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DELRAN TOWNSHIP, NJ

COASTAL VULNERABILITY

ASSESSMENT REPORT



Prepared for Delran Township by the Delaware Valley Regional Planning Commission; funded by the National Oceanic and Atmospheric Administration for the New Jersey Resilient Coastal Communities Initiative, managed by the New Jersey Department of Environmental Protection Office of Coastal and Land Use Planning



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The following people helped make this report possible:

Jeffrey Hatcher, Business Administrator, Delran Township
James Winckowski, PE, Engineer, CME Associates

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Executive Summary

Located along the Delaware River and Rancocas Creek, Delran Township is susceptible to the effects of coastal flooding (i.e., flooding along the tidal portions of the Delaware River shoreline and other tidal waterways). The combination of rising tidal waters and increasing frequency of extreme weather events along these water bodies will gradually increase the risk of coastal flooding events in the township over time.

In this project, Delran Township staff worked with the Delaware Valley Regional Planning Commission (DVRPC) to conduct a coastal vulnerability assessment (CVA), in which participants reviewed and prioritized future risks to the township from the combined effects of storm surge and sea level rise. The CVA used 2100 sea level rise projections (3.3 feet) in combination with a model that shows the depth and extent of storm surge from a Category 2 storm if it were to strike at high tide and at an angle and direction that maximized the amount of surge.

The CVA project team reviewed the impact of this “CVA scenario” on 22 assets in Delran. Assets include properties, infrastructure, or natural resources that are of high value to the community and/or facilities and populations that might be particularly vulnerable to extreme events (see Table 1). The project team determined whether each asset would get flooded using the previously described flooding scenario, what would happen to the asset if it were to be flooded, and the consequences to the township if the asset were damaged or unable to function during a flood.

Table 1: Breakdown by Type for All Analyzed Assets

Asset Category	Count
Institutional/Cultural/Government	7
Hazardous Site	4
Transportation	4
Utility	4
Emergency Facility	1
Vulnerable Population	1
Open Space	1
Total Number of Assets	22

Delran has a low overall vulnerability to the flooding scenario described, although the analysis revealed six assets that Delran should consider as being of high concern (Table 2).

Table 2: List of Asset Types Identified as High-Concern

Asset Category	Count
Utility	4
Transportation	1
Vulnerable Population	1

The six assets of high concern include the Riverside Park neighborhood (vulnerable population asset) and several assets within or near it: the berm along the Rancocas Creek waterfront (utility, specifically a flood control structure), two outfall pipes located along Norman Avenue and Stewart Avenue (also utilities and specifically flood control structures), River Drive (transportation), the township's wastewater treatment plant (utility), and the Swedes Lake dam and outfall (utility, specifically a flood control structure).

Delran Township CVA

Introduction

The municipal CVA is a tool to help communities plan for flooding along their coastlines and tidal waterways and prioritize flood mitigation strategies, enabling them to better manage and recover from these floods. Every level of government—federal, state, and local—has a role in planning for stressors and threats likely to afflict its citizens. However, municipalities that have the tools to understand, predict, and prepare for the natural disasters that occur within their borders are arguably best poised to assist their constituents in reducing potential harms associated with climate hazards and extreme weather events.

The CVA assesses the degree to which a community’s “assets” (its properties, infrastructure, natural resources, and populations) will be affected by flooding from projected sea level rise and storm events. For those assets that are affected, the CVA analyzes the consequences that their temporary or long-term loss poses to the community. With this assessment, communities will be better informed to make decisions about land use planning, flood mitigation, sea level rise adaptation, infrastructure maintenance, capital improvements, and post-disaster recovery.

On February 17, 2016, Delran Township met with DVRPC, the region’s Metropolitan Planning Organization, to begin the CVA process. The project team used a CVA methodology created by Sustainable Jersey within the New Jersey Resilient Coastal Communities Initiative, a program run by the Office of Coastal and Land Use Planning in the New Jersey Department of Environmental Protection (NJDEP). NJDEP and Sustainable Jersey developed the methodology to help municipalities prepare for sea level rise and likely increases in the frequency of extreme storm events.

Delran’s Location

Delran Township is a suburban municipality that encompasses 7.2 square miles in Burlington County, New Jersey. Located along the tidal Delaware River and Rancocas Creek, and containing additional tidal portions of Swede Run, Laurel Run, Boundary Creek, and other smaller tributaries, Delran will feel the effects of sea level rise. At the same time, it will be affected by the stronger storms anticipated in the northeastern United States. The combination of rising tidal waters, increasingly severe coastal storms, and more extreme precipitation events will increase the risk of flooding in the township over time.

Historical Flooding in Delran Township

Like other communities in New Jersey, Delran Township is susceptible to extreme precipitation events and potential flooding. However, to the knowledge of the participants in the CVA, the township has not had a highly damaging coastal flood event in recorded history, and has not reached its 1 percent chance flood elevation of 11 feet (the base flood elevation in Delran for zone AE on the Effective Flood Insurance Rate Map). During Hurricane Irene in August 2011, flood levels were between seven and eight feet above mean sea level (i.e., zero feet in elevation), or about four feet short of the 1 percent chance flood elevation. During Superstorm Sandy, attendees noted only that the neighborhood lost electricity.

CVA participants indicated that water levels associated with Hurricane Irene were the highest known water levels experienced in the township. However, the National Oceanic and Atmospheric Administration’s

(NOAA's) Burlington City tide gauge shows that Superstorm Sandy had a maximum flood height of about 7.7 feet above mean sea level.

Communities north of the head-of-tide at Trenton along the Delaware River have experienced numerous devastating riverine floods from that river since the beginning of the 20th century, with eight major floods having occurred since 1996. However, the impacts of these floods were experienced from Trenton northward, where the river is not tidal and the water is confined to a narrower channel.

Rather than focusing on major storms, CVA participants emphasized the role of nuisance flooding in their community from smaller storms. Nuisance flooding occurs in particular around low-lying parts of the Riverside Park neighborhood near Rancocas Creek. As a result, residents have sustained damages to their homes' floors and heating, ventilating, and air conditioning equipment, and the northwest corner of the neighborhood has experienced streambank erosion. Several roads in the neighborhood flood, and River Drive becomes inaccessible during storms, requiring the township to place cones as a barricade so motorists do not attempt to use it.

Delran Township's Coastal Vulnerability

Why a CVA is Relevant to Delran

Despite the lack of catastrophic coastal floods in Delran's past, the combination of sea level rise and increases in the intensity and frequency of coastal storms caused by climate change will introduce new vulnerabilities in Delran that the township will need to address.

Since 1900, the sea level has risen approximately one foot in the tidal Delaware River.¹ Climate change will continue to cause an accelerating rate of sea level rise and increases in the intensity of severe storm events in the coming decades. The following is a summary of the expected coastal and riverine flooding changes in New Jersey, assuming global greenhouse gas emissions trends continue as they are today.

Sea Level Rise

In New Jersey, the most recent sea level rise central estimate (meaning that the estimate has a 50 percent probability of being met or exceeded) is 1.4 feet from current sea levels by 2050, and 3.4 feet from current levels by 2100 assuming current rates of emissions continue.²

Figure 1 shows sea level rise projections for New Jersey at Atlantic City in 2030, 2050, and 2100. In the top chart, the box-and-whisker plots indicate sea level rise projections. In 2030 and 2050, the projections are the same for the low- and high-emissions scenarios (Representative Concentration Pathways [RCP] 2.6 and 8.5, respectively). In 2100, the red box-and-whisker plot indicates the sea level rise projection for the high-emissions scenario (RCP 8.5), and the blue box-and-whisker plot indicates sea level rise projections for a low-emissions scenario (RCP 2.6).

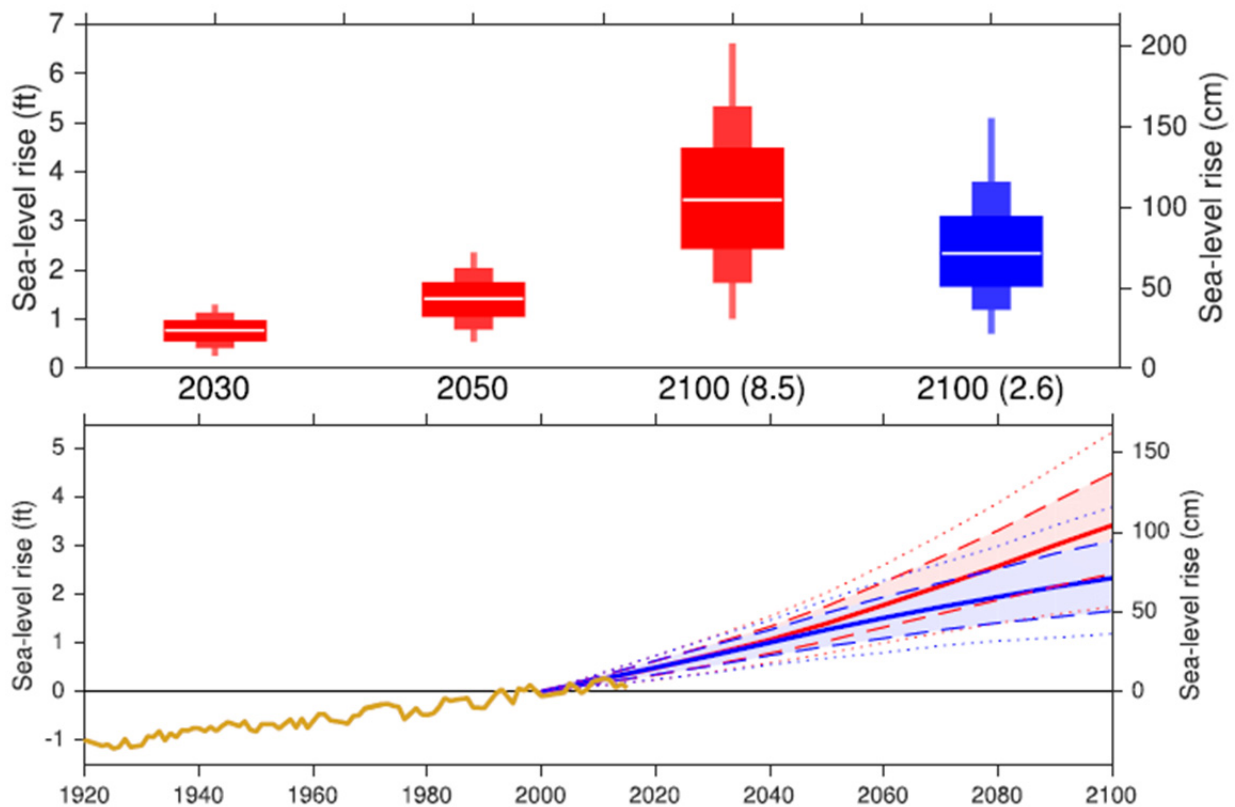
¹ Radley Horton et al., "Ch. 16: Northeast," in *Climate Change Impacts in the United States: The Third National Climate Assessment*, ed. J. M. Melillo, T. C. Richmond, and G. W. Yohe (U.S. Global Change Research Program, 2014), 373, accessed January 9, 2017, pubs.giss.nasa.gov/docs/2014/2014_Horton_ho06500e.pdf.

² R. E. Kopp et al., *Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel*, prepared for the New Jersey Climate Adaptation Alliance (New Brunswick, NJ: Rutgers University, October 2016), 2.

The white line across the middle of each box-and-whisker plot denotes the 50th percentile value (the value that has a 50 percent probability of occurring). For example, in 2050, the white line is located at 1.4 feet. Looking above the white line, again for 2050 as an example, there is a 33 percent chance that sea level rise will be between 1.4 and 1.8 feet, a 12 percent chance that sea level rise will be between 1.8 and 2.0 feet, and a 4 percent chance that sea level rise will be above 2.0 feet. The same probabilities exist for three sets of sea level rise values below the white line of the box-and-whisker plot.

In the bottom chart, the gold-colored line indicates observed tide-gauge heights. Solid red and blue lines are the 50th percentile projection for the high-emissions (RCP 8.5) and low-emissions (RCP 2.6) scenarios, respectively. Dashed lines are 17th-83rd percentile projections, and dotted lines are 5th-95th percentile projections, with blue and red shading showing the ranges for, and distinguishing between, the low- and high-emissions scenarios.

