, roadways, and natural resources in Ocean. The corresponding Table 3 identifies the names of various data sources used to conduct the analysis. The inventoried community assets have been divided into subcategories based on the FEMA Community Lifelines<sup>3</sup> (see Table 3, starting on page 16). Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society. By identifying community assets and their corresponding lifelines, Ocean can prioritize efforts to protect these assets from climate change-related natural hazards.

Asset data came from multiple sources, including Ocean County GIS, NJDEP, NJDOT, NJ Transit, Rutgers, the US Department of Homeland Security, the US Army Corps of Engineers, and Google Maps. More information about source data is included in **Appendix B: Data Sources**.



**FIGURE 8:** Asset Identification

**TABLE 3:** List of assets within the Township of Ocean considered in this analysis by type, sub-type, and coastal flood exposure.

ASSET TYPE	ASSET SUB-TYPE	ASSET COUNT	FLOOD EXPOSED ASSETS 2022	FLOOD EXPOSED ASSETS 2100
<b>Critical Services Assets</b>				
Communications	Transmission Towers	7	0	0
Energy	Gas Station	5	2 (40%)	2 (40%)
Food, Water, Shelter	Grocery	2	0	0
	Shelter Facility	9	0	0
	Water Tower	1	0	1 (100%)
	Water Tower & Treatment Plant	1	0	1 (100%)
	Public Water Supply Wells	5	3 (60%)	4 (80%)
Hazardous Materials	Contaminated Sites	4	2 (50%)	3 (75%)
	Emergency Medical Services Station	2	0	0
	Pharmacy	2	0	0
Safety and Security	Community Center	1	0	1 (100%)
	Fire Station	1	0	0
	Law Enforcement Facility	1	0	0
Transportation	Local Government Office	7	0	0
	Bus Stop	14	0	0
	Roadways	455	117 (26%)	180 (40%)
	Hurricane Evacuation Route	10	0	1 (10%)
<b>Natural Resources Assets</b>				
Natural Infrastructure	Wetlands	4,013 Acres		
	Beaches	84 Acres		
	Forests	13,414 Acres		
	Urban Parks & Habitat Areas	492 Acres		

ASSET TYPE	ASSET SUB-TYPE	ASSET COUNT	FLOOD EXPOSED ASSETS 2022	FLOOD EXPOSED ASSETS 2100
<b>Community Resources Assets</b>				
Structures	Residential Buildings	4,965	1,446	2,231
	Commercial Buildings	231	52	72
	Educational Buildings	5	0	0
	Religious Buildings	14	1	3
	Government Buildings	36	12	23

## Data Gaps and Limitations

Data and information gaps and data limitations have been identified through this process. Notably, an accurate and complete dataset of building footprints and attributes (such as elevation and foundation type) was not available in Ocean’s GIS system or through the Construction office, and the information provided by the NJDEP could not be processed to the level of accuracy needed for the report. To address this limitation, building risks were assessed using a series of simplifying assumptions to get a general starting assessment of potential building impacts and costs.<sup>4</sup>

Additionally, the scale of available demographic data compared to the scale of the study area limited the study team’s ability to incorporate neighborhood-level demographics into the analysis. The best

available demographic data was at the census tract level, and all coastal residents in Ocean fall into the same census tract, limiting the potential for geographic-based distinctions within the community. Therefore, overarching community-level data was used to analyze social vulnerability and other demographic factors. According to 2020 census tract information, the Township of Ocean has higher-than-State- average rates of elderly, disabled, and unemployed individuals.<sup>5</sup> See the **Socially Vulnerable Populations** section, starting on page 27 for additional details.

# Coastal Flooding Impacts

## Built Environment

As floodplains expand with sea level rise, the number of buildings, roadways, and other built assets exposed to coastal flooding increases dramatically, as shown in Figure 9.

Figure 10 highlights that in the near-term (2020), approximately 1,000 residential structures will be exposed to flooding during a moderate (10% annual chance) storm event. More than 600 additional

residential structures would be exposed during a major (1% annual chance) storm event. There is minor exposure to Township assets in the near-term, moderate and major floodplains, with less than 10 assets exposed. The type of assets exposed include gas stations, wells, and one contaminated site. In the near-term, the areas affected by tidal inundation are primarily undeveloped lands.

However, by the end of the century, this picture changes dramatically. By 2100, New Jersey may see approximately 5 feet of sea level rise. Many of Ocean’s residential neighborhoods, including over 1,100

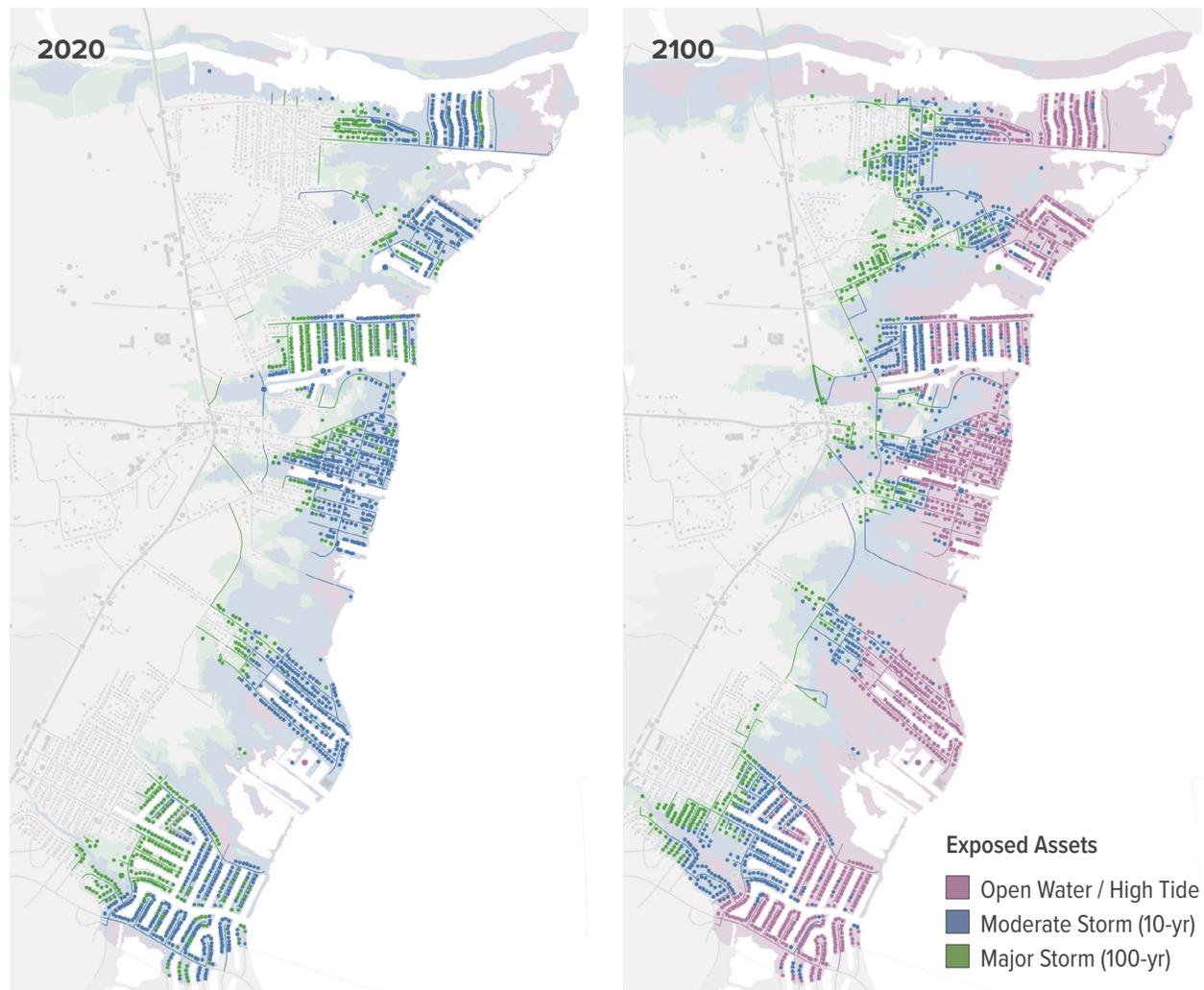


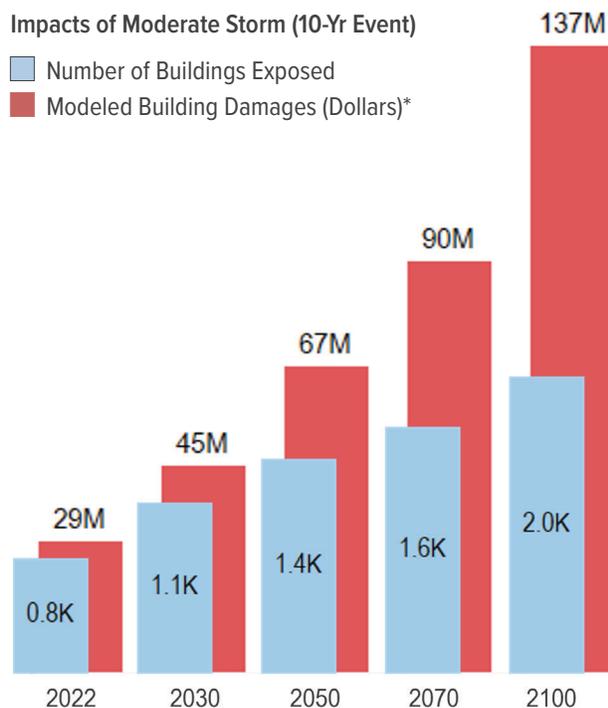
FIGURE 9: Built Asset Exposure in 2020 (left) and 2100 (right)

structures are built on low-lying land that could be fully inundated during high tide. Additionally, as floodplains expand, more structures would be exposed to moderate and major storm conditions. Between 2020 and 2100 conditions, the number of structures exposed to moderate coastal storms will nearly triple, and the number of structures exposed to major coastal storms floods is projected to grow by more than 50%.

Floodplains not only expand but also deepen, leading to more severe damages. Based on USACE data and damage functions, projections indicate that flood-related losses for a moderate storm are estimated to increase by nearly 400%, assuming a slab-on-grade foundation type.

In addition, inundation of roadways and public utility infrastructure poses risks to the Township and can exacerbate the impacts of coastal events. When infrastructure such as roadways become inundated, hazardous conditions can be created that pose a risk to public safety and property. Roadways may become flooded and cause road closures, blocking emergency services from reaching populations that may be in need. Vulnerable populations may also become isolated due to road closures, which may prevent them from accessing critical facilities. The impact of flooding on roadways is explored further on page 26. Floods can also damage utility infrastructure and interrupt critical services. Flooding of system components and facilities can damage them and cause them to stop working. Floodwaters carrying sediment and debris can clog screens and pumps. Overall, impacts from floods can disrupt service, negatively impacting emergency management procedures and slowing the recovery process for the community.

**FIGURE 10:** Building Risk Trends: Worsening Flood Exposure and Economic Losses due to a Moderate Coastal Storm (10-year event)



\* Note basic loss modeling based on USACE data and damage functions, assuming standard elevation and foundation type of slab on grade.

## Natural Infrastructure

Coastal marshes provide numerous benefits to coastal communities, including the ability to absorb storm surge and reduce the impact of coastal storms on nearby human settlements. The marsh acts as a buffer zone between the bay and the coast, slowing down and absorbing the energy of waves and storm surge. Additionally, marshes provide habitat for numerous species of plants and animals and are important for water quality regulation and carbon sequestration.

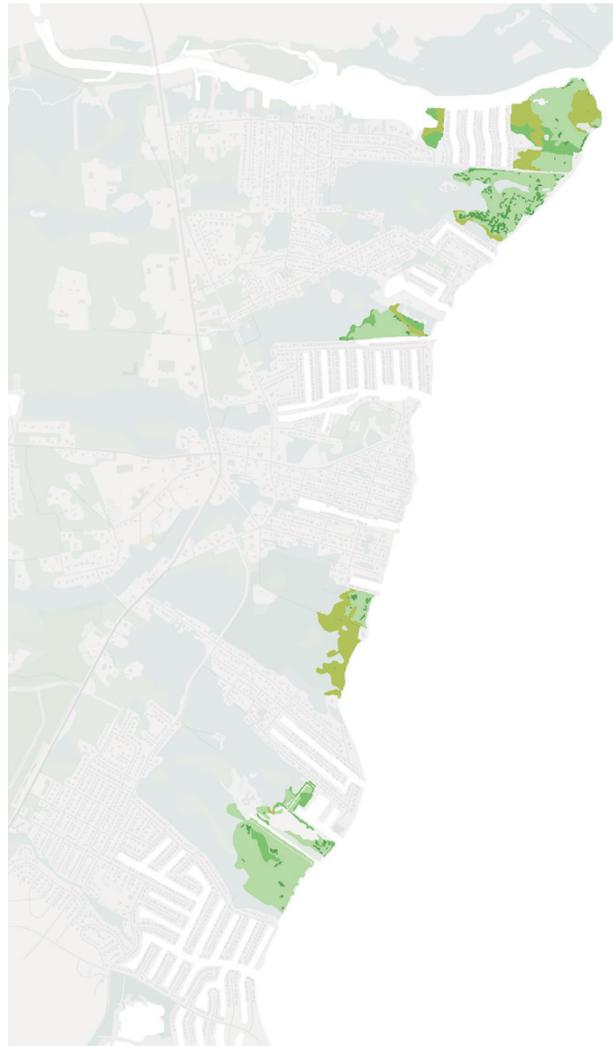
Marsh migration refers to the process by which a marsh ecosystem shifts location and migrates inland as sea levels rise. On the other hand, Marsh retreat refers to the process by which a marsh ecosystem is permanently lost due to erosion, inundation, or other factors.

Marsh migration and retreat may happen simultaneously in different areas within the marsh, depending on local environmental conditions. For example, if a marsh is experiencing sea level rise, it may migrate inland to areas where there is available space for the marsh to expand. At the same time, in areas where the coastal shoreline is eroding, the marsh may retreat and shrink in size. Figure 11 illustrates the current extent of tidal marsh habitats in the Township, and Figure 12 shows the risk of migration and retreat.

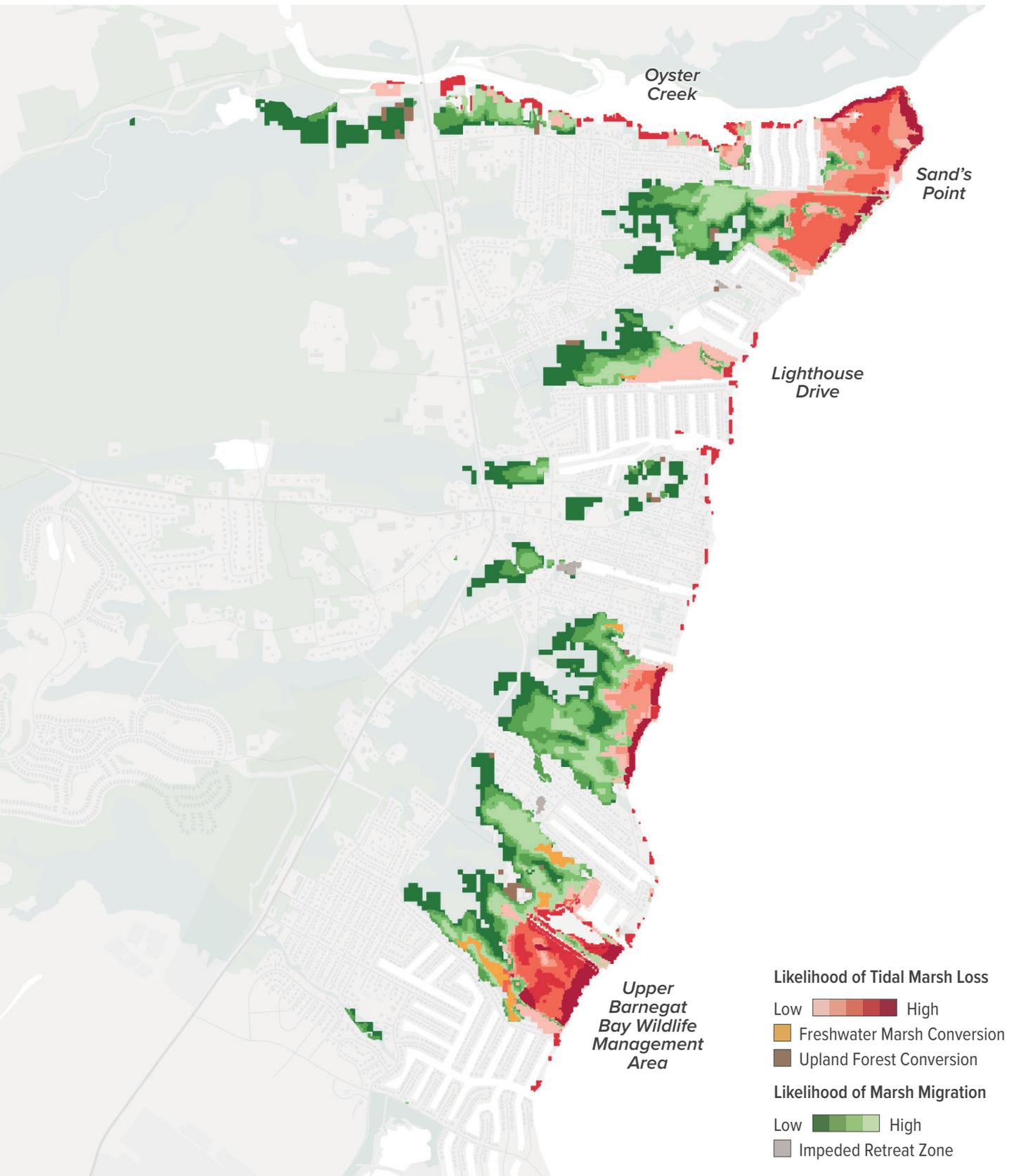
Marsh migration and retreat both endanger residential structures in Ocean, particularly in the Sand's Point and Upper Barnegat Bay areas. In these areas, changes in the natural environment may put structures at risk of flooding or sinking due to erosion, and structures may become exposed to high tide flooding and storm surge without the buffer zone a marsh provides.

Coastal sea level rise and coastal storms both impact marsh changes. Sea

level rise causes the coastline to move inland, leading to the migration of marsh ecosystems. If sea level rise occurs too quickly, or if there are barriers that prevent the marsh from migrating, such as human development or hard shoreline stabilization structures, the marsh may instead experience retreat and ultimately disappear.



