



Engineering
& Design



Climate Change- Related Hazard Vulnerability Assessment

Upper Township

Cape May County, New Jersey

October 2022 (DRAFT)

Acknowledgements

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The Township of Upper provided additional financial assistance to supplement the public engagement used to inform and develop this report.



GIS Disclaimer: The maps contained herein were prepared using available State and NJDEP digital data. The secondary maps have not been verified by the NJDEP and are not state-authorized.

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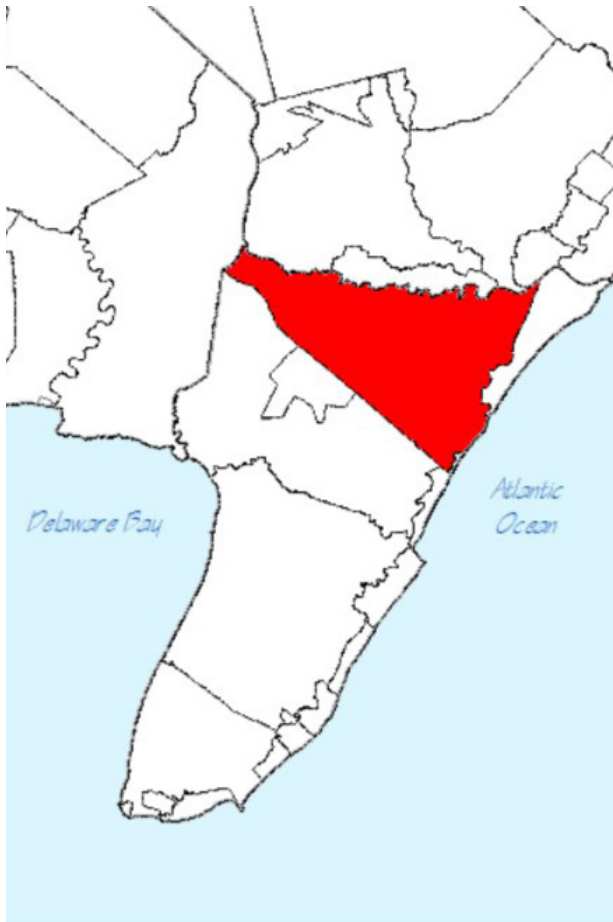


01

Introduction

Coastal communities have historically been threatened by a host of inclement weather events. Wooded communities have historically been threatened by periodic wildfires. Agricultural communities have historically been threatened by periods of drought. Upper Township has been no stranger to any of these threats historically; however, the effects of a warming planet will exacerbate these threats. Understanding the Township’s potential vulnerabilities to its built environment, natural environment, and human environment is key to identifying actions that can be taken to improve the Township’s resilience to a changing climate.

The climate change related hazard vulnerability assessment (“CCRHVA”) will review potential for impacts to physical assets of the community such as structures, infrastructure and utilities; natural system assets; and socio-economic assets associated with residents and businesses with particular emphasis on addressing environmental justice, at risk neighborhoods and vulnerable populations, where applicable. It concludes with a set of recommended action items that can be considered to mitigate these threats.



Map 1: Area Reference

Geographic Reference

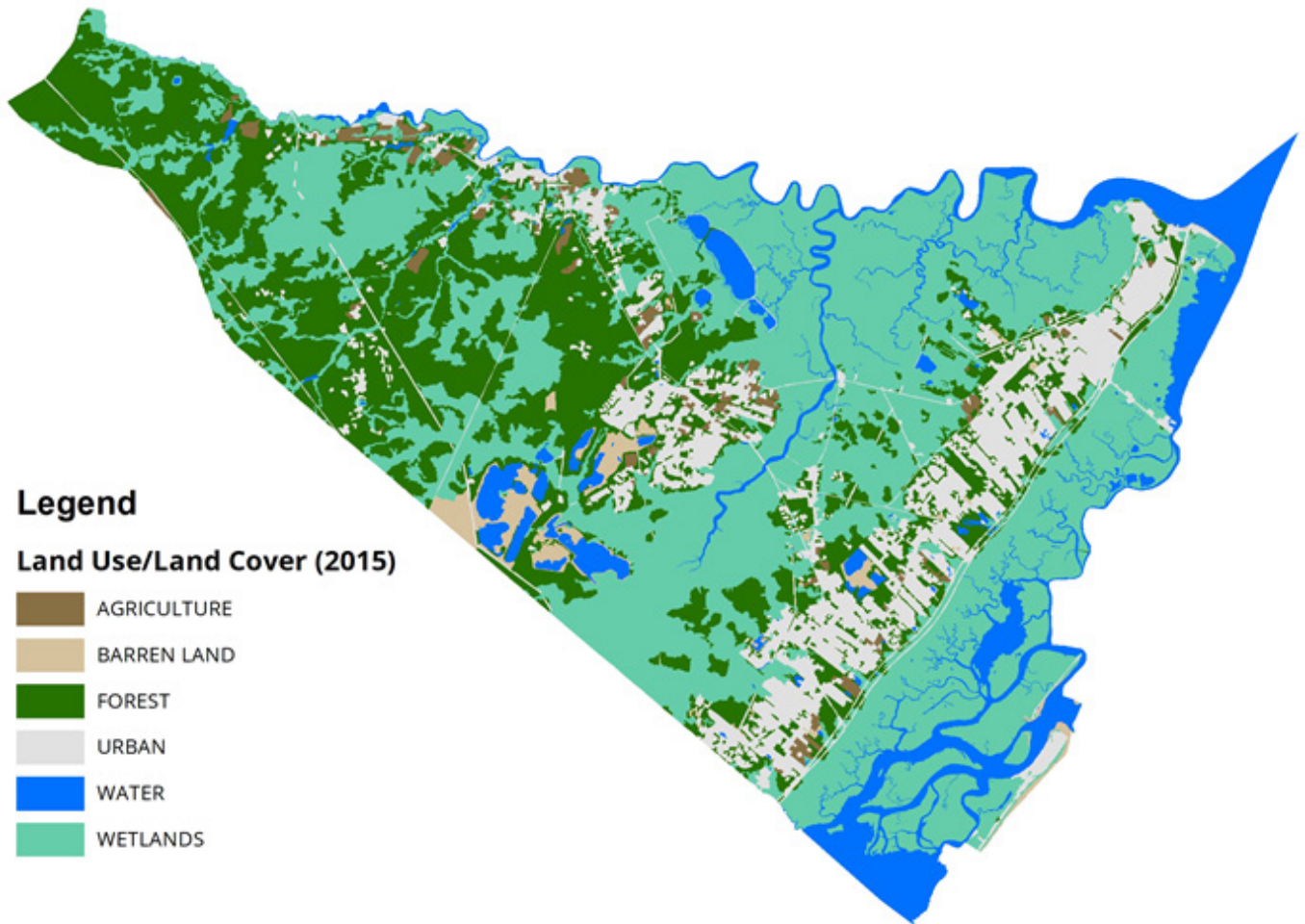
Upper Township is located at the northern end of Cape May County, where it joins Atlantic County to the north and Cumberland County to the west. Upper Township is bordered by Dennis Township and Woodbine Borough to the south and Sea Isle City and Ocean City to the east. Upper is also bordered by Maurice River Township in Cumberland County to the west and Corbin City, Egg Harbor Township and Somers Point City in Atlantic County to the north. The Atlantic Ocean makes up the eastern border of the Township. Tuckahoe River and the Great Egg Harbor Bay form the majority of the Township's northern boundary.

The Township occupies an area of approximately 43,785 acres, including 39,669 acres of land area and 4,262 acres of water area. The majority of land area is located on the mainland, but also includes the barrier island neighborhood of Strathmere, located on Ludlam Island. Similar to other large municipalities across New Jersey, Upper Township is composed of numerous smaller communities, including Beesleys Point, Marmora, Palermo, Seaville, Tuckahoe, Greenfield, Marshallville, Steelmantown, Petersburg and Strathmere. Major roadways that run through Upper Township include the Garden State Parkway, U.S. Route 9 and State Routes 49 and 50.



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Upper Township is completely encompassed within either the New Jersey Department of Environmental Protection (NJDEP) Coastal Zone, subject to the Coastal Area Facility Review Act (CAFRA) - N.J.S.A. 13:19, or the Pinelands Management Area, subject to the Pinelands Protection Act - N.J.S.A. 13:18A. Approximately 46.2 square miles of Upper Township are located within the Coastal Zone; the remaining 22.3 square miles are within the Pinelands Management Area. The dividing line runs along State Route 49, State Route 50 and County Route 610. Approximately 33.7 square miles of the Coastal Zone are overlapped by the Pinelands National Reserve.



Map 2: Estimated Land Use/Land Cover (2015)

Land Use and Land Cover

Based on the most recent evaluation of Land Use and Land Cover by NJ DEP, nearly half (47 percent) of Upper Township is classified as wetlands. Of the remaining lands, 26 percent of the Township is classified as “Forest,” followed by “Urban” developed lands at 13 percent. Water composes 11 percent of the Township’s land cover, with the remaining area split between “Barren Land” (2 percent) and “Agriculture” (1 percent).¹ This is illustrated in **Map 2** and **Figure 1**.

1. It should be noted that the Township’s Watershed Master Plan found similar numbers as part of its evaluation of land use and land cover. According to 2021 Watershed Plan: “Forest and wetlands comprise 76.9 percent of the township land area whereas water areas account for 9.6% of the total municipal area. (page 3) “Urban development comprises 13.2% of the Township land area.”



To further illustrate this picture, approximately 40 percent of the Township's land area was located within the 1 percent annual chance flood hazard area, with most of the remainder located within the 0.2 percent flood hazard area or the minimal flood hazard area. As illustrated in **Map 3**, land within the special flood hazard areas (i.e. Flood Zones A, AE, and VE) include all of Strathmere, inland to just west of the Garden State Parkway, and also areas near Cedar Swamp Creek and the Tuckahoe River.

Recent Changes at the Local, County, and State Levels

Amendments to the Municipal Land Use Law

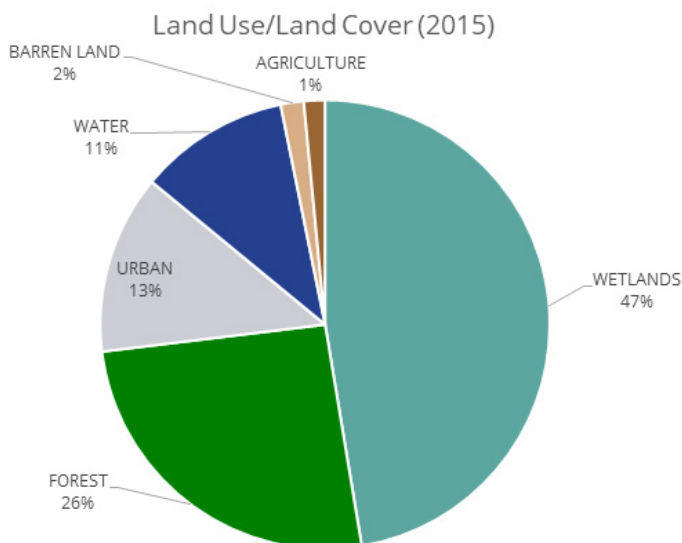
In recent years, the Municipal Land Use Law has been amended to address issues related to sustainability and resilience. In 2018, Governor Murphy signed Bill A4540 into law, requiring land use plan elements of municipal master plans to include a "statement of strategy" which addresses smart growth and the potential location of electric vehicle charging stations; storm resilience with respect to energy supply, flood-prone areas, and environmental infrastructure; and, environmental sustainability.

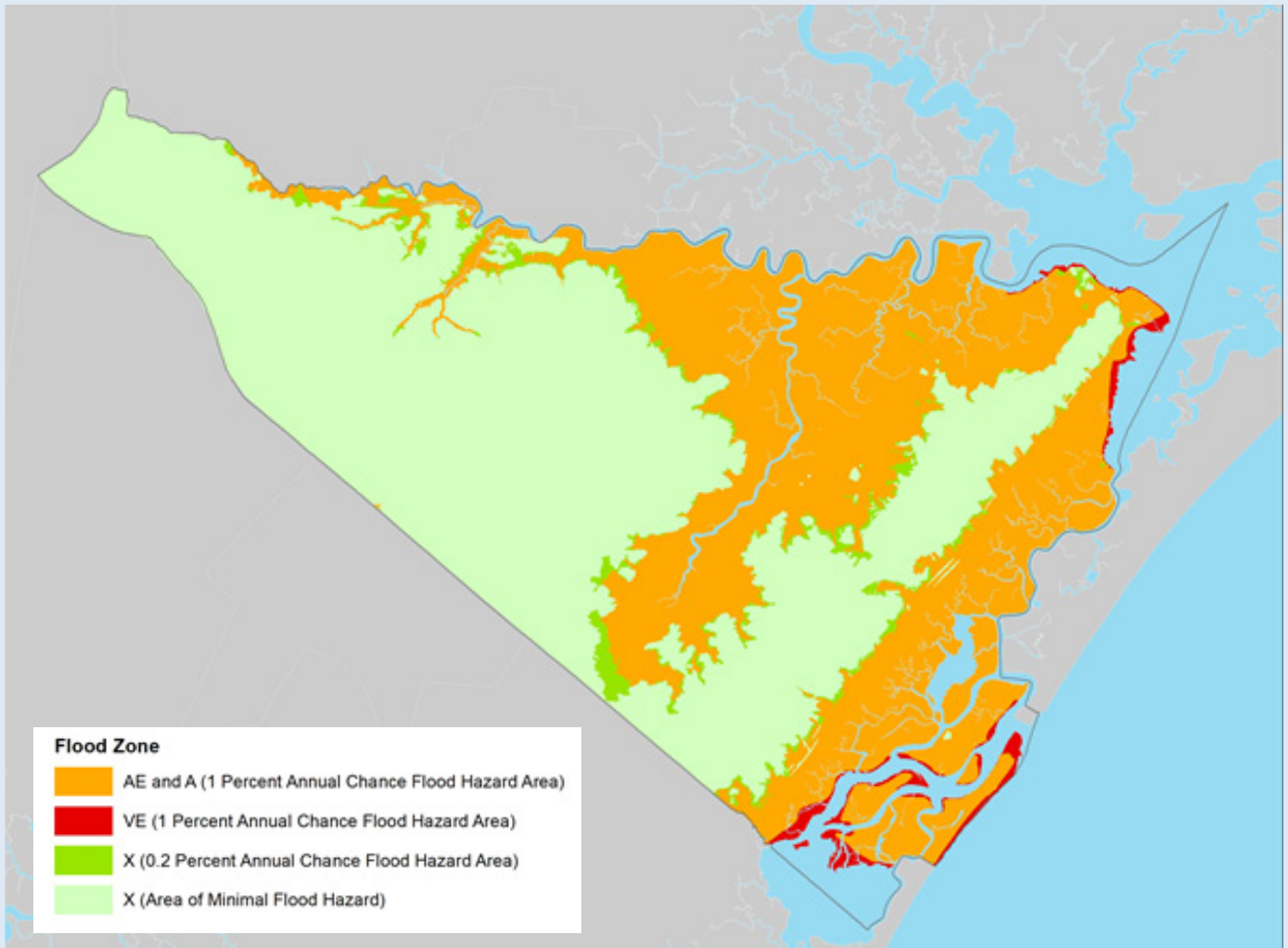
In 2021, Governor Murphy signed Bill S2607 into law, amending the Municipal Land Use Law to require that the land use element of municipal master plans include a climate change-related hazard vulnerability assessment. The text of this amendment is included below:

(h) ...a climate change-related hazard vulnerability assessment which shall

(i) analyze current and future threats to, and

Figure 1: Land Use/Land Cover by Percent Area for Upper Township (2015)





Map 3: FEMA Flood Hazard Areas in Upper Township

vulnerabilities of, the municipality associated with climate change-related natural hazards, including, but not limited to increased temperatures, drought, flooding, hurricanes, and sea-level rise;

(ii) include a buildout analysis of future residential, commercial, industrial, and other

development in the municipality, and an assessment of the threats and vulnerabilities identified in subparagraph (i) of this section related to that development;

(iii) identify critical facilities, utilities, roadways, and other infrastructure that is necessary for evacuation purposes and for



sustaining quality of life during a natural disaster, to be maintained at all times in an operational state;

(iv) analyze the potential impact of natural hazards on relevant components and elements of the master plan;

(v) provide strategies and design standards that may be implemented to reduce or avoid risks associated with natural hazards;

(vi) include a specific policy statement on the consistency, coordination, and integration of the climate-change related hazard vulnerability assessment with any existing or proposed natural hazard mitigation plan, floodplain management plan, comprehensive emergency management plan, emergency response plan, post-disaster recovery plan, or capital improvement plan; and

(vii) rely on the most recent natural hazard projections and best available science provided by the New Jersey Department of Environmental Protection.

It should be noted that the State of New Jersey Climate Change Resilience Strategy finds that “This amendment has the potential to accelerate local climate resilience actions by incorporating climate science into local planning efforts.”

Resilience Planning in Upper Township

The Township has been proactive in their resilience planning efforts. The Township has sought to align its land use planning with that of the State of New Jersey, and was awarded plan endorsement by the State Planning Commission in February 2007, and again in February 2022.

Upper Township has been an active participant in the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), which rewards communities that adopt higher standards to improve community resilience through lower flood insurance premiums for homeowners and businesses located in Special Flood Hazard Areas. As of April 1, 2022, Upper Township is a “Class 5” community, which provides a 25 percent discount for flood insurance premiums in the special flood hazard area.

The Township has amended its flood hazard ordinances to more stringent requirements. In 2012, it required 1 foot of freeboard on all new homes, substantial improvement requirements (40 percent improvements over a 10 year period), and a requirement that enclosures be deed restricted from conversion to habitable

space. In 2017, the Township amended the Flood Hazard Ordinance again to now require more than 2 feet of freeboard on all new homes. The Township amended its zoning ordinance in 2020, requiring a minimum ground floor elevation in Strathmere to be at elevation 7 (NAVD 1988) and to provide on-site sub-surface stormwater recharge for the water quality storm for the new structure.

In 2018, the Township studied bulkheads in town to identify actions that could reduce nuisance flooding, which resulted in the adoption of Ordinance No 18-2018, requiring bulkheads be constructed to elevation 8 (NAVD 1988) within 10 years.

In 2017, the Township participated in a National Fish and Wildlife Foundation project to construct a living shoreline in Strathmere adjacent to the reconstructed Bayview Drive boat ramp. This project was intended to restore a section of eroded shoreline, reduce future erosion, and enhance wildlife habitat.

In 2021, Upper Township prepared a study of “repetitive loss” properties throughout town, which are defined by FEMA as having two or more NFIP losses of at least \$1,000 each have been paid within any 10-year rolling period since 1978. Understanding the location of these properties, and the

surrounding areas, can help to evaluate and mitigate flood problems to reduce future losses.

The Township also worked with Stockton University to complete the Watershed Master Plan in October 2021 in accordance with FEMA’s NFIP requirements. The plan presented impacts of 1-5 feet of sea level rise (SLR) by the year 2100 (NOAA intermediate high projection). Impacts and recommendations were presented for Strathmere, Route 9 Corridor, Petersburg and Tuckahoe. The assessment and recommendations of that report have been used to inform this document.



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County Planning

In 2021, Cape May County adopted an update to their Hazard Mitigation Plan. Upper Township participated in the creation of that plan, and the assessment and recommendations contained herein are informed by and shared with that document. The County's Hazard Mitigation Plan included a series of 6 goals and 44 objectives.

The 6 goals include:

Goal 1: Strategically protect life and property.

Goal 2: Promote public awareness, education, and preparedness of hazards and their risks.

Goal 3: Promote resiliency, preparedness, and continuity of operations between government, businesses, and community groups and organizations.

Goal 4: Enhance Disaster Preparedness, Response and Recovery

Goal 5: Protect Open Space, the Environment, and Natural Resources through short and long-term actions focused on preservation and sustainability.

Goal 6: Promote Partnerships with government agencies, businesses, and non-profit organizations.



**CAPE MAY COUNTY
COMPREHENSIVE PLAN**

Adopted: January 20, 2022



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In 2022, Cape May County adopted its Comprehensive Plan, which evaluated and established goals and objectives for land use, environment, and transportation, as well as a set of general planning goals and objectives. The stated intent of this Comprehensive Plan is, in part, to provide a regional context and perspective for planning and land use decisions at the local level. Throughout the document, the Comprehensive Plan considers impacts from climate change, outlining goals and objectives that promote resilience.

Goals directly related to the promotion of resilience are listed below; it should be noted, however, that other goals and objectives in the document, which may not specifically reference climate resilience, such as limiting sprawl-development or avoiding the unplanned expansion of infrastructure, are also relevant to this Climate Change Related Hazard Vulnerability Assessment.

General Planning Goals and Objectives

Goal: Promote Sustainability, Resiliency and Equity

- Strongly encourage the integration of sustainability, resiliency, and equity

in all aspects of Cape May County's development and redevelopment.

- Prioritize the development of green and grey infrastructure, including stormwater management infrastructure.
- Prioritize water conservation and minimize the impacts of development on surface and groundwater resources.
- Minimize energy consumption and the impacts of development on the regional electrical grid.
- Promote the use of clean energy sources (e.g., wind and solar) where feasible and supported through local land use policies.
- Review impacts and experience with previous extreme weather events (e.g., Superstorm Sandy), and identify key lessons learned and best management practices to enhance resiliency and recovery efforts.
- Evaluate aspects of development and redevelopment proposals from the perspective of environmental justice and equity.

Goal: Monitor and Respond to Change

- Assess climate change impacts and address immediate threats in a manner that promotes sustainability, resiliency, and equity over the long term.

Goal: Implement Existing Plans

- Promote the implementation of the current Cape May County Multi-Jurisdictional Hazard Mitigation Plan

Land Use Goals and Objectives

Goal: Promote High Quality, Sustainable and Resilient Development and Redevelopment

- Minimize impervious surface cover to mitigate stormwater runoff, the burden on existing infrastructure, and pollution of surface waterways.
- Promote development and redevelopment in a manner that accounts for anticipated climate change impacts (e.g., sea level rise).
- Enhance existing infrastructure to make it more resilient to anticipated climate change impacts and extreme weather events.
- Encourage the development of green and grey infrastructure.

Environment Goals and Objectives

Goal: Account for Climate Change Considerations

- Understand potential climate change impacts on regional infrastructure (e.g., roadways) and take action to mitigate same.
- Monitor current science and issues related to climate change and the environment, and equitably account for changes to same in issues concerning Cape May County's natural and built environments.
- Prioritize new development in areas where anticipated climate change impacts are perceived to be low (e.g., location outside of areas anticipated to be impacted by sea level rise).
- Promote the use of available resources to ensure that development and redevelopment in areas of Cape May County that are vulnerable to climate change impacts take appropriate measures to mitigate the impacts of sea level rise and other anticipated climate change impacts.