Figure 1: Sea Level Rise Projections for New Jersey in 2030, 2050, and 2100



Source: Kopp et al., 2016

The data presented in this report are the result of research conducted in 2016 by the New Jersey Climate Adaptation Alliance Advisory Committee, a consortium of respected climate researchers led by a team at Rutgers University.³

Scenes from the aftermath of severe coastal storms, such as Superstorm Sandy, demonstrate the potential adverse impacts of storm surge and coastal flooding on the basic functioning of municipalities, their businesses, and their residents. While coastal storms can strike at any time, sea level rise will exacerbate

³ Ibid.

their impacts. Absent any changes in storms, a two-foot rise in sea levels, which New Jersey is likely to experience by 2100, would more than triple the frequency of dangerous coastal flooding in the region.⁴

Coastal Storms and Storm Surge

Flooding from storm surge occurs when winds associated with strong coastal storms drive water onto land. This is the exact process that produced extreme flooding on the Atlantic Coast of New Jersey during Superstorm Sandy. The tidal Delaware River did not experience the same levels of storm surge during Superstorm Sandy, but it could have happened if the storm had taken a different track.

Unlike sea level rise, storm surge is a temporary condition. However, storm surge can happen at any time, and the potential height of water pushed onto land in the Delaware River region from a strong storm is much greater than the projected amount of sea level rise. For example, storm surge heights during Superstorm Sandy exceeded 10 feet in some parts of northern New Jersey and New York, three times the median amount of projected sea level rise by 2100.

While the future frequency and intensity of coastal storms cannot be predicted with certainty, the warming in the atmosphere and oceans associated with climate change is likely to increase the intensity of coastal storms, particularly in the latter part of the 21st century.⁵

Riverine Flooding

While this report focuses primarily on coastal flooding, riverine flooding cannot be ignored and likely poses an even greater threat in some neighborhoods in Delran. CVA participants reported that flooding in upstream municipalities during storms exacerbates flooding in some of Delran's neighborhoods, citing roadway flooding in the Westover Drive neighborhood as one affected location. A culverted tributary of the Pompeston Creek has also historically created flooding on this road. CVA participants also noted the effect of flooding from Swede Run on Conrow Road and Bridgeboro Road. Scour and erosion threatens the integrity of Conrow Road, and an outdated culvert causes flooding at Bridgeboro Road and adjacent properties.

Delran currently uses the Federal Emergency Management Agency's (FEMA's) 100-year floodplain map (or "Flood Insurance Rate Map" [FIRM]) to evaluate the threat of riverine flooding. The township should continue to use this map for that purpose but at the same time should recognize that the frequency of storms with heavy downpours is projected to increase as a result of climate change.⁶ As products and models become available to project the spatial extent of this evolving threat, they should be evaluated by township officials.

Current Preparedness for Flooding

Land Use

Fortunately for Delran, the majority of assets in the township are located inland, away from its waterways and at a sufficiently high elevation to avoid widespread damage. Furthermore, much of the land that is predicted to flood in future decades along the Delaware River and Rancocas Creek is open space. Figure C4 in Appendix C demonstrates how the presence of open space prevents residents and businesses from being

⁴ Horton et al., 374.

⁵ NOAA, "Geophysical Fluid Dynamics Laboratory," in *Global Warming and Hurricanes: An Overview of Current Research Results*, accessed March 17, 2017, www.gfdl.noaa.gov/global-warming-and-hurricanes/.

⁶ Horton et al., 374.

exposed to some of the flooding predicted along the Delaware River and Swede Run. As of 2011, over 460 acres of land along tidal portions of Delran’s waterways were protected.

Emergency Operations Procedures

Delran officials and staff feel prepared for flood emergencies. Officials and emergency response managers have multiple means of township-wide communication. The township uses Nixle, which is a public alert texting system, and NJ Register Ready, a county-wide registration program for residents with limited mobility or other impairments that would make emergency evacuation more challenging. Both of these services are voluntary and require residents to register.

Vulnerable Populations

Delran Township has a population of approximately 16,856 residents (2015 5-Year American Community Survey [ACS]), and a density of 2,341 residents per square mile. There are several populations that may need additional assistance in the event of a storm, but as indicated in the “Current Preparedness” section above, the township continues to demonstrate its desire to ensure that all citizens are given the assistance they need before, during, and after storms.

Limited English Speakers

In 2015, 3.1 percent of Delran residents reported that they spoke English “not well” or “not at all,” which is higher than that reported for Burlington County (1.7 percent), although lower than that for New Jersey (6.3 percent).⁷ This population may need additional outreach to enable them to understand threats associated with incoming flooding, what is required for them to prepare, what resources are available to avoid harm, and what assistance can help with recovery from these events.

Households in Poverty

In 2015, 6.1 percent of households in Delran reported an income below the poverty level, which was below the state average of 10.5 percent but about equivalent to the county average of 6.25 percent within the same time period.⁸

Carless Households

Approximately 2.0 percent of households in Delran Township did not own cars in 2015, which is higher than the county’s reported value (1.5 percent), although relatively consistent with the state’s value (2.4 percent).⁹ Carless households face additional challenges in evacuating before a storm by relying on alternative modes of transportation to leave the township. However, the majority of residents (98.0 percent) have cars and thus more options to evacuate before an emergency.

⁷ U.S. Census Bureau, “B16004: Age by Language Spoken at Home by Ability to Speak English for the Population 5 Years and Over,” 2011–2015 ACS 5-Year Estimates.

⁸ U.S. Census Bureau, “DP03: Selected Economic Characteristics,” 2011–2015 ACS 5-Year Estimates.

⁹ U.S. Census Bureau, “B25044: Tenure by Vehicles Available,” 2011–2015 ACS 5-Year Estimates.

Residents with a Disability

In 2015, 9.2 percent of residents reported having a disability, which is lower than the state and county percentages of 10.3 percent and 11.0 percent.¹⁰ These residents may have particular mobility and medical care needs in an evacuation.

Seniors

In 2015, 18.8 percent of Delran Township residents were elderly, which is lower than the state and county percentages of 20.2 and 21.0 percent.¹¹ Nevertheless, as with residents with a disability, seniors may also have particular mobility and medical care needs in an evacuation.

Homeowners and Renters

In 2015, 75.3 percent of residents reported owning their homes, which is lower than the equivalent in Burlington County (76.5 percent) but higher than in New Jersey (64.5 percent).¹² Renters have less ability to repair their homes following a disaster, so while the majority of the township's residents, as homeowners, are more secure in this regard, there is still a substantial portion of households that, as renters, are more at risk of displacement following a severe storm.

Scenarios

The flood scenario used in this CVA shows the result of storm surge generated by a Category 2 storm plus sea level rise projection of 3.3 feet by 2100.¹³ Storm surge was modeled using NOAA's SLOSH (Sea, Lake, and Overland Surge from Hurricanes) model and shows what would happen if a Category 2 storm were to strike the Delaware Bay at an angle that would maximize storm surge at high tide. In other words, this is a "worst case scenario" for a Category 2 storm in the tidal Delaware River. **This flooding scenario will be described in this report as the "CVA scenario."**

Notably, the inundation resulting from the combined sea level rise and storm surge depicted in the CVA scenario closely resembles the 1 percent/100-year flooding extent. Figure 2 demonstrates this similarity along the Delaware River in the northwest corner of the township. FEMA uses the 1 percent scenario in its FIRMs, and Delran Township uses these maps for planning purposes. Because the extent of flooding from sea level rise in 2100 during a Category 2 storm is similar to the extent of the township's FEMA floodplain, the authors determined that the CVA scenario was not overly pessimistic or of such a low probability as to not warrant modeling. Furthermore, the storm surge heights expected in a modeled Category 2 storm are certainly possible, as was experienced in northern New Jersey during Superstorm Sandy.¹⁴ Since storm surge heights associated with a Category 3 or Category 4 storm are less likely, the authors of this report determined that these are not scenarios for which municipalities should focus their planning efforts.

¹⁰ U.S. Census Bureau, "B18101: Sex by Age by Disability Status," 2011–2015 ACS 5-Year Estimates.

¹¹ U.S. Census Bureau, "B01001: Sex by Age," 2011–2015 ACS 5-Year Estimates.

¹² U.S. Census Bureau, "B25044: Tenure by Vehicles Available," 2011–2015 ACS 5-Year Estimates.

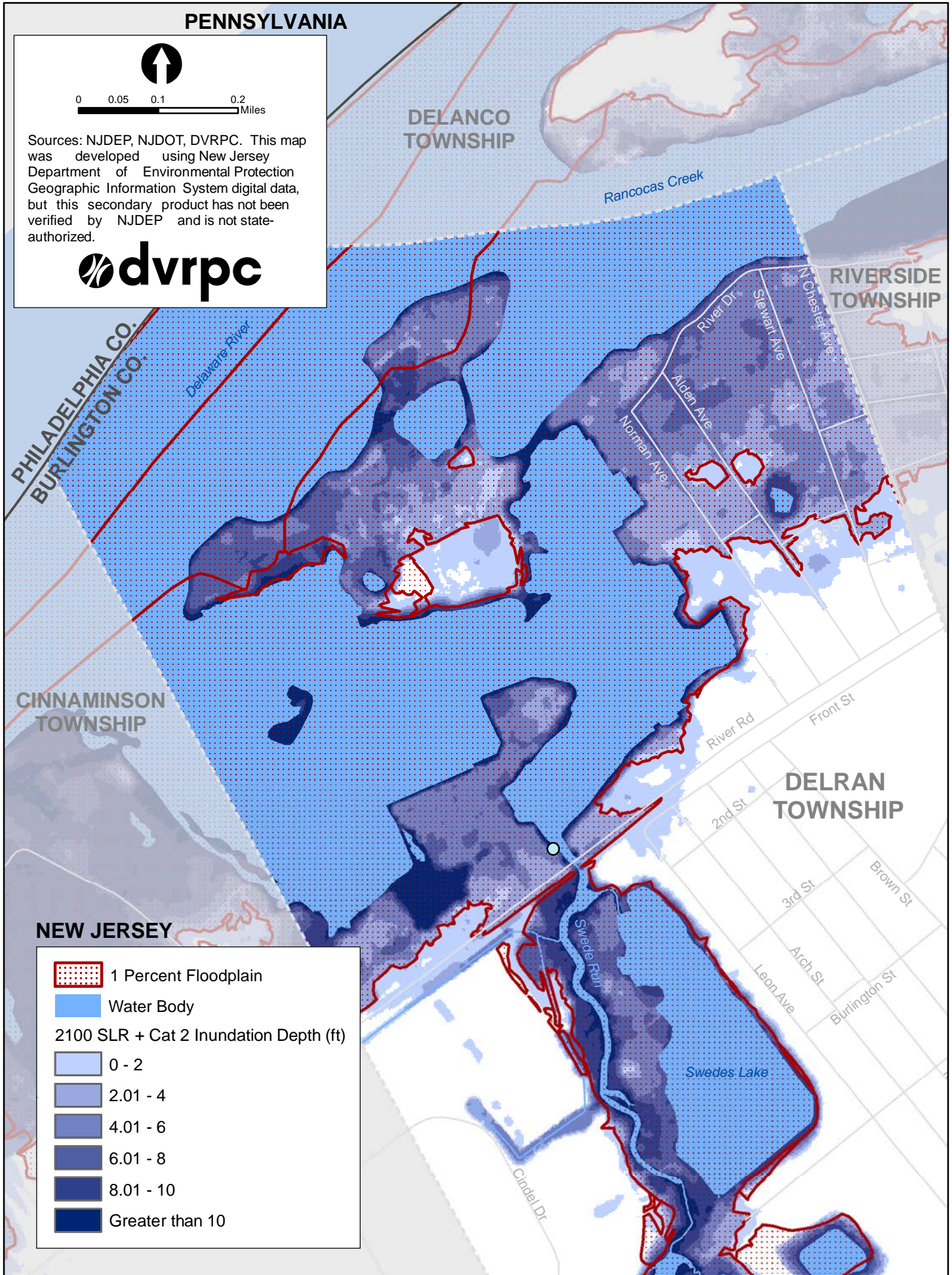
¹³ The 3.3-foot figure was from a report produced by the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel that predates the current report. The 3.3-foot figure was already built into the maps and models by the time the report with the 3.4-foot median estimate was produced.