**FIGURE 11:** Tidal Marsh Habitat Areas



**FIGURE 12:** Natural Resources at Risk: Tidal Marsh Loss and Migration

## Themes & Priority Areas

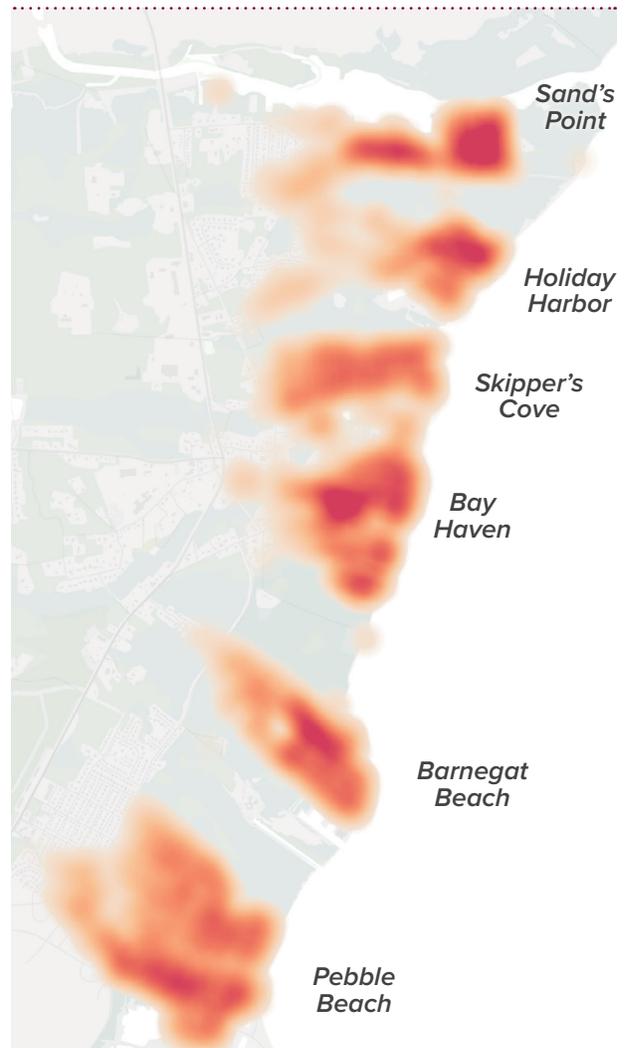
The number of buildings, roadways, and other assets exposed to coastal flooding will increase as floodplains expand with sea level rise over time. Each asset's sensitivity and capacity to adapt to worsening flood hazards depends on its exact location and characteristics such as elevation and construction materials.

As Figure 10 highlights, approximately 1,000 structures will be exposed to flooding during a moderate storm event by 2030. As sea level rise occurs, more than 700 additional structures would be exposed during a major storm event by the end of the century. These structures may be subject to flood damage, including structural damage, damaged electrical systems and gas tanks, or develop mold or wood rot. In the near-term, the areas affected by tidal inundation are primarily undeveloped lands, but over time, more and more developed areas may be permanently inundated if no preventative actions are taken.

In addition to the potential for physical damages and economic losses, social vulnerability must be considered when ensuring an equitable and effective response to climate change-related hazards. Socially vulnerable populations face the greatest risk from climate-related threats, based on factors such as race, age, health conditions, and economic status.

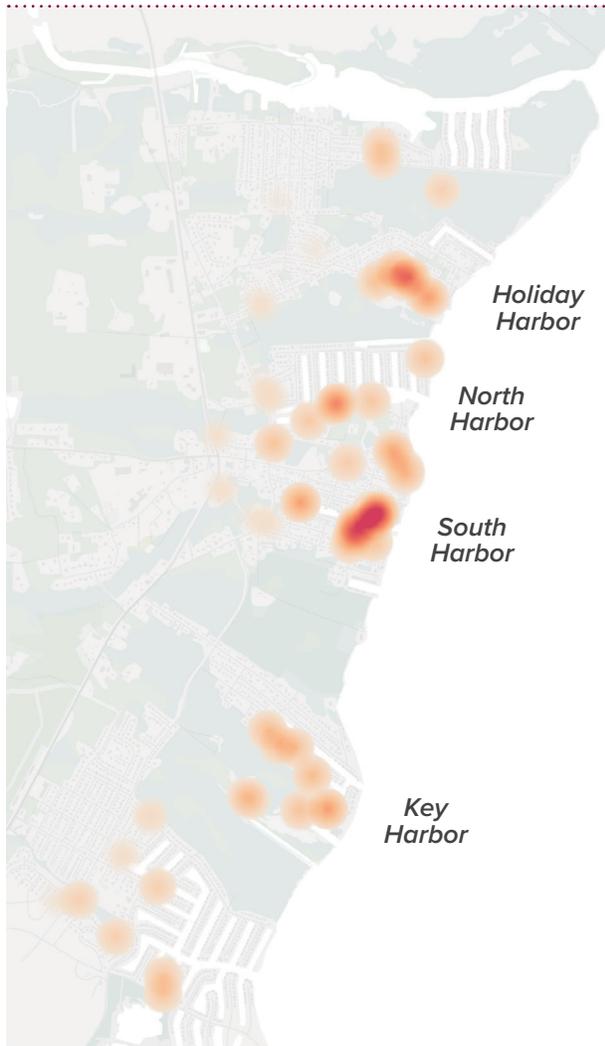
The following series of maps, grouped by theme, highlight areas of concentrated physical impacts. Note that while these maps focus on assets' exposure to coastal flooding, additional prioritization considerations will be discussed in Section 3.

**FIGURE 13:** Homes and Residents Hotspots



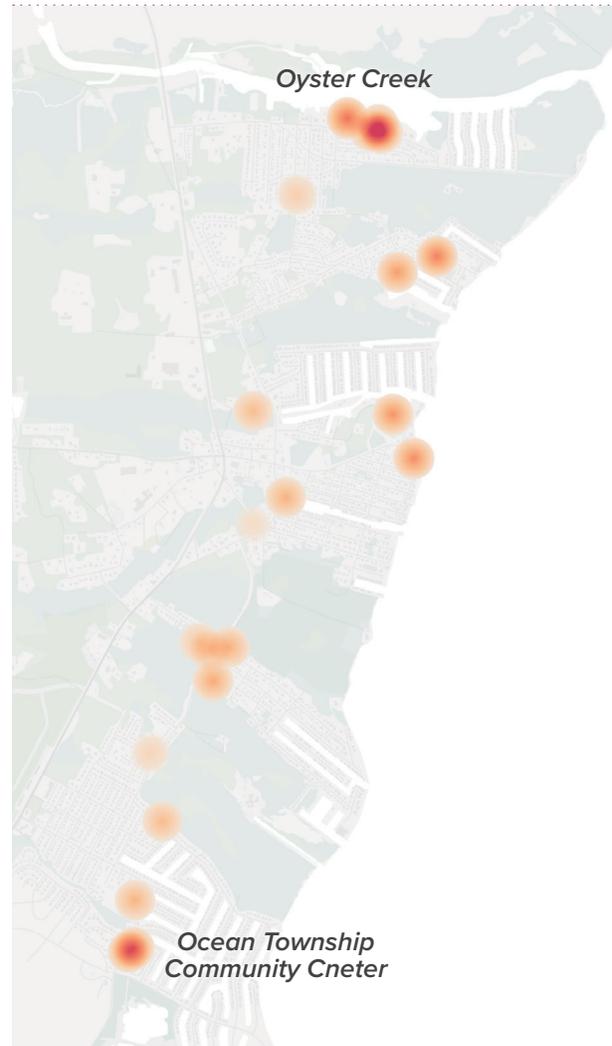
### Homes and Residents

Impacts are spread across all Ocean's coastal neighborhoods, as labeled in Figure 13. 29% of residential homes are exposed today, and that will grow to 45% in the 2100 timeframe. Residents with flood-exposed homes face decisions about whether and how to adapt their homes or even relocate elsewhere. Houses damaged by floodwaters may become unsafe or impractical for residents to continue to live in. And even undamaged homes may be impractical to inhabit if roads and surrounding infrastructure is impacted. Frequent flooding or one particularly severe flood event may lead to the displacement of residents.

**FIGURE 14:** Businesses Hot Spots

## Businesses

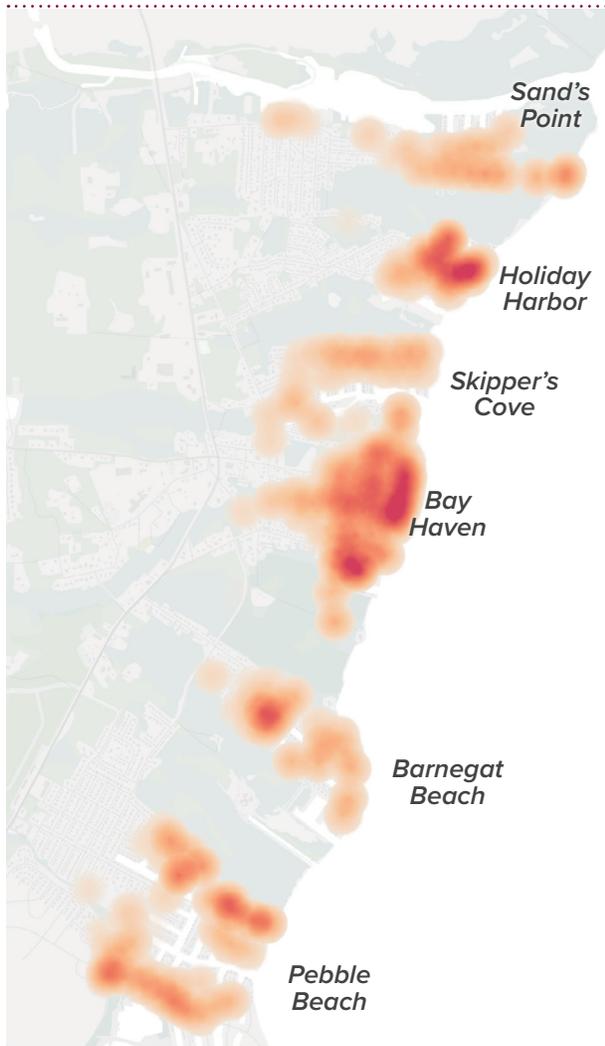
Commercial facilities are also exposed to damaging flooding, with particular concentrations in harbor areas as shown in Figure 14. These locations are primarily marinas, which serve as hubs of economic activity, providing direct employment, boat storage, and housing of restaurants and storefronts. The capacity to respond to flooding varies for each marina. Temporary or permanent business closures can have downstream effects that ripple across the community, such as supply chain disruption and loss of jobs and wages.

**FIGURE 15:** Public and Religious Facilities Hotspots

## Public and Religious Facilities

Public and religious facilities used for educational, religious, and civic uses are clustered along coastal flood-prone areas. These areas include Ocean Township Community Center and facilities near Oyster Creek. These facilities are often a source of information and also serve as resources to residents and are important community assets in post-disaster response and service provision, including serving as shelters. Two churches and four schools in Ocean are listed on the Nation Shelter System as FEMA or American Red Cross designated shelters in the event of a disaster.

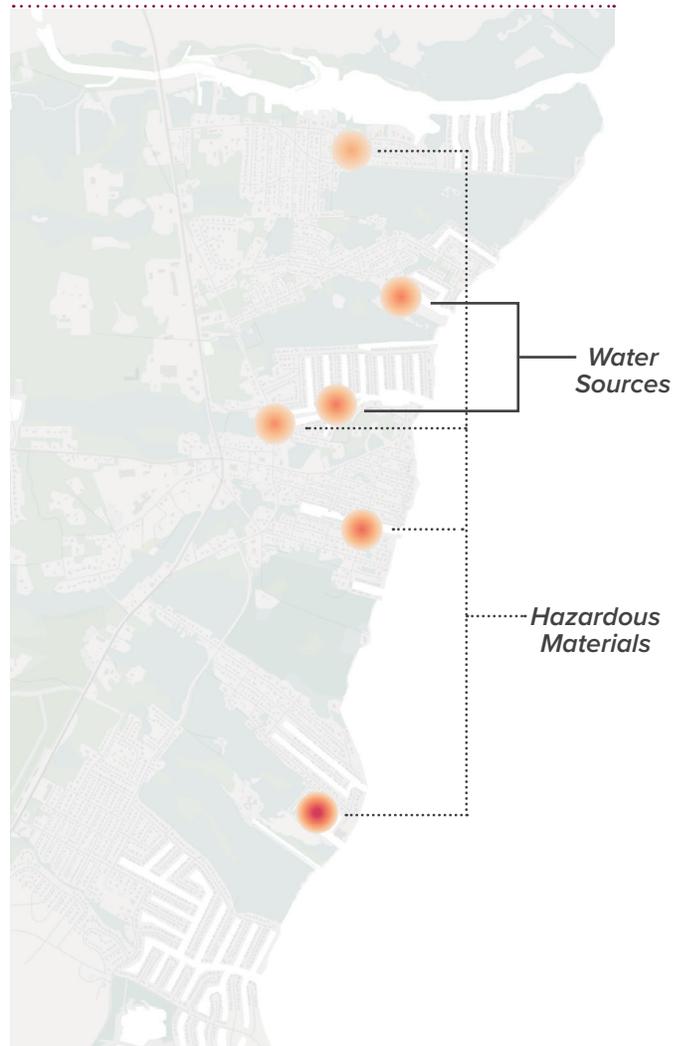
**FIGURE 16:** Road Impact Hotspots



## Roads

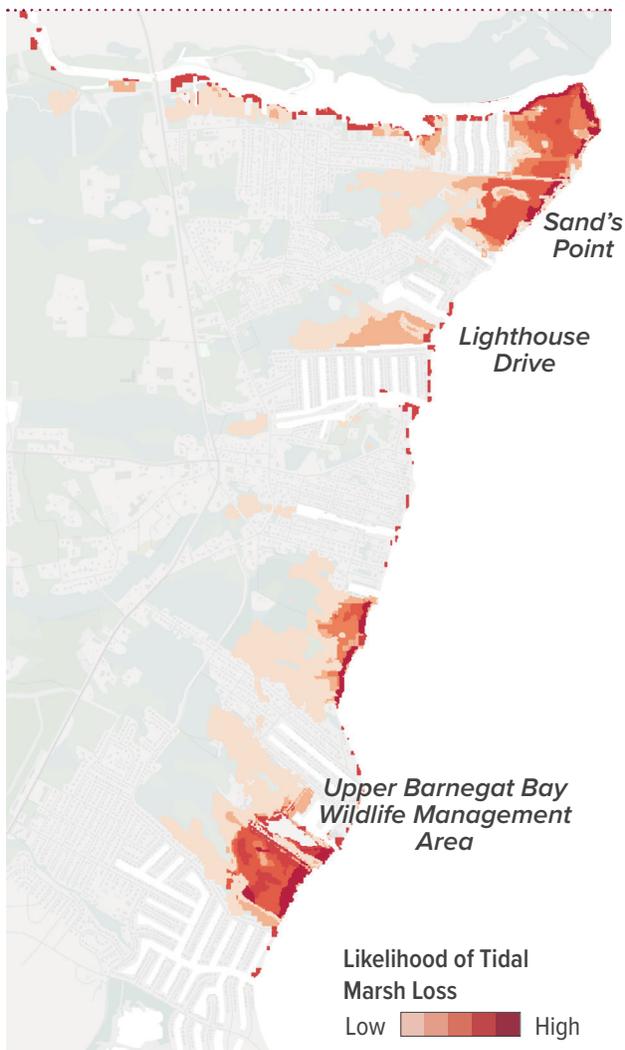
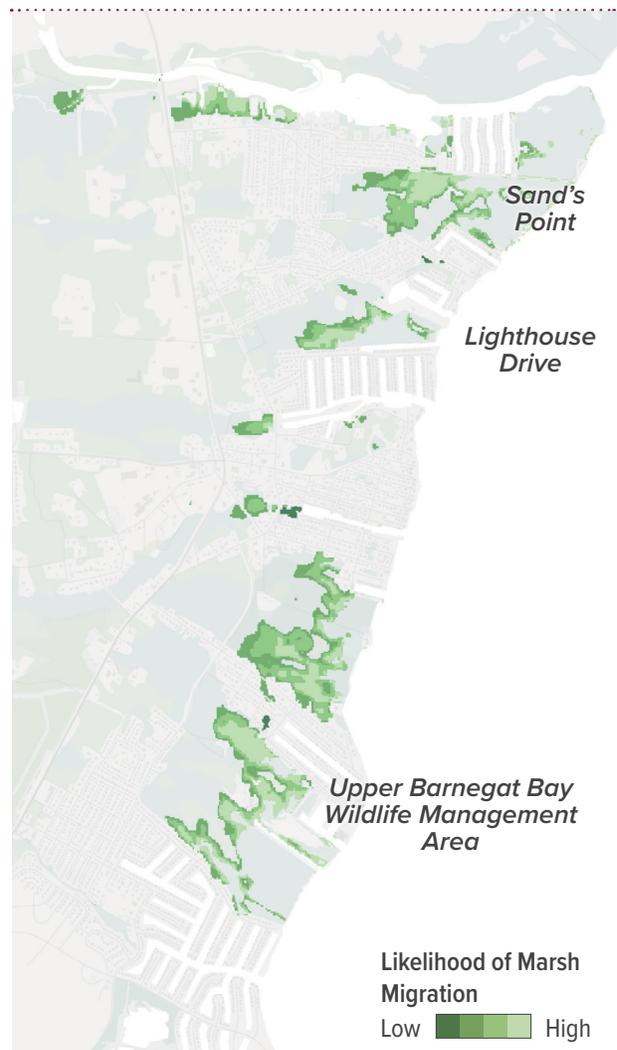
Roadways facilitate the movement of goods and people and are critical to community health and safety. Similar to buildings, roadways across coastal neighborhoods of the Township are projected to face flooding impacts, with particularly high impacts in Bay Haven and Holiday Harbor. The roads affected by flooding in these neighborhoods are primarily local roads. These local roads connect to the Garden State Parkway, a major state highway. Limited access to local and major roadways due to flooding has significant impacts, blocking evacuation routes and increasing traffic congestion.

**FIGURE 17:** Contamination Sites Hotspots



## Environmental Contaminants

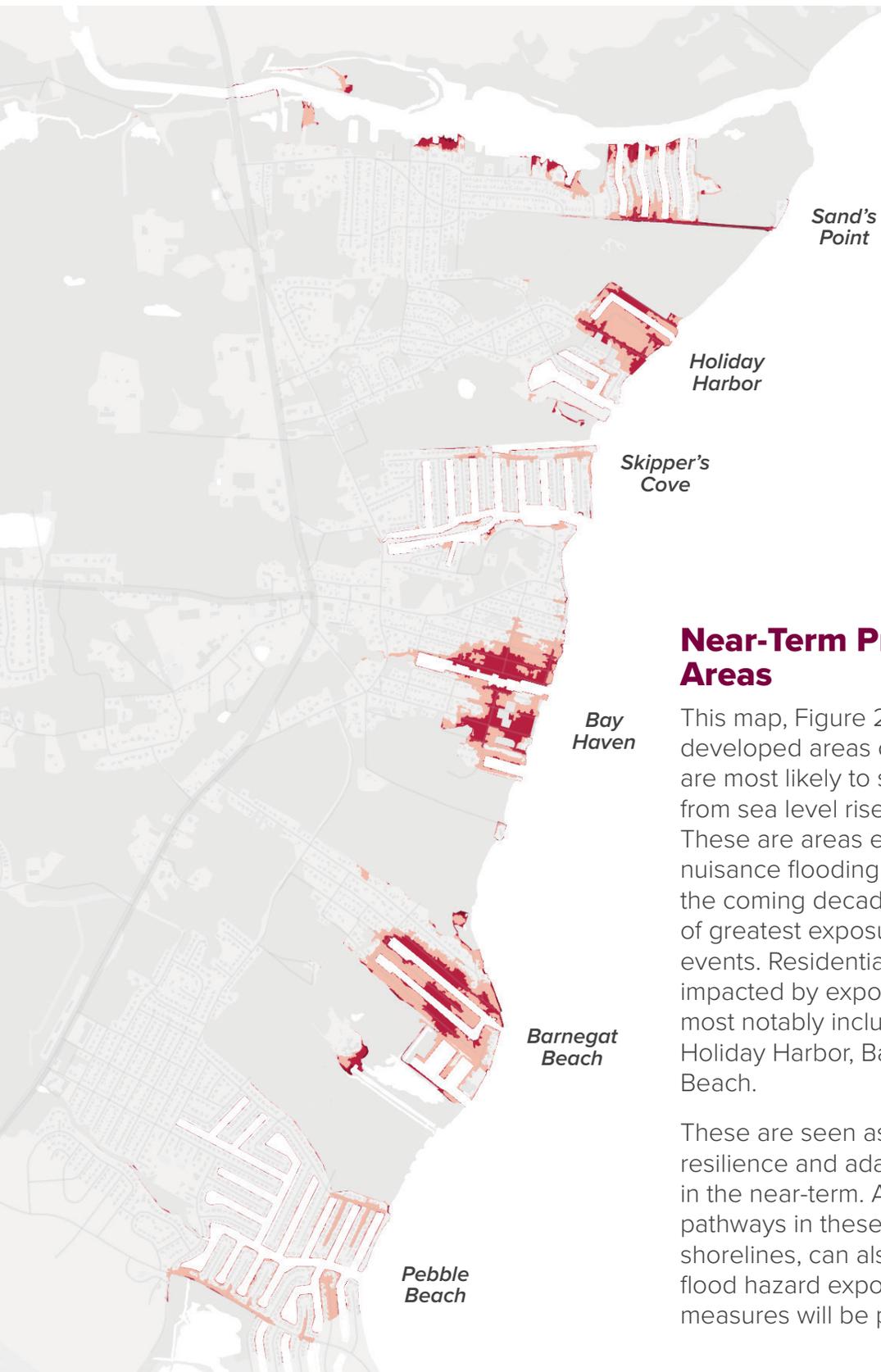
Sites containing hazardous materials, such as gas stations, marina gas stations, brownfield properties, and other contaminated sites, can all become sources of contamination in water resources, soils, and sediments. Flood events can carry contaminants from these locations to vulnerable community assets, such as drinking water wells and sensitive natural areas. This contamination can impact both public and environmental health. Flood events can also result in disruption or damage to water treatment facility services.