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Goal: Promote Natural Resource Conservation

- Encourage the assemblage of connected, contiguous areas of farmland, recreation, open space, and other conservation areas.
- Mitigate pollution of natural waterbodies (e.g., Delaware Bay, Atlantic Ocean, tidal marshlands) by minimizing stormwater runoff through the application of green and grey infrastructure.
- Target the preservation of wellhead protection and aquifer recharge areas.
- Promote the enjoyment and appreciation of Cape May County's abundant natural resources by residents and visitors.
- Protect and enhance public access to preserved areas and beaches, where appropriate.
- Encourage the preservation of forested areas on development parcels, as well as their subsequent management after development, with recognized best management practices.
- Team with relevant entities (e.g., State, constituent municipalities, and non-profit organizations) to maximize the preservation of open space and farmland properties.
- Increase awareness of Cape May County's Open Spaces Program (formerly Cape May County Open Space & Farmland Preservation Program).
- Explore opportunities to partner with municipalities and non-profit entities to expand a system of related, high-quality public spaces throughout the County.
- Explore opportunities to establish additional revenue streams in municipalities with extensive amounts of preserved lands (e.g., participation in funded carbon sequestration programs).

New Jersey Climate Change Resilience Strategy

In 2021 the State of New Jersey published the Climate Change Resilience Strategy report, offering guidance to municipalities on how they can prepare for climate-related threats in the form of six priorities, each of which include a series of strategies and implementable actions. Of the six priorities, five are particularly applicable to Upper Township and are incorporated herein.

Priority 1: Build Resilient and Healthy Communities

The Climate Resilience Strategy refers to community resiliency as “the dynamic and adaptive ability of a community to use available resources to withstand, respond to, and recover from adverse situations.” This includes “reducing exposure to hazards, managing existing vulnerabilities, and increasing a community’s capacity to efficiently respond and recover after an event.” The Strategy recommends a focus on “bouncing forward,” noting that “Too often in recovering from a crisis, there is pressure to “return to normal,” which misses key opportunities to maximize co-benefits through transformative

recovery activities. Recovery and resilience activities should enhance the community’s ability to respond better and more efficiently to adverse situations, not simply return the community to its pre-event baseline.” As part of this priority, strategies relevant to Upper Township include integrating resilience into local planning and decreasing vulnerability of existing infrastructure and development. One recent example was the adoption of Ordinance No. 11-2020, which requires a Flood Compliance Certificate for all dwelling units prior to the transfer of title to ensure that there has been no substantial or material change from non-habitable space to habitable space as indicated in the building plans upon which the Certificate of Occupancy was issued for the residential dwelling, and that there were not any other substantial or material deviation from the building plans from which the Certificate of Occupancy was issued.

Priority 2: Strengthen the Resilience of New Jersey’s Ecosystems

With significant portions of the township in the Pinelands and in the floodplain, protecting the ecosystem is particularly applicable to Upper Township. As noted



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in the Strategy, “Protecting our natural systems and restoring degraded landscapes ensures the existence of our cherished natural areas, but also serves to safeguard our communities from the impacts of climate change by using the power of nature itself.” As part of this priority, strategies relevant to Upper Township include managing natural lands for climate impacts and environmental stressors to reduce wildfire risk through risk assessment and proactive management, providing habitat connectivity in order to

support wildlife movement and adaptation to changing conditions, and restoring and enhancing damaged resources to expand ecosystem services.

Priority 3: Promote Coordinated Governance

While this priority focuses largely on communications between state agencies to promote climate resilience, it does include one strategy to actively engage local governments and other partners to develop resilience solutions, including actions that improve communication between the state and local government. The preparation of this vulnerability assessment represents a tangible result of this Priority, considering that this vulnerability assessment has been funded through a grant from NJDEP to assist Upper Township.

Priority 4: Invest in Information and Increase Public Understanding

Access to information that can inform local policy as well as the investment decisions of residents and businesses is important in supporting resilience. Engagement inevitably increases the investment and

ownership that residents feel toward their community. The Township, through its participation in the CRS program, has already taken numerous steps to provide its residents with access to materials and other information to improve resilience and preparedness, including participation in the Getting to Resilience process, which culminated in the preparation of the Getting to Resiliency Report, which was presented at a public meeting at both the Planning Board and Township Committee. The Township is a participant in the NJ Coastal Coalition a multi-jurisdictional program for public information (NJPPI) consisting of 13 communities in Atlantic and Cape May Counties, which provides a regional approach to promoting public information about flood hazards in the community. Beginning in 2020, the Township has hosted a Flood Insurance Promotion meeting, which assists residents and property owners to review their information to ensure they are being properly rated. The Township prepared a bulkhead study which included several public meetings to review how bulkheads protect and prevent flooding. Also in 2020, the Township installed a tidal flood warning system in Strathmere, allowing the Township to warn residents of real-



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time flooding hazards. The Township also disseminates information on resiliency planning through its website and through an annual mailer to residents.

As part of this priority, strategies relevant to Upper Township include expanding public communication efforts on climate change and impacts on New Jersey and expanding climate change education and training.

Priority 6: Coastal Resilience Plan

As noted in the Climate Change Resilience Strategy, one of the most visual impacts of climate change is increased flooding from both extreme weather events and a rising sea level, which will not only impact the built environment, but natural ecosystems, such as the picturesque coastal marshes that visually define Upper Township. Relevant to Upper Township are the five policy statements that inform the strategies of the Coastal Resilience Plan:

1. Engineered shore protection projects will not be financially or structurally feasible in every vulnerable area of the coastal zone. The state will prioritize major flood protection investments to large population and economic centers and areas with concentrations of critical infrastructure systems, especially in areas with socially vulnerable populations.
2. The state will continue to invest in all types of coastal resilience strategies to protect and enhance state and community assets but will prioritize non-structural and natural and nature-based features except where technically infeasible.
3. The state will support the development of comprehensive, equitable, resilience plans in every coastal municipality.
4. The state will invest in the protection, restoration, and enhancement of its coastal ecosystems to support their ecological, recreational, and economic value.
5. The State will prepare for and facilitate the evolution of the coastal zone as populations move to safer areas, and limit investments that will hinder that purpose.

Methodology

Upper Township has been involved in a number of different planning processes and studies in recent years to identify potential vulnerabilities to extreme weather. As such, this analysis will draw upon the science and information prepared as part of those studies.

Reports reviewed:

- Upper Township “Getting to Resilience” Recommendations Report. Prepared by the Jacques Cousteau National Estuarine Research Reserve. April 2015
 - 2020 Master Plan Reexamination Report and Master Plan Update. Prepared by Tiffany A. Cuvillo, PP, LLC, March 2020.
 - Watershed Master Plan, Township of Upper. Prepared by Dr. Stewart C. Farrell, Kevin Pretti, and Matthew Deibert, Stockton University Coastal Research Center, October 1, 2021.
 - Cape May County Hazard Mitigation Plan Update, May 2021. Prepared by Tetra Tech.
 - Cape May County Comprehensive Plan. Prepared by Robert Dare, PP, AICP, MCIP, and Stan Slachetka, PP, AICP of T&M Associates, and Leslie Gimeno, PP, AICP, MPA of Cape May County.
- Dated December 31, 2021, and adopted January 20, 2022 by the Cape May Planning Board.
- Repetitive Loss Area Analysis for Upper Township, New Jersey. Prepared by Tetra Tech, March 22, 2021.
 - Upper Township Master Plan. Prepared by the Upper Township Planning Board and Mary Beth Lonergan, AICP, PP of the Waetzman Planning Group (1993, Adopted January 27, 1994, with clarification and revision adopted July 21, 1994)
 - Goals and Policy Objectives
 - Land Use Plan (Amended in 2006 as part of the 2006 Reexamination and Land Use Plan Amendment, prepared by Marcia R. Shiffman, PP, AICP, CLA of Maser Consulting)
 - Housing Plan (Housing Element, Fair Share Plan, and Spending Plan updated in 2018. Prepared by Tiffany A. Cuvillo, PP, LLC of Community Development and Planning. Adopted August 8, 2018 and Endorsed August 13, 2018)
 - Circulation Plan
 - Utility Service Plan
 - Community Facilities Plan
 - Recreation Plan
 - Historic Preservation Plan
 - Conservation Plan (Updated and



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replaced in January 2011. Adopted February 17, 2011. Prepared by Marcia R. Shiffman, PP, AICP, LLA and Daniel N. Bloch PP, AICIP of Maser Consulting)

- Economic Plan
- Recycling Plan
- Upper Township Bicycle Plan (2018) Prepared by WSP.
- Municipal Public Access Plan, prepared by Paul Dietrich, PE of the Township of Upper. Submitted March 11, 2020.
- 2020 New Jersey Scientific Report on Climate Change. Prepared by New Jersey Department of Environmental

Protection.

- State of New Jersey Climate Change Resilience Strategy (2021). Prepared by New Jersey Department of Environmental Protection.
- Plan Endorsement, Municipal Self Assessment Report for the Township of Upper. Prepared September 17, 2020 by Paul Dietrich, PP, PE, Municipal Engineer.

Data Reviewed

- NJ Floodmapper
- NJ Forest Adapt



Public Engagement



Development of this Climate Change-Related Hazard Vulnerability Assessment involved the input and feedback from a range of different stakeholders. As noted in the acknowledgements section of this document, this work was made possible with financial assistance from the Coastal Zone Management Act of 1972, as amended, administered by the Office for Coastal Management, National Oceanic and Atmospheric Administration (NOAA) through the New Jersey Department of Environmental Protection, Coastal Management Program. Throughout the

preparation of this document, NJ DEP provided insights, suggestions, and other feedback. Planning staff from Colliers Engineering & Design also worked with the Township Engineer's office to obtain prior reports, studies, and other data to inform the preparation of this document. Drafts of this report were shared with the Township Engineer's office for additional insights and feedback.

In October 2022, planning staff from Colliers Engineering & Design presented the draft findings of the Climate Change-



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Related Hazard Vulnerability Assessment to a work session of the Township's Planning Board. This presentation was also used to inform the Township about the development of an interactive website and survey that would allow residents, businesses, and visitors the chance to review the findings and provide feedback.

The feedback gathered from this survey was then used to inform the final draft of the report, which was presented to the Planning Board at an advertised public meeting in December 2022.

02

Measuring Vulnerability

Introduction

As described in the previous section, the 2021 amendments to the Municipal Land Use Law require municipalities, when updating their Land Use Elements, to analyze current and future threats to, and vulnerabilities of, the municipality associated with climate change-related natural hazards, including, but not limited to increased temperatures, drought, flooding, hurricanes, and sea-level rise. The May 2021 Hazard Mitigation Plan Update for Cape May, New Jersey identifies the following hazards that pose threats to the county, including:

- Climate Change and Sea Level Rise
- Coastal Storm
- Dam Failure
- Disease Outbreak



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- Drought
- Earthquake
- Flood
- Geological Hazards
- Hazardous Materials
- Hurricane
- Land Subsidence
- Landslide
- Nor'Easters
- Severe Weather (Includes Extreme Temperature, Hailstorms, Thunderstorms, Tornadoes, Windstorms)
- Severe Winter Weather (Includes Heavy Snow, Blizzards, Freezing Rain/Sleet, Ice Storms)
- Tsunami
- Wildfire

Of the above, the Township ranked Sea Level Rise, Coastal Erosion, Disease Outbreak, Drought, and Tsunami as being considered “medium” degree hazards, while Flood, Hurricane, Nor’easter, Severe Weather, Severe Winter Weather, and Wildfire were ranked “high” degree hazards. These rankings refer to community-specific identification of primary hazard concerns based on their capabilities to withstand

impacts and rebound after the event.

Municipalities, through the 2021 County Hazard Mitigation Plan update, also had to assess their adaptive capacity, which was defined as the current ability to adjust to, protect from, or withstand a hazard event. The Township identified a moderate adaptive capacity for sea level rise, coastal erosion, disease outbreak, drought, flood, hurricane, nor’easter, severe weather, severe winter weather, tsunami, and wildfire, meaning that capacity may exist, but it is not used or could use some improvement. On the other hand, the Township indicated that it had a strong adaptive capacity toward severe winter weather, meaning that capacity exists and is in use.

For the purposes of this vulnerability analysis, the following threats were examined: increased temperatures, droughts, fire, flooding, hurricanes, and sea level rise. These threats fall into two broad categories that would impact land use in the Township, one that relates to excess heat, which includes extreme temperatures, drought, and fire, one that relates to excess water, which can include flooding, sea level rise, hurricanes and tropical weather, precipitation, and can overlap with other extreme weather events.

Hazards Overview

Increased Temperatures

The Cape May County Hazard Mitigation Plan notes that the average temperature in the state has increased by 3.5°F since the end of the 1890s, noting that this has been faster than the rest of the northeast region and the world. NJ Forest Adapt, a tool developed by Rutgers in partnership with the New Jersey Forest Service, US Forest Service, and the Northeast Regional Climate Center, shows that recent historic data from 1981 to 2010 shows that Upper Township has approximately two days per year where the maximum temperature is above 95°F.

The State's 2020 Scientific Report on Climate Change evaluates different scenarios for projecting climate change, known as Representative Concentration Pathways (RCPs). These RCPs evaluate changes to the atmospheric heat balance associated with climate change. For example, under a scenario where greenhouse gas emissions continue to rise throughout the century with little mitigation (RCP 8.5), the data suggests that the eastern sections of Upper Township will experience temperatures above 95°F for 31-40 days per year by 2080-2099,

with interior sections of the Township experiencing those temperatures up to 60 days per year. Alternatively, a scenario where greenhouse gas emissions peak in 2040 and subsequently decline (RCP 4.5) shows that for the town as a whole, it is projected that by 2080-2090, the Township will experience an average of 17 days per year where the maximum temperature exceeds 95° F. As noted in the Scientific Report on Climate Change notes that an RCP of 2.6 was developed to emphasize a significant reduction of future emissions, but are unlikely to be met even with current mitigation policies. In contrast, the RCP 8.5, identified in the report as the "high emission scenario," represents the 90th percentile of all baseline scenarios and the most unlikely outcomes. Meanwhile, RCP 4.5 is considered to be a moderate-level scenario. The Scientific Report on Climate Change notes, however, that "This does not mean that higher emission scenarios and associated projections should be discounted as they offer insight to possible conditions if mitigation measures do not continue."

The HMP cites studies that indicate that temperatures will increase by 4.1 to 5.7°F by 2050, and as high as by 10°F warmer, with 70 percent of summers hotter than



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the warmest summer experienced to date. The HMP further notes that this will also be felt during the winter months, leading to less intense cold waves, fewer sub-freezing days, and less snow accumulation.

Increased temperatures also have impacts for at risk populations, including air pollution and increased energy demands. Increased energy demands then require increased costs to cool buildings, affecting everyone but particularly low-income households. As noted in New Jersey's 2020 Scientific Report on Climate Change, air quality impacts can lead increased respiratory and cardiovascular health problems.

Also concerning the impact that climate change will have on the Upper Township is the impact that temperature changes will have on crops and forested lands. New Jersey's 2020 Scientific Report on Climate Change notes that "the ability for plants to grow efficiently depends upon climate conditions, of which temperature is one of the major factors Increased temperatures during critical growth and reproductive stages can result in crop stress and loss in profits due to a change in flavor or visual appeal...." Increased temperatures will mean longer growing seasons and a loss of winter-chill required

by some crops, benefitting some crops and harming others. Moreover, insects and invasive species are expected to expand northward as temperatures increase.

Similarly, a change in temperature will make the area more or less suitable for various species of trees and plant life, changing the composition of Upper's forested areas. As noted in the 2020 Scientific Report on Climate Change, "as New Jersey's climate becomes more similar to current southern conditions, forest composition will comparatively shift." And, as with agricultural land, invasive pests are expected to flourish in warmer temperatures, causing dramatic damage to forests.

Drought

Drought refers to an extended period of limited precipitation. While drought does not necessarily have a direct effect on buildings or infrastructure, its associated effects can impact natural resources, residents, and businesses. Some of these impacts are aesthetic, such as impacts to landscaping due to lack of rain or through water conservation restrictions, but can extend to more severe impacts, such as crop loss. One of the reasons needed for these water conservation restrictions

during drought periods is to protect groundwater from saltwater intrusion, which can be exacerbated when excessive freshwater pumping draws saltwater into the area, rendering the pump unusable for drinking or irrigation. This is particularly of concern in a place like Upper Township, where virtually the entire community is dependent upon personal wells for their water service.

In addition to the threat of saltwater intrusion, long periods of dry weather can increase the potential for wildfire risk, which can threaten many of the developed areas of Upper Township. As noted in the 2020 New Jersey Scientific Report on Climate Change, droughts can stress forests, and combined with the introduction of pests like the invasive pine beetle, have the potential to kill thousands of acres of forest, creating more potential fuel for an uncontrolled wildfire.

Wildfire

The Cape May County HMP categorizes wildfires into three types: naturally-occurring wildfire, human-caused wildfire, and prescribed fire, and are caused by lightning, human carelessness, or arson. Uncontrolled fires can impact natural lands, including forests and grasslands,

and can spread to structures. According to the HMP, secondary impacts of wildfires include the increased probability of floods, as wildfires can alter the terrain and ground conditions, making the ground less able to absorb rainfall. The NJ Climate Change Study notes that, “increases in temperature, and the hot, dry periods that result, may intensify the danger of wildfires by drying out vegetation and soil. With increases in the frequency and severity of storms, there is increased potential for lightning [sic] to occur and ignite a fire. Also, any increase in winds, which could occur from weather changes due to climate change, would also increase the spread of fires. Due to the dry sandy soils and fire prone nature of the New Jersey Pinelands, this area is susceptible to increased fire threats, especially along the wildland-urban interface.”

Of the 68.4 square miles of land that composes Upper Township, 36.5 acres, or 53.4 percent, are in a Low/Moderate Fuel Hazard Area, and 16.2 acres, or 25.1 percent, are in high to extreme fuel hazard areas for wildfire. Between 2010 and 2019, Upper Township has had 69 wildfire incidents that involved a total of 29.75 acres. According to the County HMP, Upper Township contains one of the highest



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percentages of land considered to be high to extreme fuel hazards. With hotter, drier periods resulting from increased temperatures, this number could rise with longer, more frequent wildfire seasons.

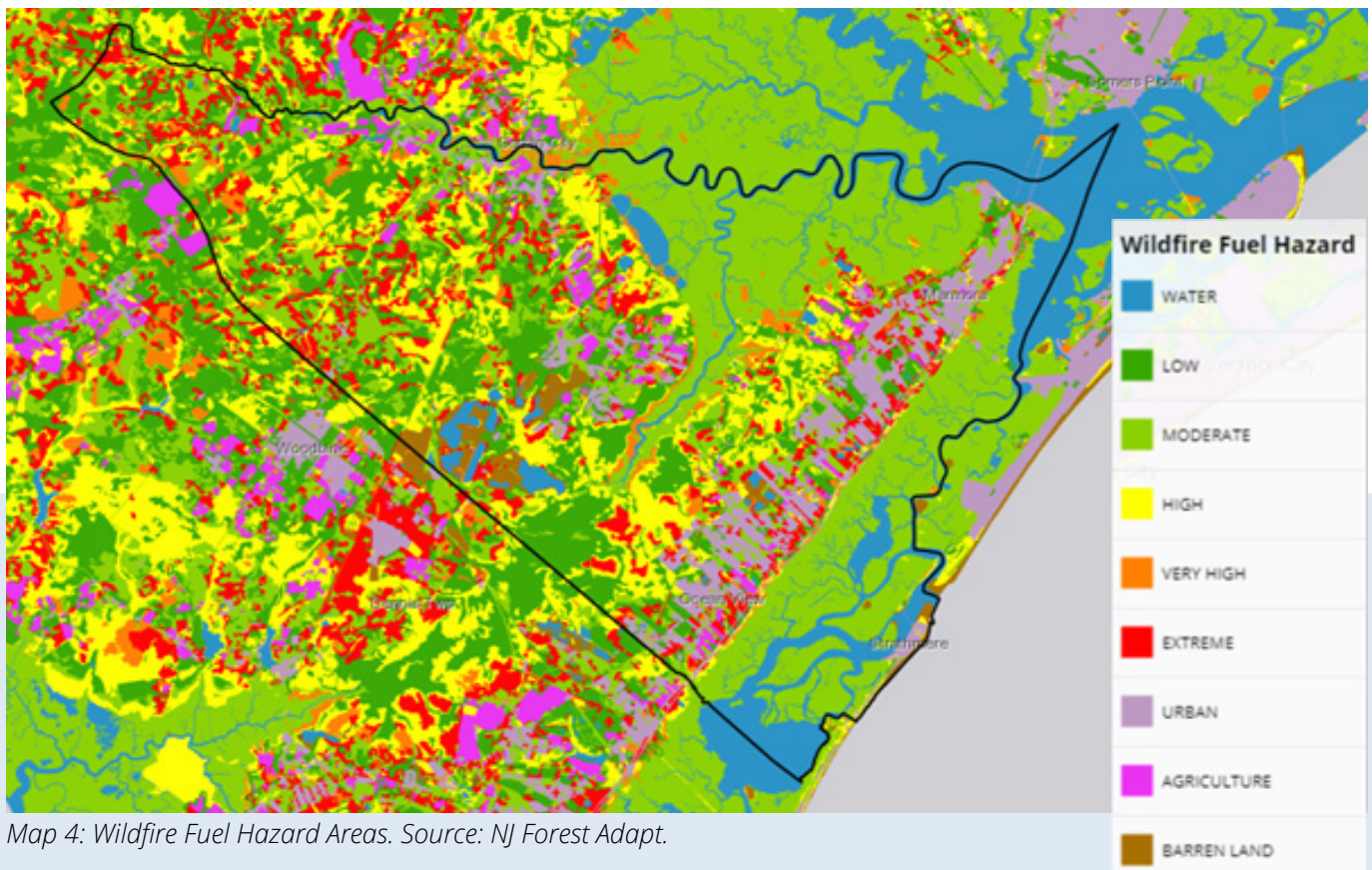
Some experts warn that “New Jersey’s Pinelands (also known as the Pine Barrens) is the lone island of contiguous forest in the 45-million-person megacity that comprises the Eastern Seaboard Whereas regular fires used to thin out the Pinelands, large swaths have remained relatively untouched for decades due to strict preservation laws. The result is a giant tinderbox of untended woods that’s surrounded by 100,000-person suburbs. A Wildfire Risk Assessment published by New Jersey compared the Pinelands to ‘an inch of gasoline covering all of south and central New Jersey.’”²

This is combined with the increased risk posed by development in the wildland-urban interface (WUI)—where houses and wildland vegetation meet or intermingle. Research shows that “when houses are built close to forests or other types of natural vegetation, they pose two problems related to wildfires. First, there will be more wildfires due to human ignitions. Second, wildfires that occur will pose a greater risk to lives and homes, they will

be hard to fight, and letting natural fires burn becomes impossible.”³ Although the WUI is minor in Upper Township as compared to somewhere like the western United States, the significant open space areas in the township do abut housing and developed areas, posing a potential threat. According to the County HMP, higher summer temperatures will likely increase the high fire risk by 10 to 30 percent, from a combination of factors, including increased lightning and dry weather conditions. At present, wildfire risk impacts a substantial segment of Upper Township’s population and built environment. The HMP estimated that 7,910 people in Upper Township, or 66.4 percent of the population, were exposed to the wildland-urban interface area, which FEMA defines as “the zone of transition between unoccupied land and human development. It is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.”⁴ In terms of building stock 5,947 buildings in Upper Township are exposed to this wildland-interface area, with an estimated replacement cost of \$4.1 billion dollars. An estimated 3,771 people (31.7 percent of Upper Township’s population), and 3,385 buildings (35.2 percent of the Township)

are exposed to the wildland-urban intermix area, which is the area where housing and wildlands intermingle. These buildings have an estimated replacement value of \$2.1 billion. Finally, an estimated 250 people, and 203 buildings, in Upper Township are exposed to what is considered wildfire fuel

extreme, very high, and high hazard areas. The replacement cost of these buildings is estimated at \$218 million.