¹⁴ The storm surge experienced in Sandy Hook in northern New Jersey during Superstorm Sandy was approximately 8.5 feet above mean higher high water. This height is commensurate with what the SLOSH model would predict for a Category 2 hurricane striking the area. Sandy was not technically a hurricane when it made landfall on the New Jersey shore, but the storm's large wind field and low pressure generated a storm surge that would normally be associated with a Category 2 hurricane according to predictive modeling.

Flood depths were determined using a baseline elevation derived from Light Detection and Ranging (LiDAR) data.¹⁵ The storm surge modeling and the baseline elevation layers were developed state-wide by NJDEP and layered on maps developed by DVRPC. The maps for this study are in Figure 2 and Appendix C.

¹⁵ Note that the projected flood events used in this assessment were generated by several models prepared by state and national agencies and professionals, and are suitable for planning purposes. However, due to the uncertainty of projections and accuracy of certain types of data, the maps should not be the sole resource for conducting site-specific analyses.

Figure 2: Northwest Corner of Delran Township and 1 Percent Floodplain



Assessing Vulnerabilities

Methodology

On February 17, 2016, DVRPC staff met with Delran Township staff (listed in the Acknowledgments section) to both discuss the township's past vulnerabilities to flooding and conduct the CVA. This group examined the vulnerability of 22 "assets," which are properties, infrastructure, or natural resources that are owned by the township or have high value to the community, as well as vulnerable populations located within the township. The assets are evaluated using a three-step process:

1. Community assets are identified, mapped, and compared with maps of flooding for selected flood scenarios to determine if they will be exposed to flooding or not.
2. The sensitivity of individual assets is determined. *Sensitivity* is shorthand for the impact of flooding on an asset. For example, a flooded basketball court will be relatively unimpacted after floodwaters recede, while paper documents in a repository will likely be permanently destroyed if exposed to flooding. While this is a clear-cut example, the sensitivity of many types of assets, such as a downtown building or shopping center, is challenging to determine with much specificity.
3. The consequence is determined by the potential effects on the community from temporary, long-term, or permanent damage to each individual asset.

Identifying and Mapping Community Assets

The CVA relies on Geographical Information Systems (GIS) maps to locate and analyze community assets and flood hazards. Community assets are identified among three categories—Built Environment, Natural Environment, and Vulnerable Populations—and are plotted using GIS. DVRPC mapped assets and plotted them against the CVA scenario to determine whether they would be exposed to flooding.

Evaluating Asset Sensitivity and Vulnerability

Sensitivity is the degree to which an asset may become affected by predicted floodwaters. *Vulnerability* is the product of exposure and sensitivity. If an asset is exposed to flooding *and* it is sensitive to flooding, then it is vulnerable. The level of vulnerability is thus a function of the level of sensitivity of an asset. In other words, an asset that is exposed to flooding and is highly sensitive to flooding would be highly vulnerable, while an asset that is exposed and moderately sensitive would be moderately vulnerable. Assets that are not exposed are not vulnerable, regardless of their sensitivity.

For each asset, vulnerability was categorized as insignificant, low, moderate, or high. A description of the categories can be found in Appendix B. When there was insufficient information to determine the exact vulnerability ranking for an asset, a range was used.

Evaluating the Consequences of Asset Damage

Consequence is the effect on the community if an asset is temporarily or permanently damaged or impaired by flooding. Consequence is ranked as insignificant, minor, moderate, or high for each asset. A description of the meaning of each ranking can be found in Appendix B.

Analysis and Findings

Delran's CVA assessment examined 22 assets, which were listed by type in Table 1.

The CVA indicates that most assets in Delran will not likely sustain many significant impacts from the combined effects of a Category 2 storm surge and sea level rise in 2100. Development is mostly located inland of tidal waterways and at higher elevations, which increases its resiliency to flooding. Nevertheless, there are some assets in Delran that are vulnerable to potential flooding.

Assets of High Concern

Six of the assets examined by this CVA were determined to be assets of high concern. These assets are the most vulnerable to flooding of the total examined and have the greatest consequences to the township should they become damaged. For the full asset matrix, see Appendix A.

Table 3: Overview of Assets Identified as High-Concern

Assets of High Concern				
Asset Name	Asset Category	Exposure (Flood Depth)	Vulnerability	Consequences
Rancocas Creek Berm	Utility	8.4–11.1 ft	Moderate to High	Moderate
Outfall Pipes	Utility	Stewart Ave: 0–10.7 ft Norman Ave: Approx. 7.6 ft	Moderate to High	Minor to Moderate
River Drive	Transportation	5.3–7.9 ft	Moderate to High	Minor to Moderate
Riverside Park Neighborhood	Vulnerable Population	0–6.0 ft	High	Moderate
Swedes Lake Dam and Outfall	Utility	0–10.9 ft	High	Minor to Moderate
Wastewater Treatment Plant	Utility	2.0–9.9 ft	Moderate to High	High

The Rancocas Creek Berm

Delran constructed a grass-covered berm along the Rancocas Creek waterfront north of the Riverside Park neighborhood in order to protect the neighborhood from high-tide floods (Figure 3). The berm may experience between 8.4 and 11.1 feet of flooding in the CVA scenario.

The berm was assigned a vulnerability rating of moderate to high. Half of the berm has already eroded. Stabilizing the berm would cost \$1.5 million, according to CVA participants. To date, the township has not been able to repair it. More information is needed on the height of the berm to determine if it could be overtopped by the depth projected in the CVA scenario, which would result in flooding of adjacent properties and cause additional damage to the berm.

Because overtopping or failure of the berm in a flood could cause damage to the Riverside Park neighborhood, a lower-income neighborhood (see the description of the asset in a following section), the berm was assigned a moderate consequences rating. However, this neighborhood makes up a relatively small portion of the township's population.

The berm also protects the township's wastewater treatment plant, and a failure or overtopping of the berm could lead to flooding around the plant. More information is needed to determine at what heights floodwaters could affect the plant's operation. The entire township relies on this plant to treat wastewater, so damages to the plant would be expensive to the township and disruptive to local businesses and homes.

Figure 3: Berm between Rancocas Creek and River Drive, Facing East



Source: Google Maps, September 2013

Outfall Pipes

Two outfall pipes located along Norman Avenue and Stewart Avenue in the Riverside Park neighborhood are anticipated to be flooded in this scenario. The outfall location for the Stewart Avenue pipe could be faced with 10.7 feet of flooding. The outfall location for the Norman Avenue pipe could reach 7.6 feet. Given these anticipated flood depths, the outfall pipes were assigned a moderate to high vulnerability because such flooding would cause a backup of water in the pipes, preventing stormwater from draining in up-slope areas. More information is needed concerning the height at which the pipes are elevated above the water when they reach the waterfront to determine the precise depths of flooding during a storm event.

The consequences of pipe failure from flooding are minor to moderate. If the pipes were unable to drain stormwater, additional flooding could occur in the Riverside Park neighborhood, adding to the depths already anticipated in the CVA scenario. However, these properties are a small portion of the total number in the township.

River Drive

River Drive is a local road in the Riverside Park neighborhood that runs along Rancocas Creek (Figure 4). In the CVA scenario, the entire road will likely be flooded, with depths ranging from 5.3 feet to 7.9 feet. River Drive was assigned a moderate vulnerability rating because extended periods of flooding, high-velocity floods, or wave action could lead to erosion of the roadbed, thereby causing long-lasting damage. However, River Drive could just as likely not be substantially affected by being temporarily overtopped by water.

The consequences of the loss of River Drive are minor to moderate, depending on whether loss of access to the road is temporary (i.e., only during a flood) or long term. The loss of River Drive would prevent adjacent residents from gaining access to their homes and would limit the available options to gain access to the township's wastewater treatment plant, outfall pipes, and to Riverside Township.

Figure 4: River Drive



Source: Google Maps, September 2013

Riverside Park Neighborhood

The Riverside Park neighborhood is a community of residents bordered by Rancocas Creek and River Drive to the north, Riverside Township to the east, NJ Route 543 to the south, and the township's marina to the west (Figure 5). It is also low-income in comparison to other neighborhoods in the township.

The neighborhood is anticipated to flood in the CVA scenario, with the exception of the households within the first tenth of a mile north of Front Street. Most flooding of properties is estimated to be six feet or less in the CVA scenario, but flooding on properties close to the waterfront could top six feet. This neighborhood was assigned a high vulnerability rating. It already gets flooded during storms, and water typically forms ponds rather than draining, which increases possible damages. CVA participants stated that 120 properties reported flooded basement issues, but few have pumps or generators to mitigate the flood waters. Flood waters have also caused erosion in the northwestern corner of the neighborhood. As a lower-income neighborhood, many residents may require more assistance in evacuating before a storm and may not be able to recover as quickly from floods as other neighborhoods in Delran.

The neighborhood was assigned a moderate consequences rating, as the temporary or long-term loss of residences is significant. Despite this level of concern, it should be noted that these properties are only a small portion of the total number in the township.

Figure 5: Elevated Homes on North Chester Avenue in the Riverside Park Neighborhood



Source: Google Maps, September 2013

Swedes Lake Dam and Outfall

The Swedes Lake dam is located at Swedes Lake (Figure 6) and is controlled by an earthen berm with a pipe and check valve. In the CVA scenario, the entire dam infrastructure will become flooded, possibly with depths of up to 10.9 feet. The asset was assigned a high vulnerability rating, as the structure already needs improvement, and the flooding predicted in the CVA scenario will likely worsen its physical condition.

The dam infrastructure was assigned a minor to moderate consequences rating. If the dam and lake were flooded in CVA scenario conditions, there would not be an impact on the overall flooding in the township since the water level of the lake already lies at a lower elevation than that of the flooding expected in the CVA scenario. However, such a flooding event would likely cause significant damage to the dam, thereby eliminating the ability of Swedes Lake to store water after the floodwaters receded.

Figure 6: Swedes Lake



Source: Google Maps, August 2017

Wastewater Treatment Plant

The township's wastewater treatment plant is located at the intersection of Norman Avenue and River Drive in the Riverside Park neighborhood (Figure 7). The entire wastewater treatment plant will likely be flooded in the CVA scenario, with depths of 9.9 feet around the north extent of the site, and between two and three feet in the center of the site. The plant was assigned a moderate to high vulnerability rating. According to CVA participants, it would require eight feet of floodwater to be damaged, a depth that is predicted to be surpassed on some parts of the site. Access to and from the site is also vulnerable: the road to the plant already floods sometimes, and entrance and egress would be blocked during the flooding predicted in this scenario.

The plant was assigned a high consequences rating. The closure of the wastewater treatment plant during and after a flood would affect the entire township. Repairs to systems that were damaged in the flood could take multiple weeks or months, during which time the township would have to find other means to treat wastewater for businesses and homes.

Figure 7: Wastewater Treatment Plant



Source: Google Maps, September 2013

A full table showing the exposure, sensitivity, and consequences of all assets can be found in Appendix A of this report. Appendix C shows a map of all listed assets superimposed with the CVA scenario, as well as inset maps showing the Riverside Park neighborhood and the confluence of the Delaware River and Rancocas Creek at a larger scale.

Municipal Assets of Lower Risk

The highest number of remaining (lower-risk) assets are hazardous sites, including two sites in other municipalities whose contaminants could enter the township during a flood. Other assets with some degree of risk include three bridges and the township's open space and habitat along its tidal waterways.

Table 4 combines the vulnerability and consequences rating to show the overall risk rating for all assets not considered to be of high concern. Eight assets are considered to be "out of harm's way" because they are not predicted to be exposed to flooding in the CVA scenario. The remaining three assets were assigned to the minor or moderate risk categories.

Table 4: Breakdown of Remaining Assets by Degree of Risk

Rating	Number of Assets
Out of Harm's Way	8
Minor Risk	2
Moderate Risk	6
Total	16

Recommendations for Delran's Assets

Because not many of its assets are vulnerable in the CVA scenario, Delran does not need to implement many adaptation measures immediately. However, action is particularly important for the assets considered to be of high concern. The asset-specific recommendations below are derived from DVRPC's introductory meeting and CVA session with Delran Township. Recommendations are organized by degree of importance.