**FIGURE 18:** Wetlands Impact Hotspots**FIGURE 19:** Areas of Potential Marsh Migration

## Wetlands

Tidal marshes along the coast and other waterways are vulnerable to impacts of sea level rise, particularly along Sand's Point Harbor, Fresh Creek, Oyster Creek, and in the Upper Barnegat Bay. The exact nature of wetland impacts is hard to predict as these marshes have can response in multiple ways to rising sea levels. These wetlands have the potential to migrate landward if not blocked by development and grow vertically if there is an adequate sediment supply. However, marshes can eventually drown if sediment input cannot offset sea level rise.

These wetland ecosystems provide many services, including the filtration of nutrients and pollutants, provision of habitat for various species, and function as natural flood buffers. Loss of these habitats can have detrimental consequences for both the natural environments and surrounding communities.



### Near-Term Priority Action Areas

This map, Figure 20, identifies the developed areas of the Township that are most likely to see near-term impacts from sea level rise and coastal flooding. These are areas exposed to tidal flooding, nuisance flooding, and inundation over the coming decades and indicate areas of greatest exposure during coastal storm events. Residential structures are primarily impacted by exposure in these areas. This most notably includes parts of Sands Point, Holiday Harbor, Bay Haven, and Barnegat Beach.

These are seen as areas to prioritize flood resilience and adaptation actions in the near-term. Actions to block flood pathways in these areas, such as protective shorelines, can also serve to mitigate inland flood hazard exposure. Potential effective measures will be presented in Section 3.

**FIGURE 20:** Inundation Areas: Near Term Sea Level Rise and Developed Land

## Socially Vulnerable Populations

The effects of climate change are more severe for socially vulnerable populations. These populations have less capacity to prepare for, respond to, and recover from climate-related hazards and events. As shown in Table 4, Ocean has a higher percentage of population over 65, population with disabilities, and unemployed civilians than the state average. Populations over 65 and with disabilities may be more vulnerable to climate change-related natural hazards that require evacuation because they may require assistance. Additionally, the

population over 65 may be more prone to respiratory illnesses or other underlying health conditions that increase their risk to extreme heat or wildfire hazards that worsen air quality. Unemployed individuals have an increased risk to climate change-related natural hazards due to a decreased capacity to recover financially from a hazard if it impacts their home or causes an injury.

**TABLE 4:** Socially Vulnerable Populations in the Township of Ocean and State of New Jersey

Demographic Variable (based on 2020 SVI data)	Township of Ocean (Both Census Tracts)	Percentage of Population	State of NJ	Percentage of Population
Total population	9,071		8,885,418	
Households	3,858		3,272,054	
Housing units	4,498		3,628,732	
Population 17 or younger	1,470	16.2%	1,953,453	22.0%
Population 65 or older	2,882	<b>31.8%</b>	1,442,938	16.2%
Population with a disability	1,273	<b>14.0%</b>	915,815	10.3%
Persons without a high school diploma	431	4.8%	600,761	6.8%
Persons below poverty	820	9.0%	1,373,150	15.5%
Civilians (age 16+) unemployed	341	<b>3.8%</b>	271,795	3.1%
Persons uninsured	355	3.9%	662,917	7.5%
Persons who speak English "less than well"	22	0.2%	503,869	5.7%
Single parent households	105	1.2%	196,489	2.2%
Minority Ethnicity (non-white)	762	8.4%	4,026,611	45.3%
Mobile homes	0	0.0%	33,411	0.4%
Housing with 10 or more units	137	1.5%	577,368	6.5%
Crowded housing units	70	0.8%	107,201	1.2%
Households with no vehicle	174	1.9%	367,585	4.1%

## Additional Hazards

The Township of Ocean also faces a range of other climate hazards, including extreme temperatures, wildfire, and inland flooding. These hazards are of lesser focus in this study effort but are noted here as they also pose significant risks to residents, infrastructure, and the local economy.

### Inland Flooding

Inland flooding, also known as stormwater or pluvial flooding, can occur when the volume of water on land exceeds the capacity of natural and built drainage systems. These flooding events are increasingly common in New Jersey due to increased rainfall and development (which includes majority impervious surfaces). Residents inside and outside the 1% annual chance floodplain may be highly vulnerable to direct and indirect impacts of inland flooding, such as structural damage, transportation disruption, power outages, disrupted emergency services, and injury.

Climate change is expected to increase the frequency and intensity of inland flooding events in the Township of Ocean. This is due to a combination of factors, including sea level rise, increased precipitation, and

more frequent and extreme weather events. Significant development would also impact inland flooding but is not anticipated as the township is fairly built out given current zoning.

Inland flooding is a particular concern for the Township of Ocean as it has been a recurring challenge and can impact infrastructure and flood homes, causing significant damage and displacement. While it was not modeled in this study, many actions that address coastal flooding will also reduce the magnitude and consequence of inland flooding.

### Extreme Temperature

The Township of Ocean also faces an increasing risk of extreme temperatures, including heatwaves and cold snaps. These temperature extremes pose risks to human health, infrastructure, and the local economy.

Heatwaves and extreme heat are expected to become more common and particularly intense in the Northeast in the coming decades as the average temperature in the Northeast region is projected to be more than 3.6°F warmer by 2035 than during the preindustrial era.<sup>6</sup>

**TABLE 5:** Projected and historic annual extreme temperature days, based on a moderate greenhouse gas emissions scenario, as described by the Intergovernmental Panel on Climate Change (IPCC).

TIMEFRAME	EXTREME HEAT		EXTREME COLD	
	DAYS WITH MAXIMUM TEMP ABOVE 95°F	CHANGE VS. HISTORICAL BASELINE	DAYS WITH MINIMUM TEMP BELOW 32°F	CHANGE VS. HISTORICAL BASELINE
Historical Baseline 1981-2010	2		94	
2050-2070	14	+12	81	-13
2080-2090	18	+16	74	-20

For winters, although there is a projected decrease in days with average temperatures below freezing, the impacts of extreme cold days will be more pronounced when they occur.

Days with extremely hot temperatures are projected to increase in frequency and severity. As Table 5 shows, the median number of days above 95 degrees Fahrenheit from 1981-2010 was 2. Projections indicate an increase to 14 days in 2050-2070 and 28 in 2080-2090. This increase in extreme heat poses a particular risk to vulnerable populations, including residents with respiratory illnesses that can be exacerbated by high temperatures and low-income residents who may lack access to cooling systems.

## Drought

A drought is a deficiency of precipitation over an extended period, resulting in a water shortage. Climate projections indicate an increase in the number of dry days and the number of consecutive dry days in Ocean County by the late century (2070 – 2099).<sup>7</sup> The projected increase in dry days, combined with the increase in extremely hot days, will exacerbate drought conditions in Ocean in the future. Warmer temperatures can intensify drought conditions by reducing surface water and drying out soils and vegetation. Drought occurrences may result in water use restrictions and increased risk of wildfire in Ocean.

Droughts can also create conditions that enable the occurrence of other natural hazard events such as wildfires. Low water flow conditions decrease the quantity and pressure of water available to fight fires, while dry conditions increase the likelihood that fires will occur. The likelihood of flash flooding also increases if a period of severe drought is followed by a period of extreme precipitation.

## Wildfire

Wildfire is characterized by large, uncontrolled fires that burn through natural areas such as forests, grasslands, and brush. As shown in Figure 21, the western portion of Ocean and areas along Route 9 contain extreme wildfire fuel hazards, putting the population, structures, and critical assets located in these areas at high risk for wildfire. The western part of Ocean is mostly comprised of forestlands, where wildfires can easily spread due to lightning strikes (which

may increase in frequency with more extreme weather events) or human activities such as campfires or discarded cigarettes. There are also residential structures located along the edge of the extreme wildfire fuel hazard area in the western part of the township that could be damaged by a wildfire that moves from the forest into more urban areas. Along Route 9, there are critical assets that are exposed to wildfires, including transmission towers, facilities use as shelters in emergency events, and bus stops. These assets are directly related to evacuating and recovering

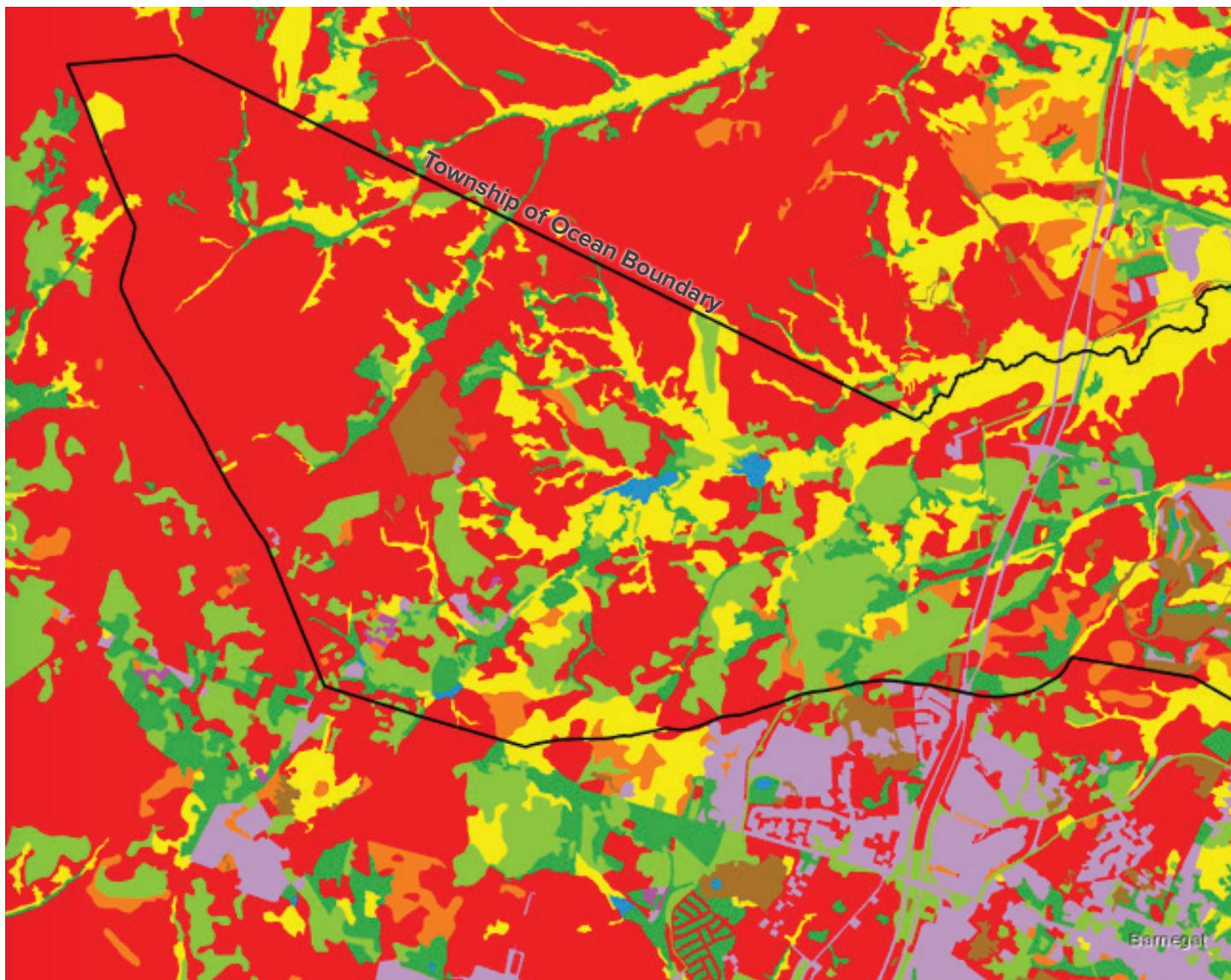


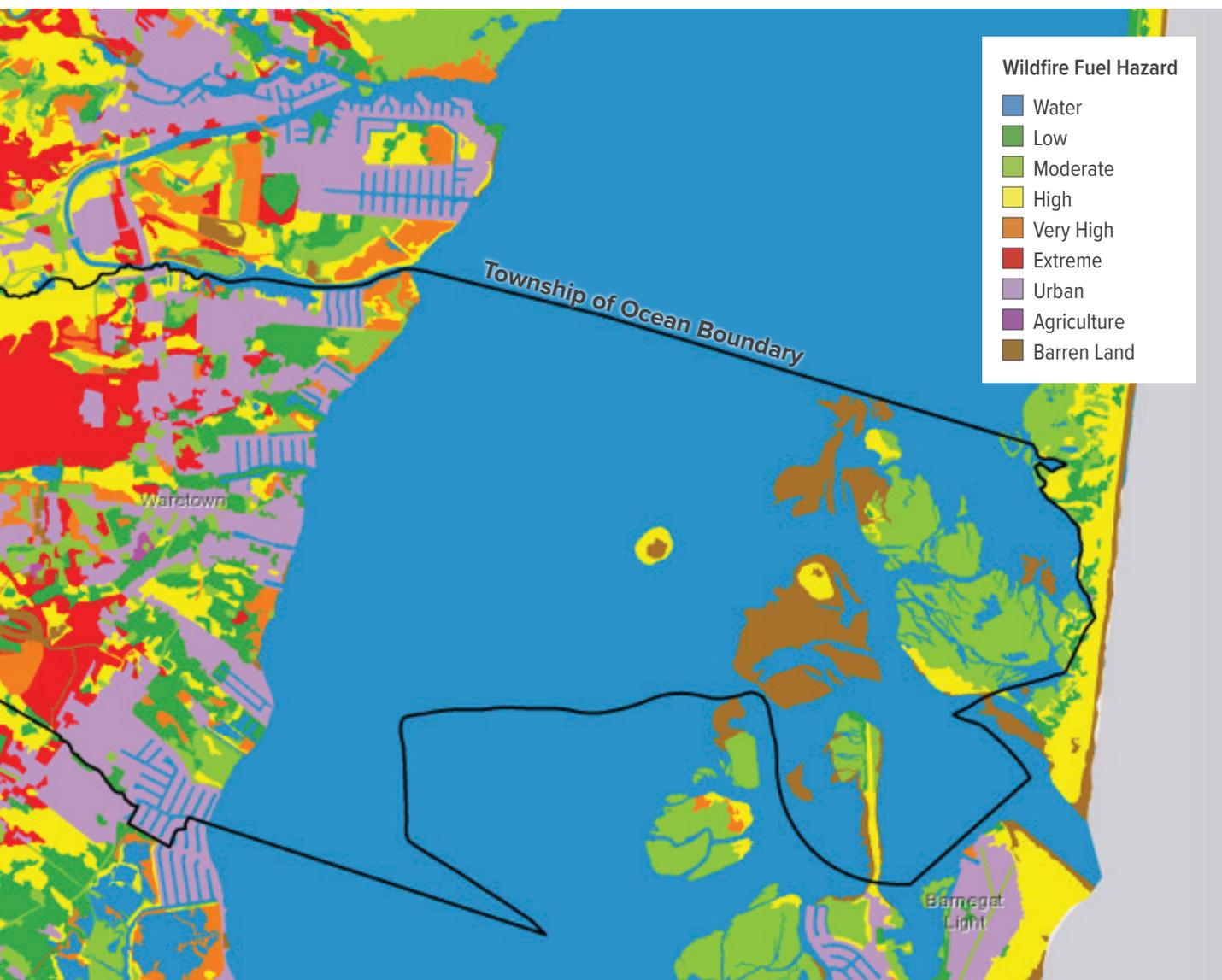
FIGURE 21: Wildfire Fuel Hazard

from a wildfire event. If these assets were to be damaged by wildfire, essential disaster response and recovery services in Ocean would be disrupted.

In New Jersey, Wildfire season has been extended 3 weeks longer in the spring and has been extended even later into the fall due to increased average temperatures. The number and extent of forest fires have also increased in the areas with the largest forest fire in state history occurring last year, burning nearly 5,000 acres in Bass River Forest

nearby to the Township of Ocean.

There have been no reported wildfires in the Township of Ocean, but there have been 35 wildfire incidents in Ocean County, as reported by the National Interagency Fire Center.<sup>8</sup> 7 of the 35 total reported wildfire incidents occurred in jurisdictions directly neighboring the Township of Ocean. Wildfires in nearby areas can reduce air quality, which can be dangerous for the population with respiratory illnesses or outdoor workers.



**FIGURE 21: WILDFIRE FUEL HAZARD** Wildfire Fuel Hazard (cont.)

# Plan Alignment

One critical component of the Resilient NJ Municipal Assistance Program is to ensure that future activities align with concurrent and previous studies, and a review of reports identified in Table 6 has been crucial in achieving this goal. The following sections provide an overview of key related plans and planning efforts and their alignment with the objectives and findings of this resilience and adaptation effort.

## Master Plan

Ocean’s *Comprehensive Master Plan*,<sup>9</sup> first adopted in 1982 and most recently reexamined in 2019, provides a review and evaluation of municipal development regulations in order to determine the need for updates and revisions. The recent reexamination reports are most relevant to resiliency and climate change impacts, in the wake of Superstorm Sandy.

The 2019 Master Plan provides a comprehensive list of goals and objectives within the following categories:

### General Development Goals

- Encourage the use of best management policies for all development to ensure the least negative impact on the overall quality of residential life and the environment in the Township.
- Review and continually update the permitted uses within each zone to ensure that only those uses compatible with the land capacity to support them are permitted.
- Promote public awareness of hazard mitigation and resiliency issues.
- Focus public agencies on community vulnerabilities to hazards such as flooding; Encourage regional

**TABLE 6:** Relevant Planning Reports and Activities Reviewed

RESOURCE	YEAR
Master Plan Reexamination Report	2019
Ocean County Hazard Mitigation Plan	2018
Ocean County Long Term Community Recovery Plan	2015
Ocean County Comprehensive Master Plan	2011
Housing Plan Element and Fair Share Plan (Midway Review)	2020
Housing Plan Element and Fair Share Plan	2017
Stormwater Management Plan	2008
Floodplain Management Plan	2015
Community Wildfire Protection Plan	2019
Waretown Town Center Economic Redevelopment Plan	2020
Stormwater Pollution Prevention Plan	2021

solutions to flood- and storm-related impacts.

- Ensure that future capital projects are designed and constructed to incorporate features that are resilient to storm- and flood-related impacts.