Map 4: Wildfire Fuel Hazard Areas. Source: NJ Forest Adapt.

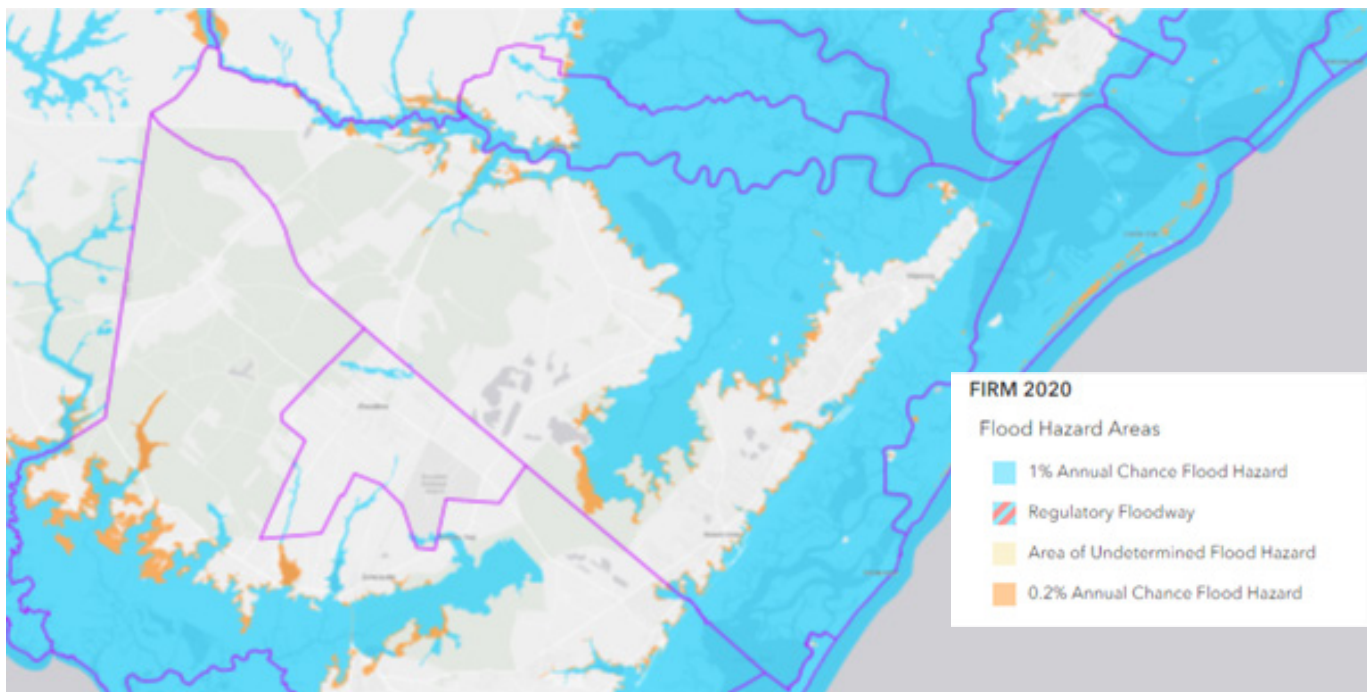
2. Dickman, Kyle. "Will America's Worst Wildfire Disaster Happen in New Jersey?" Rolling Stone. 4/20/2016.
3. Radeloff, Volker C. et als. "Rapid Growth of the US wildland-urban Interface Raises Wildfire Risk." PNAS 115 (13) 3314-3319. 3/27/2018. <https://www.pnas.org/content/115/13/3314>
4. What is the WUI. US Fire Administration. <https://www.usfa.fema.gov/wui/what-is-the-wui.html>



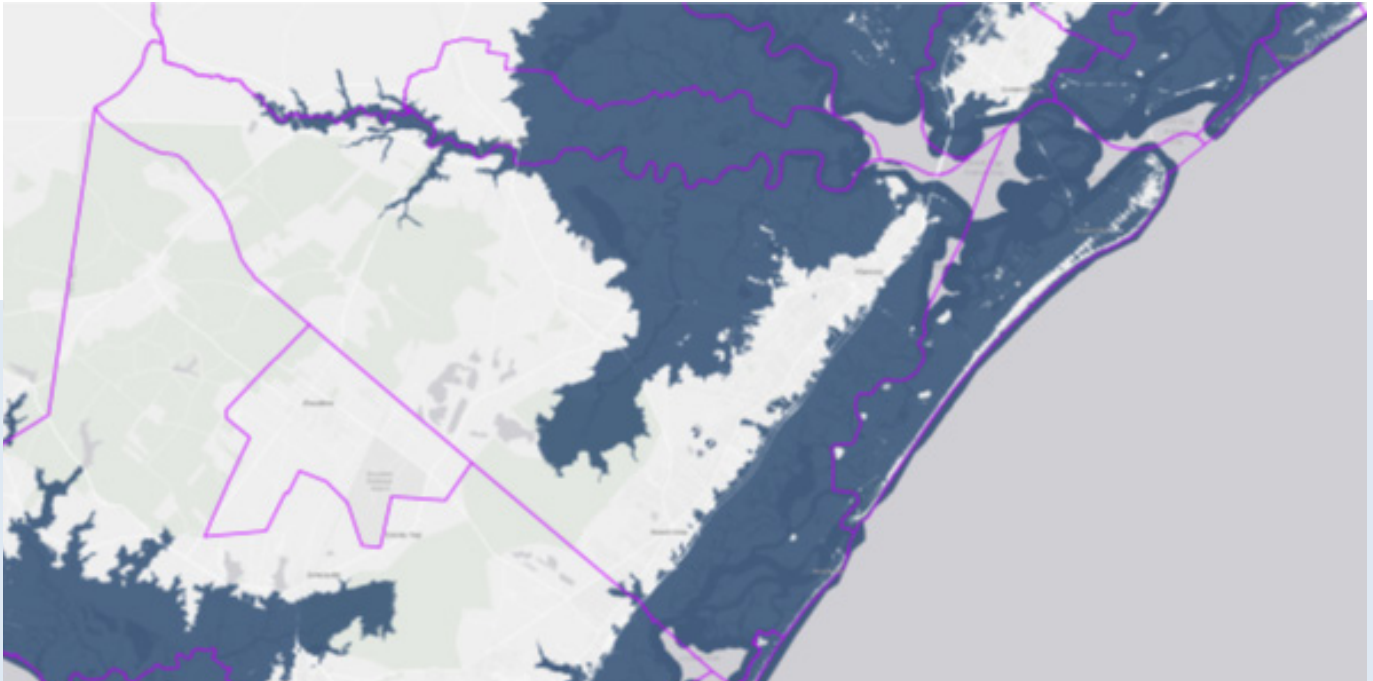
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Precipitation and Flooding

Warmer temperatures, however, will allow for more water vapor to be held in the atmosphere, leading to greater potential for precipitation, and increased amounts of it. The HMP cites estimates of annual precipitation increasing by 4 to 11 percent by 2050, and heavy precipitation events occurring 2 to 5 times more often and with more intensity by the end of the 21st century. NJ Forest Adapt using information from the Northeast Regional Climate Center at Cornell University through their Applied Climate Information System (ACIS, rcc-acis.org) indicates that the mean monthly precipitation in Upper Township, along with most of the state, has historically been between 3 and 4 inches. Under the high emissions scenario (RCP 8.5), the mean monthly precipitation for Upper Township could increase to 4 to 5 inches. This could lead to an increase in the number of flood events, further noting that over the past 50 years in New Jersey, storms with extreme rain increased by 71 percent, a faster rate than anywhere else in the United States.



Map 5: FEMA Flood Hazard Areas. Source: NJ Floodmapper



Map 6: Hurricane Sandy Storm Surge Extent. Source: NJ Floodmapper.

It should be noted that the 2021 County Hazard Mitigation Plan identifies flooding to be a major concern and threat for the county, citing the “unique geographic vulnerability and the total amount of property at risk of inundation. Cape May County owes its development and status as a world-class vacation destination to its coastal resources, and centuries of waterfront development have made its mark on the County. However, waterfront and floodplain development have resulted in considerable exposure. The NJ Hazard Mitigation Plan estimates that 39,283 people (40.4 percent of the County population) and \$15.2 billion of the county’s building stock (61.7 percent) is in the Special Flood Hazard Area.” (Page 4-25) The 2021 Cape May County Hazard Mitigation Plan Update notes that Cape May County has been included in 30 FEMA declarations, further noting that the FEMA Flood Insurance Study has identified nine major flooding events in the county since 1944. (Page 4-25) It is estimated that 19,710 acres of Upper Township, or approximately 45 percent of the community, is exposed to the 1 percent annual chance flood event area, and 20,765 acres are exposed to the 0.2 percent annual chance flood event area. This includes 1,080



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buildings in the 1 percent coastal flood hazard area, which has an estimated replacement value of \$790 million, and 5 buildings in the 1 percent riverine flood hazard area with an estimated replacement value of \$3.7 million. An additional 1,367 buildings are exposed to the 0.2 percent annual chance flood hazard area in Upper Township, with an estimated replacement cost of \$981 million. It should be noted that the developed areas at risk of flooding are estimated to represent a small, but concentrated, part of the Township. NJ Floodmapper estimates that the urban area impacted by the 1 percent annual chance flood is 671 acres, or 11.94 percent of the estimated 5,621 acres of total urban area in the Township. An additional 861 acres of urban area are estimated to be impacted by the 0.2 percent annual chance flood. Flooding is likely to be exacerbated through extreme weather events that involve more precipitation due to the atmosphere's ability to retain more moisture as it continues to warm, rising sea levels, and land subsidence.

In addition, there are 36 properties within Upper Township that are defined as "repetitive loss properties," which according to FEMA is a property for which two or more NFIP losses of at least \$1,000 each

have been paid within any 10-year rolling period since 1978. This includes 26 single family dwellings, eight 2-4 family dwellings, and two nonresidential structures. In addition, the Township contains 7 severe repetitive loss properties, including 5 single family dwellings, and two 2-4 family dwellings. FEMA defines severe repetitive loss properties as any building for which four or more separate claims have been made with each claim exceeding \$5,000, or where at least two separate claims payments have been made where the cumulative amount of such claims exceed the market value of the building within any 10 year period since 1978.

It should be noted that the 2015 Getting to Resiliency Study recommended a detailed mitigation plan for areas that experience repetitive loss. This was achieved, in part, through the preparation of a Repetitive Loss Area Analysis for Upper Township, on March 22, 2021.

Hurricanes and Tropical Weather

Hurricanes and other tropical weather (i.e. tropical storms and depressions) are always a potential threat to New Jersey, particularly its coastal communities, bringing heavy rain, storm surge, flooding, and wind damage. According to the County

Table 1: Upper Township population expected to be exposed to hurricane inundation by hurricane category. Source: Cape May County HMP.

	Category 1	Category 2	Category 3	Category 4
Population	1,324	2,820	5,679	8,301

Table 2: Buildings in Upper Township expected to be exposed to hurricane inundation by hurricane category. Source: Cape May County HMP.

	Category 1	Category 2	Category 3	Category 4
Buildings	943	2,207	4,518	6,845
Replacement Value	\$674,165,922	\$1,558,257,463	\$3,101,293,501	\$4,683,127,959

HMP, 59 tropical cyclones have tracked within 65 nautical miles of Cape May County between 1842 and 2020. In 2020, both Tropical Storm Isais and Tropical Storm Fay tracked within 65 miles of Cape May County. In reviewing these historical records, it is estimated that the county can expect a hurricane every 20 years and a major hurricane every 68 years. These estimates may change, however, as average temperatures continue to increase, increasing the frequency and intensity of storms. When combined with rising sea levels, the impacts from storm surge and flooding could cause greater impacts to already threatened areas but also threaten areas previously sheltered from storm impacts.

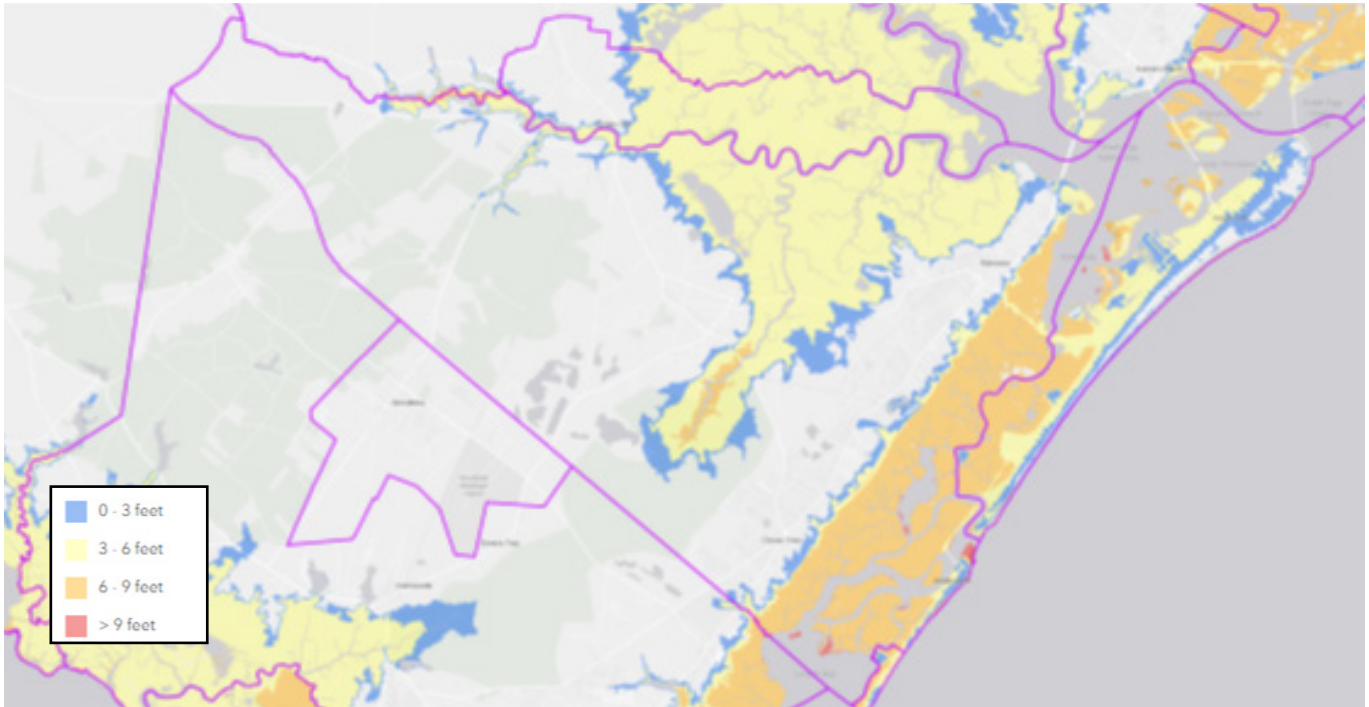
Table 1 illustrates the number of Upper Township residents that would be exposed to hurricane hazard areas, ranging from 1,324 residents (11.1 percent of the population⁵) in a Category 1 SLOSH (Sea-Lake Overland Surge from Hurricanes model), to 8,301 residents exposed to a Category 4 SLOSH (69.7 percent of the population).

Table 2 illustrates the number of buildings in Upper Township that would be exposed to hurricane inundation and the replacement value of those buildings. The images that follow (**Maps 7 through 10**) illustrate the projected storm surge inundation from Category 1-4 storms.

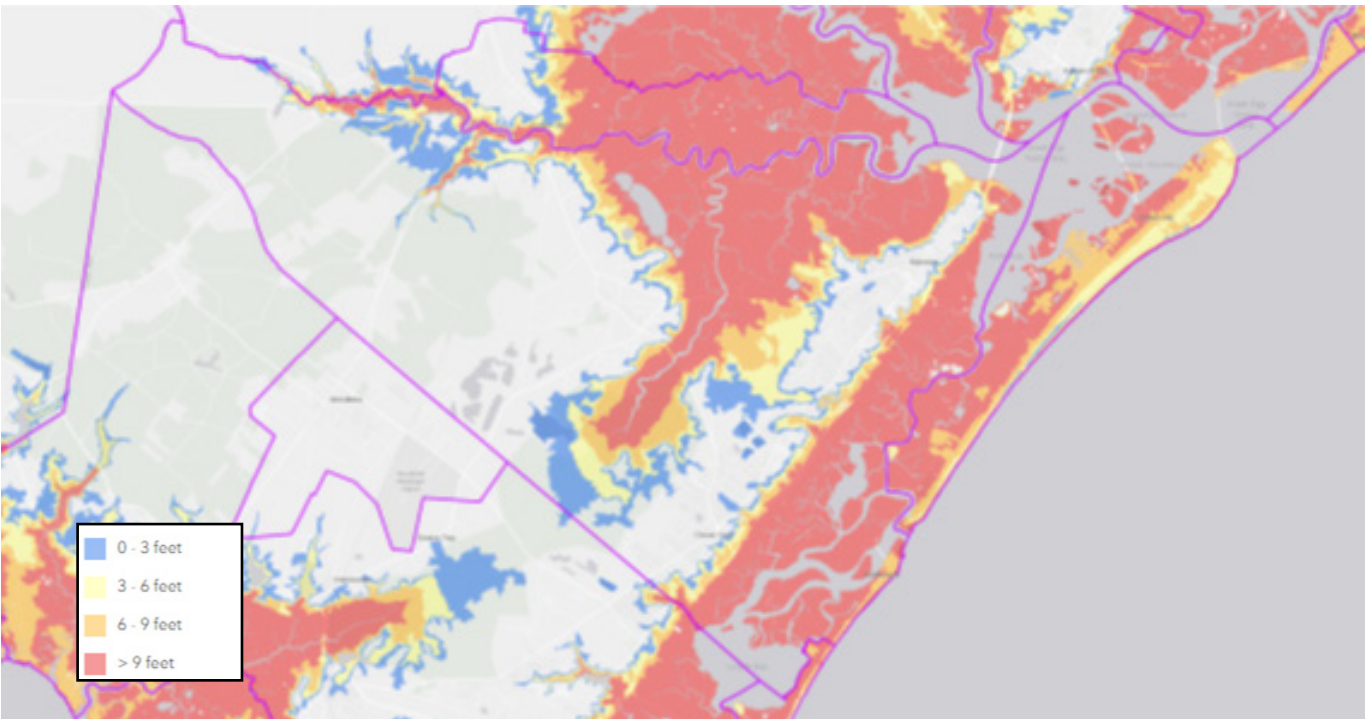
5. Population dataset used in the County HMP was the 2014-2018 American Community Survey.



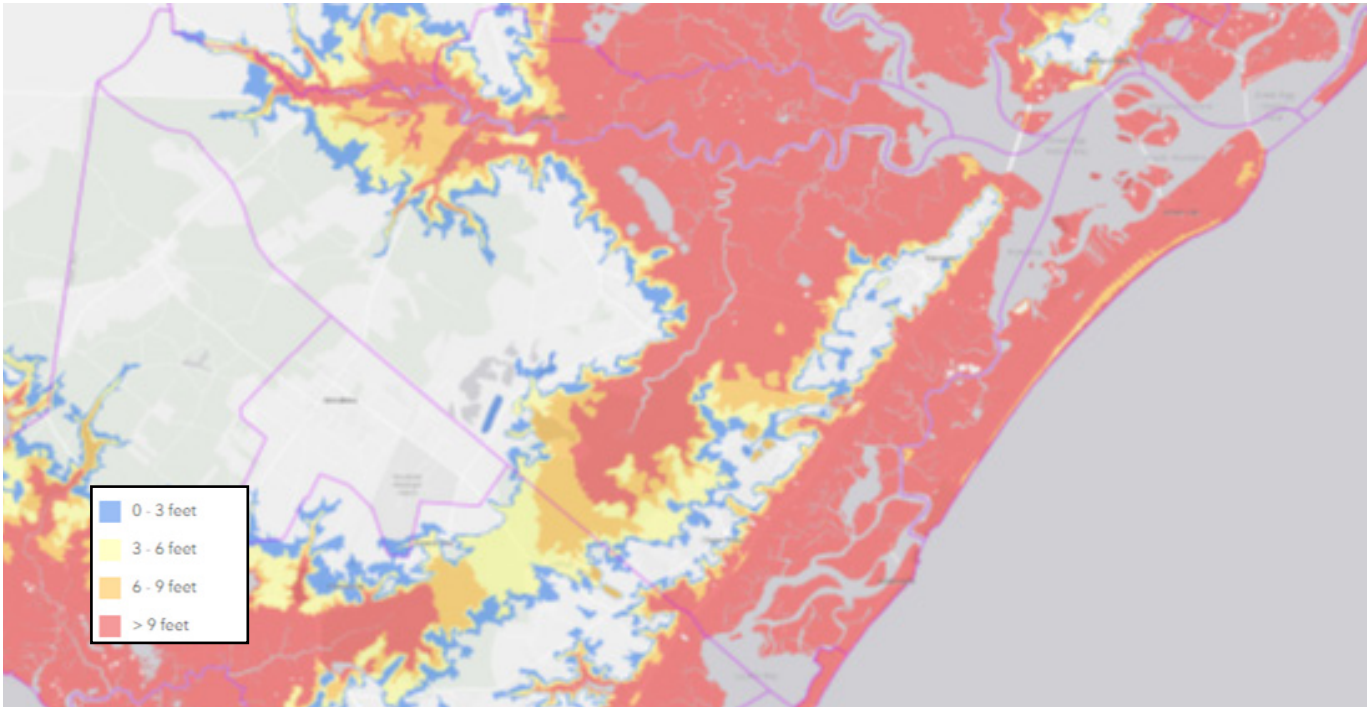
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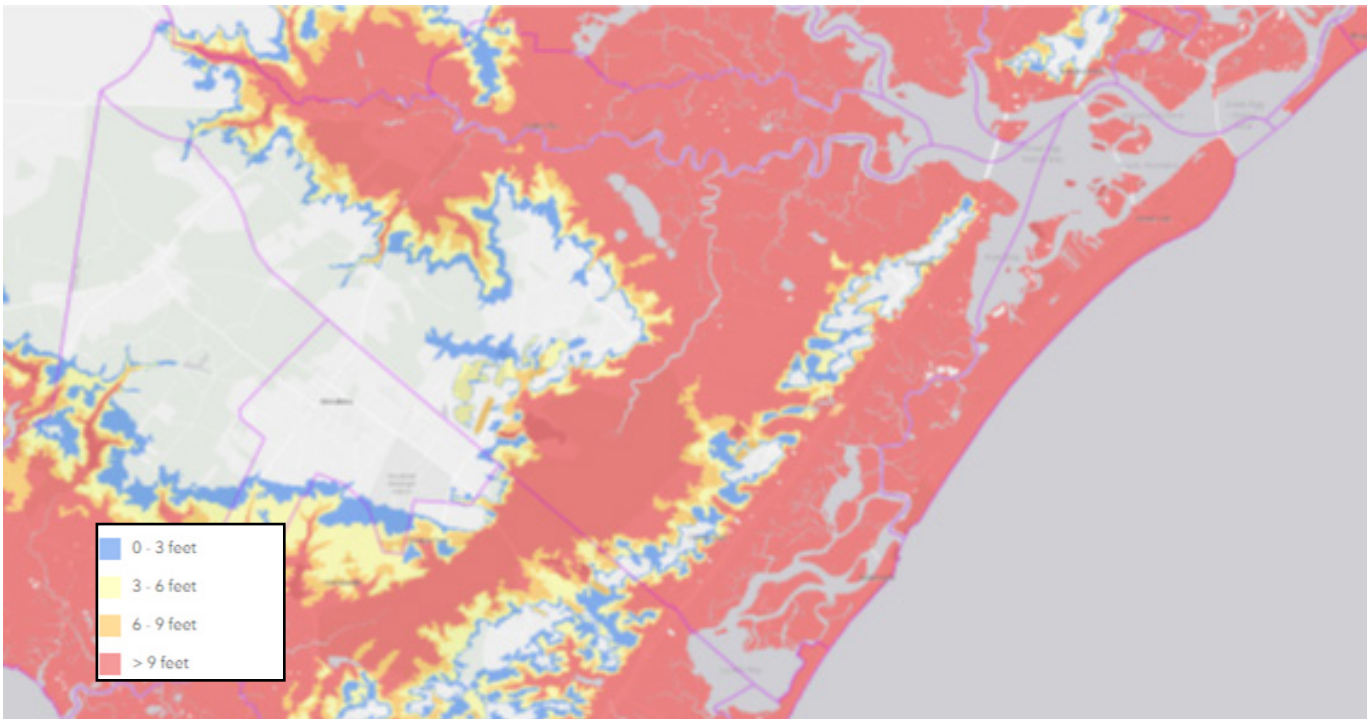
Map 7: Storm Surge SLOSH Category 1. Source: NJ Floodmapper.