Ascertain the Structural Vulnerability of Township-Owned Assets

Several of Delran Township's assets are at high risk due to coastal sea level rise, but the degree of risk is currently unknown for many of them. Delran Township should examine its berm and outfall pipes, River Drive, Swedes Lake Dam, and its wastewater treatment plant and determine what, if any, infrastructure is at risk to flooding, and what needs to be done to make it more resilient.

Protecting the Wastewater Treatment Plant

Because of the wastewater treatment plant's vulnerable location, and its importance to Delran Township, the plant is a high-priority asset for protecting. The wastewater treatment facility can be protected from flooding with berms or similar structures, or by ensuring that sensitive electrical and mechanical components are elevated above predicted flood heights. Both of these two options will require long-term planning and capital outlays. The township should consider using a cost-benefit analysis to evaluate these projects.

Outreach and Assistance for Residents in the Riverside Park Neighborhood

The Riverside Park neighborhood, as mentioned previously, is vulnerable to flooding because of its location and demographics. Residents along River Drive are particularly at risk, as they are directly along the Rancocas Creek shoreline. With River Drive so likely to be flooded in a storm, Delran should evaluate the risks posed to adjacent homes, and should work to evacuate any vulnerable residents in advance of a major storm.

Generally, the township should prioritize regular outreach for flood preparedness and disaster assistance to the residents living along those streets. The township could also work with residents of this neighborhood to ensure that the residents have well-developed emergency plans so that they can evacuate the area as necessary on their own. The township could assign "block captains" as liaisons to educate their neighbors on risks, help them evacuate before storms, and reach out to new residents in the neighborhoods at risk.

Coordination Regarding Onsite Contaminants

Delran Township is potentially vulnerable to contamination from four parcels after a flood. One site, the former Abrasive Alloy Casting Company site, is located in Delran Township. The three other sites are located in other municipalities: the Willingboro Public Works Department is in Willingboro Township, and the Alfred J. Humann and CBR Woodworking properties are in Riverside Township. These sites are all included in New Jersey's list of known contaminated sites. A flood could spread contaminants from these sites onto properties in Delran, but more information is needed before the township can reduce the likelihood of this spread occurring.

The township should meet with the site owners, municipalities (as relevant), and NJDEP to discuss the likelihood that contaminated floodwaters could leave their location onsite, and the resulting risks to the neighborhood. In particular, this group should determine where the contaminants are located onsite, how they may have percolated into the soil, where flood waters might carry them in the future, what the effect of further contamination or the spread of contamination could be, the costs of cleanup, and which entities will cover those costs.

Open Space and Habitat

Rather than opening it to development, the township should continue to preserve remaining unprotected open space along the Delaware River, Rancocas Creek, Swede Run, Swedes Lake, and other tributaries that are predicted to flood in the CVA scenario. Green Acres, Blue Acres, the Nature Conservancy, the Trust for Public Land, and the New Jersey Conservation Foundation are potential sources of funding for acquisition or easements.

Research and Communication Regarding County and State Bridges

Floodwaters in the CVA scenario may inundate three bridges in Delran, including the Route 543 Bridge and Whitesell's Bridge over Swede Run and the NJ Route 130 Bridge over Rancocas Creek. None of these bridges are controlled by the township. The township should examine its evacuation routes to ensure that none would be affected by these bridges flooding in the CVA scenario. Using the CVA data, the township may need to plan alternative routes to these bridges and provide residents and businesses with that information.

General Recommendations

The general recommendations below are organized by degree of importance within each subcategory. They are derived from the Getting to Resilience reports written by the Jacques Cousteau National Estuarine Research Reserve (JCNERR).¹⁶ JCNERR wrote these reports for municipalities that completed the Getting to Resilience questionnaire, which is a set of questions posed to municipalities about their past and ongoing work to plan for and respond to coastal flood hazards. The reports offer recommendations based on the municipality's responses to the questionnaire.

¹⁶ New Jersey Resilient Coastal Communities Initiative, *Case Studies*, accessed November 1, 2017, www.prepareyourcommunitynj.org/case-studies/.

Planning

Incorporating Coastal Hazards in Plans and Regulations

Delran should include information discussed in the CVA, particularly the flood projections and depths caused by sea level rise and storm surge, in municipal plans and ordinances. These documents may include (but are not limited to) the municipal master plan, all hazards mitigation plan, emergency response plan, zoning ordinance, subdivision and land development ordinance, and stormwater management ordinance. For example, Worcester County, Maryland, created a comprehensive plan that incorporates coastal hazards throughout the entire document.¹⁷

Long-Range Planning for Coastal Flooding

Delran should begin a community-wide planning process to prepare for the long-term effects of storm surge and sea level rise at time scales that extend beyond the standard 20- or 25-year planning horizon. This process will help the community prepare for the gradual, but steadily increasing, rates of sea level rise expected in the ensuing decades. Actions may include decisions to avoid long-term capital investments in areas that may be affected by sea level rise in 30 or 50 years.

Capital Improvements Plan or Hazard Mitigation Plan

Delran should incorporate flood mitigation projects into a municipal capital improvements plan or hazard mitigation plan. In doing so, the township can add these projects to an existing “funding pipeline” and make it easier for these projects to be funded and implemented.

Cost-Benefit Analysis for Specific Projects

Delran should consider using a cost-benefit analysis to guide long-term decision making with regard to the placement of critical municipal assets, especially shoreline protection structures, along or immediately inland of the waterfront. A cost-benefit analysis will ensure that the cost of each project over its lifespan (including internal and external costs) has been properly weighed against benefits, such as avoided flood damages and improvement in a community’s quality of life (e.g., by the creation of parks and greenspaces in flood-prone areas).

Regulations

Zoning Strategies

Zoning ordinances can be used in a variety of ways to protect community assets against flooding. For example, zoning ordinances can be used to regulate setbacks from rivers and streams, increase base flood elevations for buildings, and set requirements for stormwater management. In particular, the township should create a zoning overlay in floodplain areas, or update the existing zoning code in general, to require new construction, renovations, and/or flood-sensitive building systems to be elevated above the flood heights predicted in the CVA scenario.

¹⁷ Worcester County, Maryland, The Comprehensive Development Plan, March 14, 2006, planning.maryland.gov/PDF/OurWork/CompPlans/Worcester/06_CMP_Worcester.pdf.

Building Codes

By updating the building codes that regulate building design, construction, and landscaping, Delran can improve the ability of structures in flood-prone areas to withstand future floods.

Programs and Projects

Buying Out Floodplain Properties

The most effective way to reduce losses from flooding is to acquire improved flood-prone properties, both land and structures, demolish or relocate the structures, and restrict future development on the land with a conservation easement. Property owners in the Riverside Park neighborhood are already participating in this type of program, and it will continue to be beneficial as a means of addressing flooded properties.

Repetitive loss properties that are also threatened by future sea level rise should be a priority for potential buy-outs. In cases of properties where unimproved portions of the parcel are expected to be flooded, an easement rather than a fee simple acquisition may be more appropriate.

Restoring Floodplain Parcels to Natural Conditions

Delran Township should return any properties within flood-prone areas that were acquired through Blue Acres or other land conservation programs to natural floodplain conditions. As a municipality nears buildout, there are increasingly limited areas of land left that still perform natural floodplain functions. Returning lands to natural floodplain functions can be accomplished by restoring wetlands, planting natural vegetation, reducing sediment compaction, and creating a more natural elevation profile. Funding for this type of project is often available through FEMA grant programs.

Stormwater Management

Because Delran has a low elevation and relatively flat terrain, stormwater drainage is a problem for the township and will continue to be so as sea level rise causes the base water level in the Delaware River to increase over time. Delran should maximize the capture, storage, and infiltration of stormwater in locations outside of the flood zone to alleviate localized flooding and ponding. Green stormwater infrastructure, and other infrastructure that uses living plants to treat stormwater onsite, is an excellent approach to improving stormwater management and limiting minor flooding during less severe rainfall events.

Community Rating System

Because several residential neighborhoods in Delran are located in the FEMA floodplain and may experience significant, potentially damaging floods in the CVA scenario, the township should consider participating in FEMA's Community Rating System program to help reduce these property owners' flood insurance premiums. By participating in this voluntary program, Delran will also have the opportunity to improve its floodplain management practices and make its floodplains safer.

Living Shorelines

The township should consider living shorelines as an alternative to hard shore protection structures in efforts to restore, protect, and enhance the shoreline and its environment. Living shorelines use natural stabilization

techniques that rely on vegetative plantings, organic materials, and sand fill, or a hybrid approach combining vegetative plantings with low rock sills or living breakwaters, to keep sediment in place and reduce the erosive impact of wave energy.

Disaster Preparedness

Regional Emergency Management Coordination

Delran should develop formalized emergency management practices with Burlington County and neighboring municipalities. Some examples could include coordinating evacuation and re-entry routes, creating large-scale outreach initiatives, or expanding available sheltering options and amenities.

Continuity of Operations Plan

A continuity of operations plan is separate from an emergency operations plan and ensures that essential municipal functions continue to be performed before, during, and after a wide range of emergencies. The continuity of operations plan can help Delran prioritize essential facilities, equipment, vital records, and other assets for protection. It can also help reduce or mitigate disruptions to operations and facilitate decision making during an emergency. The Borough of Avalon has a sample plan.¹⁸

Evacuation Plan

Delran should create an evacuation plan that documents its evacuation protocol before and during disasters. Information that could be added includes evacuation routes that could be flooded, the necessary time frame to evacuate residential neighborhoods, and conditions (if any) that would spur a lane reversal in order to evacuate a greater volume of residents from the municipality.

Action Plan for Riverine Floods

Several neighborhoods in Delran receive severe noncoastal flooding during storms. By drawing upon its knowledge of past storms and topographical information, Delran should create an action plan that identifies (1) the type of storms that create flooding at vulnerable locations, (2) steps for staff and community members to take to prepare for and respond to similar storms in the future, and (3) resources available for addressing the anticipated problems.

Community Emergency Response Team (CERT)

Delran should consider creating a local CERT program. CERT programs can provide volunteer support to first responders, provide assistance to victims, help to organize volunteers at disaster sites, and collect disaster information to support first responder efforts. For small municipalities with limited staff, CERT teams are particularly useful and can help cut costs. See www.ready.gov/community-emergency-response-team for more information.

¹⁸ The Borough of Avalon, *Continuity of Operations/Continuity of Government (COOP/COG) Plan*, April 15, 2009, www.prepareyourcommunitynj.org/media/27952/Avalon_COOP_COG.pdf.

Municipal Organization

Historic Recordkeeping

Delran should collect and maintain an easily accessible record of historic storms. Residents' and municipal staff members' photographs and accounts of these events, especially ones that were not documented by state and federal agencies, are useful tools that can be used to plan for future storms. These records may identify past surge extents, conditions that caused amplification of storm damages, and vulnerable areas not shown by mapping.

Outreach

Program for Public Information (PPI)

A PPI can help organize Delran's outreach practices on flood hazards. A PPI is a researched, organized, and implemented program for public outreach that includes assessing the community's information needs; formulating messages; identifying means of conveying the messages; and implementing, monitoring, and evaluating the program. The National Flood Insurance Program's Community Rating System provides guidance on establishing a PPI, as well as information on outreach projects.¹⁹

This is a significant project, and the township may want to partner with other organizations or entities that have experience in educating residents on flood hazards, particularly those that can offer translation services from English to other major languages spoken in the township.

Public Presentations

Delran should hold annual presentations for residents, business owners, and other groups to discuss flood hazards. By continuing to emphasize the importance of planning for flooding, the township can set an example that disaster readiness should be maintained, even in relatively "quiet" times. A PPI can ensure that these presentations are effective. Publicized and recorded presentations can reduce the need for numerous one-on-one meetings with constituents.

Topics can include but are not limited to discussing the science behind different types of flooding; defining base flood elevations, flood zones, and flooding risk; providing updates on changes to FEMA's flood maps; sharing information on evacuation routes; providing recommendations for renovating a structure in the floodplain to better withstand floods; and discussing actions that can be taken to reduce flood insurance rates. Presentations could be accompanied by information on the municipality's special needs database and/or flood warning systems to get more residents registered.