### **Residential Development and Housing**

- Provide for cluster subdivision design to conserve open space and natural amenities in residential areas and to reduce road and utility cost.
- Encourage development of new residential housing units in areas that are served with adequate infrastructure including water, sewer, stormwater management, and streets, to minimize any negative environmental impacts.

### **Commercial and Industrial Development**

- Review economic development and redevelopment programs to encourage both new construction and conversion of existing non-commercial uses to viable commercial activities.
- Maximize the economic benefit of resource-based development with the lowest possible negative environmental impact.

### **Transportation and Public Facilities**

- Maintain and enhance the traffic carrying capacity of principal thoroughfares, such as Route 9, by making traffic engineering improvements and regulating access and egress.
- Improve local streets and drainage where poor conditions and problems exist.
- Expand and improve all other public services and facilities commensurate with need and population growth.

### **Conservation and Environmental Protection**

- Provide for cluster design to conserve open space and natural amenities in residential subdivisions and projects.
- Establish a system of conservation areas that are designed to limit or restrict development in wetlands, along streams, and in undeveloped bayfront locations; promote appropriate recreational uses in these conservation areas.

### **Infrastructure and Utilities**

- Install new generators at Township Hall, the Department of Public Works complex, the building that houses the Construction and Zoning, and the first aid building.
- Prepare a Capital Improvement Plan that identifies needed capital investments in public facilities to improve local resiliency.
- Develop a GIS database and user interface to catalog and inventory all infrastructure owned by the Township, including roadways, its stormwater collection system, its sanitary sewer collection system, and residential and commercial property information.
- Elevate key municipal facilities above the Base Flood Elevation.

### **Waretown Town Center**

- Create an attractive, diverse, and vibrant center consisting of mixed-use development, open space, civic buildings and residential uses.
- Protect environmentally sensitive lands and direct growth towards

areas of Township with existing infrastructure.

The Township of Ocean's ongoing planning efforts are focused on advancing the goals and objectives of the Master Plan. As shown above, many of the goals focus on growth, development, and redevelopment in a sustainable, resilient manner for the future. With a significant portion of the Township being located in the flood hazard area, the Township has identified its C-1 and C-2 commercial zones as areas in need of redevelopment along both Route 9 and Main Street. These commercial areas are located outside of the flood hazard area and remain the focus of the Township's development efforts.

Future capital projects are also to be designed and constructed to incorporate features resilient to flood- and storm-related impacts. Those include new stormwater management systems, the elevating of roadways, the elevating of critical water/wastewater infrastructure, etc.

Actions resulting from the vulnerability assessment and adaptation report will strengthen the community's resiliency and help ensure that the above goals, designated in the goals listed in the Master Plan, are met.

## Hazard Mitigation Plan

Ocean County's 2018 *Multi-Jurisdictional All-Hazard Mitigation Plan*<sup>10</sup> is a guide toward greater disaster resilience that acknowledges the individual and unique character and needs of the different communities. The purpose of the plan is to reduce property damage and save lives from the effects of future natural and man-made disasters in Ocean County. This plan can also help the county qualify for pre- and

post-disaster grant funding. Additionally, it complies with state and federal legislative requirements to local hazard mitigation planning. The Disaster Mitigation Act of 2000 Section 322 requires that local governments (municipalities/counties), as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, creating a risk assessment and vulnerability analysis, identifying and prioritizing mitigation strategies, and developing an implementation schedule for the County and each of the municipalities. The Ocean County HMP includes an appendix for the Township that covers mitigation strategies and implementation schedules. The vulnerability assessment and action items developed for the Township of Ocean in this document will also assist in identifying additional mitigation strategies to be included in the County's next HMP scheduled to be prepared sometime in 2024.

Ocean County's *Multi-Jurisdictional All-Hazard Mitigation Plan* identifies natural hazards (coastal erosion, flooding, wildfire, winter storms, etc.) and man-made hazards (hazardous materials, terrorism, transportation accidents, etc.). With its location along Barnegat Bay and within the Pinelands National Reserve, the Township of Ocean is particularly susceptible to coastal hazards, wildfire, and rising temperatures. Additionally, future climate change impacts make the Township even more vulnerable to all natural hazards.

This plan also presents a summary of repetitive loss properties for the Township of Ocean. The plan identifies 30 single-family residential properties as repetitive loss properties in the Township of Ocean. The report indicated that these properties have a combined total of \$22,697,357 in

repetitive loss payments. This information can be leveraged for future resilience project design, prioritizing, and grant application development for future resilience projects.

## Floodplain Management Plan

The intent of the Township's *2015 Floodplain Management Plan*<sup>11</sup> was to identify and assess flood hazards within the Township, establish goals and objectives for floodplain management, determine an appropriate series of actions to minimize flooding and mitigate impacts of future flooding. The Township worked with the public to develop the Floodplain Management Plan, sharing both experiences from past events and ideas for future resiliency actions. Development of the plan involved a 10-step process, including: Organizing, Involving the Public, Coordinating, Assessing the Hazard, Assessing the Problem, Setting Goals, Reviewing Possible Activities, Drafting an Action Plan, Adopting the Plan, and Implementing/Evaluating/Reviewing. All steps in the process were conducted by a Floodplain Management Committee at public hearings.

The goals included in the Township's plan are:

- Reduce loss from flood damage through codes and standards,
- Educate decision-makers and the public about stormwater management and floodplain management,
- Coordinate and prioritize maintenance of the stormwater management system,
- Protect existing properties by encouraging property owners to

build higher than the base elevation,

- Protect health and safety,
- Improve the quality of life in the Township of Ocean,
- Ensure that public funds are used in the most efficient manner.

This vulnerability assessment and resilience actions report will help to reduce loss from flood damage through recommendations for higher standards; help to educate decision-makers about floodplain management; protect existing properties with recommended options such as elevation; and generally improve the quality of life, health and safety of the citizens of the Township of Ocean. These actions further support the recommendations contained within the FMP and are anticipated to support future HMPs. The actions can also be the basis for funding requests for implementation projects to improve the quality of life in the Township of Ocean.

## Wildfire Protection Plan

The 2019 Ocean Township *Community Wildfire Protection Plan*<sup>12</sup> included goals and objectives to assess the wildfire hazards and risks within the community's forested and urban interface areas. While various wildfire risk/hazard assessments have been utilized for planning decisions in the past, the report features a new Wildland-Urban Interface (WUI) assessment. The WUI can be described as a "set of conditions" in which both vegetation (wildland fuels) and the built environment (built fuels) are influenced by weather and topography to create an environment where fire can ignite and spread through this combined fuel complex (the combination of wildland and built fuels). One cohesive and comprehensive township-wide risk assessment and spatial definition of the WUI is necessary to provide consistent decision support for

developing and implementing land use policies and regulations.

The assessment worked to estimate the likelihood and severity of a wildfire and the impact a wildfire may have on neighborhoods, structures, and/or areas of concern. Prior hazard assessments confirmed the largest wildfire risk was in the western portion of the Township, where vegetation is dense and habitation is low. The WUI assessed the risk based on where vegetation (wildland fuels) and structures (built fuels) interface and either can contribute to a wildfire. These interface areas are present throughout the Township, where development abuts natural features.

The plan also recommended updating the Fire Protection Standards across the Township and aligning content in the next update of the Township Master Plan and in the Ocean County HMP for consistency and cohesiveness. The assessment and recommendations included in the 2019 *Ocean Township Community Wildfire Protection Plan* and any subsequent updates can be used for future planning and outreach purposes.

## Growth and Development

The Township of Ocean achieved a Plan Endorsement designated from the state in 2005 and has a designated Town Center. Growth and development within the Township are focused within the Town Center and the Township's commercial zones, primarily located outside the flood and fire hazard area. Future sea level rise and natural hazards will continue to expand the areas prone to flooding. The Township is currently undertaking a renewal of the Town Center, but in all likelihood the portion of the Town Center that falls within the modeled current and future coastal flood hazard area will be

eliminated from the Center. The areas that are more flood-prone or exposed are primarily developed with residential homes and marine-oriented businesses (i.e., marinas); existing undeveloped areas are largely environmentally sensitive and not developable.

A build-out analysis conducted through the Township of Ocean's 2017 Housing Element and Fair Share Plan analyzed the overall build-out potential within the Township in order to determine the capacity for the development of affordable housing in the Township. A realistic development potential (RDP) was calculated based on the land within the Waretown Town Center (both anticipated affordable housing units and vacant land) and the land outside the Waretown Town Center, located within the sewer service area. Three sites within the Warehouse Town Center were planned and approved to expand the Township's affordable housing opportunities:

- Willows at Waretown: 76 age-restricted units
- Tradewinds at Waretown: 29 family rental units
- Ocean Commons: 12 family rental units

The cumulative RDP of these three sites is 117 units.

For the rest of the Town Center that did not have approvals for affordable housing development, the buildout calculated land based on various "regulating area" boundaries outlined in the Town Center District Redevelopment Plan. The RDP of the Town Center Zone is calculated as 94 units. The RDP calculated for the vacant land areas in other zoning districts of the Waretown Town Center was calculated as 8 units, and finally, the RDP of vacant sewerered land located outside of the

Waretown Town Center was calculated as 9 units. As previously stated, the 2017 build-out analysis was conducted to determine where affordable housing units had the potential to be developed. For the purposes of this vulnerability assessment, it is clear that the majority of the development potential within the Township is located within the Waretown Town Center, outside of the flood hazard area.

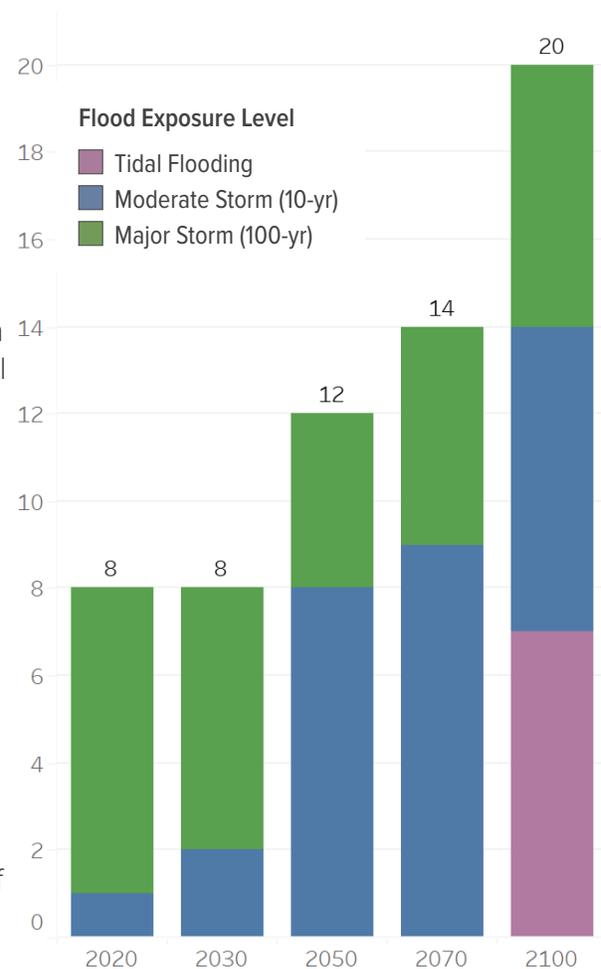
As Figure 22 illustrates, of the 53 RDP units calculated in the build-out analysis, 8 of the potential units would potentially be located inside the flooding extent of a 100-year storm based on current floodplain designations and current levels of flooding and inundation, but 20 of the potential units would fall inside the flooding limits of a projected 100-year storm in the year 2100. Additionally, 7 of those units will be located in areas projected to be exposed to tidal flooding by the end of the century. Those 7 units are:

- Evergreen Way (1 unit),
- 50 Pennsylvania Ave (5 units), and
- 2 Pennsylvania Ave (1 unit).

In addition to this 2017 residential-focused build-out analysis, the study team has used available MOD-IV data to compile a current list of vacant land in the Township (excluding open space and environmentally sensitive areas) and calculated the maximum number of residential and non-residential structures for lots that meet the minimum size requirements for the zone. This analysis found the maximum number of non-residential units anticipated would be 100 units. An additional 250

residential dwelling units could also be developed. However, the Township does not intend to focus development or redevelopment in areas with high flood hazard exposure.

**FIGURE 22:** Count of planned units by level of projected flood exposure



## SECTION 3: Resilience Strategies and Priority Areas

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This section provides a high-level overview of potential strategies and design standards that could be implemented to reduce or avoid risks detailed in the vulnerability assessment and where such actions could occur across the Township.

### Potential Strategies

As communities seek to prepare for and respond to a range of environmental hazards, it is becoming increasingly clear that a range of resiliency projects will be needed. These projects may include measures to address specific hazards, such as coastal flooding, as well as broader strategies to address multiple hazards aimed at increasing the resilience of communities over the long-term. Indeed, many different types of projects may be required to fully prepare for and respond to the challenges posed by climate change and other environmental risks. For example, a coastal flooding event may benefit from a combination of adaptation measures at the shoreline and long-term strategies that reduce the risk to buildings through effective land use planning.

In this section, a wide range of strategies to reduce risks of coastal flooding are presented in the following categories: Protective Shorelines, Resources Conservation, Site-Level Mitigation, Responsible Development, Infrastructure Enhancement, Contamination Reduction,

Community Engagement and Capacity Building.

The first five strategy types are place-based, with suitable locations highlighted in maps throughout this section and summarized in Figure 23. Maps are shaded to highlight areas where specific actions might be prioritized based on higher levels of coastal flood risk. While these priority levels are based on quantitative results from the Vulnerability Assessment presented in **Section 2**, they have also been refined and validated through engagement with the Township.

Two additional categories of resilience actions are also presented to provide a more comprehensive portfolio of climate resilience actions: Wildfire Mitigation and Extreme Heat Mitigation.

Please note that these strategy types and locations are presented as options but not formally put forward as recommendations. **Section 4** presents the results of a further examination and prioritization of these general strategy types, fitting together in a more comprehensive action plan.

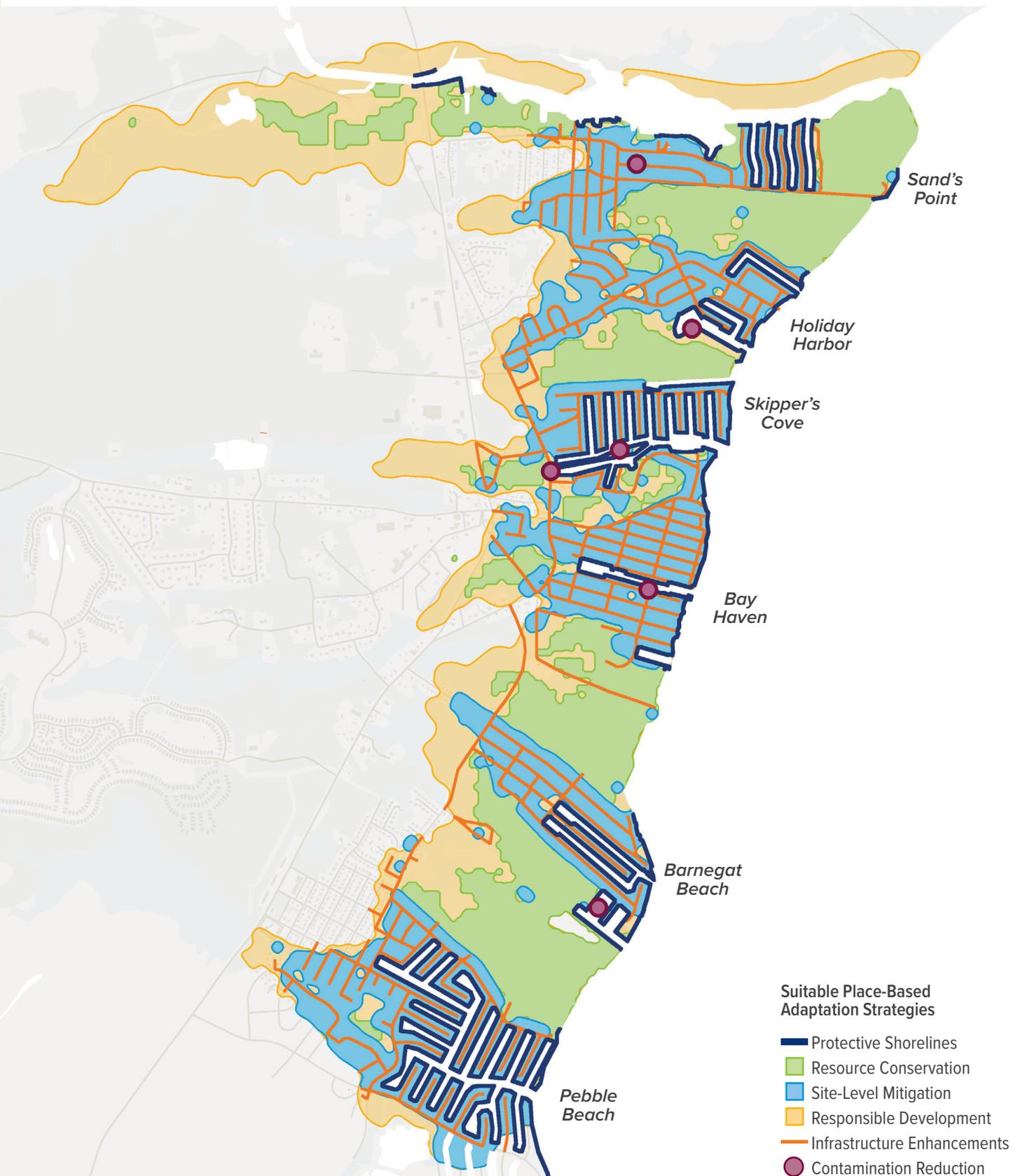


FIGURE 23: Coastal Place-Based Strategy Overview

## Protective Shorelines

Shoreline adaptation projects are an important tool for protecting coastal communities from the impacts of sea level rise and coastal flooding. These projects can take many forms, including:

- **Hard Protective Shorelines** – Man-made structures to protect inland areas from coastal waters. This includes the construction of bulkheads, seawalls, revetments, dikes, or tide-gates.
- **Living Shorelines** – Nature-based solution that integrates plants or other natural elements with harder materials for added structural stability. They are designed to break waves before they reach the shoreline.
- **Deployable Flood Protection** – Utilizes movable barriers placed in advance of a flood or storm and removed when floodwaters subside.