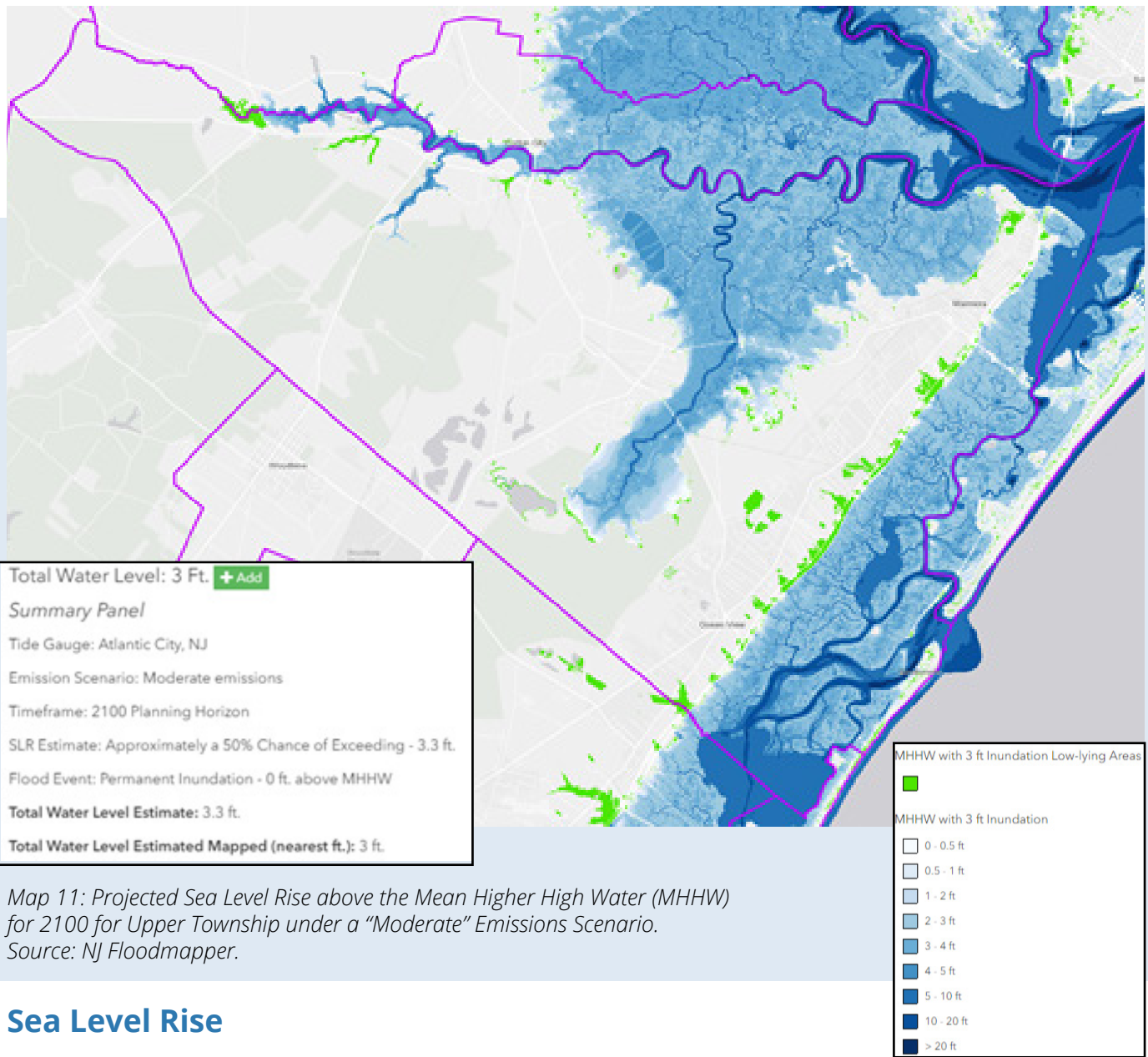
Map 8: Storm Surge SLOSH Category 2. Source: NJ Floodmapper.



Map 9: Storm Surge SLOSH Category 3. Source: NJ Floodmapper.



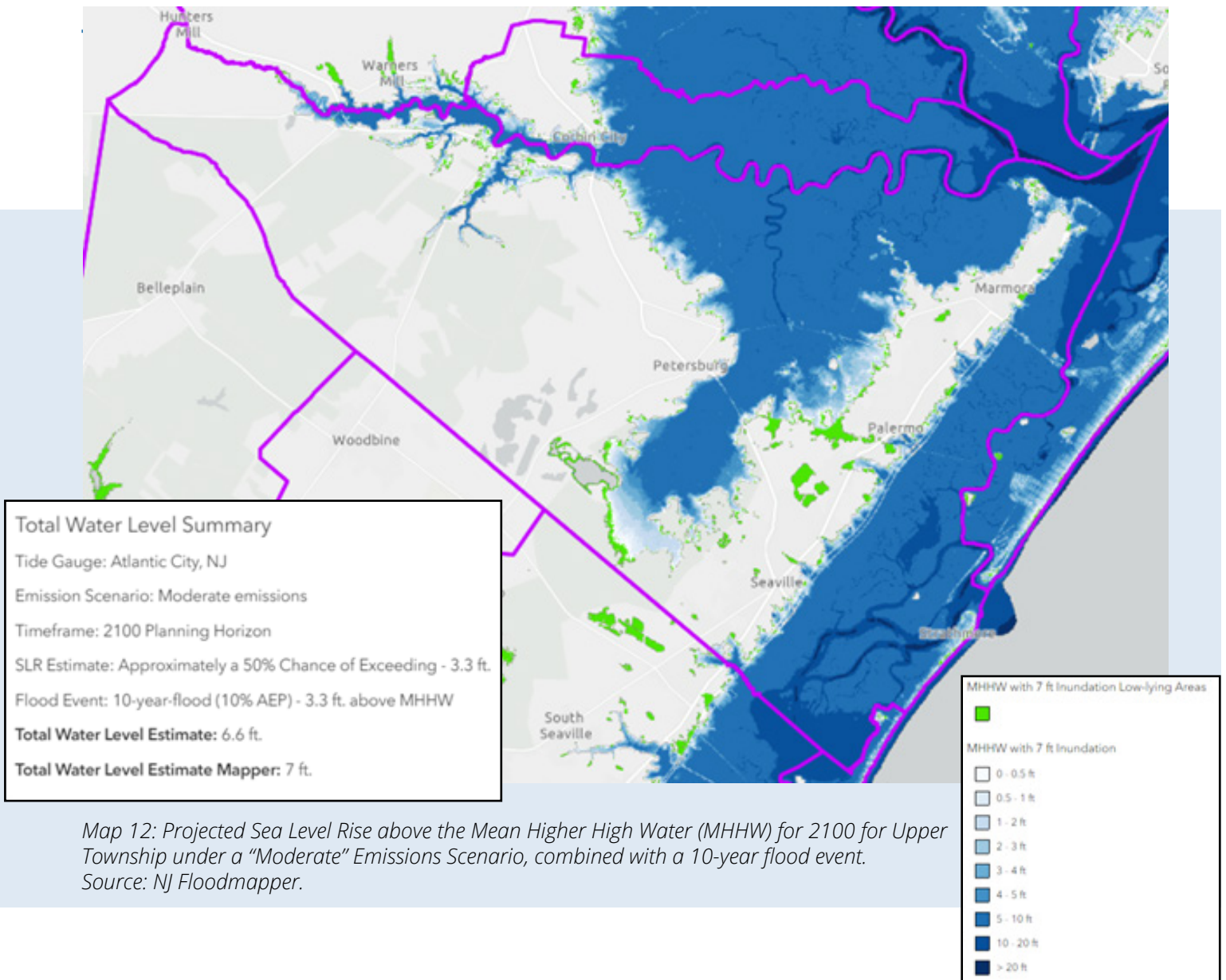
Map 10: Storm Surge SLOSH Category 4. Source: NJ Floodmapper.



Map 11: Projected Sea Level Rise above the Mean Higher High Water (MHHW) for 2100 for Upper Township under a "Moderate" Emissions Scenario. Source: NJ Floodmapper.

Sea Level Rise

As noted in the 2020 New Jersey Scientific Report on Climate Change, sea level rise in New Jersey is the result of several factors, including geological subsidence, ice melting on land, and thermal expansion of water. Sea level rise has been occurring more intensely in the northeastern United States, where it has increased 12 inches since 1900, compared to the global average of 8 inches. The report notes that the rate of sea level rise is projected to increase to a half inch every year by 2050, with projections to 2100 ranging from 0.2 to 0.6 inches per year under a low emissions scenario, 0.2 to 0.8 inches per year under a moderate emissions scenario, and 0.3 to 1.1 inches/year under a high emissions scenario. Put another way, there is a 50 percent chance that by 2100, sea levels will rise by more than 2.8 feet under a low emissions scenario, 3.3 feet under a moderate emissions scenario, and



Map 12: Projected Sea Level Rise above the Mean Higher High Water (MHHW) for 2100 for Upper Township under a "Moderate" Emissions Scenario, combined with a 10-year flood event. Source: NJ Floodmapper.

3.9 feet under a high emissions scenario.

The impacts of these rising sea levels are extensive. It can include more instances of high tide, or "sunny day" flooding of low elevation areas. As one example, the report notes that in nearby Atlantic City, there is a 95 percent chance that that sunny day flooding will occur at least 95 days per year by 2100, and there is a 50 percent chance that it will occur 355 days per year. In addition to the inconveniences and damages to structures and vegetation from this type of regular flooding, sea level rise can exacerbate flood events and storm surges, damaging property, impacting emergency response, and blocking emergency evacuation routes. Sea level rise also can hasten saltwater intrusion, the impacts of which were discussed previously.

Using the NJ Floodmapper tool, we can project the impacts of sea level rise on Upper



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Township. Without any flood events, a moderate emissions scenario in 2100 estimates a 50 percent chance of sea levels exceeding 3.3 feet. As illustrated in **Map 11**, rising sea levels would inundate the marshlands east of the Garden State Parkway and portions of Strathmere. It would impact the areas around the Cedar Swamp Creek and the eastern half of the Tuckahoe River.

Using the same assumptions as above for projected sea level rise, a 10 year flood event, approximately 3.3 feet above the mean higher high watermark, or 7 feet total water level, would inundate most of Strathmere, coastal areas of the mainland west of the Garden State Parkway, as well as areas further inland around the Cedar Swamp Creek and Tuckahoe River (See **Map 12**). NJ Floodmapper estimates that of the Township's 5,621 acres of urban land area, 723 acres, or 12.86 percent, would be impacted by 7 feet of total water level. In contrast, only 66 acres of urban area are estimated to be impacted by 2 feet of total water level.

Based on estimates prepared as part of the County HMP, the Township contains 9,627 buildings with a total replacement cost value of \$6.5 billion. It estimated that 8 buildings in town would be exposed to

1 foot of sea level rise, with a replacement cost of \$6.7 million. At 2 feet of sea level rise, 45 buildings would be exposed, with a replacement cost of \$32.6 million. At 3 feet of sea level rise, 192 buildings would be exposed and have a replacement cost of \$104.9 million. At 4 feet of sea level rise, the 431 impacted buildings in town would have a replacement cost of \$262 million. In terms of people, 6 people would be exposed to 1 foot of sea level rise, 59 people to 2 feet, 277 to 3 feet, and 623 people to 4 feet.

Critical Facilities and Infrastructure

The Office of Planning Advocacy, in their Municipal Climate Resilience Planning Guide (2021), instructs municipalities to use FEMA's Community Lifelines approach to identify critical facilities. These facilities are classified as: Safety & Security; Food, Water, Shelter; Health & Medical; Energy (Power & Fuel); Communications; Transportation; and, Hazardous Materials. Within Upper Township, this includes fire facilities, emergency medical services, health care facilities, municipal and county government offices, emergency shelters, emergency

evacuation routes, schools, water suppliers and potable water facilities, electric facilities, marinas, contaminated sites, and marinas, for a mix of approximately 70 different public, private, and semi-public facilities as identified in the County Hazard Mitigation Plan. As part of the municipal annex for Upper Township, the Township specifically identified 5 critical facilities at risk of exposure to flood risk: the Strathmere Fire Station, the NJ American Water Well Tower and Public Well, the Longport Media Communications Tower, and Atlantic City Electric substations at BL England and west of Wilkie Boulevard.

Increased Temperatures

As noted in the previous section, Upper Township is projected to experience hotter temperatures in upcoming years. Increased temperatures can affect critical facilities and infrastructure in Upper Township. The NJ Climate Resilience Strategy notes that increased heat waves may drive bulking of pavement and misalignment of rail lines. Higher temperature days can increase demands on the electrical grid when people and businesses seek relief through indoor air conditioning. Residents that do not have access to air conditioning may

require access, and transportation to, the Township's cooling shelters.

Drought

While droughts themselves may not necessarily cause direct impacts to critical facilities and infrastructure, they can exacerbate other problems that impact these facilities. As noted in the previous section, drought has the potential to exacerbate saltwater intrusion, eventually rendering wells unusable for potable use, and requiring the consumer, whether residential, commercial, or institutional to seek alternative sources. From a water capacity standpoint, the County HMP notes that droughts are a concern because the County's water is supplied by groundwater, meaning that if there is less water available, then there is diminished capability to fight fires. This is especially concerning because droughts that lead to dried crops, grasses and dying trees can increase risk of brushfires and wildfires.

Fire

Upper Township contains the following critical facilities located in areas identified for fire hazard risk.



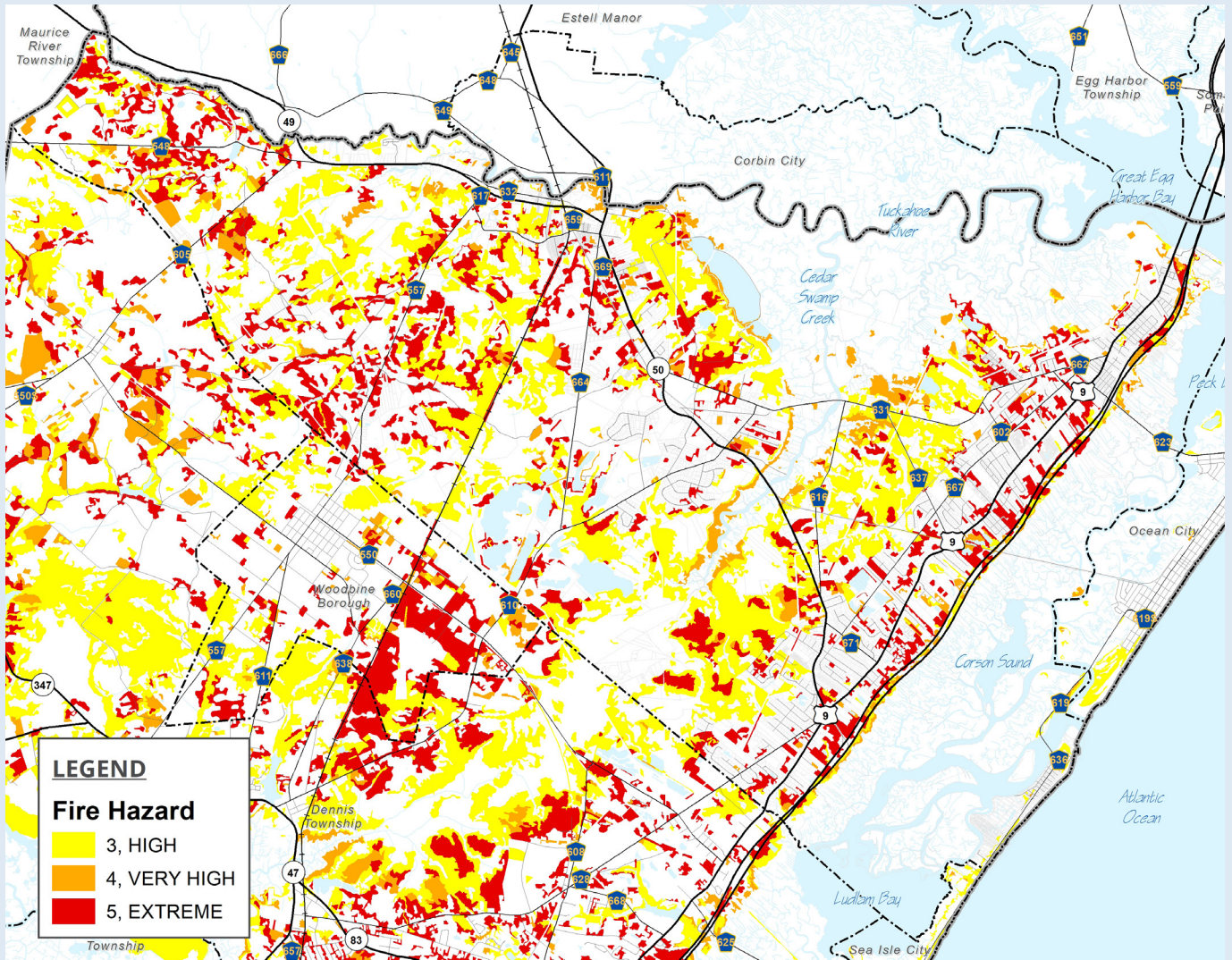
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Table 3: Critical Facilities in Fire Hazard Risk Areas. Source: Cape May County Hazard Mitigation Plan.

	High Wildfire Fuel Hazard Areas	Very High Fuel Hazard Areas	Extreme Fuel Hazard Areas
Communication Tower		1	1
County Facility		1	
Dams	1		
Day Care			1
Marinas	1		
Potable Water Tower			1
EMS		1	

As illustrated in the fire risk map (**Map 4**), the marshlands between the Garden State Parkway and the developed portions of Strathmere are mostly identified as containing a moderate fuel hazard risk. There are extreme fuel hazard risks for the developed corridor west of the Parkway to US Route 9 (**Maps 4 and 13**). Extreme fuel hazards are also found along Tuckahoe Road, Weatherby Road, Head of River

Road, and Woodbine Road. Fuel hazards in proximity to major roadways provides access to manage potential fires from an emergency management standpoint, but they also create the potential to block major evacuation routes.



Map 13: Areas of High, Very High, and Extreme Fire Risk.



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Flooding

Table 4 identifies critical facilities located in flood hazard areas. This table excludes facilities not found to be exposed to either flood event, such as DPW facilities, educational facilities, grocery/food processing, and health services.

The Cape May County Hazard Mitigation Plan identifies the following Coastal Evacuation Routes in Upper Township: State Route 49, State Route 50, US Route 9, County Route 557, County Route 623 (Roosevelt Boulevard), Bay Avenue, and the Garden State Parkway. Countywide, the Plan noted that State Route 49, State Route 50, US Route 9, Roosevelt Boulevard, County Route 619 (Bay Avenue), and the Garden State Parkway all intersected flood hazard areas. This is consistent with the Township's 2015 Getting to Resiliency study, which noted that portions of all of the evacuation routes in Upper Township had flooded during Hurricane Sandy. As part of the County HMP, Upper Township specifically identified that the intersection of Roosevelt Boulevard and the Garden State Parkway is located at a low elevation that is subject to flooding, a concern particularly for those in Ocean City that use this route for evacuation.

Table 4: Critical Facilities in Flood Hazard Areas. Sources: Cape May County HMP, NJ Floodmapper.

	1 percent	0.2 percent
Bridge	5*	5*
Communication Facility	1	1
County Facility	1	1
Dams	3	3
Fire Station	1	1
Library	1	1
Marinas	5	5
Well	2	2
Potable Water Tower		1
Superfund Site		1
TRI Sites		1
Evacuation Shelter		1
Energy Generation		1
Gas Stations	1	1
Electric Sub-station		2

* NJ Floodmapper's Built Infrastructure Assets Exposure Snapshot suggests that 13 bridges in Upper Township are exposed in a 1 percent and a 0.2 percent annual chance flood.

Upper Township, as part of the County HMP, specifically identified the following critical facilities at risk to the 1 percent and 0.2 percent annual chance flood hazard areas:

- Strathmere Vol. Fire Company Fire Station. Vulnerable to both the 1 percent and 0.2 percent annual chance flood hazard areas.
- NJ American Water—Water Tower and Public Well. Vulnerable to both the 1 percent and 0.2 percent annual chance flood hazard areas.
- Longport Media Tower Communications Tower. Vulnerable to both the 1 percent and 0.2 percent annual chance flood hazard areas.
- Atlantic City Electric Sub-Station BL England. Vulnerable to the 0.2 percent annual chance flood hazard area.
- Atlantic City Electric Sub-Station West of Wilkie Boulevard. Vulnerable to the 0.2 percent annual chance flood hazard area.
- Old Tuckahoe Rd South (County Rd-) and Roosevelt Blvd (County Rd-623)
- Roosevelt Blvd (County Rd-623) and Garden State Parkway
- Red Oak Drive
- Groundwater flooding has occurred in 2009 and 2019 due to extremely high groundwater
 - Peach Orchard Rd
 - Mt. Pleasant – Tuckahoe Rd
 - Steelmantown Area

In addition to the above, the Township has also identified the following vulnerabilities from stormwater flooding and groundwater flooding:

- Stormwater flooding occurs on



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Hurricanes

Table 5 estimates the number of critical facilities and lifelines identified in Upper Township in the Cape May County Hazard Mitigation Plan (73 critical facilities and 68 lifelines total), that are exposed to hurricane risk. These facilities are further identified in **Table 6**.

Table 5: Critical Facilities and Community Lifelines Exposed to Hurricane Risk. Source: Cape May County HMP.