Information on Floodplains

Delran Township should conduct regular outreach to residents about the natural and beneficial functions of floodplains. Preserving floodplain areas as open space or for only recreational uses is an effective strategy for reducing—if not eliminating—risks of damage or injury from floods. A continued outreach effort focused

¹⁹ National Flood Insurance Program, *Developing a Program for Public Information for Credit under the Community Rating System of the National Flood Insurance Program*, 2014, [crsresources.org/files/300/developing_a_ppi_for_credit_under_the_crs_2014.pdf](https://www.crsresources.org/files/300/developing_a_ppi_for_credit_under_the_crs_2014.pdf).

on the positive aspects of floodplains is part of a long-term strategy for getting residents to understand and support converting more of the township’s floodplain areas into open space. A white paper written by the National Association of Floodplain Managers has more information on the topic.²⁰

Coastal Hazard Disclosure Policy

Delran should create a consistent coastal hazard disclosure policy that is used by all lenders and real estate agents when speaking with potential buyers about buildings located in flood-prone areas. Disclosure of known flood, erosion, or other related hazard risks at the time of property transfer is an important educational effort consistent with the “No Adverse Impact”²¹ concept. Some states, such as Florida and California, have disclosure requirements. If a disclosure is required for property in a flood or coastal hazard area, the seller is required to notify potential buyers of the risks, and the risks can be factored into the purchase decision. If there is a berm, sea wall, or other protective structure on coastal property for sale, a disclosure policy could also require that prospective buyers be made aware of the issues surrounding such structures, particularly the need for monitoring and maintaining them. This type of policy can help sellers avoid transferring known adverse impacts that become unpleasant surprises to buyers.

Web Page with Municipal Flooding Resources

Delran should create a dedicated and easily accessible (from the home page) “Flood Information” page on its website. The process for creating and maintaining this webpage can be included in the PPI discussed previously. The web page can contain a link to the FEMA Region II website;²² FIRMs; the CVA maps; evacuation routes; the municipality’s base flood elevation; basic outreach brochures; and other information that further educates the community on coastal hazard preparation, response, and recovery. The Monmouth County Planning Department has some sample resources on its website.²³

Packaged Flood Preparedness Outreach Materials

By packaging flood-preparedness materials to residents in anticipation of future floods, Delran could save time and energy leading up to, during, and after a flooding event as outreach will already have been prepared for dispersal. The outreach should cover evacuation routes, safety procedures, shelter locations, recovery operations, procedures for entering a flooded building, steps for getting a permit for repairs, substantial damage rules, flood protection opportunities during repairs, and information on grants.

²⁰ Association of State Floodplain Managers, *Natural and Beneficial Floodplain Functions: Floodplain Management—More than Flood Loss Reduction*, September 16, 2008, www.floods.org/PDF/WhitePaper/ASFPM_NBF%20White_Paper_%200908.pdf.

²¹ Association of State Floodplain Managers, *No Inverse Impact (NAI)*, accessed November 1, 2017, www.floods.org/index.asp?menuID=460.

²² U.S. Federal Emergency Management Agency, *Region II Coastal Analysis and Mapping*, May 4, 2015, www.region2coastal.com/.

²³ Monmouth County Division of Planning, *Supporting Documents for CRS Activities*, February 7, 2017, co.monmouth.nj.us/page.aspx?Id=4382.

Resources and Funding Opportunities

Federal Programs: Flood Hazards

FEMA: Flood Mitigation Assistance Grants

The Flood Mitigation Assistance Grants Program provides funding to states, municipalities, and other groups for projects or plans that reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program. The funds for this grant program are disbursed through states. Delran should contact the New Jersey State Hazard Mitigation Officer (www.state.nj.us/njoem/) if it is interested in applying. More information is available at www.fema.gov/flood-mitigation-assistance-grant-program.

FEMA: Hazard Mitigation Grants

The Hazard Mitigation Grant Program helps communities implement hazard mitigation measures following a presidential major disaster declaration. The funds for this grant program are disbursed through states. Delran should contact the New Jersey State Hazard Mitigation Officer (www.state.nj.us/njoem/) if it is interested in applying and has an eligible project. More information is available at www.fema.gov/hazard-mitigation-grant-program.

FEMA: Pre-Disaster Mitigation Grants

The Pre-Disaster Mitigation Grant Program assists states, municipalities, and other groups in implementing a sustained pre-disaster natural hazard mitigation program to reduce overall risk from future hazards while reducing reliance on federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. The funds for this grant program are disbursed through states. Delran should contact the New Jersey State Hazard Mitigation Officer (www.state.nj.us/njoem/) if it is interested in applying. More information is available at www.fema.gov/pre-disaster-mitigation-grant-program.

Federal Programs: Community Support

Partnership for Sustainable Communities

This partnership between the U.S. Department of Housing and Urban Development (HUD), the U.S. Department of Transportation, and the Environmental Protection Agency provides grants to help communities create vibrant, healthy neighborhoods that provide more housing options, economic opportunities, and efficient transportation while reinforcing existing investments. The program website includes grant offerings from each of these agencies. More information is available at www.sustainablecommunities.gov/partnership-resources. Information about the grants available in this program is also posted on www.grants.gov.

HUD: Community Development Block Grant Program

Burlington County receives funding from the federal Community Development Block Grant Program for developing viable urban communities with an emphasis on assisting low-income persons. Funding may be used to meet urgent needs where conditions pose a threat to the health or welfare of the community. Examples of projects funded include reconstruction of affordable housing after a flood, or the redevelopment

of public access along waterways to include Americans with Disabilities Act (ADA) access. More information is available at www.co.burlington.nj.us/258/Block-Grant-Program.

U.S. Economic Development Administration: Economic Adjustment Assistance Program

This program provides financial assistance to communities experiencing gradual or sudden adverse economic changes, including but not limited to those caused by federally declared disasters. More information is available at www.eda.gov/funding-opportunities/.

Federal Programs: Infrastructure

U.S. Army Corps of Engineers: Emergency Streambank and Shoreline Protection

This program funds the construction of streambank and shoreline protection projects to reduce erosion risks for structures, including highways, municipal water supply systems and sewage disposal plants, churches, hospitals, schools, nonprofit public services, and known cultural sites. More information is available at www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Flood-Risk-Management/Section-14/.

U.S. Army Corps of Engineers: Small Flood Risk Management Projects

This program funds construction or improvement of flood control works, levees, floodwalls, impoundments, or pumping stations; flood proofing; relocation of structures; or flood warning and preparedness systems. The Corps of Engineers oversees planning, design, and construction of flood risk management projects in coordination with the project sponsor. More information on this funding resource is available at www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Flood-Risk-Management/Section-205/.

Federal Programs: Open Space and Natural Resources

U.S. Army Corps of Engineers: Aquatic Ecosystem Management and Restoration

This program provides financial and technical assistance to restore degraded aquatic ecosystems to a more natural condition. More information is available at www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Ecosystem-Restoration/Section-206/.

U.S. Army Corps of Engineers: Project Modification for Improvement of the Environment

This program offers financial and technical assistance for the planning, engineering, design, and construction of projects to restore ecosystems that have been degraded by a previously constructed Corps of Engineers project. Projects typically involve environmental restoration of aquatic, floodplain, and upland areas. More information on this program is available at www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Ecosystem-Restoration/Section-1135/.

U.S. Army Corps of Engineers: Snagging and Clearing for Flood Control

This program provides financial and technical assistance to reduce flood damages by clearing and excavating channels, as well as constructing embankments in some instances, using materials from the clearing operation. More information on this program is available at www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Flood-Risk-Management/Section-208/.

State Programs: General Assistance

NJDEP Bureau of Flood Control

The Community Assistance Program Unit in NJDEP's Bureau of Flood Control offers a range of floodplain assistance to municipalities. This unit offers assistance with floodplain issues (in person or on the phone), floodplain ordinance and floodplain map creation and adoption, solving problems on development within Special Flood Hazard Areas, Community Rating System applications and compliance, flood mapping, and disaster response.

The unit also offers regular workshops on floodplain-related topics. More information on this program is available at www.nj.gov/dep/floodcontrol/about.htm#management.

NJDEP Coastal Management Program

The New Jersey Coastal Management Program is part of the National Coastal Zone Management Program and provides resources for sustainable and resilient coastal community planning, and climate change planning. Their technical assistance offerings include contractor assistance, direct municipal grant programs, and funding for the implementation of living shorelines or other nature-based mitigation projects. The available resources are updated regularly. For more information, contact the Coastal Management Office (www.state.nj.us/dep/cmp/czm_contact.html).

State Programs: Flood Relief and Control

NJDEP Shore Protection Program

This cost-share program provides grants to protect property and infrastructure from coastal storm damage, erosion and shoreline migration, and sea level rise. Funds can be used for the protection, stabilization, restoration, or maintenance of the shore, including monitoring studies and land acquisition. Projects must be consistent with the New Jersey Shore Protection Master Plan and Coastal Zone Management Program. Project areas must be affected by normal tidal cycles and be located on public or private property that has legal, perpetual easements assigned to the state for public access and use. More information is available at www.nj.gov/dep/shoreprotection/funding.htm.

NJ Office of Emergency Management Public Assistance Program

This program was developed to assist public entities in New Jersey with getting federal funding for repairs, restorations, reconstruction, or replacement of public facilities or infrastructure damaged by a disaster. The program coordinates damage and needs assessments in response to expected or actual emergency situations as part of the Federal Disaster Assistance Program. The funds available differ for each community in each declared disaster area. More information is available at ready.nj.gov/programs/public-assistance-program.shtml.

State Programs: Open Space Preservation and Management

NJDEP Blue Acres Program

In 2009, New Jersey passed an act to authorize bonds for the acquisition of lands in the state's floodways for recreation and natural resources protection. Twenty-four million dollars are available for acquiring properties that have been damaged by storms, may be prone to incurring damage from storms or storm-related flooding,

or protect other lands from such damage. All Blue Acres acquisitions must be from willing sellers. More information is available at www.nj.gov/dep/greenacres/blue_flood_ac.html.

NJDEP Community Stewardship Incentive Program Grant

This program provides grants to local governments and shade tree commissions to help implement a comprehensive community forestry management plan. Grant categories include resiliency planning, hazard mitigation, and reforestation and tree planting. More information on the program is available at www.state.nj.us/dep/parksandforests/forest/community/grants-csip.html.

NJDEP Green Acres Program

The Green Acres Program provides low-interest loans and grants to municipal and county governments to acquire open space and develop outdoor recreation facilities. Green Acres works with local governments from grant application through project completion. All land funded under this program must be open to the public. More information is available at www.nj.gov/dep/greenacres/local.html.

NJDEP Green Communities Grant (Community Forest Program)

This program assists local governments in developing Community Forestry Management Plans that guide communities in establishing and maintaining urban and community forests. Funding is provided through the U.S. Department of Agriculture Forest Service Urban and Community Forestry Program. More information is available at www.nj.gov/dep/grantandloanprograms/nhr_gccg.htm.

State Programs: Contaminant Mitigation

NJDEP Hazardous Discharge Site Remediation Fund

This program provides grants to municipalities, counties, and redevelopment entities for investigating and remediating contaminated sites identified as areas in need of redevelopment, and for remediating contaminated sites located in a designated Brownfield Development Area. Applications are available online or may be obtained by request from NJDEP. More information on the program is available at www.nj.gov/dep/srp/finance/hdsrf/.

NJDEP Technical Assistance Grants

Technical Assistance Grants provide funding to nonprofit community groups to improve the community's understanding of the environmental conditions at a contaminated site and remediation processes. The bulk of the funding must be used to hire an independent Licensed Site Remediation Professional as a technical advisor to help interpret and comment on site documents. The grant funds are available to community groups during the Remedial Investigation phase and the Remedial Action phase of remediating a contaminated site. Local governments have to partner with an eligible nonprofit organization to make use of these funds. More information is available at www.nj.gov/dep/grantandloanprograms/sr_techassist.htm.

State Programs: Water Quality Protection

NJDEP and New Jersey Environmental Infrastructure Trust (NJEIT) Environmental Infrastructure Financing Program

This program, funded through both NJDEP and NJEIT, provides low-interest loans for constructing water quality protection facilities, including for wastewater treatment and stormwater and nonpoint source pollution management. The Financing Program also provides loans for such activities as open space land purchase and conservation, contamination remediation, and well sealing. More information is available at www.nj.gov/dep/grantandloanprograms/sr_techassist.htm and www.njeit.org/.