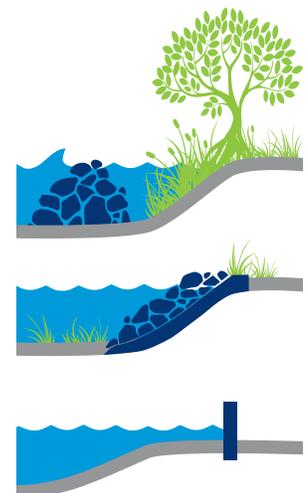
In addition to their physical and environmental benefits, some types of shoreline adaptation methods can also have positive social and economic impacts. For instance, shorelines that integrate natural features can enhance the aesthetic

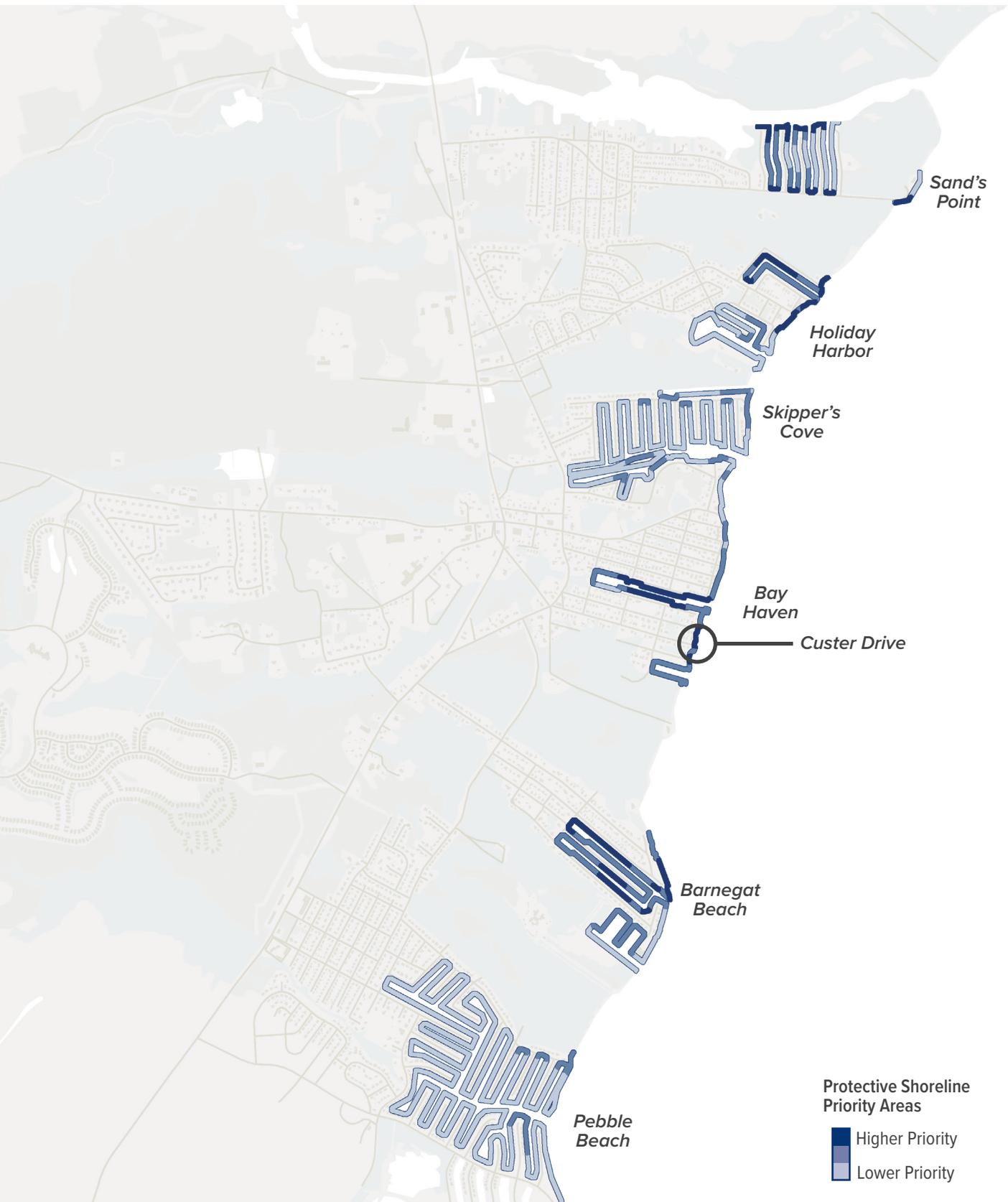
value of the coast, creating more attractive and visually pleasing environments for locals and visitors. Furthermore, these methods can provide habitat for a wide range of species, contributing to preserving and restoring biodiversity in the area. Additionally, they can create opportunities for recreational activities such as kayaking and hiking, thereby promoting healthy lifestyles and tourism. Natural and living shorelines can often be more affordable to install and maintain than hard shorelines and can be combined with hard structures to complement each other and create more resilient coastal environments.

### Building a diverse portfolio of shoreline protection strategies

Private property owners in the Township often already build bulkheads along shorelines to protect their property and buildings.

The Township has installed riprap along public boat launches, and is tracking the success of living shoreline projects in nearby communities.





**FIGURE 24:** Protective Shoreline Priority Areas

## Resource Conservation

Natural resources can be a valuable tool in resiliency and climate adaptation planning and can come in both policy-based and physical forms. These strategies may include:

- **Forest and Wetland Restoration** – Non-structural shoreline protection method involving the preservation and enhancement of natural habitat to support floodwater absorption and wave attenuation.
- **Land Incentive Programs** – Incentivizing landowners not to develop in flood-prone areas, but instead in designated growth areas that are located outside flood-prone areas.
- **Conservation Easements** – A conservation easement is a legal agreement between a landowner and either a land trust organization or a government entity that permanently limits uses of the land, while still allowing the landowner to continue to own and use their land.

Habitat and natural resource conservation

strategies can range in costs. Generally they can be used to accomplish multiple community goals. For example, increased carbon sequestering by wetlands can help mitigate climate change. Resources can also be used for tourism and local economies such as fishing. Moreover, the township can preserve and expand naturalized open spaces to create properties that can be used throughout the year and promote sustainable development and community resilience.

These natural resource strategies offer primary risk mitigation benefits, such as reducing the impacts of stormwater runoff, and secondary benefits, such as ecosystem services and community well-being.

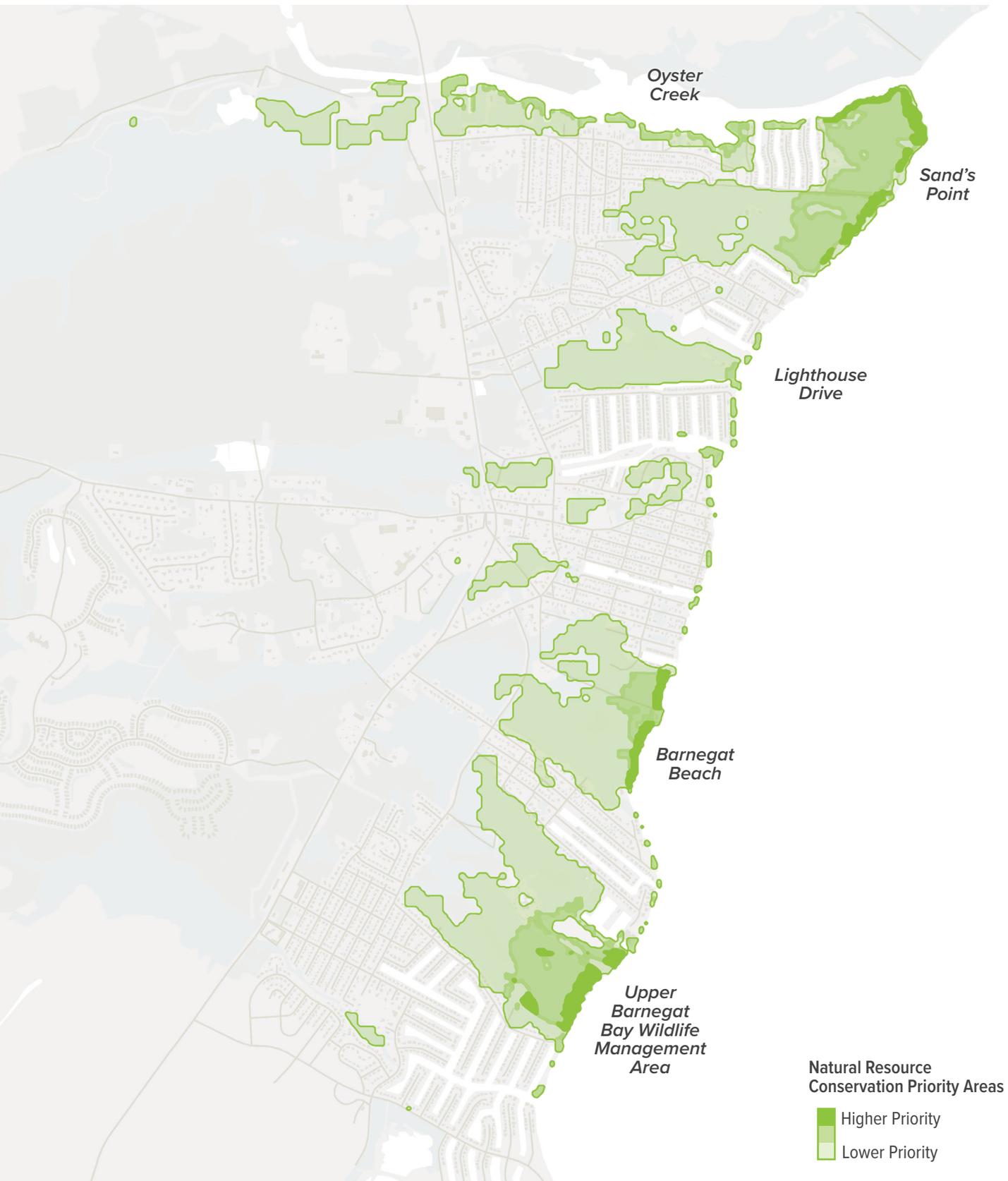
### Prioritizing Conservation

The Township of Ocean, Ocean County, NJDEP, and USFWS have all prioritized land conservation in the Township. In 2016, the Township and County partnered to purchase 57 acres of land near Lighthouse Drive to reduce development in this flood-prone area.



**“Our waterways and wetlands are what brings people here, they are how we live our lives.”**

- Resident



**FIGURE 25:** Natural Resource Conservation Priority Areas

## Buildings and Site-Level Mitigation

Building and site mitigation refer to actions taken to reduce the risk of damages from coastal flooding and other hazards associated with sea level rise and climate change to buildings and sites. These efforts include:

- **Home Acquisition or Relocation** – Moving homes or other facilities out of floodplains to reduce flood risk.
- **Structure Elevation** – Raising the first habitable floor of a building above base elevation to avoid direct flood exposure. In this process, entire structures are lifted and a permanent foundation or pilings are constructed underneath in accordance with ordinances, current building codes, and floodplain requirements.
- **Wet Floodproofing** – Modifying a structure to allow floodwaters to enter and exit without causing significant damage.
- **Dry Floodproofing** – Making structures substantially impermeable to floodwaters.

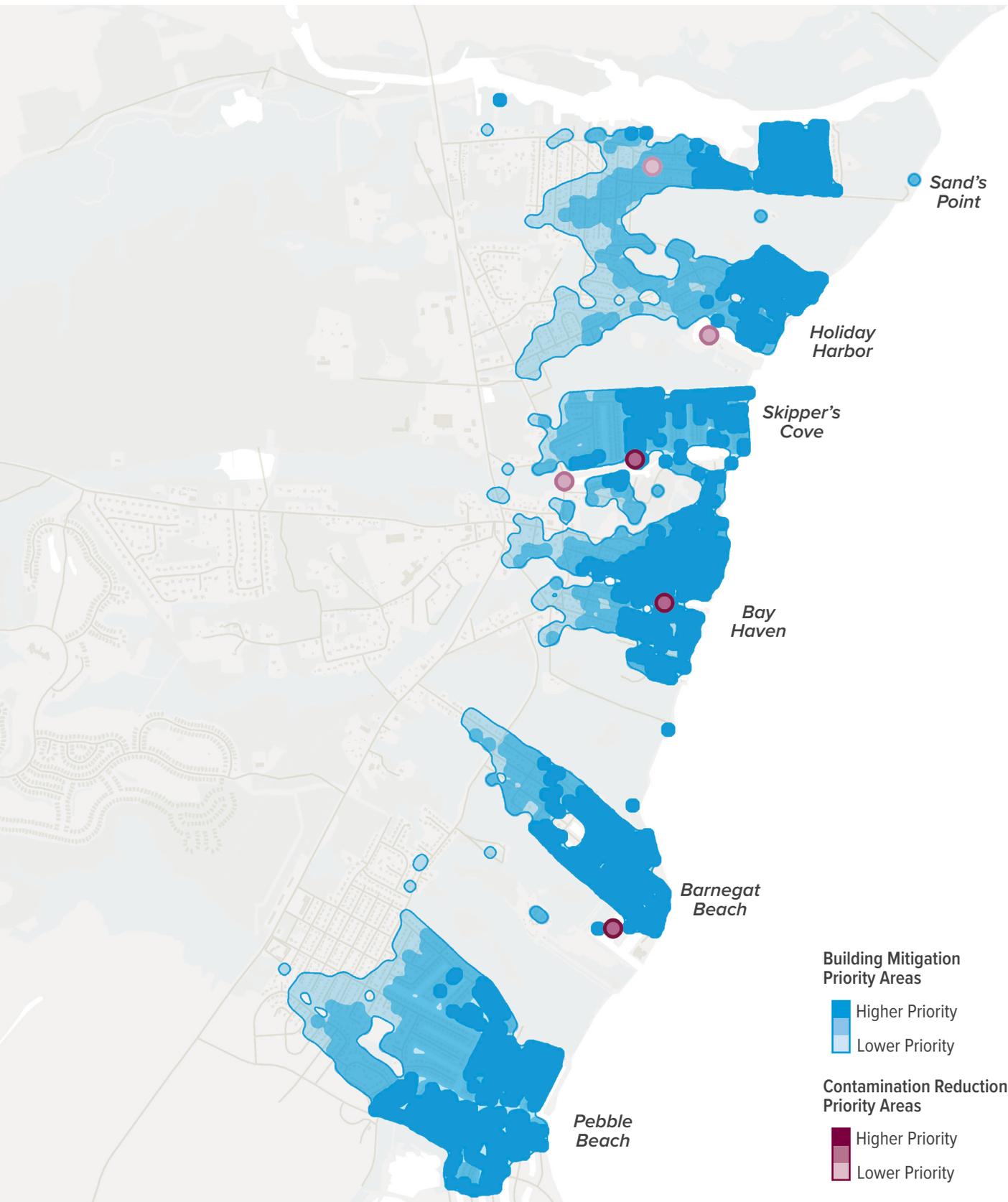
Individual property owners may be responsible for making their own buildings and sites more resilient, but often face financial barriers to do so. The high cost of these actions can be mitigated through federal grant funding such as FEMA Hazard Mitigation Program Grants<sup>13</sup> to reduce the cost burden. However, these grants are only available under specific conditions and can take years to actualize. Township or County efforts may consider offering financial assistance for site-level mitigation projects that individual property owners undertake.

There are many benefits to building and



**FIGURE 26:** Structure elevation by a private homeowner in the Township of Ocean

site mitigation efforts. By reducing the risk of damage from coastal flooding and other hazards, these efforts can protect lives and property, critical infrastructure, and economic activity, and help to preserve the natural resources and cultural heritage of coastal communities, contributing to their long-term sustainability and resilience.



**FIGURE 27:** Building and Site-Level Mitigation Priority Areas

## Responsible Development

Policy and planning tools, such as zoning and regulation, can stimulate safer development by directing where and how to build. This may involve prioritizing “high and dry development,” referring to the practice of building structures, such as homes or commercial buildings, outside of designated flood zones or in areas that are less prone to flooding. This type of development is often preferred by property owners, builders, and developers as it can reduce the risk of damage or loss due to flooding or other hazards, and may also result in lower insurance costs. Specific policy-based actions that can be implemented to encourage responsible and resilient development include:

- **Strategic Growth Areas** – Strategic growth areas contain mixed-use developments along key transportation corridors. Concentrating new development in limited geographic regions helps reduce the geographic spread of urban areas. In terms of sustainability and resilience the smart growth areas do not contain flood prone areas. This eliminates the potential exposure to flood risks while also protecting undeveloped land, open space, and natural areas.
- **Resilient Design Standards** – Updating building codes to superior standards to make development more resistant to current and future natural disasters. Potential resilient design standards that could be implemented in Ocean include elevating utilities above the lowest habitable floor, improving drainage control by grading the ground surface around homes, designing

mechanical systems for future climate conditions, or implementing minimum elevations and flood resistance measures for bulkheads..

- **Floodplain Ordinance Updates** – The floodplain ordinance governs development within the 1% annual chance floodplain. The ordinance can be updated to expand the regulatory floodplain, restricting new development to protect future flood risk.

Development regulations are rules and standards that inform the design, construction, and maintenance of buildings and infrastructure. By improving the safety and resilience of buildings and infrastructure, development regulations can reduce risks, improve energy efficiency, and enhance community livability.

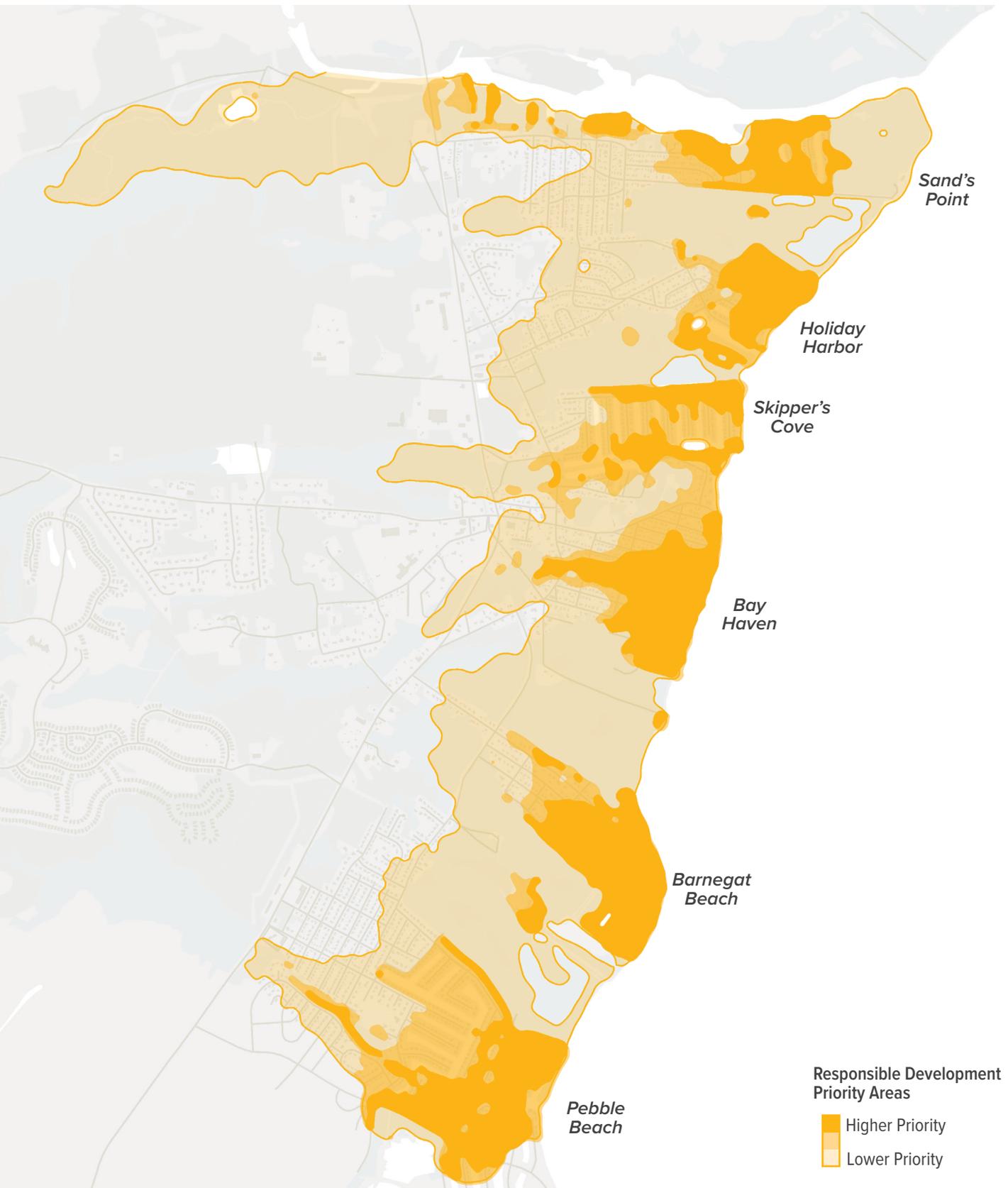
Responsible development practices do not share the same capital costs as other resilience actions. This approach generally seeks to reduce hazard risk and damage, while involving the community in planning to address concerns and build support on a regular and long-term basis. These policy-based actions may begin at any time within the next 1-10 years and will be reviewed often.