	Category 1	Category 2	Category 3	Category 4
Critical Facilities	9	18	32	42
Lifelines	9	17	31	40

Table 6: Critical Facilities and Community Lifelines Exposed to Hurricane Risk. Source: Cape May County HMP.

Header	Category 1	Category 2	Category 3	Category 4
Bridge			1	1
Communications Facility	1	1	1	2
Communications Tower		1	5	5
Dams	1	3	3	3
Fire Stations	1	1	1	3
Library	1	1	3	3
Marinas	3	3	3	3
Medical Clinics			1	1
Municipal Facilities			1	1
Wells	2	2	3	4
County Facilities		1	1	1
Day Care		1	1	2
Electric Substation		1	1	2
Potable Water Tower		1	1	1
Primary Education			1	1
Superfund		1	1	1
TRI Sites		1	1	1
EMS			1	1
EOC			1	1
Veterinary Services			1	2
DPW				1
Polling Places				2

In addition to the facilities identified in **Tables 5 and 6**, evacuation routes are also impacted by hurricane events. This includes issues relating to falling debris, such as downed trees or utility poles, as well as flooding. Countywide, the HMP estimates that 87 miles of evacuation routes (38.9 percent of the total) are exposed to coastal storm hazards under a Category 1 SLOSH, up to 93.2 percent for a Category 4 SLOSH. As noted in the prior section, portions of all of the evacuation routes in Upper Township were flooded during Hurricane Sandy. The Township's 2021 Watershed Management Plan notes that evacuation to the west is the safest pathway from storm threats, and that the Garden State Parkway is accessible when a storm surge is less than 4 feet in height. More problematic are the roads

located at lower elevation. As part of the County HMP, the Township also identified that Roosevelt Boulevard, one of the two connections to the mainland from Ocean City, is vulnerable to flooding at two feet above the mean higher high water (MHHW). The Township also identified Tuackahoe Road, particularly the stretch between Butter Road and Dennisville-Petersburg Road (CR610) are vulnerable to flooding and are inundated between 2 and 3 feet above MHHW. Similarly, State Route 50 is vulnerable to flooding above 2 feet MHHW. Additional information concerning impacts to roadways is described in the following section on sea level rise, which will exacerbate flood hazards in existing flood-prone areas.



Sea Level Rise

Of the 73 total critical facilities in Upper Township identified by the Cape May County HMP, 7 facilities are exposed at 1 foot of sea level rise, 9 are exposed at 2 feet, 10 are exposed at 3 feet, and 13 are exposed at 4 feet. **Table 7** below identifies these facilities by category and height of sea level rise.

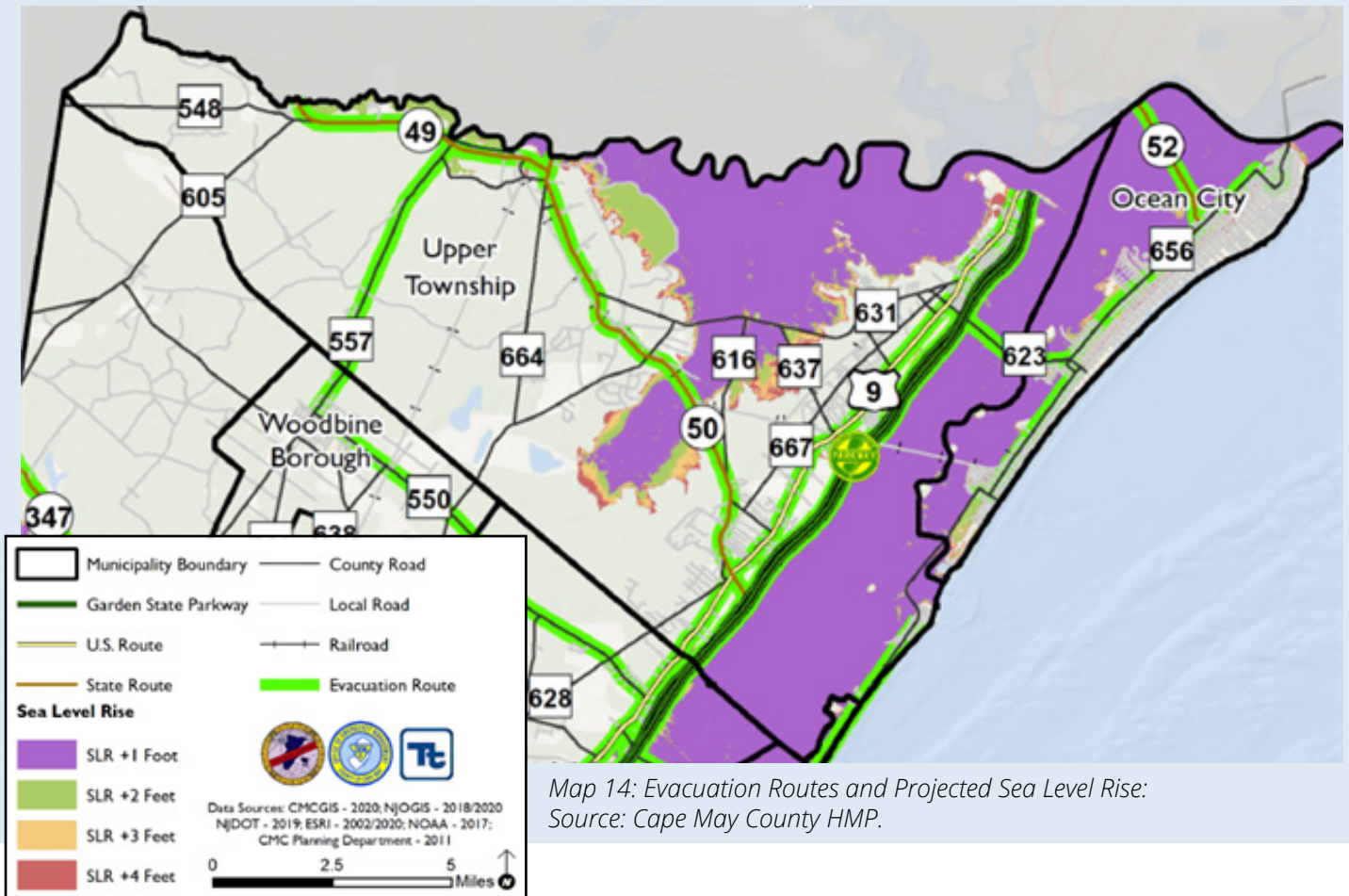
In addition to the above, NJ Floodmapper identifies 1 energy generation facility, 1 gas station, and 13 bridges would be exposed at a Total Water Level (a combination of sea-level rise and floodwater) of 7 feet.

As noted in the previous section, under a moderate emissions scenario, Upper Township is projected to experience 3.3 feet of sea level rise by 2100, without the added impacts from potential storm

surge. This could lead to problems with “sunny day” high tide flooding of numerous existing evacuation routes. As noted in the previous section, Roosevelt Boulevard is vulnerable to flooding at 2 feet MHHW; Tuackahoe Road, particularly the stretch between Butter Road and Dennisville-Petersburg Road (CR610) is vulnerable to flooding and is inundated between 2 and 3 feet above MHHW; and State Route 50 is vulnerable to flooding above 2 feet MHHW. When a 10-year flood event (approximately 3.3 feet MHHW) is combined with this sea level rise scenario, the resulting 6.6-7 feet could flood and potentially block more evacuation routes, particularly portions of the Garden State Parkway. The County HMP estimates that 20 miles of evacuation routes in the County would be inundated by 3 feet of sea level rise, and 33 miles

Table 7: Critical Facilities Exposed to Sea Level Rise. Source: Cape May County HMP.

	1 foot SLR	2 foot SLR	3 foot SLR	4 foot SLR
Bridges	4	5*	5	5
Marinas	3	3	4	5
Wells	0	1	1	1
Fire Stations				1
Library				1



Map 14: Evacuation Routes and Projected Sea Level Rise:
Source: Cape May County HMP.

by 4 feet. In addition to the flooding of evacuation routes, such events could impact local roadways, such as in Strathmere and areas near the Cedar Swamp Creek and Tuckahoe River, impeding access to these evacuation routes. **Map 14** illustrates the impacts of sea levels rising between 1 and 4 feet in relation to identified evacuation routes.



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Natural Resources

As illustrated in the review of land cover (**Figure 1 and Map 2**), forests and wetlands compose 73 percent of the Township. Water covers an additional 11 percent. NJ Floodmapper estimates that Upper Township contains 10,081 acres of interior wetlands, 10,418 acres of tidal marshes, 114 acres of beaches and dunes, 664 acres of agricultural lands, and 11,252 acres of forest. To put it another way, because urbanized developed land only covers 13 percent of the Township, the overwhelming majority of the Upper Township landscape that will be affected by climate change will be its natural systems.

Increased Temperatures, Drought, and Wildfire

As discussed in the previous section, increased temperatures and droughts have the potential to impact natural resources in Upper Township in similar ways. NJ Floodmapper notes that throughout the state, plant hardiness and heat zones will shift based on the number of days with temperatures over 86 degrees Fahrenheit, meaning different species will be better suited to the local climate than previously existed. The current plant hardiness zone of "7" will shift to 8 by 2080-2090 under an RCP of 4.5 or 8.5. The 2020 New Jersey Scientific Report on Climate Change notes that, "Climate change will influence the volume and rate of groundwater recharge in several ways. As temperatures increase and the growing season lengthens, there will be greater demand for water for irrigation use (e.g., crop, nursery, golf course, and outdoor residential), putting more stress on the water supply." (Page 73) Greater demand for water can exacerbate saltwater intrusion, which can impact irrigation for agriculture. A study by the Pinelands Commission, referenced by a 2014 New Jersey Future report also found that water level drawdowns could have

an effect on habitat volume and species richness.⁶

Increased temperatures and droughts may also stress native species. The 2020 Scientific Report on Climate Change describes how moisture tolerant species will be stressed during drought events, while oaks and pines may be more resilient; however, warmer temperatures may also make it more likely for pests to gain a larger foothold in the area, such as the southern pine beetle. Infestations and other stressors, such as drought, could create larger fuel sources for more intense wildfire events.

Flooding, Storm Surge, Hurricanes, and Sea Level Rise

As noted in the previous section, a significant portion of the Township is at risk of flooding. These flood risks are further amplified by storms (i.e. storm surge) and sea level rise. The County HMP estimates that 19,710 acres of Upper Township are exposed to the 1 percent annual chance flood event, and 20,765 acres are exposed to the 0.2 percent annual chance flood event, or 45 percent and 47.4 percent, respectively. It should be noted, however,

6. Van Abs, Daniel J., PhD, PP, AICP. *Effects of Land Development on Water Resources of the Pinelands Region*.

Ecosystem Protection

“To be resilient, New Jersey must ensure that its ecosystems are resilient. The health of an ecosystem directly affects the health and well-being of New Jersey residents who live and work near them and the economies that rely on those ecosystems.... As a priority, strengthening ecosystems serves as a resilience strategy in two ways. First, by supporting the health and diversity of ecosystems, they continue to provide valuable services as the climate changes.... Though their intrinsic value is priceless, the value of ecosystems goes far beyond aesthetics and recreation. In financial terms, the annual value of ecosystem services in New Jersey was estimated to be \$8-19 billion, many of which will lessen the impacts of climate change. Second, nature-based interventions can be less expensive alternatives to hazard mitigation or hard engineering measures, while providing additional value and services. For example, some the most valuable and cost-effective of those mitigation services come from wetlands, which also provide vital habitat and opportunities for recreation.”

NJ Climate Resilience Strategy, 2021

that the HMP acknowledges that some of this area includes waterways. NJ Floodmapper also quantified the area of natural and working lands exposed to flood risk, and found that of the 10,081 acres of interior wetlands in the Township, 3,458 are exposed to the 1 percent annual chance flood, and 4,021 are exposed to the 0.2 percent annual chance flood. Virtually all of the Township’s tidal marshes, 10,418 acres in total, are exposed to the 1 percent annual chance flood hazard area (10,417 acres) and all are exposed to the 0.2 percent annual chance flood hazard area. Over half of the 19,896 acres of open space in Upper Township are exposed in the 1 percent annual chance flood hazard area (10,332 acres), and 0.2 percent annual chance flood hazard area (10,778 acres). All of the beaches and dunes in Upper Township are exposed to both flood hazard areas. Agricultural lands are generally more sheltered from flood hazards, with 83 acres, or 12.5 percent of the 664 estimated total acres exposed to the 1 percent annual chance flood hazard area, and 144 acres (21.7 percent) exposed to the 0.2 percent annual chance flood hazard area. Similarly, of the 11,252 estimated acres of forest area, only 788 are in the 1 percent annual chance flood hazard area, and 1,004 are in

the 0.2 percent annual chance flood hazard area.

As noted in the previous section, under a moderate emissions scenario, there is at least a 50 percent chance that by 2100 sea levels will rise by over 3 feet. When combined with the flooding associated with a 10 year storm, the anticipated total water level is approximately 7 feet. NJ Floodmapper also quantified the area of natural and working lands exposed to total water levels of 2 feet and 7 feet, which are reproduced in **Table 8**. Worth noting below is that in this scenario of 7 feet Total Water Level (TWL), over a third of the Township's interior wetlands are affected, virtually all of the tidal marshes, over half of the open space and over three quarters of the beaches and dunes.

Wetlands that are permanently inundated by water due to sea level rise can drown, which will inhibit their ability to perform natural functions such as flood mitigation, wildlife habitat, and filter pollutants and excess nutrients. It is estimated that in the period between 1977 and 2012, 13 acres of coastal marshes have been eroded as a result of sea level rise and coastal storms. NJ Floodmapper estimates that under 2 feet of sea level rise, 65 acres of marshes will convert to open water, 1,106 acres will convert to mudflats, and 4 acres will convert from freshwater to salt marshes. It also estimates that 216 acres of marsh will be able to "retreat" by migrating landward, while 9 acres would be unable to retreat because of hardened structures, such as roads.

Table 8: Natural features exposed to sea level rise. Source: NJ Floodmapper

Area Name	Total Acres of Natural and Working Land Types	Acres Exposed at 2 ft Total Water Level (TWL)	Acres Exposed at 7 ft Total Water Level (TWL)
Wetlands (Interior)	10,081	1,388	3,857
Tidal Marsh	10,418	10,359	10,417
Open Space	19,896	8,619	10,659
Beaches and Dunes	114	39	88
Agricultural Lands	664	1	109
Forest	11,252	161	945



Vulnerable Populations

Understanding the vulnerable populations in a community is critical to ensuring their protection from future climate and storm threats. What constitutes a vulnerable population can vary; the federal Centers for Disease Control and Prevention (CDC) examines a number of demographic factors as part of their Social Vulnerability Index (SVI):

- Socioeconomic status (below poverty, unemployed, income, no high school diploma)
- Household composition & disability (aged 65 or older, aged 17 or younger, older than age 5 with a disability, single-parent households)
- Minority status & language (minority, speak English "less than well")
- Housing type & transportation (multi-unit structures, mobile homes, crowding, no vehicle, group quarters)

Many of these communities may have impaired mobility, or limited ability to access a personal vehicle in the event an evacuation is required. FEMA also suggests that communities identify what they refer to as “visiting populations,” such as tourists, who “may less familiar with the local environment and hazards and less prepared to protect themselves during an event.”

The social factors used to measure SVI are measured at the census tract level, providing geographically larger communities, like Upper Township, more precision in targeting and assisting potential vulnerable populations. NJ Floodmapper has incorporated the SVI into its program, allowing communities throughout the state to identify vulnerable populations. For reference, the Township contains 3 Census tracts, one covering the western half of the township (hereinafter referred to as the Petersburg/Tuckahoe tract), the northeastern section (the Marmora tract), and the southeastern section (the Ocean View/Strathmere tract). In total, NJ Floodmapper finds that Upper Township ranks in the bottom quarter in terms of containing socially vulnerable populations. It also does not contain any environmental justice communities, as

identified by NJDEP, where the nearest communities exist in neighboring Ocean City and Woodbine.

Cape May County’s update to its HMP evaluated vulnerable populations throughout the county, focusing on populations under age 5, populations over the age of 65, low income populations, disabled populations, and non-English speaking populations, all of which were measured in terms of population density (i.e. persons per square mile). Of these five indicators, densities exceeding the minimum range (i.e. population of 0-50 per square mile) in Upper Township included the populations of people under age 5 and over age 65 in the eastern tracts of the township, each having a density of 50-100 people per square mile.

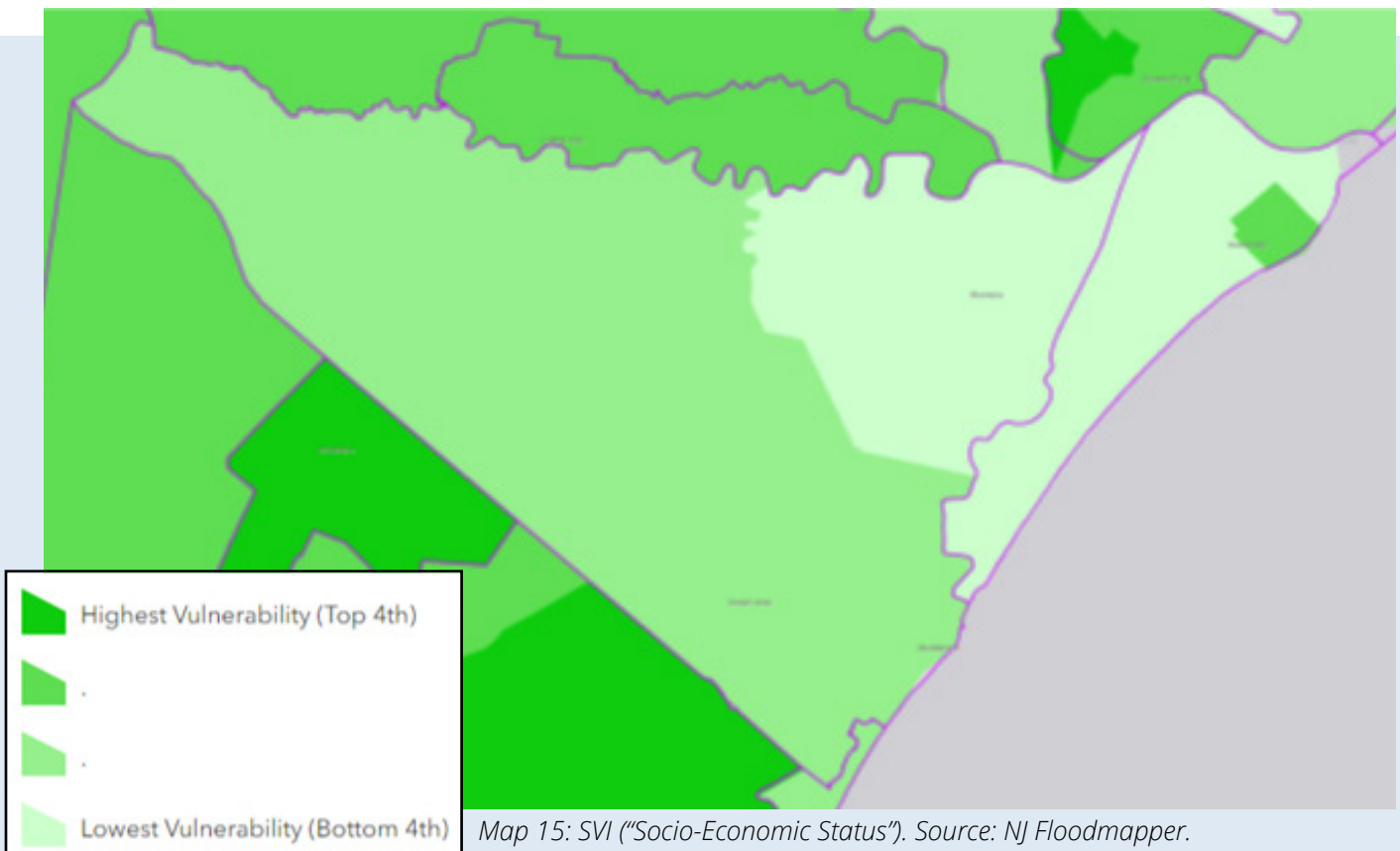
This is not to say that Upper Township does not contain communities that would be considered vulnerable to potential hazard events. Vulnerable populations in Upper Township include its tourist community, as well as certain populations found within the different SVI subcategories based on NJ Floodmapper data, as illustrated in the following section.



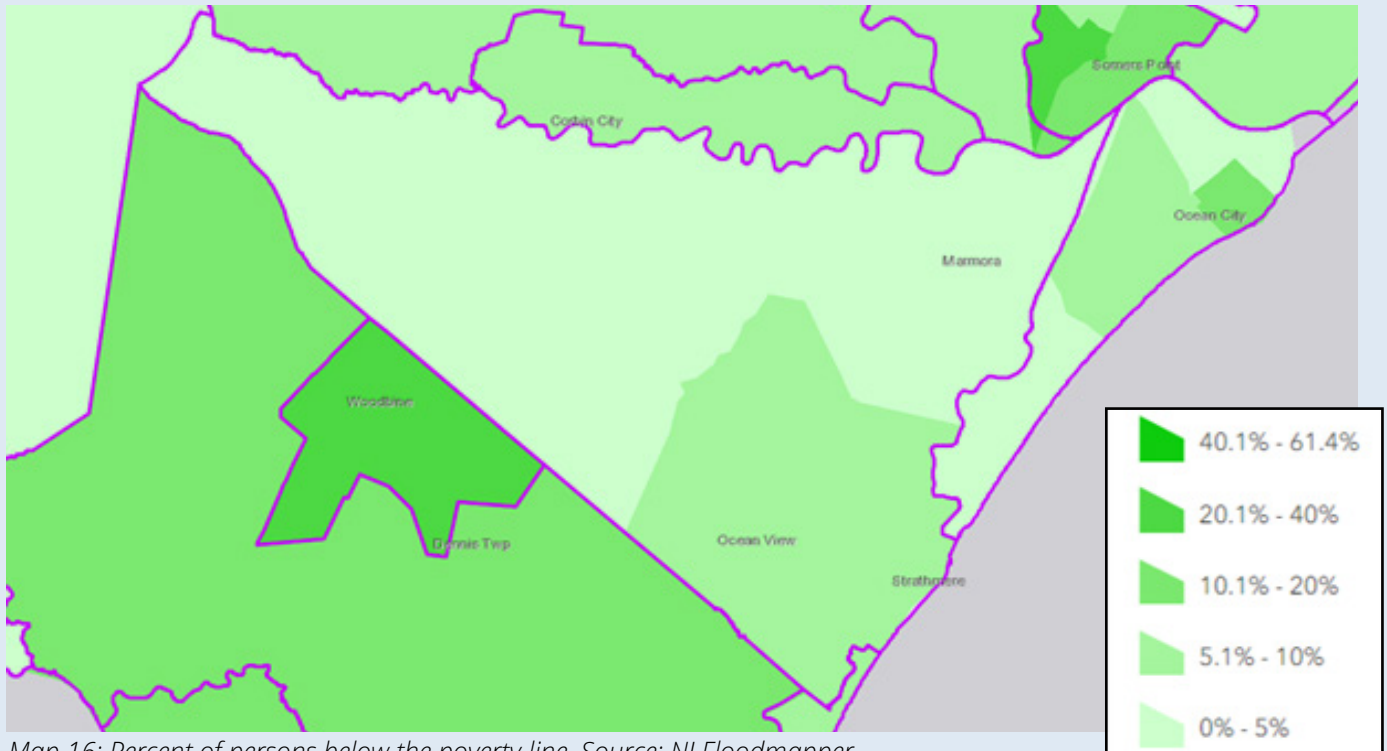
Social Vulnerability: Socio-Economic Status

Map 15 illustrates the Township's SVI under socio-economic status. The entire Township is located within the lower half of communities in terms of vulnerability, with the Marmora area located within the lower quartile. In reviewing the component indicators for socio-economic status, the following demographic indicators illustrate areas of vulnerability elevated above the minimum values, including the percentage

of persons living below the poverty line and the percentage of unemployed persons.