NJDEP Nonpoint Source Pollution Control Grants (319 Grant Program)

The Nonpoint Source Pollution Control Grants Program provides grants to reduce water quality impairment through nonpoint source pollution control projects. More information on the program is available at www.nj.gov/dep/grantandloanprograms/eps_nspc.htm.

Rutgers University Cooperative Extension Water Resources Program

The Water Resources Program is a specialized program at Rutgers Cooperative Extension that identifies and addresses community water resources issues. Their projects and programs currently include agricultural watershed planning and implementation, green infrastructure education and construction, impervious cover reduction, municipal stormwater management, community training on water quality issues, rain garden and rain barrel workshops, and watershed planning and implementation. More information is available at water.rutgers.edu/.

Water Quality Restoration Grants Program

The money from this grant program is available for watershed restoration projects that address stormwater runoff from nonpoint sources. Eligible projects include green infrastructure that reduces stormwater runoff in communities with aging combined wastewater-stormwater infrastructure; and projects that improve suburban stormwater management systems, help agricultural operations reduce nonpoint source pollution, implement water quality improvements in the Raritan River and Delaware River and Bay watersheds, construct living shorelines, improve water quality in coastal lakes, and promote environmental education. More information is available at www.state.nj.us/dep/wms/bears/npsrestgrants.html.

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Appendix A

Coastal Vulnerability Assessment Matrix

Vulnerability of Structures, Properties, and Populations in a Category 2 Storm in 2100

Sea Level Rise (SLR) Projections

YEAR	SLR FROM PRESENT
Present	-
2050	+ 1.4 ft
2100	+ 3.3 ft

TOP AREAS OF CONCERN

Asset Name	Asset Type	Asset Description	Exposure	Sensitivity	Vulnerability Rating	Consequences	Consequences Rating
Outfall Pipes	Utility (Stormwater Conveyance Structure)	Two outfall pipes located along Norman Ave. and Stewart Ave. in the Riverside Park neighborhood.	The pipes are anticipated to be flooded in this scenario. The outfall location for the Stewart Ave. pipe could be faced with 10.7 ft of flooding. The outfall location for the Norman Ave. pipe could reach 7.6 ft, but more information is needed on where the outfall is located.	The anticipated flood depths could cause a backup of water in the pipes. The extent of this flooding depends on the height at which the pipes are elevated above the water when they reach the waterfront.	Moderate to High	Failure of the pipes would cause additional flooding in the Riverside Park neighborhood, which is already anticipated to receive damages from flooding in this scenario. However, these properties are a small portion of the total number in the township.	Minor to Moderate
Rancocas Creek Berm	Utility (Flood Control Structure)	A berm located along the Rancocas Creek waterfront, north of the Riverside Park neighborhood, that keeps out high-tide water.	The berm may experience between 8.4 and 11.1 ft of flooding in this scenario.	Half of the berm has already eroded, with a cost of \$1.5 million to stabilize that the township has not been able to address. More information is needed on the height of the berm to determine if it could be overtopped by the flooding projected in the CVA scenario, which may cause additional damage to the berm.	Moderate to High	Failure of the berm could cause additional flooding in the Riverside Park neighborhood, which is already anticipated to be damaged by flooding in this scenario. However, these properties are a small portion of the total number in the township. Additional flood waters from the failure of the berm may also lead to more flooding around the wastewater treatment plant. More information is needed to determine whether this flooding could affect the plant's operation. The entire township relies on this plant to treat wastewater, so damages to the plant would be expensive to the township and disruptive to local businesses and homes.	Moderate
River Drive	Transportation	Road located in the Riverside Park neighborhood and next to Rancocas Creek.	The entire road will likely be flooded with depths ranging from 5.3 to 7.9 ft.	Extended periods of flooding, high-velocity floods, or flooding that parallels a road can cause erosion of roadway infrastructure. Most roads, however, are not substantially affected by being temporarily overtopped by water.	Moderate to High	The loss of River Dr. would prevent adjacent residents from gaining access to their homes, and would limit the available options to gain access to the township's wastewater treatment plant, and outfall pipes, and to Riverside Township.	Minor to Moderate
Riverside Park Neighborhood	Vulnerable Population	Coastal neighborhood adjacent to Riverside Township that is relatively low-income.	With the exception of the households within the first tenth of a mile north of Front St., the neighborhood is anticipated to flood in this scenario. Flooding could reach heights of 6 ft on some properties, but most flooding will be less than 6 ft.	The neighborhood is already receiving flooding, with 120 properties reporting flooded basement issues. The northwestern corner of the neighborhood also has erosion from flood waters. The neighborhood's lower-income residents may require additional assistance from the township and may recover more slowly from floods.	High	While flooding will likely damage many properties in the neighborhood, these properties are a small portion of the total number in the township.	Moderate

TOP AREAS OF CONCERN (CONTINUED)

Asset Name	Asset Type	Asset Description	Exposure	Sensitivity	Vulnerability Rating	Consequences	Consequences Rating
Swedes Lake Dam and Outfall	Utility (Flood Control Structure)	Dam and outfall located at Swedes Lake, controlled by an earthen berm with pipe and check valve.	The entire asset will become flooded, with depths of up to 10.9 ft.	The structure already needs improvement, and the flooding in this scenario will likely worsen its physical condition.	High	In this flooding scenario, there would not be an impact on the overall flooding in the township since the water level of the lake already lies at a lower elevation than that of the predicted flood waters. However, this flood would likely cause significant damage to the dam, thereby eliminating the ability of Swedes Lake to store water after the flood waters receded.	Minor to Moderate
Wastewater Treatment Plant	Utility	The township's wastewater treatment plant, located on River Dr.	The entire wastewater treatment plant will likely be flooded, with depths of 9.9 ft around the north extent of the site, and between 2 and 3 ft in the center of the site.	The plant is located on a hill and would require 8 ft of floodwater to be damaged. Given the flood depths predicted in this scenario, some parts of the plant closer to Rancocas Creek could become damaged from flooding. The road to the plant already floods occasionally and gets standing water. Entrance and egress would become more difficult in the flooding associated with this scenario.	Moderate to High	The closure of parts of the wastewater treatment plant after a flood would affect the entire township. Repairs to systems that were damaged in the flood could take multiple weeks or months, during which time the township would have to find other means to treat wastewater for businesses and homes.	High

NATURAL ENVIRONMENT

Riparian Open Space and Habitat	Open Space and Habitat	Wetlands, shrubland, and forested areas located along the Delaware River and tidal portions of Swede Run, Rancocas Creek, Laurel Run, and Boundary Creek.	The open space along each of these waterways may be faced with flooding of up to 12 ft.	The majority of the open space that may face flooding is wetlands, which are likely tolerant to the soil hydration that occurs with flooding. Some of the land area is forested, however, particularly around Swedes Lake. More information is needed about the tree species potentially affected, particularly those farther inland, and their tolerance of flooded soils.	Low to Moderate	Most of the open space that may be affected by sea level rise and storm surge is already in the 1 percent/100-year floodplain, and wetland plant and animal species already in that floodplain should be somewhat adapted to flooding conditions, although not as much as species immediately on the waterfront.	Insignificant to Moderate
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BUILT ENVIRONMENT

Abrasive Alloy Casting	Hazardous Site	Site with possible contamination.	About two-thirds of the site will likely become flooded, with depths of up to 2.6 ft.	More information on the owner's contaminant storage practices is needed to determine the site's degree of vulnerability to flooding.	Moderate to High	A flood could spread contaminants from this site onto other properties after a storm, but the consequences depend on factors that the township needs to determine, including the location of the contamination, the type of contaminants onsite, and their current rate and volume of migration through soil and groundwater.	Minor to Moderate
Alfred J. Humann	Hazardous Site	Site with possible contamination located in Riverside Township.	The entire site will likely become flooded, and may experience depths of up to 4.7 ft. More typical depths, however, will be between 2 and 3 ft.	More information on the owner's contaminant storage practices is needed to determine the site's degree of vulnerability to flooding.	Moderate to High	A flood could spread contaminants from this site onto properties in Delran Township after a storm, but the consequences depend on the location of the contamination, the type of contaminants onsite, and their current rate and volume of migration through soil and groundwater.	Minor to Moderate

BUILT ENVIRONMENT (CONTINUED)

Asset Name	Asset Type	Asset Description	Exposure	Sensitivity	Vulnerability Rating	Consequences	Consequences Rating
CBR Woodworking	Hazardous Site	Site with possible contamination located in Riverside Township.	The northwest corner of the site may be flooded with depths of up to 7.6 ft, and a small area in the center of the site may be flooded with depths of up to 3.5 ft.	More information on the owner's contaminant storage practices is needed to determine the site's degree of vulnerability to flooding.	Low to High	A flood could spread contaminants from this site onto properties in Delran Township after a storm, but the consequences depend on the location of the contamination, the type of contaminants onsite, and their current rate and volume of migration through soil and groundwater.	Minor to Moderate
County Route 543 Bridge	Transportation	A state bridge over Swede Run.	The bridge could experience almost 11 ft of flooding.	The vulnerability depends on whether overtopping occurs. The velocities of water associated with the flooding of Swede Run may also cause scouring of the bed of the waterway on which the bridge is anchored, potentially destabilizing it. If the deck of the bridge is overtopped, flood waters may also cause substantial pressure on the bridge, potentially leading to its destruction.	Low to High	The flooding of this bridge would prevent travel through and to the east and west of Delran. Drivers would have to find an alternative route during the period of flooding. If the bridge were damaged, it could take more than a year to be rebuilt.	Minor to Moderate
Delran Fire Stations	Emergency Facilities	Stations 231 and 232, located at 9 S. Bridgeboro St. and 1020 S. Chester Ave., respectively.	These assets are out of harm's way.	-	Insignificant	N/A	N/A
Delran High School	Institutional/Cultural/ Government	Public high school located at 50 Hartford Rd.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Delran Intermediate School	Institutional/Cultural/ Government	Public school for grades 3–5 located at 20 Creek Rd.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Delran Middle School	Institutional/Cultural/ Government	Public middle school located at 905 S. Chester Ave.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Holy Cross High School	Institutional/Cultural/ Government	Parochial high school located at 5035 NJ Route 130 S.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Kiddie Academy of Delran	Institutional/Cultural/ Government	Educational daycare located at 2908-A NJ Route 130 N.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Millbridge Elementary School	Institutional/Cultural/ Government	Public elementary school located at 282 Conrow Rd.	This asset is out of harm's way.	-	Insignificant	N/A	N/A
Montessori Academy - Delran	Institutional/Cultural/ Government	Private school for preschool through middle school children.	This asset is out of harm's way.	-	Insignificant	N/A	N/A

BUILT ENVIRONMENT (CONTINUED)

Asset Name	Asset Type	Asset Description	Exposure	Sensitivity	Vulnerability Rating	Consequences	Consequences Rating
NJ Route 130 Bridge	Transportation	A state bridge over Rancocas Creek.	The bridge may experience up to 10.9 ft of flooding.	<p>The vulnerability depends on whether overtopping occurs. The velocities of water associated with the flooding of Rancocas Creek may also cause scouring of the bed of the waterway on which the bridge is anchored, potentially destabilizing it. If the deck of the bridge is overtopped, flood waters may also cause substantial pressure on the bridge, potentially leading to its destruction.</p> <p>NJ Route 130 is likely elevated enough to not be affected by the predicted flood depths, but more information is needed on the height of the bridge.</p>	Low to Moderate	The flooding of this bridge would prevent travel through and to the east and west of Delran. Drivers would have to find an alternative route during the period of flooding. If the bridge were damaged, it could take more than a year to be rebuilt.	Minor to Moderate
Whitesell's Bridge	Transportation	A state bridge over Swede Run, connecting Underwood Ct.	The bridge will likely experience less than 1 ft of flooding.	<p>The vulnerability depends on whether overtopping occurs. The velocities of water associated with the flooding of Swede Run may also cause scouring of the bed of the waterway on which the bridge is anchored, potentially destabilizing it. If the deck of the bridge is overtopped, flood waters may also cause substantial pressure on the bridge, potentially leading to its destruction.</p> <p>This bridge is already close to being overtopped in floods. The projected increase in flooding from this scenario may push it closer to being overtopped.</p>	Low to High	The flooding of this bridge would hinder access to several industrial facilities that are located at the end of a cul-de-sac. There is no alternative route for these facilities. If the bridge were damaged, it could take more than a year to be rebuilt.	Minor to Moderate
Willingboro Public Works Department	Hazardous Site	Site with possible contamination located in Willingboro Township.	Almost the entire site will become flooded, with depths of up to 5.4 ft.	More information on the nature and location of the contamination is needed to determine the site's degree of vulnerability to flooding.	Moderate to High	A flood could spread contaminants from this site onto properties in Delran Township after a storm, but the consequences depend on the location of the contamination, the type of contaminants onsite, and their current rate and volume of migration through soil and groundwater.	Minor to Moderate