In public meetings, Resilient Design Standards were the most widely supported policy project.

90% of respondents were in favor of this approach.

## Resilience in Action

The Township recently updated their Flood Hazard Ordinance, implementing optional standards including a Local Design Flood Elevation of 3 feet of freeboard and a Cumulative Substantial Improvement standard for existing structures.



**FIGURE 29:** Responsible Development Priority Areas

## Infrastructure Enhancement

Infrastructure plays a critical role in building resilience to the impacts of climate change and sea level rise. Lack of access to key resources or critical infrastructure during extreme weather events can severely impact a community's ability to respond and recover. Making strategic infrastructure investments for climate change, such as increasing the drainage capacity of a stormwater system, often requires significant financial resources and coordination between different levels of government, private sector stakeholders, and communities to ensure that projects are sustainable and effective in enhancing community resilience. Infrastructure enhancement action types include:

- **Drainage Improvements** – Upgrade stormwater systems to improve drainage capacity and reduce flooding from rainfall, nuisance flooding, and coastal flooding events
- **Transportation Upgrades** –Elevate roadways and improve drainage to reduce disruptions.
- **Infrastructure Divestment** – Phase out and replace infrastructure that is no longer safe due to frequent flood inundation or erosion challenges. Divestment strategies

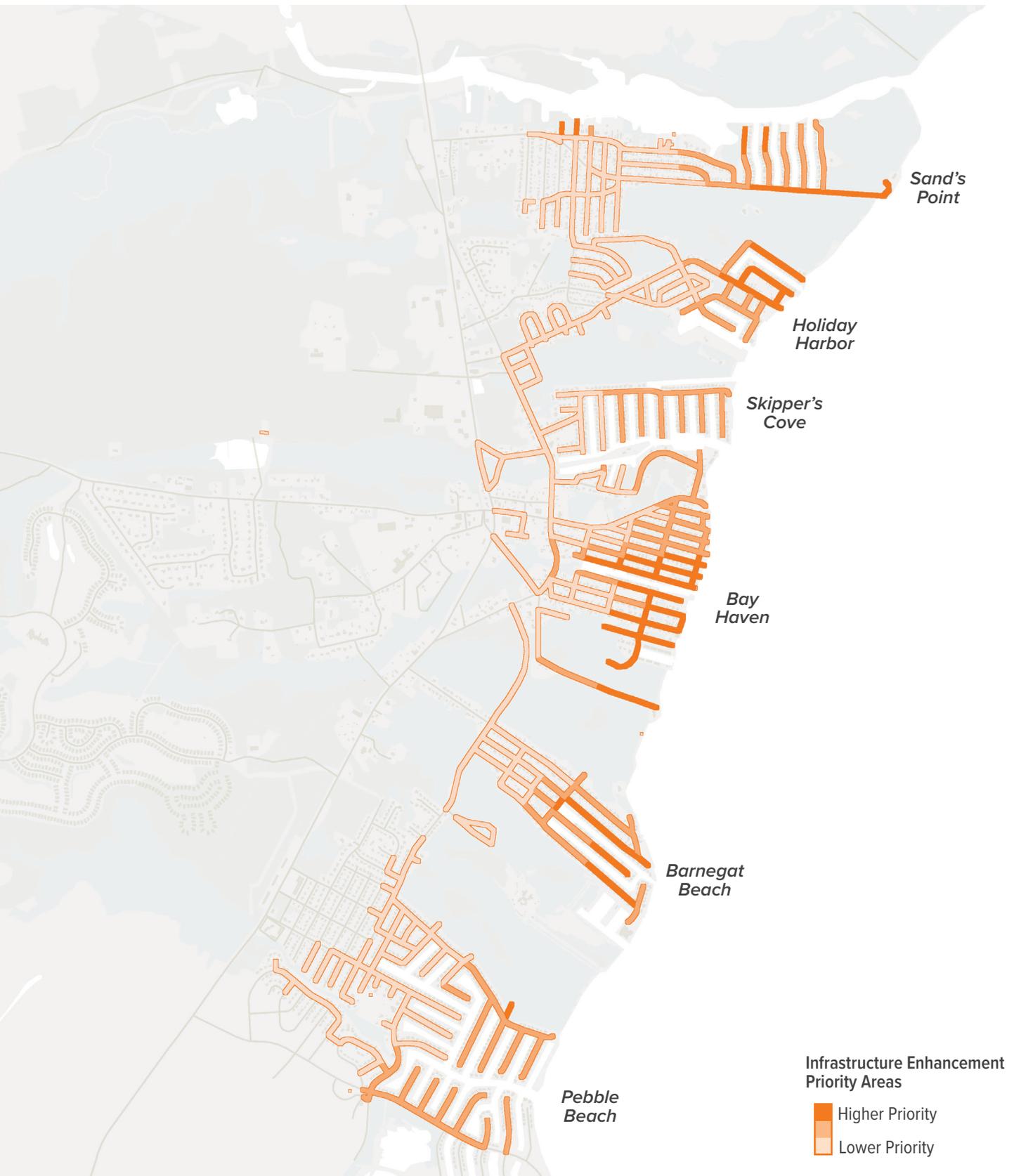
either phase out the maintenance of roads or affirmatively abandon or discontinue roads where coastal conditions make upkeep challenging or prohibitive.

The Township of Ocean is currently working on both stormwater drainage infrastructure upgrades and roadway elevation projects. Township officials noted that while NJDOT provides funding for roadway elevation work, the Township has had to rely on issuing bonds to fund the associated necessary stormwater drainage upgrades.

**100%** of community meeting participants said they were “Likely” or “Very Likely” to support drainage improvements.

## Resilience in Action

Stormwater and utility infrastructure upgrades are already going on across the Township, with recent or ongoing activities in Holiday Harbor, Skippers Cover, Bay Haven, Barnegat Beach, and Pebble Beach.

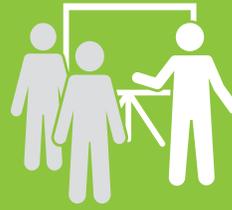


**FIGURE 30:** Infrastructure Enhancement Priority Areas

## Engagement and Capacity Building

Community engagement and capacity building are crucial aspects of building resilience in a community. Collaboration with different levels of government and community-based organizations can help create comprehensive and effective programs to increase awareness about the potential impacts of climate change and support for taking action. Strategies that may increase public education and action through engagement include:

- **Climate Resilience Working Group** – Expert and/or stakeholder oversight to guide implementation of climate resilience actions and continued planning efforts.
- **Flood Insurance Expansion & Community Rating System** – Outreach and education to increase the number of properties that have flood insurance. The Community Rating System (CRS) provides incentives to communities that engage in optional floodplain management activities, offering insurance premium discounts for actions that reduce risk.
- **Partnerships and Advocacy** – Coordinating efforts and sharing resources across municipal boundaries, scales, and sectors.



## Resilience in Action

The Township of Ocean has earned a Class 6 rating in the CRS program, which qualifies residents whose properties are located in the flood hazard area for a 20% discount on their flood insurance premiums. The Township has achieved this rating by implementing various measures to reduce flood risk, including the provision of open space within the Flood Hazard Area, superior regulatory standards, and requirements for 3 feet of freeboard above the base flood elevation.

Other measures that contribute to the Township's rating include standards for cumulative substantial improvement over a 10-year period, local drainage protection, enforcement of stormwater management, soil erosion and sediment control, and water quality regulation. Additionally, the Township engages in floodplain management planning in partnership with Ocean County, and provides public outreach and map information services to help residents better understand flood hazards and mitigation strategies.

Overall, Ocean's efforts to exceed the minimum requirements of the NFIP have resulted in a lower flood insurance rate for its residents, and have contributed to better floodplain management practices in the community.

## Wildfire Mitigation

Wildfires can be large and devastating events that may increase as temperatures rise and climate conditions change. Risk mitigation actions can take many forms and often rely on land use and forestry management practices. These include:

- **Forestry Management** – Using a combination of techniques to reduce risk and severity of wildfires while protecting the forest ecosystem. Includes reducing vegetation that can act as fuel for a fire, thinning forests, creating firebreaks, and implementing controlled burns.
- **Response and Evacuation Planning** – Planning for safely evacuating at risk people from areas of wildfire. Having well-planned evacuation routes, communication strategies, and plans for vulnerable populations can save lives during a wildfire. Current evacuation routes in Ocean are along County Road 532, US Route 9, and the Garden State Parkway.
- **Infrastructure and Building Fireproofing** – Reducing the risk of buildings catching fire through building mitigation.
- **Fire Smart Landscaping** – Landscape practices that reduce the risk of fire spreading from plants to a nearby structure. This can include creating defensible space around homes and buildings, removing highly flammable vegetation, and strategically planting fire-resistant plants.

Implementing these measures can help reduce the risk of fires spreading and causing damage.

## Extreme Heat Mitigation

Climate change has increased the frequency and intensity of extreme heat events, which poses a significant health risk to vulnerable populations. This includes the elderly, young children, and those with pre-existing health conditions. The increased heat also leads to a phenomenon called Urban Heat Island (UHI), where paved surfaces absorb heat and make urban areas even hotter. To combat this, the Township might explore various strategies, including:

- **Heat Response Planning** – Creating emergency operations-oriented plans to actively prepare and respond to heat events.
- **Establish Cooling Centers** – Designating public spaces for people seeking relief during a heatwave.
- **Tree Canopy Expansion** – Planting and maintaining non-invasive trees and other vegetation to create cooler environments.
- **Building Improvements** – Reducing heat absorption through use of green building materials and improving indoor climate of buildings.

These approaches can help reduce UHI effects, minimize health concerns, and create a more resilient community. However, vulnerable populations may still face challenges accessing these resources and may require additional support to cope with extreme heat events.

**89% of community meeting participants wanted to see resiliency actions for extreme heat mitigation.**

## SECTION 4: Resilience Action Plan

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This section describes specific actions the Township can implement to increase resilience, including project feasibility, implementation timelines, and potential funding sources.

### Action Plan Development Process

#### Stakeholder Plannign Charette

Stakeholders from the Township of Ocean, the consultant team, and a representative from NJDEP met on November 28, 2023, to identify potential resilience and adaptation action items for the Township. This meeting provided an opportunity for Township stakeholders to ground truth results from previous stages of the effort and develop more specific actions for implementation. Charette participants discussed potential benefits and feasibility for all the strategy types listed and priority areas for implementation as identified in **Section 3** and came up with fifteen specific climate resilience actions they were most interested in moving forward with.

### Action Refinement and Evaluation

After the meeting, Township representatives collaborated with the consultant team to further build out concepts and prioritize the identified actions. As part of this exercise, each of the fifteen actions were evaluated across seven feasibility-related considerations, with participants rating each of the following statements on a scale of 1 (strongly disagree) to 5 (strongly agree):

- **Social** – This proposed action would be supported and embraced by the entire community.
- **Technical** – This action is technically feasible and will result in cost-effective flood risk reduction.
- **Administrative** – There are administrative resources/staff capacity available to carry out or oversee the implementation of this

action.

- **Political** – This action would have the necessary political support to implement and maintain.
- **Legal** – This action would be within the Township’s legal authority to implement.
- **Economic** – The benefits would outweigh the costs of this action.
- **Environmental** – This action is consistent with community environmental goals and regulations.

Additionally, participants were asked to put each of the fifteen actions in ranked order, the average of which was used to develop a priority ranking.

## Funding Alignment

The consultant team reviewed a wide array of potential funding and financing sources that could help support the implementation of these projects and identified 31 state and federal programs relevant to the identified projects that the Township might consider applying to for financial support. Based on the grant program’s specific goals and requirements, each action is matched to a unique set of potential funding sources, presented at the end of this section. Additional details on the grant programs and financing resources are provided in **Appendix C: Resilience Funding and Financing Sources**.

**FIGURE 31:** View of a flood-hazard vulnerable road in Ocean Township with elevated residential buildings



## Resilience Actions

Each of the fifteen actions is presented on the following pages with a brief description and details:

- **Location** – Where specifically the action would be implemented.
- **Type** – Class of resilience strategy used in this action, in alignment with the framework presented in **Section 3**.
- **Relevant Hazards** – The main hazard(s) the action is mitigating (other hazards may be mitigated in a more limited capacity).
- **Primary Benefit** – Main goals of the resilience-related objectives that the action supports.
- **Additional Benefits** – Secondary resilience-related objectives that the action may support, although to a lesser degree.
- **Outcome Metrics** – Potential methods for tracking progress or determining action success.
- **Responsible Party** – The organization, department, or agency that would lead and take ownership of the implementation of the action.
- **Potential Partners** – Organizations or entities that may support the implementation of the action, either through coordination, participation, or funding.
- **Estimated Cost** – Tentative estimate of the cost of the action, likely based on projects of similar type and scale.
- **Plan Integration** – Other local or regional plans that already list or support the action.
- **Feasibility Scores** – Average rating across the seven feasibility factors (listed above) indicating whether implementing the action will likely be more or less challenging for the Township.
- **Feasibility Considerations** – Qualitative notes identifying components that make the action more or less challenging to implement.
- **Status** – The status of the action’s implementation: not started, planned, and in progress.
- **Timeline** – When the action would likely start: ongoing, near-term (within the next year), mid-term (next 1-3 years), and long-term (3+ years).
- **Priority Rating** – Relative priority that the local stakeholders assigned based on raking activity: High, Medium-High, Medium, Medium-Low, and Low.

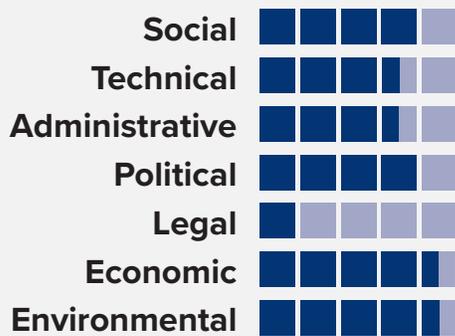


# Marsh Restoration at Sands Point

Implement marsh restoration activities at Sands Point to address erosion and habitat loss in this high tidal marsh loss region. Restore valuable habitat, improve water quality, and reduce flood impacts by reducing wave heights and water velocities.

- Location** Location Sands Point Harbor Preserve, particularly the area south of the Bay Parkway
- Type** Resource Conservation
- Relevant Hazards** Tidal Flooding, Severe Storm, Erosion
- Primary Benefits** Habitat Protection & Restoration, Erosion Prevention
- Additional Benefits** Flood Hazard Reduction, Improved Water Quality, Improved Recreation, Property Protection, Community Education
- Outcome Metrics** Acreage of habitat restored; Linear feet of shoreline stabilized
- Responsible Party** Township of Ocean
- Potential Partners** NJDEP Fish and Wildlife, New Jersey Natural Lands Trust
- Estimated Cost** \$1.5-2M
- Plan Integration** Township Master Plan

## Feasibility Scores



## Feasibility Considerations

- Marsh migration and loss are occurring rapidly at Sands Point, and there is large community support for marsh restoration actions to be implemented.
- Marsh restoration may be very expensive, depending on the approach taken.
- Requires coordination with New Jersey Natural Land Trust, the owner of the Marsh.

### Status



Not Started

### Timeline

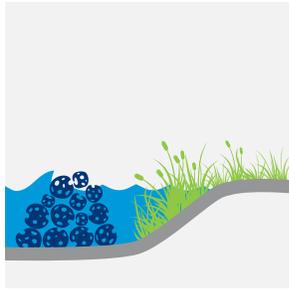


Mid-Term

### Priority Rating



Medium

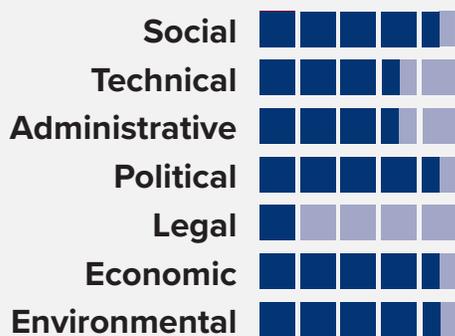


## Marsh Restoration at Barnegat Bay Lighthouse Center

At the Barnegat Bay Lighthouse Center, Wave Attenuation Devices (WADs) have been installed to create a living shoreline, protect newly planted marshland, and allow the beach to reestablish itself. Continuing resources to support and bolster these activities will be needed in the long-term.

<b>Location</b>	Upper Barnegat Bay Wildlife Management Area
<b>Type</b>	Resource Conservation
<b>Relevant Hazards</b>	Tidal Flooding, Severe Storm, Erosion
<b>Primary Benefits</b>	Habitat Protection & Restoration, Erosion Prevention
<b>Additional Benefits</b>	Flood Hazard Reduction, Improved Water Quality, Improved Recreation, Property Protection, Community Education
<b>Outcome Metrics</b>	0.2 acres of marsh habitat restored; 1,600 ft of shoreline stabilized
<b>Responsible Party</b>	Natural Resource Foundation of New Jersey
<b>Potential Partners</b>	NJDEP, The Nature Conservancy, Sovereign Consulting, Barnegat Bay Partnership, Lighthouse Center, Ocean County, Drexel University
<b>Estimated Cost</b>	\$1.5M initial installation, with lower costs for continued maintenance
<b>Plan Integration</b>	Township Master Plan Reexamination Report

### Feasibility Scores



### Feasibility Considerations

- Barnegat Bay is considered a high priority habitat area for the community.
- This project has environmental and social benefits with backing from the Township of Ocean Master Plan.
- The project has already begun implementation.

### Status



In Progress

### Timeline

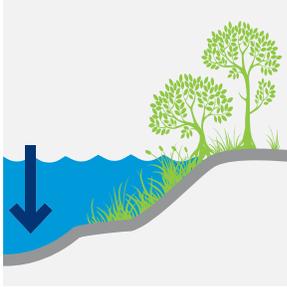


Ongoing

### Priority Rating



Medium-High

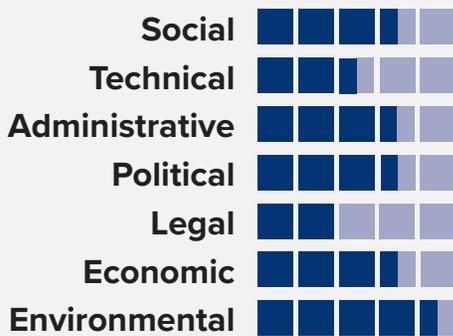


# Oyster Creek Maintenance and Dredging

Sediments and debris would be removed from Oyster Creek with routine maintenance to keep the creek clean and reduce the risk of flooding. Oyster Creek used to be regularly dredged for industrial use, and future flooding in the area is a potential concern.

<b>Location</b>	Oyster Creek
<b>Type</b>	Resource Conservation
<b>Relevant Hazards</b>	Water Quality, Inland Flooding, Severe Storm
<b>Primary Benefits</b>	Ecosystem Preservation, Improved Water Quality, Erosion Prevention
<b>Additional Benefits</b>	Flood Hazard Reduction, Property Protection
<b>Outcome Metrics</b>	Percentage or volume of sediments and debris; frequency and timeframe of routine maintenance
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	NJDEP, The Nature Conservancy, Lacey Township
<b>Estimated Cost</b>	\$2M; costs of routine maintenance are variable.
<b>Plan Integration</b>	None

## Feasibility Scores



## Feasibility Considerations

- Dredging Oyster Creek may benefit the natural environment and increase the creek's water quality.
- The definitive need and flood mitigation benefits of creek dredging have yet to be determined.
- May require coordination with the neighboring community, Lacey Township.