Map 15: SVI ("Socio-Economic Status"). Source: NJ Floodmapper.



As illustrated in **Map 16**, the percent of persons living below the poverty line in the census tract composing the Strathmere and Ocean View neighborhoods is approximately 5.1 percent. The tract composing the Petersburg/Tuckahoe neighborhoods contains approximately 4.7 percent of people living below the poverty line, and the tract containing the Marmora neighborhood contains approximately 3.7 percent.

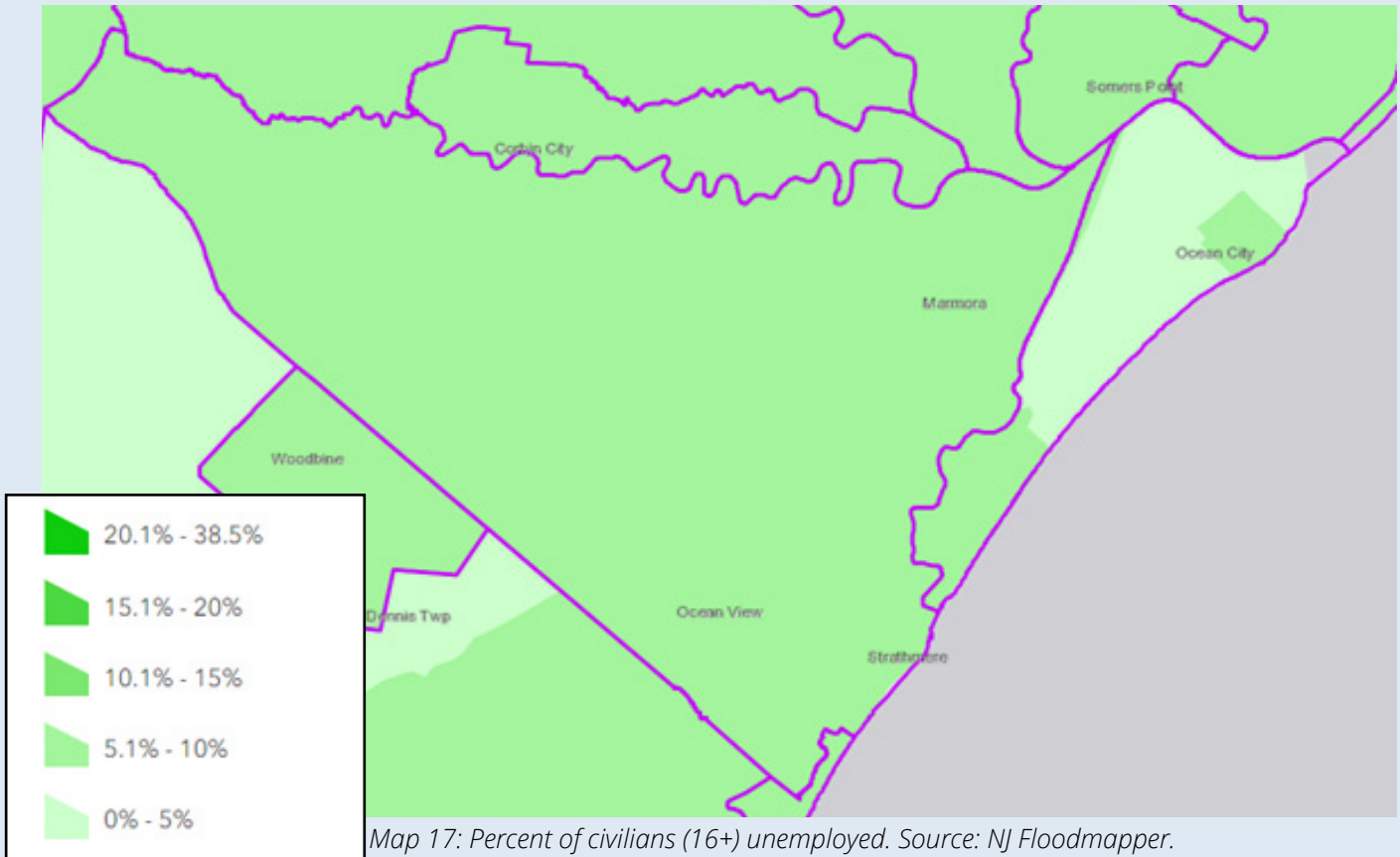
Similarly, **Map 17** shows that the percent of the population age 16 and older that is not

employed is above 5 percent, ranging from 5.3 percent in the Petersburg/Tuckahoe section of the Township to 6.7 percent in the Ocean View/Strathmere tract.

It should be noted that the percent of persons age 25 and older with no high school diploma in each of the Township's Census tracts are all less than 3 percent.



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Social Vulnerability: Household Composition and Disability

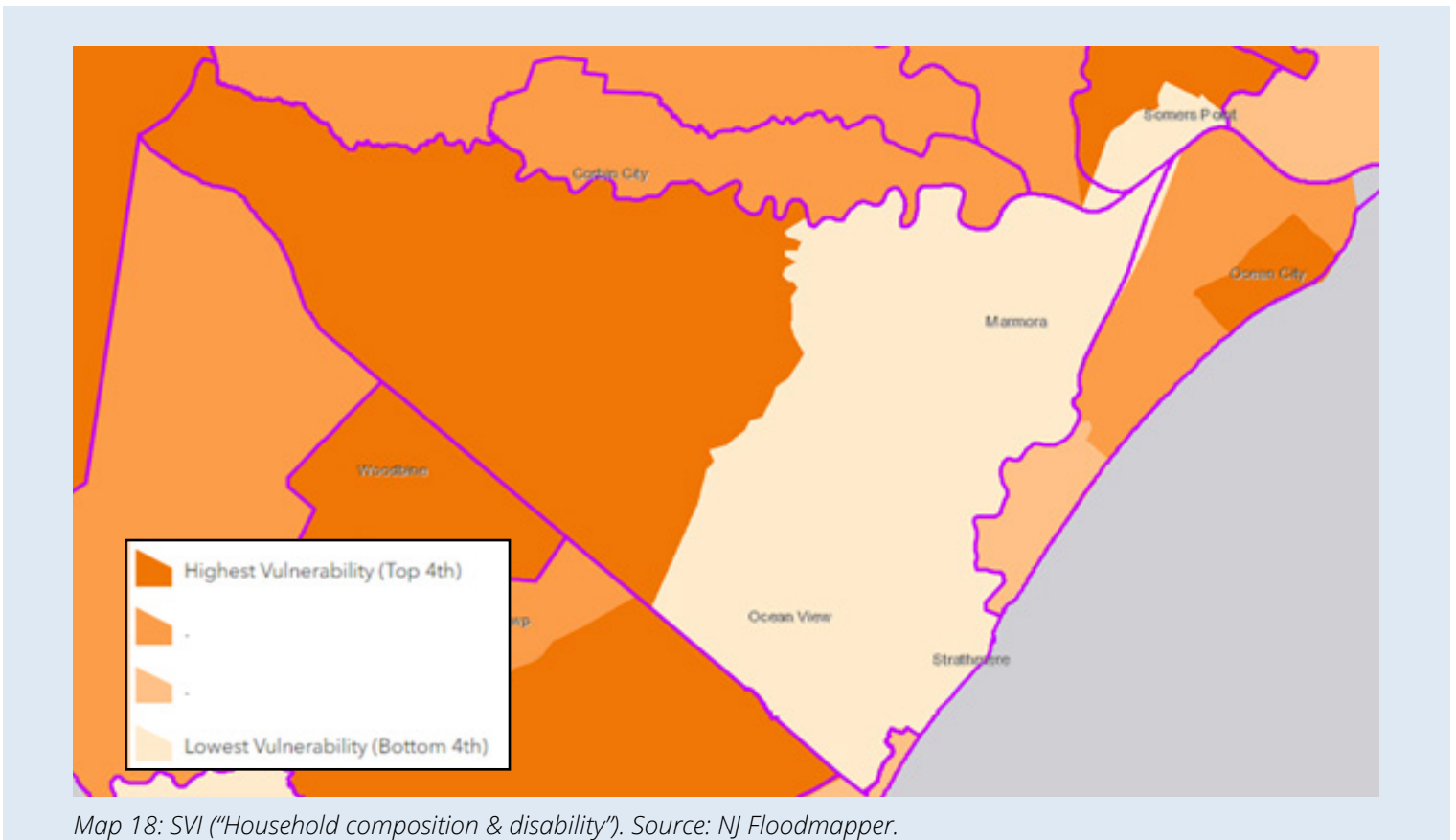
In evaluating the SVI for household composition & disability, it should be noted that while the eastern tracts fall into the lowest quartile, the Petersburg/Tuckahoe tract falls into the upper quartile, as illustrated in **Map 18**. A review of the component indicators for household composition & disability identified the following elevated demographic indicators.

The percent of the population age 65 and older is over 10 percent township-wide, ranging from 12.3 percent in the western section of the Township to over 19 percent in the eastern tracts. For the Township as a whole, approximately 18.60 percent of Upper's population is 65 or older. Conversely, the percent of the population 17 and younger represents 25 percent

of the Petersburg/Tuckahoe tract, 19.4 percent of the Marmora tract, and 20.1 percent of the Ocean View/Strathmere tract. Township-wide, approximately 21.85 percent of the population are ages 17 or younger.

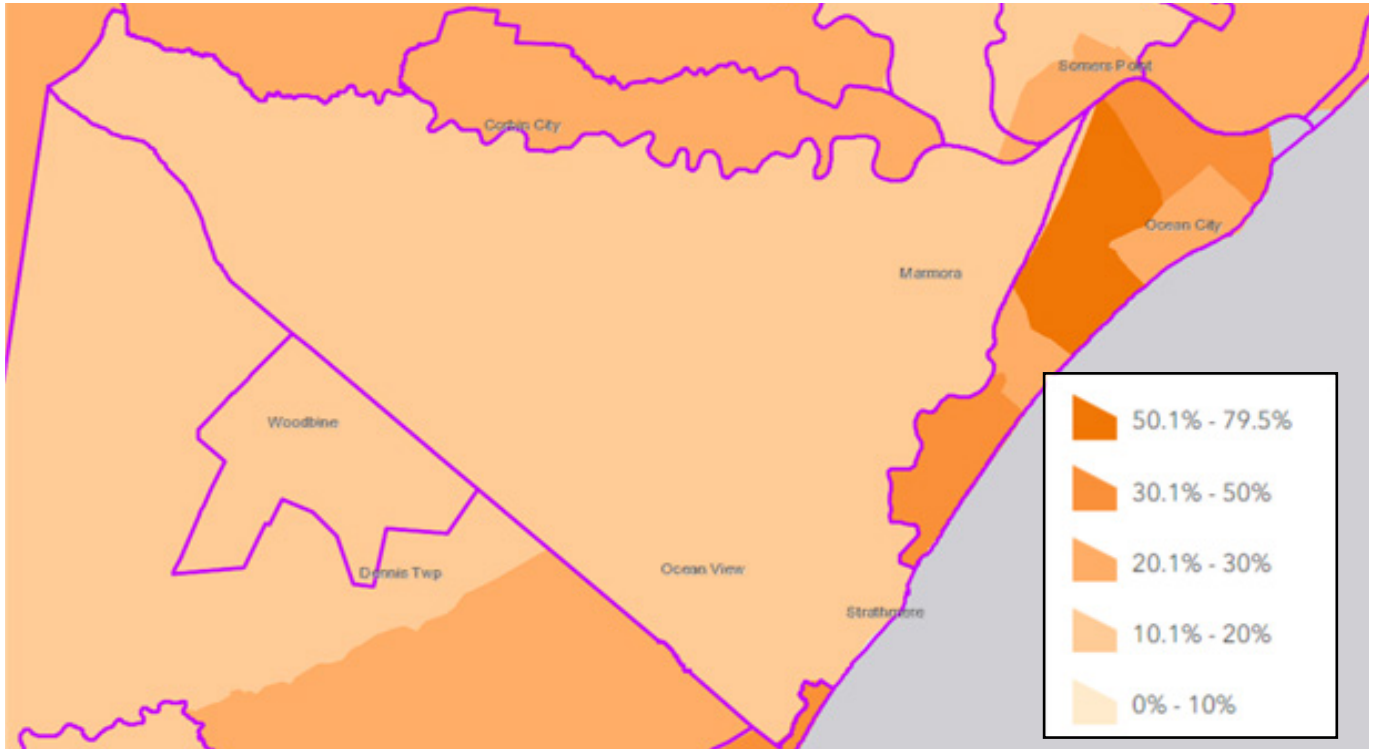
The percent of the population with a disability is somewhat elevated in the Petersburg/Tuckahoe half of the Township, compared to the eastern tracts, at 11.9 percent.

Additionally, the Petersburg/Tuckahoe half of the township contains a slightly elevated percentage of its population with single parent households with children under the age of 18, at 12.5 percent.

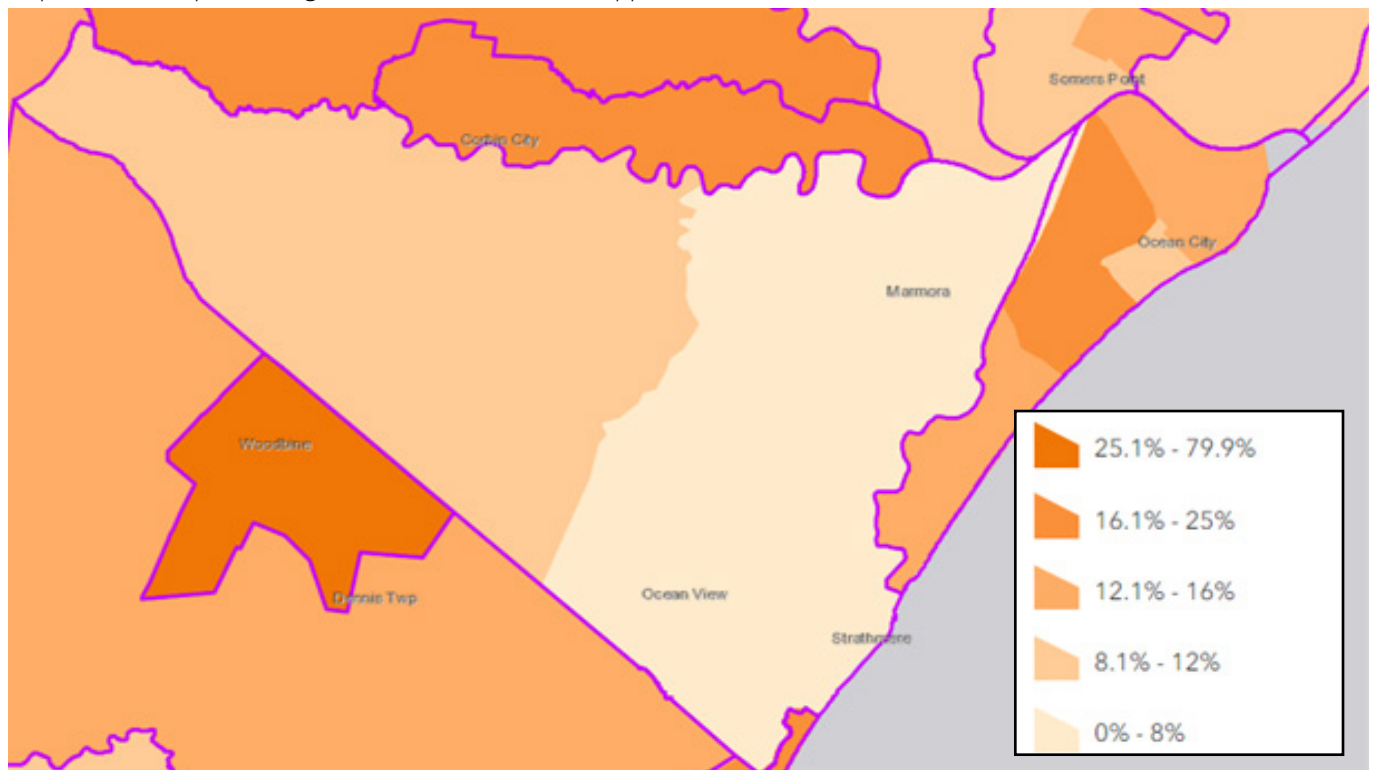




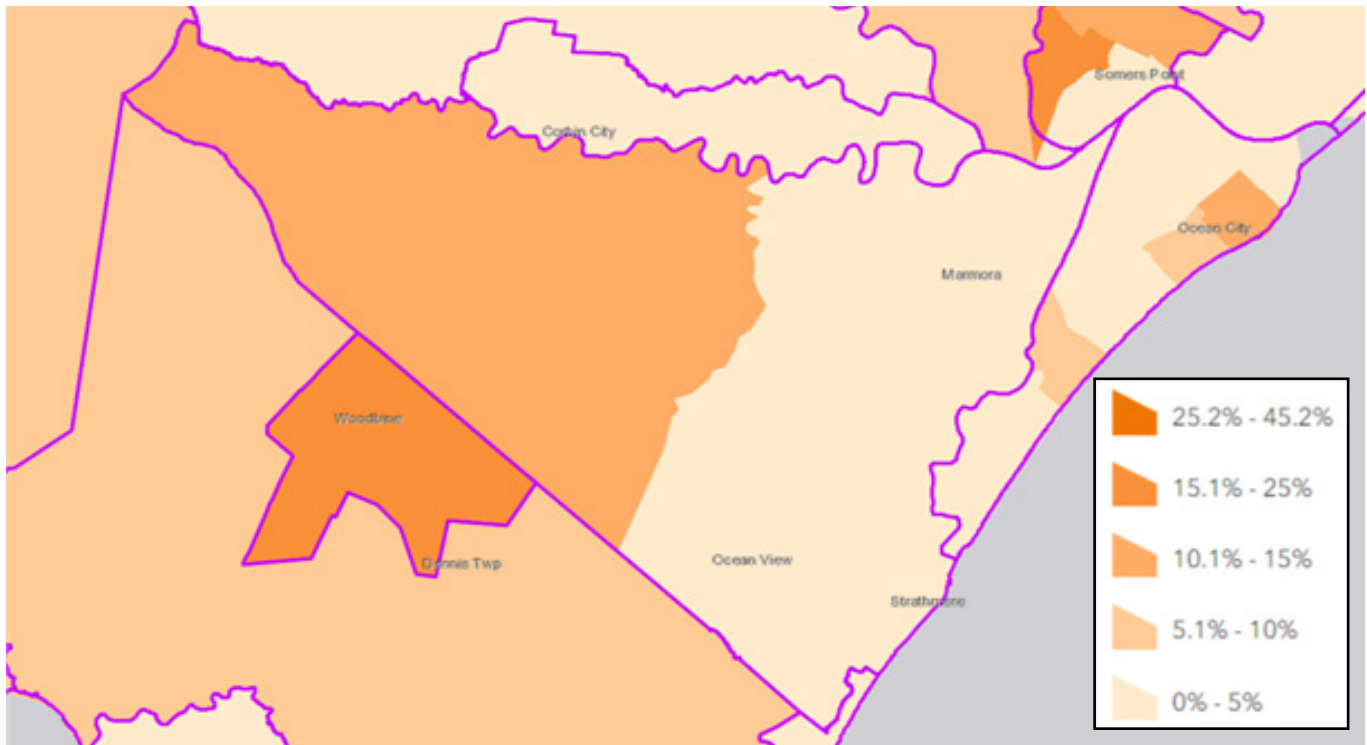
Climate Change-Related Hazard Vulnerability Assessment



Map 19: Percent persons age 65+. Source: NJ Floodmapper.



Map 20: Percent of the population with a disability. Source: NJ Floodmapper.



Map 21: Percent single parent households with children under age 18. Source: NJ Floodmapper.

Social Vulnerability: Minority Status/Language

In evaluating the SVI for Minority Status/Language, all three tracts of the Township fall into the lowest quartile. The individual indicators, including percent minority and percent of people who speak English “less than well” both fell into the lowest percentage groupings. The estimated percentage of minorities in each tract

ranged from 2.4 percent of Petersburg/Tuckahoe, to 3.5 percent of Ocean View/Strathmere. Similarly, the percent of persons age 5 and up who speak English “less than well” ranged from 0 percent in Petersburg/Tuckahoe to 0.6 percent in Ocean View/Strathmere.