Appendix B

Appendix B: Vulnerability and Consequences Rating Keys

Vulnerability Rating Key	
Level	Vulnerability Rating Given Hazard Exposure and Sensitivity
Insignificant	<p><i>Exposure to Flooding:</i> This community asset is located out of harm's way.</p> <p><i>Physical/Structural Damage:</i> No physical or structural damages expected.</p> <p><i>Disruption/Impairment:</i> No disruption in function, accessibility, or development and delivery of basic services and supplies. No apparent impacts to services, typical operations, routine, or daily life.</p> <p><i>Accessibility:</i> Key staff members are able to access facilities or locations without interruption.</p>
Low	<p><i>Exposure to Flooding:</i> Majority of this community asset is located out of harm's way.</p> <p><i>Physical/Structural Damage:</i> Minor physical or structural damages expected.</p> <p><i>Disruption/Impairment:</i> Limited disruption in function, accessibility, or development and delivery of basic services and supplies. Limited impacts to typical operations, routine, or daily life, if any.</p> <p><i>Accessibility:</i> Key staff members are able to access facilities or locations with minimal interruption.</p>
Moderate	<p><i>Exposure to Flooding:</i> Significant portion of this community asset is located in harm's way.</p> <p><i>Physical/Structural Damage:</i> Moderate physical or structural damages are sustained.</p> <p><i>Disruption/Impairment:</i> Moderate level of disruption to accessibility or mobility of asset, amenity, or population. Moderate level of interruptions to development and delivery of basic services and supplies. Typical operations, routine, or daily life are moderately affected by flood hazard scenario.</p> <p><i>Accessibility:</i> Secondary evacuation and access routes available for use if or when primary systems fail.</p>
High	<p><i>Exposure to Flooding:</i> Majority of this community asset is located in harm's way.</p> <p><i>Physical/Structural Damage:</i> Severe level of harms (destruction of property, degradation of function, and/or injury) expected, resulting in high degree of loss. Asset, amenity or population is unable to withstand flood impacts.</p> <p><i>Disruption/Impairment:</i> Severe, potentially irreparable challenges faced, requiring significant changes to asset functioning and community's daily life, yielding a "new normal." Production, provision of services, or daily routine expected to sustain high degree of disruption. Significantly reduced operational capacity of community assets and amenities; long-term or permanent relocation of asset, amenity, or population.</p> <p><i>Accessibility:</i> Severe disruptions to accessibility of asset, amenity, or population, or the disruption of this asset, cause accessibility issues to other community assets. Key individuals, material supplies, core operating systems, and functioning interrupted or unavailable.</p>

Consequences Rating Key

Level		Given Vulnerability of Assets, Rate the Magnitude or Severity of Consequences
1	Insignificant	<p><i>Injuries & Fatalities:</i> Only minor injuries, if any.</p> <p><i>Property Damages:</i> Only minor property damage.</p> <p><i>Population Displacement:</i> No population displacement.</p> <p><i>Public Health:</i> Human health impacts are negligible or not measurable.</p> <p><i>Economy:</i> Little to no impacts to major and local businesses. No loss of services.</p> <p><i>Typical Operations/Daily Life:</i> No impacts or disruptions to typical operations, routine, or daily life.</p> <p><i>Environment:</i> No lasting environmental degradation.</p> <p><i>Emergency Response:</i> No adverse effects to emergency response.</p> <p><i>Hazardous Materials:</i> No increase or change in community or ecosystem exposure to toxins or hazardous materials.</p> <p><i>Municipal Budget:</i> Negligible operational costs.</p>
2	Minor	<p><i>Injuries & Fatalities:</i> Minor injuries, limited in geographic scope and/or affected population(s).</p> <p><i>Property Damages:</i> Limited property in narrow affected area damaged or destroyed.</p> <p><i>Population Displacement:</i> Temporary displacement of a small portion of the population.</p> <p><i>Public Health:</i> Measurable but minor adverse human health effects and increase of disease.</p> <p><i>Economy:</i> Minor impacts to major and local businesses. Minor interruption of supply and services.</p> <p><i>Typical Operations/Daily Life:</i> Limited disruption to typical operations, routine, or daily life.</p> <p><i>Environment:</i> Minor damage or loss to habitat and species or functioning of the systems as a component of "green" infrastructure of the community. Small loss of natural resource base. Increased, but tolerable, stress on ecosystem.</p> <p><i>Emergency Response:</i> Slight decrease in emergency response times and effectiveness.</p> <p><i>Hazardous Materials:</i> Limited hazardous materials spill, manageable cleanup and remediation.</p> <p><i>Municipal Budget:</i> Additional but tolerable operational costs.</p>
3	Moderate	<p><i>Injuries & Fatalities:</i> Multiple deaths or injuries possible over a broad population.</p> <p><i>Property Damages:</i> Substantial property in affected area damaged or destroyed.</p> <p><i>Population Displacement:</i> Long-term population displacement over a broader segment of the population.</p> <p><i>Public Health:</i> Human health impacts are widespread, including increased risk of the spread of communicable diseases. Extended interruption of supply and services.</p> <p><i>Economy:</i> Disruptions to major and local businesses.</p> <p><i>Typical Operations/Daily Life:</i> Operations, routine, or daily life affected such that only redundant or alternative systems can be used for an extended duration. Highly vulnerable services, businesses, and populations suffer heavy adverse impacts while less sensitive systems seek alternative arrangements.</p> <p><i>Environment:</i> Major damage or loss of habitat or functioning of the systems as a component of "green" infrastructure of the community that may be permanent with adverse impacts. Large loss of natural resource base.</p> <p><i>Emergency Response:</i> Emergency response is strained and may result in significant degradation of response effectiveness and times.</p> <p><i>Hazardous Materials:</i> Large hazardous material spill with significant risk to humans and ecosystems.</p> <p><i>Municipal Budget:</i> High operational costs straining local budgets.</p>
4	High	<p><i>Injuries & Fatalities:</i> High number of deaths or injuries possible across a wide population.</p> <p><i>Property Damages:</i> Majority of property in affected area damaged or destroyed.</p> <p><i>Population Displacement:</i> Permanent and widespread population displacement.</p> <p><i>Public Health:</i> Widespread adverse and significant health impacts, possibly including spread of communicable disease.</p> <p><i>Economy:</i> Major loss of local businesses.</p> <p><i>Delivery of Services:</i> Long-term interruption of supply and services.</p> <p><i>Typical Operations/Daily Life:</i> Majority of community operations, routines, or daily life patterns intensely impacted for an extended period. Highly vulnerable services, businesses, and populations unlikely to bounce back from shock.</p> <p><i>Environment:</i> Permanent degradation of habitat and species or functioning of the systems as a component of "green" infrastructure of the community. Majority destruction of critical natural resources base.</p> <p><i>Emergency Response:</i> Need for emergency services exceeds full capacity, and/or services are degraded and not functioning.</p> <p><i>Hazardous Materials:</i> Hazardous material spill that requires multi-year cleanup and poses significant health or ecosystem risk.</p> <p><i>Municipal Budget:</i> Operational costs exceed funding and place local government into adverse long-term financial conditions.</p>



Appendix C

Figure C1: Delran Township with Flooding from Sea Level Rise in 2100 and a Category 2 Storm

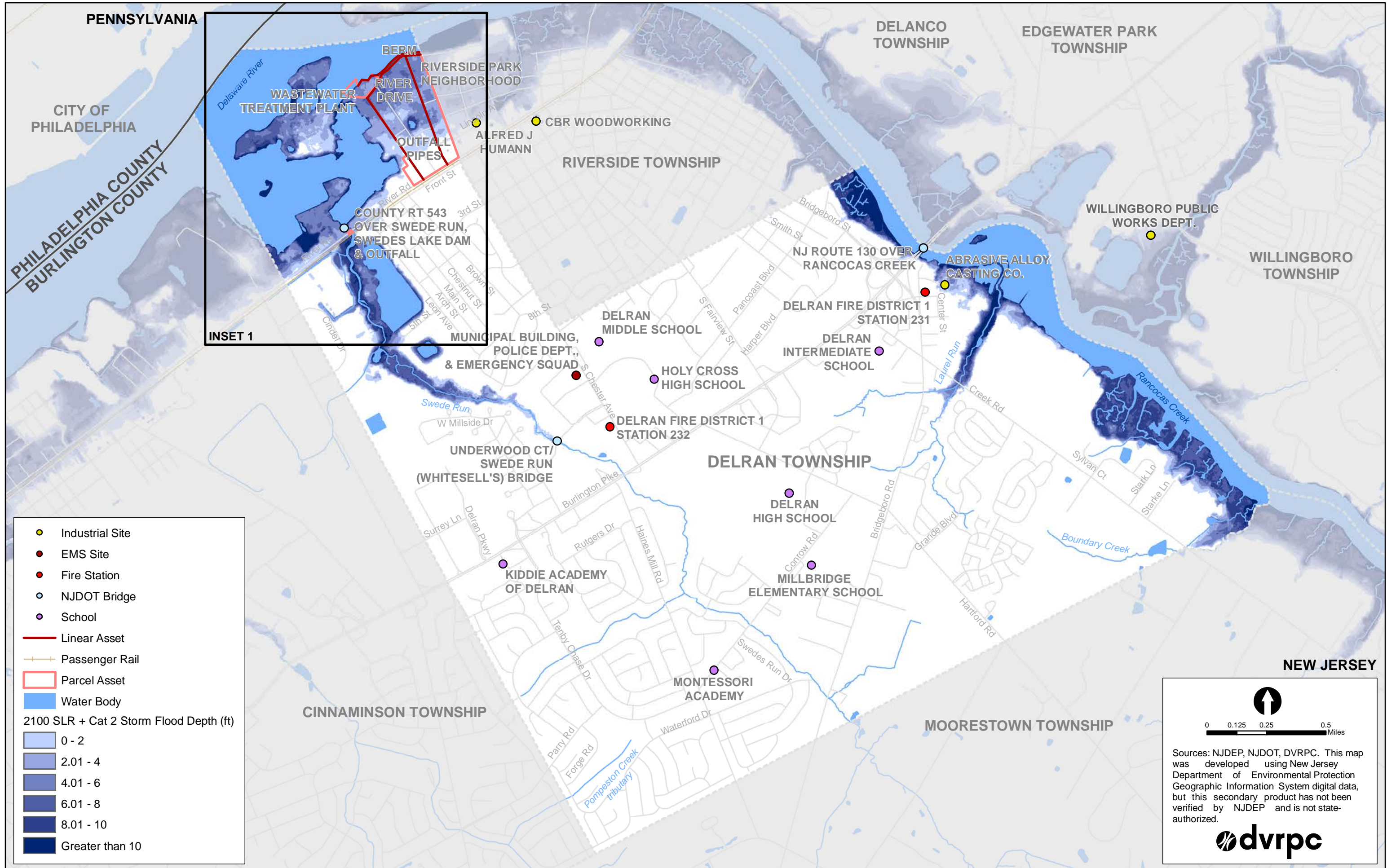
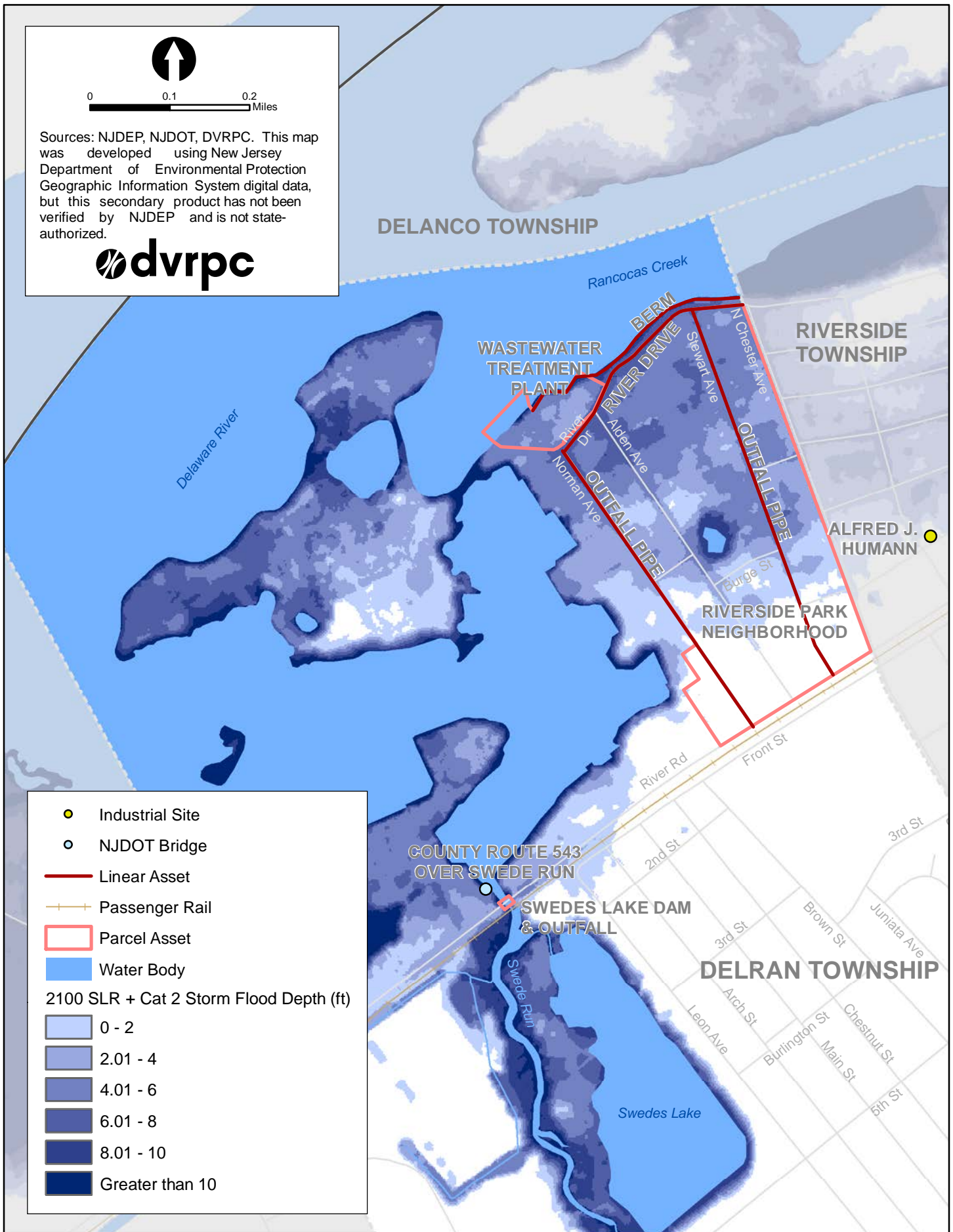