### Status



Not Started

### Timeline



Long-Term

### Priority Rating



Low

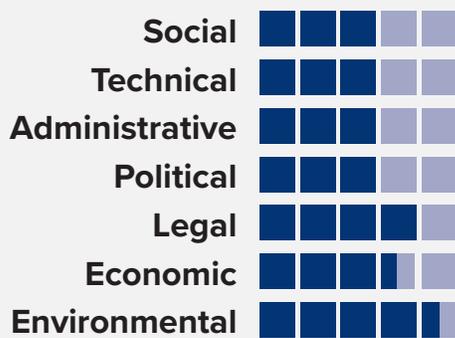


# Minimum Bulkhead Elevation Ordinance

Implement a local ordinance to set a minimum elevation for bulkheads when property owners take on new development or substantial redevelopment. The ordinance would set a minimum bulkhead height or elevation relative to a vertical datum or mean sea level.

<b>Location</b>	All coastal properties with hardened shorelines
<b>Type</b>	Protective Shorelines
<b>Relevant Hazards</b>	Tidal Flooding, Erosion, Severe Storm
<b>Primary Benefits</b>	Flood Hazard Reduction, Erosion Prevention
<b>Additional Benefits</b>	Property Protection
<b>Outcome Metrics</b>	Ordinance passed by City Council; Linear feet of complying bulkhead
<b>Responsible Party</b>	Township of Ocean Zoning Office, Construction Official
<b>Potential Partners</b>	Knowledge sharing with other communities, like Ship Bottom
<b>Estimated Cost</b>	No direct cost to the township other than administrative staff time
<b>Plan Integration</b>	None

## Feasibility Scores



## Feasibility Considerations

- Contractors who build the bulkheads strongly recommend building higher than historic heights to adapt to increasing sea levels.
- While not a commonplace regulation, the Borough of Ship Bottom, NJ, passed a similar ordinance which can be referenced as an example.
- Community concerns include added costs and protecting the view of the Bay.

### Status



Not Started

### Timeline



Near-Term

### Priority Rating



Medium-Low

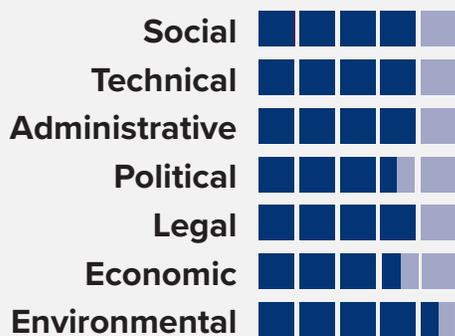


## Bulkhead and Seawall Expansion Program

Increase the number and quality (height, structural stability, flood protection potential) of bulkheads and seawalls on public and private property to further protect the shoreline, properties, and population vulnerable to increasing sea levels and storm surge.

<b>Location</b>	All coastal properties with hardened shorelines
<b>Type</b>	Protective Shorelines
<b>Relevant Hazards</b>	Tidal Flooding, Severe Storm, Erosion
<b>Primary Benefits</b>	Flood Hazard Reduction, Erosion Prevention
<b>Additional Benefits</b>	Property Protection
<b>Outcome Metrics</b>	Linear feet of constructed or enhanced shoreline
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	Ocean County
<b>Estimated Cost</b>	Construction costs between \$150 and \$1,000 per linear foot
<b>Plan Integration</b>	None

### Feasibility Scores



### Feasibility Considerations

- A benefit-cost analysis should be conducted to determine whether adding more bulkheads and seawalls would have benefits that outweigh the costs.
- Many bulkheads are on private property and would require coordination with property owners.
- Community concerns include protecting the view of the Bay.

#### Status



Not Started

#### Timeline



Mid-Term

#### Priority Rating



Medium-High

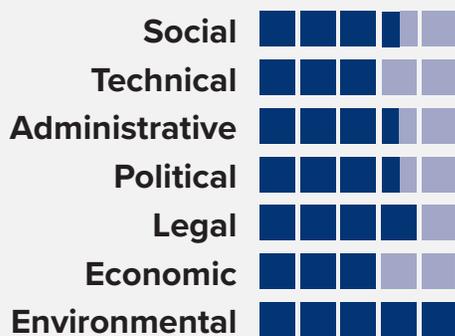


## Erosion Management at Custer Drive

Custer Drive experiences significant erosion, with the road often underwater during high tide. Erosion management strategies (such as breakwaters, riprap, bulkheads, revetments, etc.) could be implemented to reduce the effects of erosion and coastal storms.

<b>Location</b>	Custer Drive, near the South Harbor to Barnegat Bay
<b>Type</b>	Protective Shorelines
<b>Relevant Hazards</b>	Erosion, Tidal Flooding, Severe Storm
<b>Primary Benefits</b>	Erosion Prevention
<b>Additional Benefits</b>	Flood Hazard Reduction, Property Protection
<b>Outcome Metrics</b>	Linear feet of constructed or enhanced shoreline
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	NJDOT
<b>Estimated Cost</b>	Between \$50 and \$2,000 per linear feet based on the strategy implemented
<b>Plan Integration</b>	None

### Feasibility Scores



### Feasibility Considerations

- Barriers to addressing erosion on Custer Drive may include permitting and funding.
- Implementing erosion management strategies around Custer Drive could reduce flooding in surrounding areas.
- Custer Drive is underwater during high tides, making it unusable and dangerous for residents living on the road.

#### Status



Not Started

#### Timeline

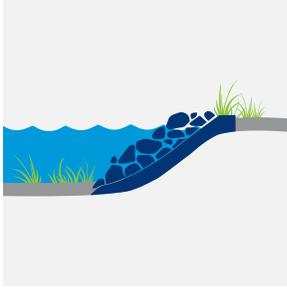


Near-Term

#### Priority Rating



High



## Riprap Installation for Shoreline Maintenance

Installing riprap and gabions outside marinas in designated high-priority areas can protect shorelines against scour, erosion, and flooding. The Township has already experienced successful erosion reduction with previous riprap installations.

<b>Location</b>	Shorelines in developed areas outside marinas
<b>Type</b>	Protective Shorelines
<b>Relevant Hazards</b>	Tidal Flooding, Erosion
<b>Primary Benefits</b>	Erosion Prevention
<b>Additional Benefits</b>	Flood Hazard Reduction, Property Protection
<b>Outcome Metrics</b>	Linear feet of riprap installed
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	Ocean County
<b>Estimated Cost</b>	Between \$50 and \$200 per linear foot
<b>Plan Integration</b>	Township Floodplain Management Plan, Township Master Plan, Ocean County All-Hazard Mitigation Plan

### Feasibility Scores

<b>Social</b>	
<b>Technical</b>	
<b>Administrative</b>	
<b>Political</b>	
<b>Legal</b>	
<b>Economic</b>	
<b>Environmental</b>	

### Feasibility Considerations

- Township has riprap at Tuscarora, Crystal Point, and Grant Bay Harbor.
- Riprap makes it difficult for people to access the shoreline for boating.
- Riprap requires constant maintenance and re-installation if maintenance is not kept up.
- Riprap is considered a cost-effective solution to erosion and flood mitigation.

### Status



In Progress

### Timeline



Ongoing

### Priority Rating



Medium



## Lighthouse Drive Neighborhood Flood Reduction

Implement strategies to reduce inland flooding in the Lighthouse Drive Neighborhood. Consider changing the elevation of the surrounding grade and installing retaining walls, new drainage systems, or relocation through the Blue Acres buy-out program.

<b>Location</b>	Western portion of Lighthouse Drive Neighborhood
<b>Type</b>	Site-Level Mitigation
<b>Relevant Hazards</b>	Inland Flooding
<b>Primary Benefits</b>	Flood Hazard Reduction, Property Protection
<b>Additional Benefits</b>	Community Health Benefits, Equity Benefits
<b>Outcome Metrics</b>	Number of homes where flood mitigation measures apply
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	NJDEP Blue Acres
<b>Estimated Cost</b>	Varies by mitigation strategy
<b>Plan Integration</b>	Township Floodplain Management Plan

### Feasibility Scores

<b>Social</b>	
<b>Technical</b>	
<b>Administrative</b>	
<b>Political</b>	
<b>Legal</b>	
<b>Economic</b>	
<b>Environmental</b>	

### Feasibility Considerations

- The Lighthouse Drive Neighborhood is outside the SFHA but is considered an at-risk neighborhood for inland flooding.
- Further study and benefit-cost analysis are required to determine the best course of action for flood mitigation strategies.
- Some residents are lower-income, and there may be equity benefits to mitigating their flood risks.

#### Status



Not Started

#### Timeline



Mid-Term

#### Priority Rating



High

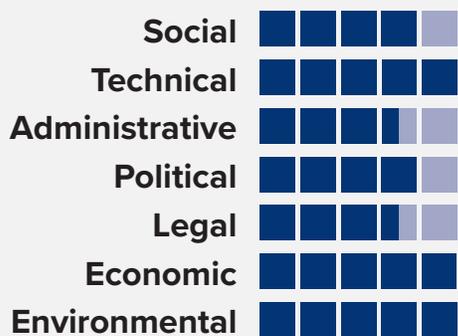


## Additional Support for Home Elevations

Support flood-prone property owners in elevating their homes, focusing on the remainder of the 203 homes damaged by Hurricane Sandy. Elevate to higher standards above BFE in compliance with the current floodplain management ordinance.

<b>Location</b>	Properties across all coastal neighborhoods
<b>Type</b>	Site-Level Mitigation
<b>Relevant Hazards</b>	Severe Storm
<b>Primary Benefits</b>	Property Protection
<b>Additional Benefits</b>	Equity Benefits
<b>Outcome Metrics</b>	Number of homes elevated
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	NJDEP
<b>Estimated Cost</b>	Average cost for home elevation on the Jersey coast is \$40,000-\$150,000
<b>Plan Integration</b>	Township Floodplain Management Plan

### Feasibility Scores



### Feasibility Considerations

- If below \$205,000 in costs, the elevation project will automatically pass the benefit-cost analysis and be considered for federal funding.
- Requires coordination with the State on applying for federal grant funding for elevation projects.
- The Township has already elevated most of the identified at-risk homes impacted by Sandy.

#### Status



In Progress

#### Timeline

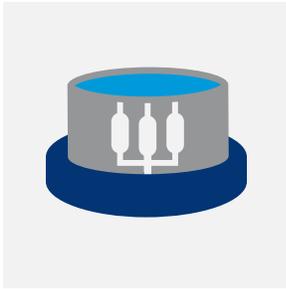


Ongoing

#### Priority Rating



Low

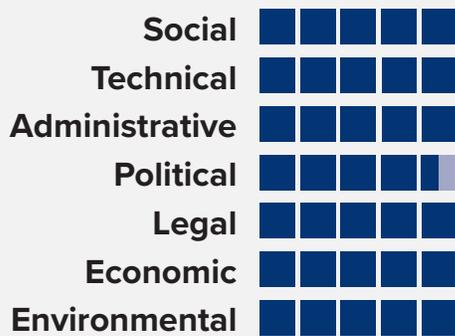


## Elevation of Water Treatment Plant and Pump Station

The Township’s primary water treatment plant and 8th Street pump station are low-lying and exposed to flooding. Elevating the water treatment plant and pump station to reduce flood vulnerability will help safeguard the public water supply.

<b>Location</b>	8th Street
<b>Type</b>	Infrastructure Enhancement
<b>Relevant Hazards</b>	Severe Storm, Water Quality, Inland Flooding
<b>Primary Benefits</b>	FEMA Community Lifeline Protection
<b>Additional Benefits</b>	Community Health Benefits, Property Protection
<b>Outcome Metrics</b>	Height of elevation
<b>Responsible Party</b>	Township of Ocean Department of Utilities
<b>Potential Partners</b>	N/A
<b>Estimated Cost</b>	\$5.8M
<b>Plan Integration</b>	None

### Feasibility Scores



### Feasibility Considerations

- Township intends to go through with this project.
- Elevating and mitigating all damages to a critical facility is considered a high priority.
- Alternatives for elevation height and full/partial elevation of all structures should be considered based on cost-effectiveness.

#### Status



Planned

#### Timeline



Near-Term

#### Priority Rating



High



## Roadway and Drainage Infrastructure Improvements

Improve roadway infrastructure by elevating flood-prone roads in conjunction with drainage improvements. Some roads have been elevated, but targeted drainage improvements are still needed in many coastal neighborhoods, including Barnegat Beach. .

<b>Location</b>	Roads across all floodprone neighborhoods
<b>Type</b>	Infrastructure Enhancement
<b>Relevant Hazards</b>	Tidal Flooding, Inland Flooding, Severe Storm
<b>Primary Benefits</b>	FEMA Community Lifeline Protection
<b>Additional Benefits</b>	Improved Emergency Preparedness & Response
<b>Outcome Metrics</b>	Miles of roadway improved
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	NJDOT
<b>Estimated Cost</b>	N/A
<b>Plan Integration</b>	Ocean County All-Hazard Mitigation Plan

### Feasibility Scores

<b>Social</b>	■ ■ ■ ■ ■
<b>Technical</b>	■ ■ ■ ■ ■
<b>Administrative</b>	■ ■ ■ ■ ■
<b>Political</b>	■ ■ ■ ■ ■
<b>Legal</b>	■ ■ ■ ■ ■
<b>Economic</b>	■ ■ ■ ■ ■
<b>Environmental</b>	■ ■ ■ ■ ■

### Feasibility Considerations

- Roadway improvements cannot effectively reduce flood risks without also improving the stormwater drainage system.
- While State funds have helped cover roadway elevation, the municipality bears the drainage improvement cost.
- The Township would align with NJDEP recommendations for design storms by improving the stormwater infrastructure.

### Status



In Progress

### Timeline



Ongoing

### Priority Rating



Medium-High

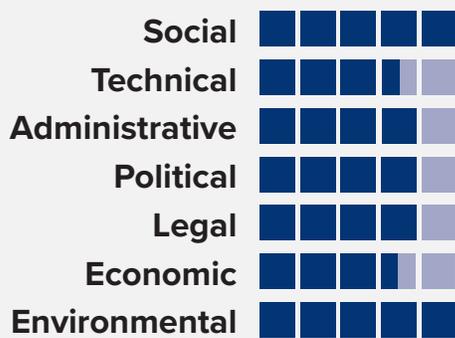


## Contamination Reduction for Sites with Hazardous Materials

Take flood risk mitigation actions, such as adding wet and dry floodproofing measures, to reduce the likelihood of flood impacts and hazardous material exposure, improving water quality and safety for the community. .

<b>Location</b>	Flood-exposed known contaminated sites on Central Ave. and Key Harbor Marina, and gas stations on Baltic Ave. and Main St.
<b>Type</b>	Contamination Reduction
<b>Relevant Hazards</b>	Severe Storm, Water Quality
<b>Primary Benefits</b>	Contamination Reduction
<b>Additional Benefits</b>	FEMA Community Lifeline Protection, Improved Water Quality
<b>Outcome Metrics</b>	Number of sites mitigated
<b>Responsible Party</b>	Township of Ocean Department of Public Works
<b>Potential Partners</b>	NJDEP, NJEPA
<b>Estimated Cost</b>	Varies by scale and nature of project from \$15,000-\$100,000
<b>Plan Integration</b>	None

### Feasibility Scores



### Feasibility Considerations

- A detailed study has not been conducted to determine the risk posed by identified contamination sites and possible mitigation strategies.
- Mitigation actions would reduce potential impacts to the natural environment, water quality, and public health.

#### Status



Not Started

#### Timeline

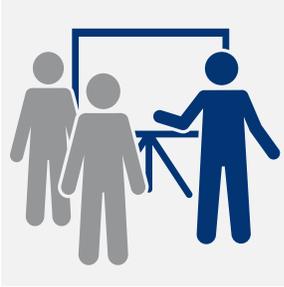


Long-Term

#### Priority Rating



Low



## Expand Engagement through Community Partners

The Township has an Environmental Commission and Green Team that facilitates work like the annual town-wide cleanup program. Expand the involvement of these commissions to support climate resilience community engagement and capacity-building efforts.

<b>Location</b>	Across the Township
<b>Type</b>	Community Engagement
<b>Relevant Hazards</b>	All Hazards
<b>Primary Benefits</b>	Community Engagement & Education
<b>Additional Benefits</b>	Improved Emergency Preparedness & Response
<b>Outcome Metrics</b>	Number of events hosted; number of residents engaged
<b>Responsible Party</b>	Township of Ocean
<b>Potential Partners</b>	Environmental Commission and Green Team, Sustainable Jersey, ANJEC
<b>Estimated Cost</b>	No direct cost to the township other than administrative staff time.
<b>Plan Integration</b>	None

### Feasibility Scores

<b>Social</b>	
<b>Technical</b>	
<b>Administrative</b>	
<b>Political</b>	
<b>Legal</b>	
<b>Economic</b>	
<b>Environmental</b>	

### Feasibility Considerations

- These groups have been facilitating the 20-year long annual town-wide cleanup program, showing
- Wider engagement might lead to increased community support for resilience measures and investments.
- Delegating responsibilities to other members of the community decreases costs and improves staff time efficiency.

### Status



Not Started

### Timeline



Near-Term

### Priority Rating



High



## Continue Firewise Efforts with NJ Forest Fire Services

Continue working with the State Fire Department for forest management activities such as prescribed burning and tree maintenance. Join and participate in the Firewise Program to educate the community on fire safety and increase Ocean’s fire preparedness.

<b>Location</b>	Western Portion of the Township
<b>Type</b>	Wildfire Mitigation
<b>Relevant Hazards</b>	Wildfire
<b>Primary Benefits</b>	Fire Hazard Reduction, Property Protection
<b>Additional Benefits</b>	Improved Emergency Preparedness & Response; Habitat Protection & Restoration
<b>Outcome Metrics</b>	Joining Firewise Program
<b>Responsible Party</b>	Township of Ocean Fire Department
<b>Potential Partners</b>	NJDEP; NJFFS
<b>Estimated Cost</b>	No direct cost to the township other than administrative staff time.
<b>Plan Integration</b>	Township Community Wildfire Protection Plan, Ocean County All-Hazard Mitigation Plan

### Feasibility Scores

<b>Social</b>	■ ■ ■ ■ ■
<b>Technical</b>	■ ■ ■ ■ ■
<b>Administrative</b>	■ ■ ■ ■ ■
<b>Political</b>	■ ■ ■ ■ ■
<b>Legal</b>	■ ■ ■ ■ ■
<b>Economic</b>	■ ■ ■ ■ ■
<b>Environmental</b>	■ ■ ■ ■ ■

### Feasibility Considerations

- No feasibility concerns and no adverse political ramifications are expected.
- This action will protect against future wildfire impacts if the forest is left unmanaged.

#### Status



In Progress

#### Timeline



Ongoing

#### Priority Rating



Medium-Low



## Continue Extreme Heat Mitigation With Ocean County

Support efforts to expand access to cooling centers and in-home air conditioning through coordination with Ocean County. Continue to identify areas of need for the establishment of new cooling centers. Consider the use of green infrastructure to mitigate heat.