Climate Change-Related Hazard Vulnerability Assessment

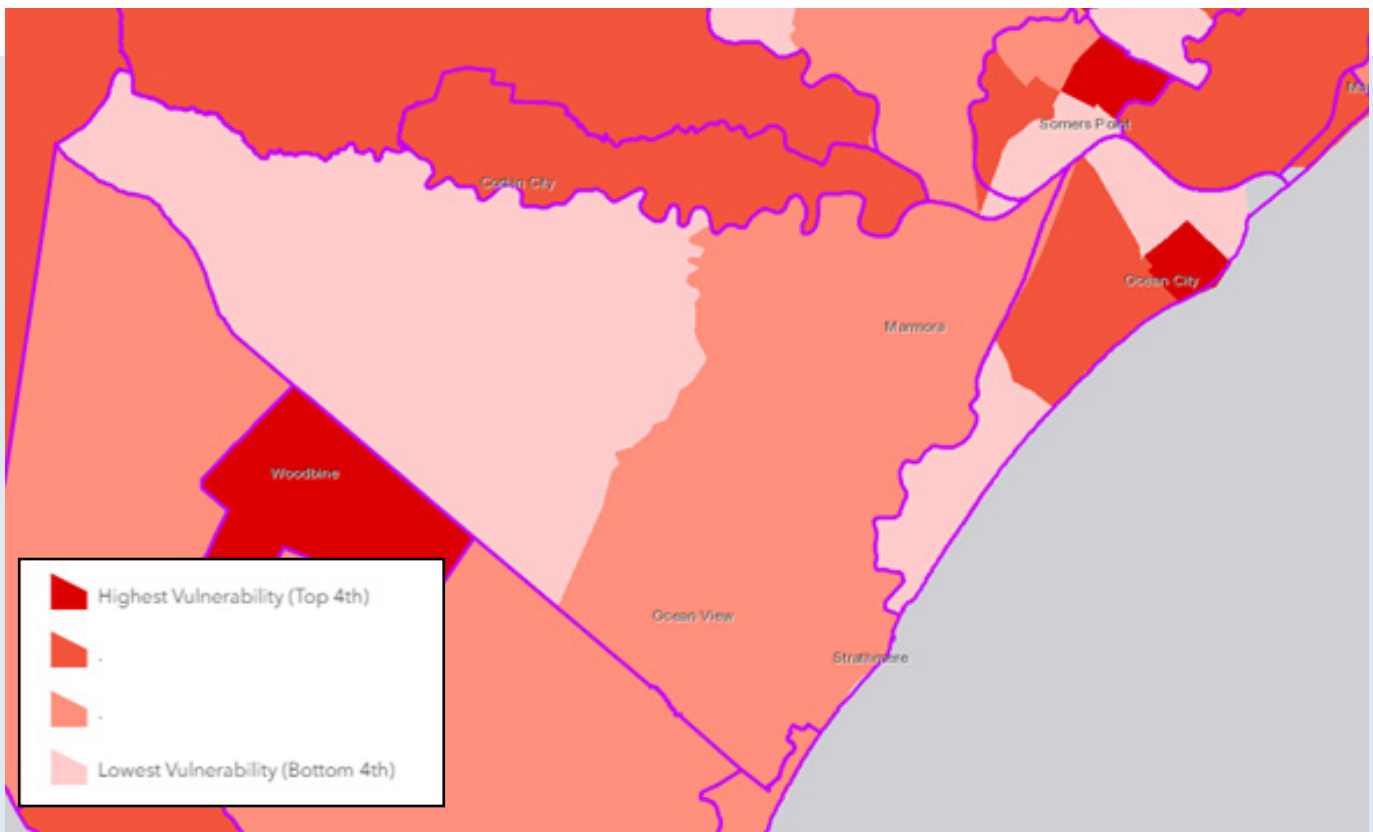
Social Vulnerability: Housing Type/Transportation

Finally, an evaluation of the SVI for Housing Type/Transportation illustrates that the Petersburg/Tuckahoe tract falls into the bottom quartile, but that the Marmora and Ocean View/Strathmere Tracts both fell into the second quartile. A review of the individual demographic indicators of this SVI suggest that a major contributing factor to these elevated figures is the high

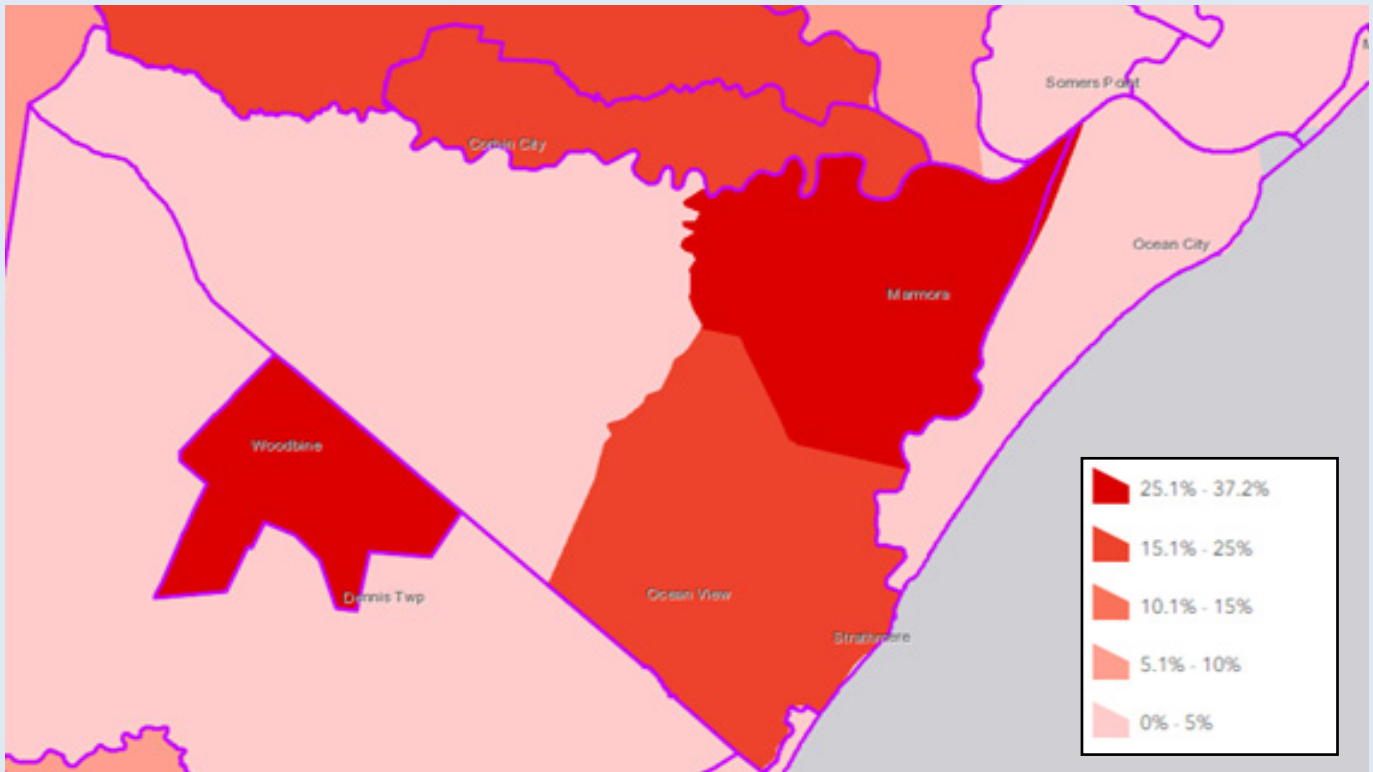
percentage of housing in the eastern tracts classified as mobile homes.

The percent of persons in institutionalized group quarters is low throughout the Township, ranging from 0 percent in Petersburg/Tuckahoe to 0.2 percent in Ocean View/Strathmere.

Similarly, the three tracts in the Township suggest that the percentage of residents



Map 22: SVI ("Housing Type/Transportation"). Source: NJ Floodmapper.



Map 23: Percent Mobile Homes Estimate. Source: NJ Floodmapper.

not containing a vehicle is also low, ranging from 1.4 percent of the Marmora tract, to 5.2 percent of the Ocean View/Strathmere tract.

The percent of occupied housing units that are considered to be “overcrowded” (i.e. with more people than rooms) is also low throughout Upper Township, ranging from 0 percent in Ocean View/Strathmere, to 0.6 percent in Marmora.

The percent of housing with 10 units or more is not a factor in Upper Township, as all three tracts are estimated not to contain

any multifamily structures containing that many housing units.

The one indicator of vulnerability in this SVI subset with significantly elevated values relates to the number of mobile homes, estimated that 1,361, or 20.89 percent of the Township’s housing stock. While the percentage of mobile homes in the Petersburg/Tuckahoe tract is 0, mobile homes represent 27.8 percent of the housing stock in the Marmora tract, and 24.7 percent of the Ocean View/Strathmere tract. NJ Floodmapper estimates that 16



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mobile homes would be exposed at 2 feet of total water level, but then 175 would be exposed at 7 foot of total water level. Similarly, 163 are exposed to a 1 percent annual chance flood, and 209 would be exposed to a 0.2 percent chance flood.

There are other measures of vulnerability outside of the CDC's SVI. ALICE, which stands for "Asset Limited, Income Constrained, and Employed" quantifies the number of working households with income above the federal poverty line that does not earn enough to afford basic necessities. NJ Floodmapper estimates that 26 percent of Upper Township's households are considered to be ALICE households. This is similar to neighboring municipalities, with the exceptions of Somers Point (42 percent), Woodbine (45 percent); and Maurice River (44 percent). The Township's veteran population, estimated at 709 residents, represents approximately 7.8 percent of the civilian population ages 18 and over.

Based on the above, the populations considered potentially vulnerable include the seasonal tourist population, the low income populations, the unemployed population, the concentrations of older and younger households, persons with disabilities, single parent households,

and the high percentage of mobile homes. As noted in the County HMP, the "Economically disadvantaged populations may be more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families." Older and younger populations, such as those over 65 and those under 17 may be more vulnerable because they may not have the ability to prepare for hazardous conditions, and may need assistance from others when such conditions occur. These populations also may be at elevated risk to health impacts from poor air quality and heat stress.

In general, each of the identified hazards would have similar impacts on these vulnerable populations. In addition, the high percentage of mobile homes creates another potential hazard, particularly those that are not properly anchored. While theoretically mobile homes could be moved to avoid potential hazards, in a way being more resilient than fixed-foundation dwellings, they could also become a potential hazard during flood events if not properly anchored and elevated.

Vulnerability and Future Development

A build out analysis was prepared for the Township in 2019 as part of the Cape May County Wastewater Management Plan.⁷ This build out found that under existing zoning,⁸ the Township could see an additional 3,731 units of housing and 9,152,040 square feet of non-residential space.⁹

The build out conducted for the County's Wastewater Management Plan was reexamined as part of this Vulnerability Analysis to compare where the zoning may have changed between 2018 and 2022. It was determined that the only changes made to the zoning map related to the creation of a Waterfront Town Center (WTC) and an Affordable Senior Housing (ASH) district, as well as the rezoning of certain parcels to add another RP (Recreation & Park) district.

Table 9: Projected Buildout.

Zone	Residential (Dwelling Units)	Non-Residential (Sq. Ft.)
AHGR	8	0
AR	33	0
ASH	60	0
C	7	0
CM2	0	43,112
CM4	0	11,808
CMP	0	117,952
F10	5	0
F25	77	0
F3	20	0
MH	153	0
MTCD	1,317	1,652,659
PV	38	0
R	427	0
R2	24	38,979
RD	64	0
TC	415	532,907
TCC	633	575,260
TR	38	0
TV	6	0
WTC	TBD*	TBD*

7. Cape May County Wastewater Management Plan. Prepared by Maser Consulting, P.A., dated January 15, 2019.

8. Zoning Map as revised through August 13, 2018.

9. For those portions of the County located within the Pinelands, the buildout for the wastewater management plan utilized data that had been prepared originally by the Pinelands Commission in 2012/2013 as part of their Kirkwood-Cohansey water supply study.



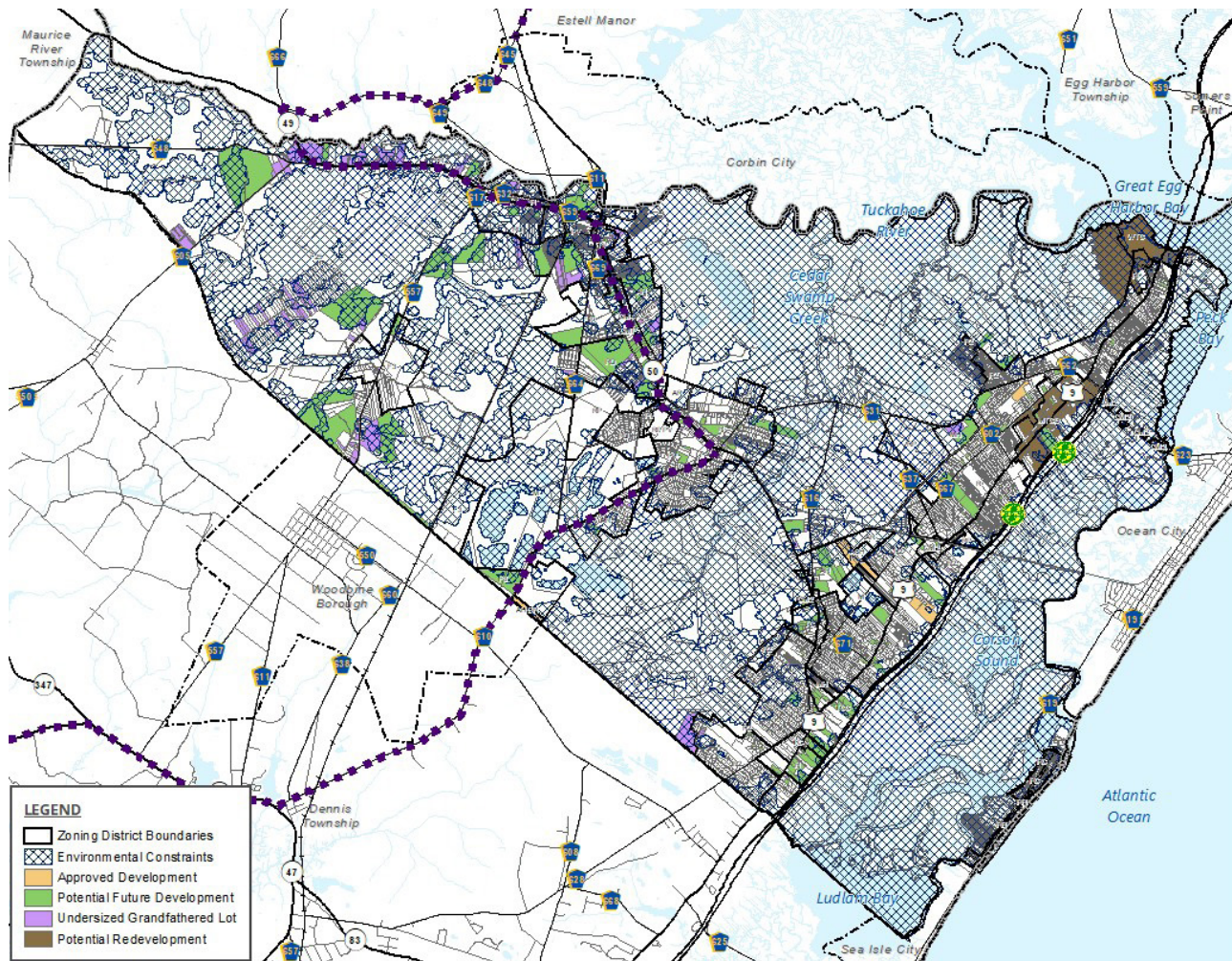
Climate Change-Related Hazard Vulnerability Assessment

The WTC district replaced the zoning in the area around Beesley's Point, including the U Utility district, an area zoned TC (Town Center), and an area zoned R (Center Residential). Just south of the new WTC district, the remaining portion of the U zone and a portion of the R zone were rezoned to RP.

As part of this climate change-related hazard vulnerability assessment, the 2019 build out analysis was revised to account for the changes to the zoning map, and includes those areas within the Pinelands. In addition, the analysis was re-run for those parcels outside of the Pinelands where land use data in the tax records were available.¹⁰ The results of this build out analysis by zone are described in **Table 9**, as well as illustrated in **Map 24**.¹¹



10. The methodology used to prepare this build out is included in the appendix of this report.



Map 24: Buildout Projections.

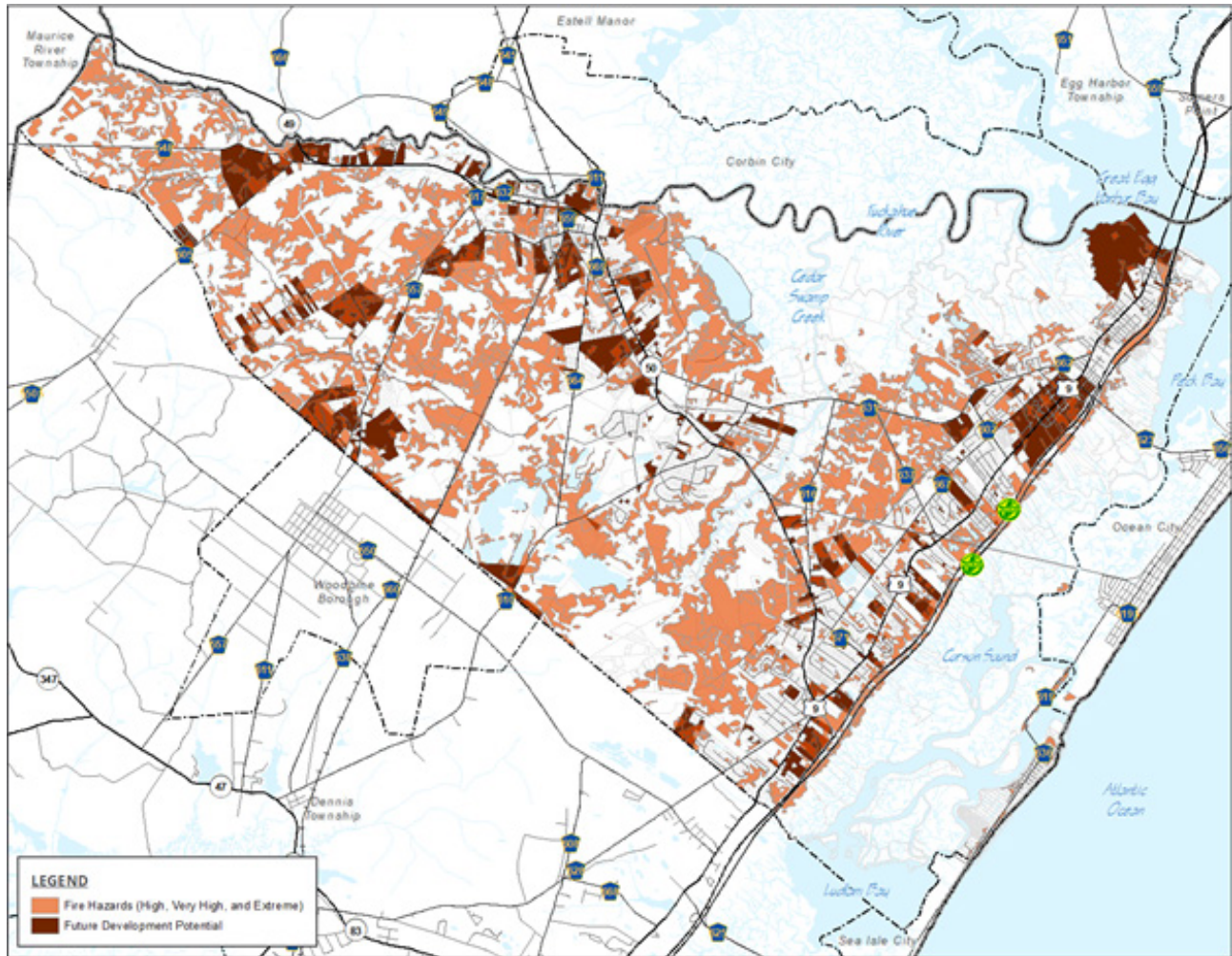
The build out anticipates most of the future development to occur west of the Garden State Parkway, generally along the Route 9 corridor, which is less constrained by environmentally sensitive areas than

elsewhere in the Township. **Maps 25 through 28** illustrate the projected threats to the Township in terms of wildfire risk as well as from flooding that results from sea level rise and storm surge.

11. The area around Beasley’s Point is in the process of being remediated and is anticipated to be redeveloped. At the time the build out was prepared (September 2022), development yields in the area around Beasley’s Point were not available as the zoning for the site is anticipated to change as a part of a redevelopment plan. An October 3, 2022 article in NJ Spotlight covering the demolition of the BJ England cooling tower (“Tower falls as green new world grows around it.” Andrew S. Lewis, NJ Spotlight News) noted that the Township has expressed interest in transforming the area into a marina district, containing a hotel, restaurant, other facilities and structures, as well as repurposing the existing substation to connect to the proposed wind farm, 15 miles offshore. These uses are conceptual only, and have yet to be formally adopted by the Township.



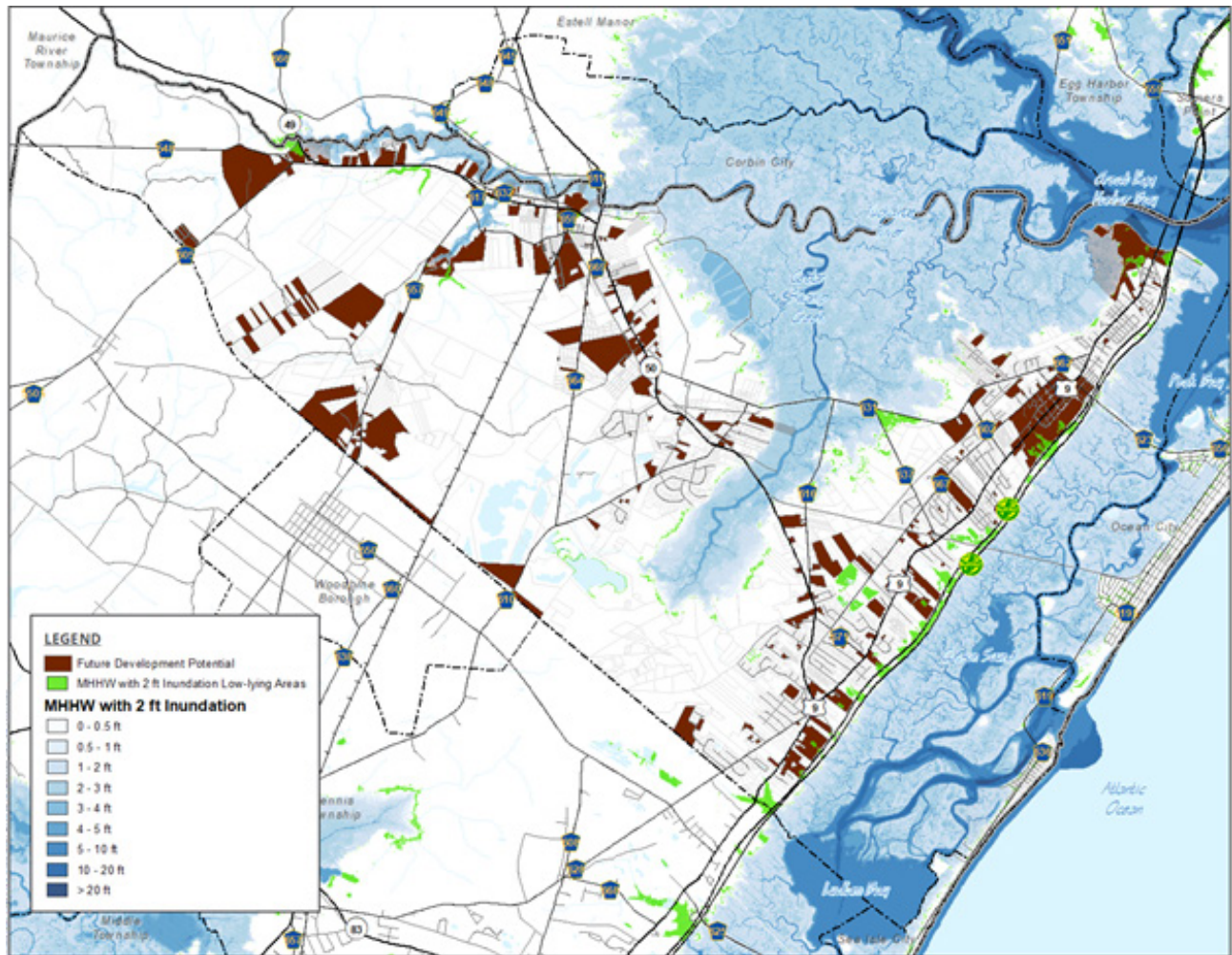
Climate Change-Related Hazard Vulnerability Assessment



Map 25: Projected future development and wildfire risk.