Figure C2: Inset 1 with Flooding from Sea Level Rise in 2100 and a Category 2 Storm



0 0.1 0.2 Miles

Sources: NJDEP, NJDOT, DVRPC. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.



Figure C3: Inset 1 with Aerials

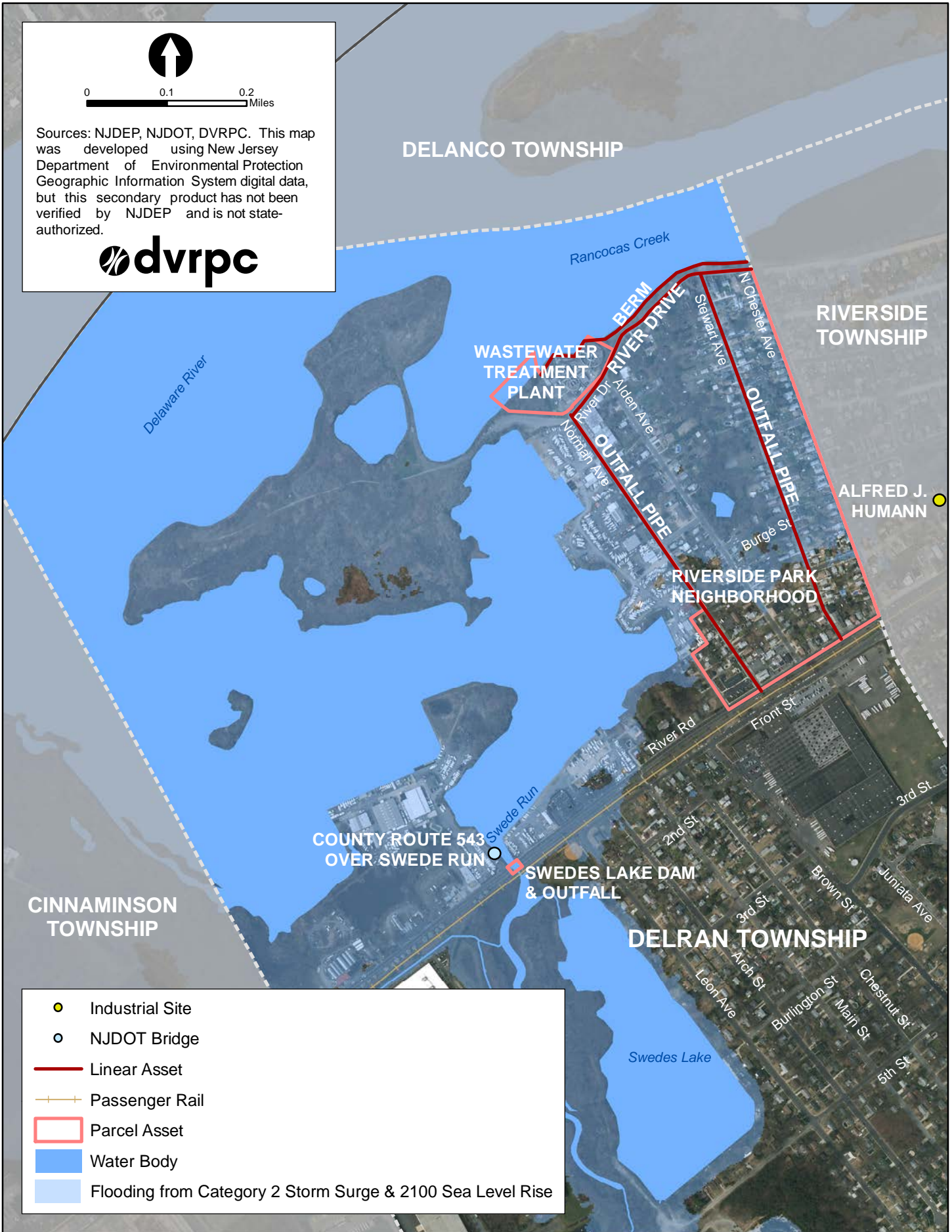
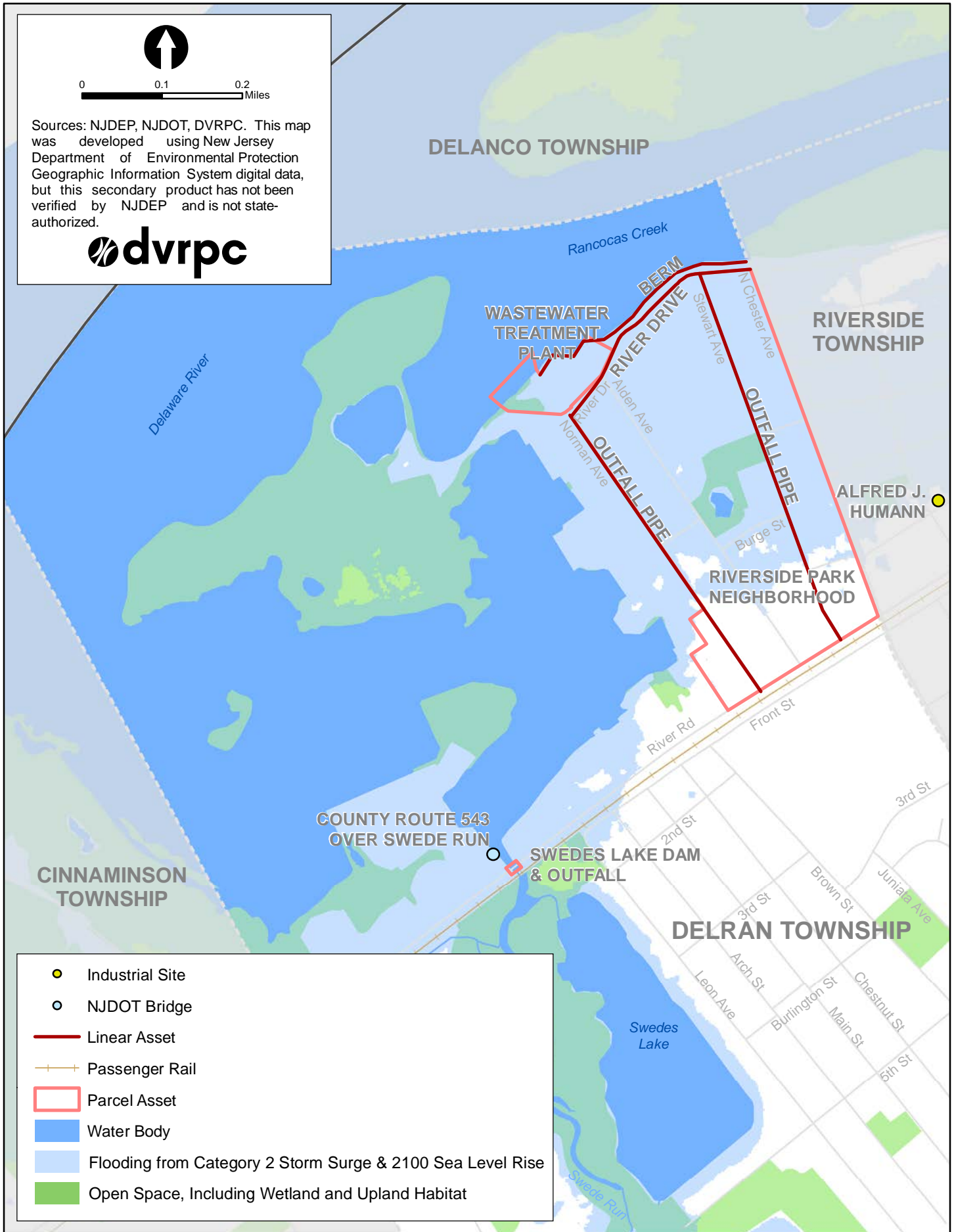


Figure C4: Inset 1 with Open Space



Delran Township Coastal Vulnerability Assessment Report

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Burlington County, Climate Change, Coastal Vulnerability Assessment, Delaware River, Delran Township, Environment, Flooding, Hazard Mitigation, Municipal Planning, Natural Resources, New Jersey, Rancocas Creek, Sea Level Rise, Swede Run, Waterfront

Abstract:

This report documents the coastal vulnerability assessment that Delaware Valley Regional Planning Commission conducted with municipal staff and residents from Delran Township in 2016. The narrative outlines projected effects of climate change in New Jersey, records Delran's historic flooding issues and the actions taken to increase its resilience to floods, and discusses the coastal vulnerability assessment's methods, findings, and recommendations.

Staff Contact:

Melissa Andrews
Environmental Planner
(215) 238-2930
mandrews@dvrpc.org



190 N. Independence Mall West, 8th Floor
Philadelphia, PA 19106-1520
Phone: (215) 592-1800
Fax: (215) 592-9125
www.dvrpc.org



**190 N Independence Mall West
8th Floor
Philadelphia, PA 19106-1520
215-592-1800
www.dvrpc.org**