<b>Location</b>	Across the Township
<b>Type</b>	Extreme Heat Mitigation
<b>Relevant Hazards</b>	Extreme Heat
<b>Primary Benefits</b>	Community Health Benefits, Improved Emergency Preparedness & Response
<b>Additional Benefits</b>	Community Engagement & Education, Equity Benefits
<b>Outcome Metrics</b>	Number of residents with access to cooling resources
<b>Responsible Party</b>	Ocean Township
<b>Potential Partners</b>	Ocean County
<b>Estimated Cost</b>	No direct cost to the township other than administrative staff time.
<b>Plan Integration</b>	Township Master Plan, Ocean County All-Hazard Mitigation Plan

### Feasibility Scores

<b>Social</b>	■ ■ ■ ■ ■
<b>Technical</b>	■ ■ ■ ■ ■
<b>Administrative</b>	■ ■ ■ ■ ■
<b>Political</b>	■ ■ ■ ■ ■
<b>Legal</b>	■ ■ ■ ■ ■
<b>Economic</b>	■ ■ ■ ■ ■
<b>Environmental</b>	■ ■ ■ ■ ■

### Feasibility Considerations

- Requires coordination with Ocean County.
- Consider the conflict with wildfire mitigation when utilizing tree planting as a heat mitigation tool.
- Identify heat islands and vulnerable populations to determine where to prioritize cooling center site selection and other heat mitigation projects.

#### Status



In Progress

#### Timeline



Ongoing

#### Priority Rating



Low

## Resilience Action Summary

Table 7 below provides a summary of all fifteen proposed resilience actions that together form the Township's Resilience Action Plan. As noted in the project descriptions, some actions are already in

progress but require continued effort and investment to continue. Others are only recently envisioned and require further study and development before they are ready for implementation. All should be integrated into future related plans.

**TABLE 7:** Summary of all fifteen proposed resilience actions, with priority rating, feasibility score (averaged across the seven factors), and timeline indicators.

ACTION	PRIORITY RATING	FEASIBILITY SCORE	TIMELINE
Elevation of Water Treatment Plant and Pump Station	★★★★★	████████	○————
Expansion of Engagement through Community Partners	★★★★★	████████	○————
Lighthouse Drive Neighborhood Flood Reduction	★★★★★	████████	—○————
Erosion Management at Custer Drive	★★★★★	████████	○————
Roadway and Drainage Infrastructure Improvements	★★★★☆	████████	○————
Bulkhead and Seawall Expansion Program	★★★★☆	████████	—○————
Marsh Restoration at Barnegat Bay Lighthouse Center	★★★★☆	████████	○————→
Riprap Installation for Shoreline Maintenance	★★★★☆	████████	○————→
Marsh Restoration at Sands Point	★★★★☆	████████	—○————
Continued Firewise Efforts with NJ Forest Fire Services	★★★★☆	████████	○————→
Minimum Bulkhead Elevation Ordinance	★★★★☆	████████	○————
Continued Extreme Heat Mitigation with Ocean County	★★★★☆	████████	○————→
Additional Support for Home Elevations	★★★★☆	████████	○————→
Contamination Reduction for Sites with Hazardous Materials	★★★★☆	████████	—○————
Oyster Creek Maintenance and Dredging	★★★★☆	████████	—○————

## A Note on Community Partnerships

Many of the strategies and action items described in this section will be well-served by partnerships between the Township and organizations that are locally-based and actively engaged in relevant work.

Coordinating with local organizations can lower cost or labor barriers for implementing new projects or maintaining existing ones. Some local organizations the Township may consider reaching out to include:

- The Marine Academy of Technology and Environmental Science (MATES), a charter academy affiliated with the Ocean County Vocational Technical School.
- Local boy- and girl-scout chapters
- Local schools and universities, including Stockton University and Rutgers University.
- Local fraternity and sorority chapters affiliated with colleges and universities.

Planning for and maintaining partnerships with community organizations can also improve the Township's grant and other funding applications' competitiveness — federal agencies including FEMA, EPA, and HUD often provide an opportunity for grant applicants to discuss local partnerships that will support grant-funded programs or projects when applying for funding.



## Balancing Competing Resilience Priorities

The Township of Ocean is working towards meeting Firewise requirements, which require fire smart landscaping strategies, including fire breaks between building and vegetation. Fire break requirements conflict with recommendations to increase the tree canopy within built-out areas of the Township to mitigate urban heat island effects. Township officials shared that fire breaks to address wildfire mitigation are a higher priority in the Township than planting trees to mitigate the urban heat island effects.

Despite these challenges, community members are interested in increasing Township resilience to extreme heat, and the Township coordinates with the County to open additional cooling centers during heat events as necessary, provide air condition units to sensitive populations, and outfit public buildings with air conditioning to comply with ADA requirements.

## Project Funding and Implementation

Realizing the vision of a resiliency plan for the Township of Ocean will require prioritizing and funding concrete adaptation projects and programs across multiple scales.

The implementation of actions presented in this plan will require significant time and resources dedicated to continued planning, stakeholder engagement, construction, and management. Specifics related to project costs, benefits, design, and feasibility will likely need to be assessed in further detail to facilitate additional planning and direct resources in the near-, medium-, and long-term.

While investing in adaptation will save the Township and residents money in the long-term, the implementation of substantial resilience projects will require significant financial capital. Grants from federal, state, and private sources can help supply this capital, and an analysis of potential funding sources was conducted to support the implementation of actions in this plan. Below is a summary of potential funding sources relevant to the Township of Ocean's resilience goals and an overview of how they align with the fifteen identified resilience actions. Note more sources and details are included in **Appendix C: Resilience Funding and Financing Sources**.

## Federal Funding Sources

The Township constantly evaluates how to utilize federal funding to support infrastructure investments and address overall flood resilience. While there is significant opportunity to apply for federal funds to support hazard and climate resilience actions, these programs are very competitive and require Township staff time and resources in order to apply, putting further pressure on already limited resources. Potential federal funding sources are listed below.

- **FEMA Building Resilient Infrastructure and Communities (BRIC)** – Funding hazard mitigation and sustainability projects that reduce the risk from disasters and natural hazards.
- **FEMA Flood Mitigation Assistance Grants (FMA)** – FEMA FMA Grants provide funding for flood mitigation planning and flood risk reduction projects that will reduce National Flood Insurance Program (NFIP) claims. Congress appropriates money annually for this grant. Potential structural elevation, acquisition, and other site-level mitigation projects recommended in this plan are compatible with these grant requirements.
- **National Fish and Wildlife Foundation (NFWF) Five Star and Urban Waters Restoration Program** – Provides modest financial assistance to diverse local partnerships focused on improving water quality, watersheds, and the species and habitats they support. Projects include a variety of ecological improvements along with targeted community outreach, education, and stewardship.

- **NFWF Coastal Resilience Fund** – Supports planning, design, and restoration of natural and nature-based solutions to help protect coastal communities from the impacts of storms, floods, and other natural hazards and enable them to recover more quickly and enhance habitats for fish and wildlife.
- **U.S. Department of Agriculture (USDA) Watershed and Flood Prevention Operations (WFPO) Program** – Provides technical and financial assistance to States, local governments, and Tribal organizations to help plan and implement authorized watershed projects for: Flood Prevention, Watershed Protection, Public Recreation, Public Fish and Wildlife, Agricultural Water Management, Municipal and Industrial Water Supply, Water Quality Management.
- **Environmental Protection Agency (EPA) National Wetlands Program Development Grants (WPDGs)** – Builds programs to protect, manage, and restore wetlands, in particular projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction and elimination of water pollution.
- **Fish and Wildlife Service (FWS) Coastal Wetlands Conservation Grant Program** – Supports long-term wetland conservation, including projects that restore and protect wetlands and associated habitats.
- **Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) Grant** – Supports surface transportation resilience to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through the support of planning activities, resilience improvements, community resilience, evacuation routes, and at-risk coastal infrastructure.
- **U.S. Department of Agriculture (USDA) Conservation Innovation Grant (CIG) National Competition** – Supports the development of new tools, approaches, practices, and technologies to further natural resource conservation on private lands.

## State Funding and Financing Sources

Over the past few years, federal agencies have expected states and municipalities to increasingly take on the burden of funding and financing mitigation. The State of New Jersey has a number of grant programs that could potentially help pay for many of the projects and approaches identified in the resilience plan without the same level of national competition and significant dependence on post-disaster funding opportunities that federal funding often requires. Select state funding opportunities are listed below:

- **NJDEP Hazardous Discharge Site Remediation Fund** – Provides grants to public entities for 100% of the investigation and a portion of the cleanup of contaminated sites identified as areas specifically needing redevelopment.

- **NJDEP Shore Protection Program** – Grants to protect public and private property and infrastructure from coastal storm damage, erosion and shoreline mitigation, and sea level rise.
- **Transportation Infrastructure Bank** – Finances transportation projects via loans to municipalities, counties, and regional authorities. The Rural Project Initiative helps rural communities overcome challenges in financing critical transportation infrastructure projects by offering funding at subsidized rates. Note: Ocean County is listed as eligible.
- **NJ Community Hazard Assistance Management Program** – Provide revolving loan funds to localities to finance projects that reduce risks from natural hazards and disasters identified on a State or local Hazard Mitigation Plan.
- **NJ Blue Acres Program** – Provides funding to move households out of harm’s way by buying out flood-prone, flood-damaged houses and preserving the vacated lands as flood storage buffers against future flooding
- **NJ Shore Protection Program** – Provides funding to protect public and private property and infrastructure from coastal storm damage, erosion and shoreline migration, and sea-level rise. Projects include beach replenishment and construction and maintenance of bulkheads, jetties, and seawalls.
- **NJ Clean Water State Revolving Fund** – Offers low-cost financing packages to local governments, including principal forgiveness and low-interest loans, for projects that support clean water, including wastewater treatment works, stormwater management, land acquisition, and landfill activities.
- **NJ Water Quality Restoration Grants for Nonpoint Source Pollution** – Provides funding for watershed restoration activities and initiatives around New Jersey that address nonpoint source pollution (NPS).

## Local Financing Strategies

Beyond state and federal sources, the Township has several options to raise funds through municipal revenue (taxes) and bonds. The Township can also look at ways to co-fund projects with public utilities and service providers, as federal and state budgets are limited. Any type of bond issued for resilience projects impacts the total indebtedness of the Township, so the Township should focus on the most cost-effective bond instrument to minimize interest costs. Example financing strategies are listed below.

- **General Obligation Bonds**
  - A general obligation bond is a municipal or city bond usually paid down through taxation and or revenue from the project that the bond paid for or funded. General Obligation bonds are backed by the full faith and credit of the City government, including its power to tax its citizens. General obligation bonds are among the safest bonds issued by governments and are generally associated with low interest costs.

- **Revenue Bonds** – Revenue bonds are backed by a specific stream of revenue. For example, the Township may issue revenue bonds to build water lines and sewage treatment facilities, with the debt to be repaid from usage fees and assessment fees. The dedicated repayment source for revenue bonds provides for lower interest costs.
- **Catastrophe Bonds** – Similar to insurance policies, catastrophe bonds reduce the financial risks that come with a high-risk natural disaster, such as a direct hit by a hurricane. Catastrophe bonds can be purchased by a municipality, which will be set to pay out to the Township if a specific event (such as a hurricane) hits the Township with specific parameters (such as a 10-foot storm surge).
- **Social Impact Bonds** – A social impact bond is a financial mechanism that works a bit like a contract, usually between a government agency or entity and the private sector. The private sector is paid a higher return on the mitigation investment if it performs better than expected. If the intervention performs worse than expected, the amount the public entity or agency has to pay the investor is reduced. At present, this is not a suitable approach due to higher interest costs.
- **Resilience Bonds** – Resilience bonds are a complex financial mechanism that uses savings from a planned flood mitigation investment to reduce the insurance premiums that a Township has to pay for a catastrophe bond, using this cost savings to fund a new mitigation investment that will reduce risk. Though resilience bonds are a new mechanism for paying for significant mitigation infrastructure projects, over the next decade, this new mechanism has the potential to become more common as cities seek new ways to fund mitigation. At this time, resilience bonds are unsuitable as they are extremely complex and have excessively high transaction costs.
- **Mitigation Bonds** – A mitigation bank acts much like a checking account, in which a series of debits out of one area can be credited to a different area. For example, if the development of a subdivision causes the destruction of a wetland, this can be offset by the creation of a new wetland somewhere else. This, in theory, results in zero net loss to the environment.
- **Municipal Revenue** – The Township can utilize a variety of municipal revenue streams to help fund flood mitigation strategies. Increasing fees and taxes or reallocating fees and taxes already in place are a few options that should be explored. Given the significant financial needs highlighted in this document, simply reallocating funds and increasing municipal revenue will not be sufficient to meet the flood mitigation needs of the Township. Regardless, the Township should continue to look for ways to allocate funds to address flood concerns efficiently and effectively.

A financing resource library in **Appendix C** provides a list of resilience financing resources and technical assistance programs that may be useful for developing a financing strategy that maximizes return on investment.

## Funding Alignment

The following tables show the suitability of various state and federal programs with each of the resilience actions. Note some

programs in this table are not mentioned in the section above but are included in **Appendix C: Resilience Funding and Financing Sources**.

**TABLE 8:** Suitability alignment between state funding and financing programs and resilience actions.

STATE PROGRAM	Elevation of Water Treatment Plant and Pump Station	Expansion of Engagement through Community Partners	Lighthouse Drive Neighborhood Flood Reduction	Erosion Management at Custer Drive	Roadway and Drainage Infrastructure Improvements	Bulkhead and Seawall Expansion Program	Marsh Restoration at Barnegat Bay Lighthouse Center	Riprap Installation for Shoreline Maintenance	Marsh Restoration at Sands Point	Continued Firewise Efforts with NJ Forest Fire Services	Minimum Bulkhead Elevation Ordinance	Continued Extreme Heat Mitigation with Ocean County	Additional Support for Home Elevations	Contamination Reduction for Hazardous Materials	Oyster Creek Maintenance and Dredging
Blue Acres Program			✓												
Clean Water State Revolving Fund	✓				✓									✓	
Community Hazard Assistance Management Program					✓			✓							
Drinking Water State Revolving Fund Program	✓													✓	
Hazardous Discharge Site Remediation Fund														✓	
Municipal Stormwater Assistance Grants			✓		✓										
Natural Climate Solutions Grants				✓			✓		✓						✓
Shore Protection Program			✓	✓		✓		✓			✓				✓
Transportation Infrastructure Bank				✓	✓										
Water Quality Restoration Grants for Nonpoint Source Pollution							✓		✓						✓

**TABLE 9:** Suitability alignment between federal funding programs and resilience actions.

FEDERAL PROGRAM	Elevation of Water Treatment Plant and Pump Station	Expansion of Engagement through Community Partners	Lighthouse Drive Neighborhood Flood Reduction	Erosion Management at Custer Drive	Roadway and Drainage Infrastructure Improvements	Bulkhead and Seawall Expansion Program	Marsh Restoration at Barnegat Bay Lighthouse Center	Riprap Installation for Shoreline Maintenance	Marsh Restoration at Sands Point	Continued Firewise Efforts with NJ Forest Fire Services	Minimum Bulkhead Elevation Ordinance	Continued Extreme Heat Mitigation with Ocean County	Additional Support for Home Elevations	Contamination Reduction for Hazardous Materials	Oyster Creek Maintenance and Dredging
DOT RAISE				✓	✓										
DOT PROTECT				✓	✓										
EPA WPDGs							✓		✓						✓
EPA WIFIA	✓														
FEMA BRIC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
FEMA FMA			✓										✓		
FWS National Coastal Wetlands Conservation Grant Program							✓		✓						✓
FWS NAWCA							✓		✓						
NFWF Five Star and Urban Waters Restoration Program				✓			✓		✓						✓
NFWF Coastal Resilience Fund			✓	✓	✓		✓		✓					✓	✓
NOAA CELCP							✓		✓						
NOAA Climate Program Office Adaptation Sciences Program		✓													
USACE CAP Section 103					✓		✓		✓						✓
USACE CAP Section 205	✓		✓		✓			✓							✓
USACE CAP Section 206							✓		✓						✓
USDA Community Facilities Direct Loan and Grant Program	✓														
USDA CIG - National Competition				✓			✓		✓						✓
USDA Emergency Community Water Assistance Grants	✓														
USDA WFPO				✓			✓		✓					✓	✓

## Conclusion

The Township of Ocean is committed to continuing to strengthen its resilience to climate-related hazards. The Township is actively in the process of implementing some of the activities listed in this plan—including elevation of the water treatment plant and 8th Street pump station and supporting residential structure elevation projects—while looking for opportunities to implement other adaptation and resilience actions presented. The findings, concepts, and actions presented here will also be integrated into the Township’s other related plans, including future updates of the *Comprehensive Master Plan*, *Floodplain Management Plan*, and *Hazard Mitigation Plan*.

Future project planning and implementation for the Township is dependent on funding and financing availability, which are likely to drive prioritization of resilience actions. The Township additionally will look to coordinate

with NJDEP on relevant permitting for projects such as riprap restoration along shorelines experiencing significant erosion.

The Township faces a range of climate hazards, including flooding, wildfire, and extreme heat, and is committed to continuing to find an appropriate balance of resilience actions to address these hazards. The Township will continue to engage in work to support its participation in CRS for flood risk reduction, FireWise for wildfire hazard, and coordinating Ocean County on addressing extreme heat vulnerability.

As one of the first municipalities to participate in the Resilient NJ Program, the Township of Ocean is eager to improve its climate resilience. This Climate Change-Related Hazard Vulnerability Assessment and Resilience Action Plan supports the Township’s continuing efforts, and is intended to serve as a continual reference for the Township in future climate resilience planning work.

## References and Endnotes

- 1 Section 19 of P.L.1975, c.291 §2 C.40:55D-28.1. [https://pub.njleg.gov/bills/2020/AL21/6\\_.HTM](https://pub.njleg.gov/bills/2020/AL21/6_.HTM)
- 2 DEP. Sea-Level Rise Guidance for New Jersey. 2021. <https://www.nj.gov/dep/bcrp/resilientnj/docs/dep-guidance-on-sea-level-rise-2021.pdf> . See Appendix A: Sea Level Rise Scenarios Methodology for more details on the data used in the analysis.
- 3 FEMA Community Lifelines. <https://www.fema.gov/emergency-managers/practitioners/lifelines>
- 4 Basic loss modeling was based on USACE data and depth-damage functions, assuming all buildings have a standard elevation and foundation type of slab-on-grade. The potential to use existing elevation certificate information to provide more accurate elevation information was explored but not implemented and would have still resulted in significant information gaps. With these modeling assumptions, this approach gives a general sense of the relative increase in risk over time, but damage estimates are likely to be higher than reality for homes that are built with an alternative reality or already elevated. An enhanced structure dataset that includes foundation type and elevation would allow for more precise economic risk modeling.
- 5 CDC Social Vulnerability Index. 2020. [https://www.atsdr.cdc.gov/placeandhealth/svi/data\\_documentation\\_download.html](https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html)
- 6 Fourth National Climate Assessment. Chapter 18: Northeast. <https://nca2018.globalchange.gov/chapter/18/>
- 7 FEMA Climate Mapping for Resilience and Adaptation. <https://livingatlas.arcgis.com/assessment-tool/explore/details>
- 8 National Interagency Fire Center. <https://www.nifc.gov/>
- 9 2019 Master Plan Reexamination Report, Ocean Township, Ocean County, New Jersey. <https://twpoceannj.gov/mgt-plans/2019-Master-Plan-Reex-Report-Adopted110719.pdf>
- 10 2018 Multi-Jurisdictional All-Hazard Mitigation Plan. <https://www.co.ocean.nj.us/WebContentFiles/d99c7d03-cbe7-47ca-9d49-8fea931376c5.pdf>
- 11 Township of Ocean 2015 Floodplain Management Plan. <https://twpoceannj.gov/FMP/Flood-Plain-Mgmt-Plan-Final.pdf>
- 12 2019 Ocean Township Community Wildfire Protection Plan. <https://twpoceannj.gov/mgt-plans/wildfire.pdf>
- 13 FEMA Hazard Mitigation Grant Program. <https://www.fema.gov/grants/mitigation/hazard-mitigation>



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