Map 25 illustrates areas where future development is anticipated in relation to areas of fire risk classified as either “High,” “Very High,” or “Extreme.” While the largest contiguous tracts of fire risk are found within the western part of the township in the Pinelands, numerous smaller pockets of fire risk are found throughout the eastern

section of the Township. The areas at risk of wildfire in the eastern section of the Township include significant portions of the Garden State Parkway median, as well as many of the areas anticipated for future development adjacent to the Parkway. Significant concentrations of fire risk areas can be found of NJ Route 50,



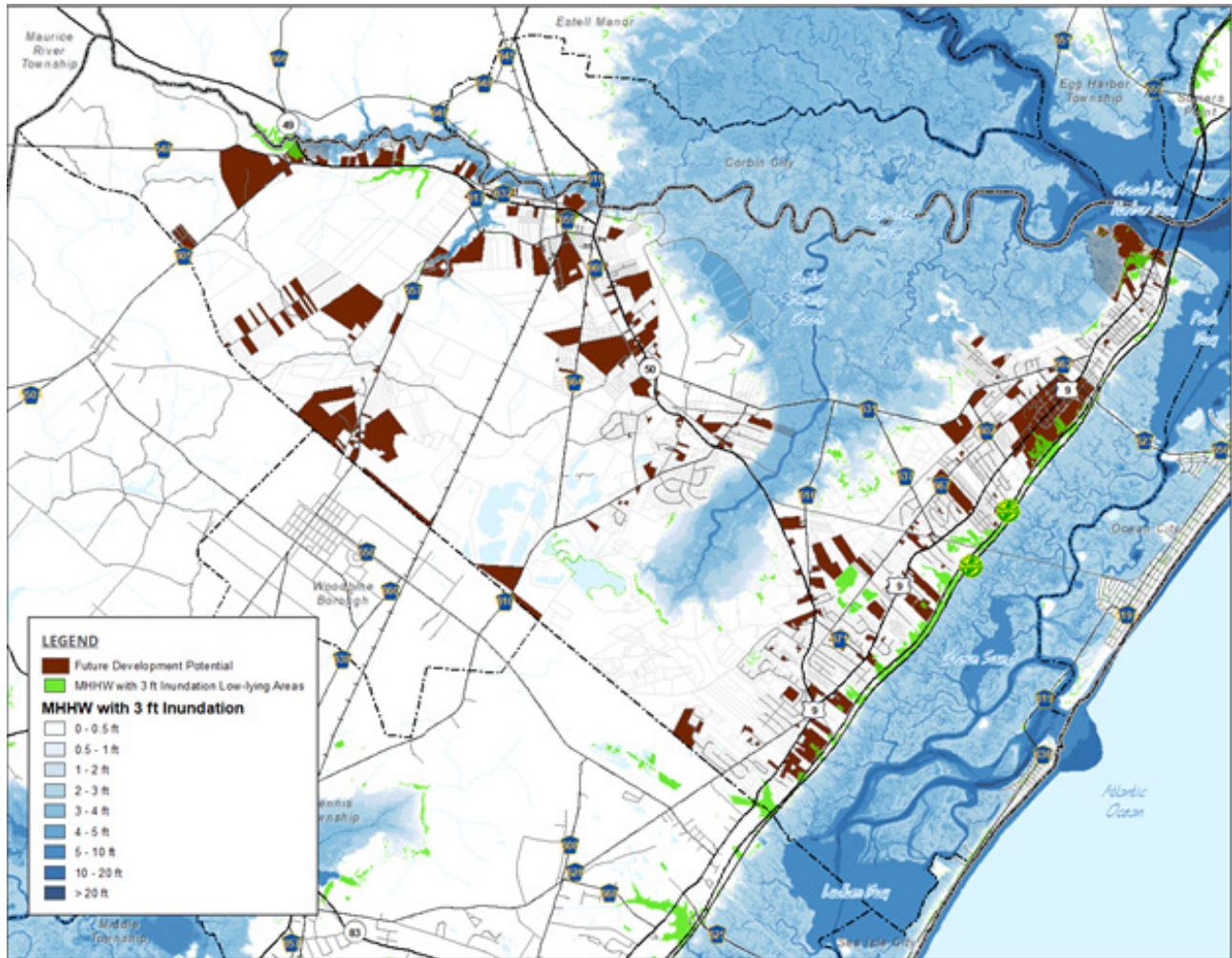
Map 26: Projected future development and 2 feet of sea level rise.

which themselves do not contain much future development potential, but are located within close proximity to future development along the Route 9 Corridor. The future Marmora Town Center also contains lands currently considered to be at risk of wildfire.

Maps 26 through 28 show future development potential in relation to future inundation. **Map 26** illustrates a scenario of 2 feet sea level rise above the existing mean higher high water level, which would affect many of the low-lying areas in Strathmere and areas immediately west of the Parkway. These impacts are



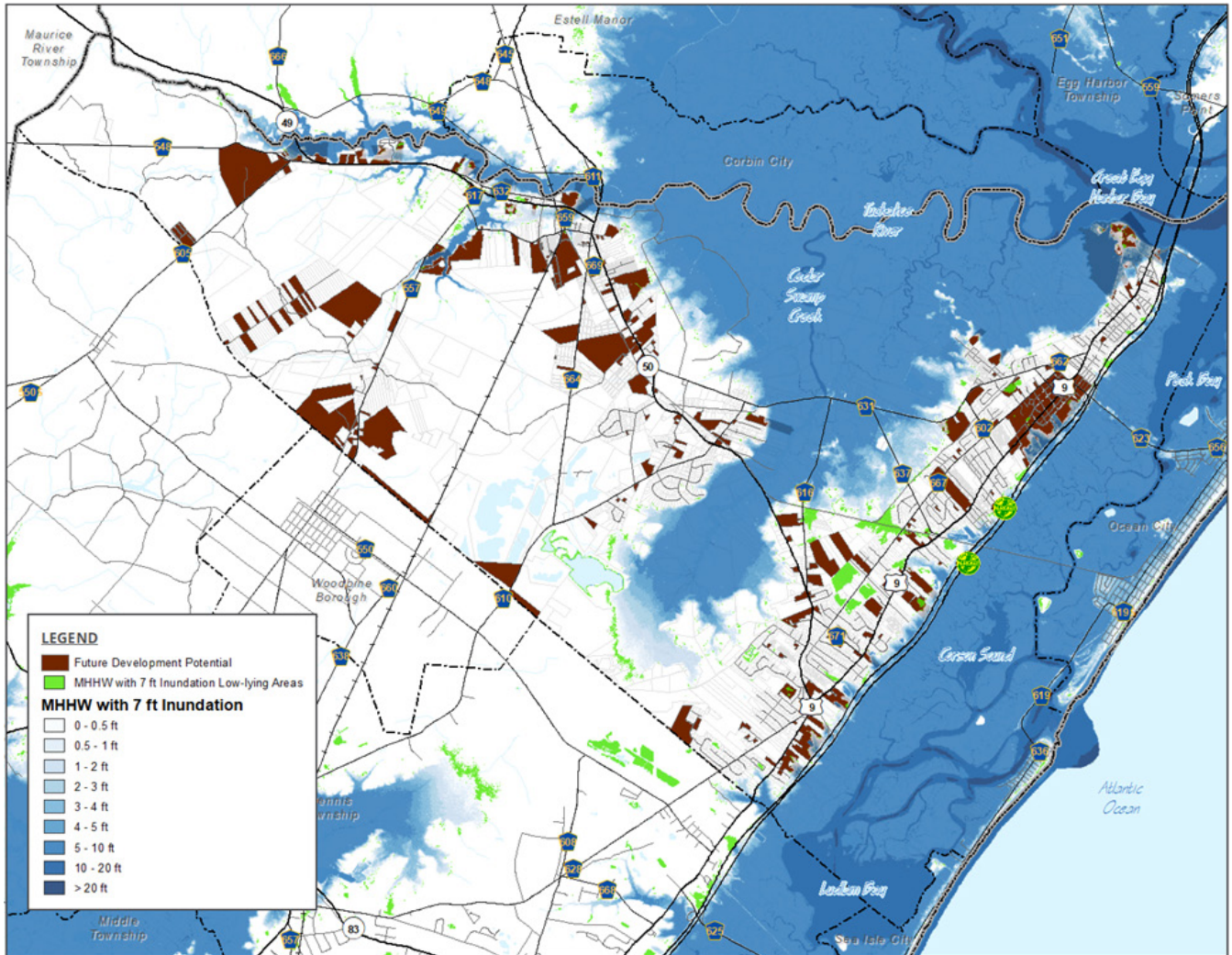
Climate Change-Related Hazard Vulnerability Assessment



Map 27: Projected future development and 3 feet of sea level rise.

exacerbated at 3 feet above the existing mean higher high water level, where low-lying areas west of the Parkway, including those portions of the Marmora Town Center east of Route 9. As described in the previous section, a total water level of 7 feet above the mean higher high water level, which would include the projected

sea level rise by 2100 under a moderate emissions scenario, combined with a 10-year storm event, would lead to significant inundation of Strathmere, as well as many of the anticipated future developments located between the Garden State Parkway and Route 9. Notably, this includes large sections of the Marmora Town Center, and



Map 28: Projected future development and 7 feet of total sea level rise.

the Beesley's Point area. Inundation would also impact those areas suitable for future development along the Tuckahoe River and associated tributaries.



03

Resilience and Adaptation Action Items

Upper Township can work to ensure its resiliency and adaptability in the face of natural hazards and climate change for generations to come by employing sound planning practices which balance development with land conservation and environmental stewardship. The township can protect its people, infrastructure, and natural environment by adopting policies to conserve and protect the water, energy, and natural resources that are assets to the township. These steps will be taken in coordination with local, county, state, and federal plans, and best practices nationwide to enact policies, adopt plans, and guide behaviors to ensure a healthy future for the community.

Coordination

This document, and the recommendations that follow, are intended to complement the efforts currently being undertaken by the State of New Jersey and Cape May County to reduce vulnerability to future risk and improve resilience. As noted throughout this report, the Township has made a concerted effort to improve its resilience through the actions it has taken as part of its participation in the National Flood Insurance Program's Community Rating System and the Plan Endorsement process. The Township can continue to build upon and advance the planning efforts undertaken by the State and County through implementation of the actions identified in the following section.

Recommendations

Upper Township has made a concerted effort to improve its resilience through its participation in the National Flood Insurance Program's Community Rating System, Sustainable Jersey as a Bronze-Certified Community, and the actions it has taken as part of the Plan Endorsement Process. The Township can continue to promote resilience through the actions described in the table that follows. Actions are categorized by type of recommendation, and also include suggested time frames, and responsible parties.





Climate Change-Related Hazard Vulnerability Assessment

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Incorporate this Vulnerability Assessment into the Land Use Element.	Master Plan	Medium	Planning Board
Incorporate the recommendations of the Repetitive Loss Study, Getting to Resilience report, Hazard Mitigation Plan, and Watershed Management Plan into a revised Master Plan.	Master Plan	Medium	Planning Board
Update the goals and objectives of the Master Plan to ensure that resiliency is requisite component of future land use and development.	Master Plan	Medium	Planning Board
Update the Conservation Plan element to identify opportunities to increase habitat connectivity and corridors to support wildlife adaptation to changing conditions. Incorporate the Getting to Resiliency Report under the Conservation Plan Element.	Master Plan	Medium	Planning Board
Consider preparation of an Economic Plan Element, with a special focus on strategies that will allow the township to explore opportunities for new ratables while accounting for the land use adaptations that will occur as a result of sea level rise.	Master Plan	Medium	Planning Board, Township Economic Development Advisory Commission
Consider preparation of a Green Building and Environmental Sustainability Element.	Master Plan	Medium	Planning Board, Green Team
Update the Circulation Element to address future roadway improvements in light of projected threats of sea level rise and flood hazard events.	Master Plan	Medium	Planning Board, Township Engineer
Update the Community Facilities Element to ensure that future community facilities are located in areas of low risk to extreme weather, particularly those facilities that are located in areas at risk of at least 3.3 feet of sea level rise. Where the relocation of community facilities is not feasible, consider alternatives, such as mobile facilities, elevation of structures, or building redesigns.	Master Plan	Medium	Planning Board

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Reexamine the land use ordinance to ensure that buildings can be constructed or retrofitted in a way that maximizes resilience to flooding and sea level rise.	Development Regulations	Short	Township Committee, Planning Board, Township Engineer
Consider the need to amend local codes to require accessory buildings be properly anchored and secured to the ground to minimize the generation of potentially hazardous and dangerous flood debris.	Development Regulations	Short	Township Committee, Planning Board, Township Engineer
Ensure development and redevelopment is informed by current and future coastal hazards and incorporates resiliency	Development Regulations	Continuing	Township Committee, Planning Board, Township Engineer
Continue to participate in FEMA's CRS Program.	Planning	Continuing	Township Committee, Township Engineer
Work with partners on the federal, state, county and local levels to coordinate resiliency efforts.	Communications	Continuing	Township, Cape May County, Pinelands Commission, State of New Jersey
Ensure that existing building, property maintenance, and zoning codes are strictly and uniformly enforced to ensure the maximum safety and integrity of buildings and structures and minimize the vulnerability to damage from potential flood and storm events.	Development Regulations	Continuing	Township Construction Office



Climate Change-Related Hazard Vulnerability Assessment

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Where acquisitions of high risk properties are not feasible, consider innovative land use strategies to reduce or eliminate repetitive loss and severe repetitive loss properties. This could include the establishment of a density transfer program, such as a Transfer of Development Rights program, or a Non-Contiguous Cluster, from areas of high risk to areas of reduced risk.	Planning & Development Regulations	Medium	Township Committee, Planning Board
Coordinate with state and county agencies to disseminate information on programs intended to assist at-risk communities.	Communications	Continuing	Township, Cape May County, State of New Jersey
With ample woodlands in the township, wildfire poses a potential risk in the future and a mitigation plan should be in place. Consider guidance from FEMA, which provides recommendations on how to prepare a Community Wildfire Protection Plan. Such plans address the following: <ul style="list-style-type: none"> Mitigate potential ignition sources. Landscaping designs around buildings. Fencing designs around buildings. Removing dead trees from areas at risk. Providing education to homeowners and tourists on techniques to reduce fire risk. Improving access to information for emergency responders, including signage and directions to hydrants and/or water access. 	Planning	Medium	Township OEM Coordinator, Local Fire Departments
Encourage neighborhood participation in the National Fire Protection Association's Firewise Communities Program, which helps educate communities on how to adapt to living with wildfire and what actions can help prevent future losses.	Planning	Medium	Township OEM Coordinator, Local Fire Departments, Neighborhood/Community Associations

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Encourage local fire departments to participate in the Ready, Set, Go! program. This program is designed and managed by the International Association of Fire Chiefs to give local fire departments outreach tools to educate residents about the dangers of wildfire, helping them to prepare and act in the event of a fire.	Planning & Communications	Medium	Township OEM Coordinator, Local Fire Departments
Make efforts to register individuals with disabilities and other access and functional needs, and their caregivers, families, friends, and associates, with the New Jersey Office of Emergency Management's Register Ready—NJ's Special Needs Registry for Disasters. This database allows first responders to be aware of the presence of these individuals and their needs in case of an emergency or disaster. This information helps emergency response agencies to better plan how to serve these individuals in the event of a disaster or other emergency, and ensures that essential warnings and updates can be efficiently communicated. Outreach efforts should include a variety of different media, including, but not limited to: paper fliers and web-based information, presentations at community meetings, and social media.	Planning	Short	Township OEM Coordinator, Township Clerk
Prepare an extreme temperature event plan to protect those residents susceptible to extreme cold weather events or heat waves.	Planning	Medium	Township OEM Coordinator
Support continuing efforts to replenish, maintain and expand the dune system along the beachfront.	Engineering & Communications	Long	Township, State of New Jersey, Army Corps of Engineers
Promote public awareness of the importance and practice of effective shoreline management.	Communications	Short	
Work with utility providers to ensure there is sufficient land in appropriate locations to ensure that substations and communications infrastructure are less susceptible to flooding, fires, and other hazards	Planning & Engineering	Ongoing	Township, NJ American Water, South Jersey Gas, Atlantic City Electric



Climate Change-Related Hazard Vulnerability Assessment

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Identify and mitigate areas of localized nuisance flooding.	Planning & Engineering	Medium/ Long	Township Engineer
Prepare a stormwater system maintenance strategy to optimize the Township's existing system.	Planning & Engineering	Medium	Township Engineer
Promote water conservation programs, such as by sponsoring rain barrel workshops, as ways to manage residential stormwater while also reducing the need for irrigation.	Communication	Medium	Township's Green Team
Continue Participation in Sustainable Jersey. Seek to upgrade certification from Bronze to Silver, with potential Gold Star Standard for Health, which includes actions relating to Emergency Management and Resiliency	Planning	Short/ Medium	Township's Green Team and Township Engineer
Promote the use of drought-tolerant native vegetation in public and private landscaping	Communications	Short	Township, Township's Green Team, Planning Board, Zoning Board
Actively seek funding opportunities to elevate critical facilities and municipal infrastructure.	Engineering	Ongoing	Township
Actively seek and promote funding opportunities for property owners to raise buildings, driveways, bulkheads, yards, and wetlands to critical flood control elevations	Engineering & Communications	Ongoing	Township
Actively seek grant funds to install or replace aging stormwater drainage system infrastructure	Engineering	Ongoing	Township, Cape May County, State of New Jersey
Actively seek funds and technical assistance to advance Township green infrastructure efforts	Engineering	Ongoing	Township, Cape May County, State of New Jersey, Sustainable Jersey

Action Items

Timing: Short = 1-2 years; Medium = 2-5 years; Long = 5-10 years; Continuing = Ongoing

Action	Category	Time Frame	Responsible Parties
Coordinate with mobile home communities to establish community-specific storm preparedness plans.	Planning	Medium	Township OEM Coordinator, Local Fire Departments, Neighborhood/ Community Associations
Work with local real estate offices to disseminate storm preparedness publications to renters, identifying locations of shelters, evacuation routes, important phone numbers and websites.	Communications	Ongoing	Township OEM Coordinator



A1

Appendix

Buildout Methodology

This section of the report describes the buildout methodology used to project future development within the Township of Upper. This analysis has been prepared in order to assess the amount of remaining developable lands within the Township of Upper and to assess the amount of potential development, if these lands were fully developed to their maximum potential. Utilizing GIS (geographic information system) technology, the amount of developable land has been assessed based on lot area and bulk requirements as compared to the minimum requirements of each individual zone district.

The results generated by these analyses were based on mathematic calculations of lot area and contiguous unconstrained land (land not encumbered with wetlands or riparian buffers) with regards to the requirements of the respective zoning. These analyses represent the total development limits of the municipality and do not account for time factors, economic factors or real estate trends. In other words, the analyses represent the maximum amount of development that could occur based on the amount of remaining developable lands. This study does not make any assumptions as to timeframe for the Township to reach full buildout, or even if it will. The results of this study are meant to

illustrate the effects that the zoning would have if the Township were to become fully built-out. The calculated development potential of each parcel is subject to site-specific review of applicable state environmental regulations as well as municipal subdivision and site plan procedures.

Data Sources

This build-out study is based on existing land use conditions and the most recently adopted zoning standards for the Township of Upper. The following discusses the data sources that were utilized in the preparation of this report and the processes for updating and validating the data. As noted, this buildout was originally prepared as part of the Cape May County Wastewater Management Plan, and updated to reflect zone changes, Pinelands area zoning, and identifiable land use changes.

- **Existing Land Use.** In order to analyze the remaining developable lands within Upper Township, a parcel database is utilized, which is linked to the Mod-IV property tax information for each parcel. Each parcel's land use type is based on the tax classification. Upper Township's parcel database was originally provided by the Cape May County Planning Department, dated November 2017. Some properties in the parcel database do not have a corresponding line item in the Mod-IV data, which results in a number of properties being unclassified. The Cape May County Planning Department previously attempted to classify those properties, to the extent possible, by utilizing the "additional lots" field for other Mod-IV records or Pictometry© images to determine whether a property is developed. Updated parcels and Mod-IV records were downloaded in June 2022 from the New Jersey Office of Geographic Information Systems website. For the revised buildout, land use classifications from the 2022 data were used for all parcels with available classifications. For all other instances, the classifications obtained from the prior buildout were utilized.
- **Zoning Boundaries.** The zoning boundaries and standards are from the Zoning Ordinance (Chapter 20) and the Zoning Map for the Township of Upper, revised July 12, 2021.



Climate Change-Related Hazard Vulnerability Assessment

- Environmental Constraints. Environmentally sensitive areas were spatially attributed to the parcel database for Upper Township to assess the amount of contiguous unconstrained land within each parcel and the constrained lands were removed from the analysis.

For the purposes of this buildout analysis, the following environmental constraints, were assumed to constrain future development within the adopted wastewater service areas:

- Open Water Bodies as delineated by the NJDEP National Hydrography Dataset (NHD) Waterbody GIS data, last updated by NJDEP on November 1, 2010.
- Freshwater Wetlands were extracted from the 2012 NJDEP Land Use/Land Cover data. Transitional area buffers were added to the constrained area. Wetlands areas associated with a primary water body (river, bay, ocean, etc.) and/or containing habitat for threatened and endangered species (Rank 3, 4 and 5 as per the NJDEP Landscape Project Version 3.3) were assumed to have exceptional resource value and 150-foot transition area buffers were applied. Isolated patches of wetlands not containing threatened and endangered species habitat were assumed to have intermediate resource value and 50-foot buffers were applied.
- Category-One (“C1”) Waters and their Tributaries as delineated by the NJDEP Surface Water Quality Standards data were given a 300-foot Special Water Resource Protection Area (SWRPA) buffer included in the constrained area.
- Riparian Buffers were added to non C1 streams in accordance with the NJDEP Flood Hazard Control Act. Streams adjacent to threatened and endangered species habitat are given a 150-foot wide riparian buffer. All other streams are given a 50-foot riparian buffer.

Methodology and Assumptions

- The Township of Upper is proposing to extend sewer service to the Marmora Town Center District and the existing development along Roosevelt Boulevard to the Ocean City Regional Wastewater Treatment Plant (WTP). Alternatively, the Marmora future sewer service area would discharge to groundwater if connection to Ocean City Regional WTP is not feasible.
- The analysis assumes that the Marmora Town Center District will be redeveloped in accordance with the underlying MTCD zone district. The buildout analysis of the Marmora Town Center District, performed by the Upper Township Engineer in September 2018, is incorporated into this analysis. The analysis was performed based on blocks rather than individual parcels in accordance with the concept plan prepared by the Upper Township Engineer.
- The permitted use(s) of each zone dictates whether each property is assigned a residential, non-residential or mixed use development.
- Where a zone permits mixed-use development, the analysis assumes that the first floor will be retail with residential on the upper floors.
- Per the request of the Township, all Township-owned properties are considered preserved and not developable for the purposes of this analysis.
- In accordance with Cape May County Health Department policy, a minimum lot area of 35,000 square feet and a minimum of 15,000 square feet of unconstrained land is needed for the development of a dwelling with a septic system. Any vacant parcel with less than the minimum residential lot size but greater than 35,000 square feet and with at least 15,000 square feet of contiguous unconstrained land is assumed to be grandfathered and is allocated a development potential of one unit. Undersize lots are also considered grandfathered if they meet the criteria in Section 20-5.6.g of the Township Zoning Code.
- The contiguous unconstrained land area of each property is calculated based on Environmental Constraints layers. Inaccessible and non-contiguous areas are removed from the contiguous unconstrained land total acreage for each property.



Climate Change-Related Hazard Vulnerability Assessment

- Properties not fronting on a public road are considered undevelopable, except where such properties are contiguous to a property with road frontage under the same ownership.
- Vacant or farmland properties containing less than 35,000 square feet of total lot area or less than 15,000 square feet of contiguous unconstrained land are considered undevelopable, unless property can be merged with adjacent lot(s) to form a conforming lot.
- Properties with site plan or subdivision approvals are assumed to be developed as per the development approvals.

